MINERAL AND ROCK SAMPLE DATABASE

PLANETARY SPECTROHOTOMETER FACILITY (PSF)

UNIVERSITY OF WINNIPEG

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A. Explanatory Notes for Sample Database

This document is designed to provide users with information on samples, associated analytical data, and spectral files associated with the Planetary Spectrophotometer Facility (PSF) at the University of Winnipeg.

It is intended to serve as the first stop in searching for and downloading spectral data, or searching for samples that may be of interest.

This document is organized somewhat randomly in the sense that many of the sections do not correspond particularly well to established mineral groups. This document and the sections have evolved as new samples have been added to this document over the years, usually by adding new sections as necessary to the end of the document.

There are two major groupings: minerals and samples from specific localities or regions, as well as other miscellaneous groups of materials. To find specific types of samples, an easy approach would be to use a Search or Find function in a word processing program.

For most of the sections, and where available, the samples are organized in the following order: (a) sample descriptions, (b) X-ray diffraction data; (c) compositional data, and (d) spectral data.

a. Sample Descriptions

Most samples use a six character identifier: three letters followed by three numbers. Depending on the source, some samples may have additional identifiers associated with the source from which the samples were procured. In some cases, samples are not housed at the University of Winnipeg, but were characterized for other investigators.

Where available, the format that we use is: sample type, locality, (source of sample), purity, and any other information such as supplier sample number, purity, form of sample, etc.

b. X-ray Diffraction Data

X-ray diffractometry (XRD), generally on powdered samples, is used to help in the identification of phase(s) present in the various samples. XRD data are present in both analogue and digital formats. In some cases, the data are of high enough quality, that absolute phase abundances can be determined.

c. Compositional Data

Compositional data have been acquired from a number of sources or using different analytical techniques. The most common are electron microprobe analysis (EMPA), where compositions are an average of a number of point analyses, or X-ray fluorescence analysis, which utilizes ~1-3 grams of sample and is more representative of average or bulk composition. Where ferrous and ferric iron abundances are given, normally ferrous iron has been determined by wet chemistry; ferric iron

content in these cases is the difference between total and ferrous iron content.

For some samples, atomic proportions have been calculated, and the methodology for this is provided below.

For a number of samples, their purity has been assessed qualitatively by powder X-ray diffractometry. Phases identified by XRD are provided where available.

d. Spectral Data

The bulk of the spectral data are reflectance spectra, although increasing numbers of Raman and thermal emission data are being added to the database.

Spectral data are organized into three columns. The first column is the sample ID (as described above), the second column provides the source of the data, usually the Reflectance Experiment Laboratory (RELAB) in the Department of Geological Sciences at Brown University (http://www.planetary.brown.edu/relabdocs/relab.htm), or the Planetary Spectrophotometer Facility (PSF) at the University of Winnipeg (http://psf.uwinnipeg.ca). The third column provides information on the physical nature of the sample and spectral measurement conditions, instrument used, and source directory. For example, a listing such as:

PYX003	PSF 031223a.001	<45 µm; 0.35-2.5 µm; i=30º,e=0º; 1 nm spectral output; ASD (directory 031223_pyroxenes)

would indicate that a spectral reflectance measurement exists for, in this example, a pyroxene (PYX003). A <45 µm powder was spectrally characterized from 0.35 to 2.5 microns, with a viewing geometry of 0º incidence angle (i) and 30º emission angle (e). The PSF Analytical Spectral Devices (ASD) FieldSpecPro High Resolution spectrometer was used for the measurements; its spectral resolution varies between ~2 and ~7 nm over the 0.35-2.5 µm range, with a 1.4 nanometre sampling interval; the data is internally resampled/interpolated by the instrument to output data at 1 nanometre intervals. For internal purposes only, we also note the directory in which the spectrum resides: in this case, the spectrum resides in the directory 031223_pyroxenes. Recently we have tried to implement a consistent directory structure using 6 digits which correspond to year (2 digits)-month (2 digits)-day(2 digits), followed by any additional descriptors that may be appropriate, so in this case the user would know that the spectra were measured on December 23, 2003.

Other commonly used PSF spectrometers include:

- an Ocean Optics S2000 spectrometer (labelled S2000 in the data base) that can acquire data from 200 to ~860 or 1100 nanometres with sub-nm resolution. In many cases, data acquired by this instrument were measured over two discrete intervals to optimize signal to noise: 200-400 and 400-1100 nm.
- an Ocean Optics Maya spectrometer (labelled Maya in the database) that can acquire data from ~190 to ~1100 nanometres with sub-nm resolution.
- a Bruker Vertex 70 Fourier-transform infrared spectrometer. It has been used to date, largely to acquire reflectance spectra and can be interfaced with various accessories to measure

bidirectional reflectance spectra over a range of angles. By changing beam splitters, light sources, and detectors, a wide wavelength range is accessible with varying spectral resolution.

- A Designs and Prototypes Model 102F field-portable Fourier transform infrared spectrometer, with a wavelength range of 2 to 16 microns.

Spectrometer Facilities that have provided data included in this database include:

PIMA = Spectral Research PIMA Instrument
PSF = University of Winnipeg Planetary Spectrophotometer Facility
RELAB= Brown University RELAB facility; this includes the RELAB instrument as well as the facility's Nicolet FTIR spectrometer.
UH= University of Hawaii spectrogoniometer
USGS= US Geological Survey spectrometer facility of Roger Clark in Colorado. Spectra measured using an integrating sphere.

The spectral data that are provided on the PSF web site have been organized into Excel spreadsheets to allow for easier dissemination and to minimize the need for external users to import and edit spectral files. We have attempted, as much as possible to provide header information in a consistent format. Data from both RELAB, where a large number of spectra were acquired, and continue to be acquired, and PSF data are available.

A.1. Notes on Analytical Data

1. In the sections concerning the number of ions on the basis of x oxygens (and ions normalized to 24 for the non-oxides), the sums do not always agree with the sums obtained by adding up the numbers in the tables. This is due to the fact that an extra decimal place was used in the calculations in order to more accurately account for the trace (tr.) elements which are present in amounts less than 0.001.

CALCULATION OF CHEMICAL FORMULAS FROM THE ANALYSES.

The weight percentage of each oxide from the analytical table is divided by its respective molecular weight. This number represents the molecular proportions of the various oxides. This number is then multiplied by the number of oxygen atoms in the oxide. These totals are added up and multiplied by the factor required to bring the total oxygens to some predetermined total. The recalculated oxygen totals are used to calculate the elemental totals as follows. The number of cations to oxygen determines this factor. In the case of SiO_2 for example, the SiO_2 oxygen total is divided by 2 to obtain the Si abundance. The analytical procedure is detailed below.

Oxide	(1) Wt.% Oxides	(2) molecular proportion of oxides	(3) atomic proportion of oxygen	(4) No. of anions on basis of 24 oxygens	(5) No. of ions in formula	
SiO_2	51.63	0.8593	1.7186	14.392	Si	7.20
Al_2O_3	7.39	0.0725	0.2175	1.821	Al	0.80
					Al	0.41
Fe_2O_3	2.50	0.0157	0.0471	0.394	Fe^{3+}	0.26
FeO	5.30	0.0738	0.0738	0.618	Fe^{2+}	0.62
MnO	0.17	0.0024	0.0024	0.021	Mn	0.02
MgO	18.09	0.4487	0.4487	3.758	Mg	3.76
CaO	12.32	0.2197	0.2197	1.840	Ca	1.84
Na_2O	0.61	0.0098	0.0098	0.082	Na	0.16
H_2O^+	2.31	0.1283	0.1283	1.074	OH	2.15
Total	100.32		2.8659		Total	17.22

$$\frac{24}{2.8659} = 8.3743$$

Column 1 lists the composition of the mineral expressed in the usual manner as weight percentages of the constituent oxides.

Column 2 is derived by dividing each column 1 entry by the molecular weight of the oxide concerned. The figures so obtained therefore express the molecular proportions of the various oxides.

Column 3 is derived from column 2 by multiplying the number of oxygen atoms in the oxide concerned. It thus gives a set of numbers proportional to the number of oxygen atoms associated with each of the elements concerned. At the foot of column 3 is the total (T).

If we require the formula based on 24 oxygen atoms (this represents half the content of the unit cell) we need to re-cast the oxygen atom proportions so that they total 24. This is done by multiplying all of them by 24/T and the results are given in *Column 4*,

Column 5 gives the number of cations associated with the oxygens in column 4. Thus for SiO_2 there is one silicon for two oxygens so the column 4 entry is divided by 2. For Al_2O_3 there are 2 aluminum atoms for every 3 oxygen atoms so the column 4 entry is multiplied by 2/3. For divalent ions the column 5 value is the same as that of column 4 and for monovalent ions (including hydrogen) the latter is doubled.

For the various assumptions inherent in this approach and examples for anions other than oxygen please see "An Introduction to the Rock Forming Minerals" by Deer *et al.* (1966).

A.2. Notes on Spectral Files

FORMAT:

The format we have tried to consistently use for the spectral data involves three columns as follows:

Column 1: Sample ID (same as those in the sample list)
Column 2: facility where spectrum was measured and digital file number
Column 3: grain size or sample description, viewing geometry, wavelength range, spectral resolution, number of spectra, instrument used, (directory of spectral file).

NOTE:

Grain size or sample description: grain size of powder measured in microns (µm), WR= whole rock; description refers to spot imaged on solid sample.

Viewing geometry: (iE=incidence angle, eE=emergence (viewing) angle):
IS = integrating sphere
Bi= bidirectional reflectance, but angles unknown.

Wavelength range: range of spectral measurements (µm).

Spectral resolution: in nm or Δ wavelength/wavelength (%).

Number of spectra measured and averaged.

++++++++++++++++++++++++++

Miscellaneous notes:

USGS spectra are available with error bars, 1x resolution indicates delta wavelength/wavelength = 200.
PIMA spectral resolution is 7-10 nm, and the spectral sampling interval is 2 nm.
"Spun" indicates that sample holder was spun to minimize any specular effects.
University of Hawaii data are currently only available in analogue form.
Some RELAB spectra are also available with error bars. These numbers will appear as a third column of numbers in the ASCII files.

1. Elements and Standards

Note: this section includes a few metals, diamonds, graphite, and some reflectance standards. Other metals are described in section 10.

1a. Sample Descriptions - Elements and Standards

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either too sparse or intimate/fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
Al foil	Pure aluminum foil (from Carter, Winnipeg).
COP101	Copper: sheet of raw copper with minor adhering black shale; Upper Peninsula, MI, USA?
DIA101	Diamond: natural (Johnson Matthey, #14237A), <1µm size, natural C.
DIA200	Diamond, natural, single crystal: Dudno region, Angola (Excalibur Mineral Co.).
DIA201	Diamond, natural, single crystal: Diamantina, M.G., Brazil (Excalibur Mineral Co.).
DIA202	Diamond, natural, single crystal (carbonado): Bangui region, Central African Republic (Excalibur Mineral Co.).
DIA203	Diamond, natural, single crystal: Liaoning Province, Wafangdian, China (Excalibur Mineral Co.).
DIA204	Diamond, natural, single crystal: Tortia, Ivory Coast (Excalibur Mineral Co.).
DIA205	Diamond, natural, single crystal: Panna region, Mayda Predesch, India (Excalibur Mineral Co.).
DIA206	Diamond, natural, single crystal: Birum Mine, Western Province, Ghana (Excalibur Mineral Co.).
DIA207	Diamond, natural, single crystal: Vaal River, Transvaal, Republic of South Africa (Excalibur Mineral Co.).
DIA208	Diamond, natural, single crystal: Kasai Province, Zaire (Excalibur Mineral Co.).
DIA209	Diamond, natural, single crystal: Sewa River, Sierra Leone (Excalibur Mineral Co.).
DIA210	Diamond, natural, single crystal: Guanaimo region, Venezuela (Excalibur Mineral Co.).
DIA211	Diamond, natural, single crystal: Udachnaya Mine, Yakutia, Russia (Excalibur Mineral Co.).
GRP101	Graphite: Ratnapura District, Sri Lanka (Excalibur Mineral Co.), natural C.
GRP102	Graphite: synthetic "amorphous" graphite (Johnson Matthey, #10130A), -300 mesh, 99.5% pure.
GRP103	Graphite: Dillon, Beaverhead County, Montana (Minerals Unlimited), with schist.
GRP104	Graphite: Seathwaite Mine, Borrowdale, Cumbria, England (David Shannon Minerals).
GRP105	Graphite: 3R - Spitzkoppe, Namibia (David Shannon Minerals). Powders made by crushing, dry sieving (?) and dissolution of host carbonate with HCl.
GRP106	Graphite: Madagascar (University of Winnipeg mineral collection #M100-6).
GRP107	Graphite: South Dakota (University of Winnipeg mineral collection #M100-5).
GRP108	Graphite: Synthetic? - A.C. Gilbert Co.
GRP200	Graphite nanopowder; synthetic (MTI Corporation); <30 nm particle size; 99.5% purity, non-crystalline; >60 m^2/g specific surface area; 100 grams; certificate of analysis provided. ["Powder must be opened, stored, and operated in inert gas (N_2) environment to avoid explosion and O_2 contamination"]; received June 8, 2010.
LCA101	Carbon lampblack: synthetic (Johnson Matthey, #14237A), <0.021µm size.
PIG321	German vine black (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set); other jar part of Historical Pigment Set; catalog no. 481-11S; 4 ounces. (black/brown group). *See section 19 of this document for data.*
PIG360	Lamp black (catalog no. 480-50B). 200 grams. (black/brown group). *See section 19 of this document for data.*
SIL101	Silicon metal, synthetic; 3 pieces.
SPR101	Sulphur: (S) Syncrude Canada Ltd. processing plant (self collected).
STD001	Synthetic N-(tert-Butyldimethylsilyl)-N-methyltrifluoroacetamide, 97% [$C_9H_{18}F_3NOSi$]. Alfa Aesar B23760; lot: 10172853; CAS: 77377-52-7; EINECS: 000-000-0 (moisture sensitive); 5 grams. Received June 2013. *[Reagent for Phoenix Mars lander? (for oxalates project)]*.
SYN001	Polytetrafuoroethylene (PTFE) powder, synthetic; 1 micron size. Aldrich #49,093-5; 100 grams. For use as reflectance standard.

SYN006 White Reflectance Coating (barium sulfate paint), 1 litre/quart. Munsell Color Lot #51702B38. For possible use as reflectance standard.
SYN007 Silicon powder, crystalline, - 325 mesh, 99.5% (metals basis), 10 grams. Alfa Aesar stock #12681, lot #F18N17.
ZNS001 Synthetic zinc stearate, ZnO 125-14% [$Zn(CH_3(CH_2)_{16}(CO_2)_2$). Alfa Aesar 33238; lot: I19X026; CAS: 557-05-1; EINECS: 209-151-9; 50 grams (received June 2013). *[Standard for MSL Curiosity]*.

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1a.1. Aluminum foils

Al foil 1 "Our Very Own" 50' heavy duty value pack.
Al foil 2 No name 50' roll.
Al foil 3 Alcan Heavy Duty Slide 30'.
Al foil 4 Alcan 25' roll.
Al foil 5 Alcan Heavy Duty 25' (wide roll).
Al foil 6 No name Heavy Duty Barbecue Strength 25' (wide roll).

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1b. XRD Data - Elements and Standards

1b.1. University of Alberta XRD analogue files:

Sample ID	*XRD analogue file*
DIA101	Z04684
GRP101	Z03155
GRP102	Z03156
LCA101	Z03154

++

1c. Compositional Data - Elements and Standards

Wt.%	GRP101	Wt. %	GRP200
C	99.1	B	<50 ppm
H	0.5	Ca	<300 ppm
N	<0.1	Cu	<20 ppm
S	0.2	Fe	<30 ppm
O	0.1	Mn	<20 ppm
ash	0.3	Pb	<5 ppm
aromaticity	1.0	Si	<300 ppm
Source	King *et al.* (1963).	MTI Corp.	

++

1d. Spectral Data - Elements and Standards

Sample	*Facility/File no.*	*Description*
[Description: grain size; viewing geometry (i°, e°); wavelength range; spectral resolution; number of spectra averaged; instrument (directory)]		
DIA101	RELAB c1sc81	<1µm; 0E/15E; 0.3-2.7µm; 5nm resolution (RELAB).
	RELAB mada01	<1µm; 30E/30E; 1.8-25.9µm; ~0.6-129 nm resolution (Nicolet FTIR).
++++++		
GRP101	RELAB c1sc79	<45µm; 0E/15E; 0.3-2.7µm; 5nm resolution (RELAB).
GRP101	RELAB casc79	<45; 30°/0°; 0.3-2.6µm; 5 nm resolution (RELAB).
GRP101	RELAB n2sc79	<45µm; 30E/30E; 0.9-3.2µm; ~0.3-3.9 nm resolution (Nicolet FTIR).
GRP101	RELAB n1sc79	<45µm; 30E/30E; 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
GRP101	RELAB lasc79	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm resolution; merged at 2.5µm (RELAB+Nicolet); note different viewing geometries.
GRP101	PSF feb2307.010	<45µm; 35°/0°; 0.35-2.5 µm;1 nm resolution; 1000 spectra averaged; ASD (directory: feb2307 meteoritic).
GRP101	PSF feb2607.010	<45µm; 35°/0°?; 0.35-2.5 µm;1 nm resolution; 1000 spectra averaged; ASD (directory: feb2607 meteoritic).
++++++		
GRP102	RELAB c1sc80	<45µm; 0E/15E; 0.3-2.7µm; 5nm (RELAB).
GRP102	RELAB casc80	<45µm; 30°/0°; 0.3-2.6µm; 5 nm(RELAB).
GRP102	RELAB lasc80	<45µm; 30°/0°,30°; 0.3-26µm; 5,1.2-129 nm; merged at 2.5µm. (RELAB+Nicolet) note different viewing geometries.
GRP102	RELAB n2sc80	<45µm; 30E/30E; 0.9-3.2µm; ~0.3-3.9 nm (Nicolet FTIR).
GRP102	RELAB n1sc80	<45µm; 30E/30E; 1.8-25.9µm; ~0.6-129 nm (Nicolet FTIR).
GRP102	PSF feb2307. 011	<45µm; 35°/0°; 0.35-2.5 µm;1 nm resolution; 1000 spectra averaged; ASD (directory: feb2307 meteoritic).
GRP102	PSF feb2607.011	<45µm; 35°/0°?; 0.35-2.5 µm;1 nm resolution; 1000 spectra averaged; ASD (directory: feb2607 meteoritic).
GRP102	PSF 100420a.006	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100420_carbon).
++++++		
GRP103	RELAB csc111	<45µm; 30E/0E; 0.3-2.6µm; 5 nm (RELAB).
GRP103	RELAB masc111	<45µm; 30E/30E; 1.8-25.9µm; ~0.6-129 nm (Nicolet FTIR).
GRP103	RELAB cagp03	<45µm; 30°/0°; 0.3-2.6µm; 5 nm(RELAB).
GRP103	RELAB lagp03	<45µm, 30°/0°,30°, 0.3-26µm; 5,1.2-129µm, merged at 2.5µm. (RELAB+Nicolet) note different viewing geometries.
++++++		
GRP104	RELAB cagp04	<45µm; 30°/0°; 0.3-2.6µm; 5 nm(RELAB).
GRP104	RELAB lagp04	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
GRP105	RELAB cagp05	<45µm; 30°/0°; 0.3-2.6µm; 5 nm(RELAB).
GRP105	RELAB lagp05	<45µm; 30°/0°,30°, 0.3-26µm; 5,1.2-129µm; merged at 2.5µm. (RELAB+Nicolet) note different viewing geometries.
++++++		
GRP106	RELAB cagp06	<45µm; 30°/0°; 0.3-2.6µm; 5 nm(RELAB).
GRP106	RELAB lagp06	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
GRP107	RELAB cagp07	<45µm; 30°/0°; 0.3-2.6µm; 5 nm(RELAB).
GRP107	RELAB lagp07	<45µm; 30°/0°,30°; 0.3-26µm; 5,1.2-129µm, merged at 2.5µm. (RELAB+Nicolet) note different viewing geometries.

++++++		
GRP200	PSF 120116a.079	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD (directory: 121016glovebox).
++++++		
LCA101	RELAB c1sc24	<0.021µm; 0E/15E; 0.34-2.7µm; 5nm (RELAB).
LCA101	RELAB n2sc24	<0.021µm; 30E/30E; 0.9-3.2µm; ~0.3-3.9 nm (Nicolet FTIR).
LCA101	RELAB n1sc24	<0.021µm; 30E/30E; 1.8-25.9µm; ~0.6-129 nm (Nicolet FTIR).
LCA101	PSF 100420a.008	<0.021 µm; 30°/0°; 0.35-2.5 µm; 1 nm output, 100 spectra averaged; ASD (Directory: 100412_Carbon-black and 100420_Carbon).
LCA101	PSF OO 79	<0.021 µm; 0º/0º; 0.2-0.86 µm (0.2-0.4 µm usable range); ~0.4 nm resolution; 200 spectra averaged; Ocean Optics S2000 (directory: Ocean Optics 000); opened in glove box.
++++++		
SYN007	PSF feb2107.014	<45µm; 35°/0°; 0.35-2.5 µm;1 nm resolution; 1000 spectra averaged; ASD (directory: feb2107 meteoritic).

++++ Unassigned samples ++++++++++++

Al foil	PSF 071115a.001	Pure aluminum foil; lightly sanded surface; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
Al cup1	PSF 071115a.007	1” Al sample cup holder spray painted black; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
Al cup2	PSF 071115a.008	1” Al sample cup holder hand painted black; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
Cdn penny	PSF 071115a.009	Canadian penny, shiny heads surface; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
Cdn penny	PSF 071115a.010	Canadian penny, less shiny tails surface; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.

Commercial aluminium foils – crinkled; Al sample cups, Al plates, steel sample cup

Measured with ASD spectrometer, bifurcated cable. Probe height adjusted to get ~80% reflectance each time.

Al foil 1	PSF oc2407.001	50 heavy duty shiny side; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 1	PSF oc2407.002	50 heavy duty dull side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 2	PSF oc2407.003	no name 50 heavy duty shiny side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 2	PSF oc2407.004	no name 50 heavy duty dull side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 3	PSF oc2407.005	Alcan heavy duty 30 shiny side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 3	PSF oc2407.006	Alcan heavy duty 30 dull side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 4	PSF oc2407.007	Alcan 25 shiny side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 4	PSF oc2407.008	Alcan 25 dull side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 5	PSF oc2407.009	Alcan heavy duty 25 shiny side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).

Al foil 5	PSF oc2407.010	Alcan heavy duty 25 dull side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 6	PSF oc2407.011	no name heavy duty 25 shiny side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al foil 6	PSF oc2407.012	no name heavy duty 25 dull side; crinkled; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al block	PSF oc2407.013	Al cylinder; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al block	PSF oc2407.014	Al cylinder; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al block	PSF oc2407.015	Al cylinder; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al plate	PSF oc2407.016	Roughened AL plate; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al disk 1	PSF oc2407.017	AlO blasted 1” Al disk; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al disk 1	PSF oc2407.018	AlO blasted 1” Al disk; other spot; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al disk 1	PSF oc2407.019	AlO blasted 1” Al disk; dirtier face; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al disk 2	PSF oc2407.020	Glass bead blasted and gold-painted 1” Al disk; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al disk 2	PSF oc2407.021	Glass bead blasted and 1” Al disk; unpainted side; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
SS disk	PSF oc2407.022	1” roughened stainless steel disk. ; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
SS disk	PSF oc2407.023	1” roughened stainless steel disk; spot 2; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).
Al disk 3	PSF oc2407.024	1” Al disk; bottom of sample disc; crinkled; i=0°, e=0° (bifurc. cable); 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: oc2407).

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END of 1.

2. Silicates

2.1. Pyroxenes

2.1a. Sample Descriptions - Pyroxenes

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either not pyroxenes or are too fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
PYX001	now amphibole AMP001 (originally labelled as enstatite): Tilly Foster Mine, Brewster, New York (Dr. David Garske, collected by Gunnar Bjareby #A106).
PYX001A	New sample of enstatite (?). Brewster, Putnam Co., NY, USA (Minerals Unlimited – June 2013).
PYX002	now incompletely characterized phase INC002 (originally labelled as pyroxene): locality unknown, probably Bancroft, Ontario (G. Hudecek).
PYX003	Bronzite: Mantyharja, Finland (Dr. David Garske #A1647) (originally labelled as hypersthene).
PYX004	now apatite APA104 (originally labelled as diopside): Wilson's Corner, Quebec (Dr. David Garske #AL14b).
PYX005	Diopside: locality unknown, probably Ontario (G. Hudecek), with some amphibole AMP305.
PYX006	Diopside: locality unknown, probably Haliburton, Ontario, with garnet (GAR108) (G. Hudecek).
PYX007	Fassaite: locality unknown, probably Ontario (G. Hudecek).
PYX008	now incompletely characterized phase INC008 (originally labelled as pyroxene): locality unknown, probably Sudbury, Ontario (G. Hudecek).
PYX009	Diopside: locality only given as Canada, probably Quebec (Banff Rock Shop).
PYX010	Salite: locality unknown, probably Bancroft, Ontario (G. Hudecek).
PYX011	Wollastonite, Harquahala Mountains, Yuma County, Arizona (Wetaskiwin Rock Show), with incompletely characterized phase INC011.
PYX012	Diopside: locality unknown, probably Ontario (G. Hudecek).
PYX013	Urbanite (Fe-Mn pyx): Mangruvan Mine, Linde, Sweden (Dr. David Garske #D1870), with pyroxene (rhodonite) PYX044.
PYX014	Norbergite: Franklin, Sussex County, New Jersey (Minerals Unlimited), in limestone with diopside (PYX183) (too intimate to separate). Norbergite is not really a pyroxene anyway.
PYX015	Endiopside: Navajo Indian Reservation, San Carlos County, Arizona (Minerals Unlimited), with olivine OLV013, volcanic bomb intrusion.
PYX016	Diopside: N.W. Bird's Creek, Ontario (Minerals Unlimited). (lot of 10 and single pieces received June 17/09).
PYX017	Endiopside: Tillamook Burn Area, approximately 20 miles east of Tillamook, near Grindstone Lookout, Tillamook County, Oregon (Minerals Unlimited).
PYX018	Diopside (Cr-rich): near Dallas Gem Mine, San Benito County, California, with tremolite (Minerals Unlimited).
PYX019	Salite: Trail Creek, Grand County, Colorado (Minerals Unlimited).
PYX020	Diopside: Hirado Mine, Hirado-Mura, Bugi-gun, Gifu-ken, Honshu, Japan (Minerals Unlimited).
PYX021	Hedenbergite: Rio Marina, Elba, Italy (Minerals Unlimited).
PYX022	now incompletely characterized phase INC022 (originally diopside): Kafveltorp Quarry, Kopperberg, Sweden (Minerals Unlimited), with olivine OLV008.
PYX023	Enstatite: Mirabel Springs, Mount St. Helena, Lake County, California (Minerals Unlimited).
PYX024	too intimate to separate: Hypersthene: Summit Rock, Klamath County, Oregon (Minerals Unlimited), with lots of other minerals.
PYX025	Diopside: Jefferson County, Colorado, with actinolite (Minerals Unlimited).
PYX026	Hedenbergite (Mn-rich): Broadway Mine, near Silver Star, Madison County, Montana (Minerals Unlimited).
PYX027	too intimate to separate: Pyroxene: near Moti, Lane County, Oregon (Minerals Unlimited), in diabase.
PYX028	too intimate to separate: Hypersthene: Summit Rock, Klamath County, Oregon (Minerals Unlimited),

in andesite.

PYX029 Diopside: Oaxaca, Oaxaca State, Mexico (Minerals Unlimited).

PYX030 *siliceous glass (obsidian?) (originally labelled as augite): Mount Lassen, Lassen County, California (Minerals Unlimited), in augite andesite with sulphur.*

PYX031 now amphibole AMP031 (originally labelled as augite): Gjerstad, Norway (Minerals Unlimited), in pegmatite.

PYX032 Hypersthene: Ekersund, Norway (Minerals Unlimited), mixed with and unknown amount of AMP232 which is not spectrally detectable but found by EMPA.

PYX033 Augite: Franklin, New Jersey (Dr. David Garske #C254).

PYX034 Endiopside: Hopi Buttes, Winslow, Arizona (Minerals Unlimited).

PYX035 Salite: Mount Etna, Sicily, Italy (Minerals Unlimited) (originally labelled as augite).

PYX036 Augite: Buffaure, Val di Fassa, Trento, Italy (Minerals Unlimited).

PYX037 Endiopside: Nye, Springwater County, Montana (Minerals Unlimited), mixed with an incompletely characterized phase (INC037) in spectrally significant amounts.

PYX038 Ferrosalite: Avery County, North Carolina (Mineral Unlimited).

PYX039 Salite: Risor, Aust-Adger, Norway (Smithsonian Institution Museum of Natural History, MNH #R15398).

PYX040 Fassaite/diopside: 1300' elevation N 30E W of Haleakala Observatory, Maui, Hawaii (University of Hawaii Collection).

PYX041 Fassaite: Val di Fassa, Italy (Dr. David Garske), with topazolite garnet GAR111.

PYX042 Enstatite: Bamle, Norway (Ward's collection).

PYX043 Clinopyroxene: analysis in Singer (1981).

PYX044 Rhodonite: Mangruvan Mine, Linde, Sweden (Dr. David Garske #D1870), with pyroxene (urbanite) PYX013.

PYX045 Diopside: Bancroft, ON, Canada (from Discovery Gemstones Ltd. – Edmonton, AB, Canada; #03D040; July 2009).

PYX050 Diopside: Schwartzenstein, Tyrol, Austria (Smithsonian Institution National Museum of Natural History (NMNH) #82,325). Received from UND Jan. 2009. [John Adams sample].

PYX051 Pyroxmangite: Homedale, Idaho, USA (Smithsonian Institution National Museum of Natural History (NMNH) #102794). Received from UND Jan. 2009. [John Adams sample].

PYX052 Augite: Templeton, Quebec, Canada (Smithsonian Institution National Museum of Natural History (NMNH) #R15161). Received from UND Jan. 2009. [John Adams sample].

PYX053 Diopside (chrome): Outokumpo Mine, Outokumpo, Finland (Smithsonian Institution National Museum of Natural History (NMNH) #106659). Received from UND Jan. 2009. [John Adams sample].

PYX054 Augite: Nasinu, Fiji (Smithsonian Institution National Museum of Natural History (NMNH) #122303). Received from UND Jan. 2009. [John Adams sample].

PYX055 Augite: Monti Rossi, Sicilia, Italy (Smithsonian Institution National Museum of Natural History (NMNH) #95707). Received from UND Jan. 2009. [John Adams sample].

PYX056 Augite: Etna, Sicilia, Italy (Smithsonian Institution National Museum of Natural History (NMNH) #86581). Received from UND Jan. 2009. [John Adams sample].

PYX057 Pigeonite: Arlington Quarry, Loudon Co., VA, USA (Smithsonian Institution National Museum of Natural History (NMNH) #91916). Received from UND Jan. 2009. [John Adams sample].

PYX058 Diopside: Wakefield, Quebec, Canada (Smithsonian Institution National Museum of Natural History (NMNH) #R10308). Received from UND Jan. 2009. [John Adams sample].

PYX059 Diopside (chrome): Yakutia, Russia (Smithsonian Institution National Museum of Natural History (NMNH) #119491). Received from UND Jan. 2009. [John Adams sample].

PYX060 Diopside: Fianarantosa, Madagascar (Smithsonian Institution National Museum of Natural History (NMNH) #R15379). Received from UND Jan. 2009. [John Adams sample].

PYX061 Enstatite (bronzite): Kraubath, Austria (Smithsonian Institution National Museum of Natural History (NMNH) #C2367). Received from UND Jan. 2009. [John Adams sample].

PYX062 Hedenbergite: Furstenberg, Sachsen, Germany (Smithsonian Institution National Museum of Natural History (NMNH) #R3022). Received from UND Jan. 2009. [John Adams sample].

PYX063 Enstatite: Webster, NC, USA (Smithsonian Institution National Museum of Natural History (NMNH) #38833). Received from UND Jan. 2009. [John Adams sample].

PYX064 Enstatite (bronzite): Bonin Islands, Japan (Smithsonian Institution National Museum of Natural History (NMNH) #95715). Received from UND Jan. 2009. [John Adams sample].

PYX070 Enstatite: Embilipitiya, Sri Lanka (low Fe variety); from Hanco Zwaan (March 2009).

PYX101 Augite: Loudon County, Virginia (Excalibur Mineral Co.).
PYX102 Diopside: locality unknown (University of Alberta GEOL330 laboratory collection #A67).
PYX103 Augite: locality unknown (University of Alberta GEOL330 laboratory collection #D77), extremely heterogeneous.
PYX104 Diopside: locality unknown (University of Alberta GEOL330 laboratory collection #unknown), with calcite CRB110.
PYX105 Diopside: locality unknown (University of Alberta GEOL330 laboratory collection #8/4/6).
PYX106 now amphibole AMP106 (originally labelled as diopside-hedenbergite): University of Alberta GEOL330 laboratory collection #8/4/5).
PYX107 Diopside: locality unknown (University of Alberta GEOL330 laboratory collection #D81), with plagioclase PLG114.
PYX108 Enstatite: Jackson County, North Carolina (University of Alberta GEOL330 laboratory collection #D76; World Mineral Supply Co.).
PYX109 Salite: locality unknown (University of Alberta GEOL330 laboratory collection #7).
PYX110 Bronzite: locality unknown (University of Alberta GEOL330 laboratory collection #8/4/4).
PYX111 Diopside: Markt Schorgass, The Fichtelgegirge, Germany (Smithsonian Institution Museum of Natural History MNH #B20009).
PYX112 Pigeonite: Heinola, Finland (Smithsonian Institution Museum of Natural History MNH #B18247).
PYX113 Salite: Gerdeshagen, Germany (Smithsonian Institution Museum of Natural History MNH #85855), with plagioclase PLG124 and olivine OLV111.
PYX114 Augite: Skaergaard Intrusion, Greenland (University of Hawaii collection #10-21-6), heterogeneous, with plagioclase PLG116 and olivine OLV022.
PYX115 Augite: Skaergaard Intrusion, Greenland (University of Hawaii collection #10-21-9), with plagioclase PLG125 and olivine OLV020.
PYX116 Spodumene: Newry Township, Maine (Minerals Unlimited), no Li analysis.
PYX117 Bronzite: India (Excalibur Mineral Co.).
PYX118 too intimate to separate: Hypersthene: Diamond Lake, Douglas County, Oregon (Excalibur Mineral Co.), microcrystals.
PYX119 Bronzite: Loch Seaforth, Harris, Outer Hebrides, Scotland (Excalibur Mineral Co.), with olivine OLV103.
PYX120 Diopside: Madoc, Ontario (Minerals Unlimited).
PYX121 Diopside (var. coccolite): Cascade Mountain, Essex County, New York (Minerals Unlimited), with calcite CRB111.
PYX122 Bustamite (Fe-Ca-Mn pyx): Franklin, Sussex County, New Jersey, with willemite (WIL110) and polyadelphite (Minerals Unlimited).
PYX123 too intimate to separate: Hypersthene: Heim Brothers Quarry, Petaluma, Sonoma County, California (Minerals Unlimited), in andesite.
PYX124 Wöhlerite (Zr-Nb-Na-Ca-etc. pyx): Skudesundsjaer, Langesundfjord, Norway (Minerals Unlimited), sparse in nepheline-syenite pegmatite.
PYX125 Hiortdahlite (Na-Ca-Zr pyx): ArNy, Langesundfjord, Norway (Minerals Unlimited), sparse with lepidomelane LEP101 and pyroxene PYX172 in nepheline-syenite pegmatite.
PYX126 Fassaite/diopside: June 1, 1929 eruption of Vesuvius, Naples, Campania, Italy (Min. Unlimited).
PYX127 Omphacite (Na-Al pyx): Tiburon Peninsula, Marin County, California (Minerals Unlimited).
PYX128 Aegerine (Na-Fe^{3+} pyx): Barkeviksjaer, Langesundfjord, Norway (Minerals Unlimited), in nepheline-syenite pegmatite.
PYX129 Babingtonite (Fe^{3+}-Fe^{2+} pyx): Hampden Quarry, West Springfield, Massachusetts (Minerals Unlimited); little sample available.
PYX130 Pectolite (Na-H pyx): near Middletown, Lake County, California (Minerals Unlimited) no H analysis.
PYX131 Fassaite: Casa Collina Quarry, Pitigliano Grosseto, Tuscany, Italy (Minerals Unlimited), with melilite MEL103.
PYX132 Schefferite (Fe-Mn pyx): Langban, Sweden (Minerals Unlimited).

PYX133	Rosenbuschite (Na-Mn-Zr-Ti-F-OH pyx): Norra Kaar, Sweden (Minerals Unlimited), little sample available.
PYX134	Lavrovite (V-rich diopside): Sljudjauka, Lake Baikal, Russia (Dr. David Garske #R54).
PYX135	Diopside: DeKalb, New York (Dr. David Garske #M21a).
PYX136	Diopside: Dog's Lake, Storrington Township, Ontario (Dr. David Garske #M22a).
PYX150	Diopside: locality unknown, probably Bancroft, Ontario (G. Hudecek), formerly OLV001.
PYX151	Fassaite: San Vito Quarry, Vesuvio, Napoli, Italy (Excalibur Mineral Co.), formerly OLV004, with spinel (supposedly) which is too intimate to separate.
PYX152	Pyroxmangite/Rhodonite (Mn pyx): Kaso Mine, Tochigi-ken, Honshu, Japan (Minerals Unlimited), formerly OLV104.
PYX153	Ureyite (Na-Cr-Al pyx): Twomow, Burma (Minerals Unlimited), with jadeite, formerly URE101.
PYX160	Augite: Goose River, Quebec (Tyson's Minerals).
PYX161	Bronzite: locality unknown (Geological Survey of Canada collection at the University of Alberta #I59), in peridotite, with olivine OLV108.
PYX162	Diopside: Timber Lake Stage, Kootenay Lake, British Columbia (R. Burwash via R. Rushton), in diopside pegmatite.
PYX163	Unknown type: locality unknown (Geological Survey of Canada collection at the University of Alberta #I62), with plagioclase feldspar PLG126.
PYX164	no good analyses obtained: Pyroxene (type unknown): locality unknown, (source unknown), with plagioclase feldspar PLG127.
PYX165	Augite: Harcourt Township, Ontario (Ward's collection).
PYX166	Augite?: Wyoming (University of Alberta GEOL401 collection).
PYX167	Augite: locality unknown (Geological Survey of Canada collection at the University of Alberta #I57), in gabbro, heterogeneous, with plagioclase PLG128.
PYX168	Unknown type: (Colorado Geological Institute #511 in University of Alberta GEOL401 laboratory collection), with plagioclase PLG129 and olivine OLV110, in norite pegmatite.
PYX169	total mystery. Do I even have a sample?
PYX170	Diopside: KR4011 xenolith from Kettle River, British Columbia (D. Canil), originally OLV109.
PYX171	Fassaite/Diopside: Palumbo Farm, Villafranca, Cecchina, near Rome, Italy (Minerals Unlimited), with OLV007.
PYX172	Augite: ArNy, Langesundfjord, Norway (Minerals Unlimited), black, non-micaceous mineral with hiortdahlite PYX125 and lepidomelane LEP101.
PYX173	Ferrosilite: Road cut near Big Squaw, Maine (mauve to brown-black with associated labradorite (PLG131), fayalite (green-brown; OLV113), and biotite (too intimate to separate) (David Shannon).
PYX174	Hedenbergite: Iron Cap prospect, Santa Teressa Mountains, Graham County, Arizona (David Shannon).
PYX180	Wollastonite: 150' level, Gold Hill Mine, Tooele County, Utah, with calcite (David Shannon Minerals) [aka WOL101].
PYX181	Rhodonite: Kaso Mine, Tochigi-ken, Honshu, Japan (David Shannon?).
PYX182	Wollastonite: Drum Valley, Tulare County, California (aka WOL101) (Minerals Unlimited).
PYX183	Diopside: Franklin, Sussex County, New Jersey (Minerals Unlimited), in limestone with norbergite (PYX014, but not really a pyroxene).
PYX184	Omphacite: Panoche Pass, San Benito County, California (with glaucophane) (Minerals Unlimited).
PYX185	Hypersthene: Lac Onatchiway, Chicoutimi County, Quebec, Canada (Minerals Unlimited).
PYX186	Hypersthene: Nain, Labrador, Canada (Minerals Unlimited).
PYX187	Diopside: Dog Lake, ON, Canada, in calcite (CRB146) [The Crystal Circle, Tucson 2011 show].
PYX188	Chrome diopside: Russia [Intergeoresources Ltd.; Tucson 2011 show].
PYX190	Augite: Kakanui, Damaru, South Island, New Zealand (Smithsonian Institution NMNH #122142; received June 11, 2007).
PYX191	Chrome diopside: near Aracuai, Minas Gerais, Brazil (Excalibur Minerals; received Dec. 7, 2007).
PYX192	Chrome diopside: Orford, Quebec, Canada; with grossular (Excalibur Minerals; received Dec. 7, 2007).
PYX193	Enstatite/norite from Springwater intrusion (~500 grams). From American Museum of Natural History, Department of Earth and Planetary Sciences; catalog number ST88-6; received May 24, 2013.

PYX205 Enstatite: Happy Canyon, Texas E7 anomalous enstatite chondrite (American Meteorite Laboratory). See MET200.
PYX206 Enstatite: Norton County, Kansas aubrite (David New Meteorites), with pyroxene PYX207. See MET201.
PYX207 Diopside: Norton County, Kansas aubrite (David New Meteorites), with pyroxene PYX206. See MET201.

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2.1.a.1. Sample descriptions: Pyroxenes - Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

Pyroxenite		SARM 5
hand sample44	**Augite	ActLabs
Wollastonite		GBW 03123 (NCS DC60124)

Pyroxenite grain size information from Brammer: <75 μm: 98%

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2.1.a.2. Sample Descriptions: Pyroxenes - John Adams and RELAB pyroxenes (Digital spectral data available from RELAB)

Sample ID	*Description*
JA2368	John Adams hypersthene. No analysis available.
106006	John Adams hypersthene. No analysis available.
2427ACM	John Adams acmite. No analysis available.
7208	John Adams hedenbergite. No analysis available.
79558	John Adams hypersthene. No analysis available.
86618	John Adams hypersthene. No analysis available.
104265	John Adams hedenbergite. No analysis available.
R7209	John Adams hypersthene. No analysis available.
112538	John Adams jadeite. No analysis available.
PP-CMP-21	RELAB clinopyroxene (diopside). See Sunshine and Pieters (1993).

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2.1a.x Pyroxenes – Alternative names for pyroxenes

Aegirine / acmite	*($NaFe^{3+}Si_2O_6$) (Na, Fe pyroxene)*
Alalite	*(faint green var. of diopside)*
Augite	*(Mg, Fe, Ca pyroxene)*
Babingtonite	*(Fe^{3+}-Fe^{2+} pyroxene)*
Baikalite	*(green var. of hedenbergite)*
Bronzite	*(12-30% Fe) (Mg, Fe pyroxene)*
Bustamite	*($(Mn,Ca,Fe)(SiO_3)$) (Ca, Mn pyroxenoid)*
Canaanite	*(gray or bluish white var. of diopside)*
Chladnite	*(Mg rich var. of enstatite; from Bishopville meteorite)*
Chrome diopside	*(Cr- rich diopside)*
Coccolite	*(granular var. of hedenbergite embedded in calcite)*
Diallage	*(lamellar var. of hedenbergite)*
Diopside	*($CaMgSi_2O_6$) (Mg, Ca pyroxene)*
Enstatite (ortho/clino)	*($MgSiO_3$) (0-12% Fe) (Mg, Fe pyroxene)*
Eulite	*(70-90% Fe) (Mg, Fe pyroxene)*
Fassaite	*(Ca-, Al-, Fe^{3+} -rich augite)*
Ferrohypersthene	*(50-70% Fe) (Mg, Fe pyroxene)*
Ferrosilite	*(90-100% Fe) (Mg, Fe pyroxene)*
Hedenbergite	*($CaFeSi_2O_6$) (Fe, Ca pyroxene)*
Hiortdahlite	*(Na-Ca-Zr pyroxene)*
Hypersthene	*(30-50% Fe) (Mg, Fe pyroxene)*
Jadeite	*($NaAlSi_2O_6$) (Na, Al pyroxene)*
Jeffersonite	*(var. of schefferite; Ca, Mg, Fe, Mn, Zn pyroxene)*
Johannsenite	*($Ca(Mn,Fe)Si_2O_6$) (Ca, Mn pyroxene)*
Lavenite	*(monoclinic)*
Lavrovite	*(V-rich var. of diopside)*
Leucaugite	*(var. of augite)*
Malacolite	*(pale coloured, translucent var. of diopside)*
Manganhedenbergite	*(var. of hedenbergite)*
Omphacite	*(Na-Al pyroxene)*
Peckhamite	*(var. of hypersthene, from Estherville meteorite)*
Pectolite	*($Ca_2NaH(SiO_3)_3$) (Ca, Na, H pyroxenoid)*
Pigeonite	*(Mg, Fe, Ca pyroxene)*
Pyroxmangite	*($(Mn,Fe)(SiO_3)$) (Mn, Fe pyroxenoid)*
Rhodonite	*($((Mn,Ca,Fe)(SiO_3))$) (Mn pyroxenoid)*
Rosenbuschite	*(Na-Mn-Zr-Ti-F-OH pyroxene)*
Salite	*(Mg, Fe, Ca pyroxene [along diopside-hedenbergite join])*
Schefferite	*(Fe-Mn pyroxene)*
Spodumene	*($LiAlSi_2O_6$) (Li, Al pyroxene)*
Traversellite	*(faint green var. of diopside)*
Urbanite	*(Fe-Mn pyroxene)*
Ureyite	*(Na-Cr-Al pyroxene)*
Victorite	*(Mg rich var. of enstatite; from Deesa meteorite)*
Violan	*(blue var. of diopside)*
Wöhlerite	*(Zr-Nb-Na-Ca etc. pyroxene)*
Wollastonite	*($CaSiO_3$) (Ca pyroxenoid)*

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2.1b. XRD Data - Pyroxenes

2.1.b.1. Analogue files from University of Alberta instrument

Sample	XRD File	Sample	XRD File	Sample	XRD File
PYX003	Z03214	PYX005		PYX006	
PYX007		PYX009	Z03243	PYX010	
PYX011		PYX012		PYX013	
PYX015	Z03215	PYX016		PYX017	
PYX018	Z03244	PYX019		PYX020	
PYX021	Z03216	PYX023	Z03245	PYX025	Z03246
PYX026	Z03247	PYX029	Z03217	PYX032	Z03226
PYX033		PYX034	Z03248	PYX035	
PYX036	Z03249	PYX037	Z03268	PYX038	Z03250
PYX039	Z03251	PYX040	Z03252	PYX041	Z03253
PYX042	Z03254	PYX043		PYX044	
PYX101	Z03269	PYX102		PYX103	Z03255
PYX104	Z03256	PYX105		PYX107	Z03257
PYX108	Z03259	PYX109		PYX110	
PYX111	Z03260	PYX112	Z03261	PYX113	
PYX114	Z03262	PYX115	Z03263	PYX116	
PYX117	Z03227	PYX119		PYX120	
PYX121		PYX122		PYX124	
PYX125		PYX126		PYX127	
PYX128		PYX129		PYX130	
PYX131	Z03233	PYX132		PYX133	
PYX134		PYX135	Z03264	PYX136	Z03265
PYX150	Z03266	PYX151	Z03232	PYX152	
PYX153		PYX160	Z03197	PYX161	Z03201
PYX162	Z03204	PYX165	Z03202	PYX167	
PYX170		PYX171		PYX172	
PYX205	Z03267	PYX206		PYX207	

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2.1c. Compositional Data - Pyroxenes

Wt. %	PYX003	PYX005	PYX006	PYX007	PYX009	PYX010	PYX011*
SiO_2	50.33	49.70	54.07	44.46	53.90	51.94	51.49
Al_2O_3	5.46	4.12	0.52	8.08	0.51	0.50	0.04
FeO^1	17.30	5.93	4.18	6.11	6.20	10.18	0.39
$Fe_2O_3^1$	1.43	0.77	2.07	2.07	0.00	4.83	n.d.
MgO	23.58	13.80	14.63	10.92	14.18	9.31	0.23
CaO	1.59	22.94	23.85	22.64	25.08	21.65	48.06
Na_2O	0.05	0.57	0.73	0.94	0.05	1.39	n.d.
TiO_2	0.41	1.48	0.02	3.92	0.01	tr.	0.05
Cr_2O_3	0.11	0.17	0.04	0.05	0.04	0.03	n.d.
V_2O_5	0.02	0.00	0.02	0.00	0.02	tr.	n.d.
CoO	0.04	0.04	0.03	0.04	0.05	0.02	n.d.
NiO	0.01	0.04	0.03	0.02	0.15	0.01	n.d.
MnO	0.29	0.11	0.18	0.27	0.26	0.52	n.d.
ZrO_2*	0.00	0.00	0.00	0.00	0.00	0.00	n.d.
TOTAL	100.62	99.67	100.37	99.52	100.45	100.38	100.26
				ATOMIC RATIOS			
Mg	68.5	41.0	42.9	35.7	39.8	30.4	0.7
Fe^{2+}	28.2	9.9	6.9	11.2	9.7	18.7	0.6
Ca	3.3	49.1	50.2	53.1	50.5	50.9	98.7
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	1.838	1.854	1.987	1.686	1.991	1.953	1.990
Al	0.162	0.146	0.013	0.314	0.009	0.023	0.002
Al	0.073	0.035	0.009	0.046	0.013	--	--
V	tr.	--	tr.	--	tr.	tr.	--
Ti	0.011	0.041	0.002	0.112	tr.	tr.	0.001
Zr	--	--	--	--	--	--	--
Cr	0.002	0.005	0.001	0.002	0.001	0.001	--
Fe^{3+}	0.039	0.021	0.057	0.059	--	0.137	--
Fe^{2+}	0.529	0.185	0.128	0.194	0.191	0.325	0.012
Mg	1.283	0.767	0.802	0.617	0.781	0.528	0.013
Ca	0.061	0.917	0.938	0.920	0.992	0.883	1.990
Co	tr.	0.001	0.001	0.001	0.002	0.001	--
Ni	tr.	0.001	0.001	0.001	0.004	tr.	--
Mn	0.009	0.004	0.005	0.009	0.008	0.016	--
Na	tr.	0.041	0.053	0.068	0.004	0.103	–
Total	4.008	4.018	3.997	4.029	3.996	3.970	4.008
M2 cations[2]		0.967	0.998	1.000	1.007	1.004	
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-7	EMPA-4	EMPA-8	EMPA-7	EMPA-8	EMPA-8	EMPA-1

1. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.

2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX012	PYX013	PYX015	PYX016	PYX017	PYX018	PYX019
SiO_2	52.12	52.48	52.07	55.08	50.57	55.17	48.41
Al_2O_3	0.50	0.56	6.34	0.23	4.09	0.37	5.29
FeO[1]	0.40	0.50	3.25	1.69	4.88	2.42	6.15
Fe_2O_3[1]	15.89	14.55	0.01	0.10	1.25	0.00	3.79
MgO	9.13	8.05	16.42	17.82	16.05	17.01	12.37
CaO	21.58	13.14	19.38	24.96	20.85	23.93	22.15
Na_2O	1.42	5.91	1.31	0.13	0.32	0.51	0.36
TiO_2	tr.	0.01	0.21	0.07	1.04	tr.	1.05
Cr_2O_3	0.08	0.04	1.39	0.03	0.78	0.91	0.03
V_2O_5	0.04	0.01	0.03	0.00	0.02	0.03	0.03
CoO	0.02	0.05	0.03	0.04	0.03	0.02	0.05
NiO	0.04	0.02	0.07	0.03	0.06	0.07	0.02
MnO	0.55	5.17	0.10	0.07	0.13	0.10	0.26
ZrO_2*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZnO*	n.d.	0.18	n.d.	n.d.	n.d.	n.d.	n.d.
TOTAL	101.77	100.67	100.61	100.25	100.07	100.54	99.96
				ATOMIC RATIOS			
Mg	36.7	45.3	51.0	48.6	47.5	47.8	39.0
Fe^{2+}	0.9	1.6	5.6	2.5	8.1	3.8	10.9
Ca	62.4	53.1	43.4	48.9	44.4	48.4	50.1
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	1.927	1.977	1.875	1.994	1.862	1.995	1.815
Al	0.022	0.023	0.125	0.006	0.138	0.005	0.185
Al	--	0.002	0.143	0.003	0.039	0.010	0.049
V	0.001	tr.	0.001	--	tr.	0.001	0.001
Ti	tr.	tr.	0.006	0.002	0.029	tr.	0.029
Zr	--	--	--	--	--	--	--
Cr	0.002	0.001	0.039	0.001	0.022	0.026	0.001
Fe^{3+}	0.442	0.412	0.001	0.002	0.035	--	0.106
Fe^{2+}	0.012	0.016	0.097	0.050	0.150	0.073	0.194
Mg	0.503	0.453	0.880	0.961	0.880	0.917	0.691
Ca	0.855	0.530	0.748	0.968	0.822	0.928	0.889
Co	0.001	0.002	0.001	0.001	0.001	0.001	0.002
Ni	0.001	0.001	0.002	0.001	0.002	0.002	0.001
Mn	0.017	0.165	0.003	0.002	0.004	0.003	0.009
Na	0.102	0.433	0.091	0.009	0.022	0.036	0.027
Zn	--	0.004	--	--	--	--	–
Total	3.886	4.019	4.012	4.000	4.006	3.998	3.998
M2 cations[2]	0.977	1.135	0.882	0.981	0.871	0.994	0.929
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-4	EMPA-5	EMPA-6	EMPA-7	EMPA-9	EMPA-7	EMPA-6

1. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.

2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX020	PYX021	PYX023	PYX025	PYX026	PYX029	PYX032
SiO_2	55.23	48.35	56.86	54.34	49.37	51.56	50.21
Al_2O_3	0.59	0.54	0.76	0.34	0.61	3.48	1.24
FeO[1]	2.07	23.25	6.36	3.46	13.62	4.20	23.65
Fe_2O_3[1]	0.00	3.81	0.83	0.00	5.07	1.39	5.11
MgO	17.06	1.25	34.04	15.99	2.79	14.01	17.57
CaO	24.08	21.66	0.65	25.20	22.54	24.22	1.59
Na_2O	0.52	0.18	0.00	0.03	0.13	0.40	0.00
TiO_2	0.09	0.00	0.01	0.01	0.01	0.38	0.19
Cr_2O_3	0.96	0.02	0.45	0.06	0.03	0.03	0.04
V_2O_5	0.05	tr.	tr.	tr.	0.01	0.00	tr.
CoO	0.05	0.06	0.03	0.04	0.05	0.03	0.06
NiO	0.06	0.02	0.08	0.02	0.03	0.03	0.01
MnO	0.10	1.17	0.17	0.51	6.71	0.31	0.53
ZrO_2*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZnO*	n.d.	n.d.	n.d.	n.d.	0.00	n.d.	n.d.
TOTAL	100.86	100.31	100.24	100.00	100.97	100.04	100.20
				ATOMIC RATIOS			
Mg	48.0	4.2	89.3	44.4	10.4	41.5	54.9
Fe^{2+}	3.3	43.7	9.4	5.4	28.7	6.9	41.5
Ca	48.7	52.1	1.3	50.2	60.9	51.6	3.6
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	1.991	1.964	1.965	1.993	1.960	1.905	1.920
Al	0.009	0.027	0.031	0.007	0.029	0.095	0.056
Al	0.017	--	--	0.008	--	0.056	--
V	0.001	tr.	tr.	tr.	tr.	--	tr.
Ti	0.002	--	tr.	tr.	tr.	0.011	0.005
Zr	--	--	--	--	--	--	--
Cr	0.028	0.001	0.012	0.002	0.001	0.001	0.001
Fe^{3+}	--	0.117	0.022	--	0.150	0.038	0.147
Fe^{2+}	0.063	0.791	0.184	0.106	0.453	0.129	0.756
Mg	0.916	0.076	1.753	0.875	0.164	0.773	1.002
Ca	0.929	0.942	0.025	0.989	0.959	0.959	0.065
Co	0.002	0.002	0.001	0.001	0.002	0.001	0.002
Ni	0.002	0.001	0.002	0.001	0.001	0.001	tr.
Mn	0.003	0.039	0.004	0.016	0.226	0.009	0.017
Na	0.037	0.015	--	0.002	0.009	0.029	--
Zn	--	--	--	--	--	--	–
Total	4.000	3.975	4.000	4.000	3.954	4.007	3.972
M2 cations[2]	0.999	0.999		1.010	1.197	0.999	
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-6	EMPA-8	EMPA-7	EMPA-8	EMPA-6	EMPA-9	EMPA-7

1. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.

2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX033	PYX034	PYX035	PYX036	PYX037	PYX038	PYX039
SiO_2	48.46	49.80	48.05	50.54	53.13	49.40	51.45
Al_2O_3	1.01	5.63	5.15	2.99	2.44	0.31	1.16
FeO^1	6.02	5.21	6.29	8.18	4.48	17.49	10.26
$Fe_2O_3^1$	7.73	2.03	2.56	1.71	n.d.	8.70	6.47
MgO	3.54	14.58	13.12	14.64	17.35	3.06	8.47
CaO	17.65	19.86	21.95	20.35	21.25	20.80	20.03
Na_2O	2.59	1.06	0.53	0.27	0.30	0.61	2.14
TiO_2	0.02	1.55	1.73	0.86	0.17	0.00	0.05
Cr_2O_3	0.06	0.12	0.03	0.07	1.12	0.02	0.02
V_2O_5	0.00	0.01	0.02	0.08	0.04	0.00	tr.
CoO	0.06	0.03	0.04	0.04	0.05	0.08	0.05
NiO	0.06	0.05	0.02	0.02	0.07	0.01	0.02
MnO	7.66	0.12	0.19	0.25	0.11	0.61	0.67
ZrO_2*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZnO*	5.04	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
TOTAL	99.90	100.05	99.68	100.00	100.51	101.09	100.79
				ATOMIC RATIOS			
Mg	18.1	47.4	40.5	43.3	49.4	11.0	29.6
Fe^{2+}	17.2	8.9	10.8	13.4	7.1	35.2	20.1
Ca	64.7	43.7	48.7	43.3	43.5	53.8	50.3
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	1.944	1.820	1.805	1.888	1.931	1.953	1.957
Al	0.048	0.180	0.195	0.112	0.069	0.014	0.043
Al	--	0.062	0.033	0.020	0.036	--	0.010
V	--	tr.	tr.	0.002	0.001	--	--
Ti	0.001	0.042	0.050	0.025	0.005	--	0.002
Zr	--	--	--	--	--	--	--
Cr	0.002	0.004	0.001	0.002	0.032	tr.	0.001
Fe^{3+}	0.234	0.055	0.072	0.047	--	0.257	0.185
Fe^{2+}	0.202	0.158	0.196	0.251	0.136	0.577	0.327
Mg	0.212	0.843	0.733	0.815	0.940	0.181	0.480
Ca	0.759	0.777	0.882	0.815	0.827	0.881	0.816
Co	0.002	0.001	0.001	0.002	0.001	0.002	0.002
Ni	0.002	0.001	0.001	0.001	0.002	tr.	0.001
Mn	0.260	tr.	0.007	0.007	0.003	0.021	0.021
Na	0.202	0.075	0.038	0.020	0.021	0.047	0.158
Zn	0.149	--	--	--	--	--	–
Total	4.017	4.019	4.014	4.007	4.004	3.934	4.003
M2 cations[2]	1.374	0.857	0.929	0.846	0.885	0.951	0.998
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-7	EMPA-9	EMPA-8	EMPA-8	EMPA-3	EMPA-7	EMPA-7

1. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.

2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX040	PYX041	PYX042	PYX043	PYX044
SiO_2	47.27	45.67	56.59	50.10	47.25
Al_2O_3	8.28	10.93	0.09	2.71	tr.
FeO[1]	4.69	1.64	8.93	4.00	0.13
Fe_2O_3[1]	2.77	2.90	0.84	1.11	0.00
MgO	13.19	12.60	33.88	17.60	2.44
CaO	20.90	23.58	0.22	20.00	5.95
Na_2O	0.63	0.00	0.00	0.19	0.03
TiO_2	1.73	0.66	0.04	0.66	tr.
Cr_2O_3	0.43	0.03	0.04		0.08
V_2O_5	tr.	0.00	tr.		0.01
CoO	0.03	0.04	0.02		0.09
NiO	0.03	0.02	0.01		0.12
MnO	0.11	0.07	0.04	0.24	42.81
ZrO_2*	0.00	0.00	0.00		0.00
ZnO*	n.d.	n.d.	n.d.		0.20
Nb_2O_5*	n.d.	n.d.	0.00		n.d.
K_2O				0.00	
P_2O_5				0.01	
LOI[2]				0.69	
Total	100.06	98.14	100.70	97.33	99.11
			ATOMIC RATIOS		
Mg	42.7	39.7	86.8		35.93
Fe^{2+}	8.5	2.9	12.8		1.07
Ca	48.8	57.4	0.4		63.00
			NUMBER OF IONS ON THE BASIS OF 6 OXYGENS		
Si	1.750	1.687	1.942		2.005
Al	0.250	0.313	0.004		tr.
Al	0.110	0.162	--		--
V	--	--	tr.		tr.
Ti	0.049	0.018	0.001		tr.
Zr	--	--	--		--
Cr	0.013	0.001	0.001		0.003
Fe^{3+}	0.078	0.080	0.021		--
Fe^{2+}	0.144	0.051	0.256		0.005
Mg	0.727	0.695	1.732		0.153
Ca	0.829	1.005	0.008		0.270
Co	0.001	0.001	0.001		0.003
Ni	0.001	0.001	tr.		0.004
Mn	0.004	0.002	0.001		1.538
Na	0.044	--	--		0.003
Zn	--	--	--		0.006
Nb	--	--	--		--
Total	4.000	4.016	3.967		3.991
M2 cations[3]	0.891	1.009			1.823
Source	U of C	U of C	U of C	Singer	U of C
Analysis	EMPA-6	EMPA-8	EMPA-9	XRF/WC	EMPA-10

1. FeO determined by wet chemistry at U. of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.
2. LOI = loss on ignition: weight loss after heating sample in air for one hour at 950°C.
3. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA. n.d. = not determined. tr.: trace (<0.01 wt.%). ++++++++++++++++++++++++++++++++++++

2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX050	PYX051	PYX052	PYX053	PYX054	PYX055
SiO_2	51.63	46.48	51.84	55.57	46.40	45.63
Al_2O_3	1.75	0.43	0.49	0.65	6.56	5.56
*Fe_2O_3**	*(4.42)*	*(23.67)*	*(4.59)*	*(3.31)*	*(11.37)*	*(11.53)*
FeO	2.65	19.04	3.81	2.41	7.08	
Fe_2O_3	1.47	2.51	0.36	0.63	3.50	
MgO	15.76	2.22	16.22	16.69	13.68	12.81
CaO	25.92	2.64	26.02	23.03	20.83	21.28
Na_2O	0.24	0.57	0.39	0.30	0.60	0.69
TiO_2	0.12	0.05	0.03	0.01	1.12	1.71
MnO	0.29	25.74	0.20	0.09	0.23	0.80
K_2O	0.12	0.03	0.00	0.01	0.05	0.04
P_2O_5	0.03	0.04	0.02	0.02	0.04	0.05
TOTAL	99.89	99.75	99.68	99.41	100.09	100.10
LOI	0.68	0.15	0.88	0.77	1.42	0.61
ppm						
Sr	82	15	105	70	120	154
Zr	47	20	10	25	71	146
V	139	63	90	60	441	446
Cr	95	<2	10	4350	90	110
Co	<2	<2	<2	21	23	18
				ATOMIC RATIOS		
Mg	43.8	15.0	43.8	48.2	41.9	
Fe^{2+}	4.2	72.2	5.8	3.9	12.2	
Ca	52.1	12.8	50.5	47.9	45.9	
M2 cations[1]	4.219	4.378	4.284	3.686	3.563	
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

1. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn).

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX056	PYX057	PYX058	PYX059	PYX060	PYX061
SiO_2	46.40	53.81	48.98	53.22		56.36
Al_2O_3	5.52	14.02	0.25	0.58		0.77
Fe_2O_3*	(11.00)	(11.17)	(0.17)	(1.55)		(6.87)
FeO		7.57	0.14	1.38		4.27
Fe_2O_3		2.76	0.01	0.02		2.12
MgO	12.85	5.84	17.92	18.04		33.96
CaO	21.40	9.76	32.45	25.60		1.82
Na_2O	0.72	3.17	0.10	0.47		0.16
TiO_2	1.75	1.41	0.08	0.09		0.03
MnO	0.19	0.16	0.05	0.06		0.17
K_2O	0.12	0.85	0.00	0.01		0.01
P_2O_5	0.04	0.33	0.03	0.03		0.02
TOTAL	99.99	99.68	100.01	99.50	0.00	99.69
LOI	0.73	2.86	5.72	0.85	1.01	2.60
ppm						
Sr	188	304	349	2104		67
Zr	160	158	52	91		10
V	439	250	148	42		67
Cr	102	20	<2	1710		2610
Co	38	10	<2	<2		38
				ATOMIC RATIOS		
Mg		34.1	43.4	48.5		90.1
Fe^{2+}		24.9	0.2	2.1		6.4
Ca		41.0	56.4	49.4		3.5
M2 cations[1]		2.416	5.241	4.164		0.334
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

[1] Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX062	PYX063	PYX064
SiO_2	46.90	54.71	
Al_2O_3	4.62	1.68	
*Fe_2O_3**	*(11.20)*	*(8.83)*	
FeO	5.41	6.05	
Fe_2O_3	5.19	2.11	
MgO	11.04	33.31	
CaO	24.17	1.37	
Na_2O	0.78	0.11	
TiO_2	0.12	0.03	
MnO	1.51	0.20	
K_2O	0.01	0.01	
P_2O_5	0.02	0.02	
TOTAL	99.77	99.60	
LOI	1.18	0.91	1.01
ppm			
Sr	53	39	
Zr	74	32	
V	77	75	
Cr	23	2845	
Co	45	70	
		ATOMIC RATIOS	
Mg	35.1	88.4	
Fe^{2+}	9.7	9.0	
Ca	55.2	2.6	
M2 cations[1]	4.387	0.261	
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

[1] Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX070	PYX070	PYX070
SiO_2	60.03		
Al_2O_3	1.19		
FeO*	(0.59)		
FeO			
Fe_2O_3			
MgO	38.94		
CaO	0.04		
Na_2O			
TiO_2	0.02		
Cr_2O_3			
V_2O_5			
CoO			
NiO			
MnO			
K_2O			
P_2O_5			
TOTAL	100.81	99.97	
LOI			
		ATOMIC RATIOS	
Mg	99.09	99.62	99.4
Fe^{2+}	0.07	0.18	
Ca	0.84	0.20	
		NUMBER OF IONS ON THE BASIS OF 6 OXYGENS	
Si	1.99		
Al	0.01		
Al	0.04		
V			
Ti			
Zr			
Cr			
Fe^{3+}			
Fe^{2+}	0.02		
Mg	1.93		
Ca			
Co			
Ni			
Mn			
Na			
Zn			
Source	Cherniak (2001)	McGuire et al. (1992)	Zwaan (1996)

* - all Fe reported as FeO

See reference list for sources of analyses.

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX101	PYX102	PYX103
SiO_2	50.63	54.72	52.06
Al_2O_3	1.49	0.94	0.98
FeO^1	12.99	1.40	11.38
$Fe_2O_3^1$	1.44	0.02	1.32
MgO	11.52	17.79	13.96
CaO	19.99	25.00	19.31
Na_2O	0.16	0.16	0.22
TiO_2	0.67	0.08	0.35
Cr_2O_3	0.14	0.04	0.07
V_2O_5	0.05	0.02	0.06
CoO	0.05	0.03	0.05
NiO	0.09	0.04	0.04
MnO	0.38	0.06	0.29
ZrO_2*	0.00	0.00	0.00
TOTAL	99.60	100.30	100.09
		ATOMIC RATIOS	
Mg	34.7	48.7	40.8
Fe^{2+}	22.0	2.1	18.7
Ca	43.3	49.2	40.5
		NUMBER OF IONS ON THE BASIS OF 6 OXYGENS	
Si	1.938	1.977	1.957
Al	0.062	0.023	0.043
Al	0.005	0.016	--
V	0.001	tr.	0.002
Ti	0.019	0.002	0.010
Zr	--	--	--
Cr	0.004	0.001	0.002
Fe^{3+}	0.041	0.001	0.037
Fe^{2+}	0.416	0.041	0.358
Mg	0.657	0.957	0.782
Ca	0.819	0.968	0.778
Co	0.002	0.001	0.002
Ni	0.003	0.001	0.001
Mn	0.012	0.002	0.009
Na	0.012	0.011	0.016
Total	3.991	4.001	3.997
M2 cations[2]	0.849	0.983	0.807
Source	U of C	U of C	U of C
Analysis	EMPA-8	EMPA-5	EMPA-6

1. FeO determined by wet chemistry at U. of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.
2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX104	PYX105	PYX107	PYX108	PYX109	PYX110	PYX111
SiO_2	54.99	54.17	52.35	56.97	52.48	56.65	54.83
Al_2O_3	0.38	0.79	2.52	0.82	0.51	0.03	0.72
FeO[1]	1.50	4.47	5.61	5.29	10.37	9.19	2.67
Fe_2O_3[1]	0.04	2.09	0.00	1.13	4.45	0.44	0.00
MgO	17.72	14.58	15.77	34.82	8.99	33.92	16.59
CaO	25.19	22.41	22.92	0.54	20.36	0.30	25.01
Na_2O	0.13	1.39	0.14	0.00	2.13	0.00	0.40
TiO_2	0.07	0.05	0.36	0.02	0.06	0.03	0.02
Cr_2O_3	0.04	0.07	0.25	0.38	0.06	0.05	0.07
V_2O_5	tr.	0.02	0.05	0.00	0.01	0.01	0.02
CoO	0.03	0.03	0.04	0.02	0.05	0.01	0.04
NiO	0.04	0.02	0.03	0.05	0.02	0.02	0.04
MnO	0.08	0.06	0.17	0.18	1.29	0.04	0.15
ZrO_2*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nb_2O_5*	n.d.	n.d.	n.d.	0.00	n.d.	0.00	n.d.
TOTAL	100.21	100.15	100.21	100.22	100.78	100.69	100.56
				ATOMIC RATIOS			
Mg	48.4	43.9	44.5	91.1	30.6	86.3	46.0
Fe^{2+}	2.3	7.5	8.9	7.8	19.7	13.2	4.2
Ca	49.3	48.6	46.6	1.1	49.7	0.5	49.8
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	1.986	1.993	1.924	1.961	2.002	1.970	1.990
Al	0.014	0.007	0.076	0.033	--	0.001	0.010
Al	0.001	0.026	0.033	--	0.023	--	0.020
V	tr.	tr.	0.001	--	tr.	tr.	tr.
Ti	0.002	0.001	0.010	0.001	0.002	0.001	0.001
Zr	--	--	--	--	--	--	--
Cr	0.001	0.002	0.007	0.010	0.002	0.001	0.002
Fe^{3+}	0.001	0.057	--	0.029	0.128	0.011	--
Fe^{2+}	0.046	0.137	0.172	0.153	0.330	0.267	0.081
Mg	0.955	0.800	0.864	1.787	0.511	1.757	0.898
Ca	0.975	0.884	0.903	0.021	0.833	0.010	0.972
Co	0.001	0.001	0.001	0.001	0.001	tr.	0.001
Ni	0.011	0.001	0.001	0.001	0.001	0.001	0.001
Mn	0.002	0.002	0.005	0.005	0.041	0.001	0.005
Na	0.009	0.099	0.010	--	0.158	--	0.028
Nb	--	--	--	--	--	--	–
Total	4.004	4.010	4.007	4.002	4.032	4.021	4.009
M2 cations[2]	0.988	0.988	0.926		1.035		1.008
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-6	EMPA-6	EMPA-6	EMPA-6	EMPA-6	EMPA-6	EMPA-6

1. FeO determined by wet chemistry at U. of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.
2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX112	PYX113*	PYX114	PYX115	PYX116	PYX117	PYX119
SiO_2	49.99	49.62	51.27	51.82	65.35	53.54	55.40
Al_2O_3	6.21	6.33	1.91	1.96	28.76	1.54	1.31
FeO[1]	16.56	7.69	11.34	10.46	0.16	16.17	9.92
Fe_2O_3[1]	0.58	0.60	0.57	0.22	n.d.	1.02	0.72
MgO	22.31	11.53	14.47	16.04	0.00	27.53	32.37
CaO	3.99	23.27	18.45	18.00	0.00	0.35	0.19
Na_2O	0.06	n.d.	0.23	0.19	0.05	0.00	0.00
TiO_2	0.53	0.52	0.95	0.84	tr.	0.03	0.04
Cr_2O_3	0.13	n.d.	0.17	0.09	0.01	0.07	0.68
V_2O_5	0.00	n.d.	0.04	0.05	0.00	0.00	0.00
CoO	0.04	n.d.	0.04	0.06	0.00	0.01	0.03
NiO	0.03	n.d.	0.04	0.05	0.00	0.05	0.05
MnO	0.26	n.d.	0.28	0.24	0.03	0.44	0.26
ZrO_2*	0.00	n.d.	0.00	0.00	0.00	0.00	0.00
Li_2O					n.d.		
TOTAL	100.69	99.56	99.76	100.02	94.36	100.75	100.97
				ATOMIC RATIOS			
Mg	64.8	35.4	41.1	46.0	--	74.7	85.1
Fe^{2+}	26.9	13.2	19.1	16.9	--	24.6	14.6
Ca	8.3	51.4	39.8	37.1	--	0.7	0.3
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	1.826	1.856	1.940	1.927	n.d.	1.931	1.935
Al	0.174	0.144	0.060	0.073	n.d.	0.065	0.055
Al	0.094	0.135	0.024	0.012	n.d.	--	--
V	--	--	0.001	0.001	n.d.	--	--
Ti	0.015	0.015	0.027	0.020	n.d.	0.001	0.001
Zr	--	--	--	--	n.d.	--	--
Cr	0.004	--	0.004	0.002	n.d.	0.002	0.019
Fe^{3+}	0.015	0.017	0.016	0.007	n.d.	0.028	0.019
Fe^{2+}	0.505	0.240	0.359	0.326	n.d.	0.487	0.290
Mg	1.214	0.643	0.773	0.890	n.d.	1.480	1.685
Ca	0.156	0.932	0.748	0.718	n.d.	0.013	0.006
Co	0.001	--	0.001	0.002	n.d.	tr.	0.001
Ni	0.001	--	0.001	0.002	n.d.	0.001	0.001
Mn	0.009	--	0.009	0.007	n.d.	0.013	0.008
Na	0.004	--	0.016	0.013	n.d.	--	--
Li					n.d.		
Total	4.018	3.982	3.979	4.000	n.d.	4.022	4.021
M2 cations[2]		>0.932	0.778	0.742			
Source	U of C	U of A	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-6	EMPA-2	EMPA-5	EMPA-5	EMPA-2	EMPA-4	EMPA-5

1. FeO determined by wet chemistry at U. of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.
2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX120	PYX121	PYX122	PYX124	PYX125	PYX126	PYX127
SiO_2	54.83	52.79	48.22	29.63	68.57	47.83	50.88
Al_2O_3	0.57	2.18	0.00	0.00	19.56	6.44	21.31
FeO[1]	3.05	0.80	0.37	1.24	0.29	5.22	7.52
Fe_2O_3[1]	0.68	1.43	0.00	n.d.	n.d.	3.80	0.92
MgO	15.84	16.80	1.09	0.04	0.00	12.38	0.08
CaO	24.20	25.73	20.71	26.52	0.00	22.20	13.23
Na_2O	0.69	0.00	0.11	6.22	11.37	0.28	4.98
TiO_2	0.04	0.11	0.00	1.01	0.01	1.32	0.06
Cr_2O_3	0.02	0.06	0.11	0.10	0.07	0.08	0.10
V_2O_5	0.00	0.00	0.01	0.00	0.00	0.03	0.05
CoO	0.04	0.02	0.08	0.15	0.04	0.05	0.00
NiO	0.04	0.03	0.09	0.14	0.01	0.04	0.00
MnO	0.35	0.10	27.27	0.62	0.01	0.16	0.08
ZrO_2*	0.00	0.00	0.00	34.26	0.04	0.00	0.00
ZnO*	n.d.	n.d.	1.68	n.d.	n.d.	n.d.	n.d.
Nb_2O_5*	n.d.	n.d.	n.d.	0.00	0.01	n.d.	n.d.
TOTAL	100.35	100.05	99.74	99.93	99.98	99.83	99.21
				ATOMIC RATIOS			
Mg	45.4	47.0	6.73	--	--	39.8	0.58
Fe^{2+}	4.8	1.2	1.27	--	--	8.9	30.56
Ca	49.8	51.8	92.00	--	--	51.3	68.86
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	2.000	1.924	1.993	1.311	2.246	1.788	1.836
Al	--	0.076	--	--	0.754	0.212	0.164
Al	0.024	0.018	--	--	0.002	0.071	0.742
V	--	--	tr.	--	--	0.001	0.001
Ti	0.001	0.003	--	0.035	tr.	0.037	0.002
Zr	--	--	--	0.848	0.001	--	--
Cr	0.001	0.002	0.003	0.003	0.002	0.002	0.003
Fe^{3+}	0.019	0.039	--	--	--	0.107	0.025
Fe^{2+}	0.092	0.024	0.012	0.045	0.008	0.163	0.227
Mg	0.861	0.913	0.067	0.003	--	0.690	0.004
Ca	0.944	1.005	0.916	1.258	--	0.889	0.512
Co	0.001	0.001	0.003	0.005	0.001	0.002	--
Ni	0.001	0.001	0.003	0.005	tr.	0.001	--
Mn	0.011	0.003	0.953	0.024	tr.	0.004	0.002
Na	0.048	--	0.009	0.535	0.722	0.020	0.349
Zn	--	--	0.052	--	--	--	--
Nb	--	--	--	--	tr.	--	–
Total	4.003	4.009	4.012	4.072	3.737	3.987	3.867
M2 cations[2]	1.005	>1.011	1.936			0.917	>0.866
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-4	EMPA-5	EMPA-5	EMPA-4	EMPA-2	EMPA-5	EMPA-1

1. FeO determined by wet chemistry at U. of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.
2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX128	PYX129	PYX130	PYX131	PYX132	PYX133	PYX134
SiO_2	51.25	52.16	53.42	43.09	53.61	n.d.	55.59
Al_2O_3	0.90	0.35	0.23	14.09	0.27	n.d.	1.08
FeO[1]	3.59	12.79	0.04	0.95	0.37	n.d.	0.22
Fe_2O_3[1]	26.45	10.55	n.d.	4.25	8.19	n.d.	0.00
MgO	0.29	0.99	0.00	11.10	11.85	n.d.	17.17
CaO	2.45	19.46	33.11	25.31	17.89	n.d.	24.54
Na_2O	12.52	0.00	8.90	tr.	3.44	n.d.	0.86
TiO_2	0.43	0.00	0.00	0.73	0.01	n.d.	0.02
Cr_2O_3	0.04	0.05	0.02	0.06	0.07	n.d.	0.10
V_2O_5	0.00	0.00	0.01	0.00	0.04	n.d.	1.27
CoO	0.04	0.07	0.01	0.04	0.03	n.d.	0.03
NiO	0.00	0.02	0.04	0.03	0.02	n.d.	0.03
MnO	0.49	0.87	0.00	0.11	4.67	n.d.	0.03
ZrO_2*	1.86	0.00	0.00	0.00	0.00	n.d.	0.00
ZnO*	n.d.	0.00	n.d.	n.d.	0.13	n.d.	n.d.
TOTAL	100.31	97.31	95.78	99.76	100.59	n.d.	100.94
				ATOMIC RATIOS			
Mg	--	--	--	37.2	47.6	n.d.	49.1
Fe^{2+}	--	--	--	1.8	0.8	n.d.	0.4
Ca	--	--	--	61.0	51.6	n.d.	50.5
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	1.979	n.d.	n.d.	1.599	1.989	n.d.	1.981
Al	0.021	n.d.	n.d.	0.401	0.011	n.d.	0.019
Al	0.021	n.d.	n.d.	0.215	--	n.d.	0.026
V	--	n.d.	n.d.	--	0.001	n.d.	0.030
Ti	0.012	n.d.	n.d.	0.020	tr.	n.d.	0.001
Zr	0.040	n.d.	n.d.	--	--	n.d.	--
Cr	0.001	n.d.	n.d.	0.002	0.002	n.d.	0.003
Fe^{3+}	0.768	n.d.	n.d.	0.118	0.230	n.d.	--
Fe^{2+}	0.116	n.d.	n.d.	0.029	0.011	n.d.	0.006
Mg	0.016	n.d.	n.d.	0.613	0.655	n.d.	0.912
Ca	0.102	n.d.	n.d.	1.006	0.711	n.d.	0.938
Co	0.001	n.d.	n.d.	0.001	0.001	n.d.	0.001
Ni	--	n.d.	n.d.	0.001	0.001	n.d.	0.001
Mn	0.016	n.d.	n.d.	0.004	0.147	n.d.	0.001
Na	0.937	n.d.	n.d.	tr.	0.247	n.d.	0.060
H	--	???	???	--	--	--	--
Zn	--	n.d.	n.d.	--	0.004	n.d.	--
Total	4.030	n.d.	n.d.	4.009	4.010	n.d.	3.979
M2 cations[2]	1.056			1.013	1.108		1.003
Source	U of C	U of C	U of C	U of C	U of C		U of C
Analysis	EMPA-4	EMPA-5	EMPA-4	EMPA-4	EMPA-4		EMPA-5

1. FeO determined by wet chemistry at U. of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.
2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX135	PYX136	PYX150	PYX151	PYX152*	PYX153	PYX160*
SiO_2	55.39	55.07	55.75	46.20	47.00	56.30	53.31
Al_2O_3	0.54	0.06	0.24	12.54	0.00	9.03	0.06
FeO[1]	1.03	1.05	2.56	1.73	7.54	3.31	8.53
Fe_2O_3[1]	0.00	0.05	0.00	2.30	0.00	n.d.	2.24
MgO	17.38	18.02	16.26	12.49	3.17	12.87	12.07
CaO	24.88	25.45	25.70	24.92	1.24	1.00	24.10
Na_2O	0.35	0.02	0.05	0.10	0.00	11.62	n.d.
TiO_2	0.02	0.05	0.00	0.55	0.06	0.18	0.04
Cr_2O_3	0.05	0.04	tr.	0.00	0.02	3.41	0.14
V_2O_5	0.01	0.03	0.00	tr.	0.01	n.d.	0.00
CoO	0.04	0.02	0.05	0.06	0.09	0.07	0.00
NiO	0.02	0.03	tr.	0.01	0.10	0.07	0.07
MnO	0.05	0.08	0.11	0.05	40.75	0.06	0.37
ZrO_2*	0.00	0.00	tr.	0.00	n.d.	n.d.	n.d.
ZnO*	n.d.	n.d.	0.03	0.05	0.15	n.d.	0.00
K_2O*	n.d.	n.d.	0.00	0.00	0.00	0.04	0.02
TOTAL	99.76	99.97	100.75	101.00	100.13	97.96	100.95
				ATOMIC RATIOS			
Mg	48.5	48.8	44.9	39.8	38.23	>56.87	35.3
Fe^{2+}	1.6	1.6	4.0	3.1	51.02	<8.21	14.0
Ca	49.9	49.6	51.1	57.1	10.75	~34.92	50.7
				NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si	2.006	1.996	2.014	1.680	1.995	2.018	1.989
Al	--	0.002	--	0.320	--	--	0.003
Al	0.024	--	0.011	0.217	--	0.382	--
V	tr.	0.001	--	tr.	tr.	--	--
Ti	0.001	0.001	--	0.015	0.002	0.005	0.001
Zr	--	--	--	--	--	--	--
Cr	0.001	0.001	tr.	--	0.001	0.097	0.004
Fe^{3+}	--	0.001	--	0.063	--	--	0.063
Fe^{2+}	0.030	0.033	0.077	0.052	0.268	0.099	0.266
Mg	0.937	0.973	0.876	0.677	0.202	0.688	0.671
Ca	0.966	0.988	0.995	0.970	0.056	0.038	0.963
Co	0.001	0.001	0.001	0.002	0.003	0.002	--
Ni	0.001	0.001	tr.	tr.	0.003	0.002	0.002
Mn	0.001	0.002	0.003	0.001	1.465	0.002	0.012
Na	0.024	0.001	0.003	0.007	--	0.808	--
Zn	--	--	0.001	0.001	0.005	--	--
K	--	--	--	--	--	0.002	0.001
Total	3.993	4.001	3.982	4.006	4.000	4.143	3.975
M2 cations[2]	0.993	0.993	1.003	0.981	1.530	0.850	0.979
Source	U of C	U of C	U of C	U of C	U of A	U of C	U of A
Analysis	EMPA-5	EMPA-5	EMPA-6	EMPA-5	EMPA-6	EMPA-6	EMPA-2

1. FeO determined by wet chemistry at U. of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.
2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX161*	PYX162*	PYX165*	PYX166	PYX167*	PYX170*	PYX171*
SiO_2	56.54	55.72	52.16	n.d.	53.39	52.49	48.11
Al_2O_3	0.53	0.00	0.30	n.d.	0.54	4.48	7.92
FeO[1]	4.06	0.95	11.30	n.d.	16.42	2.62	1.86
Fe_2O_3[1]	2.61	n.d.	5.32	n.d.	n.d.	0.34	0.00
MgO	35.25	18.10	8.25	n.d.	18.76	15.28	14.44
CaO	0.36	25.73	22.33	n.d.	10.87	22.47	25.95
Na_2O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
TiO_2	0.00	0.00	0.00	n.d.	0.56	0.04	1.07
Cr_2O_3	0.47	0.08	0.04	n.d.	0.00	0.99	0.04
V_2O_5	0.00	0.13	0.06	n.d.	0.16	0.16	0.00
CoO	0.00	0.00	0.00	n.d.	0.00	0.00	0.00
NiO	0.17	0.11	0.09	n.d.	0.27	0.20	0.14
MnO	0.20	0.00	0.75	n.d.	0.35	0.00	0.00
ZnO*	0.00	0.00	0.27	n.d.	0.00	0.00	0.08
K_2O*	n.d.	0.02	n.d.	n.d.	n.d.	n.d.	n.d.
TOTAL	100.19	100.84	100.87	n.d.	101.32	99.07	99.61
			ATOMIC RATIOS				
Mg	93.3	48.8	26.9	n.d.	52.8	46.4	42.3
Fe^{2+}	6.0	1.4	20.7	n.d.	25.8	4.5	3.1
Ca	0.7	49.8	52.4	n.d.	21.2	49.1	54.6
			NUMBER OF IONS ON THE BASIS OF 6 OXYGENS				
Si	1.948	2.000	1.986	n.d.	n.d.	1.920	1.772
Al	0.021	--	0.013	n.d.	n.d.	0.080	0.228
Al	--	--	--	n.d.	n.d.	0.114	0.115
V	--	0.003	0.001	n.d.	n.d.	0.004	--
Ti	--	--	--	n.d.	n.d.	0.001	0.030
Zr	--	--	--	n.d.	n.d.	--	--
Cr	0.013	0.002	0.001	n.d.	n.d.	0.029	0.001
Fe^{3+}	0.068	--	0.152	n.d.	n.d.	0.009	--
Fe^{2+}	0.117	0.028	0.360	n.d.	n.d.	0.080	0.057
Mg	1.810	0.968	0.468	n.d.	n.d.	0.833	0.792
Ca	0.013	0.989	0.911	n.d.	n.d.	0.881	1.024
Co	--	--	--	n.d.	n.d.	--	--
Ni	0.005	0.003	0.003	n.d.	n.d.	0.006	0.004
Mn	0.006	--	0.024	n.d.	n.d.	--	--
Na	--	--	--	n.d.	n.d.	--	--
Zn	--	--	0.008	n.d.	n.d.	--	0.002
K	--	tr.	--	n.d.	n.d.	--	–
Total	4.001	3.994	3.927	n.d.	n.d.	3.957	4.025
M2 cations[2]		>0.994	>0.945			>0.916	>1.027
Source	U of A	U of A	U of A		U of A	U of A	U of A
Analysis	EMPA-1	EMPA-2	EMPA-2		EMPA-2	EMPA-3	EMPA-3

1. FeO determined by wet chemistry at U. of Alberta; Fe_2O_3 is determined as difference between total Fe and FeO.
2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX172*	PYX174	PYX180	PYX181	PYX182	PYX183	PYX184	PYX185
SiO_2	50.46							
Al_2O_3	4.65							
FeO[1]	8.44							
Fe_2O_3	n.d.							
MgO	12.09							
CaO	23.97							
Na_2O	n.d.							
TiO_2	0.51							
Cr_2O_3	0.17							
V_2O_5	0.10							
CoO	0.00							
NiO	0.19							
MnO	0.15							
ZnO*	0.00							
K_2O*	0.00							
TOTAL	100.73							
	ATOMIC RATIOS							
Mg	35.5							
Fe^{2+}	13.9							
Ca	50.6							
	NUMBER OF IONS ON THE BASIS OF 6 OXYGENS							
Si	n.d.							
Al	n.d.							
Al	n.d.							
V	n.d.							
Ti	n.d.							
Zr	n.d.							
Cr	n.d.							
Fe^{3+}	n.d.							
Fe^{2+}	n.d.							
Mg	n.d.							
Ca	n.d.							
Co	n.d.							
Ni	n.d.							
Mn	n.d.							
Na	n.d.							
Zn	n.d.							
K	n.d.							
Total	n.d.							
M2 cations[2]								
Source	U of A							
Analysis	EMPA-1							

1. All Fe reported as FeO.

2. Sum of cations that preferentially occupy M2 site in clinopyroxene (Cr + Ca + Co + Mn + Na + Zn)

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. U of A: University of Alberta EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX186	PYX191	PYX192	Bulk PYX193	Separate PYX193
SiO_2		52.14	52.06	54.34	54.71
Al_2O_3		0.60	1.30	3.10	2.25
*Fe_2O_3**				*(10.26)*	*(10.61)*
FeO		3.95	3.60	4.84	5.57
Fe_2O_3		0.21	0.28	4.88	4.42
MgO		15.88	15.06	28.74	29.91
CaO		25.75	25.15	2.86	2.38
Na_2O		0.24	0.26	0.22	0.14
TiO_2		0.02	0.03	0.13	0.13
MnO		0.14	0.11	0.20	0.22
K_2O		0.00	0.00	0.02	0.01
P_2O_5		0.02	0.03	0.02	0.01
SO_3				0.05	0.05
TOTAL		99.64	99.27	99.94	100.42
LOI		0.69	1.39	0.30	0.27
ppm					
Rb				<2	<2
Sr		20	10	103	58
Zr		20	15	28	29
V		5	10	112	126
Ni		410	1170	550	617
Cr		1200	3650	3248	3383
Co		5	55	69	85
				ATOMIC RATIOS	
Mg		43.39	42.84	85.77	87.71
Fe^{2+}		6.05	5.74	8.10	7.27
Ca		50.56	51.41	6.13	5.02
		NUMBER OF IONS ON THE BASIS OF 6 OXYGENS			
Si					
Al					
Al					
V					
Ti					
Cr					
Fe^{3+}					
Fe^{2+}					
Mg					
Ca					
Co					
Ni					
Mn					
Na					
Zn					
K					
Source		Mertzman	Mertzman	Mertzman	Mertzman
Analysis		XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3 (*). Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).++

2.1c. Compositional Data - Pyroxenes (continued)

Wt. %	PYX205	PYX206	PYX207	PP-CMP-21
SiO_2	60.40	61.21	57.56	49.69
Al_2O_3	0.00	0.00	0.00	6.4
FeO	0.07[1]	0.08[1]	0.00	6.29[1]
Fe_2O_3	n.d.	n.d.	0.00	n.d.
MgO	40.78	41.50	21.73	15.14
CaO	0.34	0.43	23.36	20.92
Na_2O	n.d.	n.d.	n.d.	0.4
TiO_2	0.00	0.06	0.25	0.79
Cr_2O_3	0.00	0.00	0.12	0.91
V_2O_5	0.03	0.00	n.d.	n.d.
CoO	0.00	0.00	0.00	n.d.
NiO	0.12	0.00	0.15	n.d.
MnO	0.04	0.00	0.00	0.12
ZnO	0.00*	0.00*	0.00*	n.d.
K_2O	n.d.	n.d.	0.00*	0.01
P_2O_5				
TOTAL	101.78	103.28	103.17	99.76
LOI				
ppm				
Sr				
Zr				
V				
Ni				
Cr				
Co				
			ATOMIC RATIOS	
Mg	99.3	99.2	56.4	45.89
Fe^{2+}	0.1	0.1	0.0	8.52
Ca	0.6	0.7	43.4	45.59
			NUMBER OF IONS ON THE BASIS OF 6 OXYGENS	
Si	1.989	1.986	1.994	
Al	--	--	--	
Al	--	--	--	
V	0.001	--	--	
Ti	--	0.001	0.007	
Cr	--	--	0.003	
Fe^{3+}	--	--	--	
Fe^{2+}	0.002	0.002	--	
Mg	2.002	2.007	1.122	
Ca	0.012	0.015	0.867	
Co	--	--	--	
Ni	0.003	--	0.004	
Mn	0.001	--	--	
Na	--	--	--	
Zn	--	--	--	
K	--	--	–	
Total	4.010	4.011	3.997	
M2 cations[2]			>0.870	
Source	U of A	U of A	U of A	Sunshine &
Analysis	EMPA-2	EMPA-2	EMPA-1	Pieters (1993)

1. all Fe reported as FeO. n.d. = not determined. tr.: trace (<0.01 wt.%).

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.++

2.1d. Spectral Data - Pyroxenes

Sample	*Facility/File No.*	*Description*
PYX003	PSF pyx00390	45-90 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (oo directory).
PYX003	RELAB C1PP40	<45µm, 30E/0E, 0.3-3.6µm, 5nm.
PYX003	UH Analogue	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX003	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX003	PSF 160507pyx003	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX003	PSF 100707pyx003	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX003	PSF pyx003	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX003	PSF jun0707.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX003	PSF jun0707.002	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX003	PSF 345	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX003	PSF 34590	45-90 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX003	PSF pyx003.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: HED minerals MidIR_july 2012).
++++++		
PYX005	RELAB C1PP01	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
PYX005	PSF 160507pyx005	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX005	PSF 100707pyx005	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX005	PSF pyx005	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX005	PSF 100304a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
PYX005	PSF dec1606.001	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD; aka PMIX2101.
PYX005	PSF dec1406.013	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD; aka PMIX1101.
++++++		
PYX006	RELAB C1PP03	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
++++++		
PYX007	RELAB C1PP04	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
++++++		
PYX009	RELAB C1PP68	45-90µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.7µm.
PYX009	UH Analogue	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX009	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX009	PSF mar3006.000	45-90 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PYX009	PSF mar3006.014	<45 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PYX009	PSF 160507pyx009	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX009	PSF 100707pyx009	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX009	PSF pyx009	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX009	PSF pyx009.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
++++++		
PYX010	RELAB C1PP05	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
PYX010	PSF 160507pyx010	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX010	PSF 100707pyx010	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX010	PSF pyx010	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).

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PYX012d	RELAB C1PP07	45-90µm, 30°/0°, 0.3-2.6µm, 5nm.
++++++		
PYX013	RELAB C1PP08	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
++++++		
PYX015	RELAB C1PP46	<45µm, 30E/0E, 0.3-3.6µm, 5nm.
++++++		
PYX016	RELAB C1PP16	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX016	PSF 100304a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
PYX016	PSF 100412b.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
PYX016	PSF 121016a.157	<250 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
PYX016	PSF OO 157	<250 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
PYX016	PSF 121016a.211	<45 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
PYX016	PSF OO 211	<45 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
PYX016	PSF 121016a.214	45-90 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
PYX016	PSF OO 214	45-90 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
PYX016	*See also section 15.25 of this document for mixtures of this material with nanophase iron and nanophase iron-impregnated silica gels.*	
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PYX017	RELAB C1PP09	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
PYX017	PSF 160507pyx017	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX017	PSF 100707pyx017	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX017	PSF pyx017	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX017	PSF pyx017.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
PYX017	PSF dec1606.007	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD; aka PMIX2001
PYX017	PSF dec1406.001	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD; aka PMIX1001.
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PYX018	RELAB C1PP69	45-90µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
PYX018	PSF 160507pyx018	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX018	PSF 100707pyx018	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX018	PSF pyx018	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
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PYX019	RELAB C1PP11	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
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PYX020	PSF mar3006.001	<45 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PYX020	PSF mar3006.002	45-90 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PYX020	RELAB C1PP70	45-90µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
PYX020	PSF 160507pyx020	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX020	PSF 100707pyx020	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX020	PSF pyx020	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).

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PYX021	UH Analogue	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX021	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX021	RELAB C1PP12	45-90µm?, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX021	PSF 170507pyx021	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX021	PSF 100707pyx021	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX021	PSF pyx021	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
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PYX023	PSF pyx02390	45-90 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX023	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX023	RELAB C1PP13	45-90µm?, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX023	PSF 170507pyx023	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX023	PSF 100707pyx023	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX023	PSF pyx023	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX023	PSF 071116a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071116grainsize).
PYX023	PSF 071116a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
PYX023	PSF 071116a.001-002	avge; <45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
PYX023	PSF 071116a.003	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071116grainsize).
PYX023	PSF 071116a.004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.003-004	avge; 45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
PYX023	PSF 071116a.005	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071116grainsize).
PYX023	PSF 071116a.006	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.005-007	avge; 90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
PYX023	PSF 071116a.008	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071116grainsize).
PYX023	PSF 071116a.009	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.008-010	avge; 250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
PYX023	PSF 071116a.011	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071116grainsize).
PYX023	PSF 071116a.013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.017	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.011,13,17	avge; 500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
PYX023	PSF 071116a.014	whole rock; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071116grainsize).
PYX023	PSF 071116a.015	whole rock; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.016	whole rock; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071116grainsize).
PYX023	PSF 071116a.014-016	avge; whole rock; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
PYX023	PSF jun0707.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

PYX023	PSF jun0707.004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX023	PSF 2345	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX023	PSF 234590	45-90 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX023	PSF 100412b.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
PYX023	PSF 111201a.034	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 111201_optech).
PYX023	PSF pyx023.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
PYX023	PSF dec1606.006	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD; aka PMIX2106.
PYX023	PSF dec1406.023	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD; aka PMIX1111.

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Monster grain size series run: 071228 (PYX023)

PYX023	PSF 071228a.001	<10 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.002	<10 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.001-002	Average of previous two spectra.
PYX023	PSF 071228a.003	10-15 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF071228a.004	10-15 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.003-004	Average of previous two spectra.
PYX023	PSF 071228a.005	15-20 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.006	15-20 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.005-006	Average of previous two spectra.
PYX023	PSF 071228a.007	20-25 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.008	20-25 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.007-008	Average of previous two spectra.
PYX023	PSF 071228a.009	25-38 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.010	25-38 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.009-010	Average of previous two spectra.
PYX023	PSF 071228a.011	<20 µm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.012	<20 µm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.011-012	Average of previous two spectra.
PYX023	PSF 071228a.013	<25 µm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.014	<25 µm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory:

		071228grainsize).
PYX023	PSF 071228a.013-014	Average of previous two spectra.
PYX023	PSF 071228a.015	25-38 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.016	25-38 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.015-016	Average of previous two spectra.
PYX023	PSF 071228a.017	38-45 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.018	38-45 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.017-018	Average of previous two spectra.
PYX023	PSF 071228a.019	45-63 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.020	45-63 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.019-020	Average of previous two spectra.
PYX023	PSF 071228a.021	63-75 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.022	63-75 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.021-022	Average of previous two spectra.
PYX023	PSF 071228a.023	75-90 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.024	75-90 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.023-024	Average of previous two spectra.
PYX023	PSF 071228a.025	90-125 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.026	90-125 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.025-026	Average of previous two spectra.
PYX023	PSF 071228a.027	125-150 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.028	125-150 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.027-028	Average of previous two spectra.
PYX023	PSF 071228a.029	150-180 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.030	150-180 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.031	150-180 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.029-031	Average of previous three spectra.
PYX023	PSF 071228a.032	180-212 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.033	180-212 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000

		spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.034	180-212 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.032-034	Average of previous three spectra.
PYX023	PSF 071228a.035	212-250 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.036	212-250 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.037	212-250 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.035-037	Average of previous three spectra.
PYX023	PSF 071228a.038	250-300 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.039	250-300 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.040	250-300 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.038-040	Average of previous three spectra.
PYX023	PSF 071228a.041	300-355 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.042	300-355 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.043	300-355 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.041-043	Average of previous three spectra.
PYX023	PSF 071228a.044	355-425 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.045	355-425 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.046	355-425 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.044-046	Average of previous three spectra.
PYX023	PSF 071228a.047	425-500 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.048	425-500 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.049	425-500 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.047-049	Average of previous three spectra.
PYX023	PSF 071228a.050	500-600 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.051	500-600 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).

PYX023	PSF 071228a.052	500-600 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.050-052	Average of previous three spectra.
PYX023	PSF071228a.053	600-700 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.054	600-700 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.055	600-700 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.053-055	Average of previous three spectra.
PYX023	PSF 071228a.056	700-850 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.057	700-850 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.058	700-850 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.056-058	Average of previous three spectra.
PYX023	PSF 071228a.059	850-1000 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.060	850-1000 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.061	850-1000 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.059-061	Average of previous three spectra.
PYX023	PSF 071228a.062	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.063	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.064	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.065	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.066	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.062-066	Average of previous five spectra.
PYX023	PSF 071228a.067	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.068	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.069	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.070	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory:

		071228grainsize).
PYX023	PSF 071228a.071	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.067-071	Average of previous five spectra.
PYX023	PSF 071228a.072	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.073	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.074	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.075	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.076	1.7-20 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.072-076	Average of previous five spectra.
PYX023	PSF 071228a.077	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.078	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.079	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.080	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.081	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.077-081	Average of previous five spectra.
PYX023	PSF 071228a.082	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.083	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.084	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.085	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.086	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.082-086	Average of previous five spectra.
PYX023	PSF 071228a.087	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.088	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.089	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000

		spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.090	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.091	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.087-091	Average of previous five spectra.
PYX023	PSF 071228a.092	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.093	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.094	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.095	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.096	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.092-096	Average of previous five spectra.
PYX023	PSF 071228a.097	whole rock; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071228grainsize).
PYX023	PSF 071228a.098	whole rock; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.099	whole rock; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.100	whole rock; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.101	whole rock; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071228grainsize).
PYX023	PSF 071228a.097-101	Average of previous five spectra.
PYX023	PSF pyx023m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
PYX023	PSF pyx023n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
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PYX025	RELAB C1PP62	<45µm, 30E/0E, 0.3-3.6µm, 5nm.
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PYX026	UH Analogue	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX026	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX026	RELAB C1PP14	45-90µm?, 30E/0E, 0.3-2.6µm, 5 nm resol.
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PYX029	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX029	RELAB C1PP15	45-90µm?, 30E/0E, 0.3-2.6µm, 5 nm resol.
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PYX030	PSF 090728a.002	<45µm (glassy fraction); 30°/0°; 0.35-2.5 µm, 1 nm output, 1000 spectra averaged; ASD.
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PYX032	USGS 240	45-90µm, IS, 0.35-2.6µm, 1x resol.
PYX032	RELAB C1SC36	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
PYX032	RELAB C2SC36	45-90µm, 0E/15E, 0.3-2.6µm, 5nm, with errors.

PYX032	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX032	UH Analogue	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX032	PSF 170507pyx03245	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX032	PSF 100707pyx03245	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX032	PSF pyx03245	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX032	PSF pyx03290	45-90 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX032	PSF 170507pyx03290	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX032	PSF 100707pyx03290	45-90 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX032	PSF pyx03290	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX032	PSF 170507pyx032250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX032	PSF 110707pyx032250	90-250 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX032	PSF pyx032250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX032	PSF 170507pyx032500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX032	PSF 110707pyx032500	250-500 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX032	PSF pyx032500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX032	PSF 170507pyx0321000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX032	PSF 110707pyx0321000	500-1000 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX032	PSF pyx0321000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX032	PSF 071123a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF 071123a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.001-002	avge; <45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF 071123a.003	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF 071123a.004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.003-004	avge; 45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF pyx032250	90-250 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX032	PSF 071123a.005	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF 071123a.006	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.005-007	avge; 90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF pyx032500	250-500 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX032	PSF 071123a.008	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory:

		071123grainsize).
PYX032	PSF 071123a.009	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.008-010	avge; 250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF pyx0231000	500-1000 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX032	PSF 071123a.011	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF 071123a.012	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.011-013	avge; 500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF 071123a.014	whole rock roughened with 220 grit sandpaper; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071123grainsize).
PYX032	PSF 071123a.015	whole rock roughened with 220 grit sandpaper; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.017	whole rock roughened with 220 grit sandpaper; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.018	whole rock roughened with 220 grit sandpaper; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.019	whole rock roughened with 220 grit sandpaper; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (reshoot of previous sample; directory: 071123grainsize).
PYX032	PSF 071123a.014-019	avge; whole rock roughened with 220 grit sandpaper; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
PYX032	PSF jun0707.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun0707.006	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF 3245	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX032	PSF 324590	45-90 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX032	PSF feb1507.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.002-003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; average of 002 and 003; ASD.
PYX032	PSF feb1507.004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.005	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.004-005	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; average of 004 and 005; ASD.
PYX032	PSF feb1507.006	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.008	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.006-008	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; average of 006-009; ASD.
PYX032	PSF feb1507.009	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.011	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.009-011	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; average of 009-

		011; ASD.
PYX032	PSF feb1507.012	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.014	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF feb1507.012-014	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; average of 012-014; ASD.
PYX032	PSF 100413a.006	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
PYX032	PSF pyx032.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
PYX032	PSF pyx032_250_500.dpt	250-500 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
PYX032	PSF dec1606.012	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD; aka PMIX2006.
PYX032	PSF dec1406.011	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD; aka PMIX1011.
	++++ PYX032 grain size series – jun2706++++++	
PYX032	PSF jun2706.005	<45 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
PYX032	PSF jun2706.006	45-90 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
PYX032	PSF jun2706.007	90-250 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
PYX032	PSF jun2706.008	250-500 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
PYX032	PSF jun2706.009	500-1000 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).

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PYX032 – single grain study: June 1, 2009

PYX032	PSF 090601a.006	Al block "L" well: C grain (250-500 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.007	Al block "L" well: C grain (250-500 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured. ASD.
PYX032	PSF 090601a.008	Al block "L" well: C grain (250-500 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured. ASD.
PYX032	PSF 090601a.009	Al block "L" well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.010	Al block "L" well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured. ASD.
PYX032	PSF 090601a.011	Al block "L" well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured. ASD.
PYX032	PSF 090601a.030	Al block 5 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.034	Al block 10 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.035	Al block 10 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD.
PYX032	PSF 090601a.039	Al block 15 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.040	Al block 15 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. able), 1000 avg., grain shaken and remeasured,

		ASD.
PYX032	PSF 090601a.044	Al block 20 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.050	Al block 5 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.051	Al block 5 mm deep well: D' grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD.
PYX032	PSF 090601a.059	Al block 10 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.060	Al block 10 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD.
PYX032	PSF 090601a.068	Al block 15 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.069	Al block 15 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD.
PYX032	PSF 090601a.077	Al block 20 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., ASD.
PYX032	PSF 090601a.078	Al block 20 mm deep well: D grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD; grain lost.
PYX032	PSF 090601a.086	Al block 25 mm deep well: D' grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., ASD.
PYX032	PSF 090601a.087	Al block 25 mm deep well: D' grain (500-1000 µm), i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD; grain lost.
PYX032	PSF 090601a.100	45-90 µm single grain (hopefully got a grain), Al block 10 mm deep well, i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., ASD.
PYX032	PSF 090601a.101	90-250 µm single grain, Al block 10 mm deep well, i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.102	250-500 µm single grain (C grain), Al block 10 mm deep well, i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg., ASD.
PYX032	PSF 090601a.103	500-1000 µm single grain (D' grain), Al block 10 mm deep well, i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 1000 avg. ASD.
PYX032	PSF 090601a.127	45-90 µm bulk powder, i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 100 avg., ASD.
PYX032	PSF 090601a.128	90-250 µm bulk powder, i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 100 avg. ASD.
PYX032	PSF 090601a.129	250-500 µm bulk powder, i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 100 avg., ASD.
PYX032	PSF 090601a.130	500-1000 µm bulk powder, i=0°/e=0°; 0.35-2.5 µm; 1 nm res.; (bifurc. cable), 100 avg. ASD.

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PYX032 – phase angle measurements – all relative to Spectralon at i=13°, e=0° with ASD

PYX032	PSF 101001a.002	<45 µm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.011	<45 µm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.020	<45 µm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°;

		0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.029	<45 µm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.038	<45 µm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.047	<45 µm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.056	<45 µm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.066	<45 µm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.076	<45 µm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PYX032	PSF 101001a.085	<45 µm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).

++++ Bidirectional study 1. (June 2006) with ASD ++++

Series 1 (same viewing geometry for standard and sample; i=0°)

PYX032	PSF jun2806.011	<45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.012	<45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.013	<45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.014	<45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 2 (same viewing geometry for standard and sample; e=75°)

PYX032	PSF jun2806.015	<45 µm; 30°/75°; 30°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.016	<45 µm; 60°/75°; 60°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.017	<45 µm; 75°/75°; 75°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 3 (same viewing geometry for standard and sample; i=30°)

PYX032	PSF jun2806.018	<45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.019	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 4 (same viewing geometry for standard and sample; i=60°)

PYX032	PSF jun2806.020	<45 µm; 60°/60°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.021	<45 µm; 60°/30°; 60°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.022	<45 µm; 60°/0°; 60°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.023	<45 µm; 60°/-30°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

"Series" 5 (same viewing geometry for standard and sample; 30°/0°)

PYX032	PSF jun2806.024	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 6 (different viewing geometry for standard (30°/0°) and sample (e=30°))

PYX032	PSF jun2806.025	<45 µm; 30°/0°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.026	<45 µm; 30°/0°; 60°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF jun2806.027	<45 µm; 30°/0°; 75°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 7 (different viewing geometry for standard (30°/0°) and sample (i=60°)

PYX032 PSF jun2806.028 <45 µm; 30°/0°; 60°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.029 <45 µm; 30°/0°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.030 <45 µm; 30°/0°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 8 (different viewing geometry for standard (30°/0°) and sample (i=75°)
PYX032 PSF jun2806.031 <45 µm; 30°/0°; 75°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.032 <45 µm; 30°/0°; 75°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.033 <45 µm; 30°/0°; 75°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.034 <45 µm; 30°/0°; 75°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 9 (different viewing geometry for standard (30°/0°) and sample (i=0°)
PYX032 PSF jun2806.035 <45 µm; 30°/0°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.036 <45 µm; 30°/0°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.037 <45 µm; 30°/0°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.038 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 10 (different viewing geometry for standard (30°/0°) and sample (i=e: bifurcated cable)
PYX032 PSF jun2806.039 <45 µm; 30°/0°; 0°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.040 <45 µm; 30°/0°; 30°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.041 <45 µm; 30°/0°; 45°/-45°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.042 <45 µm; 30°/0°; 60°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.043 <45 µm; 30°/0°; 75°/-75°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032 PSF jun2806.044 <45 µm; 30°/0°; 15°/-15°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

++++ Bidirectional study 2. (February - March 2007) with ASD++++
Format: grain size; i°,e° for standard; i°/e° for sample; wavelength range; spectral resolution; number of spectra averaged; instrument.

Series 0a (same viewing geometry for standard and sample)
PYX032 PSF feb2707.005 <45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
PYX032 PSF feb2707.013 <45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
PYX032 PSF feb2707.021 <45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
PYX032 PSF feb2707.029 <45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).

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Series 0b (same viewing geometry for standard and sample)
PYX032 PSF feb2807.005 <45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
PYX032 PSF feb2807.013 <45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
PYX032 PSF feb2807.021 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
PYX032 PSF feb2807.029 <45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).

Series 1 (same viewing geometry for standard and sample
PYX032 PSF mar0107.005 <45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032 PSF mar0107.013 <45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032 PSF mar0107.021 <45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032 PSF mar0107.029 <45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 2 (same viewing geometry for standard and sample
PYX032 PSF mar0207a.005 <45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PYX032	PSF mar0207.013	<45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0207.021	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0207.029	<45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 3 (same viewing geometry for standard and sample)

PYX032	PSF mar0207.037	<45 µm; 60°/60°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0207.045	<45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0207.053	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0207.061	<45 µm; 60°/-30°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 4 (different viewing geometry for standard vs. sample)

PYX032	PSF mar0607.005	<45 µm; 30°/0°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0607.013	<45 µm; 30°/0°; 60°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0607.021	<45 µm; 30°/0°; 60°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0607.029	<45 µm; 30°/0°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 5 (bifurcated cable; same viewing geometry for standard and sample)

PYX032	PSF mar0707.005	<45 µm; 0°/0°; 0°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PYX032	PSF mar0707.013	<45 µm; 30°/-30°; 30°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF mar0707.021	<45 µm; 45°/-45°; 45°/-45°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX032	PSF mar0707.029	<45 µm; 60°/-60°; 60°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

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++++ Bidirectional study 3. (110506 – May 6, 2011) with ASD++++

Format: grain size; i°,e° for standard; i°/e° for sample; wavelength range; spectral resolution; number of spectra averaged; instrument.

PYX032	PSF 110506a.002	<45 µm; standard: i=18°, e=0°; sample: i=18°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.016	<45 µm; standard: i=18°, e=0°; sample: i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.017	<45 µm; standard: i=18°, e=0°; sample: i=45°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.036	<45 µm; standard: i=18°, e=0°; sample: i=60°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.037	<45 µm; standard: i=18°, e=0°; sample: i=0°, e=18°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.003	<45 µm; standard: i=18°, e=0°; sample: i=15°, e=15°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.013	<45 µm; standard: i=18°, e=0°; sample: i=30°, e=15°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.020	<45 µm; standard: i=18°, e=0°; sample: i=45°, e=15°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.033	<45 µm; standard: i=18°, e=0°; sample: i=60°, e=15°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.040	<45 µm; standard: i=18°, e=0°; sample: i=0°, e=30°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.004	<45 µm; standard: i=18°, e=0°; sample: i=15°, e=30°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.011	<45 µm; standard: i=18°, e=0°; sample: i=30°, e=30°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.021	<45 µm; standard: i=18°, e=0°; sample: i=45°, e=30°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.032	<45 µm; standard: i=18°, e=0°; sample: i=60°, e=30°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.041	<45 µm; standard: i=18°, e=0°; sample: i=0°, e=45°; 0.35-2.5 µm; 1 nm

		output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.005	<45 µm; standard: i=18°, e=0°; sample: i=15°, e=45°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.012	<45 µm; standard: i=18°, e=0°; sample: i=30°, e=45°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.024	<45 µm; standard: i=18°, e=0°; sample: i=45°, e=45°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.029	<45 µm; standard: i=18°, e=0°; sample: i=60°, e=45°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.044	<45 µm; standard: i=18°, e=0°; sample: i=0°, e=60°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.006	<45 µm; standard: i=18°, e=0°; sample: i=15°, e=60°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.007	<45 µm; standard: i=18°, e=0°; sample: i=30°, e=60°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.025	<45 µm; standard: i=18°, e=0°; sample: i=45°, e=60°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
PYX032	PSF 110506a.028	<45 µm; standard: i=18°, e=0°; sample: i=60°, e=60°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).

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PYX032 – phase angle measurements – all relative to brushed gold at i=18°, e=0°; with Bruker Vertex 70 – shot in 2011

PYX032	PSF gold 18_0.dpt	brushed gold; standard i/e= 18°/0°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF poly on gold 18_0.dpt	polystyrene on brushed gold for wavelength calibration; standard i/e= 18°/0°, sample i/e= 18°/0°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 0_18.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 0°/18°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 0_30.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 0°/30°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 0_45.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 0°/45°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 0_60.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 0°/60°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 15_15.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 15°/15°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 15_30.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 15°/30°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 15_45.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 15°/45°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 15_60.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 15°/60°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 18_0.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 18°/0°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 30_0.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 30°/0°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 30_15.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 30°/15°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 30_30.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 30°/30°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 30_45.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 30°/45°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 30_60.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 30°/60°; 1.6-25 µm; 7.7 cm^{-1}

		resolution; Bruker Vertex 70.
PYX032	PSF pyx032 45_0.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 45°/0°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 45_15.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 45°/15°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 45_30.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 45°/30°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 45_45.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 45°/45°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 45_60.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 45°/60°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 60_0.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 60°/0°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 60_15.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 60°/15°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 60_30.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 60°/30°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 60_45.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 60°/45°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
PYX032	PSF pyx032 60_60.dpt	<45 µm; standard i/e= 18°/0°, sample i/e= 60°/60°; 1.6-25 µm; 7.7 cm^{-1} resolution; Bruker Vertex 70.
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PYX033	RELAB C1PP19	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
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PYX034	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.% resol.
PYX034	RELAB C1PP17	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX034	PSF 170507pyx034	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX034	PSF 110707pyx034	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX034	PSF pyx034	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
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PYX035	RELAB C1PP18	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
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PYX036	RELAB C1SC35	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
PYX036	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX036	PSF 170507pyx036	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX036	PSF 110707pyx036	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX036	PSF pyx036	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX036	PSF pyx036.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PYX037	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.,w/INC037?
PYX037	RELAB C1PP79	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
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PYX038	UH Analogue	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX038	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX038	RELAB C1PP86	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX038	PSF 220507pyx038	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX038	PSF 110707pyx038	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX038	PSF pyx038	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX038	PSF pyx038.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PYX039	UH Analogue	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX039	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX039	RELAB C1PP28	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX039	PSF 220507pyx039	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX039	PSF 110707pyx039	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX039	PSF pyx039	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX039	PSF pyx039.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
PYX039	PSF pyx039_250_500.dpt	250-500 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PYX040	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX040	RELAB C1PP29	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
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PYX041	UH Analogue	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX041	RELAB C1PP91	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
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PYX042	PSF pyx04290	45-90 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX042	UH Analogue	38-53µm, 0E/15E, 0.35-2.55µm, 1.5% resol.
PYX042	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX042	UH Analogue	90-125µm, 0E/15E, 0.35-2.55µm, 1.5% resol.
PYX042	RELAB C1PP87	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX042	PSF 220507pyx042	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX042	PSF 110707pyx042	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX042	PSF pyx042	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX042	PSF jun0707.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX042	PSF jun0707.008	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX042	PSF 4245	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX042	PSF 424590	45-90 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX042	PSF pyx042.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
PYX042	PSF 121102a.018	<45 µm; i=30°, e=0°; 0.35-2.5 µm ASD; 1000 spectra averaged; 1 nm output. Directory: 121101mafic metal]. Aka PXMETS01.
PYX042	PSF 121016a.003	<250 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
PYX042	PSF OO 2	<250 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
PYX042	PSF 121016a.199	<45 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
PYX042	PSF OO 199	<45 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
PYX042	PSF 121016a.194	45-90 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
PYX042	PSF OO 194	45-90 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
PYX042	PSF sep0407.001	100% orthopyroxene (PYX042; <45 µm); aka COMIX1101.
PYX042	PSF 100907.016	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; aka MPMIX1001.
PYX042	PSF 100907.026	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; aka MPMIX1011.
PYX042	PSF 300807b.011	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD; aka POMIX1011

(directory: 300807b).

PYX042 PSF 31aug07.011 38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD; aka POMIX2011 (directory: 31aug07).

PYX042 PSF 06sep07.011 90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD; aka POMIX3011 (directory: 06sep07).

PYX042 PSF 060907a.001 63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD; aka POMIX4011 (directory: 060907a).

PYX042 PSF 060907b.005 45-63 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD; aka POMIX5011 (directory: 060907b).

PYX042 *See also section 15.25 of this document for mixtures of this material with nanophase iron and nanophase iron-impregnated silica gels.*

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PYX043 UH Analogue 45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

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PYX044 RELAB C1PP88 45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.

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PYX045 PSF 100522a.001 <45 µm, 30°/0°; 0.35-2.5 µm; 1000 spectra averaged; ASD (directory: 100522_rocks).

PYX045 PSF 100522a.002 45-90 µm, 30°/0°; 0.35-2.5 µm; 1000 spectra averaged; ASD (directory: 100522_rocks).

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PYX050 PSF 090319a.004 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX050 PSF 090602a.018 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX051 PSF 090319a.005 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX051 PSF 090602a.019 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX052 PSF 090319a.006 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX052 PSF 090602a.020 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX053 PSF 090319a.007 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX053 PSF 090602a.021 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX054 PSF 090319a.008 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX054 PSF 090602a.022 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX055 PSF 090319a.009 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX055 PSF 090602a.023 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX056 PSF 090319a.010 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX056 PSF 090602a.024 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX057 PSF 090319a.011 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX057 PSF 090602a.025 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX058 PSF 090319a.012 <45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

PYX058 PSF 090602a.026 <45 µm, i=30°, e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.

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PYX059	PSF 090319a.013	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 μm.
PYX059	PSF 090602a.027	<45 μm, i=30°, e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
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PYX060	PSF 090319a.014	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 μm.
PYX060	PSF 090602a.028	<45 μm, i=30°, e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
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PYX061	PSF 090319a.015	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 μm.
PYX061	PSF 090602a.029	<45 μm, i=30°, e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
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PYX062	PSF 090319a.016	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 μm.
PYX062	PSF 090602a.030	<45 μm, i=30°, e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
++++++		
PYX063	PSF 090319a.017	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 μm.
PYX063	PSF 090602a.031	<45 μm, i=30°, e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
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PYX064	PSF 090319a.018	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 μm.
PYX064	PSF 090602a.032	<45 μm, i=30°, e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
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PYX070	PSF 090313a.021	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
PYX070	PSF 090313a.022	45-90 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
PYX070	PSF pyx07045	<45μm, 30°/0°, 0.35-0.86 μm, 30 msec, 200 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX070	PSF pyx07045	<45 μm, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol. (OO S2000) (090430oo directory).
PYX070	PSF pyx07090	45-90μm, 30°/0°, 0.35-0.86 μm, 30 msec, 200 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX070	PSF pyx07090	45-90 μm, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol. (OO S2000) (090430oo directory).
PYX070	PSF pyx070.dpt	<45 μm; 30°/0°; 1.67-25.4 μm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PYX101	UH Analogue	? g.s., diffuse, 0.9-2.5μm, ? resol.
PYX101	RELAB C1PP89	45-90μm, 30E/0E, 0.3-2.6μm, 5 nm resol.
PYX101	PSF 220507pyx101	<45 μm, 0°/0° (bifurcated probe), 0.2-0.4 μm, ~0.3 nm (OO S2000).
PYX101	PSF 110707pyx101	<45 μm, 0°/0° (bifurcated probe), 0.35-0.86 μm, ~0.3 nm (OO S2000).
PYX101	PSF pyx101	<45 μm, 0°/0° (bifurcated probe), 0.2-0.86 μm; merged at 0.38 μm, 0.2-0.4 μm with D2 source, 0.35-0.86 μm with QTH source (OOS2000).
PYX101	PSF 100304a.003	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD.
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PYX102	RELAB C1PP39	45-90μm, 30E/0E, 0.3-2.6μm, 5 nm resol.
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PYX103	RELAB C1PP48	<45μm, 30E/0E, 0.3-2.75μm, 5nm, spun 0.84-2.75μm.
PYX103	UH Analogue	? g.s., diffuse, 0.9-2.5μm, ? resol.
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PYX104	RELAB C1PP56	<45μm, 30E/0E, 0.3-2.75μm, 5nm, spun 0.84-2.75μm.

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PYX105	RELAB C1PP41	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
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PYX107	RELAB C1PP54	<45µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
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PYX108	PSF pyx10890	45-90 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX108	USGS 228	45-90µm, IS, 0.35-2.6µm, 1x resol.
PYX108	RELAB C1PP43	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX108	PSF 220507pyx108	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX108	PSF 110707pyx108	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX108	PSF pyx108	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX108	PSF jun0707.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX108	PSF jun0707.010	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX108	PSF 10845	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX108	PSF 1084590	45-90 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
++++++		
PYX109	RELAB C1PP45	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX110	PSF pyx11090	45-90 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX110	RELAB C1PP47	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX110	RELAB CAPP47	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol.
PYX110	RELAB CBPP47	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm resol.
PYX110	RELAB MAPP47A	<45µm, 30°/30°, 1.8-26µm, 0.6-129nm resol.
PYX110	RELAB MAPP47B	45-90µm, 30°/30°, 1.8-26µm, 0.6-129 nm resol.
PYX110	RELAB LAPP47A	<45µm, 30°/0°,30°, 0.3-26µm, 5/0.6-129 nm resol. (merged RELAB + Nicolet, at 2.5µm) [Note different viewing geometries].
PYX110	RELAB LAPP47B	45-90µm, 30°/0°,30°, 0.3-26µm, 5/0.6-129 nm resol. (merged RELAB + Nicolet, at 2.5µm) [Note different viewing geometries].
PYX110	PSF 220507pyx110	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX110	PSF 110707pyx110	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX110	PSF pyx110	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX110	PSF jun0707a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX110	PSF jun0707a.002	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX110	PSF 11045	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX110	PSF 1104590	45-90 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
++++++		
PYX111	RELAB C1PP66	<45µm, 30E/0E, 0.3-3.6µm, 5nm.
++++++		
PYX112	PSF pyx11290	45-90 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX112	RELAB C1PP42	<45µm, 30E/0E, 0.3-3.6µm, 5nm.
PYX112	PSF jun0707a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX112	PSF jun0707a.004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX112	PSF 11245	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX112	PSF 1124590	45-90 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX112	PSF 100304a.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
PYX112	PSF pyx112.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
++++++		

PYX113	RELAB C1PP92	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX114	UH Analogue	? g.s., diffuse, 0.9-2.5µm, ? resol.
PYX114	RELAB C1PP49	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX114	PSF 220507pyx114	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX114	PSF 110707pyx114	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX114	PSF pyx114	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
++++++		
PYX115	RELAB C1PP50	<45µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
PYX115	UH Analogue	? g.s., diffuse, 0.9-2.5µm, ? resol.
++++++		
PYX116	RELAB C1PP51	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX117	RELAB C1PP44	<45µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.85-2.75µm.
PYX117	RELAB C2SC09	45-90µm, 0E/15E, 0.3-2.6µm, 5nm, with errors.
PYX117	RELAB C3SC09	45-90µm, 0E/15E, 0.3-2.6µm, 5nm, with errors (2nd run).
PYX117	RELAB C4SC09	45-90µm, 0E/15E, 0.3-2.6µm, 5nm, with errors (2 run average).
PYX117	RELAB C1SC09	45-90µm, 0E/15E, 0.3-3.6µm, 5nm, spun 1.6-2.6µm.
PYX117	RELAB CASC09	45-90µm, 0°/15°, 0.3-2.6µm, 5 nm (3 run average)
PYX117	USGS 224	45-90µm, IS, 0.35-2.6µm, 1x resol.
PYX117	PSF 220507pyx117	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX117	PSF 110707pyx117	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX117	PSF pyx117	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX117	PSF jun0707a.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX117	PSF 11745	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX117	PSF pyx117.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
++++++		
PYX119	PSF pyx11990	45-90 µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; (OO S2000) (090416oo directory).
PYX119	RELAB C1PP52	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX119	PSF 220507pyx119	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX119	PSF 110707pyx119	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX119	PSF pyx119	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PYX119	PSF jun0707a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX119	PSF jun0707a.006	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PYX119	PSF 11945	<45 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
PYX119	PSF 1194590	45-90 µm; 30°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
++++++		
PYX120	RELAB C1PP53	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX121	RELAB C1PP55	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX122	RELAB C1PP57	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX124	RELAB CAPP93	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX124	RELAB LAPP93	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX125	RELAB CAPX06	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX125	RELAB LAPX06	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB +

		Nicolet (note different viewing geometries).
++++++		
PYX126	RELAB C1PP61	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX127	RELAB C1PP63	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX128	RELAB C1PP65	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX129	RELAB CAPP94	<45µm, 30°/0°, 0.3-2.6µm, 5 nmresol. With errors.
PYX129	RELAB LAPP94	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX130	RELAB C1PP59	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX131	RELAB C1SC70	45-90µm, 0E/15E, 0.3-2.7µm, 5nm.
PYX131	PSF pyx131.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
++++++		
PYX132	RELAB C1PP67	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX134	RELAB C1PP71	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX135	RELAB C1PP58	<45µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.85-2.75µm.
++++++		
PYX136	RELAB C1PP60	<45µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
++++++		
PYX150	RELAB C1PP64	<45µm, 30E/0E, 0.3-3.6µm, 5nm.
PYX150	PSF mar3006.003	<45 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PYX150	PSF mar3006.004	45-90 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PYX150	PSF 220507pyx150	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX150	PSF 110707pyx150	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX150	PSF pyx150	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OOS2000).
PYX150	PSF sep0407.014	100% type A clinopyroxene (PYX150; <45 µm); aka COMIX1111.
PYX150	PSF 090724a.012	<45µm, 30°/0°, 0.35-2.5µm, 1nm output, ASD, 1000 avgd; aka OCMIX1011.
++++++		
PYX151	RELAB C1SC69	45-90µm, 0E/15E, 0.3-2.7µm, 5nm.
++++++		
PYX152	RELAB C1PP72	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX153	RELAB C1PP90	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX160	RELAB C1PP73	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX161	RELAB C1PP74	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX162	RELAB C1PP75	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX164	RELAB capx07	<45µm, 30°/0°, 0.3-2.6µm, 5 nmresol. With errors.
PYX164	RELAB lapx07	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		

PYX165	RELAB C1PP76	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX166	RELAB C1PP77	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
++++++		
PYX167	RELAB CAPP95	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX167	RELAB LAPP95	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
PYX167	PSF 220507pyx167	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PYX167	PSF 110707pyx167	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PYX167	PSF pyx167	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
++++++		
PYX168	RELAB C1PP78	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm resol.
PYX168	RELAB capx08	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX168	RELAB lapx08	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX170	RELAB CAPP97	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX170	RELAB LAPP97	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX171	RELAB CAPP98	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX171	RELAB LAPP98	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX172	RELAB CAPP96	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX172	RELAB LAPP96	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX174	RELAB CAPX02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX174	RELAB LAPX02	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX180	RELAB CAPX03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX180	RELAB LAPX03	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX181	RELAB CAPX04	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX181	RELAB LAPX04	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX182	RELAB CAPX05	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX182	RELAB LAPX05	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX183	RELAB capp99	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX183	RELAB lapp99	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX184	RELAB CAPX01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX184	RELAB LAPX01	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
PYX184	RELAB c1px01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX184	RELAB lbpx01	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
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PYX185	RELAB capx09	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX185	RELAB lapx09	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
++++++		
PYX186	RELAB capx10	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
PYX186	RELAB lapx10	<45µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
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PYX190	PSF jun1407c.007	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
++++++		
PYX191	PSF 080114b.005	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
PYX192	PSF 080114b.006	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
PYX193	PSF 130910a.011	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
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PYX205	RELAB C1SC01	45-90µm, 0E/15E, 0.3-3.6µm, 5nm, spun 1.6-2.6µm. See MET200.

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<u>2.1d.1. Spectral Data: Pyroxenes: John Adams and RELAB Pyroxenes</u>

JA2368	RELAB C1JA01	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
106006	RELAB C1JA03	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
2427ACM	RELAB C1JA04	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
7208	RELAB C1JA05	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
79558	RELAB C1JA07	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
86618	RELAB C1JA09	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
104265	RELAB C1JA12	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
R7209	RELAB C1JA15	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
112538	RELAB C1JA17	bulk powder, 30°/0°, 0.3-2.6µm, 5 nm.
PP-CMP-21	RELAB C1PP20	<45µm, 30°/0°, 0.3-2.6µm, 5nm.
PP-CMP-21	RELAB C1PP21	<45µm, 30°/0°, 0.3-2.75µm, 5nm.
PP-CMP-21	RELAB C1PP22	<45µm, 30°/0°, 0.315-2.7µm, 5 nm, spun.
PP-CMP-21	RELAB C1PP23	<45µm, 30°/0°, 0.3-2.75µm, 5nm, spun.
PP-CMP-21	RELAB C1PP24	45-75µm, 30°/0°, 0.3-2.6µm, 5 nm.
PP-CMP-21	RELAB C1PP25	45-75µm, 30°/0°, 0.3-2.75µm, 5 nm.
PP-CMP-21	RELAB C1PP26	45-75µm, 30°/0°, 0.325-2.7µm, 5 nm, rerun.
PP-CMP-21	RELAB C2PP21	75-125µm, 30°/0°, 0.3-2.6µm, 5 nm.
PP-CMP-21	RELAB C2PP22	75-125µm, 30°/0°, 0.3-2.75µm, 5 nm.
PP-CMP-21	RELAB C2PP23	75-125µm, 30°/0°, 0.3-2.75µm, 5 nm, chopped, spun.
PP-CMP-21	RELAB C3PP22	<25µm, 30°/0°, 0.32-2.6µm, 10 nm.
PP-CMP-21	RELAB C4PP21	25-63µm, 30°/0°, 0.32-2.6µm, 10 nm.
PP-CMP-21	RELAB C5PP21	63-125µm, 30°/0°, 0.32-2.6µm, 10 nm.
PP-CMP-21	RELAB C5PP23	<250µm, 30°/0°, 0.32-2.7µm, 10 nm.

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2.1d.x Pyroxenes – Polynomial (quadratic) fits to absorption bands

Note: polynomial fits to RELAB pyroxene spectra. Equation $y=a+bx+cx^2$
Differentiate & solve for x at y=0 i.e. 0=-b+2cx, b=2cx
Band depth, solve for y (if normalized only)

Sample	Poly. Coeff's a	b	c	Band Min(µm)	Band Depth%	Grain Size (µm)	Compil. & File#	Channels Fitted
"PYX" prefix								
				BAND I				
003				0.915		45-90	U of Hawaii	
003	11.34	-24.24	13.20	0.918		<45	brown2a-114	106-144
003/s.l.	23.99	-50.89	27.49	0.926	56.2	<45	brown2a-147	106-144
003/s.l.[f]	24.65	-52.36	28.31	0.925	57.3	<45	brown2a-175	
009[a]				0.962		45-90	U of Hawaii	
009[a]				1.121		45-90	U of Hawaii	
009[a]	6.317	-12.02	6.123	0.982		45-90	brown2d-169	121-148
009[a]	5.759	-9.559	4.276	1.118		45-90	brown2d-123	151-190
009/s.l.[a]	8.484	-16.20	8.240	0.983	47.8	45-90	brown2d-164	121-147
009/s.l.[a]	7.004	-11.56	5.149	1.123	48.4	45-90	brown2d-165	151-189
015	10.23	-21.47	11.72	0.916		<45	brown2a-117	106-144
015/s.l.	17.39	-36.37	19.77	0.920	33.7	<45	brown2a-150	106-144
015/s.l.[f]	19.28	-40.51	22.05	0.919	32.6	<45	brown2a-171	
018	11.74	-21.82	10.43	1.046		45-90	brown2d-125	120-180
018/s.l.	18.17	-33.66	16.05	1.049	47.8	45-90	brown2d-166	120-180
020[a]	3.586	-6.254	3.202	0.977		45-90	brown2d-127	111-150
020[a]	3.598	-5.622	2.584	1.088		45-90	brown2d-128	151-189
020/s.l.[a]	5.070	-8.341	4.114	1.014	15.8	45-90	brown2d-167	121-150
020/s.l.[a]	5.738	-8.728	3.872	1.127	18.1	45-90	brown2d-172	157-199
021[a]				0.960		<45	U of Hawaii	
021[a]				1.15		<45	U of Hawaii	
023				0.912		45-90	U of Hawaii	
025	2.664	-3.944	1.905	1.035		<45	brown2d-115	120-180
025/s.l.	3.576	-5.248	2.494	1.052	18.5	<45	brown2d-160	120-180
026[a]				~0.97		45-90	U of Hawaii	
026[a]				1.125		45-90	U of Hawaii	
029				1.011		45-90	U of Hawaii	
032				0.928		45-90	U of Hawaii	
034				1.005		45-90	U of Hawaii	
036				1.011		45-90	U of Hawaii	
036/s.l.	18.78	-35.77	17.34	1.031	65.2	45-90	brown3a-147	
037				1.015		45-90	U of Hawaii	
038[a]				0.950		<45	U of Hawaii	
038[a]				1.15		<45	U of Hawaii	
039[a]				0.938		<45	U of Hawaii	
039[a]				1.145		<45	U of Hawaii	
040				1.011		45-90	U of Hawaii	
041[a]				0.928		45-90	U of Hawaii	
041[a]				1.13		45-90	U of Hawaii	
042				0.917		45-90	U of Hawaii	
043				1.033		45-90	U of Hawaii	
103	1.406	-2.291	1.158	0.989		<45	brown2d-103	110-170
103/s.l.	3.413	-5.027	2.522	0.997	9.2	<45	brown2d-154	120-180
104	8.943	-15.94	7.628	1.045		<45	brown2d-109	120-180
104/s.l.	11.26	-20.00	9.529	1.049	23.4	<45	brown2d-157	120-180

107	4.333	-7.742	3.761	1.029		<45	brown2d-107	120-180
107/s.l.	5.760	-9.691	4.724	1.026	21.0	<45	brown2d-171	131-189
111	2.908	-4.506	2.162	1.042		<45	brown2d-120	120-180
111/s.l.	4.623	-7.143	3.411	1.047	11.7	<45	brown2d-163	120-180
112	10.38	-22.07	12.02	0.918		<45	brown2a-115	106-144
112/s.l.	23.06	-48.65	26.27	0.926	46.4	<45	brown2a-148	106-144
112/s.l.[f]	24.15	-51.04	27.58	0.925	46.4	<45	brown2a-173	
115	3.498	-6.526	3.312	0.985		<45	brown2d-105	120-180
115/s.l.	8.532	-15.69	7.855	0.999	30.3	<45	brown2d-155	120-180
117	14.97	-32.16	17.53	0.917		<45	brown2a-116	106-144
117	8.961	-19.58	10.79	0.907		<45	brown1a-144	101-129
117/s.l.	23.41	-50.14	27.24	0.920	66.3	<45	brown2a-149	106-144
117/s.l.[f]	23.24	-49.75	27.02	0.921	67.9	<45	brown2a-177	
117/s.l.	16.02	-34.45	18.73	0.920	82.1	45-90?	brown1b-183	106-144
135	3.110	-4.522	2.167	1.043		<45	brown2d-111	120-180
135/s.l.	3.865	-5.584	2.640	1.058	8.8	<45	brown2d-158	120-180
136	6.755	-11.58	5.550	1.043		<45	brown2d-113	120-180
136/s.l.	8.028	-13.69	6.523	1.049	15.5	<45	brown2d-159	120-180
150[a]	2.167	-3.075	1.566	0.982		<45	brown2d-117	111-150
150[a]	2.487	-3.286	1.478	1.112		<45	brown2d-118	151-189
150/s.l.[a]	3.460	-5.295	2.683	0.987	15.2	<45	brown2d-161	115-148
150/s.l.[a]	3.691	-5.031	2.225	1.131	15.3	<45	brown2d-162	155-190
++++++								
				BAND II				
003				1.784		45-90	U of Hawaii	
003	5.735	-5.933	1.631	1.819		<45	brown2a-151	26-74
003/s.l.[f]	7.124	-7.189	1.929	1.863		<45	brown2a-176	
009[a]	2.484	-1.338	.2682	2.492		45-90	brown2d-170	127-195
015	3.975	-3.827	1.065	1.797		<45	brown2a-154	26-74
015/s.l.[f]	5.294	-4.932	1.344	1.835		<45	brown2a-172	
018	10.39	-8.468	1.810	2.339		45-90	brown2d-126	127-175
020	.3075	-699.0	152.9	2.286		45-90	brown2d-129	106-194
023				1.856		45-90	U of Hawaii	
025	3.100	-1.917	.3988	2.403		<45	brown2d-116[d]	
026				2.28		45-90	U of Hawaii	
029				2.296		45-90	U of Hawaii	
032				1.958		45-90	U of Hawaii	
034				2.243		45-90	U of Hawaii	
036				2.28		45-90	U of Hawaii	
036/s.l.	12.52	-10.36	2.215	2.339		45-90	brown3a-148	
040				2.214		45-90	U of Hawaii	
042				1.878		45-90	U of Hawaii	
043				2.286		45-90	U of Hawaii	
103	.7870	-.4749	.1174	2.023		<45	brown2d-104	55-115
104	6.857	-5.204	1.105	2.355		<45	brown2d-110	105-205
107	5.070	-3.973	.8511	2.334		<45	brown2d-108	125-175
111	1.624	-.8189	.1659	2.468		<45	brown2d-121[e]	
112	4.969	-5.001	1.361	1.837		<45	brown2a-152	26-74
112/s.l.[f]	9.112	-9.113	2.413	1.888		<45	brown2a-174	
115	1.792	-1.370	.3397	2.016		<45	brown2d-106	55-115
117	7.195	-7.311	1.952	1.873		<45	brown2a-153	41-84
117/s.l.[f]	8.694	-8.739	2.303	1.897		<45	brown2a-178	
117	4.405	-4.560	1.219	1.870		45-90?	brown1a-168	41-69
135	2.627	-1.500	.3158	2.375		<45	brown2d-112	[b]
136	6.329	-4.578	.9444	2.424		<45	brown2d-114	[c]
150[a]	1.657	-.6699	.1319	2.539		<45	brown2d-119	116-204

Notes: [a] : Type A or mixed type clinopyroxene
[b] : Channels 116-142, 153-195 used for polyfit
[c] : Channels 116-135, 157-161, 171-187, 195-205 used for polyfit
[d] : Channels 106-141, 153-159, 169-205 used for polyfit
[e] : Channels 106-141, 157-163, 171-194 used for polyfit
[f] : Separate polyfit run
s.l.= straight line continuum
/ : division by straight line continuum
Band I = major absorption band near 1µm.
Band II = major absorption band near 2µm.

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END of 2.1.

2. Silicates

2.2. Olivines

2.2a. Sample Descriptions - Olivines

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either not olivines or are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
OLV001	*now pyroxene PYX150 (originally labelled as olivine): locality unknown, probably Bancroft, Ontario, Canada (G. Hudecek).*
OLV002	Chrysolite: Cinder cone, 100 m west of Hale Pohaku, south flank of Mauna Kea, Hawaii, USA (E. Cloutis), volcanic bomb inclusion.
OLV003	Forsterite: Peridot, San Carlos County, Arizona, USA (Wetaskiwin Rock Show).
OLV003a	Forsterite, San Carlos Co., AZ, USA (2 bags of peridot sand; ~1 lb.) [Tucson 2011 show].
OLV003b	Forsterite, San Carlos Co., AZ, USA (5 pounds (2-1 lb bags, 1-1 lb. bag) [Tucson 2011 show].
OLV004	*now pyroxene PYX151 (originally labelled as forsterite): San Vito Quarry, Vesuvio, Napoli, Italy (Excalibur Mineral Co.).*
OLV005	Forsterite: St. John's Island, Red Sea, Egypt (Minerals Unlimited).
OLV006	*too intimate to separate: Fayalite: Kajia-Kanagawa ken, Honshu, Japan (Minerals Unlimited).*
OLV007	Forsterite: Palumbo Farm, Villafranca, Cecchina, near Rome, Italy (Minerals Unlimited), with pyroxene PYX171.
OLV008	Forsterite: Kafveltorp Quarry, near Kopperberg, Sweden (Minerals Unlimited), with pyroxene PYX022; more received July 25, 2008.
OLV009	Forsterite: Jackson County, North Carolina, USA (Minerals Unlimited). (More (2 lbs) received June 17/09).
OLV010	Chrysolite: Green Sand Beach, near South Point, Hawaii, USA (R.B. Singer).
OLV011	Fayalite: Rockport, Massachusetts, USA (Smithsonian Institution Museum of Natural History MNH #35117).
OLV012	Forsterite: Twin Sisters Range, Washington, USA (Ward's collection #136053).
OLV013	Forsterite: Navajo Indian Reservation, San Carlos County, Arizona, USA (Minerals Unlimited), with pyroxene PYX015, volcanic bomb inclusion.
OLV014	*now apatite APA102 (originally labelled as olivine): Jacupiranga Mine, Sao Paulo State, Brazil (Nature's Treasures), with magnetite MAG101.*
OLV015	Fayalite: Zwartkloof, 707KR, 15 km west of Warmbaths, Northern Transvaal, South Africa (Smithsonian Institution Museum of Natural History MNH #36053), analysis in Pringle (1975).
OLV016	*too intimate and sparse to separate: Fayalite: Coso Hot Springs, Inyo County, California, USA (Nature's Treasures).*
OLV020	Hyalosiderite: Skaergaard Intrusion, Greenland (University of Hawaii collection #10-21-9), with pyroxene PYX115 and plagioclase PLG125.
OLV021	Chrysolite: Springwater Intrusion, Montana, USA (University of Hawaii collection #10-3-10), with chromite CHR102.
OLV022	Olivine: Skaergaard Intrusion, Greenland (University of Hawaii collection #10-21-6), with pyroxene PYX114 and plagioclase PLG116.
OLV023	Roepperite (Mn-Zn olv): Sterling Hills, New Jersey, USA (Smithsonian Institution Museum of Natural History MNH #C2824).
OLV024	Number used for olivine in Chassigny SNC meteorite.
OLV025	Chrysolite: Springwater Intrusion, Montana, USA (University of Hawaii collection #10-3-6).
OLV101	Monticellite (Ca-Mg olv): locality unknown (University of Alberta GEOL330 laboratory collection #unknown).
OLV102	Forsterite: West Loch Tarbert, Harris, Outer Hebrides, Scotland (Excalibur Mineral Co.).
OLV103	Chrysolite: Loch Seaforth, Outer Hebrides, Scotland (Excalibur Mineral Co.), with pyroxene PYX119.
OLV104	*now pyroxene PYX152 (originally labelled as tephroite, one of the other phases may be it): Kaso Mine,*

Tochigi-ken, Honshu, Japan (Minerals Unlimited).

OLV105 Knebelite (Mn-Fe olv): Highland Bell Mine, Beaverdell, British Columbia, Canada (Minerals Unlimited).

OLV106 Forsterite: Kettle River, British Columbia, Canada (X. Xue), in KR4000 xenolith.

OLV107 Forsterite: Rayfield River, British Columbia, Canada (D. Canil), in xenolith.

OLV108 Forsterite: locality unknown (Geological Survey of Canada collection at the University of Alberta #I59), in peridotite, with pyroxene PYX161. Either too intimate or confused with PYX161.

OLV109 now pyroxene PYX170 (originally labelled as olivine): KR4011 xenolith, Kettle River, British Columbia, Canada (D. Canil).

OLV110 Forsterite: locality unknown (Colorado Geological Institute #511 in University of Alberta GEOL401 collection), in norite pegmatite, with PYX168 and plagioclase PLG129. Either too intimate or confused with PYX168.

OLV111 Forsterite: Gerdeshagen, Germany (Smithsonian Institution Museum of Natural History MNH #85855), with plagioclase PLG124 and pyroxene PYX113. Either too intimate or confused with PYX113.

OLV112 Fayalite: Crystal Park, El Paso County, Colorado, USA (somewhat oxidized) (David Shannon).

OLV113 Fayalite: Road cut near Big Squaw, Maine, USA (green-brown, with ferrosilite (PYX173; mauve to brown-black, labradorite (PLG131), and biotite) (too intimate to separate) (David Shannon).

OLV114 Tephroite: Noda Tamagawa Mine, Noda Mura, Kunohe-gun, Iwate-ken, Japan, with hausmannite (HAU102), rhodochrosite and manganophyllite (too intimate to separate) (Minerals Unlimited).

OLV115 Green synthetic glass: decorative "stones"; locality unknown; perhaps China. Supplier: Abbott - China; purchased at Kuhlmann Greenhouses - Edmonton, Alberta, Canada.

OLV120 Olivine, variety monticellite: Magnet Cove, AR, USA; in carbonatite (received from Excalibur Minerals, March 27, 2008).

OLV121 Olivine, variety monticellite: Crestmore Quarry, Riverside Co., CA, USA; in calcite matrix (received from Excalibur Minerals, March 27, 2008).

OLV122 Olivine, variety monticellite: Monte Somma, Campania, Italy; 5 single crystals, 1-3 mm. (received from Excalibur Minerals, March 27, 2008).

OLV123 Olivine: North-West Frontier Province, Pakistan; large single crystals [M.K. Gems & Minerals, Tucson 2011 show].

OLV124 Olivine (Peridot sand), likely San Carlos, AZ, USA [Tucson 2011 show].

OLV125 Olivine, var,. forsterite; with calcite. Crestmore Quarry, Riverside, Riverside Co., CA, USA [Minerals Unlimited, received August 2011].

OLV201 Chrysolite: Pallasite meteorite, Imilac, Chile (Robert A. Haag) [6,P].

WIL101 Willemite: Sterling Hills, New Jersey, USA; with franklinite (SPI112) (Tyson's Minerals).

WIL110 Willemite: Franklin, Sussex County, New Jersey, USA; in calcite, with franklinite (SPI120) (Minerals Unlimited). Also a sample from same locality and supplier with magnetite (MAG122).

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2.2.a.1. Sample Descriptions: Olivines - Sample from Mike Gaffey (Feb. 2007; in Meteorites box)

Vial: 5.4. Gaffey olivine <250 µm

Vial: 5.5. Brachina meteorite (310 mg) ("Brachina meteorite, 0.31 grams") See Meteorites section.

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2.2.a.2. Sample Descriptions: Olivines - Samples from Mike Gaffey (Feb. 2009; in meteorites box)

MJG-a Unlabeled vial of coarse green sand beach sand (likely for olivine separates) (vial labelled by me)

MJG-b Unlabeled vial of coarse green sand beach sand (olivines picked out) (vial labelled by me)

MJGxxx "Green Olivine; V.F.B." crushed olivine(?) likely from MJG-b

MJGyyy "Steamed Green Olivine; VFB" (likely from MJG-b)

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2.2.a.3. Sample Descriptions: Olivines - Olivine-rich meteorites

Brachina

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2.2.4.a. Sample Descriptions: Olivines - Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012. Descriptions provided in section 30 of this document.

Olivine		DH 4912
PeridotiteJP1		JP-1
hand sample50	**Olivine	ActLabs

Olivine grain size information from Brammer: <0.125 mm

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2.2.a.x. Olivines - Alternative names for olivines

Chrysolite (10-30% Fe olivine)
Fayalite (Fe-rich olivine)
Ferrohortonolite (70-90% Fe olivine)
Forsterite (Mg-rich olivine)
Glaucochroite ($CaMnSiO_4$ olivine)
Hortonolite (50-70% Fe olivine)
Hyalosiderite (30-50% Fe olivine)
Kirschsteinite ($CaFeSiO_4$ olivine)
Knebelite ($(Mn,Fe)_2(SiO_4)$)
Monticellite ($CaMgSiO_4$ olivine)
Olivine
Tephroite (Mn_2SiO_4 olivine)
(Willemite) (compositionally has olivine type formula: Zn_2SiO_4)
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2.2b. XRD Data: Olivines

2.2.b.1. XRD Data: Olivines - Analogue files from University of Alberta instrument

Sample	XRD File	Sample	XRD File	Sample	XRD File
OLV002		OLV003	Z03218	OLV005	
OLV007		OLV008		OLV009	
OLV010		OLV011	Z03270	OLV012	
OLV013		OLV015		OLV020	
OLV021		OLV022	Z03271	OLV023	
OLV025		OLV101		OLV102	
OLV103		OLV105		OLV106	
OLV107		OLV108		OLV110	
OLV111		OLV201			

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2.2c. Compositional Data - Olivines

Wt. %	OLV002	OLV003	OLV003	OLV005	OLV007	OLV008	OLV009	OLV010
SiO_2	39.74	40.64	40.37	40.97	41.72	36.65	40.64	40.42
FeO^1	12.62	9.25	8.83	n.d.	2.71	7.15	n.d.	n.d.
$Fe_2O_3{}^1$	1.43	0.59	0.39	n.d.	0.45	0.00	n.d.	n.d.
FeO[a]	*(13.92)*		*(10.20)*	*(9.59)*			*(8.72)*	*(11.11)*
MgO	46.38	49.13	48.95	49.64	54.65	51.19	50.16	48.25
MnO	0.23	0.09	0.15	0.09	0.19	2.15	0.10	0.15
ZnO	0.00	0.00		tr.	0.00	0.11	0.01	0.00
NiO	0.32	0.33		0.32	0.01	0.03	0.31	0.43
CaO	0.13	0.07	0.16	0.00	0.63	tr.	0.00	0.19
TiO_2	tr.	0.00	0.02	tr.	0.00	0.01	0.00	tr.
Cr_2O_3	tr.	0.01		0.00	tr.	0.00	0.00	0.13
CoO	0.06	0.04		0.06	0.01	0.02	0.04	0.04
V_2O_5	0.00	0.00		0.00	0.00	tr.	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na_2O	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00
Al_2O_3	0.00	tr.	0.11	0.00	0.00	0.00	0.00	0.03
P_2O_5			0.00					
TOTAL	100.78	100.15		100.67	100.33	97.31	99.98	100.75
LOI			0.80					
ppm								
Sr			29					
Zr			22					
V			2					
Ni			3350					
Cr			412					
Co			155					
				ATOMIC RATIOS				
Mg	86.7	90.4		90.2	97.3	92.7	91.1	88.5
Fe^{2+}	13.3	9.6		9.8	2.7	7.3	8.9	11.5
				NUMBER OF IONS ON THE BASIS OF 4 OXYGENS				
Si	0.988	0.994		0.997	0.991	0.930	0.993	0.992
Al	--	tr.		--	--	--	--	0.001
V	--	--		--	--	tr.	--	--
Ti	tr.	--		tr.	--	tr.	--	tr.
Cr	tr.	tr.		--	tr.	--	--	0.002
Fe^{3+}	--	0.011		--	--	--	--	--
Fe^{2+}	0.290	0.190		0.195	0.062	0.152	0.178	0.228
Mg	1.719	1.793		1.801	1.935	1.937	1.827	1.765
Mn	0.005	0.002		0.002	0.004	0.046	0.002	0.003
Zn	--	--		tr.	--	0.002	tr.	--
Ni	0.006	0.006		0.006	tr.	0.001	0.006	0.009
Ca	0.003	0.002		--	0.016	tr.	--	0.005
Co	0.001	0.001		0.001	tr.	tr.	0.001	0.001
Total	3.013	3.000		3.002	3.008	3.069	3.007	3.006
Source	U of C	U of C	Mertzman	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-5	EMPA-5	XRF/WC	EMPA-6	EMPA-7	EMPA-6	EMPA-7	EMPA9

a. Total Fe as FeO. OLV002,007 FeO determine. by Mertzman Sept./07. n.d. = not determined. tr.: trace (<0.01 wt.%).

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as FeO. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of point analyses averaged together also indicated. U of C: University of Calgary EMPA. ++++++++++++++++++++++++

2.2c. Compositional Data - Olivines (continued)

Wt. %	OLV011	OLV012	OLV013	OLV015	OLV020	OLV021	OLV022
NMNH#	35117			36053			
SiO_2	29.78	40.95	40.68	29.83	36.15	40.14	36.50
FeO^1	61.46	n.d.	n.d.	n.d.	n.d.	n.d	28.52
$Fe_2O_3^1$	5.52	n.d.	n.d.	n.d.	n.d.	n.d.	8.64
FeO[a]	*(66.48)*	*(8.05)*	*(9.27)*	*(69.79)*	*(34.97)*	*(13.36)*	*(36.37)*
MgO	0.05	50.83	49.67	0.74	28.86	45.55	27.73
MnO	2.14	0.10	0.13	0.71	0.47	0.19	n.d.
ZnO	0.54	0.00	tr.	n.d.	0.00	tr.	n.d.
NiO	0.04	0.40	0.36	n.d.	0.10	0.27	n.d.
CaO	0.05	tr.	0.09	n.d.	0.03	0.03	0.12
TiO_2	tr.	0.00	0.00	0.04	0.03	0.01	0.01
Cr_2O_3	0.00	0.00	tr.	n.d.	tr.	0.00	n.d.
CoO	0.10	0.06	0.04	n.d.	0.12	0.05	n.d.
V_2O_5	0.00	0.00	0.00	n.d.	0.00	0.00	n.d.
K_2O	0.00	0.00	0.00	n.d.	0.00	0.00	n.d.
Na_2O	0.00	0.00	0.00	n.d.	0.00	0.00	n.d.
Al_2O_3	0.00	0.00	0.01	n.d.	0.00	0.00	0.09
TOTAL	99.18	100.39	100.25	101.11	100.73	99.60	100.82
				ATOMIC RATIOS			
Mg	0.1	91.8	90.5	1.9	59.5	85.9	63.4
Fe^{2+}	99.9	8.2	9.5	98.1	40.5	14.1	36.6
				NUMBER OF IONS ON THE BASIS OF 4 OXYGENS			
Si	1.014	0.994	0.994	0.996	0.996	1.004	1.007
Al	--	--	tr.	--	--	--	0.003
V	--	--	--	--	--	--	--
Ti	tr.	--	--	0.001	0.001	tr.	0.001
Cr	--	--	tr.	--	tr.	--	--
Fe^{3+}	--	--	--	--	--	--	--
Fe^{2+}	1.891	0.163	0.189	1.949	0.806	0.280	0.839
Mg	0.002	1.838	1.809	0.037	1.185	1.699	1.140
Mn	0.061	0.002	0.003	0.020	0.011	0.004	--
Zn	0.013	--	tr.	--	--	tr.	--
Ni	0.001	0.008	0.007	--	0.002	0.005	--
Ca	0.002	tr.	0.002	--	0.001	0.001	0.003
Co	0.003	0.001	0.001	--	0.003	0.001	--
K	--	--	--	--	--	--	--
Na	--	--	--	--	--	--	--
Total	2.988	3.006	3.006	3.003	3.005	2.995	2.993
Source	U of C	U of C	U of C	Pringle	U of C	U of C	U of A
Analysis	EMPA-5	EMPA-6	EMPA-9	(1975)	EMPA-2	EMPA-7	EMPA-1

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

a. Total Fe expressed as FeO. OLV011 and OLV022 FeO determinations by Stan Mertzman Sept./07.

Note: Source and Analysis: Mertzman: Total expressed on a volatile (LOI)-free basis and with all Fe reported as FeO. Analysis by XRF and ferrous iron (FeO) determined by wet chemistry (WC) by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Fe_2O_3 calculated as difference between total Fe and FeO.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.2c. Compositional Data - Olivines (continued)

Wt. %	OLV023	OLV025	OLV101	OLV102	OLV103	OLV105	OLV106
NMNH#	C2824						
SiO_2	28.83	39.72	38.29	40.84	39.58	30.19	40.48
FeO^1	n.d.	n.d.	n.d.	n.d.	10.14	n.d.	n.d.
$Fe_2O_3{}^1$	n.d.	n.d.	n.d.	n.d.	6.31	n.d.	n.d.
FeO[a]	*(2.24)*	*(13.81)*	*(2.73)*	*(9.09)*	*(15.88)*	*(46.86)*	*(9.32)*
MgO	3.41	46.31	23.98	50.12	44.59	1.36	49.68
MnO	56.90	0.22	0.14	0.13	0.18	20.69	0.14
ZnO	5.94	0.00	0.15	0.00	0.00	0.07	0.00
NiO	0.25	0.31	0.01	0.45	0.40	0.13	0.41
CaO	0.56	0.03	35.05	0.00	0.00	0.04	0.08
TiO_2	0.08	0.00	0.00	0.00	0.00	0.02	0.00
Cr_2O_3	0.04	0.00	0.00	0.00	tr.	0.01	0.00
CoO	0.12	0.05	0.06	0.04	0.06	0.11	0.06
V_2O_5	0.07	0.00	tr.	0.00	0.00	0.01	0.00
K_2O	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Na_2O	0.59	0.00	0.00	0.00	0.00	0.00	0.00
Al_2O_3	tr.	0.00	0.01	0.00	0.00	0.00	tr.
ZrO_2*	n.d.	n.d.	0.00	n.d.	n.d.	n.d.	n.d.
TOTAL	99.05	100.45	100.42	100.67	100.69	99.49	100.17
				ATOMIC RATIOS			
Mg	--	85.7	--	90.8	88.7	--	90.5
Fe^{2+}	--	14.3	--	9.2	11.3	--	9.5
				NUMBER OF IONS ON THE BASIS OF 4 OXYGENS			
Si	0.969	0.990	1.004	0.993	0.993	1.011	0.996
Al	tr.	--	tr.	--	--	--	tr.
V	0.002	--	tr.	--	--	tr.	--
Ti	0.002	--	--	--	--	0.001	--
Cr	0.001	--	--	--	tr.	tr.	--
Fe^{3+}	--	--	--	--	--	--	--
Fe^{2+}	0.063	0.287	0.060	0.185	0.333	1.311	0.190
Mg	0.172	1.721	0.938	1.817	1.667	0.068	1.804
Mn	1.620	0.004	0.003	0.003	0.004	0.587	0.003
Zn	0.147	--	0.003	--	--	0.002	--
Ni	0.007	0.006	tr.	0.009	0.008	0.003	0.008
Ca	0.020	0.001	0.985	--	--	0.001	0.002
Co	0.003	0.001	0.001	0.001	0.001	0.003	0.001
K	0.001	--	--	--	--	--	--
Na	0.038	--	--	--	--	--	--
Zr	--	--	--	--	--	--	–
Total	3.045	3.010	2.995	3.008	3.006	2.988	3.004
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-4	EMPA-3	EMPA-1	EMPA-8	EMPA-5	EMPA-4	EMPA-6

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

a. Total Fe expressed as FeO. OLV103 FeO determinations by Stan Mertzman Sept./07.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.2c. Compositional Data - Olivines (continued)

Wt. %	OLV107	OLV108	OLV110	OLV111
NMNH#				85855
SiO_2	41.09	40.55	37.41	37.01
FeO[1]	n.d.	n.d.	n.d.	n.d.
Fe_2O_3[1]	n.d.	n.d.	n.d.	n.d.
FeO[a]	*(10.01)*	*(9.18)*	*(35.22)*	*(37.89)*
MgO	50.81	51.14	30.75	28.48
MnO	0.17	0.11	0.20	0.69
ZnO	0.00	0.00	0.11	0.00
NiO	0.45	0.33	0.00	0.00
CaO	0.06	0.00	0.06	0.09
TiO_2	0.00	0.00	0.00	0.00
Cr_2O_3	0.03	0.00	0.04	0.00
CoO	0.00	0.00	0.00	0.00
V_2O_5	0.03	0.00	0.00	0.00
K_2O	0.00	0.00	n.d.	0.00
Na_2O	n.d.	n.d.	n.d.	n.d.
Al_2O_3	0.00	0.00	0.00	0.00
TOTAL	102.65	101.31	103.79	104.16
				ATOMIC RATIOS
Mg	90.0	90.8	60.9	57.3
Fe^{2+}	10.0	9.2	39.1	42.7
			NUMBER OF IONS ON THE BASIS OF 4 OXYGENS	
Si	0.985	0.981	0.994	0.995
Al	--	--	--	--
V	0.001	--	--	--
Ti	--	--	--	--
Cr	0.001	--	0.001	--
Fe^{3+}	--	--	--	--
Fe^{2+}	0.201	0.186	0.783	0.852
Mg	1.815	1.844	1.218	1.141
Mn	0.003	0.002	0.004	0.016
Zn	-- --	0.002	--	--
Ni	0.009	0.006	--	--
Ca	0.002	--	0.002	0.003
Co	--	--	--	--
K	--	--	--	--
Na	--	--	--	--
Zr	--	--	--	--
Total	3.017	3.019	3.004	3.007
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-8	EMPA-8	EMPA-8	EMPA-8

a. All Fe reported as FeO.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.2c. Compositional Data - Olivines (continued)

Wt. %	OLV120	OLV121	OLV201	WIL101	WIL110
SiO_2	35.96	37.46	40.36		
FeO	4.92	3.98	n.d.		
Fe_2O_3	1.70	--	n.d.		
FeO[a]			*(12.00)*	*(1.12)*	*(0.00)*
MgO	21.36	22.78	47.76		
MnO	1.17	0.52	0.26		
ZnO			0.00		
NiO			0.01		
CaO	34.31	35.20	tr.		
TiO_2	0.00	--	tr.		
Cr_2O_3			0.02		
CoO			0.03		
V_2O_5			0.00		
K_2O	--	--	0.00		
Na_2O	--	--	0.00		
Al_2O_3	0.00	--	tr.		
H_2O	0.00	0.15			
ZrO_2*			0.00		
TOTAL	100.10	100.09	100.44		
			ATOMIC RATIOS		
Mg			87.6		
Fe^{2+}			12.4		
	NUMBER OF IONS ON THE BASIS OF 4 OXYGENS				
Si			0.995		
Al			tr.		
V			--		
Ti			tr.		
Cr			tr.		
Fe^{3+}			--		
Fe^{2+}			0.247		
Mg			1.755		
Mn			0.005		
Zn					
Ni			tr.		
Ca			tr.		
Co			0.001		
K			--		
Na			--		
Zr			--		
Total			3.004		
Source	DHZ-1A	DHZ-1A	U of C	Mertzman	Mertzman
Analysis			EMPA	XRF/WC	XRF/WC

DHZ-1A indicates Deer. Howie and Zussman: Rock Forming Minerals, Volume 1a. Orthosilicates (Geological Society (1997).

a - all Fe reported as FeO.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and FeO was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= from U. of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%). ++++++++++++++++++++++++++++++++++

2.2d. Spectral Data - Olivines

Sample	*Facility/File No.*	*Description*
OLV002	RELAB C1OL01	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm
OLV002	RELAB C2OL01	<45µm, 30E/0E, 0.3-2.6µm, 5 nm
OLV002	PSF 160507olv002	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV002	PSF 090707olv002	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV002	PSF olv002	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
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OLV003	PSF 090421a.005	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
OLV003	RELAB C1SC02	45-90 µm, 0E/15E, 0.3-3.6µm, 5nm, spun 1.6-2.6µm.
OLV003	RELAB C2SC02	45-90 µm, 0E/15E, 0.3-2.6µm, 5nm.
OLV003	UH Analog	45-90 µm, 0248/15E, 0.65-2.55µm, 1.5% resol.
OLV003	RELAB CSC099	<45µm, 0E/15E, 0.3-2.7µm, 5nm.
OLV003	RELAB C1PO50	<45µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
OLV003	USGS 232	45-90 µm, IS, 0.35-2.6µm, 1x resol.
OLV003	RELAB casc02	45-90 µm, 30°/0°, 0.3-2.6µm, 5nm.
OLV003	RELAB capo50	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
OLV003	PSF 041007olv00345	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV003	PSF 090707olv00345	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV003	PSF olv00345	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
OLV003	PSF jun2706.000	<45 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
OLV003	PSF 041007olv00390	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV003	PSF 100707olv00390	45-90 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV003	PSF olv00390	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
OLV003	PSF jun2706.001	45-90 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
OLV003	PSF 041007olv003250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV003	PSF 100707olv003250	90-250 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV003	PSF olv003250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
OLV003	PSF jun2706.002	90-250 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
OLV003	PSF 041007olv003500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV003	PSF 100707olv003500	250-500 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV003	PSF olv003500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
OLV003	PSF jun2706.003	250-500 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
OLV003	PSF 041007olv0031000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV003	PSF 160707olv0031000	500-1000 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV003	PSF olv0031000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
OLV003	PSF jun2706.004	500-1000 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
OLV003	PSF 100413a.031	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).

OLV003	PSF 100420a.005	<45 μm, 30°/0°, 0.35-2.5 μm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
OLV003	PSF 100420a.004	45-90 μm, 30°/0°, 0.35-2.5 μm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
OLV003	PSF mar3006.009	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
OLV003	PSF mar3006.010	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
OLV003	PSF 111201a.035	<45 μm; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
OLV003	PSF 111201a.005	unsorted large grains (whole rock), i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
OLV003	INO olv 003	unsorted large grains (whole rock); i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 1 spectrum acquired.
OLV003	PSF olv003.dpt	<45 μm; 30°/0°; 1.67-25.4 μm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
OLV003	PSF olv003_250_500.dpt	250-500 μm; 30°/0°; 1.67-25.4 μm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
OLV003	PSF 121016a.029	100% OLV003 (<250 μm) + 0% SGE101A; ASD. aka ZMIX017.
OLV003	PSF OO 29	100% OLV003 (<250 μm) + 0% SGE101A; OO S2000; OO PSF file: 29. aka ZMIX017.
OLV003	PSF 121016a.202	100% OLV003 (<45 μm) + 0% IRO102 or IRO103; ASD; aka ZMIX109.
OLV003	PSF 100907.001	<45 μm; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD; aka MOMIX2001 (directory: 100907).
OLV003	PSF 100907.011	45-90 μm; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD; aka MOMIX2101.
OLV003	PSF 300807b.001	<38 μm; 30E/0E; 0.35-2.5 μm; 1 nm resol.; 1000 avg.; ASD; aka POMIX1001 (directory: 300807b).
OLV003	PSF 31aug07.001	38-53 μm; 30E/0E; 0.35-2.5 μm; 1 nm resol.; 1000 avg.; ASD; aka POMIX2001 (directory: 31aug07).
OLV003	PSF 06sep07.001	90-125 μm; 30E/0E; 0.35-2.5 μm; 1 nm resol.; 1000 avg.; ASD; aka POMIX3001 (directory: 06sep07).
OLV003	PSF 060907a.011	63-90 μm; 30E/0E; 0.35-2.5 μm; 1 nm resol.; 1000 avg.; ASD; aka POMIX4001 (directoyr: 060907a).
OLV003	PSF 060907b.001	45-63 μm; 30E/0E; 0.35-2.5 μm; 1 nm resol.; 1000 avg.; ASD; aka POMIX5001 (directory: 060907b).
OLV003		*See section 32 of this document for spectra of sample measured in a controlled atmosphere as well as mixed with nanophase iron.*

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<u>OLV003 – single grain study – feasibility test: October 25, 2007</u>

OLV003	PSF 071025a.000	Empty Al well; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 071025a].
OLV003	PSF 071025a.008	500-1000 μm olivine grain in well; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 071025a].
OLV003	PSF 071025a.009	500-1000 μm olivine grain in well; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 071025a].
OLV003	PSF 071025a.010	500-1000 μm olivine grain in well; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 071025a].
(OLV003)	PSF 071025a.000	Empty Al well; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 071025a].

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<u>OLV003 – single grain study: June 1, 2009</u>

OLV003	PSF 090601a.012	Al block “L” well: C grain (250-500 μm), i=0°/e=0° (bifurc. cable), 1000 avg. ASD.
OLV003	PSF 090601a.013	Al block “L” well: C grain (250-500 μm), i=0°/e=0° (bifurc. cable), 1000 avg., grain shaken and remeasured. ASD.
OLV003	PSF 090601a.014	Al block “L” well: C grain (250-500 μm), i=0°/e=0° (bifurc. cable), 1000 avg., grain shaken and remeasured. ASD.
OLV003	PSF 090601a.015	Al block “L” well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 1000 avg. ASD.
OLV003	PSF 090601a.016	Al block “L” well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 1000 avg., grain shaken and remeasured. ASD.
OLV003	PSF 090601a.029	Al block “L” well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 1000 avg. ASD.
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OLV003	PSF 090601a.031	Al block 5 mm deep well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 1000 avg. ASD.
OLV003	PSF 090601a.036	Al block 10 mm deep well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD.
OLV003	PSF 090601a.041	Al block 15 mm deep well: D grain (500-1000 μm), i=0°/e=0° (bifurc. able), 1000 avg., grain shaken and remeasured, ASD.
OLV003	PSF 090601a.045	Al block 20 mm deep well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 1000 avg. ASD; grain lost.
OLV003	PSF 090601a.052	Al block 5 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
OLV003	PSF 090601a.053	Al block 5 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
OLV003	PSF 090601a.061	Al block 10 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
OLV003	PSF 090601a.062	Al block 10 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
OLV003	PSF 090601a.070	Al block 15 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
OLV003	PSF 090601a.071	Al block 15 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
OLV003	PSF 090601a.079	Al block 20 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., ASD.
OLV003	PSF 090601a.080	Al block 20 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD; grain lost.
OLV003	PSF 090601a.088	Al block 25 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., ASD.
OLV003	PSF 090601a.089	Al block 25 mm deep well: D’ grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD; grain lost.
	++++++	
OLV003	PSF 090601a.104	45-90 μm single grain (hopefully got a grain, maybe a few), Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 1000 avg., ASD.
OLV003	PSF 090601a.106	90-250 μm single grain, Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 1000 avg. ASD.
OLV003	PSF 090601a.105	250-500 μm single grain (C grain), Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 1000 avg., ASD.
OLV003	PSF 090601a.107	500-1000 μm single grain (D’ grain), Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 1000 avg. ASD.
	++++++	
OLV003	PSF 090601a.117	500-1000 μm single grain (D’ grain), Al block 10 mm deep full bore well, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
OLV003	PSF 090601a.118	500-1000 μm single grain (D’ grain), Al block 10 mm deep full bore well, i=0°/e=0° (bifurc. cable), 100 avg., shaken and remeas, ASD.
OLV003	PSF 090601a.119	500-1000 μm single grain (D’ grain), Al block 10 mm deep full bore well,

		i=0°/e=0° (bifurc. cable), 100 avg., shaken and remeas, ASD.
OLV003	PSF 090601a.120	500-1000 μm single grain (D' grain), Al block 10 mm deep tapered well, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
OLV003	PSF 090601a.121	500-1000 μm single grain (D' grain), Al block 10 mm deep tapered well, i=0°/e=0° (bifurc. cable), 100 avg., shaken and remeas, ASD.
OLV003	PSF 090601a.122	500-1000 μm single grain (D' grain), Al block 10 mm deep tapered well, i=0°/e=0° (bifurc. cable), 100 avg., shaken and remeas, ASD.
	+++++	
OLV003	PSF 090601a.131	45-90 μm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg., ASD.
OLV003	PSF 090601a.132	90-250 μm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
OLV003	PSF 090601a.133	250-500 μm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg., ASD.
OLV003	PSF 090601a.134	500-1000 μm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
	++++++	
OLV003	PSF 100412b.007	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
OLV003	PSF 090724a.002	<45μm, 30°/0°, 0.35-2.5μm, 1nm output, ASD, 1000 avgd; aka OCMIX1001.
	++++++++	

OLV003 – phase angle measurements – all relative to Spectralon at i=30°, e=0°

OLV003	PSF 100930a.001	<45 μm; 13°/0° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
OLV003	PSF 100930a.002	<45 μm; 30°/0° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
OLV003	PSF 100930a.003	<45 μm; 60°/0° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
OLV003	PSF 100930a.004	<45 μm; 0°/30° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
OLV003	PSF 100930a.005	<45 μm; 30°/30° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
OLV003	PSF 100930a.006	<45 μm; 60°/30° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
OLV003	PSF 100930a.007	<45 μm; 0°/60° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
OLV003	PSF 100930a.008	<45 μm; 30°/60° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
OLV003	PSF 100930a.010	<45 μm; 60°/60° relative to standard at i=13°/e=0°; 0.35-2.5 μm; 1 nm output; 250 averaged spectra; ASD (Directory: 100930_angles).
	++++++++++++	

OLV003 – phase angle measurements – all relative to Spectralon at i=13°, e=0°

OLV003	PSF 101001a.001	<45 μm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 101001a.010	<45 μm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 101001a.019	<45 μm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 101001a.028	<45 μm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 101001a.037	<45 μm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 101001a.046	<45 μm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory

		101001_angles).
OLV003	PSF 101001a.055	<45 µm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 101001a.065	<45 µm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 101001a.075	<45 µm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 101001a.084	<45 µm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
OLV003	PSF 121101a.017	<45 µm; i=30°, e=0°; 0.35-2.5 µm ASD; 1000 spectra averaged; 1 nm output. Directory: 121101mafic metal]. Aka OLMETS06.
	++++++++ Glove box mixtures - OLV003 end member)+++++	
OLV003	PSF 121016a.029	<250 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
OLV003	PSF OO 29 and 35	<250 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
OLV003	PSF 121016a.202	<45 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
OLV003	PSF OO 202	<45 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
OLV003	PSF 121016a.206	45-90 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
OLV003	PSF OO 206	45-90 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
OLV003	*See also section 15.25 of this document for mixtures of this material with nanophase iron and nanophase iron-impregnated silica gels.*	
+++++++		
OLV005	RELAB C1OL02	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV005	RELAB C2OL02	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
+++++++		
OLV007	RELAB C1PO52	<45 µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
OLV007	PSF 160507olv007	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV007	PSF 100707olv007	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV007	PSF olv007	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OOS2000).
OLV007	PSF olv007.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
+++++++		
OLV008	RELAB C1PO54	45-90 µm, other info unknown, 5nm (file lost?).
OLV008	RELAB CAPO54	<45 µm; 30°/0°; 0.3-2.6µm; 5 nmresol.
OLV008	RELAB LAPO54	<45 µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
OLV008	PSF 160507olv008	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV008	PSF 100707olv008	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV008	PSF olv008	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OOS2000).
+++++++		
OLV009	RELAB C1OL03	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV009	RELAB C2OL03	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
+++++++		
OLV010	RELAB C1PO56	<45 µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.

OLV010	UH Analog	38-53 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV010	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV010	UH Analog	63-90 µm, 0E/15E, 0.35-2.55µm, 1.5% resol.
OLV010	UH Analog	90-125 µm, 0E/15E, 0.35-2.55µm, 1.5% resol.
OLV010	UH Analog	63-90 µm dry sieve, 0E/15E, 0.35-2.55µm, 1.5% resol.
++++++++		
OLV011	PSF 090421a.006	<90 µm, 30°/0°, 0.35-2.5 µm,1 nm resol., 1000 avg; ASD (45-90 µm grains over <45 µm grains).
OLV011	RELAB C1PO58	<45µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
OLV011	UH Analog	<45µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV011	PSF 160507olv011	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV011	PSF 100707olv011	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV011	PSF olv011	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OOS2000).
OLV011	PSF olv011.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
+++++++		
OLV012	RELAB C1PO60	<45 µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
OLV012	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
+++++++		
OLV013	RELAB C1OL04	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV013	RELAB C2OL04	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
+++++++		
OLV015	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV015	UH Analog	<45 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV015	RELAB C1OL05	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV015	RELAB C2OL05	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
+++++++		
OLV020	RELAB C1PO62	<45 µm, 30E/0E, 0.3-2.75µm, 5nm, spun 0.84-2.75µm.
OLV020	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV020	UH Analog	<45 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
+++++++		
OLV021	RELAB C1PO64	<45 µm, 30E/0E, 0.3-2.75µm, 5nm, spun .84-2.75µm.
OLV021	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
+++++++		
OLV022	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV022	UH Analog	<45 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV022	RELAB C1OL06	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV022	RELAB C2OL06	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV022	PSF 160507olv022	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV022	PSF 100707olv022	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
OLV022	PSF olv022	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OOS2000).
+++++++		
OLV023	UH Analog	<45 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV023	RELAB C1OL07	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV023	RELAB C2OL07	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
+++++++		
OLV024	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm,1.5% resol.(Chassigny).
OLV024	RELAB c1dd01	unsorted (?) powder; 30°0°; 0.3-2.6 µm; 5 nm resolution.
OLV024	RELAB c1dd02	<100 µm; 30°0°; 0.3-2.6 µm; 5 nm resolution.
+++++++		
OLV025	RELAB C1OL08	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV025	RELAB C2OL08	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
+++++++		

OLV101	RELAB C1OL09	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV101	RELAB C2OL09	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV101	PSF mar3006.005	<45 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
OLV101	PSF mar3006.006	45-90 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
++++++++		
OLV102	RELAB C1OL10	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV102	RELAB C2OL10	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV102	PSF olv102m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
OLV102	PSF olv102n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
+++++++		
OLV103	RELAB C1OL11	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV103	RELAB C2OL11	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV103	PSF mar3006.007	<45 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
OLV103	PSF mar3006.008	45-90 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
OLV103	PSF 160507olv103	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
OLV103	PSF olv103	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
+++++++		
OLV105	RELAB C1OL12	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV105	RELAB C2OL12	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
+++++++		
OLV106	RELAB C1OL13	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
OLV106	RELAB C2OL13	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
+++++++		
OLV107	RELAB CAPO04	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
OLV107	RELAB LAPO04	<45 µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
+++++++		
OLV112	RELAB CAPO05	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
OLV112	RELAB LAPO05	<45 µm, 30°/0°,30°; 0.3-26µm, 5/1.2-129 nm resol. Merged RELAB + Nicolet (note different viewing geometries).
+++++++		
OLV201	RELAB C1SC68	<45 µm, 0E/15E, 0.3-2.7µm, 5nm.
+++++++		
Brachina	RELAB camt49	<45 µm; 30°, e0°; 0.3-2.6 µm; 5 nm resolution.

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2.2d.1. Polynomial (quadratic) fits to olivine absorption bands (RELAB spectra)

Equation $y=a+bx+cx^2$
Differentiate & solve for x at y=0 i.e. 0=-b+2cx, b=2cx
Band depth, solve for y (if normalized only)

Sample	Poly. Coeff's a	b	c	Band Min(µm)	Band Depth%	Grain Size(µm)	Compil. & File#	Channels Fitted
"OLV" prefix								
003				1.052		45-90	U of Hawaii	
003	9.977	-18.46	8.741	1.056		45-90	brown1a-136	136-164
003/s.l.	11.62	-21.35	10.07	1.060	69.6	45-90	brown1b-177	
003	9.024	-16.19	7.668	1.056		<45	brown2a-107	131-164
003/s.l.	11.27	-20.12	9.496	1.059	38.7	<45	brown2a-140	131-169
007	6.385	-10.89	5.170	1.053		<45	brown2a-108	131-164
007/s.l.	7.780	-13.16	6.215	1.059	18.6	<45	brown2a-141	131-169
010				1.055		45-90	U of Hawaii	
010	8.258	-14.80	6.999	1.057		<45	brown2a-109	131-164
010/s.l.	11.71	-20.86	9.809	1.063	38.0	<45	brown2a-142	131-169
011				1.069		<45	U of Hawaii	
011	2.834	-4.927	2.294	1.074		<45	brown2a-110	136-169
011/s.l.	7.288	-12.38	5.680	1.090	45.8	<45	brown2a-143	141-179
012				1.050		45-90	U of Hawaii	
012	7.377	-13.01	6.175	1.053		<45	brown2a-111	131-164
012/s.l.	9.971	-17.46	8.237	1.060	28.2	<45	brown2a-144	131-169
015				1.017		45-90	U of Hawaii	
015				1.030		<45	U of Hawaii	
020				1.030		45-90	U of Hawaii	
020				1.027		<45	U of Hawaii	
020	3.089	-5.388	2.565	1.050		<45	brown2a-112	131-164
020/s.l.	7.740	-13.52	6.410	1.055	38.9	<45	brown2a-145	131-169
021				1.057		45-90	U of Hawaii	
021	7.060	-12.65	5.982	1.057		<45	brown2a-113	131-164
021/s.l.	11.47	-20.44	9.616	1.063	39.2	<45	brown2a-146	131-169
022				1.010		45-90	U of Hawaii	
022				1.033		<45	U of Hawaii	
024				1.064		N.A.	U of Hawaii	

Notes: s.l.= straight line continuum
/ = division by straight line continuum
Polynomial fits to major absorption band near 1µm.

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END of 2.2.

2. Silicates

2.3. Feldspars

2.3a. Sample Descriptions - Feldspars

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either not plagioclase or are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
PLG101	Andesine: Ylijarvi, Ylamaa, Kimi, Finland (David Shannon Minerals).
PLG102	Andesine: near Palmdale, Los Angeles County, California, USA (Minerals Unlimited).
PLG103	Albite (var. cleavelandite): Bob Ingersoll Mine, Keystone, Pennington County, South Dakota, USA (Minerals Unlimited).
PLG104	Andesine: Nain, Newfoundland and Labrador, Canada (Minerals Unlimited).
PLG105	Andesine: Sannidal, Norway (Minerals Unlimited).
PLG106	Albite: Dungannon Township, Ontario, Canada (Minerals Unlimited).
PLG107	Andesine (var. anemousite): Island of Linosa, Italy (Minerals Unlimited), intimately contaminated with aqua regia insoluble red material.
PLG108	Bytownite: Springwater Complex, Montana, USA (Dr. R. St J. Lambert), from norite layer.
PLG109	Labradorite: locality unknown (University of Alberta GEOL330 laboratory collection #A50).
PLG110	Albite: locality unknown (University of Alberta GEOL330 laboratory collection #A148).
PLG111	Bytownite: locality unknown (University of Alberta GEOL330 laboratory collection #A146).
PLG112	*now calcite CRB110 (originally bytownite): U. of Alberta GEOL330 laboratory collection #A152.*
PLG113	Labradorite: locality unknown (University of Alberta GEOL330 laboratory collection #A139).
PLG114	Anorthite: locality unknown (U. of Alberta GEOL330 lab collection #D81), with pyroxene PYX107.
PLG115	Oligoclase: Carter Mine, Holcombe Ranch, 0.5 miles north of Pleasant Gap, Madison County, North Carolina, USA (David Shannon Minerals).
PLG116	Labradorite: Skaergaard Intrusion, Greenland (University of Hawaii collection #10-21-6), with pyroxene PYX114 and olivine OLV022.
PLG117	Bytownite: Linewath, Cumbria, England (Excalibur Mineral Co.).
PLG118	Albite (var. moonstone): Colombo, Sri Lanka (Minerals Unlimited).
PLG119	Oligoclase (var. sunstone): Tvedesstrand, Norway (Minerals Unlimited Ralph Deitz collection), with quartz, analysis incomplete.
PLG120	Oligoclase: near Crown Point, Essex County, New York, USA (Minerals Unlimited).
PLG121	Oligoclase: India (Minerals Unlimited).
PLG122	Anorthite: Grass Valley, Nevada County, California (Minerals Unlimited). (More (3 lbs) received June 17/09).
PLG123	*Albite(?): Bancroft, Ontario, Canada (Minerals Unlimited) with nepheline NEP101 and mica, too intimate to separate?*
PLG124	Oligoclase?: Gerdeshagen, Germany (Smithsonian Institution Museum of Natural History MNH #85855), with pyroxene PYX113 and olivine OLV111.
PLG125	Plagioclase: Skaergaard Intrusion, Greenland (University of Hawaii collection #10-21-9), with pyroxene PYX115 and olivine OLV020.
PLG126	Plagioclase: locality unknown (Geological Survey of Canada collection at the University of Alberta #I62), analysis incomplete, with pyroxene PYX163.
PLG127	Locality unknown (source unknown), with pyroxene PYX164.
PLG128	Locality unknown (Geological Survey of Canada collection at U of Alberta).
PLG129	Plagioclase: locality unknown (Colorado Geological Institute #511 in University of Alberta GEOL401 laboratory collection), in norite pegmatite, with pyroxene PYX168.
PLG130	Anorthite: Split Rock, Minnesota (Ward's), in massive anorthosite.
PLG131	*Labradorite: Road cut near Big Squaw, Maine, USA (with ferrosilite (PYX173, mauve to brown black, fayalite (OLV113), and biotite) (too intimate to separate) (David Shannon).*
PLG132	Feldspar (5 pink, 1 gray specimen): localities unknown (Minerals Society of Manitoba).

PLG133 Feldspar, white, East German Creek, Manitoba, Canada (collected Aug. 2005).
PLG134 Plagioclase feldspar, massive white. landscaping stones by Twin Palms Motel, Phoenix, AZ, USA. Collected September 2008.
PLG135 Anorthite (An96): Miyake-jima, Tokyo, Japan, 1874 eruption (crystals covered with thin lava coating; clear underneath) [Alfredo Petrov, Tucson 2011 show].
PLG136 Amazonite: locality unknown [Western Woods Inc. Tucson 2011 show].
PLG137 Labradorite (iridescent) Antosahamamy, Ianapera, Benenitra Dept., SW Region, Tulear Province, Madagascar (December 2012 AGU Fall Meeting, purchased from Ikon Mining and Exploration).
PLG138 Buddingtonite (probably) (ammonium plagioclase); from "buddingtonite bump", Cuprite, NV, USA. (from Wendy Calvin, University of Nevada at Reno, Reno, NV, USA 89564; received April 29, 2013).
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2.3.a.1. Sample Descriptions: Feldspars - Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

KFeldspar		GBW 03116 (NCS DC61102)
hand sample6	**Potash feldspar	ActLabs
hand sample48	**Plagioclase feldspar	ActLabs

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2.3a.x Feldspars – Alternative Names

Albite (0-10% Ca)
Amphodelite (= anorthite)
Andesine (30-50% Ca)
Anorthite (90-100% Ca)
Aventurine (var. of albite; maybe also other minerals?)
Biotine (= anorthite)
Bytownite (70-90% Ca)
Christianite (= anorthite)
Cleavelandite (lamellar mass of albite)
Cyclopite (= anorthite)
Indianite (= granular anorthite from India)
Labradorite (50-70% Ca)
Latrobite (= anorthite)
Lepolite (= anorthite)
Maskelynite (glassy labradorite, from meteorites)
Moonstone (var. of albite; maybe also other minerals?)
Oligoclase (10-30% Ca)
Pericline (albite from the Alps)
Peristerite (whitish adularia-like albite)
Thiorsauite (= anorthite)
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2.3b. XRD Data - Feldspars

2.3b.1. Analogue files from U of A instrument

Sample	XRD File	Sample	XRD File	Sample	XRD File
PLG101		PLG102		PLG103	
PLG104		PLG105		PLG106	
PLG107		PLG108	Z03219	PLG109	
PLG110		PLG111		PLG113	
PLG114		PLG115		PLG116	
PLG117		PLG118		PLG119	
PLG120		PLG121		PLG122	
PLG124	Z03203	PLG125		PLG126	
PLG129	Z03199	PLG130			

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2.3b.2. University of Manitoba identifications - January 2006

Note: in many cases, albite and anorthite come up as equally good matches, probably because the JCPDS data base has few samples of intermediate composition.

PLG101 (An52.8)	Disordered albite (not a perfect match), maybe a few other very minor bands.
PLG102 (An48.3)	Anorthite and albite, maybe a minor peak or two missed.
PLG103 (An0.1)	Clean pattern - totally albite, nothing else.
PLG104 (An52.8)	Albite and/or anorthite, clean pattern.
PLG105 (An37.4)	Albite and/or anorthite and definitely some quartz (don't need much to get a strong peak).
PLG106 (An9.8)	Albite and/or anorthite, nothing else.
PLG107 (An49.2)	Albite and/or anorthite match all the peaks; no sign at all of hematite or anything else.
PLG108 (An84.7)	Albite and/or anorthite; nothing else.
PLG109 (An67.3)	Albite and/or anorthite; nothing else.
PLG110 (An1.6)	Albite totally; maybe a trace of anorthite to make peaks fit a bit better.
PLG111 (An78.6)	Albite and/or anorthite only; no sign of hematite or anything else.
PLG113 (An53.7)	Albite and/or anorthite; nothing else.
PLG114 (An94.2)	Anorthite and/or albite only; nothing else.
PLG115 (An23.5)	Albite and/or anorthite; ID of cristobalite probably not real; no sign of hematite.
PLG116 (An58.0)	Albite and/or anorthite, nothing else.
PLG117 (An85.8)	Anorthite, then albite; trace has wonky background; some clay mineral present (8.9°); muscovite or glauconite, and minor clinochlore.
PLG118 (An1.5)	Microcline fits best, albite is further down the list; but albite fits just as well or better; anorthoclase also.
PLG119 (An26.5)	Quartz and albite, no sign of hematite or goethite.
PLG120 (An14.4)	Albite and/or anorthite; no hematite or goethite.
PLG121 (An11.5)	Albite, has quartz; no hematite or goethite.
PLG122 (An92.8)	Anorthite and/or albite; plus some extra minor peaks, maybe a bit of muscovite; clinochlore/dickite or some clay to fit the lowest angle peak and a few other minor peaks.
PLG124 (An72.4)	Actually meionite (a scapolite) provides a perfect match, no sign of plagioclase.
PLG125 (An64.0)	Albite and/or anorthite; nothing else.
PLG129 (An59.7)	Albite and/or anorthite; nothing else.
PLG130 (An76.5)	Anorthite and/or albite; plus a few minor peaks - don't fit any one thing well (probably a bit of alteration?).

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2.3c. Compositional Data - Feldspars

Wt. %	PLG101	PLG102	PLG103	PLG104	PLG105	PLG106	PLG107
SiO_2	54.85	55.58	69.08	54.90	58.73	65.89	55.47
Al_2O_3	27.71	27.29	19.16	27.85	24.99	21.21	27.17
Na_2O	5.15	5.99	11.79	5.21	7.33	10.51	5.68
CaO	10.97	10.19	0.01	11.05	7.95	2.08	10.30
K_2O	0.40	0.05	0.03	0.37	0.05	0.09	0.32
SrO	0.10	0.19	0.04	0.10	0.04	0.21	0.21
BaO	0.07	0.03	tr.	0.06	0.06	0.07	0.06
Fe_2O_3*	0.46	0.11	0.03	0.41	0.07	0.07	0.54
TiO_2	0.06	0.03	0.02	0.06	0.02	0.02	0.11
NiO	0.07	0.06	0.04	0.05	0.05	0.04	0.07
MnO	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Cr_2O_3	0.02	0.03	0.03	0.04	0.00	0.03	0.03
CoO	0.03	0.03	0.03	0.03	0.01	0.01	0.03
V_2O_5	0.02	0.02	0.02	0.01	tr.	tr.	0.02
MgO	tr.	0.00	0.00	0.07	0.00	0.00	0.03
ZnO	0.01	0.01	0.01	0.01	tr.	tr.	0.02
TOTAL	99.93	99.62	100.30	100.23	99.31	100.24	100.08
				ATOMIC RATIOS			
Ab	44.9	51.4	99.8	45.1	62.3	89.7	49.0
An	52.8	48.3	0.1	52.8	37.4	9.8	49.2
Or	2.3	0.3	0.1	2.1	0.3	0.5	1.8
				NUMBER OF IONS ON THE BASIS OF 32 OXYGENS			
Si	9.943	10.069	12.032	9.923	10.586	11.578	10.038
Al	5.919	5.835	3.932	5.931	5.307	4.392	5.794
V	0.002	0.002	0.002	0.001	0.001	0.001	0.002
Ti	0.009	0.004	0.003	0.009	0.003	0.003	0.015
Fe^{3+}	0.063	0.015	0.004	0.054	0.010	0.010	0.074
Cr	0.003	0.004	0.004	0.005	--	0.004	0.004
Ca	2.130	1.981	0.002	2.139	1.538	0.391	2.000
Sr	0.011	0.020	0.004	0.011	0.004	0.021	0.022
Ba	0.005	0.002	0.001	0.004	0.004	0.005	0.004
Ni	0.010	0.009	0.005	0.008	0.008	0.005	0.011
Mn	0.001	0.001	0.001	0.001	0.001	0.001	0.003
Co	0.005	0.005	0.005	0.005	0.002	0.002	0.005
Mg	0.001	--	--	0.019	--	--	0.008
Zn	0.001	0.001	0.001	0.001	0.001	0.001	0.002
Na	1.810	2.104	3.981	1.825	2.561	3.580	1.993
K	0.093	0.011	0.006	0.087	0.012	0.021	0.074
Total	20.006	20.063	19.983	20.023	20.038	20.015	20.049
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-6	EMPA-7	EMPA-7	EMPA-6	EMPA-2	EMPA-7	EMPA-7

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.3c. Compositional Data - Feldspars (continued)

Wt. %	PLG108	PLG109	PLG110	PLG111	PLG113	PLG114	PLG115
SiO_2	46.55	50.77	68.04	48.60	54.76	43.97	62.07
Al_2O_3	32.70	31.19	20.53	33.52	28.30	34.66	23.58
Na_2O	1.71	3.60	11.58	2.32	5.23	0.65	8.98
CaO	17.28	13.71	0.36	15.46	11.15	19.03	4.99
K_2O	0.02	0.12	0.19	0.01	0.25	0.00	0.03
SrO	0.03	0.08	0.05	0.07	0.12	0.06	0.28
BaO	0.03	0.04	0.03	0.03	0.06	0.05	0.03
Fe_2O_3*	0.64	0.43	0.06	0.59	0.36	0.58	0.07
TiO_2	0.05	0.03	0.03	0.06	0.04	0.05	0.02
NiO	0.09	0.07	0.04	0.10	0.07	0.08	0.05
MnO	0.01	tr.	0.01	0.00	0.01	0.01	0.01
Cr_2O_3	0.03	0.05	0.02	0.00	0.01	0.03	0.02
CoO	0.03	0.03	0.01	0.03	0.03	0.04	0.01
V_2O_5	0.01	0.01	0.01	0.01	0.01	0.02	tr.
MgO	0.04	0.02	0.00	0.14	tr.	0.01	0.03
ZnO	0.02	0.02	0.00	0.00	0.01	0.03	tr.
TOTAL	99.24	100.17	100.96	100.94	100.41	99.27	100.17
				ATOMIC RATIOS			
Ab	15.2	32.0	97.4	21.3	45.6	5.8	76.4
An	84.7	67.3	1.6	78.6	53.7	94.2	23.5
Or	0.1	0.7	1.0	0.1	0.7	0.0	0.1
				NUMBER OF IONS ON THE BASIS OF 32 OXYGENS			
Si	8.655	9.246	11.811	8.815	9.870	8.219	11.014
Al	7.158	6.694	4.200	7.164	6.013	7.635	4.931
V	0.001	0.001	0.001	0.001	0.001	0.002	0.001
Ti	0.007	0.004	0.004	0.009	0.005	0.007	0.003
Fe^{3+}	0.089	0.059	0.008	0.081	0.049	0.082	0.010
Cr	0.004	0.008	0.003	--	0.001	0.004	0.003
Ca	3.439	2.670	0.063	3.007	2.156	3.806	0.949
Sr	0.003	0.009	0.005	0.008	0.013	0.007	0.029
Ba	0.002	0.003	0.002	0.002	0.004	0.003	0.002
Ni	0.013	0.010	0.005	0.014	0.010	0.012	0.007
Mn	0.001	0.001	0.001	--	0.001	0.001	0.001
Co	0.006	0.005	0.002	0.005	0.005	0.008	0.002
Mg	0.011	0.005	--	0.038	0.001	0.002	0.007
Zn	0.002	0.002	--	--	0.001	0.004	0.001
Na	0.616	1.271	3.897	0.817	1.829	0.236	3.090
K	0.004	0.027	0.042	0.002	0.029	--	0.006
Total	20.011	20.015	20.044	19.963	19.988	20.028	20.056
Source	U of C	U of C	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-7	EMPA-4	EMPA-6	EMPA-7	EMPA-8	EMPA-6	EMPA-7

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.3c. Compositional Data - Feldspars (continued)

Wt. %	PLG116	PLG117	PLG118	PLG119	PLG119	PLG120	PLG121	PLG122
SiO_2	53.67	46.95	66.75	62.22	64.82	65.28	65.34	44.80
Al_2O_3	29.11	33.60	18.41	22.61	21.82	21.94	21.79	35.05
Na_2O	4.64	1.58	5.46	n.d.	7.29	9.89	10.41	0.81
CaO	12.04	17.38	0.31	5.06	4.90	3.10	2.45	18.76
K_2O	0.29	0.01	8.83	n.d.	0.34	0.40	0.16	0.00
SrO	0.09	0.03	0.04	n.d.		0.06	0.06	0.08
BaO	0.04	0.04	0.03	n.d.		0.01	0.01	0.05
Fe_2O_3*	0.52	0.54	0.13	0.00	0.17	0.14	0.12	0.61
TiO_2	0.13	0.05	0.01	0.00	0.02	0.03	0.01	0.05
NiO	0.06	0.08	0.05	0.00		0.05	0.06	0.08
MnO	0.02	tr.	0.01	0.00	0.01	tr.	tr.	0.01
Cr_2O_3	0.02	0.01	0.02	0.00		0.03	0.02	0.02
CoO	0.03	0.04	0.03	0.00		0.01	tr.	0.04
V_2O_5	tr.	0.01	0.01	0.00		tr.	tr.	0.01
MgO	0.03	0.03	0.00	0.00	0.09	0.00	0.00	0.01
ZnO	0.01	0.05	0.01	0.00		0.00	tr.	0.03
P_2O_5					0.07			
TOTAL	100.70	100.40	100.10	89.88	99.53	100.94	100.43	100.41
LOI					0.33			
ppm								
Sr					224			
Zr					43			
V					<2			
Cr					<2			
				ATOMIC RATIOS				
Ab	40.4	14.1	47.8	n.d.	71.3	83.5	87.6	7.2
An	58.0	85.8	1.5	n.d.	26.5	14.4	11.5	92.8
Or	1.6	0.1	50.7	n.d.	2.2	2.1	0.9	0.0
			NUMBER OF IONS ON THE BASIS OF 32 OXYGENS					
Si	9.674	8.614	12.081	n.d.		11.426	11.467	8.270
Al	6.186	7.264	3.925	n.d.		4.526	4.506	7.622
V	0.001	0.001	0.001	n.d.		0.001	0.001	0.001
Ti	0.017	0.007	0.001	n.d.		0.004	0.001	0.007
Fe^{3+}	0.070	0.077	0.017	n.d.		0.019	0.016	0.084
Cr	0.003	0.001	0.003	n.d.		0.004	0.003	0.003
Ca	2.329	3.417	0.060	n.d.		0.578	0.464	3.703
Sr	0.011	0.003	0.004	n.d.		0.006	0.006	0.009
Ba	0.003	0.003	0.002	n.d.		0.001	0.001	0.003
Ni	0.009	0.012	0.008	n.d.		0.007	0.008	0.012
Mn	0.003	0.001	0.001	n.d.		0.001	0.001	0.001
Co	0.005	0.008	0.005	n.d.		0.002	0.001	0.008
Mg	0.008	0.008	--	n.d.		--	--	0.002
Zn	0.001	0.007	0.001	n.d.		--	0.001	0.004
Na	1.622	0.562	1.916	n.d.		3.355	3.543	0.289
K	0.065	0.002	2.033	n.d.		0.084	0.036	–
Total	20.007	19.987	20.058	n.d.		20.014	20.055	20.018
Source	U of C	U of C	U of C	U of A	Mertzman	U of C	U of C	U of C
Analysis	EMPA-7	EMPA-4	EMPA-7	EMPA-1	XRF/WC	EMPA-6	EMPA-6	EMPA6

* - all Fe reported as Fe_2O_3. n.d. = not determined. tr.: trace (<0.01 wt.%). **Note:** Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes. **Note:** Source and Analysis: EMPA indicates analysis by electron microprobe; number of point analyses averaged together also indicated. U of C: University of Calgary EMPA.+

2.3c. Compositional Data - Feldspars (continued)

Wt. %	PLG122	PLG122
SiO_2	44.80	42.99
TiO_2	0.05	0.01
Al_2O_3	35.05	32.74
FeO[1]		0.51
Fe_2O_3[1]		0.24
(Fe_2O_3)*	0.61	(0.81)
MnO	0.01	0.02
MgO	0.01	0.58
CaO	18.76	21.88
Na_2O	0.81	0.91
K_2O	0.00	0.06
P_2O_5		0.02
SO_3		0.10
SrO	0.08	
BaO	0.05	
NiO	0.08	
Cr_2O_3	0.02	
CoO	0.04	
V_2O_5	0.01	
ZnO	0.03	
TOTAL	100.41	100.12
LOI		1.10
ppm		
Sr		491
Zr		60
V		37
Ni		<2
Cr		40
Co		<1
Source	U of C	Mertzman
Analysis	EMPA-6	XRF/WC

* - all Fe reported as Fe_2O_3.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.3c. Compositional Data - Feldspars (continued)

Wt. %	PLG124	PLG124	PLG125	PLG125	PLG126
SiO_2	46.55	47.46	50.28	52.12	42.78
Al_2O_3	27.21	29.29	31.67	29.37	29.67
Na_2O	3.75	3.56	n.d.	3.83	n.d.
CaO	17.00	18.22	15.68	12.91	22.84
K_2O	n.d.	0.42	n.d.	0.28	n.d.
Fe_2O_3*	0.10	0.30	0.37	0.69	3.85
TiO_2	0.00	0.01	0.00	0.09	0.00
NiO	0.00		0.13		0.32
MnO	0.01	0.02	0.00	0.02	0.12
Cr_2O_3	0.01		0.00		0.00
CoO	0.06		0.00		0.00
V_2O_5	0.05		0.00		0.00
MgO	0.00	0.35	0.00	0.31	0.00
ZnO	n.d.		0.00		0.18
P_2O_5		0.03		0.05	
TOTAL	94.74	99.66	98.13	99.67	99.76
LOI		0.92		0.44	
ppm					
Sr		3700		492	
Zr		40		38	
V		<2		<2	
Cr		<2		<2	
			ATOMIC RATIOS		
Ab	n.d.	25.6	n.d.	34.4	n.d.
An	n.d.	72.4	n.d.	64.0	n.d.
Or	n.d.	2.0	n.d.	1.6	n.d.
			NUMBER OF IONS ON THE BASIS OF 32 OXYGENS		
Si	n.d.		n.d.		n.d.
Al	n.d.		n.d.		n.d.
V	n.d.		n.d.		n.d.
Ti	n.d.		n.d.		n.d.
Fe^{3+}	n.d.		n.d.		n.d.
Cr	n.d.		n.d.		n.d.
Ca	n.d.		n.d.		n.d.
Ni	n.d.		n.d.		n.d.
Mn	n.d.		n.d.		n.d.
Co	n.d.		n.d.		n.d.
Mg	n.d.		n.d.		n.d.
Zn	n.d.		n.d.		n.d.
Na	n.d.		n.d.		n.d.
K	n.d.		n.d.		n.d.
Total	n.d.		n.d.		n.d.
Source	U of C	Mertzman	U of A	Mertzman	U of A
Analysis	EMPA-1	XRF/WC	EMPA-1	XRF/WC	EMPA-1

* - all Fe reported as Fe_2O_3. n.d. = not determined. tr.: trace (<0.01 wt.%)

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. ++++++++++++++++++++

2.3c. Compositional Data - Feldspars (continued)

Wt. %	PLG129	PLG129	PLG130	PLG130	PLG138
SiO_2	55.35	53.61	49.27	49.20	79.71
Al_2O_3	26.17	28.47	32.08	31.74	12.39
Na_2O	n.d.	4.22	n.d.	2.60	1.18
CaO	9.93	11.94	16.02	15.56	0.29
K_2O	n.d.	0.37	0.08	0.06	5.090
*(Fe_2O_3)**	*(1.61)*	*(0.77)*	*(0.44)*	*(0.42)*	*(0.24)*
FeO					0.00
Fe_2O_3					0.24
TiO_2	0.10	0.14	0.08	0.04	0.10
NiO	0.15		0.00		
MnO	0.00	0.02	0.00	0.01	0.018
Cr_2O_3	0.00		0.00		
CoO	0.00		0.00		
V_2O_5	0.08		0.00		
MgO	0.00	0.57	0.25	0.26	0.13
ZnO	0.00		0.00		
P_2O_5		0.07		0.03	0.010
SO_3[a]					0.050
Cl					0.000
TOTAL	93.39	100.18	98.22	99.92	99.208
LOI		0.59		0.83	2.88
N^					0.57
C^					0.12
S^					0
ppm					
Sr		488		471	10
Zr		34		31	129
V		<2		<2	5
Cr		<2		<2	25
Rb					216
Ni					<2
Co					<2
				ATOMIC RATIOS	
Ab	n.d.	38.1	n.d.	23.1	
An	n.d.	59.7	n.d.	76.5	
Or	n.d.	2.2	n.d.	0.4	
Source	U of A	Mertzman	U of A	Mertzman	Mertzman
Analysis	EMPA-1	XRF/WC	EMPA-1	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3. n.d. = not determined. tr.: trace (<0.01 wt.%)

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA.

^ - N, C, and S determined using a light element analyzer. Due to the small amount of sample used, there may be issues of sample heterogeneity and representativeness.

a - SO_3 content may represent a minimum value due to heating of the sample twice.

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2.3d. Spectral Data - Feldspars

Sample	*Facility/File No.*	*Description*
PLG101	RELAB capl29	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG101	RELAB lapl29	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
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PLG102	RELAB capl30	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG102	RELAB lapl30	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
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PLG103	RELAB capl31	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG103	RELAB lapl31	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG103	PSF 150507plg103	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG103	PSF 090707plg103	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG103	PSF plg103	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG103	PSF plg103.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PLG104	RELAB capl32	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG104	RELAB lapl32	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG104	PSF 150507plg104	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG104	PSF 090707plg104	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG104	PSF plg104	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
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PLG105	RELAB capl33	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG105	RELAB lapl33	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG105	PSF 150507plg105	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG105	PSF 090707plg105	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG105	PSF plg105	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
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PLG106	RELAB capl34	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG106	RELAB lapl34	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG106	PSF 150507plg106	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG106	PSF 090707plg106	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG106	PSF plg106	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG106	PSF plg016.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012). (Mislabelled?)
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PLG107	RELAB capl35	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG107	RELAB lapl35	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
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PLG108	RELAB capl36	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG108	RELAB lapl36	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.

PLG108	USGS 236	unsorted, IS, 0.35-2.6µm, 1x resol.
PLG108	RELAB C1SC37	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
PLG108	UH Analog	? g.s., diffuse, 0.9-2.5µm, ? resol.
PLG108	PSF mar3006.015	<45 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PLG108	PSF mar3006.016	45-90 µm; 0°/0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PLG108	PSF 160507plg108	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG108	PSF 090707plg108	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG108	PSF plg108	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG108	PSF 130707plg108u	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. Unpacked (loose) sample.
PLG108	PSF 130707plg108p	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. Packed (tamped down) sample.
PLG108	PSF 130707plg108slick	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. “Slick” (packed and mirror surface made) sample.
PLG108	PSF 160707plg108packed	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. Packed (tamped down) sample.
PLG108	PSF 160707plg108unpacked	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. Unpacked (loose) sample.
PLG108	PSF 100824b.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
PLG108	PSF plg108.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
PLG108	PSF 121016a.219	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; measured in glove box; ASD; aka ZMIX121; see section 32 (directory: 121016 GLOVEBOX).
PLG108	PSF 121016a.224	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; measured in glove box; ASD; aka ZMIX124; see section 32 (directory: 121016 GLOVEBOX).
PLG108	PSF 121016a.136	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; measured in glove box; ASD; aka ZMIX086; see section 32 (directory: 121016 GLOVEBOX).
PLG108	PSF OO 219	<45 µm (100% PLG108 (<250 µm) + 0% SGE101A); 0.2-0.4 µm; i=0°, e=0° (bifurcated probe); Ocean Optics S2000; 100 averaged; aka ZMIX121.
PLG108	PSF OO 224	45-90 µm (100% PLG108 (<250 µm) + 0% SGE101A); 0.2-0.4 µm; i=0°, e=0° (bifurcated probe); Ocean Optics S2000; 100 averaged; aka ZMIX124.
PLG108	PSF OO 136	<250 µm (100% PLG108 (<250 µm) + 0% SGE101A); 0.2-0.4 µm; i=0°, e=0° (bifurcated probe); Ocean Optics S2000; 100 averaged; aka ZMIX086.
PLG108	*See also section 15.25 of this document for mixtures of this material with nanophase iron and nanophase iron-impregnated silica gels.*	
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PLG109	RELAB capl37	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG109	RELAB lapl37	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG109	PSF 160507plg109	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG109	PSF 090707plg109	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG109	PSF plg109	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG109	PSF plg109.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PLG110	RELAB capl38	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG110	RELAB lapl38	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
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PLG111	RELAB capl39	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG111	RELAB lapl39	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG111	PSF 160507plg111	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG111	PSF 090707plg111	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG111	PSF plg111	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OOS2000).
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PLG113	RELAB capl40	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG113	RELAB lapl40	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG113	PSF plg113.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PLG114	RELAB capl41	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG114	RELAB lapl41	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG114	UH Analog	? g.s., diffuse, 0.9-2.5µm, ? resol.
PLG114	PSF 160507plg114	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG114	PSF 090707plg114	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG114	PSF plg114	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OOS2000).
PLG114	PSF plg114.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PLG115	RELAB capl42	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG115	RELAB lapl42	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
PLG115	PSF 160507plg115	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG115	PSF 090707plg115	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG115	PSF plg115	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OOS2000).
PLG115	PSF 090922a.019	<45 µm, i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD; in steel sample cup.
PLG115	PSF 090922a.020	<45 µm, i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD; in steel sample cup.
PLG115	PSF 090922a.021	<45 µm, i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD; in aluminum sample cup.
PLG115	PSF 090922a.022	<45 µm, i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD; in aluminum sample cup; reshoot.
PLG115	PSF 090922a.023	<45 µm, i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD; in aluminum sample cup; reshoot.
PLG115	PSF 090922a.024	<45 µm, i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD; in aluminum sample cup; reshoot.
PLG115	PSF 090825 sub45	<45 µm; i=30/e=0; 0.35-0.86 µm; ~0.3 nm resol.; 41 msec, 1000 spectra avgd; Ocean Optics S2000 + QTH light.
PLG115	PSF 090825 45-90	45-90 µm; i=30/e=0; 0.35-0.86 µm; ~0.3 nm resol.; 41 msec, 1000 spectra avgd; Ocean Optics S2000 + QTH light.
PLG115	PSF 090825 90-250	90-250 µm; i=30/e=0; 0.35-0.86 µm; ~0.3 nm resol.; 41 msec, 1000 spectra avgd; Ocean Optics S2000 + QTH light.
PLG115	PSF 090825 25-500	250-500 µm; i=30/e=0; 0.35-0.86 µm; ~0.3 nm resol.; 41 msec, 1000 spectra avgd; Ocean Optics S2000 + QTH light.

PLG115	PSF 090825 500-1000	500-1000 μm; i=30/e=0; 0.35-0.86 μm; ~0.3 nm resol.; 41 msec, 1000 spectra avgd; Ocean Optics S2000 + QTH light.
	++++++	
PLG115	PSF 091015a.001	<45 μm; i=30/e=0; 0.35-2.5 μm; 1 nm output; 100 spectra avgd; ASD + QTH light.
PLG115	PSF 091015a.002	45-90 μm; i=30/e=0; 0.35-2.5 μm; 1 nm output; 100 spectra avgd; ASD + QTH light.
PLG115	PSF 091015a.003	90-250 μm; i=30/e=0; 0.35-2.5 μm; 1 nm output; 100 spectra avgd; ASD + QTH light.
PLG115	PSF 091015a.004	250-500 μm; i=30/e=0; 0.35-2.5 μm; 1 nm output; 100 spectra avgd; ASD + QTH light.
PLG115	PSF 091015a.005	500-1000 μm; i=30/e=0; 0.35-2.5 μm; 1 nm output; 100 spectra avgd; ASD + QTH light.
PLG115	PSF plg115.dpt	<45 μm; 30°/0°; 1.67-25.4 μm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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PLG116	RELAB capl43	<45 μm, 30°/0°; 0.3-2.6μm, 5 nm.
PLG116	RELAB lapl43	<45 μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 μm); note change in viewing geometry.
++++++		
PLG117	RELAB capl44	<45μm, 30°/0°; 0.3-2.6μm, 5 nm.
PLG117	RELAB lapl44	<45μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 μm); note change in viewing geometry.
PLG117	UH Analog	? g.s., diffuse, 0.9-2.5μm, ? resol.
PLG117	PSF plg117.dpt	<45 μm; 30°/0°; 1.67-25.4 μm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
++++++		
PLG118	RELAB capl45	<45 μm, 30°/0°; 0.3-2.6μm, 5 nm.
PLG118	RELAB lapl45	<45 μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 μm); note change in viewing geometry.
++++++		
PLG119	RELAB capl46	<45μm, 30°/0°; 0.3-2.6μm, 5 nm.
PLG119	RELAB lapl46	<45μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 μm); note change in viewing geometry.
++++++		
PLG120	RELAB capl47	<45 μm, 30°/0°; 0.3-2.6μm, 5 nm.
PLG120	RELAB lapl47	<45 μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 μm); note change in viewing geometry.
PLG120	PSF 160507plg120	<45 μm, 0°/0° (bifurcated probe), 0.2-0.4 μm, ~0.3 nm (OO S2000).
PLG120	PSF 090707plg120	<45 μm, 0°/0° (bifurcated probe), 0.35-0.86 μm, ~0.3 nm (OO S2000).
PLG120	PSF plg120	<45 μm, 0°/0° (bifurcated probe), 0.2-0.86 μm; merged at 0.38 μm, 0.2-0.4 μm with D2 source, 0.35-0.86 μm with QTH source (OOS2000).
++++++		
PLG121	RELAB capl48	<45 μm, 30°/0°; 0.3-2.6μm, 5 nm.
PLG121	RELAB lapl48	<45 μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 μm); note change in viewing geometry.
++++++		
PLG122	RELAB capl49	<45 μm, 30°/0°; 0.3-2.6μm, 5 nm.
PLG122	RELAB lapl49	<45 μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 μm); note change in viewing geometry.
PLG122	UH Analog	? g.s., diffuse, 0.9-2.5μm, ? resol.
PLG122	PSF mar3006.011	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PLG122	PSF mar3006.012	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory mar3006].
PLG122	PSF 160507plg122	<45 μm, 0°/0° (bifurcated probe), 0.2-0.4 μm, ~0.3 nm (OO S2000).

PLG122	PSF 090707plg122	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG122	PSF plg122	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG122	PSF plg122.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
++++++		
PLG124	RELAB capl51	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG124	RELAB lapl51	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
++++++		
PLG125	RELAB capl52	<45 µm, 30°/0°, 0.3-2.6 µm, 5 nm.
PLG125	RELAB bmr1pl052	<45 µm, 30°/30°, 1.67-25 µm, 0.6-129 nm.
PLG125	RELAB bkr1pl052	<45 µm, 30°/0°,30°, 0.3-25 µm, 5,0.6-129; merged RELAB+Nicolet at 1.8 µm, note change in viewing geometry.
PLG125	RELAB bkr1ec014	<45 µm, 30°/0°,30°, 0.3-25 µm, 5,0.6-129; merged RELAB+Nicolet at 1.8 µm, note change in viewing geometry.
++++++		
PLG129	RELAB capl50	<45 µm, 30°/0°; 0.3-2.6µm, 5 nm.
PLG129	RELAB lapl50	<45 µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet (at 2.525 µm); note change in viewing geometry.
++++++		
PLG130	RELAB capl53	<45 µm, 30°/0°, 0.3-2.6 µm, 5 nm.
PLG130	RELAB bmr1pl053	<45 µm, 30°/30°, 1.67-25 µm, 0.6-129 nm.
PLG130	RELAB bkr1pl053	<45 µm, 30°/0°,30°, 0.3-25 µm, 5,0.6-129; merged RELAB+Nicolet at 1.8 µm, note change in viewing geometry.
PLG130	PSF 130607plg13045	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG130	PSF 090707plg13045	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG130	PSF plg13045	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG130	PSF 130607plg13090	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG130	PSF 090707plg13090	45-90 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG130	PSF plg13090	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG130	PSF 130607plg130250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG130	PSF 090707plg130250	90-250 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG130	PSF plg130250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG130	PSF 130607plg130500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG130	PSF 090707plg130500	250-500 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG130	PSF plg130500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG130	PSF 130607plg1301000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm (OO S2000).
PLG130	PSF 090707plg1301000	500-1000 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm (OO S2000).
PLG130	PSF plg1301000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source (OO S2000).
PLG130	PSF plg130.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
PLG130	PSF plg130_250_500.dpt	250-500 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
	++++++	

PLG130 – single grain study: June 1, 2009

PLG130	PSF 090601a.017	Al block "L" well: C grain (250-500 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
PLG130	PSF 090601a.018	Al block "L" well: C grain (250-500 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured. ASD.
PLG130	PSF 090601a.019	Al block "L" well: C grain (250-500 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured. ASD.
PLG130	PSF 090601a.020	Al block "L" well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
PLG130	PSF 090601a.021	Al block "L" well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured. ASD.
PLG130	PSF 090601a.032	Al block 5 mm deep well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
PLG130	PSF 090601a.037	Al block 10 mm deep well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
PLG130	PSF 090601a.042	Al block 15 mm deep well: D grain (500-1000 μm), i=0°/e=0° (bifurc. able), 100 avg., ASD.
PLG130	PSF 090601a.046	Al block 20 mm deep well: D grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD; grain lost.
PLG130	PSF 090601a.054	Al block 5 mm deep well: D' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
PLG130	PSF 090601a.055	Al block 5 mm deep well: D' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
PLG130	PSF 090601a.063	Al block 10 mm deep well: D' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
PLG130	PSF 090601a.064	Al block 10 mm deep well: D' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
PLG130	PSF 090601a.072	Al block 15 mm deep well: D' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
PLG130	PSF 090601a.073	Al block 15 mm deep well: D' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
PLG130	PSF 090601a.081	Al block 20 mm deep well: D' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., ASD.
PLG130	PSF 090601a.082	Al block 20 mm deep well: D' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 1000 avg., grain shaken and remeasured, ASD; grain lost.
PLG130	PSF 090601a.090	Al block 25 mm deep well: D'' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., ASD.
PLG130	PSF 090601a.091	Al block 25 mm deep well: D'' grain (500-1000 μm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD; grain lost.
PLG130	PSF 090601a.108	45-90 μm single grain (hopefully got a grain), Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 1000 avg., ASD.
PLG130	PSF 090601a.109	90-250 μm single grain, Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 1000 avg. ASD.
PLG130	PSF 090601a.110	250-500 μm single grain (C grain), Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 1000 avg., ASD.
PLG130	PSF 090601a.111	500-1000 μm single grain (D'' grain), Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 1000 avg. ASD.
	++++++	
PLG130	PSF 090601a.135	45-90 μm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg., ASD.
PLG130	PSF 090601a.136	90-250 μm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
PLG130	PSF 090601a.137	250-500 μm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg., ASD.
PLG130	PSF 090601a.138	500-1000 μm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
++++++		
PLG137	PSF 130723b.013	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
PLG137	PSF 130723b.014	45-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 250 spectra averaged;

ASD. (Directory: 130723 random minerals).

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END of 2.3.

2. Silicates

2.4. Amphiboles

2.4a. Sample Descriptions - Amphiboles

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample	*Description*
AMP001	Amphibole: Tilly Foster Mine, Brewster, New York, USA (Dr. David Garske, collected by Gunnar Bjareby #A106), originally labelled as pyroxene PYX001.
AMP031	Amphibole: Gjerstad, Norway (Minerals Unlimited), originally labelled as pyroxene PYX031.
AMP101	Richterite: Langban, Sweden (Minerals Unlimited), originally labelled as richterite RIC101.
AMP106	Amphibole: locality unknown (University of Alberta GEOL330 laboratory collection #8/4/5), originally labelled as pyroxene PYX106.
AMP232	Amphibole: Ekersund, Norway (Minerals Unlimited), occurs intimately with pyroxene PYX032 but not spectrally apparent.
AMP305	Amphibole: locality unknown, probably Ontario, Canada (G. Hudecek), occurs intimately with pyroxene PYX005.

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2.4b. XRD Data - Amphiboles

None

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2.4c. Compositional Data - Amphiboles

Wt. %	AMP001	AMP031	**AMP101**	AMP101	AMP106	AMP232	AMP305
SiO_2	55.28	50.69	54.42	54.28	53.84	48.98	39.95
Al_2O_3	1.94	7.46	0.77	1.05	3.62	1.21	12.50
FeO[1]	3.54	6.02	1.35*	1.11*	7.67	23.65	5.93
Fe_2O_3[1]	0.00	0.18	n.d.		0.00	4.16	5.37
MgO	22.86	18.04	18.32	18.88	18.58	17.49	12.80
CaO	12.17	12.59	5.72	5.72	12.02	1.07	11.77
Na_2O	0.65	0.69	6.09	6.09	0.77	0.00	2.74
TiO_2	0.01	0.58	0.06	0.06	0.10	0.02	6.23
Cr_2O_3	0.02	0.02	0.02	0.07	0.34	0.04	0.07
V_2O_5	0.02	0.00	tr.	0.01[b]	0.03	0.00	0.00
CoO	0.02	0.03	0.02	0.03[b]	0.04	0.06	0.03
NiO	0.01	0.01	0.04	0.05	0.09	0.01	0.02
MnO	0.07	0.11	8.42	7.93	0.20	0.47	0.10
ZrO_2*	0.00	0.00	0.04	0.20	0.00	0.00	0.00
ZnO*	n.d.	n.d.	0.15	0.05	n.d.	n.d.	n.d.
Nb_2O_5*	n.d.	n.d.		0.03	n.d.	n.d.	n.d.
K_2O*	n.d.	n.d.		1.32[b]	n.d.	n.d.	n.d.
HfO_2				0.00[b]			
P_2O_5*	n.d.	n.d.	.	0.01[a]	n.d.	n.d.	n.d.
Cl				0.03[a]			
F*	n.d.	n.d.		1.30	n.d.	n.d.	n.d.
TOTAL	96.59	96.42	98.04	98.21	97.30	97.16	97.51
O=F,Cl			-0.55				
TOTAL			97.49				
Source	U of C	U of C	U of C	U of A	U of C	U of C	U of C
Analysis	EMPA-8	EMPA-9	EMPA-8	EMPA-5	EMPA-6	EMPA-4	EMPA-4

* - all Fe reported as FeO.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

n.d. = not determined. tr.: trace (<0.01 wt.%).

a – average of two analytical points.

b – average of three analytical points.

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2.4d. Spectral Data - Amphiboles

Sample	*Facility/File No.*	*Description*
AMP001	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
++++++		
AMP106	PSF 071212a.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
AMP106	PSF 080708.amp106	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics S2000.

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END of 2.4.

2. Silicates

2.5. Garnets

2.5a. Sample Descriptions - Garnets

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample	*Description*
GAR102	Grossular garnet, var. essonite (or hessonite): West Redding, Fairfield County, Connecticut, USA (Minerals Unlimited). Grossular: $Ca_3Al_2(SiO_4)_3$; essonite/hessonite: cinnamon-coloured variety containing iron. Forms three series, with andradite, with hibschite and katoite, and with uvarovite.
GAR103	Almandine garnet: Namib Desert, near Usakos, Namibia (Minerals Unlimited). Almandine: $Fe_3^{2+}Al_2(SiO_4)_3$. Forms two series with pyrope and spessartine.
GAR104	Andradite garnet: Stanley, Graham County, Arizona, USA; some on quartz (Minerals Unlimited) ($Ca_3Fe_2^{3+}(SiO_4)_3$). Forms two series, with grossular and with schorlomite.
GAR105	Uvarovite garnet: El Dorado, El Dorado County, California, USA (Minerals Unlimited). With chromite (CHR103). Uvarovite: $Ca_3Cr_2(SiO_4)_3$. Forms series with grossular.
GAR106	Spessartine garnet: near Los Gavilanes, Baja California, Mexico (Minerals Unlimited) ($Mn_3^{2+}Al_2(SiO_4)_3$). Forms series with almandine.
GAR107	*Andradite garnet: Red Head Lease, San Benito County, California, USA. With perovskite (PER101) (too intimate and fine grained for a decent sample) (David Shannon). Andradite: $Ca_3Fe_2^{3+}(SiO_4)_3$. Forms two series, with grossular and with schorlomite.*
GAR108	*Garnet (var. unknown): locality unknown, probably Haliburton, Ontario, Canada; with pyroxene (PYX006) (G. Hudecek).*
GAR109	Uvarovite garnet: Placer County, California, USA. With chromite (CHR107) (Minerals Unlimited). Too intimate, sparse and heterogeneous to separate. Uvarovite: $Ca_3Cr_2(SiO_4)_3$. Forms series with grossular.
GAR110	Grossular garnet: near Los Lamentos, Chihuahua, Mexico (Minerals Unlimited). (Was GRO101). Grossular: $Ca_3Al_2(SiO_4)_3$. Forms three series, with andradite, with hibschite and katoite, and with uvarovite.
GAR111	Andradite garnet, var. topazolite: Val di Fassa, Italy (Dr. David Garske), with pyroxene PYX041. (Was TOP101). Andradite: $Ca_3Fe_2^{3+}(SiO_4)_3$. Forms two series, with grossular and with schorlomite. Topazolite: transparent yellow-green variety of andradite.
GAR112	Almandine garnet: near Roxbury, Litchfield County, Connecticut, USA (Minerals Unlimited; received April 5/05). Almandine: $Fe_3^{2+}Al_2(SiO_4)_3$. Forms two series with pyrope and spessartine.
GAR113	Pyrope garnet, variety rhodolite: Kongsberg, Norway, in matrix (Minerals Unlimited; received April 5/05). Pyrope: $Mg_3Al_2(SiO_4)_3$. Rhodolite: Fe^{2+}-bearing pyrope.
GAR114	Pyrope garnet, variety rhodolite: Macon County, North Carolina, USA, in matrix (Minerals Unlimited; received April 5/05). Pyrope: $Mg_3Al_2(SiO_4)_3$. Rhodolite: Fe^{2+}-bearing pyrope.
GAR115	Andradite garnet: Garnet Hill, Calaveras County, California, USA; some with epidote, quartz, and a minor amount of scheelite ($Ca_3Fe_2^{3+}(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR116	Grossular garnet: Deep Springs Valley, Inyo County, California, USA ($Ca_3Al_2(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR117	Andradite garnet, var. polyadelphite: Franklin, Sussex, New Jersey, USA ($Ca_3Fe_2^{3+}(SiO_4)_3$), with franklinite, willemite, and calcite (Minerals Unlimited - May 17/05).
GAR118	Almandine garnet: Governador Valadares, Minas Gerais, Brazil; in gneiss ($Fe_3^{2+}Al_2(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR120	Almandine garnet: Salida, Chaffee County, Colorado, USA ($Fe_3^{2+}Al_2(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR121	Almandine garnet: Wrangell, Alaska, USA, in biotite schist ($Fe_3^{2+}Al_2(SiO_4)_3$) (Minerals Unlimited - May 17/05).

GAR122 Almandine garnet: Oetzel, Tyrol, Austria ($Fe_3^{2+}Al_2(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR123 Almandine garnet: Ampandramaika, Madagascar ($Fe_3^{2+}Al_2(SiO_4)_3$) (Minerals Unlimited - May 17/05; more received June 2013).
GAR124 Almandine garnet: Mysore District, India ($Fe_3^{2+}Al_2(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR125 Almandine garnet: Old Cat Tail Mine, Spruce Pine, North Carolina, USA; in muscovite mica ($Fe_3^{2+}Al_2(SiO_4)_3$) (Minerals Unlimited - May 17/05; more received June 2013).

GAR130 Grossular garnet: Lake Jaco, Chihuahua, Mexico ($Ca_3Al_2(SiO_4)_3$ (Minerals Unlimited: May 17/05).
GAR131 Grossular garnet: near Los Lamentos, Chihuahua, Mexico ($Ca_3Al_2(SiO_4)_3$ (Minerals Unlimited: May 17/05).

GAR140 Andradite garnet, var. melanite: near the Dallas Gem Mine, San Benito County, California, USA; on rock ($Ca_3Fe_2^{3+}(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR141 Andradite garnet, var. melanite: Frascati, Albaner Mountains, Italy ($Ca_3Fe_2^{3+}(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR142 Andradite garnet: Nightengale District, Pershing County, Nevada, USA ($Ca_3Fe_2^{3+}(SiO_4)_3$) (Minerals Unlimited - May 17/05).
GAR143 Pyrope garnet, var. rhodolite (Mg:Fe ~2:1): Macon Co., NC, USA; in matrix (Minerals Unlimited – Nov. 22/07).
GAR144 Pyrope garnet: near Taegi, Mohave Co., AZ, USA (Minerals Unlimited – Nov. 22/07; more received June 2013).
GAR145 Pyrope garnet, var. rhodolite (Mg:Fe ~2:1): Kongsberg, Norway; in matrix (Minerals Unlimited – Nov. 22/07).
GAR146 Pyrope garnet, var. rhodolite (Mg:Fe ~2:1): Gjerstad, Norway; in matrix (Minerals Unlimited – Nov. 22/07).
GAR150 Almandine garnet: Gore Mountain, Adirondack Mtns region, NY, USA. From Stan Mertzman – his sample #SAM – Gar-1 (received April 2008)
GAR151 Andradite garnet: Epidote/garnet contact metamorphic skarn around latest Triassic diabase in the rift valleys of SE Pennsylvania; Reading, PA, USA. From Stan Mertzman – his sample RT222 or US222 (received May 2008: a few grains and powder).
GAR160 Uvarovite garnet: Russia (crust on rock) [The Crystal Circle, Tucson 2011 show].
GAR161 Yellow garnet, Mali, Africa [Winnipeg Rock and Mineral Club purchase – May 2011).
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2.5a. Garnet types:

Pyrope	$Mg_3Al_2Si_3O_{12}$	*Mg*	*Al*
Almandine	$Fe^{2+}{}_3Al_2Si_3O_{12}$	Fe^{3+}	*Al*
Spessartine	$Mn_3Al_2Si_3O_{12}$	*Mn*	*Al*
Grossular	$Ca_3Al_2Si_3O_{12}$	*Ca*	*Al*
Andradite	$Ca_3(Fe^{3+},Ti)_2Si_3O_{12}$	*Ca*	Fe^{3+}, *Ti*
Uvarovite	$Ca_3Cr_2Si_3O_{12}$	*Ca*	*Cr*

Solid solution series:

- *pyrope – almandine – spessartine:* *Mg – Fe^{3+} - Mn (plus Ca)*
- *uvarovite – grossular – andradite:* *Cr – Al – Fe^{3+},Ti (plus Ca in 1st pos'n)*

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2.5b. XRD Data - Garnets

2.5b.1. Analogue files from U of A instrument

Sample	XRD File	Sample	XRD File	Sample	XRD File
GAR110	Z03200	GAR111	Z03198		

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2.5c. Compositional Data - Garnets

Wt. %	GAR102	GAR102	GAR103	GAR103
SiO_2	37.44		36.47	
TiO_2	1.26		0.51	
Al_2O_3	18.18		21.59	
Fe_2O_3	3.73		7.70	
FeO	1.75	2.53[1]	25.50	33.52[1]
MnO	0.20		2.61	
MgO	1.00		3.09	
CaO	36.07		1.89	
Na_2O	0.12		0.19	
K_2O	0.00		0.02	
P_2O_5	0.18		0.07	
TOTAL	99.93		99.64	
ppm				
Sr	41		23	
Zr	571		426	
V	133		67	
Cr	106		137	
	NUMBER OF IONS ON THE BASIS OF 24 OXYGEN			
Si				
Al				
Al				
Cr				
Fe^{3+}				
Ti				
Mg				
Fe^{2+}				
Mn				
Ca				
V				
Co				
Ni				
Zn				
P				
Na				
Total				
Source	Mertzman	U of A	Mertzman	U of A
Analysis	XRF/WC	WC	XRF/WC	WC
Type	Grossular		almandine	

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

1. FeO determined by wet chemistry (WC) at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.
n.d. = not determined. tr.: trace (<0.01 wt.%).
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2.5c. Compositional Data - Garnets (continued)

Wt. %	GAR104	GAR105	GAR106	GAR106
SiO_2	34.02		37.42	
TiO_2	0.03		0.51	
Al_2O_3	1.70		19.41	
Fe_2O_3	29.49		4.62	
FeO	0.25	3.50[1]	1.27	1.79[1]
MnO	0.25		1.06	
MgO	0.32		0.28	
CaO	34.01		35.15	
Na_2O	0.22		0.11	
K_2O	0.00		0.00	
P_2O_5	0.05		0.10	
TOTAL	100.34		99.93	
ppm				
Sr	19		30	
Zr	32		73	
V	40		104	
Cr	40		75	

NUMBER OF IONS ON THE BASIS OF 24 OXYGEN

Si				
Al				
Al				
Cr				
Fe^{3+}				
Ti				
Mg				
Fe^{2+}				
Mn				
Ca				
V				
Co				
Ni				
Zn				
P				
Na				
Total				
Source	Mertzman	U of A	Mertzman	U of A
Analysis	XRF/WC	WC	XRF/WC	WC
Type	andradite		grossular	

n.d. = not determined. tr.: trace (<0.01 wt.%).

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

1. FeO determined by wet chemistry (WC) at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

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2.5c. Compositional Data - Garnets (continued)

Wt. %	GAR110	GAR111	GAR111	GAR112	GAR113
SiO_2	40.13	39.76	38.07	41.78	40.31
TiO_2	0.46	0.36	0.41	0.76	0.16
Al_2O_3	18.61	18.10	17.40	19.90	20.37
Fe_2O_3	3.80[1]	4.90[1]	4.74	4.86	2.88
FeO	0.69[1]	1.77[1]	0.85	24.69	28.80
MnO	0.19	0.10	0.15	0.73	1.92
MgO	1.19	0.84	3.08	2.10	2.92
CaO	37.45	36.91	35.43	4.78	1.83
Na_2O			0.11	0.20	0.18
K_2O			0.02	0.06	0.11
P_2O_5			0.03	0.18	0.08
Cr_2O_3	0.11	0.06			
V_2O_5	0.00	0.15			
CoO	0.00	0.00			
NiO	0.07	0.22			
ZnO	0.00	0.00			
TOTAL	102.70*	103.17*	100.29	100.04	99.56
ppm					
Sr			84	53	34
Zr			276	125	195
V			135	56	31
Cr			105	95	40
		NUMBER OF IONS ON THE BASIS OF 24 OXYGEN			
Si	5.983	5.947			
Al	0.017	0.053			
Al	3.254	3.139			
Cr	0.013	0.007			
Fe^{3+}	0.426	0.551			
Ti	0.051	0.040			
Mg	0.264	0.187			
Fe^{2+}	0.086	0.221			
Mn	0.024	0.013			
Ca	5.982	5.916			
V	--	0.015			
Co	--	--			
Ni	0.008	0.026			
Zn	--	--			
P	--	--			
Na	--	--			
Total	16.108	16.115			
Source	U of A	U of A	Mertzman	Mertzman	Mertzman
Analysis	EMPA-2	EMPA-2			
Type	Grossular	Grossular	grossular	almandine	almandine

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis. FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.5c. Compositional Data - Garnets (continued)

Wt. %	GAR115	GAR116	GAR118	GAR120	GAR121	GAR122	GAR124
SiO_2	35.91	41.58	39.89	37.43	39.74	40.35	37.96
TiO_2	0.35	0.68	0.77	0.30	0.55	1.10	0.07
Al_2O_3	6.66	12.77	21.48	21.79	21.39	20.05	22.93
Fe_2O_3	20.09	4.21	3.05	4.46	4.82	3.77	4.36
FeO	2.28	2.37	25.32	28.63	24.92	22.42	24.27
MnO	0.65	0.25	0.17	1.15	0.91	0.87	0.37
MgO	1.04	3.93	6.20	4.20	5.19	3.27	7.27
CaO	32.89	33.56	2.31	1.41	1.90	7.38	2.74
Na_2O	0.19	0.54	0.17	0.19	0.18	0.18	0.13
K_2O	0.00	0.03	0.07	0.01	0.05	0.09	0.00
P_2O_5	0.25	0.10	0.14	0.06	0.08	0.21	0.10
TOTAL	100.31	100.02	99.57	99.63	99.73	99.69	100.20
ppm							
Sr	25	138	27	25	34	46	27
Zr	53	156	1198	546	56	216	43
V	686	93	48	27	113	173	33
Cr	543	87	47	35	185	213	50
	NUMBER OF IONS ON THE BASIS OF 24 OXYGEN						
Si							
Al							
Al							
Cr							
Fe^{3+}							
Ti							
Mg							
Fe^{2+}							
Mn							
Ca							
V							
Co							
Ni							
Zn							
P							
Na							
Total							
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC
Type	andradite	grossular	almandine	almandine	almandine	almandine	almandine

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis. FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO.

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2.5c. Compositional Data - Garnets (continued)

Wt. %	GAR130	GAR131	GAR140	GAR141	GAR142
SiO_2	37.48	37.13	33.31	32.66	38.88
TiO_2	0.85	0.31	5.50	4.03	0.25
Al_2O_3	18.35	19.86	2.84	6.01	18.85
Fe_2O_3	3.72	3.76	19.77	19.17	3.57
FeO	0.63	0.34	2.10	2.24	3.06
MnO	0.10	0.19	0.09	0.34	0.98
MgO	0.84	1.23	2.15	0.79	0.28
CaO	37.98	36.83	34.29	33.81	34.45
Na_2O	0.09	0.09	0.21	0.22	0.10
K_2O	0.00	0.02	0.00	0.01	0.04
P_2O_5	0.02	0.03	0.03	0.16	0.02
TOTAL	100.06	99.79	100.29	99.44	100.48
ppm					
Sr	33	29	42	145	35
Zr	464	265	213	2818	72
V	84	75	1135	2010	267
Cr	65	70	756	1470	209
			NUMBER OF IONS ON THE BASIS OF 24 OXYGEN		
Si					
Al					
Al					
Cr					
Fe^{3+}					
Ti					
Mg					
Fe^{2+}					
Mn					
Ca					
V					
Co					
Ni					
Zn					
P					
Na					
Total					
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC
Type	grossular	grossular	andradite	andradite	grossular

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis. FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO.

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2.5c. Compositional Data - Garnets (continued)

Wt. %	GAR143	GAR144	GAR145	GAR146	GAR150	GAR151
MertzmanID					SAM Gar-1	RT 222
SiO_2	36.19	40.03	37.60	37.22	37.89	42.12
TiO_2	0.30	0.19	0.16	0.03	1.18	0.08
Al_2O_3	20.93	22.48	20.58	21.99	19.68	0.62
Fe_2O_3	3.47	0.52	3.57	6.56	6.01	26.54
FeO	27.10	12.40	26.70	22.00	8.60	0.53
MnO	1.90	0.68	2.92	0.63	0.28	0.14
MgO	4.36	14.86	3.60	7.33	6.86	0.31
CaO	2.49	6.42	1.82	1.68	19.49	29.55
Na_2O	0.31	0.20	0.30	0.26	0.21	0.08
K_2O	0.42	0.00	0.08	0.10	0.00	0.01
P_2O_5	0.10	0.10	0.25	0.12	0.06	0.04
TOTAL	99.73	98.24	99.64	99.84	100.26	100.27
LOI	2.16	0.36	2.06	1.92	n.d.	0.25
ppm						
Sr	5	15	5	10	162	4
Zr	35	35	105	30	70	35
V	195	175	30	20	134	30
Ni	<5	15	<5	<5		5
Cr	20	11900	23	13	115	16
Co	<2	30	<2	35		20
Rb						2.3
La						68
Ce						76
U						39
Th						5
			NUMBER OF IONS ON THE BASIS OF 24 OXYGEN			
Si						
Al						
Al						
Cr						
Fe^{3+}						
Ti						
Mg						
Fe^{2+}						
Mn						
Ca						
V						
Co						
Ni						
Zn						
P						
Na						
Total						
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC
Type	almandine	pyrope	almandine	almandine	grossular	andradite

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis. FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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2.5d. Spectral Data - Garnets

Sample	*Facility/File No.*	*Description*
GAR102	RELAB caga16	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm. (Relabelled by RELAB as cagn02.asc).
GAR102	RELAB laga16	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note diff. viewing geometries. (Relabelled as lagn02.asc).
GAR102	PSF 280807.001	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR102	PSF 280807.002	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR102	PSF 080708.gar102	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics S2000.
++++++		
GAR103	RELAB cagn03	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
GAR103	RELAB lagn03	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
GAR103	PSF 280807.003	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR103	PSF 280807.004	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR104	RELAB cagn04	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
GAR104	RELAB lagn04	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
GAR104	PSF 280807.005	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR104	PSF 280807.006	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR104	PSF 080708.gar104	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics S2000.
++++++		
GAR105	RELAB cagn05	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
GAR105	RELAB lagn05	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
GAR105	PSF 290807.013	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR106	RELAB cagn06	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
GAR106	RELAB lagn06	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
GAR106	PSF 290807.014	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR106	PSF 280807.007	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR106	PSF 280807.008	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR108	RELAB cagn08	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
GAR108	RELAB lagn08	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
GAR108	PSF 290807.015	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR110	RELAB c1sc71	<45 µm, 0E/15E, 0.3-2.7µm, 5 nm.
GAR110	PSF 290807.016	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR111	RELAB cato03	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
GAR111	RELAB lato03	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
GAR111	PSF 280807.009	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR111	PSF 280807.010	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR112	PSF 280807.014	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR112	PSF 280807.015	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		

GAR113	PSF 280807.016	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR113	PSF 280807.017	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR114	PSF 280807.018	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR115	PSF 280807.019	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR115	PSF 280807.020	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR116	PSF 280807.021	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR116	PSF 280807.022	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR118	PSF 280807.023	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR118	PSF 280807.024	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR120	PSF 280807.028	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR120	PSF 280807.030	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR121	PSF 280807.031	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR121	PSF 280807.032	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR122	PSF 280807.033	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR122	PSF 280807.034	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR124	PSF 280807.035	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR124	PSF 280807.036	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR125	PSF 280807.037	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR130	PSF 290807.001	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR130	PSF 290807.002	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR131	PSF 290807.003	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR131	PSF 290807.004	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR140	PSF 290807.005	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR140	PSF 290807.006	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR141	PSF 290807.007	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR141	PSF 290807.008	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR142	PSF 290807.010	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
GAR142	PSF 290807.012	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR143	PSF 080114b.001	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR144	PSF 080114b.002	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR145	PSF 080114b.003	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
++++++		
GAR146	PSF 080114b.004	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.

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END of 2.5.

2. Silicates

2.6. Melilites

2.6a. Sample Descriptions - Melilites

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
MEL101	Melilite: Crestmore Quarry, Riverside County, California, USA (David Shannon Min.), with spinel SPI102.
MEL102	Melilite: Cave dell'Osa, Rome, Latium, Italy (Dr. David Garske #G19c), with fluorapatite APA103 and nepheline NEP102 (impure and very hard to separate).
MEL103	Melilite: Casa Collina Quarry, Pitigliano, Grosseto, Tuscany, Italy (Minerals Unlimited), with pyroxene PYX131.
MEL104	Melilite: Capo di Bova, Via Appia, Antica, near Rome, Italy (Minerals Unlimited). In leucitite, with nepheline, and contaminated with magnetite.
MEL105	Melilite: Crestmore Quarry, Riverside, Riverside County, California, USA (Minerals Unlimited). In monticellite (same locality, but different supplier and appearance than MEL101).
MEL106	Melilite: Powderhorn, Gunnison County, Colorado, USA (Excalibur Mineral Co.).
MEL107	Melilite: Alnon Island, Sweden (Excalibur Mineral Co.).
MEL108	Melilite, var. Akermanite: Lago de Vico, Viterbo, Italy (Excalibur Mineral Co.)

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2.6a.c. Alternative names for melilites:

Akermanite
Gehlenite
Melilite

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2.6b. XRD Data - Melilites

2.6b.1. Analogue files from U of A instrument.

Sample	XRD File	Sample	XRD File	Sample	XRD File
MEL101	Z03230	MEL102		MEL103	Z03231

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2.6c. Compositional Data - Melilites

Wt. %	MEL101	MEL101	MEL102	MEL102	MEL103	MEL103
P_2O_5	0.02	0.00	0.15	0.03[a]	0.02	0.00[a]
Cr_2O_3	0.07	0.03	0.09	0.07	0.10	0.14
MnO	0.20	0.14	0.25	0.02	0.19	0.01
TiO_2	0.06	0.01	0.09	0.02	0.05	0.01
SiO_2	39.09	34.59	43.66	44.88	38.74	38.73
Al_2O_3	0.00	0.30	6.21	6.81	13.68	14.64
FeO[1]	4.17	4.28^	4.45	4.11^	1.42	1.32^
Fe_2O_3[1]	n.d.		n.d.		0.00	
MgO	21.72	22.68	7.17	7.29	5.93	6.31
Na_2O*		0.03		2.35		2.33
ZrO_2*		0.00		0.00		0.01
Nb_2O_5*		0.00		0.07		0.00
K_2O*				0.39[b]		0.10[c]
CoO*				0.02[b]		0.00[c]
CaO*		35.74		32.93		37.52
NiO*		0.02		0.02		0.04
HfO_2*				0.13[b]		0.26[c]
V_2O_5*				0.04[b]		0.03[c]
Cl		0.03		0.01[a]		0.04[a]
TOTAL	65.33	97.86	62.07	99.19	60.13	101.49

NUMBER OF IONS ON THE BASIS OF 14 OXYGENS

Si	3.582		4.007		3.506	
Al	--		0.672		1.460	
P	0.002		0.012		0.002	
Nb	--		--		--	
V	--		0.001		0.001	
Ti	0.004		0.006		0.003	
Zr	--		--		--	
Hf	--		--		--	
Cr	0.005		0.007		0.007	
Fe^{3+}	--		--		--	
Mn	0.015		0.019		0.015	
Fe^{2+}	0.319		0.341		0.108	
Mg	2.967		0.981		0.800	
Co	--		0.002		--	
Ni	0.002		0.002		0.002	
Ca	3.510		3.346		3.639	
Na	0.005		0.419		0.409	
K	--		0.046		0.011	
Total	10.411		9.861		9.963	
Source	U of C	U of A	U of C	U of A	U of C	U of A
Analysis	EMPA-4	EMPA-1	EMPA-8	EMPA-5	EMPA-8	EMPA-4

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO (where available).

n.d. = not determined. tr.: trace (<0.01 wt.%).

^ - all Fe reported as FeO.

a – single analytical point.

b – average of four analytical points.

c – average of three analytical points.

++

2.6c. Compositional Data – Melilites (continued)

Wt. %	MEL104	MEL105	MEL106	MEL107
P_2O_5				
Cr_2O_3				
MnO				
TiO_2				
SiO_2				
Al_2O_3				
FeO[1]	16.71	0.83	2.10	2.88
Fe_2O_3[1]				
MgO				
Na_2O*				
ZrO_2*				
Nb_2O_5*				
K_2O*				
CoO*				
CaO*				
NiO*				
HfO_2*				
V_2O_5*				
Cl				
TOTAL				

NUMBER OF IONS ON THE BASIS OF 14 OXYGENS

Si				
Al				
P				
Nb				
V				
Ti				
Zr				
Hf				
Cr				
Fe^{3+}				
Mn				
Fe^{2+}				
Mg				
Co				
Ni				
Ca				
Na				
K				
Total				
Source	U of A	U of A	U of A	U of A
Analysis	WC	WC	WC	WC

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO (where available).
n.d. = not determined. tr.: trace (<0.01 wt.%).
^ - all Fe reported as FeO.
++

2.6d. Spectral Data - Melilites

Sample	*Facility/File No.*	*Description*
MEL101	RELAB C1SC66	<45 µm, 0E/15E, 0.3-2.7µm, 5 nm.
MEL101	RELAB CASC66	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
MEL101	RELAB LASC66	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
MEL102	RELAB CAME02	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm resol. With errors.
++++++		
MEL103	RELAB CASC67	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
MEL103	RELAB LASC67	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MEL103	RELAB C1SC67	<45 µm, 0E/15E, 0.3-2.7µm, 5 nm.
++++++		
MEL104	RELAB CAME04	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
MEL104	RELAB LAME04	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
MEL105	RELAB CAME05	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
MEL105	RELAB LAME05	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
MEL106	RELAB CAME06	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
MEL106	RELAB LAME06	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
MEL107	RELAB CAME07	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
MEL107	RELAB LAME07	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
MEL108	RELAB CAME08	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
MEL108	RELAB LAME08	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.

++

END of 2.6.

2. Silicates

2.7. Zircons

2.7a. Sample Descriptions - Zircons

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
ZIR101	Zircon: Pacoima Canyon, San Gabriel Mountains, Los Angeles County, California, USA (Minerals Unlimited), analysis incomplete.
ZIR102	Zircon: Sigulani Valley, Tambani area, Blantyre District, Malawi (Minerals Unlimited).

++

2.7b. XRD Data - Zircons

None

++

2.7c. Compositional Data - Zircons

Wt. %	ZIR101
SiO_2	34.91
TiO_2	0.18
Al_2O_3	0.02
Cr_2O_3	0.23
Fe_2O_3	n.d.
FeO	0.31
MnO	0.28
MgO	0.04
CaO	0.00*
V_2O_5	0.00*
CoO	0.00*
NiO	0.33*
ZnO	0.00*
P_2O_5*	0.14
Nb_2O_5*	0.00
K_2O*	0.00
HfO_2*	0.99
SnO_2*	0.03
TOTAL	37.46

NUMBER OF IONS ON THE BASIS OF 24 OXYGEN

Si	n.d.
Al	n.d.
Al	n.d.
Cr	n.d.
Fe^{3+}	n.d.
Ti	n.d.
Mg	n.d.
Fe^{2+}	n.d.
Mn	n.d.
Ca	n.d.
V	n.d.
Co	n.d.
Ni	n.d.
Zn	n.d.
P	n.d.
Na	n.d.
Zr	n.d.
Nb	n.d.
K	n.d.
Hf	n.d.
Sn	n.d.
Total	n.d.
Source	U of C
Analysis	EMPA-6

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. U of A: University of Alberta EMPA. *= data from University of Alberta EMPA.

All Fe reported as FeO.

n.d. = not determined. tr.: trace (<0.01 wt.%).

++

2.7d. Spectral Data - Zircons

Sample	*Facility/File No.*	*Description*
ZIR101	RELAB cazi01	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
ZIR101	RELAB lazi01	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
ZIR102	RELAB cazi02	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
ZIR102	RELAB lazi02	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.

++

END of 2.7.

2. Silicates

2.8. Framework Silicates - Miscellaneous

2.8a. Sample Descriptions - Framework Silicates: Miscellaneous

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
CAN101	*Cancrinite: Minas Gerais, Brazil (Minerals Unlimited), with sodalite SOD102, not analyzed. Not enough in the sample to separate for analysis.*
HAU101	Hauyne: Ariccia, near Rome, Italy; in rock: $((Na,Ca)_{4\text{-}8}Al_6Si_6(O,S)_{24}(SO_4,Cl)_{1\text{-}2})$ (Minerals Unlimited; blue, white, gray, sometimes green). (For pigments project).
NEP101	*Nepheline: Bancroft, Ontario, Canada (Minerals Unlimited), with plagioclase feldspar PLG123 and mica, too intimate to separate?*
NEP102	*Nepheline: Cave dell'Osa, Rome Latium, Italy (Dr. David Garske #G19c), with fluorapatite APA103 and melilite MEL102. Too intimate to separate.*
NEP103	Nepheline: Dungannon Township, Ontario, Canada (Minerals Unlimited). With biotite and chlorite.
NOS101	Nosean: Laacher See, Eifel, Kaiserstuhl, Rheinland, Germany ($Na_8Al_6Si_6O_{24}(SO_4)\cdot H_2O$ (small black crystals in phonolite; member of sodalite group. (Minerals Unlimited) (For pigment project - present in lapis lazuli according to Bacci).
RHO101	*Rhönite (rhoenite): Nickenicher Sattel, Nickenich, Eifel, Germany (Ca, Fe, Mg, Ti Al silicate) (Minerals Unlimited); with martite, on basalt. Too fine-grained and intimate to separate.*
SOD102	Sodalite: Minas Gerais, Brazil (Minerals Unlimited), with cancrinite CAN101 (Aka SOD101) $[Na_4Al_3Si_3O_{12}Cl]$.
SOD110	Sodalite: Cerro Sapo, Ayopaya, Cochabamba, Bolivia $[Na_4Al_3Si_3O_{12}Cl]$, blue material) with ankerite ($[Ca(Mg,Fe^{+2},Mn)(CO_3)_2]$ – light green crystals) and dawsonite (CRB220; $[NaAl(CO_3)(OH)_2]$ white powdery material) (From Alfredo Petrov, Tucson 2011 show).

++

2.8b. XRD Data - Framework Silicates: Miscellaneous

None

++

2.8c. Compositional Data - Framework Silicates: Miscellaneous

Wt. %	CAN101	NEP101	NEP102	NEP103	RHO101	SOD102
SiO_2						
TiO_2						
Al_2O_3						
Cr_2O_3						
Fe_2O_3						
FeO				0.22		0.28
MnO						
MgO						
CaO						
V_2O_5						
CoO						
NiO						
ZnO						
TOTAL						
NUMBER OF IONS ON THE BASIS OF 24 OXYGEN						
Si						
Al						
Al						
Cr						
Fe^{3+}						
Ti						
Mg						
Fe^{2+}						
Mn						
Ca						
V						
Co						
Ni						
Zn						
P						
Na						
Total						
Source				U of A		U of A
Analysis				WC		WC

1. FeO determined by wet chemistry (WC) at University of Alberta.

++

2.8d. Spectral Data - Framework Silicates: Miscellaneous

Sample	*Facility/File No.*	*Description*
NEP103	RELAB CANE03	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
NEP103	RELAB LANE03	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SOD102	RELAB CASO12	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SOD102	RELAB LASO12	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.

++

END of 2.8.

2. Silicates

2.9. Scapolites

2.9a. Sample Descriptions - Scapolites

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
PLG124	Meionite: Misidentified as plagioclase feldspar; U of Manitoba X-ray diffraction matches meionite perfectly.
SCA101	Scapolite: Pointe au Chene, Quebec, Canada [$(Na,Ca,K)_4(Al_3(Al,Si)_3Si_6O_{24})(Cl,CO_3,SO_4,OH)$] (Minerals Unlimited). {Wernerite(?): Crystalline with assoc. Bright orange-yellow}. Lots available, many grams of <45 and 45-90µm powders.
SCA102	Dipyre: Singatse Range, near Yerington, Lyon County, Nevada, USA [close to marialite end member] (Minerals Unlimited). {White fibro-columnar masses}. Lots of sample left, many grams of <45 and 45-90 powders.
SCA103	Marialite: Singatse Range, near Yerington, Lyon County, Nevada, USA [$Na_4(Al_3Si_9O_{24})Cl$]. (Minerals Unlimited). {Unknown, see dipyre above?}. Some sample left, lots of <45 and 45-90µm powder.
SCA104	Meionite: Lago Termorgio, Ticino, Switzerland [$Ca_4(Al_6Si_6O_{24})CO_3$] (Minerals Unlimited). {Description for Italy locality: small white or glassy crystals on rock}. Not much sample, only <45µm made (~1gram).
SCA105	Mizzonite: Susan Lode, Black Hills, near Custer, Custer County, South Dakota, USA [close to meionite end member] (Minerals Unlimited). {Rich cleavable, some assoc.}. Lots of sample, lots of <45 and 45-90µm powders.
SCA110	Scapolite: Morogoro, Tanzania (single crystal) [The Crystal Circle, Tucson 2011 show].

++

2.9b. XRD Data - Scapolites

2.9b.1. University of Manitoba - January 2006

PLG124 Meionite matches perfectly.

++

2.9c. Compositional Data - Scapolites

Wt. %	SCA101	SCA102	SCA103	SCA104	SCA105

None yet.

++

2.9c. Spectral Data - Scapolites

Sample	*Facility/File No.*	*Description*
SCA101	RELAB csc114	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SCA101	RELAB lasc114	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SCA102	RELAB csc115	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SCA102	RELAB lasc115	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SCA103	RELAB csc116	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SCA103	RELAB lasc116	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SCA104	RELAB csc117	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SCA104	RELAB lasc117	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SCA105	RELAB csc118	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SCA105	RELAB lasc118	<45 µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.

++

END of 2.9.

2. Silicates

2.10. Zeolites

2.10a. Sample Descriptions - Zeolites

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
ZEO105	Wairakite: Ejected from drill hole #66, Wairakei, New Zealand (Smithsonian Institution NMNH #137255) (Group 1 zeolite: Breck textbook).
ZEO106	Wairakite: Bandai-atami, Kohriyama, Fukushima, Japan (Smithsonian Institution NMNH #143354). (Group 1 zeolite: Breck textbook).
ZEO107	Gismondine: Capo di Bova, Rome, Italy (Smithsonian Institution NMNH #85160). (Group 1 zeolite: Breck textbook).
ZEO108	Gismondine: Castel de Decimo, Roma, Lazio, Italy (Smithsonian Institution NMNH #138649). (Group 1 zeolite: Breck textbook).
ZEO109	Thomsonite: Elipse Beach, N. shore of Lake Superior, Minnesota, USA (Smithsonian Institution NMNH #46267-1). [pink phase in pebbles]. (Group 5 zeolite: Breck textbook).
ZEO110	Thomsonite: North Table Mountain, Golden, Jefferson County, Colorado, USA (Smithsonian Institution NMNH #83259). (Group 5 zeolite: Breck textbook).
ZEO111	Scolecite: Hyerabad, India (Smithsonian Institution NMNH #93085). (Group 5 zeolite: Breck textbook).
ZEO112	Scolecite: Poonah, Maharashtra, India (Smithsonian Institution NMNH #R4301-1). (Group 5 zeolite: Breck textbook).
ZEO113	Mesolite: Advocate Harbour, Nova Scotia, Canada (Smithsonian Institution NMNH #113929). (Group 5 zeolite: Breck textbook).
ZEO114	Mesolite: Cape d'Or, Cumberland County, Nova Scotia, Canada (Smithsonian Institution NMNH #94550). (Group 5 zeolite: Breck textbook).
ZEO115	Natrolite: Sao Pedro, Sao Paulo, Brazil (Smithsonian Institution NMNH #106928). (Group 5 zeolite: Breck textbook).
ZEO116	Natrolite: Techlovice, Czechoslovakia (Smithsonian Institution NMNH #162474). (Group 5 zeolite: Breck textbook).
ZEO117	Chabazite: Christmas, Gila County, Arizona, USA (Smithsonian Institution NMNH #122868). (Group 4 zeolite: Breck textbook).
ZEO118	Chabazite: Cape Blomiden, Nova Scotia, Canada (Smithsonian Institution NMNH #R4175). (Group 4 zeolite: Breck textbook).
ZEO119	Laumontite: Great Notch, Essex County, New Jersey, USA (Smithsonian Institution NMNH #85382). (Group 1 zeolite: Breck textbook).
ZEO120	Laumontite: Baltimore, Maryland, USA (Smithsonian Institution NMNH #97504). (Group 1 zeolite: Breck textbook).
ZEO121	Stilbite: Margaretsville, Nova Scotia, Canada (Smithsonian Institution NMNH #132753). (Group 7 zeolite: Breck textbook).
ZEO122	Stilbite: Nova Scotia, Canada (Smithsonian Institution NMNH #104654). (Group 7 zeolite: Breck textbook).
ZEO123	Phillipsite: Pine Valley, Eureka County, Nevada, USA (Smithsonian Institution NMNH #122858). (Group 1 zeolite: Breck textbook).
ZEO124	Phillipsite: Garbagna, Allesandria, Italy (Smithsonian Institution NMNH #121217). (Group 1 zeolite: Breck textbook).
ZEO125	Erionite: Needle Peak, Pershing County, Nevada, USA (Smithsonian Institution NMNH #122860). (Group 2 zeolite: Breck textbook).
ZEO126	Erionite: Crooked Creek, Rome, Malheur County, Oregon, USA (Smithsonian Institution NMNH

#122847). (Group 2 zeolite: Breck textbook).

ZEO127 Clinoptilolite: Sheaville, Malheur County, Oregon, USA (Smithsonian Institution NMNH #144077). (Group 7 zeolite: Breck textbook).

ZEO128 Clinoptilolite: Fish Creek Mountains, Nevada, USA (Smithsonian Institution NMNH #114104-1). (Group 7 zeolite: Breck textbook).

ZEO129 Mordenite: Trinity Basin, Pershing County, Nevada, USA (Smithsonian Institution NMNH #122861). (Group 6 zeolite: Breck textbook).

ZEO130 Mordenite: Crooked Creek, Rome, Malheur County, Oregon, USA (Smithsonian Institution NMNH #122848). (Group 6 zeolite: Breck textbook).

ZEO131 Heulandite: Paterson, New Jersey, USA (Smithsonian Institution NMNH #R4073-1). (Group 7 zeolite: Breck textbook).

ZEO132 Heulandite: Teigarhorn, Iceland (Smithsonian Institution NMNH #138663). (Group 7 zeolite: Breck textbook).

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ZEO133 Levyne: Spray, Wheeler County, Oregon, USA ; with basalt (BAS301) [Minerals Unlimited]. (Group 2 zeolite: Breck textbook).

ZEO134 Natrolite: Headwaters of the San Benito River, San Benito County, California, USA [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO135 Natrolite: near Portsgrund, Norway [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO136 Heulandite: Lookout Point Dam, Lane County, Oregon, USA [Minerals Unlimited]. (Group 7 zeolite: Breck textbook).

ZEO137 Mesolite: Skookum-chuk Dam, Bucoda, Thurston County, Washington, USA [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO138 Natrolite: Springfield, Lane County, Oregon, USA [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO139 Offretite-erionite (cloudy white overgrowths on levyne (ZEO140) in basalt (BAS302): Beech Creek, Grant County, Oregon, USA [Minerals Unlimited]. (Group 2 zeolite: Breck textbook).

ZEO140 Levyne, with offretite-erionite (cloudy white) overgrowths (ZEO139) in basalt (BAS302): Beech Creek, Grant County, Oregon, USA [Minerals Unlimited]. (Group 2 zeolite: Breck textbook).

ZEO141 Chabazite: Bow Dam, Snake River, near Homestead, Baker County, Oregon, USA [Minerals Unlimited]. (Group 4 zeolite: Breck textbook).

ZEO142 Chabazite: Beech Creek, Grant County, Oregon, USA; in rock [Minerals Unlimited]. (Group 4 zeolite: Breck textbook).

ZEO143 Laumontite: South Fork of the Lewis River, Clark County, Washington, USA [Minerals Unlimited]. (Group 1 zeolite: Breck textbook).

ZEO144 Heulandite: Poona, India; on basalt (too thin for a basalt separate) [Minerals Unlimited]. (Group 7 zeolite: Breck textbook).

ZEO145 Heulandite: Smith's Cove, near Parrsboro, Nova Scotia, Canada [Minerals Unlimited]. (Group 7 zeolite: Breck textbook).

ZEO146 Stilbite: Flodigarry, Island of Skye, Scotland [Minerals Unlimited]. (Group 7 zeolite: Breck textbook).

ZEO147 Gmelinite: Springfield Butte, Lane County, Oregon, USA; with analcime (ANA001) and natrolite (ZEO149) [Minerals Unlimited]. (Group 4 zeolite: Breck textbook).

ZEO149 Natrolite: Springfield Butte, Lane County, Oregon, USA; with gmelinite (ZEO147) and analcime (ANA001) [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO150 Scolecite: Green Peter Dam, near Foster, Linn County, Oregon, USA; on basalt (BAS303) with stilbite (ZEO151) [Minerals Unlimited]. (Group 5 zeolite: Breck textbook). Not enough of the scolecite to separate out, but enough stilbite (ZEO151).

ZEO151 Stilbite: Green Peter Dam, near Foster, Linn County, Oregon, USA; on basalt (BAS303) with scolecite (ZEO150) [Minerals Unlimited]. (Group 7 zeolite: Breck textbook).

ZEO152 Ferrierite: Kamloops Lake, British Columbia, Canada; on chalcedony [Minerals Unlimited]. (Group 6 zeolite: Breck textbook).

ZEO153 Stilbite: Poona, India [Minerals Unlimited]. (Group 7 zeolite: Breck textbook).

ZEO154 Gonnardite (variety ranite): Barkevik, Langesundfjord, Norway; in nepheline syenite [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO155 Stilbite: Dead Indian Road, near Ashland, Jackson County, Oregon, USA [Minerals Unlimited].

(Group 7 zeolite: Breck textbook).

ZEO156 Stilbite (variety epidesmine): Perkiomenville, Montgomery County, Pennsylvania, USA [Minerals Unlimited]. (Group 7 zeolite: Breck textbook).

ZEO157 Analcime: Waldport, Lincoln County, Oregon, USA; on calcite [Minerals Unlimited]. (Group 1 zeolite: Breck textbook).

ZEO158 Thompsonite: Poona, India [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO159 Thompsonite: Drain, Douglas County, Oregon, USA [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO160 Paulingite: near Riggins, Idaho County, Idaho, USA; in basalt (BAS304) [Minerals Unlimited]. (Group 1 zeolite: Breck textbook).

ZEO161 Stellerite: Grant County, Oregon, USA [Minerals Unlimited]. (Group zeolite unknown: Breck textbook).

ZEO162 Dachiardite: Cape Lookout, Tillamook County, Oregon, USA; with mordenite (ZEO163) and clinoptilolite [ZEO164]. {mordenite is white minute crystals (crusts, assumed); clinoptilolite is a variation of heulandite; assumed to be the larger bluish-white radiating masses in the other vugs} [Minerals Unlimited]. (Group 6 zeolite: Breck textbook).

ZEO163 Mordenite: Cape Lookout, Tillamook County, Oregon, USA; with dachiardite (ZEO162) and clinoptilolite [ZEO164]. {mordenite is white minute crystals (crusts, assumed); clinoptilolite is a variation of heulandite; assumed to be the larger bluish-white radiating masses in the other vugs} [Minerals Unlimited]. (Group 6 zeolite: Breck textbook).

ZEO164 Clinoptilolite: Cape Lookout, Tillamook County, Oregon, USA; with dachiardite (ZEO162) and mordenite (ZEO163). {mordenite is white minute crystals (crusts, assumed); clinoptilolite is a variation of heulandite; assumed to be the larger bluish-white radiating masses in the other vugs} [Minerals Unlimited]. (Group 7 zeolite: Breck textbook).

ZEO165 Thomsonite (variety faroelite): The Ouirang, Island of Skye, Scotland; with chabazite (not enough chabazite for a separate) [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO166 Phillipsite: Kimberley, Grant County, Oregon, USA [Minerals Unlimited]. (Group 1 zeolite: Breck textbook).

ZEO167 Thomsonite: Grand Marais, Cook County, Minnesota, USA; in basalt (BAS305) [Minerals Unlimited]. (Group 5 zeolite: Breck textbook).

ZEO168 Analcime: Springfield Butte, Lane County, Oregon, USA; with gmelinite (ZEO147) and natrolite (ZEO149) [Minerals Unlimited]. Also labelled as ANA001. See also ZEO157 (it's analcime).

ZEO169 Prehnite: Bendoukou, Sandare District, Kayes region, Mali (see section 2.11 – low grade metamorphic minerals).

ZEO170 Prehnite: Ilimaussaq Complex, head of Kangerdluarssuk Fjord, Narrssaq Kommune, Greenland (received from Royal Ontario Museum, their sample ID M34039; March 2014; for Karly Pitman optical constants project).

2.10a.1. From Jim Crowley (USGS) June 2008 for Mars box run

ZEO200 Heulandite, USGS #42 (<45 μm powder) (from Jim Crowley at USGS, June 2008 for Mars box run).

ZEO201 Chabazite; USGS #40 (<45 μm powder) (from Jim Crowley at USGS, June 2008 for Mars box run).

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NOTE: samples in very small vials are the remains after baking at 950°C for 1 to 1-1/2 hours for loss on ignition determinations.

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2.10b. XRD Data - Zeolites

None

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2.10c. Compositional Data - Zeolites

Wt. %	ZEO105	ZEO106	ZEO107	ZEO108	ZEO109	ZEO110	ZEO111
NMNH#	137255	143354	85160	138649	46267-1	83259	93085
SiO_2	82.04	59.59	46.85	45.36	51.22	46.85	53.63
TiO_2	0.14	0.06	0.00	0.01	0.00	0.00	0.00
Al_2O_3	10.11	25.14	33.06	33.65	31.00	33.01	29.98
*Fe_2O_3**	*(1.05)*	*(0.91)*	*(0.21)*	*(0.33)*	*(0.18)*	*(0.12)*	*(0.11)*
FeO	0.29	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Fe_2O_3	0.73	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
MnO	0.03	0.02	0.01	0.01	0.01	0.01	0.01
MgO	0.29	0.22	0.06	0.13	0.08	0.05	0.04
CaO	3.20	13.35	15.28	15.56	11.24	12.32	16.28
Na_2O	0.15	0.39	0.44	0.45	6.82	6.83	0.24
K_2O	2.48	0.02	3.51	2.39	0.01	0.02	0.02
P_2O_5	0.03	0.02	0.01	0.02	0.01	0.01	0.01
TOTAL	99.52	99.75	99.81	99.36	100.65	99.63	100.34
LOI	2.59	9.01	20.32	21.33	13.13	12.82	14.12
ppm							
Sr	80	109	3124	12174	555	3401	90
Zr	98	38	54	<2	30	7	40
V	47	40	35	38	33	32	33
Cr	41	36	39	34	31	33	38
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.10c. Compositional Data - Zeolites (continued)

Wt. %	ZEO112	ZEO113	ZEO114	ZEO115	ZEO116	ZEO117	ZEO118
NMNH#	R43010-1	113929	94550	106928	162474	122868	R4175
SiO_2	68.46	51.61	52.12	52.71	50.08	65.30	64.38
TiO_2	0.00	0.00	0.00	0.00	0.01	0.37	0.00
Al_2O_3	19.43	29.35	29.67	29.04	30.25	18.17	22.30
*Fe_2O_3**	*(0.11)*	*(0.10)*	*(0.25)*	*(0.20)*	*(0.11)*	*(2.28)*	*(0.14)*
FeO	n.d.	n.d.	n.d.	n.d.	n.d.	0.28	n.d.
Fe_2O_3	n.d.	n.d.	n.d.	n.d.	n.d.	1.97	n.d.
MnO	0.00	0.01	0.01	0.01	0.01	0.04	0.01
MgO	0.09	0.13	0.06	0.11	0.05	3.05	0.09
CaO	10.39	10.24	11.05	0.97	1.56	3.40	10.18
Na_2O	1.23	8.14	6.68	17.34	16.83	4.82	0.77
K_2O	0.03	0.11	0.02	0.04	0.04	1.88	1.46
P_2O_5	0.01	0.01	0.01	0.01	0.01	0.09	0.01
TOTAL	99.77	99.73	99.89	100.47	100.16	99.49	100.11
LOI	18.94	13.38	13.00	10.27	10.29	18.39	27.19
ppm							
Sr	77	95	72	115	10201	681	6404
Zr	31	44	49	36	<2	173	<2
V	36	37	33	34	30	69	32
Cr	30	35	34	122	35	48	33
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.10c. Compositional Data - Zeolites (continued)

Wt. %	ZEO119	ZEO120	ZEO121	ZEO122	ZEO123	ZEO124	ZEO125
NMNH#	85382	97504	132753	104654	122858	121217	122860
SiO_2	65.93	38.09	68.04	67.41	65.35	66.24	70.46
TiO_2	0.00	0.00	0.00	0.00	0.18	0.66	0.52
Al_2O_3	21.30	15.72	20.12	20.76	18.54	18.77	14.81
*Fe_2O_3**	*(0.18)*	*(0.16)*	*(0.13)*	*(0.09)*	*(2.16)*	*(2.12)*	*(3.05)*
FeO	n.d.	n.d.	n.d.	n.d.	0.22	0.24	n.d.
Fe_2O_3	n.d.	n.d.	n.d.	n.d.	1.92	1.85	n.d.
MnO	0.01	0.23	0.01	0.00	0.01	0.02	0.03
MgO	0.23	0.44	0.08	0.03	0.29	1.78	1.07
CaO	10.61	43.47	7.20	9.71	0.31	4.79	0.99
Na_2O	1.10	0.32	3.76	2.09	9.18	1.30	5.20
K_2O	0.29	0.93	1.06	0.04	4.24	3.47	4.10
P_2O_5	0.01	0.03	0.01	0.01	0.07	0.06	0.06
TOTAL	99.69	99.43	100.50	100.16	100.35	99.57	100.43
LOI	17.24	26.38	17.60	18.71	16.68	15.02	10.94
ppm							
Sr	218	236	723	101	65	2230	287
Zr	23	16	25	23	200	703	577
V	31	36	37	35	60	79	145
Cr	47	38	35	35	39	67	39
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.10c. Compositional Data - Zeolites (continued)

Wt. %	ZEO126	ZEO127	ZEO128	ZEO129	ZEO130	ZEO131	ZEO132
NMNH#	122847	144077	114104-1	122861	122848	R4073-1	138663
SiO_2	70.25	73.80	77.37	71.96	64.66	66.46	69.42
TiO_2	0.32	0.30	0.06	0.68	0.54	0.00	0.00
Al_2O_3	15.97	13.22	13.53	14.42	10.00	19.78	19.18
*Fe_2O_3**	*(2.37)*	*(3.28)*	*(0.48)*	*(1.93)*	*(4.14)*	*(0.12)*	*(0.15)*
FeO	n.d.	0.24	n.d.	n.d.	n.d.	n.d.	n.d.
Fe_2O_3	n.d.	3.01	n.d.	n.d.	n.d.	n.d.	n.d.
MnO	0.05	0.05	0.01	0.01	0.09	0.01	0.01
MgO	1.45	0.34	0.81	0.38	2.56	0.02	0.03
CaO	2.29	1.72	3.31	1.52	10.34	6.66	8.32
Na_2O	2.18	1.78	1.17	4.10	2.21	2.35	1.78
K_2O	5.21	4.96	3.33	4.38	4.92	0.94	0.90
P_2O_5	0.06	0.04	0.02	0.24	0.23	0.01	0.01
TOTAL	100.25	99.58	100.13	99.73	99.82	99.91	100.32
LOI	16.14	11.57	13.20	9.41	9.61	15.65	15.70
ppm							
Sr	158	313	154	152	587	29990	4263
Zr	464	565	138	253	174	<2	3
V	116	40	42	331	195	35	32
Cr	40	32	34	39	76	39	34
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.10c. Compositional Data - Zeolites (continued)

Wt. %	ZEO133	ZEO134	ZEO135	ZEO136	ZEO137	ZEO138	ZEO139	ZEO140
None yet								
SiO_2								
TiO_2								
Al_2O_3								
Fe_2O_3*								
FeO								
Fe_2O_3								
MnO								
MgO								
CaO								
Na_2O								
K_2O								
P_2O_5								
TOTAL								
LOI								
ppm								
Sr								
Zr								
V								
Cr								
Source								
Analysis								

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2.10c. Compositional Data - Zeolites (continued)

Wt. %	ZEO141	ZEO142	ZEO143	ZEO144	ZEO145	ZEO146	ZEO147
None yet							
SiO_2							
TiO_2							
Al_2O_3							
Fe_2O_3*							
FeO							
Fe_2O_3							
MnO							
MgO							
CaO							
Na_2O							
K_2O							
P_2O_5							
SrO							
ZrO_2							
V_2O_5							
Cr_2O_3							
TOTAL							
LOI							
ppm							
Sr							
Zr							
V							
Cr							
Source							
Analysis							

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2.10c. Compositional Data - Zeolites (continued)

Wt. %	ZEO149	ZEO151	ZEO153	ZEO154	ZEO155	ZEO156	ZEO157
SiO_2							8.35
TiO_2							0.00
Al_2O_3							3.51
*Fe_2O_3**							*(1.76)*
FeO							0.57
Fe_2O_3							1.13
MnO							0.53
MgO							0.31
CaO							82.79
Na_2O							1.91
K_2O							0.12
P_2O_5							0.04
TOTAL							99.32
LOI							38.39
ppm							
Sr							147
Zr							29
V							37
Co							<2
Cr							18
Cu							110
Ni							<2
Rb							<2
Source							Mertzman
Analysis							XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.10c. Compositional Data - Zeolites (continued)

Wt. %	ZEO158	ZEO159	ZEO160	ZEO161	ZEO162	ZEO163	ZEO164
None yet							
SiO_2							
TiO_2							
Al_2O_3							
Fe_2O_3*							
FeO							
Fe_2O_3							
MnO							
MgO							
CaO							
Na_2O							
K_2O							
P_2O_5							
TOTAL							
LOI							
ppm							
Sr							
Zr							
V							
Cr							
Source							
Analysis							

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2.10c. Compositional Data - Zeolites (continued)

Wt. %	ZEO165	ZEO166	ZEO167	ZEO168	ZEO170	ZEO200	ZEO201
ROM#					M34039		
USGS#						42	40
SiO_2					45.16	66.61	62.56
TiO_2					0.00	0.00	0.00
Al_2O_3					24.99	19.40	23.48
*Fe_2O_3**					*(0.73)*	*(0.17)*	*(0.17)*
FeO					0.14	n.d.	n.d.
Fe_2O_3					0.57	n.d.	n.d.
MnO					0.012	0.01	0.01
MgO					0.05	0.09	0.04
CaO					28.24	6.10	9.02
Na_2O					0.10	2.54	3.59
K_2O					0.000	0.70	0.73
P_2O_5					0.012	0.02	0.01
SO_3					0.53	0.43	0.21
TOTAL					99.82	96.07	99.82
LOI					4.23	16.11	21.05
ppm							
Rb						10	5
Sr					61	29615	4863
Zr					28	163	136
V					<2	30	26
Ni					<2	<2	<2
Cr					<2	23	17
Co					<2	1	<1
Source					Mertzman	Mertzman	Mertzman
Analysis					XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.10c. Compositional Data - Zeolites (continued)

Wt. % (for oxides), ppm for elements, ppb for Au (from Johnson Space Center / Pranoti Asher)

Sample	ZEO105	ZEO106	ZEO107	ZEO108
Na_2O	0.1887±0.0026	0.413±0.006	0.438±0.005	0.434±0.005
K_2O	2.60±0.07	<0.08	3.53±0.10	2.41±0.08
CaO	2.99±0.18	13.34±0.29	15.7±0.4	16.0±0.4
Sc	2.451±0.028	1.855±0.021	0.1283±0.0019	0.229±0.003
Cr	2.90±0.28	5.68±0.29	3.78±0.25	3.6±0.3
FeO	0.840±0.010	0.738±0.009	0.1090±0.0019	0.225±0.003
Co	1.257±0.023	1.197±0.020	0.253±0.011	0.781±0.019
Ni	---	---	---	---
As	4.55±0.14	0.47±0.11	9.33±0.16	1.03±0.08
Se	<0.3	---	---	---
Br	---	---	---	0.16±0.03
Rb	125±4	16.0±0.9	191±6	132±4
Sr	46±10	75±11	3160±140	12100±500
Zr	76±12	15±7	<80	<33
Sb	0.529±0.019	0.762±0.023	1.185±0.021	0.584±0.015
Cs	35.0±0.5	102.6±1.5	0.396±0.012	1.029±0.022
Ba	239±9	<21	2040±40	1860±40
La	12.43±0.14	1.461±0.029	7.98±0.09	4.88±0.06
Ce	22.6±0.3	2.99±0.12	10.90±0.21	8.19±0.19
Nd	7.3±1.7	<5	3.1±1.5	<7
Sm	1.142±0.016	0.366±0.007	0.945±0.019	0.837±0.016
Eu	0.405±0.010	0.212±0.007	0.113±0.006	0.098±0.006
Tb	0.154±0.009	0.071±0.010	0.064±0.007	0.063±0.009
Yb	0.779±0.024	0.236±0.018	0.135±0.013	0.115±0.014
Lu	0.124±0.005	0.0378±0.0028	0.018±0.007	0.0179±0.0019
Hf	2.27±0.06	0.51±0.03	1.29±0.03	0.424±0.028
Ta	0.237±0.012	0.033±0.007	0.051±0.007	0.103±0.010
W	0.90±0.12	0.48±0.18	0.38±0.14	0.29±0.12
Au	5.9±1.1	<5	2.8±0.5	21.0±0.8
Th	3.89±0.06	0.224±0.022	1.344±0.028	1.52±0.03
U	0.95±0.05	<0.23	14.18±0.26	10.76±0.20

2.10c. Compositional Data - Zeolites (continued)

Wt. % (for oxides), ppm for elements, ppb for Au (from Johnson Space Center / Pranoti Asher)

Sample	ZEO109	ZEO110	ZEO111	ZEO112
Na_2O	6.44±0.08	6.48±0.08	0.2486±0.0030	1.215±0.015
K_2O	<0.4	<0.25	<0.048	<0.14
CaO	10.9±0.3	12.06±0.29	16.2±0.3	10.09±0.25
Sc	0.1583±0.0022	0.1132±0.0016	0.0917±0.0013	0.0272±0.0006
Cr	0.77±0.16	1.11±0.18	1.27±0.11	3.78±0.18
FeO	0.0805±0.0015	0.0421±0.0011	0.0356±0.0008	0.0067±0.0005
Co	0.374±0.012	0.099±0.007	0.298±0.008	0.026±0.004
Ni	---	---	17±6	---
As	<0.5	1.09±0.08	0.22±0.03	<0.57
Se	---	---	---	---
Br	0.53±0.08	---	<0.08	---
Rb	<1.3	<2.0	0.97±0.20	0.71±0.24
Sr	522±23	3190±130	49±6	50±6
Zr	12±3	---	22±3	11.0±2.1
Sb	0.089±0.009	0.085±0.009	0.099±0.005	0.037±0.007
Cs	0.723±0.015	0.949±0.017	0.187±0.006	0.050±0.005
Ba	<13	<12	9±4	<11
La	0.121±0.020	0.281±0.022	0.148±0.008	0.037±0.011
Ce	0.23±0.06	0.53±0.08	0.23±0.05	<0.22
Nd	<2.2	<2.4	<2.2	<2.7
Sm	0.0272±0.0025	0.045±0.004	0.0376±0.0017	0.0102±0.0022
Eu	0.014±0.003	0.0143±0.0027	0.0095±0.0017	<0.006
Tb	<0.019	<0.021	<0.015	<0.011
Yb	<0.050	<0.06	0.021±0.009	<0.06
Lu	0.0043±0.0015	0.0044±0.0015	0.0043±0.0018	<0.006
Hf	0.327±0.023	0.094±0.018	0.549±0.020	0.279±0.017
Ta	---	---	<0.013	---
W	---	---	---	---
Au	5.8±0.7	2.3±0.9	6.0±0.4	5.3±0.9
Th	<0.049	0.051±0.011	0.037±0.009	<0.045
U	<0.12	<0.18	0.179±0.017	<0.14

2.10c. Compositional Data - Zeolites (continued)

Wt. % (for oxides), ppm for elements, ppb for Au (from Johnson Space Center / Pranoti Asher)

Sample	ZEO113	ZEO114	ZEO115	ZEO116
Na_2O	7.51±0.09	6.30±0.07	16.29±0.19	15.98±0.19
K_2O	<0.36	<0.3	<1.3	<0.9
CaO	10.2±0.5	11.0±0.4	0.91±0.11	1.54±0.11
Sc	0.0389±0.0009	0.1547±0.0023	0.1611±0.0021	0.1337±0.0016
Cr	0.58±0.7	1.33±0.21	1.55±0.17	1.43±0.14
FeO	0.0131±0.0008	0.0807±0.0016	0.0230±0.0008	0.0487±0.0009
Co	0.050±0.006	0.154±0.009	0.263±0.008	0.143±0.005
Ni	---	---	5.3±2.0	---
As	0.42±0.13	<0.32	<0.7	<0.7
Se	---	---	---	<0.14
Br	27.4±1.4	0.98±0.10	---	---
Rb	0.60±0.26	1.0±0.3	0.88±0.29	2.03±0.22
Sr	44±8	46±9	87±6	9660±290
Zr	27±4	36±6	16±3	11.1±2.7
Sb	0.113±0.012	0.107±0.010	0.039±0.007	0.090±0.007
Cs	0.582±0.013	0.041±0.007	0.107±0.006	0.118±0.005
Ba	<21	<20	43±4	17±3
La	0.09±0.04	0.312±0.023	0.38±0.03	0.479±0.030
Ce	0.22±0.07	0.48±0.07	0.62±0.07	0.96±0.05
Nd	<2.9	<2.5	<2.2	<2.1
Sm	0.0160±0.0022	0.0374±0.0026	0.084±0.004	0.091±0.005
Eu	0.0117±0.0028	0.026±0.003	0.0236±0.0025	0.0141±0.0017
Tb	<0.08	<0.012	0.017±0.005	0.0169±0.0030
Yb	<0.06	0.042±0.015	0.039±0.013	0.044±0.011
Lu	<0.013	0.0070±0.0024	0.0065±0.0018	0.0086±0.0016
Hf	0.590±0.025	0.75±0.03	0.379±0.020	0.229±0.013
Ta	0.016±0.007	---	---	0.043±0.003
W	---	---	---	---
Au	<2.5	2.3±0.7	1.5±0.7	1.4±0.6
Th	0.030±0.013	0.045±0.013	0.027±0.012	0.209±0.011
U	<0.18	<0.15	<0.13	0.12±0.05

2.10c. Compositional Data - Zeolites (continued)

Wt. % (for oxides), ppm for elements, ppb for Au (from Johnson Space Center / Pranoti Asher)

Sample	ZEO117	ZEO118	ZEO119	ZEO120
Na_2O	4.73±0.06	0.769±0.010	1.101±0.013	0.315±0.005
K_2O	1.86±0.19	1.46±0.08	0.30±0.05	0.87±0.10
CaO	3.24±0.28	10.21±0.23	10.58±0.27	38.8±0.8
Sc	5.28±0.06	0.2416±0.0030	0.1658±0.0022	0.251±0.003
Cr	21.3±0.5	5.41±0.23	12.05±0.23	4.34±0.25
FeO	1.911±0.022	0.0827±0.0014	0.0798±0.0013	0.1064±0.0018
Co	9.40±0.12	0.191±0.008	0.595±0.011	0.352±0.011
Ni	<35	<7	8.2±1.8	---
As	2.62±0.29	0.39±0.09	0.65±0.05	<0.6
Se	<0.6	---	<0.13	---
Br	1.57±0.14	---	<0.10	---
Rb	39.3±2.0	7.5±0.5	2.9±0.3	3.3±0.4
Sr	653±29	6250±270	208±11	156±11
Zr	191±29	<9	4.8±2.3	<16
Sb	0.462±0.020	0.069±0.008	0.084±0.006	0.078±0.010
Cs	3.45±0.06	1.572±0.027	1.638±0.025	1.446±0.025
Ba	246±10	1790±40	<11	<17
La	21.82±0.26	0.212±0.013	1.002±0.017	0.657±0.024
Ce	49.7±0.7	0.44±0.06	2.24±0.06	1.15±0.09
Nd	18.3±2.2	<2.2	<2.6	<5
Sm	3.35±0.05	0.0522±0.0024	0.243±0.004	0.242±0.008
Eu	0.568±0.013	0.197±0.005	0.0259±0.0024	0.159±0.006
Tb	0.493±0.014	<0.025	0.042±0.004	0.071±0.008
Yb	1.97±0.04	0.034±0.014	0.166±0.009	0.325±0.018
Lu	0.267±0.007	0.0050±0.0014	0.0243±0.0017	0.050±0.003
Hf	5.40±0.10	0.047±0.023	0.152±0.013	---
Ta	2.99±0.07	---	0.086±0.005	---
W	1.7±0.6	<2.7	---	---
Au	12.2±1.2	2.6±0.6	8.0±0.4	<3.2
Th	19.32±0.27	<0.042	0.193±0.009	<0.04
U	2.12±0.09	<0.14	0.065±0.016	0.28±0.05

2.10c. Compositional Data - Zeolites (continued)

Wt. % (for oxides), ppm for elements, ppb for Au (from Johnson Space Center / Pranoti Asher)

Sample	ZEO121	ZEO122	ZEO123	ZEO124
Na_2O	3.56±0.04	2.012±0.023	8.66±0.10	1.272±0.018
K_2O	1.06±0.11	<0.18	4.4±0.5	3.49±0.22
CaO	6.90±0.23	9.65±0.25	0.32±0.09	4.4±0.3
Sc	0.1636±0.0022	0.0338±0.0007	1.532±0.018	4.82±0.05
Cr	3.07±0.18	6.42±0.19	6.85±0.26	35.3±0.7
FeO	0.0535±0.0011	0.0153±0.0007	1.810±0.021	2.031±0.021
Co	0.135±0.007	0.063±0.006	1.674±0.026	2.77±0.04
Ni	---	---	---	39±8
As	0.51±0.08	0.22±0.05	83.7±1.2	4.2±0.3
Se	---	---	<0.3	<0.6
Br	<0.15	---	3.39±0.21	---
Rb	4.8±0.4	1.20±0.26	40.6±1.7	103±3
Sr	716±29	62±6	44±9	2350±90
Zr	9.4±2.8	5.1±2.4	200±30	730±80
Sb	0.053±0.006	0.227±0.008	4.11±0.06	0.505±0.020
Cs	0.098±0.007	0.085±0.005	1.052±0.021	2.00±0.04
Ba	139±5	47±3	108±6	11450±210
La	0.273±0.016	0.142±0.011	1.80±0.04	126.0±1.4
Ce	0.57±0.06	0.25±0.05	4.59±0.15	225.2±2.8
Nd	<2.5	<2.1	<4.5	77±4
Sm	0.0577±0.0029	0.0245±0.0014	0.594±0.017	11.20±0.15
Eu	0.0115±0.0022	0.0049±0.0023	0.079±0.005	1.93±0.03
Tb	<0.017	<0.008	0.045±0.006	1.473±0.028
Yb	0.035±0.010	<0.028	0.139±0.014	3.80±0.06
Lu	0.0058±0.0014	<0.0028	0.0237±0.0019	0.514±0.010
Hf	0.205±0.018	0.079±0.012	6.50±0.12	17.11±0.29
Ta	0.015±0.005	<0.019	0.869±0.023	10.91±0.21
W	---	---	8.8±0.5	3.6±0.5
Au	2.0±0.4	9.2±0.5	5.3±0.8	<4.6
Th	0.122±0.011	0.035±0.007	0.431±0.019	38.0±0.5
U	0.174±0.024	<0.07	7.22±0.16	4.9±0.5

2.10c. Compositional Data - Zeolites (continued)

Wt. % (for oxides), ppm for elements, ppb for Au (from Johnson Space Center / Pranoti Asher)

Sample	ZEO125	ZEO126	ZEO127	ZEO128
Na_2O	4.89±0.6	2.181±0.028	1.745±0.0023	1.169±0.014
K_2O	4.04±0.28	5.2±0.5	4.7±0.4	3.38±0.35
CaO	0.9±0.3	2.21±0.27	1.42±0.22	3.39±0.15
Sc	5.54±0.06	4.09±0.05	4.20±0.05	3.37±0.04
Cr	8.5±0.6	5.3±0.4	4.6±0.5	2.81±0.28
FeO	2.67±0.03	2.046±0.023	2.612±0.029	0.374±0.005
Co	3.18±0.05	2.20±0.04	0.696±0.019	0.190±0.013
Ni	74±12	---	---	---
As	39.4±0.8	19.8±0.5	6.1±0.5	1.33±0.14
Se	<0.6	<0.6	<0.7	<0.6
Br	5.3±0.3	0.34±0.15	---	0.17±0.08
Rb	133±4	85.8±2.9	166±4	290±8
Sr	262±24	164±15	278±17	145±12
Zr	590±80	480±50	590±60	97±28
Sb	0.73±0.03	1.103±0.027	0.799±0.024	0.429±0.016
Cs	5.05±0.08	2.21±0.04	7.87±0.11	21.33±0.28
Ba	606±18	395±11	1740±13	270±9
La	125.1±1.4	50.6±0.6	64.9±0.7	10.14±0.12
Ce	242±3	97.8±1.2	131.8±1.7	24.6±0.4
Nd	96±6	38±3	61±4	13.4±1.8
Sm	18.19±0.25	7.04±0.10	11.54±0.16	4.66±0.06
Eu	1.456±0.028	1.044±0.020	1.246±0.022	0.097±0.006
Tb	2.41±0.04	1.015±0.019	1.690±0.028	0.851±0.017
Yb	4.76±0.08	2.54±0.04	5.65±0.08	2.07±0.03
Lu	0.608±0.013	0.355±0.008	0.753±0.013	0.276±0.005
Hf	16.35±0.30	13.07±0.22	15.42±0.26	6.82±0.12
Ta	3.54±0.08	3.13±0.07	2.27±0.05	6.34±0.13
W	2.3±0.8	---	---	---
Au	<5	<4.2	<2.8	2.0±0.6
Th	34.0±0.5	12.02±0.16	18.41±0.25	18.82±0.25
U	4.88±0.16	0.91±0.10	4.00±0.12	11.00±0.21

2.10c. Compositional Data - Zeolites (continued)

Wt. % (for oxides), ppm for elements, ppb for Au (from Johnson Space Center / Pranoti Asher)

Sample	ZEO129	ZEO130	ZEO131	ZEO132
Na_2O	3.89±0.05	2.211±0.028	2.231±0.026	1.712±0.020
K_2O	4.40±0.26	4.7±0.4	0.92±0.12	0.91±0.14
CaO	1.77±0.20	10.1±0.3	6.72±0.19	8.19±0.21
Sc	10.45±0.12	12.00±0.13	0.1084±0.0015	0.0633±0.0011
Cr	16.4±0.5	32.3±0.7	0.67±0.15	1.49±0.16
FeO	1.612±0.019	3.49±0.04	0.0208±0.0007	0.0263±0.0008
Co	1.370±0.029	8.82±0.11	0.023±0.004	0.105±0.006
Ni	---	44	---	10.0±2.1
As	223.0±3.0	30.1±0.6	<0.21	<0.14
Se	<0.9	<0.5	---	---
Br	0.62±0.12	---	---	---
Rb	93±3	98±3	20.8±0.8	4.5±0.4
Sr	138±15	585±29	30100±1100	4460±170
Zr	250±40	180±40	---	---
Sb	7.87±0.12	1.45±0.13	0.161±0.007	0.068±0.006
Cs	17.28±0.24	5.54±0.08	0.686±0.013	0.081±0.006
Ba	800±19	282±10	447±9	2200±40
La	37.2±0.4	26.1±0.3	0.139±0.013	0.123±0.010
Ce	73.0±1.0	56.9±0.8	0.35±0.06	0.22±0.05
Nd	38±3	27.8±2.7	<1.3	<1.5
Sm	7.46±0.11	6.37±0.09	0.0307±0.0017	0.0167±0.0011
Eu	1.377±0.027	1.088±0.020	<0.006	0.0072±0.0024
Tb	0.904±0.020	0.907±0.018	<0.014	<0.015
Yb	2.42±0.04	3.31±0.05	0.018±0.009	0.017±0.008
Lu	0.345±0.008	0.493±0.009	0.0030±0.0015	<0.0037
Hf	6.48±0.13	4.54±0.09	0.099±0.014	0.129±0.014
Ta	0.729±0.024	0.549±0.018	0.011±0.005	---
W	3.7±0.4	---	---	0.44±0.14
Au	3.1±1.2	4.5±1.0	2.7±0.4	0.68±0.26
Th	7.04±0.10	12.92±0.17	0.052±0.011	<0.039
U	3.50±0.10	14.8±0.3	<0.11	<0.05

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2.10d. Spectral Data - Zeolites

Sample	*Facility/File No.*	*Description*
ZEO101 - ZEO104 are listed under other silicates (prehnite and pumpellyite)		
ZEO105	RELAB c1ze05	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO105	RELAB laze05	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO106	RELAB c1ze06	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO106	RELAB laze06	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO107	RELAB c1ze07	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO107	RELAB laze07	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO108	RELAB c1ze08	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO108	RELAB laze08	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO109	RELAB c1ze09	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO109	RELAB laze09	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO110	RELAB c1ze10	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO110	RELAB laze10	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
ZEO110	PSF jul1306.009	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).
ZEO110	PSF azeo110	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
++++++		
ZEO111	RELAB c1ze11	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO111	RELAB laze11	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO112	RELAB c1ze12	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO112	RELAB laze12	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO113	RELAB c1ze13	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO113	RELAB laze13	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO114	RELAB c1ze14	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO114	RELAB laze14	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO115	RELAB c1ze15	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO115	RELAB laze15	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO116	RELAB c1ze16	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO116	RELAB laze16	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO117	RELAB c1ze17	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO117	RELAB laze17	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO118	RELAB c1ze18	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO118	RELAB laze18	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO119	RELAB c1ze19	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO119	RELAB laze19	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO120	RELAB c1ze20	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO120	RELAB laze20	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO121	RELAB c1ze21	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO121	RELAB laze21	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO122	RELAB c1ze22	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO122	RELAB laze22	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO123	RELAB c1ze23	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO123	RELAB laze23	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO124	RELAB c1ze24	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO124	RELAB laze24	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO125	RELAB c1ze25	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO125	RELAB laze25	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO126	RELAB c1ze26	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO126	RELAB laze26	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO127	RELAB c1ze27	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO127	RELAB laze27	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO128	RELAB c1ze28	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO128	RELAB laze28	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO129	RELAB c1ze29	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO129	RELAB laze29	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
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ZEO130	RELAB c1ze30	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO130	RELAB laze30	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO131	RELAB c1ze31	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO131	RELAB laze31	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO132	RELAB c1ze32	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO132	RELAB laze32	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO157	RELAB c1ze57	<45µm, 0.3-2.6µm, 30°/0°, 5 nm resolution.
ZEO157	RELAB laze57	<45µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
++++++		
ZEO169	PSF 130723b.017	<45 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output; 250 spectra averaged; ASD (directory: 130723 random minerals).
ZEO169	PSF 130723b.018	45-1000 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output; 250 spectra averaged; ASD (directory: 130723 random minerals).
++++++		
ZEO200	PSF 080801a.009	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).
ZEO200	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
++++++		
ZEO201	PSF 080801a.008	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).
ZEO201	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	

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END of 2.10.

2. Silicates

2.11. Other Silicates

2.11a. Sample Descriptions - Other Silicates

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

2.11a.1. Samples from International Space Analogue Rockstore (ISAR) – Nov. 2012

06AU01-3 Banded iron formation: Kitty's Gap outcrop, Pilbara, Australia.
99SA01-3 Chert: Buck Reef Chert, Barberton, South Africa.
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2.11a.2. Cross-calibration sample from Joern Helbert – Planet X soil challenge

PlanetX "Secret" sample from Joern Helbert (DLR) for 2009-2010 Planet X Soil Challenge – powdered (unsorted?) sample. Received Dec. 17, 2009; 5 grams.
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2.11a.3. Odd & Incompletely Characterized Samples:

INC002 Unknown: locality unknown, probably Bancroft, Ontario, Canada (G. Hudecek), originally pyroxene PYX002.
INC008 Unknown: locality unknown, probably Sudbury, Ontario, Canada (G. Hudecek), originally pyroxene PYX008.
INC011 Unknown: Harquahala Mountains, Yuma County, Arizona, USA (Wetaskiwin Rock Show), with pyroxene (wollastonite) PYX011.
INC022 Unknown: Kafveltorp Quarry, Kopperberg, Sweden (Minerals Unlimited), originally pyroxene PYX022, with olivine OLV008.
INC037 Unknown: Nye, Springwater County, Montana, USA (Minerals Unlimited), with pyroxene PYX037.
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2.11a.4. Low-grade metamorphic minerals

ZEO101 Pumpellyite: Carbunele, Paringu, Romania (Smithsonian Institution NMNH #C3189). [not a zeolite but common low grade metamorphic product].
ZEO102 Pumpellyite: Isle Royale, Lake Superior, Michigan, USA (Smithsonian Institution NMNH #82505). [not a zeolite but common low grade metamorphic product].
ZEO103 Prehnite: Kilpatrick Hills, Scotland (Smithsonian Institution NMNH #78734-1). [not a zeolite but common low grade metamorphic product].
ZEO104 Prehnite: Prospect Park, New Jersey, USA (Smithsonian Institution NMNH #171671). [not a zeolite but common low grade metamorphic product].
ZEO169 Prehnite: Bendoukou, Sandare District, Kayes Region, Mali (December 2012 AGU Fall Meeting, purchased from Ikon Mining and Exploration). [not a zeolite but common low grade metamorphic product].
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2.11a.5. Other silicates

APO101	Apophyllite: Deccan Plateau, Maharashtra, India [$KCa_4Si_8O_{20}(F,OH)$-$8H_2O$] (December 2012 AGU Fall Meeting, purchased from Ikon Mining and Exploration).
BOREA07c	Lightest coloured bands in BOREA07 banded iron formation boreal sample.
CHM103c	Chert: Host rock of chamosite (CHM103).
DIS001	Diatomaceous silica; Kieselguhr. Sigma Aldrich #392545-1KG [91053-39-3], batch #MKAA0910; 1 kg (received Dec. 12, 2009).
EME001	Emerald: Columbia (variety of beryl: $Be_3Al_2Si_6O_{18}$) (Discovery Gemstones Ltd. Edmonton, AB, Canada – August 2008).
JAD001	"Jade": locality unknown, probably British Columbia, Canada [could be nephrite (tremolite-actinolite ($Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$ (more probable); or jadeite - a pyroxenoid ($NaAlSi_2O_6$)] (acquired from 2001 Manitoba Rock and Mineral Show) (for pigments project - although not a pigment).
JAD002	Nephrite (variety of actinolite; "BC Jade"): Mud Bay beach, Vancouver, BC, Canada (self collected; July 2004) ($Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$.
JAD003	Nephrite (variety of actinolite; "BC Jade"): Mud Bay beach, Vancouver, BC, Canada (self collected; July 2004) ($Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$.
JAD004	Nephrite (variety of actinolite; "BC Jade"): Mud Bay beach, Vancouver, BC, Canada (self collected; July 2004) ($Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$.
KYA001	Kyanite; locality unknown (Al_2SiO_5).
MIS015	Milky quartz.
MSI-A2-05	Quartz vein in marble.
OPA001	Opal: locality unknown – University of Winnipeg Department of Geography collection #M268-5. "c": colourless/whitest part of the sample; "b": browner portion of the sample.
OPA002	Opal: locality unknown – University of Winnipeg Department of Geography collection "#13". "r": reddest part of the sample; "o": orange part of the sample; "y": yellowest part of the sample.
PER001	Perlite, heated (Schultz brand); locality unknown. (Amorphous water-bearing volcanic glass (obsidian) – heated (~850-950C) to drive off water and expand the structure).
PIG205	*Is it sodium silicate decahydrate or sodium sulfate decahydrate?*
PIG351	Lazurite, Baikal (lapis lazuli) (catalog no. 410-17S). 10 grams. (green/blue group). *See section 19 of this document for data.*
PIG352	Lapis lazuli, premium grade lazurite (catalog no. 410-19S). 10 grams. (green/blue group). *See section 19 of this document for data.*
PIG353	Lapis Lazuli, standard grade lazurite (catalog no. 410-18S). 10 grams. (green/blue group). *See section 19 of this document for data.*
PIG373	Lazurite (natural pigment from Natural Pigments – naturalpigments.com). Sodalite group mineral containing sulfate groups. *See section 19 of this document for data.*
POL001	Pollucite; Manitoba (Mineral Society of Manitoba) [$(Ca,Na)_2Al_2Si_4O_{10}\cdot 2H_2O$].
PYX030	siliceous glass (obsidian?) (originally labelled as augite): Mount Lassen, Lassen County, California (Minerals Unlimited), in augite andesite with sulphur.
QUA101	Quartz: locality unknown (National Museum of Nature, Ottawa).
QUA102	Quartz: locality unknown; well-developed crystal group.
QUA103	Quartz; 8 samples from unknown localities; some are amethyst (Mineral Society of Manitoba).
QUA104	Aventurine quartz (quartz + mica inclusions); Cambia, Mysore District, India (Minerals Unlimited).
QUA105	Quartz, with plagioclase (?), unknown locality (display specimen from Tyson's).
QUA107	Rose quartz (from QUA103 set).
QUA108	Amethyst (from QUA103 set).
SGE001	Synthetic silica gel: Guangyi Food Additive Co. Ltd. (December 2007).
SGE002	Synthetic silica gel – EMD Chemicals, Grade 62; 60-200 mesh; cat. #SX0143U-3; CAS 63231-67-4 (obtained from U of W Dept. of Chemistry stores; Dec. 2007). Pore size is not controlled but is probably around 60-100 Angstroms.
SGE003	Synthetic silica gel desiccant (unknown brand).
SGE004	Synthetic silica gel desiccant (unknown brand).

SGE005 Synthetic silica gel desiccant (unknown brand, 11 packets from Canadian Tire skate boxes).
SGE006 Synthetic silica gel desiccant ("packed by N.O.P.", from rice cracker snacks; 1 packet).
SGE007 Synthetic silica gel desiccant (Nippon Kako-Kizai Co. Ltd. – cobalt chloride-free); one pack.

SGE101 Synthetic silica gel: Grade 12, pore size 22 Angstroms, 28-200 mesh (75-650 microns); pore volume: 0.43 cm^3/gm, BET surface area ca. 800m^2/g. Sigma-Aldrich #21,439-6-250G, Lot: S64006-438; EC 231-545-4. 250 grams, received Dec. 18, 2009.
SGE102 Synthetic silica gel: Grade 10180, 70-230 mesh (63-230 microns), 40 Angstrom pore size; pore volume: ~0.68 cm^3/gm, BET surface area ca. 750m^2/g. Sigma-Aldrich #40,356-3-100G, lot #S30196-277. 100 grams, received Dec. 18, 2009.
SGE103 Synthetic silica gel: 70-230 mesh (63-230 microns), 60 Angstrom pore size; pore volume: 0.75 cm^3/gm, BET surface area ca. 500m^2/g. Sigma-Aldrich #28824-250G, batch #23206KB; EC 231-545-4. 250 grams, received Dec. 12, 2009.
SGE104 Synthetic silica gel: Grade 10184, 70-230 mesh (63-230 microns), 100 Angstrom pore size; surface area ca. 300m^2/g. Sigma-Aldrich #40,360-1-100G, batch #15413LH, EC 231-545-4. 100 grams, received Dec. 18, 2009.
SGE105 Synthetic silica gel: Davisil >99%, Grade 646, 35-60 mesh (250-500 microns), 150 Angstrom pore size; pore volume: ~1.15 cm^3/gm, surface area ca. 300m^2/g. Sigma-Aldrich #236845-100G, batch #MKAA4429. 100 grams, received Dec. 18, 2009.

SIL001 Silicon (IV) oxide (SiO_2): -325 mesh, fused amorphous powder; 99.8% (metals basis); Alfa Aesar stock #89709, lot #B21S042; CAS #7631-86-9; 250 g. (received Jan. 17/08).
SIL002 Silicic acid, hydrate, reagent grade; $SiO_2 \cdot XH_2O$; loss on ignition: 12%. Alfa Aesar stock #33270, lot #H03S028; CAS #7699-41-4; 100 g. (received Feb. 1, 2008).
SIL003 Obsidian – Apache tears; unknown locality (Discovery Gemstones Ltd. – Edmonton, AB, Canada; July 2009).
SIL004 Obsidian – unknown locality (Discover Gemstones Ltd. – Edmonton, AB, Canada; July 2009).
SIL016 Granular groundmass of OLV016. Coso Hot Springs, Inyo Co.,CA, USA [Nature's Treasures].

SIL100 Tridymite, in rock: near Portola, Plumas Co., CA, USA [Minerals Unlimited; received March 2008].
SIL101 Opal, variety diatomite ("diatomaceous earth"). Napa Co., CA, USA [tan chalk masses; Minerals Unlimited; received March 2008].
SIL102 Quartz, variety lechatelierite ("fulgurite"). Cline Butte, near Bend, Deschutes Co., OR, USA [pieces showing fusion crust; Minerals Unlimited; received March 2008].
SIL103 Quartz, variety flint, with chalk. White Cliffs of Dover, England [Minerals Unlimited; received March 2008].
SIL104 Quartz, sulfuritic; colour due to inclusions of sulphur. Kalahari Desert, Namibia [pale yellow, sulphur impregnated massive; Minerals Unlimited; received March 2008].
SIL105 Quartz, variety chert. Mississippian Period, Boone Formation; Jefferson City, MO, USA [off white to gray fine-grained masses; Minerals Unlimited; received March 2008].
SIL106 Opal in chert; fluorescent green SW UV. North Edwards, Kramer Hills, Kern Co., CA, USA [cream-white massive in rock; Minerals Unlimited; received March 2008].
SIL107 Quartz, variety trinitite (fused radioactive sand from the first atomic bomb); White Sands Proving Ground, NM, USA [dull green fused masses; Minerals Unlimited; received March 2008].
SIL108 Quartz, variety chrysoprase (colour due to nickel oxide); Minas Gerais, Brazil [light green masses, minor rock; Minerals Unlimited; received March 2008].
SIL109 Quartz, variety milky quartz; Carson Hill, near Angel's Camp, Calaveras Co., CA, USA [Minerals Unlimited; received March 2008].
SIL110 Quartz, variety milky quartz with limonite; Carson Hill, near Angel's Camp, Calaveras Co., CA, USA [Minerals Unlimited; received March 2008].
SIL111 Quartz, variety citrine: Rio Grande do Sul, Brazil [orange-brown chunk; Minerals Unlimited; received March 2008].
SIL112 Quartz, variety novaculite, with limonite: Hot Springs, Garland Co., Arkansas, USA [white, fine-grained, massive; Minerals Unlimited; received March 2008].
SIL113 Quartz, variety chalcedony/agate (a nodule or portion): near El Sueco, Chihuahua, Mexico [Minerals Unlimited; received March 2008].

SIL114 Quartz, variety cristobalite: Glass Mountain, near Coso, Inyo Co., CA, USA [Minerals Unlimited; received March 2008].
SIL115 Quartz, variety opal: Coober Pedy, Australia (from Bill Buhay, April 2008).
SIL116 Quartz, variety diatomaceous earth; from U of Winnipeg Biology Department (May 29, 2009); used to treat water.
SIL117 Quartz, variety lechatelierite ("fulgurite"), Morocco (Discovery Gemstones Ltd. – Edmonton, AB, Canada, July 2009).
SIL120 Cordierite, with almandine, phlogopite, and anthophyllite: Governador Valadares, Minas Gerais, Brazil [Minerals Unlimited; received March 2008].
SIL121 Cordierite, in gneiss: Sannidal, Krageroo, Telemark, Norway [gray-blue crystalline in gneiss; Minerals Unlimited; received March 2008].
SIL122 Beryl: Minas Gerais, Brazil [gray to blue cloudy crystal fragments; Minerals Unlimited; received March 2008].
SIL123 Utah lace opal: mostly orange-yellow with smaller purple area, slab with one cut face [Aspen Rock and Gem, Tucson 2011 show].
SIL124 Utah lace opal: orange-yellow, purple, and lavender coloured areas, slab with two cut faces [Aspen Rock and Gem, Tucson 2011 show].
SIL125 Utah lace opal: glassy, thinly-bedded slab with one cut face [Aspen Rock and Gem, Tucson 2011 show].
SIL126 Pink agate: locality unknown [Western Woods Inc., Tucson 2011 show].
SIL127 Rose quartz: locality unknown [Western Woods Inc., Tucson 2011 show].
SIL128 Blue chalcedony: Madagascar [Mineral Treasure, Tucson 2011 show].
SIL129 Datolite (possibly) [$CaBSiO_4(OH)$]; from Rebecca Greenberger (Brown U. – June 2013). Collected in Connecticut River valley – road cut in Tarriffville, CT, USA (41°54'3"N 72° 45'42" W).

SIL130 "Libyan glass" aka "Libyan Desert Glass" (lechatelierite): ROM #M26692, 3.9 grams, sawn portion (from Royal Ontario Museum - April 14, 2009). See also Section 16.
SIL131 "Dakhleh glass". ROM #M48024 (lechatelierite), 2 grams (from Royal Ontario Museum - April 14, 2009). See also Section 16.
SIL132 Libyan Desert Glass: Gilf Kebir region, Egypt [The Crystal Circle, Tucson 2011 show]. See also Section 16.

SIL150 Datolite: West Paterson, NJ, USA (received from Royal Ontario Museum, their sample ID E3580; March 2014; for Karly Pitman optical constants project).

SIL250 Synthetic sodium meta-silicate, nonahydrate, crystal. Baker Analyzed reagent – $Na_2SiO_3 \bullet 9H_2O$. J.T. Baker no. 3686-01; Lot G14639; CAS No. 6834-92-0; 500 grams (received July 31, 2008).
SIL251 Synthetic sodium meta-silicate pentahydrate, granular, practical. EMD (via VWR) – $Na_2SiO_3 \bullet 5H_2O$. EMD SX0750-1, Lot 46300829 500 grams; corrosive (received July 31, 2008)..
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2.11a.6. Silica-rich samples from Robin Renaut – University of Saskatchewan; received June 1, 2008

SIL200 Fossil geyser mound (100+ years); Wairakei stream, New Zealand; opal-A + ?. (his ID number: NZ007).
SIL201 Sinter – recent. Wairakei Thermal Valley, New Zealand (vent mound); Opal-A (his ID number: NZ042).
SIL202 Silicified plants; Loop Road Hot Springs. Reporoa, New Zealand; Opal-A (his ID number: NZ054).
SIL203 Geyser vent sinter; Wairakei Thermal Valley, New Zealand; Opal-A (his ID number: NZ028).
SIL204 Vent sinter; Wairakei Thermal Valley, New Zealand; Opal-A (his ID number: NZ027).
SIL205 Silicified wood; from Loop Road Hot Springs, Reporoa, New Zealand; Opal-A (his ID number: NZ056).
SIL206 Effluent sinter from Wairakei geothermal power station, New Zealand (his ID number: NZ092).
SIL207 Native sulphur cemented by Opal-A, Waiotapu, New Zealand (no sample ID number).
SIL208 Magadi-type chert (quartz), Lake Magadi, Kenya (no sample ID number).

SIL209 Magadiite with alteration products (mainly quartz, some zeolites possible), Lake Magadi, Kenya (no sample ID number).
SIL210 Scoria cemented by hydrothermal silica, Korosi Volcano. Kenya (no sample ID number).
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2.11a.7. Silica-rich sinters from New Zealand from Bruce Mountain – April 2008

SIL300 Pumice rock: Rotokawa, New Zealand (10/04/08); 4 pieces.
SIL301 Spicular microstromatolite: Rotokawa, New Zealand (10/4/08).
SIL302 Laminated sinter: Rotokawa, New Zealand (10/04/08).
SIL303 Quartz/silica sand: Waiotapu, west of Champagne Pool, New Zealand (2/4/8).
SIL304 Sulphur/sulphate: Waiotapu; Devil's Bath, New Zealand (2/4/8).
SIL305 Sulphur/sulphate: Waiotapu; Bird's Nest Crater, New Zealand (2/4/8).
SIL306 Altered volcanic: Rotokawa, New Zealand (10/04/08).
SIL307 Argillized volcanics: Waiotapu; Devil's Bath, New Zealand (2/4/8).
SIL308 Fresh sinter: Wairakei Terraces, New Zealand.
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2.11a.8. Titanite (sphene)

SIL401 Titanite (sphene): near Ribbonwood, Riverside Co., CA, USA [$CaTi(SiO_4)(O,OH,F)$]. (Minerals Unlimited, received June 17, 2009 – 4 small fragments).
SIL402 Titanite (sphene): Minas Gerais, Brazil [$CaTi(SiO_4)(O,OH,F)$]. (Minerals Unlimited, received June 17, 2009 – 2 crystal fragments).
SIL403 Titanite (sphene): Trinidad Valley, Baja California, Mexico [$CaTi(SiO_4)(O,OH,F)$]. (Minerals Unlimited, received June 17, 2009 – 2 vials of fragments).
SIL404 Titanite (sphene): Yates Uranium Mine, Sandy Creek, Pontiac Co., QC, Canada [The Crystal Circle, Tucson 2011 show].
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2.11a.9. Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

QuartzSARM49		SARM 49
QuartzQLO1		US QLO-1
Sillimanite		BCS 309
hand sample51	**Epidote	ActLabs
hand sample42	**Kyanite	ActLabs
hand sample74	**Sandstone	ActLabs
hand sample82	**Travertine	ActLabs

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2.11a.10. Samples from Brendt Hyde – Royal Ontario Museum (Feb. 2015)

M56155 Pure "tobermorite" powder.
M56115 "Tobermorite" with minor secondary phases, likely aragonite.
Su11 Pure "tobermorite".
Grey suolinite Powder and crystal sample for comparison with "tobermoreite".
++

2.11b. XRD Data - Other silicates

2.11b.1. Data and analyses from David Bish - Indiana University

OPA001c Nice opal-CT, very similar to the other OPA samples (from Dave Bish – December 2011).
OPA002o and OPA002y indistinguishable from each other, they are opal-CT, less well-ordered than ICE102 (from Dave Bish – December 2011).
QUA107 Pure quartz (from Dave Bish – December 2011).
QUA108 Pure quartz (from Dave Bish – December 2011).

2.11b.2. Data from University of Manitoba

SIL108 (Quartz – chrysoprase). XRD shows quartz and minor pecoraite ($Ni_3Si_2O_5(OH)_4$). From Raven Sharma – U of M: Nov. 2011.
SIL122 (Beryl). XRD shows only beryl. From Raven Sharma – U of M: Nov. 2011.
SIL302 (Laminated sinter). XRD shows it to be largely amorphous. Phases tentatively identified include nacrite ($Al_2Si_2O_5(OH)_4$) and bannermanite (NaV_6O_{15}). From Raven Sharma – U of M: Nov. 2011.
SIL307 (Argillized volcanics). XRD shows a significant amorphous component. Phases identified include quartz, cristobalite (and diomignite: $Li_2B_4O_7$). From Raven Sharma – U of M: Nov. 2011.
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University of Manitoba XRD Files: IDD001
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2.11b.3. University of Winnipeg data

SIL131 XRD trace is very noisy, indicative of amorphous component. Only phase identified – diopside. University of Winnipeg Bruker D8 powder XRD analysis.
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2.11c. Compositional Data - Other silicates (alphabetical order)

Wt. %	INC002	INC008	INC011	INC022	INC037
SiO_2	64.03	36.36	56.46	37.68	44.10
Al_2O_3	16.41	41.71	1.46	0.01	6.71
FeO	1.75	0.90	0.32*	8.60*	8.12
Fe_2O_3	0.51	0.64	n.d.	n.d.	2.79
MgO	0.62	0.00	23.99	48.84	23.73
CaO	0.00	1.46	13.64	tr.	3.22
Na_2O	1.09	1.87	0.45	0.01	0.05
TiO_2	0.00	tr.	0.11	tr.	0.04
Cr_2O_3	0.01	0.03	0.11	0.03	0.82
V_2O_5	tr.	0.00	n.d.	n.d.	0.04
CoO	tr.	tr.	0.00	0.02	0.03
NiO	0.00	0.00	0.04	0.01	0.07
MnO	0.07	0.97	0.00	2.43	0.28
ZrO_2*	0.00	0.00	n.d.	n.d.	0.00
TOTAL	84.49	83.94	96.58	97.63	90.00
Source	U of C	U of C	U of C	U of C	U of C
Analysis	EMPA-7	EMPA-8	EMPA-1	EMPA-8	EMPA-3

* - all Fe reported as FeO.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	JAD001	LAZ001	LAZ002	MIS015
Type	"Jade"	lazurite	lazurite	quartz
SiO_2	57.95	48.51	47.79	99.29
Al_2O_3	0.48	9.89	15.16	0.43
FeO	3.02	0.00	0.00	n.d.
Fe_2O_3	1.63	0.36	0.17	n.d.
*(Fe_2O_3)**	*(4.99)*	*(0.36)*	*(0.17)*	*(0.08)*
MgO	21.86	14.02	9.06	0.06
CaO	13.39	17.73	11.95	0.04
Na_2O	0.21	4.25	8.70	0.03
TiO_2	0.05	0.03	0.36	0.01
MnO	0.06	0.03	0.02	0.003
K_2O	0.08	1.92	2.13	0.00
P_2O_5	0.01	0.03	0.11	0.02
SO_3		0.55	2.38	
Cl				
TOTAL	99.08	97.32	97.83	99.963
LOI	1.60	2.71	0.71	0.12
ppm				
Sr	75	125	120	8
Zr	25	140	130	12
V	49	60	125	8
Co	55	<2	<2	<1
Cr	1020	25	75	25
Cu	1850	500	810	
Ni	1700	<2	<2	<5
Rb	<2	70	45	
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	OPA001c	OPA002r	OPA002y	QUA101	QUA101
Type	opal	opal	opal	quartz	quartz
SiO_2	98.60	98.71	98.64	98.98	99.77
TiO_2	0.02	0.01	0.01	0.02	n.d.
Al_2O_3	0.52	0.39	0.40	0.95	0.00
*(Fe_2O_3)**	*(0.01)*	*(0.32)*	*(0.19)*	*(0.24)*	*(0.15)*
FeO					
Fe_2O_3					
MnO	0.002	0.004	0.004	0.005	0.01
MgO	0.07	0.06	0.08	0.03	0.00
CaO	0.13	0.11	0.09	0.04	0.03
Na_2O	0.04	0.03	0.02	0.01	0.00
K_2O	0.02	0.00	0.01	0.00	0.003
P_2O_5	0.02	0.02	0.03	0.02	0.005
SO_3	0.03	0.03	0.03	0.02	0.02
Cl					0.00
TOTAL	99.462	99.684	99.504	100.315	100.058
LOI	3.67	3.22	3.09	0.20	0.00
ppm					
Sr	29	28	25	27	86
Zr	13	16	16	18	60
V	34	32	33	26	42
Co	<1	<1	<1	<1	2
Cr	<1	10	<1	1	27
Cu	535	465	335	365	
Ni	<1	10	<1	<1	<2
Rb					<5
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	QUA103	QUA107	QUA108
Type	quartz	rose quartz	amethyst
SiO_2	98.60	98.12	99.13
TiO_2	0.01	0.01	0.01
Al_2O_3	0.43	1.02	0.50
*(Fe_2O_3)**	*(0.00)*	*(0.12)*	*(0.19)*
FeO			
Fe_2O_3			
MnO	0.002	0.006	0.003
MgO	0.04	0.10	0.05
CaO	0.04	0.13	0.05
Na_2O	0.04	0.05	0.03
K_2O	0.00	0.00	0.01
P_2O_5	0.01	0.01	0.01
TOTAL	99.172	99.566	99.981
LOI	0.17	0.46	0.34
ppm			
Sr	10	12	15
Zr	10	10	15
V	5	5	10
Co	<1	<1	<1
Cr	<2	154	33
Ni	<5	<5	<5
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	SGE001	SGE002	SIL001	SIL002
Type	silica gel	silica gel	SiO_2 (syn)	silicic acid
SiO_2	98.57	98.99	98.85	98.43
TiO_2	0.08	0.02	0.02	0.03
Al_2O_3	0.27	0.08	0.49	0.53
*(Fe_2O_3)**	*(0.15)*	*(0.01)*	*(0.00)*	*(0.00)*
FeO				
Fe_2O_3				
MnO	0.002	0.001	0.002	0.002
MgO	0.06	0.05	0.04	0.05
CaO	0.13	0.14	0.07	0.07
Na_2O	0.30	0.08	0.01	0.30
K_2O	0.01	0.00	0.00	0.00
P_2O_5	0.02	0.02	0.02	0.01
SO_3	0.08	0.04	0.03	0.03
TOTAL	99.672	99.431	99.532	99.452
LOI	16.69	5.70	0.66	59.71
ppm				
Sr	39	26	26	26
Zr	165	89	51	65
V	31	23	28	29
Co	>1	2	2	<1
Cr	8	<1	<1	<1
Cu	155	15	55	110
Ni	<1	<1	<1	<1
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	SIL003	SIL004
Type	obsidian	obsidian
SiO_2	76.20	75.66
TiO_2	0.11	0.13
Al_2O_3	12.79	12.58
*(Fe_2O_3)**	*(0.80)*	*(1.59)*
FeO	0.35	0.80
Fe_2O_3	0.41	0.70
MnO	0.08	0.06
MgO	0.06	0.07
CaO	0.48	0.50
Na_2O	4.10	4.47
K_2O	4.63	4.62
P_2O_5	0.02	0.02
SO_3	0.18	0.39
TOTAL	99.45	100.09
LOI	0.37	0.00
ppm		
Sr	45	85
Zr	91	319
V	2	<1
Co		
Cr	7	2
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	SIL101	SIL102	SIL103
Type	diatomite	fulgurite	flint
SiO_2	96.98	60.10	97.88
TiO_2	0.06	1.05	0.01
Al_2O_3	1.41	17.75	1.29
*(Fe_2O_3)**	*(1.31)*	*(7.52)*	*(0.00)*
FeO		5.79	
Fe_2O_3		1.09	
MnO	0.005	0.137	0.002
MgO	0.17	3.02	0.04
CaO	0.23	5.09	0.16
Na_2O	0.08	3.72	0.04
K_2O	0.12	1.50	0.02
P_2O_5	0.03	0.20	0.03
SO_3	0.02	0.02	0.03
TOTAL	100.415	100.107	99.502
LOI	5.76	0.36	1.41
ppm			
Sr	35	565	29
Zr	30	190	18
V	71	147	23
Co	<1	10	2
Cr	20	45	<1
Cu	1100	1110	690
Ni	<1	525	<1
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	SIL104	SIL105	SIL106	SIL108	SIL109	SIL111	SIL112
Type	sulf-qtz	chert	opal/chert	chrysoprase	milky qtz	citrine	novaculite
SiO_2	98.85	99.01	64.26	95.04	99.44	98.92	99.17
TiO_2	0.01	0.02	0.01	0.01	0.01	0.01	0.04
Al_2O_3	0.86	0.99	0.16	0.22	0.64	0.77	0.55
*(Fe_2O_3)**	*(0.04)*	*(0.00)*	*(0.04)*	*(0.61)*	*(0.00)*	*(0.00)*	*(0.08)*
FeO							
Fe_2O_3							
MnO	0.002	0.002	0.004	0.018	0.002	0.002	0.002
MgO	0.06	0.04	0.60	2.78	0.06	0.03	0.04
CaO	0.05	0.08	35.11	0.11	0.05	0.05	0.06
Na_2O	0.08	0.03	0.13	0.10	0.01	0.03	0.04
K_2O	0.01	0.05	0.00	0.00	0.00	0.01	0.03
P_2O_5	0.02	0.02	0.03	0.02	0.02	0.02	0.02
SO_3	0.03	0.03	0.03	0.02	0.03	0.03	0.03
Total	100.012	100.272	100.374	98.928	100.262	99.872	100.062
LOI	0.30	0.68	22.17	2.82	0.25	3.53	0.24
ppm							
Sr	24	53	408	26	25	25	39
Zr	15	18	18	15	12	16	47
V	27	22	32	31	22	29	28
Co	5	<1	<1	20	<1	<1	<1
Cr	<1	<1	1	125	<1	2	<1
Cu	440	715	230	415	365	375	425
Ni	<1	<1	<1	10200	15	<1	30
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. % ROM ID#	SIL113	SIL114	SIL115	SIL116	SIL130	SIL131	SIL150 E3580
Type	chalcedony	cristobalite	opal	diatomite	Libyan glass	Dakhleh glass	
SiO_2	98.31	75.78	96.40	86.74	97.44	56.22	54.48
TiO_2	0.01	0.07	0.01	0.23	0.16	0.71	0.00
Al_2O_3	1.21	12.71	1.94	4.54	2.01	11.29	0.34
*(Fe_2O_3)**	*(0.01)*	*(1.17)*	*(0.10)*	*(1.75)*	*(0.15)*	*(4.59)*	*(0.14)*
FeO				0.25	0.12	0.56	0.00
Fe_2O_3				1.47	0.02	4.69	0.14
MnO	0.003	0.033	0.003	0.01	0.01	0.11	0.025
MgO	0.05	0.15	0.08	0.31	0.08	4.96	0.00
CaO	0.17	0.58	0.52	0.61	0.09	17.11	44.53
Na_2O	0.17	5.05	0.27	5.05	0.02	2.29	0.01
K_2O	0.01	3.56	0.18	0.33	0.02	1.78	0.001
P_2O_5	0.03	0.08	0.02	0.08	0.04	0.52	0.008
SO_3	0.08	0.08	0.06				0.30
TOTAL	100.053	99.263	99.583	99.62	100.01	100.24	99.829
LOI	1.06	0.68	6.37	0.35	0.50	2.81	6.01
ppm							
Sr	30	39	223	93	44	454	42
Zr	59	144	163	78	167	339	26
V	28	29	27	139	31	133	<2
Co	<1	<1	<1	2	<2	2	<2
Cr	<1	<1	<1	18	14	88	<2
Cu	415	510	385				
Ni	<1	<1	<1				<2
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	SIL200	SIL201	SIL203	SIL206
Type	NZ silica	NZ silica	NIZ silica	NZ silica
SiO_2	96.69	96.93	96.13	95.89
TiO_2	0.04	0.12	0.03	0.01
Al_2O_3	1.56	1.36	0.68	0.84
*(Fe_2O_3)**	*(0.35)*	*(0.39)*	*(0.18)*	*(1.50)*
FeO				
Fe_2O_3				
MnO	0.030	0.015	0.012	0.031
MgO	0.12	0.13	0.15	0.17
CaO	0.59	0.24	1.91	0.29
Na_2O	0.10	0.20	0.48	0.42
K_2O	0.21	0.08	0.41	0.24
P_2O_5	0.02	0.02	0.02	0.03
SO_3	0.06	0.08	0.08	0.07
TOTAL	99.770	99.565	100.082	99.491
LOI	7.82	4.88	9.69	6.40
ppm				
Sr	66	37	79	43
Zr	26	49	23	27
V	34	28	38	24
Co	<1	<1	<1	<1
Cr	<1	<1	<1	<1
Cu	520	560	685	1950
Ni	<1	<1	<1	<1
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	SIL207	SIL208	SIL302	SIL303	SIL304	SIL306
Type	NZ silica	NZ silica	NZ silica	NZ silica	NZ silica	NZ silica
SiO_2		96.81	94.22	97.62	96.15	98.51
TiO_2		0.01	0.17	0.44	0.51	0.59
Al_2O_3		1.29	5.01	1.37	2.28	0.79
*(Fe_2O_3)**		*(0.01)*	*(0.19)*	*(0.00)*	*(0.22)*	*(0.00)*
FeO					0.18	
Fe_2O_3					0.02	
MnO		0.004	0.002	0.002	0.01	0.003
MgO		0.04	0.09	0.05	0.02	0.05
CaO		1.24	0.07	0.07	0.23	0.06
Na_2O		0.29	0.10	0.04	0.05	0.03
K_2O		0.06	0.11	0.02	0.22	0.03
P_2O_5		0.03	0.06	0.01	0.02	0.02
SO_3		0.08	0.03	0.07	0.00	0.05
TOTAL		99.864	100.052	99.692	99.71	100.133
LOI	2.57	2.60	11.09	1.91	51.66	1.83
ppm						
Sr		146	140	39	39	38
Zr		62	110	299	353	306
V		22	40	28	29	28
Co		<1	<1	<1	5	<1
Cr		1	10	2	27	1
Cu		3730	665	2050		490
Ni		25	<1	<1	22	<1
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. %	ZEO101	ZEO102	ZEO103	ZEO104
NMNH#	C3189	82505	78734-1	171671
Type	pumpellyite	pumpellyite	prehnite	prehnite
SiO_2	33.97	40.32	45.53	44.67
TiO_2	0.43	0.02	0.00	0.00
Al_2O_3	23.67	24.84	25.70	22.38
*Fe_2O_3**	*(7.67)*	*(6.39)*	*(0.39)*	*(4.97)*
FeO	5.23	n.d.	n.d.	0.16
Fe_2O_3	1.86	n.d.	n.d.	4.79
MnO	0.30	0.31	0.06	0.01
MgO	31.25	5.87	0.03	0.07
CaO	2.19	22.46	28.14	28.34
Na_2O	0.04	0.05	0.11	0.01
K_2O	0.00	0.01	0.00	0.00
P_2O_5	0.07	0.02	0.01	0.01
TOTAL	99.38	100.35	100.01	100.48
LOI	11.71	8.29	4.96	4.82
ppm				
Sr	193	130	85	74
Zr	524	43	25	31
V	59	191	171	144
Cr	1276	46	41	39
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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2.11c. Compositional Data - Other silicates (alphabetical order) (continued)

Wt. % (for oxides), ppm for elements, ppb for Au (from Johnson Space Center / Pranoti Asher)

Sample	ZEO101	ZEO102	ZEO103	ZEO104
NMNH#	C3189	82505	78734-1	171671
Type	pumpellyite	pumpellyite	prehnite	prehnite
Na_2O	0.0337±0.0009	0.0418±0.0007	0.1121±0.0015	0.0263±0.0004
K_2O	<0.04	0.016±0.006	<0.019	0.010±0.003
CaO	2.26±0.21	22.1±0.5	28.5±0.6	28.2±0.6
Sc	9.10±0.10	1.723±0.020	0.0666±0.0012	0.0495±0.0018
Cr	1334±15	1.11±0.24	1.77±0.17	1.32±0.18
FeO	6.57±0.07	5.51±0.06	0.314±0.004	4.27±0.05
Co	78.3±0.9	61.4±0.7	0.047±0.006	0.496±0.012
Ni	1590±30	161±12	---	---
As	<0.6	1.08±0.08	0.25±0.05	3.03±0.07
Se	<0.08	---	---	---
Br	---	0.30±0.05	0.29±0.03	<0.09
Rb	---	---	---	---
Sr	186±17	68±16	29±7	24±6
Zr	580±70	<31	7±3	19±6
Sb	0.075±0.020	0.123±0.011	0.153±0.007	0.046±0.007
Cs	0.28±0.03	---	0.030±0.006	---
Ba	<20	30±5	<15	<16
La	95.9±1.1	4.46±0.06	0.648±0.015	0.734±0.015
Ce	220.3±2.8	12.46±0.21	1.71±0.08	1.28±0.08
Nd	111±7	11.8±1.9	<3.9	<4.0
Sm	24.6±0.3	2.098±0.028	0.315±0.005	0.153±0.004
Eu	2.64±0.04	1.505±0.028	0.153±0.0027	0.038±0.003
Tb	4.57±0.07	0.343±0.013	0.089±0.007	0.036±0.006
Yb	22.9±0.3	0.818±0.023	0.192±0.014	0.212±0.014
Lu	3.24±0.05	0.127±0.004	0.0254±0.0022	0.0208±0.0017
Hf	25.2±0.4	0.75±0.04	0.160±0.024	0.347±0.025
Ta	8.09±0.16	---	---	---
W	7.0±2.7	---	---	---
Au	<5	353±5	<1.9	9.5±0.7
Th	18.74±0.26	<0.08	0.034±0.012	0.070±0.012
U	6.40±0.19	<0.19	<0.11	0.135±0.026

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2.11d. Spectral Data - Other Silicates (alphabetical order)

Sample	*Facility/File No.*	*Description*
APO101	PSF 130723b.015	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
APO101	PSF 130723b.016	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
+++++++		
BOREA07c	PSF 071229a.106	<1 mm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
+++++++		
CHM103c	PSF 071229a.105	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
+++++++		
CO2 ice	PSF 080619a.001	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm output; 200 averaged; ASD.
+++++++		
INC037	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.,w/PYX037?
+++++++		
JAD001	RELAB caea16	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
JAD001	RELAB laea16	<45 µm, 30°/0°,30°, 0.3-26µm, 5,0.6-129 nm, merged RELAB+Nicolet; note changed viewing geometry.
+++++++		
MIS015	PSF 071120a.005	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured immediately after removal from freezer.
MIS015	PSF 071120a.012	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured after thawing to room temperature.
+++++++		
MSI-A2-05	PSF 071120a.006	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured immediately after removal from freezer.
MSI-A2-05	PSF 071120a.013	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured after thawing to room temperature.
MSI-A2-05	PSF 071229a.109	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
MSI-A2-05	PSF 071229a.119	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; measured after exposure of powder to 100% relative humidity for 1 hour; 1000 avg; ASD spectra.
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OPA001b	PSF 071116b.003	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
OPA001b	PSF 071116b.004	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD; second duplicate run. Also 003 and 004 averaged.
OPA001b	PSF 071120a.004	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured immediately after removal from freezer.
OPA001b	PSF 071120a.011	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured after thawing to room temperature.
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OPA001c	PSF 071116b.001	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
OPA001c	PSF 071116b.002	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD; second duplicate run. Also 001 and 002 averaged.
OPA001c	PSF 071229a.108	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
OPA001c	PSF 071229a.120	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; measured after exposure of powder to 100% relative humidity for 1 hour; 1000 avg; ASD spectra.
OPA001c	PSF 090121a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
OPA001c	PSF 090121a.006	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
OPA001	PSF 090602a.047	<45 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
OPA001	PSF 090602a.048	90-1000 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
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OPA002r	PSF 090121a.007	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
OPA002r	PSF 090121a.008	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
OPA002r	PSF 071116b.005	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 spectra avgd; ASD.
OPA002r	PSF 071116b.006	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 spectra avgd; ASD; second duplicate run. Also 005 and 006 averaged.
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OPA002o	PSF 090121a.009	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
OPA002o	PSF 090121a.010	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
OPA002o	PSF 071116b.007	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 spectra avgd; ASD.
OPA002o	PSF 071116b.008	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 spectra avgd; ASD; second duplicate run. Also 007 and 008 averaged.
OPA002o	PSF 071116b.009	>250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 spectra avgd; ASD.
OPA002o	PSF 071116b.010	>250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 spectra avgd; ASD; second duplicate run. Also 009 and 010 averaged.
OPA002o	PSF 071120a.002	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured immediately after removal from freezer.
OPA002o	PSF 071120a.009	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured after thawing to room temperature.
OPA002o	PSF 071120a.001	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avg; ASD; sample run prior to freezing.
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OPA002y	PSF 071116b.011	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 spectra avgd; ASD.
OPA002y	PSF 071116b.012	<250 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 spectra avgd; ASD; second duplicate run. Also 011 and 012 averaged.
OPA002y	PSF 090121a.011	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
OPA002y	PSF 090121a.012	90-250 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
OPA002y_25C	PSF 120529b.003	<45 μm, fresh; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 120529_opals).
OPA002y_120C	PSF 120530a.003	<45 μm, after heating at 120°C for 23 hours; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).
OPA002y_265C	PSF 120530a.011	<45 μm, after heating at 120°C for 23 hours, then at 265°C for 23 hours; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).
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PIG205	PSF 080801a.007	<90 μm; i=0°, e=0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).

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PIG373 – phase angle measurements – all relative to Spectralon at i=13°, e=0°

PIG373	PSF 101001a.003	<45 μm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.012	<45 μm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.021	<45 μm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.030	<45 μm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°;

		0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.039	<45 µm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.048	<45 µm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.057	<45 µm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.067	<45 µm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.077	<45 µm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.086	<45 µm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
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Planet X	PSF 100107a.001	unsorted; i=30, e=0; 0.35-2.5 µm; 1 nm output spectral sampling interval, 1000 spectra averaged; ASD instrument.
Planet X	PSF Planet X	unsorted; i=0, e=0, bifurcated cable, 200-400 nm, Ocean Optics S2000, corrected to DUV mirror, 600 spectra averaged.
Planet X	PSF Planet X	unsorted; i=0, e=0, bifurcated cable, 380-860 nm, Ocean Optics S2000, 600 spectra averaged.
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PYX030	PSF 090728a.002	<45 µm; 30/0; 0.35-2.5 µm; 1000 averaged; ASD (directory: 090728lunar dust).
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QUA101	RELAB c1qz04	<45 µm, 30°/0°, 0.3-2.6µm, 5 nmresol.
QUA101	RELAB maqz04	<45 µm, 30°/30°, 2.5-26µm, 0.6-129 nm resol. (Nicolet).
QUA101	RELAB laqz04	<45 µm, 30°/0°,30°; 0.3-26µm; 5/0.6-129 nm resol. (Merged RELAB + Nicolet at 2.5 µm; note viewing geometry change).
QUA101	PSF 071229a.149	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
QUA101	PSF 090121a.013	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
QUA101	PSF 090121a.014	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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QUA101a	PSF 071229a.150	<45 µm, slurry made with water; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
QUA101a	PSF 071229a.151	<45 µm, slurry made with water; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
QUA101a	PSF 071229a.152	<45 µm, slurry made with water; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra (different spot).
QUA101a	PSF 071229a.153	<45 µm, slurry made with water; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra (different spot).
QUA101a	PSF 080730a.035	<45 µm, slurry made with water; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra (different spot); remeasured July 31, 2008.
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QUA101	PSF 071229a.168	<45 µm, slurry made with water; frozen at -13°C for 35 minutes; spectrum measured immediately after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
QUA101	PSF 071229a.169	<45 µm, slurry made with water; frozen at -13°C for 35 minutes; spectrum

		measured 3 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
QUA101	PSF 071229a.170	<45 µm, slurry made with water; frozen at -13°C for 35 minutes; spectrum measured 5 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
QUA101	PSF 071229a.171	<45 µm, slurry made with water; frozen at -13°C for 35 minutes; spectrum measured 20 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
QUA101	PSF 071229a.172	<45 µm, slurry made with water; frozen at -13°C for 35 minutes; spectrum measured 22 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
QUA101	PSF 080708.qua101	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics.
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QUA103	PSF 071120a.003	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured immediately after removal from freezer.
QUA103	PSF 071120a.010	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD; sample frozen to -60°C and measured after thawing to room temperature.
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QUA107	PSF 090313a.024	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Absolute reflectance probably off; cup may not have been properly positioned vertically.
QUA107	PSF 090313a.025	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. redo of sample .024.
QUA107	PSF 090313a.026	90-1000 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
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QUA108	PSF 090313a.027	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
QUA108	PSF 090313a.028	90-1000 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
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SGE001	PSF 071229a.104	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.110	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured immediately after removal from freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.111	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured 2 minutes after removal from freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.112	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured 3 minutes after removal from freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.113	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured 5 minutes after removal from freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.114	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured 8 minutes after removal from freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.115	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured 17 minutes after removal from

		freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.116	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured 19 minutes after removal from freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.117	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured 38 minutes after removal from freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.118	<1 mm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, then frozen and measured 62 minutes after removal from freezer at -13°C; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.122	<250 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, re-sieved the following day (after exposure to ambient air); 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.123	250-1000 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours, re-sieved the following day (after exposure to ambient air); 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.124	250-1000 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; re-sieved the following day (after exposure to ambient air), then frozen at -13°C for 30 minutes and spectrum measured immediately after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.125	250-1000 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; re-sieved the following day (after exposure to ambient air), then frozen at -13°C for 30 minutes and spectrum measured 2 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.126	<250 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; re-sieved the following day (after exposure to ambient air), then frozen at -13°C for 30 minutes and spectrum measured immediately after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.127	<250 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; re-sieved the following day (after exposure to ambient air), then frozen at -13°C for 30 minutes and spectrum measured 2 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.128	250-1000 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; re-sieved the following day (after exposure to ambient air), then frozen at -13°C for 30 minutes and spectrum measured 11 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.129	<250 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; re-sieved the following day (after exposure to ambient air), then frozen at -13°C for 30 minutes and spectrum measured 10 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.130	250-1000 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; re-sieved the following day (after exposure to ambient air), then frozen at -13°C for 30 minutes and spectrum measured 16 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.131	<250 µm, sample crushed then exposed to 100% relative humidity at 23°C

		for 24 hours; re-sieved the following day (after exposure to ambient air), then frozen at -13°C for 30 minutes and spectrum measured 17 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.133	<250 µm, original sample crushed, never exposed to high humidity; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.134	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air); 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.135	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air), frozen at -13°C for 33 minutes, spectrum measured immediately after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.136	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air), frozen at -13°C for 33 minutes, spectrum measured 4 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.137	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air), frozen at -13°C for 33 minutes, spectrum measured 6 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.138	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air), frozen at -13°C for 33 minutes, spectrum measured 8 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.139	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air), frozen at -13°C for 33 minutes, spectrum measured 10 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.140	<250 µm, original sample crushed, never exposed to high humidity; frozen at -13°C for 57 minutes, spectrum measured immediately after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.141	<250 µm, original sample crushed, never exposed to high humidity; frozen at -13°C for 57 minutes, spectrum measured 2 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.142	<250 µm, original sample crushed, never exposed to high humidity; frozen at -13°C for 57 minutes, spectrum measured 4 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.143	<250 µm, original sample crushed, never exposed to high humidity; frozen at -13°C for 57 minutes, spectrum measured 6 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001	PSF 071229a.144	<250 µm, original sample crushed, never exposed to high humidity; frozen at -13°C for 57 minutes, spectrum measured 8 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
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SGE001b	PSF 071229a.160	<250 µm, original sample, never exposed to high humidity; baked at 100°C for 1 hour, spectrum measured 1 minute after removal from drying oven; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001b	PSF 071229a.161	<250 µm, original sample, never exposed to high humidity; baked at 100°C for 1 hour, spectrum measured 6 minutes after removal from drying oven; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.

SGE001b	PSF 071229a.162	<250 µm, original sample, never exposed to high humidity; baked at 100°C for 1 hour, spectrum measured 8 minutes after removal from drying oven; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001b	PSF 071229a.163	<250 µm, original sample, never exposed to high humidity; baked at 100°C for 1 hour, spectrum measured 11 minutes after removal from drying oven; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001b	PSF 080730a.037	<250 µm, original sample, never exposed to high humidity; baked at 100°C for 1 hour, spectrum measured 11 minutes after removal from drying oven; remeasured July 31, 2008; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
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SGE001a	PSF 071229a.164	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air), then baked at 100°C for 1 hour, spectrum measured 3 minutes after removal from drying oven; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001a	PSF 071229a.165	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air), then baked at 100°C for 1 hour, spectrum measured 6 minutes after removal from drying oven; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE001a	PSF 080730a.034	<90 µm, sample crushed then exposed to 100% relative humidity at 23°C for 24 hours; crushed and re-sieved 4 days later (after exposure to ambient air), then baked at 100°C for 1 hour, spectrum measured 6 minutes after removal from drying oven; spectrum remeasured July 31, 2008; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
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SGE002c	PSF 071229a.145	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002c	PSF 071229a.146	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002c	PSF 080730a.038	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra; remeasured July 31, 2008.
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SGE002a	PSF 071229a.147	unsorted, slurry made with water; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002a	PSF 071229a.148	unsorted, slurry made with water; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002a	PSF 071229a.154	unsorted, slurry made with water, frozen at -13°C for 30 minutes, spectrum measured immediately after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002a	PSF 071229a.155	unsorted, slurry made with water, frozen at -13°C for 30 minutes, spectrum measured 3 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002a	PSF 071229a.156	unsorted, slurry made with water, frozen at -13°C for 30 minutes, spectrum measured 5 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra (maybe also spectrum #156?).
SGE002a	PSF 071229a.157	unsorted, slurry made with water, frozen at -13°C for 30 minutes, spectrum measured 5 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra (maybe also spectrum #156?).
SGE002a	PSF 071229a.158	unsorted, slurry made with water, frozen at -13°C for 30 minutes, spectrum measured 9 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002a	PSF 071229a.159	unsorted, slurry made with water, frozen at -13°C for 30 minutes, spectrum measured 20 minutes after removal from freezer; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002a	PSF 080730a.033	unsorted slurry made with water; remeasured July 31, 2008 – sample had dried out; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.

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SGE002b	PSF 071229a.166	unsorted, exposed to 100% relative humidity at 23°C for 77 minutes; spectrum measured 1 minute after removal from humidity; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002b	PSF 071229a.167	unsorted, exposed to 100% relative humidity at 23°C for 77 minutes; spectrum measured 4 minutes after removal from humidity; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SGE002b	PSF 080730a.036	unsorted, exposed to 100% relative humidity at 23°C for 77 minutes; spectrum measured 4 minutes after removal from humidity; 30°/0°; remeasured July 31, 2008; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
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SIL001	PSF 080708.sil001	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics.
SIL001	PSF 090121a.017	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL002	PSF 080913a.055	unsorted; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 500 spectra averaged, ASD.
SIL002	PSF 090121a.018	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL003	PSF 100331a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm resampled; 1000 spectra averaged, ASD.
SIL003	PSF 100331a.002	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm resampled; 1000 spectra averaged, ASD.
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SIL004	PSF 100331a.003	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm resampled; 1000 spectra averaged, ASD.
SIL004	PSF 100331a.004	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm resampled; 1000 spectra averaged, ASD.
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SIL016	PSF 071229a.107	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD spectra.
SIL016	PSF 071116b.013	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
SIL016	PSF 071116b.014	<250 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD; second duplicate run. Also average of 013 and 014.
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SIL101	PSF 090121a.019	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL101	PSF 090121a.020	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL102	PSF 090121a.021	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL103	PSF 090121a.022	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL103	PSF 090121a.023	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL103_25C	PSF 120529b.005	<45 µm, fresh; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 120529_opals).
SIL103_120C	PSF 120530a.005	<45 µm, after heating at 120°C for 23 hours; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).
SIL103_265C	PSF 120530a.013	<45 µm, after heating at 120°C for 23 hours, then at 265°C for 23 hours; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).

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SIL104	PSF 090121a.024	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL104	PSF 090121a.025	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL105	PSF 090121a.026	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL105	PSF 090121a.027	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL106	PSF 090121a.028	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL106	PSF 090121a.029	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL108	PSF 090121a.031	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL108	PSF 090121a.032	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL109	PSF 090121a.033	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL109	PSF 090121a.034	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL111	PSF 090121a.035	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL111	PSF 090121a.036	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL112	PSF 090121a.037	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL112	PSF 090121a.038	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL113	PSF 090121a.039	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL113	PSF 090121a.040	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL114	PSF 090121a.041	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL114	PSF 090121a.042	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL115	PSF 090121a.043	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL115	PSF 090121a.044	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL115_25C	PSF 120529b.002	<45 μm, fresh; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 120529_opals).
SIL115_120C	PSF 120530a.002	<45 μm, after heating at 120°C for 23 hours; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).
SIL115_265C	PSF 120530a.010	<45 μm, after heating at 120°C for 23 hours, then at 265°C for 23 hours; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD

		(directory: 120530_opals).
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SIL116	PSF 090602a.049	unsorted, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
SIL116	PSF 090728a.009	<45µm; 30°/0°; 0.35-2.5 µm,1 nm output, 1000 spectra averaged; ASD.
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SIL122	PSF 090121a.045	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL122	PSF 090313a.029	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
SIL122	PSF 090313a.030	90-1000 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
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SIL130	PSF 090602a.035	<45 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
SIL130	PSF 090602a.036	90-1000 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
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SIL131	PSF 090602a.043	<45 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
SIL131	PSF 090602a.044	90-1000 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
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SIL200	PSF 080618a.004	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL200	PSF 080618a.005	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL200	PSF 080618a.006	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL200	PSF 090121a.046	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL200	PSF 090121a.047	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL201	PSF 080618a.007	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL201	PSF 080618a.008	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL201	PSF 080618a.009	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL201	PSF 090121a.048	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL201	PSF 090121a.049	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL203	PSF 080618a.010	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL203	PSF 080618a.011	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL203	PSF 080618a.012	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL203	PSF 080619a.008	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL203	PSF 080619a.009	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL203	PSF 080619a.010	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL203	PSF 090121a.050	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL203	PSF 090121a.051	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD.

SIL203	PSF 080801a.005	<45 μm; i=0°, e=0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).
SIL203_25C	PSF 120529b.001	<45 μm, fresh; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 120529_opals).
SIL203_120C	PSF 120530a.001	<45 μm, after heating at 120°C for 23 hours; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).
SIL203_265C	PSF 120530a.009	<45 μm, after heating at 120°C for 23 hours, then at 265°C for 23 hours; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).
SIL203	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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SIL204	PSF 080618a.013	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL204	PSF 080618a.014	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL204	PSF 080618a.015	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
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SIL206	PSF 080618a.016	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL206	PSF 080618a.017	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL206	PSF 080618a.018	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL206	PSF 090121a.052	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL206	PSF 090121a.053	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL207	PSF 080618a.019	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL207	PSF 080618a.020	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL207	PSF 080618a.021	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL207	PSF 090121a.054	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL207	PSF 090121a.055	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL208	PSF 090121a.056	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL208	PSF 090121a.057	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL209	PSF 080730a.008	unprepped surface of powdery gray material; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
SIL209	PSF 080730a.009	unprepped surface of white consolidated material; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
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SIL210	PSF 080618a.022	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL210	PSF 080618a.023	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL210	PSF 080618a.024	whole rock; 30°/0°; 0.35-2.5 μm, 2-7 nm resol., 1 nm resampled; 200

		spectra averaged, ASD; different spot.
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SIL250	PSF 080730a.020	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
SIL250	PSF 080730a.021	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD; 6 minutes later.
SIL250	PSF 080730a.022	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD; 70 minutes later.
SIL250	PSF 080730a.023	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD; 73 minutes later.
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SIL251	PSF 080913a.054	unsorted; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 500 spectra averaged, ASD.
SIL251	PSF 090127a.007	<45 µm, 30°/0°, 0.35-2.5 µm,1 nm output, 1000 averaged, ASD. Absolute reflectance probably wrong.
SIL251	PSF 090313a.031	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
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SIL300	PSF 080618a.028	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL300	PSF 080618a.029	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL300	PSF 080618a.030	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
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SIL302	PSF 080618a.031	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL302	PSF 080618a.032	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL302	PSF 080618a.033	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL302	PSF 090121a.058	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL302	PSF 090121a.059	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL302	PSF 111201a.042	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
SIL302	PSF 111201a.013	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
SIL302	INO SIL302	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 1 spectrum acquired.
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SIL303	PSF 080618a.034	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL303	PSF 090121a.060	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL303	PSF 090121a.061	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
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SIL304	PSF 080618a.035	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL304	PSF 080618a.036	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL304	PSF 080618a.037	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
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SIL305	PSF 080618a.038	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200

		spectra averaged, ASD.
SIL305	PSF 080618a.039	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL305	PSF 080618a.040	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
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SIL306	PSF 080618a.041	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL306	PSF 080618a.042	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL306	PSF 080618a.043	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL306	PSF 090121a.062	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL306	PSF 090121a.063	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SIL306	PSF 100517b.009	White surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
SIL306	PSF 111201a.043	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
SIL306	PSF 111201a.014	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
SIL306	INO SIL306	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
SIL306_25C	PSF 120529b.004	<45 µm, fresh; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 120529_opals).
SIL306_120C	PSF 120530a.004	<45 µm, after heating at 120°C for 23 hours; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).
SIL306_265C	PSF 120530a.012	<45 µm, after heating at 120°C for 23 hours, then at 265°C for 23 hours; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 120530_opals).
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SIL307	PSF 100517b.010	White powder, unsorted; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
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SIL308	PSF 080618a.044	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL308	PSF 080618a.045	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL308	PSF 080618a.046	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL308	PSF 080619a.002	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; air dried for 24 hours.
SIL308	PSF 080619a.003	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot; air dried for 24 hours.
SIL308	PSF 080619a.004	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot; air dried for 24 hours.
+++++++		
SIL401	PSF 090721a.001	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 averaged spectra; ASD.
+++++++		
SIL402	PSF 090721a.002	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 averaged spectra; ASD.
+++++++		
SIL403	PSF 090721a.003	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 averaged spectra;

		ASD.
+++++++		
ZEO101	RELAB c1ze01	<45 µm, 0.3-2.6µm, 30°/0°, 5 nmresolution.
ZEO101	RELAB laze01	<45 µm, 0.3-26µm, 30°/0°,30°; 5⁄0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
+++++++		
ZEO102	RELAB c1ze02	<45 µm, 0.3-2.6µm, 30°/0°, 5 nmresolution.
ZEO102	RELAB laze02	<45 µm, 0.3-26µm, 30°/0°,30°; 5⁄0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
+++++++		
ZEO103	RELAB c1ze03	<45 µm, 0.3-2.6µm, 30°/0°, 5 nmresolution.
ZEO103	RELAB laze03	<45 µm, 0.3-26µm, 30°/0°,30°; 5⁄0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
+++++++		
ZEO104	RELAB c1ze04	<45 µm, 0.3-2.6µm, 30°/0°, 5 nmresolution.
ZEO104	RELAB laze04	<45 µm, 0.3-26µm, 30°/0°,30°; 5⁄0.6-129 nm resolution. Merged RELAB+ Nicolet at 2.5 µm; note change in viewing geometry.
+++++++		
ZEO169	PSF 130723b.017	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
ZEO169	PSF 130723b.018	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).

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END of 2.11.

3. Clays (Phyllosilicates)

3a. Sample Descriptions - Clays

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
ALL001	Allophane: Inspiration, Gila County, Arizona, USA; in chrysocolla and rock (no formula - an amorphous hydrous aluminum silicate; $Al_2SiO_5 \cdot nH_2O$) [*an initial alteration product in igneous rock weathering and in palagonites*] (Minerals Unlimited) (description: blue masses with chrysocolla, etc.).
BEI101	Beidellite: near Cameron, Coconico County, Arizona, USA ($(Na,Ca_{0.5})_{0.3}Al_2(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$) (a smectite group mineral) (Minerals Unlimited) [*an initial alteration product in igneous rock weathering and in palagonites*](description: pure dark gray massive clay).
BEI102	Beidellite: Idaho, USA. Clay Minerals Society Source Clays Repository #SBId-1 ($(Na,Ca_{0.5})_{0.3}Al_2(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$) (50 grams; received March 2008).
BER101	Berthierine: Picton Ultramafic Dike, Picton, Ontario, Canada (Smithsonian NMNH #163358). [$(Fe^{+2},Fe^{+3},Mg)_{2\text{-}3}(Si,Al)_2O_5(OH)_4$; kaolinite-serpentine group]. *(in carbonaceous chondrites: see Akai*). (Estimated purity of ground sample: 95%).
BER102	Berthierine: France (Smithsonian NMNH #93555). [$(Fe^{+2},Fe^{+3},Mg)_{2\text{-}3}(Si,Al)_2O_5(OH)_4$; kaolinite-serpentine group]. (*in carbonaceous chondrites: see Akai*). (Estimated purity of ground sample: 98%).
CEL101	Celadonite: Mt. Baldo, near Verona, Veneto, Italy ($K(Mg,Fe^{2+})(Fe^{3+},Al)Si_4O_{10}(OH)_2$) (Smithsonian Institution NMNH #R4733) (*basaltic alteration product?*) (mica group).
CEL102	Celadonite: Wadsworth, Washoe County, Nevada, USA; in basalt ($K(Mg,Fe^{2+})(Fe^{3+},Al)Si_4O_{10}(OH)_2$) (Minerals Unlimited; received Sept. 2002; 3-1" pieces).
CHM101	Chamosite: Bardo Wroclaw, Poland (Smithsonian NMNH #R4568). [$(Fe^{+2},Mg,Fe^{+3})_5Al(Si_3Al)O_{10}(OH,O)_8$] (=*septachlorite; series with clinochlore, chlorite group) (in carbonaceous chondrites: see Bunch and Chang*). (Estimated purity of ground sample: 98%).
CHM102	Chamosite: Chamois, France (Smithsonian NMNH #R4558). [$(Fe^{+2},Mg,Fe^{+3})_5Al(Si_3Al)O_{10}(OH,O)_8$] (=*septachlorite; series with clinochlore, chlorite group) (in carbonaceous chondrites: see Bunch and Chang*). (Estimated purity of ground sample: 98%).
CHM103	Chamosite: Bonita, San Diego County, California; in chert, with pyrite (Minerals Unlimited) [$(Fe^{+2},Mg,Fe^{+3})_5Al(Si_3Al)O_{10}(OH,O)_8$] (=*septachlorite; series with clinochlore, chlorite group) (in carbonaceous chondrites: see Bunch and Chang*). (Estimated purity of ground sample: 50%; intimately mixed with chert; chert separate also made).
CHY101	Chrysocolla: Inspiration, Gila County, Arizona, USA ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$) (Minerals Unlimited) *(for pigments project)*.
CHY102	Chrysocolla: Gila County, Arizona, USA ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$) (Smithsonian Institution NMNH #87288) *(for pigments project).*
CHY103	Chrysocolla: Copper Queen Mine, Bisbee, Cochise County, Arizona, USA ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$) (Smithsonian Institution MNMH #104956) (*for pigments project*).
CLA001	Clay +?: (ironstone): Whitemud Creek area, Edmonton, Alberta, Canada (self collected).
CLA002	Clay +?: (bentonite?): Whitemud Creek area, Edmonton, Alberta, Canada (self collected).
CLA003	Clay/shale: Pembina Valley Provincial Park, "Shale Slide" area, Manitoba, Canada (self-collected, May 2005).
CLA004	Clay/shale: Pembina Valley Provincial Park, "Shale Slide" area, Manitoba, Canada (self-collected, August 19, 2007).
CLA005	Clay/shale: Pembina Valley Provincial Park, base of creek draining into Pembina River near Sunrise Point, Manitoba, Canada (self-collected, August 19, 2007).
CLI101	Clinochlore (chlorite): near Murphys, Calaveras County, California, USA

$(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$) (Minerals Unlimited) (*for pigments project*).

CLI102 Clinochlore (chlorite): Cornwall, Pennsylvania, USA ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$) (Smithsonian Institution MNMH #R14987) (*for pigments project*).

CLI103 Clinochlore (chlorite): Lane Quarry, Westfield, Massachusetts, USA ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$) (Smithsonian Institution MNMH #106730) (*for pigments project*).

COO001 Cookeite: Arkansas, USA. Clay Minerals Society Source Clays Repository #CAr-1 [$LiAl_4(Si_3Al)O_{10}(OH)_8$] (10 grams; received March 2008).

CRO101 Cronstedtite: 411 level, Llallagua, Bolivia (on hisingerite) (Smithsonian NMNH #193910). [$Fe^{+2}_2 Fe^{+3}(SiFe^{+3})O_5(OH)_4$] (*kaolinite-serpentine group) (in carbonaceous chondrites: see Bunch and Chang*). (Estimated purity of ground sample: 95%).

CRO102 Cronstedtite: Herja, Crisana-Maramures, Romania (Smithsonian NMNH #R7807-4). [$Fe^{+2}_2 Fe^{+3}(SiFe^{+3})O_5(OH)_4$] *(kaolinite-serpentine group) (in carbonaceous chondrites: see Bunch and Chang)*. (Estimated purity of ground sample: 98%).

GLA101 Glauconite: locality unknown (University of Alberta GEOL330 laboratory collection #8/5/11); [$(K,Na)(Fe^{3+},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2$].

GLA102 Glauconite: Beers Mine, Monmouth County, New Jersey (Minerals Unlimited); [$(K,Na)(Fe^{3+},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2$].

GLA103 Glauconite: Villers-sur-Mer, Calvados, France (Smithsonian NMNH #46447). [$(K,Na)(Fe^{+3},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2$]. (Estimated purity of ground sample: 98%).

GLA104 Glauconite: Bighorn Mountain, Wyoming (8000 feet), Wyoming (Smithsonian NMNH #97839). [$(K,Na)(Fe^{+3},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2$]. (Estimated purity of ground sample: 98%).

GRE001 Greenalite: La Union, Murcia, Spain. Smithsonian Institution NMNH #158902. Received May 25, 2006. [$(Fe^{2+},Fe^{3+})_{2-3}Si_2O_5(OH)_4$] *Present in carbonaceous chondrites? [kaolinite-serpentine group]*.

GRE002 Greenalite: Rock dump, Soudan Mine, Soudan, Minnesota, USA. Smithsonian Institution NMNH #123826. Received May 25, 2006. [$(Fe^{2+},Fe^{3+})_{2-3}Si_2O_5(OH)_4$]. *Present in carbonaceous chondrites? [kaolinite-serpentine group]*.

GYR001 Gyrolite: Monument, Grant County, Oregon, USA ($NaCa_{16}(Si_{23}Al)O_{60}(OH)_5 \cdot 15H_2O$) [with analcime, on basalt [BAS306]; (crystal aggregates in vugs in basalt)] (Minerals Unlimited) (*a known alteration product of basalts - see NSERC grant review*).

GYR002 Gyrolite: Fort Point, San Francisco County, California, USA ($NaCa_{16}(Si_{23}Al)O_{60}(OH)_5 \cdot 15H_2O$) [on serpentine; (white spherulitic films on serpentine SRP117] (Minerals Unlimited) (*a known alteration product of basalts - see NSERC grant review*).

HAL001 Halloysite: Tintic District, Utah, USA ($Al_2Si_2O_5(OH)_4$) [*member of kaolinite-serpentine group; initial alteration product in igneous rock weathering and in palagonites*] (Minerals Unlimited) (description: white masses). Multiple pieces received Dec. 2013.

HEC101 Hectorite: Hector, San Bernardino Co., CA, USA [$Na_{0.3}(Mg,Li)_3Si_4O_{10}(F,OH)_2$] (Minerals Unlimited; received Sept. 2002; 3-1" pieces).

HEC102 Hectorite: San Bernardino Co., CA, USA. [$Na_{0.3}(Mg,Li)_3Si_4O_{10}(F,OH)_2$]. Clay Minerals Society Source Clays Repository #SHCa-1 (250 grams; received March 2008).

HIS001 Hisingerite: New Pit, Boron, Kern County, California, USA ($Fe_2^{3+} Si_2 O_5 (OH)_4 \cdot 2H_2 O$); on basalt (BAS307). [*initial alteration product in igneous rock weathering and in palagonites*] (Minerals Unlimited) (description: black coatings on rock).

IDD001 Iddingsite: Amboy, San Bernardino County, California, USA [pseudomorphs after olivine] (Minerals Unlimited) (*an olivine alteration product*).

ILL101 Illite (green shale): Rochester, NY [$K_{1-1.5}Al_4(Si_{7-6.5}Al_{1-1.5}O_{20})(OH)_4$] (Ward's #46 E 0315).

ILL102 Illite: Silver Hill, Montana (Cambrian shale) [$K_{1-1.5}Al_4(Si_{7-6.5}Al_{1-1.5}O_{20})(OH)_4$] (Source Clay Mineral Repository #IMt-2).

ILS103 Illite-smectite mixed layer (70:30 ordered), Slovakia [$K_{1-1.5}Al_4(Si_{7-6.5}Al_{1-1.5}O_{20})(OH)_4$] (Source Clay Mineral Repository #ISCz-1)b (50 grams received Feb. 20/12).

ILS104 Illite-smectite mixed layer (60:40 ordered), Mancos Shale Ord. [$K_{1-1.5}Al_4(Si_{7-6.5}Al_{1-1.5}O_{20})(OH)_4$] (Source Clay Minerals Repository #ISMt-2).

ILL105 Illite – Cambrian shale: Silver Hill, MT, USA. Clay Minerals Society Source Clays Repository #IMt-1 (50 grams; received March 2008) (50 grams received Feb. 20/12)..

KAO101 Kaolinite: locality unknown [$Al_4 (Si_4O_{10})(OH)_8$] (University of Alberta GEOL330 laboratory collection Drawer 23, ascension 13), not analysed. KAO101-5A: surficial part of sample after

exposure in Mars box run #5. KAO101-5B: subsurface part of sample after exposure in Mars box run #5.

KAO102 Kaolinite (china clay): Edgar, Florida [Al_4 (Si_4O_{10})$(OH)_8$] (Ward's # 46 E 0995).

KAO103 Kaolinite (well ordered), Washington County, Georgia, USA [Al_4 (Si_4O_{10})$(OH)_8$] (Source Clay Minerals Repository #KGa-1b) (came as <45µm powder). (125 grams received Feb. 20/12).

KAO104 Kaolinite (poorly ordered), Warren County, Georgia, USA [Al_4 (Si_4O_{10})$(OH)_8$] (Source Clay Minerals Repository #KGA-2) (came as <45µm size powder). (125 grams received Feb. 20/12; additional 500 grams received Dec. 16, 2013).

LAP001 Laponite – synthetic: Southern Clay Products Inc. Clay Minerals Society Source Clays Repository #SYnL-1 [colloidal synthetic layered silicate-Na,Mg,Li] {$[Na^{+}_{0.7}[(Si_8Mg_{5.5}Li_{0.3})O_{20}(OH)_4]^{-0.7}$} (50 grams; received March 2008).

LEP101 Lepidomelane (var. of biotite): ArNy, Langesundfjord, Norway [$K(Mg,Fe^{2+})_3(Al,Fe^{3+})Si_3O_{10}(OH,F)_2$] (Minerals Unlimited), with pyroxenes PYX125 (hiortdahlite) and PYX172. (Estimated purity of ground sample: 95%).

LPD101 Lepidolite (lithium phyllosilicates); desk set; MB, Canada (2011).

MIC001 Mica: Old Mica Mine, near Saluda, Saluda County, South Carolina, USA; with ilmenite (ILM103), and hematite (too minor to separate) (Minerals Unlimited; received April 5/05).

MIC001 Mica: locality unknown (Mineral Society of Manitoba); 2 specimens. {Needs renumbering].

MIC002 Lepidolite: Tanco Mine, Manitoba, Canada (Mineral Society of Manitoba); 3 specimens.

MIC003 Lepidolite: locality unknown [Western Woods Inc., Tucson 2011 show].

MIC004 Biotite mica: Cardiff Twp., ON, Canada [John Medici, Tucson 2011 show].

MIC005 Phengite, var. virginite (Cr-rich phengite mica); Newfoundland, Canada [Winnipeg Rock and Mineral club purchase, May 2011].

MIN001 Minnesotaite: near Merritt Mine, Guyana Range, Minnesota, USA. Smithsonian Institution NMNH #105491. Received May 25, 2006.

MIN002 Minnesotaite: Blue Bell Mine, Riondell, British Columbia, Canada; with knebelite. [$(Fe,Mg)_3Si_4O_{10}(OH)_2$]. Smithsonian Institution NMNH #138281. Received May 25, 2006. *Present in carbonaceous chondrites?*

MIN003 Minnesotaite: Breen Mine, Waucadah, Michigan, USA. [$(Fe,Mg)_3Si_4O_{10}(OH)_2$]. Smithsonian Institution NMNH #169163. Received May 26, 2006. *Present in carbonaceous chondrites?*

MON101 Montmorillonite: [Na-Ca montmorillonite (beidellite)] 49 E 5107 Cameron, Arizona (Ward's) [API #31] [$(½Ca,Na)_{0.7}(Al,Mg,Fe)_4((Si,Al)_8O_{20})(OH)_4 \cdot nH_2O$)]. MON101-5A: surficial part of sample after exposure in Mars box run #5. MON101-5B: subsurface part of sample after exposure in Mars box run #5.

MON102 Montmorillonite: [powdered bentonite] Clay Spur, Wyoming, Ward's catalogue number 46 E 0435 [$(½Ca,Na)_{0.7}(Al,Mg,Fe)_4((Si,Al)_8O_{20})(OH)_4 \cdot nH_2O$)].

MON103 Montmorillonite (bentonite): Bentonite Spur, Wyoming, USA [$(½Ca,Na)_{0.7}(Al,Mg,Fe)_4((Si,Al)_8O_{20})(OH)_4 \cdot nH_2O$) (Minerals Unlimited; received Sept. 2002; 3-1" pieces).

MON104 Montmorillonite – Ca-rich: Apache Co., AZ, USA. [$(½Ca,Na)_{0.7}(Al,Mg,Fe)_4((Si,Al)_8O_{20})(OH)_4 \cdot nH_2O$). Clay Minerals Society Source Clays Repository #SAz-2 (50 grams; received March 2008; additional 250 grams received Dec. 16, 2013).

MON105 Montmorillonite: Otay, San Diego Co., CA, USA. [$(½Ca,Na)_{0.7}(Al,Mg,Fe)_4((Si,Al)_8O_{20})(OH)_4 \cdot nH_2O$). Clay Minerals Society Source Clays Repository #SCa-3 (50 grams; received March 2008) (50 grams received Feb. 20/12).

MON106 Montmorillonite: Gonzales Co., TX, USA. [$(½Ca,Na)_{0.7}(Al,Mg,Fe)_4((Si,Al)_8O_{20})(OH)_4 \cdot nH_2O$). Clay Minerals Society Source Clays Repository #STx-1b (250 grams; received March 2008) (250 grams received Feb. 20/12).

MON107 Montmorillonite – Na-rich: Crook Co., WY, USA. Clay Minerals Society Source Clays Repository #SWy-2 (250 grams; received March 2008) (250 grams received Feb. 20/12).

NEO101 Neotocite: Itsutanda Mine, Ibuka-Cho, Minokamo-shi, Gifu-Ken, Honshu, Japan. [$(Mn^{2+},Fe^{2+})SiO_3 \cdot H_2O(?)$] (Minerals Unlimited; received Sept. 2002; 3-1" pieces).

NEO102 Neotocite: Ittanda Mine, Minokamo-si, Gifu Prefecture, Japan [$(Mn^{2+},Fe^{2+})SiO_3 \cdot H_2O(?)$] [Alfredo Petrov, Tucson 2011 show].

NON101 Nontronite: Allentown, Lehigh County, Pennsylvania, USA [$Na_{0.3}Fe_2^{3+}(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$] (Minerals Unlimited; received Sept. 2002; 3-1" pieces).

NON102 Nontronite: Hohen Hagen, Germany. [$Na_{0.3}Fe_2^{3+}(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$]. Clay Minerals Society Source Clays Repository #NG-1 (10 grams; received March 2008).

NON103 Nontronite – brown: Uley Mine, South Australia, Australia. [$Na_{0.3}Fe_2^{3+}(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$]. Clay Minerals Society Source Clays Repository #NAu-2 (50 grams; received March 2008) (100 grams received Feb. 20/12; additional 250 grams received Dec. 16, 2013).

NON104 Nontronite – green: Uley Mine, South Australia, Australia. [$Na_{0.3}Fe_2^{3+}(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$]. Clay Minerals Society Source Clays Repository #NAu-1 (50 grams; received March 2008) (100 grams received Feb. 20/12)

PHL101 Phlogopite: Huddersfield Township, Quebec, Canada [$KMg_3Si_3AlO_{10}(F,OH)_2$] (Minerals Unlimited; received Sept. 2002; 3-1" pieces).

PIG006 See TAL102. (Synthetic talc); *See section 19 of this document for data.*

PIG315 Cold green earth - glauconite (catalog no. 420-30S). 100 grams. (green/blue group). *See section 19 of this document for data.*

PIG316 Celadonite - green earth (catalog no. 420-26S). 100 grams. (green/blue group). *See section 19 of this document for data.*

PIG317 Nicosia green earth - glauconite (catalog no. 421-31S). 2 jars of 100 grams, 1 in Historical Pigment Set. (green/blue group). *See section 19 of this document for data.*

PIG318 Dioptase, fine grade (catalog no. 420-10S). 10 grams. (green/blue group). *See section 19 of this document for data.*

PIG325 Glauconite (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set). (green/blue group). *See section 19 of this document for data.*

PLY101 Palygorskite (aka atapulgite): "Mountain leather": Pend Oreille Mine, Metaline Falls, Pend Oreille County, Washington, USA [$(Mg,Al)_2Si_4O_{10}(OH) \cdot 4H_2O$] (Minerals Unlimited; received Sept. 2002; 3-1" pieces).

PLY102 Palygorskite: Gadsen Co., FL, USA. [$(Mg,Al)_2Si_4O_{10}(OH) \cdot 4H_2O$]. Clay Minerals Society Source Clays Repository #PFl-1 (125 grams; received March 2008) (125 grams received Feb. 20/12).

PIG006 Synthetic talc (see pigments section). Aka TAL102.

REC001 Rectorite: Garland Co., Arkansas, USA. [a 1:1 interstratified diocathedral mica and dioctahedral smectite]. Clay Minerals Society Source Clays Repository #RAr-1 (50 grams; received March 2008).

RIP001 Ripidolite: El Dorado Co., CA, USA. [ferroan clinochlore: $(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH_8)$]. Clay Minerals Society Source Clays Repository #CCa-2 (50 grams; received March 2008).

SAP101 Saponite: Menzenberg, N. Honnef, Rheinish Prussia, Germany (Smithsonian NMNH #C3810). [$(Ca/2,Na)_{0.3}(Mg,Fe^{+2})_3(Si,Al)_4O_{10}(OH)_2 \cdot 4H_2O$] (smectite group). *May be in carbonaceous chondrites: see Akai article*. (Estimated purity of ground sample: 98%).

SAP102 Saponite: Ballaray, California (Smithsonian NMNH #170279). [$(Ca/2,Na)_{0.3}(Mg,Fe^{+2})_3(Si,Al)_4O_{10}(OH)_2 \cdot 4H_2O$] (smectite group). *May be in carbonaceous chondrites: see Akai article*. (Estimated purity of ground sample: 99%).

SAP103 Saponite, variety griffithite: Griffith Park, Los Angeles County, California (Minerals Unlimited); [$(Ca/2,Na)_{0.3}(Mg,Fe^{+2})_3(Si,Al)_4O_{10}(OH)_2 \cdot 4H_2O$] (smectite group). *May be in carbonaceous chondrites: see Akai article*. (Estimated purity of ground sample: 98%).

SEP101 Sepiolite: Miller Quarry, Santa Cruz, Santa Cruz County, California, USA [$Mg_4Si_6O_{15}(OH)_2 \cdot 6H_2O$]. (Minerals Unlimited; received Sept. 2002).

SEP102 Sepiolite: Valdemore, Spain. [$Mg_4Si_6O_{15}(OH)_2 \cdot 6H_2O$]. Clay Minerals Society Source Clays Repository #SepSp-1 (50 grams; received March 2008).

SRP101 Serpentine: Feather River Canyon, Plumas County, California (Minerals Unlimited) {[$A_3Si_2O_5(OH)_4$]; A = Mg, Fe^{+2}, Ni}. (kaolinite-serpentine group). *May be in carbonaceous chondrites: see Akai article.* (Estimated purity of ground sample: 98%).

SRP102 Serpentine, var. Garnierite (Ni serpentine): Nickel Mountain, near Riddle, Douglas County, Oregon (Minerals Unlimited) {[$A_3Si_2O_5(OH)_4$]; A = Mg, Fe^{+2}, Ni}. (kaolinite-serpentine group). *May be in carbonaceous chondrites: see Akai article.* (Estimated purity of ground sample: 90%).

SRP103 Asbestos: Asbestos, Quebec (Cowan Mineral Co.). [formerly ASB101; see SRP104]. {[$A_3Si_2O_5(OH)_4$]; A = Mg, Fe^{+2}, Ni}. (kaolinite-serpentine group). *May be in carbonaceous chondrites: see Akai article.* Probably same as SRP104, combined with it.

SRP104 Serpentine: Johns-Manville Co., Asbestos, Quebec, Canada (Smithsonian NMNH #152246). {[$A_3Si_2O_5(OH)_4$]; A = Mg, Fe^{+2}, Ni}. (kaolinite-serpentine group). *May be in carbonaceous*

chondrites: see Akai article. Combined with old SRP103. (Estimated purity of ground sample: 98%).

SRP105 Serpentine: Quebec, Canada (Smithsonian NMNH #147697). {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (kaolinite-serpentine group). *May be in carbonaceous chondrites: see Akai article.* (Estimated purity of ground sample: 99%).

SRP106 Serpentinite: Sand Dollar Beach, coast of southern Monterey Co., CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number SDB-1).

SRP107 Serpentinite: Sand Dollar Beach, coast of southern Monterey Co., CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number SDB-2).

SRP108 Serpentinite: Sand Dollar Beach, coast of southern Monterey Co., CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number SDB-3).

SRP109 Serpentinite: Jade Cove, 2 miles south of Sand Dollar Beach, coast of southern Monterey Co., CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number JC-1).

SRP110 Serpentinite: Clear Creek (New Idria), New Idria serpentinite body at Clear Creek, near King City, CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number CC-1).

SRP111 Serpentinite: Clear Creek (New Idria), New Idria serpentinite body at Clear Creek, near King City, CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number CC-2).

SRP112 Serpentinite: Cuesta Ridge, near San Luis Obispo, CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number CR-1).

SRP113 Serpentinite: Cuesta Ridge, near San Luis Obispo, CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number CR-2).

SRP114 Serpentinite: Cuesta Ridge, near San Luis Obispo, CA, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number CR-3).

SRP115 Serpentinite: Quarry of the Vermont Marble Company, near Proctor, VT, USA {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni} (from Linda Reinen; Pomona College; her sample number VM-14).

SRP116 Serpentinite: Malenco serpentinite body at Franscia, Italy {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (from Linda Reinen; Pomona College; her sample number MG87-8-12).

SRP117 Serpentine: Fort Point, San Francisco Co., CA, USA [with gyrolite (GYR002) (white spherulitic films)] {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (Minerals Unlimited).

SRP118 Serpentine Dallas Gem Mine, San Benito Co., CA, USA; with coalingite (CRB203) {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (Minerals Unlimited). {Bronze coloured coatings on serpentine}.

SRP119 Serpentine: Mistake Mine, Fresno Co., CA, USA; with artinite (CRB312) {$[A_3Si_2O_5(OH)_4]$; A = Mg, Fe^{+2}, Ni}. (Minerals Unlimited).

SRP120 Serpentinite: locality: ??? ROM ID#W68-35 (received from Royal Ontario Museum Dec. 2012).

SRP121 Serpentinite: locality: ??? ROM ID#W68-55 (received from Royal Ontario Museum Dec. 2012).

SRP122 Serpentinite: locality: ??? ROM ID#W71-99 (received from Royal Ontario Museum Dec. 2012).

SRP123 Serpentinite: locality: ??? ROM ID#N-104-A (received from Royal Ontario Museum Dec. 2012).

TAL101 Talc: Esmeralda County, NV, USA ($Mg_3Si_4O_{10}(OH)_2$) (Minerals Unlimited) *(for pigments project)*

TAL102 *Talc: $3MgO{\cdot}4SiO_2{\cdot}H_2O$. Aldrich: 42,043-3: 25 grams. Synthetic? Also labelled as PIG006.*

TOC101 Tochilinite: Jeffrey Mine, Asbestos, Shiton Township, Quebec, Canada (Smithsonian NMNH #148696). [$6Fe_{0.9}S{\cdot}5(Mg,Fe^{+2})(OH)_2$]. *May be in carbonaceous chondrites: see MacKinnon & Zolensky in Akai & Kanno article (also filed under sulphates and sulphides)*.

Tochilinite Spectrum (not sample) from RELAB archive.

VER101 Vermiculite: Rutherford Quarry, near Tuxedo, North Carolina (Smithsonian NMNH #C5284). [$(Mg,Fe^{+2},Al)_3(Al,Si)_4O_{10}(OH)_2{\cdot}4H_2O$] (*a group of minerals of this formula*) (Estimated purity of ground sample: 98%).

VER102 Vermiculite: Brinton's Quarry, Westchester, Pennsylvania (Smithsonian NMNH #95036-1) [$(Mg,Fe^{+2},Al)_3(Al,Si)_4O_{10}(OH)_2{\cdot}4H_2O$] (*a group of minerals of this formula*) (Estimated purity of ground sample: 96%).

VER103 Vermiculite: Vermiculite Hill, near Libby, Lincoln County, Montana (Minerals Unlimited) [$(Mg,Fe^{+2},Al)_3(Al,Si)_4O_{10}(OH)_2{\cdot}4H_2O$] (*a group of minerals of this formula*) (Estimated purity of ground sample: 96%). A few pieces received Dec. 2013.

VER104 Vermiculite (heated) – packaging material from some shipment.

VER105 Vermiculite: Gravelotte, North Transvaal, South Africa (Minerals Unlimited). $[(Mg,Fe^{+2},Al)_3(Al,Si)_4O_{10}(OH)_2 \cdot 4H_2O]$ (*a group of minerals of this formula*). Some small tabular pieces received Dec. 2013.

VER106 Vermiculite: Riverside, WY, USA; Amazon American Educational Products; pack of 10. 1 pack received January 9, 2014; 3 more packs received Jan. 14, 2014.

NOTE: samples in very small vials are the remains after baking at 950°C for 1 to 1-1/2 hours for loss on ignition determinations. Labelled as "Bk-S" (baked by Stan Mertzman).

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3a.1. Sample Descriptions- Clays: Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

FlintClay		*97b (National Bureau of Standards)
Kaolin		GBW 03121 (NCS DC60122)
RedClay		*CRM 5372-90 (ASSO)
Shale		*Sco-1 (United States Geological Survey)
Serpentinite		SARM 47
Talc		BCS 203a
hand sample1	**Talc	ActLabs
hand sample54	**Kaolinite	ActLabs

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3a.2. Sample Descriptions - Clays - Samples from Richard Leveille (May 2012) for kerolite spectral study

WC-01; <2 µm, Na-sat.	Kerolite, <2 µm, Na-saturated
WC-09; <2 µm, Na-sat.	Kerolite, <2 µm, Na-saturated
Sepiolite (NM)	No number, plundered from WUSTL.
BCS-RM #203A	Talc reference standard.

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3b. XRD Data - Clays

A number of the samples were measured by XRD at the University of Manitoba Department of Geological Sciences in May and June of 1999. The samples were run in continuous scanning mode to provide information on the <45µm size samples and whether any accessory phases are present. Other samples were run in June 2000.

When interpreting the results it was found that there are a couple of potential problems when using the JCPDS pattern matching. One is how the baseline is calculated. Minor or diffuse peaks will not be included in the matching routine if they fall below the calculated baseline. Another problem is the broadness of many of the bands; in this case peak positions may not be accurate.

Sample ID	*Tentative*	*XRD Description*
ALL001	Allophane	Allophane, and major amorphous component (U of Manitoba - April 2004). Very amorphous, chrysocolla (not bad)?, allophane?, and maybe quartz (July 06). Reanalysis by Ciprian Popa (may 2014): high Cu and low AL indicates little allophane, lots of chrysocolla – probably contains mostly opal/quartz and chrysocolla and ~4% allophane.
BEI101	Beidellite	Some beidellite, also quartz, kaolinite, montmorillonite, and possibly muscovite (U of Manitoba - April 2004)
BER101	Berthierine	Calcite, antigorite, phlogopite/berthierine matches 2 lines.
BER102	Berthierine	No good peaks, poorly crystalline/berthierine pretty good.
CEL101	Celadonite	Pure celadonite, some amorphous component (U of Manitoba - April 2004)
CEL102	Celadonite	Mostly feldspar, some celadonite, also amorphous component; different than CEL101 pattern (U of Manitoba - April 2004)
CHM101	Chamosite	Feldspar first (albite), quartz,, sample pattern didn't get low end very well.
CHM102	Chamosite	Looks good.
CHM103	Chamosite	Albite, quartz, Mg-chamosite.
CHY101	Chrysocolla	Quartz for all peaks; major amorphous component - could be chrysocolla (U of Manitoba - April 2004)
CHY102	Chrysocolla	Chrysocolla and quartz, also major amorphous component (U of Manitoba - April 2004)
CHY103	Chrysocolla	Pure chrysocolla, also major amorphous component (U of Manitoba - April 2004)
CLA001	Clay(?)	Siderite, hematite, and quartz account for almost all the peaks, some amorphous component (U of Manitoba - April 2004)
CLA002	Clay(?)	Quartz and albite, some amorphous component (U of Manitoba - April 2004)
CLI101	Clinochlore	Pure clinochlore (U of Manitoba - April 2004). Chlorite/serpentine, minor nimite (July 06).
CLI102	Clinochlore	Hendricksite and nimite, no sign of clinochlore (U of Manitoba - April 2004)
CLI103	Clinochlore	Largely clinochlore, some quartz (U of Manitoba - April 2004)
CRO101	Cronstedtite	Cronstedtite (+cassiterite).
CRO102	Cronstedtite	Cronstedtite (+ tourmaline, a bit).
GLA101	(glauconite)	XRD shows siderite and goethite; they account for almost all of the lines. There is also a 7 Angstrom peak that is not used in the fit. (File:gla101.rep).
GLA102	(glauconite)	XRD shows siderite and quartz. However a number of peaks are not fit and those found in the pattern are all weak and diffuse. (File: gla102.rep).
GLA103	Glauconite	Quartz + glauconite.
GLA104	Glauconite	Glauconite + mica (roscoelite).
GRE001	Greenalite	Greenalite and some spinel (July 06).
GRE002	Greenalite	Hematite, chlorite, muscovite; no fit to greenalite (July 06).
GYR001	Gyrolite	Pure gyrolite but intensity discrepancies, some amorphous component (U of Manitoba - April 2004)
GYR002	Gyrolite	Some amorphous component; messy XRD pattern - stichite, lizardite, hydromagnesite, and muscovite possibles; no evidence of gyrolite (U of Manitoba - April 2004)
HAL001	Halloysite	Pure halloysite and amorphous component (U of Manitoba - April 2004)

HEC101	Hectorite	Calcite and beidellite, hectorite possibly (U of Manitoba - April 2004)
HIS001	Hisingerite	Largely amorphous, hisingerite and montmorillonite possible (U of Manitoba - April 2004)
IDD001	Iddingsite	Forsterite first, some enstatite, then amphiboles.
ILL101	(illite)	XRD shows quartz and illite; goosecreekite is the best fit if illite is present.
ILL102	Illite	Quartz, illite (+ muscovite).
ILS103	Illite/smectite	Quartz, disordered illite.
ILS104	Illite/smectite	Gypsum + ... and illite + other stuff.
KAO101	(kaolinite)	XRD shows only kaolinite-1T. (File: kao101.rep).
KAO102	Kaolinite	Kaolinite and
KAO102	(kaolinite)	XRD shows only kaolinite-1T. (File: kao102.rep).
KAO103	Kaolinite (ordered)	Kaolinite
KAO104	Kaolinite (disordered)	Kaolinite
LEP101	Lepidomelane	Not in the JCPDS. Kinoshitaite (mica group) and minor amphiboles.
MIN001	Minnesotaite	Minnesotaite, quartz, siderite, plus 1 or 2 something else to account for some minor peaks (July 06).
MIN002	Minnesotaite	Greenalite, sphalerite, magnesite, calcite, fayalite
MIN003	Minnesotaite	Quartz, hematite, chlorite
MON101	(montmorillonite)	Quartz for sure. Montmorillonite doesn't appear because the expected basal clay reflection is only a broad hump. Some of the other montmorillonite bands do appear in the sample (File: mon101.rep).
MON102	(montmorillonite)	XRD shows some quartz. There is no basal match but the other montmorillonite peaks are matched. There are other peaks that are not matched however (File: mon102.rep).
MON103	Montmorillonite	Montmorillonite, some quartz, and amorphous component (U of Manitoba - April 2004)
NEO101	Neotocite	Quartz for all peaks, some amorphous component, no evidence of neotocite (U of Manitoba - April 2004)
NON101	Nontronite	Quartz and nontronite (U of Manitoba - April 2004)
PHL101	Phlogopite	Pure phlogopite (U of Manitoba - April 2004)
PLY101	Palygorskite	Largely quartz and calcite, no palygorskite peaks (U of Manitoba - April 2004)
SAP101	Saponite	Feldspars + saponite - matches the low end peak
SAP102	Saponite	Minor amphibole + saponite - ugly pattern.
SAP103	Saponite (griffithite)	Minor feldspar. Albite, saponite 16A, ferroan (July 06).
SEP101	Sepiolite	Largely calcite, some sepiolite (U of Manitoba - April 2004)
SRP101	Serpentinite	Tough to say; big peaks aren't on. pecorite, wings match so-so, clinochrysotile is second best match (July 06).
SRP102	Serpentine (garnierite)	Quartz + clinochrysotile. Confirmed July 06.
SRP104	Serpentinite	Antigorite. Pecorite best, clinochrysotile second best (July 06).
SRP105	Serpentinite	Lizardite, clinochrysotile. Lizardite and pecorite, although chrysotile provides the best single fit (July 06).
SRP106	Serpentinite	Lizardite (1M) and some magnetite (U of Manitoba - April 2004) Re-examination may 2006: Lizardite (1M) major and either magnetite or magnesioferrite (both have very similar XRD profiles).
SRP107	Serpentinite	Lizardite (1M) and some augite (U of Manitoba - April 2004) Re-examination May 2006: Clinochrysotile (2Mc1) plus forsterite; 1 peak unaccounted for.
SRP108	Serpentinite	Lizardite (1M) and some augite (U of Manitoba - April 2004) Re-examination May 2006: Lizardite (1T) plus some magnetite.
SRP109	Serpentinite	Lizardite (1M) only (U of Manitoba - April 2004) Re-examination May 2006: Antigorite 8.0M or lizardite 1M; plus something for the broad feature in the 20-25° region.
SRP110	Serpentinite	Lizardite (1M) only (U of Manitoba - April 2004) Re-examination May 2006: Clinochrysotile 2Mc1 best, but no serpentinite is ideal for the 20-25° broad feature.

SRP111	Serpentinite	Antigorite (8.0M) only (U of Manitoba - April 2004) Re-examination May 2006: Antigorite 8.0M only, clean pattern; no 20-25° feature.
SRP112	Serpentinite	Lizardite only - 1M (U of Manitoba - April 2004) Re-examination May 2006: Clinochrysotile 2Mc1; maybe lizardite (1M); some 20-25° tail in the pattern.
SRP113	Serpentinite	Lizardite only - 1M and 1T (U of Manitoba - April 2004) Re-examination May 2006: Clinochrysotile 2Mc1 plus lizardite 1T; some 20-25° tail in the pattern.
SRP114	Serpentinite	Lizardite only - 1M and 1T (U of Manitoba - April 2004) Re-examination May 2006: Lizardite 1T and chrysotile; some 20-25° tail in the pattern
SRP115	Serpentinite	Antigorite (8.0M) and magnesite (U of Manitoba - April 2004) Re-examination May 2006: Antigorite 8M plus 1 peak = magnesite; clean XRD pattern.
SRP116	Serpentinite	Antigorite (8.0M) and minor forsterite (U of Manitoba - April 2004) Re-examination May 2006: Antigorite 8.0M; clean XRD pattern.
SRP117	Serpentinite	Lizardite only - 1M and amorphous component - broad bands (U of Manitoba - April 2004) Re-examination May 2006: messy XRD pattern; clinochrysotile 2Mc1 plus brucite.
SRP118	Serpentinite	Lizardite only - 1M (U of Manitoba - April 2004) Re-examination May 2006: Clinochrysotile 2Mc1 plus brucite; some 20-25° tail in the XRD pattern.
SRP119	Serpentinite	Lizardite only - 1M and 1T (U of Manitoba - April 2004) Re-examination May 2006: Clinochrysotile 2Mc1 plus lizardite and brucite; some 20-25° tail in the XRD pattern.
SRP120	Serpentinite	Lizardite, chrysotile (UWinnipeg Bruker D8 XRD).
SRP121	Serpentinite	Chrysotile, lizardite, chromite (UWinnipeg Bruker D8 XRD).
SRP122	Serpentinite	Chrysotile, lizardite, magnetite, baumite, antigorite, talc (UWinnipeg Bruker D8 XRD).
SRP123	Serpentinite	Lizardite, chrysotile, chromite (UWinnipeg Bruker D8 XRD).
TAL101	Talc	Talc only (U of Manitoba - April 2004)
TAL102	Talc	Talc only (U of Manitoba - April 2004)
TOC101	Tochilinite	Clinochrysotile (no sign of tochilinite)
VER101	Vermiculite	Not a match
VER102	Vermiculite	Not a match
VER103	Vermiculite	Biotite/phlogopite.

Note: XRD patterns for the various serpentinite polymorphs in the data bases are often very similar to each other. In addition, there are undoubtedly questions relating to the relative quality of the powder patterns: wavelength range, criteria used to identify peaks, spectral resolution, actual identity and purity of the samples used, etc.

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3c. Compositional Data - Clays

Wt. %	ALL001	ALL001[x]	BEI101	BEI102	BER101	BER102	CEL101	CEL102
NMNH #					163358	93555	R4733	MU
CMS#				SBId-1				
SiO_2	47.85	47.50	63.59		35.09	27.94	57.51	54.89
Al_2O_3	4.79	1.76	22.74		3.78	7.92	2.53	15.90
TiO_2	0.00	0.01	0.75		2.02	0.52	0.00	1.17
Fe_2O_3	0.15	0.04	5.24		n.d.	30.59	18.19	9.00
FeO	0.00	0.18	0.18		n.d.	20.41	3.57	1.25
*(Fe_2O_3)**	*(0.15)*	*(0.24)*	*(5.44)*		*(13.46)*	*(53.27)*	*(22.16)*	*(10.39)*
MnO	0.00	0.01	0.02		0.16	0.11	0.02	0.14
MgO	0.40	0.79	2.09		26.24	3.42	6.91	3.95
CaO	0.63	0.68	1.25		17.16	4.57	0.20	6.07
Na_2O	0.00	1.47	1.04		0.25	0.28	0.22	3.32
K_2O	0.09	0.15	2.19		0.61	0.05	10.28	3.37
P_2O_5	0.05	0.16	0.04		0.80	1.81	0.01	0.43
SO_3	0.23							
TOTAL	54.19	52.77	99.15		99.57	99.89	99.84	99.63
LOI	12.56	13.07	12.86		18.10	6.45	5.37	4.34
LOI[1]					0.8	6.5		
LOI[2]					1.5	1.3		
LOI[3]					21.4	19.5		
LOI[4]					23.7	27.3		
ppm								
Sr	35	109	530		1475	167	20	615
Zr	10	33	198		243	210	40	175
V	10	44	172		183	1000	315	170
Cr	<5	30	70		1390	390	25	65
Co	40		5					
Cu	39.8%	46.8%	1650					
Ni	125	5	<2					
Rb	4	2	85					
U	400							
Source	Mertzman	Mertzman	Mertzman	CMS	Mertzman	Mertzman	Mertzman	Mertz.
Analysis	XRF/WC	XRF/WC	XRF/WC		XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

[x] Reanalysis by Stan Mertzman of new split prepared April 2006 for Janice Bishop et al study.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History. CMS: Clay Minerals Society.

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3c. Compositional Data - Clays (continued)

Wt. %	CHM101	CHM102	CHM102[x]	CHM103
NMNH #	R4568	R4558	R4558	
SiO_2	50.25	27.38	21.77	66.77
Al_2O_3	15.67	6.97	5.62	15.65
TiO_2	2.24	0.42	0.23	0.72
Fe_2O_3	9.62	n.d.	25.92	2.82
FeO	4.31	n.d.	29.09	1.91
*(Fe_2O_3)**	*(14.41)*	*(57.05)*	*(58.25)*	*(4.94)*
MnO	0.20	0.15	0.51	0.45
MgO	4.78	3.59	4.06	2.92
CaO	7.97	3.36	6.36	3.04
Na_2O	2.83	0.27	0.77	3.25
K_2O	0.83	0.05	0.06	1.68
P_2O_5	0.29	0.90	1.71	0.17
SO_3				
TOTAL	99.47	100.14	99.34	99.59
LOI	5.29	12.58	20.87	4.07
LOI[1]	1.9	1.3		0.9
LOI[2]	1.8	2.1		0.5
LOI[3]	9.2	14.2		8.6
LOI[4]	12.9	17.6		10.0
ppm				
Sr	317	101	242	184
Zr	189	197	130	186
V	257	920	717	66
Cr	63	370	439	37
Co			65	
Cu			70	
Ni			45	
Rb			5	
U				
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History.

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3c. Compositional Data - Clays (continued)

Wt. %	CHY101	CHY102	CHY103	CLA001	CLA002	CLA004	CLA005
NMNH #			104956				
SiO_2	50.59	43.89	21.15	17.33	71.86	82.21	53.11
Al_2O_3	2.04	1.14	44.70	3.85	12.32	9.19	16.88
TiO_2	0.02	0.00	0.00	0.19	0.75	0.38	0.72
Fe_2O_3	0.23	0.00	0.16	64.35	6.44	2.67	3.24
FeO	0.00	0.33	0.00	5.26	0.74	0.82	1.25
*(Fe_2O_3)**	*(0.23)*	*(0.33)*	*(0.16)*	*(70.20)*	*(7.26)*	*(3.58)*	*(4.63)*
MnO	0.01	0.01	0.06	2.45	0.21	0.25	0.03
MgO	0.39	0.48	0.20	0.76	0.78	1.48	1.37
CaO	0.83	0.73	0.92	2.15	1.75	0.80	16.51
Na_2O	0.96	1.16	0.37	0.76	2.69	0.28	0.26
K_2O	0.13	0.02	0.03	0.53	2.34	1.64	2.59
P_2O_5	0.21	0.26	0.06	0.65	0.16	0.07	0.27
SO_3						0.12	2.05
CuO			32.4				
TOTAL	55.41	48.02	100.05	98.87	100.12	100.00	98.42
LOI	11.60		26.58	17.10	4.86	7.19	20.06
LOI[a]	14.34	14.97					
LOI[1]							
LOI[2]							
LOI[3]							
LOI[4]							
ppm							
Sr	150	67	205	135	355	208	334
Zr	35	28	30	100	365	155	193
V	20	30	45	92	95	282	353
Cr	<2	<2	35	85	175	96	115
Ni						25	65
Co						4	7
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

a: LOI – duplicate analysis.

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History.

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3c. Compositional Data - Clays (continued)

Wt. %	CLI101	CLI101[x]	CLI102	CLI103	CRO101	CRO102
NMNH #			R14987		193910	R7807-4
SiO_2	33.78	33.68	37.74	38.04	16.15	16.36
Al_2O_3	21.63	21.63	11.52	15.77	0.24	0.06
TiO_2	0.22	0.15	0.07	0.01	0.00	0.02
Fe_2O_3	4.23	3.89	11.49	5.37	63.51	52.79
FeO	5.96	6.54	4.84	24.45	15.96	26.79
*(Fe_2O_3)**	*(10.85)*	*(11.16)*	*(16.87)*	*(32.54)*	*(81.25)*	*(82.56)*
MnO	0.20	0.20	0.05	0.20	0.16	0.01
MgO	32.18	32.60	27.15	11.79	0.22	0.18
CaO	0.07	0.06	0.78	1.29	0.56	0.07
Na_2O	0.11	0.18	0.22	0.23	0.72	0.27
K_2O	0.00	0.00	5.81	0.00	0.00	0.01
P_2O_5	0.02	0.03	0.04	0.02	0.12	0.01
SO_3	0.32					
TOTAL	99.38	99.69	100.25	99.89	99.42	99.55
LOI	11.89	13.76	5.37	9.61	8.64	9.86
LOI[1]					2.4	0.7
LOI[2]					2.0	0.3
LOI[3]					11.7	9.3
LOI[4]					16.1	10.3
ppm						
Sr	8	72	15	244	5	6
Zr	15	28	55	25	2	4
V	140	126	50	525	27	29
Cr	375	467	15	150	6	31
Co	80	103				
Cu	260	30				
Ni	1120	770				
Rb	<2	5				
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History.

[x] Reanalysis by Stan Mertzman of new split prepared April 2006 for Janice Bishop et al study.

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3c. Compositional Data - Clays (continued)

Wt. %	GLA101	GLA102	GLA103	GLA104	GRE001	GRE002
NMNH #			46447	97839	158902	123826
SiO_2	29.52	35.31	60.45	52.86	28.05	28.48
Al_2O_3	9.18	9.66	9.95	7.80	0.62	21.87
TiO_2	0.28	0.34	0.26	0.06	0.03	1.29
Fe_2O_3	35.06	36.99	16.06	22.65	25.05	29.00
FeO	15.19	10.16	1.51	2.06	36.43	10.62
*(Fe_2O_3)**	*(51.94)*	*(47.15)*	*(17.74)*	*(24.94)*	*(65.54)*	*(40.80)*
MnO	0.07	0.07	0.02	0.16	1.23	0.08
MgO	2.19	2.19	3.51	3.91	3.06	1.25
CaO	2.64	1.72	0.95	0.73	0.30	0.15
Na_2O	0.28	0.25	0.20	0.13	0.80	0.63
K_2O	2.22	2.58	6.27	8.63	0.00	4.71
P_2O_5	1.55	0.66	0.14	0.20	0.05	0.11
TOTAL	99.87	99.93	99.49	99.42	99.68	99.37
LOI	18.04	14.03	9.53	7.16	10.81	5.64
LOI[1]	1.8	5.3	1.0	0.3		
LOI[2]	2.4	2.6	2.4	1.3		
LOI[3]	20.5	29.9	10.6	12.2		
LOI[4]	24.7	37.8	21.0	13.8		
ppm						
Sr	49	28	27	12	50	75
Zr	48	66	158	67	20	70
V	610	615	106	57	60	320
Cr	560	500	163	47	50	300
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History.

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3c. Compositional Data - Clays (continued)

Wt. %	GYR001	GYR002	HAL001	HAL001	HEC101
SiO_2			53.18	52.73	59.06
Al_2O_3			45.46	45.51	0.07
TiO_2			0.00	0.02	0.00
Fe_2O_3			0.44	0.14	0.09
FeO			0.00	0.10	0.00
*(Fe_2O_3)**			*(0.44)*	*(0.26)*	*(0.09)*
MnO			0.01	0.00	0.01
MgO			0.11	0.12	27.68
CaO			0.15	0.17	10.83
Na_2O			0.07	0.00	2.43
K_2O			0.05	0.05	0.06
P_2O_5			0.14	0.20	0.03
SO_3				0.00	
TOTAL			99.61	99.06	100.26
LOI			16.29	16.33	17.15
LOI[1]					
LOI[2]					
LOI[3]					
LOI[4]					
ppm					
Sr			20	28	370
Zr			15	21	25
V			10	24	40
Cr			145	580?	10
Co			2	13	
Cu			50		
Ni			125	40	
Rb			2		
Source			Mertzman	Mertzman	Mertzman
Analysis			XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History.

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3c. Compositional Data - Clays (continued)

Wt. %	HIS001	IDD001	ILL101	ILL101	ILL102	ILL102
Ward's ID			46E0315	46E0315		
SCMR ID			IMt-2	IMt-2	ISCz-1	ISCz-1
SiO_2	46.36	42.92	55.1	63.43	51.6	60.63
Al_2O_3	5.71	3.61	22.0	20.78	25.6	21.97
TiO_2	0.48	0.10	0.63	0.93	0.039	0.74
Fe_2O_3	30.53	3.47	5.28	2.64	1.11	4.44
FeO	0.00	5.61	1.34	2.11	<0.1	1.31
*(Fe_2O_3)**	*(30.53)*	*(9.70)*		*(4.98)*		*(5.90)*
MnO	0.39	0.17	NA	0.04	0.04	0.04
MgO	9.77	39.56	2.8	2.43	2.46	2.23
CaO	2.00	2.34	0.02	0.56	0.67	0.26
Na_2O	3.17	0.30	0.08	0.29	0.32	0.16
K_2O	0.26	0.01	8.04	6.22	5.36	7.96
P_2O_5	0.08	0.02	n.d.	0.10	0.04	0.09
SrO			n.d.		n.d.	
H_2O-			1.0		n.d.	
H_2O+			6.4		n.d.	
TOTAL	98.75[a]	98.73[a]	102.69	99.76	97.4	99.98
LOI	14.63	0.15		5.44	10.2	5.66
LOI[1]		3.3	2.0		3.9	
LOI[2]		2.0	0.5		3.7	
LOI[3]		7.0	12.4		3.6	
LOI[4]		12.3	14.9		11.2	
ppm						
Sr	320	20		120		175
Zr	340	30		175		145
V	75	95		125		90
Cr	640	2100		65		60
Co	50	110				
Cu	2400	700				
Ni	400	2650				
Rb	<2	<2				
Source	Mertzman	Mertzman	Hower & Mowat (1966)	Mertzman	CMS	Mertzman
Analysis	XRF/WC	XRF/WC		XRF/WC		XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. CMS: Clay Minerals Society. SCMR: Source Clay Minerals Repository. Ward's : Ward's Science.

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3c. Compositional Data - Clays (continued)

Wt. %	ILS103	ILS103	ILS103	ILS104
SCMR ID	ISCz-1	ISMt-2	ISMt-2	
SiO_2	47.64	51.2	67.14	54.85
Al_2O_3	25.19	26.3	22.89	28.62
TiO_2	n.d.	0.17	0.18	0.25
Fe_2O_3	0.95	1.49	1.13	2.19
FeO	n.d.	0.1	0.24	0.48
*(Fe_2O_3)**			*(1.40)*	*(2.72)*
MnO	n.d.	0.01	0.01	0.02
MgO	2.22	2.41	1.90	2.00
CaO	0.22	1.4	0.28	6.08
Na_2O	0.08	0.04	0.08	0.30
K_2O	5.18	4.74	5.68	5.02
P_2O_5	n.d.	0.05	0.04	0.11
SrO	4.46	n.d.		n.d.
H_2O-	5.54	n.d.		n.d.
H_2O+	n.d.	n.d.		n.d.
TOTAL	91.30	100.5	99.60	99.97[a]
LOI		12.6	7.50	13.06
LOI[1]				8.0
LOI[2]				0.1
LOI[3]				12.5
LOI[4]				20.6
ppm				
Sr			68	708
Zr			185	204
V			5	39
Cr			<2	21
Source	Sucha	CMS	Mertzman	Mertzman
Analysis			XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations and notes: LOI: loss on ignition. CMS: Clay Minerals Society. SCMR: Source Clay Minerals Repository. Sucha = Dr. Vladimir Sucha, Comenius University, Slovakia.

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3c. Compositional Data - Clays (continued)

Wt. %	KAO101
SiO_2	54.03
TiO_2	0.41
Al_2O_3	42.60
*(Fe_2O_3)**	*(0.71)*
FeO	0.26
Fe_2O_3	0.42
MnO	0.01
MgO	0.44
CaO	0.64
Na_2O	0.04
K_2O	0.466
P_2O_5	0.457
Cl	0.00
SO_3	0.06
TOTAL	99.863
LOI	14.69
ppm	
Sr	401
Zr	151
V	104
Ni	10
Cr	95
Co	<1
Rb	20
Source	Mertzman
Analysis	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. CMS: Clay Minerals Society. SCMR: Source Clay Minerals Repository.

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3c. Compositional Data - Clays (continued)

Wt. %	KAO101	KAO102	KAO103	KAO103	KAO103	KAO103	KAO103
Ward's ID		46E0995					
SCMR ID			KGa-1b	KGa-1b	KGa-1b	KGa-1b	KGa-1b
SiO_2	53.49	53.53	43.1	45.0	44.2	43.36	52.17
Al_2O_3	43.28	43.26	38.5	38.0	39.7	38.58	44.76
TiO_2	0.43	1.66	1.7	1.58	1.39	1.67	1.87
Fe_2O_3	0.36	0.08	0.28	0.26	0.13	0.35	0.00
FeO	0.32	0.41	<0.1	0.02	0.08		0.14
*(Fe_2O_3)**	*(0.72)*	*(0.54)*					*(0.16)*
MnO	0.01	0.01	0.04	0.00	0.002		0.01
MgO	0.29	0.32	0.14	0.02	0.03	0.04	0.13
CaO	0.63	0.30	0.07	0.02	--	0.04	0.06
Na_2O	0.10	0.06	0.08	0.01	0.013	0.05	0.07
K_2O	0.48	0.19	0.05	0.04	0.050	0.00	0.02
P_2O_5	0.47	0.06	0.08	0.05	0.34	0.37	0.07
S	n.d.	n.d.	n.d.	n.d.	n.d.		
F[5]	n.d.	n.d.	n.d.	(0.013)	n.d.		
TOTAL	99.90	99.93					99.32
LOI	14.55	14.24					14.19
LOI[c]			14.2	14.31			
110-550°C[e]						13.60	
550-1000°C[e]						1.45	
-550[e]					12.6		
550-1000[e]					1.18		
TOTAL[d]			98.3[d]			99.51[d]	
LOI[1]	2.8	3.0					
LOI[2]	0.0	1.0					
LOI[3]	18.6	21.9					
LOI[4]	21.4	25.9					
ppm							
Sr	290	70					75
Zr	109	185					350
V	83	140					220
Cr	95	100					135
Source	Mertzman	Mertzman	CMS	Cl	MH	Mermut	Mertzman
Analysis	XRF/WC	XRF/WC					XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[c]: LOI: loss on ignition – included in total. [d]: Total includes loss on ignition. [e]: weight loss over various temperature intervals; see original data sources for explanations.

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at UWinnipeg. [2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at UWinnipeg. [3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at UWinnipeg. [4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at UWinnipeg. [5]: fluorine by Thomas, not included in total.

Abbreviations and notes: LOI: loss on ignition. CMS: Clay Minerals Society. SCMR: Source Clay Minerals Repository. Ward's: Ward's Science. Mermut data: <2 µm fraction analyzed (see Mermut and Cano for details).

Sources of data: CL: Clemency; MH: Haydn [analyses from Data Handbook for Clay Materials and other Non-Metallic Minerals]; CMS = Clay Minerals Society; Sucha = Dr. Vladimir Sucha, Comenius University, Slovakia.

Analysis from CMS Source Clay Minerals Repository (CMS): <2µm fraction analyzed.++++++++++++

3c. Compositional Data - Clays (continued)

Wt. %	KAO104	KAO104	KAO104	KAO104	KAO104
SCMR ID	KGa-2	KGa-2	KGa-2	KGa-2	KGa-2
SiO_2	44.2	43.9	43.7	43.49	51.61
Al_2O_3	37.2	38.5	33.6	38.14	44.67
TiO_2	2.17	2.08	2.28	1.91	2.49
Fe_2O_3	1.14	0.98	1.01	1.15	0.62
FeO	0.05	0.15	n.d.		0.48
*(Fe_2O_3)**					*(1.15)*
MnO	0.00	--	0.02		0.01
MgO	0.04	0.03	0.03	0.04	0.11
CaO	0.04	0.03	0.02	0.03	0.02
Na_2O	0.02	<0.005	<0.01	0.06	0.00
K_2O	0.02	0.065	0.04	0.02	0.04
P_2O_5	0.06	0.045	0.11	0.32	0.06
S	n.d.	0.02	n.d.		
SO_3					0.07
F[5]	(0.020)	n.d.	n.d.		
TOTAL					100.23
LOI					14.20
LOI[c]	14.24		14.5		
110-550°C[e]				13.30	
550-1000°C[e]				1.73	
-550[e]		12.6			
550-1000[e]		1.17			
TOTAL[d]			100.4	100.19	
LOI[1]	1.2				
LOI[2]	0.1				
LOI[3]	18.0				
LOI[4]	19.3				
ppm					
Sr					86
Zr					266
V					136
Cr					142
Ni					5
Co					<1
Source	CL	MH	CMS	Mermut	Mertzman
Analysis					XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO determined by wet chemistry (WC) and Fe_2O_3 taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes. n.d. = not determined. tr.: trace (<0.01 wt.%).

[c]: LOI: loss on ignition – included in total. [d]: Total includes loss on ignition. [e]: weight loss over various temperature intervals; see original data sources for explanations.

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at UWinnipeg. [2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at UWinnipeg. [3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at UWinnipeg. [4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at UWinnipeg. [5]: fluorine by Thomas, not included in total.

Abbreviations and notes: LOI: loss on ignition. CMS: Clay Minerals Society. SCMR: Source Clay Minerals Repository. Ward's: Ward's Science. Mermut data: <2 µm fraction analyzed (see Mermut and Cano for details).

Sources of data: CL: Clemency; MH: Haydn [analyses from Data Handbook for Clay Materials and other Non-Metallic Minerals]; CMS = Clay Minerals Society; Sucha = Dr. Vladimir Sucha, Comenius University, Slovakia.

Analysis from CMS Source Clay Minerals Repository (CMS): <2µm fraction analyzed.++++++++++

3c. Compositional Data - Clays (continued)

Wt. %	LEP101	MIN001	MIN002	MIN003
NMNH #		105491	138281	169163
SiO_2	37.65	41.46	12.98	52.68
Al_2O_3	7.40	2.35	1.55	5.78
TiO_2	2.29	0.07	0.13	0.20
Fe_2O_3	19.43	11.78	5.12	26.70
FeO	8.61	27.35	30.37	9.75
*(Fe_2O_3)**	*(29.00)*	*(42.18)*	*(38.87)*	*(37.54)*
MnO	1.21	6.42	7.54	0.09
MgO	2.75	3.71	1.91	2.33
CaO	7.26	2.06	14.55	0.47
Na_2O	2.70	0.58	3.62	0.32
K_2O	5.75	0.79	0.00	0.00
P_2O_5	3.34	0.18	0.10	0.37
ZnO			19.00	
TOTAL		99.80	81.25	99.78
LOI		16.46	5.19	3.55
LOI^1	0.6			
LOI^2	0.8			
LOI^3	7.1			
LOI^4	8.5			
ppm				
Sr	188	55	75	110
Zr	1780	35	55	105
V	61	85	60	105
Cr	14	70	15	80
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History.

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3c. Compositional Data - Clays (continued)

Wt. %	MON101	MON101	MON102	MON102	MON102	MON103
Ward's ID	46 E 0995	46 E 0995	46 E 0435	46 E 0435	46E 0435	
API #	31	31				
SiO_2	54.37	65.85	60.96	61.47	65.90	64.81
Al_2O_3	17.79	19.89	18.27	22.17	21.91	22.71
TiO_2	0.56	0.67	0.08	0.09	0.15	0.15
Fe_2O_3	7.14	5.65	2.83	4.32	0.21	5.19
FeO	0.27	0.26	0.14	n.d.	4.05	0.00
*(Fe_2O_3)**		*(5.94)*			*(4.71)*	*(5.19)*
MgO	1.20	2.02	2.96	2.73	2.52	2.90
CaO	1.83	0.94	0.10	0.14	1.41	0.53
Na_2O	0.26	1.30	1.44	3.18	2.27	2.79
K_2O	2.49	2.90	0.31	0.03	0.54	0.56
MnO	n.d.	0.02	n.d.	tr.	0.04	0.01
P_2O_5	n.d.	0.04	n.d.	0.02	0.07	0.06
H_2O (-)	6.31		6.78			
H_2O (+)	6.79		6.56			
H_2O				6.02		
TOTAL		99.57			99.52	99.71
LOI		10.38			10.38	10.50
TOTAL[c]	99.50		100.43	100.17		
LOI[1]	2.7		2.5			
LOI[2]	2.2		5.6			
LOI[3]	10.0		9.4			
LOI[4]	14.9		17.5			
ppm						
Sr		348			325	140
Zr		213			225	295
V		78			<2	41
Cr		10			<2	10
Source	Schultz	Mertzman	Schultz	Earley et al.	Mertzman	Mertzman
Analysis		XRF/WC	(1969)	(1953)	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[c]: Total includes loss on ignition.

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at UWinnipeg. [2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at UWinnipeg. [3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at UWinnipeg. [4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at UWinnipeg.

[1] Loss on ignition upon heating of sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon further heating of sample (in air) to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon further heating of sample (in air) to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Notes and abbreviations: API: American Petroleum Institute. Ward's: Ward's Science.

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3c. Compositional Data - Clays (continued)

Wt. %	MON104	NEO101	NON101	NON103
SiO_2	67.03	72.06	61.40	56.08
Al_2O_3	19.75	0.22	9.49	4.89
TiO_2	0.25	0.00	0.38	0.56
Fe_2O_3	0.85	0.28	22.08	34.15
FeO	0.79	0.00	0.79	0.65
*(Fe_2O_3)**	*(1.73)*	*(0.28)*	*(22.96)*	*(34.87)*
MgO	6.97	1.36	1.07	0.98
CaO	3.37	0.22	0.10	1.79
Na_2O	0.06	0.12	0.15	0.52
K_2O	0.17	0.00	3.67	0.06
MnO	0.10	25.53	0.03	0.01
P_2O_5	0.03	0.02	0.51	0.09
SO_3	0.09			0.06
TOTAL	99.55	99.81	99.76	99.91
LOI	21.70	7.32	8.56	9.79
ppm				
Sr	433	45	40	112
Zr	359	42	445	70
V	83	68	70	220
Cr	47	5	15	68
Ni	2			13
Co	<1			<1
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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3c. Compositional Data - Clays (continued)

Wt. %	PHL101	PLY101	SAP101	SAP102	SAP103	SAP103[x]	SEP101
NMNH #			C3810	170279			
SiO_2	44.53	79.94	62.89	56.31	46.92	51.27	48.76
Al_2O_3	13.23	1.45	18.76	5.14	9.86	16.17	0.02
TiO_2	0.34	0.03	0.90	0.72	0.30	1.07	0.00
Fe_2O_3	1.15	1.16	7.29	0.42	14.25	7.09	1.41
FeO	2.65	0.00	0.39	0.54	3.94	3.67	0.00
*(Fe_2O_3)**	*(4.10)*	*(1.16)*	*(7.72)*	*(0.96)*	*(18.63)*	*(11.17)*	*(1.41)*
MgO	25.78	1.46	1.85	30.86	17.52	7.82	22.72
CaO	0.11	15.48	2.30	2.18	4.29	8.68	27.32
Na_2O	0.26	0.08	2.12	2.87	0.73	2.84	0.10
K_2O	10.87	0.16	2.69	0.41	0.07	0.39	0.02
MnO	0.08	0.03	0.04	0.03	0.39	0.29	0.10
P_2O_5	0.02	0.19	0.16	0.13	0.04	0.13	0.02
TOTAL	99.32	99.98	99.43[a]	99.61[a]	98.75[a]	99.83	100.47
LOI	0.43	9.76	12.27	14.36	17.25	6.16	23.96
LOI[1]			8.6	12.6	12.5		
LOI[2]			4.4	2.8	4.3		
LOI[3]			33.5[d]	19.4[d]	19.1[d]		
LOI[4]			46.5[d]	34.8[d]	35.9[d]		
ppm							
Sr	125	70	386	70	186	299	195
Zr	20	35	580	316	53	104	25
V	45	105	117	50	80	204	40
Cr	10	10	52	32	72	221	5
Co						50	
Cu						15	
Ni						3	
Rb						5	
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History.

[x] Reanalysis by Stan Mertzman of new split prepared April 2006 for Janice Bishop et al study.

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3c. Compositional Data - Clays (continued)

Wt. %	SRP101	SRP102	SRP102[x]
SiO_2	44.51	85.70	78.83
Al_2O_3	10.26	0.22	0.20
TiO_2	0.71	0.00	0.01
Fe_2O_3	2.05	2.39	0.11
FeO	1.36	0.29	2.38
*(Fe_2O_3)**	*(3.56)*	*(2.71)*	*(2.76)*
MgO	39.46	11.36	10.15
CaO	0.23	0.06	0.06
Na_2O	0.25	0.09	0.24
K_2O	0.06	0.01	0.00
MnO	0.08	0.04	0.05
P_2O_5	0.05	0.01	0.03
TOTAL	99.17	100.20	92.33
LOI	13.59	5.58	5.45
LOI^1	0.3	0.8	
LOI^2	0.8	0.5	
LOI^3	30.1	10.1	
LOI^4	31.2	11.4	
ppm			
Sr	205	7	23
Zr	210	21	20
V	65	39	10
Cr	650	590	830
Co			44
Ni			7.4%
Cu			145
Rb			3
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition.

[x] Reanalysis by Stan Mertzman of new split prepared April 2006 for Janice Bishop et al study.

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3c. Compositional Data - Clays (continued)

Wt. %	SRP104	SRP105	SRP106	SRP106	SRP107	SRP107
NMNH #	152246	147697				
Reinen #			SDB-1	SDB-1	SDB-2	SDB-2
SiO_2	44.21	48.66	45.16	45.30	43.74	44.33
Al_2O_3	0.32	0.04	1.78	1.28	2.65	2.27
TiO_2	0.04	0.00	0.03	0.04	0.08	0.08
Fe_2O_3	10.11	0.71		7.28		5.66
FeO	1.34	1.34		1.60		3.73
*(Fe_2O_3)**	*(11.60)*	*(2.20)*	*(8.7)*	*(9.06)*	*(9.57)*	*(9.78)*
MgO	43.21	48.75	42.26	43.20	39.36	39.66
CaO	0.07	0.06	0.60	0.58	3.16	2.91
Na_2O	0.14	0.11	0.96	0.02	0.63	0.08
K_2O	0.00	0.00	0.01	0.00	0.03	0.00
MnO	0.08	0.02	0.12	0.12	0.22	0.24
P_2O_5	0.01	0.01	0.00	0.02	0.00	0.02
TOTAL	99.68	99.85	99.62	99.62	99.44	99.40
LOI	12.21	13.89	n.d.	14.86	n.d.	9.37
LOI[1]	0.6	1.7				
LOI[2]	1.6	1.7				
LOI[3]	43.4	24.5				
LOI[4]	45.6	27.9				
ppm						
Sr	5	45	17	58	5	46
Zr	20	19	8	10	6	10
V	40	39	26	10	40	35
Cr	510	17	1865	1925	2820	2940
Co			58	138	67	145
Ni			1746	2750	2469	3280
Cu			13		111	
Zn			21		45	
Rb			6	<2	4	<2
Y			1		0	
Nb			0		0	
Ba			28		38	
Source	Mertzman	Mertzman	Asher	Mertzman	Asher	Mertzman
Analysis	XRF/WC	XRF/WC	XRF	XRF/WC	XRF	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: Asher. Analysis by Pranoti Asher (Georgia Southern University) by XRF. Totals expressed on a volatile-free basis.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History. Reinen: Linda Reinen – Pomona College.++++++++++++++++++++++++++++++++++

3c. Compositional Data - Clays (continued)

Wt. %	SRP108	SRP108	SRP109	SRP109	SRP110	SRP110
Reinen #	SDB-3	SDB-3	JC-1	JC-1	CC-1	CC-1
SiO_2	43.97	43.30	46.41	45.87	45.11	44.84
Al_2O_3	3.34	2.98	2.42	2.04	1.40	0.98
TiO_2	0.09	0.10	0.06	0.07	0.01	0.01
Fe_2O_3		9.18		4.23		6.51
FeO		3.00		3.70		2.37
*(Fe_2O_3)**	*(10.6)*	*(12.51)*	*(7.74)*	*(8.34)*	*(8.52)*	*(9.14)*
MgO	36.97	36.76	41.81	42.23	43.37	43.69
CaO	3.62	3.53	0.26	0.32	0.19	0.24
Na_2O	0.67	0.14	0.82	0.05	0.81	0.02
K_2O	0.04	0.00	0.00	0.00	0.00	0.00
MnO	0.16	0.16	0.13	0.14	0.13	0.12
P_2O_5	0.00	0.02	0.00	0.02	0.00	0.02
TOTAL	99.46	99.54	99.65	99.08	99.54	99.06
LOI	n.d.	10.11		12.51		13.25
LOI[1]						
LOI[2]						
LOI[3]						
LOI[4]						
ppm						
Sr	2	44	4	47	2	47
Zr	10	10	6	10	6	10
V	50	45	23	15	17	10
Cr	2750	3025	1835	2185	2682	2845
Co	70	125	49	102	55	110
Ni	2279	3030	1552	2280	1840	2270
Cu	91		25		23	
Zn	37		43		26	
Rb	3	<2	3	<2	3	<2
Y	0		0		3	
Nb	0		0		0	
Ba	26		12		35	
Source	Asher	Mertzman	Asher	Mertzman	Asher	Mertzman
Analysis	XRF	XRF/WC	XRF	XRF/WC		XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: Asher. Analysis by Pranoti Asher (Georgia Southern University) by XRF. Totals expressed on a volatile-free basis.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. Reinen: Linda Reinen – Pomona College.

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3c. Compositional Data - Clays (continued)

Wt. %	SRP111	SRP111	SRP112	SRP112	SRP113	SRP113
NMNH #	152246	152246	147697	147697		
Reinen #	CC-2	CC-2	CR-1	CR-1	CR-2	CR-2
SiO_2	46.99	46.60	47.36	46.96	46.30	45.09
Al_2O_3	1.17	0.75	0.53	0.12	0.55	0.18
TiO_2	0.01	0.01	0.00	0.01	0.00	0.01
Fe_2O_3		4.88		5.27		10.10
FeO		2.72		2.87		0.25
*(Fe_2O_3)**	*(7.75)*	*(7.90)*	*(8.40)*	*(8.46)*	*(9.54)*	*(10.38)*
MgO	42.42	43.17	42.42	43.26	42.01	42.49
CaO	0.41	0.44	0.01	0.05	0.01	0.05
Na_2O	0.70	0.01	0.67	0.01	0.73	0.03
K_2O	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.10	0.09	0.13	0.14	0.18	0.18
P_2O_5	0.00	0.02	0.00	0.02	0.00	0.02
TOTAL	99.55	98.99	99.52	99.03	99.32	98.43
LOI		12.06		11.16		14.94
LOI[1]						
LOI[2]						
LOI[3]						
LOI[4]						
ppm						
Sr	9	52	0	44	0	45
Zr	3	10	7	10	6	10
V	18	15	5	5	4	5
Cr	2337	2605	2260	1905	3593	4755
Co	47	87	53	100	69	195
Ni	1967	2180	2303	2945	2983	4720
Cu	53		34		23	
Zn	33		28		38	
Rb	7	<2	0	<2	2	<2
Y	0		1		2	
Nb	6		0		2	
Ba	8		14		12	
Source	Asher	Mertzman	Asher	Mertzman	Asher	Mertzman
Analysis	XRF	XRF/WC	XRF	XRF/WC	XRF	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: Asher. Analysis by Pranoti Asher (Georgia Southern University) by XRF. Totals expressed on a volatile-free basis.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History. Reinen: Linda Reinen – Pomona College.

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3c. Compositional Data - Clays (continued)

Wt. %	SRP114	SRP114	SRP115	SRP115
Reinen #	CR-3	CR-3	VM-14	VM-14
SiO_2	46.36	45.29	43.47	41.12
Al_2O_3	1.63	1.24	2.17	1.82
TiO_2	0.00	0.00	0.04	0.04
Fe_2O_3		6.76		6.70
FeO		1.08		2.63
*(Fe_2O_3)**	*(7.87)*	*(7.96)*	*(9.65)*	*(9.62)*
MgO	42.68	44.52	43.01	45.72
CaO	0.02	0.06	0.09	0.13
Na_2O	0.79	0.01	0.91	0.01
K_2O	0.00	0.00	0.00	0.00
MnO	0.14	0.15	0.16	0.16
P_2O_5	0.00	0.02	0.00	0.06
TOTAL	99.49	99.25	99.50	98.68
LOI		14.64		16.33
LOI[1]				
LOI[2]				
LOI[3]				
LOI[4]				
ppm				
Sr	0	50	2	44
Zr	9	15	9	10
V	3	3	18	25
Cr	2705	2705	2632	2895
Co	55	110	64	142
Ni	2278	3100	2307	3815
Cu	78		11	
Zn	23		28	
Rb	2	<2	5	<2
Y	0		1	
Nb	0		0	
Ba	37		9	
Source	Asher	Mertzman	Asher	Mertzman
Analysis	XRF	XRF/WC	XRF	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: Asher. Analysis by Pranoti Asher (Georgia Southern University) by XRF. Totals expressed on a volatile-free basis.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. Reinen: Linda Reinen – Pomona College.

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3c. Compositional Data - Clays (continued)

Wt. %	SRP116	SRP116	SRP117	SRP118	SRP118	SRP119
Reinen #	MG87-8-12	MG87-8-12				
SiO_2	44.28	43.96	40.74	46.94	46.31	49.23
Al_2O_3	1.98	1.39	0.36	0.46	0.13	0.20
TiO_2	0.01	0.02	0.00	0.00	0.01	0.00
Fe_2O_3		3.71	6.80		3.23	3.04
FeO		5.51	2.51		0.58	1.78
*(Fe_2O_3)**	*(9.44)*	*(9.83)*	*(9.59)*	*(3.60)*	*(3.87)*	*(5.02)*
MgO	40.16	40.75	46.89	48.02	48.93	44.00
CaO	2.86	2.72	0.09	0.01	0.06	0.05
Na_2O	0.60	0.03	0.15	0.73	0.00	0.12
K_2O	0.03	0.00	0.00	0.00	0.00	0.00
MnO	0.16	0.16	0.15	0.06	0.08	0.12
P_2O_5	0.00	0.02	0.01	0.00	0.02	0.01
SO_3			0.57			0.74
TOTAL	99.52	98.88	98.55	99.82	99.41	99.49
LOI		6.83	17.23		14.57	13.69
LOI[1]						
LOI[2]						
LOI[3]						
LOI[4]						
ppm						
Sr	3	45	36	0	45	28
Zr	6	10	24	6	10	27
V	33	35	67	0	5	42
Cr	2729	2805	5815	929	1225	50
Co	63	141	115	24	70	60
Ni	1798	2565	2570	806	1075	110
Cu	61		10	14		10
Zn	33			27		
Rb	5	<2	<2	3	<2	<2
Y	0			0		
Nb	0			0		
Ba	33			18		
Source	Asher	Mertzman	Mertzman	Asher	Mertzman	Mertzman
Analysis	XRF	XRF/WC	XRF/WC	XRF	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: Asher. Analysis by Pranoti Asher (Georgia Southern University) by XRF. Totals expressed on a volatile-free basis.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. Reinen: Linda Reinen – Pomona College.

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3c. Compositional Data - Clays (continued)

Wt. %	SRP120	SRP121	SRP122	SRP123
ROM #	W68-35	W68-55	W71-99	N-104-A
SiO_2	45.72	44.25	43.78	44.58
Al_2O_3	1.27	3.14	2.90	0.86
TiO_2	0.03	0.06	0.16	0.00
Fe_2O_3	5.64	7.32	7.30	7.09
FeO	3.19	2.29	2.26	2.85
*(Fe_2O_3)**	*(9.19)*	*(9.86)*	*(9.81)*	*(10.26)*
MgO	42.93	41.27	42.41	43.07
CaO	0.10	0.71	0.15	0.10
Na_2O	0.07	0.06	0.07	0.06
K_2O	0.01	0.00	0.00	0.00
MnO	0.13	0.16	0.13	0.23
P_2O_5	0.12	0.01	0.03	0.01
SO_3				
TOTAL	99.57	99.52	99.44	99.17
LOI	12.92	12.19	11.61	12.58
ppm				
Sr	93	85	80	84
Zr	28	32	31	33
V	78	88	111	73
Cr	1920	1695	1832	3363
Co	96	122	96	104
Ni	3301	2338	4018	3119
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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3c. Compositional Data - Clays (continued)

Wt. %	TAL101	TAL102	TOC101	VER101	VER102	VER103	VER104
NMNH #			148696	C5284	95036-1		
SiO_2	63.23		46.76	41.60	43.20	41.74	44.21
Al_2O_3	1.46		0.78	14.85	13.88	13.63	10.96
TiO_2	0.03		0.01	1.73	1.08	1.24	1.21
Fe_2O_3	0.55		n.d.	18.80	9.14	4.52	7.27
FeO	0.43		n.d.	0.79	0.99	5.02	1.61
*(Fe_2O_3)**	*(1.03)*		*(7.21)*	*(19.68)*	*(10.24)*	*(10.10)*	*(9.06)*
MgO	32.46		44.27	14.22	24.10	22.51	26.06
CaO	0.29		0.11	0.11	1.33	0.25	0.47
Na_2O	0.12		0.13	0.18	0.27	0.36	0.09
K_2O	0.00		0.00	7.62	5.66	9.39	6.86
MnO	0.01		0.16	0.19	0.09	0.10	0.06
P_2O_5	0.11		0.01	0.09	0.02	0.02	0.09
SO_3	0.25						0.18
TOTAL	99.08		99.44	100.27	99.87	99.34	99.25
LOI	3.72		13.03	6.82	11.03	2.92	6.96
LOI[1]				2.7	7.6	3.6	
LOI[2]				0.5	5.4	2.1	
LOI[3]				9.7	9.9	9.8	
LOI[4]				12.9	22.9	15.5	
ppm							
Sr	25		14	37	110	57	56
Zr	54		18	29	22	32	22
V	41		45	199	117	110	30
Cr	3		1040	125	2475	1960	226
Co	3						99
Ni	20						109
Cu	25						
Rb	2						
Source	Mertzman		Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC		XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[1] Loss on ignition upon heating sample (in air) to 110°C (%) at University of Winnipeg.

[2] Loss on ignition upon heating sample (in air) from 110°C to 180°C (%) at University of Winnipeg.

[3] Loss on ignition upon heating sample (in air) from 180°C to 700°C (%) at University of Winnipeg.

[4] Total loss on ignition upon heating of sample from room temperature to 700°C (in air) (%) at Univ. of Winnipeg.

Abbreviations: LOI: loss on ignition. NMNH: Smithsonian Institution National Museum of Natural History.

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3c. Compositional Data - Clays (continued)

Wt. %	VER106
SiO_2	45.79
TiO_2	1.26
Al_2O_3	22.23
FeO	7.06
Fe_2O_3	1.54
*(Fe_2O_3)**	*(9.39)*
MnO	0.09
MgO	13.74
CaO	1.08
Na_2O	3.60
K_2O	2.64
P_2O_5	0.07
SO_3	0.06
TOTAL	99.95
LOI	5.29
ppm	
Sr	163
Zr	442
V	264
Ni	54
Cr	158
Co	22
Source	Mertzman
Analysis	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: Asher. Analysis by Pranoti Asher (Georgia Southern University) by XRF. Totals expressed on a volatile-free basis.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Abbreviations: LOI: loss on ignition.

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3d. Spectral Data - Clays

Sample	*Facility/File No.*	*Description*
ALL001	RELAB caal02	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
ALL001	RELAB laal02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
ALL001	PSF 120229b.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
BEI101	RELAB cabe03	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BEI101	RELAB labe03	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
BEI101	PSF may0106.008	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
BEI101	PSF abei101	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
BEI101	PSF 120229b.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
BEI101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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BEI102	PSF 120228a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
++++++		
BER101	RELAB cabe01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
BER101	RELAB labe01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
++++++		
BER102	RELAB cabe02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
BER102	RELAB labe02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
BER102	PSF may0106.003	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
BER102	PSF aber102	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
BER102	PSF 120229b.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
BER102	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
++++++		
CEL101	RELAB c1ea19a	<45µm; 30°0°; 0.3-2.6µm, 5 nmresolution.
CEL101	RELAB bkr1ea019a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
CEL101	RELAB bkr2ea019a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
CEL101	PSF 120229b.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CEL102	RELAB c1ea20a	<45µm; 30°0°; 0.3-2.6µm, 5 nmresolution.
CEL102	RELAB bkr1ea020a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
CEL102	RELAB bkr2ea020a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and

		Nicolet merged near 2.5 µm; note change in viewing geometry.
CEL102	PSF 120504a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120504_clays].
++++++		
CHM101	RELAB cach15	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHM101	RELAB lach15	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
CHM101	PSF 120229b.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CHM102	PSF 090421a.012	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
CHM102	RELAB cach16	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHM102	RELAB lach16	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
CHM102	PSF 050707chm102	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
CHM102	PSF 120707chm102	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
CHM102	PSF chm102	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
CHM102	PSF mar2106.009	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106aarefnw).
CHM102	PSF achm102	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106airrefnw).
CHM102	PSF chm102m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
CHM102	PSF chm102n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
CHM102	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
++++++		
CHM103	RELAB cach17	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHM103	RELAB lach17	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
CHM103	PSF 120229b.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CHY101	RELAB caea13	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHY101	RELAB laea13	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
CHY101	PSF 120229b.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CHY102	RELAB c1ea21a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
CHY102	RELAB bkr1ea021a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
CHY102	RELAB bkr2ea021a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
CHY102	PSF 120229b.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CHY103	RELAB c1ea22a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
CHY103	RELAB bkr1ea022a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and

		Nicolet merged near 1.3 µm; note change in viewing geometry.
CHY103	RELAB bkr2ea022a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
CHY103	PSF 120229b.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CLA001	RELAB c1ea23a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
CLA001	RELAB bkr1ea023a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
CLA001	RELAB bkr2ea023a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
CLA001	PSF 120229b.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CLA002	RELAB c1ea24a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
CLA002	RELAB bkr1ea024a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
CLA002	RELAB bkr2ea024a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
CLA002	PSF 120229b.011	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CLA003	PSF 120229b.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CLA004	PSF 111201a.050	<1000 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CLA004	PSF 111201a.027	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CLA004	INO CLA004	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 3 sets of spectra acquired.
CLA004	INO CLA004_2	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 3 sets of spectra acquired.
++++++		
CLA005	PSF 120504a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120504_clays].
++++++		
CLI101	RELAB caea14	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CLI101	RELAB laea14	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
CLI101	PSF 100413a.011	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
CLI101	PSF 080128a.013	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
CLI101	PSF nov1505.053	<45 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; spectrum acquired at start of Mars box run without sapphire window.
CLI101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
++++++		
CLI102	RELAB c1ea25a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
CLI102	RELAB bkr1ea025a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
CLI102	RELAB bkr2ea025a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.

CLI102	PSF 120229b.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
CLI103	RELAB c1ea26a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
CLI103	RELAB bkr1ea026a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
CLI103	RELAB bkr2ea026a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
CLI103	PSF 120229b.014	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
COO001	PSF 120228a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
++++++		
CRO101	RELAB cacr21	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRO101	RELAB lacr21	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
CRO101	PSF pig1307.038	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
CRO101	PSF may0106.004	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
CRO101	PSF acro101	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
CRO101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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CRO102	RELAB cacr22	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRO102	RELAB lacr22	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
CRO102	PSF 120229b.015	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
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GLA101	RELAB C1SC19	<45µm, 0E/15E, 0.34-2.7µm, 5nm.
GLA101	RELAB c2sc19	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
GLA101	RELAB lasc19	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
GLA101	PSF 120229b.016	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
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GLA102	RELAB c1ea08	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
GLA102	RELAB laea08	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
GLA102	PSF 120229b.017	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
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GLA103	RELAB caea10	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
GLA103	RELAB laea10	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
GLA103	PSF may0106.005	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
GLA103	PSF agla103	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
GLA103	PSF 120229b.018	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].

GLA103	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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GLA104	RELAB caea11	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
GLA104	RELAB laea11	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
GLA104	PSF 120229b.018	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
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GRE001	PSF jul1306.003	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).
GRE001	PSF agre001	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
GRE001	RELAB c1gr11a	<45 µm; 30°, 0°; 0.3-2.6 µm; 5 nm resolution.
GRE001	RELAB bir1gr011a	<45 µm; i=30°, e=0°; 1-25 µm; 0.2-20.5 nm resolution; Nicolet.
GRE001	RELAB bkr1gr011a	<45 µm; i=30, e=0°/30°; 0.3-25 µm; 5, 0.2-20.5 nm resolution; RELAB + Nicolet, merged at 1.37 µm; note different viewing geometry.
GRE001	PSF 120228a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
GRE001	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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GRE002	RELAB c1gr12a	<45 µm; 30°, 0°; 0.3-2.6 µm; 5 nm resolution.
GRE002	RELAB bir1gr012a	<45 µm; i=30°, e=0°; 1-25 µm; 0.2-20.5 nm resolution; Nicolet.
GRE002	RELAB bkr1gr012a	<45 µm; i=30, e=0°/30°; 0.3-25 µm; 5, 0.2-20.5 nm resolution; RELAB + Nicolet, merged at 1.37 µm; note different viewing geometry.
GRE002	PSF 120228a.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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GYR001	RELAB cagy01	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
GYR001	RELAB lagy01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
GYR001	PSF 120228a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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GYR002	RELAB cagy02	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
GYR002	RELAB lagy02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
GYR002	PSF 120228a.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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HAL001	RELAB caha01	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
HAL001	RELAB laha01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
HAL001	PSF may0106.009	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
HAL001	PSF ahal001	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
HAL001	PSF 120229b.020	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
HAL001	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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HEC101	RELAB c1ea27a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
HEC101	RELAB bkr1ea027a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and

		Nicolet merged near 1.3 µm; note change in viewing geometry.
HEC101	RELAB bkr2ea027a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
HEC101	PSF 120229b.021	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
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HEC102	PSF 120228a.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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HIS001	RELAB cahi01	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
HIS001	RELAB lahi01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
HIS001	PSF may0106.006	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
HIS001	PSF ahis001	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
HIS001	PSF 120228a.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
HIS001	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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IDD001	RELAB caid01	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
IDD001	RELAB laid01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
IDD001	PSF 120229b.022	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
ILL101	RELAB cail01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
ILL101	RELAB lail01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
ILL101	PSF 120229b.023	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120229_clays].
++++++		
ILL102	RELAB cail02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
ILL102	RELAB lail02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
ILL102	PSF 120218a.025	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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ILL105	PSF 130910a.015	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
ILL105	PSF 120228a.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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ILS103	RELAB cail03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
ILS103	RELAB lail03	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
ILS103	PSF 130910a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
ILS103	PSF 120218a.026	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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ILS104	RELAB cail04	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
ILS104	RELAB lail04	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).

ILS104	PSF emix0823.011	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
ILS104	PSF 120218a.027	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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KAO101	RELAB caka01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
KAO101	RELAB laka01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
KAO101-5B	PSF 090602a.012	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
KAO101-5A	PSF 090602a.013	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
KAO101	PSF 090602a.014	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
KAO101	PSF jul1306.004	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).
KAO101	PSF akao101	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
KAO101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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KAO102	RELAB caka02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
KAO102	RELAB laka02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
KAO102	PSF 120218a.028	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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KAO103	RELAB caka03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
KAO103	RELAB laka03	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
KAO103	PSF 071212a.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
KAO103	PSF 111201a.032	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
KAO103	INO KAO103	<45 µm; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 1 spectrum acquired.
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KAO104	RELAB caka04	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
KAO104	RELAB laka04	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
KAO104	PSF emix0823.009	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
KAO104	PSF 120218a.029	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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LAP001	PSF 120228a.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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LEP101	RELAB caea12	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
LEP101	RELAB laea12	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
LEP101	PSF 120218a.030	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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MIC002	PSF 120228a.011	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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MIC003	PSF 120218a.031	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD

		[Directory: 120218_clays].
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MIC004	PSF 120218a.032	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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MIC005	PSF 120218a.033	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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MIN001	RELAB c1mn01a	<45 µm; 30°, 0°; 0.3-2.6 µm; 5 nm resolution.
MIN001	RELAB bir1mn001a	<45 µm; i=30°, e=0°; 1-25 µm; 0.2-20.5 nm resolution; Nicolet.
MIN001	RELAB bkramn001a	<45 µm; i=30, e=0°/30°; 0.3-25 µm; 5, 0.2-20.5 nm resolution; RELAB + Nicolet, merged at 1.37 µm; note different viewing geometry.
MIN001	PSF 120228a.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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MIN002	RELAB c1mn02a	<45 µm; 30°, 0°; 0.3-2.6 µm; 5 nm resolution.
MIN002	PSF jul1306.006	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).
MIN002	PSF amin002	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
MIN002	RELAB bir1mn002a	<45 µm; i=30°, e=0°; 1-25 µm; 0.2-20.5 nm resolution; Nicolet.
MIN002	RELAB bkramn002a	<45 µm; i=30, e=0°/30°; 0.3-25 µm; 5, 0.2-20.5 nm resolution; RELAB + Nicolet, merged at 1.37 µm; note different viewing geometry.
MIN002	PSF 120228a.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
MIN002	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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MIN003	RELAB c1mn03a	<45 µm; 30°, 0°; 0.3-2.6 µm; 5 nm resolution.
MIN003	RELAB bir1mn003a	<45 µm; i=30°, e=0°; 1-25 µm; 0.2-20.5 nm resolution; Nicolet.
MIN003	RELAB bkr1mn003a	<45 µm; i=30, e=0°/30°; 0.3-25 µm; 5, 0.2-20.5 nm resolution; RELAB + Nicolet, merged at 1.37 µm; note different viewing geometry.
MIN003	PSF 120228a.014	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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MON101	RELAB camo01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MON101	RELAB lamo01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
MON101	PSF 050707mon101	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
MON101	PSF 120707mon101	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
MON101	PSF mon101	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
MON101-4B	PSF 090602a.015	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
MON101-4A	PSF 090602a.016	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
MON101	PSF 090602a.017	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
MON101	PSF jun0506.005	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
MON101	PSF amon101	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
MON101	PSF mon101m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1}

		resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
MON101	PSF mon101n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
MON101	PSF 120218a.034	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
MON101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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MON102	RELAB camo02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MON102	RELAB lamo02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
MON102	PSF 120218a.035	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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MON103	PSF 090421a.011	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
MON103	RELAB c1ea28a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
MON103	RELAB bkr1ea028a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
MON103	RELAB bkr2ea028a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
MON103	PSF 111201a.031	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
MON103	PSF 111201a.003	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
MON103	INO MON103	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
MON103	PSF emix0823.010	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
MON103	PSF 120218a.036	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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MON104	PSF 120228a.015	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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MON105	PSF 120228a.016	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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MON106	PSF 130910a.006	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
MON106	PSF 120228a.019	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
MON106	PSF 120504a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120504_clays].
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MON107	PSF 130910a.007	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
MON107	PSF 120228a.020	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
MON107	PSF 120504a.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120504_clays].
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NEO101	RELAB c1ea29a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
NEO101	RELAB bkr1ea029a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
NEO101	RELAB bkr2ea029a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and

		Nicolet merged near 2.5 µm; note change in viewing geometry.
NEO101	PSF 120218a.037	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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NEO102	PSF 120228a.021	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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NON101	PSF 090421a.010	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
NON101	RELAB c1ea30a	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
NON101	RELAB bkr1ea030a	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
NON101	RELAB bkr2ea030a	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
NON101	PSF 050707non101	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
NON101	PSF 120707non101	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
NON101	PSF non101	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
NON101		
NON101	PSF jul1306.007	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).
NON101	PSF nov1505.051	<45 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; spectrum acquired at start of Mars box run without sapphire window.
NON101	PSF anon101	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
NON101	PSF non101m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
NON101	PSF non101n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
NON101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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NON102	PSF 120228a.017	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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NON103	PSF 130910a.014	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
NON103	PSF 120228a.018	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
++++++		
NON104	PSF 130910a.008	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
NON104	PSF 120504a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120504_clays].
++++++		
PHL101	RELAB c1ea31a	unsorted; 30°0°; 0.3-2.6µm, 5 nm resolution.
PHL101	RELAB bkr1ea031a	unsorted; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
PHL101	RELAB bkr2ea031a	unsorted; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
PHL101	PSF 090127a.003	<1 mm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD. Probably

		not properly calibrated.
PHL101	PSF 090313a.014	<1 mm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
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PIG006	RELAB caec06	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
PIG006	RELAB laec06	<45μm; 30°/0° & 30°/30°; 0.3-26μm; 5nm / 1.2-129 nm; merged at 2.5μm (RELAB+Nicolet) note different viewing geometries.
PIG006	PSF 080708.pig006	<45 μm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics.
PIG006	PSF 130910a.009	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
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PLY101	RELAB c1ea32a	<45μm; 30°0°; 0.3-2.6μm, 5 nmresolution.
PLY101	RELAB bkr1ea032a	<45μm; 30°/0°,30°; 0.3-50μm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 μm; note change in viewing geometry.
PLY101	RELAB bkr2ea032a	<45μm; 30°/0°,30°; 0.3-50μm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 μm; note change in viewing geometry.
PLY101	PSF 120218a.038	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
++++++		
PLY102	PSF 120228a.022	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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REC001	PSF 120228a.023	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
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SAP101	RELAB casa57	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SAP101	RELAB lasa57	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54μm; note different viewing geometry).
SAP101	PSF 100413a.016	<45 μm, 30°/0°, 0.35-2.5 μm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
SAP101	PSF may0106.007	<45 μm; i=0°, e=0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
SAP101	PSF asap101	<45 μm; i=35°, e=0°; 2-16 μm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
SAP101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
++++++		
SAP102	RELAB casa58	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SAP102	RELAB lasa58	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54μm; note different viewing geometry).
SAP102	PSF 120218a.039	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SAP103	RELAB casa59	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SAP103	RELAB lasa59	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54μm; note different viewing geometry).
SAP103	PSF 120218a.040	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
++++++		
SEP101	RELAB c1ea33a	<45μm; 30°0°; 0.3-2.6μm, 5 nmresolution.
SEP101	RELAB bkr1ea033a	<45μm; 30°/0°,30°; 0.3-50μm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 μm; note change in viewing geometry.
SEP101	RELAB bkr2ea033a	<45μm; 30°/0°,30°; 0.3-50μm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 μm; note change in viewing geometry.

SEP101	PSF 120218a.041	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
++++++		
SEP102	PSF 120228a.024	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120228_clays].
++++++		
SRP101	RELAB casr06	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SRP101	RELAB lasr06	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
SRP101	PSF 120218a.042	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
++++++		
SRP102	RELAB casr07	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SRP102	RELAB lasr07	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
SRP102	PSF 120218a.043	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
++++++		
SRP104	RELAB casr09	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SRP104	RELAB lasr09	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
SRP104	PSF 130910a.010	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
SRP104	PSF nov1505.052	<45 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged; spectrum acquired at start of Mars box run without sapphire window.
SRP104	PSF 111201a.030	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
SRP104	PSF 120218a.044	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
SRP104	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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SRP105	RELAB casr10	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SRP105	RELAB lasr10	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
SRP105	PSF 120218a.045	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP106	RELAB casr11	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP106	RELAB bkr1sr011	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP106	RELAB bkr2sr011	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP106	PSF 100413a.026	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
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SRP107	RELAB casr12	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP107	RELAB bkr1sr012	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP107	RELAB bkr2sr012	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP107	PSF 120218a.046	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
++++++		
SRP108	RELAB casr13	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP108	RELAB bkr1sr013	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and

		Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP108	RELAB bkr2sr013	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP108	PSF 120218a.047	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP109	RELAB casr14	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP109	RELAB bkr1sr014	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP109	RELAB bkr2sr014	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP109	PSF 120218a.048	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP110	RELAB casr15	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP110	RELAB bkr1sr015	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP110	RELAB bkr2sr015	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP110	PSF 120218a.049	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP111	RELAB bkr1sr016	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP111	RELAB bkr2sr016	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP111	PSF 120218a.050	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP112	RELAB casr17	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP112	RELAB bkr1sr017	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP112	RELAB bkr2sr017	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP112	PSF 120218a.051	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP113	RELAB casr18	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP113	RELAB bkr1sr018	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP113	RELAB bkr2sr018	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP113	PSF 120218a.052	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP114	RELAB casr19	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP114	RELAB bkr1sr019	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP114	RELAB bkr2sr019	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP114	PSF 120218a.053	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP115	RELAB casr20	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP115	RELAB bkr1sr020	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.

SRP115	RELAB bkr2sr020	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP115	PSF 120218a.054	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD Directory: 120218_clays].
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SRP116	RELAB casr21	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP116	RELAB bkr1sr021	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP116	RELAB bkr2sr021	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP116	PSF 120218a.055	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP117	RELAB casr22	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
SRP117	RELAB lasr22	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
SRP117	PSF 100413a.001	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
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SRP118	RELAB casr23	<45µm; 30°0°; 0.3-2.6µm, 5 nm resolution.
SRP118	RELAB bkr1sr023	<45µm; 30°/0°,30°; 0.3-50µm; 5/0.6-475 nm resolution; RELAB and Nicolet merged near 1.3 µm; note change in viewing geometry.
SRP118	RELAB bkr2sr023	<45µm; 30°/0°,30°; 0.3-50µm; 5/1.1-475 nm resolution; RELAB and Nicolet merged near 2.5 µm; note change in viewing geometry.
SRP118	PSF 120218a.056	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP119	RELAB casr24	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SRP119	RELAB lasr24	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
SRP119	PSF 120218a.057	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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SRP120	PSF 131020a.006	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131020_serpentinites).
SRP120	PSF 131021a.006	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131021serps).
SRP120	PSF 120627a	unsorted – sample mechanically crushed for 25 seconds; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 200 spectra averaged (directory: Serp ROM).
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SRP121	PSF 131020a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131020_serpentinites).
SRP121	PSF 131021a.002	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131021serps).
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SRP122	PSF 131020a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131020_serpentinites).
SRP122	PSF 131021a.005	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131021serps).
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SRP123	PSF 131020a.004	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131020_serpentinites).
SRP123	PSF 131021a.004	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131021serps).
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TAL101	RELAB caea15	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
TAL101	RELAB laea15	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
TAL101	PSF pig1307.039	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
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Test of number of averages on spectral quality – TAL101

TAL101	PSF Test.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm spectral output; ASD; 1000 averages on standard and dark; 1000 spectra averaged [Directory: Test (111006_number of averages test)].
TAL101	PSF Test.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm spectral output; ASD; 1000 averages on standard and dark; 500 spectra averaged [Directory: Test (111006_number of averages test)].
TAL101	PSF Test.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm spectral output; ASD; 1000 averages on standard and dark; 200 spectra averaged [Directory: Test (111006_number of averages test)].
TAL101	PSF Test.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm spectral output; ASD; 1000 averages on standard and dark; 100 spectra averaged [Directory: Test (111006_number of averages test)].
TAL101	PSF Test.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm spectral output; ASD; 1000 averages on standard and dark; 50 spectra averaged [Directory: Test (111006_number of averages test)].
TAL101	PSF Test.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm spectral output; ASD; 1000 averages on standard and dark; 10 spectra averaged [Directory: Test (111006_number of averages test)].
TAL101	PSF Test.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm spectral output; ASD; 1000 averages on standard and dark; 5 spectra averaged [Directory: Test (111006_number of averages test)].
TAL101	PSF Test.011	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm spectral output; ASD; 1000 averages on standard and dark; 1 spectrum only of clay [Directory: Test (111006_number of averages test)].
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TAL102	PSF 120218a.058	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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TOC101	RELAB cato02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
TOC101	RELAB lato02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
TOC101	PSF 120218a.059	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
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Tochilinite	RELAB	<125 µm; 30°/0°; 0.3-2.6 µm (RELAB archive).
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VER101	RELAB cave01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
VER101	RELAB lave01	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
VER101	PSF 120218a.060	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
++++++		
VER102	RELAB cave02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
VER102	RELAB lave02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
VER102	PSF 120218a.061	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].
++++++		
VER103	RELAB cave03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
VER103	RELAB lave03	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at

2.54µm; note different viewing geometry).

VER103 PSF 120218a.062 <45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 120218_clays].

+++++

VER106???????????

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END of 3.

4. Borates, Nitrates, Nitrites, Phosphates

4a. Sample Descriptions - Borates, Nitrates, Nitrites, Phosphates

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample *Description*

4.1a. Borates

BOR001 Kernite: Boron, Kern Co., CA, USA; with borax and mud [$Na_2B_4O_6(OH)_2$ ●$3H_2O$] (may attract moisture from the air; store in closed container; Minerals Unlimited) received July 25, 2008.

BOR002 Borax: Boron, Kern Co., CA, USA [$Na_2B_4O_5(OH)_4$ ●$8H_2O$] (Minerals Unlimited) received July 25, 2008.

+++++++

4.2a. Nitrates

NIT001 Sodium nitrate [$NaNO_3$], synthetic. Anachemia #83720-300 (500 g); crystals, reagent ACS. (*For Italians carbonates on Mars project*).

NIT002 Potassium nitrate [KNO_3], synthetic. Anachemia #74336-300 (500 g); crystals, reagent ACS. (*For Italians carbonates on Mars project).*

NIT003 Ferric nitrate nonahydrate [$Fe^{3+}(NO_3)_3 \cdot 9H_2O$]. Fisher Scientific #I110-500; lot #017128. *For nanophase iron production (from University of Winnipeg Department of Chemistry stores Dec. 8, 2009).*

NIT004 Ammonium nitrate, synthetic. University of Winnipeg Department of Chemistry stores. Anachemia, technical grade, 95-100% purity); lot #210703.

++++++++

4.3a. Nitrites

NTR001 Sodium nitrite ($NaNO_2$)(?): EMD #SX0665-1, reagent grade 99.5%. From University of Winnipeg Department of Chemistry stores.

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4.4a. Phosphates

PHS101 Chlorapatite: Oodegarden, Bamle Parish, Telemark, Norway (Minerals Unlimited). (Was APA101).

PHS102 Apatite: Jacupiranga Mine, Sao Paulo State, Brazil (Nature's Treasures), with magnetite MAG101, analysis incomplete, originally labelled as olivine OLV014. No sample left. (Was APA102).

PHS103 *Fluorapatite: Cave dell'Osa, Rome, Latium, Italy (Dr. David Garske #G19c), with melilite MEL102 and nepheline NEP102. Too intimate to separate? (Was APA103).*

PHS104 Apatite: Wilson's Corner, Quebec (Dr. David Garske #AL14b), originally PYX004. Location of sample presently unknown. (Was APA104).

PHS105 Graftonite: Palermo Mine, North Groton, New Hampshire, USA (Minerals Unlimited), [$(Fe,Mn)_3(PO_4)_2$], with triphyllite TRI101. (Was GRA101).

PHS106 Sarcopside: Bull Moose Mine, Custer County, South Dakota, USA (Minerals Unlimited), [$(Fe,Mn)_3(PO_4)_2$]. (Was SAR101).

PHS107 Ammonium phosphate, dibasic: ($(NH_4)_2HPO_4$); synthetic (J.T. Baker Chemical Co.), reagent grade, 99.9% purity. (Was PHO101).

PHS108 Triphyllite: Palermo Mine, North Groton, New Hampshire, USA (Minerals Unlimited), with graftonite

GRA101. (Was TRI101).

PHS109 *Whitlockite: Palermo Mine, North Groton, New Hampshire (Minerals Unlimited), [ideally $Ca_9(Mg,Fe^{2+})H(PO_4)_7$], too intimate and sparse to separate. (Was WHI101).*

PHS110 Turquoise; locality unknown [$CuAl_6(PO_4)_4(OH)_8 \cdot 4H_2O$ [Discovery Minerals Ltd.; Edmonton, AB] 2 pieces.

PHS111 Whitlockite: Big Fish River, YT, Canada [ideally $Ca_9(Mg,Fe^{2+})H(PO_4)_7$] [Discovery Minerals Ltd.: Edmonton, AB, Canada - August 2008].

PHS112 Anhydrous potassium hydrogen phosphate [KH_2PO_4] (synthetic); UW Chemistry stores?

PHS113 Anhydrous sodium hydrogen phosphate (dibasic); UW Chemistry stores?

PHS120 Whitlockite: Tip Top Mine, Custer Co., SD, USA (Excalibur Minerals) (originally labelled as PHS111 for some strange reason (received Dec. 6, 2007).

PIG319 Vivianite, blue ochre (catalog no. 410-20S). 10 grams. (green/blue group). *See section 19 of this document for data.*

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4.5a. Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

Borax		*AN30 (CERAM)

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4b. XRD Data - Borates, Nitrates, Nitrites, Phosphates

None

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4c. Compositional Data - Borates, Nitrates, Nitrites, Phosphates

	NIT004
Wt.%	NH3NO3
SiO_2	0.00
TiO_2	0.00
Al_2O_3	0.07
*(Fe_2O_3)**	*(0.04)*
FeO	0
Fe_2O_3	0.04
MnO	0.009
MgO	1.67
CaO	0.05
Na_2O	0.00
K_2O	0.004
P_2O_5	0.003
SO_3[a]	0.070
Cl	0.118
TOTAL	2.037
LOI	99.62
ppm	
Rb	<1
Sr	20
Zr	29
V	<2
Ni	<2
Cr	<2
Co	<2
Wt.%^	
N	36.66
C	0.29
S	0
Source	Mertzman
Analysis	XRF/WC

* - all Fe reported as Fe_2O_3.

^ - N, C, and S determined using a light element analyzer. Due to the small amount of sample used, there may be issues of sample heterogeneity and representativeness.

A - SO_3 content may represent a minimum value due to heating of the sample twice.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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4c. Compositional Data - Borates, Nitrates, Nitrites, Phosphates (continued)

Wt. %	PHS101	PHS102	PHS104	PHS105	**PHS105**	PHS106	**PHS106**	PHS108
P_2O_5	38.73	n.d.		40.29		38.87		n.d.
Cr_2O_3	0.11	0.03		0.04		0.02		0.00
MnO	0.15	0.01		14.33	14.33	12.44	12.02	8.70
TiO_2	0.09	0.00		0.02		0.00		0.00
SiO_2	0.05	0.05		0.00		0.09		0.34
Al_2O_3	tr.	0.06		0.00		0.00		2.48
FeO	0.28*	0.03*		31.23		32.87		29.49
Fe_2O_3	n.d.	n.d.		0.00		13.79		0.00
MgO	0.22	0.16		1.54		0.12		3.16
Na_2O	0.00	n.d.		0.00		0.00		n.d.
ZrO_2	0.00	n.d.		0.00		0.00		n.d.
Nb_2O_5	0.00	n.d.		0.00		0.00		n.d.
CaO	53.33	54.83		10.98		tr.		3.54
NiO	0.00	0.00		0.02		0.03		0.00
ZnO	0.00	n.d.		0.22	0.22	n.d.	0.02	0.00
F	0.00	n.d.		0.00	0.07	n.d.	0.00	n.d.
Cl	6.23	n.d.		0.00	0.01	0.00	0.01	n.d.
TOTAL	99.19	55.17		98.67		98.23		47.71
O=F,Cl	-1.41							
TOTAL	97.78							
	NUMBER OF IONS ON THE BASIS OF 26 O,OH,F,Cl (apatite) & 8 O,OH,F,Cl (others)							
P	5.861	n.d.		1.980		1.932		n.d.
Nb	--	n.d.		--		--		n.d.
Si	0.009	n.d.		--		0.005		n.d.
Ti	0.012	n.d.		0.001		--		n.d.
Zr	--	n.d.		--		--		n.d.
Cr	0.015	n.d.		0.002		0.001		n.d.
Al	0.001	n.d.		--		--		n.d.
Fe^{3+}	--	n.d.		--		0.609		n.d.
Mn	0.023	n.d.		0.704		0.619		n.d.
Fe^{2+}	0.042	n.d.		1.516		1.614		n.d.
Mg	0.059	n.d.		0.133		0.011		n.d.
Ca	10.214	n.d.		0.683		tr.		n.d.
Ni	--	n.d.		tr.		0.001		n.d.
Zn	--	n.d.		0.009		--		n.d.
Na	--	n.d.		--		--		n.d.
F	--	n.d.		--		--		n.d.
Cl	1.887	n.d.		--		--		n.d.
OH	--	n.d.		--		--		n.d.
Total	18.123	n.d.		5.028		4.792		n.d.
Source	U of C	U of A		U of C	U of A	U of C	U of A	U of A
Analysis	EMPA-8	EMPA-1		EMPA-8	EMPA-6	EMPA-8	EMPA-6	EMPA1

* All Fe reported as FeO.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. U of A: University of Alberta EMPA.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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4d. Spectral Data - Borates, Nitrates, Nitrites, Phosphates

Sample	*Facility/File No.*	*Description*
4.1. Borates		
BOR001	PSF 080730a.000	<500 µm; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
BOR002	PSF 080730a.001	<500 µm; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
++++++++++++++++++++++++++++++++		
4.2. Nitrates		
NIT001	PSF 081222a.037	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
NIT001	PSF nit001	<45 µm; ~3 cm^{-1} resolution; 2-16 µm, 30°/0°; D&P; Hanning apodized.
NIT001	PSF nit001nosm	<45 µm; ~3 cm^{-1} resolution; 2-16 µm, 30°/0°; D&P; no smoothing.
++++++		
NIT002	PSF 081222a.038	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
NIT002	PSF nit002	<45 µm; ~3 cm^{-1} resolution; 2-16 µm, 30°/0°; D&P; Hanning apodized.
NIT002	PSF nit002nosm	<45 µm; ~3 cm^{-1} resolution; 2-16 µm, 30°/0°; D&P; no smoothing.
++++++++++++++++++++++++++++++++		
4.3. Nitrites		
NTR001	PSF 081222a.039	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
NTR001	PSF ntr001	<45 µm; ~3 cm^{-1} resolution; 2-16 µm, 30°/0°; D&P.
++++++++++++++++++++++++++++++++		
4.4. Phosphates		
PHS101	RELAB caap03	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
PHS101	RELAB laap03	<45 µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
++++++		
PHS102	RELAB caap04	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
PHS102	RELAB laap04	<45 µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
++++++		
PHS105	RELAB cagf01	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
PHS105	RELAB lagf01	<45 µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
++++++		
PHS106	RELAB casa44	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
PHS106	RELAB lasa44	<45 µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
++++++		
PHS107	RELAB caph17	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
PHS107	RELAB laph17	<45 µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
PHS107	RELAB cbph17	45-90 µm, 30E/0E, 0.3-2.6µm, 5 nm.
PHS107	RELAB laph17b	45-90 µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
++++++		
PHS108	RELAB catr01	<45 µm, 30E/0E, 0.3-2.6µm, 5 nm.
PHS108	RELAB latr01	<45 µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.

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END of 4.

5. Carbonates, Oxalates

5.1. Carbonates
5.2. Oxalates
++++++++++++++++++++

5.1a. Sample Descriptions - Carbonates

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample *Description*

++++++***Anhydrous carbonates***++++++

CRB101 Ankerite: Chihuahua, Mexico; one with pyrite, pyrrhotite and quartz; other with sphalerite, pyrite, calcite and quartz [$Ca(Mg,Fe^{+2},Mn)(CO_3)_2$] (Minerals Unlimited). {Cream to brown crystals with assoc. on rock. Dana: white, grey, reddish, XLs, masses, compact, granular}.Couple of grams of <45 and 45-90µm made (dry sieved). *[trigonal - dolomite group; forms two series, with dolomite, and with kutnohorite]*.

CRB102 Aragonite+calcite: Washington County, Utah, USA [$CaCO_3$] (Minerals Unlimited). {Silky white compact masses, some rock}. Lots of sample and <45 and 45-90µm sizes made (dry sieved). *[orthorhombic - aragonite group; trimorphic with calcite and vaterite]*.

CRB103 Dolomite: Bamle, Telemark, Norway [$CaMg(CO_3)_2$] (Minerals Unlimited). {Grey-white cleavable}. Lots of sample and <45 and 45-90µm samples made (dry sieved). *[trigonal - dolomite group; forms two series, with ankerite, and with kutnohorite]*.

CRB104 Gaspeite: Lemieux Township, Gaspe Nord County, Gaspe Peninsula, Quebec, Canada [$(Ni,Mg,Fe^{+2})CO_3$] (Minerals Unlimited). {Green crystalline masses, minor rock}. Lots of sample and <45 and 45-90µm sizes made (dry sieved). *[trigonal - calcite group; forms a series with magnesite]*.

CRB105 Huntite: Currant Creek, Nevada, USA; in magnesite (CRB114) [$Mg_3Ca(CO_3)_4$] (Minerals Unlimited). {White chalky masses in and on magnesite}. Only <45µm grain size made due to very limited amount of sample (<1 gram) (dry sieved) (More received - May 4, 2001). *[trigonal]*.

CRB106 Magnesite: Snarum, Norway [$MgCO_3$] (Minerals Unlimited). {Yellowish-white cleavable or off-white coarse granular, some assoc.}. Lots of sample and <45 and 45-90µm sample made (dry sieved). *[trigonal - calcite group; forms two series with gaspeite and with siderite]*.

CRB107 Nahcolite: Searles Lake, San Bernardino County, California, USA [$NaHCO_3$] (Minerals Unlimited). {MU description: off-white crystallized masses; Dana: white, grey, reddish, crystals, masses, granular, compact}. MU sample is grayish, dirty looking. Lots of sample left; lots of <45 and 45-90µm sizes made (dry sieved). *[monoclinic] {it is a bicarbonate}.*

CRB108 Siderite: Ivigtut, in the Arksuk Fiord, Frederikshaab District, West Greenland; with cryolite [$FeCO_3$] (Minerals Unlimited). Lots of sample and <45 and 45-90µm samples made (dry sieved). *[trigonal - calcite group; forms two series, with magnesite, and with rhodocrosite]*.

CRB109 Calcite: locality unknown (University of Alberta GEOL330 laboratory collection #A152), originally PLG112, then CAL101. Some <45 and 45-90µm sample available (few grams) (dry sieved). *[trigonal; calcite group; trimorphic with aragonite and vaterite; forms a series with rhodocrosite]*.

CRB110 Calcite: locality unknown (University of Alberta GEOL330 laboratory collection # unknown), [$CaCO_3$] with pyroxene PYX104, originally CAL102. <45µm sample made (dry sieved). *[trigonal; calcite group; trimorphic with aragonite and vaterite; forms a series with rhodochrosite]*.

CRB111 Calcite: Cascade Mountain, Essex County, New York, USA (Minerals Unlimited), [$CaCO_3$] w/ pyroxene PYX121, orig. CAL103. Only <45µm sample made (dry sieved). *[trigonal; calcite*

group; trimorphic with aragonite and vaterite; forms a series with rhodochrosite].

CRB112 Calcite: Pendleton County, West Virginia, USA (Ward's), originally CAL110, [$CaCO_3$]. Lots of sample available, only <45µm size made (dry sieved). *[trigonal; calcite group; trimorphic with aragonite and vaterite; forms a series with rhodochrosite]*.

CRB113 Manganocalcite: Funeral Mountains, Nevada, USA [$(Mn,Ca)CO_3$] (Manitoba Museum of Man and Nature #M306). Entire sample used for powder, a few grams of both <45 and 45-90µm available (dry sieved). *[trigonal; trimorphic with aragonite and vaterite; forms a series with rhodochrosite]*.

CRB114 Magnesite: Currant Creek, Nevada, USA; with huntite (CRB105) [$Mg(CO_3)$] (Minerals Unlimited). Lots available, made both <45 and 45-90µm grain sizes (dry sieved). *[trigonal - calcite group; forms two series with gaspeite and with siderite]*. CRB114-4A = surficial part of sample from Mars box after run #4; CRB114-4B = subsurface part of sample from Mars box after run #4.

CRB115 Huntite: Tea Tree Gully, South Australia, Australia [$Mg_3Ca(CO_3)_4$] (Minerals Unlimited). {White chalky masses in and on magnesite}. *[trigonal]*.

CRB116 Calcite: Oklahoma, USA [$CaCO_3$] (National Museum of Nature, Ottawa). *[orthorhombic - aragonite group; trimorphic with calcite and vaterite] (originally labelled as aragonite).*

CRB117 Dolomite: Penfield Quarry, Penfield, New York, USA [$CaMg(CO_3)_2$] (from Salt Minerals). *[trigonal - dolomite group; forms two series, with ankerite, and with kutnohorite]*.

CRB118 Calcite: Chihuahua, Mexico [$CaCO_3$] (Manitoba Rock and Mineral Show) *[orthorhombic - aragonite group; trimorphic with calcite and vaterite] (originally labelled as aragonite).* CRB118-AX1: sample from Mars box after run #1.

CRB119 Aragonite, mostly: Goodsprings, Clark County, Nevada, USA [$CaCO_3$] (Minerals Unlimited). *[orthorhombic - aragonite group; trimorphic with calcite and vaterite]*.

CRB120 Aragonite: near Silverton, Briscoe County, Texas, USA [$CaCO_3$] (Minerals Unlimited). *[orthorhombic - aragonite group; trimorphic with calcite and vaterite]*.

CRB121 Ankerite: Zacatecas, Mexico [$Ca(Mg,Fe^{+2},Mn)(CO_3)_2$]; with quartz, pyrite and sphalerite (Minerals Unlimited). {Minerals Unlimited catalogue description: cream to brown crystals with assoc. on rock. Dana: white, grey, reddish, XLs, masses, compact, granular}. *[trigonal - dolomite group; forms two series, with dolomite, and with kutnohorite]*.

CRB122 Calcite, minor dolomite: near Yeso, De Baca County, New Mexico, USA [$CaCO_3$] (Minerals Unlimited). *[orthorhombic - aragonite group; trimorphic with calcite and vaterite] (originally labelled as aragonite).*

CRB123 Aragonite, wee bit of calcite: Molina de Aragon, Guadalajara, Spain [$CaCO_3$] (Minerals Unlimited). *[orthorhombic - aragonite group; trimorphic with calcite and vaterite]*.

CRB124 Aragonite: Erzberg Eisenwurz, Stiermark, Austria [$CaCO_3$] (Smithsonian Institution MNMH #B10111) *[orthorhombic - aragonite group; trimorphic with calcite and vaterite]*.

CRB125 Aragonite: Stiermark, Austria [$CaCO_3$] (Smithsonian Institution MNMH #B16198) *[orthorhombic - aragonite group; trimorphic with calcite and vaterite]*.

CRB126 Shortite: Stauffer Mine, Green River, Wyoming, USA; in mudstone matrix [$Na_2Ca_2(CO_3)_3$] [Excalibur Minerals, received June 13, 2006], Description: yellow fluorescent, blue phosphorescent crystal sections to 1 cm and denser aggregates richly scattered through a mudstone matrix, which is fluorescent as well; the shortite occurs as nearly transparent pale yellow blocky masses; one 6 cm sample.

CRB127 Calcite: locality unknown (Mineral Society of Manitoba); 1 piece.

CRB128 Calcite, probably Joplin, Missouri, USA (display specimen from Tyson), with pyrite (PRT106).

CRB129 Calcite rhomb (calcite spar), with colour bands (display specimen from Tyson's).

CRB130 Ankerite: Mt. St. Hilaire, QC, Canada [$Ca(Mg,Fe^{+2},Mn)(CO_3)_2$] (from Discovery Gemstones Ltd. – Edmonton, AB, Canada, #02D182; July 2009).

CRB131 Calcite: Axel Heiberg Island, Nunavut, Canada (vicinity of springs) (from Mike Craig, Aug. 09).

CRB132 Calcite: Pine Point, NWT, Canada. Massive sample (from Discovery Gemstones, Edmonton, AB, Canada; Aug. 2013); 3 pieces; creamy white.

CRB133 Dolomite; Mt. Brussilhof Mine, Radium, BC, Canada (from Discovery Gemstones, Edmonton, AB, Canada; Aug. 2013); 1 piece – crystalline.

CRB134 Dolomite; Radium, BC, Canada (from Discovery Gemstones, Edmonton, AB, Canada; Aug. 2013); 4 pieces – crystalline.

CRB140 Ankerite: Cerro Sapo, Ayopaya, Cochabamba, Bolivia [$Ca(Mg,Fe^{+2},Mn)(CO_3)_2$] – light green crystals;

with dawsonite (CRB220; [$NaAl(CO_3)(OH)_2$] white powdery material) and sodalite (SOD110 [$Na_4Al_3Si_3O_{12}Cl$], blue material). [From Alfredo Petrov, Tucson 2011 show).

CRB141 Siderite: Huanuni Mine, Oruro, Bolivia [$FeCO_3$], spheroidal. [Alfredo Petrov, Tucson 2011 show].

CRB142 Rhodochrosite: locality unknown [$MnCO_3$] [Western Wood Inc., Tucson 2011 show].

CRB143 Siderite: Madagascar (single crystal) [Mineral Treasure, Tucson 2011 show].

CRB144 Magnesite: Brumado, Bahia, Brazil (two single crystals) [The Crystal Circle, Tucson 2011 show].

CRB145 Siderite: Governador Valadares, Minas Gerais, Brazil (single crystal) [The Crystal Circle, Tucson 2011 show].

CRB146 Calcite: Dog Lake, ON, Canada, with diopside (PYX187) [The Crystal Circle, Tucson 2011 show].

CRB147 Gaspeite: Australia [$(Ni,Mg,Fe^{+2})CO_3$], cut slab, mostly gaspeite [Gem Art Center, Tucson 2011 show].

CRB148 Siderite: Eagle Mine, Gilman, Eagle Co., CO, USA [LeHigh Minerals, Tucson 2011 show].

CRB149 Magnesite: Baymag mine, AB, Canada 2 pieces (a few kg total weight); received Nov. 14, 2013.

++++++***Hydrous carbonates***++++++++++

CRB201 Artinite: near Hernandez, San Benito County, California, USA; on serpentine, with hydromagnesite [$Mg_2(CO_3)(OH)_2 \cdot 3(H_2O)$] (Minerals Unlimited). {White acicular crystals on rock}. Not much sample available, only <45µm sample made (~1g) (dry sieved). *[monoclinic]*.

CRB202 *Brugnatellite: Higashi-Kuroda-guchi, Inasa cho, Inasa gun, Aichi Prefecture, Japan; with artinite and hydromagnesite on serpentine [$Mg_6Fe^{+3}(CO_3)(OH)_{13} \cdot 4(H_2O)$] (Minerals Unlimited). Not enough sample to separate and too intimate. {Returned to Minerals Unlimited?}. [hexagonal]*

CRB203 Coalingite: near the Dallas Gem Mine, San Benito County, California, USA; on serpentine (SRP118) [$Mg_{10}Fe^{+3}2(CO_3)(OH)_{24} \cdot 2(H_2O)$] (Minerals Unlimited). {Bronze coloured coatings on serpentine}. Little sample available, only enough for <45µm grain size sample (dry sieved). *[trigonal]*.

CRB204 Dawsonite: Francon Quarry, Montreal, Quebec, Canada; in rock. [$NaAl(CO_3)(OH)_2$] (Minerals Unlimited). {Tiny colourless XLs in vugs in rock M/M; Dana: white radiating bladed XLs}. Just enough for <45µm sample (dry sieved). *[orthorhombic]*.

CRB205 *Dypingite: near the Dallas Gem Mine, San Benito County, California; on serpentine [$Mg_5(CO_3)_4(OH)_2 \cdot 5(H_2O)$] (Minerals Unlimited). {White crust of tiny crystal aggregates on rock}. Too intimate and micro to separate. [monoclinic?]*

CRB206 Gaylussite: Searles Lake, San Bernardino County, California, USA [$CaCO_3.Na_2CO_3 \cdot 5(H_2O)$] (Minerals Unlimited). {Loose single crystals, larger crystals are skeletal; Dana: white, yellowish-white}. Made <45 and 45-90µm (dry sieved), a bit of sample left. *[monoclinic]*.

CRB207 *Hydromagnesite: Mistake Mine, Fresno County, California; on serpentine [$Mg_5(CO_3)_4(OH)_2 \cdot 4(H_2O)$] (Minerals Unlimited). {Tiny aggregates of bladed crystals on serpentine?}. Too small, returned to Minerals Unlimited [monoclinic]*

CRB208 Hydromagnesite: San Benito Mountains, San Benito County, California, USA [$Mg_5(CO_3)_4(OH)_2 \cdot 4(H_2O)$]. (Ted Roush's sample; Minerals Unlimited). {Off-white massive; Dana: silky white}. Made <45 and 45-90µm samples (dry sieved). *[monoclinic]*.

CRB209 Hydrotalcite: Snarum, Norway; with manasseite and serpentine, var. lizardite. (See CRB210). [$Mg_6Al_2(CO_3)(OH)_{16} \cdot 4(H_2O)$] (Minerals Unlimited; and Manitoba Museum of Man and Nature #M629). {Dana: lamellar massive or foliated. Somewhat fibrous white, pearly]. Lots, <45 and 45-90µm powders made (dry sieved). *[trigonal; dimorphic with manasseite; hydrotalcite group]*.

CRB210 Manasseite: Snarum, Norway; with hydrotalcite and serpentine, var. lizardite. (See CRB209). [$Mg_6Al_2(CO_3)(OH)_{16} \cdot 4(H_2O)$] (Minerals Unlimited). {Grey with hydrotalcite and lizardite}. Lots of sample, have few grams of <45 and 45-90 sample (dry sieved). *[hexagonal; dimorphic with hydrotalcite; manasseite group]*.

CRB211 Pirssonite: Searles Lake, San Bernardino County, California, USA [$CaCO_3.Na_2CO_3.2(H_2O)$] (Minerals Unlimited). {For Wyoming sample: glassy crystalline veins in marl, separate XLs; Dana: colourless to white prismatic XLs}. Have 1 gram left, made a couple of grams of <45 and 45-90µm samples (dry sieved). *[orthorhombic]*.

CRB212 Pyroaurite: Valle Grama Quarry, Molina di Laghi, Posina Valley, Vicenza, Veneto, Italy; on calcite [$Mg_6Fe^{+3}{}_2(CO_3)(OH)_{16} \cdot 4(H_2O)$] (Minerals Unlimited). {Minute, colourless to tan, bladed crystals on matrix; Dana: gold-like submetallic scales}. Barely enough for a <45µm grain size sample (dry

sieved). *[trigonal; dimorphic with sjogrenite; hydrotalcite group]*.

CRB213 Thermonatrite: Keeler, Inyo County, California, USA [$Na_2CO_3 \cdot (H_2O)$] (Minerals Unlimited). A few grams of clean sample left; lots of <45 and 45-90µm sample available (dry sieved). *[orthorhombic] {XRD shows only trona – a bicarbonate}*

CRB214 Trona: Green River, Sweetwater County, Wyoming, USA [$Na_3(CO_3)(HCO_3) \cdot 2(H_2O)$] (Minerals Unlimited). {Tan fibrous masses; Dana: fibrous or columnar massive, grey or yellowish white}. Lots, made<45 and 45-90µm (dry sieved). *[monoclinic] {XRD shows only trona –a bicarbonate}.*

CRB215 Hydromagnesite: Atlin, British Columbia, Canada [$Mg_5(CO_3)_4(OH)_2.4(H_2O)$] (Manitoba Museum of Man and Nature #M233). {Dana: crystals, small, tufted, also amorphous as chalky crusts, white}. Lots of sample, made lots of <45µm and some 45-90µmsize (dry sieved). *[monoclinic]*.

CRB216 Hydromagnesite: Iwaki, Takamatsu, Japan [$Mg_5(CO_3)_4(OH)_2 \cdot 4(H_2O)$] (from Dr. M. Miyamoto, <100µm). Little sample, all made into <45µm powder(dry sieved). *[monoclinic]*.

CRB217 Brugnatellite: Cava di Serpentino del Crestun, Torre Santa Maria, Valmalenco, Sondrio, Italy (type locality) [$Mg_6Fe^{+3}(CO_3)(OH)_{13} \cdot 4(H_2O)$] (Dr. Pietro Vignola; Fulvio Grazioli Collection). Powdered sample provided (~1 gram), made only <45µm sample (dry sieved). *[hexagonal]*.

CRB218 Artinite: Rocca di Castellaccio, Torre di Santa Maria, Valmalenco, Sondrio, Italy [$Mg_2(CO_3)(OH)_2 \cdot 3(H_2O)$](Dr. Pietro Vignola; Fulvio Grazioli Collection). Powdered sample provided (~1 g), made only <45µm sample (dry sieved). *[monoclinic]*.

CRB220 Dawsonite: Cerro Sapo, Ayopaya, Cochabamba, Bolivia ([$NaAl(CO_3)(OH)_2$] white powdery material) with ankerite (CRB140 [$Ca(Mg,Fe^{+2},Mn)(CO_3)_2$] – light green crystals) and sodalite (SOD110 [$Na_4Al_3Si_3O_{12}Cl$], blue material). [from Alfredo Petrov, Tucson 2011 show).

CRB310 Northupite: Searles Lake, San Bernardino County, California, USA [$Na_3Mg(CO_3)_2Cl$] (Minerals Unlimited). 2 small crystals. Only <45µm size made (entire sample used) (dry sieved). *[cubic]*.

CRB311 Alumohydrocalcite: Mount Hamilton, Santa Clara County, California, USA; pink phase in nickel-stained rock (Minerals Unlimited). Very minor in rock. Too sparse and intimate to separate.[triclinic]

CRB312 Artinite: Mistake Mine, Fresno County, California, USA; on serpentine (SRP119) (Minerals Unlimited) [$Mg_2(CO_3)(OH)_2 \cdot 3(H_2O)$] (Minerals Unlimited catalogue description: white acicular crystals on rock). *[monoclinic]*.

CRB313 Pyroaurite: Langban, Vermland, Sweden [$Mg_6Fe^{+3}{}_2(CO_3)(OH)_{16} \cdot 4(H_2O)$] (Minerals Unlimited). *[trigonal; dimorphic with sjogrenite; hydrotalcite group]*.

CRB314 Artinite: Staten Island, New York City, NY, USA; on serpentine, with hydromagnesite [$Mg_2(CO_3)(OH)_2 \cdot 3(H_2O)$] (National Museum of Nature, Ottawa). {White acicular crystals on rock}. Not much sample available. *[monoclinic]*.

CRB315 Hydromagnesite: Staten Island, New York City, NY, USA; on serpentine, with artinite [$Mg_5(CO_3)_4(OH)_2.4(H_2O)$] (National Museum of Nature, Ottawa). Not much sample available. *[monoclinic]*.

CRB316 Stichtite: Drill core from Megantic Mine, Black Lake, Quebec, Canada (ROM sample ID M56437); pink grains in serpentinite/talc core [$Mg_6Cr_2(CO_3)(OH)_{16} \cdot 4H_2O$ (from Royal Ontario Museum Dec. 2012).

++++++***Synthetic carbonates***+++++

CRB401 Ammonium carbonate: (NH_4HCO_3); synthetic (Mallinckrodt; U of W Chemistry Department), 99.98% purity, N.F. Crushed and dry sieved to <45 and 45-90µm grain sizes. *(see also "Ammonium-bearing minerals").*

CRB402 Sodium bicarbonate [$NaHCO_3$] (synthetic); UW Chemistry stores?

CRB403 Synthetic magnesium carbonate hydrate [$MgCO_3 \cdot Mg(OH)_2 \cdot xH_2O$ (x≈3)] Alfa Aesar Puratronic 99.996% (metals basis); 10796, lot: 23779; CAS39409-82-0; EINECS: 235-192-7; 5 grams (fine powder). Received June 2013.

CRB404 Synthetic magnesium carbonate tetrahydrate, reagent grade, MgO ≈40-43.5% [$4MgCO_3 \cdot Mg(OH)_2 \cdot 4H_2O$ approx. Alfa Aesar 33333; lot: J29T030; CAS: 39409-82-0; EINECS: 235-192-7; 100 grams. Received June 2013.

+++++***For pigments project***+++++

CRB501 Malachite: Copper Queen Mine, Bisbee, Cochise County, Arizona, USA ($Cu_2^{2+}(CO_3)(OH)_2$) (Minerals Unlimited) *(for pigments project - green). [monoclinic]*.

CRB502 Cerussite: Tsumeb, Namibia ($PbCO_3$) (Minerals Unlimited). {Pure mineral is white, but mine is black, probably due to impurities(?)} *(for pigments project).[orthorhombic; aragonite group]*.

CRB503 Azurite: Juanita Mine, Magdalena, Socorro County, New Mexico, USA ($Cu_3^{+2}(CO_3)_2(OH)_2$ (with limonite, malachite, and clay) (Minerals Unlimited) *(for pigments project - blue) [monoclinic]*.

CRB504 Azurite: locality unknown ($Cu_3^{+2}(CO_3)_2(OH)_2$ (acquired at 2001 Manitoba Rock and Mineral Show) *(for pigment project). [monoclinic]*.

CRB505 Hydrocerussite: Langban, Varmland, Sweden ($Pb_3(CO_3)_2(OH)_2$) (Smithsonian Institution MNMH #B8107) *(for pigments project).*

CRB506 Cerussite: Mammoth Mine, Wallace, Idaho, USA ($PbCO_3$) (Smithsonian Institution MNMH #96778) *(for pigments project).*

CRB507 Cerussite: Lone Elm, near Joplin, Missouri, USA ($PbCO_3$) (Smithsonian Institution MNMH #C2130-1) *(for pigments project).*

CRB508 Malachite: Canton, Georgia, USA ($Cu_2^{2+}(CO_3)(OH)_2$) (Smithsonian Institution MNMH #78806) *(for pigments project - green) [monoclinic]*.

CRB509 Malachite: El Cobre Mine, Zacatecas, Mexico ($Cu_2^{2+}(CO_3)(OH)_2$) (Smithsonian Institution MNMH #143514) *(for pigments project - green) [monoclinic]*.

CRB510 Azurite: Guangdong, China ($Cu_3^{+2}(CO_3)_2(OH)_2$) (Smithsonian Institution MNMH #145930) *(for pigments project - blue) [monoclinic]*.

CRB511 Azurite: Chessy, Lyon, Rhone, France ($Cu_3^{+2}(CO_3)_2(OH)_2$) (Smithsonian Institution MNMH #148829) *(for pigments project - blue) [monoclinic]*.

++++++***Newer carbonate samples***++++++

CRB600 Coral, water washed; Sandy Beach park, east coast of Oahu, Hawaii, USA (self collected).

CRB610 Carbonate; multi-hued banded cave deposit; Velo (?), Greece, self-collected.

CRB700 "Carbonates from green sand" (separated from sample box provided by Mike Gaffey, Feb. 2007).

CRB701 Siderite: Mt. St. Hilaire, QC, Canada [#04D1000; Discovery Gemstones Ltd., Edmonton, AB]. 1 mass. (purchased July 28, 2007).

CRB702 Malachite; locality unknown [Discovery Gemstones Ltd., Edmonton, AB], 5 pieces. (purchased July 28, 2007).

CRB710 Clams from shore of Lake Winnipeg – Sunset Beach, Hecla Island, MB, Canada (collected August, 2007).

CRB714 Clams, Lake Manitoba, Ambroise Provincial Park beach, MB, Canada (collected July 2008).

CRB715 Cobaltoan calcite; Bou Azzer District, Tazenakht, Ouarazate Province, Souss-Massa-Draa Region, Morocco (December 2012 AGU Fall Meeting, purchased from Ikon Mining and Exploration).

CRB716 Rhodochrosite; Wudong Mine, Liubao, Wushou Prefecture, Guangxi Zhuang A.R., China (December 2012 AGU Fall Meeting, purchased from Ikon Mining and Exploration).

CRB717 Orange calcite; Chihuahua, Mexico (December 2012 AGU Fall Meeting; purchased from Ikon Mining and Exploration).

++++++***Synthetic carbonates – isotopic effects***++++++

CRB-S01 Synthetic calcium carbonate, 99% ^{13}C-enriched. From Boz Wing and Ben Webber – McGill University (June 2009).

CRB-S02 Synthetic calcium carbonate, isotopically normal. From Boz Wing and Ben Webber – McGill University (June 2009).

++++++***Synthetic carbonates***++++++

PIG004 Synthetic calcite ($CaCO_3$) *(also for pigments project). See section 19 of this document for data.*

PIG009 Synthetic hydrocerussite (lead (II) carbonate, basic ($(PbCO_3)_2 \cdot Pb(OH)_2$)) *(also for pigments project). See section 19 of this document for data.*

PIG024 Synthetic malachite (copper (II) carbonate, basic ($CuCO_3 \cdot Cu(OH)_2$)) *(also for pigments project). See*

section 19 of this document for data.

PIG349 Azurite, coarse (catalog no. 410-11S). 10 grams. (green/blue group). *See section 19 of this document for data.*

PIG350 Malachite, medium (catalog no. 420-21S). 10 grams. (green/blue group). *See section 19 of this document for data.*

PIG354 Malachite, fine grade (catalog no. 420-20S). 5 vials of 10 grams each = 50 grams. (green/blue group). *See section 19 of this document for data.*

PIG372 Malachite (Historical Pigments Set, catalog no. 420-20G), 100 grams. (green/blue group). *See section 19 of this document for data.*

SYN009 Sodium carbonate (Na_2CO_3), synthetic, anhydrous, ACS 99.5% min, 50 grams. Alfa Aesar stock #11552, lot #F19N36, cas #497-19-8.

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5.1.1a. Sample Descriptions - Baked carbonate samples

CRB206Bk Gaylussite - 29.11% mass loss (30% predicted). 65 minutes at 165°C.
CRB206Bka Gaylussite - 27.74% mass loss (30% predicted). 40 minutes at 165°C.

CRB208Bk Hydromagnesite - 1.58% mass loss (15% predicted). 80 minutes at 380°C.

CRB209Bk Hydrotalcite - 14.7% mass loss (12% predicted). 20 minutes at 100°C.

CRB210Bk Manasseite - 4.91% mass loss (12% predicted). 60 minutes at 340°C.

CRB211Bk Pirssonite - 13.57% mass loss (15% predicted). 40 minutes at 220°C.

CRB213Bk Thermonatrite - 22.92% mass loss (15% predicted). 25 minutes at 115°C.
CRB213Bka Thermonatrite - 15.27% mass loss (15% predicted). 25 minutes at 115°C (unchopped).
CRB213Bkb Thermonatrite - 22.59% mass loss (15% predicted). 25 minutes at 115°C (chopped up).

CRB214Bk Trona - 28.77% mass loss (16% predicted). 25 minutes at 115°C.
CRB214Bkb Trona - 24.66% mass loss (16% predicted). 25 minutes at 115°C (unchopped).
CRB214Bkc Trona - 27.76% mass loss (16% predicted). 25 minutes at 115°C (chopped).
CRB215Bk Hydromagnesite - 21.21% mass loss (15% predicted). 40 minutes at 375°C.

Groups and series (involving my samples):

- *Aragonite group (orthorhombic): aragonite, cerussite*
- *Calcite group (trigonal): calcite, gaspeite, magnesite, rhodochrosite, siderite*
- *Dolomite group (trigonal): ankerite, dolomite*
- *Hydrotalcite group (trigonal): pyroaurite, hydrotalcite*
- *Manasseite group (?): ? (page missing)*

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5.1.2a. Sample Descriptions - International Space Analogue Rockstore (ISAR)

Nov. 2012 (see section 20.28)

09SV05-4 Carbonate: Sverefjell outcrop, Svalbard, Norway; associated with 09SV02-3 and 09SV15-4.
11CY04-3 Carbonate: Katydata outcrop, Nicosia district, Cyprus.

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5.1.3a. Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

AragoniteAK		UNS AK
Dolomite71306		GBW 07114 (NCS DC71306)
hand sample3	**Calcite	ActLabs
hand sample53	**Dolomite	ActLabs
hand sample72	**Limestone	ActLabs
hand sample82	**Travertine	ActLabs

Aragonite AK grain size info (from Brammer):

>0.09 mm	*2.60%*
0.071-0.090 mm	*2.10%*
0.040-0.071 mm	*3.80%*
<0.040 mm	*91.50%*

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5.1.4a. Monohydrocalcite samples from South Australia – Sample Descriptions

Received from Ian Swainson – July 2008.

CRB800 Monohydrocalcite: Lake Butler, Australia. Sample tag: "TV037. L Butler 2. CaCO3-H2O. POS4." Vial label: "Monohydrocalcite. Lake Butler. Collected 2001. 2." Received from Ian Swainson: AECL, Chalk River, ON, Canada, July 25, 2008.

CRB801 Monohydrocalcite: Lake Butler, Australia. Sample tag: "TV007. L Butler. CaCO3-H2O. POS6." Vial label: "Monohydrocalcite. Lake Butler. G19.222". Received from Ian Swainson: AECL, Chalk River, ON, Canada, July 25, 2008.

CRB802 Monohydrocalcite: Lake Butler, Australia. Sample tag: "TV007. L. Butler. Monohydrocalcite. 1. POS3." Vial labels (2 vials in package): "(Vial 1): 1. Lake Butler. Ground for XRD. (Vial 2): "Monohydrocalcite. Lake Butler. Collected 2001. 1." Received from Ian Swainson: AECL, Chalk River, ON, Canada, July 25, 2008.

CRB803 Monohydrocalcite: Lake Butler, Australia. Sample tag: "L Butler. Monohydrocalcite. TV033. POS5." Vial label: Monohydrocalcite. Lake Butler. Collected 2002. 3." Received from Ian Swainson: AECL, Chalk River, ON, Canada, July 25, 2008.

CRB804 Monohydrocalcite: Lake Fellmongery, Australia. Sample tag: "TV034. L Fellmongery. Mono. POS7." Vial label: "Monohydrocalcite. Lake Fellmongery." Received from Ian Swainson: AECL, Chalk River, ON, Canada.

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5.2a. Sample descriptions - Oxalates

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either not plagioclase or are too fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

See also section 19.2.8. and 19.29 - Pigments/artists materials from Alfa Aesar – received December 11, 2006 (ART001-003) and June 2007 (ART004 and 006)- For oxalate study

ART001 Sodium oxalate, ACS 99.5+% (Alfa Aesar stock #41759; 50 grams) [$Na_2C_2O_4$].
ART002 Oxalic acid, anhydrous, 98% (Alfa Aesar stock #44410; 50 grams) [HO_2CCO_2H].
ART003 Calcium oxalate: $CaC_2O_4 \cdot H_2O$. Synthetic: Alfa Aesar #32430 (lot #H21N04), 99%; 100 g. Synthetic whewellite; weathering product of statuary (Smith and Clark, Reviews in Conservation, vol. 2, (2001), pp. 92-106. Irritates lungs, eyes, skin. (also PIG204).
ART004 Sodium oxalate, ACS 99.5% Reagent (Sigma-Aldrich #223433; 100 grams).
ART006 Dimethyl oxalate, 99% (Sigma-Aldrich #135623; 100 grams).

CRB711 Caoxite: Cerchiara Mine, La Spezia, Liguria, Italy [$Ca(C_2O_4) \cdot 3H_2O$] (aka calcium oxalate trihydrate) (Excalibur Minerals) (received Dec. 6, 2007).
CRB712 Weddellite: near Biggs, Wasco Co., OR, USA (light brown) [$Ca(C_2O_4) \cdot 2H_2O$] (aka calcium oxalate dihydrate) (Excalibur Minerals) (received Dec. 6, 2007).
CRB713 Whewellite: Pirineus Mine, Itinga, Minas Gerais, Brazil; on eosphorite [$Ca(C_2O_4) \cdot H_2O$] (aka calcium oxalate monohydrate) (Excalibur Minerals) (received Dec. 6, 2007).
CRB715 Iron (II) oxalate dihydrate, synthetic, [$FeC_2O_4 \cdot 2H_2O$], 99%; Alfa Aesar stock #A13479, Lot #10136824; CAS #6047-25-2; 250 g. (received Feb. 20, 2009).
CRB720 Magnesium oxalate dihydrate, synthetic [$MgC_2O_4 \cdot 2H_2O$], 98.5%+; Alfa Aesar stock #43976; Lot #J19S011; CAS #547-66-0; 100 g. (received Feb. 20, 2009) **[was CRB716]**

M46323 Whewellite (calcium oxalate), powdered sample and small crystals; received from Brendt Hyde of the Royal Ontario Museum – January 23, 2012.

OXA001 Potassium oxalate [$K_2C_2O_4$] (synthetic); UW Chemistry stores?
OXA002 Sodium oxalate [$Na_2C_2O_4$] (synthetic); same as ART001?
OXA010 Whewellite: spare coating on rock with ankerite, sphalerite, dickite, and chalcopyrite (received from Gunnar Farber Mineralien; received February 6, 2012; #1719.).
OXA011 Whewellite: 4 crystals: Karl Liebnecht Mine, Oelnitz, Zwickau, Saxony, Germany (Gunnar Farber Mineralien; received February 6, 2012).
OXA012 Weddellite: 1 piece, 1 vial; Meersboden Ablagerung, Weddell See, Antarktis/TYP (Gunnar Farber Mineralien; received February 6, 2012).
OXA013 Weddellite; 1 piece (with newberyite and halite; Punta Verde, Chile (Gunnar Farber Mineralien; received February 6, 2012).
OXA014 Synthetic ammonium oxalate monohydrate, ACS, 99.0-101.0%, granular [$(COONH_4)_2 \bullet H_2O$. Alfa Aesar 36228; lot: K15Y004; CAS: 6009-70-7; EINECS: 214-202-3; 100 grams (received June 2013) (see OXA017).
OXA015 Synthetic nickel oxalate, dehydrate; [$NiC_2O_4 \cdot 2H_2O$]; Alfa Aesar #39454, lot: S20A005; CAS: 6018-94-6; 50 grams (received Dec. 5, 2014).
OXA016 Copper (II) oxalate hemihydrate [$CuC_2O_4 \cdot 0.5H_2O$]; Alfa Aesar #A15365, lot: 10182243; CAS: 5893-66-3; 50 grams (received Dec. 5, 2014).
OXA017 Synthetic ammonium oxalate monohydrate, 98%; [$(COONH_4)_2 \cdot H_2O$]; Alfa Aesar #A10263, lot: 10178794; CAS: 6009-70-7; 100 grams (received Dec. 5, 2014) (see OXA014).
OXA018 Synthetic lead (II) oxalate, Puratronic 99.999% (metals basis); [PbC_2O_4?]; Alfa Aesar #122999, lot: S94965; CAS: 814-93-7; 5 grams (received Dec. 5, 2014).
OXA019 Synthetic cadmium oxalate [$C_2H_2CDO_4$]. AK Scientific Inc.: Z1768; lot #MH38857; (814-88-0); 5 grams; received Dec. 2014.
PIG204 Calcium oxalate: $CaC_2O_4 \cdot H_2O$. Synthetic: Alfa Aesar #32430 (lot #H21N04), 99%; 100 g. Synthetic weddelite (*weathering product of statuary (Smith and Clark, Reviews in Conservation, vol. 2,*

(2001), pp. 92-106). Irritates lungs, eyes, skin. (also ART003). *See section 19 of this document for data.*

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5b. XRD Data - Carbonates and Oxalates

A number of the samples were measured by XRD at the University of Manitoba Department of Geological Sciences in May and June of 1999, and in June of 2003, unless otherwise indicated. The samples were run in continuous scanning mode to provide information on the <45µm size samples and whether any accessory phases are present. Files are in the format crb###,rep.

5.1b. XRD Data - Carbonates

CRB101 (ankerite)	Almost pure quartz.
CRB102 (aragonite)	XRD shows aragonite+calcite in approximately equal amounts.
CRB103 (dolomite)	XRD shows only dolomite.
CRB104 (gaspeite)	Almost all gaspeite and a bit of laumontite (?) (zeolite: $CaAl_2Si_4O_{12}\cdot 4H_2O$).
CRB105 (huntite)	Huntite plus a few very minor peaks.
CRB106 (magnesite)	XRD shows only magnesite.
CRB107 (nahcolite)	XRD shows mostly nahcolite, also thenardite (Na_2SO_4) + halite (definite and minor).
CRB108 (siderite)	XRD shows only siderite.
CRB109 (calcite)	XRD shows only calcite.
CRB110 (calcite)	XRD shows only calcite.
CRB111 (calcite)	XRD shows only calcite.
CRB112 (calcite)	XRD shows only calcite.
CRB113 (manganocalcite)	XRD shows only calcite.
CRB114 (magnesite)	Magnesite plus other stuff- probably huntite; some broad and low angle peaks.
CRB115 (huntite)	Pure huntite.
CRB116 (aragonite)	Pure calcite.
CRB117 (dolomite)	Pure dolomite.
CRB118 (aragonite)	Pure calcite.
CRB119 (aragonite)	Mostly aragonite, some quartz and calcite.
CRB120 (aragonite)	Pure aragonite.
CRB122 (aragonite)	Nearly pure calcite, minor dolomite.
CRB123 (aragonite)	Nearly pure aragonite, a wee bit of calcite.
CRB124 (aragonite)	Pure aragonite.
CRB125 (aragonite)	Pure aragonite.
CRB126 (shortite)	Pure shortite (July 06).
CRB149 (magnesite)	UofW Bruker D8: Almost all magnesite, very minor dolomite.
CRB201 (artinite)	Only artinite but peak intensities don't jibe.
CRB203 (coalingite)	Meta-alunogen is best fit ($Al_4(SO_4)_627H_2O$), peaks are broad; coalingite is possible but other stuff as well; gibbsite ($Al(OH)_3$) and brucite ($Mg(OH)_2$) come up also.
CRB204 (dawsonite)	Dawsonite but peak intensities don't jibe.
CRB206 (gaylussite)	XRD shows only gaylussite
CRB208 (hydromagnesite)	XRD shows almost total magnesite, no hydromagnesite shows up.
CRB209 (hydrotalcite)	XRD shows hydrotalcite (nearly all), and maybe minor stichite (Mg6Cr2(CO3)(OH)16·4H2O); manasseite also made the cut.
CRB210 (manasseite)	No really sharp peaks; manasseite is a decent match, maybe also antigorite ($(Mg,Fe^{+2})_3Si_2O_5(OH)_4$)
CRB211 (pirssonite)	Pirssonite plus a few very minor peaks.
CRB212 (pyroaurite)	XRD shows calcite for matching some peaks, many still unidentified peaks (perhaps dolomite, aragonite).
CRB213 (thermonatrite)	XRD shows only trona.
CRB214 (trona)	XRD shows only trona.
CRB215 (hydromagnesite)	XRD shows almost all hydromagnesite, with a bit of magnesite.
CRB216 (hydromagnesite)	Nearly pure hydromagnesite with a bit of artinite.
CRB217 (brugnatellite)	from Italy (no need)
CRB218 (artinite)	from Italy (no need)

CRB310 (northupite)	Almost pure northupite.
CRB312 (artinite)	XRD shows only artinite.
CRB313 (pyroaurite)	XRD suggests that sjogrenite matches the major peaks; pyroaurite also matches the 2 major peaks but not the others.
CRB314 (artinite)	Mostly hydromagnesite and lizardite, a bit of artinite; also a high background indicating amorphous phases.
CRB315 (hydromagnesite)	Hydromagnesite + ? for a low end peak.
CRB501 (malachite)	Nearly pure malachite, high background indicates some amorphous material as well.
CRB502 (cerussite)	Pure cerussite.
CRB503 (azurite)	Pure azurite; high background indicates some amorphous material as well.
CRB504 (azurite)	Pure azurite; high background indicates some amorphous material as well.
CRB505 (hydrocerussite)	Pure calcite.
CRB506 (cerussite)	Pure cerussite.
CRB507 (cerussite)	Pure cerussite.
CRB508 (malachite)	Nearly pure malachite, minor amount of quartz; high background indicates some amorphous material as well.
CRB509 (malachite)	Pure malachite; high background indicates some amorphous material as well.
CRB510 (azurite)	Nearly pure azurite, a couple of minor mystery peaks; high background indicates some amorphous material as well.
CRB511 (azurite)	Pure azurite; high background indicates some amorphous material as well.

*+++++**Baked samples**+++++*

CRB206Bk (baked gaylussite)	Nyererite ($Na_2Ca(CO_3)_2$).
CRB208Bk (baked hydromagnesite)	Almost pure magnesite.
CRB209Bk (baked hydrotalcite)	Mostly hydrotalcite.
CRB210Bk (baked manasseite)	No decent matches; some serpentine.
CRB211Bk (baked pirssonite)	Nyererite ($Na_2Ca(CO_3)_2$).
CRB213Bk (baked “thermonatrite”)	Natrite (Na_2CO_3), and wegscheiderite ($Na_5(CO_3)(HCO_3)_3$). (File: crb213.rep)
CRB213Bkb (baked “thermonatrite”)	Trona, natrite (Na_2CO_3), and wegscheiderite ($Na_5(CO_3)(HCO_3)_3$). (File: crb213bk.rep).
CRB214Bk (baked trona)	Natrite (Na_2CO_3), and a bit of trona.
CRB215Bk (baked hydromagnesite)	Almost entirely magnesite.

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5c. Compositional data - Carbonates and Oxalates

5c.x. Carbonates – Ideal Formulas

Wt. %	Alumo-hydro-calcite	Ankerite*	Aragonite	Artinite	Azurite	Brugnatellite
CO_2	26.2	44.0	44.0	22.4	25.5	7.9
MgO		10.1		41.0		43.6
FeO		17.9				
Fe_2O_3						14.4
CaO	16.7	28.0	56.0			
Al_2O_3	30.3					
NiO						
MnO						
Na_2O						
CuO					69.2	
PbO						
OH/H_2O	26.8			36.6	5.3	34.1
TOTAL	100	100	100	100	100	100

Wt. %	Calcite	Cerussite	Coalingite	Dawsonite	Dolomite	Dypingite
CO_2	44.0	16.5	5.1	30.6	47.7	36.3
MgO			46.9		21.9	41.5
FeO						
Fe_2O_3			18.6			
CaO	56.0				30.4	
Al_2O_3				35.4		
NiO						
MnO						
Na_2O				21.5		
CuO						
PbO		83.5				
OH/H_2O			29.4	12.5		22.2
TOTAL	100	100	100	100	100	100

Wt. %	Gaspeite*	Gaylussite	Huntite	Hydro-magnesite	Hydrotalcite	Magnesite
CO_2	41.5	29.7	49.9	37.6	7.3	52.2
MgO	12.6		34.2	43.1	40.0	47.8
FeO	22.5					
Fe_2O_3						
CaO		18.9	15.9			
Al_2O_3					16.9	
NiO	23.4					
MnO						
Na_2O		20.9				
CuO						
PbO						
OH/H_2O		30.5		19.3	35.8	
TOTAL	100	100	100	100	100	100

Notes: for ankerite assume only Fe^{2+} and Mg present in equal amounts (no Mn). For gaspeite assume equal parts Ni, Mg, and Fe^{2+}.

5c.x Carbonates – Ideal Formulas (continued)

Wt. %	Malachite	Manasseite	Mangano-calcite*	Nahcolite	Natrite	Northupite*	Nyererite
CO_2	19.9	7.3	40.9	52.4	41.5	31.1	42.7
MgO		40.0				16.2	
FeO							
Fe_2O_3							
CaO			26.1				27.2
Al_2O_3		16.9					
NiO							
MnO			33.0				
Na_2O				36.9	58.5	37.4	30.1
CuO	72.0						
PbO							
Cl						14.3	
OH/H_2O	8.1	35.8		10.7			
TOTAL	100	100	100	100	100	100	100

Wt. %	Pirssonite	Pyroaurite	Siderite	Thermo-nitrite	Trona	Wegscheiderite
CO_2	36.3	6.7	38.0	35.5	38.9	49.4
MgO		36.6				
FeO			62.0			
Fe_2O_3		24.1				
CaO	23.2					
Al_2O_3						
NiO						
MnO						
Na_2O	25.6			50.0	41.2	43.5
CuO						
PbO						
Cl						
OH/H_2O	14.9	32.6		14.5	19.9	7.1
TOTAL	100	100	100	100	100	100

Note: assumes equal parts Mn and Ca in manganocalcite. “Excess” oxygen in northupite subtracted from CO_2 total for simplicity.

5c. Compositional Data - Carbonates and Oxalates

5.1c. Compositional Data - Carbonates

Wt. %	CRB101	CRB101	CRB102	CRB102	CRB103	CRB103
SiO_2		52.52		0.00		0.02
TiO_2		0.01		0.00		0.00
Al_2O_3		0.44		0.00		0.00
FeO		14.58				
Fe_2O_3		9.38				
*(Fe_2O_3)**		*(25.58)*		*(0.06)*		*(6.84)*
MnO		1.63		0.00		0.14
MgO		1.46		1.06		32.42
CaO		16.83		98.16		60.19
Na_2O		0.75		0.35		0.16
K_2O		0.00		0.00		0.00
P_2O_5		0.03		0.02		0.02
TOTAL		99.25		99.65		99.79
LOI		14.49		44.47		46.66
ppm:						
Sr		103		4175		144
Zr		10		15		5
V		5		5		20
Co		<2		<2		<2
Cr		3		<2		<2
Ni		50		<2		<2
Rb		<2		<2		<2
Elemental abundances						
Ca	1.83		53.1		37.4	
Mg	1.05		0.428		12.2	
Fe	2.72		0.015		2.24	
Mn	0.171		0		0.082	
as oxides:						
MgO	1.74		0.71		20.23	
FeO	3.50		0.02		2.88	
CaO	2.56		74.29		52.32	
MnO	0.22		0.00		0.11	
Source	UW	Mertzman	UW	Mertzman	UW	Mertzman
Analysis	AA	XRF/WC	AA	XRF/WC	AA	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB104	CRB104	CRB105	CRB105	CRB106	CRB106
SiO_2		6.33		26.86		0.19
TiO_2		0.02		0.03		0.00
Al_2O_3		0.19		0.60		0.08
FeO		1.05				0.73
Fe_2O_3		7.03				0.57
*(Fe_2O_3)**		*(8.20)*		*(0.21)*		*(1.38)*
MnO		0.37		0.03		0.03
MgO		23.26		67.34		96.73
CaO		0.48		4.31		1.59
Na_2O		0.50		0.00		0.00
K_2O		0.00		0.00		0.00
P_2O_5		0.03		0.04		0.02
NiO		60.35				
TOTAL		99.73		99.42		100.02
LOI		47.05		38.28		51.55
ppm:						
Sr		37		322		73
Zr		5		15		5
V		5		5		3
Co		675		<2		5
Cr		630		<2		<2
Ni		above		<2		160
Rb		<2		<2		40
Elemental abundances						
Ca	0.26		5.61		0.929	
Mg	6.39		18.2		21.4	
Fe	2.57		0.298		0.513	
Mn	0.106		0		0.003	
Ni	9.20					
as oxides:						
MgO	10.60		30.18		35.49	
FeO[a]	3.31		0.38		0.66	
CaO	0.36		7.85		1.30	
NiO	11.71					
MnO	0.14		0.00		<0.01	
Source	UW	Mertzman	UW	Mertzman	UW	Mertzman
Analysis	AA	XRF/WC	AA	XRF/WC	AA	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB107	CRB107	CRB108	CRB108	CRB109	CRB109	CRB110
SiO_2		4.76		0.00		0.11	
TiO_2		0.07		0.03		0.00	
Al_2O_3		1.04		0.08		0.01	
FeO				35.67			
Fe_2O_3				55.08			
*(Fe_2O_3)**		*(0.63)*		*(94.72)*		*(0.00)*	
MnO		0.02		3.83		0.01	
MgO		0.96		0.76		1.41	
CaO		1.37		0.07		97.75	
Na_2O		34.10		0.66		0.41	
K_2O		0.68		0.01		0.00	
P_2O_5		0.05		0.03		0.02	
TOTAL		43.68		100.19		99.72	
LOI		40.20		32.63		43.43	
ppm:							
Sr		270		25		366	
Zr		10		5		10	
V		5		45		10	
Co		5		<2		<2	
Cr		<2		<2		<2	
Ni		160		<2		<2	
Rb		40		<2		<2	
Elemental abundances							
Ca	0.15		0.413		55.7		52.6
Mg	0.938		0.072		0.476		1.34
Fe	0.27		52.66		0.0066		0.241
Mn	0.0105		2.106		0.003		0.083
Na	18.3						
Al	0.544						
as oxides:							
MgO	1.56		0.12		0.79		2.22
FeO[a]	0.35		67.75		0.01		0.31
CaO	0.21		0.58		77.92		73.59
Al_2O_3	1.03						
MnO	0.01		2.72		0.01		0.11
Na_2O	24.67						
Source	UW	Mertzman	UW	Mertzman	UW	Mertzman	UW
Analysis	AA	XRF/WC	AA	XRF/WC	AA	XRF/WC	AA

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB111	CRB111	CRB112	CRB112	CRB113	CRB114	CRB114
SiO_2		0.08		0.00			31.21
TiO_2		0.01		0.00			0.00
Al_2O_3		0.00		0.00			0.00
FeO							
Fe_2O_3							
*(Fe_2O_3)**		*(0.05)*		*(0.00)*	*(0.00)*		*(0.00)*
MnO		0.02		0.07			0.01
MgO		0.37		0.29			53.79
CaO		98.01		98.57			14.63
Na_2O		0.38		0.36			0.02
K_2O		0.00		0.00			0.00
P_2O_5		0.03		0.03			0.04
TOTAL		98.95		99.32			99.70
LOI		43.17		43.13	42.12[2]		34.57
ppm:							
Sr		3185		144			327
Zr		15		5			20
V		10		10			10
Co		<2		<2			<2
Cr		<2		<2			12
Ni		<2		40			<2
Rb		<2		<2			<2
Elemental abundances							
Ca	57.1		58.3		51.0	3.27	
Mg	0.119		0.11		0.105	22.1	
Fe	0.02		0.016		0.285	0.037	
Mn	0.0124		0.0522		2.25	0.00247	
as oxides:							
MgO	0.20		0.18		0.17	36.65	
FeO[a]	0.03		0.02		0.37	0.05	
CaO	79.88		81.56		71.35	4.57	
MnO	0.02		0.07		2.91	<0.01	
Source	UW	Mertzman	UW	Mertzman	UW	UW	Mertzman
Analysis	AA	XRF/WC	AA	XRF/WC	AA	AA	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB115	CRB116	CRB117	CRB118	CRB119	CRB120	CRB121
MgO		1.29	36.91	1.90	0.39	1.23	
(FeO[a])							
FeO		0.00	0.00	0.00	0.00	0.00	
Fe_2O_3		0.19	0.93	0.11	0.21	0.58	
*(Fe_2O_3)**	*(0.00)*[2]	*(0.19)*	*(0.93)*	*(0.11)*	*(0.21)*	*(0.58)*	
CaO		96.98	61.45	97.03	70.43	91.17	
Al_2O_3		0.07	0.00	0.05	0.29	1.01	
MnO		0.13	0.10	0.00	0.00	0.01	
Na_2O		0.05	0.06	0.22	0.04	0.20	
SiO_2		0.19	0.00	0.97	28.01	4.32	
TiO_2		0.00	0.00	0.00	0.00	0.03	
K_2O		0.00	0.00	0.00	0.00	0.19	
P_2O_5		0.07	0.01	0.00	0.02	0.04	
TOTAL		98.97	99.46	100.28	99.39	98.78	
LOI[b]	49.42[c]	42.06	46.40	43.07	34.40	40.57	
LOI T°	950°C	950°C	950°C	950°C	950°C	950°C	
LOI time	30 min.	30 min.	30 min.	30 min.	30 min.	30 min.	
ppm							
Sr		8730	190	130	2590	9730	
Zr		40	45	15	20	65	
V		<5	<5	5	<5	8	
Cr		<5	<5	8	<5	10	
Co							
Ni							
Rb							
Elemental abundances							
Ca	9.63						
Mg	24.0						
Fe	0.0372						
Mn	0						
as oxides:							
MgO	39.80						
(FeO[a])	(0.05)						
CaO	13.47						
MnO	0.00						
Source	UW	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	
Analysis	AA	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

LOI T° = maximum baking temperature. LOI time – duration of heating. LOI[c] - Ignition loss done at University of Winnipeg.

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB122	CRB123	CRB124	CRB125	CRB131
NMNH #			B10111	B16198	
MgO	4.09	0.60	0.19	0.26	0.06
FeO	0.00				0.01
Fe_2O_3	0.34				0.01
*(Fe_2O_3)**	*(0.34)*	*(0.14)*	*(0.10)*	*(0.00)*	*(0.02)*
CaO	93.01	96.49	99.52	98.74	98.99
Al_2O_3	0.49	0.37	0.00	0.00	0.10
MnO	0.57	0.01	0.00	0.00	0.21
Na_2O	0.12	0.09	0.35	0.34	0.06
SiO_2	1.15	0.87	0.00	0.00	0.00
TiO_2	0.00	0.00	0.00	0.00	0.00
K_2O	0.06	0.05	0.00	0.00	0.01
P_2O_5	0.07	0.03	0.02	0.02	0.01
SO^3					0.06
TOTAL[a]	99.90	98.65	100.18	99.36	99.52
LOI[b]	39.23	42.08	43.66	43.27	42.67
LOI T°	950°C	950°C	950°C	950°C	
LOI time	30 min.	30 min.	30 min.	30 min.	
ppm					
Sr	750	10760	109	62	150
Zr	20	25	10	5	49
V	50	5	15	10	34
Cr	5	10	<2	<2	15
Co			<2	<2	<1
Ni			45	<2	12
Rb			<2	<2	
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

LOI T° = maximum baking temperature. LOI time – duration of heating.

NMNH #: Smithsonian Institution National Museum of Natural History sample ID.

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB149
SiO_2	1.43
TiO_2	0.01
Al_2O_3	0.51
FeO	0.34
Fe_2O_3	0.04
*(Fe_2O_3)**	*(0.42)*
MnO	0.03
MgO	93.60
CaO	3.58
Na_2O	0.32
K_2O	0.00
P_2O_5	0.01
SO_3	0.06
TOTAL	99.97
LOI	52.61
ppm	
Sr	174
Zr	133
V	15
Ni	<1
Cr	5
Co	<1
Source	Mertzman
Analysis	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB201	CRB203	CRB204	CRB206	CRB206
Ca	2.51	3.9	1.8	24.7	
Mg	24.9	30.8	0.0729	0.019	
Fe	0.0943	8.49	0.00913	0.0048	
Mn	0	0.317	0	0.00105	
Na			5.53	16.1	
as oxides:					
MgO	41.30	51.08	0.12	0.03	
FeO[a]	0.12	10.92	0.01	0.01	
CaO	3.51	5.46	2.52	34.56	
MnO	0.00	0.41	0.00	<0.01	
Na_2O			7.45	21.70	
LOI[a]		23.42		29.11	27.74
LOI					50.86[b]
LOI T°		950°C		165°C	165°C
LOI time		30 min.		65 min.	40 min.
Source	UW	UW	UW	UW	UW
Analysis	AA	AA	AA	AA	AA

[a]: LOI: Loss on ignition represents weight loss after heating sample in air.
[b] – LOI ignition weight loss done at Franklin and Marshall College (by Stan Mertzman).
Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).
LOI T° = maximum baking temperature. LOI time – Duration of heating.
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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB208	CRB208	CRB209	CRB209
MgO	36.30	98.71	41.46	38.89
(FeO^a)	0.02		1.13	
FeO				1.35
Fe_2O_3				3.19
*(Fe_2O_3)**		*(0.00)*		*(4.69)*
CaO	0.33	0.48	0.06	0.53
Al_2O_3		0.00	9.48	30.76
MnO	0.00	0.01	<0.01	0.01
Na_2O		0.00		0.29
SiO_2		0.10		24.62
TiO_2		0.01		0.10
K_2O		0.00		0.03
P_2O_5		0.03		0.18
TOTAL		99.34		100.10
LOI		51.90		54.38
LOI[c]	1.58		14.7	
LOI T°	380°C	950°C	100°C	950°C
LOI time	80 min.	30 min.	20 min.	30 min.
ppm				
Sr		87		93
Zr		5		10
V		5		25
Co		<2		20
Cr		25		140
Ni		65		750
Rb		<2		<2
Wt. %				
Ca	0.237		0.044	
Mg	21.89		25.0	
Fe	0.018		0.875	
Mn	0		0.00361	
Al			5.02	
Source of analysis	UW	Mertzman	UW	Mertzman
Analysis	AA	XRF/WC	AA	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

LOI T° = maximum baking temperature. LOI time – duration of heating. LOI[c] - Ignition loss done at University of Winnipeg.

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB210	CRB210	CRB211	CRB211	CRB212
MgO	27.20	66.38	0.19	0.57	
FeO		0.96			
Fe_2O_3		2.88			
*(Fe_2O_3)**		*(3.95)*		*(0.12)*	
CaO	0.06	2.18	36.65	33.67	
Al_2O_3	20.40	23.45		0.27	
MnO	0.01	0.01	<0.01	0.01	
Na_2O		0.00	26.96	0.90	
SiO_2		3.45		26.06	
TiO_2		0.00		0.01	
K_2O		0.00		0.10	
P_2O_5		0.04		0.03	
TOTAL		99.46		61.74	
LOI		17.94		67.46	
LOI[c]	4.91		13.57		
LOI T°	340°C	950°C	220°C	950°C	
LOI time	60 min.	30 min.	40 min.	30 min.	
ppm					
Sr		68		2010	
Zr		5		5	
V		5		5	
Co		5		<2	
Cr		75		5	
Ni		65		25	
Rb		<2		10	
Wt. %					
Ca	0.0436		26.2		
Mg	16.4		0.115		
Fe	1.57		0.36		
Mn	0.0088		0.00232		
Na			20.0		
Al	10.8				
Source	UW	Mertzman	UW	Mertzman	
Analysis	AA	XRF/WC	AA	XRF/WC	

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

LOI T° = maximum baking temperature. LOI time – duration of heating. LOI[c] - Ignition loss done at University of Winnipeg.

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB213	CRB213	CRB213	CRB213
MgO	0.09			0.08
FeO				0.00
Fe_2O_3				0.31
*(Fe_2O_3)**				*(0.31)*
CaO	0.38			0.29
Al_2O_3				0.00
MnO	0.00			0.02
Na_2O	53.64			97.95
SiO_2				1.16
TiO_2				0.00
K_2O				0.09
P_2O_5				0.05
TOTAL				99.95
LOI				40.19
ppm				
Sr				5
Zr				10
V				<5
Cr				<5
Wt. %				
Ca	0.271			
Mg	0.053			
Fe	0.011			
Mn	0			
Na	39.8			
LOI[c]	22.92	15.27*	22.59	
LOI T°	115°C	115°C	115°C	950°C
LOI time	25 min.	25 min.	25 min.	30 min.
Source	UW	UW	UW	Mertzman
Analysis	AA	AA	AA	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

LOI T° = maximum baking temperature. LOI time – duration of heating. LOI[c] - Ignition loss done at University of Winnipeg.

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB214	CRB214	CRB214	CRB214	CRB215	CRB215
MgO	0.05			0.03	25.26	73.43
FeO[a]	0.01				0.04	
Fe_2O_3						
*(Fe_2O_3)**				*(0.03)*		*(0.18)*
CaO	0.31			0.07	0.47	0.53
Al_2O_3				0.00		0.10
NiO						
MnO	<0.01			0.01	0.01	0.01
Na_2O	47.98			41.78		0.00
K_2O				0.00		0.04
SiO_2				0.00		1.24
TiO_2				0.00		0.01
P_2O_5				0.02		0.04
TOTAL				41.94		75.58
LOI				43.06		47.89
ppm						
Sr				36		195
Zr				5		5
V				<2		5
Co				<2		<2
Cr				5		10
Ni				80		55
Rb				20		25
Wt. %						
Ca	0.224				0.337	
Mg	0.032				15.23	
Fe	0.0099				0.034	
Mn	0.00113				0.00758	
Na	35.6					
LOI[c]	28.77	24.66	27.76		21.21	
LOI T°	115°C	115°C	115°C	950°C	375°C	950°C
LOI time	25 min.	25 min.	25 min.	30 min.	40 min.	30 min.
Source	UW	UW	UW	Mertzman	UW	Mertzman
Analysis	AA	AA	AA	XRF/WC	AA	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

LOI T° = maximum baking temperature. LOI time – duration of heating. LOI[c] - Ignition loss done at University of Winnipeg.

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB216	CRB217	CRB218	CRB310	CRB311
Ca				0.756	
Mg				9.01	
Fe				0.088	
Mn				0.0154	
Na				24.1	
as oxides:					
CO_2		7.78	21.85		
MgO		42.79	43.32	14.94	
FeO				0.11[a]	
Fe_2O_3		13.20			
CaO				1.06	
MnO		1.80		0.02	
Na_2O				32.48	
H_2O		33.77	34.32		
TOTAL		99.34	99.49		
Source of analysis	UW	Italians	Italians	UW	
Analysis	AA			AA	

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).
Italians: Sample analyses provided by Dr. Pietro Vignola.
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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB312	CRB312	CRB313
MgO	36.32	78.51	31.34
FeO	0.96[a]		22.00[a]
Fe_2O_3			
*(Fe_2O_3)**		*(3.69)*	
CaO	0.14	0.19	2.17
Al_2O_3		0.09	
MnO	0.00	0.08	0.45
Na_2O		0.00	
K_2O		0.00	
P_2O_5		0.02	
SiO_2		16.96	
TiO_2		0.01	
TOTAL		99.55	
LOI		44.55	
ppm:			
Sr		64	
Zr		5	
V		5	
Co		50	
Cr		455	
Ni		1550	
Rb		<2	
Wt. %			
Ca	0.103		1.55
Mg	21.9		18.9
Fe	0.748		17.1
Mn	0		0.35
Source	UW	Mertzman	UW
Analysis	AA	XRF/WC	AA

* - all Fe reported as Fe_2O_3.

a – all Fe reported as FeO.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB314	CRB315	CRB501	CRB502	CRB503	CRB504
MgO						
Fe_2O_3			0.61	0.03		0.79
FeO			0.00	0.00		0.00
*(Fe_2O_3)**	*0.00*	*0.0*	*(0.61)*	*(0.03)*	*(0.00)*	*(0.79)*
CaO						
Al_2O_3						
NiO						
MnO			0.00	0.00		0.00
Na_2O						
TOTAL			0.61	0.54		0.36
LOI[b]		36.29	28.21	15.80	25.60	30.65
ppm						
CuO			99.1%			98.7%
PbO				83.5%		
Source	UW	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	AA	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

Source UW: analysis by atomic absorption spectroscopy at the University of Winnipeg (and all Fe reported as FeO).

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5.1c. Compositional Data - Carbonates (continued)

Wt. %	CRB505	CRB506	CRB507	CRB508	CRB509	CRB510	CRB511
NMNH #	B8107	96778	C2130-1	78806	143514	145930	148829
MgO	0.46					4.37	
FeO	0.07					0.00	
Fe_2O_3	0.00					1.71	
*(Fe_2O_3)**	*(0.07)*					*(1.71)*	*(0.00)*
CaO	95.34					1.25	
Al_2O_3	0.00					6.81	
MnO	3.50					0.05	
Na_2O	0.58					0.00	
K_2O	0.00					0.00	
P_2O_5	0.02					0.00	
PbO		83.52	83.41				
CuO				71.85	71.98	39.43	69.60
SiO_2	0.00					18.62	
TiO_2	0.00					0.15	
TOTAL	99.97	99.95	99.94	99.86	100.36	100.36	99.53
LOI	41.39	16.43	16.53	28.01	28.38	27.97	29.93
LOI[a]	41.77						
ppm:							
Sr	139						
Zr	3						
V	25						
Co	<2						
Cr	<2						
Ni	85						
Rb	<2						
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[a]: Duplicate LOI determination.

NMNH #: Smithsonian Institution National Museum of Natural History sample number.

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5d. Spectral Data - Carbonates and Oxalates (in alphabetical order)

Sample	*Facility/File No.*	*Description*
ART001	PSF 090313a.001	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
ART001	RELAB cacb80	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
ART001	RELAB bir1cb080A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
ART001	RELAB bkr1cb080A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
++++++		
ART002	PSF 090313a.002	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
ART002	PSF 090313a.003	90-1000 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
ART002	RELAB cacb81	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
ART002	RELAB bir1cb081A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
ART002	RELAB bkr1cb081A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 0.93 µm.
+++++++		
ART006	PSF 090313a.004	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
ART006	PSF 090313a.005	90-1000 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
CRB101	RELAB cacb01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB101	RELAB lacb01a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB101	RELAB cbcb01	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB101	RELAB lacb01b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB102	RELAB cacb02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB102	RELAB lacb02a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB102	RELAB cbcb02	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB102	RELAB lacb02b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB103	RELAB cacb03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB103	RELAB lacb03a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB103	RELAB cbcb03	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB103	RELAB lacb03b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB103	PSF 130910a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. (Directory: Minerals for Jim).
CRB103	PSF 111201a.044	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 111201_optech).
+++++++		
CRB104	RELAB cacb04	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB104	RELAB lacb04a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB104	RELAB cbcb04	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB104	RELAB lacb04b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB105	PSF 090421a.015	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
CRB105	RELAB cacb05	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB105	RELAB lacb05a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB105	PSF crb105	<45 µm, 35°/0°, 2-16 µm; D&P 102F; 100 spectra averaged.
CRB105	PSF jul1306.001	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).

CRB105	PSF acrb105	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
CRB105	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
CRB106	RELAB cacb06	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB106	RELAB lacb06a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB106	RELAB cbcb06	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB106	RELAB lacb06b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
++++++		
CRB107	RELAB cacb07	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB107	RELAB lacb07a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB107	RELAB cbcb07	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB107	RELAB lacb07b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB108	RELAB cacb08	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB108	RELAB lacb08a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB108	RELAB cbcb08	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB108	RELAB lacb08b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB108	PSF jul1306.002	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).
CRB108	PSF acrb108	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
CRB108	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
CRB109	RELAB cacb09	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB109	RELAB lacb09a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB109	RELAB cbcb09	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB109	RELAB lacb09b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB110	RELAB cacb10	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB110	RELAB lacb10a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB111	RELAB cacb11	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB111	RELAB lacb11a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB111	PSF 071212a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
+++++++		
CRB112	RELAB cacb12	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB112	RELAB lacb12a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB112	RELAB cbcb12	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB112	RELAB lacb12b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB112	RELAB CACA10	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB112	RELAB LACA10	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
CRB112	PSF pig1307.033	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
+++++++		
CRB113	RELAB cacb13	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB113	RELAB lacb13a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB113	RELAB cbcb13	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB113	RELAB lacb13b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB114	PSF 090421a.016	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
CRB114	RELAB bkr1cb014a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.550 µm.

CRB114	PSF crb114	<45 µm, 35°/0°, 2-16 µm; D&P 102F; 100 spectra averaged.
CRB114	PSF crb114feb01.rtx	45-90 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
CRB114	PSF jun0506.004	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
CRB114	PSF acrb114	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
CRB114	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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CRB114-4A	PSF 090602a.004	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
CRB114-4B	PSF 090602a.003	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
CRB114	PSF 090602a.005	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
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CRB115	RELAB bkr1cb015a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.570 µm.
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CRB116	PSF 090421a.003	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
CRB116	RELAB bkr1cb016a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.585 µm.
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CRB117	RELAB bkr1cb017a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.560 µm.
CRB117	PSF 071212a.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
CRB117	PSF 111201a.016	whole rock; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
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CRB118	RELAB bkr1cb018a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.575 µm.
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CRB118-AX1	PSF 090602a.001	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
CRB118	PSF 090602a.002	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
CRB118	PSF 111201a.045	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CRB118	PSF 111201a.017	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CRB118	INO CRB 118	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
CRB118	PSF nov1505.054	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #1 WITH sapphire window (Directory: nov1505).
CRB118	PSF nov1505.055	90-180 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #1 WITH sapphire window (Directory: nov1505).
CRB118	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
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CRB119	RELAB cacb19	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB119	RELAB bkr1cb019a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.525 µm.
CRB119	PSF 130910a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. (Directory: Minerals for Jim).
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CRB120	RELAB cacb20	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB120	RELAB bkr1cb020a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at

		2.525 µm.
CRB120	PSF pig1307.035	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
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CRB122	RELAB cacb42	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB122	RELAB bkr1cb042a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.550 µm.
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CRB123	RELAB cacb43	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB123	RELAB bkr1cb043a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.550 µm.
+++++++		
CRB124	RELAB cacb44	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB124	RELAB bkr1cb044a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.550 µm.
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CRB125	RELAB cacb45	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB125	RELAB bkr1cb045a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.580 µm.
+++++++		
CRB126	PSF 090421a.017	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
CRB126	PSF jul1606crb126	<45 µm, 35°/0°, 2-16 µm, D&P 102F.
CRB126	PSF jan2407crb126dp	unknown grain size, 35°/0°, 2-16 µm, D&P 102F; smoothed; 100 spectra averaged; D&P; good quality.
CRB126	PSF jan2407crb126dp2	unknown grain size, 35°/0°, 2-16 µm, D&P 102F; unsmoothed; 100 spectra averaged; D&P; good quality.
CRB126	PSF crb126.rtx	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
CRB126	PSF crb126dp.rtx	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; good spectrum.
CRB126	PSF crb126dp2.rtx	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; good spectrum.
CRB126	RELAB cacb62	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB126	RELAB bir1cb062A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB126	RELAB bkr1cb062A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
CRB126	RELAB cbcb62	45-90 µm; 30º/0º; 0.28-2.6 µm; 5 nm resolution, RELAB.
CRB126	RELAB bir1cb062B	45-90 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB126	RELAB bkr1cb062B	45-90 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
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CRB128	RELAB cacb63	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB128	RELAB bir1cb063A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB128	RELAB bkr1cb063A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
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CRB130	RELAB cacb64	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB130	RELAB bir1cb064A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB130	RELAB bkr1cb064A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
CRB130	PSF 130910a.013	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. (Directory: Minerals for Jim).
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CRB131	RELAB cacb65	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB131	RELAB bir1cb065A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB131	RELAB bkr1cb065A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.

CRB131	PSF 111201a.046	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
+++++++		
CRB140	RELAB cacb66	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB140	RELAB bir1cb066A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB140	RELAB bkr1cb066A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
+++++++		
CRB141	RELAB cacb67	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB141	RELAB bir1cb067A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB141	RELAB bkr1cb067A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
+++++++		
CRB142	RELAB cacb68	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB142	RELAB bir1cb068A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB142	RELAB bkr1cb068A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
+++++++		
CRB143	RELAB cacb69	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB143	RELAB bir1cb069A	<45 µm; 30º/30º; 0.9-25 µm; 0.1-20 nm resolution, Nicolet.
CRB143	RELAB bkr1cb069A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
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CRB144	RELAB cacb70	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB144	RELAB bir1cb070A	<45 µm; 30º/30º; 0.9-25 µm; 0.1-20 nm resolution, Nicolet.
CRB144	RELAB bkr1cb070A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
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CRB145	RELAB cacb71	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB145	RELAB bir1cb071A	<45 µm; 30º/30º; 0.9-25 µm; 0.1-20 nm resolution, Nicolet.
CRB145	RELAB bkr1cb071A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
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CRB145 – transmission measurements for optical constants

CRB145	PSF CRB145_000	Pure KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.000	Pure KBr; i=0°, e=180°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_001	1% 20-25 µm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.001	1% 20-25 µm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_002	0.1% 20-25 µm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.002	0.1% 20-25 µm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_003	1% 45-63 µm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.003	1% 45-63 µm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_004	0.1% 45-63 µm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).

CRB145	PSF 140326b.004	0.1% 45-63 μm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_005	1% 63-75 μm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.005	1% 63-75 μm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_006	0.1% 63-75 μm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.006	0.1% 63-75 μm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_007	1% 106-125 μm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.007	1% 106-125 μm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_008	0.1% 106-125 μm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.008	0.1% 106-125 μm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_009	1% 180-212 μm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.009	1% 180-212 μm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
CRB145	PSF CRB145_010	0.1% 180-212 μm CRB145 in KBr; i=0°, e=180°; 7000-400 cm^{-1}; 2 cm^{-1} resolution; 100 spectra averaged; Bruker Vertex 70 (directory: CRB_145_FTIR_Trans).
CRB145	PSF 140326b.010	0.1% 180-212 μm CRB145 in KBr; i=0°, e=180°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326_CRB145).
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CRB147	RELAB cacb72	<45 μm; 30º/0º; 0.28-2.6 μm; 5nm resolution, RELAB.
CRB147	RELAB bir1cb072A	<45 μm; 30º/30º; 0.9-25 μm; 0.1-20 nm resolution, Nicolet.
CRB147	RELAB bkr1cb072A	<45 μm; 30º/0º/30°; 0.28-25 μm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 μm.
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CRB148	*RELAB cacb73*	*<45 μm; 30º/0º; 0.28-2.6 μm; 5nm resolution, RELAB. Bad spectrum?*
CRB148	*RELAB bir1cb073A*	*<45 μm; 30º/30º; 0.8-25 μm; 0.1-20 nm resolution, Nicolet. Bad spectrum?*
CRB148	*RELAB bkr1cb073A*	*<45 μm; 30º/0º/30°; 0.28-25 μm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 μm. Bad spectrum?*
CRB148	PSF 150211a.003	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 150211carbonates].
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CRB149	PSF 131119a.003	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (Directory: 131119 randoms).
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CRB201	RELAB cacb21	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
CRB201	RELAB lacb21a	<45μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB203	RELAB cacb23	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
CRB203	RELAB lacb23a	<45μm, 30°/0°,30°, 0.3-26μm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB204	RELAB cacb24	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB204	RELAB lacb24a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB205	PSF 090319a.028	whole rock – brownish surface with sparse green serpentine veins rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB205	PSF 090319a.029	whole rock – biggest piece – white "mold" partially covered whole rock surface – spot 1, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB205	PSF 090319a.030	whole rock – biggest piece – white "mold" partially covered whole rock surface – spot 2, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB205	PSF 090319a.031	whole rock – small piece, striated white whole rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
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CRB206	RELAB cacb26	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB206	RELAB cbcb26	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB206	RELAB lacb26a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB206	RELAB lacb26b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB206Bk	RELAB cccb26	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB206Bk	RELAB lacb26c	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB208	PSF 090421a.001	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
CRB208	RELAB cacb28	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB208	RELAB cbcb28	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB208	RELAB lacb28a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB208	RELAB lacb28b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB208	PSF 111201a.047	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CRB208	PSF 111201a.018	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CRB208	INO CRB 208	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
CRB208	PSF crb208m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
CRB208	PSF crb208n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
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CRB208Bk	RELAB cccb28	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB208Bk	RELAB lacb28c	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB209	RELAB cacb29	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB209	RELAB cbcb29	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB209	RELAB lacb29a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB209	RELAB lacb29b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB209Bk	RELAB cccb29	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB209Bk	RELAB lacb29c	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
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CRB210	RELAB cacb30	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB210	RELAB cbcb30	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB210	RELAB lacb30a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB210	RELAB lacb30b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.

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CRB210Bk	RELAB cccb30	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB210Bk	RELAB lacb30c	<45µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB211	RELAB cacb31	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB211	RELAB lacb31a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB211	RELAB cbcb31	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB211	RELAB lacb31b	45-90µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
	+++++++	
CRB211Bk	RELAB cccb31	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB211Bk	RELAB lacb31c	<45µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB212	RELAB cacb32	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB212	RELAB lacb32a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB213	RELAB cacb33	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB213	RELAB cbcb33	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB213	RELAB lacb33a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB213	RELAB lacb33b	45-90µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
	+++++++	
CRB213Bk	RELAB cccb33	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB213Bk	RELAB lacb33c	<45µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
CRB213Bk-b	RELAB cdcb33	<45µm, 30°/0°, 0.3-2.6µm,5 nm.
CRB213Bk-b	RELAB lacb33d	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
++++++		
CRB214	RELAB cacb34	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB214	RELAB cbcb34	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB214	RELAB lacb34a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB214	RELAB lacb34b	45-90µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
	+++++++	
CRB214Bk	RELAB cccb34	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB214Bk	RELAB lacb34c	<45µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
CRB214Bk-b	RELAB cdcb34	<45µm, 30°/0°, 0.3-2.6µm,5 nm.
CRB214Bk-b	RELAB lacb34d	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB215	PSF 090421a.002	<45 µm, 30°/0°, 0.35-2.5 µm,1 nm resol., 1000 avg; ASD.
CRB215	PSF 090421a.018	<45 µm, 30°/0°, 0.35-2.5 µm,1 nm resol., 1000 avg; ASD.
CRB215	RELAB cacb35	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB215	RELAB lacb35a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB215	RELAB cbcb35	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB215	RELAB lacb35b	45-90µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
CRB215	PSF crb215	<45 µm, 35°/0°, 2-16 µm; D&P 102F; 100 spectra averaged.
CRB215	PSF jun0506.008	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
CRB215	PSF acrb215	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
CRB215	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
	+++++++	
CRB215Bk	RELAB cccb35	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB215Bk	RELAB lacb35c	<45µm, 30°/0°,30°, 0.3-26µm,5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB216	RELAB cacb36	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB216	RELAB lacb36a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		

CRB217	RELAB cacb37	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB217	RELAB lacb37a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB217	RELAB cbcb37	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB217	RELAB lacb37b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB218	RELAB cacb38	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB218	RELAB lacb38a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
CRB218	RELAB cbcb38	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB218	RELAB lacb38b	45-90µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB310	RELAB cacb39	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB310	RELAB lacb39a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm; merged RELAB+Nicolet.
+++++++		
CRB312	PSF 090421a.004	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
CRB312	RELAB cacb46	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB312	RELAB bkr1cb046a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.580 µm.
+++++++		
CRB313	RELAB cacb47	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB313	RELAB bkr1cb047a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.545 µm.
+++++++		
CRB314	RELAB cacb48	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB314	RELAB bkr1cb048a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.580 µm.
+++++++		
CRB315	RELAB cacb49	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB315	RELAB bkr1cb049a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.540 µm.
+++++++		
CRB401	RELAB cacb41	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB401	RELAB lacb41a	<45µm, 30°/0°,30°, 0.3-26µm, 5,0.6-129 nm, merged RELAB+Nicolet; note changed viewing geometry.
CRB401	RELAB cbcb41	45-90µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB401	RELAB lacb41b	45-90µm, 30°/0°,30°, 0.3-26µm, 5,0.6-129 nm, merged RELAB+Nicolet; note changed viewing geometry.
+++++++		
CRB501	RELAB cacb51	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB501	RELAB lacb51	<45µm, 30°/0°,30°, 0.3-26µm, 5,0.6-129 nm, merged RELAB+Nicolet; note changed viewing geometry.
+++++++		
CRB502	RELAB cacb52	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB502	RELAB lacb52	<45µm, 30°/0°,30°, 0.3-26µm, 5,0.6-129 nm, merged RELAB+Nicolet; note changed viewing geometry.
+++++++		
CRB503	RELAB cacb53	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB503	RELAB lacb53	<45µm, 30°/0°,30°, 0.3-26µm, 5,0.6-129 nm, merged RELAB+Nicolet; note changed viewing geometry.
+++++++		
CRB504	RELAB cacb54	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB504	RELAB lacb54	<45µm, 30°/0°,30°, 0.3-26µm, 5,0.6-129 nm, merged RELAB+Nicolet; note changed viewing geometry.
+++++++		
CRB505	RELAB cacb55	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB505	RELAB bkr1cb055a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.580 µm.

+++++++		
CRB506	RELAB cacb56	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB506	RELAB bkr1cb056a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.580 µm.
CRB506	PSF pig1307.032	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
+++++++		
CRB507	RELAB cacb57	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB507	RELAB bkr1cb057a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.550 µm.
+++++++		
CRB508	RELAB cacb58	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB508	RELAB bkr1cb058a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.550 µm.
+++++++		
CRB509	RELAB cacb59	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB509	RELAB bkr1cb059a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.570 µm.
+++++++		
CRB510	RELAB cacb60	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB510	RELAB bkr1cb060a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.540 µm.
+++++++		
CRB511	RELAB cacb61	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CRB511	RELAB bkr1cb061a	<45µm, 30°/0°,30°, 0.3-26µm, 5, 1.2-120 nm; merged RELAB+Nicolet at 2.540 µm.
+++++++		
CRB701	RELAB cacb74	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB701	RELAB bir1cb074A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB701	RELAB bkr1cb074A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
CRB701	PSF 130910a.003	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. (Directory: Minerals for Jim).
+++++++		
CRB702	RELAB cacb75	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB702	RELAB bir1cb075A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB702	RELAB bkr1cb075A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
+++++++		
CRB711	PSF 090319a.024	whole rock – fresh host whole rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB711	PSF 090319a.025	whole rock – weathered host whole rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB711	PSF 090319a.026	whole rock – partially caoxite covered rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB711	PSF 090319a.027	whole rock – white “mold” covered area adjacent to caoxite mass whole rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
CRB712	PSF 090319a.022	whole rock – host rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB712	PSF 090319a.023	whole rock – partially weddellite covered rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
CRB713	PSF 090319a.020	whole rock – host rock surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB713	PSF 090319a.021	whole rock – partially whewellite covered rock surface, 30°/0°; 0.35-2.5 µm;

		2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
CRB715	PSF 090313a.006	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB715	RELAB cacb76	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB715	RELAB bir1cb076A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB715	RELAB bkr1cb076A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
CRB715	PSF 130723b.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
CRB715	PSF 130723b.002	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
+++++++		
CRB716	PSF 090313a.007	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB716	PSF 090313a.008	90-1000 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
CRB716	PSF 130723b.009	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
CRB716	PSF 130723b.010	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
+++++++		
CRB717	PSF 130723b.005	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
CRB717	PSF 130723b.006	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
+++++++		
CRB800	PSF 080730a.005	unsorted powder from XRD vial; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CRB800	RELAB cacb77	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB800	RELAB bir1cb077A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB800	RELAB bkr1cb077A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
+++++++		
CRB801	PSF 080730a.006	unsorted powder from XRD vial; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CRB801	RELAB cacb78	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB801	RELAB bir1cb078A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB801	RELAB bkr1cb078A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
+++++++		
CRB802	PSF 080730a.003	unsorted powder from XRD vial; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
+++++++		
CRB803	PSF 080730a.004	unsorted powder from XRD vial; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
+++++++		
CRB804	PSF 080730a.007	unsorted powder from XRD vial; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
+++++++		
CRB-S01	PSF 090731a.001	unsorted; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged, ASD.
CRB-S01	RELAB cacb82	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB-S01	RELAB bir1cb082A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB-S01	RELAB bkr1cb082A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.

CRB-S01	PSF CRB-S01a	unsorted; 2.5-12.5 µm; 0.4 cm^{-1} resolution; Buck spectrometer; 12 minute integration time.
CRB-S01	PSF CRB-S01b	unsorted; 2.5-12.5 µm; 0.4 cm^{-1} resolution; Buck spectrometer; 12 minute integration time (remeasure?).
+++++++		
CRB-S02	PSF 090731a.002	unsorted; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged, ASD.
CRB-S02	RELAB cacb83	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
CRB-S02	RELAB bir1cb083A	<45 µm; 30º/30º; 0.8-25 µm; 0.1-20 nm resolution, Nicolet.
CRB-S02	RELAB bkr1cb083A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
CRB-S02	PSF CRB-S02a	unsorted; 2.5-12.5 µm; 0.4 cm^{-1} resolution; Buck spectrometer; 12 minute integration time.
CRB-S02	PSF CRB-S02b	unsorted; 2.5-12.5 µm; 0.4 cm^{-1} resolution; Buck spectrometer; 12 minute integration time (remeasure?).
+++++++		
OXA015	PSF 141208a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 140208oxalatesulfides].
OXA015	PSF oxa015	<45 µm; 0°/0°; 0.2-0.4 µm usable range; deuterium light; 200 spectra averaged; Maya [Directory: 140208oxalatesulfides].
OXA015	PSF 141208a.003	<45 µm; 30°/0° ASD, 0°/0° Maya; 0.2-2.5 µm; merged Maya + ASD (Maya with UV, ASD with QTH; merged at 399 nm); 200 and 500 spectra averaged [Directory: 140208oxalatesulfides].
+++++++		
OXA016	PSF 141208a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 140208oxalatesulfides].
OXA016	PSF oxa016	<45 µm; 0°/0°; 0.2-0.4 µm usable range; deuterium light; 200 spectra averaged; Maya [Directory: 140208oxalatesulfides].
OXA016	PSF 141208a.002	<45 µm; 30°/0° ASD, 0°/0° Maya; 0.2-2.5 µm; merged Maya + ASD (Maya with UV, ASD with QTH; merged at 399 nm); 200 and 500 spectra averaged [Directory: 140208oxalatesulfides].
+++++++		
OXA018	PSF 141208a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 140208oxalatesulfides].
OXA018	PSF oxa018	<45 µm; 0°/0°; 0.2-0.4 µm usable range; deuterium light; 200 spectra averaged; Maya [Directory: 140208oxalatesulfides].
OXA018	PSF 141208a.001	<45 µm; 30°/0° ASD, 0°/0° Maya; 0.2-2.5 µm; merged Maya + ASD (Maya with UV, ASD with QTH; merged at 399 nm); 200 and 500 spectra averaged [Directory: 140208oxalatesulfides].
+++++++		
OXA019	PSF 141208a.004	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 140208oxalatesulfides].
OXA019	PSF oxa019	<45 µm; 0°/0°; 0.2-0.4 µm usable range; deuterium light; 200 spectra averaged; Maya [Directory: 140208oxalatesulfides].
OXA019	PSF 141208a.004	<45 µm; 30°/0° ASD, 0°/0° Maya; 0.2-2.5 µm; merged Maya + ASD (Maya with UV, ASD with QTH; merged at 399 nm); 200 and 500 spectra averaged [Directory: 140208oxalatesulfides].
+++++++		
PIG004	RELAB caec04	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG004	RELAB laec04	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG004	PSF 080708.pig004	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics S2000.
PIG004	PSF 130910a.004	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. (Directory: Minerals for Jim).
+++++++		

PIG009	RELAB caec09	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG009	RELAB laec09	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
PIG024	RELAB c1ec12	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG024	RELAB bkr1ec012	<45µm, 30°/0°,30°, 0.3-26µm,5, 1.2-120 nm; merged RELAB+Nicolet at 2.550 µm.
+++++++		
PIG204	RELAB c1ec14	<45 µm, 30°/0°, 0.3-2.6 µm, 5 nm.
PIG204	RELAB bmr1ec014	<45 µm, 30°/30°, 1.67-25 µm,0.6-129 nm.
PIG204	RELAB bkr1ec014	<45 µm, 30°/0°,30°, 0.3-25 µm, 5,0.6-129; merged RELAB+Nicolet at 1.8 µm, note change in viewing geometry.
PIG204	PSF 090313a.016	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
SYN009	PSF syn009	<45 µm, 35°/0°, 2-16 µm; D&P 102F; 100 spectra averaged; smoothed.
SYN009	PSF syn009nosm	<45 µm, 35°/0°, 2-16 µm; D&P 102F; 100 spectra averaged; not smoothed.
SYN009	RELAB cacb79	<45 µm; 30º/0º; 0.28-2.6 µm; 5nm resolution, RELAB.
SYN009	RELAB bir1cb079A	<45 µm; 30º/30º; 0.8-25 µm;0.1-20 nm resolution, Nicolet.
SYN009	RELAB bkr1cb079A	<45 µm; 30º/0º/30°; 0.28-25 µm; 5, 0.1-20 nm resolution; merged RELAB+Nicolet at 1.8 µm.
+++++++		

NOTE: Some of the spectra were measured with the following detectors at RELAB: PbSe (0.9-3.2µm), and DTGS (mid-IR; 1.8-26µm). The reason is that there is a mismatch between RELAB and mid-IR spectra due to non-linearity, etc. of DTGS. ++

6. Hydroxides

6a. Sample Descriptions - Hydroxides

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
OOH001	Bauxite: Guyana (Minerals Unlimited). Lots of sample; made <45 and 45-90µm fractions (dry sieve). Sample is predominantly gibbsite.
OOH002	Bauxite: Pulaski County, Arkansas, USA (Minerals Unlimited). Lots of sample, made <45 and 45-90µm fractions (dry sieve). Sample is predominantly gibbsite.
OOH003	Goethite: Cary Mine, Ironwood, Gogebic County, Michigan, USA; with hematite stain ["-FeO·OH] (Minerals Unlimited). Lots of sample [DHZ: yellowish-brown to red]. Lots of sample, made <45 and 45-90µm fractions (dry sieve).
OOH004	Gibbsite: Minas Gerais, Brazil (Minerals Unlimited) [$Al(OH)_3$] (Minerals Unlimited). A couple of grams (DHZ: white, pale pink, pale green, grey, light brown; MU: white, compact radial fibrous masses). Couple of grams of <45 and 45-90µm made (dry sieve) made.
OOH005	Böhmite: Picheney et Cie Mines, Les Baux, Bouche du Rhone, Provence, France; with minor mixture of other aluminum and iron oxides [(-AlO(OH)] (Minerals Unlimited) some sample. (DHZ: white when pure; MU: red to cream earthy masses). Lots of sample, lots of <45 and 45-90µm made (dry sieve).
OOH006	Manganite: Atikokan, Ontario, Canada [MnO·OH] (Minerals Unlimited). Lots of sample. [S&S: black striated crystals, commonly twinned]. Some <45 and 45-90µm made (dry sieve).
OOH007	Diaspore: Donally Mine, near Thorne, Mineral County, Nevada, USA; with pyrophyllite ["-AlO(OH)] (Minerals Unlimited). (MU: light grey-brown crystalline with assoc.; DHZ: white, white-grey or colourless; pyrophyllite: many colours, pearly). Tons of sample, lots of <45 and 45-90µm made (dry sieve).
OOH008	"Diaspore": Chinese bauxite, high-diaspore, with minor anatase, quartz, kaolinite, and 1% hematite (Alcan Aluminum, #4080). Partially precrushed; made lots of 45-90µm and <45µm fractions (dry sieve).
OOH009	"Diaspore": Chinese bauxite, high-diaspore, with minor anatase, quartz, kaolinite, and 1% hematite (Alcan Aluminum, #4086). Partially precrushed; made lots of 45-90µm and <45µm fractions (dry sieve).
OOH010	"Diaspore": Greek bauxite, high-diaspore, with some boehmite and hematite, and smaller amounts of anatase, quartz, kaolinite, and calcite, and probably traces of goethite and gibbsite (hydrargillite) (Alcan Aluminum, #30941-K). Partially precrushed; made lots of 45-90µm and <45µm fractions (dry sieve).
OOH011	Diaspore (manganoan): Postmasburg, Orange Free State, South Africa (Smithsonian Institution National Museum of Natural History MNMH #140594) (dry sieve).
OOH012	Diaspore: Chester, Hampton County, Massachusetts, USA (Smithsonian Institution National Museum of Natural History MNMH #81900-1). Made lots of <45 and 45-90µm fractions (dry sieve).
OOH013	Diaspore: Crestmore, Riverside County, California, USA (Smithsonian Institution National Museum of Natural History MNMH #140597). Made lots of <45 and 45-90µm fractions (dry sieve).
OOH014	Manganite: Caland Pit, Atikokan, Ontario, Canada [MnO·OH] (Tyson's Fine Minerals).
OOH020	Goethite: Ore Hill, Salisbury Hill, Salisbury, CT, USA (crystals) [Mostly Micros: Jason G. Clark Coll. #1564; Tucson 2011 show].
OOH021	Goethite/limonite: Mesabi Iron Range, Chisholm/Hibbing, Minnesota, USA [Mostly Micros, Jason G. Clark Coll. – Coll. 1960 #1573; Tucson 2011 show].
OOH022	Brucite: Texas, Lancaster Co., PA, USA (crystallized plate) ["The Williams' Mineral Cabinet of Peru, Nebr."; Lehigh Minerals, Tucson 2011 show].

OOH030 Sodium hydroxide [NaOH], synthetic, EMD Chemicals (NaOH); from Department of Geography supply (Dec. 08).
OOH031 Potassium hydroxide [KOH], synthetic. Mallinckrodt #6984-03, analytical reagent (pellets); from Department of Geography supply (Jan. 09).
OOH032 Magnesium hydroxide [$Mg(OH)_2$] (synthetic brucite), synthetic, 95-100.5%. Alfa Aesar stock #12367 or L13949, lot #E21T031, CAS #1309-42-8; 100 grams (synthetic brucite)
OOH033 Sodium hydroxide [NaOH) (synthetic); UW Chemistry stores? (same as OOH030?).
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PIG001 Synthetic gibbsite. See Pigments section (for pigments project). *See section 19 of this document for data.*
PIG018 Iron (III) oxide, hydrated (FeO(OH)). Synthetic version of goethite. *See Pigments section (for pigments project). See section 19 of this document for data.*
PIG202 Calcium hydroxide: $Ca(OH)_2$. Synthetic: Sigma Aldrich #23-923-2 (100 g), 95%+. *Context: Ann Massing - unknown application but art related.* Corrosive, causes burns. *See section 19 of this document for data.*
PIG332 Goethite, brown ochre (catalog no. 460-50B). 100 grams. (red/orange group). *See section 19 of this document for data.*
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WS08 Winnipeg snow, collected at -22°C, January 2008.
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6b. XRD Data - Hydroxides

6.b.1. XRD of samples from Alcan International provided in analogue form.

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6c. Compositional data - Hydroxides

6c.1. Compositional Data - Hydroxides: Data from Alcan International

Thermogravimetric analysis (TGA) curves - all samples (Alcan International)
Differential scanning calorimetry (DSC) curves - all samples (Alcan International)
Infrared transmission spectra - all samples (Alcan International)
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6c.2. Compositional Data - Hydroxides: Mineralogical Analysis

Sample	*Phases Present*
OOH008	82-88% diaspore, ~4% quartz, ~4% kaolinite, ~4% anatase (TiO_2), <1% others, including hematite.
OOH009	82-88% diaspore, ~4% quartz, ~4% kaolinite, ~4% anatase (TiO_2), <1% others, including hematite.
OOH010	71-76% diaspore and boehmite, 12-15% hematite, ~3% anatase, ~2% quartz, ~4% kaolinite, ~2% calcite, traces of gibbsite and goethite, <1% other minerals.

Mineralogical data provided by Alcan International.
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6c. Compositional Data - Hydroxides

Wt. %	OOH001	OOH002	OOH003	OOH003	OOH004	OOH005	OOH006	OOH007
Al_2O_3	58.56	50.81	1.22	0.47	57.04	47.79	0.75	46.84
Fe_2O_3*	0.54	7.55	89.29	96.17	0.08	16.00	0.03	0.13
FeO				0.43				
SiO_2	1.83	4.25	1.40	1.02	0.47	19.38	0.31	37.29
TiO_2	1.99	2.08	0.07	0.04	0.03	2.08	0.32	0.94
CuO	0.01	0.01	0.01		0.02	0.02	0.06	0.03
MgO	0.02	0.06	0.19	0.89	0.02	0.02	0.06	0.03
CaO	0.05	0.15	0.06	0.07	0.05	0.21	0.24	0.09
MnO	0.003	0.12	0.21	0.23	0.02	0.10	79.13	0.02
NiO_2	0.002	0.003	0.01		0.005	0.02	0.09	0.01
V_2O_5	0.02	0.05	0.004		0.001	0.05	0.00	0.04
ZnO	0.01	0.01	0.03		0.01	0.03	0.05	0.02
ZrO_2	0.16	0.22	0.002		0.002	0.08	0.01	0.02
Na_2O	0.34	0.25	0.48	0.00	0.00	0.80	0.82	0.59
K_2O				0.02				
P_2O_5				0.61				
TOTAL[a]				99.95				
LOI[b]				10.36				
LOI[c]		30.7	9.8	10.36				
LOI[d]	31.0	26.9	10.0		30.2	10.2	18.9	8.3
LOI[d]	Gi	Gi	Go		Gi	Bo+Go	Ma	Di
TOTAL[e]	94.535	96.263/ 92.463	102.776/ 102.976	99.95	87.948	96.78	100.77	94.35
			ICP-AES Elemental analyses(wt.%); ppm for Mertzman data					
Al	31.0	26.9	0.647		30.2	25.3	0.395	24.8
Cu	0.00931	0.00994	0.00578		0.0176	0.0194	0.0485	0.0259
Fe	0.3760	5.2828	82.5000		0.0534	11.2	0.0215	0.0909
Mg[f]	0.0121	0.0384	0.108		0.0110	0.0385	0.0572	0.0111
Mn	0.00238	0.0919	0.1660		0.0176	0.0767	61.3	0.0150
Ni	0.00135	0.00205	0.00766		0.00324	0.0148	0.0581	0.0057
Si	0.8530	1.9842	0.6550		0.2210	9.0416	0.147	17.4
Ti	1.1921	1.2499	0.0432		0.0160	1.2476	0.00303	0.562
V	0.0112	0.0265	0.00199	45	0.000709	0.0290	n.d.	0.0211
Zn	0.0110	0.0113	0.0235		0.00974	0.0202	0.0436	0.0163
Zr	0.1190	0.1650	0.00168	15	0.00169	0.0613	0.00045	0.0166
Ca	0.0345	0.1080	0.0408		0.0364	0.148	0.169	0.0623
Na[f]	0.147	0.0977	0.348		n.d.	0.338	0.366	0.472
Sr				5				
Cr				5				
Diss.	clear	clear	clear		clear	clear	clear	clear
Source	Alcan	Alcan	Alcan	Mertzman	Alcan	Alcan	Alcan	Alcan
Analysis	ICP-AES	ICP-AES	ICP-AES	XRF/WC	ICP-AES	ICP-AES	ICP-AES	ICP-AES

* - all Fe assumed as Fe_2O_3 for Alcan data. n.d. - not determined.

[a] Total expressed on a volatile free basis. [b]: LOI: Loss on ignition represents weight loss after heating sample in air. [c] LOI[c] = measured loss on ignition: 25-1000°C (wt. %) (from Alcan International). [d] LOI[d] = calculated loss on ignition based on the following scenarios: Gi = all Al_2O_3 as gibbsite; Go = all Fe_2O_3 as goethite; Bo = all Al_2O_3 as boehmite; Di = all Al_2O_3 as diaspore; Ma = all MnO as manganite; Di+Go = all Al_2O_3 as diaspore and all Fe_2O_3 as goethite; Bo+Go = all Al_2O_3 as boehmite and all Fe_2O_3 as goethite (from Alcan International). [e] Total includes LOI (from Alcan International). Includes duplicate analyses for OOH002 and OOH003. [f] Mg and Na are average of low and high values obtained. Source Mertzman indicates analysis by XRF and ferrous iron by wet chemistry by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Totals are expressed on a volatile (LOI)-free basis and all Fe as Fe_2O_3. ICP-AES = Inductively coupled plasma atomic emission spectroscopy. Diss. = notes on appearance of solution during dissolution (from Alcan International).++++++++++++++++++++++++

6c. Compositional Data - Hydroxides (continued)

Wt. %	OOH008	OOH009	OOH010	OOH011	OOH012	OOH013
NMNH#				140594	81900-1	140597
Alcan #	4080	4086	30941-K			
Al_2O_3	70.27	73.86	56.10	83.68	81.22	83.87
Fe_2O_3	0.27	1.15	18.71	0.12	0.62	0.49
SiO_2	7.02	2.69	3.47	0.19	0.28	0.08
TiO_2	5.47	3.74	2.65	0.01	0.15	0.08
CuO	0.02	0.02	0.01	0.05	0.06	0.07
MgO	0.07	0.05	0.13	0.02	0.04	0.06
CaO	0.08	0.08	1.81	0.04	0.90	0.06
MnO	0.01	0.001	0.08	0.15	0.01	0.02
NiO_2	0.01	0.01	0.08	0.02	0.01	0.01
V_2O_5	0.05	0.06	0.10	0.001	0.02	0.02
ZnO	0.03	0.02	0.01	0.02	0.01	0.02
ZrO_2	0.26	0.25	0.07	0.002	0.003	0.001
Na_2O	1.21	0.54	0.82	0.47	1.10	0.46
LOI[a]	12.4	13.0	9.9/12.0	14.8	14.3	14.8
LOI[b]	Di	Di	Di/Di+Bo	Di	Di	Di
TOTAL[c]	97.17	95.471 96.04	93.94/	99.573	98.723	100.041
			ICP-AES Elemental analyses (wt.%)			
Al	37.2	39.1	29.7	44.3	44.5	44.4
Cu	0.0132	0.0182	0.00678	0.0365	0.0495	0.0523
Fe	0.187	0.806	12.8	0.0809	0.423	0.344
Mg[d]	0.0433	0.0365	0.0711	0.00981	0.0123	0.0355
Mn	0.00728	0.000548	0.0177	0.116	0.0207	0.0133
Ni	0.00718	0.00524	0.0544	0.0130	0.00292	0.00469
Si	3.2775	1.2565	1.5311	0.0885	0.0393	0.0364
Ti	2.7323	2.2441	1.5876	0.00724	0.0890	0.0485
V	0.0277	0.0341	0.0537	0.000497	0.00863	0.0128
Zn	0.0202	0.0187	0.0344	0.0177	0.0135	0.0147
Zr	0.190	0.185	0.0560	0.00143	0.000973	0.000475
Ca	0.0546	0.0537	1.0081	0.0301	0.0445	0.0434
Na[d]	0.773	0.294	0.3025	0.3655	0.3065	0.460
Diss.	clear	clear	coarse	clear	clear	clear
Source	Alcan	Alcan	Alcan	Alcan	Alcan	Alcan
Analysis	ICP-ASE	ICP-AES	ICP-AES	ICP-AES	ICP-AES	ICP-AES
Al_2O_3[e]	70-75	70-75	60-65			
LOI[e]	12-14	12-14	11-13			

NMNH#: sample ID for samples from the Smithsonian Institution National Museum of Natural History. Alcan#: sample ID for samples from Alcan International.

[a] LOI[a] = measured loss on ignition from 100 to 1000°C (wt. %) (from Alcan International); mostly bound water and CO_2.

[b] LOI[b] = calculated loss on ignition based on the following scenarios: Gi = all Al_2O_3 as gibbsite; Go = all Fe_2O_3 as goethite; Bo = all Al_2O_3 as boehmite; Di = all Al_2O_3 as diaspore; Ma = all MnO as manganite; Di+Go = all Al_2O_3 as diaspore and all Fe_2O_3 as goethite; Bo+Go = all Al_2O_3 as boehmite and all Fe_2O_3 as goethite (from Alcan International).).

[c] Total includes LOI (from Alcan International). Includes duplicate analyses for OOH010.

[d] Mg and Na are average of low and high values obtained.

[e] Range for multiple samples from these deposits (from Alcan International).

ICP-AES = Inductively coupled plasma atomic emission spectroscopy. Diss. = notes on appearance of solution during dissolution (from Alcan International).

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6d. Spectral Data - Hydroxides

SAMPLE	FACILITY/FILE NO.	DESCRIPTION
OOH001	RELAB CAHO01	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH001	RELAB LAHO01A	<45µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH001	RELAB CBHO01	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH001	RELAB LAHO01B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH001	Alcan 3550701	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH002	RELAB CAHO02	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH002	RELAB LAHO02A	<45µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH002	RELAB CBHO02	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH002	RELAB LAHO02B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH002	Alcan 3550702	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH003	RELAB CAHO03	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH003	RELAB LAHO03A	<45µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH003	RELAB CBHO03	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH003	RELAB LAHO03B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH003	PSF 050707ooh003	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
OOH003	PSF 120707ooh003	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
OOH003	PSF ooh003	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
OOH003	PSF 071212a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
OOH003	PSF jun0506.009	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
OOH003	PSF aooh003	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
OOH003	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
OOH003	Alcan 3550703	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH004	RELAB CAHO04	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH004	RELAB LAHO04A	<45µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH004	RELAB CBHO04	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH004	RELAB LAHO04B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH004	PSF pig1307.037	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
OOH004	Alcan 3550704	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH005	RELAB CAHO05	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH005	RELAB LAHO05A	<45µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH005	RELAB CBHO05	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH005	RELAB LAHO05B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH005	Alcan 3550705	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		

OOH006	RELAB CAHO06	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH006	RELAB LAHO06A	<45µm, 30°/0°,30°; 0.32-26µm,5, 0.6-129 nm; merged RELAB + Nicolet.
OOH006	RELAB CBHO06	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH006	RELAB LAHO06B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH006	Alcan 3550706	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH007	RELAB CAHO07	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH007	RELAB LAHO07A	<45µm, 30°/0°,30°; 0.32-26µm,5, 0.6-129 nm; merged RELAB + Nicolet.
OOH007	RELAB CBHO03	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH007	RELAB LAHO03B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH007	Alcan 3550707	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH008	RELAB CAHO08	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH008	RELAB LAHO08A	<45µm, 30°/0°,30°; 0.32-26µm,5, 0.6-129 nm; merged RELAB + Nicolet.
OOH008	RELAB CBHO08	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH008	RELAB LAHO08B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH008	RELAB kaho08c	<5µm, 30°/30°; 0.9-26µm; 0.3-129 nm; Nicolet, dry sieve.
OOH008	Alcan 357172	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH009	RELAB CAHO09	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH009	RELAB LAHO09A	<45µm, 30°/0°,30°; 0.32-26µm,5, 0.6-129 nm; merged RELAB + Nicolet.
OOH009	RELAB CBHO09	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH009	RELAB LAHO09B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH009	RELAB kaho09c	<5µm, 30°/30°; 0.9-26µm; 0.3-129 nm; Nicolet, wet sieve.
OOH009	Alcan 357173	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH010	RELAB CAHO10	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH010	RELAB LAHO10A	<45µm, 30°/0°,30°; 0.32-26µm,5, 0.6-129 nm; merged RELAB + Nicolet.
OOH010	RELAB CBHO10	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH010	RELAB LAHO10B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH010	Alcan 357171	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH011	RELAB CAHO11	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH011	RELAB LAHO11A	<45µm, 30°/0°,30°; 0.32-26µm,5, 0.6-129 nm; merged RELAB + Nicolet.
OOH011	RELAB CBHO11	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH011	RELAB LAHO11B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH011	Alcan 3550708	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH012	RELAB CAHO12	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH012	RELAB LAHO12A	<45µm, 30°/0°,30°; 0.32-26µm,5, 0.6-129 nm; merged RELAB + Nicolet.
OOH012	RELAB CBHO12	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH012	RELAB LAHO12B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH012	RELAB kaho12c	<5µm, 30°/30°; 0.9-26µm; 0.3-129 nm; Nicolet, wet sieve.
OOH012	PSF jun0506.006	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
OOH012	PSF aooh012	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4

		without sapphire window (Directory: jun0506inairnw).
OOH012	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
OOH012	Alcan 3550709	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH013	RELAB CAHO13	<45µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH013	RELAB LAHO13A	<45µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH013	RELAB CBHO13	45-90µm, 30E/0E, 0.32-2.55µm, 5 nm.
OOH013	RELAB LAHO13B	45-90µm, 30°/0°,30°; 0.32-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet.
OOH013	RELAB kaho13c	<5µm, 30°/30°; 0.9-26µm; 0.3-129 nm; Nicolet, wet sieve.
OOH013	Alcan 3550710	unsorted; 400-4000 cm^{-1} transmission spectrum.
+++++++		
OOH022	PSF 130409a.001	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output.; 500 spectra averaged; ASD (directory: 130409_brucite).
+++++++		
OOH030	PSF 081222a.040	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
OOH030	PSF 090313a.009	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
OOH030	PSF 090313a.010	90-1000 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
OOH031	PSF 090313a.011	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
OOH031	PSF 090313a.012	90-1000 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra 3averaged; ASD.
OOH031	*PSF 090127a.002*	*<45 µm, 30°/0°, 0.35-2.5 µm,1 nm output, 1000 averaged, ASD. Probably not properly calibrated.*
+++++++		
OOH032	PSF 090313a.013	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
OOH032	PSF 100413a.021	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
+++++++		
PIG018	PSF 130910a.018	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
+++++++		
PIG202	*PSF 090127a.001*	*<45 µm, 30°/0°, 0.35-2.5 µm,1 nm output, 1000 averaged, ASD. Probably not properly calibrated.*
PIG202	PSF 090313a.015	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
WS08	PSF 080124a.004	unsorted; fresh snow (-22°C); measured immediately after collection in cooled, black krylon paint coated 2" diameter Al sample disk container; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.005	unsorted; fresh snow (-22°C); measured 30 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.006	unsorted; fresh snow (-22°C); measured 60 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.007	unsorted; fresh snow (-22°C); measured 90 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.008	unsorted; fresh snow (-22°C); measured 120 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra

averaged; ASD spectra.

WS08	PSF 080124a.009	unsorted; fresh snow (-22°C); measured 150 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.010	unsorted; fresh snow (-22°C); measured 180 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.011	unsorted; fresh snow (-22°C); measured 210 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.012	unsorted; fresh snow (-22°C); measured 240 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.013	unsorted; fresh snow (-22°C); measured 270 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.014	unsorted; fresh snow (-22°C); measured 300 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.015	unsorted; fresh snow (-22°C); measured 330 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.
WS08	PSF 080124a.016	unsorted; fresh snow (-22°C); measured 360 seconds after collection of 080124a.004; 30°/0°; 0.35-2.5 µm; 1 nm resolution; 200 spectra averaged; ASD spectra.

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6d. Hydroxides – Spectral data – from RELAB archival data base

Akaganeite	RELAB c1jb48	powder, c1jb48; i=30°, e=0°; 0.3-2.6 µm; RELAB.
Maghemite	RELAB c1jb43	powder, c1jb43; i=30°, e=0°; 0.3-2.6 µm; RELAB.
Lepidocrocite-H	RELAB c1jb49	powder, c1jb49; i=30°, e=0°; 0.3-2.6 µm; RELAB.
Lepidocrocite-DS	RELAB c1jb50	powder, c1jb50; i=30°, e=0°; 0.3-2.6 µm; RELAB.
Lepidocrocite-1	RELAB c1jb41	<125 µm, c1jb41; i=30°, e=0°; 0.3-2.6 µm; RELAB.
Lepidocrocite-2	RELAB c1jb56	<125 µm, c1jb56; i=30°, e=0°; 0.3-2.6 µm; RELAB.
Feroxyhite	RELAB c1jb52	powder, c1jb52; i=30°, e=0°; 0.3-2.6 µm; RELAB.
Ferrihydrite	RELAB c1jb45	powder, c1jb45; i=30°, e=0°; 0.3-2.6 µm; RELAB.
Ferrihydrite-syn	RELAB c1jb46	<45 µm. Synthetic powder, c1jb46; i=30°, e=0°; 0.3-2.6 µm; RELAB.

++

END of 6.

7. Bromides, Chlorides, Fluorides, Perchlorates

7a. Sample Descriptions - Bromides, Chlorides, Fluorides, Perchlorates

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID *Description*

7a.1. Bromides

SYN005 Potassium bromide (KBr), synthetic; Spectrograde powder, 100 grams. International Crystal Labs, part #0011-4540, cas # 7758-02-3. For KBr infrared disks.

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7a.2. Chlorides

ART005 Calcium chloride dihydrateCS 99+%; synthetic (Sigma-Aldrich #223506; 25 grams).

CHL101 Sal-ammoniac: (NH_4Cl), Paricutin Volcano, Michoacan, Mexico; on rock (Minerals Unlimited). Dry sieved to <45 and 45-90µm sizes; a few grams of sample still left. *(See also "Ammonium-bearing minerals").*

CHL102 Ammonium chloride: (NH_4Cl); synthetic (Fisher Scientific) 99.99% purity. Crushed and dry sieved to <45 and 45-90µm grain sizes. *(See also "Ammonium-bearing minerals").*

CHL103 Paratacamite: Mason Pass, Lyon County, Nevada, USA ($Cu_2^{+2}(OH)_3Cl$) (Minerals Unlimited) *(for pigments project - green).*

CHL104 Atacamite: Chiquicamata, Chile ($Cu_2^{+2}(OH)_3Cl$) (Minerals Unlimited) *(for pigments project - green).*

CHL105 Atacamite: San Manuel, Arizona, USA ($Cu_2^{+2}(OH)_3Cl$) (Smithsonian Institution MNMH #154535) *(for pigments project - green).*

CHL106 Paratacamite: Chiquicamata, Chile ($Cu_2^{+2}(OH)_3Cl$) (Smithsonian Institution MNMH #B8667) *(for pigments project - green).*

CHL107 Atacamite: Atacama, Chile ($Cu_2^{+2}(OH)_3Cl$) (Smithsonian Institution MNMH #17691) *(for pigments project - green).*

CHL108 Sylvite: Heringen-Werra, Thuringia, Germany (KCl). (Minerals Unlimited). *(Possible evaporation product on Mars: Morse and Marion article).*

CHL109 Sodium chloride [NaCl] (synthetic); UW Chemistry stores?

CHL110 Ammonium chloride [NH_4Cl] (synthetic); UW Chemistry stores?

CHL111 Potassium chloride [KCl] (synthetic); UW Chemistry stores?

CHL112 Halite (sodium chloride), natural blue; caused by deformation of crystal lattice; Klodawa Salt Mine, Poland (December 2012 AGU Fall Meeting, purchased from Ikon Mining and Exploration).

LAW101 Lawrencite: synthetic $FeCl_2$ (ESPI Corp., #K2870R). Sample left.

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7a.3. Fluorides

FLU101 Fluorite (CaF_2): Unknown locality (self-collected).

FLU102 Fluorite (CaF_2); unknown locality (display specimen from Tyson's), with galena (GAL101).

SYN004 Magnesium fluoride (MgF_2), synthetic; random crystals, 99.99+ % optical grade. Aldrich #378836, 5 grams. *Possible reflectance standard.*

SYN012 Synthetic calcium fluoride (CaF_2). Alfa Aesar Puratronic, 99.9925% (metals basis). Stock #10681, lot

#22912, CAS #7789-75-5; 10 grams; powder. *Possible reflectance standard.*

SYN013 Synthetic barium fluoride (BaF_2). Alfa Aesar Puratronic, 99.99% (metals basis). Stock #10647, lot #20932, CAS #7787-32-8; 25 grams; powder. *Possible reflectance standard.*

SYN014 Synthetic magnesium fluoride (MgF_2). Alfa Aesar Puratronic, 99.99% (metals basis). Stock #40755, lot #21361, CAS #7783-40-6; 10 grams; powder. *Possible reflectance standard.*

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7a.4. Perchlorates

PRC001 Iron (II) perchlorate hydrate, synthetic, reagent grade [$Fe(ClO_4)_2 \cdot xH_2O$]; Alfa Aesar Stock #11646; Lot #G22T013; CAS #335159-18-7; 100 g.

PRC002 Iron (III) perchlorate hydrate, synthetic, reagent grade [$Fe(ClO_4)_3 \cdot xH_2O$]; Alfa Aesar Stock #11647; Lot #E06T051; CAS #13537-24-1; 100 g.

PRC003 Magnesium perchlorate, anhydrous, ACS [$Mg(ClO_4)_2$]; Alfa Aesar Stock #11636; Lot #H06T011; CAS #20034-81-8; 100 g.

PRC004 Calcium perchlorate hydrate, reagent grade, crystalline [$Ca(ClO_4)_2 \cdot xH_2O$]. Alfa Aesar 11655; Lot: J12W027; CAS: 13477-36-6; EINECS: 236-768-0; 250 grams; received January 6, 2014.

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7a.5. Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

hand sample4	**Fluorite	ActLabs

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7b. XRD Data - Bromides, Chlorides, Fluorides, Perchlorates

CHL101 XRD shows only sal-ammoniac (measured at U of Manitoba, May-June 1999; file: chl101.rep).
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7c. Compositional Data - Bromides, Chlorides, Fluorides, Perchlorates (continued)

Wt.%	CHL101	CHL102
SiO_2	0.16	0.00
TiO_2	0.00	0.00
Al_2O_3	0.25	0.00
*(Fe_2O_3)**	*(0.22)*	*(0.04)*
FeO	0	0
Fe_2O_3	0.22	0.04
MnO	0.013	0.006
MgO	0.00	0.00
CaO	0.11	0.01
Na_2O	0.04	0.00
K_2O	0.041	0.000
P_2O_5	0.009	0.008
SO_3[a]	0.090	0.090
Cl	40.317	49.556
TOTAL	41.249	49.711
LOI	99.09	99.93
ppm		
Rb	65	<1
Sr	3	3
Zr	14	14
V	<2	<2
Ni	45	<2
Cr	<2	<2
Co	2	<2
Wt.%^		
N	25.09	25.14
C	0.18	0.12
S	0	0
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

^ - N, C, and S determined using a light element analyzer. Due to the small amount of sample used, there may be issues of sample heterogeneity and representativeness.

A - SO_3 content may represent a minimum value due to heating of the sample twice.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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7c. Compositional Data - Bromides, Chlorides, Fluorides, Perchlorates (continued)

Wt.%	CHL101	CHL102	CHL103	CHL104
Cl				
N				
H				
TOTAL				0.00
LOI				26.17
Source				Mertzman
Analysis				XRF/WC

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

[a] LOI represents weight loss after heating sample to 950°C.

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7d. Spectral Data - Bromides, Chlorides, Fluorides, Perchlorates – Spectral Files (alphabetical order)

Sample	*Facility/File No.*	*Description*
CHL101	RELAB cacl50	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
CHL101	RELAB lacl50	<45µm, 30°/0°,30°; 0.3-26µm, 5,0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
CHL101	RELAB cbcl50	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
CHL101	RELAB lacl50b	45-90µm, 30°/0°,30°; 0.3-26µm,5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
+++++++		
CHL102	RELAB cacl49	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
CHL102	RELAB cbcl49	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
CHL102	RELAB lacl49b	45-90µm, 30°/0°,30°; 0.3-26µm,5, 0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
+++++++		
CHL103	RELAB cacl51	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
CHL103	RELAB lacl51	<45µm, 30°/0°,30°; 0.3-26µm, 5,0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
+++++++		
CHL104	RELAB cacl52	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
CHL104	RELAB lacl52	<45µm, 30°/0°,30°; 0.3-26µm, 5,0.6-129 nm; merged RELAB + Nicolet; note change in viewing geometry at 2.5µm.
CHL104	PSF 111201a.020	whole rock – blue spot; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CHL104	PSF 111201a.021	whole rock – black spot; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CHL104	PSF 111201a.022	whole rock – brown spot, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
CHL104	INO chl104	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 1 spectrum acquired.
+++++++		
CHL105	PSF pig1307.040	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD (aka pig1311).
+++++++		
CHL112	PSF 130723b.003	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
CHL112	PSF 130723b.004	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
+++++++		
LAW101	RELAB calw01	<120 nm, 30°/0°, 0.3-2.6µm, 5 nm.
	RELAB lalw01	*spectrum not measured; sample melted under light beam.*
+++++++		
PRC001	PSF 090313a.017	<1 mm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
PRC001	PSF 091026 prc001	<1000 µm; 0°/0° (bifurcated fibres); 0.2-0.4 µm; ~0.3 nm resolution; 100 averaged; Ocean Optics S2000.
+++++++		
PRC002	PSF 090313a.018	<1 mm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
PRC002	PSF 091026 prc002	<1000 µm; 0°/0° (bifurcated fibres); 0.2-0.4 µm; ~0.3 nm resolution; 100 averaged; Ocean Optics S2000.
+++++++		
PRC003	PSF 090313a.019	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
PRC003	PSF 091026 prc003	>45 µm; 0°/0° (bifurcated fibres); 0.2-0.4 µm; ~0.3 nm resolution; 100

		averaged; Ocean Optics S2000.
PRC003	PSF 090313a.020	90-1000 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
PRC003	PSF 111201a.048	unsorted; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
PRC003	INO prc003	unsorted; i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 1 spectrum acquired.
++++++++		
SYN014	PSF syn014	unsorted powder; *Measured with deuterium and QTH lamps – usable range (200-~400 nm for deuterium; ~400-1130 nm for QTH) spectra merged at 400 nm; bifurcated cable (i=e=0°); ~0.4 nm sampling interval, ~1.85 nm spectral resolution; 600 msec integration time; 200 spectra averaged (Directory: 130927pah uv reflectance)*

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END of 7.

8. Sulfates

8a. Sample Descriptions - Sulphates

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
CRB221	Gypsum: White Sands, NM, USA. Location: southern edge of dune field, next to state highway 70. Received (~500 grams) from Anna Szynkiewicz, Geological Sciences, UTEP, El Paso, TX, USA, August 2011. **Why did I label it CRB?**
PIG002	Synthetic anhydrite (Calcium sulphate ($CaSO_4$). (*also for pigments project). See section 19 of this document for data.*
PIG003	Synthetic barite (Barium sulphate ($BaSO_4$). Aldrich 24,335-3: 100 grams (99% purity) *(also for pigments project). See section 19 of this document for data.*
PIG005	Synthetic gypsum (Calcium sulphate dihydrate $CaSO_4 \cdot 2H_2O$) *(also for pigments project). See section 19 of this document for data.*
PIG021	Synthetic anglesite (Lead (II) sulphate) *(also for pigments project). See section 19 of this document for data.*
PIG203	Synthetic aluminum sulfate: $Al_2(SO_4)_3 \cdot XH_2O$ (X=14-18). Synthetic: Alfa Aesar #36294) lot K15L39), 98-102%, 250 g. Alunogen synthetic *(see Bishop (LPSC 30; possible Martian surface material).* Irritates skin and eyes. *See section 19 of this document for data.*
PIG205	Synthetic sodium sulfate decahydrate: $Na_2SO_4 \cdot 10H_2O$. Synthetic: Aldrich #403008 - batch 04031KO. 99+%. Synthetic mirabilite *(Morse and Marion, American Journal of Science, possible Martian surface material from modelling). See section 19 of this document for data.*
PIG206	Synthetic barium sulfate (barite; $BaSO_4$). Alfa Aesar Puratronic grade: 99.998% metals basis. CAS #7727-43-7; Stock #10651-14, lot #S20736; 25 grams.
PIG222	Synthetic magnesium sulphate, anhydrous, 99.5% min. Alfa Aesar: stock #33337; CAS #7487-88-9; lot #D14T066; 500 grams.
PIG304	Yellow jarosite (catalog no. 430-17S). 100 grams. (white/yellow/orange group). *See section 19 of this document for data.*
PIG305	Jarosite (catalog no. 430-15S). 100 grams (white/yellow/orange group). *See section 19 of this document for data.*
PIG331	Cerussite, natural lead white (catalog no. 470-10S). 50 grams. (white/yellow/orange group). *See section 19 of this document for data.*
+++++++	
SPT101	Mascagnite: (ammonium sulphate; $(NH_4)_2SO_4$); The Geysers, Sonoma County, California, USA (Minerals Unlimited). [Cellular white to gray-white masses]. Dry sieved to <45 and 45-90µm sizes; a few grams of solid sample still left. *(See also "ammonium-bearing minerals").*
SPT102	Boussingaultite: (hydrous ammonium magnesium sulphate; $(NH_4)_2Mg(SO_4)_2 \cdot 6(H_2O)$); The Geysers, Sonoma County, California, USA (Minerals Unlimited; in vial). [No description]. Dry sieved to <45 and 45-90µm sizes; a few grams of pieces still left. *(See also "Ammonium-bearing minerals").*
SPT103	Letovicite: (ammonium acid sulphate; $(NH_4)_3H(SO_4)_2$), with mascagnite. The Geysers, Sonoma County, California, USA (Minerals Unlimited; in vial). [No description; use as mixed phase]. Dry sieved to <45 and 45-90µm sizes; a few grams of pieces still left. *(See also "Ammonium-bearing minerals").*
SPT104	Ferric ammonium sulphate: $(FeNH_4(SO_4)_2 \cdot 12H_2O)$; synthetic (BDH Chemicals); 99.99% purity analytical reagent grant. Not crushed due to alteration problem and "stickiness". *(See also "Ammonium-bearing minerals").*
SPT105	Ammonium sulphate: $(NH_4)_2SO_4$); synthetic (Anachemia); synthetic, reagent grade A.C.S., >99% purity. Crushed and dry sieved to <45 and 45-90µm grain sizes. *(See also "Ammonium-bearing*

minerals").

SPT106 Ferrous ammonium sulphate: ($(NH_4)_2FeSO_4 \cdot 6H_2O$); BDH Chemicals?); analytical reagent grade; 99.9% purity. Crushed and dry sieved to <45 and 45-90µm grain sizes. *(See also "Ammonium-bearing minerals").*

SPT107 Jarosite: Skouriotissa Mine, Cyprus (Smithsonian NMNH #104139-1). [$KFe_3^{+3}(SO_4)_2(OH)_6$] (alunite group).

SPT108 Jarosite: Warner Mine, S. of Hot Springs, Mineral County, Nevada, USA (Smithsonian NMNH #95074-1). [$KFe_3^{+3}(SO_4)_2(OH)_6$] (alunite group).

SPT109 Metavoltine: Borate, San Bernardino County, California [$K_2Na_6Fe^{+2}Fe_6^{+3}(SO_4)_{12}O_2 \cdot 18H_2O$], with coquimbite [SPT131] and halotrichite [SPT132] (Minerals Unlimited) [ochre-coloured masses with other sulphates] *(see also SPT176 and 177).*

SPT110 Romerite: Sulphur Hole, near Borate, San Bernardino County, California, USA [$Fe^{+2}Fe_2^{+3}(SO_4)_4 \cdot 14H_2O$] (Minerals Unlimited) [small brown crystals with other sulphates].

SPT111 Voltaite: Island Mountain Mine, Trinity County, California, USA; with römerite (SPT134) and copiapite (SPT135) [$K_2Fe_5^{+2}Fe_4^{+3}(SO_4)_{12} \cdot 18H_2O$] (Minerals Unlimited) [black masses in other sulphates] [not yet analyzed]. Description of sample: voltaite = black; romerite = brown; copiapite = yellow (and other sulphates) (more received Dec. 2/05).

SPT112 Amarantite: Yazd, Iran [$Fe^{+3}(SO_4)(OH) \cdot 3H_2O$] (Minerals Unlimited) [red fine-grained masses?; catalogue has Chile but mine is from Iran] (more received Dec. 2/05).

SPT113 Jarosite: Sierra Gorda, Chile; with copiapite (SPT125) [$KFe_3^{+3}(SO_4)_2(OH)_6$] (alunite group) (Minerals Unlimited) [compact brown massive; copiapite is yellow].

SPT114 Natrojarosite: Laurium, Greece [$NaFe_3^{+3}(SO_4)_2(OH)_6$] (alunite group) (Minerals Unlimited) [no description]. (more received Dec. 2/05: description: with limonite).

SPT115 Jarosite: Arabia District, Pershing County, Nevada, USA [$KFe_3^{+3}(SO_4)_2(OH)_6$] (alunite group) (Minerals Unlimited) [brown massive or crystals on or in quartz] (more received Dec. 2/05).

SPT116 Jarosite: Copiapa Jarosite Mine, Dona Ana County, New Mexico, USA; with hematite [$KFe_3^{+3}(SO_4)_2(OH)_6$] (alunite group) (Minerals Unlimited). (more received Dec. 2/05). SPT116-X1: sample after exposure in Mars box run #1.

SPT117 Copiapite: Alma Pyrite Mine, Leona Heights, Oakland, Alameda County, California, USA [$Fe^{+2}Fe_4^{+3}(SO_4)_6 \cdot (OH)_2 \cdot 20H_2O$] (Minerals Unlimited) [yellow crystalline masses] (more received Dec. 2/05).

SPT118 Halotrichite: Alma Pyrite Mine, Leona Heights, Oakland, Alameda County, California, USA [$Fe^{+2}Al_2(SO_4)_4 \cdot \cdot 22H_2O$] (Minerals Unlimited) [white fibrous to acicular].

SPT119 Coquimbite: Dexter #7 Mine, San Rafael Swell, Utah, USA [$Fe_2^{+3}(SO_4)_3 \cdot 9H_2O$] (Minerals Unlimited) [groups of small sharp lavender crystals] (more received Dec. 2/05).

SPT120 Hydronium jarosite: Rustler Mine, Tooele County, Utah, USA [$(H_3O)Fe_3^{+3}(SO_4)_2 \cdot (OH)_6$] (Minerals Unlimited) (alunite group).

SPT121 Fibroferrite: Skouriatissa, Cyprus [$Fe^{+3}(SO_4) \cdot (OH) \cdot 5H_2O$] (Minerals Unlimited) [tan to grey crystalline] (more received Dec. 2/05; original sample all crushed).

SPT122 Römerite: Alcaparrosa, Chile; with coquimbite (see SPT126) and halotrichite (too sparse to get a separate of it), and copiapite [$Fe^{+2}Fe_2^{+3}(SO_4)_4 \cdot 14H_2O$] (Minerals Unlimited) [pale pink crystalline in coquimbite, or yellow-brown crystalline masses] (received more Dec. 2/05).

SPT123 Sideronatrite: Capitol Reef National Monument, Wayne County, Utah, USA [$Na_2Fe^{+3}(SO_4)_2 \cdot (OH) \cdot 3H_2O$] (Minerals Unlimited) [orange crystalline aggregates on, or veinlets in, rock] (more received Dec. 2/05).

SPT124 Botryogen: Redington Mine, Knoxville, Napa County, California, USA [$MgFe^{+3}(SO_4)_2 \cdot (OH) \cdot 7H_2O$] (Minerals Unlimited) [Dana: usually in reniform or botryoidal shapes; deep hyacinth red, ochre-yellow] (more received Dec. 2/05).

SPT125 Copiapite: Sierra Gorda, Chile; with jarosite (see SPT113) [$Fe^{+2}Fe_4^{+3}(SO_4)_6 \cdot (OH)_2 \cdot 20H_2O$] (Minerals Unlimited) [MU description of pure sample: yellow crystalline masses; Dana: yellow].

SPT126 Coquimbite: Alcaparrosa, Chile; with römerite (see SPT122) and halotrichite [$Fe_2^{+3}(SO_4)_3 \cdot 9H_2O$] (Minerals Unlimited) [MU description of pure sample: groups of small sharp lavender crystals] (more received Dec. 2/05). *Also see other Alcaparossa, Chile samples (e.g., SPT122).*

SPT127 Gypsum (var. selenite): Utah, USA [$CaSO_4 \cdot 4H_2O$] (University of Winnipeg collection M168-39) *(for pigments project).* SPT127-X1: sample after exposure in Mars box run #1.

SPT128 Anhydrite: locality unknown [$CaSO_4$] (University of Winnipeg collection M170-1) *(for pigments*

project).

SPT129 Alunite: Marysvale, Piute County, Utah, USA [$KAl_3(SO_4)_2(OH)_6$] (Minerals Unlimited).

SPT130 Melanterite: Oage Mine, Ominato, Aomori-ken, Honshu, Japan [$Fe^{2+}SO_4 \cdot 7H_2O$] (Minerals Unlimited) [green crystals] (more received Dec. 2/05).

SPT131 Coquimbite: Borate, San Bernardino County, California, USA [$Fe_2^{+3}(SO_4)_3 \cdot 9H_2O$], with metavoltine [SPT109] and halotrichite [SPT132] (Minerals Unlimited) [MU description of pure sample: groups of small sharp lavender crystals] (see also SPT176, 177).

SPT132 Halotrichite: Borate, San Bernardino County, California, USA [$Fe^{+2}Al_2(SO_4)_4 \cdot \cdot 22H_2O$] , with metavoltine [SPT109] and coquimbite [SPT131] (Minerals Unlimited) [MU description of pure sample: white fibrous to acicular].

SPT133 Metavoltine: Alcaparrosa, Chile [$K_2Na_6Fe^{+2}Fe_6^{+3}(SO_4)_{12}O_2 \cdot 18H_2O$]; with copiapite (Minerals Unlimited).

SPT134 Romerite: Island Mountain Mine, Trinity County, California, USA [$Fe^{+2}Fe_2^{+3}(SO_4)_4 \cdot 14H_2O$]; with voltaite (SPT111) and copiapite (SPT135) (Minerals Unlimited) [black masses (are the voltaite) in other sulphates; MU description of römerite from CA: small brown crystals; can also be pale pink or yellow brown]. Description of sample: voltaite = black; romerite = brown; copiapite = yellow (and other sulphates) (more received Dec. 2/05; description: "on these, the romerite is the tiny brown crystals).

SPT135 Copiapite: Island Mountain Mine, Trinity County, California, USA [$Fe^{+2}Fe_4^{+3}(SO_4)_6 \cdot (OH)_2 \cdot 20H_2O$]; with voltaite (SPT111) and romerite (SPT134) (Minerals Unlimited) [black masses (are the voltaite) in other sulphates; MU description of römerite from CA: small brown crystals; can also be pale pink or yellow brown]. Description of sample: voltaite = black; romerite = brown; copiapite = yellow (and other sulphates).

SPT136 Sideronatrite: Sierra Gorda, Chile [$Na_2Fe^{+3}(SO_4)_2 \cdot (OH) \cdot 3H_2O$] (Minerals Unlimited).

SPT137 Kornelite: Coso Hot Spring, Inyo County, California, USA [$Fe_2^{3+}(SO_4)_3 \cdot 7H_2O$]; with copiapite (SPT138) [Minerals Unlimited]. (Description in Minerals Unlimited catalogue: kornelite: lavender fibrous masses in sinter; copiapite = yellow) (water soluble) (more received Dec. 2/05).

SPT138 Copiapite: Coso Hot Spring, Inyo County, California, USA [$Fe^{+2}Fe_4^{+3}(SO_4)_6 \cdot (OH)_2 \cdot 20H_2O$]; with kornelite (SPT137) [Minerals Unlimited]. (Description in Minerals Unlimited catalogue: kornelite: lavender fibrous masses in sinter; copiapite = yellow).

SPT139 Rhomboclase: Alcaparrosa, Chile [$HFe^{3+}(SO_4)_2 \cdot 4H_2O$], Dec. 2/05 batch (only?) may also have associated romerite and szomolnokite (Minerals Unlimited) (Water soluble) (more received Dec. 2/05); no more of original batch left in bulk form

SPT140 Pickeringite: Kelly Mine, Red Mountain, Randsburg Mining District, San Bernardino County, California, USA [$MgAl_2(SO_4)_4 \cdot 22H_2O$] (Minerals Unlimited) (water soluble) (Minerals Unlimited catalogue description: off-white fibrous crystalline masses) (more received Dec. 2/05).

SPT141 Kieserite: Stassfurt, Saxony, Germany [$MgSO_4 \cdot H_2O$] (Minerals Unlimited) (water soluble) (more received Dec. 2/05).

SPT142 Hexahydrite: Salt Lake, Box Elder County, Utah, USA [$MgSO_4 \cdot 6H_2O$], altered from epsomite (Minerals Unlimited) (water soluble) (more received Dec. 2/05: vials and chunks).

SPT143 Hexahydrite: Basque Lakes, near Ashcroft, British Columbia, Canada [$MgSO_4 \cdot 6H_2O$], altered from epsomite (Minerals Unlimited) (water soluble) (more received Dec. 2/05: vials and chunks). SPT143-X1: sample after exposure in Mars box run #1.

SPT144 Rozenite: Getchell Mine, near Golconda, Humboldt County, Nevada, USA [$Fe^{2+}SO_4 \cdot 4H_2O$] (Minerals Unlimited).

SPT145 Anglesite: Excepcion Mine, Villa Ahumada, Chihuahua, Mexico ($PbSO_4$) (Minerals Unlimited) (for pigments project).

SPT146 Barite: Castle Dome, Yuma County, Arizona, USA ($BaSO_4$) (Minerals Unlimited) (for pigments project).

SPT147 Anglesite: Tsumeb, Namibia ($PbSO_4$) (Smithsonian Institution MNMH #163581) (for pigments project - white).

SPT148 Anglesite: Italy ($PbSO_4$) (Smithsonian Institution MNMH #B10901) (for pigments project - white).

SPT149 Synthetic ferric sulphate [$Fe^{3+}{}_4(SO_4)_3$]. Anachemia 4492; CAS 10028-22-5; lot 000706 (Mfg. date: July 10, 2000); 500 grams (used for wet chem. iron titration).

SPT150 Lazurite: Afghanistan ($(Na,Ca)_{7\text{-}8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$) (Minerals Unlimited) *(for pigments project). (Was LAZ101).*

SPT151 Lazurite: locality unknown ($(Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$) (purchased at 2001 Manitoba Rock and Mineral Show) *(for pigments project). (Was LAZ102).*

SPT152 Lazurite: Chile ($(Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$) (Smithsonian Institution MNMH #126134) *(for pigments project). (Was LAZ103).*

SPT153 Lazurite: Cordicleres, Argentina ($(Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$) (Smithsonian Institution MNMH #C2677) *(for pigments project). (Was LAZ104).*

SPT154 Lazurite: Afghanistan [Tucson 2011 show].

SPT154 Glauberite: Bertram Siding, Salton Sea, Imperial County, California, USA ($Na_2Ca(SO_4)_2$) (Minerals Unlimited; November 2003). (*Possible product of evaporation on Mars, modelled (Morse and Marion article).*

SPT155 Alunogen: Manhattan Mine, Napa County, California, USA: ($Al_2(SO_4)_3 \cdot 17H_2O$). (Minerals Unlimited; November 2003). *(Possible evaporation product on Mars: see Bishop (LPSC 30) article)* (more received Dec. 2/05).

SPT156 Polyhalite: 18 miles northeast of Carlsbad, Eddy County, New Mexico, USA; with halite. ($K_2Ca_2Mg(SO_4)_4 \cdot 2H_2O$). (Minerals Unlimited: orange-brown compact; November 2003). *(Possible evaporation product on Mars; Morse and Marion article).*

SPT157 Sulphate - weathered deposit - Ellef Ringnes Island, Nunavut, Canada; collected by Paul Budkewitsch - Canada Centre for Remote Sensing (April 2004); his sample number 33-A. *(Spectral evidence of jarosite).*

SPT158 Sulfate - mirabilite (Glauber's salt) - Chaplin, Saskatchewan, Canada (self collected) ($Na_2SO_4 \cdot 10H_2O$) (July 2004). SPT158Bk After heating to 950°C for 1 hour for XRF (Mertzman).

SPT159 Bloedite: Chuquicamata, Chile; ($Na_2Mg(SO_4)_2 \cdot 4H_2O$); with kröhnkite ($Na_2Cu(SO_4)_2 \cdot 2H_2O$) (SPT161); bloedite colour can be colourless, grayish, bluish green or reddish due to inclusions); kröhnkite is light blue to dark sky blue, greenish blue to yellowish green on exposure) (Minerals Unlimited: glassy masses with blue kröhnkite; "Mineral is water soluble - do not wash") (November 2004).

SPT160 Thenardite: near Sodaville, Mineral County, Nevada, USA; (Na_2SO_4); glassy crystallized masses (Minerals Unlimited; "This mineral may collect moisture from the air - in wet climate keep in a closed container to preserve; This mineral is water soluble -do not wash") (November 2004).

SPT161 Kröhnkite: Chuquicamata, Chile; ($Na_2Cu(SO_4)_2 \cdot 2H_2O$); with bloedite ($Na_2Mg(SO_4)_2 \cdot 4H_2O$) (SPT159); bloedite colour can be colourless, grayish, bluish green or reddish due to inclusions); kröhnkite is light blue to dark sky blue, greenish blue to yellowish green on exposure) (Minerals Unlimited: glassy masses with blue kröhnkite; "Mineral is water soluble - do not wash") (November 2004).

SPT162 Epsomite: synthetic Magnesium sulfate USP - Shopper's Drug Mart Life Brand Epsom Salt ($Mg(SO_4) \cdot 7H_2O$ - ideal formula) (December 2004).

SPT163 Amarantite: Sierra Gorda, Chile; with metasideronatrite (SPT164), copiapite (SPT165), and ferrinatrite (SPT166) (Minerals Unlimited, received Dec. 2/05) [amarantite = red; sideronatrite = yellow, fibrous/massive; copiapite = yellow, scales, granules, massive; ferrinatrite = greenish or gray to white; usually spherical, rarely acicular] (December 2005).

SPT164 Metasideronatrite: Sierra Gorda, Chile; with amarantite (SPT163), copiapite (SPT165), and ferrinatrite (SPT166) (Minerals Unlimited, received Dec. 2/05) [amarantite = red; sideronatrite = yellow, fibrous/massive; copiapite = yellow, scales, granules, massive; ferrinatrite = greenish or gray to white; usually spherical, rarely acicular] (December 2005).

SPT165 Copiapite: Sierra Gorda, Chile; with amarantite (SPT163), metasideronatrite (SPT164), and ferrinatrite (SPT166) (Minerals Unlimited, received Dec. 2/05) [amarantite = red; sideronatrite = yellow, fibrous/massive; copiapite = yellow, scales, granules, massive; ferrinatrite = greenish or gray to white; usually spherical, rarely acicular] (December 2005).

SPT166 Ferrinatrite: Sierra Gorda, Chile; with amarantite (SPT163), metasideronatrite (SPT164), and copiapite (SPT165) (Minerals Unlimited, received Dec. 2/05) [amarantite = red; sideronatrite = yellow, fibrous/massive; copiapite = yellow, scales, granules, massive; ferrinatrite = greenish or gray to white; usually spherical, rarely acicular] (December 2005).

SPT167 Voltaite (etc.): Alcaparossa, Chile [Minerals Unlimited] (received Dec. 2/05) (Dana: dull olive green to brown or black).

SPT168 Pickeringite: Tucumcari, Quay County, New Mexico, USA [Minerals Unlimited] (received Dec. 2/05).

SPT169 Hexahydrite: Cueva de la Soledad, Zaragosa, Spain [Minerals Unlimited] (received Dec. 2/05).

SPT170 Kornelite: Leviathan Mine, Alpine County, California, USA; with other sulphates (unspecified) [Minerals Unlimited] (received Dec. 2/05).
SPT171 Romerite: Leviathan Mine, near Markleeville, Alpine County, California, USA; with voltaite (SPT172) [Minerals Unlimited] (received Dec. 2/05).
SPT172 Voltaite: Leviathan Mine, near Markleeville, Alpine County, California, USA; with romerite (SPT171) [Minerals Unlimited] (received Dec. 2/05).
SPT173 Fibroferrite: Sierra Gorda, Chile [Minerals Unlimited] (received Dec. 2/05).
SPT174 Kieserite: Heringen-Werra, Thuringia, Germany [Minerals Unlimited] (received Dec. 2/05).
SPT175 Copiapite: Sulphur Hole, Borate, San Bernardino County, California, USA [Minerals Unlimited] (received Dec. 2/05).
SPT176 Metavoltine: Sulphur Hole, near Borate, San Bernardino County, California, USA; with coquimbite (SPT177) [Minerals Unlimited]. May be the same as metavoltine SPT109 and coquimbite (SPT131), but locality descriptions are slightly different (received Dec. 2/05).
SPT177 Coquimbite: Sulphur Hole, near Borate, San Bernardino County, California, USA; with metavoltine (SPT176) [Minerals Unlimited]. May be the same as metavoltine SPT109 and coquimbite (SPT131), but locality descriptions are slightly different (received Dec. 2/05).
SPT178 Gypsum: Long Meg Mine, Little Salkeld, Cumberland, England; variety selenite [Minerals Unlimited] (received Dec. 2/05). More received December 20, 2011.
SPT179 Romerite: Sierra Gorda, Chile [Minerals Unlimited] (received Dec. 2/05).
SPT180 Jarosite: Santo Tomas Lode, Atoche Mine, Cercado Province, Oruro, Bolivia; with quartz [Minerals Unlimited] (received Dec. 2/05).
SPT181 Halotrichite: Corral Hollow, Alameda County, California, USA [Minerals Unlimited] (received Dec. 2/05).
SPT182 Anhydrite: near Penrith, Cumbria, England [Minerals Unlimited] (received Dec. 2/05).
SPT183 Anhydrite: Carlsbad, Eddy County, New Mexico, USA [Minerals Unlimited] (received Dec. 2/05).
SPT184 Gypsum (variety selenite): locality unknown (Mineral Society of Manitoba); 1 specimen (January 2007).
SPT185 Gypsum; locality unknown (Mineral Society of Manitoba); 1 specimen (January 2007).
SPT186 Lazurite, lapis lazuli; locality unknown [Discovery Gemstones Ltd.; Edmonton, AB], 5 pieces; may also contain sodalite, hauyne, calcite, and pyrite (July 2007).
SPT187 Celestine: Caledon, ON, Canada ($SrSO_4$); orange platey occurrence (collected by Billy Cloutis). "unusual orange celestine, in platy aggregates, from quarries in the vicinity of the Forks of the Credit River, A. Sabina, 1986, GSC Misc. Report 39, pp. 135-137; best orange said to be from a small quarry on Hart House Farm in the Caledon Hills district, per.com. Ray Hill" (November 2007).
SPT188 Gypsum ("desert rose"), from New Mexico, USA? (display specimen) (November 2007).
SPT189 Gypsum ("rose") from Red River Floodway, Winnipeg, MB, Canada (November 2007).
SPT190 Hanksite: Searles Lake, San Bernardino Co., CA, USA [$KNa_{22}(SO_4)_9(CO_3)_2Cl$]; two crystals with some powdery white coating (halite?) (Nonesuch Minerals; Tucson show 2011).
SPT191 Synthetic anhydrous magnesium sulphate [$MgSO_4$] (synthetic); UW Chemistry stores (November 2007).
SPT192 Synthetic sodium sulphate [Na_2SO_4] (synthetic); UW Chemistry stores? (November 2007)
SPT193 Anhydrite: Naica Mine, Naica, Mun. De Saucillo, Chihuahua, Mexico; spray of bluish crystals (Ikon Mining and Exploration; purchased at December 2012 AGU Fall Meeting).
SPT194 Gypsum – selenite (deep orange colour); Salinas de Otuma, Pisco Province, Ica Department, Peru (December 2012 AGU Fall Meeting; purchased from Ikon Mining and Exploration).

SPT200 Sulfate deposit - dry surface of west end of West Coteau Lake, Saskatchewan, Canada (collected July 2005).
SPT201 Sulfate deposit - dry surface of west end of West Coteau Lake, Saskatchewan, Canada (collected July 2005).

SPT300 Meridianiite; produced from heating of synthetic epsomite (SPT162) to produce monohydrate (kieserite; SPT301) and mixing with water at just above stoichiometry and freezing at -5°C to produce (hopefully) meridianiite.
SPT301 "Kieserite": produced from heating of synthetic epsomite (SPT162) at temperature required to drive

off enough water to produce monohydrate.

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TOC101 Tochilinite: Jeffrey Mine, Asbestos, Shiton Township, Quebec, Canada (Smithsonian NMNH #148696). [$6Fe_{0.9}S \cdot 5(Mg,Fe^{+2})(OH)_2$]. *May be in carbonaceous chondrites: see MacKinnon & Zolensky in Akai & Kanno article (also filed under clays and sulphides).*

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8a.1. Sample Descriptions - Sulphates - Samples collected in Gypsumville, MB, Canada - August 23, 2006

Note: original sample IDs were without the "G" suffix. See also section 20.2 for additional sulfate samples.

SPT200G Anhydrite?: spoil pile at south quarry, Gypsumville, Manitoba, Canada.
SPT201G Anhydrite?: spoil pile at south quarry, Gypsumville, Manitoba, Canada.
SPT202G Anhydrite?: spoil pile at south quarry, Gypsumville, Manitoba, Canada.
SPT203G Anhydrite?: spoil pile at south quarry, Gypsumville, Manitoba, Canada.
SPT204G Anhydrite?: spoil pile at south quarry, Gypsumville, Manitoba, Canada.
SPT205G Anhydrite?: spoil pile at south quarry, Gypsumville, Manitoba, Canada.
SPT206G Anhydrite?: spoil pile at south quarry, Gypsumville, Manitoba, Canada.
SPT207G Gypsum: spoil pile at south quarry, Gypsumville, Manitoba, Canada.
SPT208G Gypsum: spoil pile at south quarry, Gypsumville, Manitoba, Canada.

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8a.3. Sample Descriptions - Sulphates: Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

AnhydriteAN		GUW AN
hand sample37	**Barite	ActLabs
hand sample41	**Gypsum	ActLabs

AnhydriteAN grain size info from Brammer:

>0.315 mm	*trace*
0.2-0.315 mm	*trace*
0.1-0.2 mm	*2.00%*
0.09-0.1 mm	*1.00%*
0.063-0.09 mm	*trace*
<0.063 mm	*97.00%*

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8b. XRD Data - Sulphates

A number of the samples were measured by XRD at the University of Manitoba Department of Geological Sciences in May and June of 1999. The samples were run in continuous scanning mode to provide information on the <45µm size samples and whether any accessory phases are present. Additional samples were run in October 2000.

Sample	*Tentative*	*XRD description*
SPT101	(mascagnite)	XRD shows almost pure mascagnite with very minor tschermigite ($(NH_4)Al(SO_4)_2 \cdot 12H_2O$) (File: spt101.rep).
SPT102	(boussingaultite)	XRD shows almost pure boussingaultite and minor ammonium sulphate ($(NH_4)_2S_2O_8$) (File: spt102.rep).
SPT103	(letovicite)	XRD shows predominantly boussingaultite; gypsum is also present, perhaps letovicite and/or tschermigite (File: spt103.rep).
SPT104	(synthetic)	No need for XRD (synthetic).
SPT105	(synthetic)	No need for XRD (synthetic).
SPT106	(synthetic)	No need for XRD (synthetic).
SPT107	(jarosite)	Natrojarosite and goethite; 1 big peak missed.
SPT108	(jarosite)	Natrojarosite and a tiny bit of quartz.
SPT109	(metavoltine)	Ferricopiapite and metavoltine.
SPT110	(romerite)	Rhomboclase (an Fe sulphate hydroxide) + minor pyrite, + some romerite.
SPT111	(voltaite)	Romerite and voltaite.
SPT112	(amarantite)	Amarantite and minor hematite.
SPT113	(jarosite)	Jarosite, minor copiapite.
SPT114	(natrojarosite)	Natrojarosite, minor goethite (and hematite?).
SPT115	(jarosite)	Jarosite.
SPT116	(jarosite)	Jarosite.
SPT117	(copiapite)	Copiapite.
SPT118	(halotrichite)	Halotrichite + minor pickeringite.
SPT119	(coquimbite)	Coquimbite
SPT120	(hydronium jarosite)	Jarosite + quartz (major).
SPT121	(fibroferrite)	Fibroferrite + minor butlerite
SPT122	(romerite)	Major romerite, minor coquimbite.
SPT123	(sideronatrite)	Sideronatrite + something else (unidentified).
SPT124	(botryogen)	Pure botryogen.
SPT125	(Copiapite)	Pure ferricopiapite.
SPT126	(coquimbite)	Pure coquimbite + paracoquimbite.
SPT127	(gypsum)	Pure gypsum.
SPT128	(anhydrite)	Anhydrite + minor gypsum.
SPT129	(alunite)	Alunite.
SPT130	(melanterite)	Rozenite + melanterite
SPT131	(coquimbite)	Coquimbite + some copiapite + quartz.
SPT132	(halotrichite)	Anhydrite + coquimbite + quartz.
SPT133	(metavoltine)	Copiapite or metavoltine (ferricopiapite fits better).
SPT134	(romerite)	Coquimbite + romerite + szomolnokite.
SPT135	Copiapite	Mainly magnesiocopiapite, some szomolnokite, minor pyrite (U of Manitoba - April 2004)
SPT136	(sideronatrite)	Sideronatrite (although intensity of 100 peak is off) + jarosite (+ezcurrite) + pyrite.
SPT137	Kornelite	Nearly pure paracoquimbite, possibly minor kornelite (U of Manitoba - April 2004)
SPT138	Copiapite	Copiapite and paracoquimbite (U of Manitoba - April 2004)
SPT139	Rhomboclase	Pure rhomboclase (U of Manitoba - April 2004)
SPT140	Pickeringite	Nearly pure pickeringite (apjohnite also identified, but its pattern is almost identical to pickeringite) (U of Manitoba - April 2004)
SPT141	Kieserite	Nearly pure kieserite, minor halite (U of Manitoba - April 2004)
SPT142	Hexahydrite	Largely hexahydrite and pickeringite, some amorphous component (U of Manitoba - April 2004)
SPT143	Hexahydrite	Pure hexahydrite, some amorphous component (U of Manitoba - April 2004)

SPT144	Rozenite	Szomolnokite mostly, some rozenite, and minor pyrite (U of Manitoba - April 2004)
SPT145	Anglesite	Pure anglesite (U of Manitoba - April 2004)
SPT146	Barite	Pure barite (U of Manitoba - April 2004)
SPT147	Anglesite	Anglesite mostly, minor cerussite (U of Manitoba - April 2004)
SPT148	Anglesite	Pure anglesite (U of Manitoba - April 2004)
SPT150	Lazurite	Lazurite mostly, some phlogopite, minor augite, minor calcite (U of Manitoba - April 2004)
SPT151	Lazurite	Lazurite mostly, minor phlogopite and augite (U of Manitoba - April 2004)
SPT152	Lazurite	Lazurite, wollastonite largely, and calcite (U of Manitoba - April 2004)
SPT153	Lazurite	Lazurite, wollastonite, and calcite (U of Manitoba - April 2004)
SPT178	Gypsum	Measured by Stan Mertzman at Franklin and Marshall College (Nov. 2013). Phases identified: gypsum only.

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8c. Compositional Data - Sulphates

8c.x. Sulphates – Ideal Formulas

Wt.%	Alunite	Amarantite	Anglesite	Anhydrite	Barite	Botryogen
Al_2O_3	36.9					
FeO						
Fe_2O_3		35.8				19.2
MgO						9.7
CaO				41.2		
Na_2O						
K_2O	11.4					
NH_4						
PbO			72.7			
BaO					65.7	
SO_3	38.7	35.9	27.3	58.8	34.3	38.6
OH/H_2O	13.0	28.3				32.5
Total	100	100	100	100		100

Wt.%	Boussing-aultite	Copiapite	Coquimbite	Ferricopiapite	Fibroferrite	Gypsum
Al_2O_3						
FeO		5.7				
Fe_2O_3		25.6	28.4	30.3	30.8	
MgO	11.2					
CaO						32.5
Na_2O						
K_2O						
NH_4	10.0					
PbO						
BaO						
SO_3	44.4	38.5	42.8	39.0	30.9	46.5
OH/H_2O	34.4	30.2	28.8	30.7	38.3	21.0
Total	100	100	100	100	100	100

8c.x. Sulphates – Ideal Formulas (continued)

Wt.%	Halotrichite	Hexahydrite	Hydronium jarosite	Jarosite	Kieserite	Kornelite
Al_2O_3	11.5					
FeO	8.1					
Fe_2O_3			49.8	47.8		30.4
MgO		17.6			29.1	
CaO						
Na_2O						
K_2O				9.4		
NH_4						
PbO						
BaO						
SO_3	36.0	35.1	33.3	32.0	57.9	45.7
OH/H_2O	44.4	47.3	16.9	10.8	13.0	23.9
Total	100	100	100	100	100	100

Wt.%	Letovicite	Mascagnite	Melanterite	Metavoltine	Natrojarosite	Pickeringite
Al_2O_3						11.9
FeO			25.8	3.4		
Fe_2O_3				22.6	49.4	
MgO						4.7
CaO						
Na_2O				8.8	6.4	
K_2O				4.5		
NH_4	21.8	27.3				
PbO						
BaO						
SO_3	64.8	72.7	28.8	45.4	33.0	37.3
OH/H_2O	13.4		45.4	15.3	11.2	46.1
Total	100	100	100	100	100	100

Wt.%	Rhombo-clase	Romerite	Rozenite	Sideronatrite	Voltaite
Al_2O_3					
FeO		8.9	32.1		17.5
Fe_2O_3	24.9	19.9		21.9	15.5
MgO					
CaO					
Na_2O				17.0	
K_2O					4.6
NH_4					
PbO					
BaO					
SO_3	49.9	39.9	35.8	43.9	46.7
OH/H_2O	25.2	31.3	32.1	17.2	15.7
Total	100	100	100	100	100

Calculations: 1. Add up total molecular weight of all atoms (e.g., alunite = 414.3). 2. Multiply the amount of each oxide by its molecular weight and divide by total molecular weight (e.g., alunite use 0.5 x molecular weight of K_2O). 3. Should total 100%.

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8c. Compositional Data - Sulphates

Wt.%	SPT101	SPT101	SPT102	SPT103	SPT107
NMNH#[1]					104139-1
F and M[a]					
SiO_2			4.04	6.32	0.02
TiO_2			0.00	0.00	0.02
Al_2O_3			0.35	0.49	0.00
*(Fe_2O_3)**			*(0.84)*	*(1.03)*	*(89.94)*
FeO			0.36	0.21	0.16
Fe_2O_3			0.44	0.80	89.76
MnO			0.039	0.060	0.02
MgO			10.71	7.07	0.18
CaO			1.04	0.89	0.22
Na_2O			0.01	0.01	6.79
K_2O			0.002	0.003	2.15
P_2O_5			0.018	0.017	0.04
SO_3[a]			53.640	44.500	
Cl			0.000	0.000	
TOTAL			70.693	60.396	99.38
LOI			71.15	86.60	31.63
N^			5.85	9.98	
C^			0.22	0.29	
S^			17.94	19.61	
S as SO_3[a]			44.79	48.96	
Fand M[a]					
ppm					
Sr			15	5	130
Zr			20	18	20
V			3	<2	63
Co			25	20	<2
Cr			169	97	20
Ni			750	315	<2
Rb			<1	<1	10
UofW[b]					
(FeO)				45.55	
MgO					<0.01
K_2O					0.29
LOI	49.07		65.70		33.21
LOI (°C)	590°C		500°C		550°C
UofA[c]					
N	19.6481	19.6618	6.2113	9.4927	
C	0	0	0	0.6101	
H	5.9277	5.9206	4.4165	5.3959	
S	24.5009	24.3334	19.0984	19.8564	10.3712 11.1607[d]
SO_3	61.18	60.76	47.69	49.58	25.93 27.87[d]

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)**: LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

b. Analyses by atomic absorption spectroscopy at the University of Winnipeg (summer 2000 and 2001). (FeO): total Fe expressed as FeO. LOI: weight loss for samples heated in air to the temperature indicated (LOI (ºC))..

c. H, C, N, and S determined by ignition at the U. of Alberta (Aug/2000). S also expressed as SO_3. d. Duplicate analysis.

1. NMNH# = Smithsonian Institution of National Museum of Natural History sample ID number.

^ - N, C, and S determined using a light element analyzer. Due to the small amount of sample used, there may be issues of sample representativeness.a - SO_3 content may be a minimum value due to heating of the sample twice.+++++++++

8c. Compositional Data - Sulphates (continued)

Wt.%	SPT108	SPT109	SPT110	SPT110	SPT111	SPT112
NMNH#[1]	95074-1					
FandM[a]						
SiO_2	2.60	18.23		0.00	27.74	11.21
TiO_2	0.05	0.23		0.00	0.07	0.23
Al_2O_3	0.47	7.68		0.10	0.84	3.63
(Fe_2O_3)	*(85.68)*	*(68.51)*		*(29.31)*	*(23.94)*	*(78.13)*
FeO	0.21	2.94	16.04	12.04	10.01	0.26
FeO					12.44[h]	
Fe_2O_3	85.45	65.24		15.93	12.82	77.84
MnO	0.01	0.05		0.02	0.07	0.23
MgO	0.24	0.95		0.00	0.41	0.39
CaO	0.26	0.90		0.00	0.68	1.85
Na_2O	8.86	1.74		0.32	0.28	0.57
K_2O	1.18	1.17		0.00	0.61	1.08
P_2O_5	0.09	0.06		0.00	0.02	1.68
TOTAL	99.44	99.52		99.43	99.56	99.00
LOI	34.31	66.29	59.20		54.95	39.82
SO_3				40.04	33.90	
H_2O				29.64	11.00	
FandM[a]						
ppm						
Sr	780	190		2	95	40
Zr	25	82		8	50	125
V	61	66		4	65	210
Co	<2	860			35	<2
Cr	25	58		<2		50
Ni	<2	225				40
Rb	28	125				20
Cu				1730		
Pb				4815		
Zn				4315		
UofW[b]						
Al_2O_3	0.06					
(FeO)	37.94	20.26	23.50		21.75	
MgO	0.02					
K_2O	0.31	0.30			0.22	
Na_2O		0.46				
LOI	*70.54*		*68.18*			
LOI (°C)	550°C		590°C			
UofA[c]						
S	11.4683	15.1752	28.8745	28.4103	17.3127	8.7556
SO_3	28.64	37.90	72.10	71.03	43.23	21.86

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

b. Analyses by atomic absorption spectroscopy at the University of Winnipeg (summer 2000 and 2001). (FeO): total Fe expressed as FeO. LOI: weight loss (loss on ignition) for samples heated in air to the temperature indicated (LOI (ºC))..

c. H, C, N, and S determined by ignition at the University of Alberta (August 2000). S also expressed as SO_3.

d. Duplicate analysis.

1. NMNH# = Smithsonian Institution of National Museum of Natural History sample ID number.

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8c. Compositional Data - Sulphates (continued)

Wt.%	SPT113	SPT114	SPT115	SPT116	SPT117	SPT118
FandM[a]						
SiO_2	0.02	0.00	0.38	0.05	13.86	
TiO_2	0.04	0.01	0.09	0.02	0.16	
Al_2O_3	0.71	0.00	0.06	0.11	8.28	
(Fe_2O_3)	*(88.56)*	*(83.53)*	*(79.24)*	*(82.84)*	*(66.94)*	
FeO	0.30	0.26	0.21	0.29	0.00	0.22
Fe_2O_3	88.23	83.24	79.01	82.52	66.94	
MnO	0.01	0.01	0.01	0.01	0.21	
MgO	0.17	5.59	0.26	0.17	8.47	
CaO	0.60	6.94	0.07	0.17	0.47	
Na_2O	7.38	1.45	0.49	4.77	0.79	
K_2O	1.85	1.47	18.28	10.38	0.43	
P_2O_5	0.06	0.02	0.12	0.91	0.08	
TOTAL	99.40	99.02	99.00	99.43	99.69	
LOI	40.81	17.24	34.20	35.46	66.85	71.11
FandM[a]						
ppm						
Sr	<2	515	<2	2640	18	
Zr	15	20	15	25	39	
V	75	60	75	75	100	
Co	<2	<2	<2	<2	52	
Cr	15	10	13	600	130	
Ni	<2	75	<2	<2	52	
Rb	20	15	120	220	13	
UofW[b]						
Al_2O_3						6.50
(FeO)	36.48	46.16	37.78	37.67	18.72	0.03
MgO	0.004		0.004	0.01	2.93	7.96
K_2O	0.06		9.25	5.28		
LOI	41.41	24.04	40.96	29.55	95.37	
LOI (°C)	550°C	550°C	550°C	550°C	590°C	
UofA[c]						
S	13.1193	10.1162	12.7933	13.0143	15.9981	17.2389
SO_3	32.76	25.26	31.95	32.50	39.95	43.05

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

b. Analyses by atomic absorption spectroscopy at the University of Winnipeg (summer 2000 and 2001). (FeO): total Fe expressed as FeO. LOI: weight loss (loss on ignition) for samples heated in air to the temperature indicated (LOI (ºC)).

c. H, C, N, and S determined by ignition at the University of Alberta (August 2000). S also expressed as SO_3.

d. Duplicate analysis.

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8c. Compositional Data - Sulphates (continued)

Wt.%	SPT119	SPT120	SPT120	SPT121	SPT122	SPT123
FandM[a]						
SiO_2	1.95	72.93	50.62	2.60	0.62	
TiO_2	0.06	0.28	0.14	0.04	0.06	
Al_2O_3	16.09	1.68	0.74	0.21	0.80	
(Fe_2O_3)	*(79.16)*	*(22.64)*	*(12.17)*	*(95.02)*	*(96.85)*	
FeO	0.27	0.40		0.00	0.51	0.36
Fe_2O_3	78.86	22.20		95.02	96.28	
MnO	0.01	0.02	0.03	0.04	0.02	
MgO	0.82	0.84	0.69	0.31	0.28	
CaO	0.09	0.44	0.48	0.70	0.73	
Na_2O	0.28	0.48	0.31	0.58	0.48	
K_2O	1.25	0.07	0.07	0.10	0.01	
P_2O_5	0.11	0.42	0.34	0.03	0.03	
SO_3			5.46			
TOTAL	99.82	99.80	71.05	99.63	99.88	
LOI	71.11	10.14	10.56	63.22	69.36	43.38
FandM[a]						
ppm						
Sr	<2	295	87	15	<2	
Zr	24	<2	383	29	15	
V	67	1600	597	72	69	
Co	<2	<2	60	<2	160	
Cr	40	280	155	48	25	
Ni	<2	240	287	<2	<2	
Rb	25	<2	40	8	10	
Cu			44.666			
Pb			10+%			
Mo			appreciable			
Sb			a bit			
Ag			detectable			
As			likely			
UofW[b]						
(FeO)	17.82	13.93		26.06	24.78	18.24
MgO	0.01			0.01	0.03	0.003
Na_2O						20.60
LOI	*54.31*	*12.95*		*87.32*	*76.44*	
LOI (°C)	675°C	550°C		650°C	590°C	
UofA[c]						
C		0.3589				
H		0.4061				
S	18.4954	2.0549	2.0647	14.1687	17.1093	16.8169
SO_3	46.19	5.13	5.16	35.38	42.73	41.99

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

b. Analyses by atomic absorption spectroscopy at the University of Winnipeg (summer 2000 and 2001). (FeO): total Fe expressed as FeO. LOI: weight loss (loss on ignition) for samples heated in air to the temperature indicated (LOI (ºC))..

c. H, C, N, and S determined by ignition at the University of Alberta (August 2000). S also expressed as SO_3.

d. Duplicate analysis.

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8c. Compositional Data - Sulphates (continued)

Wt.%	SPT124	SPT125	SPT126	SPT126	SPT127	SPT128
FandM[a]						
SiO_2	4.96	4.39		1.14	0.00	0.00
TiO_2	0.02	0.06		0.09	0.00	0.00
Al_2O_3	0.76	2.01		1.25	0.20	0.15
(Fe_2O_3)	(62.79)	(27.01)		(94.05)	(0.03)	(0.04)
FeO	0.96	0.00	0.45	0.34	0.00	0.00
Fe_2O_3	61.79	27.01		93.67	0.03	0.04
MnO	0.26	0.01		0.08	0.00	0.00
MgO	29.02	0.27		1.34	0.07	0.06
CaO	0.14	0.41		0.34	32.46	46.06
Na_2O	0.25	4.25		0.44	0.30	0.78
K_2O	0.04	1.69		0.04	0.00	0.00
P_2O_5	0.03	0.07		0.04	0.01	0.02
SO_3				0.96		
TOTAL	98.27	99.16			100.20	100.38
LOI	*62.94*		*67.55*	*71.45*	*20.58*	*15.89*
LOI			*70.47*[d]			
SO_3		33.16		31.30	46.55	37.38
H_2O		25.83				
FandM[a]						
ppm						
Sr	<2	<5		6	200	700
Zr	18	15		<1	9	10
V	56	90		13	<2	4
Co	680					
Cr	2223	55		8	<2	4
Ni	13020					
Rb	2					
Pb				65		
Zn				2345		
UofW[b]						
(FeO)	16.27	26.56	24.16		0.00	0.01
MgO	9.35	0.06	0.05			
LOI	*53.40*	*49.24*	*90.54*		*45.95*	
LOI (°C)	650°C	650°C	675°C		500°C	
UofA[c]						
S	14.3490	15.3060	17.7273		10.2939	19.1753
SO_3	35.83	38.22	44.27		25.71	47.88

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

b. Analyses by atomic absorption spectroscopy at the University of Winnipeg (summer 2000 and 2001). (FeO): total Fe expressed as FeO. LOI: weight loss (loss on ignition) for samples heated in air to the temperature indicated (LOI (ºC))..

c. H, C, N, and S determined by ignition at the University of Alberta (August 2000). S also expressed as SO_3.

d. Duplicate analysis.

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8c. Compositional Data - Sulphates (continued)

Wt.%	SPT129	SPT129	SPT129	SPT130	SPT131	SPT132
FandM[a]						
SiO_2	0.00				83.58	83.25
TiO_2	0.00				0.71	0.46
Al_2O_3	74.51				1.71	2.64
(Fe_2O_3)	*(0.06)*				*(12.28)*	*(7.81)*
FeO	0.05			25.54	3.68	0.19
Fe_2O_3	0.00				8.19	7.60
MnO	0.00				0.02	0.03
MgO	0.07				0.54	0.33
CaO	0.12				0.37	4.17
Na_2O	0.46				0.29	0.43
K_2O	23.54				0.06	0.20
P_2O_5	0.76				0.09	0.04
TOTAL	99.52				99.65	99.36
LOI	40.15			67.28	27.28	23.82
FandM[a]						
ppm						
Sr	3420				825	690
Zr	20				250	175
V	135				55	48
Co	<2				24	65
Cr	40				23	22
Ni	8				44	36
Rb	25				<2	17
UofW[b]						
(FeO)	0.02			27.70	2.13	0.06
MgO				0.004	0.05	
CaO				0.11		
Na_2O				0.02		
LOI	*19.54*			*96.60*	*45.38*	
LOI (°C)	650°C			650°C	675°C	
UofA[c]						
S	14.3686	12.4819	14.6222	12.9207	5.7283	6.2651
SO_3	35.88	31.17	36.51	32.26	14.31	15.65

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

b. Analyses by atomic absorption spectroscopy at the University of Winnipeg (summer 2000 and 2001). (FeO): total Fe expressed as FeO. LOI: weight loss (loss on ignition) for samples heated in air to the temperature indicated (LOI (ºC)).

c. H, C, N, and S determined by ignition at the University of Alberta (August 2000). S also expressed as SO_3.

d. Duplicate analysis.

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8c. Compositional Data - Sulphates (continued)

Wt.%	SPT133	SPT134	SPT135	SPT136	SPT137	SPT138
FandM[a]						
SiO_2	0.80			22.51	0.03	
TiO_2	0.02			0.46	0.10	
Al_2O_3	0.37			0.42	3.37	
(Fe_2O_3)	(96.75)	(0.00)[d]		(53.15)	(33.12)	
FeO	0.00	8.56		0.44	0.00	
Fe_2O_3	96.75			52.66	33.12	0.00(?)
MnO	0.06			0.02	0.00	
MgO	0.58			1.40	0.18	
CaO	0.16			6.36	0.06	
Na_2O	0.59			10.33	0.62	
K_2O	0.02			4.82	0.04	
P_2O_5	0.03			0.12	0.04	
TOTAL	99.38			99.59	37.56	0.00
LOI	*68.79*	*66.07*		*27.98*	*71.67*	*71.21*
LOI		59.96[d]				
SO_3					25.44	
FandM[a]						
ppm						
Sr	<2			10	10	
Zr	18			50	45	
V	55			87	10	
Co	1405			3	525	
Cr	28			45	4	
Ni	25			13	125	
Rb	9			190	<2	
Cu					1450	
UofW[b]						
(FeO)	26.89			15.02		
MgO	0.09			<0.001		
Na_2O	0.07			12.23		
LOI		77.59				
LOI (°C)		590°C				
UofA[c]						
S	16.7464	17.1065		15.3979		
SO_3	41.82	42.72		38.45		

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

b. Analyses by atomic absorption spectroscopy at the University of Winnipeg (summer 2000 and 2001). (FeO): total Fe expressed as FeO. LOI: weight loss (loss on ignition) for samples heated in air to the temperature indicated (LOI (ºC))..

c. H, C, N, and S determined by ignition at the University of Alberta (August 2000). S also expressed as SO_3.

d. Duplicate analysis.

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8c. Compositional Data - Sulphates (continued)

Wt.%	SPT139	SPT139	SPT140	SPT141	SPT142	SPT143	SPT144
FandM[a]							
SiO_2		0.48	4.84	0.00	6.61	0.00	31.42
TiO_2		0.04	0.05	0.00	0.10	0.00	0.98
Al_2O_3		0.02	40.87	0.02	34.14	0.06	10.77
(Fe_2O_3)	(98.24)	(12.01)	(0.48)	(0.80)	(0.00)	(27.35)	
FeO		0.28	0.38	0.00	0.00	0.00	8.88
Fe_2O_3	0.00(?)	97.93	11.59	0.48	0.80	0.00	17.48
MnO		0.01	1.11	0.01	0.37	0.01	0.03
MgO		0.02	21.65	15.38	26.19	25.09	1.99
CaO		0.22	0.95	0.06	0.83	0.46	1.48
Na_2O		0.08	2.79	13.82	0.58	0.94	0.66
K_2O		0.01	0.22	4.04	0.49	0.09	1.28
P_2O_5		0.01	0.17	0.02	0.18	0.04	0.11
SO_3		0.50				23.53	
TOTAL	0.00	99.63	84.66	33.83	70.29	26.69	99.60
LOI	74.66	74.79	77.03	46.55	71.70	38.11	29.55
SO_3		26.87					
FandM[a]							
ppm							
Sr		<2	80	30	175	90	100
Zr		10	35	25	50	25	215
V		<1	55	30	50	30	170
Co			525	5	420	<2	45
Cr		21	100	<5	80	15	75
Ni			1825	<2	2330	<2	20
Rb			10	15	13	<2	70
Cu			2600	520	3050	600	1700
Pb		5					
Zn		33					

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

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8c. Compositional Data - Sulphates (continued)

Wt.%	SPT145	SPT146	SPT147	SPT148	SPT150	SPT151
NMNH#[1]			163581	B10901		
FandM[a]						
SiO_2	0.00	0.00			47.31	44.75
TiO_2	0.00	0.23			0.02	0.42
Al_2O_3	0.00	0.23			9.96	15.19
(Fe_2O_3)	*(0.00)*	*(0.00)*			*(0.41)*	*(0.16)*
FeO	0.00	0.00			0.00	0.00
Fe_2O_3	0.00	0.00			0.41	0.61
MnO	0.00	0.00			0.02	0.01
MgO	0.08	0.00			14.10	10.35
CaO	0.03	0.27			18.41	13.30
Na_2O	0.16	0.07			4.29	8.59
K_2O	0.00	0.00			2.08	2.51
P_2O_5	0.04	0.02			0.04	0.10
S	11.80					
SO_3		34.15			2.88	2.90
TOTAL	12.11	34.97			100.04	99.30
LOI	*1.07*	*0.07*			*1.09*	*0.73*
Cl					0.52	1.02
FandM[a]						
ppm						
Sr	80	15920			140	85
Zr	<5	75			135	140
V	40	425			56	130
Co	20	<2				
Cr	<5	<5			10	118
Ni	650	35				
Rb	<5	7				
Cu	1600	190				

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

1. NMNH# = Smithsonian Institution of National Museum of Natural History sample ID number.

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8c. Compositional Data - Sulphates (continued)

Wt. %	SPT156	SPT158	SPT160	SPT162	SPT178
FandM[a]					
SiO_2	0.00	5.45	0.00	0.00	0.00
TiO_2	0.00	0.04	0.00	0.00	0.00
Al_2O_3	0.00	1.02	0.00	0.01	0.00
(Fe_2O_3)	*(0.02)*	*(0.06)*	*(0.00)*	*(0.04)*	*(0.44)*
FeO	0.00	0.42	0.00	0.01	
Fe_2O_3	0.02	0.19	0.00	0.03	
MnO	0.006	0.02	0.007	0.01	0.00
MgO	6.17	0.27	0.00	29.68	0.00
CaO	18.27	0.57	0.03	0.06	41.12
Na_2O	0.04	39.77	44.24	0.04	0.00
K_2O	14.032	0.21	0.000	0.00	0.001
P_2O_5	0.016	0.05	0.017	0.02	0.010
Cl					0.00
SO_3	61.38	51.35	55.49	70.44	57.91
TOTAL	99.934	99.41	99.784	100.30	99.481
LOI	7.70	1.66	0.14	47.52	20.92
FandM[a]					
ppm					
Sr	1007	121	62	44	511
Zr	36	80	<2	32	56
V	<2	35	<2	<1	27
Ni	<2	2	<2	2	<2
Cr	<2	13	<2	12	<2
Co	<2	<2	<2	20	<1
Rb					<1
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

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8c. Compositional Data - Sulphates (continued)

Wt.%	SPT207	TOC101
NMNH#[1]		148696
FandM[a]		
SiO_2	0.71	
TiO_2	0.01	
Al_2O_3	0.15	
(Fe_2O_3)		
FeO	0.52	
Fe_2O_3	0.22	
MnO	0.00	
MgO	0.47	
CaO	97.33	
Na_2O	0.15	
K_2O	0.04	
P_2O_5	0.03	
SO_3		
TOTAL	99.69	
LOI	*20.91*	

FandM[a]	
ppm	
Sr	2450
Zr	75
V	5
Cr	<2

UofA[b]		
S		0.00
SO_3	46.31[c]	0.00

a. Analysed by X-ray fluorescence at Franklin and Marshall College by Stan Mertzman. Elemental totals expressed on a volatile-free basis (and with all Fe reported as Fe_2O_3). FeO determined by wet chemistry and Fe_2O_3 as difference between total Fe and FeO. *(Fe_2O_3)*: All Fe reported as Fe_2O_3. LOI = loss on ignition: weight loss after heating to 950°C for 1 to 1-1/2 hours.

b. H, C, N, and S determined by ignition at the University of Alberta (August 2000). S also expressed as SO_3.

c. SO_3 determined as S at U of W September 2007 using CHNS analyzer.

1. NMNH# = Smithsonian Institution of National Museum of Natural History sample ID number.

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8d. Spectral Data - Sulphates

Sample	*Facility/File No.*	*Description*
PIG002	RELAB caec02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG002	RELAB laec02	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.580µm (RELAB+Nicolet) note different viewing geometries.
PIG002	PSF 080708.pig002	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics.
+++++++		
PIG003	RELAB caec03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG003	RELAB laec03	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.580µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
PIG005	RELAB caec05	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG005	RELAB laec05	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.580µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
PIG021	RELAB c1ec13	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG021	RELAB bkr2ec013	<45 µm; 30°/0°,30°; 0.3-50 µm; 1.2-475 nm resolution; merged RELAB+ Nicolet at 2.55 µm; note different viewing geometry.
PIG021	RELAB bkr1ec013	<45 µm; 30°/0°,30°; 0.3-50 µm; 0.7-475 nm resolution; merged RELAB+ Nicolet at 1.3 µm; note different viewing geometry.
+++++++		
PIG205	PSF 080619a.027	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
PIG205	PSF 080619a.028	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; melted/hardened central pit.
PIG205	PSF 080619a.029	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; topped off.
PIG205	PSF 080619a.030	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; topped off, different spot?.
PIG205	PSF 080619a.031	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; topped off, different spot?.
PIG205	PSF 080619a.032	larger grains; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
PIG205	PSF 080619a.033	larger grains; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; melted/hardened central pit.
PIG205	PSF 080619a.034	larger grains; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
PIG205	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT101	RELAB casf15	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT101	RELAB lasf15a	<45µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2560 nm; change in view geometry at merge.
SPT101	RELAB cbsf15	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT101	RELAB lasf15b	45-90µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; change in view geometry at merge.
+++++++		
SPT102	RELAB casf16	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT102	RELAB lasf16a	<45µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2530 nm; change in viewing geometry at 2.5µm.
SPT102	RELAB cbsf16	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT102	RELAB lasf16b	45-90µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Sample spectrum may have been altered due to heating by incident light beam

		during first run; remeasured after first spectrum with lower incident light intensity.
SPT102	RELAB lbsf16b	45-90µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Measured with lower incident light intensity.
+++++++		
SPT103	RELAB casf17	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT103	RELAB lasf17a	<45µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Sample spectrum may have been altered due to heating by incident light beam during first run; remeasured after first spectrum with lower incident light intensity.
SPT103	RELAB lbsf17a	<45µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Measured with lower incident light intensity.
SPT103	RELAB cbsf17	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT103	RELAB lasf17b	45-90µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Sample spectrum may have been altered due to heating by incident light beam during first run; remeasured after first spectrum with lower incident light intensity.
SPT103	RELAB lbsf17b	45-90µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Measured with lower incident light intensity.
+++++++		
SPT104	RELAB c1sf18	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
SPT104	RELAB lasf18	unsorted, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Sample spectrum may have been altered due to heating by incident light beam during first run; remeasured after first spectrum with lower incident light intensity.
SPT104	RELAB lbsf18	unsorted, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Measured with lower incident light intensity.
+++++++		
SPT105	RELAB casf19	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT105	RELAB lasf19a	<45µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Sample spectrum may have been altered due to heating by incident light beam during first run; remeasured after first spectrum with lower incident light intensity.
SPT105	RELAB lbsf19a	<45µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; note change in viewing geometry at 2.5µm. Measured with lower incident light intensity.
SPT105	RELAB cbsf19	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT105	RELAB lasf19b	45-90µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2500 nm; note change in viewing geometry at 2.5µm.
+++++++		
SPT106	RELAB casf20	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT106	RELAB lasf20a	<45µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2540 nm; note change in viewing geometry at 2.5µm.
SPT106	RELAB cbsf20	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
SPT106	RELAB lasf20b	45-90µm, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet at 2550 nm; change in view geometry at merge.
SPT106	RELAB ccsf20	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
SPT106	RELAB lasf20c	unsorted, 30°/0°,30°; 0.3-26µm, 5, 0.6-129 nm; merged RELAB + Nicolet

		at 2550 nm; change in viewing geometry at 2.5µm.
+++++++		
SPT107	RELAB casf21	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT107	RELAB lasf21a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2525 nm; note different viewing geometry).
SPT107	PSF 050707spt107	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
SPT107	PSF 120707spt107	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
SPT107	PSF spt107	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
+++++++		
SPT108	RELAB casf22	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT108	RELAB lasf22a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2525 nm; note different viewing geometry).
+++++++		
SPT109	RELAB casf23	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT109	RELAB lasf23a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2525 nm; note different viewing geometry).
+++++++		
SPT110	RELAB casf24	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT110	RELAB lasf24a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2515 nm; note different viewing geometry).
+++++++		
SPT111	RELAB casf25	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT111	RELAB lasf25a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT112	RELAB casf26	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT112	RELAB lasf26a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT113	RELAB casf27	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT113	RELAB lasf27a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT114	RELAB casf28	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT114	RELAB lasf28a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT115	RELAB casf29	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT115	RELAB lasf29a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT115	PSF 071212a.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
+++++++		
SPT116	RELAB casf30	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT116	RELAB lasf30a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT116	PSF 090602a.007	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
SPT116	PSF spt116m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
SPT116	PSF spt116n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
SPT116	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	

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SPT116-X1	PSF 090602a.006	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
+++++++		
SPT117	RELAB casf31	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT117	RELAB lasf31a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2575 nm; note different viewing geometry).
SPT117	PSF mar2106.001	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106aarefnw).
SPT117	PSF aspt117	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106airrefnw).
SPT117	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT118	RELAB casf32	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT118	RELAB lasf32a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2575 nm; note different viewing geometry).
+++++++		
SPT119	RELAB casf33	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT119	RELAB lasf33a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT120	RELAB casf34	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT120	RELAB lasf34a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT120	PSF 080801a.006	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).
SPT120	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT121	RELAB casf35	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT121	RELAB lasf35a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2530 nm; note different viewing geometry).
SPT121	PSF 090127a.005	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD. Absolute reflectance may be wrong.
SPT121	PSF 090313a.032	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
SPT121	PSF aspt121	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106airrefnw).
SPT121	PSF 080801a.004	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).
SPT121	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT122	RELAB casf36	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT122	RELAB lasf36a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2540 nm; note different viewing geometry).
SPT122	PSF 071212a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
+++++++		
SPT123	RELAB casf37	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT123	RELAB lasf37a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2540 nm; note different viewing geometry).
+++++++		
SPT124	RELAB casf38	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT124	RELAB lasf38a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at

		2500 nm; note different viewing geometry).
+++++++		
SPT125	RELAB casf39	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT125	RELAB lasf39a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT125	PSF 080801a.002	<90 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).
SPT125	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT126	RELAB casf40	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT126	RELAB lasf40a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT126	PSF 080801a.003	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).
SPT126	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT127	RELAB casf41	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT127	RELAB lasf41a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT127	PSF 090602a.009	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
SPT127	PSF may0106.001	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
SPT127	PSF aspt127	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
SPT127	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
SPT127-X1	PSF 090602a.008	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
+++++++		
SPT128	RELAB casf42	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT128	RELAB lasf42a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2540 nm; note different viewing geometry).
SPT128	PSF 090127a.004	<45 µm, 30°/0°, 0.35-2.5 µm,1 nm output, 1000 averaged, ASD. Absolute reflectance may be wrong.
SPT128	PSF 090313a.033	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
SPT128	PSF mar2106.003	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106aarefnw).
SPT128	PSF aspt128	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106airrefnw).
SPT128	PSF spt128m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
SPT128	PSF spt128n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
SPT128	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT129	RELAB casf43	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT129	RELAB lasf43a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT129	PSF mar2106.004	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars

		box run #2 without sapphire window (Directory: mar2106aarefnw).
SPT129	PSF aspt129	<45 μm; i=35°, e=0°; 2-16 μm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106airrefnw).
SPT129	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT130	RELAB casf44	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT130	RELAB lasf44a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2540 nm; note different viewing geometry).
SPT130	PSF 071212a.006	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avg; ASD.
+++++++		
SPT131	RELAB casf45	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT131	RELAB lasf45a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT132	RELAB casf46	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT132	RELAB lasf46a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT133	RELAB casf47	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT133	RELAB lasf47a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2540 nm; note different viewing geometry).
+++++++		
SPT134	RELAB casf48	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT134	RELAB lasf48a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT136	RELAB casf50	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT136	RELAB lasf50a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT137	RELAB casf51	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT137	RELAB lasf51a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT137	PSF mar2106.005	<45 μm; i=0°, e=0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106aarefnw).
SPT137	PSF aspt137	<45 μm; i=35°, e=0°; 2-16 μm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106airrefnw).
SPT137	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT138	RELAB casf52	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT138	RELAB lasf52a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT139	RELAB casf53	<45μm, 30°/0°, 0.3-2.6μm, 5 nm.
SPT139	RELAB lasf53a	<45μm, 30°/0°,30°, 0.3-26μm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT139	PSF mar2106.006	<45 μm; i=0°, e=0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106aarefnw).
SPT139	PSF 080801a.001	<45 μm; i=0°, e=0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 1000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #6 (Directory: runsix 080801).
SPT139	PSF aspt139	<45 μm; i=35°, e=0°; 2-16 μm; 11-72 nm resolution; 100 spectra averaged –

		D&P FTIR. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106airrefnw).
SPT139	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT140	RELAB casf54	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT140	RELAB lasf54a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2575 nm; note different viewing geometry).
+++++++		
SPT141	PSF 090421a.008	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD; clumpy.
SPT141	RELAB casf55	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT141	RELAB lasf55a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT141	PSF mar2106.007	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106aarefnw).
SPT141	PSF aspt141	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106airrefnw).
SPT141	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT142	PSF 090421a.009	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
SPT142	RELAB casf56	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT142	RELAB lasf56a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2575 nm; note different viewing geometry).
SPT142	PSF 071212a.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
+++++++		
SPT143	RELAB casf57	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT143	RELAB lasf57a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2525 nm; note different viewing geometry).
SPT143	PSF 050707spt143	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
SPT143	PSF 120707spt143	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
SPT143	PSF spt143	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
SPT143	PSF 090602a.011	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
SPT143	PSF 091026 spt143	<45 µm; 0°/0° (bifurcated fibres); 0.2-0.4 µm; ~0.3 nm resolution; 100 averaged; Ocean Optics S2000.
SPT143	PSF may0106.002	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
SPT143	PSF aspt143	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #3 without sapphire window (Directory: may0106).
SPT143	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
SPT143-X1	PSF 090602a.010	<45 µm, 0°/0° (bifurc. cable), 0.35-2.5 µm; 1 nm resol., 100 avg, ASD.
+++++++		
SPT144	RELAB casf58	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT144	RELAB lasf58a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT144	PSF mar2106.008	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #2 without sapphire window (Directory: mar2106aarefnw).
SPT144	PSF aspt144	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #2

		without sapphire window (Directory: mar2106airrefnw).
SPT144	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
SPT145	RELAB casf59	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT145	RELAB lasf59a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT146	RELAB casf60	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT146	RELAB lasf60a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
SPT146	PSF pig1307.034	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
+++++++		
SPT147	RELAB casf61	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT147	RELAB bkr2sf061a	<45 µm; 30°/0°,30°; 0.3-50 µm; 1.2-475 nm resolution; merged RELAB+ Nicolet at 2.55 µm; note different viewing geometry.
SPT147	RELAB bkr1sf061a	<45 µm; 30°/0°,30°; 0.3-50 µm; 0.7-475 nm resolution; merged RELAB+ Nicolet at 1.3 µm; note different viewing geometry.
+++++++		
SPT148	RELAB casf62	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT148	RELAB bkr2sf062a	<45 µm; 30°/0°,30°; 0.3-50 µm; 1.2-475 nm resolution; merged RELAB+ Nicolet at 2.55 µm; note different viewing geometry.
SPT148	RELAB bkr1sf062a	<45 µm; 30°/0°,30°; 0.3-50 µm; 0.7-475 nm resolution; merged RELAB+ Nicolet at 1.3 µm; note different viewing geometry.
+++++++		
SPT149	PSF 090731b.001	<45µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD; July 31/09.
SPT149	PSF 090731b.002	45-90µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD; July 31/09.
+++++++		
SPT150	RELAB caea17	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT150	RELAB laea17	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT151	RELAB caea18	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT151	RELAB laea18	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet at 2550 nm; note different viewing geometry).
+++++++		
SPT152	RELAB casf63	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT152	RELAB bkr2sf063a	<45 µm; 30°/0°,30°; 0.3-50 µm; 1.2-475 nm resolution; merged RELAB+ Nicolet at 2.55 µm; note different viewing geometry.
SPT152	RELAB bkr1sf063a	<45 µm; 30°/0°,30°; 0.3-50 µm; 0.7-475 nm resolution; merged RELAB+ Nicolet at 1.3 µm; note different viewing geometry.
+++++++		
SPT153	RELAB casf64	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPT153	RELAB bkr2sf064a	<45 µm; 30°/0°,30°; 0.3-50 µm; 1.2-475 nm resolution; merged RELAB+ Nicolet at 2.55 µm; note different viewing geometry.
SPT153	RELAB bkr1sf064a	<45 µm; 30°/0°,30°; 0.3-50 µm; 0.7-475 nm resolution; merged RELAB+ Nicolet at 1.3 µm; note different viewing geometry.
+++++++		
SPT158	PSF 080730a.002	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
+++++++		
SPT162	PSF 080619a.011	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SPT162	PSF 080619a.012	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SPT162	PSF 080619a.013	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra

averaged, ASD.

SPT162	PSF 091026 spt162	<45 µm; 0°/0° (bifurcated fibres); 0.2-0.4 µm; ~0.3 nm resolution; 100 averaged; Ocean Optics S2000.
SPT162	PSF 100304a.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
SPT162	PSF 080125a.007	unsorted epsomite (SPT162); room temp. spectrum; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 500 spectra averaged; ASD.
+++++++		
SPT193	PSF 130723b.007	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
SPT193	PSF 130723b.008	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
+++++++		
SPT194	PSF 130723b.011	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
SPT194	PSF 130723b.012	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 250 spectra averaged; ASD. (Directory: 130723 random minerals).
+++++++		
SPT204	PSF 071212a.011	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
+++++++		
SPT207	PSF 090421a.007	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm resol., 1000 avg; ASD.
SPT207	PSF 050707spt207	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics.
SPT207	PSF 120707spt207	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics.
SPT207	PSF spt207	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics.
SPT207	PSF jun1407c.002	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SPT207	PSF jun1407c.003	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SPT207	PSF jun1407c.004	90-250 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SPT207	PSF jun1407c.005	250-500 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SPT207	PSF jun1407c.006	500-1000 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SPT207	PSF jun1407c.007	1000-2000 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SPT207	PSF jun1407c.008	2000-4000 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SPT207	PSF jun1407c.009	4000-6000 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SPT207	PSF 071212a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
+++++++		

Meridianiite synthesis run and comparison

SPT300	PSF 080123a.032	unsorted; quick-melting slurry of probably meridianiite, water and epsomite; measured immediately after removal from -5°C freezer; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
SPT300	PSF 080123a.033	unsorted; more stable (close to stoichiometric) material, much less ice; measured immediately after removal from -5°C freezer; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
SPT300	PSF 080123a.034	unsorted; more stable (close to stoichiometric) material, much less ice; same as #.033; measured 2 minutes after removal from -5°C freezer; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
SPT300	PSF 080123a.035	unsorted; more stable (close to stoichiometric) material, much less ice; same as #.033; measured 4 minutes after removal from -5°C freezer; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
SPT300	PSF 080123a.036	unsorted; more stable (close to stoichiometric) material, much less ice; same as #.033; measured 6 minutes after removal from -5°C freezer; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD.
SPT301	PSF 13.006	unsorted; monohydrate ("kieserite") made from heating of epsomite (SPT162); room temp. spectrum; 30°/0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD.
+++++++		
TOC001	RELAB lato02	<45 µm; i=30º, e=0º30º; 0.3-26 µm; 5, 1.3-29 nm resolution; merged

RELAB+Nicolet; note change in viewing geometry.

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END of 8.

9. Oxides

9.1. Spinels

9.1a. Sample Descriptions - Spinels

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
HER101	Hercynite: Sycamore Canyon, Cochise County, Arizona, USA (Dr. David Garske #G112a).
SPI101	Spinel: Salem District, Kangayam, Madras Province, India (Minerals Unlimited), single crystal.
SPI102	Spinel: Crestmore Quarry, Riverside County, California, USA (David Shannon Minerals), *with melilite MEL101 in probe disc at least.*
SPI112	Spinel, var. franklinite: Sterling Hill, New Jersey, USA (Tyson's Fine Minerals).
SPI113	Spinel, var. pleonaste: near Acaponeta, Nyarit, Mexico (Minerals Unlimited). *[not a spinel by microprobe]*.
SPI114	Spinel, var. pleonaste: Anakie, Queensland, Australia (Minerals Unlimited).
SPI115	Spinel, var. pleonaste: near Hawthorne, Lyon County, Nevada, USA (Minerals Unlimited). Intimately mixed with calcite and quartz(?).
SPI116	Spinel: Helena, Montana, USA (Minerals Unlimited).
SPI117	Spinel: Limecrest, New Jersey, USA (Minerals Unlimited). Intimately assoc. with calcite and mica..
SPI118	Spinel, var. gahnite: near Stratford, Alleghany County, North Carolina, USA (Minerals Unlimited). In quartz with some limonitic staining.
SPI119	Spinel: Parker Mine, Notre Dame de Laus, Quebec, Canada (Tyson's Minerals and David Shannon Minerals).
SPI120	Spinel, var. franklinite: Franklin, Sussex County, New Jersey, USA (Minerals Unlimited and Excalibur Mineral Co.). Associated with calcite and willemite (WIL110).
SPI121	Spinel: Mogok, Burma (Carousel Gems and Minerals) *[poor polish on probe disc; many little grains]*.
SPI122	Spinel: Sri Lanka (David Shannon Minerals). *[poor polish on probe disc; many little grains]*.
SPI123	Spinel, var. gahnite: Otjozondjupa region, near Otjiva, Namibia (David Shannon Minerals). Crystals in chondrodite and biotite matrix.
SPI124	Spinel: Amity, Orange County, New York, USA (Excalibur Mineral Co.).
SPI125	Spinel, var. pleonaste: Kinkaid Siding, Mineral County, Nevada, USA (Excalibur Mineral Co.).
SPI126	Spinel: Ambatomaninty, Madagascar (Excalibur Mineral Co.).
SPI127	Spinel, var. galaxite: Bo Phloi, Kanchoutabori Province, Thailand (Excalibur Mineral Co.). *[poor polish on probe disc]*.
SPI128	*Spinel, var. galaxite: Bald Knob, Alleghany County, North Carolina, USA (Excalibur Mineral Co.). Too intimate and fine-grained to use.*
SPI129	*Spinel, var. nichromite: Bon Accord deposit, Barberton, South Africa. Microscopic grains, with trevorite (SPI130) in serpentine (Minerals Unlimited); too intimate to separate.*
SPI130	*Spinel, var. trevorite: Bon Accord deposit, Barberton, South Africa. With microscopic grains of nichromite (SPI129) in serpentine (Minerals Unlimited); too intimate to separate..*
SPI131	*Spinel, var. coulsonite: Buena Vista Hills, near Lovelock, Pershing County, Nevada. Microscopic, intergrown with magnetite and scapolite. (Minerals Unlimited); too intimate to separate.*
SPI132	*Spinel, var. magnesioferrite: Kaiserstuhl, Black Forest Germany. In calcite (Minerals Unlimited) (not enough to probe, but spectra of selected regions on whole rock may be possible).*
SPI133	Spinel, var. Gahnite: Pyrite Mine, Charlmont, Massachusetts, USA (Excalibur Mineral Co.)
SPI134	*Magnesioferrite: Langban, Vermland, Sweden; in calcite-dolomite matrix ($MgFe^{3+}{}_2O_4$) (Minerals Unlimited); too intimate or sparse to separate.*

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9.1a. Sample Descriptions - Spinels: Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

Coulsonite	Spinel	NCS DC 19003A

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9.1.x. SPINEL-TYPE MINERALS: Pseudonyms and Formulas

Most important end members are preceded by asterisk.

(*ALEXANDRITE*)	$BeAl_2O_4$	Emerald-green chrysoberyl (Mason & Berry). Not a spinel.
(*ALMANDINE*)	$MgAl_2O_4$	Violet spinel (Dana). Note: A garnet has the same name.
AUTOMOLITE	$ZnAl_2O_4$	Pseudonym for gahnite (Dana).
* BALAS RUBY	$MgAl_2O_4$	Pale red variety of spinel (DH&Z).
(*BIXBYITE*)	$MnFe_2O_4$	Black variety of braunite (Dana). Not a spinel.
BRUNOGEIERITE	$(Ge^{2+},Fe^{2+})Fe^{3+}{}_2O_4$	A recognized species (Fleischer).
(*CAT'S EYE*)	$BeAl_2O_4$	Green chatoyant chrysoberyl (Dana). Also used for other minerals, not a spinel.
* CEYLONITE	$MgAl_2O_4$	Spinel with significant Fe^{2+} replacing Mg (DH&Z).
* CHLOROSPINEL	$MgO\square(Al,Fe)_2O_3$	Grass-green spinel due to Cu; Fe replaces Al (Dana).
CHROMITE	$Fe^{2+}Cr_2O_4$	An end member (DH&Z).
(*CHRYSOBERYL*)	$BeAl_2O_4$	Spinel formula but olivine structure. Not a spinel. (Mason).
COCHROMITE	$(Co,Ni,Fe^{2+})(Cr,Al)_2O_4$	A recognized species (Fleischer).
COULSONITE	$Fe^{2+}V^{3+}{}_2O_4$	A recognized species (Fleischer).
CUPROSPINEL	$(Cu^{2+},Mg)Fe^{3+}{}_2O_4$	A recognized species (Fleischer).
(*CREDNERITE*)	$Cu_3Mn_4O_9$	A black variant of chrysoberyl (Dana). Not a spinel?
(*CYMOPHANE*)	$BeAl_2O_4$	Pseudo-opalescent variety of chrysoberyl (Dana). Not a spinel?
DYSLUITE	$ZnAl_2O_4$	A Zn-,Fe-, Mn-gahnite (Dana). Yellowish- to greyish-brown.
FRANKLINITE	$ZnFe^{3+}{}_2O_4$	An end member (DH&Z).
GAHNITE	$ZnAl_2O_4$	An end member (DH&Z).
GALAXITE	$MnAl_2O_4$	An end member (DH&Z).
HAUSMANNITE	$MnMn_2O_4$	Distorted spinel structure (Mason).
* HERCYNITE	$Fe^{2+}Al_2O_4$	An end member (DH&Z).
(*HETEROCLINE*)	$(Mn,Si)_2O_3$	Impure braunite. Not a spinel. (Dana).
* JACOBSITE	$MnFe^{3+}{}_2O_4$	An end member (DH&Z).
* KREITTONITE	$ZnAl_2O_4$	A Zn-, Fe-, Mg-gahnite; velvet- to greenish-black (Dana).
MAGHEMITE	(γ-Fe_2O_3)	Has spinel structure (DH&Z).
MAGNESIOCHROMITE	$MgCr_2O_4$	An end member (DH&Z).
* MAGNESIOFERRITE	$MgFe^{3+}{}_2O_4$	An end member (DH&Z).
MAGNETITE	$Fe^{2+}Fe^{3+}{}_2O_4$	An end member (DH&Z).
MANGAN-MAGNETITE	$Fe^{2+}Fe^{3+}{}_2O_4$	Magnetite with 4-6% Mn (Dana).
MANGANO-CHROMITE	$(Mn^{2+},Fe^{2+})(Cr^{3+},V^{3+})_2O_4$	A recognized species (Fleischer).
(*MARCELINE*)	$(Mn,Si)_2O_3$	Impure braunite. Not a spinel. (Dana).
(*MINIUM*)	Pb_3O_4	Var.(?) of chrysoberyl; red w/ yellow (Dana). Not a spinel.
NICHROMITE	$(Ni,Co,Fe^{2+})(Cr^{3+},Fe^{3+},Al)_2O_4$	A recognized species (Fleischer).
* PICOTITE	$MgAl_2O_4$	Hercynite with appreciable Cr replacing Al. (DH&Z).
* PLEONASTE	$MgAl_2O_4$	Spinel with appreciable Fe^{2+} replacing Mg (DH&Z).
(*PSEUDOBROOKITE*)	Fe_2TiO_5	Not a spinel (DH&Z). Uncertain composition (Dana).
* QANDILITE	$(Mg,Fe^{2+})_2(Ti,Fe^{2+},Al)O_4$	A recognized species (Fleischer).
* RINGWOODITE		An isostructural silicate (Fleischer).
* RUBICELLE	$MgAl_2O_4$	Yellow or orange-red spinel (Dana).
* RUBY SPINEL	$MgAl_2O_4$	Clear or reddish spinel (Dana).
* SPINEL	$MgAl_2O_4$	An end member (DH&Z).
* TREVORITE	$NiFe^{3+}{}_2O_4$	An end member (DH&Z).
* ULVOSPINEL	$Fe^{2+}{}_2TiO_4$	An end member (DH&Z).
* VUORELAINENITE	$(Mn^{2+},Fe^{2+})(V^{3+},Cr^{3+})_2O_4$	A recognized species (Fleischer).
ZINCOCHROMITE	$ZnCr^{3+}{}_2O_4$	A recognized species (Fleischer).

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9.1b. XRD Data - Spinels

9.1b.1. Analog University of Alberta files

Sample	UofA file	Sample	U of A file
HER101	Z03223	SPI101	Z03234

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9.1b.2. University of Manitoba Files:

HER101	XRD shows only hercynite.
SPI101	XRD shows only spinel.
SPI112	XRD shows only franklinite.
SPI113	XRD shows diopside and albite (could it be basaltic glass?).
SPI114	XRD shows only hercynite.
SPI115	XRD shows only spinel.
SPI116	XRD shows only spinel.
SPI117	XRD shows only spinel.
SPI118	XRD shows only gahnite.
SPI119	XRD shows only spinel.
SPI120	XRD shows only franklinite.
SPI121	XRD shows only spinel.
SPI122	XRD shows only spinel.
SPI123	XRD shows only spinel.
SPI124	XRD shows only spinel.
SPI125	XRD shows spinel plus minor calcite.
SPI126	XRD shows only spinel.
SPI127	XRD shows only hercynite.
SPI133	XRD shows only gahnite.

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9.1c. Compositional Data – Spinels (alphabetical)

***Note:* analyses provided in two alphabetically ordered sets below.**

9.1c.1. Larger analytical suite

Wt. %	HER101	HER101	SPI101*	SPI101	SPI102	SPI112
P_2O_5	tr.	0.00[2]	n.d.		0.00	n.d.
Cr_2O_3	0.05	0.03	0.41		0.06	0.05
MnO	0.12	0.07	0.00	0.0	0.07	4.68
TiO_2	0.67	0.61	0.14		0.01	0.18
SiO_2	0.07	0.09	0.38		0.00	0.06
Al_2O_3	59.84	61.78	70.33	70.3	70.51	1.54
(FeO)[1]	*(20.79)*	*(19.78)*	*(0.52)*	*(0.5)*	*(7.62)*	*(63.44)*
FeO	15.18#		0.52#		n.d.	0.00#
Fe_2O_3	6.23#		~0.00#		n.d.	70.50#
MgO	18.01	18.37	26.72	26.7	24.78	0.35
Na_2O	0.03*	0.05	n.d.		n.d.	n.d.
ZrO_2	0.00*	0.00	n.d.		n.d.	n.d.
K_2O	0.00*	0.08[2]	n.d.		n.d.	n.d.
CoO	0.04*	0.04[2]	0.09*		n.d.	n.d.
CaO	0.00*	tr.	0.02*		n.d.	0.02
NiO	0.04*	0.06	0.10*		n.d.	0.07
HfO_2	0.02*	0.00[2]	n.d.		n.d.	n.d.
V_2O_5	0.14*	0.14[2]	0.13*		n.d.	n.d.
SnO	0.00*	tr.[3]	n.d.		n.d.	n.d.
ZnO	n.d.		1.03*	1.0	n.d.	29.05
Nb_2O_5		0.02				
Cl		0.03[2]				
TOTAL	100.44	101.22	99.87	98.5	103.05	106.50
			NUMBER OF IONS ON THE BASIS OF 32 OXYGENS			
V	0.019		0.016		n.d.	0.000
Ti	0.105		0.020		0.002	0.040
Si	0.014		0.072		0.000	0.018
Cr	0.008		0.093		0.009	0.012
Al	14.654		15.841		15.820	0.532
Fe^{3+}	0.974		0.000		n.d.	15.562
Mn	0.021		0.000		0.011	1.163
Fe^{2+}	2.639		0.083		1.213	0.000
Mg	5.581		7.616		7.028	0.153
Co	0.006		0.014		n.d.	0.000
Ca	0.000		0.006		n.d.	0.007
Ni	0.006		0.015		n.d.	0.016
Na	0.013		n.d.		n.d.	0.000
Zn	0.000		0.146		n.d.	6.387
Total	24.040		23.922		24.083	23.890
Source	U of C	U of A	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-2	EMPA-2	EMPA	EMPA-4	EMPA

#-Fe^{3+}/Fe_{tot} from Dick Morris at NASA JSC - determined by Mossbauer.
* - determined by electron microprobe at the University of Alberta.
1. (FeO): all Fe reported as FeO.
2. Single analytical point.
3. Average of 5 analytical points.
n.d.: not determined. tr.: trace (<0.01 wt.%).
U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
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9.1c. Compositional Data - Spinels (continued)

9.1c.1. Larger analytical suite (continued)

Wt. %	SPI114	SPI114	SPI115	SPI115
P_2O_5	n.d.		n.d.	
Cr_2O_3	0.15	0.15	0.00	0.00
MnO	0.09^	0.10	0.14^	0.10
TiO_2	0.58	0.58	0.21	0.21
SiO_2	0.13	0.13	0.01	0.01
Al_2O_3	61.82^	58.56	65.55^	61.81
(FeO)[1]	*(18.00^)*	*(17.57)*	*(6.61)*	*(6.61)*
FeO	14.04#		3.17#	
Fe_2O_3	4.40#		3.82#	
MgO	18.56^	19.32	25.74^	25.93
Na_2O	0.01		0.01	
CaO	0.00	0.00	0.00	0.00
NiO	0.19	0.19	0.00	0.00
V_2O_5	0.33	0.33	0.00	0.00
ZnO	0.14^	0.10	0.08	0.08
TOTAL	100.44	97.03	98.73	94.76

NUMBER OF IONS ON THE BASIS OF 32 OXYGENS

V	0.045		0.000	
Ti	0.089		0.031	
Si	0.026		0.002	
Cr	0.025		0.000	
Al	14.956		15.282	
Fe^{3+}	0.680		0.569	
Mn	0.016		0.024	
Fe^{2+}	2.411		0.524	
Mg	5.682		7.594	
Co	0.000		0.000	
Ca	0.000		0.000	
Ni	0.031		0.000	
Na	0.005		0.005	
Zn	0.021		0.012	
Total	23.987		24.043	
Source	U of C	U of M	U of C	U of M
Analysis	EMPA-4	EMPA-8	EMPA-4	EMPA-6

^: Determined by electron microprobe analysis at the University of Manitoba.
1. (FeO): all Fe reported as FeO.
n.d.: not determined.
#-Fe^{3+}/Fe_{tot} from Dick Morris at NASA JSC - determined by Mossbauer.
U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
++

9.1c. Compositional Data - Spinels (continued)

9.1c.1. Larger analytical suite (continued)

Wt. %	SPI116	SPI116	SPI117	SPI117	SPI118	SPI118	SPI119	SPI119
P_2O_5	n.d.		n.d.		n.d.		n.d.	
Cr_2O_3	0.00	0.00	0.15	0.15	0.04	0.04	0.06	0.06
MnO	0.17^	0.24	0.12^	0.10	0.06^	0.08	0.18^	0.15
TiO_2	0.00	0.00	0.00	0.00	0.13	0.13	0.05	0.05
SiO_2	<0.01	tr.	0.00	0.00	<0.01	0.05	0.01	0.01
Al_2O_3	69.22^	64.89	69.16^	64.87	56.64^	56.99	64.75^	61.43
(FeO)[1]	*(2.04^)*	*(1.52)*	*(2.92^)*	*(3.08)*	*(6.89^)*	*(6.68)*	*(12.27^)*	*(11.86)*
FeO	2.04#		2.92#		6.55#		9.33#	
Fe_2O_3	~0.00#		0.00#		0.38#		3.27#	
MgO	25.77^	25.94	24.54^	24.70	1.77^	1.94	21.36^	21.75
Na_2O	0.04	0.04	0.06	0.06	1.16	1.16	<0.01	0.01
ZrO_2	n.d.		n.d.		n.d		n.d.	
K_2O	n.d.		n.d.		n.d.		n.d.	
CoO	n.d.		n.d.		n.d.		n.d.	
CaO	<0.01	tr.	0.00	0.00	0.04	0.04	<0.01	0.01
NiO	0.00	0.00	<0.01	tr.	0.09	0.09	0.03	0.03
V_2O_5	0.00	0.00	0.06	0.06	0.36	0.36	0.04	0.04
SnO	n.d.		n.d.		n.d.		n.d.	
ZnO	1.92^	1.17	2.56^	2.13	33.31^	34.71	0.92^	0.84
TOTAL	99.17	93.80	99.58	95.14	100.53	102.23	100.01	96.24

NUMBER OF IONS ON THE BASIS OF 32 OXYGENS

V	0.000		0.007		0.056		0.005	
Ti	0.000		0.000		0.023		0.008	
Si	0.000		0.000		0.000		0.002	
Cr	0.000		0.024		0.008		0.010	
Al	15.907		15.940		15.778		15.367	
Fe^{3+}	0.000		0.000		0.067		0.495	
Mn	0.028		0.020		0.011		0.030	
Fe^{2+}	0.333		0.477		1.296		1.572	
Mg	7.495		7.158		0.624		6.415	
Co	0.000		0.000		0.000		0.000	
Ca	0.000		0.000		0.007		0.000	
Ni	0.000		0.000		0.017		0.005	
Na	0.014		0.023		0.531		0.000	
Zn	0.277		0.369		5.813		0.137	
Total	24.054		24.018		24.231		24.046	
Source	U of A	U of M	U of A	U of M	U of A	U of M	U of A	U of M
Analysis	EMPA-4	EMPA-6	EMPA-4	EMPA-6	EMPA-4	EMPA-6	EMPA-4	EMPA-6

1. (FeO): all Fe reported as FeO.
U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
^: Determined by electron microprobe analysis at the University of Manitoba.
n.d.: not determined. tr.: trace (<0.01 wt.%).
#-Fe^{3+}/Fe_{tot} from Dick Morris at NASA JSC - determined by Mossbauer.
++

9.1c. Compositional Data - Spinels (continued)

9.1c.1. Larger analytical suite (continued)

Wt. %	SPI120	SPI120	SPI121	SPI122
P_2O_5	n.d.		n.d.	n.d.
Cr_2O_3	0.08		0.19	0.25
MnO	11.15^	12.8	0.02^	0.02^
TiO_2	0.05		0.00	0.00
SiO_2	0.04		0.00	0.00
Al_2O_3	1.01^	1.0	69.88^	70.84^
(FeO)[1]	*(55.70^)*	*(57.4)*	*(0.16^)*	*(0.22^)*
FeO	0.00#		n.d.	n.d.
Fe_2O_3	61.90#		n.d.	n.d.
MgO	0.30^	0.4	27.76^	27.73^
Na_2O	n.d.		n.d.	n.d.
ZrO_2	n.d.		n.d.	n.d.
K_2O	n.d.		n.d.	n.d.
CoO	n.d.		n.d.	n.d.
CaO	0.02		0.00	0.00
NiO	0.13		0.00	0.00
V_2O_5	n.d.		n.d.	n.d.
SnO	n.d.		n.d.	n.d.
ZnO	21.70^	26.0	0.55^	0.33^
TOTAL	96.38		98.56	99.39
			NUMBER OF IONS ON THE BASIS OF 32 OXYGENS	
V	n.d.		n.d.	n.d.
Ti	0.013		0.000	0.000
Si	0.013		0.000	0.000
Cr	0.021		0.029	0.038
Al	0.389		15.903	15.966
Fe^{3+}	15.219		0.000	0.000
Mn	3.086		0.004	0.003
Fe^{2+}	0.000		0.026	0.036
Mg	0.145		7.994	7.909
Co	0.000		0.000	0.000
Ca	0.008		0.000	0.000
Ni	0.033		0.000	0.000
Na	0.000		0.000	0.000
Zn	5.234		0.079	0.047
Total	24.161		24.035	23.999
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-4	EMPA	EMPA-2	EMPA-2

1. (FeO): all Fe reported as FeO.
^: Determined by electron microprobe analysis at the University of Manitoba.
U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
n.d.: not determined.
#-Fe^{3+}/Fe_{tot} from Dick Morris at NASA JSC - determined by Mossbauer.
++

9.1c. Compositional Data - Spinels (continued)

9.1c.1. Larger analytical suite (continued)

Wt. %	SPI123	SPI123	SPI124	SPI124	SPI125	SPI125
P_2O_5	n.d.		n.d.		n.d.	
Cr_2O_3	0.11	0.10	0.03	0.03	0.02	0.02
MnO	0.33^	0.33	0.09^	0.08	0.16^	0.14
TiO_2	0.04	0.04	0.02	0.02	0.43	0.43
SiO_2	0.01	0.01	0.01	0.01	0.05	0.05
Al_2O_3	65.79^	62.31	67.85^	64.19	65.30^	61.46
(FeO)[1]	*(13.21^)*	*(13.00)*	*(7.24^)*	*(7.10)*	*(7.18^)*	*(7.08)*
FeO	12.42#		6.88#		3.59#	
Fe_2O_3	0.88#		0.40#		3.98#	
MgO	19.10^	19.38	22.49^	22.76	25.90^	25.66
Na_2O	0.01	0.01	0.03	0.03	<0.01	tr.
ZrO_2	n.d.		n.d.		n.d.	
K_2O	n.d.		n.d.		n.d.	
CoO	n.d.		n.d.		n.d.	
CaO	0.01	0.01	0.00	0.00	0.00	0.00
NiO	0.02	0.02	<0.01	tr.	<0.01	tr.
V_2O_5	n.d.	0.08	n.d.	0.03	n.d.	0.00
SnO	n.d.		n.d.		n.d.	
ZnO	0.84^	0.79	1.57^	1.35	0.05^	0.08
TOTAL	99.56	96.07	99.37	95.60	99.48	94.94

NUMBER OF IONS ON THE BASIS OF 32 OXYGENS

V	n.d.		n.d.		n.d.	
Ti	0.006		0.003		0.064	
Si	0.002		0.002		0.010	
Cr	0.018		0.005		0.003	
Al	15.771		15.888		15.153	
Fe^{3+}	0.134		0.060		0.590	
Mn	0.057		0.016		0.027	
Fe^{2+}	2.114		1.144		0.592	
Mg	5.794		6.665		7.606	
Co	0.000		0.000		0.000	
Ca	0.002		0.000		0.000	
Ni	0.003		0.000		0.000	
Na	0.005		0.012		0.000	
Zn	0.126		0.231		0.007	
Total	24.032		24.026		24.052	
Source	U of A	U of M	U of A	U of M	U of A	U of M
Analysis	EMPA-4	EMPA-9	EMPA-4	EMPA-6	EMPA-2	EMPA-3

1. (FeO): all Fe reported as FeO.
^: Determined by electron microprobe analysis at the University of Manitoba.
U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined. tr.: trace (<0.01 wt.%).
#-Fe^{3+}/Fe_{tot} from Dick Morris at NASA JSC - determined by Mossbauer.
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9.1c. Compositional Data - Spinels (continued)

9.1c.1. Larger analytical suite (continued)

Wt. %	SPI126	SPI126	SPI127	SPI127	SPI133	SPI133
P_2O_5	n.d.		n.d.		n.d.	
Cr_2O_3	0.04	0.04	0.23	0.23	0.00	0.00
MnO	0.18^	0.17	0.15^	0.13	0.08	0.08
TiO_2	0.03	0.03	0.68	0.68	0.01	0.01
SiO_2	0.02	0.02	0.13	0.13	0.00	0.00
Al_2O_3	64.68^	59.00	61.29^	57.29	56.05	56.05
(FeO)[1]	*(13.83^)*	*(16.26)*	*(17.97^)*	*(18.05)*	*(6.18)*	*(6.18)*
FeO	12.03#		12.58#		5.31#	
Fe_2O_3	2.00#		5.98#		0.96#	
MgO	19.11^	18.95	19.37^	19.30	0.00	0.00
Na_2O	0.01	0.01	0.00	0.00	0.00	0.00
ZrO_2	n.d.		n.d.		n.d.	
K_2O	n.d.		n.d.		n.d.	
CoO	n.d.		n.d.		n.d.	
CaO	<0.01	tr.	0.00	0.00	<0.01	
NiO	0.03	0.03	0.20	0.20	0.00	0.00
V_2O_5	n.d.	0.00	n.d.	0.34	n.d.	0.00
SnO	n.d.		n.d.		n.d.	
ZnO	1.08^	0.95	0.14^	0.13	37.49	37.49
TOTAL	99.21	95.47	100.75	96.47	99.90	99.80

NUMBER OF IONS ON THE BASIS OF 32 OXYGENS

V	n.d.		n.d.		n.d.	
Ti	0.005		0.104		0.002	
Si	0.004		0.026		0.000	
Cr	0.007		0.037		0.000	
Al	15.608		14.774		15.968	
Fe^{3+}	0.356		0.983		0.187	
Mn	0.031		0.026		0.016	
Fe^{2+}	2.013		2.089		1.062	
Mg	5.836		5.909		0.000	
Co	0.000		0.000		0.000	
Ca	0.000		0.000		0.000	
Ni	0.005		0.033		0.000	
Na	0.005		0.000		0.000	
Zn	0.164		0.021		6.692	
Total	24.033		24.003		23.926	
Source	U of A	U of M	U of A	U of M	U of A	U of M
Analysis	EMPA-2	EMPA-3	EMPA-1	EMPA-3	EMPA	EMPA-9

1. (FeO): all Fe reported as FeO.
^: Determined by electron microprobe analysis at the University of Manitoba.
U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined. tr.: trace (<0.01 wt.%).
#-Fe^{3+}/Fe_{tot} from Dick Morris at NASA JSC - determined by Mossbauer.
++

9.1c. Compositional Data - Spinels (continued)

9.1c.2. Smaller analytical suite

Wt.%	SPI110 1st run	SPI110 2nd run	SPI112	SPI113	SPI114 1st run	SPI114 2nd run
SiO_2	tr.	0.02	0.05	69.95	0.16	0.13
TiO_2	0.00	0.00	0.18	0.00	0.40	0.47
Al_2O_3	0.01	0.02	1.54	8.29	57.14	56.57
Cr_2O_3	tr.	tr.	0.06	0.00	0.57	0.01
$(FeO)^1$	0.90	0.78	63.44	5.11	15.85	18.45
MnO	68.67	55.61	4.68	tr.	0.11	0.11
MgO	tr.	0.07	0.36	0.00	19.56	18.32
CaO	tr.	0.01	0.02	0.04	0.00	0.00
NiO	0.00	0.01	0.07	0.00	0.27	0.19
ZnO	tr.	0.03	29.05	0.00	0.14	0.10
TOTAL	69.59	56.54	99.45	83.39	94.20	94.35
Source	U of A	U of A	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-6	EMPA-6	EMPA-6	EMPA-6	EMPA-6

1. $(FeO)^1$: All Fe reported as FeO.
U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated.
SPI110 and SPI114 analyzed in two runs.

++

9.1c. Compositional Data - Spinels (continued)

9.1c.2. Smaller analytical suite (continued)

Wt.%	SPI115 1st run	SPI115 2nd run	SPI116 1st run	SPI116 2nd run
SiO_2	0.03	0.03	0.02	tr.
TiO_2	0.20	0.16	0.00	0.00
Al_2O_3	58.54	60.95	62.66	64.40
Cr_2O_3	0.00	0.00	0.00	0.00
$(FeO)^1$	7.01	6.82	2.91	1.14
MnO	0.16	0.12	0.13	0.35
MgO	25.02	25.30	25.36	25.16
CaO	0.00	0.00	0.00	0.00
NiO	0.00	tr.	0.00	0.00
ZnO	0.07	0.05	0.65	1.44
TOTAL	91.03	93.43	91.73	92.49
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-6	EMPA-6	EMPA-6

1. $(FeO)^1$: All Fe reported as FeO.
U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated.
Samples analyzed in two runs.

++

9.1c. Compositional Data - Spinels (continued)

9.1c.2. Smaller analytical suite (continued)

Wt.%	SPI117 1st run	SPI117 2nd run	SPI118 1st run	SPI118 2nd run
SiO_2	0.02	tr.	tr.	0.04
TiO_2	57.64	tr.	0.00	0.11
Al_2O_3	0.01	62.85	54.17	54.85
Cr_2O_3	0.04	0.14	0.02	0.05
$(FeO)^1$	23.83	3.13	7.46	7.81
MnO	1.36	0.11	0.08	0.15
MgO	14.97	23.91	1.73	1.98
CaO	0.01	tr.	0.00	0.04
NiO	0.05	tr.	tr.	0.14
ZnO	0.03	2.24	34.57	34.22
TOTAL	97.96	92.38	98.03	99.39
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-6	EMPA-5	EMPA-5

1. $(FeO)^1$: All Fe reported as FeO.
U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated.
Samples analyzed in two runs.

++

9.1c. Compositional Data - Spinels (continued)

9.1c.2. Smaller analytical suite (continued)

Wt.%	SPI119 1st run	SPI119 2nd run	SPI120 1st run	SPI120 2nd run
SiO_2	0.00	0.01	0.05	0.10
TiO_2	0.00	0.04	0.05	0.20
Al_2O_3	57.65	59.50	1.03	1.00
Cr_2O_3	0.02	0.04	0.08	0.10
$(FeO)^1$	12.02	12.10	57.37	58.80
MnO	0.11	0.18	12.84	12.47
MgO	20.17	20.97	0.36	0.36
CaO	0.00	tr.	0.02	0.06
NiO	0.00	0.02	0.12	0.24
ZnO	0.82	0.90	26.05	26.75
TOTAL	90.79	93.76	97.97	100.08
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-6	EMPA-6	EMPA-6

1. $(FeO)^1$: All Fe reported as FeO.
U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated.
Samples analyzed in two runs.

++

9.1c. Compositional Data - Spinels (continued)

9.1c.2. Smaller analytical suite (continued)

Wt.%	SPI121 1st run	SPI121 2nd run	SPI122 1st run	SPI122 2nd run
SiO_2	0.00	0.00	0.00	0.00
TiO_2	0.00	0.00	0.00	0.00
Al_2O_3	62.53	55.76	62.05	56.58
Cr_2O_3	0.19	0.31	0.25	0.26
$(FeO)^1$	0.00	0.03	0.00	0.00
MnO	0.00	0.00	0.00	0.00
MgO	26.17	22.91	26.01	23.06
CaO	0.00	0.00	0.00	0.00
NiO	0.00	0.00	0.00	0.00
ZnO	0.38	0.31	0.22	0.16
TOTAL	89.27	79.32	88.53	80.06
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-6	EMPA-6	EMPA-6

1. $(FeO)^1$: All Fe reported as FeO.
U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated.
Samples analyzed in two runs.

++

9.1c. Compositional Data - Spinels (continued)

9.1c.2. Smaller analytical suite (continued)

Wt.%	SPI123 1st run	SPI123 2nd run	SPI124 1st run	SPI124 2nd run
SiO_2	0.00	0.00	tr.	0.01
TiO_2	0.00	0.00	0.03	0.02
Al_2O_3	59.70	60.24	62.13	62.68
Cr_2O_3	0.00	0.00	0.02	tr.
$(FeO)^1$	12.97	13.18	7.28	7.32
MnO	0.17	0.19	0.06	0.05
MgO	18.11	18.60	21.24	21.87
CaO	0.00	0.00	tr.	0.00
NiO	0.00	0.00	0.00	0.01
ZnO	0.72	0.73	1.37	1.37
TOTAL	91.67	92.94	92.13	93.33
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-6	EMPA-6	EMPA-6

1. $(FeO)^1$: All Fe reported as FeO.
U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated.
Samples analyzed in two runs.

++

9.1c. Compositional Data - Spinels (continued)

9.1c.2. Smaller analytical suite (continued)

Wt.%	SPI125 1st run	SPI125 2nd run	SPI126 1st run	SPI126 2nd run
SiO_2	0.01	0.06	tr.	0.02
TiO_2	0.25	0.37	0.06	0.03
Al_2O_3	61.32	59.64	60.84	59.63
Cr_2O_3	0.01	tr.	0.06	0.02
$(FeO)^1$	6.59	7.24	13.40	15.20
MnO	0.18	0.15	0.21	0.18
MgO	24.45	24.98	18.98	19.23
CaO	0.00	0.00	0.00	tr.
NiO	tr.	0.01	0.03	0.04
ZnO	0.05	0.05	0.94	1.09
TOTAL	92.86	92.50	94.52	95.44
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-6	EMPA-6	EMPA-6

1. $(FeO)^1$: All Fe reported as FeO.
U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated.
Samples analyzed in two runs.

++

9.1c. Compositional Data - Spinels (continued)

9.1c.2. Smaller analytical suite (continued)

Wt.%	SPI127 1st run	SPI127 2nd run
SiO_2	0.12	0.14
TiO_2	0.56	0.53
Al_2O_3	56.21	55.60
Cr_2O_3	0.19	0.20
$(FeO)^1$	17.90	18.62
MnO	0.13	0.13
MgO	18.67	18.73
CaO	tr.	tr.
NiO	0.20	0.23
ZnO	0.11	0.06
TOTAL	94.09	94.24
Source	U of A	U of A
Analysis	EMPA-6	EMPA-6

1. $(FeO)^1$: All Fe reported as FeO.
U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated.
Samples analyzed in two runs.

++

9.1c. Compositional Data - Spinels (continued)

9.1c.3. Compositional Data - Spinels: Fe^{+3}/Fe_{Tot} (ferric iron/total iron) from Dick Morris using Mossbauer spectroscopy.

Sample	*Ferric/Total iron*
HER101	0.27
SPI101	<0.02 (too little Fe for a good measurement)
SPI112	1.00
SPI114	0.22
SPI115	0.52
SPI116	<0.10 (too little Fe for a good measurement)
SPI117	0.00
SPI118	0.05
SPI119	0.24
SPI120	1.00
SPI121	(too little Fe?)
SPI122	(too little Fe?)
SPI123	0.06
SPI124	0.05
SPI125	0.50
SPI126	0.13
SPI127	0.30
SPI133	0.14

To use these values, we multiply the total FeO number in the sample by the percentage that is ferric (from the Mossbauer) and by 1.1113 to allow for the extra oxygen this entails.

As an example, consider HER101. It has 20.79% FeO as determined by FeO, and a ferric/total iron ratio of 0.27.

Therefore we break this total down as follows:

*(1-0.27) * 20.79% FeO = 0.73 * 20.79 = 15.18% FeO*
*0.27 * 20.79% FeO * 1.1113 = 6.24% Fe_2O_3.*
++

9.1d. Spectral Data - Spinels

Sample	*Facility/File No.*	*Description*
HER101	RELAB C1SC74	<45µm, 0E/15E, 0.3-2.7µm, 5 nm.
HER101	RELAB CASC74	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
HER101	RELAB LASC74	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI101	RELAB C1SC75	<45µm, 0E/15E, 0.3-2.7µm, 5 nm.
SPI101	RELAB CASC75	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
++++++		
SPI112	RELAB LASC75	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
SPI112	RELAB CASP12	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI112	RELAB LASP12	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SPI113	RELAB CASP13	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI113	RELAB LASP13	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI114	RELAB CASP14	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI114	RELAB LASP14	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI115	RELAB CASP15	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI115	RELAB LASP15	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI116	RELAB CASP16	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI116	RELAB LASP16	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI117	RELAB CASP17	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI117	RELAB LASP17	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI118	RELAB CASP18	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI118	RELAB LASP18	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI119	RELAB CASP19	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI119	RELAB LASP19	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI120	RELAB CASP20	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI120	RELAB LASP20	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI121	RELAB CASP21	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI121	RELAB LASP21	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI122	RELAB CASP22	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI122	RELAB LASP22	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm

		(RELAB+Nicolet), note different viewing geometries.
++++++		
SPI123	RELAB CASP23	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI123	RELAB LASP23	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet), note different viewing geometries.
++++++		
SPI124	RELAB CASP24	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI124	RELAB LASP24	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SPI125	RELAB CASP25	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI125	RELAB LASP25	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SPI126	RELAB CASP26	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI126	RELAB LASP26	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SPI127	RELAB CASP27	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI127	RELAB LASP27	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
SPI133	RELAB CASP33	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
SPI133	RELAB LASP33	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.

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END of 9.1.

9. Oxides

9.2. Magnetites

9.2a. Sample Descriptions - Magnetites

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
MAG101	Magnetite: Jacupiranga Mine, Sao Paulo State, Brazil (Nature's Treasures), with apatite APA102.
MAG102	Magnetite: Utah, USA (Green's Rock Shop).
MAG103	Magnetite: Langesundfjord, Norway (Minerals Unlimited). In nepheline syenite.
MAG104	Magnetite: from 2500' level, ZCA #4, Balmet, New York, USA (David Shannon).
MAG105	Magnetite: 100 km west of Bangui, Central African Republic (David Shannon).
MAG106	Magnetite: Christie Mine, San Benito County, California, USA. In dolomite; separated w/ HCl (David Shannon).
MAG107	Magnetite: near the Dallas Gem Mine, San Benito County, California, USA (on serpentine) (Minerals Unlimited; more received June 2013). *[poorly polished, no usable probe results]*.
MAG108	Magnetite: Marble Mountains, San Bernardino County, California, USA (Minerals Unlimited).
MAG109	Magnetite: Magnet Cove, Hot Spring County, Arkansas, USA (Minerals Unlimited).
MAG110	Magnetite: Grangesberg, Sweden (Minerals Unlimited).
MAG111	Magnetite: Oka, Quebec, Canada (Minerals Unlimited).
MAG112	Magnetite: Gladhammar, Sweden (Minerals Unlimited).
MAG113	Magnetite: Republic, Marquette County, Michigan, USA (Minerals Unlimited).
MAG114	Magnetite: Las Piedras Mine, Barrio Junta, Puerto Rico, USA (with malachite) (Minerals Unlimited).
MAG115	Magnetite (sand): Walker Mine, Mother Lode District, California, USA (Minerals Unlimited).*[poorly polished probe disc, no usable probe results; there are sulphur bearing phases in the probe disc as well]*.
MAG116	*Magnetite: Evje, Norway (Minerals Unlimited). [not a magnetite by probe; sample has a bit of magnetite only]*.
MAG117	Magnetite: Washington County, Utah, USA (Minerals Unlimited).
MAG118	Magnetite: Glacier National Park, Montana, USA (with pyroxene (too sparse)) (Minerals Unlimited).
MAG119	Magnetite: Gabbs, Nye County, Nevada, USA (Minerals Unlimited).
MAG120	Magnetite, var. lodestone: Great Western Mine, Iron Mountain, west of Cedar City, Iron County, Utah, USA (Minerals Unlimited). *[lousy finish on probe disc, there are also some silicates in the disc mount]*.
MAG121	Magnetite: Tilly Foster Mine, Brewster, Putnam County, New York, USA (Minerals Unlimited).
MAG122	Magnetite: Franklin, Sussex County, New Jersey, USA (with willemite) (Minerals Unlimited).*[some calcium-bearing phases also come up during probing]*.
MAG123	Magnetite: Espanola, Ontario, Canada (National Museum of Nature, Ottawa).
MAG124	Magnetite: locality unknown (Manitoba Rock and Mineral Show).
MAG200	Magnetite – nanopowder; synthetic ("Iron oxide (Fe_3O_4) Nanopowder") (MTI Corporation); 20 nm particle size; SOL-GEL manufacturing method; 99.5% purity, crystalline; >60 m^2/g specific surface area; 100 grams; certificate of analysis provided. ["Fe_3O_4-alpha nanopowder is stable in air"]; received June 8, 2010.

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9.2b. XRD Data - Magnetites

9.2b.1. University of Alberta analogue XRD files

Sample	*File*
MAG101	Z03221

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9.2c. Compositional Data – Magnetites (alphabetical order)

Wt.%	MAG101	MAG101	MAG101	MAG101	MAG101
P_2O_5		0.00			0.01
TiO_2	2.11	3.17	3.30	4.99	3.04
FeO	83.63[1]	86.09[1]			26.52[2]
Fe_2O_3					63.71[2]
Na_2O	0.00	0.44			
SiO_2	0.03	0.29	0.03	0.03	0.00
Cr_2O_3	0.00	0.00			0.03
CoO	0.00	0.00			0.00*
MgO	4.20	3.21	3.45	1.94	3.63
K_2O	0.00	0.02			0.00*
MnO	0.66	1.09			0.60
NiO	0.01	0.00			0.00*
ZnO		0.00			
Al_2O_3	0.53	0.37	1.67	0.31	0.33
V_2O_5		0.35			0.36*
CaO	0.00	0.00	0.03	0.04	0.00*
TOTAL	91.17	95.03			98.23
Source	U of A	U of A	U of A	U of A	U of C
Analysis	EMPA-1	EMPA-2	EMPA-4	EMPA-2	EMPA-6

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at the Univ. of Alberta, and Fe_2O_3 taken as difference between total Fe and FeO.
U of A: electron microprobe analysis at the University of Alberta.
* EMPA results from U of A.
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9.2c. Compositional Data - Magnetites (continued)

Wt. %	MAG102	MAG102^	MAG103^	MAG103	MAG104	MAG105	MAG106
P_2O_5	n.d.			n.d.	n.d.	n.d.	n.d.
Cr_2O_3	0.01	0.08	0.08	<0.01	0.02	<0.01	0.27
MnO	0.06	0.17	0.57	2.00	0.08	0.06	0.53
TiO_2	0.04	0.21	1.73	7.28	0.01	0.01	4.55
SiO_2	0.00	2.30	0.13	0.00	0.00	0.00	0.00
Al_2O_3	0.38	0.48	0.16	0.43	0.02	0.03	<0.01
(FeO)[1]	*(88.546)*	*(88.05)*	*(90.73)*	*(83.131)*	*(88.941)*	*(92.36)*	*(86.82)*
FeO[2]	28.37			28.80	29.44[3]	29.82[3]	
Fe_2O_3[2]	66.88			60.38	56.22[3]	59.22[3]	
MgO	0.61	0.36	0.00	<0.01	0.13	0.01	0.35
Na_2O	0.00			0.00	0.00	0.00	0.00
K_2O	n.d.			n.d.	n.d.	n.d.	n.d.
CoO	n.d.			n.d.	n.d.	n.d.	n.d.
CaO	0.00	0.42	0.06	0.00	0.00	0.00	0.00
NiO	0.03	0.23	0.21	<0.01	0.00	0.00	0.06
V_2O_5	0.17			0.05	0.03	0.03	0.26
ZnO	0.03	0.04	0.08	0.42	3.80	0.00	<0.01
TOTAL	96.58	92.34	93.75	99.37	93.03	92.49	92.84
Source	U of M	U of A	U of A	U of M	U of M	U of M	U of M
Analysis	EMPA-12	EMPA-6	EMPA-6	EMPA-9	EMPA-6	EMPA-6	EMPA-5

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 taken as difference between total and ferrous iron.
3. FeO determined by wet chemistry at Franklin and Marshall College by Stan Mertzman (WC); Fe_2O_3 taken as difference between total and ferrous iron.

U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined.
* = University of Alberta EMPA analysis.
^ = sample analyzed in two runs.
++

9.2c. Compositional Data - Magnetites (continued)

Wt. %	MAG107	MAG108	MAG109	MAG110	MAG111	MAG112	MAG113	MAG114
P_2O_5		n.d.	n.d.	n.d.		n.d.	n.d.	n.d.
Cr_2O_3		<0.01	0.00	<0.01	0.01	0.01	<0.01	<0.01
MnO		0.24	1.77	0.24	4.41	0.04	0.01	0.10
TiO_2		0.06	11.29	0.01	4.42	0.04	0.38	0.10
SiO_2		0.00	0.00	0.00	0.39	0.00	0.00	0.00
Al_2O_3		0.13	3.87	0.08	4.28	0.18	1.39	0.06
(FeO)[1]		*(90.34)*	*(73.35)*	*(91.86)*	*(71.25)*	*(91.36)*	*(88.63)*	*(89.86)*
FeO[2]	28.25[4]	21.51[3]	20.76[3]	19.08[3]	17.1[3]	26.81[3]	19.39[3]	1.21[3]
Fe_2O_3[2]		66.44[3]	50.28[3]	70.66[3]	52.25[3]	61.56[3]	67.08[3]	88.52[3]
MgO		1.48	6.74	0.00	6.81	0.02	0.43	<0.01
Na_2O		0.00	0.00	0.00	0.36	0.00	0.00	0.00
CaO		0.00	0.00	0.00	0.09	0.00	0.00	0.00
NiO		0.00	0.00	0.01	0.03	0.09	0.02	0.02
V_2O_5		0.00	0.35	0.03	0.00	0.01	0.03	0.03
ZnO		0.00	0.01	0.00	0.11	0.02	0.00	0.07
TOTAL		92.24	97.39	92.23	92.15	91.77	90.89	90.24
Source	Mertzman	U of M	U of M	U of M	U of M	U of M	U of M	U of M
Analysis	WC	EMPA-6	EMPA-6	EMPA-5	EMPA-4	EMPA-7	EMPA-7	EMPA-6

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 taken as difference between total and ferrous iron.
3. FeO determined by wet chemistry at Franklin and Marshall College by Stan Mertzman (WC); Fe_2O_3 taken as difference between total and ferrous iron.
4. FeO determined by wet chemistry at Franklin and Marshall College by Stan Mertzman (WC).

U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined.
* = University of Alberta EMPA analysis.
++

9.2c. Compositional Data - Magnetites (continued)

Wt. %	MAG116	MAG117	MAG118	MAG119	MAG120	MAG121	MAG122
P_2O_5		n.d.	n.d.				
Cr_2O_3	0.00	0.01	0.01	0.01	0.00	0.01	0.01
MnO	0.28	0.02	0.02	0.07	0.01	0.04	0.08
TiO_2	0.00	1.24	0.13	0.10	0.04	0.25	0.03
SiO_2	0.00	0.00	0.00	0.01	0.03	0.07	1.97
Al_2O_3	4.24	0.57	0.19	0.21	0.17	0.54	0.08
(FeO)[1]	*(10.04)*	*(86.73)*	*(91.35)*	*(90.01)*	*(89.17)*	*(89.75)*	*(86.81)*
FeO[2]		11.69[3]	23.5[3]	22.66[3]	19.51[3]	22.43[3]	3.98[3]
Fe_2O_3[2]		73.74[3]	65.23[3]	64.83[3]	67.49[3]	64.82[3]	82.39[3]
MgO	12.90	1.04	0.07	0.23	0.18	0.32	1.00
Na_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.02
CaO	0.00	0.00	0.00	0.01	0.02	0.01	0.30
NiO	0.00	0.05	0.04	0.03	0.07	0.05	0.07
V_2O_5	0.00	0.57	0.31	0.21	0.22	0.18	0.17
ZnO	0.00	0.01	0.00	<0.01	0.07	0.03	<0.01
TOTAL	27.46	90.27	92.11	90.76	89.98	91.24	90.53
Source	U of M	U of M	U of M	U of M	U of M	U of M	U of M
Analysis	EMPA-6	EMPA-5	EMPA-5	EMPA-4	EMPA-1	EMPA-4	EMPA-4

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 taken as difference between total and ferrous iron.
3. FeO determined by wet chemistry at Franklin and Marshall College by Stan Mertzman (WC); Fe_2O_3 taken as difference between total and ferrous iron.

U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined.
* = University of Alberta EMPA analysis.
++

9.2c. Compositional Data - Magnetites (continued)

Wt. %	MAG200
Ca	<0.01
Cl	<0.07
Cr	<0.002
H20	<0.20
K	<0.001
Mg	<0.008
Mn	<0.3
Na	<0.005
Ni	<0.01
Pb	<0.001
SiO2	<0.02
SO_4^{2-}	<0.05

Analysis from MTI Corp.

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9.2d. Spectral Data - Magnetites

Sample	*Facility/File No.*	*Description*
MAG101	RELAB C1SC25	45-90µm, 0E/15E, 0.34-2.7µm, 5 nm.
MAG101	RELAB C2SC25	45-90µm, 0E/15E, 0.3-2.6µm, 5 nm, with errors.
MAG101	RELAB CBSC25	<45µm, 0E/15E, 0.3-2.6µm, 5 nm.
MAG101	RELAB CASC25	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG101	RELAB LASC25	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
MAG102	RELAB CAMG02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG102	RELAB LAMG02	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG102	PSF 100420a.007	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100420_carbon).
MAG102	PSF Mag_102.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG103	RELAB CAMG03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG103	RELAB LAMG03	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG103	PSF 050707mag103	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
MAG103	PSF 120707mag103	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
MAG103	PSF mag103	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
MAG103	PSF Mag_103.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG104	RELAB CAMG04	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG104	RELAB LAMG04	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG104	PSF Mag_104.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG105	RELAB CAMG05	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG105	RELAB LAMG05	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG105	PSF Mag_105.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG106	RELAB CAMG06	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG106	RELAB LAMG06	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
MAG107	RELAB CAMG07	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG107	RELAB LAMG07	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG107	PSF Mag_107.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG108	RELAB CAMG08	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG108	RELAB LAMG08	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm

		(RELAB+Nicolet) note different viewing geometries.
MAG108	PSF Mag_108.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG109	RELAB CAMG09	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG109	RELAB LAMG09	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG109	PSF Mag_109.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG110	RELAB CAMG10	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG110	RELAB LAMG10	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG110	PSF Mag_110.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG111	RELAB CAMG11	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG111	RELAB LAMG11	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG111	PSF Mag_111.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG112	RELAB CAMG12	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG112	RELAB LAMG12	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG112	PSF Mag_112.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
MAG112	PSF jul1306.005	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).
MAG112	PSF amag112	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
MAG112	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
+++++++		
MAG113	RELAB CAMG13	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG113	RELAB LAMG13	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG113	PSF Mag_113.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG114	RELAB CAMG14	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG114	RELAB LAMG14	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG114	PSF Mag_114.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG115	RELAB CAMG15	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG115	RELAB LAMG15	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG115	PSF Mag_115.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG116	RELAB CAMG16	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG116	RELAB LAMG16	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.

MAG116	PSF Mag_116.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG117	RELAB CAMG17	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG117	RELAB LAMG17	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG117	PSF Mag_117.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG118	RELAB CAMG18	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG118	RELAB LAMG18	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG118	PSF Mag_118.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG119	RELAB CAMG19	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG119	RELAB LAMG19	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG119	PSF Mag_119.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG120	RELAB CAMG20	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG120	RELAB LAMG20	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG120	PSF Mag_120.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG121	RELAB CAMG21	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG121	RELAB LAMG21	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG121	PSF Mag_121.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG122	RELAB CAMG22	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MAG122	RELAB LAMG22	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
MAG122	PSF Mag_122.spec	<45 µm; 198-1132 nm; i=30°, e=0°; 0.42-0.48 nm resolution; Maya spectrometer (Directory: Maya_MAG20713).
+++++++		
MAG200	PSF 100616a.011	20 nm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged, ASD (Directory: 100615_crypto; 100615_nano).

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9.2d.1. Magnetites: Polynomial (quadratic) fits to 1 micron band (RELAB spectra)

Equation $y=a+bx+cx^2$
Differentiate & solve for x at y=0 i.e. 0=-b+2cx, b=2cx
Band depth, solve for y (if normalized only)

Sample	*Poly. Coeff's*			*Band*	*Band*	*Grain*	*Compil.*	*Channels*
	a	*b*	*c*	*Min(µm)*	*Depth%*	*Size (µm)*	*& File#*	*Fitted*
MAG101	.3993	-.6822	.3328	1.025		45-90	brown1a-158	131-149
MAG101/s.l.	2.262	-2.768	1.257	1.101	26.2	45-90	brown1b-192	120-190

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END of 9.2.

9. Oxides

9.3. Chromites

9.3a. Sample Descriptions - Chromites

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
CHR101	Chromite: Valley Springs, Calaveras County, California, USA (Minerals Unlimited).
CHR102	Chromite: Springwater Intrusion, Montana, USA (U. of Hawaii collection #10-3-10), with olivine OLV021.
CHR103	Chromite: El Dorado, El Dorado County, California, USA (Minerals Unlimited); w/ uvarovite garnet (GAR105).
CHR104	Chromite: Manila Bay, The Philippines (Minerals Unlimited). With serpentine ("spotted leopard ore").
CHR105	Chromite: Red Ledge Mine, Washington, Nevada County, California, USA (Minerals Unlimited).
CHR106	Chromite: Jacksonville, Tuolumne County, California, USA (with uvarovite) (Minerals Unlimited)
CHR107	Chromite: Placer County, California, USA (with uvarovite garnet (GAR109)) (Minerals Unlimited).
CHR108	Chromite: Headwaters of the San Benito River, San Benito County, California, USA (Minerals Unlimited).
CHR109	Chromite: El Dorado County, California, USA (Excalibur Mineral Co.).
CHR110	Chromite: Delight Quarry, Reistertown, Baltimore County, Maryland, USA (Minerals Unlimited).

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9.3a.1. Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

hand sample16	**Chromite	ActLabs

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9.3b. XRD Data - Chromites

9.3b.1. Analogue files from U of A instrument

None.
+++++++

9.3b.2. University of Manitoba files:

CHR101	XRD shows either coulsonite (FeV_2O_4) or nichromite ($NiCr_2O_4$) or magnesiochromite ($(Mg,Fe)(Cr,Al)_2O_4$) plus minor clinochlore ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$).
CHR103	XRD shows mostly magnesiochromite with minor andradite and perhaps magnetite.
CHR104	XRD shows only spinel.
CHR105	XRD shows magnesiochromite ($(Mg,Fe)(Cr,Al)_2O_4$) plus some minor clinochlore ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$).

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9.3c. Compositional Data – Chromites (alphabetical order)

Wt.%	CHR101	CHR101	CHR101	CHR102	CHR102	CHR102
SiO_2	0.23	0.00		0.13		0.07
Al_2O_3	10.87	10.98		18.75		19.73
MgO	14.50	13.62		9.11		9.88
CaO	0.09	0.09		0.08		0.05
TiO_2	0.12	0.15		0.84		0.67
(FeO)[1]	*15.11*	*(14.97)*	*(14.97)*	*(27.94)*	*(27.94)*	*27.91*
FeO[2]		10.93	14.47	22.63	25.27	
Fe_2O_3[2]		3.83	0.56	5.90	2.97	
MnO	0.15	0.26		0.35		0.52
K_2O	0.00	0.00		0.00		0.06
P_2O_5	0.00	tr.		tr.		0.00
Cr_2O_3	56.70	57.56		40.98		40.92
CoO	0.00	0.00		0.00		0.00
NiO	0.23	0.23		0.00		0.00
ZnO	0.10					0.00
V_2O_5	0.20	0.19		0.28		0.23
Na_2O	1.68					1.51
TOTAL		97.84		99.05		
Source	U of A	U of C	U of A	U of C	U of A	U of A
Analysis	EMPA-2	EMPA-6	WC	EMPA-6	WC	EMPA-1

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at Univ. of Alberta (WC); Fe_2O_3 taken as difference between total and ferrous iron.
U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta; # of analytical points indicated.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined.
tr.: trace (<0.01 wt.%).

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9.3c. Compositional Data - Chromites (continued)

Wt. %	CHR103	CHR103^	CHR104^	CHR104	CHR105	CHR106
P_2O_5	n.d.			n.d.	n.d.	n.d.
Cr_2O_3	63.10	62.85	35.87	35.80	51.28	56.66
MnO	0.31	0.32	0.20	0.20	0.29	0.62
TiO_2	0.05	0.06	0.25	0.06	0.36	0.14
SiO_2	0.02	tr.	0.16	<0.01	0.02	0.06
Al_2O_3	6.99	6.78	30.07	30.05	17.07	9.89
(FeO)[1]	*(16.14)*	*(16.08)*	*(13.12)*	*(13.41)*	*(15.75)*	*(21.01)*
FeO[2]	11.94			10.46	13.23	15.55
Fe_2O_3[2]	4.66			3.28	2.80	6.07
MgO	12.16	11.88	17.43	17.42	13.44	10.26
Na_2O	0.00			0.00	0.00	0.00
K_2O	n.d.			n.d.	n.d.	n.d.
CoO	n.d.			n.d.	n.d.	n.d.
CaO	0.03	0.00	0.01	<0.01	<0.01	<0.01
NiO	0.10	0.07	0.32	0.25	0.12	0.06
ZnO		tr.	0.07			
V_2O_5	0.20			0.05	0.26	0.14
TOTAL	99.56	98.04	97.40	97.57	98.87	99.45
			NUMBER OF IONS ON THE BASIS OF 32 OXYGENS			
V	0.035			0.008	0.043	0.025
Ti	0.010			0.011	0.068	0.029
Si	0.006			0.000	0.005	0.017
Cr	13.149			6.733	10.248	12.451
Al	2.171			8.421	5.084	2.159
Fe^{3+}	0.928			0.587	0.533	1.269
Mn	0.070			0.040	0.062	0.145
Fe^{2+}	2.632			2.081	2.796	3.614
Mg	4.778			6.179	5.065	4.252
Co	--			--	--	--
Ca	0.008			0.000	0.000	0.000
Ni	0.021			0.047	0.024	0.013
Na	0.000			0.000	0.000	0.000
Total	23.808			24.107	23.928	23.974
Source	U of M	U of A	U of A	U of M	U of M	U of M
Analysis	EMPA-8	EMPA-6	EMPA-6	EMPA-5	EMPA-4	EMPA-6

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 taken as difference between total and ferrous iron.
U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta; # of analytical points indicated.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined.
tr.: trace (<0.01 wt.%).
^ = samples analyzed in two EMPA runs.
++

9.3c. Compositional Data - Chromites (continued)

Wt. %	CHR107	CHR108	CHR109	CHR110
P_2O_5	n.d.	n.d.	n.d.	
Cr_2O_3	63.99	52.06	58.84	
MnO	0.31	0.25	0.31	
TiO_2	0.13	0.28	0.32	
SiO_2	0.01	0.01	<0.01	
Al_2O_3	5.49	16.78	8.51	
(FeO)[1]	*(16.62)*	*(14.22)*	*(17.36)*	
FeO[2]	13.63	12.94	14.24	
Fe_2O_3[2]	3.32	1.42	3.47	
MgO	12.40	14.35	12.36	
Na_2O	0.00	0.00	<0.01	
K_2O	n.d.	n.d.	n.d.	
CoO	n.d.	n.d.	n.d.	
CaO	<0.01	0.00	<0.01	
NiO	0.10	0.11	0.08	
V_2O_5	0.10	0.20	0.14	
TOTAL	99.48	98.40	98.27	
			NUMBER OF IONS ON THE BASIS OF 32 OXYGENS	
V	0.017	0.041	0.030	
Ti	0.026	0.053	0.064	
Si	0.002	0.002	0.000	
Cr	13.497	10.424	12.387	
Al	1.726	5.006	2.670	
Fe^{3+}	0.667	0.271	0.696	
Mn	0.071	0.053	0.070	
Fe^{2+}	3.041	2.741	3.173	
Mg	4.932	5.419	4.907	
Co	--	--	--	
Ca	0.000	0.000	0.000	
Ni	0.021	0.023	0.018	
Na	0.000	0.000	0.000	
Total	24.000	24.033	24.015	
Source	U of M	U of M	U of M	
Analysis	EMPA-6	EMPA-5	EMPA-10	

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 taken as difference between total and ferrous iron.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined.
tr.: trace (<0.01 wt.%).

++

9.3c. Compositional Data - Chromites (continued)

9.3c.1. Fe^{+3}/Fe_{Tot} (ferric iron/total iron) from Dick Morris using Mossbauer spectroscopy:

Sample	*Ferric/Total iron*
CHR101	0.23
CHR102	0.19
CHR103	0.26
CHR104	0.22
CHR105	0.16
CHR107	0.18
CHR108	0.09
CHR109	0.18

To use these values, we multiply the total FeO number in the sample by the percentage that is ferric (from the Mossbauer) and by 1.1113 to allow for the extra oxygen this entails.

As an example, consider HER101. It has 20.79% FeO as determined by FeO, and a ferric/total iron ratio of 0.27.

Therefore we break this total down as follows:

(1-0.27) * 20.79% FeO = 0.73 * 20.79 = 15.18% FeO
0.27 * 20.79% FeO * 1.1113 = 6.24% Fe_2O_3.
++

9.3d. Spectral Data - Chromites

Sample	*Facility/File No.*	*Description*
CHR101	RELAB CACR11	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR101	RELAB LACR11	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
CHR102	RELAB CACR12	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR102	RELAB LACR12	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
CHR103	RELAB CACR13	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR103	RELAB LACR13	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
CHR104	RELAB CACR14	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR104	RELAB LACR14	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
CHR105	RELAB CACR15	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR105	RELAB LACR15	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
CHR106	RELAB CACR16	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR106	RELAB LACR16	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
CHR107	RELAB CACR17	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR107	RELAB LACR17	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
CHR108	RELAB CACR18	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR108	RELAB LACR18	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
CHR109	RELAB CACR19	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CHR109	RELAB LACR19	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.

++

END of 9.3.

9. Oxides

9.4. Perovskites

9.4a. Sample Descriptions - Perovskites

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
PER101	*Perovskite: Red Head Lease, San Benito County, California. USA. With andradite garnet (GAR107; garnet too intimate and fine grained to separate) (David Shannon Minerals).*
PER102	Perovskite: Magnet Cove, Arkansas, USA (Ward's via U. Of Alberta GEOL330 lab collection) *(little sample available).*
PER103	Perovskite: synthetic $CaTiO_3$ (ESPI Corp., #K1005G). <45µm sample by crushing and dry sieving (?). Sample left.
PER120	Perovskite: Tapira, Brazil (#54-C-1) (Bjarne Gautason) *[no perovskite grains exposed on "others" microprobe disc]*.
PER121	Perovskite: Serra Negra, Minas Gerais, Brazil (#89-B-5), from a massive perovskite/magnetite in carbonatite; annealed in argon (Bjarne Gautason)
PER122	Perovskite: Ice River Complex, BC, Canada (Bjarne Gautason); >90% perovskite.
PER123	Perovskite: Achmatowsk, Ural Mountains, Russia; in chlorite (Bjarne Gautason and The Collector's Edge - 402 Gladiola St., Golden, CO [303 278 9724]).
PER124	Perovskite (cerian): Afrikanda, Kola, Russia. In hornblende, with magnetite and titanite (David Shannon) *[no perovskite grains exposed on "others" microprobe disc, probably just seeing hornblende]*.

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9.4b. XRD Data - Perovskites

9.4b.1. Analogue files from U of A instrument.

Sample	XRD File
PER101	Z03225

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9.4c. Compositional Data – Perovskites (alphabetical order)

Wt. %	PER101	PER101	PER101	PER120	PER121 AP	PER121 OD
P_2O_5	0.02	0.01	0.15			
Cr_2O_3	0.09	0.00	0.00		0.00	0.00
MnO	0.12	0.00	0.07		0.01	tr.
TiO_2	55.72	59.15	59.19		63.13	63.02
SiO_2	0.05	tr.	0.17		0.00	0.00
Al_2O_3	0.00	0.09	0.18		0.04	0.07
(FeO)[1]	*(0.40)*	*(0.07)*	*(0.21)*	*(3.20)*	*(0.91)*	*(1.07)*
FeO[2]	n.d.			n.d.	0.85	
Fe_2O_3[2]	n.d.			n.d.	0.05	
MgO	0.00	0.04	0.00		0.00	0.02
Na_2O		0.10	0.00		0.35	0.43
K_2O			0.00			
ZrO_2		0.00[3]				
Nb_2O_5		0.04[3]				
CaO		42.26	42.21		37.81	37.34
NiO		0.02	0.10		0.01	tr.
V_2O_5			0.37		0.39	0.38
CoO			0.07			
ZnO			0.00		0.00	0.00
Cl		0.03				
TOTAL		99.24			102.64	102.33

NUMBER OF IONS ON THE BASIS OF 24 OXYGENS

Ca	8.364					
Ti	7.740					
P	0.003					
Nb	0.003					
Si	0.009					
Zr	--					
Cr	0.013					
Al	--					
Fe^{3+}	--					
Mn	0.019					
Fe^{2+}	0.062					
Mg	--					
Ni	0.003					
Na	0.035					
Total	16.251					
Source	U of C	U of A	U of A	???	U of M	U of M
Analysis	EMPA-8	EMPA-1	EMPA-2	???	EMPA-5	EMPA-6

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 taken as difference between total and ferrous iron.
3. Average of 7 analyses.

U of C: electron microprobe analysis at the University of Calgary; # of analytical points indicated.
U of A: electron microprobe analysis at the University of Alberta.
U of M: electron microprobe analysis at the University of Manitoba.
n.d.: not determined. tr.: trace (<0.01 wt.%).
* = University of Alberta EMPA analysis.
++

9.4c. Compositional Data - Perovskites (continued)

Wt.%	PER122 OD	PER122 OD	PER122 AP	PER123 OD
Na_2O	0.44	0.37	0.39	0.42
SiO_2	0.00	0.00	0.00	0.00
MgO	0.02	0.01	0.02	0.01
Al_2O_3	0.06	0.06	0.06	0.06
TiO_2	60.48	64.01	60.59	60.11
CaO	37.55	37.77	37.51	37.43
V_2O_3	0.40	0.30	0.39	0.39
Cr_2O_3	tr.	0.00	0.00	tr.
NiO	tr.	0.00	0.01	0.01
(FeO)[1]	*1.10*	*0.75*	*(1.08)*	*(1.07)*
FeO[2]			1.08	1.07
Fe_2O_3			0.00	0.00
MnO	0.01	tr.	0.00	tr.
ZnO	0.00	0.00	0.00	0.00
TOTAL	100.07	103.28	100.04	99.49
Source	U of M	U of M	U of M	U of M
Analysis	EMPA-7	EMPA-6	EMPA-6	EMPA-8

1. (FeO): all Fe reported as FeO.
2. FeO determined by wet chemistry at University of Alberta; Fe_2O_3 taken as difference between total and ferrous iron.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of M: electron microprobe analysis at the University of Manitoba.

tr.: trace (<0.01 wt.%).

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9.4d. Spectral Data - Perovskites

Sample	*Facility/File No.*	*Description*
PER101	RELAB C1SC73	<45µm, 0E/15E, 0.3-2.7µm, 5 nm.
PER101	RELAB CASC73	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PER101	RELAB LASC73	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
PER102	RELAB CAPV02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PER102	RELAB LAPV02	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
PER103	RELAB CAPV03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PER103	RELAB LAPV03	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
PER120	RELAB CAPV20	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PER120	RELAB LAPV20	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
PER121	RELAB CAPV21	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PER121	RELAB LAPV21	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
PER122	RELAB CAPV22	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PER122	RELAB LAPV22	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
PER123	RELAB CAPV23	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PER123	RELAB LAPV23	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
PER124	RELAB CAPV24	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PER124	RELAB LAPV24	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.

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END of 9.4.

9. Oxides

9.5. Ilmenites

9.5a. Sample Descriptions - Ilmenites

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
ILM101	Ilmenite: KrageroN, Telemark, Norway (Minerals Unlimited) (ideally $FeTiO_3$).
ILM102	Ilmenite: St. Urbain, Quebec, Canada ($FeTiO_3$) (National Museum of Nature, Ottawa).
ILM103	Ilmenite: Old Mica Mine, near Saluda, Saluda County, South Carolina, USA ($FeTiO_3$); with mica (MIC001), and hematite (too minor to separate) (Minerals Unlimited; received April 5/05).
ILM110	Ilmenite, var. menaccanite: Egersund, Norway (Excalibur Mineral Co., received June 3/05; their no. 3510 - Michigan College of Mines).
ILM111	Ilmenite, var. iserine: Iserweise (Izerska Louka), Bohemia, Czech Republic (Excalibur Mineral Co., received June 3/05).
ILM112	Ilmenite: Riverside County, California, USA; ilmenite ore. (Excalibur Mineral Co., label information: Mt 63B SP; Hmt 50B, Psp; Ilmt 50c, Mag 1c; AWP 1709 (one); AW Pinger Collection; received June 3/05).
ILM113	Ilmenite: E. of Hartwell Dam, Anderson County, South Carolina, USA (Excalibur Mineral Co., received June 3/05).
ILM114	Ilmenite: Rock Flat, near McCall, Idaho, USA (Excalibur Mineral Co., received June 3/05).
ILM115	Ilmenite: Tellnes, Norway (Excalibur Mineral Co., received June 3/05).
ILM116	Ilmenite: Sorel, Quebec, Canada (Excalibur Mineral Co., received June 3/05).
ILM117	Ilmenite: Glidden M., Lenoir, Caldwell County, North Carolina, USA (Excalibur Mineral Co., label info: 50 C, AWP 1719 (non-mag) (one); [A.W. Pinger Collection?]; received June 3/05).
ILM118	Ilmenite: Chester Emry Mine, Chester, Massachusetts, USA; with corundophyllite (Excalibur Mineral Co., received June 3/05).
ILM119	Ilmenite: Valle di Susa, Torino Piemonte, Italy; with albite and clinochlore (Excalibur Mineral Co., received June 3/05).
ILM120	Ilmenite: Antisirabe District, Madagascar (Excalibur Mineral Co., received June 3/05).
ILM121	Ilmenite: Graves Mountain, Lincoln County, North Carolina, USA (Excalibur Mineral Co., received June 3/05).
	++++++++++*received Feb. 2010 (from Caroline Morisset)*++++++
ILM151	Caroline Morisset sample #2006-C1; Bignell deposit, St. Urbain, QC, Canada area. XRF data, powdered sample and thin section images available. Received as powder. (Label on vial: "2006-C1; Ilmenite M 0.2 (almost pure)").
ILM152	Caroline Morisset sample #2006-D1; Bignell deposit, St. Urbain, QC, Canada area. XRF data, powdered sample and thin section images available. Received as powder. (Label on vial: "2006-D1; Ilmenite M 0.2 (almost pure)").
ILM153	Caroline Morisset sample #2009-B1; Coulomb West deposit, St. Urbain, QC, Canada area. XRF data, powdered sample and thin section images available. Received as powder. (Label on vial: "2009-B1; Ilmenite M 0.2 (almost pure)").
ILM154	Caroline Morisset sample #2015-B4; Coulomb East deposit, St. Urbain, QC, Canada area. XRF data, powdered sample and thin section images available. Received as powder. (Label on vial: "2015-B4; Ilmenite M 0.2 LClé Ba+ (pure)").
ILM155	Caroline Morisset sample #2030-B2; General Electric deposit, St. Urbain, QC, Canada area. XRF data, powdered sample and thin section images available. Received as powder. (Label on vial: "2030-B2; Ilmenite M 0.3 (almost pure)").
ILM156	Caroline Morisset sample #2036-D2; Furnace deposit, St. Urbain, QC, Canada area. XRF data, powdered sample and thin section images available. Received as powder. (Label on vial: "2036-

D2; Ilmenite M 0.2 Lclé Ba+ (pure)").

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ILM200 Synthetic ilmenite (Sigma Aldrich, iron (II) titanate, -100 mesh; prod. no. 400874. Received from Miriam Riner and Mark Robinson, Arizona State U., Sept. 25/07.

ILM201 Synthetic ilmenite (Sigma Aldrich, iron (II) titanate, -100 mesh; prod. no. 400874. Received directly from Sigma Aldrich May 20, 2009 [100 grams].

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Grain size information on ilmenite from Brammer: <75 μm: 99.20%

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9.5b. XRD Data - Ilmenites

9.5b.1. Analogue files from U of A instrument

Sample	XRD File
ILM101	Z03220

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9.5.b.2. Powder XRD scans at UWinnipeg with Bruker D8

Sample	Phases identified	
	Very likely	Less likely
ILM101	Hematite	Ilmenite
ILM103	Ilmenite	
ILM110	Magnetite-ulvospinel	
ILM111	Ilmenite	Ecandrewsite (syn ZnTiO3)
ILM112	Magnesiocoulsonite (syn. Mg2VO4)/magnetite titanian	
ILM113	Hematite	Ilmenite
ILM114	Ilmenite; nickel manganese titanium oxide (Ni.5 Mn.5)TiO3	
ILM115	Magnetite	
ILM116	Ilmenite	Hematite; nickel manganese titanium oxide (Ni.5 Mn.5)TiO3
ILM117	Chlorite-serpentine (Mg,Al)6(Si,Al)4O10 (OH)8	Ilmenite
ILM118	Margarite Ca2Li.21Mg.21Al8Si4O20(OH)4	
ILM119	Magnesiohornblende, Actinolite	
ILM120	Ilmenite	Magnetite
ILM121	Ilmenite	Hematite, iron oxide
ILM151	Ilmenite	
ILM152	Ilmenite	
ILM153	Ilmenite	
ILM154	Ilmenite	
ILM155	Ilmenite	
ILM156	Ilmenite	
ILM200	Ilmenite	

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9.5c. Compositional Data – Ilmenites (alphabetical order)

Wt. %	ILM101	ILM101	ILM101	ILM101	ILM101	ILM101	ILM101
P_2O_5	<0.01	0.00	n.d.			0.00	0.03
Cr_2O_3	0.02	0.00	n.d.		0.01	0.00	
MnO	0.02	0.13	n.d.		0.04	0.13	0.01
TiO_2	47.61	57.24	53.50	51.23	54.96	57.25	63.28
SiO_2	0.20	0.31	0.22	0.07	0.27	0.31	0.40
Al_2O_3	0.01	0.24	0.16	0.13	0.13	0.25	0.72
FeO[1]	42.79	35.79	40.41^	44.13^	37.92^	38.44^	33.05
Fe_2O_3[1] (Fe_2O_3)*	2.90	2.90					1.38
MgO	0.01	0.13	0.03	0.06	0.07	0.13	0.43
Na_2O	n.d.	0.00	n.d.		0.08	0.00	0.41
K_2O	n.d.	0.00	n.d.		0.00	0.00	0.01
CoO	n.d.	0.00	n.d.		0.04	0.00	
CaO	n.d.	0.00	0.07	0.00	0.05	0.00	0.15
NiO	n.d.	0.00	n.d.		tr.	0.00	
V_2O_5	n.d.	0.51	n.d.			0.50	
ZnO_2	n.d.	0.00	n.d.			0.00	
TOTAL	93.56	97.25	94.39	95.62	93.57	97.01	99.87
ppm							
Sr							45
Zr							50
V							632
Cr							75
Co							<2
Source	Uof C	UofA	UofA	U of A	U of A	U of A	Mertzman
Analysis	EMPA-8	EMPA-8	EMPA-4	EMPA-1	EMPA-3	EMPA-2	XRF/WC

* - all Fe reported as Fe_2O_3.

^ - all Fe reported as FeO.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

n.d. = not determined. tr.: trace (<0.01 wt.%).

n.d.: not determined. Tr.: trace (<0.01 wt.%).

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9.5c. Compositional Data - Ilmenites (continued)

Wt. %	ILM102	ILM102	ILM103	ILM110	ILM111	ILM112	ILM113
SiO_2	0.85	0.61	0.09	0.18	0.00	2.92	0.22
TiO_2	52.49	50.69	64.20	0.17	54.59	35.01	31.74
Al_2O_3	0.83	0.94	0.28	0.99	1.35	5.33	0.54
*(Fe_2O_3)**							
Fe_2O_3[1]	26.64	18.61	1.32	78.14	13.00	29.86	50.55
FeO[1]	15.78	24.64	31.60	0.00	25.66	22.01	15.20
MnO	0.25	0.12	1.19	14.01	0.21	0.22	0.46
MgO	2.42	2.72	0.43	1.35	4.17	3.30	0.60
CaO	0.21	0.32	0.07	0.06	0.07	0.13	0.05
Na_2O	0.10	0.61	0.39	4.59	0.32	0.27	0.23
K_2O	0.08	0.08	0.03	0.01	0.01	0.03	0.02
P_2O_5	0.08	0.12	0.03	0.04	0.04	0.10	0.06
TOTAL	99.63	99.46	99.63	99.54	99.42	99.18	99.67
ppm							
Sr	5	50	26	41	23	28	21
Zr	135	294	23	53	395	115	36
V	1405	1426	<5	42	1262	2354	936
Cr	<5	465	5	25	120	410	100
Co		110	<2	<2	75	215	<2
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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9.5c. Compositional Data - Ilmenites (continued)

Wt. %	ILM114	ILM115	ILM116	ILM117	ILM118	ILM119	ILM120	ILM121
SiO_2	1.53	0.32	0.90	20.41	25.81	52.31	0.64	0.47
TiO_2	58.45	27.40	49.39	29.93	4.26	1.89	30.68	5.75
Al_2O_3	5.09	4.64	1.74	7.84	37.75	10.25	5.60	0.78
*(Fe_2O_3)**								
Fe_2O_3[1]	2.76	33.84	14.48	0.51	10.75	1.80	20.82	90.73
FeO[1]	27.46	30.49	29.31	19.87	7.72	8.94	32.08	0.96
MnO	0.76	0.18	0.07	0.12	0.09	0.30	0.17	0.02
MgO	1.95	2.48	2.64	9.89	0.72	8.92	2.05	0.69
CaO	0.50	0.05	0.22	5.32	6.26	8.34	0.07	0.05
Na_2O	0.45	0.19	0.38	0.26	2.14	3.62	0.24	0.02
K_2O	0.02	0.01	0.02	0.49	0.21	0.10	0.01	0.01
P_2O_5	0.05	0.04	0.03	0.36	0.03	0.20	0.04	0.17
TOTAL	99.12	99.64	99.18	99.55	99.69	99.73	99.43	99.65
ppm								
Sr	38	20	35	180	395	82	25	118
Zr	401	79	223	290	164	183	99	37
V	517	3230	1773	1393	383	409	3630	2744
Cr	2050	450	410	1405	101	465	2920	310
Co	5	310	32	105	<2	<2	15	<2
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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9.5c. Compositional Data - Ilmenites (continued)

Wt%	ILM151	ILM152	ILM153	ILM154	ILM155	ILM156
SiO_2	0.06	bd	0.04	0.14	0.05	bd
TiO_2	42.71	45.27	44.62	47.39	44.31	39.38
Al_2O_3	0.04	0.00	0.03	0.03	0.07	0.00
V_2O_3	0.28	0.27	0.29	0.30	0.26	0.36
Cr_2O_3	0.08	0.47	0.15	0.18	0.13	0.08
(Fe_2O_3)*	58.14	53.56	55.32	52.02	55.31	61.59
MnO	0.17	0.21	0.16	0.16	0.17	0.14
ZnO	0.01	0.01	0.01	0.00	0.01	bd
MgO	2.44	2.99	2.73	3.22	3.14	2.22
CaO	0.01	0.04	0.01	0.02	0.02	0.01
LOI	-2.88	-3.10	-2.82	-3.17	-2.79	-3.14
TOTAL	101.06	99.71	100.53	100.28	100.69	101.24
Fe_2O_3	20.47	14.46	16.30	11.22	17.44	26.18
FeO	33.89	35.17	35.11	36.71	34.07	31.86
Si *apfu*	0.001	0.000	0.001	0.003	0.001	0.000
Ti	0.802	0.855	0.841	0.887	0.830	0.850
Al	0.001	0.000	0.001	0.001	0.002	0.000
V	0.006	0.005	0.006	0.006	0.005	0.007
Cr	0.002	0.009	0.003	0.003	0.003	0.001
Fe^{3+}	0.385	0.273	0.307	0.210	0.327	0.491
Fe^{2+}	0.708	0.739	0.736	0.764	0.710	0.665
Mn	0.004	0.004	0.003	0.003	0.004	0.003
Zn	0.000	0.000	0.000	0.000	0.000	0.000
Mg	0.091	0.112	0.102	0.120	0.117	0.082
Ca	0.000	0.001	0.000	0.001	0.001	0.000
Total	2.000	2.000	2.000	1.999	2.000	2.000
Xilm	79	84	83	88	81	73
Xhem	21	16	17	12	19	27
RO	45	46	46	47	45	43
R_2O_3	11	8	9	6	9	14
TO_2	44	46	46	47	45	43
Source	Morisset	Morisset	Morisset	Morisset	Morisset	Morisset

Notes: cations are calculated on the basis of 2 cations and Fe^{3+} and Fe^{2+}+Mg+Mn+Ti followed by a calculation based on 3 oxygens. Xilm (ilm/ilm+hem); Xhem (hem/hem+ilm); ilm (Ti-Mg-Mn+Al/2); hem (0.5*(Fe^{2+}+Fe^{3+}+Mg+Mn-Ti) (Lindsley and Frost, 1992). RO (MgO+CaO+MnO+ZnO+FeO); all in molar %); R_2O_3 (Al_2O_3+V_2O_3+Cr_2O_3+Fe_2O_3; all in molar %); TO_2 (TiO_2 in molar %).

* - all Fe reported as Fe_2O_3.

bd: below detection limit.

LOI: loss on ignition.

Morisset: analytical data provided by Caroline Morisset.

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9.5c. Compositional Data - Ilmenites (continued)

ILM151-156 – Trace Elements

ppm	ILM151	ILM152	ILM153	ILM154	ILM155	ILM156
Sc	39.95	42.89	66.57	62.13	35.41	44.41
V	2075	2010	2071	1962	1954	2573
Cr	599	3566	1116	1118	1029	511
Mn	1437	1875	1385	1357	1466	1185
Co	34.6	79.3	117.8	100.1	78.7	51.0
Ni	77	235	291	181	161	15
Cu	16	99	5	4	8	6
Zn	121	79	45	97	43	75
Rb	1.3	1.4	1.4	1.4	1.4	1.3
Sr	2.3	1.6	3.9	2.5	2.2	0.6
Y	0.50	0.28	0.47	0.49	0.26	0.26
Zr	31.45	19.94	22.77	22.43	41.67	66.68
Nb	20.79	1.52	1.36	2.38	3.94	30.48
Sn	7.20	2.81	0.91	0.70	4.06	5.20
La	0.341	0.187	0.309	0.436	0.149	0.085
Ce	0.802	0.374	0.913	1.372	0.303	0.216
Pr	0.104	0.044	0.120	0.169	0.040	0.031
Nd	0.427	0.164	0.543	0.751	0.156	0.143
Sm	0.087	0.032	0.127	0.169	0.034	0.030
Eu	0.051	0.010	0.050	0.044	0.014	0.007
Gd	0.095	0.003	0.093	0.114	0.035	0.032
Tb	0.015	0.005	0.018	0.019	0.006	0.004
Dy	0.091	0.034	0.086	0.087	0.035	0.018
Ho	0.019	0.007	0.016	0.015	0.007	0.004
Er	0.077	0.044	0.039	0.042	0.019	0.010
Tm	0.018	0.012	0.006	0.006	0.004	0.001
Yb	0.177	0.163	0.066	0.061	0.041	0.006
Lu	0.037	0.035	0.013	0.011	0.009	0.001
Hf	1.40	0.74	0.64	0.68	0.94	3.38
Ta	1.28	0.01	0.00	0.18	0.19	1.70
Pb	7.1	15.5	6.8	12.9	7.6	9.7
Th	0.023	0.015	0.034	0.064	0.016	0.018
U	0.044	0.078	0.002	0.003	0.007	0.007
Source	Morisset	Morisset	Morisset	Morisset	Morisset	Morisset

Morisset: analytical data provided by Caroline Morisset.
Trace element compositions (HR-ICP-MS) of ilmenite separates (from University of British Columbia); analyses by Caroline Morisset.
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9.5c. Compositional Data - Ilmenites (continued)

Wt. %	ILM201
P_2O_5	0.12
MnO	0.05
TiO_2	52.58
SiO_2	0.19
Al_2O_3	0.07
FeO[1]	42.12
Fe_2O_3[1]	0.22
(*Fe_2O_3*)*	*(47.03)*
MgO	0.01
Na_2O	0.10
K_2O	0.05
CaO	0.05
SO_3	0.06
TOTAL	100.31
LOI	0.79
ppm	
Sr	55
Zr	98
V	<3
Cr	267
Ni	85
Co	<2
Source	Mertzman
Analysis	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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9.5d. Spectral Data - Ilmenites

Sample	*Facility/File No.*	*Description*
ILM101	RELAB C1SC34	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
ILM101	PSF 150507ilm10145	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM101	PSF 150507ilm10190	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM101	PSF 110707ilm10145	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM101	PSF ilm10145	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
ILM101	PSF 110707ilm10190	45-90 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM101	PSF ilm10190	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
ILM101	PSF 290807.020	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM101	PSF 290807.021	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM101	PSF ilm101.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
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ILM102	PSF 041007ilm102	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM102	PSF 290807.022	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM102	PSF 290807.023	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
	++++***Grain size series***+++++	
ILM102	PSF 071201b.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.001-002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD.
ILM102	PSF 071201b.003	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.003-004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD.
ILM102	PSF 071201b.005	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.006	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.005-007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD.
ILM102	PSF 071201b.008	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.009	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.008-010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD.
ILM102	PSF 071201b.011	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.012	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
ILM102	PSF 071201b.011-013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD.
+++++++		
ILM103	PSF 041007ilm10345	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM103	PSF 041007ilm10390	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM103	PSF 041007ilm103250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM103	PSF 041007ilm103500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM103	PSF 041007ilm1031000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM103	PSF 121007ilm10345	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM103	PSF ilm10345	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
ILM103	PSF 121007ilm10390	45-90 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM103	PSF ilm10390	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
ILM103	PSF 121007ilm103250	90-250 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM103	PSF ilm103250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
ILM103	PSF 121007ilm103500	250-500 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM103	PSF ilm103500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.

ILM103	PSF 121007ilm1031000	500-1000 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM103	PSF ilm1031000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
ILM103	PSF 290807.024	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM103	PSF 290807.025	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM103	PSF ilm103.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
++++++++***ILM103 – single grain study: June 1, 2009***+++++		
ILM103	PSF 090601a.022	Al block "L" well: C grain (250-500 µm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.023	Al block "L" well: C grain (250-500 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured. ASD.
ILM103	PSF 090601a.024	Al block "L" well: C grain (250-500 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured. ASD.
ILM103	PSF 090601a.025	Al block "L" well: C grain (250-500 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured. ASD.
ILM103	PSF 090601a.026	Al block "L" well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.027	Al block "L" well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured. ASD.
ILM103	PSF 090601a.028	Al block "L" well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured. ASD.
	++++++	
ILM103	PSF 090601a.033	Al block 5 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.038	Al block 10 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.043	Al block 15 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. able), 100 avg., ASD.
ILM103	PSF 090601a.047	Al block 20 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.056	Al block 5 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.057	Al block 5 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
ILM103	PSF 090601a.065	Al block 10 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.066	Al block 10 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
ILM103	PSF 090601a.074	Al block 15 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.075	Al block 15 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD.
ILM103	PSF 090601a.083	Al block 20 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., ASD.
ILM103	PSF 090601a.084	Al block 20 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD; grain lost.
ILM103	PSF 090601a.092	Al block 25 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., ASD.
ILM103	PSF 090601a.093	Al block 25 mm deep well: D grain (500-1000 µm), i=0°/e=0° (bifurc. cable), 100 avg., grain shaken and remeasured, ASD; grain lost.
ILM103	PSF 090601a.112	45-90 µm single grain, Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 100 avg., ASD.
ILM103	PSF 090601a.113	90-250 µm single grain, Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.114	250-500 µm single grain (C grain), Al block 10 mm deep well, i=0°/e=0°

		(bifurc. cable), 100 avg., ASD.
ILM103	PSF 090601a.115	500-1000 µm single grain (D'' grain), Al block 10 mm deep well, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
	+++++++	
ILM103	PSF 090601a.139	45-90 µm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg., ASD.
ILM103	PSF 090601a.140	90-250 µm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
ILM103	PSF 090601a.141	250-500 µm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg., ASD.
ILM103	PSF 090601a.142	500-1000 µm bulk powder, i=0°/e=0° (bifurc. cable), 100 avg. ASD.
+++++++		
ILM110	PSF 290807.026	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM110	PSF 290807.027	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM110	PSF ilm110.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM111	PSF 290807.028	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM111	PSF 290807.030	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM111	PSF ilm111.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM112	PSF 290807.031	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM112	PSF 290807.032	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM112	PSF ilm112.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM113	PSF 290807.033	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM113	PSF 290807.034	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM113	PSF ilm113.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM114	PSF 290807.035	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM114	PSF 290807.036	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM114	PSF ilm114.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM115	PSF 300807.001	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM115	PSF 300807.002	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM115	PSF ilm115.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM116	PSF 300807.003	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM116	PSF 300807.004	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM116	PSF ilm116.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM117	PSF 300807.005	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM117	PSF 300807.006	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM117	PSF ilm117.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM118	PSF 300807.007	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM118	PSF 300807.008	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM118	PSF ilm118.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM119	PSF 300807.009	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM119	PSF 300807.010	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.

ILM119	PSF ilm119.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM120	PSF 300807.011	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM120	PSF 300807.012	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM120	PSF ilm120.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM121	PSF 300807.013	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM121	PSF 300807.014	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
ILM121	PSF ilm121.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM151	PSF 100305a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
ILM151	PSF 100304b.003	45-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avg; ASD.
ILM151	PSF ilm151.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM152	PSF 100305a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
ILM152	PSF 100304b.004	45-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avg; ASD.
ILM152	PSF ilm152.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM153	PSF 100305a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
ILM153	PSF 100304b.005	45-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avg; ASD.
ILM153	PSF ilm153.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM154	PSF 100305a.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
ILM154	PSF 100304b.006	45-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avg; ASD.
ILM154	PSF ilm154.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM155	PSF 100305a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
ILM155	PSF 100304b.007	45-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avg; ASD.
ILM155	PSF ilm155.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM156	PSF 100305a.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
ILM156	PSF 100304b.008	45-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avg; ASD.
ILM156	PSF ilm156.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
+++++++		
ILM200	PSF 041007ilm20045	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM200	PSF 041007ilm20090	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
ILM200	PSF 121007ilm20045	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM200	PSF ilm20045	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
ILM200	PSF 121007ilm20090	45-90 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
ILM200	PSF ilm20090	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
ILM200	PSF 100824b.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
ILM200	PSF ilm200.spec	<45 µm; 0°/0° (bifurcated probe); 0.42 nm resolution; Maya spectrometer (directory: 20130613).
ILM200	PSF 091006a.007	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD;

		aka LAN008.
ILM200	PSF 091021 LAN008	<45 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source; aka LAN008.
ILM200	PSF 091015 LAN008	<45 μm; i=0°/e=0° (bifurcated probe); 0.35-0.86 μm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source; aka LAN008.
ILM200	PSF LAN008 merged	Merged Oceaan Optics UV + visible spectra; aka LAN008.

++**END of 9.5.**++++++++++++++

9. Oxides

9.6. Other Oxides

9.6a. Sample Descriptions - Other Oxides

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

i) M_1O_2 Oxides: Rutile, anatase, brookite

BRO001 Brookite (TiO_2): Magnet Cove, AK, USA (trimorphous with anatase and rutile) [Rockaholics LLC, Tucson 2011 show] (M_1O_2 oxide).

CO2-1 Carbon dioxide, solid (dry ice); from Linde.

PIG007 Synthetic anatase (TiO_2). See Pigments section for details (M_1O_2 oxide). *See section 19 of this document for data.*

PIG008 Synthetic rutile (TiO_2). See Pigments section for details (M_1O_2 oxide). *See section 19 of this document for data.*

PIG201 Manganese (IV) oxide: MnO_2. Synthetic: 100 grams: -60 +230 mesh; 99%+. Aldrich #243442. *(Black pigment, affected by Raman laser heating. Ideally want beta MnO_2 (pyrolusite). See Smith and Clark (2001) art Raman article for context).* Oxidizing, harmful; harmful by inhalation and if swallowed; avoid contact with eyes; target organs: central nervous system, lungs (M_1O_2 oxide). *See section 19 of this document for data.*

PIG330 Titanium white/titanium dioxide (catalog no. 475-21S). 2 jars of 100 grams each. (white/yellow/orange group). *See section 19 of this document for data.*

PIG358 Pyrolusite, Mineral brown black (catalog no. 480-20S). 100 grams. (black/brown group). *See section 19 of this document for data.*

PRL101 Pyrolusite: Lake Valley, Sierra County, New Mexico, USA; in rock. ($-$Mn^{+4}O_2$) (Minerals Unlimited). *(For pigments project- black pigment affected by Raman heating - Smith and Clark)* (M_1O_2 oxide).

RUT101 Rutile: near Roseland, Nelson County, Virginia, USA (Minerals Unlimited) (ideally TiO_2) *(for pigments project)* (M_1O_2 oxide).

RUT102 Rutile: Kragero, Telemark, Norway (Minerals Unlimited) (ideally TiO_2) *(for pigments project)* (M_1O_2 oxide).

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ii) M_1O_2 Oxides: Carbon dioxide ice

CO2-1 Carbon dioxide pellets from Linde.

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iii) $M_{13}O_{19}$ Oxides: Hibonite

HIB101 Hibonite: Esiva, Fort Dauphine, Madagascar (Minerals Unlimited and David Shannon), contains some rare earth elements, alternative analysis in Maaskant et al. (1980). (ideally $(Ca,Ce)(Al,Ti,Mg)_{12}O_{19}$).

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iv) M_8O_{13} Oxides: Mullite

MUL101 Mullite: Type locality, Loch Scridian, Isle of Mull, Scotland; with corundum and anorthite [$Al_6Si_2O_{13}$] (Minerals Unlimited; received Sept. 2002; 3-1" pieces) (pink phase).

+++++++

v) M_2O_3 Oxides: Corundum, Hematite, Braunnite, Antimony oxide

BRA101 *Braunnite: Kuratomi Mine, Tsukumi-shi, Oita-ken, Kyushu, Japan; with feitnechtite and rhodochrosite (too intimate to separate) (Minerals Unlimited). (ideally $Mn^{+2}Mn_6^{+3}SiO_{12}$).*

COR101 Corundum: Sigulani Village, Tambani area, Blantyre District, Malawi (Minerals Unlimited). (ideally "-Al_2O_3).

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HEM101 Hematite: (Dick Morris sample HMS3; from Pfizer; produced by calcination of iron salts) *[See Morris et al., JGR 90, pp. 3126-3144 (1985) for description]*. <140 nm powder provided. (ideally "-Fe_2O_3).

HEM102 Hematite: Bouse, Arizona, USA ("-Fe_2O_3) (Tyson's Fine Minerals).

HEM103 Hematite: locality unknown ("-Fe_2O_3) (National Museum of Nature, Ottawa).

HEM104 Hematite; locality unknown [Discovery Gemstones Ltd., Edmonton, AB; July 28, 2007]. 8 pieces.

HEM105 Hematite, with quartz. Florence Mine, Egremont, Cumbria, England. (Minerals Unlimited). Multiple pieces received Dec. 2013.

HEM200 Hematite – nanopowder; synthetic ("Iron oxide (Fe_2O_3, alpha) nanopowder") (MTI Corporation); 30 nm particle size; SOL-GEL manufacturing method; 99.9% purity, crystalline; >50 m^2/g specific surface area; 100 grams; certificate of analysis provided. ["Fe_2O_3-alpha nanopowder is stable in air"]; received June 8, 2010.

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PIG011 Synthetic antimony oxide (Sb_2O_3). See Pigments section *(for pigments project). See section 19 of this document for data.*

PIG023 Synthetic chromium (III) oxide (Cr_2O_3). See Pigments section *(for pigments project). See section 19 of this document for data.*

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PIG312 Hematite (contains natural iron oxide) (catalog no. 450-31S). 100 grams. (red/orange group). *See section 19 of this document for data.*

PIG313 Hematite Crimean (catalog no. 450-34S). 100 grams. (red/orange group). *See section 19 of this document for data.*

PIG314 Violet hematite; violet caput mortem (cold hematite) (catalog no. 450-32S). 100 grams. (red/orange group). *See section 19 of this document for data.*

PIG323 Hematite (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set). (red/orange group). *See section 19 of this document for data.*

SYN010 Synthetic aluminum oxide (Al_2O_3), *a* 99.9% (metals basis); 20-50 microns APS, spherical powder. Alfa Aesar #42571-22; stock number 42571; Lot #D10R003, CAS# 1344-28-1; 100 grams. *For possible use as ultraviolet reflectance standard.*

SYN011 Synthetic aluminum oxide (Al_2O_3), *a* 99.99% (metals basis); 1.0 micron APS powder. Alfa Aesar #39815-14; stock number 39815; Lot #J05Q066, CAS# 1344-28-1; 25 grams. *For possible use as ultraviolet reflectance standard.*

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vi) M_3O_4 Oxides: Alexandrite, Hausmannite, Minium

ALE101 Alexandrite (var. of chrysoberyl): Fort Victoria, Zimbabwe (Tyson's Fine Minerals). (ideally $BeAl_2O_4$).

HAU101 Hausmannite (distorted spinel structure): N'Chwaning Mine, Kuruman, South Africa (formerly SPI110) (Tyson's Fine Minerals). (ideally $Mn^{+2}Mn_2^{+3}O_4$).

HAU102 Hausmannite (distorted spinel structure): Noda Tamagawa Mine, Noda Mura, Kunohe-gun, Iwate-ken, Japan; with manganophyllite, rhodochrosite and tephroite (OLV114) (Minerals Unlimited). (ideally $Mn^{+2}Mn_2^{+3}O_4$). Little sample available.

MIN101 Minium: 30 miles south of Tucson, Arizona, USA ($Pb_2^{2+}Pb^{4+}O_4$) (Smithsonian Institution) *(for*

pigments project).

MIN102 Minium: Del Pratt shaft, BHP Mine, Broken Hill, New South Wales, Australia (Smithsonian Institution) *(for pigments project).*

PIG014 Synthetic lead oxide (Pb_3O_4) (no natural analogue?). See Pigments section *(for pigments project). See section 19 of this document for data.*

PIG348 Minium, red lead (Surik) (catalog no. 457-10S). 50 grams. (red/orange group). *See section 19 of this document for data.*

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vii) M_3O_5 oxides

SYN020 Titanium oxide (Ti_3O_5); synthetic; 99.9% metals basis; 25 grams. Alfa Aesar #39000; lot G01Z029; CAS: 12065-65-5.

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viii) MO oxides

PIG010 Synthetic zincite (ZnO). See Pigments section *(for pigments project). See section 19 of this document for data.*

PIG022 Synthetic lead (II) oxide (PbO). See Pigments section *(for pigments project). See section 19 of this document for data.*

PIG101 Synthetic litharge (PbO) (Smithsonian Institution MNMH #93589). See Pigments section *(for pigments project - red). See section 19 of this document for data.*

PIG329 Zinc oxide (catalog no. 475-31S). 4 ounces. (white/yellow/orange group). *See section 19 of this document for data.*

TIO001 Synthetic titanium (II) oxide (TiO). Optical grade, 99+% (metals basis); 3 mm pieces, 25g. Alfa Aesar #88520, lot B23HC. Received Dec. 5, 2013.

WUS101 Wustite: synthetic FeO (Alfa Chemical Co., #10718); <45µm powder by crushing and wet sieving (?). Sample left.

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ix) Peroxides and hydroxides (water)

H2O001 Distilled water from Geography Department supply – Dec. 30/08.

POX001 Hydrogen peroxide, 35% w/w aq. soln., stab. (Alfa Aesar #L14000; 100 ml; received May 23, 2008).

POX002 Sodium peroxide, 95% (Alfa Aesar #L13306; 50 g; received May 23, 2008)Na_2O_2.

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9.6a.1. Samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

RutileSX58		DH 5803
hand sample15	**Hematite	ActLabs
hand sample32	**Pyrolusite	ActLabs

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9.6b. XRD Data - Other Oxides

9.6b.1. Analogue files from U of A instrument

Sample	*XRD File*
HIB101	Z03222

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9.6c. Compositional Data - Other Oxides (alphabetical order) (continued)

Wt. % Morris#	COR101	HEM101[3] (HMS3)	HEM102	HEM103	HEM104	HEM105
P_2O_5		0.00	0.04	0.02	0.02	0.02
SO_3		0.25	0.32	0.40	0.07	0.06
MnO		0.00	0.01	0.02	0.01	0.02
TiO_2		0.03	0.02	0.03	0.06	0.02
SiO_2		1.06	0.29	0.31	0.24	2.48
Al_2O_3		0.39	0.71	0.71	0.26	0.14
FeO	0.00	0.19	0.91	1.33	7.52	1.35
Fe_2O_3		97.40	96.66	96.35	89.77	94.61
*(Fe_2O_3)**			*(97.67)*	*(97.83)*	*(98.13)*	*(96.11)*
MgO		0.14	0.36	0.35	0.07	0.11
CO_2		0.04				
(+)H_2O		0.27				
(-)H_2O		0.29				
K_2O		0.00				
CaO		0.06	0.13	0.05	0.06	0.04
Na_2O			0.29	0.28	0.18	0.19
K_2O			0.01	0.01	0.02	0.01
TOTAL		100.12	99.85[b]	100.01[b]	99.12	99.20
LOI			0.00	0.20	0.33	0.40
ppm						
Sr			<2	<2	1	87
Zr			20	23	22	50
V			78	105	43	93
Co			735	760	<1	<2
Cr			20	10	25	35
Cu			260	190		
Ni			<5	<5	25	<2
Rb			<5	<5		
Source	U of A	Morris	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

U of A: FeO determined by wet chemistry at the University of Alberta.

3. Analysis from Morris et al. (1985)

* - All Fe expressed as Fe_2O_3

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9.6c. Compositional Data - Other Oxides (alphabetical order) (continued)

Wt. %	HEM200
Ca	<0.01
Cl	<0.07
Cr	<0.002
H2O	<0.20
K	<0.001
Mg	<0.008
Mn	<0.3
Na	<0.005
Ni	<0.01
Pb	<0.001
SiO_2	<0.02
SO_4^{2-}	<0.05

Analysis from MTI Corp.

9.6c. Compositional Data - Other Oxides (alphabetical order)

Wt. %	HIB101	HIB101	HIB101	HIB101
P_2O_5	0.02		tr.[5]	0.00
Cr_2O_3	0.08		0.04	0.00
MnO	0.06		0.00	0.00
TiO_2	3.19	3.02	2.88	5.63
SiO_2	0.52	0.58	0.59	0.58
Al_2O_3	73.31	75.93	77.05	75.56
FeO	3.66[1]	3.46[1]	3.32[1]	3.83[1]
Fe_2O_3	n.d.			
MgO	2.38	2.35	2.42	2.76
Na_2O			0.05	0.36
ZrO_2			0.03	
Nb_2O_5			0.15	
K_2O			0.02[3]	0.00
CoO			0.01[3]	0.00
CaO		6.03	5.92	5.89
NiO			0.01	0.24
HfO_2			0.09[3]	
V_2O_5			0.31[3]	0.00
ZnO_2				0.40
SnO_2				
Cl			0.03[2]	
TOTAL	89.63	91.37	92.89	95.25
LOI				
Source	U of C	U of A	U of A	U of A
Analysis	EMPA-7	EMPA-1	EMPA-5	EMPA-2

Note: Source and Analysis: U of A: electron microprobe analysis at the University of Alberta; number of analytical points indicated. U of C: electron microprobe analysis at the University of Calgary; number of analytical points indicated.

1. All Fe reported as FeO.
2. Average of 2 analytical points.
3. Average of 3 analytical points.

n.d.: not determined. tr.: trace (<0.01 wt.%).

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9.6c. Compositional Data - Other Oxides (alphabetical order) (continued)

Wt. %	RUT101	RUT101	RUT101	RUT101	RUT102
P_2O_5	tr.	0.05		tr.	0.03
Cr_2O_3	0.12			0.18	
MnO	0.00	0.00		tr.	0.00
TiO_2	96.63	95.54	98.43	99.72	97.25
SiO_2	0.00	0.70	0.01	tr.	0.09
Al_2O_3	0.03	0.61	0.10	0.06	0.25
FeO	0.43[3]	0.49	0.94[3]	0.36[3]	0.65
Fe_2O_3		0.70			0.06
MgO	0.00	0.35	0.05	0.04	0.39
Na_2O		0.72		0.07	0.68
ZrO_2				0.04[4]	
Nb_2O_5				0.06[4]	
K_2O		0.02		0.01[4]	0.02
CaO		0.48	0.02	0.01	0.09
NiO				0.06[4]	
HfO_2					
SnO_2				0.01[4]	
Cl				0.02	
TOTAL		99.98			99.69
LOI		0.32			0.18
ppm					
Sr		<2			<2
Zr		80			640
V		740			1620
Cr		500			527
Ni		175			123
Co		<2			<2
Source	U of C	Mertzman	U of A	U of A	Mertzman
Analysis	EMPA-8	XRF/WC	EMPA-1	EMPA-1	XRF/WC

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of C: University of Calgary EMPA. *= data from University of Alberta EMPA.

3. All Fe reported as FeO.

4. Average of 6 analytical points.

n.d.: not determined. tr.: trace (<0.01 wt.%).

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9.6d. Spectral Data - Other Oxides (alphabetical order)

Sample	*Facility/File No.*	*Description*
ALE101	RELAB caal03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
ALE101	RELAB laal03	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
BRA101	PSF 090319a.032	whole rock – matte brown surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
BRA101	PSF 090319a.033	whole rock – lighter part of crystalline mass, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
CO2-1	PSF 080619a.001	crushed, unsorted, 30°/0°, 0.35-2.5 µm, 2-7 nm resolution, 200 spectra averaged, ASD.
+++++++		
COR101	RELAB CACD01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
COR101	RELAB LACD01	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
H2O001	PSF 081222a.049	liquid; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; room temp.
H2O001cup	PSF 081222a.050	empty sample cup; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; shot empty without changing vertical height.
+++++++		
HAU101	RELAB csc120	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
HAU101	RELAB lasc120	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
+++++++		
HAU102	PSF 090319a.034	whole rock – matte brown surface, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
HAU102	PSF 090319a.035	whole rock – crystalline mass with many purple crystals, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
+++++++		
HEMATITE		
HEM101	RELAB cahe01	<120 nm, 30°/0°, 0.3-2.6µm, 5 nm.
	RELAB lahe01a	<120 nm, 30°/0,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet, different viewing geometry).
HEM101	PSF 220507hem101	<120 nm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
HEM101	PSF 110707hem101	<120 nm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
HEM101	PSF hem101	<120 nm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
+++++++		
HEM102	RELAB cahe02	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
	RELAB lahe02	<45 µm, 30°/0,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet, different viewing geometry).
HEM102	PSF 220507hem102	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
HEM102	PSF 110707hem102	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
HEM102	PSF hem102	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.

HEM102	PSF 130707hem102up	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. Unpacked (loose) sample; Ocean Optics S2000.
HEM102	PSF 130707hem102p	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. Packed (tamped down) sample; Ocean Optics S2000.
HEM102	PSF 130707hem102slick	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. "Slick" (tamped down and mirror surface made) sample; Ocean Optics S2000.
HEM102	PSF 160707hem102unpacked	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm. Unpacked (loose) sample; Ocean Optics S2000.
+++++++		
HEM103	RELAB cahe03	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
	RELAB lahe03	<45 µm, 30°/0,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet, different viewing geometry).
HEM103	PSF hem103m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
HEM103	PSF hem103n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
++++Grain size series: HEM103+++++		
HEM103	PSF 220507hem10345	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF 110707hem10345	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF hem10345	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
HEM103	PSF 220507hem10390	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF 110707hem10390	45-90 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF hem10390	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
HEM103	PSF 220507hem103250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF 110707hem103250	90-250 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF hem103250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
HEM103	PSF 220507hem103500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF 110707hem103500	250-500 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF hem103500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
HEM103	PSF 220507hem1031000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF 110707hem1031000	500-1000 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
HEM103	PSF hem1031000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
+++++++Grain size series: HEM103+++++		
HEM103	PSF 071201a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize).

HEM103	PSF 071201a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize; reshoot of previous sample).
HEM103	PSF 071201a.001-002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD (directory: 071201grainsize).
HEM103	PSF 071201a.003	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize).
HEM103	PSF 071201a.004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize; reshoot of previous sample).
HEM103	PSF 071201a.003-004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD (directory: 071201grainsize).
HEM103	PSF 071201a.005	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize).
HEM103	PSF 071201a.006	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize; reshoot of previous sample).
HEM103	PSF 071201a.007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize; reshoot of previous sample).
HEM103	PSF 071201a.005-007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD (directory: 071201grainsize).
HEM103	PSF 071201a.008	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize).
HEM103	PSF 071201a.009	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize; reshoot of previous sample).
HEM103	PSF 071201a.010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize; reshoot of previous sample).
HEM103	PSF 071201a.008-010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD (directory: 071201grainsize).
HEM103	PSF 071201a.011	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize).
HEM103	PSF 071201a.012	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize; reshoot of previous sample).
HEM103	PSF 071201a.013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD (directory: 071201grainsize; reshoot of previous sample).
HEM103	PSF 071201a.011-013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, avgd; ASD (directory: 071201grainsize).
	+++++++	
HEM103	PSF 111201a.039	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
+++++++		
HEM104	PSF 130910a.017	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
+++++++		
HEM200	PSF 100616a.012	30 nm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged, ASD (Directory: 100615_crypto; 100615_nano).
+++++++		
HIB101	RELAB C1SC72	<45µm, 0E/15E, 0.3-2.7µm, 5 nm.
+++++++		
PIG007	PSF 050707pig007	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
PIG007	PSF 120707pig007	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
PIG007	PSF pig007	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
PIG007	PSF 080913a.052	<45 µm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 500 spectra averaged, ASD.
+++++++		

PIG008	PSF 050707pig008	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
PIG008	PSF 120707pig008	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
PIG008	PSF pig008	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
PIG008	PSF 080913a.053	<45 µm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 500 spectra averaged, ASD.
+++++++		
POX001c	PSF 081222a.046	liquid; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; -23° C, immediately after bringing inside.
POX001c	PSF 081222a.047	liquid; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; -23° C, 3 minutes after bringing inside.
POX001cup	PSF 081222a.048	empty sample cup; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; shot empty without changing vertical height.
Distilled water	PSF 081222a.049	Distilled water; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; room temperature.
Empty cup	PSF 081222a.050	Empty cup for distilled water, same position; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; shot empty without changing vertical height.
++++++		
POX002	PSF 081222a.041	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
POX002	PSF 091026 pox002	unsorted pellets; 0°/0° (bifurcated fibres); 0.2-0.4 µm; ~0.3 nm resolution; 100 averaged; Ocean Optics S2000.
POX002f	PSF 081222a.042	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; -23° C, immediately after bringing inside.
POX002f	PSF 081222a.043	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; -23° C, 3 minutes after bringing inside.
POX002f	PSF 081222a.044	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; -23° C, 6 minutes after bringing inside.
POX002f	PSF 081222a.045	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; -23° C, 9 minutes after bringing inside.
POX002	PSF 130910a.016	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).
+++++++		
RUT101	PSF 080114b.007	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
+++++++		
RUT102	PSF 080114b.008	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 spectra avgd; ASD.
+++++++		
WUS101	RELAB c1sc13	<63µm, 0°/15°, 0.34-2.7µm, 5nm.
WUS101	PSF feb2107.017	<45 µm, 35°/0°, 0.35-2.5 µm, 1 nm, 1000 avg, ASD (directory: feb2107 meteoritic).
WUS101	PSF feb2107.018	45-90 µm, 35°/0°, 0.35-2.5 µm, 1 nm, 1000 avg, ASD (directory: feb2107 meteoritic).

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9.6d.1. Other oxides - Polynomial (quadratic) fits to spectra

Equation $y=a+bx+cx^2$
Differentiate & solve for x at y=0 i.e. 0=-b+2cx, b=2cx
Band depth, solve for y (if normalized only)

Sample	Poly. Coeff's a	b	c	Band Min(µm)	Band Depth%	Grain Size (µm)	Compil. & File#	Channels Fitted
WUS101	2.989	-1.811	.9042	1.001		<63	brown1a-146	111-139

WUS101/s.l.	1.407	-.9944	.4772	1.042	11.1	<63	brown1b-184	111-174

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END of 9.6.

10. Metals and "Ides"

10.1. Metals
10.2. Carbides
10.3. Nitrides
10.4 Phosphides
10.5. Selenides
10.6. Silicides
10.7. Sulphides
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10a. Sample Descriptions - Metals and "Ides"

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID *Description*

10a.1. METALS/ALLOYS

See also Meteorites, and Synthetics and Elemental sections

AWA101	Awaruite: Josephine County, Oregon, USA (Minerals Unlimited).
IRO101	Iron: synthetic Fe (ESPI Corp., #K2869B), +325 mesh, 3N+ purity. Unsorted (>45µm) powder.
IRO102	Iron, synthetic nanophase; average particle size <50 nm. MTI Corporation. PCVD manufacturing method, 50 grams ordered. Packed under vacuum.; 40-60 metres^2/gram surface area. *Note: open/stored in Ar atmosphere only.* Received June 18, 2008.
IRO103	Iron, synthetic powder, spherical, <10 micron, 99.9%+ (metals basis), 99.5% (Alfa Aesar stock #00170-14, 62-03-02; lot #L05R011) 25 grams.
MTL001	Cobalt foil: 25 x 25 mm, p.1 mm thick; Alfa Aesar #42658 (99.95% metals basis).
MTL002	Nickel foil: 50 x 50 mm, 0.1 mm thick; Alfa Aesar #44821 (99.5% metals basis).
MTL003	Tin foil: 50 x 50 mm, 0.1 mm thick; Alfa Aesar #11460 (Puratronic 99.998% metals basis).
MTL004	Titanium foil: 150 x 50 mm, 0.127 mm thick, annealed; Alfa Aesar #00971 (99% metals basis).
MTL005	Zinc foil: 30 x 10 cm, 0.25 mm thick; Alfa Aesar #10436 (99.98% metals basis).
MTL006	Silver foil: 150 x 150 mm, 0.025 mm thick; Alfa Aesar #12190 (stock #K08S017); annealed 99.95% (metals basis).
MTL007	Silver foil: 50 x 50 mm, 0.127 mm thick; Alfa Aesar #11440 (stock #J09N21); annealed 99.9% (metals basis).
MTL008	Silver capsules pressed: 5 x 3.5 mm; Elemental Microanalysis Ltd; D2002.
NIC101	Nickel: synthetic Ni (ESPI Corp., #K3603E), -500 mesh, 3N6 purity. <45µm sample by crushing and dry sieving (?). Sample left.
NIF101	Nickel-iron 50:50 alloy: synthetic (ESPI Corp., #K3602O). <45µm sample by crushing and dry sieving (?). Sample left.
SIC101	Silicon carbide: synthetic SiC (Carveth Metallurgical Ltd., unsorted). <37µm sample by dry sieving. Sample left.
SIC102	Silicon carbide: synthetic SiC (ET Enterprises Ltd., <7µm size). <7µm sample used as is. Sample left.
SIL101	Silicon metal, synthetic; 3 pieces.
SYN002	Gold powder, synthetic, spherical, - 325 mesh, 99/9% (metals basis) 5 grams. Alfa Aesar #43900. *For use as reflectance standard.*
SYN003	Aluminum powder, spherical, APS 17-30 microns, 99% (metals basis). 100 grams. Alfa Aesar stock #10576; lot #I21K08. *For use as reflectance standard.*

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10a.1.1. Metal samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

CuMo	Metal alloy	*USZ 3-85 (Central Geological Laboratory)

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10a.2. CARBIDES

CEM101 Cementite: synthetic Fe_3C, -325 mesh (Alfa Chemical Co., #88173). <45µm powder made by crushing (?) and wet sieving (?). Sample left.

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10a.3. NITRIDES

CAR101 Carlsbergite: synthetic CrN (ESPI Corp., #K1367R). No powder made. Sample left.
TIN001 Titanium nitride (TiN), synthetic. "99.5% (metals basis), Alfa Aesar stock number 41556-18, lot #X29S045.CAS #25583-20-4." 50 grams.

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10a.4. PHOSPHIDES

See also Meteorites section.

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10a.5. SELENIDES

PIG013 Synthetic cadmium selenide (CdSe) *(no natural analogue) (for pigments project). See section 19 of this document for data.*

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10a.6. SILICIDES

SYN008 Iron silicide ($FeSi_2$), 99.9% (metals basis), 5 grams. Alfa Aesar stock #14022, lot #C26M51, CAS #12022-99-0.

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10a.7. SULPHIDES

ALA101 Alabandite: Alchichicha, Puebla, Mexico (Minerals Unlimited).
CAS001 Calcium sulphide, synthetic (CaS) (oldhamite); "99.9% (metals basis excluding Sr) Sr typically 500 ppm 5g (glass); CAS #20548-54-3. Alfa Aesar stock number 13121, lot #G16U051, -325 mesh powder". 5 grams (packed under argon).
CHA101 Chalcopyrite: Temegami, Ontario, Canada (Cowan Mineral Co.).
CHA102 Chalcopyrite: Butte, Silver Bow County, Montana, USA; with bornite and quartz (Minerals Unlimited).

CHA103 Chalcopyrite; locality unknown (Mineral Society of Manitoba); 3 specimens.
CIN101 Cinnabar: Arcana Creek, near Aleknagic, Alaska, USA (HgS) (Minerals Unlimited) *(for pigments project).*
CIN102 Cinnabar: New Almaden, California, USA (HgS) (Smithsonian Institution #C458) *(for pigments project - red).*
CIN103 Cinnabar: Idria, Carinthia, Austria (HgS) (Smithsonian Institution MNMH #78539-1) *(for pigments project - red).*
CUB101 Cubanite: Mackinaw Mine, Monte Cristo, Snohomish County, Washington, USA (Minerals Unlimited), contains chalcopyrite CUB101a and cubanite CUB101b.
GAL101 Galena, unknown locality [PbS], (display specimen from Tyson's), with fluorite (FLU102).
GRE101 Greenockite: San Bernardino County, California, USA (CdS) (Smithsonian Institution MNMH #156721) (for pigment project - yellow). Too sparse to get a pure separate (thin yellow coating on rock).
HAW101 Hawleyite: Eureka County, Nevada, USA (CdS) (Smithsonian Institution MNMH #120642) (for pigment project - yellow). Too sparse to get a pure separate (thin yellow coating on rock).
MAC101 Mackinawite: Hitura, Finland (Minerals Unlimited).
MAR101 Marcasite: locality unknown (University of Alberta GEOL330 laboratory collection # unknown), intimately mixed with pyrite.
MAR103 Marcasite: Athabasca oil sands, Fort McMurray, Alberta, Canada (self collected).
MAR104 Marcasite cast: Athabasca oil sands, Fort McMurray, Alberta, Canada (self collected).
MAR110 Marcasite: Consumer's Quarry, Racine, Wisconsin, USA; with calcite (Minerals Unlimited).
MAR111 Marcasite: Tri-State Mining District, Kansas, USA; with sphalerite (SPH103) (Minerals Unlimited).
MAR112 Marcasite: Texas Mine, Hockerville, Ottawa Co., OK, USA (received from Royal Ontario Museum, their sample ID M27691; March 2014; *for Karly Pitman optical constants project).*
ORP101 Orpiment: Getchell Mine, near Golconda, Humboldt County, Nevada, USA (As_2S_3); with realgar, on rock (Minerals Unlimited) (light sensitive) *(for pigments project - yellow).* More received June 11/07.
ORP102 Orpiment: Felsobanya, Romania (As_2S_3) (Smithsonian Institution MNMH #R13305) *(for pigments project - yellow).*
ORP103 Orpiment: Manhattan, Nevada, USA (As_2S_3) (Smithsonian Institution MNMH #155082) *(for pigments project - yellow).*
PEN101 Pentlandite: Sudbury, Ontario, Canada (Cowan Mineral Co.).
PIG012 Synthetic cadmium sulphide (CdS) (no natural analogue?). *See Pigments section (for pigments project). See section 19 of this document for data.*
PIG015 Synthetic mercury sulphide - red (HgS) (synthetic version of vermilion/cinnabar. *See Pigments section (for pigments project). See section 19 of this document for data.*
PIG016 Synthetic mercury sulphide - black (HgS) (synthetic version of vermilion/cinnabar. *See Pigments section (for pigments project). See section 19 of this document for data.*
PIG308 Orpiment (catalog no. 430-20S). 10 grams; 0.35 ounces. (white/yellow/orange group). *See section 19 of this document for data.*
PIG309 Cinnabar, warm (catalog no. 450-10S). 10 grams. (red/orange group). *See section 19 of this document for data.*
PIG384 Realgar; originally mislabelled as PIG309 (Natural Pigments #450-20S), 10 grams (red-orange group). *See section 19 of this document for data.*
PRH101 Pyrrhotite: locality unknown (University of Alberta GEOL330 laboratory collection # unknown).
PRH102 Pyrrhotite: Creighton Mine, Sudbury, Ontario, Canada; with chalcopyrite and plagioclase feldspar (Minerals Unlimited).
PRH103 Pyrrhotite: Kuratomi Mine, Tsukumi shi, Oita ken, Kyushu, Japan (Minerals Unlimited).
PRH104 Pyrrhotite: near Crown Point, Essex County, New York, USA; with limonite (Minerals Unlimited).
PRH105 Pyrrhotite: Murray Mine, Nipissing District. Ontario (received from Royal Ontario Museum, their sample ID M3924; March 2014; *for Karly Pitman optical constants project).*
PRT101 Pyrite: locality unknown (University of Alberta GEOL330 laboratory collection # unknown).
PRT102 Pyrite: locality unknown (from some rock show).
PRT103 Pyrite: Island of Elba, Italy (Minerals Unlimited).
PRT104 Pyrite: locality unknown (Mineral Society of Manitoba).
PRT105 Pyrite-bearing carbonate?, northern Ontario?

PRT106 Pyrite, probably from Joplin, Missouri; display specimen (from Tysons), with calcite (CRB128).
PRT107 Pyrite, probably from Nanisivik Mine, NWT, Canada; 4 1.5" pieces; from Manitoba Museum gift shop – December 2013.
PRT108 Pyrite: Bingham, UT, USA (received from Royal Ontario Museum, their sample ID M8751; March 2014; *for Karly Pitman optical constants project).*
REA101 Realgar: Getchell Mine, near Golconda, Humboldt County, Nevada, USA (AsS) (Minerals Unlimited) (light sensitive) *(for pigments project)*. More received June 11/07.
REA102 Realgar: Cavnic, Crisana-Maramures, Romania (AsS) (Smithsonian Institution MNMH #159151) *(for pigments project).*
REA103 Realgar: Basses Alps, France (AsS) (Smithsonian Institution MNMH #B551) *(for pigments project).*
SPH101 Sphalerite: Bromley Hill Mine, Nenthead, Alston, Cumbria, England [(Zn,Fe)S] (Minerals Unlimited).
SPH102 Sphalerite: Ballard Mine, Baxter Springs, Kansas, USA [(Zn,Fe)S] (Minerals Unlimited).
SPH103 Sphalerite: Tri-State Mining District, Kansas, USA; with marcasite (MAR111) (Minerals Unlimited).
SPH104 Sphalerite: locality unknown (Mineral Society of Manitoba); 3 specimens.
SUL001 Synthetic copper (II) sulphide, 99.5% (metals basis); Alfa Aesar #14718, lot: R19A012; CAS: 22205-45-4; 50 grams (received Dec. 5, 2014).
SUL002 Synthetic nickel sulphide, 99.9% (metals basis); -200 mesh powder [Ni_3S_2]; Alfa Aesar #35661, lot: C12Y018; CAS: 12035-72-2; 10 grams (received Dec. 5, 2014).
TRO101 Cubanite: Alta Mine, Del Norte County, California (Minerals Unlimited), labelled as troilite but more cubanite-like analysis.
TRO201 Troilite: Canyon Diablo iron meteorite, Coconino County, Arizona (David Shannon Minerals).
TRO202 Troilite: synthetic FeS (ESPI Corp., #K28860), 3N purity. Sample left.<45µm powders made from original powdered sample without crushing (TRO202) and with crushing (TRO202g), and after exposure to air (TRO202i). Sample left. See also Meteorite section.
TRO203 Synthetic troilite, stoichiometric FeS (Alfa Aesar, Tech. grade, 99% purity; #A15569-30; Avocado Research Chemicals No. 1317-37-9, lot #C5417A). <45 and 45-90µm powders made by crushing and dry sieving. Sample left.
TOC101 Tochilinite: Jeffrey Mine, Asbestos, Shiton Township, Quebec, Canada (Smithsonian NMNH #148696). [$6Fe_{0.9}S \cdot 5(Mg,Fe^{+2})(OH)_2$]. *(May be in carbonaceous chondrites: see MacKinnon & Zolensky in Akai & Kanno article (also filed under clays and sulphates).*
VIO101 Violarite: Perseverance Mine, Agnew, Western Australia, Australia (brown submetallic) [$Fe^{2+}Ni_3^{2+}S_4$]; with pyrite (Minerals Unlimited).

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10a.7.1. Sulphide samples from Alex Koujelev at Canadian Space Agency for LIBS development

Samples received February 2012.
Descriptions provided in section 30 of this document.

Hand sample10	**Galena	ActLabs
Hand sample17	**Pyrite	ActLabs
hand sample27	**Chalcopyrite	ActLabs

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10b. XRD Data - Metals and "Ides" (alphabetical order)

10b.1. Analogue files from U of A instrument

Sample	*XRD File*
ALA101	Z03273
AWA101	Z03272
CEM101	Z04687
CUB101	Z03239
MAC101	Z03241
MAR101	Z03237
MET101	Z03229
PEN101	Z03240
PRH101	Z03235
PRT101	Z03236
SIC101	Z03153
SIC102	Z04683
TRO101	Z03238
TRO201	Z03224
TRO202	Z04717

10b.2. University of Manitoba XRD analysis

TRO202, 202g, and 203 were measured by XRD at the University of Manitoba Department of Geological Sciences in May and June of 1999. The samples were run in step scan mode to provide information on structural differences between the <45µm size samples and whether any accessory phases are present.

TRO202	Sample is predominantly troilite, with definitely some sulphur and minor goethite and pyrrhotite (File: tro202.rep). (XRD completed).
TRO202g	Sample is even more predominantly troilite, with definitely some sulphur and minor goethite and pyrrhotite (File: tro202g.rep). (XRD completed).
TRO203	Sample is predominantly troilite with a bit of wustite (aluminum is from the sample holder). (File: tro203.rep). (XRD completed).

Comparison of the 3 spectra shows some structural offsets between TRO203 versus TRO202 and TRO202g. TRO202g has larger full width half maximum versus TRO202, otherwise the patterns are nearly identical.
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10b.3. Quantitative XRD results from Dave Bish (2009)

TRO201:
79% troilite (FeS)
18% pyrrhotite $(Fe_{1-x})S$
2% greigite (Fe_3S_4)
1% *a*-iron

TRO202:
52% troilite (FeS)
21% pyrrhotite $(Fe_{1-x})S$
17% goethite (FeOOH)
9% sulfur (S)
1% *a*-iron

TRO203:
85% troilite (FeS)
7% pyrrhotite $(Fe_{1-x})S$
7% *a*-iron
2% greigite (Fe_3S_4)
++

10c. Compositional Data - Metals and "Ides"

10c.1. Metals

Wt. %	AWA101	IRO102	MET101	MET101	MET101	MET102	MET102	MET102
Fe	25.86	99.99	93.39	91.84	93.91	92.49	91.59	92.94
Ni	71.50	<0.09	6.07	6.05	6.08	5.93	6.04	5.87
Na	0.07		0.00	0.28	0.01	0.00	0.13	0.01
S	0.00		0.00	0.01	tr.	0.00	0.00	0.00
V	0.00		0.00	0.00		0.00	0.00	
Co	0.88		0.50	0.50		0.61	0.61	
P	0.03		0.02	0.04	0.02	0.05	0.05	0.05
Cr	0.00	<0.006	0.18	0.18		0.03	0.03	
Mg	0.17		0.00	0.00		0.00	0.00	
Mn	0.00	<0.086	0.00	0.00	0.01	0.03	0.05	0.02
Cu	0.00		0.00	0.00	0.02	0.00	tr.	0.00
Al	0.05		0.03	0.03		0.01	0.01	
Pb	0.57		0.87	0.87		0.57	0.57	
Zn	0.00		0.11	0.11		0.05	0.05	
Ti	0.00		0.00	0.00		0.00	0.00	
Ca		<0.04						
Si		<0.22						
TOTAL	99.13	~99.99	101.17	99.91	100.05	99.77	99.14	
			IONS NORMALIZED TO 24					
Fe	6.493		22.355			22.402		
Ni	17.078		1.382			1.366		
Na	0.042		--			--		
S	--		--			--		
V	--		--			--		
Co	0.209		0.114			0.141		
P	0.014		0.008			0.022		
Cr	--		0.047			0.008		
Mg	0.098		--			--		
Mn	--		--			0.007		
Cu	--		--			--		
Al	0.027		0.015			0.005		
Pb	0.039		0.056			0.038		
Zn	--		0.023			0.011		
Ti	--		--			–		
Source Analysis	U of A EMPA-3	MTI^	U of A EMPA-1	U of A EMPA-1	U of A EMPA-3	U of A EMPA-1	U of A EMPA-1	U of A EMPA-2

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of A: University of Alberta EMPA.

tr. = trace (<0.01 wt.%)

^ - Analysis provided by MTI Corporation

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10c. Compositional Data - Metals and "Ides"

10c.4. Phosphides

Wt. %	SCR101	SCR101	SCR102	SCR102	SCR102
Fe	66.37	66.17	56.51	57.21	
Ni	15.54	15.44	24.68	24.68	
Na	0.00	0.00	0.00	0.00	
S	0.05	0.04	0.02	0.03	
V	0.00		0.00	0.00	
Co	0.33		0.15	0.15	
P	14.18	12.08	12.77	13.13	12.07
Cr	0.02		0.00	0.04	
Mg	0.01		0.00	0.03	
Mn	0.00	0.01	0.00	0.00	0.03
Cu	0.00	0.00	0.00	0.00	0.00
Al	0.04		0.09	0.09	
Pb	0.79		0.67	0.70	
Zn	0.00		0.00	0.00	
Ti	0.00		0.00	0.00	
TOTAL	97.33	93.74	94.89	96.07	
			IONS NORMALIZED TO 24		
Fe	14.822		13.064		
Ni	3.301		5.441		
Na	--		--		
S	0.020		0.008		
V	--		--		
Co	0.070		0.037		
P	5.711		5.366		
Cr	0.005		--		
Mg	0.005		--		
Mn	--		--		
Cu	--		--		
Al	0.019		0.043		
Pb	0.047		0.041		
Zn	--		--		
Ti	--		–		
Source	U of A	U of A	U of A	U of A	U of A
Analysis	EMPA-5	EMPA-5	EMPA-2	EMPA-2	EMPA-1

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of A: University of Alberta EMPA. *= data from University of Alberta EMPA.

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10c. Compositional Data - Metals and "Ides"

10c.7. Sulphides

Wt. %	ALA101	ALA101	CHA101	CHA101	CUB101a	CUB101b
Fe	0.67	0.64	32.19	32.21	32.11	42.17
Ni	0.03	tr.	0.00	0.00	0.03	0.00
Na	0.04	0.03	0.00	0.00	0.00	0.00
S	35.07	35.08	32.78	30.99	33.41	35.48
V	0.00		0.00		0.00	0.00
Co	0.06		0.00		0.04	0.00
P	0.01	0.01[a]	tr.	0.01[a]	0.05	0.02
Cr	0.00		0.00		0.14	0.01
Mg	0.03		0.00		0.02	0.03
Mn	62.85	59.21[a]	0.03	0.03[a]	0.00	0.00
Cu	0.01	0.02[a]	34.02	30.88[a]	31.75	20.88
Al	0.09		0.00		0.07	0.00
Pb	0.00		0.00		0.00	0.00
Zn	0.00		0.00		0.00	0.00
Ti	0.00		0.00		tr.	0.01
TOTAL	98.86	94.99	99.02	94.12	97.62	98.60
			IONS NORMALIZED TO 24			
Fe	0.127		6.480		6.491	8.266
Ni	0.005		--		0.006	--
Na	0.018		--		--	--
S	11.627		11.495		11.766	12.114
V	--		--		--	--
Co	0.011		--		0.008	--
P	0.003		0.001		0.018	0.007
Cr	--		--		0.031	0.002
Mg	0.013		--		0.009	0.013
Mn	12.159		0.006		--	--
Cu	0.002		6.018		5.641	3.597
Al	0.035		--		0.029	--
Pb	--		--		--	--
Zn	--		--		--	--
Ti	--		--		0.001	0.001
Source	U of A	U of A	U of A	U of A	U of A	U of A
Analysis	EMPA-3	EMPA-5	EMPA-2	EMPA-4	EMPA-2	EMPA-2

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of A: University of Alberta EMPA.

^ - a mumber of other analytical points gave totals of 80-90% (possibly oxidized?).

a – average of two analytical points.

tr. = trace (<0.01 wt.%).

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10c. Compositional Data - Metals and "Ides" (alphabetical order; continued)

10c.7. Sulphides (continued)

Wt. %	MAC101	MAR101	MAR101	PEN101	PEN101
Fe	44.31	45.45	45.49	58.38	58.68
Ni	28.53	0.00	0.02	0.64	0.64
Na	0.04	0.02	0.04	0.02	0.03
S	25.81	54.98	53.35	40.90	39.57
V	0.00	0.00		0.00	
Co	1.22	0.04		0.00	
P	0.00	0.00	tr.[a]	0.00	
Cr	0.00	0.00		0.02	
Mg	0.08	0.00		0.00	
Mn	0.04	0.00	0.01[a]	0.00	
Cu	0.00	0.00	0.01[a]	0.00	
Al	0.06	0.04		0.00	
Pb	0.00	0.00		0.00	
Zn	0.00	0.00		0.00	
Ti	0.00	0.00		0.02	
TOTAL	100.09	100.53	98.92	99.98	98.92
			IONS NORMALIZED TO 24		
Fe	9.012	7.714		10.750	
Ni	5.519	--		0.112	
Na	0.019	0.009		0.009	
S	9.145	16.256		13.123	
V	--	--		--	
Co	0.235	0.007		--	
P	--	--		--	
Cr	--	--		0.004	
Mg	0.037	--		--	
Mn	0.008	--		--	
Cu	--	--		--	
Al	0.025	0.014		--	
Pb	--	--		--	
Zn	--	--		--	
Ti	--	--		0.002	
Source	U of A	U of A	U of A	U of A	U of A
Analysis	EMPA-1^	EMPA-2	EMPA-7	EMPA-2	EMPA-7

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of A: University of Alberta EMPA. *= data from University of Alberta EMPA.

^ - a number of other analytical points gave totals of 80-90% (possibly oxidized?).

a – average of three point analyses.

tr. = trace (<0.01 wt.%).

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10c. Compositional Data - Metals and "Ides" (alphabetical order; continued)

10c.7. Sulphides (continued)

Wt. %	PRH101	PRH101	PRH101	PRT101	PRT101	PRT102	PRT103
Fe	58.53	57.39	58.66	45.97	45.75		
Ni	0.70	0.67	0.71	0.00	0.01		
Na	0.03	0.15	0.03	0.06	0.04		
S	40.36	38.34	39.45	54.10	54.47		
V	0.00	0.00		0.00			
Co	0.07	0.06		0.01			
P	0.00	0.00	tr.[a]	0.00	0.01[a]		
Cr	0.08	0.07		0.00			
Mg	0.04	0.04		0.08			
Mn	0.00	0.00	0.01[a]	0.00	0.00[a]		
Cu	0.00	0.00	0.00[a]	0.00	0.00[a]		
Al	0.05	0.05		0.08			
Pb	0.00	0.00		0.00			
Zn	0.18	0.16		0.00			
Ti	0.00	0.00		0.00			
TOTAL	100.04	96.93	98.86	100.30	100.28		
				IONS NORMALIZED TO 24			
Fe	10.798			7.840			
Ni	0.123			--			
Na	0.013			0.025			
S	12.972			16.073			
V	--			--			
Co	0.012			0.002			
P	--			--			
Cr	0.016			--			
Mg	0.017			0.031			
Mn	--			--			
Cu	--			--			
Al	0.020			0.029			
Pb	--			--			
Zn	0.029			--			
Ti	--			--			
Source	U of A	U of A	U of A	U of A	U of A		
Analysis	EMPA-3	EMPA-3	EMPA-6	EMPA-2	EMPA-9		

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of A: University of Alberta EMPA.

a – average of three point analyses.

tr. – trace (<0.01 wt.%).

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10c. Compositional Data - Metals and "Ides" (alphabetical order; continued)

10c.7. Sulphides (continued)

Wt. %	TRO101	TRO101	TRO201	TRO201
Fe	40.99	42.20	61.50	61.54
Ni	0.10	0.08	0.03	0.03
Na	0.00	0.00	0.01	0.02
S	34.75	33.75	37.71	36.63
V	0.00		0.00	
Co	0.00		0.02	
P	0.00	0.01[a]	0.00	tr.[a]
Cr	0.06		0.32	
Mg	0.07		0.00	
Mn	0.00	0.01[a]	0.00	0.02[a]
Cu	20.84	20.09[a]	0.00	0.01[a]
Al	0.04		0.02	
Pb	0.00		0.00	
Zn	0.00		0.08	
Ti	0.02		0.00	
TOTAL	96.87	96.14	99.69	98.25
			IONS NORMALIZED TO 24	
Fe	8.180		11.558	
Ni	0.019		0.005	
Na	--		0.004	
S	12.082		12.345	
V	--		--	
Co	--		0.003	
P	--		--	
Cr	0.013		0.065	
Mg	0.032		--	
Mn	--		--	
Cu	3.655		--	
Al	0.017		0.007	
Pb	--		--	
Zn	--		0.013	
Ti	0.002		–	
Source	U of A	U of A	U of A	U of A
Analysis	EMPA-6	EMPA-9	EMPA-5	EMPA-14

Note: Source and Analysis: EMPA indicates analysis by electron microprobe; number of discrete point analyses that were averaged together also indicated. U of A: University of Alberta EMPA. *= data from University of Alberta EMPA.

a – average of three point analyses.

tr. – trace (<0.01 wt.%).

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10c. Compositional Data - Metals and "Ides" (alphabetical order; continued)

10c.7. Sulphides (continued)

Wt. %	TRO202	TRO203
SiO_2		0.00
TiO_2		0.06
Al_2O_3		0.45
(Fe_2O_3)*		(63.33)
FeO^1		0.00
$Fe_2O_3{}^1$		63.33
MnO		0.16
MgO		0.05
CaO		0.00
Na_2O		0.10
K_2O		0.00
P_2O_5		0.00
S		36.10
TOTAL		100.25
LOI	12.49	4.52
ppm		
Sr		<5
Zr		10
V		<5
Co		30
Cr		70
Cu		350
Ni		140
Rb		<5
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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10c. Compositional Data - Metals and "Ides" (alphabetical order; continued)

10c.7.1. Sulphides (continued) –as oxides

Wt.%	MAR112	PRH105C	PRT108
ROM ID#	M27691	M3924	M8751
SiO_2	0.12	0.17	0.06
TiO_2	0.02	0.03	0.02
Al_2O_3	0.00	0.01	0.08
*(Fe_2O_3)**	*(99.10)*	*(94.75)*	*(98.65)*
FeO	0.53	1.90	0.00
Fe_2O_3	98.51	92.64	98.65
MnO	0.046	0.027	0.025
MgO	0.00	0.17	0.00
CaO	0.04	0.09	0.32
Na_2O	0.09	0.20	0.08
K_2O	0.007	0.007	0.013
P_2O_5	0.006	0.006	0.018
SO_3	0.07	0.11	0.30
TOTAL	99.499	95.570^	99.566
LOI	34.84	13.84	33.79
Cu	0.2-0.3		0.1-0.2
ppm			
Sr	35	8	49
Zr	10	<2	22
V	29	8	21
Ni	380	38800	100
Cr	70	385	72
Co	<2	1925	40
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

^ - total low due to high Ni.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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10d. Spectral Data - Metals and "Ides" (alphabetical order)

Sample	*Facility/File No.*	*Description*
ALA101	PSF 081222a.035	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
+++++++		
AWA101	RELAB c1sc14	45-90 µm, 0E/15E, 0.34-2.7µm, 5nm.
+++++++		
CAR101	RELAB cacn01	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
CAR101	RELAB lacn01	<45 µm, 30°/0,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet, different viewing geometry).
CAR101	PSF feb2107.011	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb 2107 meteoritic).
CAR101	PSF 121016a.082	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
CAR101	PSF OO 82	unsorted; 0º/0º; 0.2-0.86 µm (0.2-0.4 µm usable range); ~0.4 nm resolution; 200 spectra averaged; Ocean Optics S2000 (directory: Ocean Optics 000); opened in glove box.
+++++++		
CAS001	PSF 121016a.081	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
CAS001	PSF 121016a.121	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
CAS001	PSF 121016a.124	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
CAS001	PSF OO 81	unsorted; 0º/0º; 0.2-0.86 µm (0.2-0.4 µm usable range); ~0.4 nm resolution; 200 spectra averaged; Ocean Optics S2000 (directory: Ocean Optics 000); opened in glove box.
+++++++		
CEM101	RELAB c1sc84	<45 µm, 0E/15E, 0.3-2.7µm, 5nm.
	RELAB mace01	<45 µm (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
CEM101	PSF feb2107.012	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2107 meteoritic).
CEM101	PSF feb2017.013	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2107 meteoritic).
+++++++		
CIN102	PSF pig1307.036	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
+++++++		
IRO101	RELAB c1sc11	<63 µm, 0E/15E, 0.34-2.7µm, 5nm.
IRO101	RELAB c2sc11	<63 µm, 0E/15E, 0.34-2.7µm, 5 nm, spun 0.84-2.7µm.
IRO101	PSF feb2007.002	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2007 meteoritic).
IRO101	PSF feb2007.003	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2007 meteoritic).
+++++++		
IRO102	PSF 121016a.015	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.031	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF OO 15	<50 nm; 0º/0º; 1200-860 nm (200-400 nm usable range); ~0.3 nm resol.; opened in glove box; 100 avgd.; Ocean Optics S2000; re-measured periodically while in glove box.
IRO102	PSF 121016a.065	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.075	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.

IRO102	PSF 121016a.077	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.094	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.109	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.123	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.156	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.160	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.161	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.163	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.164	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	*See also section 15 of this document for various mixture involving IRO102.*	

+++++IRO102 monitored in glove box ++++++++++++++++++

Opened in glove box (received packed in neutral atmosphere) - spectra shot periodically to monitor integrtity of glove box (search for signs of oxidation)

IRO102a	0 minutes after opening	ASD PSF file: 121016a.167
IRO102b	5 minutes after opening	ASD PSF file: 121016a.168
IRO102c	10 minutes after opening	ASD PSF file: 121016a.169
IRO102d	20 minutes after opening	ASD PSF file: 121016a.170
IRO102e	18 hours after opening	ASD PSF file: 121016a.172
IRO102f	40 hours after opening	ASD PSF file: 121016a.193

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IRO103	PSF 121016a.013	<10 µm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
IRO103	PSF 121016a.105	<10 µm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
IRO103	PSF OO 13	<10 µm; 0º/0º; 1200-860 nm (200-400 nm usable range); ~0.3 nm resol.; opened in glove box; 100 avgd.; Ocean Optics S2000.
IRO103	*See also section 15 of this document for various mixture involving IRO103.*	

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MAR101	RELAB c1sc78	<45µm, 0E/15E, 0.3-2.7µm, 5nm.

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MTL001	PSF 071115a.003	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.

+++++++

MTL002	PSF 071115a.004	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.

+++++++

MTL003	PSF 071115a.005	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.

+++++++

MTL004	PSF 071115a.002	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.

+++++++

MTL005	PSF 071115a.006	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.

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MTL006	PSF 071212b.002	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
MTL006	PSF 071212b.004	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
MTL006	PSF 071212b.006	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
+++++++		
MTL007	PSF 071212b.001	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
MTL007	PSF 071212b.003	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
MTL007	PSF 071212b.005	lightly sanded surface (with black sandpaper); 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
+++++++		
MTL008	PSF 071204a.001	pressed, crinkled surface; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
MTL008	PSF 071204a.002	pressed, crinkled surface; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
MTL008	PSF 071204a.003	pressed, crinkled surface; 30°/0°; 0.35-2.5 µm; 1 nm res.; 1000 avg, ASD.
+++++++		
NIC101	RELAB c1sc10	<25 µm, 0E/15E, 0.34-2.7µm, 5 nm, spun 0.84-2.7µm.
NIC101	PSF feb2007.004	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2007 meteoritic).
+++++++		
NIF101	RELAB c1sc12	<63 µm, 0E/15E, 0.34-2.7µm, 5nm.
NIF101	RELAB c2sc12	<63 µm, 0E/15E, 0.34-3.8µm, 5nm, spun 0.84-2.7µm, with errors.
NIF101	PSF feb2007.005	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2007 meteoritic).
NIF101	PSF feb2007.006	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2007 meteoritic).
+++++++		
PEN101	PSF 100304a.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
+++++++		
PRH101	RELAB c1sc76	<45µm, 0E/15E, 0.3-2.7µm, 5nm.
PRH101	PSF 100304a.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
+++++++		
PRT101	RELAB c1sc77	<45µm, 0E/15E, 0.3-2.7µm, 5nm.
PRT101	PSF 100304a.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
PRT101	PSF jul1306.008	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1306inairnw).
PRT101	PSF aprt101	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #5 without sapphire window (Directory: jul1106inairnw).
PRT101	V	
+++++++		
PRT102	RELAB csc119	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PRT102	RELAB lasc119	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PRT102	PSF 071212a.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
+++++++		
SIC101	RELAB c1sc82	<37 µm, 0E/15E, 0.3-2.7µm, 5nm.
SIC101	RELAB masc112	<37 µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
+++++++		
SIC102	RELAB c2sc82	<7 µm, 0E/15E, 0.3-2.7µm, 5nm.
SIC102	RELAB masc110	<7 µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
+++++++		
SCR101 45	PSF feb2307.008	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (feb2307

		meteoritic).
SCR101 45-90	PSF feb2307.009	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2307 meteoritic).
SCR101 45	PSF feb2607.008	<45µm; 35°/0°?; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (feb2607 meteoritic).
SCR101 45-90	PSF feb2607.009	<45µm; 35°/0°?; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2607 meteoritic).
Also see meteorites section (section 16).		
+++++++		
SUL001	PSF 141208a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 140208oxalatesulfides].
SUL001	PSF sul001	<45 µm; 0°/0°; 0.2-0.4 µm usable range; deuterium light; 200 spectra averaged; Maya [Directory: 140208oxalatesulfides].
SUL001	PSF 141208a.005	<45 µm; 30°/0° ASD, 0°/0° Maya; 0.2-2.5 µm; merged Maya + ASD (Maya with UV, ASD with QTH; merged at 399 nm); 200 and 500 spectra averaged [Directory: 140208oxalatesulfides].
+++++++		
SUL002	PSF 141208a.006	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 140208oxalatesulfides].
SUL002	PSF sul002	<45 µm; 0°/0°; 0.2-0.4 µm usable range; deuterium light; 200 spectra averaged; Maya [Directory: 140208oxalatesulfides].
SUL002	PSF 141208a.006	<45 µm; 30°/0° ASD, 0°/0° Maya; 0.2-2.5 µm; merged Maya + ASD (Maya with UV, ASD with QTH; merged at 399 nm); 200 and 500 spectra averaged [Directory: 140208oxalatesulfides].
+++++++		
SYN008	PSF feb2107.015	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2107 meteoritic).
SYN008	PSF feb2107.016	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2107 meteoritic).
SYN008	PSF feb2607.008	<45 µm; 35°/0°?; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2607 meteoritic).
SYN008	PSF feb2607.009	45-90 µm; 35°/0°?; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2607 meteoritic).
+++++++		
TIN101	PSF 120116a.080.	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD (directory: 121016glovebox).
TIN101	PSF OO 80	unsorted; 0º/0º; 0.2-0.86 µm (0.2-0.4 µm usable range); ~0.4 nm resolution; 200 spectra averaged; Ocean Optics S2000 (directory: Ocean Optics 000); opened in glove box.
+++++++		
TRO101	PSF feb2307.004	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2307 meteoritic).
TRO101	PSF feb2607.004	<45µm; 35°/0°?; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2607 meteoritic).
+++++++		
TRO201	RELAB C1SC64	<45µm, 0E/15E, 0.3-2.7µm, 5nm.
TRO201	RELAB CAEA01	45-90µm, 30°/0°, 0.3-2.6, 5 nm, after “exposure” to air for 2 years.
TRO201	RELAB CBEA01	<45µm, 30°/0°, 0.3-2.6, 5 nm, after “exposure” to air for 2 years.
TRO201A	RELAB CCEA01	<45µm, 30°/0°, 0.3-2.6, 5 nm, after “exposure” to air for 2 years; heated at ~200°C for 1 hour.
TRO201	RELAB LAEA01A	45-90µm, 30°/30°, 0.3-26µm, 12-129 nm, after “exposure” to air for 2 years (Nicolet).
TRO201	RELAB LAEA01B	<45µm, 30°/30°, 0.3-26µm, 1.2-129 nm, after “exposure” to air for 2 years (Nicolet).
TRO201A	RELAB LAEA01C	<45µm, 30°/30°, 0.3-26µm, 5 nm, after “exposure” to air for 2 years; heated at ~200°C for 1 hour (Nicolet).

TRO201	PSF feb2307.005	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2307.005).
TRO201	PSF feb2607.005	<45µm; 35°/0°?; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2607 meteoritic).
TRO201	PSF 100304a.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.

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TRO202	RELAB c1sc65	<45 µm, 0E/15E, 0.3-2.7µm, 5nm.
TRO202	RELAB CAEA02	45-90 µm, 30°/0°, 0.3-2.6, 5 nm, after "exposure" to air for 2 years.
TRO202	RELAB CBEA02	<45 µm, 30°/0°, 0.3-2.6, 5 nm, after "exposure" to air for 2 years.
TRO202A	RELAB CCEA02	<45 µm, 30°/0°, 0.3-2.6, 5 nm, after "exposure" to air for 2 years; heated at ~200°C for 1 hour.
TRO202	RELAB LAEA02A	45-90 µm, 30°/30°, 0.3-26µm, 12.-129 nm, after "exposure" to air for 2 years (Nicolet).
TRO202	RELAB LAEA02B	<45 µm, 30°/30°, 0.3-26µm, 12-129 nm, after "exposure" to air for 2 years (Nicolet).
TRO202A	RELAB LAEA02C	<45 µm, 30°/30°, 0.3-26µm, 12-129 nm, after "exposure" to air for 2 years; heated at ~200°C for 1 hour (Nicolet).
TRO202g	RELAB CGEA02	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm, after "exposure" to air for 2 years.
TRO202g	RELAB CHEA02	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm, after "exposure" to air for 2 years; heated at ~200°C for 1 hour.
TRO202g	RELAB LAEA02G	<45 µm, 30°/30°, 0.3-26µm, 12-129 nm, after "exposure" to air for 2 years (Nicolet).
TRO202gA	RELAB LAEA02H	<45 µm, 30°/30°, 0.3-26µm, 12.-129 nm, after "exposure" to air for 2 years; heated at ~200°C for 1 hour (Nicolet).
TRO202	PSF feb2307.006	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2307 meteoritic).
TRO202	PSF feb2607.006	<45µm; 35°/0°?; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2607 meteoritic).

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TRO203	RELAB caea09	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
TRO203	RELAB laea09a	<45 µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
TRO203	RELAB cbea09	45-90 µm, 30°/0°, 0.3-2.6µm, 5nm.
TRO203	RELAB laea09b	45-90 µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
TRO203	PSF feb2307.007	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2307 meteoritic).
TRO203	PSF feb2607.007	<45µm; 35°/0°?; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD (directory: feb2607 meteoritic).

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See also Meteorites section for some troilite information.

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END of 10.

11. Basalts and Igneous Samples

11.1. Iceland basalts
11.2. Columbia River basalts
11.3. Basalts - various localities
11.4. Basalt-related rocks
11.5. Basalts/samples - Hawaii
11.6. Silica-coated basalts - Hawaii
11.7. Andesites - Hayden Butte, Arizona
11.8. Samples - Tucson, AZ
11.9. Fresh Komatiites - various localities
11.10. Igneous rocks from CSA
11.11. ISAR Samples
11.12. Lonar crater, India
11.13. Miscellaneous igneous rocks
11.14. Marin Co. CA - greenstone
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11a. Basalts and Igneous Samples - Sample Descriptions

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID *Description*

11.1a. BASALTS - Iceland

BAS201 Basalt: Veidivötn Volcanic System, Iceland (postglacial age) (B. Gautason sample # Th-A), analysis in Gautason (1980).
BAS202 Basalt: Veidivötn Volcanic System, Iceland (postglacial age) (B. Gautason, sample # Th-D), analysis in Gautason (1980).

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11.2a. BASALTS - Columbia River Basalts

BAS203 Basalt: Columbia River Plateau, Frenchman Springs (S. Atkinson sample #SA-56), analysis (including various trace elements) in Atkinson (1989).
BAS204 Basalt: Columbia River Plateau, Roza Dike, Priest Rapids (S. Atkinson sample #SA-73), analysis (including various trace elements) in Atkinson (1989).
BAS205 Basalt: Columbia River Plateau, Roza Dike (S. Atkinson sample #SA-78), analysis (including various trace elements) in Atkinson (1989).

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11.2a.(i) SUE ATKINSON COLUMBIA RIVER BASALTS

SA-14 Basalt: Roza Member of the Columbia River Basalt Group; dikelet. Whitman County, Washington, Winona Quadrangle; 17N/40E/20SE.
SA-16 Basalt: Roza Member of the Columbia River Basalt Group; scoria. Whitman County, Washington, Winona Quadrangle; 17N/39E/10NE.
SA-19 Basalt: Roza Member of the Columbia River Basalt Group; near vent flows. Whitman County,

	Washington, Dusty Quadrangle; 16N/41E/21.
SA-20	Basalt: Roza Member of the Columbia River Basalt Group; dike. Garfield County, Washington, Almota Quadrangle; 13N/42E/1N (assumes sample is from margin of dike).
SA-21	Basalt: Roza Member of the Columbia River Basalt Group; dike. Garfield County, Washington, Almota Quadrangle; 13N/42E/1N (assumes sample is from core of dike).
SA-24	Basalt: Roza Member of the Columbia River Basalt Group; dike. Garfield County, Washington, Almota Quadrangle; 13N/42E/1N.
SA-26	Basalt: Roza Member of the Columbia River Basalt Group; near vent flow. Asotin County, Washington, Saddle Butte Quadrangle; 10N/44E/30NNW.
SA-27	Basalt: Roza Member of the Columbia River Basalt Group; dike. Asotin County, Washington, Saddle Butte Quadrangle; 9N/44E/20SWNE.
SA-28	Basalt: Roza Member of the Columbia River Basalt Group; dike. Asotin County, Washington, Saddle Butte Quadrangle; 9N/44E/20SWNE.
SA-29	Basalt: Roza Member of the Columbia River Basalt Group; dike. Asotin County, Washington, Saddle Butte Quadrangle; 9N/44E/20SWNE.
SA-30A	Basalt: Roza Member of the Columbia River Basalt Group; dike. Asotin County, Washington, Saddle Butte Quadrangle; 9N/44E/20SWNE.
SA-35	Basalt: Roza Member of the Columbia River Basalt Group; near vent flow. Asotin County, Washington, Anatone Quadrangle; 7N/44E/1.
SA-36	Basalt: Roza Member of the Columbia River Basalt Group; dike. Asotin County, Washington, Anatone Quadrangle; 7N/44E/25SE.
SA-37	Basalt: Roza Member of the Columbia River Basalt Group; dike. Asotin County, Washington, Anatone Quadrangle; 7N/44E/25SE.
SA-38C	Basalt: Roza Member of the Columbia River Basalt Group; core of dike. Asotin County, Washington, Anatone Quadrangle; 7N/44E/25SE.
SA-40	Basalt: Roza Member of the Columbia River Basalt Group; margin of dike. Asotin County, Washington, Anatone Quadrangle; 7N/44E/25SE.
SA-40C	Basalt: Roza Member of the Columbia River Basalt Group; core of dike. Asotin County, Washington, Anatone Quadrangle; 7N/44E/25SE.
SA-41C	Basalt: Roza Member of the Columbia River Basalt Group; core of dike. Asotin County, Washington, Anatone Quadrangle; 7N/44E/25SE.
SA-43	Basalt: Roza Member of the Columbia River Basalt Group; near vent flow. Wallowa County, Oregon, Elk Mountain Quadrangle; 2N/45E/25SW.
SA-44	Basalt: Roza Member of the Columbia River Basalt Group; near vent flows. Wallowa County, Oregon, Elk Mountain Quadrangle; 2N/45E/25SW.
SA-47	Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-49	Basalt: Roza Member of the Columbia River Basalt Group; near vent flows. Wallowa County, Oregon, Elk Mountain Quadrangle; 2N/45E/25SW.
SA-50	Basalt: Roza Member of the Columbia River Basalt Group; margin of dike. Wallowa County, Oregon, Elk Mountain Quadrangle; 4N/45E/34ENW.
SA-51	Basalt: Roza Member of the Columbia River Basalt Group; core of dike. Wallowa County Oregon, Elk Mountain Quadrangle; 4N/45E/34ENW.
SA-52	Basalt: Roza Member of the Columbia River Basalt Group; core of dike. Wallowa County, Oregon, Elk Mountain Quadrangle; 4N/45E/34ENW.
SA-53	Basalt: Roza Member of the Columbia River Basalt Group; dike. Wallowa County, Oregon, Elk Mountain Quadrangle; 4N/45E/34ESW.
SA-54	Basalt: Roza Member of the Columbia River Basalt Group; dike. Wallowa County, Oregon, Elk Mountain Quadrangle; 4N/45E/34ESW.
SA-55	Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-56	Basalt: Columbia River Plateau, Frenchman Springs (Roza Member of the Columbia River Basalt Group) (aka BAS203).
SA-57	Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-58	Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-59	Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-60	Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-61A	Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.

SA-62 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-63 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-64 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-65 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-66 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-67 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-68 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-70 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-71 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-72 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-73 Basalt: Columbia River Plateau, Roza Dike, Priest Rapids. Aka BAS204.
SA-74 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-75 Basalt: Roza Member of the Columbia River Basalt Group; plateau proper flow. Yakima County, Washington, Yakima Quadrangle; 14N/19E/9W.
SA-76 Basalt: Roza Member of the Columbia River Basalt Group; unknown locality.
SA-78 Basalt: Columbia River Plateau, Roza Dike. Aka BAS205.

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11.3a. BASALTS - Various localities

BAS301 Basalt: Spray, Wheeler County, Oregon, USA; with levyne (zeolite; ZEO133) [Minerals Unlimited].
BAS302 Basalt: Beech Creek, Grant County, Oregon, USA; with offretite-erionite (ZEO139) overgrowths on levyne (ZEO140) [Minerals Unlimited].
BAS303 Basalt: Green Peter Dam, near Foster, Linn County, Oregon, USA; with scolecite (ZEO150) and stilbite (ZEO151).
BAS304 Basalt: near Riggins, Idaho County, Idaho, USA; with paulingite (ZEO160) [Minerals Unlimited].
BAS305 Basalt: Grand Marais, Cook County, Minnesota, USA, with thomsonite (ZEO167) [Minerals Unlimited].
BAS306 Basalt: Monument, Grant County, Oregon, USA [with gyrolite and analcime] (Minerals Unlimited).
BAS307 Basalt: New Pit, Boron, Kern County, California, USA; with hisingerite (HIS001) (Fe_2^{3+} Si_2 O_5 $(OH)_4$ · $2H_2$ O) [Minerals Unlimited] (hisingerite description: black coatings on rock).
BAS308 Basalt: Giant's Causeway, Northern Ireland [from Geoff Scott].
BAS309 Basalt: Giant's Causeway, Northern Ireland [from Geoff Scott]; probably from younger part of the flow than BAS308.

BAS400 Basalt (vesicular, a'a): landscaping stone; weathered to red colour (Columbia River basalt?); packed in Regway, Idaho, USA.

BAS500 Weathered basalt - Mud Bay beach, Vancouver, BC, Canada (self collected, July 2004).
BAS501 Weathered olivine basalt - Mud Bay beach, Vancouver, BC, Canada (self collected, July 2004).
BAS502 Weathered olivine basalt - Mud Bay beach, Vancouver, BC, Canada (self collected, July 2004).

BAS503 Basalt/andesite cobble: Santorini island, Greece (collected by W. Cloutis August 2009).

BAS504 Basalt (?); St. Kitt's, collected by Patricia Fitzpatrick (Feb. 2013). Coordinates: 17.40345 N, -62.78012 E.

BAS600 Basalt, ilmenite-bearing; 57th Avenue Quarry diabase. Collected from loose blocks/talus pile in corner of the quarry from K. Gordon's thesis. Provided by John Green and Paul Weiblen at University of Minnesota (October 2013); ~6 pound boulder.

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11.4a. BASALT-RELATED ROCKS

BAS501X Diabase: Salem Neck, Massachusetts, USA (University of Alberta #Di.15; JAA 122 [essentials:

plagioclase, clinopyroxene; sills and dikes].

BAS502X Essexite: Mount Royal, Quebec (University of Alberta #G.11; GSC #115) [essentials: plagioclase, orthoclase, pyroxene, biotite, amphibole; plutonic].

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11.5a. BASALTS/SAMPLES FROM HAWAII (HAWxxx: February 2004)

11.5a.1. BASALTIC GLASSES

BAS101 Basaltic glass: Kilauea Caldera, 1956 flow?, Hawaii (E. Cloutis), 999p on microprobe printout. “A” is <45 µm grain size; “B” is 45-90 µm grain size.

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11.5a.2. BASALTIC “SAND”

BSB101 Basalt (Black Sand Beach sand): Southeast coast, island of Hawaii, Hawaii (R.B. Singer), not analyzed.

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11.5a.3. HAWAII (2004)

HAW001 Weathered olivine basalt; northeast corner of plateau above Halemaumau crater; Halemaumau Trail, Kilauea caldera, Big Island, Hawaii, USA.

HAW002 Sulphur (and sulphur dioxide crust); northeast corner of plateau above Halemaumau crater; Halemaumau Trail, 1982(?) fire fountain ridge, Kilauea caldera, Big Island, Hawaii, USA.

HAW003 Sulphur encrusted and weathered basalts; northeast corner of plateau above Halemaumau crater; Halemaumau Trail, 1982(?) fire fountain ridge, Kilauea caldera, Big Island, Hawaii, USA.

HAW004 Sulphur (and sulphur dioxide crust); northeast corner of plateau above Halemaumau crater; Halemaumau Trail, 1982(?) fire fountain ridge, Kilauea caldera, Big Island, Hawaii, USA.

HAW005 Sulphur dioxide crust (?) on basalt; northeast corner of plateau above Halemaumau crater; Halemaumau Trail, 1982(?) fire fountain ridge, Kilauea caldera, Big Island, Hawaii, USA.

HAW006 Basalt (partially weathered); Kohala Mountain crest, road cut - Highway 250, Big Island, Hawaii, USA.

HAW007 A’a flow (1977? from Pu’u Kia’i, borrow pit at side of road, approx. ½ mile east of Queen’s Bath (Punalu’u Heiau), on Highway 137, southeast corner of Big Island, Hawaii, USA.

HAW008 Weathered basaltic soil, Kohala Mountain crest, road cut - Highway 250, Big Island, Hawaii, USA.

HAW009 A’a flow (1977? from Pu’u Kia’i, borrow pit at side of road, approx. ½ mile east of Queen’s Bath (Punalu’u Heiau), on Highway 137, southeast corner of Big Island, Hawaii, USA.

HAW010 A’a flow (1977? from Pu’u Kia’i, borrow pit at side of road, approx. ½ mile east of Queen’s Bath (Punalu’u Heiau), on Highway 137, southeast corner of Big Island, Hawaii, USA.

HAW011 A’a flow (1977? from Pu’u Kia’i, borrow pit at side of road, approx. ½ mile east of Queen’s Bath (Punalu’u Heiau), on Highway 137, southeast corner of Big Island, Hawaii, USA.

HAW012 Sulphur encrusted and weathered basalt; northeast corner of plateau above Halemaumau crater; Halemaumau Trail, 1982(?) fire fountain ridge, Kilauea caldera, Big Island, Hawaii, USA.

HAW013 Weathered soil (palagonite?) adjacent to upper parking lot on Mauna Kea Summit Road (John A. Burns Way parking lot), just before upper paved section begins; Big Island, Hawaii, USA.

HAW014 Volcanic bomb: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW015 Pu’u Huluhulu; junction of Saddle Road and Mauna Kea Summit Road; soil 5 cm from contact of lava flow and underlying cinder (see Bell et al., JGR vol. 98, no. E2, pp. 3373-3385 (1993); Big Island, Hawaii, USA.

HAW016 Pu’u Huluhulu; junction of Saddle Road and Mauna Kea Summit Road; soil 20 cm from contact of lava flow and underlying cinder (see Bell et al., JGR vol. 98, no. E2, pp. 3373-3385 (1993); Big Island, Hawaii, USA.

HAW017 Pu’u Huluhulu; junction of Saddle Road and Mauna Kea Summit Road; soil 50 cm from contact of lava flow and underlying cinder (see Bell et al., JGR vol. 98, no. E2, pp. 3373-3385 (1993); Big Island, Hawaii, USA.

HAW018	Pu'u Huluhulu; junction of Saddle Road and Mauna Kea Summit Road; soil 80 cm from contact of lava flow and underlying cinder (see Bell et al., JGR vol. 98, no. E2, pp. 3373-3385 (1993); Big Island, Hawaii, USA.
HAW019	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW020	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW021	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW022	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW023	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW024	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW025	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW026	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW027	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW028	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW029	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW030	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW031	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW032	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW033	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW034	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW035	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW036	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW037	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW038	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW039	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW040	Unsorted xenolith and basalt fragments: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW041	Unsorted finer grained xenolith and basalt fragments: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW042	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW043	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW044	Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.
HAW045	Cinders; Pu'u Huluhulu, intersection of Saddle Road and Mauna Kea Summit Road; Big Island,

Hawaii, USA.

HAW046 A’a flow adjacent to Pu’u Nene (1843 flow); Big Island Hawaii, USA.

HAW047 Basaltic soil (palagonite?); 1 mile up from Hale Pohaku (John A Burns Road, adjacent to 1st parking lot?); likely 0-2 cm depth; Big Island, Hawaii, USA.

HAW048 Water-washed olivine basalt; mouth of Kolekole stream, N of Hilo along Highway 19; Big Island, Hawaii, USA.

HAW049 Basaltic soil (palagonite?); Mauna Kea Summit Road; soil adjacent to upper parking lot, 0-2 cm depth; Big Island, Hawaii, USA.

HAW050 Basaltic soil (palagonite?); Mauna Kea Summit Road; soil adjacent to upper parking lot, 2-8 cm depth; Big Island, Hawaii, USA.

HAW051 Cinders; Pu’u Nene cinder cone; near junction of Saddle Road and Mauna Kea Summit Road, Big Island Hawaii, W-NW flank, 30" below surface; Big Island, Hawaii, USA.

HAW052 Basalt; northern flank of Subaru Telescope site; Mauna Kea summit; Big Island, Hawaii, USA.

HAW053 Palagonitic soil (?); John P. Burns way parking lot (likely 1 mile up from Hale Pohaku; adjacent to first parking lot 1st; 2-8 cm depth); See sample HAW047; Big Island, Hawaii, USA.

HAW054 Unsorted fragments and soil; mostly from HAW047 sample; all from Mauna Kea Summit Road above Hale Pohaku; from broken bags and spillage; Big Island, Hawaii, USA.

HAW055 Surficial sample: Steam Vent trail, Kilauea Caldera, Hawaii Volcanoes National Park, Big Island, Hawaii, USA.

HAW056 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW057 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW058 Cinders/ash: Pu’u Huluhulu quarry (west side of pu’u), Junction of Summit Road and Mauna Kea Access Road, Big Island, Hawaii, USA.

HAW059 Surficial deposit from below surface at vent: Sulfur Banks trail, Kilauea Caldera, Hawaii Volcanoes National Park, Big Island, Hawaii, USA.

HAW060 Pahoehoe flow: recent lava flows at end of Chain of Craters Road, Big Island, Hawaii, USA.

HAW061 Pahoehoe flow: recent lava flows at end of Chain of Craters Road, Big Island, Hawaii, USA.

HAW062 A’a flow: recent lava flows at end of Chain of Craters Road, Big Island, Hawaii, USA.

HAW063 A’a flow: recent lava flows at end of Chain of Craters Road, Big Island, Hawaii, USA.

HAW064 Pahoehoe flow: recent lava flows at end of Chain of Craters Road, Big Island, Hawaii, USA.

HAW065 Olivine basalt: recent lava flows at end of Chain of Craters Road?, Big Island, Hawaii, USA.

HAW066 Cinders/ash: Pu’u Huluhulu quarry (west side of pu’u), Junction of Summit Road and Mauna Kea Access Road, Big Island, Hawaii, USA.

HAW067 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW068 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW069 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW070 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW071 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW072 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW073 Unsorted xenolith fragments and grains from samples HAW067-072: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW074 Surficial deposit from below ground surface at vent: Sulfur Banks Trail, Kilauea Caldera, Hawaii Volcanoes National Park. Big Island, Hawaii, USA.

HAW075 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW076 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW077 Xenolith: unnamed Pu’u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island,

Hawaii, USA.

HAW078 Xenolith: unnamed Pu'u WSW of Hale Pohaku base camp, Mauna Kea summit road, Big Island, Hawaii, USA.

HAW101 Weathered basalt: Rocky Hill, road cut, NE of Punahou School grounds, Honolulu, Oahu, Hawaii, USA.
HAW102 Basaltic soil: Koko Crater - Botanical Garden, Honolulu, Oahu, Hawaii, USA.
HAW103 Basaltic soil: Koko Crater - Botanical Garden, Honolulu, Oahu, Hawaii, USA.
HAW104 Weathered basalt: Rocky Hill, road cut, NE of Punahou School grounds, Honolulu, Oahu, Hawaii, USA.
HAW105 Weathered basalt: Rocky Hill, road cut, NE of Punahou School grounds, Honolulu, Oahu, Hawaii, USA.
HAW106 Weathered basalt: Rocky Hill, road cut, NE of Punahou School grounds, Honolulu, Oahu, Hawaii, USA.
HAW107 Basalt: red-black contact; Makapuhu Head lighthouse west side of highway of roadside turnout; SE coast of Oahu, Hawaii, USA.
HAW108 Weathered basalt: Round Top Road road cut on east side city lookout; Honolulu, Oahu, Hawaii, USA.
HAW109 Basalt: base of Waipuhio Slide area, Palolo Valley, Honolulu, Hawaii, USA.
HAW110 Basalt: base of Waipuhio Slide area, Palolo Valley, Honolulu, Hawaii, USA.
HAW111 Basalt: base of Waipuhio Slide area, Palolo Valley, Honolulu, Hawaii, USA.
HAW112 Olivine-rich sand deposit: Sandy Beach park, east side of Oahu, Hawaii, USA.
HAW113 Weathered basalt: Round Top Road road cut on east side city lookout; Honolulu, Oahu, Hawaii, USA.
HAW114 Beach sand: just south of Waianae Beach Park, west side of Oahu, Hawaii, USA.
HAW115 Weathered basaltic soil: Tantalus Ridge, city lookout road cut, Honolulu, Oahu, Hawaii, USA.
HAW116 Weathered basalt: Koko Crater floor - in Botanical Garden area; Honolulu, Oahu, Hawaii, USA.
HAW117 Weathered basalt: Koko Crater floor - in Botanical Garden area; Honolulu, Oahu, Hawaii, USA.
HAW118 Weathered basalt: Koko Crater floor - in Botanical Garden area; Honolulu, Oahu, Hawaii, USA.
HAW119 Weathered basalt: Koko Crater floor - in Botanical Garden area; Honolulu, Oahu, Hawaii, USA.
HAW120 Weathered basalt (and fragments from HAW116-121): Koko Crater floor - in Botanical Garden area; Honolulu, Oahu, Hawaii, USA.

HAW200 Unsorted samples and fragments, spills from samples HAW055-078 and 101-120; both Oahu and Big Island, Hawaii, USA.

HAW300-305 Volcanic bombs and fragments, Big Island, cinder cone W of Hale Pohaku.
HAW306-311 Volcanic bomb and pahoehoe fragments, Oahu and Big Island, HI, USA.
HAW312-329 Volcanic bomb fragments, xenoliths, and olivine phenocrystic basalt, Big Island, HI, USA, collected by Vicky and Geneva.
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11.6a. Silica-coated basalts from Hawaii (from Brad Jolliff, Washington University – June 2009)

Key: H = Hawaii; KD = Kau Desert; KC = Kilauea Caldera; EA = end of arroyo; ST = solfatara; 71, 74, and 82 refer to year of the flow.

HKD02-74-03 "1974 flow surface" – Hawaii Kau Desert 1974 flow. Discontinuous yellow-white encrustation on pahoehoe surface.
HKD02-ST-74 "1974 flow near solfatara 2, down from vent" – Hawaii Kau Desert, solfatara, 1974 flow. Discontinuous yellow-white encrustation on pahoehoe surface.
HKD03-EA29 "spatter from 1974 flow and end of arroyo basalts – site 2 fissure vent. Brightly colored material downwind of fissure." Hawaii Kau Desert end of arroyo 2003 flow. Discontinuous yellow-white encrustation on pahoehoe surface.
HKC03-71 "1971 flow surface" – Hawaii Kilauea caldera, 1971 flow. Discontinuous multi-hued encrusted or altered surface on pahoehoe.
HKC03-82-24A "1982 flow surface, one of two pieces". Hawaii Kilauea Caldera, 1982 flow. Discontinuous gray amorphous/glassy surface on pahoehoe fragment.

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11.7a. Andesitic samples from Hayden Butte, Arizona

North end of Arizona State University campus adjacent to football stadium ("A" mountain). Loose fragments and partially dislodged bedrock collected along path to summit (June 8, 2009).

Bleaching and/or iron oxide staining subset:

HAY001 Piece with red-orange iron oxide staining on one surface.
HAY002 Piece with red-orange iron oxide staining and some bleaching on surface.
HAY003 Piece with red-orange iron oxide staining and some bleaching on surface.
HAY004 Piece with red-orange iron oxide staining and some bleaching on surface.
HAY005 Piece with red-orange iron oxide staining and some bleaching on surface.

HAY010 Piece with light-toned encrustations on two surfaces.
HAY011 Piece with light-toned encrustations on two surfaces,
HAY012 Piece with partial light-toned/reddish encrustation on one surface, bleached other surface, unaltered other surfaces, some iron oxide staining.
HAY013 Piece with light-toned encrustation on one surface, bleaching on other surface.
HAY014 Piece with light-toned encrustations on most surfaces.
HAY015 Piece with partial orange-red encrustation on one surface, bleaching on other surface.
HAY016 Piece with light-toned encrustation on one surface, some light-toned staining/bleaching on other surface.
HAY017 Piece with rough light-toned encrustations on two surfaces.
HAY018 Piece with light-toned encrustation on two surfaces.
HAY019 Piece with partial light-toned encrustation on one surface, minor bleaching and iron oxide staining on remaining surfaces.
HAY020 Piece with partial light-toned encrustation on four surfaces, minor bleaching on other surfaces,
HAY021 Piece with light-toned/beige encrustation on one surface, bleaching on other surface.
HAY022 Piece with brown/beige encrustation on one surface.
HAY023 Piece with partial light-toned irregular encrustations on two surfaces.

Bleaching only subset:

HAY030 Piece with light-toned bleaching on two surfaces.

Desert varnish subset:

HAY040 Piece with grey-black coating (desert varnish?) on multiple surfaces – irregular.
HAY041 Piece with grey-black coating (desert varnish?) on multiple surfaces.
HAY042 Piece with variably glossy grey-black coating (desert varnish?) on multiple surfaces.
HAY043 Piece with gray-black coating (desert varnish?) and iron oxide staining.
HAY044 Piece with discontinuous grey-black coating/staining (desert varnish?) and iron oxide staining.
HAY045 Piece with discontinuous grey-black coating/staining (desert varnish?), iron oxide staining, and bleaching.
HAY046 Piece with discontinuous grey-black coating/staining (desert varnish?), iron oxide staining, and bleaching.

Desert varnish subset (2) – collected December 8, 2014

HAY050 Fist-sized piece with mostly continuous black, sometimes shiny black coating, and subsurface orange subsurface weathering layer; piece from bigger boulder - andesite.
HAY051 Small fragment with discontinuous black shiny desrt varnish surface and subsurface orange weathered layer; piece from bigger boulder - andesite.
HAY052 Fist-sized piece with mostly continuous black, sometimes shiny black coating, and subsurface orange subsurface weathering layer; piece from bigger boulder - andesite.
HAY053 Fist-sized piece with mostly continuous black, sometimes shiny black and, in spots, orange coating, and partially penetrative black coating on face in contact with ground; intact cobble - andesite.

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11.8a. Samples from Tucson, AZ (collected Nov. 2011)

AZ001 Andesite?; with iron oxide- and black desert varnish-stained surfaces (landscaping stone from bank near Tucson Marriott).
AZ002 Vesicular basalt (fresh) with one weathered surface (from LPL parking lot).

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11.9a. Fresh Komatiites (from Igor Puchtel, U of Maryland – January 2012)

501-3 Spinifex-textured komatiite; 3.3 Weltevreden Formation, Barberton GB (Connolly et al. 2011)
501-9 Cumulate komatiite; 3.3 Weltevreden Formation, Barberton GB (Connolly et al. 2011)
ZV-74 Chilled margin; 2.7 GA Belingwe GB, Zimbabwe (Puchtel et al., 2009)
91106 Cumulate komatiite; 2.4 Ga Vetreny Belt, Fennoscandinavian Shield (Puchtel et al., 1996)

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11.10a. Igneous rocks from Alex Koujelev at Canadian Space Agency (February 2012).

See section 30 of document for descriptions and analyses.

Andesite73302		GBW 07104 (NCS DC73302)
AndesiteAGV2		US AGV-2
AndesiteJA1		JA-1
AndesiteJA2		JA-2
AndesiteJA3		JA-3
Anorthosite2120		VS 2120-81
AnorthositeMO11		VS MO11
AnorthositeANG		VS MO10
BasaltBCR2		US BCR-2
BasaltBHVO2		US BHVO-2
BasaltJB2		JB-2
GabbroJGb2		JGb-2
Gabbro71304		GBW 07112 (NCS DC71304)
Granite		JG-2
GranodioriteJG1a		JG-1a
GranodioriteGSP2		US GSP-2
HornblenditeJH1		JH-1
Obsidian		SRM 278
OrthoGabbro		VS MO7
PeridotiteJP1		JP-1
Pyroxenite		SARM 5

Rhyolite71305		GBW 07113 (NCS DC71305)
RockFer2		*FeR-2 (Geological Survey of Canada)
Serpentinite		SARM 47
SyeniteJSy1		JSy-1
SyeniteSARM2		SARM 2
UBRockDC72301		GBW 07101 (NCS DC72301)
Hand sample57	**Granite	ActLabs
Hand sample62	**Andesite	ActLabs
Hand sample63	**Syenite	ActLabs
Hand sample64	**gabbro	ActLabs
Hand sample65	**Basalt	ActLabs
Hand sample66	**Rhyolite	ActLabs
Hand sample67	**Obsidian	ActLabs

FeR-2 grain size information from Brammer: average 0.07 mm
Obsidian grain size information from Brammer: <200 mesh
Pyroxenite grain size information from Brammer: <75 μm: 98%
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11.11a. Samples from International Space Analogue Rockstore (ISAR) – Nov. 2012 (see section 20.28)

07SA20-3 Basalt: Komatii River outcrop, Barberton, South Africa.
09ET01-3 Basalt: Etna, Sicilia, Italy.
09SV02-3 Dunite: Sverefjell outcrop, Svalbard, Norway; associated with 09SV05-4 and 09SV15-4.
09SV15-4 Basalt: Sverefjell outcrop, Svalbard, Norway; associated with 09SV02-3 and 09SV05-4.
09TE08-4 Phonolite: El Tiede Volcano, Tenerife, Canary Islands, Spain.
10SA09-3 Komatiite: Komatii River, Barberton, South Africa.
11CA02-3 Komatiite: Dundonald outcrop, Ontario, Canada.
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11.12a. Lonar Crater, India

LON001 Lonar crater, India, impact melt rock sample (~50 grams). From Dr. Md. Arif, Research Associate, Indian Institute of Geomagnetism (IIG), Kalamboli Highway, New Panvel (W), Navi Mumbai 410 218, Maharashtra, India; tel: (91) 9930153727; (91) 22 2748 4156. Received October 30, 2013. First piece is black and vesicular with glassy rinds on upper and lower surfaces (42 grams). Second batch (received Nov. 26, 2013) is 4 big fragments, all black and vesicular, some with apparent flow features (total weight: 376 grams).

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11.13a. Miscellaneous igneous rocks

GRN101 Greenstone (metamorphic rock): Feather River Canyon, Plumas County, California (Minerals Unlimited).
PRD101 Peridotite (kimberlite; “blue ground”): Murfreesboro, Pike County, Arkansas. Mica-augite peridotite (Minerals Unlimited).
GRN101 Granulite: quartz, feldspar, garnet (grossular?), amphibole: glacial erratic - Whitemud Creek area,

Edmonton, Alberta, Canada.
BRE101 Breccia - volcanic(?); Mud Bay beach, Vancouver, BC, Canada (self-collected, July 2004).
RHY001-004 Rhyolite (probably); 4 pieces from grounds of Tucson hotel, 1 with malachite staining [Tucson 2011].

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11.14a. Marin Co, CA, USA – Jurassic greenstones

GGB001-007 Jurassic greenstone (some with weathered and slickensides surfaces) – at NE base of Golden Gate Bridge, Marin Co, CA, USA. Collected dec. 3, 2011.

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11b. XRD Data - Basalts and Igneous Samples

BAS600	U of W Bruker D8.	Pattern fit by anorthite (sodian), ilmenite, magnetite (titanian), quartz, kaolinite, biotite, saponite, sodium magnesium scandium silicate fluoride.
LON001	U of W Bruker D8	Phases identified: diopside, labradorite, albite, magnetite; diffractogram is noisy with broad amorphous humps (Nov. 2013).

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11c. Compositional Data - Basalts and Igneous Samples (by groups)

11c.1. Iceland Basalts

Wt. %	BAS201[1]	BAS202[1]
SiO_2	49.4	49.0
TiO_2	1.63	1.60
Al_2O_3	14.4	16.8
Fe_2O_3	1.51	1.37
FeO	10.0	9.17
MnO	0.20	0.20
MgO	7.23	6.12
CaO	12.6	12.8
Na_2O	2.24	2.22
K_2O	0.21	0.22
P_2O_5	0.20	0.19
TOTAL	99.62	99.69
Source	Gautason	Gautason

All Fe reported as Fe_2O_3.
Bjarni Gautason (pers. comm.).
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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.2. Columbia River Basalts

Wt. %	BAS203[1]	BAS204[1]	BAS205[1]
Atkinson #	SA-56	SA-73	SA-78
SiO_2	52.50	50.91	51.55
TiO_2	2.80	3.58	3.13
Al_2O_3	13.45	12.78	13.19
Fe_2O_3	n.d.	n.d.	n.d.
FeO	14.11	15.26	14.36
MnO	0.22	0.25	0.23
MgO	4.54	4.43	4.59
CaO	8.32	8.58	8.55
Na_2O	2.86	2.52	2.90
K_2O	1.40	1.30	1.29
P_2O_5	0.54	0.80	0.69
TOTAL	100.74	100.41	100.48
Source	Atkinson	Atkinson	Atkinson

All Fe reported as FeO.

Atkinson: values from Susan Atkinson thesis (Atkinson, 1989).

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.2. Columbia River Basalts (continued)

Wt. %	SA-14	SA-16	SA-19	SA-20#	SA-20
SiO_2	52.92	51.84	51.46	52.73	51.71
Al_2O_3	14.71	13.71	13.66	14.53	14.69
TiO_2	3.322	3.298	3.065	3.136	2.91
FeO*	11.51	15.18	13.66	11.73	
*(Fe_2O_3)**					*(13.21)*
FeO					6.01
Fe_2O_3					6.53
MnO	0.177	0.204	0.211	0.197	0.18
CaO	9.33	8.01	8.91	9.40	9.62
MgO	3.18	3.71	4.47	3.24	3.44
K_2O	1.24	1.22	1.31	1.47	1.09
Na_2O	2.93	2.08	2.62	2.91	2.76
P_2O_5	0.700	0.755	0.635	0.658	0.62
SO_3					0.00
TOTAL					100.23
LOI					2.67
ppm					
Co					43
Ni	12	14	19	26	75
Cr	53	28	54	57	90
Sc	40	43	40	44	
V	444	421	414	423	441
Ba	566	521	459	537	
Rb	35	29	30	37	
Sr	342	304	310	332	348
Zr	195	191	178	188	183
Y	47	48	43	45	
Nb	17.8	19.2	18.3	17.4	
Ga	24	20	24	22	
Cu	36	19	26	29	
Zn	145	142	134	133	
Pb	8	9	8	10	
La	20	24	18	25	
Ce	43	70	50	78	
Th	6	5	5	4	
Source	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Mertzman
Analysis					XRF/WC

Major element totals have been normalized to 100% on a volatile-free basis. Analyses from Atkinson (1989).
* Total Fe expressed as FeO.
# Analysis for sample SA-20M.
Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.
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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.2. Columbia River Basalts (continued)

Wt. %	SA-21$	SA-24	SA-26	SA-27
SiO_2	51.76	51.58	51.54	51.57
Al_2O_3	13.30	13.21	13.37	13.25
TiO_2	3.168	3.153	3.160	3.105
FeO*	13.76	14.13	14.06	14.26
MnO	0.223	0.229	0.229	0.230
CaO	8.50	8.41	8.51	8.39
MgO	4.35	4.36	4.25	4.41
K_2O	1.54	1.49	1.24	1.57
Na_2O	2.69	2.74	2.94	2.53
P_2O_5	0.713	0.700	0.705	0.690
ppm				
Ni	13	12	11	11
Cr	26	28	29	30
Sc	42	39	40	38
V	413	413	410	402
Ba	530	530	535	527
Rb	36	36	33	46
Sr	308	302	304	303
Zr	187	186	186	186
Y	47	44	45	45
Nb	17.5	19.4	16.9	18.3
Ga	25	22	25	21
Cu	18	24	23	22
Zn	133	134	134	128
Pb	10	8	9	9
La	29	36	27	6
Ce	59	50	73	61
Th	4	3	4	5
Source	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)

Major element totals have been normalized to 100% on a volatile-free basis. Analyses from Atkinson (1989).
* Total Fe expressed as FeO.
$ Analysis for sample SA-21C.
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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.2. Columbia River Basalts (continued)

Wt. %	SA-28	SA-29	SA-30A	SA-35	SA-36	SA-37	SA-38C	SA-40
SiO_2	51.61	51.55	51.65	51.67	52.13	51.79	52.50	51.90
Al_2O_3	13.27	13.31	13.23	13.28	13.29	13.11	13.88	13.51
TiO_2	3.168	3.121	3.155	3.187	3.171	3.145	3.233	3.153
FeO*	13.99	13.86	13.87	14.09	13.81	14.23	12.81	13.78
MnO	0.230	0.229	0.238	0.216	0.210	0.223	0.199	0.252
CaO	8.52	8.49	8.47	8.32	8.59	8.53	8.95	8.83
MgO	4.41	4.48	4.44	4.15	3.96	4.18	3.53	4.05
K_2O	1.56	1.42	1.46	1.35	1.58	1.43	1.41	1.19
Na_2O	2.54	2.84	2.80	3.03	2.56	2.67	2.77	2.66
P_2O_5	0.698	0.698	0.695	0.709	0.705	0.700	0.714	0.670
ppm								
Ni	16	12	14	14	16	13	9	13
Cr	30	33	29	32	26	29	27	46
Sc	38	38	43	42	39	40	39	43
V	410	404	422	429	407	413	418	410
Ba	533	536	528	597	513	497	532	540
Rb	43	36	34	36	48	37	35	32
Sr	302	299	302	305	305	303	319	313
Zr	184	183	187	187	187	188	186	183
Y	46	45	47	52	46	46	46	46
Nb	15.8	18.2	18.0	15.8	16.8	16.8	17.5	17.1
Ga	22	21	21	23	24	23	25	19
Cu	22	21	22	20	27	25	22	23
Zn	132	130	132	138	140	137	138	129
Pb	10	9	7	10	10	9	9	8
La	37	11	16	30	30	20	18	26
Ce	51	61	64	70	61	71	41	47
Th	3	5	4	2	3	4	3	4
Source	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)

Major element totals have been normalized to 100% on a volatile-free basis. Analyses from Atkinson (1989).
* Total Fe expressed as FeO.
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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.2. Columbia River Basalts (continued)

Wt. %	SA-40C	SA-41C	SA-43	SA-44	SA-47#	SA-49	SA-50	SA-51
SiO_2	51.66	52.07	51.99	51.69		51.91	51.39	51.49
Al_2O_3	13.40	13.24	13.41	13.82		13.72	13.32	13.27
TiO_2	3.175	3.168	3.057	3.026		3.072	3.129	3.122
FeO*	13.83	13.80	13.82	14.12		13.49	14.15	14.23
MnO	0.225	0.220	0.218	0.212		0.241	0.226	0.221
CaO	8.58	8.53	8.51	8.21		8.77	8.68	8.54
MgO	4.26	4.20	4.16	4.11		4.11	4.50	4.47
K_2O	1.48	1.45	1.25	1.20		1.30	1.42	1.44
Na_2O	2.69	2.62	2.94	2.96		2.71	2.49	2.55
P_2O_5	0.702	0.697	0.652	0.666		0.662	0.683	0.672
ppm								
Ni	13	14	13	17		14	13	9
Cr	25	31	37	46		41	33	29
Sc	41	40	36	41		40	41	40
V	428	413	410	414		410	402	415
Ba	508	518	556	513		619	510	529
Rb	35	36	29	32		44	41	45
Sr	305	299	307	308		320	311	305
Zr	187	188	186	184		183	184	185
Y	46	46	46	47		44	47	44
Nb	17.0	17.9	16.7	15.4		18.0	18.8	18.3
Ga	25	23	22	23		22	21	22
Cu	24	28	28	30		23	27	29
Zn	133	130	133	134		130	133	134
Pb	11	12	8	8		9	6	7
La	21	26	25	34		13	25	31
Ce	52	65	29	43		37	62	35
Th	6	4	6	3		3	3	4
Source	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)		Atkinson (1989)	Atkinson (1989)	Atkinson (1989)

Major element totals have been normalized to 100% on a volatile-free basis. Analyses from Atkinson (1989).
* Total Fe expressed as FeO.
# Analysis for SA-47 not available.
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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.2. Columbia River Basalts (continued)

Wt. %	SA-51	SA-52	SA-53	SA-54	SA-75
SiO_2	48.47	50.88	51.42	51.53	51.32
Al_2O_3	12.33	13.16	13.38	13.58	13.15
TiO_2	4.15	3.142	3.032	3.017	3.113
Fe_2O_3	7.79				
FeO	9.42				
FeO*		14.67	14.10	13.76	14.36
MnO	0.25	0.233	0.219	0.241	0.228
CaO	7.50	8.52	8.61	8.80	8.48
MgO	4.29	4.70	4.52	4.36	4.54
K_2O	1.51	1.25	1.46	1.46	1.42
Na_2O	2.12	2.77	2.58	2.62	2.72
P_2O_5	0.88	0.685	0.667	0.632	0.682
TOTAL	99.76				
LOI	4.83				
ppm					
Ni		12	12	16	13
Cr	325	31	38	47	35
Sc		40	38	40	44
V	499	413	409	408	413
Ba		509	477	488	508
Rb		27	35	38	34
Sr	298	305	304	305	301
Zr	249	185	183	180	185
Y		47	45	43	44
Nb		17.3	17.8	16.2	17.8
Ga		22	22	23	22
Cu		21	22	25	28
Zn		132	131	125	132
Pb		11	11	7	8
La		19	17	24	22
Ce		66	39	40	71
Th		1	5	3	6
Source	Mertzman	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)	Atkinson (1989)
Analysis	XRF/WC				

Major element totals have been normalized to 100% on a volatile-free basis for Atkinson analyses (Analyses from Atkinson (1989)).

* Total Fe expressed as FeO.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.3. Various localities

Wt.%	BAS600
SiO_2	42.63
TiO_2	6.56
Al_2O_3	11.75
FeO	5.60
Fe_2O_3	11.87
*(Fe_2O_3)**	*(18.09)*
MnO	0.22
MgO	5.88
CaO	11.36
Na_2O	2.38
K_2O	0.29
P_2O_5	0.08
SO_3	0.07
TOTAL	99.31
LOI	0.91
ppm	
Sr	188
Zr	72
V	735
Ni	75
Cr	45
Co	44
Source	Mertzman
Analysis	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.4. Hawaii

Wt. %	BAS101	BAS101	BAS101	BSB101
SiO_2	50.58	46.00	50.47	49.51
Al_2O_3	13.13	12.91	13.07	12.65
Na_2O	3.05	2.74	2.61	1.99
CaO	10.71	10.69	10.75	9.76
K_2O	0.54	0.55	0.54	0.36
FeO[1]	10.60	11.81^	13.19^	8.84
Fe_2O_3[1]	1.07			2.66
*(Fe_2O_3)**				*(12.48)*
TiO_2	3.19	2.94		2.15
NiO	0.06	tr.		
MnO	0.18		0.19	0.17
Cr_2O_3	0.05	tr.		
CoO	0.04			
V_2O_5	0.00	0.39		
MgO	6.38		6.33	9.51
ZnO	0.02			
SrO	0.09			
BaO	0.06			
P_2O_5				0.22
S				0.40
TOTAL	99.75	88.03	97.15	99.20[b]
LOI[c]				0.70
ppm				
Sr				330
Zr				140
V				270
Co				50
Cr				460
Cu				280
Ni				230
Rb				7
Source	U of A EMPA-4	U of A EMPA-1	U of C EMPA	Mertzman XRF/WC

* - all Fe reported as Fe_2O_3.
^ - all Fe reported as FeO.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

Note: Source and Analysis: U of A EMPA indicates analysis by electron microprobe at the University of Alberta; number of discrete point analyses that were averaged together also indicated.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

n.d. = not determined. tr.: trace (<0.01 wt.%).

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.4. Hawaii (continued)

Wt.%	HAW006	HAW049	HAW063
SiO_2	50.61	40.32	49.86
TiO_2	2.61	3.93	2.44
Al_2O_3	17.45	25.90	13.16
FeO	5.58	2.77	6.77
Fe_2O_3	5.32	12.77	5.12
*(Fe_2O_3)**	*(11.52)*	*(15.85)*	*(12.64)*
MnO	0.22	0.32	0.18
MgO	3.84	3.73	8.29
CaO	6.63	4.69	10.65
Na_2O	4.27	2.38	2.24
K_2O	1.94	0.59	0.44
P_2O_5	0.91	1.22	0.26
SO_3	0.00	0.10	0.06
TOTAL	100.00	99.03	100.22
LOI	1.04	12.99	1.85
ppm			
Sr	1249	1050	395
Zr	449	539	183
V	106	146	347
Ni	35	30	149
Cr	8	50	479
Co	29	47	33
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.7. Hayden Butte, AZ, USA

Wt.%	HAY020
SiO_2	59.67
TiO_2	0.55
Al_2O_3	16.08
FeO	0.21
Fe_2O_3	4.35
*(Fe_2O_3)**	*(4.58)*
MnO	0.10
MgO	3.66
CaO	4.72
Na_2O	6.48
K_2O	3.25
P_2O_5	0.30
SO_3	0.00
TOTAL	99.39
LOI	3.95
ppm	
Sr	316
Zr	163
V	60
Ni	75
Cr	145
Co	38
Source	Mertzman
Analysis	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.9. Komatiites

Wt.%	91106	ZV-74	501-3	501-9
Sample type	Komatiite	Komatiite	Komatiite	Komatiite
SiO_2	47.8	46.3	47.7	44.9
TiO_2	0.451	0.330	0.184	0.110
Al_2O_3	8.5	6.56	5.29	2.91
Fe_2O_3	11.7	12.4	10.15	7.44
MnO	0.177	0.196	0.152	0.088
MgO	22.6	26.1	30.5	42.1
CaO	7.00	6.57	5.18	1.74
Na_2O	1.28	0.87	0.09	0.07
K_2O	0.39	0.041	0.12	0.03
P_2O_5	0.07	0.021	0.02	0.01
LOI	0.89	2.31	7.80	9.79
ppm				
Cr	2131	2279	2454	2214
V	161	143	108	101
Co	96	99	95	101
Ni	952	1668	1561	2532
Zr	40			
Nb	1.3			
Y	10.1			
Sr	109			
Rb	9			
Ba	123			
La	5.05			
Ce	11.2			
Nd	6.34			
Sm	1.50			
Eu	0.494			
Gd	1.61			
Dy	1.73			
Er	1.06			
Yb	1.02			
Mg/(Mg+Fe)	0.793			
Source	Puchtel et al. (1996)	Puchtel et al. (1996)	Connolly et al. (2011)	Connolly et al. et al. (2011)

Analyses from Puchtel et al. (1996) and Connolly et al. (2011).

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.12. Lonar Crater, India

Wt.%	LON001
SiO_2	50.34
TiO_2	2.38
Al_2O_3	13.19
FeO	5.08
Fe_2O_3	9.63
*(Fe_2O_3)**	*(15.28)*
MnO	0.21
MgO	5.10
CaO	9.77
Na_2O	2.25
K_2O	0.66
P_2O_5	0.24
SO_3	0.00
TOTAL	99.42
LOI	0.32
ppm	
Sr	323
Zr	211
V	347
Ni	202
Cr	116
Co	30
Source	Mertzman
Analysis	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c.13. Miscellaneous Rocks

Wt. %	RHY001
SiO_2	75.84
TiO_2	0.17
Al_2O_3	12.86
*(Fe_2O_3)**	*(0.30)*
MnO	0.02
MgO	0.10
CaO	0.22
Na_2O	0.17
K_2O	10.085
P_2O_5	0.040
Cl	0.00
SO_3	0.06
TOTAL	99.865
LOI	1.13
ppm	
Sr	111
Zr	276
V	40
Ni	5
Cr	71
Co	<1
Rb	189
FeO	n.d.
Fe_2O_3	n.d.
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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11c. Compositional Data - Basalts and Igneous Samples (by groups; continued)

11c. (i) Analytical data: Electron microprobe

Phases analyzed by electron microprobe by M. Izawa (Feb. 2014):

HAW063: pyroxene, chromite, olivine, plagioclase phenocryst, plagioclase.
SA-20: feldspar, augite, ilmenite, titanomagnetite.
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11d. Spectral Data - Basalts and Igneous Samples (alphabetical order)

Sample	*Facility/File No.*	*Description*
BAS101A	RELAB caba01	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BAS101A	RELAB laba01a	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
BAS101B	RELAB cbba01	45-90µm, 30°/0°, 0.3-2.6 µm, 5nm.
BAS101B	RELAB laba01b	45-90µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
BAS101C	RELAB ccba01	90-250µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BAS101C	RELAB laba01c	90-250µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
BAS101D	RELAB cdba01	250-500µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BAS101D	RELAB laba01d	250-500µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
BAS101	PSF 090728a.003	<45µm; 30°/0°; 0.35-2.5 µm, 1 nm output, 1000 spectra averaged; ASD.
+++++++		
BAS201	RELAB caba02	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BAS201	RELAB laba02	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
+++++++		
BAS202	RELAB caba03	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BAS202	RELAB laba03	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
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BAS203	RELAB caba04	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BAS203	RELAB laba04	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
+++++++		
BAS204	RELAB caba05	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BAS204	RELAB laba05	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
BAS204	PSF 091021 LAN001	<45 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source; aka LAN001.
BAS204	PSF 091015 LAN001	<45 µm; i=0°/e=0° (bifurcated probe); 0.35-0.86 µm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.; aka LAN001
BAS204	PSF LAN001 merged	Merged Oceaan Optics UV + visible spectra; aka LAN001.
BAS204	PSF 091021 LAN101	90-250 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resol.; 1500 msec, 100 spectra avgd; Ocean Optics S2000 and D2 source; aka LAN101.
BAS204	PSF 091015 LAN101	90-250 µm; i=0°/e=0° (bifurc. probe); 0.35-0.86 µm; ~0.3 nm resol.; 40 msec, 1000 spectra avgd; Ocean Optics S2000, QTH 50W; aka LAN101.
BAS204	PSF LAN101 merged	Merged Oceaan Optics UV + visible spectra; aka LAN101.
+++++++		
BAS205	RELAB caba06	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
BAS205	RELAB laba06	<45µm, 30°/0°,30°, 0.3-26µm, 0.6-129 nm (merged RELAB+Nicolet, at 2.54µm; note different viewing geometry).
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BAS400	PSF 090807.012	weathered surface; 35°/0°; 0.35-2.5 µm; 100 avg; 1 nm resol.; ASD.
+++++++		
BAS600	PSF 131025A.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, ASD; 500 spectra averaged (Directory: 131025 Basalt).

BAS600	PSF 131025A.002	45-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, ASD; 500 spectra averaged (Directory: 131025 Basalt).
+++++++		
BSB101	RELAB cabs02	<45μm, 30°/0°, 0.3-2.6 μm, 5 nm.
BSB101	RELAB labs02	<45μm, 30°/0°,30°, 0.3-26μm, 06-129 nm (merged RELAB+Nicolet, at 2.54μm; note different viewing geometry).
+++++++		
HAW001	PSF 090728a.006	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW003a	PSF 100430a.011	Flat yellow surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW003b	PSF 100430a.012	Rough yellow surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW003c	PSF 100430a.013	Light rough surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW003d	PSF 100430a.014	Light gray vesicular surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
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HAW005a	PSF 100430a.015	White vesicular surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW005b	PSF 100430a.016	White coating surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
+++++++		
HAW006	PSF 174b	Interior surface 1; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; Ocean Optics.
HAW006	PSF 175b	Exterior surface 1; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; Ocean Optics.
HAW006	PSF 177b	Interior surface 2; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; Ocean Optics.
HAW006	PSF 178b	Exterior surface 2; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; Ocean Optics.
HAW006	PSF 181b	Interior surface 3; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; Ocean Optics.
HAW006	PSF 182b	Exterior surface 3; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; Ocean Optics.
HAW006	PSF 1	Interior surface 1; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; shot in air Ocean Optics (Directory Ocean Optics 121030 HAW006); for UV range (200-400 nm).
HAW006	PSF 2	Exterior surface 1; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; shot in air Ocean Optics (Directory Ocean Optics 121030 HAW006) ; for UV range (200-400 nm).
HAW006	PSF 3	Interior surface 2; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; shot in air Ocean Optics (Directory Ocean Optics 121030 HAW006) ; for UV range (200-400 nm).
HAW006	PSF 4	Exterior surface 2; i=0°, e-0°; 0.2-0.4 μm; 100 spectra averaged; shot in air Ocean Optics (Directory Ocean Optics 121030 HAW006) ; for UV range (200-400 nm).
HAW006	PSF 1	Interior surface 1; i=0°, e-0°; ~0.35-0.86 μm; 1000 spectra averaged; shot in air Ocean Optics (Directory Ocean Optics 121030 HAW006); for visible range (~350-860 nm).
HAW006	PSF 2	Exterior surface 1; i=0°, e-0°; ~0.35-0.86 μm; 1000 spectra averaged; shot in air Ocean Optics (Directory Ocean Optics 121030 HAW006); for visible range (~350-860 nm).
HAW006	PSF 3	Interior surface 2; i=0°, e-0°; ~0.35-0.86 μm; 1000 spectra averaged; shot in air Ocean Optics (Directory Ocean Optics 121030 HAW006); for

		visible range (~350-860 nm).
HAW006	PSF 4	Exterior surface 2; i=0°, e-0°; ~0.35-0.86 µm; 1000 spectra averaged; shot in air Ocean Optics (Directory Ocean Optics 121030 HAW006); for visible range (~350-860 nm).
HAW006	PSF 121016a.174	Interior surface 1; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; ASD (directory: 121016 glovebox).
HAW006	PSF 121016a.175	Exterior surface 1; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; ASD (directory: 121016 glovebox).
HAW006	PSF 121016a.177	Interior surface 2; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; ASD (directory: 121016 glovebox).
HAW006	PSF 121016a.178	Exterior surface 2; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; ASD (directory: 121016 glovebox).
HAW006	PSF 121016a.181	Interior surface 3; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; ASD (directory: 121016 glovebox).
HAW006	PSF 121016a.184	Exterior surface 3; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; ASD (directory: 121016 glovebox).
HAW006	PSF 121030a.001	Interior surface 1; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; shot in air; ASD (directory: 121016 HAW006).
HAW006	PSF 121030a.002	Exterior surface 1; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; shot in air; ASD (directory: 121016 HAW006).
HAW006	PSF 121030a.003	Interior surface 2; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; shot in air; ASD (directory: 121016 HAW006).
HAW006	PSF 121030a.004	Interior surface 2; i=30°, e=0°; 0.35-2.5 µm; 200 spectra averaged; shot in air; ASD (directory: 121016 HAW006).
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HAW007a	PSF 100430a.001	Dark shiny surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW007b	PSF 100430a.002	Light vesicular surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW007c	PSF 100430a.003	Red vesicular surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
+++++++		
HAW011	PSF 080415a.009	<45µm; 30°/0°; 0.35-2.5 µm,1 nm output, 1000 spectra averaged; ASD.
HAW011	PSF 080422a.001	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (080422 HAW Basalts directory).
+++++++		
HAW012a	PSF 100430a.007	Dull gray vesicular surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW012b	PSF 100430a.008	Yellow vesicular surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW012c	PSF 100430a.009	Dark red vesicular surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAW012d	PSF 100430a.010	Dark gray vesicular surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
+++++++		
HAW013	PSF 080415a.001	<45µm; 30°/0°; 0.35-2.5 µm,1 nm output, 1000 spectra averaged; ASD.
HAW013	PSF 090728a.007	<45µm; 30°/0°; 0.35-2.5 µm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW015????	PSF 080415a.002	<45µm; 30°/0°; 0.35-2.5 µm, 1 nm output, 1000 spectra averaged; ASD. (or HAW045?)
+++++++		
HAW016dry	PSF 120106a.030	unsorted powder - dry; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 120106_HED).

HAW016fro	PSF 120106a.019	unsorted powder, saturated with water (42 wt%) and frozen, i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 120106_HED).
+++++++		
HAW022	PSF 111201a.024	whole rock – oxidized surface; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
HAW022	PSF 111201a.025	whole rock – unoxidized surface, i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
HAW022	INO HAW022	whole rock; i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 3 sets of spectra acquired.
+++++++		
HAW045	PSF 080415a.003	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
HAW045	PSF 090728a.008	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW046	PSF 080415a.010	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW047	PSF 080415a.004	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW049	PSF 080415a.005	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW053	PSF 080415a.006	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW055	PSF 080415a.007	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW060	PSF 080415a.011	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW074	PSF 080415a.012	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
+++++++		
HAW103	PSF 080415a.008	<45μm; 30°/0°; 0.35-2.5 μm,1 nm output, 1000 spectra averaged; ASD.
HAW103	PSF 080422a.002	90-250 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (080422 HAW Basalts directory).
+++++++		
HAY013a	PSF 100517b.005	Interior gray surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAY013b	PSF 100517b.006	Exterior tan surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
++++++		
HAY030a	PSF 100517b.007	Interior gray surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HAY030b	PSF 100517b.008	Exterior brown/gray surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
++++++++++++++++++++++++++++++++++++		
HKC03-71a	PSF 100517b.011	Brown stain smooth surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HKC03-71b	PSF 100517b.012	Gray/blue/tan smooth surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HKC03-71c	PSF 100517b.013	Gray/blue rough surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
HKC03-71	PSF 111201a.023	whole rock surface; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
HKC03-71	INO HKC03-71	whole rock; i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
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HKC03-82	PSF 100430a.004	Blue/gray lustre surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
+++++++		
HKD03a	PSF 100430a.005	Blue/black surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory:

		100430_surface).
HKD03b	PSF 100430a.006	Yellow surface; i=30°, e=0°; 1000 spectra averaged; ASD (directory: 100430_surface).
+++++++		
LON001	PSF 131114a.003	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 500 spectra averaged; 1 nm spectral output; ASD (directory: 131114).
+++++++		
SA-14a	PSF 090421a.020	<45 µm, 30°/0°, 0.35-2.5 µm,1 nm resol., 1000 avg; ASD.
SA-14b	PSF sa14b.rtx.asc	45-90 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
+++++++		
SA-51	PSF sa51feb01.rtx.asc	45-90 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
SA-51a	PSF 090421a.021	<45 µm, 30°/0°, 0.35-2.5 µm,1 nm resol., 1000 avg; ASD.
SA-51	PSF sa51bm.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
SA-51	PSF sa51n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16, 2006).
++++SA-51 grain size series++++		
SA-51	PSF 220507sa51a45	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF 110707sa51b45	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF sa51b45	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
SA-51	PSF 220507sa51c90	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF 110707sa51c90	45-90 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF sa51c90	45-90 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
SA-51	PSF 230507sa51d250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF 110707sa51d250	90-250 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF sa51d250	90-250 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
SA-51	PSF 230507sa51e500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF 110707sa51e500	250-500 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF sa51e500	250-500 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
SA-51	PSF 230507sa51f1000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF 110707sa51e1000	500-1000 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
SA-51	PSF sa51e1000	500-1000 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
+++SA-51 grain size series+++++		

SA-51	PSF 071101a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (directory: 071101grainsize).
SA-51	PSF 071101a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF avg of 002 & 003	<45 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF 071101a.004	45-90 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (directory: 071101grainsize).
SA-51	PSF 071101a.005	45-90 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF avg of 004 & 005	45-90 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF 071101a.006	90-250 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (directory: 071101grainsize).
SA-51	PSF 071101a.007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF avg of 006 & 007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF 071101a.008	250-500 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (directory: 071101grainsize).
SA-51	PSF 071101a.009	250-500 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF 071101a.010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF avg of 008-010	250-500 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF 071101a.011	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (directory: 071101grainsize).
SA-51	PSF 071101a.012	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF 071101a.013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF avg of 011-013	500-1000 µm; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF 071101a.014	cut surface; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (directory: 071101grainsize).
SA-51	PSF 071101a.015	cut surface; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF 071101a.016	cut surface; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD (reshoot of previous sample; directory: 071101grainsize).
SA-51	PSF avg of 014-016	cut surface; 30°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
	+++++SA-51b- grain size series – jun2706++++++	
SA-51b	PSF jun2706.010	<45 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
SA-51b	PSF jun2706.011	45-90 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
Sa-51b	PSF jun2706.012	90-250 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
SA-51b	PSF jun2706.013	250-500 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
SA-51b	PSF jun2706.014	500-1000 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
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OLV003	PSF jun2706.000	<45 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
OLV003	PSF jun2706.001	45-90 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
OLV003	PSF jun2706.002	90-250 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
OLV003	PSF jun2706.003	250-500 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).

OLV003	PSF jun2706.004	500-1000 µm; 0°/0° (bifurcated probe); 0.35-2.5 µm; 1 nm output; 2000 averages; ASD [directory: jun2706).
++++Sa-51 grain size series++++		
SA-51	PSF feb1607a.002	<45 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.003	<45 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF avg of 002 & 003	<45 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.004	45-90 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.005	45-90 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF avg of 004 & 005	45-90 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.006	90-250 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.007	90-250 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.008	90-250 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF avg of 006-008	90-250 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.009	250-500 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.010	250-500 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.011	250-500 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF avg of 009-011	250-500 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.012	500-1000 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.013	500-1000 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF feb1607a.014	500-1000 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
SA-51	PSF avg of 012-014	500-1000 µm; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol., ASD.
++++SA-51 Monster grain size series+++++++		
SA-51	071229a.001	<10 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.002	<10 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.001-002	Average of previous two spectra.
SA-51	071229a.003	10-15 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.004	10-15 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.003-004	Average of previous two spectra.
SA-51	071229a.005	15-20 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.006	15-20 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.005-006	Average of previous two spectra.
SA-51	071229a.007	20-25 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.008	20-25 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.007-008	Average of previous two spectra.
SA-51	071229a.009	25-38 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.010	25-38 µm (wet sieved with isopropyl alcohol); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.009-010	Average of previous two spectra.
SA-51	071229a.011	<20 µm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.012	<20 µm (dry sieved); i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 1000 spectra

		averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.011-012	Average of previous two spectra.
SA-51	071229a.013	<25 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.014	<25 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.013-014	Average of previous two spectra.
SA-51	071229a.015	25-38 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.016	25-38 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.015-016	Average of previous two spectra.
SA-51	071229a.017	38-45 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.018	38-45 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.017-018	Average of previous two spectra.
SA-51	071229a.019	45-63 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.020	45-63 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.019-020	Average of previous two spectra.
SA-51	071229a.021	63-75 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.022	63-75 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.021-022	Average of previous two spectra.
SA-51	071229a.023	75-90 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.024	75-90 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.023-024	Average of previous two spectra.
SA-51	071229a.025	90-125 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.026	90-125 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.025-026	Average of previous two spectra.
SA-51	071229a.027	125-150 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.028	125-150 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.027-028	Average of previous two spectra.
SA-51	071229a.029	150-180 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.030	150-180 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).

SA-51	071229a.031	150-180 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.029-031	Average of previous three spectra.
SA-51	071229a.032	180-212 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.033	180-212 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.034	180-212 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.032-034	Average of previous three spectra.
SA-51	071229a.035	212-250 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.036	212-250 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.037	212-250 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.035-037	Average of previous three spectra.
SA-51	071229a.038	250-300 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.039	250-300 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.040	250-300 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.038-040	Average of previous three spectra.
SA-51	071229a.041	300-355 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.042	300-355 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.043	300-355 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.041-043	Average of previous three spectra.
SA-51	071229a.044	355-425 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.045	355-425 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.046	355-425 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.044-046	Average of previous three spectra.
SA-51	071229a.047	425-500 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.048	425-500 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.049	425-500 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory:

		071229grainsize).
SA-51	071229a.047-049	Average of previous three spectra.
SA-51	071229a.050	500-600 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.051	500-600 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.052	500-600 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.050-052	Average of previous three spectra.
SA-51	071229a.053	600-700 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.054	600-700 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.055	600-700 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.053-055	Average of previous three spectra.
SA-51	071229a.056	700-850 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.057	700-850 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.058	700-850 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.056-058	Average of previous three spectra.
SA-51	071229a.059	850-1000 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.060	850-1000 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.061	850-1000 μm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.059-061	Average of previous three spectra.
SA-51	071229a.062	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.063	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.064	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.065	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.066	1.0-1.4 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.062-066	Average of previous five spectra.
SA-51	071229a.067	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.068	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000

		spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.069	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.070	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.071	1.4-1.7 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.067-071	Average of previous five spectra.
SA-51	071229a.072	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.073	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.074	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.075	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.076	1.7-2.0 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.072-076	Average of previous five spectra.
SA-51	071229a.077	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.078	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.079	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.080	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.081	2.0-2.36 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.077-081	Average of previous five spectra.
SA-51	071229a.082	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.083	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.084	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.085	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.086	2.36-2.8 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).

SA-51	071229a.082-086	Average of previous five spectra.
SA-51	071229a.087	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.088	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.089	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.090	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.091	2.8-3.35 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.087-091	Average of previous five spectra.
SA-51	071229a.092	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.093	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.094	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.095	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.096	3.35-4.75 mm (dry sieved); i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.092-096	Average of previous five spectra.
SA-51	071229a.097	whole rock; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (directory: 071229grainsize).
SA-51	071229a.098	whole rock; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.099	whole rock; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.100	whole rock; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.101	whole rock; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged; ASD (repack/reshoot of previous sample; directory: 071229grainsize).
SA-51	071229a.097-101	Average of previous five spectra.

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++++ *SA-51: Bidirectional study (March 2007)*++++

Format: grain size; i°,e° for standard; i°/e° for sample; wavelength range; spectral resolution; number of spectra averaged; instrument.

1. Basalt powder

Series 0a (same viewing geometry for standard and sample)

SA-51b	PSF feb2707.003	<45 μm; 0°/30°; 0°/30°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
SA-51b	PSF feb2707.011	<45 μm; 0°/45°; 0°/45°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
SA-51b	PSF feb2707.019	<45 μm; 0°/60°; 0°/60°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD

(directory: feb2707 meteoritic).
SA-51b PSF feb2707.027 <45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).

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SA-51 chip PSF feb2707.006 chip; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
SA-51 chip PSF feb2707.014 chip; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
SA-51 chip PSF feb2707.022 chip; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
SA-51 chip PSF feb2707.030 chip; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).

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Series 0b (same viewing geometry for standard and sample)

SA-51b PSF feb2807.003 <45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
SA-51b PSF feb2807.011 <45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
SA-51b PSF feb2807.019 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
SA-51b PSF feb2807.027 <45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).

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Series 0b (same viewing geometry for standard and sample)

SA-51 chip PSF feb2807.006 <45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
SA-51 chip PSF feb2807.014 <45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
SA-51 chip PSF feb2807.022 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
SA-51 chip PSF feb2807.030 <45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).

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Series 1 (same viewing geometry for standard and sample

SA-51a PSF mar0107.003 <45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0107.011 <45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0107.019 <45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0107.027 <45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 2 (same viewing geometry for standard and sample

SA-51a PSF mar0707a.003 <45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0207.011 <45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0207.019 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0207.027 <45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 3 (same viewing geometry for standard and sample)

SA-51a PSF mar0207.035 <45 µm; 60°/60°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0207.043 <45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0207.051 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0207.059 <45 µm; 60°/-30°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 4 (different viewing geometry for standard vs. sample)

SA-51a PSF mar0607.003 <45 µm; 30°/0°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0607.011 <45 µm; 30°/0°; 60°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0607.019 <45 µm; 30°/0°; 60°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a PSF mar0607.027 <45 µm; 30°/0°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 5 (bifurcated cable; same viewing geometry for standard and sample)

SA-51a	PSF mar0707.003	<45 µm; 0°/0°; 0°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51a	PSF mar0707.011	<45 µm; 30°/-30°; 30°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SA-51a	PSF mar0707.019	<45 µm; 45°/-45°; 45°/-45°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SA-51a	PSF mar0707.027	<45 µm; 60°/-60°; 60°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

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2. Basalt chip

Format: grain size; i°,e° for standard; i°/e° for sample; wavelength range; spectral resolution; number of spectra averaged; instrument.

Series 1 (same viewing geometry for standard and sample

SA-51 chip	PSF mar0107.006	<45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0107.014	<45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0107.022	<45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0107.030	<45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 2 (same viewing geometry for standard and sample

SA-51 chip	PSF mar0707a.006	<45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0207.014	<45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0207.022	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0207.030	<45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 3 (same viewing geometry for standard and sample)

SA-51 chip	PSF mar0207.038	<45 µm; 60°/60°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0207.046	<45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0207.054	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0207.062	<45 µm; 60°/-30°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 4 (different viewing geometry for standard vs. sample)

SA-51 chip	PSF mar0607.006	<45 µm; 30°/0°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0607.014	<45 µm; 30°/0°; 60°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0607.022	<45 µm; 30°/0°; 60°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0607.030	<45 µm; 30°/0°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 5 (bifurcated cable; same viewing geometry for standard and sample)

SA-51 chip	PSF mar0707.006	<45 µm; 0°/0°; 0°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
SA-51 chip	PSF mar0707.014	<45 µm; 30°/-30°; 30°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SA-51 chip	PSF mar0707.022	<45 µm; 45°/-45°; 45°/-45°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
SA-51 chip	PSF mar0707.030	<45 µm; 60°/-60°; 60°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

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SA-53d	PSF 080422a.003	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (080422 HAW Basalts directory).

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SA-54	PSF 090728a.004	<45µm; 30°/0°; 0.35-2.5 µm, 1nm output, 1000 spectra averaged; ASD.

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SA-59d	PSF 080422a.004	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (080422 HAW Basalts directory).

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SA-60sb	PSF 090807.012	smooth cut surface; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol.; ASD (aka MIXB012).
SA-60rb	PSF 090807.013	rough surface; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol.; ASD.
SA-60rb	PSF 090807.014	rough surface, reshoot; 35°/0°; 0.35-2.5 µm; 1000 avg; 1 nm resol.; ASD.
SA-60	PSF 080619a.017	surface (smooth cut?); 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.

SA-60	PSF 080619a.018	surface (smooth cut?); 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
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SA-65d	PSF 080422a.005	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (080422 HAW Basalts directory).
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SA-66d	PSF 080422a.006	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (080422 HAW Basalts directory).
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SA-67d	PSF 080422a.007	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (080422 HAW Basalts directory).
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SA-70d	PSF 080422a.008	90-250 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (080422 HAW Basalts directory).
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SA-75	PSF 090728a.005	<45µm; 30°/0°; 0.35-2.5 µm, 1nm output, 1000 spectra averaged; ASD.

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END of 11.

12. Palagonites and Planetary Regolith Analogues

12.1. Palagonites and Buell dust
12.2. Planetary soil analogues
12.3. OB-1/CHENOBI lunar highland simulant components
12.4. JAXA – Shimizu Corp. lunar analogues
12.5. Synthetic nanophase iron-impregnated silica gel
12.6. University of Winnipeg lunar analogues
12.7. Arizona Test Dust
12.8. Mt. St. Helens ash
12.9. Chinese loess
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12a. Sample Descriptions - Palagonites and Planetary Regolith Analogues

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are too sparse or fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*

12a.1. Palagonites and Buell dust

BUE101	"Buell" dust from Frederic Juenneman (January 2004).
PAL101	Palagonite: (from Dick Morris, sample #**HWMK600**). <45µm fraction separated without crushing from bulk (<1mm) sample; dry sieve. Collected from south side of road to Very Long Baseline Array telescope (3720 m elevation; Morris et al., 2000).
PAL101A	Palagonite: (from Dick Morris, sample #**HWMK600**). <45µm fraction separated without crushing from bulk (<1mm) sample; dry sieve. Baked at ~160°C for 2 hours in air, sealed in vial after baking and weighing; 9.6% weight loss.
PAL101B	Palagonite: (from Dick Morris, sample #**HWMK600**). <45µm fraction separated without crushing from bulk (<1mm) sample; dry sieve. Baked at ~600°C for 2 hours in air, sealed in vial after baking and weighing; 16.4% weight loss.
PAL102	Palagonite: (from Ted Roush, summit of Mauna Kea, sample **#91-16**). <45µm fraction separated without crushing from bulk (<2mm) sample; dry sieve.
PAL102x	Palagonite: (from Ted Roush, summit of Mauna Kea, sample **#91-16**). <45µm fraction separated without crushing from bulk (<2mm) sample; dry sieve; rest of sample prepared (spectral properties of PAL102 and PAL102x may not be the same (will be determined from next batch of spectra).
PAL102A	Palagonite: (from Ted Roush, summit of Mauna Kea, sample **#91-16**). <45µm fraction separated without crushing from bulk (<1mm) sample; dry sieve. Baked at ~160°C for 2 hours in air, sealed in vial after baking and weighing; 6.7% weight loss.
PAL102B	Palagonite: (from Ted Roush, summit of Mauna Kea, sample **#91-16**). <45µm fraction separated without crushing from bulk (<1mm) sample; dry sieve. Baked at ~600°C for 2 hours in air, sealed in vial after baking and weighing; 14.8% weight loss.
PAL103	Palagonite: **JSC Mars-1**; Pu'u Nene ash, Island of Hawaii, Hawaii, USA (2050 m elevation) (Martian regolith simulant) Johnson Space Centre; unsorted.

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12a.2. Planetary soil analogues

PSA001 **CHENOBI** lunar highlands regolith physical stimulant. NORCAT and EVC: batch number 1, date of mix: June 30/09. 2 1-kg cans available; 3 1-kg cans distributed to MPBC and Alex Ellery at Carleton University. Contains Shawmere anorthosite plus glass made by fusing Shawmere anorthosite (only 2 components in it?).

PSA002 **JSC Mars-1A** Martian regolith stimulant, <1 mm size fraction. "*Used by NASA as a spectral analogue to the bright regions of Mars*". From Planet LLC (Orbital Technologies Corporation; DBA Planet LLC). 5 1-kg containers received.

PSA003 **JSC-1A Lunar regolith stimulant**, <1 mm size fraction. "*Used by NASA as a chemical and mechanical analogue to the lunar mare regions"*. From Planet LLC (Orbital Technologies Corporation; DBA Planet LLC). 5 1-kg containers received.

PSA004 **Mojave Mars Simulant**, from JPL via Jon Abbatt at University of Toronto; received October 30, 2011. [see Peters et al., 2008).

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12a.3. OB-1/CHENOBI lunar highland simulant components

AN-1 **Shawmere anorthosite**; Shawmere, Ontario (An_{78}); drill core; consists of ~97 vol% plagioclase (An_{78}), ~1 vol% olivine, ~ vol% orthoclase, ~0.2-0.5 vol% orthopyroxene and clinopyroxene, accessory opaques, apatite, and zircon (Battler and Spray 2009).; received Nov. 23/09.

FG-1 **Fayalitic glass**; mine tailings slag; CIPW fayalite olivine normative (Battler and Spray 2009); received Nov. 23/09 (40 g of crushed samples).

OB-1 Lunar stimulant made from AN-1 and FG-1.

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12a.4. JAXA – Shimizu Corp. lunar analogues (from Makiko Ohtake – Feb. 2010)

FJS-1 Lunar mare stimulant – produced from Mt. Fuji basalt for JAXA (~ 1 kg received); Apollo 16 simulant.

Shimizu-HS Lunar highland stimulant. "New" stimulant of lunar highland from Shimizu Corp.; composition/characterization unknown.

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12a.5. Synthetic nanophase iron-impregnated silica gel – August 2010

Two pore sizes of silica gel impregnated with two concentrations of ferric nitrate solution and reduced at University of Manitoba in carbon monoxide to produce nanophase iron-impregnated silica gels for use in producing lunar mare and highland analogues.

SGE101A SGE101 synthetic silica gel (22 Angstrom pore size; 75-650 μm grain size (28-200 mesh) impregnated with 1 N ferric nitrate solution; heated in air and reduced in carbon monoxide at University of Manitoba.

SGE101B SGE101 synthetic silica gel (22 Angstrom pore size; 75-650 μm grain size (28-200 mesh) impregnated with 0.1 N ferric nitrate solution; heated in air and reduced in carbon monoxide at University of Manitoba.

SGE105A SGE105 synthetic silica gel (150 Angstrom pore size; 250-500 μm grain size (35-60 mesh) impregnated with 1 N ferric nitrate solution; heated in air and reduced in carbon monoxide at University of Manitoba.

SGE105B SGE105 synthetic silica gel (150 Angstrom pore size; 250-500 μm grain size (35-60 mesh) impregnated with 0.1 N ferric nitrate solution; heated in air and reduced in carbon monoxide at University of Manitoba.

Some of these mixtures are also described in section 15 of this document.

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12a.6. University of Winnipeg lunar analogues – August 23, 2010

UWM1P: Mare simulant 1 precursor (no nanophase iron):

45 wt% spectral type B clinopyroxene (PYX016; <45 µm grain size)
45 wt% anorthositic plagioclase feldspar (PLG108; <45 µm grain size)
10 wt% synthetic stoichiometric ilmenite (ILM201; <45 µm grain size)

UWH1P: Highland simulant 1 precursor (no nanophase iron):

9 wt% spectral type B clinopyroxene (PYX016; <45 µm grain size)
90 wt% anorthositic plagioclase feldspar (PLG108; <45 µm grain size)
1 wt% synthetic stoichiometric ilmenite (ILM201; <45 µm grain size)

UWM1: Mare simulant 1:

33.75 wt% spectral type B clinopyroxene (PYX016; <45 µm grain size)
33.75 wt% anorthositic plagioclase feldspar (PLG108; <45 µm grain size)
7.5 wt% synthetic stoichiometric ilmenite (ILM201; <45 µm grain size)
25 wt% nanophase-impregnated silica gel (150 nm pore size; ~90-500 µm grain size)

UWH1: Highland simulant 1:

6.75 wt% spectral type B clinopyroxene (PYX016; <45 µm grain size)
67.5 wt% anorthositic plagioclase feldspar (PLG108; <45 µm grain size)
0.75 wt% synthetic stoichiometric ilmenite (ILM201; <45 µm grain size)
25 wt% nanophase-impregnated silica gel (150 nm pore size; ~90-500 µm grain size)
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12a.7. Arizona Test Dust

ATD001 **Arizona Test Dust**, 0-3 microns [500 grams from Powder Technology Inc.; received May 19, 2011] (for MATMOS dust project).
ATD002 **Arizona Test Dust**, 0-70 microns [500 grams from Powder Technology Inc.; received May 19, 2011] (for MATMOS dust project).

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12a.8. Mt. St. Helens ash

MSH-ASH Ash from pyroclastic flow deposits – May 18, 1980 eruption of Mt. St. Helens, WA, USA (from Brittany Brand, Boise State University, Dept. of Geosciences, 1910 University Drive, Boise, ID, USA 83725).

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12a.9. Chinese loess

Received from Dr. Hoingrui Fan, Institute of Geology and Geophysics, Chinese Academy of Science (?) via Dr. Xueming (Eric) Yang, Manitoba Geological Survey (September 2013); collected by Mr. Gu Chaoyan. Samples are from Linxia City, Gansu Province, China. GPS site: N35.638, E 103.148. Sediment time is ~20,000 year ago. No published information on the samples.

YP-12D Fine-grained lighter brown loess.
YP-13D Fine-grained medium brown powder (~500 grams).
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12b. XRD Data - Palagonites and Planetary Regolith Analogues

12b.1. Available from original sources:

- PAL101 (HWMK600): Dick Morris;
- PAL102 (#91-16): Ted Roush.

12b.2. University of Manitoba files:

PAL101 XRD peaks: many are broad, most match to albite.
PAL101a XRD peaks: many are broad, most match to albite.
PAL101b XRD peaks: many are broad, most match to anorthite and hematite.
PAL102 XRD peaks: many are broad, most match to anorthite.
PAL102a XRD peaks: many are broad, most match to albite.
PAL102b XRD peaks: many are broad, most match to anorthite.
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12c. Compositional Data - Palagonites and Planetary Regolith Analogues (by groups)

12.1.c. Palagonites and Buell Dust (continued)

SAMPLE	PAL101[a]	PAL101	PAL102	PAL102[b]	PAL103[c]
SiO_2	41.24	41.28	47.19	45.5	34.5
TiO_2		3.77	3.47	3.24	3.0
Al_2O_3	25	26.02	21.95	18.4	18.5
Fe_2O_3	12.58	13.00	11.73	13.1	12.4
FeO	2.77	2.59	2.67		n.a.
MnO	0.29	0.30	0.24	0.22	0.2
MgO	3.52	3.26	3.12	3.91	2.7
CaO	5.11	4.64	5.13	6.02	4.9
Cr_2O_3	0.01				
V_2O_5	0.02				
Na_2O	2.74	2.50	2.21	3.24	1.9
K_2O	0.67	0.65	0.98	1.07	0.5
P_2O_5	1.34	1.52	0.61	0.59	0.7
TOTAL	99.19	99.82	99.60	100.4	101.1
LOI	13.89	15.45	10.30	4.77	21.8
ppm					
Sr		938	1220		
Zr		693	497		
V		130	97		
Cr		25	22		
Source	Morris	Mertzman[d]	Mertzman[d]	Banin	Allen et al.
Analysis	et al. (2000)	XRF/WC	XRF/WC	et al. (1997)	(1997, 1998)

[a] PAL101 from Dick Morris, analysis by Dick Morris (HWMK600). Analysis of 5-53 µm fraction (Morris et al., 2000).

[b] PAL102 from Ted Roush, analysis by Ted Roush (91-16). All Fe reported as Fe_2O_3. Analysis of <2 mm fraction by Banin et al. (1997).

[c] PAL103 from Johnson Space Centre; Carlton B. Allen; analysis in EOS. (Allen et al., 1997, 1998).

[d] Analyses from Stan Mertzman, performed September 2007, on <45 µm dry sieved fractions.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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12c. Compositional Data - Palagonites and Planetary Regolith Analogues (by groups, continued)

12.2c. Planetary Soil Analogues

Wt. %	PSA001 CHENOBI	PSA002 JSC Mars-1A	PSA002 JSC Mars-1A	PSA002 JSC-Mars-1A
SiO_2	47.50	43.48	34.5	40.83
TiO_2	0.06	3.62	3.0	3.85
Al_2O_3	31.69	22.09	18.5	25.08
Cr_2O_3		0.03		
FeO	1.41		2.8	4.45
Fe_2O_3	0.16		9.3	12.02
*(Fe_2O_3)**	*(1.73)*	*(16.08)*		*(16.97)*
MnO	0.02	0.26	0.2	0.30
MgO	0.72	4.22	2.7	2.86
CaO	15.99	6.05	4.9	5.87
Na_2O	2.35	2.34	1.9	1.97
K_2O	0.04	0.70	0.5	0.42
P_2O_5	0.02	0.78	0.7	0.90
SO_3	0.12	0.31		0.00
TOTAL	100.24	99.96	79.00	99.05
LOI	0.42	17.36	21.8	21.60
TOTAL			100.806^	
ppm				
Sr	207			1088
Zr	173			504
V	29			175
Ni	5			68
Cr	15			129
Co	<1			39
Source	Mertzman	Morris et al. (2000)	Allen et al. (1997, 1998)	Mertzman
Analysis	XRF/WC			XRF/WC

[a] All Fe reported as Fe_2O_3.

^ – total includes loss on ignition (volatiles).

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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12c. Compositional Data - Palagonites and Planetary Regolith Analogues (by groups, continued)

12.2c. Planetary Soil Analogues (continued)

Wt. %	PSA003 JSC Lunar-1A	PSA003 JSC Lunar-1A	PSA004 Mojave Mars	PSA004 Mojave Mars
SiO_2	46.21	47.71	49.4	51.92
TiO_2	1.68	1.59	1.09	1.07
Al_2O_3	15.78	15.02	17.1	18.29
Cr_2O_3		0.04	0.05	
FeO	7.74	7.35		3.05
Fe_2O_3	3.32	3.44		6.25
*(Fe_2O_3)**	*(11.92)*		*(10.87)*	*(9.64)*
MnO	0.19	0.18	0.17	0.20
MgO	9.10	9.01	6.08	5.08
CaO	10.38	10.42	10.45	10.43
Na_2O	3.07	2.70	3.28	3.25
K_2O	0.76	0.82	0.48	0.45
P_2O_5	0.68	0.66	0.17	0.16
SO_3	0.06		0.10	0.07
TOTAL	99.83	98.94	99.4	100.56
LOI	0.63	0.71	3.39	4.96
TOTAL		99.65^		
ppm				
Sr	865			312
Zr	168			122
V	237			185
Ni	3			65
Cr	212			337
Co	29			58
Source	Mertzman	McKay et al. (1994)	Peters et al. (2008)	Mertzman
Analysis	XRF/WC			XRF/WC

[a] All Fe reported as Fe_2O_3.

^ – total includes loss on ignition (volatiles).

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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12c. Compositional Data - Palagonites and Planetary Regolith Analogues (by groups, continued)

12.2c. Planetary Soil Analogues (continued)

Wt. %	PSA002 JSC Mars-1a	PSA002 JSC Mars-1a	PSA003 JSC Lunar-1a	PSA004 MMS	PSA002 JSC Mars-1A
SiO_2	43.48	34.5	47.71	49.4	40.83
TiO_2	3.62	3.0	1.59	1.09	3.85
Al_2O_3	22.09	18.5	15.02	17.1	25.08
Cr_2O_3	0.03		0.04	0.05	
Fe_2O_3*	[16.08]			[10.87]	[16.97]
Fe_2O_3		9.3	3.44		12.02
FeO		2.8	7.35		4.45
MnO	0.26	0.2	0.18	0.17	0.30
MgO	4.22	2.7	9.01	6.08	2.86
CaO	6.05	4.9	10.42	10.45	5.87
Na_2O	2.34	1.9	2.70	3.28	1.97
K_2O	0.70	0.5	0.82	0.48	0.42
P_2O_5	0.78	0.7	0.66	0.17	0.90
SO_3	0.31	n.a.		0.10	0.00
Cl	NA	n.a		NA	
LOI	17.36	21.8	0.71	3.39	21.60
TOTAL	99.7		99.65	99.4	99.05[b]
ppm					
Sr					1088
Zr					504
V					175
Ni					68
Cr					129
Co					39
Source	Morris et al. (2000)	Allen et al. (1997, 1998)	McKay et al. (1994)	Peters et al. (2008)	Mertzman
Analysis					XRF/WC

* - All Fe reported as Fe_2O_3.

[b] – Total on a volatile-free basis (Mertzman).

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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12c. Compositional Data - Palagonites and Planetary Regolith Analogues (by groups, continued)

12.4.c. JAXA - Shimizu Corp. Lunar Analogues

Wt. %	FJS-1	Shimizu-HS
SiO_2	49.19	54.01
TiO_2	1.51	0.69
Al_2O_3	16.90	18.06
FeO	7.75	6.16
Fe_2O_3	4.18	3.20
*(Fe_2O_3)**	*(12.79)*	*(10.05)*
MnO	0.20	0.17
MgO	5.70	3.58
CaO	9.75	9.95
Na_2O	2.67	2.21
K_2O	0.71	0.71
P_2O_5	0.30	0.10
SO_3	0.06	0.05
TOTAL	99.78	99.54
LOI	4.76	0.74
ppm		
Sr	374	325
Zr	107	68
V	414	271
Ni	56	59
Cr	147	215
Co	25	20
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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12c. Compositional Data - Palagonites and Planetary Regolith Analogues (by groups, continued)

12.8.c. Mt. St. Helen's ash

	MSH-ASH	
Wt. %	MSH-001	MSH-ASH
Sample type	St. Helen's ash	St. Helen's ash
SiO_2	60.34	61.28
TiO_2	0.92	0.88
Al_2O_3	17.54	17.13
*(Fe_2O_3)**	*(6.79)*	*(6.56)*
FeO	2.78	3.71
Fe_2O_3	3.70	2.44
MnO	0.11	0.11
MgO	2.77	2.61
CaO	5.54	5.40
Na_2O	4.53	4.26
K_2O	1.226	1.18
P_2O_5	0.188	0.19
Cl	0.00	
SO_3	0.05	0.06
TOTAL	100.004	99.66
LOI	0.98	1.54
ppm		
Sr	564	516
Zr	161	141
V	166	132
Ni	5	9
Cr	45	45
Co	7	2
Rb	25	
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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12c. Compositional Data - Palagonites and Planetary Regolith Analogues (continued)

12c.1. Phases analyzed by electron microprobe by M. Izawa (Feb. 2014):

Shimizu HS: plagioclase, orthopyroxene, clinopyroxene, ilmenite.

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12d. Spectral Data - Palagonites and Planetary Regolith Analogues (sorted by group)

Sample	*Facility/File No.*	*Description*
12d.1. Palagonites and Buell dust		
BUE101	PSF 081222a.036	unsorted; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
+++++++		
PAL101	RELAB CAPA03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol.
PAL101	RELAB MAPA03A	<45µm, 30°/30°, 1.8-16µm, 0.6-129 nm resol.
PAL101	RELAB LAPA03A	<45µm, 30°/0°,30°; 0.3-26µm, 5/0.6-129 nm resol. (Merged RELAB +Nicolet at 2.5µm) [Note different viewing geometries].
PAL101	PSF 160507pal101	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
PAL101	PSF 090707pal101	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
PAL101	PSF pal101	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
PAL101	PSF 071101a.001	<45 µm; 30°/0°, 0.35-2.5 µm, 1000 avg, 1 nm resol., ASD.
PAL101	PSF jun0506.007	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
PAL101	PSF apal101	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
PAL101	PSF pal101m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
PAL101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
	+++++++	
PAL101A	RELAB capa06	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PAL101A	RELAB lapa06a	<45µm, 30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (Merged RELAB + Nicolet @ 2.5µm, different viewing geometry).
	+++++++	
PAL101B	RELAB capa07	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PAL101B	RELAB lapa07a	<45µm, 30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (Merged RELAB + Nicolet @ 2.5µm, different viewing geometry).
+++++++		
PAL102	RELAB CAPA04	<45µm, 30°/0°, 0.3-2.6µm, 5 nm resol.
PAL102	RELAB MAPA04A	<45µm, 30°/30°, 1.8-16µm, 0.6-129 nm resol.
PAL102	RELAB LAPA04A	<45µm, 30°/0°,30°; 0.3-26µm, 5/0.6-129 nm resol. (Merged RELAB +Nicolet at 2.5µm) [Note different viewing geometries].
PAL102	PSF 160507pal102	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm; Ocean Optics S2000.
PAL102	PSF 090707pal102	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm; Ocean Optics S2000.
PAL102	PSF pal102	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source; Ocean Optics S2000.
	+++++++	
PAL102A	RELAB capa08	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PAL102A	RELAB lapa08a	<45µm, 30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (Merged RELAB + Nicolet @ 2.5µm, different viewing geometry).
	+++++++	
PAL102B	RELAB capa09	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PAL102B	RELAB lapa09a	<45µm, 30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (Merged RELAB + Nicolet @

2.5µm, different viewing geometry).

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PAL102x RELAB c1pa13 <45µm, 30°/0°, 0.3-2.6µm, 5 nm.

PAL102x RELAB lapa13 <45µm, 30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (Merged RELAB + Nicolet @ 2.5µm, different viewing geometry).

++++ PAL102x: Bidirectional study (February and March 2007)++++

Format: grain size; i°,e° for standard; i°/e° for sample; wavelength range; spectral resolution; number of spectra averaged; instrument.

Series 0a (same viewing geometry for standard and sample)

PAL102x PSF feb2707.002 <45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).

PAL102x PSF feb2707.010 <45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).

PAL102x PSF feb2707.018 <45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).

PAL102x PSF feb2707.026 <45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).

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Series 0b (same viewing geometry for standard and sample)

PAL102x PSF feb2807.002 <45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).

PAL102x PSF feb2807.010 <45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).

PAL102x PSF feb2807.018 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).

PAL102x PSF feb2807.026 <45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).

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Series 1 (same viewing geometry for standard and sample)

PAL102x PSF mar0107.002 <45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0107.010 <45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0107.018 <45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0107.026 <45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 2 (same viewing geometry for standard and sample

PAL102x PSF mar0707a.002 <45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0207.010 <45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0207.018 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0207.026 <45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 3 (same viewing geometry for standard and sample)

PAL102x PSF mar0207.034 <45 µm; 60°/60°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0207.042 <45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0207.050 <45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0207.058 <45 µm; 60°/-30°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 4 (different viewing geometry for standard vs. sample)

PAL102x PSF mar0607.002 <45 µm; 30°/0°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0607.010 <45 µm; 30°/0°; 60°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0607.018 <45 µm; 30°/0°; 60°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x PSF mar0607.026 <45 µm; 30°/0°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 5 (bifurcated cable; same viewing geometry for standard and sample)

PAL102x PSF mar0707.002 <45 µm; 0°/0°; 0°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PAL102x	PSF mar0707.010	<45 µm; 30°/-30°; 30°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PAL102x	PSF mar0707.018	<45 µm; 45°/-45°; 45°/-45°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
PAL102x	PSF mar0707.026	<45 µm; 60°/-60°; 60°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

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PAL103	PSF 090421a.019	<45 µm, 30°/0°, 0.35-2.5 µm,1 nm resol., 1000 avg; ASD.
PAL103	RELAB c1pa10	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PAL103	RELAB lapa10	<45µm, 30°/0°,30°; 0.3-26 µm, 5/0.6-129 nm (Merged RELAB + Nicolet @ 2.5µm, different viewing geometry).

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12d.2. Planetary soil analogues

PSA001a	PSF 090929a.001	<45 µm: sieved only, not crushed; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 averaged, ASD.
PSA001b	PSF 090929a.002	<45 µm: crushed then sieved; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 averaged, ASD.

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PSA002a	PSF 090929a.003	<45 µm: sieved only, not crushed; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 averaged, ASD.
PSA002b	PSF 090929a.004	<45 µm: crushed then sieved; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 averaged, ASD.
PSA002	PSF 111201a.052	unsorted powder; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
PSA002	INO PSA002	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 3 sets of spectra acquired.
PSA002	INO PSA002_2	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 3 sets of spectra acquired; re-shoot of sample.
PSA002	INO --	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 200 spectra averaged.

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PSA003a	PSF 090929a.005	<45 µm: sieved only, not crushed; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 averaged, ASD.
PSA003b	PSF 090929a.006	<45 µm: crushed then sieved; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 averaged, ASD.
PSA003	PSF 111201a.053	unsorted powder; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
PSA003	INO --	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 200 spectra averaged.

+++++++

PSA004	PSF 111118b.002	unsorted powder; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, ASD; 200 spectra averaged [Directory: 111118_stuff].
PSA004	PSF 130910a.012	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. Directory: (Minerals for Jim).

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12d.2.1. Raman spectra

JSC-Mars1A	PSF JSC-Mars-A	unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged; 532 nm laser (directory: 131201_PAH_JSCMARS_mixtures).

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12d.3. OB-1/CHENOBI lunar highland stimulant components

AN-1	PSF 091203c.001	<45 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203-AN1].
AN-1	PSF 091203c.002	45-90 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203-AN1].
AN-1	PSF 091203c.003	90-125 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203-AN1].
AN-1	PSF 091203c.004	125-250 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203-AN1].
AN-1	PSF 091203c.005	250-500 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203-AN1].
AN-1	PSF 091203c.006	500-1000 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203-AN1].
AN-1	PSF 091203c.007	1000-2000 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203-AN1].
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FG-1	PSF 091203b.001	<45 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203FG-1].
FG-1a	PSF 091214b.001	<45 μm (made by crushing >500 μm fraction rather than sieving the bulk as-received sample) dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged, ASD [Directory 091211_FG1].
FG-1	PSF 091203b.002	45-90 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203FG-1].
FG-1	PSF 091214b.002	45-90 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged, ASD [Directory 091211_FG1].
FG-1	PSF 091203b.003	90-125 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203FG-1].
FG-1	PSF 091214b.003	90-125 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged, ASD [Directory 091211_FG1].
FG-1	PSF 091203b.004	125-250 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203FG-1].
FG-1	PSF 091214b.004	125-250 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged, ASD [Directory 091211_FG1].
FG-1	PSF 091203b.005	250-500 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203FG-1].
FG-1	PSF 091214b.005	250-500 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged, ASD [Directory 091211_FG1].
FG-1	PSF 091203b.006	>500 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203FG-1].
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12d.4. JAXA – Shimizu Corp. lunar analogues (from Makiko Ohtake – Feb. 2010)

FJS-1	PSF 100311a.004	<45 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory 100311).
FJS-1	PSF 100311a.005	unsorted (as-received); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory 100311).
FJS-1	PSF 121016a.083	<250 μm; i=30º, e=0º; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
FJS-1	PSF OO 83	<250 μm; i=30º, e=0º; 0.2-0.86 μm (.2-0.4 μm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
FJS-1	PSF 121016a.228	<45 μm; i=30º, e=0º; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
FJS-1	PSF OO 228	<45 μm; i=30º, e=0º; 0.2-0.86 μm (.2-0.4 μm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).
FJS-1	PSF 121016a.231	45-90 μm; i=30º, e=0º; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).

FJS-1	PSF OO 231	45-90 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra avgd.; Ocean Optics S2000 (directory: Ocean Optics 000).

FJS-1 *See also section 15.25 of this document for mixtures of this material with nanophase iron and nanophase iron-impregnated silica gels.*

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Shimizu-HS	PSF 100311a.002	<45 µm dry sieved; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100311).
Shimizu-HS	PSF 100311a.003	unsorted (as-received); 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100311).

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12d..5. Synthetic nanophase iron-impregnated silica gel – August 2010

SGE101A	PSF 100824b.001	75-650 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
SGE101B	PSF 100824b.002	75-650 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
SGE101A	PSF 121016a.007	unsorted; 30º/0º; 0.35-2.5 µm; 1 nm resol.; 200 avgd.; ASD.
SGE101A	PSF OO 7	unsorted; 0º/0º; 1200-860 nm (200-400 nm usable range); ~0.3 nm resol.; 100 avgd.; Ocean Optics S2000.
SGE101A	*See also section 15 of this document for various mixture involving SGE101A.*	

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SGE105A	PSF 100824b.003	75-650 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
SGE105B	PSF 100824b.004	75-650 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
SGE105A	PSF 121016a.011	unsorted; 30º/0º; 0.35-2.5 µm; 1 nm resol.; 200 avgd.; ASD.
SGE105A	PSF OO 11	unsorted; 0º/0º; 1200-860 nm (200-400 nm usable range); ~0.3 nm resol.; 100 avgd.; Ocean Optics S2000.
SGE105A	*See also section 15 of this document for various mixture involving SGE105A.*	

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(12d.5) 32.2.2. FJS-1 (JAXA lunar mare simulant; <45, 45-90, and <250 µm)

a. <250 µm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 µm + nanophase iron (IRO102 or IRO103)

FJS-1	PSF 121016a.083	100% FJS-1 (<250 µm) + 0% SGE101A (file ZMIX052).
FJS-1	PSF OO 83	100% FJS-1 (<250 µm) + 0% SGE101A (file ZXMI052).
FJS-1	PSF 121016a.228	100% FJS-1 (<45 µm) + 0% IRO102 or IRO103 (file ZMIX127).

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12d.6. UW lunar analogues

SGE101A	PSF 100824b.001	75-650 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
SGE101B	PSF 100824b.002	75-650 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
SGE105A	PSF 100824b.003	75-650 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
SGE105B	PSF 100824b.004	75-650 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
UWMIP	PSF 100824b.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD

		(directory 100824_nanophase).
UWHIP	PSF 100824b.006	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
UWM1	PSF 100824b.007	<45 and 75-650 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
UWH1	PSF 100824b.008	<45 and 75-650 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
PLG108	PSF 100824b.012	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).
ILM200	PSF 100824b.013	<45 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory 100824_nanophase).

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END of 12.

13. Lunar Samples, Analogues, and Glasses

13.1. Lunar soil samples from NASA
13.2. Lunar analogue synthetic glasses
13.3. Fulgurite from Bruce Jarnot
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13.1.a. Lunar soil samples from NASA (2008) - Sample Descriptions

Apollo lunar soil samples (never exposed to atmosphere)
Sample descriptions - as provided by NASA

Generic	Specific	Weight (g)	Description
10084	2008	0.536	Fines
10084	2009	0.502	Fines
12030	184	0.503	<1 mm fines
12030	185	0.511	<1 mm fines
15041	64	0.500	LT. 1MM (<1 mm?)
15041	71	0.500	LT. 1MM (<1 mm?)
61221	176	0.517	Fines
61221	177	0.506	Fines
64801	175	0.503	Fines
64801	176	0.510	Fines
71061	13	0.500	
71061	14	0.520	

Sample ID	**Description**
10084,2008,162	Apollo 11 regolith sample (<1 mm?)
10084,2009,162	Apollo 11 regolith sample (<1 mm?)
12030,184,7	Apollo 12 regolith sample (<1 mm?)
12030,185,7	Apollo 12 regolith sample (<1 mm?)
15041,64,20	Apollo 15 regolith sample (<1 mm?)
15041,71,20	Apollo 15 regolith sample (<1 mm?)
61221,176,25	Apollo 16 regolith sample (<1 mm?)
61221,177,25	Apollo 16 regolith sample (<1 mm?)
64081,175,4	Apollo 16 regolith sample (<1 mm?)
64081,176,4	Apollo 16 regolith sample (<1 mm?)
71061,13,5	Apollo 17 regolith sample (<1 mm?)
71061,14,5	Apollo 17 regolith sample (<1 mm?)

See sections 32.1, 32.2 of this document for lunar and air-sensitive samples opened in glove box under dry nitrogen and carbon dioxide-free atmosphere (December 2012).
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13.2.a. Lunar Analogue Synthetic Glasses – Sample descriptions

SAMPLE	*OLD*	*END MEMBER ABUNDANCES (wt%)*					
	I.D.	*OPX*	*CPX*	*OLV*	*PLG*	*ILM*	*GLA*
ILM101	L4	0.0	0.0	0.0	0.0	100.0	0.0
PYX036	L5	0.0	100.0	0.0	0.0	0.0	0.0
PYX032	L6	100.0	0.0	0.0	0.0	0.0	0.0
PLG108	L7	0.0	0.0	0.0	100.0	0.0	0.0
OLV003	--	0.0	0.0	100.0	0.0	0.0	0.0
G1	L2	0.0	0.0	0.0	0.0	0.0	100.0
GB1	L1	50.0	0.0	0.0	20.0	5.0	25.0
GF1	L3	66.7	0.0	0.0	26.7	6.7	0.0
GB2[a]	L8	50.0	0.0	0.0	20.0	5.0	25.0
GF2[a]	L9	66.7	0.0	0.0	26.7	6.7	0.0
G3	L32	0.0	0.0	0.0	0.0	0.0	100.0
GB3	L28	52.6	0.0	0.0	21.1	0.0	26.3
GF3	L25	71.4	0.0	0.0	28.6	0.0	0.0
G4[e]	L31	0.0	0.0	0.0	0.0	0.0	100.0
GB4[c]	L29	33.3	0.0	0.0	13.3	3.3	50.0
GB5[b]	L26	33.3	0.0	0.0	13.3	3.3	50.0
GB6[b]	L27	16.7	0.0	0.0	6.7	1.7	75.0
GB7[d]	L30	33.3	0.0	0.0	13.3	3.3	50.0
G8	L11	0.0	0.0	0.0	0.0	0.0	100.0
GB8	L10	42.1	0.0	0.0	16.8	20.0	21.1
GF8	L12	53.3	0.0	0.0	21.3	25.3	0.0
G9	L14	0.0	0.0	0.0	0.0	0.0	100.0
GB9	L13	25.0	0.0	50.0	10.0	2.5	12.5
GF9	L15	28.6	0.0	57.1	11.4	2.9	0.0
G10	L17	0.0	0.0	0.0	0.0	0.0	100.0
GB10	L16	75.0	0.0	0.0	10.0	2.5	12.5
GF10	L18	85.7	0.0	0.0	11.4	2.9	0.0
G11	L20	0.0	0.0	0.0	0.0	0.0	100.0
GB11	L19	31.2	0.0	0.0	50.0	3.1	15.6
GF11	L21	37.0	0.0	0.0	59.3	3.7	0.0
G12	L23	0.0	0.0	0.0	0.0	0.0	100.0
GB12	L22	0.0	50.0	0.0	20.0	5.0	25.0
GF12	L24	0.0	66.7	0.0	26.7	6.7	0.0

NOTES: OPX, orthopyroxene (PYX032); CPX, clinopyroxene (PYX036); OLV, olivine (OLV003); PLG, plagioclase feldspar (PLG108); ILM, ilmenite (ILM101); GLA, glass.
All samples contain 45-90µm sized mineral grains unless otherwise noted.
All glasses were fused for 15 minutes unless otherwise noted.
Each glass contains the same initial proportions of minerals as the glass free sample with which it is numerically paired; e.g., glass G1 was made from the same proportions of minerals as sample GF1.
[a] Contains <45µm sized plagioclase.
[b] Contains glass G1.
[c] Contains <45µm sized glass G1.
[d] Contains glass G4.
[e] Glass G4 fused for 90 minutes.
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13.2.a.1. Lunar Analogue Glasses - Descriptions

Sample ID	Description
G1	Lunar analogue glass, formerly L2 [P].
G3	Lunar analogue glass, formerly L32 [P].
G4	Lunar analogue glass, formerly L31, glass is heterogeneous [P].
G8	Lunar analogue glass, formerly L11, glass is heterogeneous [P].
G9	Lunar analogue glass, formerly L14, glass is heterogeneous [P].
G10	Lunar analogue glass, formerly L17, glass is heterogeneous [P].
G11	Lunar analogue glass, formerly L20 [P].
G12	Lunar analogue glass, formerly L23 [P].

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13.3.a. Fulgurite from Bruce Jarnot – December 2013

[Bruce Jarnot: 443-684-4196; bmjarnot@aol.com].

Description: "These specimens were created in August 2002 by a lightning strike, blown transformer and downed power line on Route 177 (Farmington, Connecticut), diagonally across from the Volunteer Fire Department. The downed power lines resulted in three-plus hours of sustained high voltage current flow, which created an electric furnace with reducing environment – melting sand and gravel into glass, reducing iron oxide and silicon dioxide and melting aluminum debris. This resulted in formation of "native" iron, silicon and aluminum, along with subsequent formation of Si/Fe/Al alloys of differing compositions. A cursory study of the resultant material was presented at the 2002 annual Lunar and Planetary Society meeting, and was contributed as a platform technical presentation at the annual 2003 Rochester Mineralogical symposium". Preliminary results in Sheffer et al. (2003) and Sheffer et al. (2006).

13 samples received December 2013.

1	7 small (sub-cm low density (aluminum?) fragments.
2	Low density (~3 x 2 x 2 cm) granular aggregate with frothy welded surfaces.
3	Low density (~2 x 2 x 2 cm) granular aggregate with frothy welded surfaces and embedded blebs.
4	Low density (~2 x 2 x 2 cm) granular aggregate with frothy welded surfaces and embedded blebs.
5	Low density (~3 x 3 x 2 cm) granular aggregate with frothy welded surfaces and embedded blebs.
6	Frothy (~1 cm) glassy bleb with smaller metallic embedded blebs.
7	Frothy (~1 cm) glassy bleb with smaller metallic embedded blebs.
8	Frothy 3 cm long piece, vesiculated with glassy surface.
9	Frothy, glass-welded aggregate (~2 cm) with lined vesicle.
10	Aggregate (~3 cm) with large metallic bleb and partial glassy surface.
11	Aggregate (~1.5 cm) with large metallic bleb and partial glassy surface.
12	Aggregate (~3 cm) with large metallic blebs and partial glassy surface.
13	Glassy metallic piece (~3 cm) and smaller fragment; high density.

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13b. XRD Data - Lunar Samples, Analogues, and Glasses

13.2.b. XRD Data - Lunar Analogue Glasses

13.2b.1. Analogue files from U of A instrument

Sample	*XRD File*
Synthetic Glasses	
G1	Z03145
G3	Z03152
G4	Z03151
G8	Z03146
G9	Z03147
G10	Z03148
G11	Z03149
G12	Z03150

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13c. Compositional Data - Lunar Samples, Analogues and Glasses

13.2.c. Compositional Data - Lunar Analogue Glasses

Wt. % Point description	G3(L32)*	G4(L31)*	G4(L31)* Bright Spot	G9(L14)* Matrix	G9(L14)* Dark Blob	G9(L14)* Bright Spot
SiO_2	48.76	44.28	0.55	41.17	40.48	46.92
Al_2O_3	12.09	10.48	9.55	1.15	0.00	12.80
Na_2O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
CaO	7.24	6.45	0.29	1.59	0.18	7.40
K_2O	0.06	0.00	0.00	0.06	0.00	0.05
FeO[1]	9.96	15.34	69.06	13.46	11.42	19.03
FeO(avg)				7.35 for G9		
Fe_2O_3[1]	10.97	9.81	n.d.	(n.d.)	(n.d.)	(n.d.)
TiO_2	0.58	3.74	8.02	0.83	0.06	4.40
NiO	0.28	0.00	0.00	0.29	0.33	0.00
MnO	0.41	0.53	0.41	0.28	0.22	0.52
Cr_2O_3	0.00	0.00	1.03	0.12	0.00	0.00
CoO	0.00	0.00	0.00	0.00	0.00	0.00
V_2O_5	0.00	0.15	0.00	0.00	0.00	0.00
MgO	11.64	12.02	7.96	40.08	49.68	7.98
ZnO	0.23	0.36	0.00	0.18	0.00	0.00
TOTAL	102.22	103.16	96.87	99.21	102.37	99.10
Source Analysis	U of A EMPA-1	U of A EMPA-1	U of A EMPA-1	U of A EMPA-1	U of A EMPA-2	U of A EMPA-1

U of A: indicates analysis conducted at the University of Alberta by electron microprobe (EMPA) and number of points analyzed for each sample.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

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13.2.c. Compositional Data - Lunar Analogue Glasses (continued)

Wt. % Point description	G9(L14)* Brightest Spot	G10(L17)* Matrix	G10(L17)* Bright Spot	G10(L17)* Bright Wisp	G11(L20)*	G12(L32)*
SiO_2	0.88	46.45	0.59	36.96	45.62	45.12
Al_2O_3	6.88	6.29	3.90	5.35	21.50	11.38
Na_2O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
CaO	0.20	4.59	0.09	2.34	11.07	17.33
K_2O	0.00	0.05	0.00	0.16	0.05	0.08
FeO[1] FeO(avg)	68.23	12.17	78.58	43.80	5.84	6.10
Fe_2O_3[1]	n.d.	13.49	n.d.	n.d.	6.99	4.79
TiO_2	1.98	1.97	1.57	1.83	2.06	4.03
NiO	0.33	0.00	0.00	0.00	0.00	0.00
MnO	0.44	0.42	0.62	0.38	0.19	0.11
Cr_2O_3	0.32	0.03	1.59	0.09	0.07	0.24
CoO	0.00	0.00	0.00	0.00	0.00	0.00
V_2O_5	0.00	0.00	0.00	0.07	0.10	0.00
MgO	12.68	13.50	8.49	9.53	6.02	9.32
ZnO	0.21	0.00	0.36	0.00	0.00	0.00
TOTAL	92.15	98.96	95.79	100.51	99.51	98.50
Source Analysis	U of A EMPA-1	U of A EMPA-2	U of A EMPA-1	U of A EMPA-1	U of A EMPA-1	U of A EMPA-1

U of A: indicates analysis conducted at the University of Alberta by electron microprobe (EMPA) and number of points analyzed for each sample.

1. FeO determined by wet chemistry at Univ. of Alberta; Fe_2O_3 is difference between total Fe and FeO.

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13d. Spectral Data - Lunar Samples, Analogues, and Glasses

13.1d. Spectral Data - Lunar Samples

Note: samples were only opened and characterized in a humidity- and oxygen-free, nitrogen-purged glove box.

13.1.d. (i) Maya_UV spectra (only 200-~400 nm range is usable)

See also section 32.2.1 of this document

Sample	Spectrum ID	Description
10084,2008,162	PSF 121214lunar.8	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
10084,2009,162	PSF 121214lunar.7	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
12030,184,7	PSF 121214lunar.9	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
12030,185,7	PSF 121214lunar.10	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
15041,64,20	PSF 121214lunar.2	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
15041,71,20	PSF 121214lunar.1	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
61221,176,25	PSF 121214lunar.3	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
61221,177,25	PSF 121214lunar.4	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
64081,175,4	PSF 121214lunar.11	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
64081,176,4	PSF 121214lunar.12	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
71061,13,5	PSF 121214lunar.5	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).
71061,14,5	PSF 121214lunar.6	<1 mm (unsorted); 200-~400 nm; i=0°, e=0°; 0.48-0.42 nm resolution; 600 msec integration time; 100 spectra averaged. Maya spectrometer (directory: 121214lunar).

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13.1.d. (ii) Lunar samples - Spectral data - ASD spectra (350-2500 nm)

Sample	Spectrum ID	Description
10084,2008,162	PSF 12121a.008	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
10084,2009,162	PSF 12121a.007	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
12030,184,7	PSF 12121a.009	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
12030,185,7	PSF 12121a.011	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
15041,64,20	PSF 12121a.002	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
15041,71,20	PSF 12121a.001	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
61221,176,25	PSF 12121a.003	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
61221,177,25	PSF 12121a.004	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
64081,175,4	PSF 12121a.012	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
64081,176,4	PSF 12121a.013	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
71061,13,5	PSF 12121a.005	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).
71061,14,5	PSF 12121a.006	<1 mm (unsorted); 350-2500 nm; i=30°, e=0°; 1 nm output; 500 spectra avgd. ASD spectrometer (directory: 121214lunar).

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13.1.d. (iii) Lunar samples - Spectral data – D&P spectra(2-16 μm; diffuse gold standard; reflectance)

Sample	Spectrum ID	Description
10084,2008,162	PSF 121214lunar.8	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
10084,2009,162	PSF 121214lunar.7	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
12030,184,7	PSF 121214lunar.9	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
12030,185,7	PSF 121214lunar.10	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
15041,64,20	PSF 121214lunar.2	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
15041,71,20	PSF 121214lunar.1	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
61221,176,25	PSF 121214lunar.3	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
61221,177,25	PSF 121214lunar.4	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
64081,175,4	PSF 121214lunar.11	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
64081,176,4	PSF 121214lunar.12	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
71061,13,5	PSF 121214lunar.5	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).
71061,14,5	PSF 121214lunar.6	<1 mm (unsorted); 2-16 μm; i=30°, e=0°; 3 cm^{-1} resolution; 100 spectra averaged. D&P 102F spectrometer (directory: 1212114lunar).

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13.1.d. (iv) Lunar samples – Raman spectra (200—4000 cm^{-1}) B&WTek 532 nm Raman

Sample	Spectrum ID	Description
10084,2008,162	PSF 121214lunar.14	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
10084,2009,162	PSF 121214lunar.13	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
12030,184,7	PSF 121214lunar.15	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
12030,185,7	PSF 121214lunar.16	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
15041,64,20	PSF 121214lunar.4	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
15041,64,20	PSF 121214lunar.9	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
15041,71,20	PSF 121214lunar.1	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
15041,71,20	PSF 121214lunar.2	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
15041,71,20	PSF 121214lunar.3	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
15041,71,20	PSF 121214lunar.8	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
61221,176,25	PSF 121214lunar.5	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
61221,176,25	PSF 121214lunar.6	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
61221,176,25	PSF 121214lunar.7	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
61221,177,25	PSF 121214lunar.10	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
64081,175,4	PSF 121214lunar.17	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
64081,176,4	PSF 121214lunar.18	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
71061,13,5	PSF 121214lunar.11	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).
71061,14,5	PSF 121214lunar.12	<1 mm (unsorted); 200-4000 cm^{-1}; 100 mW laser; 65000 msec integration time; 1 spectrum avgd. (directory: 121214lunar).

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13d. Spectral Data - Lunar Samples, Analogues, and Glasses

13.2.d. Spectral Data - Lunar Analogue Mixtures and Synthetic Glasses

Sample	*Facility/File No.*	*Description*
ILM101	RELAB C1SC34	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
PYX036	RELAB C1SC35	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
PYX032	RELAB C1SC36	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
PLG108	RELAB C1SC37	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
G1	RELAB C1SC32	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB1	RELAB C1SC31	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GF1	RELAB C1SC33	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB2	RELAB C1SC38	<45 & 45-90µm mixture, 30E/0E, 0.3-2.6µm, 5nm.
GF2	RELAB C1SC39	<45 & 45-90µm mixture, 30E/0E, 0.3-2.6µm, 5nm.
G3	RELAB C1SC62	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB3	RELAB C1SC58	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GF3	RELAB C1SC55	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
G4	RELAB C1SC61	45-90µm, 30E/0E, 0.3-2.6µm, 5 nm.
GB4	RELAB C1SC59	<45 & 45-90µm mixture, 30E/0E, 0.3-2.6µm, 5nm.
GB5	RELAB C1SC56	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB6	RELAB C1SC57	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB7	RELAB C1SC60	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
G8	RELAB C1SC41	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB8	RELAB C1SC40	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GF8	RELAB C1SC42	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
G9	RELAB C1SC44	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB9	RELAB C1SC43	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GF9	RELAB C1SC45	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
G10	RELAB C1SC47	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB10	RELAB C1SC46	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GF10	RELAB C1SC48	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
G11	RELAB C1SC50	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB11	RELAB C1SC49	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GF11	RELAB C1SC51	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
G12	RELAB C1SC53	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GB12	RELAB C1SC52	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.
GF12	RELAB C1SC54	45-90µm, 30E/0E, 0.3-2.6µm, 5nm.

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13.2.d.1. Lunar Analogue Mixtures and Synthetic Glasses – Polynomial (Quadratic) Fits to Absorption Bands

Equation $y=a+bx+cx^{2}$.. Differentiate & solve for x at y=0 i.e. 0=-b+2cx, b=2cx.
Band depth, solve for y (if normalized only)

Sample	Polyn. Coeff's a	b	c	Band "Min."(µm)	Compil. Depth (%)	Channels & File#	Fitted
BAND I							
PYX036	3.902	-7.508	3.681	1.020		brown3a-69	136-154
PYX032	3.016	-6.429	3.490	0.921		brown3a-71	111-129
PYX032/s.l.[c]	14.78	-31.11	16.65	0.934	75.2	brown3a132	115-145
PLG108	3.503	-4.612	1.824	1.264		brown3a-73	181-199
GB1	16.41	-33.68	18.19	0.926		brown3a-65	
GB1/s.l.	14.83	-30.47	16.29	0.9352	41.8	lundat2-195	
GB1/s.l.[c]	13.75	-28.15	15.01	0.938	44.8	brown3a-128	115-145
GB1/G1	16.28	-33.73	18.25	0.9241	30.5	lundat2-197	
GB1/G1[d]	16.92	-35.08	18.96	0.925		brown3a-190	
GB1/G1n[e]	12.52	-25.70	13.85	0.928		brown3a-141	117-137
GF1	2.949	-6.134	3.316	0.925		brown3a-67	116-134
GF1/s.l.	16.37	-34.00	18.18	0.9351	52.7	lundat2-196	
GF1/s.l.[c]	14.30	-29.59	15.79	0.937	56.3	brown3a-130	65-95
GF1/G1[d]	16.70	-35.03	18.93	0.925		brown3a-193	
GB2	1.876	-3.696	2.001	0.924		brown3a-74	116-134
GB2/s.l.[c]	9.527	-18.87	10.07	0.937	31.3	brown3a-134	115-145
GB2/s.l.	10.61	-21.12	11.28	0.9362	27.6	lundat2-198	
GB2/G1	9.583	-19.08	10.28	0.9280	31.5	lundat2-199	
GB2/G1[d]	13.79	-27.58	14.83	0.930		brown3a-194	
GF2	3.487	-7.032	3.795	0.926		brown3a-76	116-134
GF2/s.l.	12.65	-25.62	13.66	0.9378	36.3	lundat2-200	
GF2/s.l.[c]	11.49	-23.18	12.35	0.938	38.7	brown3a-136	115-145
GF2/G1[d]	13.90	-28.36	15.27	0.929		brown3a-195	
GF3	4.210	-8.868	4.804	0.9230		lundat2-205	
GB3	1.487	-3.058	1.659	0.922		brown3a-82	116-134
GB3/G3	12.30	-25.23	13.61	0.9269		lundat2-215	
GB3/s.l.	13.14	-26.93	14.39	0.9357		lundat2-216	
GB3/s.l.[c]	12.73	-26.03	13.90	0.936	45.6	brown3a-142	115-145
GF3/s.l.	15.55	-32.26	17.21	0.9372		lundat2-217	
GB4	1.113	-2.233	1.238	0.902		brown3a-84	113-129
GB4/s.l.	7.655	-14.31	7.481	0.9564		lundat2-224	
GB4/s.l.[c]	7.794	-14.67	7.685	0.954	20.7	brown3a-144	115-145
GB4/G1[d]	7.021	-13.32	7.365	0.904		brown3a-196	
GB5	.8610	-1.753	.9535	0.919		brown3a-78	116-134
GB5/G1	11.45	-23.22	12.57	0.9236		lundat2-218	
GB5/G1[d]	14.97	-30.47	16.45	0.926		brown3a-191	
GB5/s.l.	11.35	-22.83	12.17	0.9380		lundat2-219	
GB5/s.l.[c]	10.19	-20.37	10.86	0.938	36.2	brown3a-138	115-145
GB6	.3917	-.7637	.4158	0.918		brown3a-80	116-134
GB6/G1	7.082	-13.69	7.435	0.9206		lundat2-220	
GB6/G1[d]	9.592	-18.66	10.10	0.924		brown3a-192	
GB6/s.l.	7.524	-14.47	7.653	0.9454		lundat2-221	
GB6/s.l.[a]	8.230	-15.83	8.333	0.9498		brown3a-157	
GB6/s.l.[b]	7.496	-14.42	7.636	0.9442		brown3a-161	
GB6/s.l.[c]	8.041	-15.49	8.167	0.948	30.4	brown3a-140	115-145
GB7	.9077	-1.831	.9903	0.924		brown3a-86	116-134
GB7/G4	11.23	-22.76	12.34	0.9222		lundat2-222	
GB7/s.l.	11.46	-22.99	12.24	0.9391		lundat2-223	

GB7/s.l.[c]	10.79	-21.60	11.48	0.941	37.0	brown3a-146115-145
GB8	1.680	-3.458	1.872	0.9236		lundat2-195
GB8/G8	16.39	-33.74	18.30	0.9219	16.2	lundat2-201
GB8/s.l.	13.94	-28.41	15.24	0.9321	30.0	lundat2-202
GF8	2.648	-5.519	2.992	0.9223		lundat2-196
GF8/s.l.	16.41	-33.82	18.14	0.9322	35.3	lundat2-203
GB9	2.469	-4.753	2.432	0.9772		lundat2-197
GB9/G9	5.871	-10.80	5.663	0.9536	27.8	lundat2-204
GB9/s.l.	10.95	-20.98	10.68	0.9822	35.3	lundat2-205
GF9	3.931	-7.644	3.910	0.9775		lundat2-198
GF9/s.l.	11.32	-21.87	11.12	0.9834	43.3	lundat2-206
GB10	2.611	-5.511	2.982	0.9240		lundat2-199
GB10/G10	24.51	-51.66	27.93	0.9248		lundat2-207
GB10/s.l.	17.46	-36.41	19.48	0.9345		lundat2-208
GF10	3.656	-7.761	4.207	0.9224		lundat2-200
GF10/s.l.	16.87	-35.31	18.89	0.9346		lundat2-209
GB11	2.422	-4.889	2.645	0.9242		lundat2-201
GB11/G11	8.560	-17.07	9.129	0.9349		lundat2-210
GB11/s.l.	11.36	-22.62	12.06	0.9378		lundat2-211
GF11	4.049	-8.329	4.503	0.9248		lundat2-202
GF11/s.l.	13.49	-27.42	14.64	0.9365		lundat2-213
GB12	2.656	-5.000	2.460	1.0163		lundat2-203
GB12/G12	8.952	-18.28	10.05	0.9095		lundat2-212
GB12/s.l.	12.94	-23.87	11.45	1.0424		lundat2-213
GF12	3.892	-7.391	3.623	1.0200		lundat2-204
GF12/s.l.	15.27	-28.55	13.74	1.0389		lundat2-214Fitted
BAND II						
PYX036	5.890	-4.930	1.072	2.299		brown3a-70 136-154
PYX032	2.941	-2.929	.7512	1.950		brown3a-72 66-84
PYX032/s.l.[c]	6.017	-5.906	1.491	1.981		brown3a-13370-100
GB1	20.08	-19.60	5.086	1.927		brown3a-66 66-84
GB1/s.l.	9.144	-8.743	2.212	1.9763		lundat2-195
GB1/s.l.[c]	8.219	-7.848	1.987	1.975		brown3a-12965-95
GB1/G1[d]	6.550	-5.995	1.467	2.043		brown3a-197
GB1/G1n[e]	5.895	-5.402	1.320	2.046		brown3a-14285-110
GB1/G1	6.017	-5.480	1.343	2.0402		lundat2-197
GF1	3.548	-3.499	.8990	1.946		brown3a-68 61-84
GF1/s.l.	7.506	-7.211	1.813	1.9887		lundat2-196
GF1/s.l.[c]	6.088	-5.806	1.458	1.991		brown3a-13165-95
GF1/G1[d]	5.605	-5.240	1.286	2.037		brown3a-200
GB2	1.343	-1.193	.3107	1.920		brown3a-75 66-84
GB2/s.l.	6.823	-6.263	1.577	1.9857		lundat2-198
GB2/s.l.[c]	6.382	-5.837	1.468	1.988		brown3a-13570-100
GB2/G1	3.789	-3.224	.7556	2.1334		lundat2-199
GB2/G1[d]	4.935	-4.189	.9810	2.135		brown3a-201
GF2	3.592	-3.404	.8671	1.963		brown3a-77 66-84
GF2/s.l.	6.968	-6.482	1.613	2.0093		lundat2-200
GF2/s.l.[c]	6.559	-6.102	1.519	2.009		brown3a-13770-100
GF2/G1[d]	4.729	-4.184	.9934	2.106		brown3a-202
GB3	2.473	-2.433	.6293	1.933		brown3a-83 66-84
GB3/G3	5.831	-5.415	1.340	2.0205		lundat2-217
GB3/s.l.	8.814	-8.425	2.126	1.9814		lundat2-218
GB3/s.l.[c]	8.080	-7.686	1.942	1.979		brown3a-14370-100
GF3	3.331	-3.267	.8392	1.9465		lundat2-216
GF3/s.l.	6.616	-6.361	1.597	1.9915		lundat2-219

GB4	.6947	-.9638	.2613	1.844	brown3a-85 46-64
GB4/s.l.	6.744	-5.977	1.491	2.0044	lundat2-226
GB4/s.l.[c]	6.124	-5.380	1.343	2.003	brown3a-14570-100
GB4/G1[d]	4.210	-3.108	.6954	2.235	brown3a-203
GB5	1.221	-1.187	.3112	1.907	brown3a-79 56-79
GB5/G1	4.562	-3.962	.9685	2.0454	lundat2-220
GB5/G1[d]	5.801	-5.083	1.242	2.046	brown3a-198
GB5/s.l.	10.06	-9.608	2.452	1.9592	lundat2-221
GB5/s.l.[c]	8.422	-7.974	2.043	1.952	brown3a-13970-100
GB6	.5239	-.4923	.1352	1.821	brown3a-81 41-59
GB6/G1[d]	4.009	-3.126	.7615	2.053	brown3a-199
GB6/G1	2.752	-2.055	.5009	2.0513	lundat2-222
GB6/s.l.	7.139	-6.578	1.707	1.9268	lundat2-223
GB6/s.l.[a]	10.33	-9.800	2.518	1.9460	brown3a-159
GB6/s.l.[c]	9.269	-8.739	2.254	1.939	brown3a-14170-100
GB7	1.233	-1.194	.3138	1.902	brown3a-87 56-74
GB7/G4	5.580	-4.921	1.201	2.0487	lundat2-224
GB7/s.l.	9.195	-8.692	2.213	1.9638	lundat2-225
GB8	1.480	-1.426	.3678	1.9386	lundat2-206
GB8/G8	9.544	-8.706	2.157	2.0181	lundat2-201
GB8/s.l.	9.446	-8.968	2.272	1.9736	lundat2-202
GF8	2.136	-2.065	.5295	1.9500	lundat2-207
GF8/s.l.	9.342	-8.897	2.238	1.9877	lundat2-203
GB9	2.042	-1.873	.4823	1.9417	lundat2-208
GB9/G9	8.549	-7.625	1.905	2.0013	lundat2-204
GB9/s.l.	8.142	-7.458	1.895	1.9678	lundat2-205
GF9	3.590	-3.377	.8673	1.9468	lundat2-209
GF9/s.l.	8.787	-8.163	2.061	1.9803	lundat2-206
GB10	2.191	-2.159	.5552	1.9443	lundat2-210
GB10/G10	12.57	-12.10	3.046	1.9862	lundat2-207
GB10/s.l.	8.767	-8.505	2.147	1.9807	lundat2-208
GF10	2.971	-2.935	.7525	1.9502	lundat2-211
GF10/s.l.	7.227	-7.034	1.770	1.9870	lundat2-209
GB11	2.429	-2.312	.6022	1.9196	lundat2-212
GB11/G11	3.097	-2.673	.6336	2.1094	lundat2-210
GB11/s.l.	8.801	-8.240	2.090	1.9713	lundat2-211
GF11	3.657	-3.521	.9044	1.9466	lundat2-213
GF11/s.l.	8.741	-8.284	2.085	1.9866	lundat2-212
GB12	3.075	-2.506	.5558	2.2544	lundat2-214
GB12/G12	8.810	-7.052	1.484	2.3760	lundat2-214
GB12/s.l.	7.067	-5.613	1.194	2.3505	lundat2-215
GF12	4.774	-3.941	.8574	2.2982	lundat2-215
GF12/s.l.	8.334	-6.743	1.429	2.3593	lundat2-216

Notes: s.l.= straight line continuum (sample divided by s.l. continuum); / = line of division; [a] : Straight line continuum pinned at 0.975µm; [b] : Straight line continuum pinned at 0.4µm; [c,d] : Discrete data run; [e] : Spectrum divided by second spectrum "normalized" to first; Band I = major absorption band near 1µm; Band II = major absorption band near 2µm.

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END of 13.

14. Chromates

14a. Sample Descriptions - Chromates

[FORMAT: Sample #, type, locality, association/comments, (supplier/supplier sample number)].
Note: sample IDs in italics are either too sparse or intimate/fine-grained to separate.
Note: sample names are generally those used by the suppliers (and may be erroneous).

Sample ID	*Description*
CRC001	Crocoite: Tasmania, Australia ($PbCrO_4$) (from Sue Atkinson) *(for pigments project).*
CRC002	Crocoite: Beresowsk, Urals, USSR ($PbCrO_4$) (Smithsonian Institution MNMH #B11577) *(for pigments project).*
CRC003	Crocoite: Dundas, Tasmania, Australia ($PbCrO_4$) (Smithsonian Institution MNMH #C4606-6) *(for pigments project).*
PIG017	Synthetic lead (II) chromate (($PbCrO_4$); synthetic version of crocoite. See Pigments section *(for pigments project). See section 19 of this document for data.*
PIG020	Synthetic barium chromate ($BaCrO_4$). See Pigments section *(for pigments project). See section 19 of this document for data.*
CHO001	Synthetic potassium dichromate [$K_2Cr_2O_7$]. Aldrich #20,780-2; lot no. 07805CS); 100 grams; *for iron wet chemistry titration.*

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14b. XRD Data - Chromates

None.

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14c. Compositional Data - Chromates

None (see Pigments section).

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14d. Spectral Data - Chromates

See Pigments section.

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END of 14.

15. Mineral Mixtures

15a. Sample Descriptions - Mineral Mixtures

15.1. Two-pyroxene mixtures
15.2. Olivine + orthopyroxene
15.3. Olivine + clinopyroxene
15.4. Olivine + metal
15.5. Olivine + othropyroxene + metal
15.6. Olivine + opaques
15.7. Olivine + chromite ± metal
15.8. Orthropyroxene + metal and/or opaques
15.9. Orthopyroxene + palagonite, hematite, or plagioclase feldspar
15.10. Metal + accessory phases
15.11. Aubrite + troilite
15.12. Diaspore + other phases
15.13. Carbonates/nitrates + basalt or palagonite
15.14. Two-clay mixtures
15.15. Gypsum + basalt + palagonite
15.16. Barium sulphate + pyroxene
15.17. Pancam mixture tests (basalt, silica, sulphate, palagonite)
15.18. Gaffey (1976) mineral mixtures and miscellaneous samples
15.19. Basalt + ilmenite
15.20. Carbonaceous chondrite simulants (clays/hydroxides + carbon black)
15.21. Carbonaceous chondrite simulants (clays + graphite/magnetite)
15.22. Glass + mafic silicates
15.23. Asteroid Boznemcova simulants (pyroxene, plagioclase, olivine)
15.24. HED meteorites + CM2 carbonaceous chondrites and CM2-bearing howardite
15.25. Air-sensitive mixtures
15.26. PAHs + other materials
15.27. Two-pyroxene mixtures (RELAB archive)
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Note: *see also section 32 of this document for additional samples and mixture measured in a controlled atmosphere. Unless otherwise indicated, intimate powdered mixtures are implied.*

FORMAT: *Sample No., end members: descriptions, abundances, grain sizes in microns, (old sample I.D. no. if any).*

NOTE: *Samples are sorted by project type.*
End member abundances expressed on a weight % basis unless otherwise indicated.
Intimately mixed mixtures unless otherwise indicated.
Abbreviations: OLV: olivine; OPX: orthopyroxene, aka low-calcium pyroxene; CPX: clinopyroxene, aka high-calcium pyroxene; type A CPX: spectral type A clinopyroxene (Adams, 1974); type B CPX: spectral type B clinopyroxene (Adams, 1974).

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Sample ID	Description

15.1a. Two pyroxene mixtures

PYX009	100% PYX009 (type A clinopyroxene), 45- 90µm.
PYX038	100% PYX038 (type A clinopyroxene?), 45-90 µm.
MIX201	PYX009:PYX038, 60:40, both 45-90 µm.

++++++

PYX023 100% PYX023 (orthopyroxene), 45-90 µm.
PYX032 100% PYX032 (orthopyroxene); 45-90 µm.
MIX205 44% PYX023 (45-90µm) + 56% PYX032 (45-90µm)(simulation of another pyroxene).
++++++

15.1.1a. Series 1: PYX032 (OPX) + PYX040 (type B CPX)

PYX032 100% PYX032; 45-90 µm.
PYX040 100% PYX040; 45-90 µm.
MIX230 75% PYX032 (orthopyroxene, 45-90µm) + 25% PYX040 (clinopyroxene, 45-90µm).
MIX231 50% PYX032 (orthopyroxene, 45-90µm) + 50% PYX040 (clinopyroxene, 45-90µm).
MIX232 25% PYX032 (orthopyroxene, 45-90µm) + 75% PYX040 (clinopyroxene, 45-90µm).
++++++

15.1.2a. Series 2: PYX003 (OPX) + PYX036 (type B CPX)

PYX003 100% PYX003; 45-90 µm.
PYX036 100% pyx036; 45-90 µm.
MIX250 75% PYX003 (orthopyroxene, 45-90µm) + 25% PYX036 (clinopyroxene, 45-90µm).
MIX251 50% PYX003 (orthopyroxene, 45-90µm) + 50% PYX036 (clinopyroxene, 45-90µm).
MIX252 25% PYX003 (orthopyroxene, 45-90µm) + 75% PYX036 (clinopyroxene, 45-90µm).
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15.1.3a. Series 3a: Type A clinopyroxene (PYX150) + orthopyroxene (PYX042); both <45 µm

COMIX1101 0% type A clinopyroxene (PYX150; <45 µm) + 100% orthopyroxene (PYX042; <45 µm).
COMIX1102 10% type A clinopyroxene (PYX150; <45 µm) + 90% orthopyroxene (PYX042; <45 µm).
COMIX1103 20% type A clinopyroxene (PYX150; <45 µm) + 80% orthopyroxene (PYX042; <45 µm).
COMIX1104 30% type A clinopyroxene (PYX150; <45 µm) + 70% orthopyroxene (PYX042; <45 µm).
COMIX1105 40% type A clinopyroxene (PYX150; <45 µm) + 60% orthopyroxene (PYX042; <45 µm).
COMIX1106 50% type A clinopyroxene (PYX150; <45 µm) + 50% orthopyroxene (PYX042; <45 µm).
COMIX1107 60% type A clinopyroxene (PYX150; <45 µm) + 40% orthopyroxene (PYX042; <45 µm).
COMIX1108 70% type A clinopyroxene (PYX150; <45 µm) + 30% orthopyroxene (PYX042; <45 µm).
COMIX1108.5 75% type A clinopyroxene (PYX150; <45 µm) + 25% orthopyroxene (PYX042; <45 µm).
COMIX1109 80% type A clinopyroxene (PYX150; <45 µm) + 20% orthopyroxene (PYX042; <45 µm).
COMIX1109.5 85% type A clinopyroxene (PYX150; <45 µm) + 15% orthopyroxene (PYX042; <45 µm).
COMIX1110 90% type A clinopyroxene (PYX150; <45 µm) + 10% orthopyroxene (PYX042; <45 µm).
COMIX1110.5 95% type A clinopyroxene (PYX150; <45 µm) + 5% orthopyroxene (PYX042; <45 µm).
COMIX1111 100% type A clinopyroxene (PYX150; <45 µm) + 0% orthopyroxene (PYX042; <45 µm).
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15.1.4a. Series 3b: Type A clinopyroxene (PYX150) + orthopyroxene (PYX042); both 45-90 µm

COMIX2101 0% type A clinopyroxene (PYX150; 45-90 µm) + 100% orthopyroxene (PYX042; 45-90 µm).
COMIX2102 10% type A clinopyroxene (PYX150; 45-90 µm) + 90% orthopyroxene (PYX042; 45-90 µm).
COMIX2103 20% type A clinopyroxene (PYX150; 45-90 µm) + 80% orthopyroxene (PYX042; 45-90 µm).
COMIX2104 30% type A clinopyroxene (PYX150; 45-90 µm) + 70% orthopyroxene (PYX042; 45-90 µm).
COMIX2105 40% type A clinopyroxene (PYX150; 45-90 µm) + 60% orthopyroxene (PYX042; 45-90 µm).
COMIX2106 50% type A clinopyroxene (PYX150; 45-90 µm) + 50% orthopyroxene (PYX042; 45-90 µm).
COMIX2107 60% type A clinopyroxene (PYX150; 45-90 µm) + 40% orthopyroxene (PYX042; 45-90 µm).
COMIX2108 70% type A clinopyroxene (PYX150; 45-90 µm) + 30% orthopyroxene (PYX042; 45-90 µm).
COMIX2108.5 75% type A clinopyroxene (PYX150; 45-90 µm) + 25% orthopyroxene (PYX042; 45-90 µm).
COMIX2109 80% type A clinopyroxene (PYX150; 45-90 µm) + 20% orthopyroxene (PYX042; 45-90 µm).
COMIX2109.5 85% type A clinopyroxene (PYX150; 45-90 µm) + 15% orthopyroxene (PYX042; 45-90 µm).
COMIX2110 90% type A clinopyroxene (PYX150; 45-90 µm) + 10% orthopyroxene (PYX042; 45-90 µm).
COMIX210.5 95% type A clinopyroxene (PYX150; 45-90 µm) + 5% orthopyroxene (PYX042; 45-90 µm).
COMIX2111 100% type A clinopyroxene (PYX150; 45-90 µm) + 0% orthopyroxene (PYX042; 45-90 µm).
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15.1.5a. Series 4a: Type B clinopyroxene (PYX017) + orthopyroxene (PYX032); both <45 µm

PMIX1001 100% type B clinopyroxene (PYX017; <45 µm) + 0% orthopyroxene (PYX032; <45 µm).
PMIX1002 90% type B clinopyroxene (PYX017; <45 µm) + 10% orthopyroxene (PYX032; <45 µm).
PMIX1003 80% type B clinopyroxene (PYX017; <45 µm) + 20% orthopyroxene (PYX032; <45 µm).
PMIX1004 70% type B clinopyroxene (PYX017; <45 µm) + 30% orthopyroxene (PYX032; <45 µm).
PMIX1005 60% type B clinopyroxene (PYX017; <45 µm) + 40% orthopyroxene (PYX032; <45 µm).
PMIX1006 50% type B clinopyroxene (PYX017; <45 µm) + 50% orthopyroxene (PYX032; <45 µm).
PMIX1007 40% type B clinopyroxene (PYX017; <45 µm) + 60% orthopyroxene (PYX032; <45 µm).
PMIX1008 30% type B clinopyroxene (PYX017; <45 µm) + 70% orthopyroxene (PYX032; <45 µm).
PMIX1009 20% type B clinopyroxene (PYX017; <45 µm) + 80% orthopyroxene (PYX032; <45 µm).
PMIX1010 10% type B clinopyroxene (PYX017; <45 µm) + 90% orthopyroxene (PYX032; <45 µm).
PMIX1011 0% type B clinopyroxene (PYX017; <45 µm) + 100% orthopyroxene (PYX032; <45 µm).
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15.1.6a. Series 4b: Type B clinopyroxene (PYX017) + orthopyroxene (PYX032); both 90-180 µm

PMIX2001 100% type B clinopyroxene (PYX017; 90-180 µm) + 0% orthopyroxene (PYX032; 90-180 µm).
PMIX2002 80% type B clinopyroxene (PYX017; 90-180 µm) + 20% orthopyroxene (PYX032; 90-180 µm).
PMIX2003 60% type B clinopyroxene (PYX017; 90-180 µm) + 40% orthopyroxene (PYX032; 90-180 µm).
PMIX2004 40% type B clinopyroxene (PYX017; 90-180 µm) + 60% orthopyroxene (PYX032; 90-180 µm).
PMIX2005 20% type B clinopyroxene (PYX017; 90-180 µm) + 80% orthopyroxene (PYX032; 90-180 µm).
PMIX2006 0% type B clinopyroxene (PYX017; 90-180 µm) + 100% orthopyroxene (PYX032; 90-180 µm).
++++++

15.1.7a. Series 5a: Type B clinopyroxene (PYX005) + orthopyroxene (PYX023); both <45 µm

PMIX1101 100% type B clinopyroxene (PYX005; <45 µm) + 0% orthopyroxene (PYX023; <45 µm).
PMIX1102 90% type B clinopyroxene (PYX005; <45 µm) + 10% orthopyroxene (PYX023; <45 µm).
PMIX1103 80% type B clinopyroxene (PYX005; <45 µm) + 20% orthopyroxene (PYX023; <45 µm).
PMIX1104 70% type B clinopyroxene (PYX005; <45 µm) + 30% orthopyroxene (PYX023; <45 µm).
PMIX1105 60% type B clinopyroxene (PYX005; <45 µm) + 40% orthopyroxene (PYX023; <45 µm).
PMIX1106 50% type B clinopyroxene (PYX005; <45 µm) + 50% orthopyroxene (PYX023; <45 µm).
PMIX1107 40% type B clinopyroxene (PYX005; <45 µm) + 60% orthopyroxene (PYX023; <45 µm).
PMIX1108 30% type B clinopyroxene (PYX005; <45 µm) + 70% orthopyroxene (PYX023; <45 µm).
PMIX1109 20% type B clinopyroxene (PYX005; <45 µm) + 80% orthopyroxene (PYX023; <45 µm).
PMIX1110 10% type B clinopyroxene (PYX005; <45 µm) + 90% orthopyroxene (PYX023; <45 µm).
PMIX1111 0% type B clinopyroxene (PYX005; <45 µm) + 100% orthopyroxene (PYX023; <45 µm).
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15.1.8a. Series 5b: Type B clinopyroxene (PYX005) + orthopyroxene (PYX023); both 90-180 µm

PMIX2101 100% type B clinopyroxene (PYX005; 90-180 µm) + 0% orthopyroxene (PYX023; 90-180 µm).
PMIX2102 80% type B clinopyroxene (PYX005; 90-180 µm) + 20% orthopyroxene (PYX023; 90-180 µm).
PMIX2103 60% type B clinopyroxene (PYX005; 90-180 µm) + 40% orthopyroxene (PYX023; 90-180 µm).
PMIX2104 40% type B clinopyroxene (PYX005; 90-180 µm) + 60% orthopyroxene (PYX023; 90-180 µm).
PMIX2105 20% type B clinopyroxene (PYX005; 90-180 µm) + 80% orthopyroxene (PYX023; 90-180 µm).
PMIX2106 0% type B clinopyroxene (PYX005; 90-180 µm) + 100% orthopyroxene (PYX023; 90-180 µm).
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15.2a. Olivine + orthopyroxene mixtures

OLV010 100% OLV010; <63 µm.
OLV010 100% OLV010; 63-125 µm.
PYX042 100% PYX042 (OPX); <63 µm.
PYX042 100% PYX042 (OPX); 63-125 µm.
MIX203 OLV010:PYX042, 50:50, 31.5:29.5 of <63µm sized minerals and 18.5:20.5 of 63-125µm minerals (regolith simulation).
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OLV003 100% OLV003; 45-90 µm.
PYX032 100% PYX032 (OPX); 45-90 µm.
MIX210 50% OLV003 (olivine, 45-90µm) + 50% PYX032 (orthopyroxene, 45-90µm).

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OLV020	100% OLV020; 45-90 µm.
PYX032	100% PYX032 (OPX); 45-90 µm.
MIX212	50% OLV020 (olivine, 45-90µm) + 50% PYX032 (orthopyroxene, 45-90µm).

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15.2.1a. Series 1: OLV022 + PYX003 (OPX)

OLV022	100% OLV022; 45-90 µm.
PYX003	100% PYX003 (OPX); 45-90 µm.
MIX240	75% OLV022 (olivine, 45-90µm) + 25% PYX003 (orthopyroxene, 45-90µm).
MIX241	50% OLV022 (olivine, 45-90µm) + 50% PYX003 (orthopyroxene, 45-90µm).
MIX242	25% OLV022 (olivine, 45-90µm) + 75% PYX003 (orthopyroxene, 45-90µm).

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15.2.2a. Series 2a: Orthopyroxene (PYX042) + olivine (OLV003); both <38 µm.

POMIX1001	0% orthopyroxene (PYX042; <38 µm) + 100% olivine (OLV003; <38 µm).
POMIX1002	10% orthopyroxene (PYX042; <38 µm) + 90% olivine (OLV003; <38 µm).
POMIX1003	20% orthopyroxene (PYX042; <38 µm) + 80% olivine (OLV003; <38 µm).
POMIX1004	30% orthopyroxene (PYX042; <38 µm) + 70% olivine (OLV003; <38 µm).
POMIX1005	40% orthopyroxene (PYX042; <38 µm) + 60% olivine (OLV003; <38 µm).
POMIX1006	50% orthopyroxene (PYX042; <38 µm) + 50% olivine (OLV003; <38 µm).
POMIX1007	60% orthopyroxene (PYX042; <38 µm) + 40% olivine (OLV003; <38 µm).
POMIX1008	70% orthopyroxene (PYX042; <38 µm) + 30% olivine (OLV003; <38 µm).
POMIX1009	80% orthopyroxene (PYX042; <38 µm) + 20% olivine (OLV003; <38 µm).
POMIX1010	90% orthopyroxene (PYX042; <38 µm) + 10% olivine (OLV003; <38 µm).
POMIX1011	100% orthopyroxene (PYX042; <38 µm) + 0% olivine (OLV003; <38 µm).

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15.2.3a. Series 2b: Orthopyroxene (PYX042) + olivine (OLV003); 38-53 µm.

POMIX2001	0% orthopyroxene (PYX042; 38-53 µm) + 100% olivine (OLV003; 38-53 µm).
POMIX2002	10% orthopyroxene (PYX042; 38-53 µm) + 90% olivine (OLV003; 38-53 µm).
POMIX2003	20% orthopyroxene (PYX042; 38-53 µm) + 80% olivine (OLV003; 38-53 µm).
POMIX2004	30% orthopyroxene (PYX042; 38-53 µm) + 70% olivine (OLV003; 38-53 µm).
POMIX2005	40% orthopyroxene (PYX042; 38-53 µm) + 60% olivine (OLV003; 38-53 µm).
POMIX2006	50% orthopyroxene (PYX042; 38-53 µm) + 50% olivine (OLV003; 38-53 µm).
POMIX2007	60% orthopyroxene (PYX042; 38-53 µm) + 40% olivine (OLV003; 38-53 µm).
POMIX2008	70% orthopyroxene (PYX042; 38-53 µm) + 30% olivine (OLV003; 38-53 µm).
POMIX2009	80% orthopyroxene (PYX042; 38-53 µm) + 20% olivine (OLV003; 38-53 µm).
POMIX2010	90% orthopyroxene (PYX042; 38-53 µm) + 10% olivine (OLV003; 38-53 µm).
POMIX2011	100% orthopyroxene (PYX042; 38-53 µm) + 0% olivine (OLV003; 38-53 µm).

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15.2.4a. Series 2c: Orthopyroxene (PYX042) + olivine (OLV003); 90-125 µm.

POMIX3001	0% orthopyroxene (PYX042; 90-125 µm) + 100% olivine (OLV003; 90-125 µm).
POMIX3002	10% orthopyroxene (PYX042; 90-125 µm) + 90% olivine (OLV003; 90-125 µm).
POMIX3003	20% orthopyroxene (PYX042; 90-125 µm) + 80% olivine (OLV003; 90-125 µm).
POMIX3004	30% orthopyroxene (PYX042; 90-125 µm) + 70% olivine (OLV003; 90-125 µm).
POMIX3005	40% orthopyroxene (PYX042; 90-125 µm) + 60% olivine (OLV003; 90-125 µm).
POMIX3006	50% orthopyroxene (PYX042; 90-125 µm) + 50% olivine (OLV003; 90-125 µm).
POMIX3007	60% orthopyroxene (PYX042; 90-125 µm) + 40% olivine (OLV003; 90-125 µm).
POMIX3008	70% orthopyroxene (PYX042; 90-125 µm) + 30% olivine (OLV003; 90-125 µm).
POMIX3009	80% orthopyroxene (PYX042; 90-125 µm) + 20% olivine (OLV003; 90-125 µm).
POMIX3010	90% orthopyroxene (PYX042; 90-125 µm) + 10% olivine (OLV003; 90-125 µm).
POMIX3011	100% orthopyroxene (PYX042; 90-125 µm) + 0% olivine (OLV003; 90-125 µm).

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15.2.5a. Series 2d: Orthopyroxene (PYX042) + olivine (OLV003); 63-90 µm (original M.Sc. 1986 samples).

POMIX4001 0% orthopyroxene (PYX042; 63-90 µm) + 100% olivine (OLV003; 63-90 µm).
POMIX4002 10% orthopyroxene (PYX042; 63-90 µm) + 90% olivine (OLV003; 63-90 µm).
POMIX4003 80% orthopyroxene (PYX042; 63-90 µm) + 20% olivine (OLV003; 63-90 µm).
POMIX4004 70% orthopyroxene (PYX042; 63-90 µm) + 30% olivine (OLV003; 63-90 µm).
POMIX4005 60% orthopyroxene (PYX042; 63-90 µm) + 40% olivine (OLV003; 63-90 µm).
POMIX4006 50% orthopyroxene (PYX042; 63-90 µm) + 50% olivine (OLV003; 63-90 µm).
POMIX4007 40% orthopyroxene (PYX042; 63-90 µm) + 60% olivine (OLV003; 63-90 µm).
POMIX4008 30% orthopyroxene (PYX042; 63-90 µm) + 70% olivine (OLV003; 63-90 µm).
POMIX4009 20% orthopyroxene (PYX042; 63-90 µm) + 80% olivine (OLV003; 63-90 µm).
POMIX4010 90% orthopyroxene (PYX042; 63-90 µm) + 10% olivine (OLV003; 63-90 µm).
POMIX4011 100% orthopyroxene (PYX042; 63-90 µm) + 0% olivine (OLV003; 63-90 µm).
POMIX4012 95% orthopyroxene (PYX042; 63-90 µm) + 5% olivine (OLV003; 63-90 µm).
POMIX4013 85% orthopyroxene (PYX042; 63-90 µm) + 15% olivine (OLV003; 63-90 µm).
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15.2.6a. Series 2e: Orthopyroxene (PYX042) + olivine (OLV010); 45-63 µm (original M.Sc. 1986 samples).

POMIX5001 0% orthopyroxene (PYX042; 45-63 µm) + 100% olivine (OLV010; 45-63 µm).
POMIX5002 10% orthopyroxene (PYX042; 45-63 µm) + 90% olivine (OLV010; 45-63 µm).
POMIX5006 50% orthopyroxene (PYX042; 45-63 µm) + 50% olivine (OLV010; 45-63 µm).
POMIX5010 90% orthopyroxene (PYX042; 45-63 µm) + 10% olivine (OLV010; 45-63 µm).
POMIX5011 100% orthopyroxene (PYX042; 45-63 µm) + 0% olivine (OLV010; 45-63 µm).
POMIX5014 25% orthopyroxene (PYX042; 45-63 µm) + 75% olivine (OLV010; 45-63 µm).
POMIX5015 75% orthopyroxene (PYX042; 45-63 µm) + 25% olivine (OLV010; 45-63 µm).

M.Sc. series: used PYX02 = my PYX042; OLV is Green Sand Beach = my OLV010.
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15.3a. Olivine + clinopyroxene mixtures

OLV003 100% OLV003; 45-90 µm.
PYX026 100% PYX026 (type A CPX); 45-90 µm.
MIX211 50% OLV003 (olivine, 45-90µm) + 50% PYX026 (clinopyroxene, 45-90µm).
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OLV022 100% OLV022; 45-90 µm.
PYX036 100% PYX036 (type B CPX); 45-90 µm.
MIX213 50% OLV022 (olivine, 45-90µm) + 50% PYX036 (clinopyroxene, 45-90µm).
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15.3.1a. Series 1: OLV020 + PYX040 (type B CPX)

OLV020 100% OLV020; 45-90 µm.
PYX040 100% PYX040; 45-90 µm.
MIX220 75% OLV020 (olivine, 45-90µm) + 25% PYX040 (clinopyroxene, 45-90µm).
MIX221 50% OLV020 (olivine, 45-90µm) + 50% PYX040 (clinopyroxene, 45-90µm).
MIX222 25% OLV020 (olivine, 45-90µm) + 75% PYX040 (clinopyroxene, 45-90µm).
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15.3.2a. Series 2: OLV003 + PYX150 (type A CPX) – August 2009

OCMIX1001 100% OLV003 (olivine, <45 µm) + 0% PYX150 (clinopyroxene, <45µm)
OCMIX1002 90% OLV003 (olivine, <45 µm) + 10% PYX150 (clinopyroxene, <45µm)
OCMIX1003 80% OLV003 (olivine, <45 µm) + 20% PYX150 (clinopyroxene, <45µm)
OCMIX1004 70% OLV003 (olivine, <45 µm) + 30% PYX150 (clinopyroxene, <45µm)
OCMIX1005 60% OLV003 (olivine, <45 µm) + 40% PYX150 (clinopyroxene, <45µm)
OCMIX1006 50% OLV003 (olivine, <45 µm) + 50% PYX150 (clinopyroxene, <45µm)
OCMIX1007 40% OLV003 (olivine, <45 µm) + 60% PYX150 (clinopyroxene, <45µm)
OCMIX1008 30% OLV003 (olivine, <45 µm) + 70% PYX150 (clinopyroxene, <45µm)
OCMIX1009 20% OLV003 (olivine, <45 µm) + 80% PYX150 (clinopyroxene, <45µm)

OCMIX1010 10% OLV003 (olivine, <45 µm) + 90% PYX150 (clinopyroxene, <45µm)
OCMIX1011 0% OLV003 (olivine, <45 µm) + 100% PYX150 (clinopyroxene, <45µm)
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15.3.3a. OLV003 (<45 µm) + PYX016 (type B CPX, <45 µm) – April 2010

OLV003 100% OLV003, <45 µm.
PYX016 100% PYX016, <45 µm.
MIX031 80 wt% OLV003 (<45 µm) + 20 wt% PYX016 (<45 µm).
MIX032 60 wt% OLV003 (<45 µm) + 40 wt% PYX016 (<45 µm).
MIX033 40 wt% OLV003 (<45 µm) + 60 wt% PYX016 (<45 µm).
MIX034 20 wt% OLV003 (<45 µm) + 80 wt% PYX016 (<45 µm).
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15.4a. Olivine + metal

15.4.1a. Series 1: OLV003 + MET101

OLV003 100% OLV003; 45-90 µm.
MET101 100% MET101; 45-90 µm (beaten).
MIX260 75% OLV003 (olivine, 45-90µm), 25% MET101 (meteoritic metal, 45-90µm (beaten)), (#B6b).
MIX261 50% OLV003 (olivine, 45-90µm) + 50% MET101 (meteoritic metal, 45-90µm (beaten)), (#B6c).
MIX262 25% OLV003 (olivine, 45-90µm) + 75% MET101 (meteoritic metal, 45-90µm (beaten)), (#B6d).
MIX263 75% OLV003 (olivine,<45µm) + 25% MET101 (meteoritic metal, <45µm (beaten)), (#MIX105).
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15.4.2a. Series 2: OLV003 + MET101A

MOMIX2001 100% olivine (OLV003; <45 µm) + 0% meteoritic metal (MET101A; <45 µm) (aka OLV003).
MOMIX2002 90% olivine (OLV003; <45 µm) + 10% meteoritic metal (MET101A; <45 µm).
MOMIX2003 80% olivine (OLV003; <45 µm) + 20% meteoritic metal (MET101A; <45 µm).
MOMIX2004 70% olivine (OLV003; <45 µm) + 30% meteoritic metal (MET101A; <45 µm).
MOMIX2005 60% olivine (OLV003; <45 µm) + 40% meteoritic metal (MET101A; <45 µm).
MOMIX2006 50% olivine (OLV003; <45 µm) + 50% meteoritic metal (MET101A; <45 µm).
MOMIX2007 40% olivine (OLV003; <45 µm) + 60% meteoritic metal (MET101A; <45 µm).
MOMIX2008 30% olivine (OLV003; <45 µm) + 70% meteoritic metal (MET101A; <45 µm).
MOMIX2009 20% olivine (OLV003; <45 µm) + 80% meteoritic metal (MET101A; <45 µm).
MOMIX2010 10% olivine (OLV003; <45 µm) + 90% meteoritic metal (MET101A; <45 µm).
MOMIX2011 15% olivine (OLV003; <45 µm) + 85% meteoritic metal (MET101A; <45 µm).
MET101A 0% olivine (OLV003; <45 µm) + 100% meteoritic metal (MET101A; <45 µm).
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MOMIX2101 100% olivine (OLV003; 45-90 µm) + 0% meteoritic metal (MET101A; 45-90 µm) (aka OLV003)
MOMIX2102 50% olivine (OLV003; 45-90 µm) + 50% meteoritic metal (MET101A; 45-90 µm).
MET100 0% olivine (OLV003; 45-90 µm) + 100% meteoritic metal (MET101A; 45-90 µm).
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15.4.3a. Series 3: OLV011 + MET01 (both <45 µm); (high Fe olv + metal)

OLV011 100% olivine (OLV011; <45 µm).
MOMIX3000 50% olivine (OLV011; <45 µm) + 50% meteoritic metal (MET01; <45 µm).
MET101 100% meteoritic metal (MET101; <45 µm).
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15.4.4a. Series 4: OLV007 + MET01 (both <45 µm); (low Fe olv + metal)

OLV007 100% olivine (OLV007; <45 µm).
MOMIX4000 50% olivine (OLV007, <45 µm) + 50% meteoritic metal (MET01, <45 µm).
MET101 100% meteoritic metal (MET101; <45 µm).
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15.4.5a. Series 5: Pallasite (MET030) slab spectra (roughened with 120 grit sandpaper)

MET030-1	Spot 1, centred on olivine grain
MET030-2	Spot 2, centred on olivine grain
MET030-3	Spot 3, centred on olivine + abundant metal
MET030-4	Spot 4, centred on olivine + less metal (edge lit up – escaping light)
MET030-5	Spot 5, centred on mostly olivine, little metal

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15.4.6a. Series 6: Olivine (OLV003, <45 µm) sprinkled on Odessa iron meteorite slab (MET01, roughened with 120 grit sandpaper)

OLMETS01	Odessa iron meteorite slab (MET01), no olivine.
OLMETS02	MET01 with lightest olivine coating
OLMETS03	MET01 with heavier olivine coating
OLMETS04	MET01 with heaviest olivine coating (metal not visible)
OLMETS05	MET01 with uber-heaviest olivine coating (metal not visible)
OLMETS06	OLV003, <45 µm in sample cup

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15.5a. Olivine + orthopyroxene + metal

OLV003	100% OLV003; 45-90 µm.
PYX117	100% PYX117; 45-90 µm.
MET101	100% MET101; 45-90 µm.
MIX266	30% OLV003 (olivine, 45-90µm) + 40% PYX117 (orthopyroxene, 45-90µm) + 30% MET101 (meteoritic metal, 45-90µm) (#B11a).
MIX271	42.9% OLV003 (olivine, 45-90µm) + 57.1% PYX117 (orthopyroxene, 45-90µm) (metal free version of MIX266) (#B11b).

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15.6a. Olivine + opaques: carbon black, magnetite, etc.

OLV003	100% OLV003; 45-90 µm.
LCA101	100% LCA101; <0.021 µm.
MIX283	99.9% OLV003 (olivine, 45-90µm) + 0.1% LCA101 (amorphous carbon, <0.021µm) (#D8a).
MIX284	99.5% OLV003 (olivine, 45-90µm) + 0.5% LCA101 (amorphous carbon, <0.021µm) (#D8b).
MIX285	98% OLV003 (olivine, 45-90µm) + 2% LCA101 (amorphous carbon, <0.021µm) (#D8c).
	++++++
OLV003	100% OLV003; <45 µm.
LCA101	100% LCA101; <0.021 µm.
MIX286	99.5% OLV003 (olivine, <45µm) + 0.5% LCA101 (amorphous carbon, <0.021µm) (#W4).
	++++++
OLV003	100% OLV003; 45-90 µm.
MAG101	100% MAG101; <45 µm.
MIX290	90% OLV003 (olivine, 45-90µm) + 10% MAG101 (magnetite, <45µm) (#D9d).
	++++++
OLV003	100% OLV003; 45-90 µm.
MAG101	100% MAG101; 45-90 µm.
MIX291	90% OLV003 (olivine, 45-90µm) + 10% MAG101 (magnetite, 45-90) (#D9b).
MIX292	50% OLV003 (olivine, 45-90µm) + 50% MAG101 (magnetite, 45-90µm) (#D9c).
	++++++
OLV003	100% OLV003; 45-90 µm.
SIC101	100% SIC101; <37 µm.
MIX300	98% OLV003 (olivine, 45-90µm) + 2% SIC101 (silicon carbide, <37µm) (#MIX01).
	++++++
OLV003	100% OLV003; <45 µm.
SIC101	100% SIC101; <37 µm.
MIX301	98% OLV003 (olivine, <45µm) + 2% SIC101 (silicon carbide, <37µm) (#MIX100).
	++++++
OLV003	100% OLV003; <45 µm.

SIC102 100% SIC102; <7 µm.
MIX310 98% OLV003 (olivine, 45-90µm) + 2% SIC102 (silicon carbide, <7µm) (#MIX11).
MMIX01 Pratt mixture model: 97.2%/2.8% OLV003/SIC102 70µm/5µm (assumed)
MMIX11 Pratt mixture model: 97.2%/2.8% OLV003/SIC102 70µm/5µm (assumed)
++++++
OLV003 100% OLV003; 45-90 µm.
SIC102 100% SIC102; <7 µm.
MIX311 98% OLV003 (olivine, <45µm) + 2% SIC102 (silicon carbide, <7µm) (#MIX101).
++++++
OLV003 100% OLV003; 45-90 µm.
GRP101 100% GRP101; <45 µm.
MIX320 98% OLV003 (olivine, 45-90µm) + 2% GRP101 (graphite, <45µm) (#MIX07).
++++++
OLV003 100% OLV003; <45 µm.
GRP101 100% GRP101; <45 µm.
MIX321 98% OLV003 (olivine, <45µm) + 2% GRP101 (graphite, <45µm) (#MIX104).
++++++
OLV003 100% OLV003; 45-90 µm.
GRP102 100% GRP102; <45 µm.
MIX330 98% OLV003 (olivine, 45-90µm) + 2% GRP102 (synthetic amorphous graphite, <45µm) (#MIX02).
MIX333 95% OLV003 (olivine, 45-90 µm) + 5% GRP102 (synthetic amorphous graphite, <45µm).
++++++
OLV003 100% OLV003; <45 µm.
GRP102 100% GRP102; <45 µm.
MIX331 98% OLV003 (olivine, <45µm) + 2% GRP102 (synthetic amorphous graphite, <45µm) (#MIX102).
MIX332 95% OLV003 (olivine, <45µm) + 5% GRP102 (synthetic amorphous graphite, <45µm) (#MIX107).
++++++
OLV003 100% OLV003; 45-90 µm.
CTE101 100% CTE101; <37 µm.
MIX340 98% OLV003 (olivine, 45-90µm) + 2% CTE101 (coal tar extract, <37µm) (#MIX03).
++++++
OLV003 100% OLV003; <45 µm.
CTE101 100% CTE101; <37 µm.
MIX341 98% OLV003 (olivine, <45µm) + 2% CTE101 (coal tar extract, <37µm) (#MIX103).
MIX342 95% OLV003 (olivine, <45µm) + 5% CTE101 (coal tar extract, <37µm) (#MIX106).
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OLV003 100% OLV003; 45-90 µm.
Bitumen 100% bitumen; liquid.
MIX350 98% OLV003 (olivine, 45-90µm) + 2% BITUMEN (liquid) (#MIX10).
++++++
OLV003 100% OLV003; 45-90 µm.
CEM101 100% CEM101; <45 µm.
MIX360 98% OLV003 (olivine, 45-90µm) + 2% CEM101 (cementite, <45µm) (#MIX08).
MIX361 75% OLV003 (olivine, 45-90µm) + 25% CEM101 (cementite, <45µm) (#MIX04).
++++++
OLV003 100% OLV003; 45-90 µm.
DIA101 100% DIA101; <1 µm.
MIX370 98% OLV003 (olivine, 45-90µm) + 2% DIA101 (diamond, <1µm) (#MIX06).
++++++
OLV003 100% OLV003; 45-90 µm.
WUS101 100% WUS101; <45 µm.
MIX380 75% OLV003 (olivine, 45-90µm) + 25% WUS101 (wustite, <45µm) (#MIX05).
++++++

15.6.1a. Series: olivine (<45 µm) + carbon black.
OLV003 <45 µm, dry sieved.

OMIX061 99.9 wt% OLV003 (olivine, <45 µm) + 0.1 wt% LCA101 (carbon black, <0.021 µm).
OMIX062 99.5 wt% OLV003 (olivine, <45 µm) + 0.5 wt% LCA101 (carbon black, <0.021 µm).
OMIX063 98 wt% OLV003 (olivine, <45 µm) + 2 wt% LCA101 (carbon black, <0.021 µm).
OMIX064 95 wt% OLV003 (olivine, <45 µm) + 5 wt% LCA101 (carbon black, <0.021 µm).
LCA101 <0.021 µm, dry sieved.
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15.7a. Olivine + chromite ± metal

OLV003 100% OLV003; 45-90 µm.
CHR103 100% CHR103; <45 µm.
MIX520 95% OLV003 (olivine, 45-90µm) + 5% CHR103 (chromite, <45µm).
MIX521 90% OLV003 (olivine, 45-90µm) + 10% CHR103 (chromite, <45µm).
MIX522 80% OLV003 (olivine, 45-90µm) + 20% CHR103 (chromite, <45µm).
MIX523 70% OLV003 (olivine, 45-90µm) + 30% CHR103 (chromite, <45µm).
++++++
OLV003 100% OLV003; <45 µm.
CHR101 100% CHR101; <45 µm.
MIX524 95% OLV003 (olivine, <45µm) + 5% CHR103 (chromite, <45µm).
MIX525 90% OLV003 (olivine, <45µm) + 10% CHR103 (chromite, <45µm).
MIX526 80% OLV003 (olivine, <45µm) + 20% CHR103 (chromite, <45µm).
MIX527 70% OLV003 (olivine, <45µm) + 30% CHR103 (chromite, <45µm).
++++++
OLV003 100% OLV003; <45 µm.
CHR103 100% CHR103; <45 µm.
MET101 100% MET101; <45 µm (beaten).
MIX528 67.5% OLV003 (olivine, <45µm) + 22.5% MET101 (meteoritic metal, <45µm, beaten) + 10% CHR103 (chromite, <45µm).
++++++
OLV003 100% OLV003; 45-90 µm.
CHR103 100% CHR101; <45 µm.
MET101 100% MET101; <45 µm (beaten).
MIX529 67.5% OLV003 (olivine, 45-90µm) + 22.5% MET101 (meteoritic metal, 45-90µm, beaten) + 10% CHR103 (chromite, <45µm).
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15.8a. Orthopyroxene + metal and/or opaques

PYX032 100% PYX032; 45-90 µm.
MET101 100% MET101; 45-90 µm.
MIX265 50% PYX032 (orthopyroxene, 45-90µm) + 50% MET101 (meteoritic metal, 45-90µm).
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15.8.1a. Series 1: PYX117 + MET101

PYX117 100% PYX117; 45-90 µm.
MET101 100% MET101; 45-90 µm.
MIX267 75% PYX117 (orthopyroxene, 45-90µm) + 25% MET101 (meteoritic metal, 45-90µm).
MIX268 50% PYX117 (orthopyroxene, 45-90µm) + 50% MET101 (meteoritic metal, 45-90µm).
MIX269 25% PYX117 (orthopyroxene, 45-90µm) + 75% MET101 (meteoritic metal, 45-90µm).
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PYX117 100% PYX117; 45-90 µm.
MET101 100% MET101; 45-90 µm.
LCA101 100% LCA101; <0.021 µm.
MIX272 49.5% PYX117 (orthopyroxene, 45-90µm) + 49.5% MET101 (meteoritic metal, 45-90µm) + 1% LCA101 (amorphous carbon, <0.021µm) (#D15).
++++++

15.8.2a. Series 2: PYX032 + LCA101

PYX032 100% PYX032; 45-90 µm.
LCA101 100% LCA101; <0.021 µm.
MIX280 99.9% PYX032 (orthopyroxene, 45-90µm) + 0.1% LCA101 (amorphous carbon, <0.021µm) (#W1).
MIX281 99.5% PYX032 (orthopyroxene, 45-90µm) + 0.5% LCA101 (amorphous carbon, <0.021µm) (#W2).
MIX282 98% PYX032 (orthopyroxene, 45-90µm) + 2% LCA101 amorphous carbon, <0.021µm) (#W3).
++++++

15.8.3a. Series 3a: PYX042 + MET101A (<45 µm)

MPMIX1001 100% orthopyroxene (PYX042; <45 µm) + 0% meteoritic metal (MET101A; <45 µm) (aka PYX042).
MPMIX1002 90% orthopyroxene (PYX042; <45 µm) + 10% meteoritic metal (MET101A; <45 µm).
MPMIX1003 80% orthopyroxene (PYX042; <45 µm) + 20% meteoritic metal (MET101A; <45 µm).
MPMIX1004 70% orthopyroxene (PYX042; <45 µm) + 30% meteoritic metal (MET101A; <45 µm).
MPMIX1005 60% orthopyroxene (PYX042; <45 µm) + 40% meteoritic metal (MET101A; <45 µm).
MPMIX1006 50% orthopyroxene (PYX042; <45 µm) + 50% meteoritic metal (MET101A; <45 µm).
MPMIX1007 40% orthopyroxene (PYX042; <45 µm) + 60% meteoritic metal (MET101A; <45 µm).
MPMIX1008 30% orthopyroxene (PYX042; <45 µm) + 70% meteoritic metal (MET101A; <45 µm).
MPMIX1009 20% orthopyroxene (PYX042; <45 µm) + 80% meteoritic metal (MET101A; <45 µm).
MPMIX1010 10% orthopyroxene (PYX042; <45 µm) + 90% meteoritic metal (MET101A; <45 µm).
MPMIX1012 5% orthopyroxene (PYX042; <45 µm) + 95% meteoritic metal (MET101A; <45 µm).
MPMIX1011 0% orthopyroxene (PYX042; <45 µm) + 100% meteoritic metal (MET101A; <45 µm).
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15.8.4a. Series 3b: PYX042 + MET101A (45-90 µm)

MPMIX1101 100% orthopyroxene (PYX042; 45-90 µm) + 0% meteoritic metal (MET101A; 45-90 µm) (aka PYX042).
MPMIX1102 50% orthopyroxene (PYX042; 45-90 µm) + 50% meteoritic metal (MET101A; 45-90 µm).
MPMIX1103 0% orthopyroxene (PYX042; 45-90 µm) + 100% meteoritic metal (MET101A; 45-90 µm) (aka MET100).
++++++

15.8.5a. Series 4: PYX032 + MET01 (both <45 µm); (high-Fe opx + metal)

PYX032 100% PYX032; <45 µm.
MET101 100% MET101; <45 µm.
MPMIX3000 50% orthopyroxene (PYX032; <45 µm) + 50% meteoritic metal (MET01; <45 µm).
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15.8.6a. Series 5: PYX070 + MET01 (both <45 µm); (low Fe opx + metal)

PYX070 100% PYX070; <45 µm.
MET101 100% MET101; <45 µm.
MPMIX4000 50% orthopyroxene (PYX070, <45 µm) + 50% meteoritic metal (MET01, <45 µm).
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15.8.7a. Series 6: MET020 + MET01 (both < 45 µm); (aubrite + metal)

MET020 100% MET020; <45 µm.
MET101 100% MET101; <45 µm.
MPMIX5000 50% aubrite (MET020, <45 µm) + 50% meteoritic metal (MET01, <45 µm).
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15.8.8a. PYX032 + LCA101

PYX032 100% PYX032; <45 µm, dry sieved
OMIX11 99.9 wt% PYX032 (opx, <45 µm) + 0.1 wt% LCA101 (carbon black, <0.021 µm).
OMIX12 99.5 wt% PYX032 (opx, <45 µm) + 0.5 wt% LCA101 (carbon black, <0.021 µm).
OMIX13 98 wt% PYX032 (opx, <45 µm) + 2 wt% LCA101 (carbon black, <0.021 µm).
OMIX14 95 wt% PYX032 (opx, <45 µm) + 5 wt% LCA101 (carbon black, <0.021 µm).
LCA101 100% LCA101; <0.021 µm, dry sieved.
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15.8.9a. Orthopyroxene (PYX032; <45 µm) sprinkled on Odessa iron meteorite slab (MET01; roughened with 120 grit sandpaper)

XMETS01 100% PYX042; <45 µm, in sample cup.
PXMETS02 MET01 slab, no pyroxene coating.
PXMETS03 MET01 with light pyroxene coating
PXMETS04 MET01 with heavier pyroxene coating
PXMETS05 MET01 with uber-heavy pyroxene coating
PXMETS06 MET01 with lightest pyroxene coating
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15.9a. Orthopyroxene + palagonite, hematite, or plagioclase feldspar

PYX110 100% PYX110; 45-90 µm.
PAL101 100% PAL101; <45 µm.
MIX501 90% PYX110 (pyroxene, 45-90µm) + 10% PAL101 (palagonite, <45µm)
MIX502 80% PYX110 (pyroxene, 45-90µm) + 20% PAL101 (palagonite, <45µm)
MIX503 70% PYX110 (pyroxene, 45-90µm) + 30% PAL101 (palagonite, <45µm)
MIX504 60% PYX110 (pyroxene, 45-90µm) + 40% PAL101 (palagonite, <45µm)
MIX505 50% PYX110 (pyroxene, 45-90µm) + 50% PAL101 (palagonite, <45µm)
MIX506 40% PYX110 (pyroxene, 45-90µm) + 60% PAL101 (palagonite, <45µm)
MIX507 30% PYX110 (pyroxene, 45-90µm) + 70% PAL101 (palagonite, <45µm)
MIX508 20% PYX110 (pyroxene, 45-90µm) + 80% PAL101 (palagonite, <45µm)
MIX509 10% PYX110 (pyroxene, 45-90µm) + 90% PAL101 (palagonite, <45µm)
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PYX110 100% PYX110; <45 µm.
PAL101 100% PAL101; <45 µm.
MIX510 80% PYX110 (pyroxene, <45µm) + 20% PAL101 (palagonite, <45µm)
MIX511 60% PYX110 (pyroxene, <45µm) + 40% PAL101 (palagonite, <45µm)
MIX512 40% PYX110 (pyroxene, <45µm) + 60% PAL101 (palagonite, <45µm)
++++++
PYX110 100% PYX110; 45-90 µm.
PAL102 100% PAL102; <45 µm.
MIX515 80% PYX110 (pyroxene, 45-90µm) + 20% PAL102 (palagonite, <45µm).
MIX516 60% PYX110 (pyroxene, 45-90µm) + 40% PAL102 (palagonite, <45µm)
++++++
PYX110 100% PYX110; 45-90 µm.
PAL102 100% PAL102; <45 µm.
HEM101 100% HEM101; <140 nm.
MIX517 80% PYX110 (pyroxene, 45-90µm) + 20% HEM101 (hematite, <140nm)
MIX518 60% PYX110 (pyroxene, 45-90µm) + 40% HEM101 (hematite, <140nm)
++++++

15.9.1a. Orthopyroxene + plagioclase feldspar

PYX032 100% PYX032; <45 µm.
PLG115 100% PLG115; <45 µm.
MIXOP1 30% orthopyroxene (PYX032, <45 µm) + 70% plagioclase feldspar (PLG115, <45 µm).
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15.10a. Metal + accessory phases: carbon black, troilite

MET101 100% MET101; 45-90 µm.
LCA101 100% LCA101; <0.021 nm.
MIX270 99.5% MET101 (meteoritic metal, 45-90µm) + 0.5% LCA101 (amorphous carbon, <0.021µm) (#D7a).
++++++
MET101 100% MET101; <45 µm.

TRO201 100% TRO201; <45 µm.
MIX275 10% TRO201 (meteoritic troilite, <45µm) + 90% MET101 (meteoritic metal, <45µm) (#MIX09).
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15.11a. Aubrite + troilite

MET201 100% MET201; 45-90 µm.
TRO202g 100% TRO202g; <45 µm.
MIX400 90% MET201 (aubrite, 45-90µm) + 10% TRO202g (synthetic crushed troilite, <45µm,).
++++++
MET201 100% MET201; <45 µm.
TRO202g 100% TRO202g; <45 µm.
MIX401 90% MET201 (aubrite, <45µm) + 10% TRO202g (synthetic crushed troilite, <45µm).
++++++
MET200 100% MET200; <45 µm.
TRO202g 100% TRO202; <45 µm.
MIX402 90%MET200 (aubrite, <45µm) + 10% TRO202 (synthetic uncrushed troilite, <45µm).
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15.12a. Diaspore + other phases

PAL102 100% PAL102; <45 µm.
OOH012 100% OOH012; <45 µm.
MIX530 80% PAL102 (palagonite, <45µm) + 20% OOH012 (diaspore, <45µm).
MIX531 60% PAL102 (palagonite, <45µm) + 40% OOH012 (diaspore, <45µm).
MIX532 40% PAL102 (palagonite, <45µm) + 60% OOH012 (diaspore, <45µm).
MIX533 80% PAL102 (palagonite, <45µm) + 20% OOH012 (diaspore, 45-90µm).
MIX534 60% PAL102 (palagonite, <45µm) + 40% OOH012 (diaspore, 45-90µm).
MIX535 40% PAL102 (palagonite, <45µm) + 60% OOH012 (diaspore, 45-90µm).
MIX536 95% PAL103 (palagonite, <45µm) + 5% OOH012 (diaspore, <45µm).
++++++
PAL102x 100% PAL102x; <45 µm.
OOH012 100% OOH012; <45 µm.
MIX537 95% PAL102x (palagonite, <45µm) + 5% OOH012 (diaspore, <45µm). With newly made PAL102 (spectrally different than original PAL102).
MIX540 90% PAL102x (palagonite, <45 µm) + 10% OOH012 (diaspore, <45µm). With new PAL102 separate.
MIX541 95% PAL102x (palagonite, <45 µm) + 5% OOH012 (diaspore, <45µm). With new PAL102 separate.
++++++
PAL102x 100% PAL102x; <45 µm.
OOH012 100% OOH012; 45-90 µm.
MIX542 95% PAL102x (palagonite, <45 µm) + 5% OOH012 (diaspore, 45-90µm). With new PAL102 separate.
++++++
PYX110 100% PYX110; <45 µm.
OOH013 100% OOH013; <45 µm.
MIX630 95% PYX110 (orthopyroxene, <45µm) + 5% OOH013 (diaspore, <45µm).
MIX631 75% PYX110 (orthopyroxene, <45µm) + 25% OOH013 (diaspore, <45µm).
++++++
QUA101 100% QUA101; <45 µm.
OOH013 100% OOH013; <45 µm.
MIX632 95% QUA101 (quartz, <45µm) + 5% OOH013 (diaspore, <45µm).
MIX633 75% QUA101 (quartz, <45µm) + 25% OOH013 (diaspore, <45µm).
++

15.13a. Carbonates/nitrites + basalt or palagonite (for analysis of Mars Express PFS spectra)

SA-14 100% SA-14; <45 µm.

CRB105 100% CRB105; <45 µm.
MIXI01 95% SA-14 (basalt, <45 µm) + 5% CRB105 (carbonate: huntite, <45 µm).
MIXI02 90% SA-14 (basalt, <45 µm) + 10% CRB105 (carbonate: huntite, <45 µm).
MIXI03 80% SA-14 (basalt, <45 µm) + 20% CRB105 (carbonate: huntite, <45 µm).
++++++
SA-14 100% SA-14; <45 µm.
CRB114 100% CRB114; <45 µm.
MIXI11 95% SA-14 (basalt, <45 µm) + 5% CRB114 (carbonate: magnesite, <45 µm).
MIXI12 90% SA-14 (basalt, <45 µm) + 10% CRB114 (carbonate: magnesite, <45 µm).
MIXI13 80% SA-14 (basalt, <45 µm) + 20% CRB114 (carbonate: magnesite, <45 µm).
++++++
SA-14 100% SA-14; <45 µm.
CRB215 100% CRB215; <45 µm.
MIXI21 95% SA-14 (basalt, <45 µm) + 5% CRB215 (carbonate: hydromagnesite, <45 µm).
MIXI22 90% SA-14 (basalt, <45 µm) + 10% CRB215 (carbonate: hydromagnesite, <45 µm).
MIXI23 80% SA-14 (basalt, <45 µm) + 20% CRB215 (carbonate: hydromagnesite, <45 µm).
++++++
PAL103 100% PAL103; <45 µm.
CRB105 100% CRB105; <45 µm.
MIXI31 95% PAL103 (palagonite, <45 µm) + 5% CRB105 (carbonate: huntite, <45 µm).
MIXI32 90% PAL103 (palagonite, <45 µm) + 10% CRB105 (carbonate: huntite, <45 µm).
MIXI33 80% PAL103 (palagonite, <45 µm) + 20% CRB105 (carbonate: huntite, <45 µm).
++++++
PAL103 100% PAL103; <45 µm.
CRB114 100% CRB114; <45 µm.
MIXI41 95% PAL103 (palagonite, <45 µm) + 5% CRB114 (carbonate: magnesite, <45 µm).
MIXI42 90% PAL103 (palagonite, <45 µm) + 10% CRB114 (carbonate: magnesite, <45 µm).
MIXI43 80% PAL103 (palagonite, <45 µm) + 20% CRB114 (carbonate: magnesite, <45 µm).
++++++
PAL103 100% PAL103; <45 µm.
CRB215 100% CRB215; <45 µm.
MIXI51 95% PAL103 (palagonite, <45 µm) + 5% CRB215 (carbonate: hydromagnesite, <45 µm).
MIXI52 90% PAL103 (palagonite, <45 µm) + 10% CRB215 (carbonate: hydromagnesite, <45 µm).
MIXI53 80% PAL103 (palagonite, <45 µm) + 20% CRB215 (carbonate: hydromagnesite, <45 µm).
++++++
PAL103 100% PAL103; <45 µm.
CRB126 100% CRB126; <45 µm.
MIXI61 90% PAL103 (palagonite, <45 µm) + 10% CRB126 (carbonate: shortite, <45 µm).
MIXI62 90% SA-14 (basalt, <45 µm) + 10% CRB126 (carbonate: shortite, <45 µm).
++++++
SA-14 100% SA-14; <45 µm.
NTR001 100% NTR001; <45 µm.
MIXI63 90% SA-14 (basalt, <45 µm) + 10% NTR001 (sodium nitrite, <45 µm).
++++++
SA-14 100% SA-14; 45-90 µm.
CRB114 100% CRB114; 45-90 µm.
MIXI75 95% SA-51 (basalt, 45-90 µm) + 5% CRB114 (magnesite, 45-90 µm).
MIXI76 90% SA-51 (basalt, 45-90 µm) + 10% CRB114 (magnesite, 45-90 µm).
MIXI77 80% SA-51 (basalt, 45-90 µm) + 20% CRB114 (magnesite, 45-90 µm).
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15.13.1a. New series for Francois Poulet: Magnesite (CRB114) + palagonite (PAL103)

15.13.1.1a. Intimate mixtures of <45 µm size powders
PAL103 0% CRB114 + 100% PAL103
MIXI81 10% CRB114 + 90% PAL103

MIXI82	20% CRB114 + 80% PAL103
MIXI83	40% CRB114 + 60% PAL103
MIXI84	60% CRB114 + 40% PAL103
MIXI85	80% CRB114 + 20% PAL103
MIX43	20% CRB114 + 80% PAL103 (older mixture)
CRB114	100% CRB114 + 0% PAL103

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15.13.2a. Palagonite dust (PAL103, <45 µm) on magnesite (CRB114, <45 µm)

Note: progressively thicker dust coatings on the same sample

CRB114	No dust – pure magnesite (<45 µm)
PAL103	Pure palagonite (<45 µm)
Dust drop 1	102 µm thick palagonite dust coating
Dust drop 2	152 µm thick palagonite dust coating
Dust drop 3	190 µm thick palagonite dust coating
Dust drop 4	260 µm thick palagonite dust coating
Dust drop 5	283 µm thick palagonite dust coating
Dust drop 6	381 µm thick palagonite dust coating
Dust drop 7	403 µm thick palagonite dust coating
Dust drop 8	465 µm thick palagonite dust coating
Dust drop 9	499 µm thick palagonite dust coating
Dust drop 10	525 µm thick palagonite dust coating

++

15.14a. Two clay mixtures (August 2007, for Encana project)

KAO104	100% KAO104; <45 µm.
ILS104	100% ILS104; <45 µm.
EMIX1	25% kaolinite (KAO104), 75% illite-smectite (ILS104) ; all <45 µm
EMIX2	50% kaolinite (KAO104), 50% illite-smectite (ILS104) ; all <45 µm
EMIX3	75% kaolinite (KAO104), 75% illite-smectite (ILS104) ; all <45 µm

++++++

KAO104	100% KAO104; <45 µm.
MON103	100% MON103; <45 µm.
EMIX4	25% kaolinite (KAO104), 75% montmorillonite (MON103) ; all <45 µm
EMIX5	50% kaolinite (KAO104), 50% montmorillonite (MON103) ; all <45 µm
EMIX6	75% kaolinite (KAO104), 25% montmorillonite (MON103) ; all <45 µm

++++++

KAO104	100% KAO104; <45 µm.
ILS104	100% ILS104; <45 µm.
MON103	100% MON103; <45 µm.
EMIX7	33% kaolinite (KAO104), 33% illite (ILS104) , 33% montmorillonite (MON103); all <45 µm

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15.15a. Gypsum + basalt + palagonite (Aug. 2007 for Mars polar dunes)

SPT207	100% SPT207; 90-250 µm.
SA-60	100% SA-60; 90-250 µm.
BMIX001	5% gypsum (SPT207; 90-250 µm) + 95% basalt (SA-60; 90-250 µm)
BMIX002	10% gypsum (SPT207; 90-250 µm) + 90% basalt (SA-60; 90-250 µm)
BMIX003	15% gypsum (SPT207; 90-250 µm) + 85% basalt (SA-60; 90-250 µm)
BMIX004	20% gypsum (SPT207; 90-250 µm) + 80% basalt (SA-60; 90-250 µm)
BMIX005	25% gypsum (SPT207; 90-250 µm) + 75% basalt (SA-60; 90-250 µm) – same as
BMIX006	50% gypsum (SPT207; 90-250 µm) + 50% basalt (SA-60; 90-250 µm) – same as MIXB04

BMIX007 75% gypsum (SPT207; 90-250 µm) + 25% basalt (SA-60; 90-250 µm) – same as MIXB08

MIXB01 25% gypsum (SPT207; 90-250 µm) + 75% basalt (SA-60; 90-250 µm) – same as BMIX005
MIXB02 50% gypsum (SPT207; 90-250 µm) + 50% basalt (SA-60; 90-250 µm)
MIXB03 75% gypsum (SPT207; 90-250 µm) + 25% basalt (SA-60; 90-250 µm)
++++++
SPT207 100% SPT207; 90-250 µm.
SA-60 100% SA-60; <45 µm.
MIXB04 50% gypsum (SPT207; 90-250 µm) + 50% basalt (SA-60; <45 µm) – same as BMIX006
++++++
SPT207 100% SPT207; <45 µm.
SA-60 100% SA-60; 90-250 µm.
MIXB05 50% gypsum (SPT207; <45 µm) + 50% basalt (SA-60; 90-250 µm)
++++++
SPT207 100% SPT207; 90-250 µm.
PAL103 100% PAL103; <45 µm.
MIXB06 25% gypsum (SPT207; 90-250 µm) + 75% palagonite (PAL103 ; <45 µm)
MIXB07 50% gypsum (SPT207; 90-250 µm) + 50% palagonite (PAL103 ; <45 µm)
MIXB08 75% gypsum (SPT207; 90-250 µm) + 25% palagonite (PAL103 ; <45 µm) – same as BMIX007
++++++
SPT207 100% SPT207; 90-250 µm.
SA-60 100% SA-60; 90-250 µm.
PAL103 100% PAL103; <45 µm.
SPT107 100% SPT107; <45 µm.
MIXB 14.2% gypsum (SPT207; 90-250 µm) + 80.8% basalt (SA-60; 90-250 µm) + 5% palagonite (PAL103; <45 µm)
MIXBu 18.05% gypsum (SPT207; 90-250 µm) + 72.2% basalt (SA-60; 90-250 µm) + 4.75% palagonite (PAL103; <45 µm) + 5% jarosite (SPT107; <45 µm)
MIXBx 19% gypsum (SPT207; 90-250 µm) + 76% basalt (SA-60; 90-250 µm) + 5% palagonite (PAL103; <45 µm)
MIXBz 23.5% gypsum (SPT207; 90-250 µm) + 71.5% basalt (SA-60; 90-250 µm) + 5% palagonite (PAL103; <45 µm)
++++++
MIXB012 Smooth cut basalt surface, no palagonite coating (aka SA-60sb)
MIXB013 Rough basalt surface, no palagonite coating (aka SA-60sb)
MIXB014 Red (weathered) basalt surface, no basalt coating (aka SA-60sb)
MIXB015 Smooth cut basalt surface + thin coating of palagonite (PAL103 ; <45 µm)
MIXB016 Smooth cut basalt surface + thick coating of palagonite (PAL103 ; <45 µm)
MIXB017 Smooth cut basalt surface + thinner coating of palagonite (PAL103 ; <45 µm)
MIXB018 Smooth cut basalt surface + thinnest coating of palagonite (PAL103 ; <45 µm)
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15.16a. Barium sulfate + pyroxene (for Loredana Pompillio)

lormix001 0% barium sulfate ($BaSO_4$; 10-15 µm) + 100% orthopyroxene (PYX023; 45-90 µm).
lormix002 30% barium sulfate ($BaSO_4$; 10-15 µm) + 70% orthopyroxene (PYX023; 45-90 µm).
lormix003 50% barium sulfate ($BaSO_4$; 10-15 µm) + 50% orthopyroxene (PYX023; 45-90 µm).
lormix004 70% barium sulfate ($BaSO_4$; 10-15 µm) + 30% orthopyroxene (PYX023; 45-90 µm).
lormix005 90% barium sulfate ($BaSO_4$; 10-15 µm) + 10% orthopyroxene (PYX023; 45-90 µm).
$BaSO_4$ 100% $BaSO_4$; 10-15 µm.
++++++
lormix006 0% barium sulfate ($BaSO_4$; 10-15 µm) + 100% clinopyroxene (PYX005; 45-90 µm).
lormix007 30% barium sulfate ($BaSO_4$; 10-15 µm) + 70% clinopyroxene (PYX005; 45-90 µm).
lormix008 50% barium sulfate ($BaSO_4$; 10-15 µm) + 50% clinopyroxene (PYX005; 45-90 µm).
lormix009 70% barium sulfate ($BaSO_4$; 10-15 µm) + 30% clinopyroxene (PYX005; 45-90 µm).
lormix010 90% barium sulfate ($BaSO_4$; 10-15 µm) + 10% clinopyroxene (PYX005; 45-90 µm).

$BaSO_4$	100% $BaSO_4$; 10-15 µm.
	++++++
lormix011	0% barium sulfate ($BaSO_4$; 10-15 µm) + 100% orthopyroxene (PYX032; 45-90 µm).
lormix012	30% barium sulfate ($BaSO_4$; 10-15 µm) + 70% orthopyroxene (PYX032; 45-90 µm).
lormix013	50% barium sulfate ($BaSO_4$; 10-15 µm) + 50% orthopyroxene (PYX032; 45-90 µm).
lormix014	70% barium sulfate ($BaSO_4$; 10-15 µm) + 30% orthopyroxene (PYX032; 45-90 µm).
lormix015	90% barium sulfate ($BaSO_4$; 10-15 µm) + 10% orthopyroxene (PYX032; 45-90 µm).
$BaSO_4$	100% barium sulfate ($BaSO_4$; 10-15 µm) + 0% orthopyroxene (PYX032; 45-90 µm).

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15.17a. Pancam mixture tests

SIL203	100% SIL203; <1 mm.
SPT162	100% SPT162; <1 mm.
rmix001	90% SIL203 (silica sinter, <1 mm) + 10% SPT162 (epsomite, <1 mm).
	++++++
SA-60	100% SA-60; slab.
SPT162	100% SPT162; <63 µm.
rmix002	basalt slab (SA-60) with thin coating of SPT162 (epsomite, <63 µm).
rmix003	basalt slab (SA-60) with refreshed coating of SPT162 (epsomite, <63 µm).
	++++++
PAL101	100% PAL101; <45 µm.
SPT162	100% SPT162; <45 µm.
rmix004	PAL101 (palagonitic soil, <45 µm) with dusting of SPT162 (epsomite, <45 µm).

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15.18a. Gaffey mineral mixtures

Received Feb/09 along with meteorite samples) From box labelled "Gaffey Lab Mixtures; Kaolin, Fe, Olivine, etc…."

15.18.1a. Kaolinite + Fe (presumably made with MG-10 (Fe (3 µ))

MG-1	"Kao + Fe; 13% Fe"
MG-2	"Kao + Fe; 40% Fe"
MG-3	"Kao + Fe; 7% Fe"
MG-4	"Kaolin"

++++++

15.18.2a. Sil. acid + Fe (presumably silicic acid (MG-7) and made with MG-10 (Fe (3 µ))

MG-5	"Sil. acid + Fe; 8.1% Fe"
MG-6	"Sil. acid + Fe; 36% Fe"
MG-7	"Sil. acid; (100 mesh)"
MG-8	"Sil. acid + Fe; 3.6% Fe"

++++++

15.18.3a. Sil. acid + Kao (presumably silicic acid (MG-7) and Kaolinite (MG-4))

MG-9	"Sil. acid + Kao; 45% Kao"

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15.18.4a. Presumed Fe end member for mixtures

MG-10	"Fe (3µ)"

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15.18.5a. Olivine + Fe (presumably from sample and vial labelled ""Green Olivine, V.F.B." and MG-10 Fe)

MG-11	"Olivine (<45 µm) + Fe; 9.6% Fe"
MG-12	"Olivine (125-250 µm) + Fe; (6.4% Fe)"

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15.18.6a. Miscellaneous vials

MJG-a	Unlabeled vial: probably Green Sand Beach sand, unsorted grains.
MJG-b	Unlabeled vial: looks like MJG-a picked over for olivine.
MJG-c	"Green olivine V.F.B.", probably olivine powder made from MJG-a vial.
MJG-d	"Steamed green olivine VFB", probably olivine from MJG-a vial.

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15.19a. Basalt + ilmenite (Sept.-Oct. 2009) for lunar stimulant project

LAN001	100% basalt (BAS204, <45 μm) + 0% ilmenite (ILM200, <45 μm); aka BAS204 (<45 μm).
LAN002	99% basalt (BAS204, <45 μm) + 1% ilmenite (ILM200, <45 μm).
LAN003	98% basalt (BAS204, <45 μm) + 2% ilmenite (ILM200, <45 μm).
LAN004	96% basalt (BAS204, <45 μm) + 4% ilmenite (ILM200, <45 μm).
LAN005	93% basalt (BAS204, <45 μm) + 7% ilmenite (ILM200, <45 μm).
LAN006	90% basalt (BAS204, <45 μm) + 10% ilmenite (ILM200, <45 μm).
LAN007	80% basalt (BAS204, <45 μm) + 20% ilmenite (ILM200, <45 μm).
LAN008	0% basalt (BAS204, <45 μm) + 100% ilmenite (ILM200, <45 μm); aka ILM200, <45 μm).
	++++++
LAN101	100% basalt (BAS204; 90-250 μm) + 0% ilmenite (ILM200, <45 μm); aka BAS204 (90-250 μm).
LAN102	99% basalt (BAS204; 90-250 μm) + 1% ilmenite (ILM200, <45 μm).
LAN103	98% basalt (BAS204; 90-250 μm) + 2% ilmenite (ILM200, <45 μm).
LAN104	96% basalt (BAS204; 90-250 μm) + 4% ilmenite (ILM200, <45 μm).
LAN105	93% basalt (BAS204; 90-250 μm) + 7% ilmenite (ILM200, <45 μm).
LAN106	90% basalt (BAS204; 90-250 μm) + 10% ilmenite (ILM200, <45 μm).
LAN107	80% basalt (BAS204; 90-250 μm) + 20% ilmenite (ILM200, <45 μm).
LAN008	100% ILM200; <45 μm (aka ILM200).

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15.20a. Carbonaceous chondrite simulants (minerals + carbon black); see also 15.6.1 and 15.8.8

15.20.1a. Serpentinite (blue-sloped, contains magnetite) + carbon black

SRP117	100% SRP117; <45 μm, dry sieved.
OMIX001	99.9 wt% SRP117 (serpentinite, <45 μm) + 0.1 wt% LCA101 (carbon black, <0.021 μm).
OMIX002	99.5 wt% SRP117 (serpentinite, <45 μm) + 0.5 wt% LCA101 (carbon black, <0.021 μm).
OMIX003	98 wt% SRP117 (serpentinite, <45 μm) + 2 wt% LCA101 (carbon black, <0.021 μm).
OMIX004	95 wt% SRP117 (serpentinite, <45 μm) + 5 wt% LCA101 (carbon black, <0.021 μm).
LCA101	100% LCA101; <0.021 μm, dry sieved.

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15.20.2a. Chlorite (clinochlore) + carbon black

CLI101	100% CLI101; <45 μm, dry sieved.
OMIX021	99.9 wt% CLI101 (chlorite, <45 μm) + 0.1 wt% LCA101 (carbon black, <0.021 μm).
OMIX022	99.5 wt% CLI101 (chlorite, <45 μm) + 0.5 wt% LCA101 (carbon black, <0.021 μm).
OMIX023	98 wt% CLI101 (chlorite, <45 μm) + 2 wt% LCA101 (carbon black, <0.021 μm).
OMIX024	95 wt% CLI101 (chlorite, <45 μm) + 5 wt% LCA101 (carbon black, <0.021 μm).
LCA101	100% LCA101; <0.021 μm, dry sieved.

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15.20.3a. Saponite + carbon black

SAP101	100% SAP101; <45 μm, dry sieved.
OMIX031	99.9 wt% saponite (SAP101, <45 μm) + 0.1 wt% LCA101 (carbon black, <0.021 μm).
OMIX032	99.5 wt% saponite (SAP101, <45 μm) + 0.5 wt% LCA101 (carbon black, <0.021 μm).
OMIX033	98 wt% saponite (SAP101, <45 μm) + 2 wt% LCA101 (carbon black, <0.021 μm).
OMIX034	95 wt% saponite (SAP101, <45 μm) + 5 wt% LCA101 (carbon black, <0.021 μm).
LCA101	100% LCA101; <0.021 μm, dry sieved.

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15.20.4a. Synthetic brucite + carbon black

OOH032	100% OOH032; <45 µm, dry sieved.
OMIX041	99.9 wt% OOH032 (brucite, <45 µm) + 0.1 wt% LCA101 (carbon black, <0.021 µm).
OMIX041	99.5 wt% OOH032 (brucite, <45 µm) + 0.5 wt% LCA101 (carbon black, <0.021 µm).
OMIX041	98 wt% OOH032 (brucite, <45 µm) + 2 wt% LCA101 (carbon black, <0.021 µm).
OMIX041	95 wt% OOH032 (brucite, <45 µm) + 5 wt% LCA101 (carbon black, <0.021 µm).
LCA101	100% LCA101; <0.021 µm, dry sieved.

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15.20.5a. Serpentinite (flat-sloped, no magnetite) + carbon black

SRP106	100% SRP106; <45 µm, dry sieved.
OMIX051	99.9 wt% SRP106 (serpentinite, <45 µm) + 0.1 wt% LCA101 (carbon black, <0.021 µm).
OMIX052	99.5 wt% SRP106 (serpentinite, <45 µm) + 0.5 wt% LCA101 (carbon black, <0.021 µm).
OMIX053	98 wt% SRP106 (serpentinite, <45 µm) + 2 wt% LCA101 (carbon black, <0.021 µm).
OMIX054	95 wt% SRP106 (serpentinite, <45 µm) + 5 wt% LCA101 (carbon black, <0.021 µm).
LCA101	100% LCA101; <0.021 µm, dry sieved.

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15.21a. Carbonaceous chondrite simulants: Clays + graphite or magnetite

15.21.1a. Serpentinite (SRP117, <45 µm) + synthetic amorphous graphite (GRP102, <45 µm)

SRP117	100% SRP117; <45 µm.
MIX335	99.5% SRP117 (serpentinite, <45 µm) + 0.5 % GRP102 (synthetic amorphous graphite, <45 µm).
MIX336	98% SRP117 (serpentinite, <45 µm) + 2 % GRP102 (synthetic amorphous graphite, <45 µm).
MIX337	95% SRP117 (serpentinite, <45 µm) + 5 % GRP102 (synthetic amorphous graphite, <45 µm).
SRP102	100% GRP102; <45 µm.

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15.21.2a. Serpentinite (SRP117, <45 µm) + magnetite (MAG102, <45 µm)

SRP117	100% SRP117; <45 µm.
MAG102	100% MAG102; <45 µm.
MIX338	95% SRP117 (serpentinite, <45 µm) + 5 % MAG102 (magnetite, <45 µm).
MIX339	90% SRP117 (serpentinite, <45 µm) + 10 % MAG102 (magnetite, <45 µm).

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15.21.3a. Serpentine (SRP117, <45 µm) + nanophase magnetite (MAG200; <20 nm)

SRP117	100% SRP117 + 0% MAG200
CMIX01	98% SRP117 + 2% MAG200
CMIX02	95% SRP117 + 5% MAG200
CIMX03	90% SRP117 + 10% MAG200
CMIX04	80% SRP117 + 20% MAG200
MAG200	0% SRP117 + 100% MAG200

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15.21.4a. Saponite (SAP103, <45 µm) + nanophase magnetite (MAG200, <20 nm)

SAP103	100% SAP103 + 0% MAG200
CMIX11	98% SAP103 + 2% MAG200
CMIX12	95% SAP103 + 5% MAG200
CIMX13	90% SAP103 + 10% MAG200
CMIX14	80% SAP103 + 20% MAG200
MAG200	0% SAP103 + 100% MAG200

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15.21.5a. Cronstedtite (CRO101, <45µm) + nanophase magnetite (MAG200, <20 nm)

CRO101	100% CRO101 + 0% MAG200
CMIX21	98% CRO101 + 2% MAG200
CMIX22	95% CRO101 + 5% MAG200
CIMX33	90% CRO101 + 10% MAG200
CMIX24	80% CRO101 + 20% MAG200
MAG200	0% CRO101 + 100% MAG200

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15.22a. Glass and mafic mixtures – for Mars north polar region

15.22.1a. Tektite (TEK004, <45 μm) + clinopyroxene – spectral type B (PYX016, <45 μm)

TEK004	100% TEK004; Tektite, <45 μm.
PYX016	100% PYX016; Clinopyroxene, type B, <45 μm.
MIX001	80 wt% PYX016 (<45 μm) + 20 wt% TEK004 (<45 μm).
MIX002	60 wt% PYX016 (<45 μm) + 40 wt% TEK004 (<45 μm).
MIX003	40 wt% PYX016 (<45 μm) + 60 wt% TEK004 (<45 μm).
MIX004	20 wt% PYX016 (<45 μm) + 80 wt% TEK004 (<45 μm).

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15.22.2a. Tektite (TEK004, <45 μm) + olivine (OLV003, <45 μm)

TEK004	100% TEK004; Tektite, <45 μm.
OLV003	100% OLV003; olivine, <45 μm.
MIX011	80 wt% OLV003 (<45 μm) + 20 wt% TEK004 (<45 μm).
MIX012	60 wt% OLV003 (<45 μm) + 40 wt% TEK004 (<45 μm).
MIX013	40 wt% OLV003 (<45 μm) + 60 wt% TEK004 (<45 μm).
MIX014	20 wt% OLV003 (<45 μm) + 80 wt% TEK004 (<45 μm).

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15.22.3a. Tektite (TEK004, <45 μm) + orthopyroxene (PYX023, <45 μm)

TEK004	100% TEK004; Tektite, <45 μm.
PYX023	100% PYX023; orthopyroxene, <45 μm.
MIX021	80 wt% PYX023 (<45 μm) + 20 wt% TEK004 (<45 μm).
MIX022	60 wt% PYX023 (<45 μm) + 40 wt% TEK004 (<45 μm).
MIX023	40 wt% PYX023 (<45 μm) + 60 wt% TEK004 (<45 μm).
MIX024	20 wt% PYX023 (<45 μm) + 80 wt% TEK004 (<45 μm).

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15.23a. Asteroid Boznemcova simulants: type A CPX + OLV + PLG

PYX009	100% PYX009; 45-90 μm (spectral type A CPX).
PLG108	100% PLG108; 45-90 μm (plagioclase).
OLV003	100% OLV003; 45-90 μm (olivine).
BOZ001	91% PYX009 + 9% PLG108 + 0% OLV003 (all 45-90 μm) (aka BOZ001a)
BOZ002	83% PYX009 + 17% PLG108 + 0% OLV003 (all 45-90 μm) (aka BOZ001b)
BOZ003	77% PYX009 + 15% PLG108 + 8% OLV003 (all 45-90 μm) (aka BOZ001c)
BOZ004	72% PYX009 + 14% PLG108 + 14% OLV003 (all 45-90 μm) (aka BOZ001d)
BOZ005	67% PYX009 + 13% PLG108 + 20% OLV003 (all 45-90 μm) (aka BOZ001e)
BOZ006	62.5% PYX009 + 12.5% PLG108 + 25% OLV003 (all 45-90 μm) (aka BOZ001f)
BOZ007	59% PYX009 + 12% PLG108 + 29% OLV003 (all 45-90 μm) (aka BOZ001g)
BOZ008	45.5% PYX009 + 9% PLG108 + 45.5% OLV003 (all 45-90 μm) (aka BOZ001h)
BOZ009	33.3% PYX009 + 33.3% PLG108 + 33.3% OLV003 (all 45-90 μm) (aka BOZ001i)

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15.24a. HED + CM2 carbonaceous chondrite mixtures and PRA 04401 (for Vesta)

Note: *Millbillillie = eucrite; Murchison = CM2 carbonaceous chondrite; PRA 04401 = CM2 xenolith-bearing*

howardite.
Millbillillie eucrite + Murchison CM2 chondrite
NWA 5748 howardite + Murchison CM2 chondrite
PRA 04401 CM2 xenolith-bearing howardite
See Meteorites section (section 16.16) for sample descriptions and spectra..
++

15.25a. Mixtures involving npFe-impregnated silica gel (2 sizes) or nanophase Fe (2 sizes)

Mixtures made with air-sensitive nanophase iron that was opened in glove box under dry nitrogen and carbon dioxide-free atmosphere (December 2012).

15.25.1a. Cherokee Springs LL6 chondrite: <250 µm + silica gel/nanophase iron.
15.25.2a. FJS-1 (JAXA Lunar Mare Simulant): <45, 45-90, and <250 µm + silica gel/nanophase iron.
15.25.3a. OLV003 (olivine): <45, 45-90, and <250 µm + silica gel/nanophase iron.
15.25.4a. PLG108 (plagioclase feldspar): <45, 45-90, and <250 µm + silica gel/nanophase iron.
15.25.5a. PYX016 (clinopyroxene; spectral type B): <45, 45-90, and <250 µm + silica gel/nanophase iron.
15.25.6a. PYX042 (orthopyroxene): <45, 45-90, and <250 µm + silica gel/nanophase iron.

15.25.1a. Cherokee Springs LL6 chondrite: whole rock, and <250 µm + SGE105A, SGE101A, IRO102, or IRO103

a. <250 µm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 µm + nanophase iron (IRO102 or IRO103)

Cherokee Springs	Whole rock
Cherokee Springs	Whole with uncrushable metal inclusions added back in
++++++++++	
ZMIX035	100% Cherokee Springs LL6 (<250 µm) + 0% SGE105A
ZMIX035a	90% Cherokee Springs LL6 (<250 µm) + 10% SGE105A
ZMIX035b	80% Cherokee Springs LL6 (<250 µm) + 20% SGE105A
ZMIX035c	50% Cherokee Springs LL6 (<250 µm) + 50% SGE105A
SGE105A	0% Cherokee Springs LL6 (<250 µm) + 100% SGE105A
++++++++	
ZMIX035	100% Cherokee Springs LL6 (<250 µm) + 0% SGE105A
ZMIX035d	90% Cherokee Springs LL6 (<250 µm) + 10% SGE101A
ZMIX035e	80% Cherokee Springs LL6 (<250 µm) + 20% SGE101A
ZMIX035f	50% Cherokee Springs LL6 (<250 µm) + 50% SGE101A
SGE101A	0% Cherokee Springs LL6 (<250 µm) + 100% SGE101A
++++++	
ZMIX035	100% Cherokee Springs LL6 (<250 µm) + 0% IRO102 (50 nm)
ZMIX036	99.9% Cherokee Springs LL6 (<250 µm) + 0.1% IRO102 (50 nm)
ZMIX037	99.5% Cherokee Springs LL6 (<250 µm) + 0.5% IRO102 (50 nm)
ZMIX038	99% Cherokee Springs LL6 (<250 µm) + 1% IRO102 (50 nm)
ZMIX039	98% Cherokee Springs LL6 (<250 µm) + 8% IRO102 (50 nm)
ZMIX040	95% Cherokee Springs LL6 (<250 µm) + 5% IRO102 (50 nm)
ZMIX041	90% Cherokee Springs LL6 (<250 µm) + 10% IRO102 (50 nm)
ZMIX042	80% Cherokee Springs LL6 (<250 µm) + 10% IRO102 (50 nm)
ZMIX043	70% Cherokee Springs LL6 (<250 µm) + 30% IRO102 (50 nm)
IRO102	0% PYX042 (<250 µm) + 100% IRO102 (50 nm)
++++++	
ZMIX035	100% Cherokee Springs LL6 (<250 µm) + 0% IRO103 (10 µm)
ZMIX044	99.9% Cherokee Springs LL6 (<250 µm) + 0.1% IRO103 (10 µm)
ZMIX045	99.5% Cherokee Springs LL6 (<250 µm) + 0.5% IRO103 (10 µm)
ZMIX046	99% Cherokee Springs LL6 (<250 µm) + 1% IRO103 (10 µm)
ZMIX047	98% Cherokee Springs LL6 (<250 µm) + 2% IRO103 (10 µm)

ZMIX048 95% Cherokee Springs LL6 (<250 μm) + 5% IRO103 (10 μm)
ZMIX049 90% Cherokee Springs LL6 (<250 μm) +10% IRO103 (10 μm)
ZMIX050 80% Cherokee Springs LL6 (<250 μm) + 20% IRO103 (10 μm)
ZMIX051 70% Cherokee Springs LL6 (<250 μm) + 30% IRO103 (10 μm)
ZMIX010 0% Cherokee Springs (<250 μm) + 100% IRO103 (10 μm)
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15.25.2a. FJS-1 (JAXA lunar mare simulant: <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

ZMIX052 100% FJS-1 (<250 μm) + 0% SGE101A
ZMIX052a 90% FJS-1 (<250 μm) + 10% SGE101A
ZMIX052b 80% FJS-1 (<250 μm) + 20% SGE101A
ZMIX052c 50% FJS-1 (<250 μm) + 50% SGE101A
SGE101A 0% FJS-1 (<250 μm) + 100% SGE101A
+++++++
ZMIX052 100% FJS-1 (<250 μm) + 0% SGE105A
ZMIX052d 90% FJS-1 (<250 μm) + 10% SGE105A
ZMIX052e 80% FJS-1 (<250 μm) + 20% SGE105A
ZMIX052f 50% FJS-1 (<250 μm) + 50% SGE105A
SGE105A 0% FJS-1 (<250 μm) + 100% SGE105A
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ZMIX127 100% FJS-1 (<45 μm) + 0% IRO102 or IRO103
ZMIX128 95% FJS-1 (<45 μm) + 5% IRO102 (50 nm)
ZMIX129 95% FJS-1 (<45 μm) + 5% IRO103 (10 μm)
ZMIX130 100% FJS-1 (45-90 μm) + 0% IRO102 or IRO103
ZMIX131 95% FJS-1 (45-90 μm) + 5% IRO102 (50 nm)
ZMIX132 95% FJS-1 (45-90 μm) + 5% IRO103 (10 μm)

ZMIX052 100% FJS-1 (<250 μm) + 0% IRO102 (50 nm)
ZMIX053 99.9% FJS-1 (<250 μm) + 0.1% IRO102 (50 nm)
ZMIX054 99.5% FJS-1 (<250 μm) + 0.5% IRO102 (50 nm)
ZMIX055 99% FJS-1 (<250 μm) + 1% IRO102 (50 nm)
ZMIX056 98% FJS-1 (<250 μm) + 2% IRO102 (50 nm)
ZMIX057 95% FJS-1 (<250 μm) + 5% IRO102 (50 nm)
ZMIX058 90% FJS-1 (<250 μm) + 10% IRO102 (50 nm)
ZMIX059 80% FJS-1 (<250 μm) + 20% IRO102 (50 nm)
ZMIX060 70% FJS-1 (<250 μm) + 30% IRO102 (50 nm)
IRO102 0% FJS-1 (<250 μm) + 100% IRO102 (50 nm)
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ZMIX052 100% FJS-1 (<250 μm) + 0% IRO103 (10 μm)
ZMIX061 99.9% FJS-1 (<250 μm) + 0.1% IRO103 (10 μm)
ZMIX062 99.5% FJS-1 (<250 μm) + 0.5% IRO103 (10 μm)
ZMIX063 99% FJS-1 (<250 μm) + 1% IRO103 (10 μm)
ZMIX064 98% FJS-1 (<250 μm) + 2% IRO103 (10 μm)
ZMIX065 95% FJS-1 (<250 μm) + 5% IRO103 (10 μm)
ZMIX066 90% FJS-1 (<250 μm) + 10% IRO103 (10 μm)
ZMIX067 80% FJS-1 (<250 μm) + 20% IRO103 (10 μm)
ZMIX068 70% FJS-1 (<250 μm) + 30% IRO103 (10 μm)
IRO103 0% FJS-1 (<250 μm) + 100% IRO103 (10 μm)
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15.25.3a. OLV003 (olivine): <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

ZMIX017	100% OLV003 (<250 μm) + 0% SGE101A
ZMIX017a	90% OLV003 (<250 μm) + 10% SGE101A
ZMIX017b	80% OLV003 (<250 μm) + 20% SGE101A
ZMIX017c	50% OLV003 (<250 μm) + 50% SGE101A
SGE101A	0% OLV003 (<250 μm) + 100% SGE101A
++++++++	
ZMIX017	100% OLV003 (<250 μm) + 0% SGE105A
ZMIX017d	90% OLV003 (<250 μm) + 10% SGE105A
ZMIX017e	80% OLV003 (<250 μm) + 20% SGE105A
ZMIX017f	50% OLV003 (<250 μm) + 50% SGE105A
SGE105A	0% OLV003 (<250 μm) + 100% SGE105A
++++++++	
ZMIX109	100% OLV003 (<45 μm) + 0% IRO102 or IRO103
ZMIX110	95% OLV003 (<45 μm) + 5% IRO102 (50 nm)
ZMIX111	95% OLV003 (<45 μm) + 5% IRO103 (10 μm)
ZMIX112	100% OLV003 (45-90 μm) + 0% IRO102 or IRO103
ZMIX113	95% OLV003 (45-90 μm) + 5% IRO102 (50 nm)
ZMIX114	95% OLV003 (45-90 μm) + 5% IRO103 (10 μm)
++++++++	
ZMIX017	100% OLV003 (<250 μm) + 0% IRO102 (50 nm)
ZMIX019	99.9% OLV003 (<250 μm) + 0.1% IRO102 (50 nm)
ZMIX020	99.5% OLV003 (<250 μm) + 0.5% IRO102 (50 nm)
ZMIX021	99% OLV003 (<250 μm) + 1% IRO102 (50 nm)
ZMIX022	98% OLV003 (<250 μm) + 2% IRO102 (50 nm)
ZMIX023	95% OLV003 (<250 μm) + 5% IRO102 (50 nm)
ZMIX024	90% OLV003 (<250 μm) + 10% IRO102 (50 nm)
ZMIX025	80% OLV003 (<250 μm) + 20% IRO102 (50 nm)
ZMIX026	70% OLV003 (<250 μm) + 30% IRO102 (50 nm)
IRO102	0% OLV003 (<250 μm) + 100% IRO102 (50 nm)
ZMIX017	100% OLV003 (<250 μm) + 0% IRO103 (10 μm)
ZMIX027	99.9% OLV003 (<250 μm) + 0.1% IRO103 (10 μm)
ZMIX028	99.5% OLV003 (<250 μm) + 0.5% IRO103 (10 μm)
ZMIX029	99% OLV003 (<250 μm) + 1% IRO103 (10 μm)
ZMIX030	98% OLV003 (<250 μm) + 2% IRO103 (10 μm)
ZMIX031	95% OLV003 (<250 μm) + 5% IRO103 (10 μm)
ZMIX032	90% OLV003 (<250 μm) + 10% IRO103 (10 μm)
ZMIX033	80% OLV003 (<250 μm) + 20% IRO103 (10 μm)
ZMIX034	70% OLV003 (<250 μm) + 30% IRO103 (10 μm)
IRO103	0% OLV003 (<250 μm) + 100% IRO103 (10 μm)

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<u>15.25.4a. PLG108 (plagioclase feldspar): <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.</u>

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

ZMIX086	100% PLG108 (<250 μm) + 0% SGE101A
ZMIX086a	90% PLG108 (<250 μm) + 10% SGE101A
ZMIX086b	80% PLG108 (<250 μm) + 20% SGE101A
ZMIX086c	50% PLG108 (<250 μm) + 50% SGE101A
SGE101A	0% PLG108 (<250 μm) + 100% SGE101A

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ZMIX086 100% PLG108 (<250 μm) + 0% SGE105A
ZMIX086d 90% PLG108 (<250 μm) + 10% SGE105A
ZMIX086e 80% PLG108 (<250 μm) + 20% SGE105A
ZMIX086f 50% PLG108 (<250 μm) + 50% SGE105A
SGE105A 0% PLG108 (<250 μm) + 100% SGE105A
+++++++++
ZMIX121 100% PLG108 (<45 μm) + 0% IRO102 or IRO103
ZMIX122 95% PLG108 (<45 μm) + 5% IRO102 (50 nm)
ZMIX123 95% PLG108 (<45 μm) + 5% IRO103 (10 μm)
ZMIX124 100% PLG108 (45-90 μm) + 0% IRO102 or IRO103
ZMIX125 95% PLG108 (45-90 μm) + 5% IRO102 (50 nm)
ZMIX126 95% PLG108 (45-90 μm) + 5% IRO103 (10 μm)
++++++++
ZMIX086 100% PLG108 (<250 μm) + 0% IRO103 (10 μm)
ZMIX087 99.9% PLG108 (<250 μm) + 0.1% IRO103 (10 μm)
ZMIX088 99.5% PLG108 (<250 μm) + 0.5% IRO103 (10 μm)
ZMIX089 99% PLG108 (<250 μm) + 1% IRO103 (10 μm)
ZMIX090 98% PLG108 (<250 μm) + 2% IRO103 (10 μm)
ZMIX091 95% PLG108 (<250 μm) + 5% IRO103 (10 μm)
ZMIX092 90% PLG108 (<250 μm) + 10% IRO103 (10 μm)
ZMIX093 80% PLG108 (<250 μm) + 20% IRO103 (10 μm)
ZMIX094 70% PLG108 (<250 μm) + 30% IRO103 (10 μm)
ZMIX086 100% PLG108 (<250 μm) + 0% IRO103 (10 μm)
IRO103 0% PLG108 (<250 μm) + 100% IRO103 (10 μm)
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ZMIX086 100% PLG108 (<250 μm) + 0% IRO102 (50 nm)
ZMIX095 99.9% PLG108 (<250 μm) + 0.1% IRO102 (50 nm)
ZMIX096 99.5% PLG108 (<250 μm) + 0.5% IRO102 (50 nm)
ZMIX097 99% PLG108 (<250 μm) + 1% IRO102 (50 nm)
ZMIX098 98% PLG108 (<250 μm) + 2% IRO102 (50 nm)
ZMIX099 95% PLG108 (<250 μm) + 5% IRO102 (50 nm)
ZMIX100 90% PLG108 (<250 μm) + 10% IRO102 (50 nm)
ZMIX101 80% PLG108 (<250 μm) + 20% IRO102 (50 nm)
ZMIX102 70% PLG108 (<250 μm) + 30% IRO102 (50 nm)
IRO102 0% PLG108 (<250 μm) + 100% IRO102 (50 nm)
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15.25.5a. PYX016 (clinopyroxene, type B): <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

ZMIX069 100% PYX016 (<250 μm) + 0% SGE101A
ZMIX069a 90% PYX016 (<250 μm) + 10% SGE101A
ZMIX069b 80% PYX016 (<250 μm) + 20% SGE101A
ZMIX069c 50% PYX016 (<250 μm) + 50% SGE101A
SGE101A 0% PYX016 (<250 μm) + 100% SGE101A
++++++++
ZMIX069 100% PYX016 (<250 μm) + 0% SGE105A
ZMIX069d 90% PYX016 (<250 μm) + 10% SGE105A
ZMIX069e 80% PYX016 (<250 μm) + 20% SGE105A
ZMIX069f 50% PYX016 (<250 μm) + 50% SGE105A
SGE105A 0% PYX016 (<250 μm) + 100% SGE105A
++++++++
ZMIX115 100% PYX016 (<45 μm) + 0% IRO102 or IRO103

ZMIX116 95% PYX016 (<45 μm) + 5% IRO102 (50 nm)
ZMIX117 95% PYX016 (<45 μm) + 5% IRO103 (10 μm)
ZMIX118 100% PYX016 (45-90 μm) + 0% IRO102 or IRO103
ZMIX119 95% PYX016 (45-90 μm) + 5% IRO102 (50 nm)
ZMIX120 95% PYX016 (45-90 μm) + 5% IRO103 (10 μm)
++++++++
ZMIX069 100% PYX016 (<45 μm) + 0% IRO103 (10 μm)
ZMIX070 99.9% PYX016 (<45 μm) + 0.1% IRO103 (10 μm)
ZMIX071 99.5% PYX016 (<45 μm) + 0.5% IRO103 (10 μm)
ZMIX072 99% PYX016 (<45 μm) + 1% IRO103 (10 μm)
ZMIX073 98% PYX016 (<45 μm) + 2% IRO103 (10 μm)
ZMIX074 95% PYX016 (<45 μm) + 5% IRO103 (10 μm)
ZMIX075 90% PYX016 (<45 μm) + 10% IRO103 (10 μm)
ZMIX076 80% PYX016 (<45 μm) + 20% IRO103 (10 μm)
ZMIX077 70% PYX016 (<45 μm) + 30% IRO103 (10 μm)
IRO103 0% FJS-1 (<250 μm) + 100% IRO103 (10 μm)
++++++++
ZMIX069 100% PYX016 (<45 μm) + 0% IRO102 (50 nm)
ZMIX078 99.9% PYX016 (<45 μm) + 0.1% IRO102 (50 nm)
ZMIX079 99.5% PYX016 (<45 μm) + 0.5% IRO102 (50 nm)
ZMIX080 99% PYX016 (<45 μm) + 1% IRO102 (50 nm)
ZMIX081 98% PYX016 (<45 μm) + 2% IRO102 (50 nm)
ZMIX082 95% PYX016 (<45 μm) + 5% IRO102 (50 nm)
ZMIX083 90% PYX016 (<45 μm) + 10% IRO102 (50 nm)
ZMIX084 80% PYX016 (<45 μm) + 20% IRO102 (50 nm)
ZMIX085 70% PYX016 (<45 μm) + 30% IRO102 (50 nm)
IRO102 0% PYX016 (<250 μm) + 100% IRO102 (50 nm)
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15.25.6a. PYX042 (orthopyroxene): <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

ZMIX001 100% PYX042 (<250 μm) + 0% SGE101A
ZMIX001a 90% PYX042 (<250 μm) + 10% SGE101A
ZMIX001b 80% PYX042 (<250 μm) + 20% SGE101A
ZMIX001c 50% PYX042 (<250 μm) + 50% SGE101A
SGE101A 0% PYX042 (<250 μm) + 100% SGE101A
++++++++
ZMIX069 100% PYX042 (<250 μm) + 0% SGE105A
ZMIX001d 90% PYX042 (<250 μm) + 10% SGE105A
ZMIX001e 80% PYX042 (<250 μm) + 20% SGE105A
ZMIX001f 50% PYX042 (<250 μm) + 50% SGE105A
SGE105A 0% PYX042 (<250 μm) + 100% SGE105A
+++++++++
ZMIX103 100% PYX042 (45-90 μm) + 0% IRO102 or IRO103
ZMIX104 95% PYX042 (45-90 μm) + 5% IRO102 (50 nm)
ZMIX105 95% PYX042 (45-90 μm) + 5% IRO103 (10 μm)
ZMIX106 100% PYX042 (<45 μm) + 0% IRO102 or IRO103
ZMIX107 95% PYX042 (<45 μm) + 5% IRO102 (50 nm)
ZMIX108 95% PYX042 (<45 μm) + 5% IRO103 (10 μm)
+++++++
ZMIX001 100% PYX042 (<250 μm) + 0% IRO103 (10 μm)
ZMIX002 99.9% PYX042 (<250 μm) + 0.1% IRO103 (10 μm)
ZMIX003 99.5% PYX042 (<250 μm) + 0.5% IRO103 (10 μm)

ZMIX004 99% PYX042 (<250 μm) + 1% IRO103 (10 μm)
ZMIX005 98% PYX042 (<250 μm) + 2% IRO103 (10 μm)
ZMIX006 95% PYX042 (<250 μm) + 5% IRO103 (10 μm)
ZMIX007 90% PYX042 (<250 μm) + 10% IRO103 (10 μm)
ZMIX008 80% PYX042 (<250 μm) + 20% IRO103 (10 μm)
ZMIX009 70% PYX042 (<250 μm) + 30% IRO103 (10 μm)
ZMIX010 0% PYX042 (<250 μm) + 100% IRO103 (10 μm)
+++++++++
ZMIX001 100% PYX042 (<250 μm) + 0% IRO102 (50 nm)
ZMIX009A 99.9% PYX042 (<250 μm) + 0.1% IRO102 (50 nm)
ZMIX010A 99.5% PYX042 (<250 μm) + 0.5% IRO102 (50 nm)
ZMIX011A 99.0% PYX042 (<250 μm) + 1.0% IRO102 (50 nm)
ZMIX012A 98% PYX042 (<250 μm) + 2% IRO102 (50 nm)
ZMIX013A 95% PYX042 (<250 μm) + 5% IRO102 (50 nm)
ZMIX014A 90% PYX042 (<250 μm) + 10% IRO102 (50 nm)
ZMIX015A 80% PYX042 (<250 μm) + 20% IRO102 (50 nm)
ZMIX016A 70% PYX042 (<250 μm) + 30% IRO102 (50 nm)
IRO102 0% PYX042 (<250 μm) + 100% IRO102 (50 nm)
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15.26a. PAHs + other materials

15.26.1a. JSC-Mars1 and polycyclic aromatic hydrocarbons mixtures (for Mars2020)

Note: PAHs added after dissolving in solvent.

Mars2020-1 100% JSC Mars-1 Mars regolith stimulant, unsorted (aka PSA002).
Mars2020-2 95% Mars-JSC-1 + 5% anthracene (ORG002)
Mars2020-3 95% Mars-JSC-1 + 5% anthracene (ORG002)
Mars2020-4 98% Mars-JSC-1 + 2% anthracene (ORG002)
Mars2020-5 98% Mars-JSC-1 + 2% anthracene (ORG002)
ORG002 100% ORG002; dissolved, mixed, and solvent evaporated.
++++++
Mars2020-1 100% JSC Mars-1 Mars regolith stimulant, unsorted (aka PSA002).
Mars2020-6 95% Mars-JSC-1 + 5% naphtho [2,3-a] pyrene (ORG014)
Mars2020-7 98% Mars-JSC-1 + 2% naphtho [2,3-a] pyrene (ORG014)
Mars2020-8 99% Mars-JSC-1 + 1% naphtho [2,3-a] pyrene (ORG014)
Mars2020-9 99% Mars-JSC-1 + 1% naphtho [2,3-a] pyrene (ORG014)
ORG014 100% ORG014; dissolved, mixed, and solvent evaporated.

++++++++
130830_1 0.001% ORG002 from DCM solution in JSC Mars-1 matrix
130830_2 0.01% ORG002 from DCM solution in JSC Mars-1 matrix
130830_3 0.05% ORG002 from DCM solution in JSC Mars-1 matrix
130830_4 0.1% ORG002 from DCM solution in JSC Mars-1 matrix
130830_5 0.1% ORG002 dry mixed in JSC Mars-1 matrix
130830_6 0.5% ORG002 dry mixed in JSC Mars-1 matrix
130830_7 1% ORG002 dry mixed in JSC Mars-1 matrix
130830_8 2% ORG002 dry mixed in JSC Mars-1 matrix
130830_9 5% ORG002 dry mixed in JSC Mars-1 matrix
130830_10 "Messy slut dry mixture"
130830_11 100% JSC Mars-1
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15.26.2a. PAHs + magnesium fluoride (SYN014)

SYN014	Synthetic magnesium fluoride; unsorted, fine-grained.
OSM001	5 wt% ORG002 (anthracene) + 95 wt.% SYN014; unsorted, fine-grained.
OSM002	1 wt% ORG002 (anthracene) + 99 wt.% SYN014; unsorted, fine-grained.
ORG002	Anthracene; unsorted, coarse grained.

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15.27a. Two-pyroxene mixtures – RELAB spectra (Jessica Sunshine)

c1xp14	25% orthopyroxene (PE30), 75% clinopyroxene (PP21), <45 µm.
c1xp12	40% orthopyroxene (PE30), 60% clinopyroxene (PP21), <45 µm.
c1xp24	25% orthopyroxene (PE30), 75% clinopyroxene (PP21), 45-75 µm.
c1xp22	40% orthopyroxene (PE30), 60% clinopyroxene (PP21), 45-75 µm.
c1xp05	25% orthopyroxene (PE30), 75% clinopyroxene (PP21), 75-125 µm.
c1xp03	40% orthopyroxene (PE30), 60% clinopyroxene (PP21), 75-125 µm.

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NOTES: End member abundances are provided in weight percentages in the form x%:y% where x+y equals 100%. Grain sizes are provided in microns for each end member; where both end members are the same grain size only one number is provided. Sample description abbreviations are the same as those used in the mineral tables. "Beaten" refers to meteoritic metal beaten after grinding to yield more equidimensional grains.

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15a.x. M.Sc. Olivine + Orthopyroxene series – Samples available

1. Series 1. 63-90 microns Orthopyroxene + Olivine
(PYX02 = my PYX042; OLV is Green Sand Beach = my OLV010)

OLV/PYX	0/100
	5/95
	10/90
	20/80
	30/70
	40/60
	50/50
	60/40
	70/30
	90/10
	100/0

2. Series 2. 45-63 microns Orthopyroxene + Olivine

OLV/PYX	0/100
	10/90
	25/75
	50/50
	75/25
	90/10
	0/100

3. Series 3. <<38 microns - Orthopyroxene + Olivine
only 1 sample: 10/90 Olv/Pyx

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15d. Spectral Data - Mineral Mixtures (by series)

Sample	*Facility/File No.*	*Description*

15.1d. Two pyroxene mixtures

MIX201	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX205	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX009	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX038	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

See section 2.1 (Pyroxenes) for additional end member spectra

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15.1.1d. Series 1: PYX032 (OPX) + PYX040 (type B CPX)

MIX230	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX231	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX232	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX032	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX040	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

See section 2.1 (Pyroxenes) for additional end member spectra

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15.1.2d. Series 2: PYX003 (OPX) + PYX036 (type B CPX)

MIX250	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX251	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX252	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX003	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX036	UH Analogue	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

See section 2.1 (Pyroxenes) for additional end member spectra

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15.1.3d. Series 3a: Type A clinopyroxene (PYX150) + orthopyroxene (PYX042); both <45 µm

COMIX1101	PSF sep0407.001	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1102	PSF sep0407.002	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1103	PSF sep0407.003	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1104	PSF sep0407.004	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1105	PSF sep0407.005	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1106	PSF sep0407.006	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1107	PSF sep0407.007	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1108	PSF sep0407.008	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1108.5	PSF sep0407.009	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1109	PSF sep0407.010	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1109.5	PSF sep0407.011	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1110	PSF sep0407.012	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1110.5	PSF sep0407.013	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX1111	PSF sep0407.014	<45 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.

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15.1.4d. Series 3b: Type A clinopyroxene (PYX150) + orthopyroxene (PYX042); both 45-90 µm

COMIX2101	PSF sep0407a.001	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2102	PSF sep0407a.002	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2103	PSF sep0407a.003	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2104	PSF sep0407a.004	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2105	PSF sep0407a.005	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2106	PSF sep0407a.006	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2107	PSF sep0407a.007	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.

COMIX2108	PSF sep0407a.008	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2108.5	PSF sep0407a.009	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2109	PSF sep0407a.010	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2109.5	PSF sep0407a.011	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2110	PSF sep0407a.012	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2110.5	PSF sep0407a.013	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.
COMIX2111	PSF sep0407a.014	45-90 µm; 30E/0E; 0.35-2.5µm; 1 nm resol.; 1000 avg.; ASD.

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15.1.5d. Series 4a: Type B clinopyroxene (PYX017) + orthopyroxene (PYX032); both <45 µm

PMIX1001	PSF dec1406.001	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1002	PSF dec1406.002	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1003	PSF dec1406.003	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1004	PSF dec1406.004	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1005	PSF dec1406.005	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1006	PSF dec1406.006	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1007	PSF dec1406.007	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1008	PSF dec1406.008	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1009	PSF dec1406.009	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1010	PSF dec1406.010	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1011	PSF dec1406.011	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.

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15.1.6d. Series 4b: Type B clinopyroxene (PYX017) + orthopyroxene (PYX032); both 90-180 µm

PMIX2001	PSF dec1606.007	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2002	PSF dec1606.008	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2003	PSF dec1606.009	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2004	PSF dec1606.010	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2005	PSF dec1606.011	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2006	PSF dec1606.012	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.

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15.1.7d. Series 5a: Type B clinopyroxene (PYX005) + orthopyroxene (PYX023); both <45 µm

PMIX1101	PSF dec1406.013	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1102	PSF dec1406.014	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1103	PSF dec1406.015	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1104	PSF dec1406.016	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1105	PSF dec1406.017	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1106	PSF dec1406.018	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1107	PSF dec1406.019	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1108	PSF dec1406.020	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1109	PSF dec1406.021	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1110	PSF dec1406.022	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX1111	PSF dec1406.023	<45 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.

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15.1.8d. Series 5b: Type B clinopyroxene (PYX005) + orthopyroxene (PYX023); both 90-180 µm

PMIX2101	PSF dec1606.001	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2102	PSF dec1606.002	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2103	PSF dec1606.003	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2104	PSF dec1606.004	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2105	PSF dec1606.005	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.
PMIX2106	PSF dec1606.006	90-180 µm; 35E/0E; 0.35-2.5µm; 1 nm resol.; 2000 avg.; ASD.

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15.2d. Olivine + orthopyroxene mixtures

MIX203	UH Analog	mixed, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX210	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX212	UH Analog	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV003	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV010	UH Analogue	<63 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV010	UH Analogue	63-125 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV020	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX032	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX042	UH Analogue	<63 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX042	UH Analogue	63-125 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

See sections 2.1 (Pyroxenes) and 2.2 (Olivines) for additional end member spectra.

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15.2.1d. Series 1: OLV022 + PYX003

MIX240	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX241	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX242	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV022	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX003	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

See sections 2.1 (Pyroxenes) and 2.2 (Olivines) foradditional end member spectra.

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15.2.2d. Series 2a: Orthopyroxene (PYX042) + olivine (OLV003); both <38 µm.

POMIX1001	PSF 300807b.001	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1002	PSF 300807b.002	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1003	PSF 300807b.003	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1004	PSF 300807b.004	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1005	PSF 300807b.005	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1006	PSF 300807b.006	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1007	PSF 300807b.007	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1008	PSF 300807b.008	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1009	PSF 300807b.009	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1010	PSF 300807b.010	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX1011	PSF 300807b.011	<38 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.

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15.2.3d. Series 2b: Orthopyroxene (PYX042) + olivine (OLV003); 38-53 µm.

POMIX2001	PSF 31aug07.001	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2002	PSF 31aug07.002	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2003	PSF 31aug07.003	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2004	PSF 31aug07.004	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2005	PSF 31aug07.005	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2006	PSF 31aug07.006	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2007	PSF 31aug07.007	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2008	PSF 31aug07.008	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2009	PSF 31aug07.009	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2010	PSF 31aug07.010	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX2011	PSF 31aug07.011	38-53 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.

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15.2.4d. Series 2c: Orthopyroxene (PYX042) + olivine (OLV003); 90-125 µm.

POMIX3001	PSF 06sep07.001	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3002	PSF 06sep07.002	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3003	PSF 06sep07.003	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.

POMIX3004	PSF 06sep07.004	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3005	PSF 06sep07.005	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3006	PSF 06sep07.006	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3007	PSF 06sep07.007	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3008	PSF 06sep07.008	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3009	PSF 06sep07.009	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3010	PSF 06sep07.010	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX3011	PSF 06sep07.011	90-125 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.

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15.2.5d. Series 2d: Orthopyroxene (PYX042) + olivine (OLV003); 63-90 µm (original M.Sc. 1986 samples).

POMIX4001	PSF 060907a.011	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4002	PSF 060907a.010	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4003	PSF 060907a.009	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4004	PSF 060907a.008	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4005	PSF 060907a.007	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4006	PSF 060907a.006	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4007	PSF 060907a.005	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4008	PSF 060907a.004	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4009	PSF 060907a.003	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4010	PSF 060907a.002	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4011	PSF 060907a.001	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4012	PSF 060907a.012	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX4013	PSF 060907a.013	63-90 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.

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15.2.6d. Series 2e: Orthopyroxene (PYX042) + olivine (OLV003); 45-63 µm (original M.Sc. 1986 samples).

POMIX5001	PSF 060907b.001	45-63 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX5002	PSF 060907b.002	45-63 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX5006	PSF 060907b.003	45-63 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX5010	PSF 060907b.004	45-63 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX5011	PSF 060907b.005	45-63 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX5014	PSF 060907b.006	45-63 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
POMIX5015	PSF 060907b.007	45-63 µm; 30E/0E; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.

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15.3d. Olivine + clinopyroxene mixtures

MIX211	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX213	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV003	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV022	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX026	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX036	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

See sections 2.1 (Pyroxenes) and 2.2 (Olivines) for additional end member spectra.

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15.3.1d. Series 1: OLV020 + PYX040 (type B CPX)

MIX220	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX221	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MIX222	UH Analog	45-90µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
OLV020	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
PYX040	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

See sections 2.1 (Pyroxenes) and 2.2 (Olivines) for additional end member spectra.

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15.3.2d. Series 2: OLV003 + PYX150 (type A cpx) – August 2009

OCMIX1001	PSF 090724a.002	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1002	PSF 090724a.003	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1003	PSF 090724a.004	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1004	PSF 090724a.005	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1005	PSF 090724a.006	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1006	PSF 090724a.007	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1007	PSF 090724a.008	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1008	PSF 090724a.009	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1009	PSF 090724a.010	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1010	PSF 090724a.011	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.
OCMIX1011	PSF 090724a.012	<45µm, 30°/0°, 0.35-2.5µm, 1 nm output, ASD, 1000 avgd.

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15.3.3d. OLV003 (<45 µm) + PYX016 (type B, <45 µm) – April 2010

OLV003	PSF 100412b.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
PYX016	PSF 100412b.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX031	PSF 100412b.017	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX032	PSF 100412b.018	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX033	PSF 100412b.019	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX034	PSF 100412b.020	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).

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15.4d. Olivine + metal

15.4.1d. Series 1: OLV003 + MET101

MIX260	RELAB C1SC03	--, 0E/15E, 0.34-2.7µm, 5nm.
MIX261	RELAB C1SC04	--, 0E/15E, 0.34-2.7µm, 5nm.
MIX262	RELAB C1SC05	--, 0E/15E, 0.34-2.7µm, 5nm.
MIX263	RELAB CSC101	--, 0E/15E, 0.3-2.7µm, 5nm.
OLV003	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.
MET101	UH Analogue	45-90 µm, 0E/15E, 0.65-2.55µm, 1.5% resol.

See sections 2.2 (Olivines) and 16. (Meteorites) for additional end member spectra.

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15.4.2d. Series 2: OLV003 + MET101

MOMIX2001	PSF 100907.001	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2002	PSF 100907.002	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2003	PSF 100907.003	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2004	PSF 100907.004	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2005	PSF 100907.005	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2006	PSF 100907.006	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2007	PSF 100907.007	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2008	PSF 100907.008	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2008	PSF 090127a.008	--, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD. Absolute reflectance may be wrong.
MOMIX2008	PSF 090313a.034	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
MOMIX2009	PSF 100907.009	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2009	PSF 090127a.009	--, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD. Absolute

reflectance may be wrong.

MOMIX2009	PSF 090313a.035	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
MOMIX2010	PSF 100907.010	--; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2010	PSF 090127a.010	--, 30°/0°, 0.35-2.5 μm, 1 nm output, 1000 averaged, ASD. Absolute reflectance may be wrong.
MOMIX2010	PSF 090313a.036	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
MOMIX2011	PSF 090313a.039	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
MET101A	PSF 041007.008	--; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2101	PSF 100907.011	--; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD.
MOMIX2102	PSF 100907.012	--; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD.
MET100	PSF 100907.029	--; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD.

Note: *areal mixtures of these samples (with "A" suffix) have been generated as mathematical linear combinations of the end member spectra (see database).*

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15.4.3d. Series 3: OLV011 + MET101

MOMIX3000	PSF 090313a.041	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
MET101A	PSF 041007.008	--; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD.

See sections 2.2 (Olivines) and 16. (Meteorites) for (additional) end member spectra.

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15.4.4d. Series 4: Olivine (OLV007) + Metal (MET01)

MOMIX4000	PSF 090319a.003	<45 μm, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 μm.
MET101A	PSF 041007.008	--; 35°/0°; 0.35-2.5 μm; 1 nm resol.; 1000 avgd; ASD.

See sections 2.2 (Olivines) and 16. (Meteorites) for (additional) end member spectra.

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15.4.5a. Series 5: Pallasite (MET030) slab spectra (roughened with 120 grit sandpaper)

See section 16 (Meteorites) for spectra.

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15.4.6a. Series 6: Olivine (OLV003, <45 μm) sprinkled on Odessa iron meteorite slab (MET01, roughened with 120 grit sandpaper)

OLMETS01	PSF 121101a.012	<45 μm olivine (OLV003) on slab (Odessa iron meteorite (MET01) roughened with 120 grit sandpaper); i=30°, e=0°; 0,35-2.5 μm; 2-7 nm resol., 1 nm output; 1000 spectra avgd.; ASD (directory: 121101mafic metal); no olivine.
OLMETS02	PSF 121101a.013	<45 μm olivine (OLV003) on slab (Odessa iron meteorite (MET01) roughened with 120 grit sandpaper); i=30°, e=0°; 0,35-2.5 μm; 2-7 nm resol., 1 nm output; 1000 spectra avgd.; ASD (directory: 121101mafic metal); with lightest olivine coating.
OLMETS03	PSF 121101a.014	<45 μm olivine (OLV003) on slab (Odessa iron meteorite (MET01) roughened with 120 grit sandpaper); i=30°, e=0°; 0,35-2.5 μm; 2-7 nm resol., 1 nm output; 1000 spectra avgd.; ASD (directory: 121101mafic metal); with heavier olivine coating.
OLMETS04	PSF121101a.015	<45 μm olivine (OLV003) on slab (Odessa iron meteorite (MET01) roughened with 120 grit sandpaper); i=30°, e=0°; 0,35-2.5 μm; 2-7 nm resol., 1 nm output; 1000 spectra avgd.; ASD (directory: 121101mafic metal); with heaviest olivine coating (metal not visible).
OLMETS05	PSF 121101a.016	<45 μm olivine (OLV003) on slab (Odessa iron meteorite (MET01)

		roughened with 120 grit sandpaper); i=30°, e=0°; 0,35-2.5 μm; 2-7 nm resol., 1 nm output; 1000 spectra avgd.; ASD (directory: 121101mafic metal); with uber-heaviest olivine coating (metal not visible).
OLMETS06	PSF 121101a.017	<45 μm olivine (OLV003) on slab (Odessa iron meteorite (MET01) roughened with 120 grit sandpaper); i=30°, e=0°; 0,35-2.5 μm; 2-7 nm resol., 1 nm output; 1000 spectra avgd.; ASD (directory: 121101mafic metal); OLV003, <45 μm in sample cup.

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15.5d. Olivine + orthopyroxene + metal

MIX266	RELAB C1SC07	--, 0E/15E, 0.34-2.7μm, 5nm.
MIX266	RELAB C2SC07	--. 0E/15E, 0.3-2.6μm, 5nm, with errors.
MIX271	RELAB C1SC08	--, 0E/15E, 0.34-2.7μm, 5nm.
OLV003	UH Analogue	45-90 μm, 0E/15E, 0.65-2.55μm, 1.5% resol.
PYX117	UH Analogue	45-90 μm, 0E/15E, 0.65-2.55μm, 1.5% resol.

See sections 2.1 (Pyroxenes) and 2.2 (Olivines) for additional end member spectra.

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15.6d. Olivine + opaques: carbon black, magnetite, etc.

MIX283	RELAB C1SC21	--, 0E/15E, 0.34-2.7μm, 5nm.
MIX283	PSF 100420a.018	i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd, ASD (Directory: 100420_Carbon).
MIX284	RELAB C1SC22	--, 0E/15E, 0.34-2.7μm, 5nm.
MIX284	PSF 100420a.019	i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd, ASD (Directory: 100420_Carbon).
MIX285	RELAB C1SC23	--, 0E/15E, 0.34-2.7μm, 5nm.
MIX285	PSF 100420a.020	i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd, ASD (Directory: 100420_Carbon).
MIX286	RELAB C1SC18	--, 0E/15E, 0.34-2.7μm, 5nm.
MIX286	PSF 100420a.021	i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd, ASD (Directory: 100420_Carbon).
MIX290	RELAB C1SC28	--, 0E/15E, 0.34-2.7μm, 5nm.
MIX290	RELAB C2SC28	--, 0E/15E, 0.3-2.6μm, 5nm, with errors.
MIX290	RELAB C3SC28	--, 0E/15E, 0.3-2.6μm, 5nm, with errors (2nd run).
MIX290	RELAB C4SC28	--, 0E/15E, 0.3-2.6μm, 5nm, with errors (2 run average).
MIX291	RELAB C1SC26	--, 0E/15E, 0.34-2.7μm, 5nm.
MIX291	RELAB C2SC26	--, 0E/15E, 0.3-2.6μm, 5nm, with errors.
MIX291	RELAB C3SC26	--, 0E/15E, 0.3-2.6μm, 5nm, with errors (2nd run).
MIX291	RELAB C4SC26	--, 0E/15E, 0.3-2.6μm, 5nm, with errors (2 run average).
MIX292	RELAB C1SC27	--, 0E/15E, 0.34-2.7μm, 5nm.
MIX292	RELAB C2SC27	--, 0E/15E, 0.3-2.6μm, 5nm, with errors.
MIX292	RELAB C3SC27	--, 0E/15E, 0.3-2.6μm, 5nm, with errors (2nd run).
MIX292	RELAB C4SC27	--, 0E/15E, 0.3-2.6μm, 5nm, with errors (2 run average).
MIX300	RELAB C1SC85	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX310	RELAB C2SC85	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX320	RELAB C1SC91	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX330	RELAB C1SC86	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX332	RELAB CSC103	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX340	RELAB C1SC87	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX341	RELAB CSC100	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX342	RELAB CSC102	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX350	RELAB C1SC94	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX360	RELAB C1SC92	--, 0E/15E, 0.3-2.7μm, 5nm.
MIX361	RELAB C1SC88	--, 0E/15E, 0.3-2.7μm, 5nm.

MIX370	RELAB C1SC90	--, 0E/15E, 0.3-2.7µm, 5nm.
MIX380	RELAB C1SC89	--, 0E/15E, 0.3-2.7µm, 5nm.
MMIX01	RELAB MMIX01	OLV003:SIC102 972:28, 70µm:5µm, 0E/15E, 0.3-2.7µm, 5nm.
MMIX11	RELAB MMIX11	OLV003:SIC102 972:28, 70µm:5µm, 0E/15E, 0.3-2.7µm, 5nm.
	++++ end member spectra for 15.6.++++++	
OLV003	RELAB c1sc02	45-90 µm; 0°/15°; 0.3-3.6 µm; 5nm.
OLV003	RELAB csc099	<45 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
LCA101	RELAB c1sc24	<0.021 µm; 0°/15°; 0.34-2.7 µm; 5 nm.
MAG101	RELAB c2sc25	45-90 µm; 0°/15°; 0.3-2.6 µm; 5nm.
MAG101	RELAB cbsc25	<45 µm; 0°/15°; 0.3-2.6 µm; 5 nm.
SIC101	RELAB c1sc82	<37 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
SIC102	RELAB c2sc82	<7 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
GRP101	RELAB c1sc79	<45 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
GRP102	RELAB c1sc80	<45 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
CTE101	RELAB c1sc83	<37 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
CEM101	RELAB c1sc84	<45 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
DIA101	RELAB c1sc81	<1 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
WUS101	RELAB c1sc13	<63 µm; 0°/15°; 0.34-2.7 µm; 5nm.

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15.6.1d. CC stimulant: Olivine (OLV003, < 45µm) + carbon black (LCA101)

OLV003	PSF100413a.031	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX061	PSF 100413a.032	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX062	PSF 100413a.033	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX063	PSF 100413a.034	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX064	PSF 100413a.035	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
LCA101	PSF 100420a.008	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100420_Carbon).

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OLV003	PSF 100420a.005	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
OLV003	PSF 100420a.004	45-90 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX330	PSF 100420a.001	--, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX331	PSF 100420a.002	--, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX332	PSF 100420a.003	--, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX333	PSF 100420a.009	--, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
GRP102	PSF 100420a.006	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).

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15.7d. Olivine + chromite ± metal

MIX520	RELAB c1mx20	30°/0°, 0.3-2.6µm, 5 nm.
MIX521	RELAB c1mx21	30°/0°, 0.3-2.6µm, 5 nm.
MIX522	RELAB c1mx22	30°/0°, 0.3-2.6µm, 5 nm.
MIX523	RELAB c1mx23	30°/0°, 0.3-2.6µm, 5 nm.
MIX524	RELAB c1mx24	30°/0°, 0.3-2.6µm, 5 nm.

MIX524	RELAB lamx24	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm.
MIX525	RELAB c1mx25	30°/0°, 0.3-2.6µm, 5 nm.
MIX525	RELAB lamx25	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm.
MIX526	RELAB c1mx26	30°/0°, 0.3-2.6µm, 5 nm.
MIX526	RELAB lamx26	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm.
MIX527	RELAB c1mx27	30°/0°, 0.3-2.6µm, 5 nm.
MIX527	RELAB lamx27	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm.
MIX528	RELAB c1mx28	30°/0°, 0.3-2.6µm, 5 nm.
MIX528	RELAB lamx28	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm.
MIX529	RELAB c1mx29	30°/0°, 0.3-2.6µm, 5 nm.
MIX529	RELAB lamx29	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm.
OLV003	RELAB c1sc02	45-90 µm; 0°/15°; 0.3-3.6 µm; 5nm.
OLV003	RELAB csc099	<45 µm; 0°/15°; 0.3-2.7 µm; 5 nm.
CHR103	RELAB cacr13	<45 µm; 30°/0°; 0.3-2.6 µm; 5 nm.
MET101	RELAB casc63	<45 µm; 30°/0°; 0.3-2.6 µm; 5 nm.
MET101	RELAB sbsc06	45-90 µm; 30°/0°; 0.3-2.6 µm; 5nm.

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15.8d. Orthopyroxene + metal and/or opaques

MIX265	USGS 244	IS, 0.35-2.6µm, 1x resol.
MIX265	RELAB C1SC105	--, 0E/15E, 0.3-2.6µm, 5nm, with errors.
PYX032	RELAB c2sc36	45-90 µm; 0°/15°; 0.3-2.6 µm; 5nm.
PYX032	USGS 240	45-90 µm; IS; 0.35-2.6 µm; 1x resolution.
MET101	RELAB c1sc06	45-90 µm beaten; 0°/15°; 0.3-2.7 µm; 5 nm.
MET101	USGS 264	45-90 µm; IS, 0.35-2.6 µm; 1x resolution.

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15.8.1d. Series 1: PYX117 + MET101

MIX267	USGS 256	IS, 0.35-2.6µm, 1x resol.
MIX267	RELAB C1SC107	--, 0E/15E, 0.3-2.6µm, 5nm, with errors.
MIX267	RELAB C2SC107	--, 0E/15E, 0.3-2.6µm, 5nm, with errors (2nd run).
MIX267	RELAB C3SC107	--, 0E/15E, 0.3-2.6µm, 5nm, with errors (2 run average).
MIX268	USGS 252	IS, 0.35-2.6µm, 1x resol.
MIX268	RELAB C1SC108	--, 0E/15E, 0.3-2.6µm, 5nm, with errors.
MIX268	RELAB C2SC108	--, 0E/15E, 0.3-2.6µm, 5nm, with errors (2nd run).
MIX268	RELAB C3SC108	--, 0E/15E, 0.3-2.6µm, 5nm, with errors (2 run average).
MIX269	USGS 248	IS, 0.35-2.6µm, 1x resol.
MIX269	RELAB C1SC109	--, 0E/15E, 0.3-2.6µm, 5nm, with errors.
MIX269	RELAB C2SC109	--, 0E/15E, 0.3-2.6µm, 5nm, with errors (2nd run).
MIX269	RELAB C3SC109	--, 0E/15E, 0.3-2.6µm, 5nm, with errors (2 run average).
MIX272	RELAB C1SC29	--, 0E/15E, 0.34-2.7µm, 5nm.
PYX117	USGS 224	45-90 µm; IS; 0.35-2.6 µm; 1x resolution.
PYX117	RELAB c2sc09	45-90 µm; 0°/15°; 0.3-2.6 µm; 5nm resolution.
MET101	USGS 264	45-90 µm; IS, 0.35-2.6 µm; 1x resolution.
MET101	RELAB c1sc06	45-90 µm beaten; 0°/15°; 0.3-2.7 µm; 5 nm.
LCA101	RELABc1sc24	<0.021 µm; 0°/15°; 0.34-2.7 µm; 5 nm resolution.

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15.8.2d. Series 2: PYX032 + LCA101

MIX280	RELAB C1SC15	--, 0E/15E, 0.34-2.7µm, 5nm.
MIX280	PSF 071201a.014	--; 30°/0°; 0.35-2.5 nm; 1 nm resol.; 1000 averaged spectra; ASD (directory: 071201grainsize).
MIX280	PSF 100420a.015	i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd, ASD (Directory: 100420_Carbon).
MIX281	RELAB C1SC16	--, 0E/15E, 0.34-2.7µm, 5nm.

MIX281	PSF 071201a.015	--; 30°/0°; 0.35-2.5 nm; 1 nm resol.; 1000 averaged spectra; ASD (directory: 071201grainsize).
MIX281	PSF 100420a.016	i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd, ASD (Directory: 100420_Carbon).
MIX282	RELAB C1SC17	--, 0E/15E, 0.34-2.7µm, 5nm.
MIX282	PSF 071201a.016	--; 30°/0°; 0.35-2.5 nm; 1 nm resol.; 1000 averaged spectra; ASD (directory: 071201grainsize).
MIX282	PSF 100420a.017	i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd, ASD (Directory: 100420_Carbon).
PYX032	RELAB c2sc36	45-90 µm; 0°/15°; 0.3-2.6 µm; 5nm.
PYX032	PSF jun0707.006	45-90 µm; 30°/0°; 0.35-2.5 µm; 2-7 nm resolution; ASD.
LCA101	PSF 100420a.008	<0.021 µm; 30°/0°; 0.35-2.5 µm; 2-7 nm resolution; ASD.
LCA101	RELAB c1sc24	<0.021 µm; 0°/15°; 0.34-2.7 µm;5 nm resolution.
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15.8.3d. Series 3a: PYX042 + MET101A (<45 µm)

MPMIX1001	PSF 100907.016	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1002	PSF 100907.017	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1003	PSF 100907.018	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1004	PSF 100907.019	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1005	PSF 100907.020	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1006	PSF 100907.021	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1006	PSF 090127a.011	--, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD. Absolute reflectance may be wrong.
MPMIX1006	PSF 090313a.037	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
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MPMIX1007	PSF 100907.022	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1007	PSF 090127a.012	--, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD. Absolute reflectance may be wrong.
MPMIX1007	PSF 090313a.038	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
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MPMIX1008	PSF 100907.023	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1009	PSF 100907.024	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1010	PSF 100907.025	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1010	PSF mpmix1010	--, 30°/0°, 0.35-0.86 µm, 30 msec, 1000 avg., ~0.3 nm resol. Ocean Optics (090430oo directory).
MPMIX1010	PSF mpmix1010	--, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (directory).
MPMIX1011	PSF 100907.026	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1012	PSF 090313a.040	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
MPMIX1012	PSF mpmix1012	--, 30°/0°, 0.35-0.86 µm, 30 msec, 1000 avg., ~0.3 nm resol. Ocean Optics (090430oo directory).
MPMIX1012	PSF mpmix1012	--, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
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15.8.4d. Series 3b: PYX042 + MET101A (45-90 µm)

MPMIX1101	PSF 100907.027	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1102	PSF 100907.028	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MPMIX1103	PSF 100907.029	--; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
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15.8.5d. Series 4: PYX032 + MET01 (both <45 µm); (high-Fe opx + metal)

PYX032	PSF jun0707.005	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol.; 1000 spectra avgd; ASD.
MET101	PSF 100907.026	<45 µm; i=35°, e=0°; 0.35-2.5 µm; 2-7 nm resol.; 1000 spectra averaged; ASD (directory: 100907); aka MPMIX1011.
MPMIX3000	PSF 090313a.042	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.

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15.8.6d. Series 5: Orthopyroxene (PYX070) + Metal (MET01), both <45 µm

PYX070	PSF 090313a.021	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 1000 spectra averaged; ASD (directory: 090313a).
MET101	PSF 100907.026	<45 µm; i=35°, e=0°; 0.35-2.5 µm; 2-7 nm resol.; 1000 spectra averaged; ASD (directory: 100907); aka MPMIX1011.
MPMIX4000	PSF 090319a.001	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm

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15.8.7d. Series 6: Orthopyroxene (MET020/PYX207) + Metal (MET01), both <45 µm

MET020	PSF 091118a.019	unsorted; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol.; 1000 spectra averaged; ASD (directory: 091103_Gaffmet); aka PYX207.
MET101	PSF 100907.026	<45 µm; i=35°, e=0°; 0.35-2.5 µm; 2-7 nm resol.; 1000 spectra averaged; ASD (directory: 100907); aka MPMIX1011.
MPMIX5000	PSF 090319a.002	<45 µm, 30°/0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD; data noisy beyond 1.8 µm.

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15.8.8d. CC simulants: Orthopyroxene (PYX032, <45 µm) + carbon black (LCA101)

PYX032	PSF100413a.006	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX011	PSF 100413a.007	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX012	PSF 100413a.008	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX013	PSF 100413a.009	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX014	PSF 100413a.010	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
LCA101	PSF 100420a.008	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100420_Carbon).

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15.8.9a. Orthopyroxene (PYX032; <45 µm) sprinkled on Odessa iron meteorite slab (MET01; roughened with 120 grit sandpaper)

See section 16 (Meteorites) for spectra.

PXMETS01	PSF 121101a.018?	100% PYX042; <45 µm, in sample cup.
PXMETS02	PSF 121101a.019	MET01 slab, no pyroxene coating.
PXMETS03	PSF 121101a.020	MET01 with light pyroxene coating
PXMETS04	PSF 121101a.021	MET01 with heavier pyroxene coating
PXMETS05	PSF 121101a.022	MET01 with uber-heavy pyroxene coating
PXMETS06	PSF 121101a.023	MET01 with lightest pyroxene coating

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15.9d. Orthopyroxene + palagonite or hematite

MIX501	RELAB C1MX01	--; 30°/0°, 0.3-2.6µm, 5 nm.

MIX501	RELAB LAMX01	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged Relab+Nicolet@2.5µm, viewing geom. change).
MIX502	RELAB C1MX02	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX502	RELAB LAMX02	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX503	RELAB C1MX03	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX503	RELAB LAMX03	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX504	RELAB C1MX04	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX504	RELAB LAMX04	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX505	RELAB C1MX05	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX505	RELAB LAMX05	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX506	RELAB C1MX06	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX506	RELAB LAMX06	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX507	RELAB C1MX07	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX507	RELAB LAMX07	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX508	RELAB C1MX08	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX508	RELAB LAMX08	--; 30/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX509	RELAB C1MX09	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX509	RELAB LAMX09	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX510	RELAB C1MX10	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX510	RELAB LAMX10	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX511	RELAB C1MX11	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX511	RELAB LAMX11	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX512	RELAB C1MX12	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX512	RELAB LAMX12	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX515	RELAB C1MX15	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX515	RELAB LAMX15	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX516	RELAB C1MX16	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX516	RELAB LAMX16	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX517	RELAB C1MX17	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX517	RELAB LAMX17	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
MIX518	RELAB C1MX18	--; 30°/0°, 0.3-2.6µm, 5 nm.
MIX518	RELAB LAMX18	--; 30°/0°,30°, 0.3-26µm, 5, 0.6-129 nm res. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
PYX110	RELAB lapp47a	<45 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
PYX110	RELAB lapp47b	45-90 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
PAL101	RELAB lapa03a	<45 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
PAL102	RELAB lapa04a	<45 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (Merged RELAB+Nicolet @2.5µm, viewing geom. change).
HEM101	RELAB lahe01a	<140 nm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (Merged

RELAB+Nicolet @2.5µm, viewing geom. change).

See sections 2.1 (Pyroxenes), section 12 (palagonites), and section 9.6 (hematite) for (additional) end member spectra.

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15.10d. Metal + accessory phases: carbon black, troilite

MIX270	RELAB C1SC20	--, 0E/15E, 0.34-2.7µm, 5nm.
MIX275	RELAB C1SC93	--, 0E/15E, 0.3-2.7µm, 5nm.
MET101	RELAB c1sc63	<45 µm beaten; 0°/15°; 0.3-2.7 µm; 5 nm.
MET101	RELAB c1sc06	45-90 µm beaten; 0°/15°; 0.3-2.7 µm; 5 nm.
LCA101	RELAB c1sc24	<0.021 µm; 0°/15°; 0.34-2.7 µm; 5 nm.
TRO201	RELAB c1sc64	<45 µm; 0°/15°; 0.3-2.7 µm; 5 nm.

See also sections 1 (LCA) and 16 for (additional) end member spectra.

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15.11d. Aubrite + troilite

MIX400	RELAB C1EA05	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MIX401	RELAB C1EA06	45-90/<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
MIX401	RELAB c1ea07	<45µm, 30°/0°, 0.3-2.6 µm, 5 nm.
MIX401	RELAB laea07	<45, 30°/0°,30°; 0.3-26 µm, 5/ 0.6-129 nm (merged RELAB + Nicolet; note changed viewing geometry.
MET200	RELAB caea03	45-90 µm; 30°/0°; 0.3-2.6 µm; 5nm.
MET201	RELAB cbea04	<45 µm; 30°/0°; 0.3-2.6 µm; 5 nm.
MET201	RELAB caea04	45-90 µm; 30°/0°; 0.3-2.6 µm; 5nm.
TRO202	RELAB cbea02	<45 µm; 30°/0°; 0.3-2.6 µm; 5 nm.
TRO202g	RELAB cgea02	<45 µm; 30°/0°; 0.3-2.6 µm; 5nm.

See also sections 16 for (additional) end member spectra.

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15.12d. Diaspore + other phases

MIX530	RELAB c1mx40	30°/0°, 0.3-2.6µm, 5 nm.
MIX530	RELAB lamx40	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet @2.5µm, viewing geometry change).
MIX531	RELAB c1mx41	30°/0°, 0.3-2.6µm, 5 nm.
MIX531	RELAB lamx41	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet @2.5µm, viewing geometry change).
MIX532	RELAB c1mx42	30°/0°, 0.3-2.6µm, 5 nm.
MIX532	RELAB lamx42	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet @2.5µm, viewing geometry change).
MIX533	RELAB c1mx43	30°/0°, 0.3-2.6µm, 5 nm.
MIX533	RELAB lamx43	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet @2.5µm, viewing geometry change).
MIX534	RELAB c1mx44	30°/0°, 0.3-2.6µm, 5 nm.
MIX534	RELAB lamx44	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet @2.5µm, viewing geometry change).
MIX535	RELAB c1mx45	30°/0°, 0.3-2.6µm, 5 nm.
MIX535	RELAB lamx45	30°/0°,30°; 0.3-26µm, 5/0.6-129 nm (merged RELAB+Nicolet @2.5µm, viewing geometry change).
MIX536	RELAB c1mx46	30°/0°, 0.3-2.6µm, 5 nm.
MIX536	RELAB lamx46	30°/0°,30°, 0.3-26µm, 5/0.6-129 nm (merged RELAB + Nicolet @2.5µm, viewing geometry change).
MIX537	RELAB c1mx47	30°/0°, 0.3-2.6µm, 5 nm.
MIX537	RELAB lamx47	30°/0°,30°, 0.3-26µm, 5/0.6-129 nm (merged RELAB + Nicolet @2.5µm, viewing geometry change).
MIX540	RELAB c1mx50	30°/0°, 0.3-2.6µm, 5 nm.
MIX540	RELAB lamx50	30°/0°,30°, 0.3-26µm, 5/0.6-129 nm (merged RELAB + Nicolet @2.5µm,

		viewing geometry change).
MIX541	RELAB c1mx51	30°/0°, 0.3-2.6µm, 5 nm.
MIX541	RELAB lamx51	30°/0°,30°, 0.3-26µm, 5/0.6-129 nm (merged RELAB + Nicolet @2.5µm, viewing geometry change).
MIX542	RELAB c1mx52	30°/0°, 0.3-2.6µm, 5 nm.
MIX542	RELAB lamx52	30°/0°,30°, 0.3-26µm, 5/0.6-129 nm (merged RELAB + Nicolet @2.5µm, viewing geometry change).
MIX630	RELAB c1mx53	30°/0°, 0.3-2.5µm, 5 nm resol.
MIX630	RELAB mamx53	30°/30°, 2.5-25µm, 0.6-129 nm resol. (Nicolet).
MIX630	RELAB lamx53	30°/0°,30°, 0.3-25µm, 5/0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
MIX631	RELAB c1mx54	30°/0°, 0.3-2.5µm, 5 nm resol.
MIX631	RELAB mamx54	30°/30°, 2.5-25µm, 0.6-129 nm resol. (Nicolet).
MIX631	RELAB lamx54	30°/0°,30°, 0.3-25µm, 5/0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
MIX632	RELAB c1mx55	30°/0°, 0.3-2.5µm, 5 nm resol.
MIX632	RELAB mamx55	30°/30°, 2.5-25µm, 0.6-129 nm resol. (Nicolet).
MIX632	RELAB lamx55	30°/0°,30°, 0.3-25µm, 5/0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
MIX633	RELAB c1mx56	30°/0°, 0.3-2.5µm, 5 nm resol.
MIX633	RELAB mamx56	30°/30°, 2.5-25µm, 0.6-129 nm resol. (Nicolet).
MIX633	RELAB lamx56	30°/0°,30°, 0.3-25µm, 5/0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
	+++++ end member spectra++++++	
OOH012	RELAB caho121	<45 µm; 30°/0°; 0.3-2.6 µm; 5nm resol. (RELAB).
OOH012	RELAB cboh12	45-90 µm; 30°/0°; 0.3-2.6 µm; 5nm resol. (RELAB).
OOH012	RELAB laho12a	<45 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
OOH012	RELAB laho12b	45-90 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
OOH013	RELAB caho131	<45 µm; 30°/0°; 0.3-2.6 µm; 5nm resol. (RELAB).
PAL102	RELAB capa04	<45 µm; 30°/0°; 0.3-2.6 µm; 5 nm resol. (RELAB).
PAL102	RELAB lapa04a	<45 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
PAL102x	RELAB c1pa13	<45 µm; 30°/0°; 0.3-2.6 µm; 5nm resol. (RELAB).
PAL102x	RELAB lapa13	<45 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
PYX110	RELAB capp47	<45 µm; 30°/0°; 0.3-2.6 µm; 5 nm resol. (RELAB).
PYX110	RELAB lapp47a	<45 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
PYX110	RELAB mapp47a	<45 µm; 30°/30°; 1.8-26 µm; 0.6-129 nm resol. (Nicolet).
QUA101	RELAB c1qz04	<45 µm; 30°/0°; 0.3-2.6 µm; 5 nm resol. (RELAB).
QUA101	RELAB laqz04	<45 µm; 30°/0°,30°; 0.3-26 µm; 5, 0.6-129 nm resol. (merged RELAB + Nicolet at 2.5 µm, viewing geometry change).
QUA101	RELAB maqz04	<45 µm; 30°/30°; 1.8-26 µm; 0.6-129 nm resol. (Nicolet).

See sections 6 (hydroxides), 12 (palagonites) 2.1 (pyroxenes), and 2.11 (quartz) for (additional) end member spectra.

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15.13d. Carbonates/nitrites + basalt or palagonite (for analysis of Mars Express PFS spectra)

MIXI01	PSF apr0506.005	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI01	PSF mixi01.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI02	PSF apr0506.011	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI02	PSF mixi02.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI03	PSF apr0506.017	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.

MIXI03	PSF mixi03.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI03	PSF 090421a.022	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
MIXI11	PSF apr0506.006	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI11	PSF mixi11.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI12	PSF apr0506.012	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI12	PSF mixi12.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI13	PSF apr0506.018	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI13	PSF mixi13.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI13	PSF 090421a.023	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
MIXI21	PSF apr0506.007	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI21	PSF mixi21.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI22	PSF apr0506.013	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI22	PSF mixi22.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI23	PSF apr0506.019	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI23	PSF mixi23.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI23	PSF 090421a.024	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
MIXI31	PSF apr0506.008	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI31	PSF mixi31.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI32	PSF apr0506.014	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI32	PSF mixi32.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI33	PSF apr0506.020	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI33	PSF mixi33.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI33	PSF 090421a.025	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
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MIXI41	PSF apr0506.009	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI41	PSF mixi41.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI42	PSF apr0506.015	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI42	PSF mixi42.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI43	PSF apr0506.021	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI43	PSF mixi43.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI43	PSF 090421a.026	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
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MIXI51	PSF apr0506.010	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI51	PSF mixi51.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI52	PSF apr0506.016	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI52	PSF mixi52.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.
MIXI53	PSF apr0506.022	i=0°, e=0°, bifurcated probe; ASD spectra, 0.35-2.5 µm, 1 nm nominal.
MIXI53	PSF mixi53.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative

		to Infragold.
MIXI53	PSF 090421a.027	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
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MIXI61	PSF mixi61.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; bad spectrum.
MIXI61	PSF amixi61.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold.; D&P; bad spectrum.
MIXI61	PSF mixi61dp.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; good spectrum.
MIXI61	PSF mixi61dp2.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; good spectrum.
MIXI61	PSF 090421a.028	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
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MIXI62	PSF mixi62.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; bad spectrum.
MIXI62	PSF amixi62.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; bad spectrum.
MIXI62	PSF mixi62dp.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; good spectrum.
MIXI62	PSF mixi62dp2.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; good spectrum.
MIXI62	PSF 090421a.029	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
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MIXI63	PSF mixi63.rtx.asc	i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
MIXI75	PSF mixi75feb01.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
MIXI75	PSF 090421a.030	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
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MIXI76	PSF mixi76feb01.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
MIXI76	PSF 090421a.031	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
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MIXI77	PSF mixi77feb01.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
MIXI77	PSF 090421a.032	i=30°, e=0°, 0.35-2.5 µm, 1 nm resol., 1000 avg.; ASD.
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CRB105	PSF apr0506.003	<45 µm; i=e=0° (bifurcated cable); 0.35-2.5 µm; 2-7 nm resolution (1 nm output); 2000 spectra avgd.; ASD (directory: apr0506).
CRB105	PSF crb105.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
CRB114	PSF apr0506.002	<45 µm; i=e=0° (bifurcated cable); 0.35-2.5 µm; 2-7 nm resolution (1 nm output); 2000 spectra avgd.; ASD (directory: apr0506).
CRB114	PSF crb114.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
CRB126	PSF crb126.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality; smoothed.
CRB126	PSF crb126nosm.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality; unsmoothed.
CRB126	PSF crb126dp.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; good spectrum.
CRB126	PSF crb126dp2.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; good spectrum.
CRB215	PSF apr0506.004	<45 µm; i=e=0° (bifurcated cable); 0.35-2.5 µm; 2-7 nm resolution (1 nm output); 2000 spectra avgd.; ASD (directory: apr0506).
CRB215	PSF crb215feb01.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol.

		relative to Infragold; D&P; unknown quality.
NTR001	PSF	unsorted; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
PAL103	PSF apr0506.000	<45 µm; i=e=0° (bifurcated cable); 0.35-2.5 µm; 2-7 nm resolution (1 nm output); 2000 spectra avgd.; ASD (directory: apr0506).
PAL103	PSF pal103feb01.rtx.asc	45-90 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
SA14	PSF apr0506.001	<45 µm; i=e=0° (bifurcated cable); 0.35-2.5 µm; 2-7 nm resolution (1 nm output); 2000 spectra avgd.; ASD (directory: apr0506).
SA14	PSF sa14.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
SA14b	PSF sa14b.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
SA51	PSF sa51feb01.rtx.asc	45-90 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality.
SYN009	PSF syn009.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality; smoothed.
SYN009	PSF syn009nosm.rtx.asc	<45 µm; i=35°, e=0°, D&P FTIR, 2-16 µm, no thermal correct, 6 cm^{-1} resol. relative to Infragold; D&P; unknown quality; unsmoothed.

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<u>15.13.1d. Magnesite (CRB114, <45 µm) + palagonite (PAL103, <45 µm) intimate mixtures</u>

PAL103	PSF 110531a.006	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra avgd, ASD (directory: 110531_palagonite)
PAL103	PSF pal103 100%.dpt	<45 µm; i=30°, e=0°; 1.67-25.4 µm; 8 cm^{-1} resolution, Bruker (directory: 110531)
MIX43	PSF 110531a.010	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra averaged, ASD (directory: 110531_palagonite).
MIXI81	PSF 110531a.009	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra avgd, ASD (directory: 110531_palagonite)
MIXI81	PSF crb114 10%.dpt	<45 µm; i=30°, e=0°; 1.67-25.4 µm; 8 cm^{-1} resolution, Bruker (directory: 110531)
MIXI82	PSF 110531a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra avgd, ASD (directory: 110531_palagonite)
MIXI83	PSF 110531a.004	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra avgd, ASD (directory: 110531_palagonite)
MIXI83	PSF crb114 40%.dpt	<45 µm; i=30°, e=0°; 1.67-25.4 µm; 8 cm^{-1} resolution, Bruker (directory: 110531)
MIXI84	PSF 110531a.003	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra avgd, ASD (directory: 110531_palagonite)
MIXI84	PSF crb114 60%.dpt	<45 µm; i=30°, e=0°; 1.67-25.4 µm; 8 cm^{-1} resolution, Bruker (directory: 110531)
MIXI85	PSF 110531a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra avgd, ASD (directory: 110531_palagonite)
MIXI85	PSF crb114 80%.dpt	<45 µm; i=30°, e=0°; 1.67-25.4 µm; 8 cm^{-1} resolution, Bruker (directory: 110531)
CRB114	PSF 110531a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra avgd, ASD (directory: 110531_palagonite)
CRB114	PSF crb114 100%.dpt	<45 µm; i=30°, e=0°; 1.67-25.4 µm; 8 cm^{-1} resolution, Bruker (directory: 110531)

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<u>15.13.2d. Palagonite dust (PAL103, <45 µm) on magnesite (CRB114, <45 µm)</u>

Note: progressively thicker dust coatings on the same sample

CRB114	PSF 110606a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 250 spectra avgd; ASD (no

		dust – pure magnesite) (directory 110606_dust)
CRB114	PSF crb114 clean.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (no dust – pure magnesite) (directory 110606 Dust Coatings)
PAL103	PSF 110606a.002	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (pure palagonite) (directory 110606_dust)
PAL103	PSF pal103.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (pure palagonite) (directory 110606 Dust Coatings)
Dust drop 1	PSF 110606a.003	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (102 μm thick dust coating) (directory 110606_dust)
Dust drop 1	PSF crb114 drop 1.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (102 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 2	PSF 110606a.004	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (152 μm thick dust coating) (directory 110606_dust)
Dust drop 2	PSF crb114 drop 2.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (152 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 3	PSF 110606a.005	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (190 μm thick dust coating) (directory 110606_dust)
Dust drop 3	PSF crb114 drop 3.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (190 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 4	PSF 110606a.006	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (260 μm thick dust coating) (directory 110606_dust)
Dust drop 4	PSF crb114 drop 4.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (260 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 5	PSF 110606a.007	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (283 μm thick dust coating) (directory 110606_dust)
Dust drop 5	PSF crb114 drop 5.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (283 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 6	PSF 110606a.008	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (381 μm thick dust coating) (directory 110606_dust)
Dust drop 6	PSF crb114 drop 6.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (381 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 7	PSF 110606a.009	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (403 μm thick dust coating) (directory 110606_dust)
Dust drop 7	PSF crb114 drop 7.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (403 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 8	PSF 110606a.010	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (465 μm thick dust coating) (directory 110606_dust)
Dust drop 8	PSF crb114 drop 8.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (465 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 9	PSF 110606a.011	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (499 μm thick coating) (directory 110606_dust)
Dust drop 9	PSF crb114 drop 9.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (499 μm thick coating) (directory 110606 Dust Coatings)
Dust drop 10	PSF 110606a.012	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output, 250 spectra avgd; ASD (525 μm thick coating) (directory 110606_dust)
Dust drop 10	PSF crb114 drop 10.dpt	<45 μm; i=30°, e=0°; 1.67-25.4 μm; 8 cm^{-1} resolution, Bruker (525 μm thick coating) (directory 110606 Dust Coatings)

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15.14d. Two clay mixtures (August 2007, for Encana project)

EMIX1	PSF emix0823.002	i=35°, e=0°; 0.35-2.5 μm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
EMIX2	PSF emix0823.003	i=35°, e=0°; 0.35-2.5 μm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
EMIX3	PSF emix0823.004	i=35°, e=0°; 0.35-2.5 μm; 1 nm resol.; 1000 averaged spectra; ASD

		(directory: emix0823).
EMIX4	PSF emix0823.005	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
EMIX5	PSF emix0823.006	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
EMIX6	PSF emix0823.007	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
EMIX7	PSF emix0823.008	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
ILS104	PSF emix0823.011	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823) (directory: emix0823).
KAO104	PSF emix0823.009	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).
MON103	PSF emix0823.010	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (directory: emix0823).

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15.15d. Gypsum + basalt + palagonite (Aug. 2007 for Mars polar dunes)

MIXB01	PSF 090807.002	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB02	PSF 090807.003	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB03	PSF 090807.004	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB04	PSF 090807.005	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB05	PSF 090807.006	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB06	PSF 090807.007	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB07	PSF 090807.008	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB08	PSF 090807.009	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB012	PSF 090807.012	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB013	PSF 090807.013	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD; aka Rough basalt (Aug.9, 2007).
MIXB014	PSF 090807.014	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD; aka Red basalt (Aug.9, 2007).
MIXB015	PSF 090807.015	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB016	PSF 090807.016	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB017	PSF 090807.017	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB018	PSF 090807.018	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXBz	PSF 090807.019	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB	PSF 090807.020	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).
MIXB	PSF 090807.021	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD; repacked (Aug.9, 2007).
MIXBx	PSF 090807.022	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).

MIXBx	PSF 090807.023	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD; repacked (Aug.9, 2007).
MIXBu	PSF 090807.024	i=35°, e=0°; 0.35-2.5 µm; 1 nm resol.; 1000 averaged spectra; ASD (Aug.9, 2007).

Also see sections 8 (Sulphates), 11 (Basalts), and 13 (palagonites) for (additional) end member spectra.

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15.16d. Barium sulfate + pyroxene (for Loredana Pompillio)

lormix001	PSF oct1107.001	45-90 µm ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD; aka PYX023 (45-90 µm).
lormix002	PSF oct1107.002	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix003	PSF oct1107.003	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix004	PSF oct1107.004	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix005	PSF oct1107.005	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix006	PSF oct1107.006	45-90 µm ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD; aka PYX005 (45-90 µm).
lormix007	PSF oct1107.007	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix008	PSF oct1107.008	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix009	PSF oct1107.009	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix010	PSF oct1107.010	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix011	PSF oct1107.011	45-90 µm ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD; aka PYX032 (45-90 µm).
lormix012	PSF oct1107.012	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix013	PSF oct1107.013	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix014	PSF oct1107.014	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
lormix015	PSF oct1107.015	-- ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.
BaSO4	PSF oct1107.016	~10-15 µm ; i=30°/e=0° ; 0.35-2.5 µm ; 1 nm resol. ; 1000 averaged spectra ; ASD.

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15.17d. Pancam mixtures for Melissa Rice

rmix001	PSF 080619a.014	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
rmix001	PSF 080619a.015	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
rmix001	PSF 080619a.016	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
rmix002	PSF 080619a.019	--; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
rmix002	PSF 080619a.020	--; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
rmix003	PSF 080619a.021	--; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
rmix003	PSF 080619a.022	--; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
rmix003	PSF 080619a.023	--; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
rmix004	PSF 080619a.024	<45 µm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
rmix004	PSF 080619a.025	<45 µm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
rmix004	PSF 080619a.026	<45 µm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SA-60	PSF 080619a.017	whole rock slab surface; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SA-60	PSF 080619a.018	whole rock slab surface; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm

		resampled; 200 spectra averaged, ASD.
SIL203	PSF 080619a.008	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SIL203	PSF 080619a.009	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SIL203	PSF 080619a.010	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SPT162	PSF 080619a.011	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SPT162	PSF 080619a.012	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SPT162	PSF 080619a.013	<1 mm; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.

See also sections 8 (sulfates) and 13 (palagonites) for (additional) end member spectra.

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15.19d. Basalt + ilmenite (Sept. 2009).

LAN001	PSF 090929c.001	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra avgd, ASD.
LAN001	PSF 091021 LAN001	<45 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source.
LAN001	PSF 091015 LAN001	<45 µm; i=0°/e=0° (bifurcated probe); 0.35-0.86 µm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.
LAN001	PSF LAN001 merged	Merged Oceaan Optics UV + visible spectra.
LAN002	PSF 090929c.002	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra avgd, ASD.
LAN002	PSF 091021 LAN002	<45 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source.
LAN002	PSF 091015 LAN002	<45 µm; i=0°/e=0° (bifurcated probe); 0.35-0.86 µm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.
LAN002	PSF LAN002 merged	Merged Oceaan Optics UV + visible spectra.
LAN003	PSF 090929c.003	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra avgd, ASD.
LAN003	PSF 091021 LAN003	<45 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source.
LAN003	PSF 091015 LAN003	<45 µm; i=0°/e=0° (bifurcated probe); 0.35-0.86 µm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.
LAN003	PSF LAN003 merged	Merged Oceaan Optics UV + visible spectra.
LAN004	PSF 090929c.004	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra avgd, ASD.
LAN004	PSF 091021 LAN004	<45 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source.
LAN004	PSF 091015 LAN004	<45 µm; i=0°/e=0° (bifurcated probe); 0.35-0.86 µm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.
LAN004	PSF LAN004 merged	Merged Oceaan Optics UV + visible spectra.
LAN005	PSF 090929c.005	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra avgd, ASD.
LAN005	PSF 091021 LAN005	<45 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source.
LAN005	PSF 091015 LAN005	<45 µm; i=0°/e=0° (bifurcated probe); 0.35-0.86 µm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.
LAN005	PSF LAN005 merged	Merged Oceaan Optics UV + visible spectra.
LAN006	PSF 090929c.006	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra avgd, ASD.
LAN006	PSF 091021 LAN006	<45 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source.
LAN006	PSF 091015 LAN006	<45 µm; i=0°/e=0° (bifurcated probe); 0.35-0.86 µm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.
LAN006	PSF LAN006 merged	Merged Oceaan Optics UV + visible spectra.
LAN007	PSF 090929c.007	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra avgd, ASD.
LAN007	PSF 091021 LAN007	<45 µm; i=0°/e=0° (bifurcated probe); 0.2-0.4 µm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source.

LAN007	PSF 091015 LAN007	<45 μm; i=0°/e=0° (bifurcated probe); 0.35-0.86 μm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.
LAN007	PSF LAN007 merged	Merged Oceaan Optics UV + visible spectra.
LAN008	PSF 090929c.008	<45 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra avgd, ASD.
LAN008	PSF 091021 LAN008	<45 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resolution; 1500 msec, 100 spectra averaged; Ocean Optics S2000 and D2 source.
LAN008	PSF 091015 LAN008	<45 μm; i=0°/e=0° (bifurcated probe); 0.35-0.86 μm; ~0.3 nm resolution; 40 msec, 1000 spectra averaged; Ocean Optics S2000, QTH 50W source.
LAN008	PSF LAN008 merged	Merged Oceaan Optics UV + visible spectra.
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LAN101	PSF 091006a.001	<45 with 90-250 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
LAN101	PSF 091021 LAN101	<45 with 90-250 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resol.; 1500 msec, 100 spectra avgd; Ocean Optics S2000 and D2 source.
LAN101	PSF 091015 LAN101	<45 μm with 90-250 μm; i=0°/e=0° (bifurc. probe); 0.35-0.86 μm; ~0.3 nm resol.; 40 msec, 1000 spectra avgd; Ocean Optics S2000, QTH 50W.
LAN101	PSF LAN101 merged	Merged Oceaan Optics UV + visible spectra.
LAN102	PSF 091006a.002	<45 with 90-250 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
LAN102	PSF 091021 LAN102	<45 with 90-250 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resol.; 1500 msec, 100 spectra avgd; Ocean Optics S2000 and D2 source.
LAN102	PSF 091015 LAN102	<45 μm with 90-250 μm; i=0°/e=0° (bifurc. probe); 0.35-0.86 μm; ~0.3 nm resol.; 40 msec, 1000 spectra avgd; Ocean Optics S2000, QTH 50W.
LAN102	PSF LAN102 merged	Merged Oceaan Optics UV + visible spectra.
LAN103	PSF 091006a.003	<45 with 90-250 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
LAN103	PSF 091021 LAN103	<45 with 90-250 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resol.; 1500 msec, 100 spectra avgd; Ocean Optics S2000 and D2 source.
LAN103	PSF 091015 LAN103	<45 μm with 90-250 μm; i=0°/e=0° (bifurc. probe); 0.35-0.86 μm; ~0.3 nm resol.; 40 msec, 1000 spectra avgd; Ocean Optics S2000, QTH 50W.
LAN103	PSF LAN103 merged	Merged Oceaan Optics UV + visible spectra.
LAN104	PSF 091006a.004	<45 with 90-250 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
LAN104	PSF 091021 LAN104	<45 with 90-250 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resol.; 1500 msec, 100 spectra avgd; Ocean Optics S2000 and D2 source.
LAN104	PSF 091015 LAN104	<45 μm with 90-250 μm; i=0°/e=0° (bifurc. probe); 0.35-0.86 μm; ~0.3 nm resol.; 40 msec, 1000 spectra avgd; Ocean Optics S2000, QTH 50W.
LAN104	PSF LAN104 merged	Merged Oceaan Optics UV + visible spectra.
LAN105	PSF 091006a.005	<45 with 90-250 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
LAN105	PSF 091021 LAN105	<45 with 90-250 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resol.; 1500 msec, 100 spectra avgd; Ocean Optics S2000 and D2 source.
LAN105	PSF 091015 LAN105	<45 μm with 90-250 μm; i=0°/e=0° (bifurc. probe); 0.35-0.86 μm; ~0.3 nm resol.; 40 msec, 1000 spectra avgd; Ocean Optics S2000, QTH 50W.
LAN105	PSF LAN105 merged	Merged Oceaan Optics UV + visible spectra.
LAN106	PSF 091006a.006	<45 with 90-250 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
LAN106	PSF 091021 LAN106	<45 with 90-250 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resol.; 1500 msec, 100 spectra avgd; Ocean Optics S2000 and D2 source.
LAN106	PSF 091015 LAN106	<45 μm with 90-250 μm; i=0°/e=0° (bifurc. probe); 0.35-0.86 μm; ~0.3 nm resol.; 40 msec, 1000 spectra avgd; Ocean Optics S2000, QTH 50W.
LAN106	PSF LAN106 merged	Merged Oceaan Optics UV + visible spectra.
LAN107	PSF 091006a.007	<45 with 90-250 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
LAN107	PSF 091021 LAN107	<45 with 90-250 μm; i=0°/e=0° (bifurcated probe); 0.2-0.4 μm; ~0.3 nm resol.; 1500 msec, 100 spectra avgd; Ocean Optics S2000 and D2 source.

LAN107	PSF 091015 LAN107	<45 μm with 90-250 μm; i=0°/e=0° (bifurc. probe); 0.35-0.86 μm; ~0.3 nm resol.; 40 msec, 1000 spectra avgd; Ocean Optics S2000, QTH 50W.
LAN107	PSF LAN107 merged	Merged Oceaan Optics UV + visible spectra.

Also see sections 9.5 (Ilmenites) and 11 (Basalts) for (additional) end member spectra.
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15.20d. Carbonaceous chondrite simulants

15.20.1d. Serpentinite (SRP117, <45 μm; blue-sloped, with magnetite) + carbon black

SRP117	PSF100413a.001	<45 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX001	PSF 100413a.002	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX002	PSF 100413a.003	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX003	PSF 100413a.004	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX004	PSF 100413a.005	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
LCA101	PSF 100420a.008	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100420_Carbon).

Also see sections 1 (Carbon black) and 3 (Clays) for (additional) end member spectra.
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15.20.2d. Chlorite (CLI101 (clinochlore), <45 μm) + carbon black

CLI101	PSF100413a.011	<45 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX021	PSF 100413a.012	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX022	PSF 100413a.013	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX023	PSF 100413a.014	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX024	PSF 100413a.015	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
LCA101	PSF 100420a.008	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100420_Carbon).

Also see sections 1 (Carbon black) and 3 (Clays) for (additional) end member spectra.
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15.20.3d. Saponite (SAP101, <45 μm) + carbon black

SAP101	PSF100413a.016	<45 μm; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX031	PSF 100413a.017	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX032	PSF 100413a.018	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX033	PSF 100413a.019	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX034	PSF 100413a.020	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
LCA101	PSF 100420a.008	mixture; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100420_Carbon).

Also see sections 1 (Carbon black) and 3 (Clays) for (additional) end member spectra.
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15.20.4d. Synthetic brucite (OOH032, <45 µm) + carbon black

OOH032	PSF100413a.021	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX041	PSF 100413a.022	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX042	PSF 100413a.023	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX043	PSF 100413a.024	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX044	PSF 100413a.025	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
LCA101	PSF 100420a.008	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100420_Carbon).

Also see sections 1 (Carbon black) and 6 (hydroxides) for (additional) end member spectra.

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15.20.5d. Serpentinite (SRP106; flat-sloped, no magnetite, <45 µm) + carbon black

SRP106	PSF100413a.026	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX051	PSF 100413a.027	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX052	PSF 100413a.028	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX053	PSF 100413a.029	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
OMIX054	PSF 100413a.030	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100412_Carbon_black).
LCA101	PSF 100420a.008	mixture; i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd., ASD (Directory: 100420_Carbon).

Also see sections 1 (Carbon black) and 3 (Clays) for (additional) end member spectra.

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15.21d. CC simulants: serpentinite + graphite or magnetite

15.21.1d. Serpentinite (SRP117, <45 µm) + synthetic amorphous graphite (GRP102, <45 µm)

SRP117	PSF 100413a.001	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX335	PSF 100420a.010	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX336	PSF 100420a.011	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX337	PSF 100420a.012	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
GRP102	PSF 100420a.006	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).

Also see sections 1 (graphite) and 3 (Clays) for (additional) end member spectra.

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15.21.2d. Serpentinite (SRP117, <45 µm) + magnetite (MAG102, <45 µm)

SRP117	PSF 100413a.001	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX338	PSF 100420a.013	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).
MIX339	PSF 100420a.014	<45 µm, 30°/0°, 0.35-2.5 µm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).

MAG102	PSF 100420a.007	<45 μm, 30°/0°, 0.35-2.5 μm, 1 nm output, 1000 spectra avgd., ASD (Directory: 100420_carbon).

Also see sections 9.2 (magnetite) and 3 (Clays) for (additional) end member spectra.
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15.21.3d. Serpentine (SRP117, <45 μm) + nanophase magnetite (MAG200, <20 nm)

SRP117	PSF 110202a.001	<45 μm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX01	PSF 110202a.004	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX02	PSF 110202a.007	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX03	PSF 110202a.010	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX04	PSF 110202a.013	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
MAG200	PSF 100616a.011	20 nm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged, ASD (Directory: 100615_crypto; 100615_nano).

Also see sections 9.2 (magnetite) and 3 (Clays) for (additional) end member spectra.
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15.21.4d. Saponite (SAP103, <45 μm) + nanophase magnetite (MAG200, <20 nm)

SAP103	PSF 110202a.002	<45 μm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX11	PSF 110202a.005	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX12	PSF 110202a.008	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX13	PSF 110202a.011	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX14	PSF 110202a.014	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
MAG200	PSF 100616a.011	20 nm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged, ASD (Directory: 100615_crypto; 100615_nano).

Also see sections 9.2 (magnetite) and 3 (Clays) for (additional) end member spectra.
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15.21.5d. Cronstedtite (CRO101, <45 μm) + nanophase magnetite (MAG200, <20 nm)

CRO101	PSF 110202a.003	<45 μm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX21	PSF 110202a.006	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX22	PSF 110202a.009	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX23	PSF 110202a.012	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
CMIX24	PSF 110202a.015	<45 μm and <20 nm, 30°/0°, 0.35-2.5 μm, 1 nm output, 200 spectra avgd., ASD (Directory: 110202_clays).
MAG200	PSF 100616a.011	20 nm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged, ASD (Directory: 100615_crypto; 100615_nano).

Also see sections 9.2 (magnetite) and 3 (Clays) for (additional) end member spectra.
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15.22d. Glass and mafic mixtures – for Mars north polar region

15.22.1d. Tektite (TEK004, <45 μm) + clinopyroxene – spectral type B (PYX016, <45 μm)

TEK004	PSF 100412b.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
PYX016	PSF 100412b.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX001	PSF 100412b.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX002	PSF 100412b.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX003	PSF 100412b.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX004	PSF 100412b.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).

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15.22.2d. Tektite (TEK004, <45 µm) + olivine (OLV003, <45 µm)

TEK004	PSF 100412b.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
OLV003	PSF 100412b.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX011	PSF 100412b.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX012	PSF 100412b.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX013	PSF 100412b.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX014	PSF 100412b.011	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).

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15.22.3d. Tektite (TEK004, <45 µm) + orthopyroxene (PYX023, <45 µm)

TEK004	PSF 100412b.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
PYX023	PSF 100412b.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX021	PSF 100412b.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX022	PSF 100412b.014	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX023	PSF 100412b.015	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).
MIX024	PSF 100412b.016	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).

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TEK004	PSF 100429a.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100428_reruns).
PYX023	PSF 100429a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100428_reruns).
MIX021	PSF 100429a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100428_reruns).
MIX022	PSF 100429a.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100428_reruns).
MIX023	PSF 100429a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100428_reruns).
MIX024	PSF 100429a.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100428_reruns).

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15.23d. Asteroid Boznemcova simulants: type A CPX (PYX009) + PLG108 + OLV003

BOZ001	PSF mar3006.017	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
BOZ002	PSF mar3006.018	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
BOZ003	PSF mar3006.019	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
BOZ004	PSF mar3006.020	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
BOZ005	PSF mar3006.021	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
BOZ006	PSF mar3006.022	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
BOZ007	PSF mar3006.023	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
BOZ008	PSF mar3006.024	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
BOZ009	PSF mar3006.025	45-90 μm (all phases); 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
	++++ end member spectra ++++	
OLV003	PSF mar3006.009	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
OLV003	PSF mar3006.010	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
OLV101	PSF mar3006.005	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
OLV101	PSF mar3006.006	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
OLV103	PSF mar3006.007	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
OLV103	PSF mar3006.008	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PLG108	PSF mar3006.015	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PLG108	PSF mar3006.016	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PLG122	PSF mar3006.011	<450 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PLG122	PSF mar3006.012	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PYX009	PSF mar3006.000	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PYX009	PSF mar3006.014	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PYX020	PSF mar3006.001	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PYX020	PSF mar3006.002	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PYX150	PSF mar3006.003	<45 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PYX150	PSF mar3006.004	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].
PLG108	PSF mar3006.016	45-90 μm; 0°/0° (bifurcated cable); 0.35-2.5 μm; 1 nm output; 2000 spectra averaged; ASD [directory: mar3006].

See also sections 2.1(pyroxenes), 2.2 (olivines) and 2.3 (plagioclase) for (additional) end member spectra.

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15.24d. HED + CM2 carbonaceous chondrite mixtures (for Vesta)

Note: *Millbillillie = eucrite; Murchison = CM2 carbonaceous chondrite; PRA 04401 = CM2 xenolith-bearing howardite.*

Millbillillie eucrite + Murchison CM2 chondrite
PRA 04401 CM2 xenolith-bearing howardite
NWA 5748 howardite + Murchison CM2 chondrite
See Meteorites section (section 16.16) for spectra (and sample descriptions).
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15.25d. Spectral Data involving npFe-impregnated silica gel (2 sizes) or nanophase Fe (2 sizes) - Spectral data

ASD spectra: i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged (directory: 121016GLOVE BOX).
Ocean Optics S2000 spectra: 200-400 nm usable range; 0.36 nm spectral resolution; i=0°, e=0°; 100 or 300 spectra averaged (Directory: Ocean Optics 121121 npfe_silicagel and Ocean Optics 000).

Mixtures made with air-sensitive nanophase iron that was opened in glove box under dry nitrogen and carbon dioxide-free atmosphere (December 2012).

15.25.1d. Cherokee Springs LL6 chondrite: <250 μm + silica gel/nanophase iron.
15.25.2d. FJS-1 (JAXA Lunar Mare Simulant): <45, 45-90, and <250 μm + silica gel/nanophase iron.
15.25.3d. OLV003 (olivine): <45, 45-90, and <250 μm + silica gel/nanophase iron.
15.25.4d. PLG108 (plagioclase feldspar): <45, 45-90, and <250 μm + silica gel/nanophase iron.
15.25.5d. PYX016 (clinopyroxene; spectral type B): <45, 45-90, and <250 μm + silica gel/nanophase iron.
15.25.6d. PYX042 (orthopyroxene): <45, 45-90, and <250 μm + silica gel/nanophase iron.

15.25.1d. Sub250 – Cherokee Springs LL6 chondrite (whole rock) and <250 μm + SGE105A< SGE101A,. IRO102, or IRO103.
a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

See also section 16 of this document for Cherokee Springs LL6 chondrite information and any additional spectra, section 10 for IRO102 and IRO103, and section 12 for SGE101A and SGE105A.

Cherokee Springs Whole rock ASD PSF file: 121121a.035
Cherokee Springs Whole with metal inclusions ASD PSF file: 121121a.036

ZMIX035	100% Cherokee Springs LL6 (<250 μm). ASD PSF file: 121016a.053. OO PSF file: 53.
ZMIX035a	90% Cherokee Springs LL6 (<250 μm) + 10% SGE105A ASD PSF file: 121121a.044. OO PSF file: 44.
ZMIX035b	80% Cherokee Springs LL6 (<250 μm) + 20% SGE105A ASD PSF file: 121121a.045. OO PSF file: 45.
ZMIX035c	50% Cherokee Springs LL6 (<250 μm) + 50% SGE105A ASD PSF file: 121121a.046. OO PSF file: 46.
SGE105A	100% SGE105A ASD PSF file: 121121a.007. OO PSF file: 11.

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ZMIX035	100% Cherokee Springs LL6 (<250 μm). PSF file: 121016a.053. OO PSF file: 53.
ZMIX035d	90% Cherokee Springs LL6 (<250 μm) + 10% SGE101A ASD PSF file: 121121a.047. OO PSF file: 47.
ZMIX035e	80% Cherokee Springs LL6 (<250 μm) + 20% SGE101A ASD PSF file: 121121a.048. OO PSF file: 48.
ZMIX035f	50% Cherokee Springs LL6 (<250 μm) + 50% SGE101A ASD PSF file: 121121a.049. OO PSF file: 49.

SGE101A 100% SGE101A ASD PSF file: 121121a.007. OO PSF file: 7.
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ZMIX035 100% Cherokee Springs LL6 (<250 μm). ASD PSF file: 121016a.053. OO PSF file 53.
ZMIX036 99.9% Cherokee Springs LL6 (<250 μm) + 0.1% IRO102 (50 nm). ASD PSF file: 121016a.055. OO PSF file 55.
ZMIX037 99.5% Cherokee Springs LL6 (<250 μm) + 0.5% IRO102 (50 nm). ASD PSF file: 121016a.056. OO PSF file 56.
ZMIX038 99% Cherokee Springs LL6 (<250 μm) + 1% IRO102 (50 nm). ASD PSF file: 121016a.057. OO PSF file 57.
ZMIX039 98% Cherokee Springs LL6 (<250 μm) + 8% IRO102 (50 nm). ASD PSF file: 121016a.058. OO PSF file 58.
ZMIX040 95% Cherokee Springs LL6 (<250 μm) + 5% IRO102 (50 nm). ASD PSF file: 121016a.060. OO PSF file 60.
ZMIX041 90% Cherokee Springs LL6 (<250 μm) + 10% IRO102 (50 nm). ASD PSF file: 121016a.061. OO PSF file 61.
ZMIX042 80% Cherokee Springs LL6 (<250 μm) + 10% IRO102 (50 nm). ASD PSF file: 121016a.062. OO PSF file 62.
ZMIX043 70% Cherokee Springs LL6 (<250 μm) + 30% IRO102 (50 nm). ASD PSF file: 121016a.064. OO PSF file 64.
IRO102 100% IRO102 (50 nm). ASD PSF file: 121016a.015. OO PSF file 15.
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ZMIX035 100% Cherokee Springs LL6 (<250 μm). ASD PSF file: 121016a.053. OO PSF file 53.
ZMIX044 99.9% Cherokee Springs LL6 (<250 μm) + 0.1% IRO103 (10 μm). ASD PSF file: 121016a.067. OO PSF file 67.
ZMIX045 99.5% Cherokee Springs LL6 (<250 μm) + 0.5% IRO103 (10 μm). ASD PSF file: 121016a.068. OO PSF file 68.
ZMIX046 99% Cherokee Springs LL6 (<250 μm) + 1% IRO103 (10 μm). ASD PSF file: 121016a.069. OO PSF file 69.
ZMIX047 98% Cherokee Springs LL6 (<250 μm) + 2% IRO103 (10 μm). ASD PSF file: 121016a.070. OO PSF file 70.
ZMIX048 95% Cherokee Springs LL6 (<250 μm) + 5% IRO103 (10 μm). ASD PSF file: 121016a.071. OO PSF file 71.
ZMIX049 90% Cherokee Springs LL6 (<250 μm) +10% IRO103 (10 μm). ASD PSF file: 121016a.072. OO PSF file 72.
ZMIX050 80% Cherokee Springs LL6 (<250 μm) + 20% IRO103 (10 μm). ASD PSF file: 121016a.073. OO PSF file 73.
ZMIX051 70% Cherokee Springs LL6 (<250 μm) + 30% IRO103 (10 μm). ASD PSF file: 121016a.074. OO PSF file 74.
ZMIX010 100% IRO103 (10 μm). ASD PSF file: 121016a.013. OO PSF file 13.
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15.25.2d. FJS-1 (JAXA lunar mare simulant) <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

See also section 12 of this document for FJS-1 information and any additional spectra, section 10 for IRO102 and IRO103, and section 12 for SGE101A and SGE105A.

ZMIX052 100% FJS-1 (<250 μm) ASD PSF file: 121016a.083. OO PSF file: 83.
ZMIX052a 90% FJS-1 (<250 μm) + 10% SGE101A ASD PSF file: 121121a.029. OO PSF file: 29.
ZMIX052b 80% FJS-1 (<250 μm) + 20% SGE101A ASD PSF file: 121121a.030. OO PSF file: 30.
ZMIX052c 50% FJS-1 (<250 μm) + 50% SGE101A ASD PSF file: 121121a.031. OO PSF file: 31.
SGE101A 100% SGE101A ASD PSF file: 121121a.007. OO PSF file: 7.
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ZMIX052 100% FJS-1 (<250 μm) ASD PSF file: 121016a.083. OO PSF file: 83.

ZMIX052d	90% FJS-1 (<250 μm) + 10% SGE105A	ASD PSF file: 121121a.032. OO PSF file: 32.
ZMIX052e	80% FJS-1 (<250 μm) + 20% SGE105A	ASD PSF file: 121121a.033. OO PSF file: 33.
ZMIX052f	50% FJS-1 (<250 μm) + 50% SGE105A	ASD PSF file: 121121a.034. OO PSF file: 34.
SGE105A	100% SGE105A	ASD PSF file: 121121a.011. OO PSF file: 11.
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ZMIX127	100% FJS-1 (<45 μm)	ASD PSF file: 121016a.228. OO PSF file: 228.
ZMIX128	95% FJS-1 (<45 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.229. OO PSF file: 229.
ZMIX129	95% FJS-1 (<45 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.230. OO PSF file: 230.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX130	100% FJS-1 (45-90 μm)	ASD PSF file: 121016a.231. OO PSF file: 231.
ZMIX131	95% FJS-1 (45-90 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.233. OO PSF file: 233.
ZMIX132	95% FJS-1 (45-90 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.238. OO PSF file: 238.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX052	100% FJS-1 (<250 μm)	ASD PSF file: 121016a.083. OO PSF file: 83.
ZMIX053	99.9% FJS-1 (<250 μm) + 0.1% IRO102 (50 nm)	ASD PSF file: 121016a.084. OO PSF file: 84.
ZMIX054	99.5% FJS-1 (<250 μm) + 0.5% IRO102 (50 nm)	ASD PSF file: 121016a.085. OO PSF file: 85.
ZMIX055	99% FJS-1 (<250 μm) + 1% IRO102 (50 nm)	ASD PSF file: 121016a.087. OO PSF file: 87.
ZMIX056	98% FJS-1 (<250 μm) + 2% IRO102 (50 nm)	ASD PSF file: 121016a.088. OO PSF file: 88.
ZMIX057	95% FJS-1 (<250 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.089. OO PSF file: 89.
ZMIX058	90% FJS-1 (<250 μm) + 10% IRO102 (50 nm)	ASD PSF file: 121016a.090. OO PSF file: 90.
ZMIX059	80% FJS-1 (<250 μm) + 20% IRO102 (50 nm)	ASD PSF file: 121016a.091. OO PSF file: 91.
ZMIX060	70% FJS-1 (<250 μm) + 30% IRO102 (50 nm)	ASD PSF file: 121016a.093. OO PSF file: 93.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
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ZMIX052	100% FJS-1 (<250 μm)	ASD PSF file: 121016a.083. OO PSF file: 83.
ZMIX061	99.9% FJS-1 (<250 μm) + 0.1% IRO103 (10 μm)	ASD PSF file: 121016a.096. OO PSF file: 96.
ZMIX062	99.5% FJS-1 (<250 μm) + 0.5% IRO103 (10 μm)	ASD PSF file: 121016a.097. OO PSF file: 97.
ZMIX063	99% FJS-1 (<250 μm) + 1% IRO103 (10 μm)	ASD PSF file: 121016a.098. OO PSF file: 98.
ZMIX064	98% FJS-1 (<250 μm) + 2% IRO103 (10 μm)	ASD PSF file: 121016a.099. OO PSF file: 99.
ZMIX065	95% FJS-1 (<250 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.100. OO PSF file: 100.
ZMIX066	90% FJS-1 (<250 μm) + 10% IRO103 (10 μm)	ASD PSF file: 121016a.102. OO PSF file: 102.
ZMIX067	80% FJS-1 (<250 μm) + 20% IRO103 (10 μm)	ASD PSF file: 121016a.103. OO PSF file: 103.
ZMIX068	70% FJS-1 (<250 μm) + 30% IRO103 (10 μm)	ASD PSF file: 121016a.104. OO PSF file: 104.
IRO103	IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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<u>15.25.3d. OLV003 (olivine): <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.</u>

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

See also section 2.2 of this document for OLV003 information and any additional spectra, section 10 for IRO102 and IRO103, and section 12 for SGE101A and SGE105A.

ZMIX017	100% OLV003 (<250 μm)	ASD PSF file: 121016a.029. OO PSF file: 29 and 35.
ZMIX017a	90% OLV003 (<250 μm) + 10% SGE101A	ASD PSF file: 121121a.021. OO PSF file: 21.
ZMIX017b	80% OLV003 (<250 μm) + 20% SGE101A	ASD PSF file: 121121a.022. OO PSF file: 22.
ZMIX017c	50% OLV003 (<250 μm) + 50% SGE101A	ASD PSF file: 121121a.023. OO PSF file: 23.
SGE101A	100% SGE101A	ASD PSF file: 121121a.007. OO PSF file: 7.
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ZMIX017	100% OLV003 (<250 μm)	ASD PSF file: 121121a.029. OO PSF file: 29 and 35.
ZMIX017d	90% OLV003 (<250 μm) + 10% SGE105A	ASD PSF file: 121121a.025. OO PSF file: 25.

ZMIX017e	80% OLV003 (<250 μm) + 20% SGE105A	ASD PSF file: 121121a.026. OO PSF file: 26.
ZMIX017f	50% OLV003 (<250 μm) + 50% SGE105A	ASD PSF file: 121121a.027. OO PSF file: 27.
SGE105A	100% SGE105A	ASD PSF file: 121121a.011. OO PSF file: 11.
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ZMIX109	100% OLV003 (<45 μm) + 0% IRO102 or IRO103	ASD PSF file: 121016a.202. OO PSF file: 202.
ZMIX110	95% OLV003 (<45 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.203. OO PSF file: 203.
ZMIX111	95% OLV003 (<45 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.205. OO PSF file: 205.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX112	100% OLV003 (45-90 μm) + 0% IRO102 or IRO103	ASD PSF file: 121016a.206. OO PSF file: 206.
ZMIX113	95% OLV003 (45-90 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.207. OO PSF file: 207.
ZMIX114	95% OLV003 (45-90 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.208. OO PSF file: 208.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX017	100% OLV003 (<250 μm)	ASD PSF file: 121016a.029. OO PSF file: 29 and 35.
ZMIX019	99.9% OLV003 (<250 μm) + 0.1% IRO102 (50 nm)	ASD PSF file: 121016a.030. OO PSF file: 30.
ZMIX020	99.5% OLV003 (<250 μm) + 0.5% IRO102 (50 nm)	ASD PSF file: 121016a.032. OO PSF file: 32.
ZMIX021	99% OLV003 (<250 μm) + 1% IRO102 (50 nm)	ASD PSF file: 121016a.033
ZMIX022	98% OLV003 (<250 μm) + 2% IRO102 (50 nm)	ASD PSF file: 121016a.034. OO PSF file: 34.
ZMIX023	95% OLV003 (<250 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.035
ZMIX024	90% OLV003 (<250 μm) + 10% IRO102 (50 nm)	ASD PSF file: 121016a.036. OO PSF file: 36.
ZMIX025	80% OLV003 (<250 μm) + 20% IRO102 (50 nm)	ASD PSF file: 121016a.038. OO PSF file: 38.
ZMIX026	70% OLV003 (<250 μm) + 30% IRO102 (50 nm)	ASD PSF file: 121016a.040. OO PSF file: 40.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
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ZMIX017	100% OLV003 (<250 μm) + 0% IRO103 (10 μm)	ASD PSF file: 121016a.029. OO PSF file: 29 and 35.
ZMIX027	99.9% OLV003 (<250 μm) + 0.1% IRO103 (10 μm)	ASD PSF file: 121016a.042. OO PSF file: 42.
ZMIX028	99.5% OLV003 (<250 μm) + 0.5% IRO103 (10 μm)	ASD PSF file: 121016a.043
ZMIX029	99% OLV003 (<250 μm) + 1% IRO103 (10 μm)	ASD PSF file: 121016a.045. OO PSF file: 45.
ZMIX030	98% OLV003 (<250 μm) + 2% IRO103 (10 μm)	ASD PSF file: 121016a.046. OO PSF file: 47.
ZMIX031	95% OLV003 (<250 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.048. OO PSF file: 48.
ZMIX032	90% OLV003 (<250 μm) + 10% IRO103 (10 μm)	ASD PSF file: 121016a.049. OO PSF file: 49.
ZMIX033	80% OLV003 (<250 μm) + 20% IRO103 (10 μm)	ASD PSF file: 121016a.050. OO PSF file: 50.
ZMIX034	70% OLV003 (<250 μm) + 30% IRO103 (10 μm)	ASD PSF file: 121016a.051. OO PSF file: 51.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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15.25.4d. PLG108 (plagioclase feldspar): <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

See also section 2.3 of this document for PLG108 information and any additional spectra, section 10 for IRO102 and IRO103, and section 12 for SGE101A and SGE105A.

ZMIX086	100% PLG108 (<250 μm)	ASD PSF file: 121016a.136. OO PSF file: 136.
ZMIX086a	90% PLG108 (<250 μm) + 10% SGE101A	ASD PSF file: 121121a.015. OO PSF file: 15.
ZMIX086b	80% PLG108 (<250 μm) + 20% SGE101A	ASD PSF file: 121121a.016. OO PSF file: 16.
ZMIX086c	50% PLG108 (<250 μm) + 50% SGE101A	ASD PSF file: 121121a.017. OO PSF file: 17.
SGE101A	100% SGE101A	ASD PSF file: 121121a.007. OO PSF file: 7.
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ZMIX086	100% PLG108 (<250 μm)	ASD PSF file: 121016a.136. OO PSF file: 136.

ZMIX086d	90% PLG108 (<250 μm) + 10% SGE105A	ASD PSF file: 121121a.018. OO PSF file: 18.
ZMIX086e	80% PLG108 (<250 μm) + 20% SGE105A	ASD PSF file: 121121a.019. OO PSF file: 19.
ZMIX086f	50% PLG108 (<250 μm) + 50% SGE105A	ASD PSF file: 121121a.020. OO PSF file: 20.
SGE105A	100% SGE105A	ASD PSF file: 121121a.011. OO PSF file: 11.
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ZMIX121	100% PLG108 (<45 μm)	ASD PSF file: 121016a.219. OO PSF file: 219.
ZMIX122	95% PLG108 (<45 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.220. OO PSF file: 220.
ZMIX123	95% PLG108 (<45 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.223. OO PSF file: 223.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX124	100% PLG108 (45-90 μm)	ASD PSF file: 121016a.224. OO PSF file: 224.
ZMIX125	95% PLG108 (45-90 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.225. OO PSF file: 225.
ZMIX126	95% PLG108 (45-90 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.226. OO PSF file: 226.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX086	100% PLG108 (<250 μm)	ASD PSF file: 121016a.136. OO PSF file: 136.
ZMIX087	99.9% PLG108 (<250 μm) + 0.1% IRO103 (10 μm)	ASD PSF file: 121016a.138. OO PSF file: 137.
ZMIX088	99.5% PLG108 (<250 μm) + 0.5% IRO103 (10 μm)	ASD PSF file: 121016a.139. OO PSF file: 139.
ZMIX089	99% PLG108 (<250 μm) + 1% IRO103 (10 μm)	ASD PSF file: 121016a.140. OO PSF file: 140.
ZMIX090	98% PLG108 (<250 μm) + 2% IRO103 (10 μm)	ASD PSF file: 121016a.141. OO PSF file: 141.
ZMIX091	95% PLG108 (<250 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.142. OO PSF file: 142.
ZMIX092	90% PLG108 (<250 μm) + 10% IRO103 (10 μm)	ASD PSF file: 121016a.143. OO PSF file: 143.
ZMIX093	80% PLG108 (<250 μm) + 20% IRO103 (10 μm)	ASD PSF file: 121016a.144. OO PSF file: 144.
ZMIX094	70% PLG108 (<250 μm) + 30% IRO103 (10 μm)	ASD PSF file: 121016a.145. OO PSF file: 145.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013
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ZMIX086	100% PLG108 (<250 μm)	ASD PSF file: 121016a.136. OO PSF file: 136.
ZMIX095	99.9% PLG108 (<250 μm) + 0.1% IRO102 (50 nm)	ASD PSF file: 121016a.147. OO PSF file: 147.
ZMIX096	99.5% PLG108 (<250 μm) + 0.5% IRO102 (50 nm)	ASD PSF file: 121016a.148. OO PSF file: 148.
ZMIX097	99% PLG108 (<250 μm) + 1% IRO102 (50 nm)	ASD PSF file: 121016a.149. OO PSF file: 149.
ZMIX098	98% PLG108 (<250 μm) + 2% IRO102 (50 nm)	ASD PSF file: 121016a.150. OO PSF file: 150.
ZMIX099	95% PLG108 (<250 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.151. OO PSF file: 151.
ZMIX100	90% PLG108 (<250 μm) + 10% IRO102 (50 nm)	ASD PSF file: 121016a.152. OO PSF file: 152.
ZMIX101	80% PLG108 (<250 μm) + 20% IRO102 (50 nm)	ASD PSF file: 121016a.153. OO PSF file: 153.
ZMIX102	70% PLG108 (<250 μm) + 30% IRO102 (50 nm)	ASD PSF file: 121016a.154. OO PSF file: 154.
IRO102	IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
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15.25.5d. PYX016 (clinopyroxene, type B): <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

See also section 2.1 of this document for PYX016 information and any additional spectra, section 10 for IRO102 and IRO103, and section 12 for SGE101A and SGE105A.

ZMIX069	100% PYX016 (<250 μm)	ASD PSF file: 121121a.157. OO PSF file: 157.
ZMIX069a	90% PYX016 (<250 μm) + 10% SGE101A	ASD PSF file: 121121a.008. OO PSF file: 8.
ZMIX069b	80% PYX016 (<250 μm) + 20% SGE101A	ASD PSF file: 121121a.009. OO PSF file: 9.
ZMIX069c	50% PYX016 (<250 μm) + 50% SGE101A	ASD PSF file: 121121a.010. OO PSF file: 10.
SGE101A	100% SGE101A	ASD PSF file: 121121a.007. OO PSF file: 7.
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ZMIX069	100% PYX016 (<250 μm)	ASD PSF file: 121121a.157. OO PSF file: 157.
ZMIX069d	90% PYX016 (<250 μm) + 10% SGE105A	ASD PSF file: 121121a.012. OO PSF file: 12.

ZMIX069e	80% PYX016 (<250 μm) + 20% SGE105A	ASD PSF file: 121121a.013. OO PSF file: 13.
ZMIX069f	50% PYX016 (<250 μm) + 50% SGE105A	ASD PSF file: 121121a.014. OO PSF file: 14.
SGE105A	100% SGE105A	ASD PSF file: 121121a.011. OO PSF file: 11.
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ZMIX115	100% PYX016 (<45 μm)	ASD PSF file: 121016a.211. OO PSF file: 211.
ZMIX116	95% PYX016 (<45 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.212. OO PSF file: 212.
ZMIX117	95% PYX016 (<45 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.213. OO PSF file: 213.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX118	100% PYX016 (45-90 μm) + 0% IRO102 or IRO103	ASD PSF file: 121016a.214. OO PSF file: 214.
ZMIX119	95% PYX016 (45-90 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.215. OO PSF file: 215.
ZMIX120	95% PYX016 (45-90 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.216. OO PSF file: 216.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX069	100% PYX016 (<250 μm)	ASD PSF file: 121016a.157. OO PSF file: 157.
ZMIX070	99.9% PYX016 (<250 μm) + 0.1% IRO103 (10 μm)	ASD PSF file: 121016a.112. OO PSF file: 112.
ZMIX071	99.5% PYX016 (<250 μm) + 0.5% IRO103 (10 μm)	ASD PSF file: 121016a.113. OO PSF file: 113.
ZMIX072	99% PYX016 (<250 μm) + 1% IRO103 (10 μm)	ASD PSF file: 121016a.114. OO PSF file: 114.
ZMIX073	98% PYX016 (<250 μm) + 2% IRO103 (10 μm)	ASD PSF file: 121016a.116. OO PSF file: 116.
ZMIX074	95% PYX016 (<250 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.117. OO PSF file: 117.
ZMIX075	90% PYX016 (<250 μm) + 10% IRO103 (10 μm)	ASD PSF file: 121016a.118. OO PSF file: 118.
ZMIX076	80% PYX016 (<250 μm) + 20% IRO103 (10 μm)	ASD PSF file: 121016a.119. OO PSF file: 119.
ZMIX077	70% PYX016 (<250 μm) + 30% IRO103 (10 μm)	ASD PSF file: 121016a.120. OO PSF file: 120.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX069	100% PYX016 (<250 μm)	ASD PSF file: 121016a.157. OO PSF file: 157.
ZMIX078	99.9% PYX016 (<250 μm) + 0.1% IRO102 (50 nm)	ASD PSF file: 121016a.125. OO PSF file: 125.
ZMIX079	99.5% PYX016 (<250 μm) + 0.5% IRO102 (50 nm)	ASD PSF file: 121016a.126. OO PSF file: 126.
ZMIX080	99% PYX016 (<250 μm) + 1% IRO102 (50 nm)	ASD PSF file: 121016a.128. OO PSF file: 128.
ZMIX081	98% PYX016 (<250 μm) + 2% IRO102 (50 nm)	ASD PSF file: 121016a.129. OO PSF file: 130.
ZMIX082	95% PYX016 (<250 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.131. OO PSF file: 131.
ZMIX083	90% PYX016 (<250 μm) + 10% IRO102 (50 nm)	ASD PSF file: 121016a.133. OO PSF file: 133.
ZMIX084	80% PYX016 (<250 μm) + 20% IRO102 (50 nm)	ASD PSF file: 121016a.134. OO PSF file: 134.
ZMIX085	70% PYX016 (<250 μm) + 30% IRO102 (50 nm)	ASD PSF file: 121016a.135. OO PSF file: 135.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
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15.25.6d. PYX042 (orthopyroxene): <45, 45-90, and <250 μm + SGE105A, SGE101A, IRO102, or IRO103.

a. <250 μm + npFe-impregnated silica gel (SGE101A: 22 A pores; high-Fe) or (SGE105A: 150 A pores; high-Fe)
b. <250 μm + nanophase iron (IRO102 or IRO103)

See also section 2.1 of this document for PYX042 information and any additional spectra, section 10 for IRO102 and IRO103, and section 12 for SGE101A and SGE105A.

ZMIX001	100% PYX042 (<250 μm)	ASD PSF file: 121016a.003. OO PSF file: 2.
ZMIX001a	90% PYX042 (<250 μm) + 10% SGE101A	ASD PSF file: 121121a.038. OO PSF file: 38.
ZMIX001b	80% PYX042 (<250 μm) + 20% SGE101A	ASD PSF file: 121121a.039. OO PSF file: 39.
ZMIX001c	50% PYX042 (<250 μm) + 50% SGE101A	ASD PSF file: 121121a.040. OO PSF file: 40.
SGE101A	100% SGE101A	ASD PSF file: 121121a.007. OO PSF file: 7.
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ZMIX001	100% PYX042 (<250 μm)	ASD PSF file: 121016a.003. OO PSF file: 2.
ZMIX001d	90% PYX042 (<250 μm) + 10% SGE105A	ASD PSF file: 121121a.041. OO PSF file: 41.
ZMIX001e	80% PYX042 (<250 μm) + 20% SGE105A	ASD PSF file: 121121a.042. OO PSF file: 42.

ZMIX001f	50% PYX042 (<250 μm) + 50% SGE105A	ASD PSF file: 121121a.043. OO PSF file: 43.
SGE105A	100% SGE105A	ASD PSF file: 121121a.011. OO PSF file: 11.
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ZMIX103	100% PYX042 (45-90 μm)	ASD PSF file: 121016a.194. OO PSF file: 194.
ZMIX104	95% PYX042 (45-90 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.197. OO PSF file: 197.
ZMIX105	95% PYX042 (45-90 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.198. OO PSF file: 198.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX106	100% PYX042 (<45 μm)	ASD PSF file: 121016a.199. OO PSF file: 199.
ZMIX107	95% PYX042 (<45 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.200. OO PSF file: 200.
ZMIX108	95% PYX042 (<45 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.201. OO PSF file: 201.
IRO102	100% IRO102 (50 nm)	ASD PSF file: 121016a.031. OO PSF file: 15.
IRO103	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX001	100% PYX042 (<250 μm)	ASD PSF file: 121016a.003. OO PSF file: 2.
ZMIX002	99.9% PYX042 (<250 μm) + 0.1% IRO103 (10 μm)	ASD PSF file: 121016a.004. OO PSF file: 4.
ZMIX003	99.5% PYX042 (<250 μm) + 0.5% IRO103 (10 μm)	ASD PSF file: 121016a.005
ZMIX004	99% PYX042 (<250 μm) + 1% IRO103 (10 μm)	ASD PSF file: 121016a.007. OO PSF file: 7.
ZMIX005	98% PYX042 (<250 μm) + 2% IRO103 (10 μm)	ASD PSF file: 121016a.008. OO PSF file: 8.
ZMIX006	95% PYX042 (<250 μm) + 5% IRO103 (10 μm)	ASD PSF file: 121016a.009. OO PSF file: 9.
ZMIX007	90% PYX042 (<250 μm) + 10% IRO103 (10 μm)	ASD PSF file: 121016a.010. OO PSF file: 10.
ZMIX008	80% PYX042 (<250 μm) + 20% IRO103 (10 μm)	ASD PSF file: 121016a.011. OO PSF file: 11.
ZMIX009	70% PYX042 (<250 μm) + 30% IRO103 (10 μm)	ASD PSF file: 121016a.012. OO PSF file: 12.
ZMIX010	100% IRO103 (10 μm)	ASD PSF file: 121016a.013. OO PSF file: 13.
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ZMIX001	100% PYX042 (<250 μm) + 0% IRO102 (50 nm)	ASD PSF file: 121016a.003. OO PSF file: 2.
ZMIX009A	99.9% PYX042 (<250 μm) + 0.1% IRO102 (50 nm)	ASD PSF file: 121016a.016
ZMIX010A	99.5% PYX042 (<250 μm) + 0.5% IRO102 (50 nm)	ASD PSF file: 121016a.017. OO PSF file: 16.
ZMIX011A	99.0% PYX042 (<250 μm) + 1.0% IRO102 (50 nm)	ASD PSF file: 121016a.019. OO PSF file: 19.
ZMIX012A	98% PYX042 (<250 μm) + 2% IRO102 (50 nm)	ASD PSF file: 121016a.020. OO PSF file: 20.
ZMIX013A	95% PYX042 (<250 μm) + 5% IRO102 (50 nm)	ASD PSF file: 121016a.022. OO PSF file: 22.
ZMIX014A	90% PYX042 (<250 μm) + 10% IRO102 (50 nm)	ASD PSF file: 121016a.023. OO PSF file: 23.
ZMIX015A	80% PYX042 (<250 μm) + 20% IRO102 (50 nm)	ASD PSF file: 121016a.024. OO PSF file: 24.
ZMIX016A	70% PYX042 (<250 μm) + 30% IRO102 (50 nm)	ASD PSF file: 121016a.025. OO PSF file: 26.
IRO102	0% PYX042 (<250 μm) + 100% IRO102 (50 nm)	ASD PSF file: 121016a.015. OO PSF file: 15.
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15.26d. JSC-Mars1 and polycyclic aromatic hydrocarbons mixtures (for Mars2020)

Raman spectra: iRaman 532 instrument; 50 mW power, collection spot size ~80 μm; ~1 mm beam diameter; sampling volume: ~5 mm^3; 174-4004 cm^{-1} range; 20 spectra averaged.

PAHs added after dissolving in solvent

Mars2020-1 JSC Mars-1 Mars regolith stimulant, unsorted; 7419 msec integration time; unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

Mars2020-2 95% Mars-JSC-1 + 5% anthracene (ORG002); 101 msec integration time; unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

Mars2020-3 95% Mars-JSC-1 + 5% anthracene (ORG002); 3151 msec integration time; unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

Mars2020-4 98% Mars-JSC-1 + 2% anthracene (ORG002); 2107 msec integration time; unsorted powder; i=0°,

e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

Mars2020-5 98% Mars-JSC-1 + 2% anthracene (ORG002); 4002 msec integration time; unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

Mars2020-6 95% Mars-JSC-1 + 5% naphtho [2,3-a] pyrene (ORG014); 19 msec integration time; unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

Mars2020-7 98% Mars-JSC-1 + 2% naphtho [2,3-a] pyrene (ORG014); 108 msec integration time; unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

Mars2020-8 99% Mars-JSC-1 + 1% naphtho [2,3-a] pyrene (ORG014); 77 msec integration time; unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

Mars2020-9 99% Mars-JSC-1 + 1% naphtho [2,3-a] pyrene (ORG014); 8724 msec integration time; unsorted powder; i=0°, e=0°; 174-4000 cm^{-1}; 4 cm^{-1} resolution; 50mW power; 7419 ms integration time; 20 spectra averaged (directory: 131201_PAH_JSCMARS_mixtures).

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(i) ASD reflectance spectra: i=30°, e=0°; 0.35-2.5 μm; 200 spectra averaged; 68 msec integration time.

130830_1 0.001% ORG002 from DCM solution in JSC Mars-1 matrix
130830_2 0.01% ORG002 from DCM solution in JSC Mars-1 matrix
130830_3 0.05% ORG002 from DCM solution in JSC Mars-1 matrix
130830_4 0.1% ORG002 from DCM solution in JSC Mars-1 matrix
130830_5 0.1% ORG002 dry mixed in JSC Mars-1 matrix
130830_6 0.5% ORG002 dry mixed in JSC Mars-1 matrix
130830_7 1% ORG002 dry mixed in JSC Mars-1 matrix
130830_8 2% ORG002 dry mixed in JSC Mars-1 matrix
130830_9 5% ORG002 dry mixed in JSC Mars-1 matrix
130830_10 "Messy slut dry mixture"
130830_11 100% JSC Mars-1
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(ii) 405 nm UV fluorescence: Maya spectrometer; 200-1130 nm (usable range: ~400-1130 nm); i=30°, e=0° (405 nm UV laser as illimination source).

130830_1 0.001% ORG002 from DCM solution in JSC Mars-1 matrix
130830_2 0.01% ORG002 from DCM solution in JSC Mars-1 matrix
130830_3 0.05% ORG002 from DCM solution in JSC Mars-1 matrix
130830_4 0.1% ORG002 from DCM solution in JSC Mars-1 matrix
130830_5 0.1% ORG002 dry mixed in JSC Mars-1 matrix
130830_6 0.5% ORG002 dry mixed in JSC Mars-1 matrix
130830_7 1% ORG002 dry mixed in JSC Mars-1 matrix
130830_8 2% ORG002 dry mixed in JSC Mars-1 matrix
130830_9 5% ORG002 dry mixed in JSC Mars-1 matrix
130830_10 "Messy slut dry mixture"
130830_11 100% JSC Mars-1
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(iii)3655 nm UV fluorescence: Maya spectrometer; 200-1130 nm (usable range: ~400-1130 nm); i=30°, e=0° (365 nm UV lamp as illumination source).

130830_1 0.001% ORG002 from DCM solution in JSC Mars-1 matrix
130830_2 0.01% ORG002 from DCM solution in JSC Mars-1 matrix
130830_3 0.05% ORG002 from DCM solution in JSC Mars-1 matrix

130830_4	0.1% ORG002 from DCM solution in JSC Mars-1 matrix
130830_5	0.1% ORG002 dry mixed in JSC Mars-1 matrix
130830_6	0.5% ORG002 dry mixed in JSC Mars-1 matrix
130830_7	1% ORG002 dry mixed in JSC Mars-1 matrix
130830_8	2% ORG002 dry mixed in JSC Mars-1 matrix
130830_9	5% ORG002 dry mixed in JSC Mars-1 matrix
130830_10	"Messy slut dry mixture"
130830_11	100% JSC Mars-1

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(iv) UV reflectance: Maya spectrometer; 200-1130 nm (usable range: ~200-600 nm); i=0°, e=0°; 500 msec integration time; 200 spectra averaged.

130830_1	0.001% ORG002 from DCM solution in JSC Mars-1 matrix
130830_2	0.01% ORG002 from DCM solution in JSC Mars-1 matrix
130830_3	0.05% ORG002 from DCM solution in JSC Mars-1 matrix
130830_4	0.1% ORG002 from DCM solution in JSC Mars-1 matrix
130830_5	0.1% ORG002 dry mixed in JSC Mars-1 matrix
130830_6	0.5% ORG002 dry mixed in JSC Mars-1 matrix
130830_7	1% ORG002 dry mixed in JSC Mars-1 matrix
130830_8	2% ORG002 dry mixed in JSC Mars-1 matrix
130830_9	5% ORG002 dry mixed in JSC Mars-1 matrix
130830_10	"Messy slut dry mixture"
130830_11	100% JSC Mars-1

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(c) UV spectra – Maya spectrometer

Measured with deuterium and QTH lamps – usable range (200-~400 nm for deuterium; ~400-1130 nm for QTH) spectra merged at 400 nm; bifurcated cable (i=e=0°); ~0.4 nm sampling interval, ~1.85 nm spectral resolution; 600 msec integration time; 200 spectra averaged (Directory: 130927pah uv reflectance)

SYN014	PSF syn014	*Synthetic magnesium fluoride; unsorted, fine-grained.*
OSM001	PSF osm001	*5 wt% ORG002 (anthracene) + 95 wt.% SYN014; unsorted, fine-grained.*
OSM002	PSF osm002	*1 wt% ORG002 (anthracene) + 99 wt.% SYN014; unsorted, fine-grained.*
ORG002	PSF 0rg002	*Anthracene; unsorted, coarse grained.*

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15.27d. Two-pyroxene mixtures – RELAB spectra (Jessica Sunshine)

c1xp14	RELAB c1px14	<45 µm; i=30°, e=0°; 0.325-2.7 µm; 5 nm resol. (RELAB).
c1xp12	RELAB c1px12	<45 µm; i=30°, e=0°; 0.325-2.7 µm; 5 nm resol. (RELAB).
c1xp24	RELAB c1px24	45-75 µm; i=30°, e=0°; 0.325-2.7 µm; 5 nm resol. (RELAB).
c1xp22	RELAB c1px22	45-75 µm; i=30°, e=0°; 0.325-2.7 µm; 5 nm resol. (RELAB).
c1xp05	RELAB c1px05	75-125 µm; i=30°, e=0°; 0.325-2.7 µm; 5 nm resol. (RELAB).
c1xp03	RELAB c1px03	75-125 µm; i=30°, e=0°; 0.325-2.7 µm; 5 nm resol. (RELAB).

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15.1.x. M.Sc. OLIVINE/ORTHOPYROXENE MIXTURES

Band fits were applied to the olivine+orthopyroxene mixture spectra that were measured at the University of Hawaii (and are only available in analogue form). The mixtures involve olivine OLV010 and pyroxene PYX042.

	Grain Size of Mixtures			
OLV/PYX Ratio	38-53µm	63-90µm Wet sieved	63-90µm Dry sieved	90-125µm
100/0	x	x	x	x
95/5	x		x	x
90/10	x	x	x	x
85/15	x		x	x
80/20	x	x	x	x
75/25	x		x	x
70/30	x	x	x	x
65/35	x		x	x
60/40	x	x	x	x
55/45	x		x	x
50/50	x	x	x	x
45/55	x		x	x
40/60	x	x	x	x
35/65	x		x	x
30/70	x	x	x	x
25/75	x		x	x
20/80	x	x	x	x
15/85	x	x	x	x
10/90	x	x	x	x
5/95	x	x	x	x
0/100	x			x

X indicates sample with these end member abundances was spectrally characterized.

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15.1d.x. Polynomial (Quadratic) Fits to Absorption Bands

Equation $y=a+bx+cx^2$. Differentiate & solve for x at y=0 i.e. 0=-b+2cx, b=2cx
Band depth, solve for y (if normalized only)

Sample	Poly. Coeff's a	b	c	Band Min(µm)	Band Depth%	Grain Size(µm)	Compil. & File#	Channels Fitted
"MIX" prefix								
BAND I								
201				many		45-90	U of Hawaii	
203				0.920		Regol.	U of Hawaii	
205				0.90		45-90	U of Hawaii	
210				0.928		45-90	U of Hawaii	
211				many		45-90	U of Hawaii	
212				0.932		45-90	U of Hawaii	
213				1.0		45-90	U of Hawaii	
220				0.98		45-90	U of Hawaii	
221				0.985		45-90	U of Hawaii	
222				0.985		45-90	U of Hawaii	
230				0.928		45-90	U of Hawaii	
231				0.936		45-90	U of Hawaii	
232				0.965		45-90	U of Hawaii	

240				0.928		45-90	U of Hawaii	
241				0.915		45-90	U of Hawaii	
242				0.915		45-90	U of Hawaii	
250				0.915		45-90	U of Hawaii	
251				0.937		45-90	U of Hawaii	
252				0.978		45-90	U of Hawaii	
260	3.613	-6.523	3.102	1.051		45-90	brown1a-137	131-159
260/s.l.	8.241	-14.33	6.783	1.056	32.7	45-90	brown1b-178	131-169
261	1.790	-3.138	1.516	1.035		45-90	brown1a-138	131-159
261/s.l.	5.237	-8.309	3.940	1.054	14.4	45-90	brown1b-179	131-169
262	.8617	-1.431	.7326	0.977		45-90	brown1a-139	131-143
262/s.l.	1.761	-1.555	.7753	1.003	1.9	45-90	brown1b-180	131-169
266	2.645	-5.475	2.986	0.917		45-90	brown1a-140	
266/s.l.	12.89	-26.64	14.43	0.923	40.5	45-90	brown1b-181	101-139
266	2.719	-2.727	.7381	1.847		45-90	brown1a-166	46-69
271	5.426	-11.43	6.181	0.925		45-90	brown1a-142	
271/s.l.	13.80	-29.19	15.78	0.925	69.9	45-90	brown1b-182	100-139
271	6.031	-6.221	1.666	1.867		45-90	brown1a-167	46-69
272	1.144	-2.006	.9913	1.012		45-90	brown1a-162	131-149
272/s.l.	6.896	-11.24	5.300	1.060	6.3	45-90	brown1b-196	120-160
280	1.221	-2.569	1.398	0.919		45-90	brown1a-148	111-129
280/s.l.	17.32	-36.16	19.38	0.933	54.7	45-90	brown1b-185	101-145
280	1.602	-1.593	.4124	1.931		45-90	brown1a-169	41-74
281	.6663	-1.382	.7451	0.927		45-90	brown1a-150	111-129
281/s.l.	14.98	-30.79	16.47	0.935	41.0	45-90	brown1b-186	100-140
281	.5635	-.5462	.1408	1.940		45-90	brown1a-170	51-79
282	.1590	-.3163	.1724	0.917		45-90	brown1a-152	106-124
282	1.057	-9.511	.2493	1.908		45-90	brown1a-171	26-99
282/s.l.	7.700	-14.93	8.074	0.925	20.2	45-90	brown1b-187	100-140
283	2.604	-4.760	2.271	1.048		45-90	brown1a-155	136-154
283/s.l.	13.37	-23.94	11.30	1.059	31.0	45-90	brown1b-189	120-160
284	1.056	-1.902	.9091	1.046		45-90	brown1a-156	136-154
284/s.l.	10.47	-18.36	8.677	1.058	24.2	45-90	brown1b-190	120-160
285	.3457	-.5987	.2844	1.053		45-90	brown1a-157	136-154
285/s.l.	4.895	-7.591	3.572	1.063	13.8	45-90	brown1b-191	120-160
286	.6560	-1.065	.5332	0.999		<45OL	brown1a-154	126-144
286/s.l.	4.812	-7.226	3.380	1.069	5.0	<45OL	brown1b-188	125-165
290	3.519	-6.409	3.034	1.056		<45MT	brown1a-161	131-149
290	2.778	-4.993	2.358	1.059		<45MT	mmixdata149	121-159
290/s.l.	12.93	-23.24	10.97	1.059	37.9	<45MT	brown1b-195	120-160
291	4.075	-7.453	3.569	1.044		45-90	brown1a-159	141-159
291	5.450	-9.964	4.714	1.057		45-90	mmixdata148	121-159
291/s.l.	14.81	-27.06	12.79	1.058	50.3	45-90	brown1b-193	120-160
292	1.545	-2.784	1.318	1.056		45-90	brown1a-160	131-149
292/s.l.	9.974	-17.53	8.262	1.061	32.5	45-90	brown1b-194	120-160

BAND II

201				2.18		45-90	U of Hawaii	
203				1.850		Regol.	U of Hawaii	
205				1.902		45-90	U of Hawaii	
210				1.940		45-90	U of Hawaii	
212				1.92		45-90	U of Hawaii	
213				2.23		45-90	U of Hawaii	
220				1.9		45-90	U of Hawaii	
221				2.16		45-90	U of Hawaii	
222				2.18		45-90	U of Hawaii	

230	1.912	45-90	U of Hawaii
231	1.927	45-90	U of Hawaii
232	1.933	45-90	U of Hawaii
240	1.81	45-90	U of Hawaii
241	1.784	45-90	U of Hawaii
242	1.784	45-90	U of Hawaii
250	1.81	45-90	U of Hawaii
251	1.90	45-90	U of Hawaii
252	2.22	45-90	U of Hawaii

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END of 15.

16. Meteorites, Tektites, and Impactites

16a. Sample Descriptions - Meteorites, Tektites, and Impactites

16.1 Iron meteorites
16.2. Aubrites
16.3. Enstatite chondrites
16.4. Pallasites
16.5. Mesosiderites
16.6. Carbonaceous chondrites
16.7. Ordinary chondrites
16.8. Martian meteorites
16.9. Anomalous achondrites
16.10. Brachinites
16.11. HEDs
16.12. Ureilites
16.13.Angrites
16.14. Unknown types
16.15. Primitive achondrites
16.16.Meteorite mixtures
16.17. Tektites
16.18. Impact glasses
16.19. Non-meteorites and possible meteorites
16.20. Laser irradiated meteorites – Jeff Gillis-Davis
16.21. Bennu analogues – mixtures and meteorites
16.22. "Fake" Murchison heating experiments
16.23. Parr bomb runs on meteorites

Note: Subsection 1: Samples available at University of Winnipeg
Subsections 2, 3…: samples on loan to University of WInnipeg
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Format: Sample type, name, locality, source.
Sample ID *Description*

16.1a. Iron Meteorites and Components

16.1.1a. Iron meteorites available at the University of Winnipeg

MET01 Odessa, Texas, coarse octahedrite; ground into <45 (A), 45-90 (B), and 90-250 (C) µm fractions by hand using garnet sandpaper and then magnetically separated and dry sieved, April 2006.

MET01a Odessa IAB Iron (coarse octahedrite): Odessa, Texas (Robert A. Haag); 1 kg original main mass; slice preserved with epoxy/varnish – removed for powder preparation.

MET01b Odessa IAB Iron (coarse octahedrite): Odessa, Texas (Wetaskiwin Rock Show), weathered fragment; ~5 grams.

MET02 Ataxite; Hoba, 9.4 g from Smithsonian Institution (USNM #6506); received May 10, 2006; ground into <45 (A), 45-90 (B), and 90-250 (C) µm fractions by hand using garnet sandpaper and then magnetically separated and dry sieved, April 2006.

MET03 Hexahedrite, North Chile; 15.8 g from Smithsonian Institution (USNM #1220); received May 10, 2006; ground into <45 (A), 45-90 (B), and 90-250 (C) µm fractions by hand using garnet sandpaper and then magnetically separated and dry sieved, April 2006.

MET04a Campo de Cielo IAB iron (coarse octahedrite, Og) (from Mark Zalcik); 1 of 4 pieces mounted in

coloured epoxy (blue epoxy-mounted fragment).

MET04b Campo de Cielo IAB iron (coarse octahedrite, Og) (from Mark Zalcik); 2 of 4 pieces mounted in coloured epoxy (green epoxy-mounted fragment).

MET04c Campo de Cielo IAB iron (coarse octahedrite, Og) (from Mark Zalcik); 3 of 4 pieces mounted in coloured epoxy (red epoxy-mounted fragment).

MET04d Campo de Cielo IAB iron (coarse octahedrite, Og) (from Mark Zalcik); 4 of 4 pieces mounted in coloured epoxy.

MET05a Canyon Diablo IAB Iron: Canyon Diablo, near Meteor Crater, AZ, USA (David New)

MET05b Canyon Diablo IAB Iron: Canyon Diablo, near Meteor Crater, AZ, USA, (Collector's Marketing Group), weathered fragment.

MET06 Unknown locality, and type, supposedly from Nevada, USA, and part of a much larger amount (forwarded by Mark Zalcik, Feb. 2005).

MET101 Meteoritic metal from Odessa, Texas iron meteorite; magnetic fraction. Ground from inclusion-free portion of meteorite, magnetic fraction separated. Ground with electric belt sander. "Beaten" fractions also made by "grinding" fraction of this metal (INITIALLY very ribbony in appearance) in alumina mortar and pestle. Early fraction sometimes also labelled MET100.

MET101A Meteoritic metal from Odessa, Texas iron meteorite; magnetic fraction. Ground from inclusion-free portion of meteorite, magnetic fraction separated. Ground by hand with emery paper to avoid heating of belt sander. Unsorted fraction.

SCR101 Schreibersite: Canyon Diablo iron meteorite, Arizona (David Shannon Minerals) (see section 10).

SCR102 Schreibersite: Imilac, Chile pallasite (Robert A. Haag) (see section 10).

TRO201 Meteoritic troilite from Canyon Diablo iron meteorite (inclusion). See Sulphides section.

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16.1.2a. Iron meteorites on loan from the University of North Dakota (Mike Gaffey)

Tucson Iron (Si-rich) meteorite – anomalous. Spectra measured for University of North Dakota.

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16.2a. Aubrites and components

16.2.1a. Aubrites available at the University of Winnipeg

MET020 Norton County aubrite: Norton C., KS, USA (David New), cleanest fraction.

MET021 Happy Canyon aubrite(?): Happy Canyon, Texas (American Meteorite Laboratory), variously classified as E7, anomalous aubrite or E chondrite impact melt. (none left? all used in mixtures?), cleanest fraction.

MET200 Happy Canyon, Texas [aubrite] (American Meteorite Laboratory), variously classified as E7, anomalous aubrite or E-chondrite impact melt. 1.6 grams available, all crushed for 45-90µm and <45µm samples (wet sieved). Washed with HCl to remove staining and minor opaques.

MET201 Norton County, Kansas [aubrite] (David New), classified as anomalous aubrite; contains ~10% olivine. A few grams available. Some crushed and wet sieved for 45-90µm and <45µm samples. No acid removal of staining done. Sample definitely contains enstatite and olivine.

MET300 Bishopville aubrite; "fresh" sample. <~1 mm powder prepared by Tom Burbine; measured at RELAB.

MET301 Bishopville aubrite; "red" sample. <~1mm powder prepared by Tom Burbine; measured at RELAB.

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16.2.2a. Aubrites on loan from the University of North Dakota (Mike Gaffey)

These are the meteorites measured by Mike Gaffey for his 1974 PhD thesis and 1976 JGR paper (3 boxes received June 2008 for re-measurement). Original vial labels used below. Note: italicized type refers to information from external sources.

METCF1 "Cumberland Falls AVG.", aubrite; whole rock – unsorted powder. (Box labelled "Cumberland Falls Inclusion", also with letter from Verkouteren).
METCF2 "Cumberland Falls chondritic inclusion, <200 mesh, 53.27 mg" (very small amount of sample available) . (Box labelled "Cumberland Falls Inclusion", also with letter from Verkouteren).
METCF3 "Cumberland Falls chondritic inclusion, >200 mesh, 20.50 mg" (very small amount of sample available) . (Box labelled "Cumberland Falls Inclusion", also with letter from Verkouteren).

MJG224 "Bishopville P50e Ae 77.0 mg" (unsorted powder) . (Gaffey unlidded box – unlabeled).
MJG225 "Bishopville Me 251-3, 1886-8; 0.777 gm; aubrite" (fragments and powder) . (Gaffey unlidded box – unlabeled).
MJG236 Norton Co. #523.3x – Aubrite – powder. (Gaffey box labelled "ASU and Yale (unmeasured) samples").
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16.2.3a. Aubrites on loan from the University of New Mexico – June 2009

N102a.1 Norton County aubrite slab with one rough saw-cut face (~20 grams).
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16.3a. Enstatite chondrites and components

16.3.1a. Enstatite chondrites available at the University of Winnipeg

MET310 Al Haggounia 001 –EL3 – originally classified as aubrite. 27.3 gram slice; found near Al Haggounia, Morocco in 2005/2006 (from RASC Winnipeg Branch December 2009); heavily iron oxide stained.
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16.3.2a. Enstatite chondrites on loan from the University of North Dakota (Mike Gaffey)

These are the meteorites measured by Mike Gaffey for his 1974 PhD thesis and 1976 JGR paper (3 boxes received June 2008 for re-measurement). Original vial labels used below. Note: italicized type refers to information from external sources.

MJG183 Atlanta #427.1x – EL6 – powder. (Gaffey box labelled "ASU and Yale (unmeasured) samples").
MJG190 St. Mark's #737 – EH5 – powder. (Gaffey box labelled "ASU and Yale (unmeasured) samples").
MJG217 "Khairpur E6 Me-1538 1.6 gm" (single fragment) . (Gaffey unlidded box – unlabeled).
MJG218 "Hvittis E6 Me 578 1.498 gm" (fragments and powder) . (Gaffey unlidded box – unlabeled).
MJG219 "Daniel's Kuil E6 Me-1500 0.489 gm" (single fragment and powder) . (Gaffey unlidded box – unlabeled).
MJG220 "St. Mark's E5 Me-2608 0.4735 gm" (powder) . (Gaffey unlidded box – unlabeled).
MJG221 "Abee E4 Me-2474 0.881 gm" (single fragment and powder) . (Gaffey unlidded box – unlabeled).
MJG222 "Pillistfer E6 Me-1646 0.819 gm" (single fragment and powder) . (Gaffey unlidded box – unlabeled).
MJG223 "Indarch E4" (powder) . (Gaffey unlidded box – unlabeled).
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16.3.3a. Enstatite chondrites on loan from the University of Western Ontario (Matt Izawa)

These are the meteorites measured at HOSERLab for Matthew Izawa, as part of a larger study of E chondrites.

QUE 94204 EH7; unsorted powder.
LAP 02225 EH impact melt; unsorted powder.
ALHA81021 EL6; unsorted powder
TIL 91714 EL5; unsorted powder.
EET 87746 EH4; unsorted powder.

PCA 91020 EL3; unsorted powder.
LEW 88180 EH5; unsorted powder.
EET 96135 EH4/5; unsorted powder; subsample: EET96135.16.
MAC 02747 EL4; unsorted powder.
MAC 02837 EL3; unsorted powder.
MET 00783 EH4; unsorted powder.
NWA 2212 EL6; unsorted powder.
NWA 717 EL6; unsorted powder.
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16.4a. Pallasites and components

16.4.1a. Pallasites available at the University of Winnipeg

MET030 Imilac, Chile (Robert A. Haag) (1 of 2 individual pieces).
MET031 Imilac, Chile (Robert A. Haag) (2 of 2 individual pieces).
OLV201 Olivine from Imilac pallasite (MET030).
MET032 Seymchan pallasite (Magadan District, Russia; 62° 54' N, 152° 26' E; find - 1967). Two polished and lacquered slabs (~50 grams total weight) [from December 2012 AGU meeting].
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16.4.2.a. Pallasites on loan from the Royal Ontario Museum (Kim Tait/Brendt Hyde)

Springwater-A Springwater pallasite – on loan from Royal Ontario Museum. Slab – containing phosphate (farringtonite) – rich area (August 2013). Note that sample is covered in epoxy to prevent rust – not removed prior to spectra. On loan from the Royal Ontario Museum.
Springwater-B Saw-cut fines (<25 µm) from Springwater pallasite. On loan from the Royal Ontario Museum.
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16.5a. Mesosiderites and components

16.5.1a. Mesosiderites available at the University of Winnipeg

MET040 Vaca Muerta mesosiderite: Vaca Muerta, Chile (Robert A. Haag)
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16.6a. Carbonaceous chondrites and components

16.6.1a. Carbonaceous chondrites available at the University of Winnipeg

CAI100 Powdered mixture of 2 calcium-aluminum inclusions from Allende meteorite; unsorted powder.
MET050 Allende CV3 chondrite: Allende, Mexico (Robert A. Haag) ; interior slice.
NWA801 CR2 chondrite: Whole intact sample (~8 grams) from Royal Ontario Museum (dark brown exterior and interior).
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16.6.2a. Carbonaceous chondrites on loan from the University of North Dakota (Mike Gaffey)

These are the meteorites measured by Mike Gaffey for his 1974 PhD thesis and 1976 JGR paper (3 boxes received June 2008 for re-measurement). Original vial labels used below. Note: italicized type refers to information from external sources.

MJG001 Meghei (CM2) <32 Original. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 200 mg) of fine powder (<32 μm)].

MGJ002 Meghei (CM2) 32-100 ground. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 200 mg) of fine powder (32-100 μm)].

MGJ003 Alais – (CI); Me – 1486. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 200 mg) of fine powder (<150 μm?)].

MJG004 Orgueil – (CI). ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 50 mg) of fine powder (<150 μm?)].

MJG005 Allende – CV3; Me – 2632. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 400 mg) of fine powder (<150 μm?)].

MGJ006 Mokoia – CV2; ASU #75.1. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 400 mg) of fine powder (<150 μm?)].

MJG007 Warrenton CO3. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 400 mg) of fine powder (<150 μm?)].

MJG008 Vigarano – CV3; Me – 782. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 400 mg) of fine powder (<150 μm?)].

MJG009 Murchison – CM2; Me – 2641. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 400 mg) of fine powder (<150 μm?)].

MJG010 Murray – CM2; ASU #635.2. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 400 mg) of fine powder (<150 μm?)].

MJG011 Nogoya – CM2; Me – 1680. ("Gaffey Meteorite Inventory. Carbonaceous Chondrites (box 1)"). [small amount (maybe 400 mg) of fine powder (<150 μm?)].

MJG191 Leoville #821 – CV3.0 – powder. (Gaffey box labelled "ASU and Yale (unmeasured) samples"). [small amount (maybe 400 mg) of fine powder (<150 μm?)].

MJG226 "Murchison C2 Me 2641 2.6 gm" (two fragments and some powder) . (Gaffey unlidded box – unlabeled). [2.6 grams of sample, largely as two pieces with a bit of abraded off powder].

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16.6.3a. Carbonaceous chondrites on loan from NASA JSC (Pierre Hudon)

Samples provided to University of Winnipeg for spectral measurements (and returned).

Meteorite	Class
MET01070	CM1
PCA02012	CM2
MET00639	CM2
WIS91600	CM2
QUE97077	CM2
QUE99038	CM2
ALH82101	CO3
FRO95002	CO3
MET00737	CO3
FRO99040	CO3
QUE93744	CV3
MET01149	CK3
ALH85002	CK4
PCA91470	CK4
DAV92300	CK4
EET83311	CK5
PCA91082	CR2
QUE99177	CR2
MET00426	CR2
MAC87320	CR2
EET87770	CR
PCA91467	CH

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16.6.4a. Samples on loan from Arizona State University (Jim Bell) – April 2011 – rescued from Cornell

JFB-01 "Allende 0.5-2. mm ("ALL")"; 500-2000 micron grain size (CV3).
JFB-02 "Allende (NMNH 3658) ("ALL")" unsorted powder (0- >2000 microns) (CV3).
JFB-03 "("ALLENDE")" – looks like sorted medium-grained powder (75-250 microns) (CV3).
JFB-04 "Allende" ("ALL") – looks like very fine-grained powder (<150, mostly <45 microns) (CV3).

JFB-11 "Orgueil <150 μm" (CI1).

JFB-21 "Murchison >150 μm ("MUR")" (CM2),
JFB-22 "Murchison #5377 ("MUR")" – looks like sorted coarse-grained powder (CM2).
JFB-23 "Murchison crushed 5/21/77 ("MUR")" – looks like fine-grained powder (CM2).
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16.6.5a. Samples on loan from the Planetary Science Institute (Vishnu Reddy)

Allende Saw-cut fines (<25 μm) (CV3).
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16.6.6a. Samples from the Royal Ontario Museum (Kim Tait, 2012)

Murchison CM2 carbonaceous chondrite. Three pieces with saw cut/broken faces, one with fusion crust. 10.39 grams total weight. ROM #M52364. To be consumed; received in 2012.
Murchison CM2 carbonaceous chondrite. 1.76 grams of "clean" saw-cut powder (ROM ID: M52364); can be consumed; received Nov. 18/14.
Murchison CM2 carbonaceous chondrite. 7 grams of "contaminated" saw-cut powder (ROM ID: M52364); "probably contaminated with SiC/Al_2O_3, otherwise fine"; can be consumed; received Nov. 18/14.

NWA 2210 CH3 chondrite (15-20 vol.% metal). End slice (~3 grams; ~1 x 0.5 cm face) (ROM ID: M53138); dark/black saw-cut face, no real evidence of rust except along a partial fracture and on exterior surface; received Nov. 18/14.

SaU 290 CH3 chondrite (~15 vol. % metal). Two interior slices (1: ~2 grams; ~2 x 1 cm face; 2: ~1 gram; ~1 x 0.5 cm face)). Has minor interior rust, a few fractures, fusion crust along edge of slice; also has metal-rich and metal-poor enclaves; sm aller piece seems to have more rust. (ROM ID: LM52935); received Nov. 18/14.

Spectra of spots on fusion crust and saw cut faces of three pieces, powders of small subsamples; spectra of a single progressively crushed sample; mixtures of coarse and fine powders.

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16.6.7a. Carbonaceous chondrites – RELAB archive

Name	*Petrologic type/subtype*
CI chondrites	
Alais	CI1
Ivuna	CI1
Orgueil	CI1

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CM chondrites

A-881280	CM2
A-881594	CM2
A-881955	CM2
ALHA 81002	CM2
ALH 83100	CM2.1
ALH 84029	CM2
ALH 84033	CM2
ALH 84044	CM2
ALH 85013	CM2
Bells	CM2
Boriskino	CM2
Cold Bokkeveld	CM2.2
EET83250	CM2
EET83389	CM2
EET90021	CM2
EET90043	CM2 or C3 ungrouped
GRO85202	CM2
LEW87016	CM2
LEW87022	CM2
LEW87148	CM2
LEW88001	CM2
LON94101	CM2
MAC88101	CM2
MAC88176	CM2
Mighei	CM2
Murchison	CM2.5/2.7
Murray	CM2.4-2.5/2.6
Nogoya	CM2.2
QUE93005	CM2.1
Y74642	CM2
Y74662	CM2
Y791191	CM2
Y791198	CM2.4/2.6
Y791824	CM2
Y793585	CM2
Y82042	CM1-2

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CK chondrites

A-882113,86	CK4
ALH85002	CK4
EET92002	CK4
Karoonda	CK4
Y693	CK4-5
EET87256	CK5
EET87507	CK5
Y82102	CK5
Y82103	CK5
EET87860	CK5-6
A-881551	CK6
LEW87009	CK6

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CR chondrites

GRO95577	CR1
A-881595	CR2

EET87747	CR2
EET87770	CR2
EET92042	CR2
GRA95229	CR2
MAC87300	CR2
Renazzo	CR2
Y793495	CR2
LEW85332	CR2-ungrouped

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CO chondrites

ALH77307	CO3.0
A-881632	CO3.1
Y82050	CO3.1
Kainsaz	CO3.1/3.6
Y791717	CO3.3/3.6
Felix	CO3.2/2.6
Ornans	CO3.3/36
ALH85003	CO3.4/3.5
Lance	CO3.4/3.6
ALH77003	CO3.5/3.6
ALH83018	CO3.5/3.6
Warrenton	CO3.6/3.7

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CV chondrites

NWA3118	CV3
ALHA81003	CV3.0-3.1
ALH84028,84	CV3 OxA
Allende	CV3.2-3.3 OxA
Mokoia	CV3.0-3.2 OxB
Grosnaja	CV3.2-3.3 OxB
ALH85006	CV3 Ox
TIL91722	CV3 Reduced
Leoville	CV3.0 Reduced
Vigarano	CV3.2-3.3 Reduced
Coolidge	CV3.8 Reduced
Y86751	CV3

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C-ungrouped and ATCCs

DaG430	C3-ungrouped
MCY92500	C2-unassigned
Tagish Lake	C2- unique
WIS91600	C2 – ungrouped, heated
EET83355	C2-heated
MAC88107	CM2 or CO3-heated
Kaidun	C breccia
EET87522	CM2
EET96029	CM2
LEW90500	CM2
MAC88100	CM2
GRO95566	CM2 or C2-ungrouped
A-881334	CM2-heated
A-881458	CM2-heated
A-881655	CM2-heated

Y793321	CM2-heated
Y82054	CM2-heated
Y82098	CM2-heated
Y86695	CM2-heated
Dho225	CM-heated
Dho735	CM-heated
EET96010	CM-heated
LEW85311	CM-heated
PCA91008	CM-heated
PCA91084	CM-heated
Y794080	CM-heated

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16.6.8a. Lab-heated carbonaceous chondrites – on loan from Takahiro Hiroi – Brown University

Samples whose spectra were reported by Hiroi et al. (1995-1997). Ivuna spectra reported for unheated and 100-700°C in 100°C increments. Murchison spectra reported for unheated and 400-1000°C in 100°C increments.

(i) Heated Ivuna (CI1)

100°C	Only a few tiny grains
200°C	Only a few tiny grains
300°C	Vial empty?
400°C	Vial empty?
500°C	Only a few tiny grains
600°C	Vial empty?

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(ii) Heated Murchison (CM2)

400°C	~200 mg of sample (<63 µm).
500°C	~200 mg of sample (<63 µm).
600°C	~100 mg of sample (<63 µm).
700°C	~150 mg of sample (<63 µm).
800°C	~150 mg of sample (<63 µm).
900°C	~100 mg of sample (<63 µm).
1000°C	~100 mg of sample (<63 µm).

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Ivuna	CI1; unheated and 100-700°C in 100°C increments
Murchison	CM2, unheated and 400-1000°C in 100°C increments

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16.6.9a. Samples from Kurt Mengel – Technische Universitat Clausthal (received July 2014)

For Parr bomb heating experiments

CM2	Jbilet Winselwan	2 grams of powder (vial label: 1-420, 1-644, 1-525; 07.07.14 2 g)

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16.6.10a. Samples from Chris Herd – University of Alberta – Tagish Lake

Two subsamples of Tagish Lake ungrouped carbonaceous chondrite received – Sept. 2014 for spectroscopy.

Collection number	Weight/description
MET11611/P-10a/11/p3	0.237 grams – crushed and sieved bulk powder.
MET11611/P-4/2	0.176 grams – crushed and sieved bulk powder.

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16.6.11a. Samples from Mike Zolensky at NASA JSC – received September 2014

Samples that could be found from heating experiments done in the 1990s.

(i) Ivuna — Microprobe disc with five small (~1 mm diameter) grain assemblages for samples heated to 300, 400, 500, 600, and 700°C.

(ii) Murchison
a. Potted butt for probe analysis – 1" diameter epoxy disc with 8 ~4 mm diameter pieces: 1200°C heated sample.
b. Potted butt for probe analysis – 1" diameter epoxy disc with 5 ~3 mm diameter pieces: 1315°C heated sample.
c. Potted butt for probe analysis – 1" diameter epoxy disc with 2 ~5 mm diameter pieces: 1400°C heated sample.
d. Aluminum foil wrapped sample – "Murchison powder annelaed at 575°C". Consists of minor amount of very fine-grained reddish-brown powder.

(iii) Small box labeled "Clayton" – 6 vials.
1. "Murchison starting material. RNC. 1". ~25 mg of fine-grained dark powder.
2. "Murchison RMT-100°C. RNC. 2." – Only a few dark grains in vial.
3. "Murchison Residue 100-300°C. RNC. 3." - ~15 mg of fine-grained dark powder.
4. "Murchison Residue 300-440°C. RNC. 4." - ~15 mg of fine-grained dark powder.
5. "Murchison Residue 440-600°C. RNC. 5." - ~15 mg of fine-grained dark powder.
6. "Murchison Residue 600-700°C. RNC. 6." - ~10 mg of fine-grained dark powder.

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16.6.12a. Carbonaceous chondrites on loan from the University of Western Ontario (Matt Izawa)

These are the meteorites measured at HOSERLab for Matthew Izawas.

Allende — CV3; unsorted powder.

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Subsamples of Tagish Lake ungrouped C chondrite:

pb-02 20.050	Unsorted powder.
pm-05	Unsorted powder
tl-d 20.050 pb-02 chip	Chip
mg-02 tl-d white label	Unsorted powder
pm05 <18 mesh	Sorted powder
tl mg02 yellow dot vial	Unsorted powder

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16.7a. Ordinary and unsorted chondrites

16.7.1a. Ordinary and unsorted chondrites available at the University of Winnipeg

Cherokee Springs	LL6 chondrite fall (from Smithsonian Institution – Tim McCoy. Provided for destructive analysis.
MET060	Tulia(a) H3-4 Chondrite: Tulia (a), Swisher Co., TX, USA (Mineralogical Research Co.); end slice.
MET061	New Concord L6 Chondrite: New Concord, Muskingum Co., OH, USA (David New?); end slice.
MET062	Julesberg L3 Chondrite: Julesberg, CO, USA (Mineralogical Research Co.); end slice.
MET063	Taiban(b) L6 chondrite: Taiban (b), DeBaca Co., NM, USA (shocked) (Mineralogical Research Co.); end slice.

MET064 La Criolla L6 chondrite : La Criolla, Argentina (Robert A. Haag), intact specimen.
MET065 Ozona H6 chondrite : Ozona, Crockett Co.. TX, USA; now a powder.
MET066 Chondrite: China (Jasper Rock and Jade – August 2008).
MET067 Chondrite: Sahara Desert, Morocco (Discovery Gemstones Ltd. – Edmonton, AB, Canada).
MET068 Chondrite, Morocco (Discovery Gemstones Ltd. – Edmonton, AB, Canada, #08D428; July 2009).
MET069 MWA 869: L4-L6 fragmented breccia: Northwest Africa near Tindouf, Algeria; found in 2000. Slice with apparent carbonaceous chondrite inclusion (Nature's Own, Dec. 16, 2009 ("some fragments even include carbonaceous inclusions").
MET070 Stony (ordinary?) chondrite – cut piece; North Africa (33 grams); appears to be breccia with light-dark lithologies and large troilite nodule [David's Displays, Tucson 2011 show].

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16.7.2a. Ordinary and unsorted chondrites on loan from the Planetary Science Institute (Vishnu Reddy)

Chelyabinsk-1 LL5 chondrite (S4, W0). Fell February 15, 2013. Piece 1: 2.53 grams – impact melt [Two intact fragments purchased from Big Kahuna Meteorites by Vishnu Reddy (late April 2013)].
Chelyabinsk-2 LL5 chondrite (S4, W0). Fell February 15, 2013. Piece 2: 2.17 grams (not impact melt). [Two intact fragments purchased from Big Kahuna Meteorites by Vishnu Reddy (late April 2013)].
Chelyabinsk-3 LL5 chondrite (S4, W0). Fell February 15, 2013. Two fragments with saw-cut faces received from Big Kahuna Meteorites Nov. 21, 2013. This piece has more fusion crust exposed around the periphery (cut off centre of fragment).
Chelyabinsk-4 LL5 chondrite (S4, W0). Fell February 15, 2013. Two fragments with saw-cut faces received from Big Kahuna Meteorites Nov. 21, 2013. This piece has less fusion crust exposed around the periphery (cut closer to centre of fragment).

Chergach H chondrite: slice; dark and light lithologies (from Vishnu Reddy; received January 6, 2014).

Franconia H5 chondrite: slice; dark and light lithologies (from Vishnu Reddy; received January 6, 2014).

Mreira L6 ordinary chondrite. Fall/find: December 16, 2012 – Mauritania. Shock stage: S6; weathering stage: W0. Two pieces: (1) Cut (on two faces) slice: 5.47 grams. Shows two lithologies – light and dark with shock veining in the light lithology, almost fully intact fusion crust. (2) Partially intact (70% fusion crust) fragment – 3.47 grams. Powder mixtures made with light (unshocked) and dark (shocked fraction). Powder prepared for light-dark lithology mixtures; crushed and dry sieved to <45 μm, larger metal particles not included.
Thika L6 ordinary chondrite fall – Kenya 2011. 8.3 grams total weight in three pieces; 1 with minor fusion crust (received May 27, 2014).

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16.7.3a. Ordinary and unsorted chondrites on loan from the University of North Dakota (Mike Gaffey)

These are the meteorites measured by Mike Gaffey for his 1974 PhD thesis and 1976 JGR paper (3 boxes received June 2008 for re-measurement). Original vial labels used below. Note: italicized type refers to information from external sources.

MJG100 Missnof; H (4,5). ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MJG101 Cangas – De – Onis; H5. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MGJ102 Marion; L6. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MGJ103 Dhurmsala; LL6. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MGJ104 Barwise; *H5*, Me – 2605; 0.893 gm. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MGJ105 Kesen; H4. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MJG106 Hamlet #1; LL(3,4); Me – 2588; 0.847 gm. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MJG107 Djati-Pengilon; H6. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MJG108 Hessle; H5. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
MJG109 Soko-Banja; LL4; Me-319; 0.816 gm. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").

MJG110 Vouille, *L6*. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG111 Jelica; LL6; Me – 1353; 1.005 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG112 Soko-Banja; LL4. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MGJ113 Castalia; H5. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG114 Dimmitt; H3,4. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG115 Allegan; H5. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG116 Bald Mountain; L4; Me- 2392; 1.150 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG117 Bur-Gheluri; H5. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG118 Parnallee; LL 3. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG119 Vavilovka; LL6; Me – 1659; 1.634 g. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG120 St. Severin; LL6; Me – 2664; 3.0 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG121 Weston; H4. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG122 Bremervorde; H3; Me – 438; 0.850 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG123 Pultusk; H5; #H1-8; 0.415gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG124 Holbrook; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG125 Buschof; L6; Me – 1475; 0.9655 g. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG126 Lancon; H6; Me – 526; 0.949 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG127 Rose City; H5; Me – 2396; 4.0 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG128 Kernouve; H6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG129 Cabezo de Mayo; L6; Me -1514; 0.931 g. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG130 Forest City; H5; #H1-3; 0.197 gm, 0.519 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG132 Lancon; H6; Me – 526 (empty). (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG133 Tysnes Island; H4; Me – 1719; 0.806 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG134 Ochansk; H4; Me – 1440; 0.768 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG135 Benares; LL6; 0.71 gm; Me – 216. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG136 Gruneburg; H3; Me – 1478; 0.622 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG137 Utrecht; L6; Me – 1700; 1.256 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG138 Manbhoom; LL6; Me – 583; 0.501 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)”).
MJG139 Olmedilla: *H5 according to Field* Museum (L type on vial). (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG140 Quenggouh; H4; Me-1614; 1.308 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG141 Pavlograd; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MGJ142 Colby (Wis.); L6; Me-1989; 0.469 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG143 Mocs; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG144 Mezo-Madaras; L3. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG145 Shelburne; L5. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG146 Molina; L5. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG147 New Concord; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG148 Zavid; L6; Me-1861; 1.8925 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG149 Beaver Creek; H4; #H1-1; 0.409 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG150 Apt; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG151 Bjurbole; L4; #H1-2; 1.056 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG152 Olivenza; LL5; #H1-6; 0.490 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG153 Auamale; L6; Me-1837; 1.123 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG154 Modoc; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG155 Fisher; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG156 Bjurbole; L4; Min. Stain. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG157 Alfianello; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG158 Homestead; L5; #H1-4; 0.520 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG159 Segowlie; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG160 Ausson; L5; Non-stained. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG161 L’Aigle; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).

MJG162 Ausson; L5. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG163 Drake Creek; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG164 Dandapur; L6. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG165 Andover; L6; Me-146E; 1.436 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG166 Tadjera; L5 (Black); Mezc5L; 0.943 gm (Me-2652 according to Field Museum) (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG167 Borkut; L5. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG168 Manbhoom; LL6; Original <90 microns. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG169 Queen’s Mercy; H6; Me-2100; 0.793 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG170 Gruneberg; H3; Silicate <90 microns. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG171 Touniunes-le-Grasse; L6; Me-2672; 0.939 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG172 Nerft ; L6 ; Me-585 ; 0.249 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG173 Farmington; L5. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG174 Sevrukovo; L5; Me-1602-3; 1.259 gm. (“Gaffey Meteorite Inventory. Ordinary Chondrites (box 3)”).
MJG175 Kunashak #741 - L6 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG176 Kelly #398.1x – LL4 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG177 Saratov #740 – L4 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG178 Bursa #734 – L6 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG179 Richardton #100h – H5 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG180 Beardsley #134ax – H4-5 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG181 Bruderheim #705 – L6 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG182 Zhovtnevyi #743 – H5 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG184 Chainpur #424.1 – LL3.5 - powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG185 Saline #107b – H5 - powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG186 Leedey #489.1 – L6 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG187 Lake Labyrinth #369.2 – LL6 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG188 Pervomaisky #742 – L6 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG189 Pantar #503.3 – H5 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG192 Chantonnay #341.2 – L6 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).
MJG193 Elenovka #745 – L5 – powder. (Gaffey box labelled “ASU and Yale (unmeasured) samples”).

MJG194 “Beaver, Okla. L5 fragments (some with sawn and broken faces, few grams)”. (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG195 “Homestead L5 silicate <90 μm” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG196 “Gruneberg H3 metal” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG197 “Lancon H6 – Me-526” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG198 “Cynthiana L4 silicate” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG199 “Ochansk H4 cleaned metal” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG200 “Nanjemoy H6 metal” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG201 “Andover L6 metal” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG202 “Cabezo de Mayo L6 silicate <70 μm” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG203 “Soko-Banja LL4 90-180 μm original” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG204 “Zavid L6 silicate separate <90 μm” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG205 “Zavid L6 metal” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG206 “Homestead L5 metal” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG207 “Cabezo de Mayo L6 metal” . (Gaffey box labelled “Ordinary chondrites and metal silicate separates”).
MJG208 “Beaver Ok. L5 magnetic Fe-rich” . (Gaffey box labelled “Ordinary chondrites and metal silicate

separates").

MJG209 "Beaver Ok. L5 non-magnetic silicate <90 μm" . (Gaffey box labelled "Ordinary chondrites and metal silicate separates").

MJG210 "Soko-Banja LL4 (Me-319) original <90 μm" . (Gaffey box labelled "Ordinary chondrites and metal silicate separates").

MJG211 "Tennasilm P175 L4 77.7 mg" . (Gaffey box labelled "Ordinary chondrites and metal silicate separates").

MJG213 "Ochansk P142 H4 211.3 mg" . (Gaffey box labelled "Ordinary chondrites and metal silicate separates").

MJG214 "Forsyth P196 L6 90.5 mg" (fragments) . (Gaffey box labelled "Ordinary chondrites and metal silicate separates").

MJG215 Cape Girardeau P320 H6 131.8 g" (fragments; probably mg) . (Gaffey box labelled "Ordinary chondrites and metal silicate separates").

MJG233 "Cynthiana L4" (small amount of powder). (Box labelled "Gaffey Lab Mixtures: Kaolin, Fe, Olivine, etc.; Cynthiana L4; Nanjemoy H6; Andover Sil <90 μ L6").

MJG234 "Nanjemoy H6" (fragment plus powder) . (Box labelled "Gaffey Lab Mixtures: Kaolin, Fe, Olivine, etc.; Cynthiana L4; Nanjemoy H6; Andover Sil <90 μ L6").

MJG235 "Andover L6 Sil <90 μm" (powder) . (Box labelled "Gaffey Lab Mixtures: Kaolin, Fe, Olivine, etc.; Cynthiana L4; Nanjemoy H6; Andover Sil <90 μ L6").

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16.7.4a. Ordinary and unsorted chondrites on loan NASA Astromaterials Facility

LAP04840 Amphibole-bearing chondrite. Returned to JSC 2012.

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16.7.5a. Ordinary chondrites from Kurt Mengel (Technische Universitat Clausthal) – July 2014-07-15

For determining whether salt inclusions are present and spectrally expressed.
For possible aqueous alteration experiments
Powdered samples provided by Kurt Mengel – July 2014

ZAG H3-6 ordinary chondrite. 3 vials:
1. <100 μm powder: 4.2 grams
2. 100-200 μm powder: 6.1 grams
3. 250-630 μm powder: 2.7 grams

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16.8a. Martian Meteorites

16.8.1a. Martian meteorites available at the University of Winnipeg

MET080 Tissint (Morocco) shergottite fall (July 28, 2011): 2 vials, ~100 mg total weight (AGU Dec. 2012).

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16.9a. Anomalous achondrites

16.9.1a. Anomalous achondrites available at the University of Winnipeg

None

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16.9.2a. Anomalous achondrites on loan from the Planetary Science Institute (Vishnu Reddy)

NWA6704 Ungrouped achondrite. Contains olivine (Fa51.6-53.2, Ni-rich), chromite, orthopyroxene (Fa41.6-42.4 Wo2.8-3.6), plagioclase (Ab 92-93), and awaruite. O isotopes plot in the acapulcoite-lodranite field. Weathering is low; unshocked (powder)
NWA6704 Ungrouped achondrite. 0.866 polished slab received from Vishnu Reddy (May 2014).
NWA6704 Ungrouped achondrite. 12.2 gram uncut fragment received from Vishnu Reddy (from the Hupé Collection); received Sept. 15, 2014.
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16.10a. Brachinites

16.10.1a. Brachinites available at the University of Winnipeg

None
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16.10.2a. Brachinites on loan from the University of North Dakota (Mike Gaffey)

These are the meteorites measured by Mike Gaffey for his 1974 PhD thesis and 1976 JGR paper (3 boxes received June 2008 for re-measurement). Original vial labels used below. Note: italicized type refers to information from external sources.

MET400 Brachina meteorite (labelled as "Brachina meteorite, 0.31 grams" (powdered sample)); from Mike Gaffey (Feb. 2007)
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16.11a. Howardite, eucrites, and diogenites (HEDs)

16.11.1a. HED meteorites available at the University of Winnipeg

None
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16.11.2a. HED meteorites on loan from the University of North Dakota (Mike Gaffey)

These are the meteorites measured by Mike Gaffey for his 1974 PhD thesis and 1976 JGR paper (3 boxes received June 2008 for re-measurement). Original vial labels used below. Note: italicized type refers to information from external sources.

16.11.2.1a. Eucrites
MJG216 "Bereba MEL2 (?)" (powder). (Gaffey unlidded box – unlabeled).
MJG228 "Moama <37 recrushed". (Box labelled "Moama Property of Professor J.F. Lovering…").
MJG229 "Moama (Euc) <37" . (Box labelled "Moama Property of Professor J.F. Lovering…").
MJG230 "Moama (Euc) 37< <74" (lid label: measured 10/21/81) . (Box labelled "Moama Property of Professor J.F. Lovering…").
MJG231 "Moama (Euc) 74<". (Box labelled "Moama Property of Professor J.F. Lovering…").
MJG232 "Moama Eucrite 2.412 gm Geology School Melb. University" (smaller vial; fragments) . (Box labelled "Moama Property of Professor J.F. Lovering…").
MJG300 Camel Donga eucrite – small slab (~3 grams) . (Box labelled "Cumberland Falls Inclusion", also with letter from Verkouteren).
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16.11.2.2a. Diogenites

MJG212 "Y77256,10,50 300 mg for reflectance" (fragments) . (Gaffey box labelled "Ordinary chondrites and metal silicate separates"). *Note: "Y" prefix appears to be added later – different ink colour; is likely ALHA77256; looks like a diogenite under binocular microscope.*

++

16.11.3a. HED meteorites on loan from Westfalische Wilhems-Universitat Munster and Max Planck Institute (Andreas Nathues)

Millbillillie	Eucrite, slice, 5.9 grams (first shipment)
NWA 2968	Dunitic diogenite, slice, 5.0 grams (first shipment)
NWA 5748	Howardite, slice, 5.2 grams (first shipment)
NWA 5751	Howardite, slice, 5.5 grams (first shipment)
NWA 6013	Olivine-rich diogenite, slice, 5.2 grams (first shipment)
NWA 6477	Eucrite, slice, 5.1 grams (received Sept. 2011)
JAH 626	Shocked eucrite, 3 sawn chips, 5.4 grams total weight (received Sept. 2011)
Talampaya	Cumulate eucrite, 4 sawn chips, 5.3 grams total weight (received Sept. 2011)
NWA 1836	Cumulate eucrite, slice, 5.0 grams (received Sept. 2011)
NWA 1942	Howardite, chip, 5.1 grams (received Sept. 2011)
NWA 1943	Howardite, slice, 5.1 grams (received Sept. 2011)
Tatahouine	Diogenite, (end?) slice, 5.6 grams (received Sept. 2011)

Samples prepared from these (and returned to Andreas Nathues)

Millbillillie-a	Millbillillie eucrite, <45 μm, dry sieved.
Millbillillie-b	Millbillillie eucrite, 45-90 μm, dry sieved.
Millbillillie-c	Millbillillie eucrite, 90-250 μm, dry sieved.
Millbillillie-d	Millbillillie eucrite, 250-500 μm, dry sieved.

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16.11.4a. HED meteorites on loan from NASA Astromaterials Facility

PRA 04401 CM2-bearing howardite. Generic: PRA 04 401; Specific: 18; Parent: 8; weight: 3.068 grams (received Nov. 16, 2011). Returned to JSC 2012.

PRA 04401-a	PRA 04401 howardite (+ CM2 xenoliths), <45 μm, dry sieved.
PRA 04401-b	PRA 04401 howardite (+ CM2 xenoliths), 45-90 μm, dry sieved.
PRA 04401-c	PRA 04401 howardite (+ CM2 xenoliths), 90-250 μm, dry sieved.

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16.11.5. HED meteorites on loan from Vishnu Reddy (Planetary Science Institute)

NWA 7465 Monomict eucrite; Northwest Africa. Full slice: 1.76 grams. Fall/find: July 2012. Received from Big Kahuna Meteorites Dec. 12, 2013; for Vishnu Reddy study.

Dhofar 485 Howardite.

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16.12a. Ureilites

16.12.1a. Ureilites available at the University of Winnipeg

None

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16.12.2a. Ureilites on loan from the University of North Dakota (Mike Gaffey)

These are the meteorites measured by Mike Gaffey for his 1974 PhD thesis and 1976 JGR paper (3 boxes received June 2008 for re-measurement). Original vial labels used below. Note: italicized type refers to information from external sources.

MJG227 "Novo-Urei Me-582 (Ureilite)" (powder) . (Gaffey unlidded box – unlabeled).
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16.12.3a. Ureilites on loan from NASA JSC (Pierre Hudon)

ID and class (from Pierre Hudon). Samples provided to University of Winnipeg for spectral measurements (and returned).

ALHA77257
ALH81101
ALH82130
DaG319
EET87517
EET87720
EET96042
Goalpara
GRA95205
GRO96675
Kenna
LEW88201
META78008
MET01085
Novo Urei
NWA1500
PCA82506
Y791538
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16.13a. Angrites

16.13.1a. Angrites available at the University of Winnipeg

None
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16.13.2a. Angrites (spectra only) from RELAB data base

Spectra (not samples) from Tom Burbine - Mt. Holyoke College

D'Orbigny
LEW86010
Sahara 99555
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16.14a. Unknown meteorite types

16.14.1. Unknown meteorite types available at the University of Winnipeg

None
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16.14.2a. Unknown meteorite types on loan from the University of North Dakota (Mike Gaffey)

These are the meteorites measured by Mike Gaffey for his 1974 PhD thesis and 1976 JGR paper (3 boxes received June 2008 for re-measurement). Original vial labels used below. Note: italicized type refers to information from external sources.

MJG131 Unknown sample – no label on vial. ("Gaffey Meteorite Inventory. Ordinary Chondrites (box 2)").
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16.15a. Primitive Achondrites

16.15.1a. Primitive achondrites available at the University of Winnipeg

None
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16.15.2a. Primitive achondrites (spectra only) from RELAB data base

EET84302 Chromite-rich lodranite/acapulcoite (spectra from Hiroi). Sample EET843021 is spectrum of fusion crust, EET843022-6 are of different faces; EET843027 is average of faces 2-6.
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16.16a. Meteorite mixtures

See also Section 15 of this document

16.16.1a. Meteorite mixtures available at the University of Winnipeg

See section 15 of this document.
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16.16.2a. Meteorite mixtures on loan from the University of North Dakota (Mike Gaffey)

These are mixtures provided by Mike from the University of North Dakota for spectral measurements (and returned to them).

och45	0% eucrite (<45 µm) + 100% ordinary chondrite (<45 µm).
03euc045	3% eucrite (<45 µm) + 97% ordinary chondrite (<45 µm).
06euc045	6% eucrite (<45 µm) + 94% ordinary chondrite (<45 µm).
09euc045	9% eucrite (<45 µm) + 91% ordinary chondrite (<45 µm).
12euc045	12% eucrite (<45 µm) + 88% ordinary chondrite (<45 µm).
15euc045	15% eucrite (<45 µm) + 85% ordinary chondrite (<45 µm).
18euc045	18% eucrite (<45 µm) + 82% ordinary chondrite (<45 µm).
20euc045	20% eucrite (<45 µm) + 80% ordinary chondrite (<45 µm).
25euc045	25% eucrite (<45 µm) + 75% ordinary chondrite (<45 µm).
30euc045	30% eucrite (<45 µm) + 70% ordinary chondrite (<45 µm).
35euc045	35% eucrite (<45 µm) + 65% ordinary chondrite (<45 µm).
euc045	100% eucrite (<45 µm) + 0% ordinary chondrite (<45 µm).
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och4590	0% eucrite (45-90 µm) + 100% ordinary chondrite (45-90 µm).
03euc4590	3% eucrite (45-90 µm) + 97% ordinary chondrite (45-90 µm).

06euc4590 6% eucrite (45-90 µm) + 94% ordinary chondrite (45-90 µm).
09euc4590 9% eucrite (45-90 µm) + 91% ordinary chondrite (45-90 µm).
12euc4590 12% eucrite (45-90 µm) + 88% ordinary chondrite (45-90 µm).
15euc4590 15% eucrite (45-90 µm) + 85% ordinary chondrite (45-90 µm).
18euc4590 18% eucrite (45-90 µm) + 82% ordinary chondrite (45-90 µm).
20euc4590 20% eucrite (45-90 µm) + 80% ordinary chondrite (45-90 µm).
25euc4590 25% eucrite (45-90 µm) + 75% ordinary chondrite (45-90 µm).
30euc4590 30% eucrite (45-90 µm) + 70% ordinary chondrite (45-90 µm).
35euc4590 35% eucrite (45-90 µm) + 65% ordinary chondrite (45-90 µm).
euc4590 100% eucrite (45-90 µm) + 0% ordinary chondrite (45-90 µm).
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16.16.3a. Meteorite mixtures on loan from Max Planck Institute (Andreas Nathues)

Millbillillie eucrites + Murchison CM2 carbonaceous chondrite (for Dawn Vesta data analysis)

VES001 100% Millbillillie eucrite (from DLR, <45 µm)
VES002 95% Millbillillie eucrite (<45 µm) + 5% Murchison CM2 (<45 µm)
VES003 90% Millbillillie eucrite (<45 µm) + 10% Murchison CM2 (<45 µm)
VES004 80% Millbillillie eucrite (<45 µm) + 20% Murchison CM2 (<45 µm)
VES005 70% Millbillillie eucrite (<45 µm) + 30% Murchison CM2 (<45 µm)
VES006 60% Millbillillie eucrite (<45 µm) + 40% Murchison CM2 (<45 µm)
VES007 50% Millbillillie eucrite (<45 µm) + 50% Murchison CM2 (<45 µm)
VES008 40% Millbillillie eucrite (<45 µm) + 40% Murchison CM2 (<45 µm)
VES009 100% Murchison CM2 (from Jim Bell – ASU; <45 µm)
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16.16.4a. Meteorite mixtures on loan from Paul Buchanan

EET87503 HED + glass from the same meteorite (August 2013)

Sample used to produce mixtures of an HED + glass (glass made from the HED). The HED is the howardite EET87503. The glass is <300 µm and the howardite powder is <~250 µm. Returned to Paul Buchanan.

MGM01 100% EET87503 + 0% Glass.
MGM02 85% EET87503 + 15% Glass.
MGM03 70% EET87503 + 30% Glass.
MGM04 65% EET87503 + 45% Glass.
MGM05 50% EET87503 + 50% Glass.
MGM06 45% EET87503 + 55% Glass.
MGM07 30% EET87503 + 70% Glass.
MGM08 15% EET87503 + 85% Glass.
MGM09 0% EET87503 + 100% Glass.
++

16.16.5a. Meteorite mixtures on loan from the Planetary Science Institute (Vishnu Reddy)

NWA 7465 eucrite + Chergach H chondrite (unshocked lithology), <45 µm intimate mixtures

ECM001 100% NWA 7465 + 0% Chergach light lithology.
ECM002 95% NWA 7465 + 5% Chergach light lithology.
ECM003 90% NWA 7465 + 10% Chergach light lithology.
ECM004 85% NWA 7465 + 15% Chergach light lithology.
ECM005 80% NWA 7465 + 20% Chergach light lithology.
ECM006 75% NWA 7465 + 25% Chergach light lithology.

ECM007 0% NWA 7465 + 100% Chergach light lithology.
++

16.16.6a. Meteorite mixtures on loan from the Planetary Science Institute (Vishnu Reddy)

Dhofar 485 howardite + Bassikounou H5 chondrite – powdered intimate mixtures (for Vishnu Reddy)

Dhofar 485 100% Dhofar 485 (howardite; <45 μm). (VMM007/VMM107).
VMM001 95% Dhofar 485 (howardite, <45 μm) + 5% Bassikounou (H5 chondrite, <45 μm).
VMM002 90% Dhofar 485 (howardite, <45 μm) + 10% Bassikounou (H5 chondrite, <45 μm).
VMM003 85% Dhofar 485 (howardite, <45 μm) + 15% Bassikounou (H5 chondrite, <45 μm).
VMM004 80% Dhofar 485 (howardite, <45 μm) + 20% Bassikounou (H5 chondrite, <45 μm).
VMM005 75% Dhofar 485 (howardite, <45 μm) + 25% Bassikounou (H5 chondrite, <45 μm).
VMM006 100% Bassikounou (H5 chondrite, <45 μm).
++

16.16.7a. Meteorite mixtures on loan from the Planetary Science Institute (Vishnu Reddy)

Dhofar 485 howardite + Chelyabinsk LL5 chondrite – powdered intimate mixtures (for Vishnu Reddy)

Dhofar 485 100% Dhofar 485 (howardite; <45 μm). (VMM007/VMM107).
VMM101 95% Dhofar 485 (howardite, <45 μm) + 5% Chelyabinsk (LL5 chondrite, <45 μm).
VMM102 90% Dhofar 485 (howardite, <45 μm) + 10% Chelyabinsk (LL5 chondrite, <45 μm).
VMM103 85% Dhofar 485 (howardite, <45 μm) + 15% Chelyabinsk (LL5 chondrite, <45 μm).
VMM104 80% Dhofar 485 (howardite, <45 μm) + 20% Chelyabinsk (LL5 chondrite, <45 μm).
VMM105 75% Dhofar 485 (howardite, <45 μm) + 25% Chelyabinsk (LL5 chondrite, <45 μm).
VMM106 100% Chelyabinsk (LL5 chondrite, <45 μm).
++

16.16.8a. Meteorite mixtures on loan from the Planetary Science Institute (Vishnu Reddy)

Chergach H5 chondrite – light and dark lithologies - powdered intimate mixtures (for Vishnu Reddy)

CMM200 <45 μm; 100% Chergach dark lithology + 0% Chergach light lithology.
CMM201 <45 μm; 90% Chergach dark lithology + 10% Chergach light lithology.
CMM202 <45 μm; 80% Chergach dark lithology + 20% Chergach light lithology.
CMM203 <45 μm; 70% Chergach dark lithology + 30% Chergach light lithology.
CMM204 <45 μm; 60% Chergach dark lithology + 40% Chergach light lithology.
CMM205 <45 μm; 50% Chergach dark lithology + 50% Chergach light lithology.
CMM206 <45 μm; 40% Chergach dark lithology + 60% Chergach light lithology.
CMM207 <45 μm; 30% Chergach dark lithology + 70% Chergach light lithology.
CMM208 <45 μm; 20% Chergach dark lithology + 80% Chergach light lithology.
CMM209 <45 μm; 10% Chergach dark lithology + 90% Chergach light lithology.
CMM210 <45 μm; 0% Chergach dark lithology + 100% Chergach light lithology.
++

16.16.9a. Meteorite mixtures on loan from the Planetary Science Institute (Vishnu Reddy)

Mreira L6 ordinary chondrite (shocked) – light and dark lithologies - powdered intimate mixtures (for Vishnu Reddy)

MM01: 100% dark lithology + 0% light lithology, <45 μm powder.
MM02: 95% dark lithology + 5% light lithology, <45 μm powder.
MM03: 90% dark lithology + 10% light lithology, <45 μm powder.
MM04: 80% dark lithology + 20% light lithology, <45 μm powder.
MM05: 70% dark lithology + 30% light lithology, <45 μm powder.

MM06: 60% dark lithology + 40% light lithology, <45 μm powder.
MM07: 50% dark lithology + 50% light lithology, <45 μm powder.
MM08: 40% dark lithology + 60% light lithology, <45 μm powder.
MM09: 30% dark lithology + 70% light lithology, <45 μm powder.
MM10: 20% dark lithology + 80% light lithology, <45 μm powder.
MM11: 10% dark lithology + 90% light lithology, <45 μm powder.
MM12: 5% dark lithology + 95% light lithology, <45 μm powder.
MM13: 0% dark lithology + 100% light lithology, <45 μm powder.
++

16.16.10a. Meteorite mixtures on loan from the Planetary Science Institute (Vishnu Reddy)

Dhofar 485 howardite + Thika L6 chondrite – powdered intimate mixtures (for Vishnu Reddy)

Dhofar 485	100% Dhofar 485 (howardite; <45 μm). (VMM007/VMM107; VMM201).
VMM202	95% Dhofar 485 (howardite, <45 μm) + 5% Thika (L6 chondrite, <45 μm).
VMM203	90% Dhofar 485 (howardite, <45 μm) + 10% Thika (L6 chondrite, <45 μm).
VMM204	85% Dhofar 485 (howardite, <45 μm) + 15% Thika (L6 chondrite, <45 μm).
VMM205	80% Dhofar 485 (howardite, <45 μm) + 20% Thika (L6 chondrite, <45 μm).
VMM206	75% Dhofar 485 (howardite, <45 μm) + 25% Thika (L6 chondrite, <45 μm).
VMM207	50% Dhofar 485 (howardite, <45 μm) + 50% Thika (L6 chondrite, <45 μm).
VMM208	0% Dhofar 485 (howardite, <45 μm) + 100% Thika (L6 chondrite, <45 μm).

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16.16.11a. Meteorite mixtures – University of Winnipeg and Vishnu Reddy

NWA 5748 howardite + Murchison CM2 chondrite (JFB001 sample)

VES300	100% NWA 5748 howardite + 0% Murchison CM2 chondrite; both <45 μm.
VES301	0% NWA 5748 howardite + 100% Murchison CM2 chondrite; both <45 μm.
VES302	95% NWA 5748 howardite + 5% Murchison CM2 chondrite; both <45 μm.
VES303	90% NWA 5748 howardite + 10% Murchison CM2 chondrite; both <45 μm.
VES304	80% NWA 5748 howardite + 20% Murchison CM2 chondrite; both <45 μm.
VES305	70% NWA 5748 howardite + 30% Murchison CM2 chondrite; both <45 μm.
VES306	60% NWA 5748 howardite + 40% Murchison CM2 chondrite; both <45 μm.
VES307	50% NWA 5748 howardite + 50% Murchison CM2 chondrite; both <45 μm.
VES308	40% NWA 5748 howardite + 60% Murchison CM2 chondrite; both <45 μm.

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16.16.12a. Meteorite mixtures from Max Planck Institute (Gunni Thangjam) – October 2014-10-21

82 samples in total.
Samples used in the mixtures and abbreviations):

HD:	DaG 779: diogenite-rich howardite
CM:	Jbilet: CM2 carbonaceous chondrite
GL:	Millbillillie glass – glass made from Millbillillie eucrites
HE:	NWA 1929: Eucrite-rich howardite
OL:	Olivine: terrestrial olivine

These abbreviations are used in the mixture descriptions below; numbers following the 2 letter abbreviations refer to the weight percent abundances. The sample/powder preparation of the howardites are done in two ways. Each sample is divided into two halves, and one half is used to prepare samples in just only 0-63 micron size (reference sample), while the other half is used to prepare samples in various grain sizes (0-63, 63-125, 125-250, 250-630).

Sample No.	*Mixture-Name*	*Grain size (µm)*
a) HE-GL mixtures; 0-63 µm		
1	2. HE20-GL80	<63 µm
2	4. HE40-GL60	<63 µm
3	5. HE50-GL50	<63 µm
4	6. HE60-GL40	<63 µm
5	7. HE70-GL30	<63 µm
6	8. HE80-GL20	<63 µm
7	9. HE90-GL10	<63 µm
b) HD-GL mixtures; 0-63 µm		
8	2. HD20-GL80	<63 µm
9	4. HD40-GL60	<63 µm
10	5. HD50-GL50	<63 µm
11	6. HD60-GL40	<63 µm
12	7. HD70-GL30	<63 µm
13	8. HD80-GL20	<63 µm
14	9. HD90-GL10	<63 µm
c) HE-CM2 mixtures; 0-63 µm		
15	1. HE10-CM90	<63 µm
16	2. HE20-CM80	<63 µm
17	3. HE30-CM70	<63 µm
18	4. HE40-CM60	<63 µm
19	5. HE50-CM50	<63 µm
20	6. HE60-CM40	<63 µm
21	7. HE70-CM30	<63 µm
22	8. HE80-CM20	<63 µm
23	9. HE90-CM10	<63 µm
d) HD-CM2 mixtures; 0-63 µm		
24	1. HD10-CM90	<63 µm
25	2. HD20-CM80	<63 µm
26	3. HD30-CM70	<63 µm
27	4. HD40-CM60	<63 µm
28	5. HD50-CM50	<63 µm
29	6. HD60-CM40	<63 µm
30	7. HD70-CM30	<63 µm
31	8. HD80-CM20	<63 µm
32	9. HD90-CM10	<63 µm
e) HD-OL mixtures; 0-63 µm		
33	1. HD10-OL90	<63 µm
34	2. HD20-OL80	<63 µm
35	3. HD30-OL70	<63 µm
36	4. HD40-OL60	<63 µm
37	5. HD50-OL50	<63 µm
38	6. HD60-OL40	<63 µm
39	7. HD70-OL30	<63 µm
40	8. HD80-OL20	<63 µm
41	9. HD90-OL10	<63 µm
f) HE-OL mixtures; 0-63 µm		
42	1. HE10-OL90	<63 µm
43	2. HE20-OL80	<63 µm

44	3. HE30-OL70	<63 μm
45	4. HE40-OL60	<63 μm
46	5. HE50-OL50	<63 μm
47	6. HE60-OL40	<63 μm
48	7. HE70-OL30	<63 μm
49	8. HE80-OL20	<63 μm
50	9. HE90-OL10	<63 μm
g) HE-OL mixtures; 63-125 μm		
51	1. HE10-OL90	63-125 μm
52	2. HE20-OL80	63-125 μm
53	3. HE30-OL70	63-125 μm
54	4. HE40-OL60	63-125 μm
55	5. HE50-OL50	63-125 μm
56	6. HE60-OL40	63-125 μm
57	7. HE70-OL30	63-125 μm
58	8. HE80-OL20	63-125 μm
59	9. HE90-OL10	63-125 μm
h) HD-OL mixtures; 63-125 μm		
60	1. HD10-OL90	63-125 μm
61	2. HD20-OL80	63-125 μm
62	3. HD30-OL70	63-125 μm
63	4. HD40-OL60	63-125 μm
64	5. HD50-OL50	63-125 μm
65	6. HD60-OL40	63-125 μm
66	7. HD70-OL30	63-125 μm
67	8. HD80-OL20	63-125 μm
68	9. HD90-OL10	63-125 μm
i) Pure samples		
69	1. HE	<63 μm
70	2. HE	63-125 μm
71	3. HE	125-250 μm
72	4. HE	250-630 μm
73	5. HE-all	<630 μm? ("whole sample/Reference sample, 0-63")
74	1. HD	<63 μm
75	2. HD	63-125 μm
76	3. HD	125-250 μm
77	4. HD	250-630 μm
78	5. HD-all	<630 μm? ("whole sample/Reference sample, 0-63")
79	1. CM	<63 μm
80	1. OL	<63 μm
81	2. OL	63-125 μm
82	1. GL	<63 μm

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16.17a. Tektites

16.17.1a. Tektites available at the University of Winnipeg

TEK001	Indochinite	Indochina (from Houston Museum).
TEK002	Indochinite	Indochina (from Houston Museum).
TEK003	Australite	Australia (Collector's Marketing Corp.).

TEK004	Indochinite	ZhanJiang, Guangdong, China (Nature's Own, Dec. 17, 2009).
TEK005	Indochinite	Dianbai, Guangdong, China (Medusa, Elora, ON, Canada).
TEK006	Indochinite	Dianbai, Guangdong, China (Medusa, Elora, ON, Canada).
TEK007	Indochinite	Guangdong Province, China [John Medici Collection, Tucson 2011 show].
TEK008	Moldavite	Locenice, Czech Republic [The Crystal Circle, Tucson 2011 show].
TEK009	Australite	Tektite: Australia [Williams Minerals/Crystal Universe Pty. Ltd., Tucson 2011 show].
TEK010	Australite	Tektite: Australia [Williams Minerals/Crystal Universe Pty. Ltd., Tucson 2011 show].
TEK011	Indochinite	Tektites (5) (indochinites) – southeast Asia [December 2012 AGU Fall meeting; Ikon Mining and Exploration]; ~10 grams each – 5 samples.
TEK012	Tektite	Indochinite; ZhanJiang, GuangDong, China (purchased at December 2012 AGU Fall Meeting).
TEK013	Tektite	Indochinite; ZhanJiang, GuangDong, China (purchased at December 2012 AGU Fall Meeting).

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16.18a. Impact glasses

16.18.1a. Impact glasses available at the University of Winnipeg

SIL130	"Libyan glass" aka "Libyan Desert Glass" (lechatelierite): ROM #M26692, 3.9 grams, sawn portion (from Royal Ontario Museum - April 14, 2009). See also Section 2.11 for analyses. Provided for destructive analysis.
SIL131	"Dakhleh glass". ROM #M48024 (lechatelierite), 2 grams (from Royal Ontario Museum - April 14, 2009). See also Section 2.11 for analyses. Provided for destructive analysis.
SIL132	Libyan Desert Glass: Gilf Kebir region, Egypt [The Crystal Circle, Tucson 2011 show]. See also Section 2.11 for analyses.

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16.19a. Non-meteorites and possible meteorites

16.19.1a. Samples available at the University of Winnipeg

MNO001	Fragments of a much larger piece (serpentinite/hornblendite?). From Raven Thundercrag (examined in ~2003).
MNO002	Fragments from a supposed witnessed fall; Fairford, MB, Canada (2003).
MNO003	Fragments from a larger "meteorite" – from Mike Conrad (date unknown).
MNO004	Rock "F3" collected during 1999-2000 meteorite hunt in Saskatchewan, probably Craik or Holdfast.
MNO005	Iron concretions, near Hondo, TX, USA (aka MIS013); collected by Sue Atkinson (~1988); 3 pieces, one cut open.
MNO006	Iron concretion, collected during 1999-2000 meteorite hunt in Saskatchewan; probably Holdfast.
MNO007	Fragments of a rock that suddenly "appeared" near Winnipegosis, MB, Canada (along with various pieces of "literature").

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16.20a. Laser irradiated meteorites – Jeff Gillis-Davis

16.20.1a. Allende CV carbonaceous chondrite from the University of Hawaii (Jeff Gillis-Davis)

Laser irradiation in vacuum chamber performed by Jeff Gillis-Davis at University of Hawaii (May 2014).

Allende fresh	Not irradiated
Allende 5 minutes	Laser irradiated for 5 minutes

Allende 10 minutes Laser irradiated for 10 minutes

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16.21. Bennu analogues – mixtures and meteorites (from Devin Schrader, Smithsonian Institution)

Received from Devin Schrader at Smithsonian Institution (Oct. 6, 2014). To test mineral detection algorithms for OSIRIS-REx spectrometers.
Enclosed letter: VIS-NIR Ser. #2. Please find enclosed the last 5 analog samples for analysis.

Sample ID	Weight (analog powder)
Steve-v	0.4896 g
Wanda-v	0.4903 g
Tony-v	0.4859 g
Bucky-v	0.4857 g
Selina-v	0.4839 g
Bruce-v	0.4844 g
Natasha-v	0.4796 g
Clint-v	0.4900 g
Peggy-v	0.4900 g
Nick-v	0.4911 g

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16.22a. "Fake" Murchison heating experiments

A simulated ("fake") Murchison meteorite was created to better determine the cause of spectral properties of heated Murchison conducted by Taki Hiroi, Mike Zolensky et al. in the 1990s, as well as to better determine which phases may account for the spectral differences.

The fake Murchison consisted of 85% ASB267 (a dark serpentinite to represent the abundant phyllosilicates), 5% shungite (an aromatic-rich terrestrial organic to represent the organic phases), TRO203 (synthetic troilite to represent the sulfides in Murchison), and 5% MAG200 (nanophase magnetite to represent the magnetite in Murchison).

XRD and spectroscopy were run on the samples before and after every stage of heating. Heating was done in 100 C increments and samples were characterized by XRD and reflectance (ASD spectrometer) before and after every temperature increment. Unless otherwise noted, a new sample was used for every temperature increment. Samples were all run in a continuous flow of nitrogen, and heated for one week at the required temperature interval, expect for the 1100° C (2 hours at this temperature; heated and cooled twice) and the 1200°C run (half an hour at this temperature), due to limitations on oven capabilities.

Sample IDs are as follows:

HASB267	Unheated ASB267 (serpentinite); <63 µm
HSHU	Unheated SHU102 (shungite); <63 µm
HTRO	Unheated TRO203 (troilite); <45 µm
HMAG	Unheated MAG200 (magnetite); <20 µm
WMM	Fake Murchison mixture (described above); <63 µm

Temperature	*ASB267*	*SHU102*	*TRO203*	*MAG200*	*Fake Murchison*
100°C heated samples:	HASB 100	HSHU 100	HTRO 100	HMAG 100	WMM 100
200°C heated samples:	HASB 200	HSHU 200	HTRO 200	HMAG 200	WMM 200
300°C heated samples:	HASB 300	HSHU 300	HTRO 300	sample spill	sample spill
400°C heated samples:	HASB 400	HSHU 400	HTRO 400	HMAG 400	WMM 400

500°C heated samples:	HASB 500	HSHU 500	HTRO 500	HMAG 500	WMM 500
600°C heated samples:	HASB 600	HSHU 600	HTRO 600	HMAG 600	WMM 600
700°C heated samples:	HASB 700	HSHU 700	HTRO 700	HMAG 700	WMM 700
800°C heated samples:	HASB 800	no more SHU run	HTRO 800	HMAG 800	WMM 800
900°C heated samples:	HASB 900	no more SHU run	HTRO 900	HMAG 900	WMM 900
1000°C heated samples-1:	HASB 1000	no more SHU run	HTRO 1000	HMAG 1000	WMM 1000
1100°C heated samples-2:	HASB 1100	no more SHU run	HTRO 1100	HMAG 1100	WMM 1100
1200°C heated samples:	HASB 1200	no more SHU run	HTRO 1200	HMAG 1200	WMM 1200

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16.23a. Parr bomb runs on selected meteorites

This section describes closed system heating experiments (using Teflon-lined Parr bombs) conducted on the following meteorites:

Jbilet: CM2 chondrite
Zag: Ordinary (H3-6 chondrite) with salt inclusions
Murchison: CM2 chondrite
"Fake" Murchison: 85% serpentinite (ASB267; <63 µm) + 5% shungite (SHU102; <63 µm) + 5% troilite (TRO203; <45 µm) + 5% nanophae magnetite (MAG200; <20 nm)

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Experimental procedures: 6 Parr bombs were used for closed system heating as follows:

1. Jbilet 1 gram of meteorite run dry: 200°C for 104 days.
2. Zag: 1 gram of meteorite + 1 gram of distilled deionized water: 200°C for 111 days.
3. Murchison: 1 gram of meteorite + 1 gram of distilled deionized water: 200°C for 111 days.
4. Murchison: 1 gram of meteorite run dry: 200°C for 111 days.
5. WMM (fake Murchison): 1 gram of sample run dry: 200°C for 111 days).
6. WMM (fake Murchison): 1 gram of sample + 1 gram of distilled deionized water: 200°C for 111 days.

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16.1a.x. Minerals Present in Calcium-Aluminum Inclusions (CAIs)

Andradite
Anorthite
Calcite
Corundum
Diopside
Fassaite
Grossularite
Hercynite
Hibonite
Melilite
Nepheline
Olivine
Perovskite
Plagioclase
Rhönite
Sodalite
Spinel
Wollastonite

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16b. XRD Data - Meteorites, Tektites, and Impactites (by subsections)

16.11b. XRD Data - HEDs

University of Winnipeg Rietveld refinement results (Bruker D8 analysis)

Wt.%	JaH 626 Euc.	Millbillillie Euc.	NWA 1836 Euc.	NWA 1942 How.	NWA 1943 How.	NWA 2968 Dunitic diog.
Plagioclase	40	49	28	35	43	n.d.
Pigeonite	59	24	55	34	27	n.d.
Augite	n.d.	12	n.d.	n.d.	15	n.d.
Orthopyroxene	n.d.	14	17	30	15	tr.
Ilmenite	1	1	tr.	n.d.	n.d.	n.d.
Olivine	n.d.	n.d.	n.d.	1	n.d.	89
Chromite	n.d.	tr.	n.d	n.d.	n.d.	5
Troilite	n.d.	tr.	n.d.	n.d.	n.d.	3
Cristobalite	n.d.	n.d.	n.d.	n.d	n.d.	n.d.
Anatase	n.d.	n.d.	n.d	n.d.	n.d.	n.d.

Wt.%	NWA 5751 How.	NWA 6013 Diog.	NWA 6477 Euc.	Talampaya Euc.	Tatahouine Diog.
Plagioclase	28	7	54	65	n.d.
Pigeonite	13	n.d.	33	32	n.d.
Augite	7	n.d.	13	1	n.d.
Orthopyroxene	50	65	n.d.	n.d.	97
Ilmenite	n.d.	n.d.	tr.	2	n.d.
Olivine	1	27	n.d.	n.d.	tr.
Chromite	tr.	1	tr.	tr.	tr.
Troilite	n.d.	n.d.	tr.	tr.	n.d.
Cristobalite	n.d.	n.d.	n.d.	n.d.	tr.
Anatase	n.d.	n.d.	n.d.	n.d.	2

n.d.: not detected; tr.: trace (<1 wt.%).

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16.18b. XRD Data - Impact glasses

SIL131 XRD trace is very noisy, indicative of amorphous component. Only phase identified – diopside. (University of Manitoba Bruker D8 analysis - November 2011).

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16.20b. Laser irradiated meteorites – Jeff Gillis-Davis

16.20b.1. Allende CV carbonaceous chondrite

Laser irradiation in vacuum chamber performed by Jeff Gillis-Davis at University of Hawaii (May 2014).

Allende fresh Not irradiated
Allende 5 minutes Laser irradiated for 5 minutes
Allende 10 minutes Laser irradiated for 10 minutes

Three samples analyzed by XRD at University of Winnipeg: no sign of iron peaks seen in the three XRD patterns (June 2014). Peak heights decline with increasing irradiation.

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16c. Compositional Data - Meteorites, Tektites, and Impact Glasses

16.17c. Tektites

Wt.%	TEK001	TEK003	TEK004
SiO_2	71.47	72.54	72.71
TiO_2	0.80	0.78	0.74
Al_2O_3	14.15	13.29	12.59
(Fe_2O_3)*	(5.61)	(5.20)	(5.03)
Fe_2O_3	0.42	0.64	0.35
FeO	4.67	4.10	4.21
MnO	0.11	0.09	0.10
MgO	2.22	2.12	1.92
CaO	1.98	2.08	2.30
Na_2O	1.37	1.54	1.30
K_2O	2.57	2.51	2.36
P_2O_5	0.07	0.08	0.04
SO_3			0.17
TOTAL	99.83	99.77	99.26
LOI	0.50	0.71	
ppm			
Sr	146	146	158
Zr	271	303	271
V	110	108	83
Cr	71	76	84
Co	4	4	
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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16d. Spectral Data - Meteorites, Tektities and Impactites (by subsections)

Sample	*Facility/File No.*	*Description*

16.1d. Iron meteorites and components

16.1.1d. University of Winnipeg samples

MET01	PSF 121101a.012	slab, roughened with 120 grit sandpaper (for mafic metal sprinkling experiments); i=30°, e=0°; 0.35-2.5 µm ASD; 1 nm output; 1000 spectra averaged (directory: 121101maficmetal). Aka OLMETS01.
MET01	PSF 121101a.018	slab, roughened with 120 grit sandpaper (for mafic metal sprinkling experiments); i=30°, e=0°; 0.35-2.5 µm ASD; 1 nm output; 1000 spectra averaged (directory: 121101maficmetal). Aka PXMETS02.
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MET01A	PSF feb1607.002	<45 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD (directory: feb1607 meteoritic).
MET01B	PSF feb1607.004	45-90 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD (directory: feb1607 meteoritic).
MET01C	PSF feb1607.005	90-250 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD (directory: feb1607 meteoritic).
MET01A	PSF feb1907.002	<45 µm, 35°/0°, 0.35-2.5 µm,1 nm resol., 1000 spectra averaged; ASD (directory: feb1907 meteoritic).
MET01B	PSF feb1907.003	45-90 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol.; 1000 spectra avaraged; ASD (directory: feb1907 meteoritic).
MET01C	PSF feb1907.004	90-250 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol.; 1000 spectra averaged; ASD (directory: feb1907).
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MET01 400	PSF feb2107.022	slab, roughened with 400 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET01 220	PSF feb2107.025	slab, roughened with 220 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET01 120	PSF feb2107.028	slab, roughened with 120 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET01 60	PSF feb2107.031	slab, roughened with 60 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET01a	PSF 090921a.023	slab; interior saw-cut surface 1, spot 1 (inclusion); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.024	slab; interior saw-cut surface 1, spot 2 (inclusion); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.025	slab; interior saw-cut surface 1, spot 3 (inclusion); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.026	slab; interior saw-cut surface 1, spot 4 (inclusion); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.027	slab; interior saw-cut surface 1, spot 5 (inclusion); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.028	slab; interior saw-cut surface 1, spot 6 (inclusion: schreibersite?); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.029	slab; interior saw-cut surface 1, spot 7 (inclusion with minor embedded silicates); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.030	slab; interior saw-cut surface 1, spot 8 (inclusion with minor embedded silicates); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.031	slab; interior saw-cut surface 2, spot 9 (inclusion with minor embedded silicates); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged;

ASD.

MET01a	PSF 090921a.032	slab; interior saw-cut surface 2, spot 10 (inclusion: troilite?); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.
MET01a	PSF 090921a.033	slab; interior saw-cut surface 2, spot 11 (inclusion: schreibersite?); i=30°/e=0°; 0.35-2.5 µm; 1 nm output; 100 spectra averaged; ASD.

++++ MET01A: Bidirectional study (March 2007)++++

Format: grain size; i°,e° for standard; i°/e° for sample; wavelength range; spectral resolution; number of spectra averaged; instrument.

Series 0a (same viewing geometry for standard and sample)

MET101A	PSF feb2707.004	<45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
MET101A	PSF feb2707.012	<45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
MET101A	PSF feb2707.020	<45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).
MET101A	PSF feb2707.028	<45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2707 meteoritic).

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Series 0b (same viewing geometry for standard and sample)

MET101A	PSF feb2807.004	<45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
MET101A	PSF feb2807.012	<45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
MET101A	PSF feb2807.020	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).
MET101A	PSF feb2807.028	<45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (directory: feb2807 meteoritic).

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Series 1 (same viewing geometry for standard and sample)

MET01a	PSF mar0107.004	<45 µm; 0°/30°; 0°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0107.012	<45 µm; 0°/45°; 0°/45°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0107.020	<45 µm; 0°/60°; 0°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0107.028	<45 µm; 0°/75°; 0°/75°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 2 (same viewing geometry for standard and sample

MET01a	PSF mar0707a.004	<45 µm; 30°/60°; 30°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0207.012	<45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0207.020	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0207.028	<45 µm; 30°/-60°; 30°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 3 (same viewing geometry for standard and sample)

MET01a	PSF mar0207.036	<45 µm; 60°/60°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0207.044	<45 µm; 30°/30°; 30°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0207.052	<45 µm; 30°/0°; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0207.060	<45 µm; 60°/-30°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

Series 4 (different viewing geometry for standard vs. sample)

MET01a	PSF mar0607.004	<45 µm; 30°/0°; 60°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0607.012	<45 µm; 30°/0°; 60°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0607.020	<45 µm; 30°/0°; 60°/30°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0607.028	<45 µm; 30°/0°; 60°/60°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

Series 5 (bifurcated cable; same viewing geometry for standard and sample)

MET01a	PSF mar0707.004	<45 µm; 0°/0°; 0°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
MET01a	PSF mar0707.012	<45 µm; 30°/-30°; 30°/-30°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
MET01a	PSF mar0707.020	<45 µm; 45°/-45°; 45°/-45°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.
MET01a	PSF mar0707.028	<45 µm; 60°/-60°; 60°/-60°; 0.35-2.5 µm; 1 nm resol.; 1000 avg; ASD.

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MPMIX1011 0% orthopyroxene (PYX042; <45 µm) + 100% meteoritic metal (MET101A; <45 µm).

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MET101A	PSF 100907.026	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; aka MPMIX1011.
MET101A	PSF 100907.029	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; aka MPMIX1103.
MET101A	PSF feb1907.002	<45 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample) (directory: feb1907 meteoritic).
MET101 45	PSF feb1907.003	<45 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample) (directory: feb1907 meteoritic).
MET101U	PSF feb1907.004	45-90 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample, unbeaten) (directory: feb1907 meteoritic).
MET101U	PSF feb1907.005	90-125 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample, unbeaten) (directory: feb1907 meteoritic).
MET101U	PSF feb1907.006	125-255 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample, unbeaten) (directory: feb1907 meteoritic).
MET101B	PSF feb1907.007	45-90 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample, beaten) (directory: feb1907 meteoritic).
MET101B	PSF feb1907.008	90-125 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample, beaten) (directory: feb1907 meteoritic).
MET101B	PSF feb1907.009	125-255 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample, beaten) (directory: feb1907 meteoritic).

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MET101A	PSF feb2107.002	<45 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (original MET101 sample) (directory: feb2107 meteoritic).
MET101 <45	PSF feb2107.003	<45 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (directory: feb2107 meteoritic).
MET101B	PSF feb2107.004	45-90 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (directory: feb2107 meteoritic).
MET101B	PSF feb2107.005	90-125 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (directory: feb2107 meteoritic).
MET101B	PSF feb2107.006	125-255 µm, 35°/0°, 0.35-2.5 µm, 1 nm resol., 1000 spectra averaged; ASD (directory: feb2107 meteoritic).

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MET101	PSF 041007met100	<45 µm, 0°/0° (bifurcated probe), 0.2-0.4 µm, ~0.3 nm.
MET101	PSF 130707met100	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
MET101	PSF met100	<45 µm, 0°/0° (bifurcated probe), 0.2-0.86 µm; merged at 0.38 µm, 0.2-0.4 µm with D2 source, 0.35-0.86 µm with QTH source.
MET101	PSF 160707met101	<45 µm, 0°/0° (bifurcated probe), 0.35-0.86 µm, ~0.3 nm.
MET101	RELAB C1SC63	<45µm, beaten, 0E/15E, 0.3-2.7µm, 5nm.
MET101	USGS 260	<45µm, IS, 0.35-2.6µm, 1x resol.
MET101	USGS 264	45-90µm, IS, 2.1-2.6µm, 1x resol.
MET101	USGS 216	45-90µm, IS, 0.35-2.6µm, 1x resol.
MET101	RELAB C1SC06	45-90µm beaten, 0E/15E, 0.34-2.7µm, 5nm.
MET101	RELAB C2SC06	45-90µm, unbeaten, 0E/15E, 0.3-2.6µm, 5nm.
MET101	RELAB C3SC06	45-90µm, unbeaten, 0E/15E, 0.3-2.6µm, 5nm (2nd run).
MET101	RELAB C4SC06	45-90µm, unbeaten, 0E/15E, 0.3-2.6µm, 5nm, with errors (2 run average).
MET101	USGS 220	125-255µm, IS, 0.35-2.6µm, 1x resol.

MET101	RELAB casc63	<45µm, beaten, 30°/0°, 0.3-2.6µm, 5 nm.
MET101	RELAB sbsc06	45-90µm, 0.3-2.6µm, 30°/0°, 5 nm resol. Smoothed with 5 point filter.
MET101	RELAB cbsc06	45-90µm, 0.3-2.6µm, 30°/0°, 5 nm resol.; not smoothed.
MET101	RELAB lasc06	45-90µm, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resol., (Merged RELAB+ Nicolet @2.5µm, note viewing geometry change), smoothed.
MET101	PSF 100304a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD.
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MET101A	RELAB s1sc99	unsorted, 0.3-2.6µm, 30°/0°, 5 nm resol. Smoothed with 5 point filter.
MET101A	RELAB c1sc99	unsorted, 0.3-2.6µm, 30°/0°, 5 nm resol.; not smoothed.
MET101A	RELAB lasc99	unsorted, 0.3-26µm, 30°/0°,30°; 5/0.6-129 nm resol., (Merged RELAB+ Nicolet @2.5µm, note viewing geometry change),smoothed.
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MET02A	PSF feb1607.006	<45 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD (directory: feb1607 meteoritic).
MET02B	PSF feb1607.007	45-90 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD (directory: feb1607 meteoritic).
MET02C	PSF feb1607.008	90-250 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD; very little sample (directory: feb1607 meteoritic).
MET02 400	PSF feb2107.023	slab, roughened with 400 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET02 220	PSF feb2107.026	slab, roughened with 220 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET02 120	PSF feb2107.029	slab, roughened with 120 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET02 60	PSF feb2107.032	slab, roughened with 60 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
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MET03A	PSF feb1607.009	<45 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD (directory: feb1607 meteoritic).
MET03B	PSF feb1607.010	45-90 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD (directory: feb1607 meteoritic).
MET03C	PSF feb1607.011	90-250 µm; 35°/0°?; 0.35-2.5 µm; 1 nm output; ASD; 1000 spectra averaged; ASD; not enough sample (directory: feb1607 meteoritic).
MET03 400	PSF feb2107.024	slab, roughened with 400 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET03 220	PSF feb2107.027	slab, roughened with 220 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET03 120	PSF feb2107.030	slab, roughened with 120 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
MET03 60	PSF feb2107.033	slab, roughened with 60 grit sandpaper, 35°/0°, 0.35-2.5 µm, 1 nm resol., ASD (directory: feb2107 meteoritic).
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SCR101	See Phosphides section (section 10)	
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TRO201	See Sulphides section (section 10)	
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TRO202	See Sulphides section (section 10)	
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TRO203	See Sulphides section (section 10)	
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16.1.2d. University of North Dakota samples

TUCSON	PSF tuc1d	slab, rusty side, 30°/0°, 2-16 µm, D&P, 6 cm-1 resol.
TUCSON	PSF tuc2d	slab, cloudy spot, 30°/0°, 2-16 µm, D&P, 6 cm-1 resol.

TUCSON	PSF tuc3d	slab, cloudy spot after sanding, 30°/0°, 2-16 µm, D&P, 6 cm-1 resol.
TUCSON	PSF may1807.004	slab, rusty side, 30°/0°, 0.25-2.5 µm, ASD, 1 nm resol.
TUCSON	PSF may1807.005	slab, cloudy spot, 30°/0°, 0.35-2.5 µm, ASD, 1 nm resol.
TUCSON	PSF may1807.006	slab, cloudy spot after sanding, 30°/0°, 0.35-2.5 µm, ASD, 1 nm resol.

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16.2d. Aubrites and components

16.2.1d. University of Winnipeg samples

MET020	PSF met020	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics (080708 directory).
MET020	PSF met02045	<45µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
MET020	PSF met02045	<45µm, 30°/0°, 0.35-0.86 µm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
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MET200	RELAB CBEA03	<45µm, 30°/0°, 0-.3-2.6µm, 5 nm.
MET200	RELAB CAEA03	45-90µm, 30°/0°, 0-.3-2.6µm, 5nm.
MET200	RELAB LAEA03B	<45µm, 30°/30°, 0-.3-26µm, 1.2-129 nm (Nicolet).
MET200	RELAB LAEA03A	45-90µm, 30°/30°, 0-.3-26µm, 1.2-129 nm (Nicolet).
MET200	RELAB C1SC01	45-90µm, 0E/15E, 0.3-3.6µm, 5nm, spun 1.6-2.6µm. See PYX205.
MET200	PSF met20045	<45µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
MET200	PSF met20090	45-90µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
MET200	PSF met20045	<45µm, 30°/0°, 0.35-0.86 µm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
MET200	PSF met20090	45-90µm, 30°/0°, 0.35-0.86 µm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
MET200	RELAB C1SC01	45-90µm, 0E/15E, 0.3-3.6µm, 5nm, spun 1.6-2.6µm. See PYX205.
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MET201	RELAB CBEA04	<45µm, 30°/0°, 0-.3-2.6µm, 5 nm.
MET201	RELAB CAEA04	45-90µm, 30°/0°, 0-.3-2.6µm, 5nm.
MET201	RELAB LAEA04B	<45µm, 30°/0°, 0-.3-26µm, 1.2-129 nm (Nicolet).
MET201	RELAB LAEA04A	45-90µm, 30°/0°, 0-.3-26µm, 1.2-129 nm (Nicolet).
MET201	PSF met20145	<45µm, 30°/0°, 0.35-0.86 µm, 30 msec, 200 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
MET201	PSF met20190	45-90µm, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
MET201	PSF met20145	<45µm, 30°/0°, 0.35-0.86 µm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
MET201	PSF met20190	45-90µm, 30°/0°, 0.35-0.86 µm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
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MET300	RELAB latb10	<~1mm, 30°/0°,30°; 5, 0.6-129 nm, merged at 2550 nm.
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MET301	RELAB latb11	<~1mm, 30°/0°,30°; 5, 0.6-129 nm, merged at 2550 nm.

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16.2.2d. University of North Dakota samples

METCF1	PSF 090313a.044	whole rock powder, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD.
METCF1	PSF 090313a.045	whole rock powder, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra-a averaged; ASD. Same as .044 repacked and reshot.
metcf1	PSF metcf1	unsorted coarse powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
metcf1	PSF mcf1	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
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METCF1	PSF 091118a.021	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
METCF1	PSF 091118a.022	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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METCF2	PSF 090313a.046	<200 mesh, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Not enough sample to fill cup – black painted “M” cup.
METCF2	PSF 090313a.047	<200 mesh, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Same as .046 repacked and reshot. Not enough sample to fill cup – black painted “M” cup.
METCF2	PSF 091118a.023	<200 mesh; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
METCF2	PSF 091118a.024	<200 mesh; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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METCF3	PSF 090313a.048	>200 mesh, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Not enough sample to fill cup – black painted “M” cup.
METCF3	PSF 090313a.049	>200 mesh, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Same as .048 repacked and reshot. Not enough sample to fill cup – black painted “M” cup.
METCF3	PSF 091118a.025	>200 mesh; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
METCF3	PSF 091118a.026	>200 mesh; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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METCF*	PSF 090313a.050	black painted “M” cup, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Shot empty well of cup.
METCF*	PSF 090313a.051	black painted “M” cup, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Shot black surface of cup.
METCF**	PSF 090313a.052	unpainted “M” cup, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Shot unpainted empty well of cup.
METCF**	PSF 090313a.053	unpainted “M” cup, 30°/0°; 0.35-2.5 μm; 2-7 nm resol., 1 nm output, 1000 spectra averaged; ASD. Shot unpainted surface of cup.
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mjg177	PSF mjg177	unsorted (coarse) powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
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mjg224	PSF mjg224a	coarse fragments, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg224	PSF mjg224b	coarse fragments with powder infill, 30°/0°, 0.35-0.86 μm, 30 msec, 300

		avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg224	PSF 091112a.017	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
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mjg225	PSF mjg225	unsorted (coarse) powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg225	PSF mjg225	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
mjg225	PSF 091112a.018	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg225	PSF 091112a.019	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg236	PSF 091118a.019	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg236	PSF 091118a.020	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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16.2.3d. Norton County aubrite slab (on loan from University of New Mexico)

Sandpaper	PSF 090921a.001	garnet sandpaper used to prep Norton Co.; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.002	slab; exterior surface, spot 1 (red area); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.003	slab; exterior surface, spot 2 (massive pyroxene); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.004	slab; exterior surface, spot 3a (black vein); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.005	slab; exterior surface, spot 3b (black vein); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.006	slab; exterior surface, spot 4 (grey breccia); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.007	slab; exterior surface, spot 5 (red silicate); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.008	slab; exterior surface, spot 1 (massive pyroxene); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.009	slab; exterior surface, spot 7 (grey breccia); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.010	slab; exterior surface, spot 8 (big crystal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.011	slab; interior saw-cut surface, spot 7 (metal grain); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.012	slab; interior saw-cut surface, spot 8 (average gray breccia area); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.013	slab; interior saw-cut surface, spot 9 (big crystal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.014	slab; interior saw-cut surface, spot 10 (big crystal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.015	slab; interior saw-cut surface, spot 11 (average grey breccia); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.016	slab; interior saw-cut surface, spot 12 (orange-stained area with metal grain); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.

N102a.1	PSF 090921a.017	slab; interior saw-cut surface, spot 13 (average grey breccia); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.018	slab; interior saw-cut surface, spot 14 (rusty spot); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.019	slab; interior saw-cut surface, spot 15 (average grey breccia); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.020	slab; interior saw-cut surface, spot 16 (big crystal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.021	slab; interior saw-cut surface, spot 17 (big crystal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
N102a.1	PSF 090921a.022	slab; interior saw-cut surface, spot 18 (metal grain); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.

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16.3d. Enstatite chondrites and components

16.3.2d. University of North Dakota samples

mjg183	PSF mjg183	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
mjg183	PSF mjg183	fine brownish unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg183	PSF 091104a.001	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg183	PSF 091104a.002	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg190	PSF mjg190	unsorted coarse powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg190	PSF mjg190	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
mjg190	PSF 091104a.015	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg190	PSF 091104a.016	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg217	PSF mjg217a	fragment – broken facer, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg217	PSF mjg217b	fragment – other broken face, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg217	PSF mjg217c	fragment – cut face, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
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mjg217	PSF 091112a.003	chip – cut surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg217	PSF 091112a.004	chip – broken surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
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mjg218	PSF mjg218a	fragment- broken face, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).

mjg218	PSF mjg218b	fragment – cut face, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg218	PSF mjg218c	triangular fragment – rough face, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg218	PSF mjg218d	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
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mjg218	PSF 091112a.005	chip – cut surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg218	PSF 091112a.006	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
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mjg219	PSF mjg219a	unsorted powder with largest fragment removed, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg219	PSF mjg219b	unsorted powder with largest fragment in powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg219	PSF mjg219	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
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mjg219	PSF 091112a.007	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg219	PSF 091112a.008	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg220	PSF mjg220	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg220	PSF mjg220	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
mjg220	PSF 091112a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg220	PSF 091112a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg221	PSF mjg221a	fragment – cut face, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg221	PSF mjg221b	fragment – rougher face, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg221	PSF mjg221c	unsorted coarse powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg221	PSF 091112a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg221	PSF 091112a.012	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg222	PSF mjg222a	unsorted powder with largest fragment removed, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).

mjg222	PSF mjg222b	unsorted powder with largest fragment in powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg222	PSF mjg222	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
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mjg222	PSF 091112a.013	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg222	PSF 091112a.014	chip – broken surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
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mjg223	PSF mjg223a	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg223	PSF mjg223	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
mjg223	PSF 091112a.015	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg223	PSF 091112a.016	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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16.3.3d. Enstatite chondrites on loan from the University of Western Ontario (Matt Izawa)

These are the meteorites measured at HOSERLab for Matthew Izawa, as part of a larger study of E chondrites.

QUE 94204	RELAB 081222a.001	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
LAP 02225	RELAB 081222a.004	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
ALHA81021	RELAB 081222a.006	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
TIL 91714	RELAB 081222a.007	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
EET 87746	RELAB 081222a.009	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
PCA 91020	RELAB 081222a.011	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
LEW 88180	RELAB 081222a.013	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
EET 96135	RELAB 081222a.015	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
MAC 02747	RELAB 081222a.016	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
MAC 02837	RELAB 081222a.017	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		

MET 00783	RELAB 081222a.018	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
NWA 2212	RELAB 081222a.019	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
+++++		
NWA 717	RELAB 081222a.020	unsorted powder; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).

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16.3.4d.E chondrites: RELAB archive data

(i) Heated Abee E-chondrite (heated in 10^{-5} H_2 for one week)

Abee	RELAB c1mt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; unheated.
Abee	RELAB camt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated to 400°C.
Abee	RELAB cbmt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated to 500°C.
Abee	RELAB ccmt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated to 600°C.
Abee	RELAB cdmt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated to 700°C.
Abee	RELAB cemt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated to 800°C.
Abee	RELAB cfmt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated to 900°C.
Abee	RELAB cgmt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated to 1000°C.
	+++++Other heating conditions++++++	
Abee	RELAB chmt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated in N_2 at 35 mTorr.
Abee	RELAB cimt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resol.; heated in N_2 at 320 mTorr.
Abee	RELAB cjmt40	<125 μm; i=30°, e=0°; 0.3-2.6 μm; 5 nm resolution; heated in N_2 at 3 Torr.

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16.4d. Pallasites and components

16.4.1d. University of Winnipeg samples

MET030	PSF 090921a.034	slab; interior saw-cut surface 1, spot 1 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.035	slab; interior saw-cut surface 1, spot 1 (mostly olivine; resanded); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.036	slab; interior saw-cut surface 1, spot 2 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.037	slab; interior saw-cut surface 1, spot 1 (mostly olivine; resanded); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.038	slab; interior saw-cut surface 1, spot 3 (olivine+metal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.039	slab; interior saw-cut surface 1, spot 4 (olivine+metal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.040	slab; interior saw-cut surface 2, spot 5 (olivine+metal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.041	slab; interior saw-cut surface 2, spot 6 (mostly olivine); i=30°/e=0°; 0.35-

		2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.042	slab; interior saw-cut surface 2, spot 7 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090921a.043	slab; interior saw-cut surface 2, spot 7, again (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090922a.001	slab; interior saw-cut surface 1, spot 1 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090922a.002	slab; interior saw-cut surface 1, spot 2 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090922a.003	slab; interior saw-cut surface 1, spot 3 (olivine+metal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090922a.004	slab; interior saw-cut surface 1, spot 4 (olivine+metal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090922a.005	slab; interior saw-cut surface 2, spot 5 (olivine+metal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090922a.006	slab; interior saw-cut surface 2, spot 6 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET030	PSF 090922a.007	slab; interior saw-cut surface 2, spot 7 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
	++++++	
MET030	PSF 121101a.001	Slab after removal of lacquer, spot 1: centred on olivine grain; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; 1 nm output; ASD [directory: 121101maficmetal].
MET030	PSF 121101a.002	Slab after removal of lacquer, spot 2: centred on olivine grain; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; 1 nm output; ASD [directory: 121101maficmetal].
MET030	PSF 121101a.003	Slab after removal of lacquer, spot 3: centred on olivine plus metal; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; 1 nm output; ASD [directory: 121101maficmetal].
MET030	PSF 121101a.004	Slab after removal of lacquer, spot 4: centred on olivine plus less metal than spot 3 (edge lit up –escaping light?); i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; 1 nm output; ASD [directory: 121101maficmetal].
MET030	PSF 121101a.005	Slab after removal of lacquer, spot 5: centred on olivine grain, little metal; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; 1 nm output; ASD [directory: 121101maficmetal].
++++++		
MET031	PSF 090922a.008	slab; interior saw-cut surface 1, spot 8 (mostly dark green olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET031	PSF 090922a.009	slab; interior saw-cut surface 1, spot 9 (mostly dark green olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET031	PSF 090922a.010	slab; interior saw-cut surface 1, spot 10 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET031	PSF 090922a.011	slab; interior saw-cut surface 1, spot 11 (mostly olivine); i=30°/e=0°; 0.35-

		2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET031	PSF 090922a.012	slab; interior saw-cut surface 2, spot 12 (mostly olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET031	PSF 090922a.013	slab; interior saw-cut surface 2, spot 13 (mostly dark green olivine); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
MET031	PSF 090922a.014	slab; interior saw-cut surface 2, spot 14 (olivine+metal); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; (may have lacquer features).
++++++		
OLV201	RELAB C1SC68	<45μm, 0E/15E, 0.3-2.7μm, 5nm.

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16.4.2d. Royal Ontario Museum samples

SpringwaterA	PSF 130925a.001	Springwater slab spot A (phosphate); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.002	Springwater slab spot B (phosphate); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.003	Springwater slab spot C (phosphate); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.004	Springwater slab spot D (phosphate); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.005	Springwater slab spot E (phosphate); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.006	Springwater slab spot F (unoxidized olivine in phosphate enclave); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.007	Springwater slab spot G (unoxidized olivine in phosphate enclave); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.008	Springwater slab spot H (unoxidized olivine in phosphate enclave); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.009	Springwater slab spot I (oxidized olivine in metal enclave); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.010	Springwater slab spot J (oxidized olivine in metal enclave); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130925a.011	Springwater slab spot K (metal); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130927a.032	Springwater slab spot L (metal); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130927a.034	Springwater slab spot M (metal); 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
+++++		
Springwater	PSF 131002b.001	Springwater slab spot A; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 500 spectra averaged; ASD.
Springwater	PSF 131002b.002	Springwater slab spot B; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 500 spectra averaged; ASD.
Springwater	PSF 131002b.003	Springwater slab spot C&D; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 500 spectra averaged; ASD.
Springwater	PSF 131002b.004	Springwater slab spot E; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated

		cable); 500 spectra averaged; ASD.
Springwater	PSF 131002b.005	Springwater slab spot F; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 500 spectra averaged; ASD.
Springwater	PSF 131002b.006	Springwater slab spot G; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 500 spectra averaged; ASD.
Springwater	PSF 131002b.007	Springwater slab spot H; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 500 spectra averaged; ASD.
Springwater	PSF 131002b.008	Springwater slab spot I; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 500 spectra averaged; ASD.
Springwater	PSF 131002b.009	Springwater slab spot J; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 500 spectra averaged; ASD.

+++++++Saw-cut fines+++++++++

SpringwaterA	PSF 130927a.036	Springwater saw cut fines; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130927a.038	Springwater saw cut fines; unsorted, re-pack 1; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 130927a.039	Springwater saw cut fines; unsorted, re-pack 2; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 500 spectra averaged; ASD (Directory: Springwater).
SpringwaterA	PSF 131017b.001	Springwater saw cut fines; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
SpringwaterA	PSF 131017b.002	Springwater saw cut fines; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
SpringwaterA	PSF 131017b.003	Springwater saw cut fines; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
SpringwaterA	PSF 131017b.001	Springwater saw cut fines; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
SpringwaterA	PSF 131017b.004	Springwater saw cut fines; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
SpringwaterA	PSF 131017b.005	Springwater saw cut fines; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
SpringwaterA	PSF 131017b.006	Springwater saw cut fines; slidedragged across sample; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
SpringwaterA	PSF 131017b.007	Springwater saw cut fines; sample rotated during spectral acquisition; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
SpringwaterA	PSF 131017b.001-005	Springwater saw cut fines; average of first five runs; unsorted; 0.35-2.5 μm; 1 nm output; i=30°, e=0°; 1000 spectra averaged; ASD (Directory: 131017_springwater).
Springwater	PSF 131002a.001	Springwater saw-cut fines; 0.35-2.5 μm; 1 nm output; i=0°, e=0° (bifurcated cable); 1000 spectra averaged; ASD.

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Springwater	PSF springwater spot A.spec	Springwater slab spot A; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot B.spec	Springwater slab spot B; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot C&D.spec	Springwater slab spot C&D; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot E.spec	Springwater slab spot E; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot F.spec	Springwater slab spot F; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot G.spec	Springwater slab spot G; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.

Springwater	PSF springwater spot H.spec	Springwater slab spot H; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot I.spec	Springwater slab spot I; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot J.spec	Springwater slab spot J; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot K.spec	Springwater slab spot K; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot L.spec	Springwater slab spot L; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.
Springwater	PSF springwater spot M.spec	Springwater slab spot M; ~0.35-1.113 μm; ~0.4 nm resolution; i=0°, e=0° (bifurcated cable); Maya.

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16.5d. Mesosiderites and components

16.5.1d. University of Winnipeg samples

MET040	PSF 090921a.044	slab; interior saw-cut surface, spot 1 (silicate enclave on edge); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
MET040	PSF 090921a.045	slab; interior saw-cut surface, spot 2 (low-metal area); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
MET040	PSF 090921a.046	slab; interior saw-cut surface, spot 3 (higher metal area); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
MET040	PSF 090921a.047	slab; interior saw-cut surface, spot 1, again (silicate enclave on edge); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
MET040	PSF 090921a.048	"B3" unsorted powder: non-magnetic fraction; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD.
	++++++	
MET040	PSF 090922a.015	slab; interior saw-cut surface, spot 1 (silicate enclave on edge); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; may have lacquer features.
MET040	PSF 090922a.016	slab; interior saw-cut surface, spot 2 (low-metal area); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; may have lacquer features.
MET040	PSF 090922a.017	slab; interior saw-cut surface, spot 3 (higher metal area); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; may have lacquer features.
MET040	PSF 090922a.018	slab; interior saw-cut surface, spot 4 (small silicate enclave); i=30°/e=0°; 0.35-2.5 μm; 1 nm output; 100 spectra averaged; ASD; may have lacquer features.
	++++++	
MET040	PSF 121101a.006	slab; interior saw-cut surface, spot 1; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD; lacquer removed.
MET040	PSF 121101a.007	slab; interior saw-cut surface, spot 2; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD; lacquer removed.
MET040	PSF 121101a.008	slab; interior saw-cut surface, spot 3; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD; lacquer removed.
MET040	PSF 121101a.009	slab; interior saw-cut surface, on/near big silicate grain, spot 4; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD; lacquer removed.
MET040	PSF 121101a.010	slab; interior saw-cut surface, spot 5, perhaps more metal; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD; lacquer removed.
MET040	PSF 121101a.011	slab; interior saw-cut surface, spot 6, middle of slab; i=30°, e=0°; 0.35-2.5

µm; 1 nm output; 1000 spectra averaged; ASD; lacquer removed.
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16.6d. Carbonaceous chondrites and components

16.6.1d. University of Winnipeg samples

CAI100	RELAB CACA00	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
CAI100	RELAB LACA00	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
++++++		
MET050a	PSF 120215a.001	slab surface; spot 1; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 120215_allende].
MET050b	PSF 120215a.002	slab surface; spot 2; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 120215_allende].
MET050c	PSF 120215a.003	slab surface; spot 3; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 120215_allende].
MET050d	PSF 120215a.004	slab surface; spot 4; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 120215_allende].
MET050e	PSF 120215a.005	slab surface; spot 5; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 120215_allende].
MET050f	PSF 120215a.006	slab surface; spot 6; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 120215_allende].
MET050	PSF 120216a.022	<125 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 500 averaged spectra [Directory: 120215_meteorites].
MET050	PSF 120216a.023	<125 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 500 averaged spectra; repack and reshoot [Directory: 120215_meteorites].
++++++		
NWA801a	PSF 121205a.001	exterior surface; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 121205_NWA].
NWA801b	PSF 121205a.002	interior (saw-cut) surface; 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 121205_NWA].
NWA801a	PSF 121205a.003	<45 µm powder from whole rock (interior and exterior); 30°/0°; 0.35-2.5 µm; 1 nm output; ASD; 200 averaged spectra [Directory: 121205_NWA].

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16.6.2d. University of North Dakota samples

mjg001	PSF 090814c.003	"<32" (microns?); i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg001	PSF 090814c.004	"<32" (microns?); i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg002	PSF 090814c.001	"32-100 ground" (microns?); i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg002	PSF 090814c.002	"32-100 ground" (microns?); i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
++++++		
mjg003	PSF 090814c.005	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg003	PSF 090814c.006	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.

++++++++++ **Same phase angle for standard and sample**++++++++++++++++

mjg003	PSF 100425a.001	~<150 μm; 0°/15°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.004	~<150 μm; 0°/30°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.007	~<150 μm; 0°/45°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.010	~<150 μm; 0°/60°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.013	~<150 μm; 15°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.016	~<150 μm; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.019	~<150 μm; 45°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.022	~<150 μm; 60°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.025	~<150 μm; 0°/-0° - bifurcated cable; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.028	~<150 μm; 15°/-15° - bifurcated cable; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.031	~<150 μm; 30°/-30° - bifurcated cable; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.034	~<150 μm; 45°/-45° - bifurcated cable; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.037	~<150 μm; 60°/-60° - bifurcated cable; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI). Not reliable spectrum.
mjg003	PSF 100425a.039	~<150 μm; 60°/-60° - bifurcated cable; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg003	PSF 100425a.042	~<150 μm; 45°/-45° - bifurcated cable; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI). Redone.
mjg003	PSF 100425a.045	~<150 μm; 0°/30°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI). Regular packing.
mjg003	PSF 100425a.046	~<150 μm; 0°/30°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI). Fluffed with needle.
mjg003	PSF 100425a.047	~<150 μm; 0°/30°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI). Packed tight.
Bmask	PSF 100425a.050	black mask used to mask out Al cup; 0°/30°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
Al_cup	PSF 100425a.051	surface of Al sandblasted cup; 0°/30°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).

++++++*MJG003 – phase angle measurements – all relative to Spectralon at i=13°, e=0°*++++++

mjg003	PSF 101001a.008	~<150 μm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.017	~<150 μm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.026	~<150 μm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.035	~<150 μm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.044	~<150 μm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°,

		e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.053	~<150 µm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.063	~<150 µm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.073	~<150 µm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.082	~<150 µm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg003	PSF 101001a.094	~<150 µm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles). Done after light source replaced.
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mjg004	PSF 090814c.007	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg004	PSF 090814c.008	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
	++++++	
mjg004	PSF 100425a.002	~<150 µm; 0°/15°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.005	~<150 µm; 0°/30°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.008	~<150 µm; 0°/45°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.011	~<150 µm; 0°/60°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.014	~<150 µm; 15°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.017	~<150 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.020	~<150 µm; 45°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.023	~<150 µm; 60°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.026	~<150 µm; 0°/-0° - bifurcated cable; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.029	~<150 µm; 15°/-15° - bifurcated cable; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.032	~<150 µm; 30°/-30° - bifurcated cable; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.035	~<150 µm; 45°/-45° - bifurcated cable; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.040	~<150 µm; 60°/-60° - bifurcated cable; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
mjg004	PSF 100425a.043	~<150 µm; 45°/-45° - bifurcated cable; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI). Redone.
mjg004	PSF 100425a.048	~<150 µm; 0°/30°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI). Regular packing.
mjg004	PSF 100425a.049	~<150 µm; 0°/30°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI). Fluffed with needle.

Bmask	PSF 100425a.050	black mask used to mask out Al cup; 0°/30°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
Al_cup	PSF 100425a.051	surface of Al sandblasted cup; 0°/30°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD (Director: 100425_CI).
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mjg005	PSF 090814c.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg005	PSF 090814c.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg005	PSF 120216a.001	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites).
mjg005	PSF 120216a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites); repacked and reshot.
++++++		
mjg006	PSF 090814c.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg006	PSF 090814c.012	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg006	PSF 120216a.002	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites).
mjg006	PSF 120216a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites); repacked and reshot.
++++++		
mjg007	PSF 090814c.013	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg007	PSF 090814c.014	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg007	PSF 090814c.015	chip; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
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mjg008	PSF 090817b.002	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg008	PSF 090817b.003	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg008	PSF 120216a.003	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites).
mjg008	PSF 120216a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites); repacked and reshot.
++++++		
mjg009	PSF 090817b.004	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg009	PSF 090817b.005	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
++++++		
mjg010	PSF 090817b.006	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg010	PSF 090817b.007	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
++++++		
mjg011	PSF 090817b.008	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg011	PSF 090817b.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
++++++		
mjg191	PSF 901104a.017	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra

averaged, ASD, (091103_Gaffmet directory).

mjg191	PSF 901104a.018	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
mjg191	PSF 120216a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites).
mjg191	PSF 120216a.012	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites); repacked and reshot.
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mjg226	PSF 091118a.001	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg226	PSF 091118a.002	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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16.6.3d. Carbonaceous chondrites - Pierre Hudon samples

MET01070	RELAB c1ph43	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
MET01070	RELAB bkr1ph43	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
PCA02012	RELAB c1ph44	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
PCA02012	RELAB bkr1ph44	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
MET00639	RELAB c1ph32	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
MET00639	RELAB bkr1ph32	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
WIS91600	RELAB c1ph33	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
WIS91600	RELAB bkr1ph33	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
QUE97077	RELAB c1ph51	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
QUE97077	RELAB bkr1ph51	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
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QUE99038	RELAB c1ph52	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
QUE99038	RELAB bkr1ph52	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
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ALH82101	RELAB c1ph34	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
ALH82101	RELAB bkr1ph34	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
FRO95002	RELAB c1ph42	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
FRO95002	RELAB bkr1ph42	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
MET00737	RELAB c1ph50	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
MET00737	RELAB bkr1ph50	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
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FRO99040	RELAB c1ph57	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
FRO99040	RELAB bkr1ph57	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
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QUE93744	RELAB c1ph41	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
QUE93744	RELAB bkr1ph41	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
MET01149	RELAB c1ph45	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
MET01149	RELAB bkr1ph45	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
ALH85002	RELAB c1ph35	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
ALH85002	RELAB bkr1ph35	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
PCA91470	RELAB c1ph46	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
PCA91470	RELAB bkr1ph46	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
DAV92300	RELAB c1ph53	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
DAV92300	RELAB bkr1ph53	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
EET83311	RELAB c1ph47	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
EET83311	RELAB bkr1ph47	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
PCA91082	RELAB c1ph48	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
PCA91082	RELAB bkr1ph48	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
QUE99177	RELAB c1ph54	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
QUE99177	RELAB bkr1ph54	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
MET00426	RELAB c1ph55	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
MET00426	RELAB bkr1ph55	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
MAC87320	RELAB c1ph56	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
MAC87320	RELAB bkr1ph56	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
EET87770	RELAB C1SC98	<45µm, fragment #,19, 30E/0E, 0.3-2.7µm, 5nm, with errors.
EET87770	RELAB C2SC98	<45µm, fragment #,19, 0E/15E, 0.3-2.7µm, 5nm, with errors.
++++++		
PCA91467	RELAB c1ph49	<75µm, 30°/0°, 0.3-2.6 µm, 5nm.
PCA91467	RELAB bkr1ph49	<75µm, 30°/0°,30°; 0.3-50 µm; 5/0.3-475 nm resol. (RELAB+Nicolet, note change in viewing geometry).

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16.6.4d. Samples on loan from Arizona State University (Jim Bell) – April 2011 – rescued from Cornell

(1) Phase angle measurements – all relative to Spectralon at i=15°, e=0°. Used mix of <45 and 45-90 µm JFB Murchison sample.

Murchison	PSF 140620b.001	<90 µm; i=15°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 140620 Murchison).
Murchison	PSF 140620b.002	<90 µm; i=0°, e=30°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged;

		ASD (directory: 140620 Murchison).
Murchison	PSF 140620b.003	<90 µm; i=0°, e=60°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 140620 Murchison).
Murchison	PSF 140620b.004	<90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 140620 Murchison).
Murchison	PSF 140620b.005	<90 µm; i=30°, e=30°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 140620 Murchison).
Murchison	PSF 140620b.006	<90 µm; i=30°, e=60°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 140620 Murchison).
Murchison	PSF 140620b.007	<90 µm; i=60°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 140620 Murchison).
Murchison	PSF 140620b.008	<90 µm; i=60°, e=30°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 140620 Murchison).
Murchison	PSF 140620b.009	<90 µm; i=60°, e=60°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 140620 Murchison).

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jfb-02 (Allende)	PSF 120216a.005	<2000 µm; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites).
jfb-02 (Allende)	PSF 120216a.013	<2000 µm; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites); repacked and reshot.
jfb-01 (Allende)	PSF 120216a.006	500-2000 µm; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites).
jfb-01 (Allende)	PSF 120216a.014	500-2000 µm; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites); repacked and reshot.
jfb-04 (Allende)	PSF 120216a.007	<150 µm; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites).
jfb-04 (Allende)	PSF 120216a.015	<150 µm; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites); repacked and reshot.
jfb-03 (Allende)	PSF 120216a.008	75-250 µm; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites).
jfb-03 (Allende)	PSF 120216a.016	75-250 µm; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 500 spectra averaged, ASD (Directory: 120216 meteorites); repacked and reshot.

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16.6.6d. Carbonaceous chondrites from the Royal Ontario Museum

(1) Murchison: Spectra of spots on fusion crust (Fusion) and saw-cut faces (Saw) of the three pieces.

Murchison	PSF 140616a.001	SawA.001: spot in top left, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.002	SawA.002: spot in top right, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.003	SawA.003: spot in upper middle, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.004	SawA.004: spot in right middle, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.005	SawA.005: spot in lower middle, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.006	SawA.006: spot in bottom right, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.007	FusionA.007: spot in top left, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.008	FusionA.008: spot in top middle, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.009	FusionA.009: spot in middle, solid surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm

output; 200 spectra averaged; ASD (directory: 140616 murchison).

Murchison	PSF 140616a.010	FusionA.010: spot in bottom, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.011	SawB.011: spot in bottom left, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.012	SawB.012: spot in bottom right, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.013	SawB.013: spot in middle, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.014	SawB.014: spot in top left, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.015	SawB.015: spot in top right, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.016	FusionB.016: spot in middle left, white blob, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.017	FusionB.017: spot in bottom, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.018	FusionB.018: spot in middle, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.019	FusionB.019: spot in top, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.020	SawC.020: spot in bottom left, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.021	SawC.021: spot in bottom right, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.022	SawC.022: spot in top right, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.023	SawC.023: spot in top left, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.024	SawC.024: spot in middle, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.025	FusionC.025: spot in bottom left, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.026	FusionC.026: spot in middle, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.027	FusionC.027: spot in top right, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).
Murchison	PSF 140616a.028	FusionC.028: spot in top left, solid surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 140616 murchison).

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(2) Murchison: Spectra of different subsamples of the chips (~200 mg each).

Visually different parts of the Murchison chips were identified, removed from the samples, powdered and dry sieved to <150 μm and spectrally characterized twice.

Murchison	PSF 140702a.001	MSV001, <150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.002	MSV001, <150 μm, repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.003	MSV002, <150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.004	MSV002, <150 μm, repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.005	MSV003, <150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra

averaged; ASD (directory: 140702 Murchison).

Murchison	PSF 140702a.006	MSV003, <150 μm, repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.007	MSV004, <150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.008	MSV004, <150 μm, repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.009	MSV005, <150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.010	MSV005, <150 μm, repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.011	MSV006, <150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).
Murchison	PSF 140702a.012	MSV006, <150 μm, repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140702 Murchison).

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(3) Murchison: Spectra of a single subsample measured during progressive crushing

A single subsample of Murchison was progressively crushed and dry sieved and shot when all material passed through a particular sieve.

Murchison	PSF 140703a.001	all <1000 μm (sample MGS001); i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.002	all <1000 μm (sample MGS001), repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.003	all <500 μm (sample MGS001); i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.004	all <500 μm (sample MGS001), repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.005	all <250 μm (sample MGS001); i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.006	all <250 μm (sample MGS001), repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.007	all <150 μm (sample MGS001); i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.008	all <150 μm (sample MGS001), repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.009	all <90 μm (sample MGS001); i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.010	all <90 μm (sample MGS001), repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.011	all <45 μm (sample MGS001); i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).
Murchison	PSF 140703a.012	all <45 μm (sample MGS001), repacked and reshot; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 140703 Murchison).

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(4) Murchison: Effects of particle packing on Murchison powder

A single<90 μm powder fraction of Murchison was spectrally characterized after regular packing in a cup, with additional powder sieved on top, and after tamping down the sample with the face of a glass slide. Spectra shot at two different phase angles (30/0 and 60/60).

Murchison	PSF 140708a.001	<90 μm, regular sample cup packing; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 140708a Murchison).
Murchison	PSF 140708a.002	<90 μm, regular sample cup packing; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 140708a Murchison).
Murchison	PSF 140708a.003	<90 μm, regular sample cup packing with loose additional powder sieved on top; i=60°, e=6°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 140708a Murchison).
Murchison	PSF 140708a.004	<90 μm, regular sample cup packing with loose additional powder sieved on top; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 140708a Murchison).
Murchison	PSF 140708a.005	<90 μm, powder sample tamped down with face of a glass slide; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 140708a Murchison).
Murchison	PSF 140708a.006	<90 μm, powder sample tamped down with face of a glass slide; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 140708a Murchison).

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(5) Parr bomb runs (2014) – pre-Parr bomb exposure spectra

Murchison-pre wet	PSF 140702a.001-003	<150 μm, three duplicate spectra of sample (dry sample, pre-Parr bomb run with water); i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: Murchison].
Murchison-pre dry	PSF 140702a.004-006	<150 μm, three duplicate spectra of sample (dry, pre-Parr bomb dry run sample); i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: Murchison].

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16.6.7d. Carbonaceous chondrites – RELAB archive

CI chondrites

Alais	RELAB mgp084	<150 μm; integ. sphere; 0.35-2.525 μm; 5 nm resol.
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Ivuna	RELAB c1mb60	<125 μm; 30/0; 0.3-2.6 μm; 5 nm resol.
Ivana	RELAB c1mp18	<125 μm (probable); 30/0; 0.3-2.6 μm; 5 nm resol.
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Orgueil	RELAB c1mb57	<100 μm; 30/0; 0.3-2.6 μm; 5 nm resol.
Orgueil	RELAB mgp078	<150 μm; integr. sphere; 0.35-2.525 μm; 5 nm resol.
Orgueil	RELAB mgp080	<150 μm; integr. sphere; 0.35-2.525 μm; 5 nm resol.
Orgueil	RELAB ccms03	100-200 μm; 30/0; 0.35-2.6 μm; 5 nm resol.
Orgueil	RELAB cdms03	<40 μm; 30/0; 0.35-2.6 μm; 5 nm resol.
Orgueil	RELAB cfms03	40-100 μm; 30/0; 0.35-2.6 μm; 5 nm resol.
Orgueil	RELAB s1rs44	<45 μm; 30/0; 0.3->2.6 μm; 5 nm resol.

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CM chondrites

A-881280, 90	RELAB c1mp56	<125 μm; 30/0; 0.3-2.6 μm; 5 nm resol.
+++++		
A-881594,62	RELAB c1mp57	<125 μm; 30/0; 0.3-2.6 μm; 5 nm resol.
+++++		
A-881955, 70	RELAB c1mp37	<125 μm; 30/0; 0.3-2.6 μm; 5 nm resol.

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ALHA 81002	RELAB c1mb50	<100 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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ALH 83100	RELAB c1mb51	<100 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH 83100, 196	RELAB c1mc01	<500 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH 83100, 102	RELAB camh59	<180 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH 83100,102	RELAB cbmh59	<180 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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ALH 84029	RELAB c1mb52	<100 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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ALH 84033,21	RELAB c1mp14	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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ALH 84044,16	RELAB c1mp15	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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ALH 85013,32	RELAB c1mp23	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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Bells #1226B(1)	RELAB c1mb53	<100 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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Boriskino	RELAB s1rs46	<45 µm; 30/0; 0.32-2.7 µm; 5 nm resol.
++++++		
Cold Bokkeveld	RELAB c1mb61	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Cold Bokkeveld	RELAB mgp086	<75 µm; integr, sphere; 0.35-2.525 µm; 5 nm resol.
Cold Bokkeveld	RELAB mgp088	75-150 µm; integr, sphere; 0.35-2.525 µm; 5 nm resol.
Cold Bokkeveld	RELAB mgp090	15-500 µm; integr, sphere; 0.35-2.525 µm; 5 nm resol.
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EET83250,7	RELAB c1mp40	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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EET83389,15	RELAB c1mp42	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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EET90021,10	RELAB c1mp43	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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EET90043,8	RELAB c1mp44	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
GRO85202,16	RELAB c1mp17	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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LEW87016,12	RELAB c1mp62	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
LEW87022,26	RELAB c1mp20	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
LEW87148,15	RELAB c1mp16	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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LEW88001,14	RELAB c1mp63	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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LON94101,19	RELAB c1mp26	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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MAC88101,12	RELAB c1mp64	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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MAC88176,16	RELAB c1mp47	<125 µm?; 30/0; 0.3-2.6 µm; 5 nm resol.
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Mighei	RELAB cbms01	100-200 µm, bulk; 30/0; 0.35-2.6 µm; 5 nm resol.
Mighei	RELAB ccms01	100-200 µm, bulk; 30/0; 0.35-2.6 µm; 5 nm resol.
Mighei	RELAB cems01	100-200 µm, olivine-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Mighei	RELAB cfms01	100-200 µm, olivine-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Mighei	RELAB cmms01	100-200 µm, matrix-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Mighei	RELAB cnms01	100-200 µm, matrix-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Mighei	RELAB cdms01	<40 µm, bulk; 30/0; 0.35-2.6 µm; 5 nm resol.

Mighei	RELAB cgms01	<40 µm, olivine-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Mighei	RELAB coms01	<40 µm, matrix-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Mighei 4b	RELAB c1ma62	>200 µm, laser-irradiated, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei 4c	RELAB c1ma63	125-200 µm, laser-irradiated, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei 4e	RELAB c1ma64	40-75 µm, laser-irradiated, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei 4d	RELAB c1ma65	75-125 µm, laser-irradiated, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei 4f	RELAB c1ma66	<40 µm, laser-irradiated, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei 4eg	RELAB c1ma68	<45 µm, 4e ground to <45 µm, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei 4bcg	RELAB c1ma70	<45 µm, 4b+4c ground to <45 µm, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei 4dg	RELAB c1ma71	<45 µm, 4d ground to <45 µm, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei	RELAB c1ma72	sorted powder; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei	RELAB c1mb55	<100 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Mighei	RELAB mgp092	<150 µm; integr. sphere; 0.35-2.525 µm; 5 nm resol.
Mighei	RELAB s1rs42	<45 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
+++++		
Murchison	RELAB c2mb64	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB c3mb64	<63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB c4mb64	63-125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB camh52	<90 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cbmh52	<90 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB ccmh52	<180 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB mgp094	<150 µm; integr. sphere; 0.35-2.525 µm; 5 nm resol.
Murchison	RELAB cdms02	<200 µm; 30/0; 0.35-2.6 µm; 5 nm resol.
Murchison	RELAB cbms02	100-200 µm, not enriched; 30/0; 0.35->2.6 µm; 5 nm resol.
Murchison	RELAB ccms02	100-200 µm, not enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Murchison	RELAB cems02	100-200 µm, olivine enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Murchison	RELAB cfms02	100-200 µm, olivine-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Murchison	RELAB cgms02	<40 µm, olivine-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Murchison	RELAB cmms02	100-200 µm, matrix-enriched; 30/0; 0.35->2.6 µm; 5 nm resol.
Murchison	RELAB cnms02	100-200 µm, matrix-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Murchison	RELAB coms02	<40 µm, matrix-enriched; 30/0; 0.35-2.6 µm; 5 nm resol.
Murchison	RELAB s1rs45	<45 µm; 30/0; 0.335->2.6 µm; 5 nm resol.
	++++++	
Murchison IOM	RELAB c1og01	<125 µm (IOM: insoluble organic matter); i=30°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB caog02	125-150 µm (IOM: insoluble organic matter); i=30°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB cbog02	125-150 µm (IOM: insoluble organic matter); i=10°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB ccog02	125-150 µm (IOM: insoluble organic matter); i=50°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB caog03	90-106 µm (IOM: insoluble organic matter); i=30°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB cbog03	90-106 µm (IOM: insoluble organic matter); i=10°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB ccog03	90-106 µm (IOM: insoluble organic matter); i=50°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB caog04	55-63 µm (IOM: insoluble organic matter); i=30°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB cbog04	55-63 µm (IOM: insoluble organic matter); i=10°, e=0°; 10 nm resolution; 0.32-2.55 µm.
Murchison IOM	RELAB ccog04	55-63 µm (IOM: insoluble organic matter); i=50°, e=0°; 10 nm resolution; 0.32-2.55 µm.
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Murray	RELAB c1mb56	<100 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murray	RELAB mgp098	<150 µm; integr. sphere; 0.35-2.525 µm; 5 nm resol.

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Nogoya RELAB c2mb62 <125 µm; 30/0; 0.3-2.6 µm; 5 nmresol.
Nogoya RELAB c3mb62 <63 µm; 30/0; 0.3-2.6 µm; 5 nmresol.
Nogoya RELAB c4mb64 63-125 µm; 30/0; 0.3-2.6 µm; 5nm resol.
Nogoya RELAB mgp100 <150 µm; integr. sphere; 0.35-2.525 µm; 5 nm resol.
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QUE93005,13 RELAB c1mp52 <125 µm; 30/0; 0.3-2.6 µm;5 nm resol.
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Y74642 RELAB c1mb75 <125 µm; 30/0; 0.3-2.6 µm; 5 nmresol.
++++++
Y74662 RELAB c1mb76 <125 µm; 30/0; 0.3-2.6 µm; 5 nmresol.
Y74662,101 RELAB c1mp11 <125 µm; 30/0; 0.3-2.6 µm;5 nm resol.
++++++
Y791191,87 RELAB c1mp30 <125 µm; 30/0; 0.3-2.6 µm;5 nm resol.
++++++
Y791198,90 RELAB c1mp12 <125 µm; 30/0; 0.3-2.6 µm;5 nm resol.
++++++
Y791824,95 RELAB c1mp31 <125 µm; 30/0; 0.3-2.6 µm;5 nm resol.
++++++
Y793585,62 RELAB c1mp32 <125 µm; 30/0; 0.3-2.6 µm;5 nm resol.
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Y82042,60 RELAB c1mp07 <125 µm; 30/0; 0.3-2.6 µm; 5nm resol.
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CK chondrites
A-882113,86 RELAB c1mp109 <125 µm; 30/0; 0.3-0.88 µm; 5 nm resol.
++++++
ALH85002,25 RELAB c1mb81 powder?; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH85002,25 RELAB c2mb81 <125 µm; 30/0; 0.3-2.6 µm;5 nm resol.
ALH85002,25 RELAB camb81 <25 µm; 30/0; 0.3-2.6 µm;5 nm resol.
ALH85002,25 RELAB cbmb81 25-45 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH85002,25 RELAB ccmb81 45-75 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH85002,25 RELAB cdmb81 75-125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH85002,34 RELAB camh58 <180 µm; 30/0; 0.3-2.6 µm;5 nm resol.
ALH85002,34 RELAB cbmh58 <180 µm; 30/0; 0.3-2.6 µm;5 nm resol.
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EET92002,10 RELAB c1mc03 <500 µm; 30/0; 0.3-2.6 µm;5 nm resol.
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Karoonda RELAB mgp140 <150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
++++++
Y693 RELAB c1mb77 <125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++
EET87256,11 RELAB c1lm18 powder, unsorted?; 30/0; 0.3-2.6 µm; 5 nm resol.
EET87256,11 RELAB c1mp03 <63 µm; 30/0; 0.3-2.6 µm;5 nm resol.
++++++
EET87507,27 RELAB c1mb92 <125 µm; 30/0; 0.3-2.6 µm;5 nm resol.
++++++
Y82102,87 RELAB c1mp106 <125 µm; 30/0; 0.3-0.88 µm;5 nm resol.
++++++
Y82103,90 RELAB c1mp107 <125 µm; 30/0; 0.3-0.88 µm;5 nm resol.
++++++
EET87860,5 RELAB c1lm19 powder, unsorted?; 30/0; 0.3-2.6 µm; 5 nm resol.
EET87860,5 RELAB c1mp04 <63 µm; 30/0; 0.3-2.6 µm; 5nm resol.
++++++
A-881551,87 RELAB c1mp110 <125 µm; 30/0; 0.3-0.88 µm; 5 nm resol.
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LEW87009,4	RELAB c1lm17	powder, unsorted?; 30/0; 0.3-2.6 µm; 5 nm resol.
LEW87009,28	RELAB c1mb88	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
LEW87009,4	RELAB c1mp05	<63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.

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CR chondrites

GRO95577,6	RELAB c1mp61	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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A-881595,94	RELAB c1mp39	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
EET87747	RELAB c1mb82	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
EET87770,19	RELAB c1sc92	<250 µm; 30/0; 0.3-2.7 µm; 5 nm resol.
++++++		
EET92042,17	RELAB c1mp25	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
GRA95229,8	RELAB c1mt48	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
MAC87300,46	RELAB c1mp45	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Renazzo	RELAB c1mb58	<100 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Y793495,106	RELAB c1mp38	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
LEW85332,48	RELAB c1mt17	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.

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CO chondrites

ALH77307,95	RELAB bkr1mp102	<125 µm; 30/0; 0.3-2.49 µm (FTIR from 1.995 µm); 5 nm resol.
ALH77307,99	RELAB c1mp117	<125 µm, spun; 30/0; 0.3-2.56 µm; 5 nm resol.
+++++++		
A-881632,95	RELAB bkr1mp104	<125 µm; 30/0; 0.3-2.6 µm (FTIR from 1.995 µm); 5 nm resol.
+++++++		
Y82050,130	RELAB bkr1mp103	<125 µm; 30/0; 0.3-2.6 µm (FTIR from 1.995 µm); 5 nm resol.
++++++		
Kainsaz	RELAB mgp104	<150 µm; integr. sphere; 30/0; 0.35-2.5 µm; 5 nm resol.
Kainsaz	RELAB s1rs41	<45 µm; 30/0; 0.3-2.6 µm (FTIR from 1.995 µm); 5 nm resol.
++++++		
Y791717,90	RELAB c1mb93	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Felix	RELAB mgp102	<150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
++++++		
Ornans	RELAB mgp110	<150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
++++++		
ALH85003,30	RELAB c1mp116	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Lance	RELAB mgp106	150-500 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
Lance	RELAB mgp108	<75 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
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ALH77003,110	RELAB c1mb80	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH77003,81	RELAB camh55	<180 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH77003,81	RELAB cbmh55	<180 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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ALH83018,37	RELAB c1mb79	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH83018,25	RELAB camh59	<180 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
ALH83018,25	RELAB cbmh59	<180 µm; 30/0; 0.3-2.6 µm; 5 nm resol.

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Warrenton	RELAB mgp116	slab; integr. sphere; 0.35-2.5 µm; 5 nm resol.
Warrenton	RELAB mgp120	<75 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
Warrenton	RELAB mgp122	75-150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
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CV chondrites

NWA3118	RELAB c1mp129	CV host; <125 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
NWA3118	RELAB c1mp130	dark inclusion; <125 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
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ALHA81003,31	RELAB c1mt16	<125 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
++++++		
ALH84028,84	RELAB c1mb78	<125 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
ALH84028,84	RELAB c2mb78	powder?; 30/0; 0.35-2.5 µm; 5 nm resol.
ALH84028,84	RELAB camb78	<25 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
ALH84028,84	RELAB cbmb78	25-45 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
ALH84028,84	RELAB ccmb78	45-75 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
ALH84028,84	RELAB cdmb78	75-125 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
ALH84028,85	RELAB c1mc05	<500 µm; 30/0; 0.35-2.5 µm; 5 nm resol.
++++++		
Allende	RELAB caca	bulk powder of unsorted CAIs; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB c2mb63	<125 µm; 30/0; 0.3-2.6 µm; 5nm resol.
Allende	RELAB c3mb63	<63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB c4mb63	63-125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB camb63	heated to 400º C, <63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB cbmb63	heated to 500º C, <63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB ccmb63	heated to 600º C, <63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB cdmb63	heated to 700º C, <63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB cemb63	heated to 800º C, <63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB cfmb63	heated to 900º C, <63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB cgmb63	heated to 1000º C, <63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB chmb63	heated to 1100º C, <63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Allende	RELAB cimb63	heated to 1200º C, <63 µm; 30/0; 0.36-2.6 µm; 5 nm resol.
Allende	RELAB camh57	<180 µm; 30/0; 0.3-2.6 µm; 5nm resol.
Allende	RELAB cBmh57	<180 µm; 30/0; 0.3-2. µm; 5 nm resol.
Allende	RELAB mgp124	<150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
Allende	RELAB s1rs40	<45 µm; 30/0; 0.35-2.5 µm; 5nm resol.
Allende	RELAB cls746	Allende #4; <1000 µm; unknown viewing geometry; 0.35-2.5 µm; 5 nm resol.
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Mokoia	RELAB mgp136	<150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
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Grosnaja	RELAB mgp128	<75 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
Grosnaja	RELAB mgp130	75-150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
Grosnaja	RELAB mgp132	150-500 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
Grosnaja	RELAB s1rs43	<45 µm; 30/0; 0.3-2.6 µm; 5nm resol.
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ALH85006,24	RELAB c1mt46	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
TIL91722,8	RELAB c1mp65	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Leoville	RELAB mgp134	<150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
++++++		
Vigarano	RELAB mgp138	<150 µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
Vigarano	RELAB c1mb59	<100 µm; 30/0; 0.3-2.6 µm; 5nm resol.
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Coolidge	RELAB mgp126	<150µm; integr. sphere; 0.35-2.5 µm; 5 nm resol.
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Y86751	RELAB c1mp09	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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C-ungrouped and ATCCs

DaG430	RELAB c1mp127	<125 µm, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
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MCY92500,9	RELAB c1mp48	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Tagish Lake	RELAB c2mt11	ET01-B lithology; <125 µm, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Tagish Lake	RELAB c2mt12	PMO 5c lithology; <125 µm, spun; 30/0; 0.3-2.6 µm; 5 nm resol.
Tagish Lake	RELAB bkr1mt020	ET01-B lithology, heated to 300ºC; <125 µm, spun (FTIR >2 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Tagish Lake	RELAB bkr1mt021	PMO 5c lithology, heated to 500ºC; <125 µm, spun (FTIR >2 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Tagish Lake	RELAB bkr1mt022	PMO 5c lithology, heated to 600ºC; <125 µm, spun (FTIR >2 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Tagish Lake	RELAB c1mt24	heated at 100ºC for 1 week in oxygen eater; unknown grain size, spun (FTIR >2 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Tagish Lake	RELAB c1mt25l0	pressed powder for laser orradiation; <125 µm, spun (FTIR >2 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Tagish Lake	RELAB c1mt25l1	pressed powder, 5mJ laser irradiated; <125 µm, spun (FTIR >2 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Tagish Lake	RELAB c1mt26	heated at 200ºC for 1 week in oxygen eater; unknown grain size, spun (FTIR >2 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
WIS91600,23	RELAB s1mp51	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
EET83355,23	RELAB c1mp41	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
MAC88107,36	RELAB c1mp46	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Kaidun	RELAB c1ma73	<45 µm; 30/0; 0.3-2.6 µm; 5 nmresol.
Kaidun	RELAB c1ma74	45-100 µm; 30/0; 0.3-2.6 µm; 5nm resol.
Kaidun	RELAB c1ma75	100-250 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Kaidun	RELAB c1ma76	>250 µm; 30/0, spun; 0.3-2.6 µm; 5 nm resol.
Kaidun	RELAB c1mb98	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
EET87522,29	RELAB c1mp21	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
EET96029,14	RELAB c1mp115	<125 µm; 30/0, spun; 0.3-2.6 µm; 5 nm resol.
++++++		
LEW90500	RELAB c1mb54	<100 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
LEW90500,45	RELAB c1mc02	<500 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
MAC88100,30	RELAB c1mp22	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
MAC88100,30	RELAB c1mp22l0	pressed powder for laser irradiation, <125 µm; 30/0, spun; 0.3-2.6 µm; 5 nm resol.
MAC88100,30	RELAB c1mp22l1	5mJ laser irradiated pressed powder, <125 µm; 30/0, spun; 0.3-2.6 µm; 5 nm resol.
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GRO95566,7	RELAB c1mp60	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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A-881334,70	RELAB c1mp35	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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A-881458,69	RELAB c1mp36	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
+++++		
A-881655,67	RELAB c1mp55	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Y793321,99	RELAB c1mp13	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Y82054,106	RELAB c1mp58	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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Y82098,101	RELAB c1mp08	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Y86695,104	RELAB c1mp34	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
Dho225	RELAB c1ma78	powder; 30/0, spun; 0.3-2.6 µm; 5 nm resol.
+++++		
Dho735	RELAB c1ma77	powder; 30/0, spun; 0.3-2.6 µm; 5 nm resol.
++++++		
EET96010,21	RELAB c1mt15	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
LEW85311,36	RELAB c1mp24	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
++++++		
PCA91008,15	RELAB c1mp49	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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PCA91084,8	RELAB c1mp50	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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Y794080,58	RELAB c1mp33	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
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<u>Lab-heated carbonaceous chondrites</u>

Ivuna	RELAB c1mb60	<125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Ivuna	RELAB c1mp18	powder; unheated sample; 30/0; 0.3-2.6 µm; 5 nm resol. (listed as c1mp60 on spreadsheet).
Ivuna	RELAB camp18	<125 µm, heated to 300°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Ivuna	RELAB cbmp18	<125 µm, heated to 400°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Ivuna	RELAB ccmp18	<125 µm, heated to 500°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Ivuna	RELAB cdmp18	<125 µm, heated to 600°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Ivuna	RELAB cemp18	<125 µm, heated to 700°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Ivuna	RELAB cfmp18	<125 µm, heated to 100°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Ivuna	RELAB cgmp18	<125 µm, heated to 200°C; 30/0; 0.3-2.6 µm; 5 nm resol.
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Ivuna	RELAB lamp60	powder; i=30°, e=0°/30°; 0.3-26 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; unheated sample.
Ivuna	RELAB ncmp18f	powder; i=30°, e=0°/30°; 0.3-26 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 100°C.
Ivuna	RELAB ncmp18g	powder; i=30°, e=0°/30°; 0.3-26 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 200°C.
Ivuna	RELAB ncmp18a	powder; i=30°, e=0°/30°; 0.3-26 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 300°C.
Ivuna	RELAB ncmp18b	powder; i=30°, e=0°/30°; 0.3-26 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 400°C.
Ivuna	RELAB ncmp18c	powder; i=30°, e=0°/30°; 0.3-26 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 500°C.
Ivuna	RELAB ncmp18d	powder; i=30°, e=0°/30°; 0.3-26 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 600°C.
Ivuna	RELAB ncmp18e	powder; i=30°, e=0°/30°; 0.3-26 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 700°C.

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Murchison	RELAB c3mb64	<63 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB camb64	<63 µm, heated to 400°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cbmb64	<63 µm, heated to 500°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB ccmb64	<63 µm, heated to 600°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cdmb64	<63 µm, heated to 700°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cemb64	<63 µm, heated to 800°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cfmb64	<63 µm, heated to 900°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cgmb64	<63 µm, heated to 1000°C; 30/0; 0.3-2.6 µm; 5 nm resol.

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Murchison	RELAB c4mb64	63-125 µm; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB chmb64	63-125 µm, heated to 400°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cimb64	63-125 µm, heated to 500°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cjmb64	63-125 µm, heated to 600°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB ckmb64	63-125 µm, heated to 700°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB clmb64	63-125 µm, heated to 800°C; 30/0; 0.3-2.6 µm; 5 nm resol.
Murchison	RELAB cmmb64	63-125 µm, heated to 900°C; 30/0; 0.3-2.6 µm; 5 nm resol.

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Murchison	RELAB bmr3mb064	powder; i=30°, e=30°; 1.67-25 µm; 0.6-129 nm resol.; Nicolet; unheated sample.
Murchison	RELAB ncmb64a	<63 µm, i=30°, e=0°/30°; 0.3-2.6 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 400° C.
Murchison	RELAB ncmb64b	<63 µm, i=30°, e=0°/30°; 0.3-2.6 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 500° C.
Murchison	RELAB ncmb64c	<63 µm, i=30°, e=0°/30°; 0.3-2.6 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 600° C.
Murchison	RELAB ncmb64d	<63 µm, i=30°, e=0°/30°; 0.3-2.6 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 700° C.
Murchison	RELAB ncmb64e	<63 µm, i=30°, e=0°/30°; 0.3-2.6 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 800° C.
Murchison	RELAB ncmb64f	<63 µm, i=30°, e=0°/30°; 0.3-2.6 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 900° C.
Murchison	RELAB ncmb64g	<63 µm, i=30°, e=0°/30°; 0.3-2.6 µm; 5, 0.6-129 nm resol.; merged RELAB+Nicolet; heated to 1000° C.

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<u>16.6.9a. Samples from Kurt Mengel – Technische Universitat Clausthal (received July 2014)</u>

Note: "wet" and "dry" refer to two subsamples of Jbilet that were measured at the start of an experimental run where the splits are being heated in Parr bombs with (wet) or without (dry) added water in a 1:1 water:rock ratio.

Jbilet CM2	PSF 140723a.001	<63 µm, wet; i=30°, e=0°; 0.35-2.5 µm; 500 spectra averaged; 1 nm output; ASD (directory: 140723 jbelite cm2).
Jbilet CM2	PSF 140723a.002	<63 µm, wet; i=30°, e=0°; 0.35-2.5 µm; 500 spectra averaged; 1 nm output; ASD (directory: 140723 jbelite cm2); repacked and reshot.
Jbilet CM2	PSF 140723a.003	<63 µm, dry; i=30°, e=0°; 0.35-2.5 µm; 500 spectra averaged; 1 nm output; ASD (directory: 140723 jbelite cm2).
Jbilet CM2	PSF 140723a.004	<63 µm, dry; i=30°, e=0°; 0.35-2.5 µm; 500 spectra averaged; 1 nm output; ASD (directory: 140723 jbelite cm2); repacked and reshot.
Jbilet-pre dry	PSF 140723a.004	<63 µm, original sample (pre-Parr bomb); i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].

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16.6.10a. Tagish Lake samples from Chris Herd at University of Alberta (September 2014)

T10 = MET11611/P-10a/11/p3 0.237 grams – crushed and sieved bulk powder.
T4 = MET11611/P-4/2 0.176 grams – crushed and sieved bulk powder.

(a) ASD spectra – 10 repeat shots without repacking sample

TL4	PSF 141002a.003	<106 μm; shot 1; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.004	<106 μm; shot 2; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.005	<106 μm; shot 3; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.006	<106 μm; shot 4; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.007	<106 μm; shot 5; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.008	<106 μm; shot 6; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.009	<106 μm; shot 7; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.010	<106 μm; shot 8; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.011	<106 μm; shot 9; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL4	PSF 141002a.012	<106 μm; shot 10; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
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TL10	PSF 141002a.013	<106 μm; shot 1; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.014	<106 μm; shot 2; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.015	<106 μm; shot 3; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.016	<106 μm; shot 4; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.017	<106 μm; shot 5; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.018	<106 μm; shot 6; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.019	<106 μm; shot 7; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.020	<106 μm; shot 8; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.021	<106 μm; shot 9; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).
TL10	PSF 141002a.022	<106 μm; shot 10; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 141002 Mets).

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(b) Ocean Optics Maya spectra – 400-1000 nm

TL4	PSF TL4.spec	<106 μm; i=30°, e=0°; 400-1132 nm; ~0.4 nm resolution; 1000 spectra averaged; Maya spectrometer (directory: maya-tagish).
TL10	PSF TL10.spec	<106 μm; i=30°, e=0°; 400-1132 nm; ~0.4 nm resolution; 1000 spectra averaged; Maya spectrometer (directory: maya-tagish).

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16.6.12d. Carbonaceous chondrites on loan from the University of Western Ontario (Matt Izawa)

These are the meteorites measured at HOSERLab for Matthew Izawas.

Allende	RELAB 081222a.008	unsorted powder; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).

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Subsamples of Tagish Lake ungrouped C chondrite:

pb-02 20.050	RELAB 081222a.002	unsorted powder; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
pm-05	RELAB 081222a.003	unsorted powder; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
tl-d 20.050 pb-02 chip	RELAB 081222a.005	unsorted powder; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
mg-02 tl-d white label	RELAB 081222a.010	unsorted powder; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
pm05 <18 mesh	RELAB 081222a.012	unsorted powder; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).
pm05 <18 mesh	PSF pm05.dpt	<18 mesh; i=30°, e=0°; 1.67-25 µm; 4 cm^{-1} resolution; ~197100 spectr averaged (15 hour) – long scan to get good SNR; Bruker Vertex 70.
tl mg02 yellow dot vial	RELAB 081222a.014	unsorted powder; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; sample cup masked; ASD (Directory: 081222tagmet).

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16.7d. Ordinary chondrites and components

16.7.1d. University of Winnipeg samples

Cherokee Springs	LL6 chondrite fall (from Smithsonian Institution – Tim McCoy. See Section 32 of this document for spectral files (and this meteorite mixed with nanophase iron).	
Cherokee Springs	PSF 121121a.035	whole rock; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD.
Cherokee Springs	PSF 121121a.036	whole rock with metal inclusions; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
Cherokee Springs	PSF 121121a.053	<250 µm; i=30º, e=0º; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 121016glovebox).
Cherokee Springs	PSF OO 53	<250 µm; i=30º, e=0º; 0.2-0.86 µm (.2-0.4 µm usable range); 1 nm output; 100 spectra averaged; Ocean Optics S2000 (directory: Ocean Optics 000).
Cherokee Springs	*See also section 15.25 of this document for mixtures of this meteorite with nanophase iron and*	

nanophase iron-impregnated silica gels.
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16.7.2d. Ordinary and unsorted chondrites on loan from the Planetary Science Institute (Vishnu Reddy)

(a) Chelyabinsk

Note: "fc" refers to unshocked sample (with fusion crust still intact when received).
"imb" refers to shocked sample (impact melt breccia) received as a slice.
Unless otherwise indicated, spectra were acquired for fusion crust-free faces or powders.

(i) Phase angle effects: 45-90 µm powders: ASD spectra

Chelyabinsk	PSF fc_90_45_i0e30.txt	45-90 µm powder of FC sample; standard: i=18°/e=0°; sample: i=0°, e=30°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_90_45_i0e45.txt	45-90 µm powder of FC sample; standard: i=18°/e=0°; sample: i=0°, e=45°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_90_45_i18e0.txt	45-90 µm powder of FC sample; standard: i=18°/e=0°; sample: i=18°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_90_45_i30e0.txt	45-90 µm powder of FC sample; standard: i=18°/e=0°; sample: i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_90_45_i30e30.txt	45-90 µm powder of FC sample; standard: i=18°/e=0°; sample: i=30°, e=30°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_90_45_i45e0.txt	45-90 µm powder of FC sample; standard: i=18°/e=0°; sample: i=45°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_90_45_i45e45.txt	45-90 µm powder of FC sample; standard: i=18°/e=0°; sample: i=45°, e=45°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
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Chelyabinsk	PSF imb_90_45_i0e30.txt	45-90 µm powder of IMB sample; standard: i=18°/e=0°; sample: i=0°, e=30°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_90_45_i0e45.txt	45-90 µm powder of IMB sample; standard: i=18°/e=0°; sample: i=0°, e=45°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_90_45_i18e0.txt	45-90 µm powder of IMB sample; standard: i=18°/e=0°; sample: i=18°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_90_45_i30e0.txt	45-90 µm powder of IMB sample; standard: i=18°/e=0°; sample: i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_90_45_i30e30.txt	45-90 µm powder of IMB sample; standard: i=18°/e=0°; sample: i=30°, e=30°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_90_45_i45e0.txt	45-90 µm powder of IMB sample; standard: i=18°/e=0°; sample: i=45°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_90_45_i45e45.txt	45-90 µm powder of IMB sample; standard: i=18°/e=0°; sample: i=45°, e=45°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(ii) Phase angle effects: 90-250 µm powders: ASD spectra

Chelyabinsk	PSF fc_250_90_i0e30.txt	90-250 µm powder of FC sample; standard: i=18°/e=0°; sample: i=0°, e=30°; 0.35-2.5 µm; 2-7 nm resolution; 500 spectra averaged; ASD.

Chelyabinsk	PSF fc_250_90_i0e45.txt	90-250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=0°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_250_90_i18e0.txt	90-250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=18°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_250_90_i30e0.txt	90-250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_250_90_i30e30.txt	90-250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=30°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_250_90_i45e0.txt	90-250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=45°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_250_90_i45e45.txt	90-250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=45°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
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Chelyabinsk	PSF imb_250_90_i0e30.txt	90-250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=0°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_250_90_i0e45.txt	90-250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=0°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_250_90_i18e0.txt	90-250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=18°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_250_90_i30e0.txt	90-250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_250_90_i30e30.txt	90-250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=30°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_250_90_i45e0.txt	90-250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=45°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_250_90_i45e45.txt	90-250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=45°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(iii) Phase angle effects:< 45 μm powders: ASD spectra

Chelyabinsk	PSF fc_sub45_i0e30.txt	<45 μm powder of FC sample; standard: i=18°/e=0°; sample: i=0°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub45_i0e45.txt	<45 μm powder of FC sample; standard: i=18°/e=0°; sample: i=0°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub45_i18e0.txt	<45 μm powder of FC sample; standard: i=18°/e=0°; sample: i=18°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub45_i30e0.txt	<45 μm powder of FC sample; standard: i=18°/e=0°; sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub45_i30e30.txt	<45 μm powder of FC sample; standard: i=18°/e=0°; sample: i=30°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub45_i45e0.txt	<45 μm powder of FC sample; standard: i=18°/e=0°; sample: i=45°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub45_i45e45.txt	<45 μm powder of FC sample; standard: i=18°/e=0°; sample: i=45°,

		e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
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Chelyabinsk	PSF imb_sub45_i0e30.txt	<45 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=0°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub45_i0e45.txt	<45 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=0°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub45_i18e0.txt	<45 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=18°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub45_i30e0.txt	<45 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub45_i30e30.txt	<45 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=30°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub45_i45e0.txt	<45 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=45°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub45_i45e45.txt	<45 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=45°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(iv) Phase angle effects: <250 μm powders: ASD spectra

Chelyabinsk	PSF fc_sub250_i0e30.txt	<250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=0°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub250_i0e45.txt	<250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=0°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub250_i18e0.txt	<250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=18°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub250_i30e0.txt	<250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub250_i30e30.txt	<250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=30°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub250_i45e0.txt	<250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=45°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_sub250_i45e45.txt	<250 μm powder of FC sample; standard: i=18°/e=0°; sample: i=45°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
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Chelyabinsk	PSF imb_sub250_i0e30.txt	<250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=0°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub250_i0e45.txt	<250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=0°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub250_i18e0.txt	<250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=18°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub250_i30e0.txt	<250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub250_i30e30.txt	<250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=30°, e=30°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

Chelyabinsk	PSF imb_sub250_i45e0.txt	<250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=45°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_sub250_i45e45.txt	<250 μm powder of IMB sample; standard: i=18°/e=0°; sample: i=45°, e=45°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(v) Merged ASD + Bruker Vertex 70 spectra (i=30°, e=0°), various grain sizes

Chelyabinsk	PSF fc_90_45.txt	45-90 μm powder of FC sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
Chelyabinsk	PSF fc_250_90.txt	90-250 μm powder of FC sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
Chelyabinsk	PSF fc_sub45.txt	<45 μm powder of FC sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
Chelyabinsk	PSF fc_sub250.txt	<250 μm powder of FC sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
Chelyabinsk	PSF fc_surface.txt	whole rock surface of FC sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
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Chelyabinsk	PSF imb_90_45.txt	45-90 μm powder of IMB sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
Chelyabinsk	PSF imb_250_90.txt	90-250 μm powder of IMB sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
Chelyabinsk	PSF imb_sub45.txt	<45 μm powder of IMB sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
Chelyabinsk	PSF imb_sub250.txt	<250 μm powder of IMB sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.
Chelyabinsk	PSF imb_surface.txt	whole rock surface of IMB sample; standard and sample: i=30°, e=0°; 0.35-25 μm; 2-7 nm and 1 cm^{-1} resolution; 500 and 1000 spectra averaged; ASD + Bruker Vertex 70; merged at 2.222 μm.

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(vi) Fusion crust powder spectra – ground off both samples:unsorted powders: ASD spectra

Chelyabinsk	PSF fc_fusion crust_asd.txt	unsorted powder of fusion crust from FC sample; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_fusion crust_asd.txt	unsorted powder of fusion crust from IMB sample; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(vii) Whole rock spectra before removal of fusion crust – various spots: ASD spectra

Chelyabinsk	PSF WholeRock_fc_1s1.txt	whole rock face of FC sample; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF WholeRock_fc_1s2.txt	whole rock face of FC sample; standard and sample: i=30°, e=0°; 0.35-

		2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF WholeRock_fc_2s.txt	whole rock face of FC sample; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF WholeRock_imb_f1.txt	whole rock face of IMB sample; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF WholeRock_imb_f2.txt	whole rock face of IMB sample; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF WholeRock_imb_h1.txt	whole rock face of IMB sample; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF WholeRock_imb_h2.txt	whole rock face of IMB sample; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(viii) Powder spectra: 45-90 μm – packing effects: ASD spectra

Chelyabinsk	PSF fc_90_45_i30e0.txt	45-90 μm powder of FC sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_90_45_i30e0_dense.txt	45-90 μm powder of FC sample, dense packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_90_45_i30e0_loose.txt	45-90 μm powder of FC sample, loose packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
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Chelyabinsk	PSF imb_90_45_i30e0.txt	45-90 μm powder of IMB sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_90_45_i30e0_dense.txt	45-90 μm powder of IMB sample, dense packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_90_45_i30e0_loose.txt	45-90 μm powder of IMB sample, loose packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(ix) Powder spectra: 90-250 μm – packing effects: ASD spectra

Chelyabinsk	PSF fc_250_90_i30e0.txt	90-250 μm powder of FC sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_250_90_i30e0_dense.txt	90-250 μm powder of FC sample, dense packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF fc_250_90_i30e0_loose.txt	90-250 μm powder of FC sample, loose packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
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Chelyabinsk	PSF imb_250_90i30e0.txt	90-250 μm powder of IMB sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_250_90_i30e0_dense.txt	90-250 μm powder of IMB sample, dense packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk	PSF imb_250_90_i30e0_loose.txt	90-250 μm powder of IMB sample, loose packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra

averaged; ASD.

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(x) Powder spectra: <45 μm – packing effects: ASD spectra

Chelyabinsk PSF fc_sub45_i30e0.txt <45 μm powder of FC sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk PSF fc_sub45_i30e0_dense.txt <45 μm powder of FC sample, dense packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk PSF fc_sub45_i30e0_loose.txt <45 μm powder of FC sample, loose packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
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Chelyabinsk PSF imb_sub45_i30e0.txt <45 μm powder of IMB sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk PSF imb_sub45_i30e0_dense.txt <45 μm powder of IMB sample, dense packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk PSF imb_sub45_i30e0_loose.txt <45 μm powder of IMB sample, loose packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(xi) Powder spectra: <250 μm – packing effects: ASD spectra

Chelyabinsk PSF fc_sub250_i30e0.txt <250 μm powder of FC sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk PSF fc_sub250_i30e0_repack.txt <250 μm powder of FC sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD; emptied, repacked and reshot – regular packing.
Chelyabinsk PSF fc_sub250_i30e0_dense pack.txt <250 μm powder of FC sample, dense packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk PSF fc_sub250_i30e0_loose pack.txt <250 μm powder of FC sample, loose packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
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Chelyabinsk PSF imb_sub250_i30e0.txt <250 μm powder of IMB sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk PSF imb_sub250_i30e0_repack.txt <250 μm powder of IMB sample, regular packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD; emptied, repacked, and reshot – regular packing.
Chelyabinsk PSF imb_sub250_i30e0_dense pack.txt <250 μm powder of IMB sample, dense packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.
Chelyabinsk PSF imb_sub250_i30e0_loose pack.txt <250 μm powder of IMB sample, loose packing; standard and sample: i=30°, e=0°; 0.35-2.5 μm; 2-7 nm resolution; 500 spectra averaged; ASD.

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(xii) Chelyabinsk: Maya spectra

Chelyabinsk	PSF fc_FusionCrust_UVreflect.txt	unsorted powder of fusion crust from FC sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF imb_FusionCrust_UVreflect.txt	unsorted powder of fusion crust from IMB sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF WholeRock_fc_UVreflect.txt	whole rock surface of FC sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF WholeRock_imb_UVreflect.txt	whole rock surface of IMB sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF fc_90_45_UVreflect.txt	45-90 μm powder of FC sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF imb_90_45_UVreflect.txt	45-90 μm powder of IMB sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF fc_250_90_UVreflect.txt	90-250 μm powder of FC sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF imb_250_90_UVreflect.txt	90-250 μm powder of IMB sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF fc_sub45_UVreflect.txt	<45 μm powder of FC sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF imb_sub45_UVreflect.txt	<45 μm powder of IMB sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF fc_sub250_UVreflect.txt	<250 μm powder of FC sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.
Chelyabinsk	PSF imb_sub250_UVreflect.txt	<250 μm powder of IMB sample; standard and sample: i=0°, e=0° (bifurcated cable); ~0.2-0.4 μm usable range; ~0.4 nm resolution; 100 spectra averaged; Maya spectrometer.

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(xiii) Chelyabinsk: Bruker Vertex 70 FTIR spectra

Chelyabinsk	PSF WholeRock_fc_a1_FTIR.txt	whole rock face (spot a1) of FC sample; standard and sample: i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF WholeRock_fc_a2_FTIR.txt	whole rock face (spot a2) of FC sample; standard and sample: i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF WholeRock_fc_b_FTIR.txt	whole rock face (spot b) of FC sample; standard and sample: i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF WholeRock_imb_a1_FTIR.txt	whole rock face (spot a1) of IMB sample; standard and sample: i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF WholeRock_imb_a2_FTIR.txt	whole rock face (spot a2) of IMB sample; standard and sample: i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1000 spectra averaged;

		Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF WholeRock_imb_b_FTIR.txt	whole rock face (spot b) of IMB sample; standard and sample: i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
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Chelyabinsk	PSF fc_90_45_i30e0_FTIR.txt	45-90 μm powder of FC sample; standard and sample: i=30°, e=0°; 1-25 μm; 1 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF imb_90_45_i30e0_FTIR.txt	45-90 μm powder of IMB sample; standard and sample: i=30°, e=0°; 1-25 μm; 1 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF fc_250_90_i30e0_FTIR.txt	90-250 μm powder of FC sample; standard and sample: i=30°, e=0°; 1-25 μm; 1 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF imb_250_90_i30e0_FTIR.txt	90-250 μm powder of IMB sample; standard and sample: i=30°, e=0°; 1-25 μm; 1 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF fc_sub45_i30e0_FTIR.txt	<45 μm powder of FC sample; standard and sample: i=30°, e=0°; 1-25 μm; 1 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF imb_sub45_i30e0_FTIR.txt	<45 μm powder of IMB sample; standard and sample: i=30°, e=0°; 1-25 μm; 1 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF fc_sub250_i30e0_FTIR.txt	<250 μm powder of FC sample; standard and sample: i=30°, e=0°; 1-25 μm; 1 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.
Chelyabinsk	PSF imb_sub250_i30e0_FTIR.txt	<250 μm powder of IMB sample; standard and sample: i=30°, e=0°; 1-25 μm; 1 cm^{-1} resolution; 1000 spectra averaged; Bruker Vertex 70 spectrometer.

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(b) Mreira

Mreira	PSF 131001a.001	MM01: 100% dark lithology + 0% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.002	MM02: 95% dark lithology + 5% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131002a.002	MM01: 100% dark lithology + 0% light lithology, <45 μm powder; i=0°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: randoms).
Mreira	PSF 131002a.003	MM13: 0% dark lithology + 100% light lithology, <45 μm powder; i=0°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: randoms).
Mreira	PSF 100%D	MM01: 100% dark lithology + 0% light lithology, <45 μm powder; i=0°/e=0°; 0.4-1.13 μm; ~0.3 nm; Maya; 100 spectra averaged. (Directory: 131002 mreira).
Mreira	PSF 100%L	MM13: 0% dark lithology + 100% light lithology, <45 μm powder; i=0°/e=0°; 0.4-1.13 μm; ~0.3 nm; Maya; 100 spectra averaged. (Directory: 131002 mreira).

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See also section 16.16.9 for mixtures of light and dark lithologies.

Mreira slice	PSF 130927a.001	Slice, side 1, dark region Spot A; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.002	Slice, side 1, dark region Spot B; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.003	Slice, side 1, dark region Spot C; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.004	Slice, side 1, dark region Spot D; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).

Mreira slice	PSF 130927a.005	Slice, side 1, dark + light region Spot E; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.006	Slice, side 1, light region Spot F; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.007	Slice, side 1, light region Spot G; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.008	Slice, side 1, light region Spot H; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.009	Slice, side 1, light region Spot I; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.010	Slice, side 1, light region Spot J; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.011	Slice, side 2, dark region Spot K; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.012	Slice, side 2, dark region Spot L; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.013	Slice, side 2, dark region Spot M; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.014	Slice, side 2, dark + light region Spot N; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.015	Slice, side 2, light region Spot O; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.016	Slice, side 2, light region Spot P; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.017	Slice, side 2, light region Spot Q; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.018	Slice, side 2, light region Spot R; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.019	Slice, side 2, light region Spot S; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.020	Slice, side 2, light region Spot T; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira slice	PSF 130927a.021	Slice, side 2, light region Spot U; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
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Mreira stone	PSF 130927a.022	Stone, inner broken surface Spot V; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira stone	PSF 130927a.023	Stone, inner broken surface Spot W; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira stone	PSF 130927a.024	Stone, inner broken surface Spot X; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira stone	PSF 130927a.025	Stone, fusion crust Spot Y; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira stone	PSF 130927a.026	Stone, fusion crust Spot Z; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira stone	PSF 130927a.027	Stone, fusion crust Spot AA; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira stone	PSF 130927a.028	Stone, fusion crust Spot BB; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira stone	PSF 130927a.029	Stone, fusion crust Spot CC; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
Mreira stone	PSF 130927a.030	Stone, fusion crust Spot DD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD (directory: Mreira).
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Thika L6	PSF 140609.008	aka VMM208; 100% Thika L6; <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).

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16.7.3d. University of North Dakota samples

mjg100	PSF 090817b.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg100	PSF 090817b.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
++++++		
mjg101	PSF 090817b.012	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg101	PSF 090817b.013	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
++++++		
mjg102	PSF 090817b.014	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg102	PSF 090817b.015	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg103	PSF 090817b.016	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg103	PSF 090817b.017	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.

++++++*MJG103 – phase angle measurements – all relative to Spectralon at i=13°, e=0°*++++++

mjg103	PSF 101001a.007	~<150 μm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.016	~<150 μm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.025	~<150 μm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.034	~<150 μm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.043	~<150 μm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.052	~<150 μm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.062	~<150 μm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.071	~<150 μm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.081	~<150 μm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg103	PSF 101001a.090	~<150 μm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).

mjg103	PSF 101001a.093	~<150 µm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles). Redo after light source crapped out.
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mjg104	PSF 090821a.001	smooth flat surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg104	PSF 090821a.002	rough weathered surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg104	PSF 090821a.003	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg104	PSF 090821a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg105	PSF 090821a.005	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg105	PSF 090821a.006	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg106	PSF 090821a.007	chip- rough surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg106	PSF 090821a.008	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg106	PSF 090821a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg107	PSF 090821a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg107	PSF 090821a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg107	PSF 090821a.012	chip – rough vitreous surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
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mjg108	PSF 090821a.013	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg108	PSF 090821a.014	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg109	PSF 090821a.015	chip – rough surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg109	PSF 090821a.016	chip – rough surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg110	PSF 090826b.001	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg110	PSF 090826b.002	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg111	PSF 090826b.003	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg111	PSF 090826b.004	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg111	PSF 090826b.005	chip – rough surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
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mjg112	PSF 090826b.006	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg112	PSF 090826b.007	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg113	PSF 090826b.008	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg113	PSF 090826b.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg114	PSF 090826b.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg114	PSF 090826b.012	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg115	PSF 090827a.001	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg115	PSF 090827a.002	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg116	PSF 090827a.003	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg116	PSF 090827a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg116	PSF 090827a.005	chip – rough surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
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mjg117	PSF 090827a.006	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg117	PSF 090827a.007	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg118	PSF 090827a.008	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg118	PSF 090827a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg119	PSF 090827a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg119	PSF 090827a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg119	PSF 090827a.012	chip – rough surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
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mjg120	PSF 090827a.013	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg120	PSF 090827a.014	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg121	PSF 090827a.015	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg121	PSF 090827a.016	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg122	PSF 090827a.017	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).

mjg122	PSF 090827a.018	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg123	PSF 090827a.019	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg123	PSF 090827a.020	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg124	PSF 090827a.021	chip - surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg124	PSF 090827a.022	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg124	PSF 090827a.023	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg125	PSF 090827a.024	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg125	PSF 090827a.025	chip – rough surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg125	PSF 090827a.026	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg126	PSF 090827a.027	chip – rough surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg126	PSF 090827a.028	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg126	PSF 090827a.029	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg127	PSF 090827a.030	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg127	PSF 090827a.031	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg128	PSF 090827a.032	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg128	PSF 090827a.033	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg129	PSF 090828a.001	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg129	PSF 090828a.002	chip – rough surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg129	PSF 090828a.003	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg130	PSF 090828a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg130	PSF 090828a.005	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (09…0814Gaffmet directory); repacked and reshot.
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mjg133	PSF 090828a.008	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg133	PSF 090828a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg133	PSF 090828a.010	chip – cut metallic surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000

spectra averaged, ASD, (090814Gaffmet directory).

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mjg134	PSF 090828a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg134	PSF 090828a.012	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg134	PSF 090828a.013	chip – rough surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).

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mjg135	PSF 090828a.014	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg135	PSF 090828a.015	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.

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mjg136	PSF mjg136	<90 μm silicates powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg136	PSF 090828a.016	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg136	PSF 090828a.017	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.

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mjg137	PSF 090828a.018	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg137	PSF 090828a.019	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg137	PSF 090828a.020	chip; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).

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mjg138	PSF 090828a.021	chip; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).

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mjg139	PSF 090828a.022	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg139	PSF 090828a.023	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.

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mjg140	PSF 090828a.024	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg140	PSF 090828a.025	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.

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mjg141	PSF 090828a.026	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg141	PSF 090828a.027	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.

++++++++++++*MJG141 – phase angle measurements – all relative to Spectralon at i=13°, e=0°*++++++

mjg141	PSF 101001a.005	~<150 μm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.014	~<150 μm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.023	~<150 μm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°,

		e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.032	~<150 µm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.041	~<150 µm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.050	~<150 µm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.059	~<150 µm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.069	~<150 µm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.079	~<150 µm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg141	PSF 101001a.088	~<150 µm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
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mjg142	PSF 090828a.028	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg142	PSF 090828a.029	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg143	PSF 090828a.030	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg143	PSF 090828a.031	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg143	PSF 090828a.032	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
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mjg144	PSF mjg144	unsorted coarse powder, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg144	PSF 090828a.033	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg144	PSF 090828a.034	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg145	PSF 090828a.035	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg145	PSF 090828a.036	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg146	PSF 090828a.037	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg146	PSF 090828a.038	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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mjg147	PSF 090828a.039	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra

		averaged, ASD, (090814Gaffmet directory).
mjg147	PSF 090828a.040	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); repacked and reshot.
mjg147	PSF 090828a.041	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
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mjg148	PSF 090828a.042	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg148	PSF 090828a.043	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory); reshot.
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mjg149	PSF 090831a.001	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg149	PSF 090831a.002	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
mjg149	PSF 090831a.003	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
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mjg150	PSF 090831a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg150	PSF 090831a.005	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg151	PSF 090831a.006	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg151	PSF 090831a.007	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
mjg151	PSF 090831a.008	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
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mjg152	*PSF* --	*not enough sample (090831_Gaffmet directory).*
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mjg153	PSF 090831a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg153	PSF 090831a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
mjg153	PSF 090831a.011	chip; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
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mjg154	PSF 090831a.012	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg154	PSF 090831a.013	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg155	PSF 090831a.014	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg155	PSF 090831a.015	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg156	PSF 090831a.016	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg156	PSF 090831a.017	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg157	PSF 090831a.018	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).

mjg157	PSF 090831a.019	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg158	PSF 090831a.020	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
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mjg159	PSF 090831a.021	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg159	PSF 090831a.022	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg160	PSF 090831a.023	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg160	PSF 090831a.024	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg161	PSF 090916a.001	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg161	PSF 090916a.002	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg162	PSF 090916a.003	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg162	PSF 090916a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg163	PSF 090916a.005	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg163	PSF 090916a.006	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg164	PSF 090916a.007	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg164	PSF 090916a.008	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg165	PSF 090916a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg165	PSF 090916a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg166	PSF 090916a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg166	PSF 090916a.012	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg167	PSF 090916a.013	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg167	PSF 090916a.014	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg168	PSF 090916a.015	<90 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg168	PSF 090916a.016	<90 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg169	PSF mjg169a	unsorted coarse powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg169	PSF mjg169b	fragment in unsorted coarse powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg169	PSF 090916a.017	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg169	PSF 090916a.018	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
mjg169	PSF 090916a.019	chip; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
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mjg170	PSF 090916a.020	silicate <90 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg170	PSF 090916a.021	silicate <90 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg171	PSF 090916a.022	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg171	PSF 090916a.023	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
mjg171	PSF 090916a.024	chip; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
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mjg172	PSF 090916a.025	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg172	PSF 090916a.026	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg173	PSF 090916a.027	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg173	PSF 090916a.028	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg174	PSF 090916a.029	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg174	PSF 090916a.030	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
mjg174	*PSF 090916a.031*	*chip; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory). Not saved or overwritten?*
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mjg175	PSF mjg175	unsorted fine powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg175	PSF 090916a.032	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory).
mjg175	PSF 090916a.033	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (090831Gaffmet directory); repacked and reshot.
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mjg176	PSF 091103a.001	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg176	PSF 091103a.002	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg177	PSF 091103a.003	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra

		averaged, ASD, (091103_Gaffmet directory).
mjg177	PSF 091103a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg178	PSF 091103a.005	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg178	PSF 091103a.006	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg179	PSF 091103a.007	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg179	PSF 091103a.008	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg180	PSF 091103a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg180	PSF 091103a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg181	PSF 091103a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg181	PSF 091103a.012	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg182	PSF 091103a.013	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg182	PSF 091103a.014	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg184	PSF mjg184	unsorted fine powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg184	PSF 091114a.003	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg184	PSF 091104a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg185	PSF 091104a.005	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg185	PSF 091104a.007	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg186	PSF 091014a.006	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg186	PSF 091104a.008	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg187	PSF mjg187	unsorted fine powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg187	PSF 091104a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg187	PSF 091104a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg188	PSF 091104a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra

averaged, ASD, (091103_Gaffmet directory).

mjg188 PSF 091104a.012 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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mjg189 PSF 091104a.013 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).

mjg189 PSF 091104a.014 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103Gaffmet directory); repacked and reshot.

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mjg192 PSF 091114a.019 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).

mjg192 PSF 091104a.020 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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mjg193 PSF 091111a.001 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).

mjg193 PSF 091111a.002 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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mjg194 PSF 091111a.003 chip – cut surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).

mjg194 PSF 091111a.004 chip – broken surface; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).

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mjg195 PSF 091111a.005 <90 micron silicate (non-magnetic?) powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).

mjg195 PSF 091111a.006 <90 micron silicate (non-magnetic?) powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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mjg196 PSF 091111a.007 unsorted metal-rich; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).

mjg196 PSF 091111a.008 unsorted metal-rich; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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mjg197 PSF 091111a.009 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).

mjg197 PSF 091111a.010 unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

++++++++*MJG197 – phase angle measurements – all relative to Spectralon at i=13°, e=0°*++++++

mjg197 PSF 101001a.004 ~<150 μm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).

mjg197 PSF 101001a.013 ~<150 μm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).

mjg197 PSF 101001a.022 ~<150 μm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).

mjg197 PSF 101001a.031 ~<150 μm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).

mjg197 PSF 101001a.040 ~<150 μm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory

		101001_angles).
mjg197	PSF 101001a.049	~<150 µm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg197	PSF 101001a.058	~<150 µm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg197	PSF 101001a.068	~<150 µm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg197	PSF 101001a.078	~<150 µm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg197	PSF 101001a.087	~<150 µm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
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mjg198	PSF 091111a.011	unsorted silicate-rich powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg198	PSF 091111a.012	unsorted silicate-rich powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg199	PSF 091111a.013	unsorted “cleaned metal”; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg199	PSF 091111a.014	unsorted “cleaned metal”; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg200	PSF 091111a.015	unsorted metal-rich powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg200	PSF 091111a.016	unsorted metal-rich powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg201	PSF 091111a.017	unsorted magnetic (metal-rich) powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg201	PSF 091111a.018	unsorted magnetic (metal-rich) powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg202	PSF 091111a.019	<70 microns non-magnetic powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg202	PSF 091111a.020	<70 microns non-magnetic powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg203	PSF 091111a.021	90-180 microns; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg203	PSF 091111a.023	90-180 microns; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg204	PSF 091111a.024	<90 micron non-magnetic fraction; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg204	PSF 091111a.027	<90 micron non-magnetic fraction; i=30°/e=0°, 0.35-2.5 µm, 1 nm output,

		1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg205	PSF 091111a.028	unsorted magnetic powder fraction; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg205	PSF 091111a.029	unsorted magnetic powder fraction; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg206	PSF 091111a.030	unsorted metal-rich (magnetic) powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg206	PSF 091111a.031	unsorted metal-rich (magnetic) powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg207	PSF 091111a.032	unsorted magnetic (metal-rich) powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg207	PSF 091111a.033	unsorted magnetic (metal-rich) powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg208	PSF 091111a.034	unsorted magnetic fraction powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg208	PSF 091111a.035	unsorted magnetic fraction powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg209	PSF 091111a.036	<90 microns non-magnetic powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg209	PSF 091111a.037	<90 microns non-magnetic powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg210	PSF 091111a.038	<90 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg210	PSF 091111a.039	<90 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg211	PSF 091111a.040	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg211	PSF 091111a.041	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
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mjg213	PSF 091111a.044	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg213	PSF 091111a.045	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg214	PSF 091111a.046	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); probably no second run (mjg215 likely saved instead of mjg214 second run).
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mjg215	PSF 091111a.047	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); probably mjg215 saved in place of mjg214.
mjg215	PSF 091111a.048	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra

averaged, ASD, (091103_Gaffmet directory).

mjg215	PSF 091111a.049	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg233	PSF 091118a.013	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg233	PSF 091118a.014	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg234	PSF 091118a.015	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg234	PSF 091118a.016	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg235	PSF 091118a.017	<90 microns non-magnetic fraction powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg235	PSF 091118a.018	<90 microns non-magnetic fraction powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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16.7.4d. Samples on loan from NASA Astromaterials Facility

LAP04840	PSF lap04840b	Unsorted powder, 30°/0°, 2-16 µm, D&P instrument, 6 cm-1 resol.
LAP04840	PSF lap04840s	<250 µm, 30°/0°, 2-16 µm, D&P instrument, 6 cm-1 resol.
LAP04840	PSF may1807.003	Unsorted powder, 30°/0°, 0.35-2.5 µm, ASD, 1 nm resol.
LAP04840	PSF may1807.009	<250 µm, 2-16 µm, 30°/0°, 0.35-2.5 µm, ASD, 1 nm resol.
LAP04840	PSF may1807.001	Unsorted powder, 0°/0°, 0.35-2.5 µm, bifurc. probe, ASD, 1 nm resol.

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16.7.5d. Ordinary chondrites from Kurt Mengel (Technische Universitat Clausthal) – July 2014-07-15

For aqueous alteration experiments
Powdered samples provided by Kurt Mengel – July 2014
Note: see section 16.23 for Parr bomb run after-heating results.

Zag-pre wet	PSF 141219a.005	<100 µm, original sample (dry sample , pre-Parr bomb run with water); i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 141219 HE 1000].

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16.9d. Anomalous Achondrites and components

16.9.2d. Samples from Vishnu Reddy

NWA6704	PSF 111105b.001	Chip; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. (directory: 111105_HED6).
NWA6704	PSF 111105b.002	<150 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. (directory: 111105_HED6).
NWA6704	PSF 140404a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD. (directory: 111105_HED6).
NWA6704	PSF nwa6704.spec	<45 µm; i=30°, e=0°; 0.4-1.1 µm; ~0.5 nm resolution; 500 spectra averaged; Maya (directory: nwa6704 maya).
NWA6704	PSF nwa6704.spec	<45µm; i=30°, e=0°, 0.2-0.4 µm; ~0.5 nm resolution; 200 spectra averaged; Maya (directory: nwa6704 sub45\uv).
NWA6704	PSF nwa6704	<45 µm; i=30°, e=0°; 8500-400 cm^{-1}; 2 cm^{-1} resolution; 1500 spectra

averaged; Bruker Vertex 70 (directory: ftir nwa6704).

NWA6704	PSF 141002a.001	<25 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD. (directory: 141002 Mets).
	++++++	
NWA6704	PSF nwa6704.spec	<45 μm; i=30°, e=0°; 0.2-0.4 μm usable spectral range; ~0.4 nm resolution; 200 spectra averaged; Maya spectrometer. (directory: nwa6704 sub45\uv; 140406).
NWA6704	PSF nwa6704.spec	<45 μm; i=30°, e=0°; 0.4-1.113 μm usable spectral range; ~0.4 nm resolution; 500 spectra averaged; Maya spectrometer. (directory: nwa6704 maya; 140404).
	++++++	
NWA6704	PSF ftir nwa6704	<45 μm; i=30°, e=0°; 8500-400 cm^{-1} (~1.18-25 μm); 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 spectrometer. (directory: ftir nwa6704).

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16.10d. Brachinites and components

16.10.2d. University of North Dakota samples

MET400	PSF 090127a.006	unsorted powder (<250 μm?), 30°/0°, 0.35-2.5 μm, 1 nm output, 1000 averaged, ASD.

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16.11d. Howardites, Eucrites and Diogenites (HEDs) and components

16.11.2d. University of North Dakota samples

16.11.2.1d. Eucrites

mjg216	PSF mjg216	unsorted powder, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg216	PSF 091112a.001	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg216	PSF 091112a.002	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg228	PSF mjg228	<37 μm, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg228	PSF moama37	<37 μm, 30°/0°, 0.35-0.86 μm, 30 msec, 1000 avg., ~0.3 nm resol.; Ocean Optics (090430oo directory).
mjg228	PSF 091118a.005	<37 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg228	PSF 091118a.006	<37 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.
++++++		
mjg229	*PSF* --	*vial was empty (091103_Gaffmet directory).*
++++++		
mjg230	PSF mjg230	37-74 μm, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).

mjg230	PSF 091118a.007	37-74 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg230	PSF 091118a.008	37-74 microns; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

++++++

mjg231	PSF mjg231	>74 μm, 30°/0°, 0.35-0.86 μm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg231	PSF 091118a.009	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg231	PSF 091118a.010	unsorted powder; i=30°/e=0°, 0.35-2.5 μm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

++++++++*MJG231 – phase angle measurements – all relative to Spectralon at i=13°, e=0°*++++++

mjg231	PSF 101001a.006	<74 μm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.015	<74 μm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.024	<74 μm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.033	<74 μm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.042	<74 μm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.051	<74 μm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.060	<74 μm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.070	<74 μm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.080	<74 μm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
mjg231	PSF 101001a.089	<74 μm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).

+++++++mjg231 (Moama eucrites, <74 μm) mid-IR phase angles++++++++++

All measurements relative to gold standard at i=0°, e=18° (.DPT files)*

mjg231	PSF mjg231 0_15	<74 μm; i=0°, e=15° (15° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 0_18	<74 μm; i=0°, e=18° (18° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 0_30	<74 μm; i=0°, e=30° (30° phase angle) relative to diffuse gold at i=0°,

		e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 0_45	<74 μm; i=0°, e=45° (45° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 0_60	<74 μm; i=0°, e=60° (60° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 15_15	<74 μm; i=15°, e=15° (30° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 15_30	<74 μm; i=15°, e=30° (15° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 15_45	<74 μm; i=15°, e=45° (60° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 15_60	<74 μm; i=15°, e=60° (75° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 18_0	<74 μm; i=18°, e=0° (18° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 30_0	<74 μm; i=30°, e=0° (30° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 30_15	<74 μm; i=30°, e=15° (45° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 30_30	<74 μm; i=30°, e=30° (60° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 30_45	<74 μm; i=30°, e=45° (75° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 30_60	<74 μm; i=30°, e=60° (90° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 45_15	<74 μm; i=45, e=15° (60° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 45_30	<74 μm; i=45°, e=30° (75° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 45_45	<74 μm; i=45°, e=45° (90° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 45_60	<74 μm; i=45°, e=60° (105° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 60_0	<74 μm; i=60°, e=0° (60° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 60_15	<74 μm; i=60°, e=15° (75° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).

mjg231	PSF mjg231 60_30	<74 μm; i=60°, e=30° (90° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 60_45	<74 μm; i=60°, e=45° (105° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).
mjg231	PSF mjg231 60_60	<74 μm; i=60°, e=60° (120° phase angle) relative to diffuse gold at i=0°, e=18°); 1.6-25 μm (6000-400 cm^{-1}); 15 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70 (directory: mjg231 phase angles).

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Moama eucrite (mjg231; 74-250 μm) phase angle measurements, all relative to Spectralon at i=18°, e=0° (ASD)
Format: grain size; i°,e° for standard; i°/e° for sample; wavelength range; spectral resolution; number of spectra averaged; instrument.

mjg231 (Moama) PSF 110506a.001	74-250 μm; standard: i=18°, e=0°; sample: i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.015	74-250 μm; standard: i=18°, e=0°; sample: i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.018	74-250 μm; standard: i=18°, e=0°; sample: i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.035	74-250 μm; standard: i=18°, e=0°; sample: i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.038	74-250 μm; standard: i=18°, e=0°; sample: i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.048	74-250 μm; standard: i=18°, e=0°; sample: i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.014	74-250 μm; standard: i=18°, e=0°; sample: i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.019	74-250 μm; standard: i=18°, e=0°; sample: i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.034	74-250 μm; standard: i=18°, e=0°; sample: i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.039	74-250 μm; standard: i=18°, e=0°; sample: i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.047	74-250 μm; standard: i=18°, e=0°; sample: i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.010	74-250 μm; standard: i=18°, e=0°; sample: i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.022	74-250 μm; standard: i=18°, e=0°; sample: i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.031	74-250 μm; standard: i=18°, e=0°; sample: i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.042	74-250 μm; standard: i=18°, e=0°; sample: i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.046	74-250 μm; standard: i=18°, e=0°; sample: i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.009	74-250 μm; standard: i=18°, e=0°; sample: i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.023	74-250 μm; standard: i=18°, e=0°; sample: i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.030	74-250 μm; standard: i=18°, e=0°; sample: i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.043	74-250 μm; standard: i=18°, e=0°; sample: i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama) PSF 110506a.045	74-250 μm; standard: i=18°, e=0°; sample: i=15°, e=60°; 0.35-2.5 μm; 1 nm

		output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama)	PSF 110506a.008	74-250 µm; standard: i=18°, e=0°; sample: i=30°, e=60°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama)	PSF 110506a.026	74-250 µm; standard: i=18°, e=0°; sample: i=45°, e=60°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).
mjg231 (Moama)	PSF 110506a.027	74-250 µm; standard: i=18°, e=0°; sample: i=60°, e=60°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 110506_phases).

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mjg232	PSF mjg232a	fragments – rough surfaces, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg232	PSF mjg232b	largest fragment face, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg232	PSF 091118a.011	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg232	PSF 091118a.012	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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mjg300	PSF mjg300a	cut chip – face 1, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg300	PSF mjg300b	cut chip – face 2, 30°/0°, 0.35-0.86 µm, 30 msec, 300 avg., ~0.3 nm resol.; data are poor, just used to search for 506 nm feature; Ocean Optics (090416oo directory).
mjg300	PSF 091118a.027	chip – cut surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg300	PSF 091118a.028	chip – cut surface; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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16.11.2.2d. Diogenites

mjg212	PSF 091111a.042	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg212	PSF 091111a.043	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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16.11.3d.: (1) HEDs from Germany (first batch) – grain size effects for Millbillillie – ASD spectra

Millbillillie-a	PSF 111122b.001	Millbillillie eucrite, <45 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output, 200 spectra averaged; ASD [Directory: 111122PRA].
Millbillillie-b	PSF 111122b.002	Millbillillie eucrite, 45-90 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output, 200 spectra averaged; ASD [Directory: 111122PRA].
Millbillillie-c	PSF 111122b.003	Millbillillie eucrite, 90-250 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output, 200 spectra averaged; ASD [Directory: 111122PRA].
Millbillillie-d	PSF 111122b.004	Millbillillie eucrite, 250-500 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output, 200 spectra averaged; ASD [Directory: 111122PRA].

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16.11.3d.: (2) Second batch of HEDs from Germany – JaH 626 <250 µm – ASD spectra

JAH626	PSF 110927a.029	<250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output, 200 spectra averaged;

ASD [directory: 110927_test].
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16.11.3d.: (3) Second batch of HEDs from Germany – grain size effects – ASD spectra

JAH626,a	PSF 120106a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
JAH626,b	PSF 120106a.002	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
JAH626,c	PSF 120106a.003	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
JAH626,d	PSF 120106a.004	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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NWA1942,a	PSF 120106a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1942,b	PSF 120106a.006	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1942,c	PSF 120106a.007	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1942,d	PSF 120106a.008	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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NWA1943,a	PSF 120106a.009	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1943,b	PSF 120106a.010	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1943,c	PSF 120106a.011	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1943,d	PSF 120106a.012	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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NWA1836,a	PSF 120106a.013	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1836,b	PSF 120106a.014	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1836,c	PSF 120106a.015	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA1836,d	PSF 120106a.016	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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NWA6477,a	PSF 120106a.017	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA6477,b	PSF 120106a.018	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA6477,c	PSF 120106a.019	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA6477,d	PSF 120106a.020	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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Tatahouine,a	PSF 120106a.021	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
Tatahouine,b	PSF 120106a.022	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
Tatahouine,c	PSF 120106a.023	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].

Tatahouine,d	PSF 120106a.024	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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Talampaya,a	PSF 120106a.025	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
Talampaya,b	PSF 120106a.026	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
Talampaya,c	PSF 120106a.027	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
Talampaya,d	PSF 120106a.028	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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NWA2968,a	PSF 120106a.044	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA2968,b	PSF 120106a.045	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA2968,c	PSF 120106a.046	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA2968,d	PSF 120106a.047	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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NWA5748,a	PSF 120106a.048	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA5748,b	PSF 120106a.049	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA5748,c	PSF 120106a.050	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA5748,d	PSF 120106a.051	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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NWA5751,a	PSF 120106a.052	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA5751,b	PSF 120106a.053	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA5751,c	PSF 120106a.054	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA5751,d	PSF 120106a.055	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
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NWA6013,a	PSF 120106a.056	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA6013,b	PSF 120106a.057	45-90 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA6013,c	PSF 120106a.058	90-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].
NWA6013,d	PSF 120106a.059	250-500 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; ASD, 200 spectra averaged [directory: 120106 HED].

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16.11.3d. (4) Phase angle measurements on German HEDs – ASD spectra

(4.a). NWA 5751 Howardite

(i) Spectra shot relative to Spectralon at i=0°, e=18° - whole rock (saw-cut surfaces)

NWA 5751	PSF 110718a.101	whole rock surface; i=0°, e=18°; 0.35-2.5 µm; 1 nm output; 200 spectra

averaged; ASD [Directory: 110718_HED Whole rock].

NWA 5751	PSF 110718a.106	whole rock surface; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.111	whole rock surface; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.116	whole rock surface; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.001	whole rock surface; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.006	whole rock surface; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.011	whole rock surface; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.016	whole rock surface; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.021	whole rock surface; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.026	whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.031	whole rock surface; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.036	whole rock surface; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.041	whole rock surface; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.046	whole rock surface; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.051	whole rock surface; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.056	whole rock surface; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.061	whole rock surface; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.066	whole rock surface; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.071	whole rock surface; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.076	whole rock surface; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.081	whole rock surface; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.086	whole rock surface; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.091	whole rock surface; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5751	PSF 110718a.096	whole rock surface; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

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(ii) Spectra shot relative to Spectralon at i=0°, e=18° - <45 μm powders

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA5751	PSF 110725a.001	<45 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.021	<45 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD

[Directory: 110725_HED phases 2].

NWA5751 PSF 110725a.041 <45 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110725a.061 <45 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110724a.001 <45 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA5751 PSF 110724a.021 <45 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA5751 PSF 110724a.041 <45 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA5751 PSF 110724a.061 <45 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA5751 PSF 110724a.081 <45 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA5751 PSF 110725a.081 <45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110725a.101 <45 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110725a.121 <45 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110725a.141 <45 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110725a.161 <45 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110726a.001 <45 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA5751 PSF 110726a.021 <45 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA5751 PSF 110726a.041 <45 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA5751 PSF 110726a.061 <45 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA5751 PSF 110726a.081 <45 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA5751 PSF 110727a.001 <45 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA5751 PSF 110727a.021 <45 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA5751 PSF 110727a.041 <45 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA5751 PSF 110727a.061 <45 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA5751 PSF 110727a.081 <45 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iii) Spectra shot relative to Spectralon at i=0°, e=18° - 45-90 μm powders

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA5751 PSF 110725a.006 45-90 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110725a.026 45-90 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5751 PSF 110725a.046 45-90 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged;

		ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.066	45-90 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110724a.006	45-90 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.026	45-90 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.046	45-90 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.066	45-90 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.086	45-90 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110725a.086	45-90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.106	45-90 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.126	45-90 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.146	45-90 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.166	45-90 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110726a.006	45-90 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.026	45-90 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.046	45-90 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.066	45-90 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.086	45-90 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110727a.006	45-90 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.026	45-90 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.046	45-90 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.066	45-90 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.086	45-90 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(vi) Spectra shot relative to Spectralon at i=0°, e=18° - 90-250 μm powders

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA5751	PSF 110725a.011	90-250 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.031	90-250 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.051	90-250 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.071	90-250 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged;

		ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110724a.011	90-250 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.031	90-250 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.051	90-250 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.071	90-250 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.091	90-250 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110725a.091	90-250 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.111	90-250 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.131	90-250 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.151	90-250 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.171	90-250 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110726a.011	90-250 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.031	90-250 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.051	90-250 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.071	90-250 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.091	90-250 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110727a.011	90-250 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.031	90-250 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.051	90-250 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.071	90-250 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.091	90-250 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(v) Spectra shot relative to Spectralon at i=0°, e=18° - 250-500 μm powders

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA5751	PSF 110725a.016	250-500 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.036	250-500 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.056	250-500 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.076	250-500 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110724a.016	250-500 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged;

		ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.036	250-500 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.056	250-500 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.076	250-500 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110724a.096	250-500 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5751	PSF 110725a.096	250-500 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.116	250-500 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.136	250-500 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.156	250-500 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110725a.176	250-500 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5751	PSF 110726a.016	250-500 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.036	250-500 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.056	250-500 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.076	250-500 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110726a.096	250-500 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5751	PSF 110727a.016	250-500 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.036	250-500 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.056	250-500 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.076	250-500 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5751	PSF 110727a.096	250-500 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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16.11.3d. (4) Phase angle measurements on German HEDs – ASD spectra (continued)

(4.b). NWA 5748 Howardite

(i) Spectra shot relative to Spectralon at i=0°, e=18° - whole rock (saw-cut surfaces)

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA 5748	PSF 110718a.102	whole rock surface; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.107	whole rock surface; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.112	whole rock surface; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

NWA 5748	PSF 110718a.117	whole rock surface; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.002	whole rock surface; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.007	whole rock surface; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.012	whole rock surface; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.017	whole rock surface; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.022	whole rock surface; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.027	whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.032	whole rock surface; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.037	whole rock surface; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.042	whole rock surface; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.047	whole rock surface; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.052	whole rock surface; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.057	whole rock surface; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.062	whole rock surface; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.067	whole rock surface; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.072	whole rock surface; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.077	whole rock surface; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.082	whole rock surface; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.087	whole rock surface; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.092	whole rock surface; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 5748	PSF 110718a.097	whole rock surface; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

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(ii) Spectra shot relative to Spectralon at i=0°, e=18° -<45 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA5748	PSF 110725a.002	<45 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.022	<45 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.042	<45 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.062	<45 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA5748	PSF 110724a.002	<45 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.022	<45 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.042	<45 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.062	<45 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.082	<45 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110725a.082	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.102	<45 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.122	<45 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.142	<45 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.162	<45 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110726a.002	<45 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.022	<45 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.042	<45 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.062	<45 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.082	<45 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110727a.002	<45 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.022	<45 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.042	<45 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.062	<45 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.082	<45 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iii) Spectra shot relative to Spectralon at i=0°, e=18° - 45-90 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA5748	PSF 110725a.007	45-90 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.027	45-90 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.047	45-90 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.067	45-90 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110724a.007	45-90 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA5748	PSF 110724a.027	45-90 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.047	45-90 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.067	45-90 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.087	45-90 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110725a.087	45-90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.107	45-90 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.127	45-90 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.147	45-90 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.167	45-90 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110726a.007	45-90 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.027	45-90 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.047	45-90 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.067	45-90 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.087	45-90 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110727a.007	45-90 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.027	45-90 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.047	45-90 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.067	45-90 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.087	45-90 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iv) Spectra shot relative to Spectralon at i=0°, e=18° - 90-250 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA5748	PSF 110725a.012	90-250 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.032	90-250 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.052	90-250 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.072	90-250 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110724a.012	90-250 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.032	90-250 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA5748	PSF 110724a.052	90-250 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.072	90-250 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.092	90-250 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110725a.092	90-250 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.112	90-250 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.132	90-250 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.152	90-250 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.172	90-250 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110726a.012	90-250 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.032	90-250 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.052	90-250 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.072	90-250 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.092	90-250 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110727a.012	90-250 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.032	90-250 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.052	90-250 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.072	90-250 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.092	90-250 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(v) Spectra shot relative to Spectralon at i=0°, e=18° - 250-500 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA5748	PSF 110725a.017	250-500 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.037	250-500 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.057	250-500 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.077	250-500 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110724a.017	250-500 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.037	250-500 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.057	250-500 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA5748	PSF 110724a.077	250-500 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110724a.097	250-500 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA5748	PSF 110725a.097	250-500 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.117	250-500 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.137	250-500 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.157	250-500 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110725a.177	250-500 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA5748	PSF 110726a.017	250-500 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.037	250-500 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.057	250-500 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.077	250-500 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110726a.097	250-500 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA5748	PSF 110727a.017	250-500 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.037	250-500 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.057	250-500 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.077	250-500 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA5748	PSF 110727a.097	250-500 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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16.11.3d. (4) Phase angle measurements on German HEDs – ASD spectra (continued)

(4.c). NWA 2968 Dunitic diogenite

(i) Spectra shot relative to Spectralon at i=0°, e=18° - whole rock (saw-cut surfaces)

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA 2968	PSF 110718a.103	whole rock surface; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.108	whole rock surface; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.113	whole rock surface; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.118	whole rock surface; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.003	whole rock surface; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.008	whole rock surface; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

NWA 2968	PSF 110718a.013	whole rock surface; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.018	whole rock surface; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.023	whole rock surface; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.028	whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.033	whole rock surface; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.038	whole rock surface; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.043	whole rock surface; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.048	whole rock surface; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.053	whole rock surface; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.058	whole rock surface; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.063	whole rock surface; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.068	whole rock surface; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.073	whole rock surface; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.078	whole rock surface; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.083	whole rock surface; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.088	whole rock surface; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.093	whole rock surface; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 2968	PSF 110718a.098	whole rock surface; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

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(ii) Spectra shot relative to Spectralon at i=0°, e=18° - <45 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA2968	PSF 110725a.003	<45 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.023	<45 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.043	<45 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.063	<45 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110724a.003	<45 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.023	<45 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.043	<45 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA2968	PSF 110724a.063	<45 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.083	<45 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110725a.083	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.103	<45 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.123	<45 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.143	<45 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.163	<45 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110726a.003	<45 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.023	<45 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.043	<45 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.063	<45 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.083	<45 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110727a.003	<45 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.023	<45 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.043	<45 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.063	<45 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.083	<45 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iii) Spectra shot relative to Spectralon at i=0°, e=18° - 45-90 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA2968	PSF 110725a.008	45-90 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.028	45-90 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.048	45-90 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.068	45-90 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110724a.008	45-90 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.028	45-90 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.048	45-90 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.068	45-90 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA2968	PSF 110724a.088	45-90 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110725a.088	45-90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.108	45-90 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.128	45-90 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.148	45-90 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.168	45-90 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110726a.008	45-90 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.028	45-90 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.048	45-90 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.068	45-90 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.088	45-90 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110727a.008	45-90 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.028	45-90 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.048	45-90 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.068	45-90 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.088	45-90 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iv) Spectra shot relative to Spectralon at i=0°, e=18° - 90-250 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA2968	PSF 110725a.013	90-250 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.033	90-250 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.053	90-250 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.073	90-250 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110724a.013	90-250 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.033	90-250 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.053	90-250 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.073	90-250 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.093	90-250 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA2968	PSF 110725a.093	90-250 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.113	90-250 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.133	90-250 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.153	90-250 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.173	90-250 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110726a.013	90-250 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.033	90-250 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.053	90-250 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.073	90-250 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.093	90-250 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110727a.013	90-250 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.033	90-250 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.053	90-250 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.073	90-250 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.093	90-250 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(v) Spectra shot relative to Spectralon at i=0°, e=18° - 250-500 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA2968	PSF 110725a.018	250-500 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.038	250-500 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.058	250-500 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.078	250-500 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110724a.018	250-500 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.038	250-500 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.058	250-500 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.078	250-500 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110724a.098	250-500 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA2968	PSF 110725a.098	250-500 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA2968	PSF 110725a.118	250-500 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.138	250-500 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.158	250-500 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110725a.178	250-500 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA2968	PSF 110726a.018	250-500 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.038	250-500 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.058	250-500 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.078	250-500 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110726a.098	250-500 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
NWA2968	PSF 110727a.018	250-500 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.038	250-500 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.058	250-500 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.078	250-500 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
NWA2968	PSF 110727a.098	250-500 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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16.11.3d. (4) Phase angle measurements on German HEDs – ASD spectra (continued)

(4.d). NWA 6013 Olivine-rich diogenite

(i) Spectra shot relative to Spectralon at i=0°, e=18° - whole rock (saw-cut surfaces)

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA 6013	PSF 110718a.104	whole rock surface; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.109	whole rock surface; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.114	whole rock surface; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.119	whole rock surface; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.004	whole rock surface; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.009	whole rock surface; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.014	whole rock surface; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.019	whole rock surface; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.024	whole rock surface; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra

averaged; ASD [Directory: 110718_HED Whole rock].

NWA 6013	PSF 110718a.029	whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.034	whole rock surface; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.039	whole rock surface; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.044	whole rock surface; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.049	whole rock surface; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.054	whole rock surface; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.059	whole rock surface; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.064	whole rock surface; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.069	whole rock surface; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.074	whole rock surface; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.079	whole rock surface; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.084	whole rock surface; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.089	whole rock surface; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.094	whole rock surface; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
NWA 6013	PSF 110718a.099	whole rock surface; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

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(ii) Spectra shot relative to Spectralon at i=0°, e=18° - <45 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA6013	PSF 110725a.004	<45 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA6013	PSF 110725a.024	<45 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA6013	PSF 110725a.044	<45 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA6013	PSF 110725a.064	<45 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
NWA6013	PSF 110724a.004	<45 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA6013	PSF 110724a.024	<45 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA6013	PSF 110724a.044	<45 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA6013	PSF 110724a.064	<45 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA6013	PSF 110724a.084	<45 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
NWA6013	PSF 110725a.084	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD

[Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.104 <45 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.124 <45 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.144 <45 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.164 <45 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110726a.004 <45 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.024 <45 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.044 <45 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.064 <45 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.084 <45 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110727a.004 <45 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.024 <45 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.044 <45 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.064 <45 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.084 <45 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iii) Spectra shot relative to Spectralon at i=0°, e=18° - 45-90 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA6013 PSF 110725a.009 45-90 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.029 45-90 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.049 45-90 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.069 45-90 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110724a.009 45-90 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.029 45-90 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.049 45-90 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.069 45-90 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.089 45-90 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110725a.089 45-90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.109 45-90 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged;

ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.129 45-90 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.149 45-90 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.169 45-90 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110726a.009 45-90 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.029 45-90 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.049 45-90 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.069 45-90 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.089 45-90 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110727a.009 45-90 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.029 45-90 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.049 45-90 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.069 45-90 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.089 45-90 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iv) Spectra shot relative to Spectralon at i=0°, e=18° - 90-250 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA6013 PSF 110725a.014 90-250 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.034 90-250 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.054 90-250 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.074 90-250 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110724a.014 90-250 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.034 90-250 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.054 90-250 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.074 90-250 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.094 90-250 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110725a.094 90-250 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.114 90-250 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.134 90-250 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged;

ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.154 90-250 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.174 90-250 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110726a.014 90-250 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.034 90-250 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.054 90-250 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.074 90-250 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.094 90-250 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110727a.014 90-250 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.034 90-250 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.054 90-250 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.074 90-250 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.094 90-250 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(v) Spectra shot relative to Spectralon at i=0°, e=18° - 250-500 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

NWA6013 PSF 110725a.019 250-500 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.039 250-500 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.059 250-500 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.079 250-500 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110724a.019 250-500 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.039 250-500 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.059 250-500 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.079 250-500 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110724a.099 250-500 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].

NWA6013 PSF 110725a.099 250-500 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.119 250-500 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.139 250-500 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.159 250-500 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra

averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110725a.179 250-500 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

NWA6013 PSF 110726a.019 250-500 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.039 250-500 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.059 250-500 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.079 250-500 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110726a.099 250-500 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

NWA6013 PSF 110727a.019 250-500 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.039 250-500 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.059 250-500 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.079 250-500 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

NWA6013 PSF 110727a.099 250-500 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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16.11.3d. (4) Phase angle measurements on German HEDs – ASD spectra (continued)

(4.e). Millbillillie eucrite

(i) Spectra shot relative to Spectralon at i=0°, e=18° - whole rock (saw-cut surfaces)

Spectra shot relative to Spectralon at i=0°, e=18°.

Millbillillie PSF 110718a.105 whole rock surface; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.110 whole rock surface; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.115 whole rock surface; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.120 whole rock surface; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.005 whole rock surface; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.010 whole rock surface; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.015 whole rock surface; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.020 whole rock surface; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.025 whole rock surface; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.030 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie PSF 110718a.035 whole rock surface; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

Millbillillie	PSF 110718a.040	whole rock surface; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.045	whole rock surface; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.050	whole rock surface; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.055	whole rock surface; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.060	whole rock surface; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.065	whole rock surface; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.070	whole rock surface; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.075	whole rock surface; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.080	whole rock surface; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.085	whole rock surface; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.090	whole rock surface; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.095	whole rock surface; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].
Millbillillie	PSF 110718a.100	whole rock surface; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110718_HED Whole rock].

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(ii) Spectra shot relative to Spectralon at i=0°, e=18° - <45 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

Millbillillie	PSF 110725a.005	<45 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.025	<45 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.045	<45 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.065	<45 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110724a.005	<45 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.025	<45 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.045	<45 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.065	<45 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.085	<45 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110725a.085	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.105	<45 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.125	<45 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

Millbillillie	PSF 110725a.145	<45 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.165	<45 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110726a.005	<45 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.025	<45 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.045	<45 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.065	<45 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.085	<45 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110727a.005	<45 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.025	<45 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.045	<45 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.065	<45 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.085	<45 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iii) Spectra shot relative to Spectralon at i=0°, e=18° - 45-90 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

Millbillillie	PSF 110725a.010	45-90 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.030	45-90 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.050	45-90 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.070	45-90 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110724a.010	45-90 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.030	45-90 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.050	45-90 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.070	45-90 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.090	45-90 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110725a.090	45-90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.110	45-90 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.130	45-90 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.150	45-90 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

Millbillillie	PSF 110725a.170	45-90 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110726a.010	45-90 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.030	45-90 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.050	45-90 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.070	45-90 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.090	45-90 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110727a.010	45-90 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.030	45-90 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.050	45-90 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.070	45-90 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.090	45-90 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(iv) Spectra shot relative to Spectralon at i=0°, e=18° - 90-250 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

Millbillillie	PSF 110725a.015	90-250 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.035	90-250 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.055	90-250 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.075	90-250 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110724a.015	90-250 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.035	90-250 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.055	90-250 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.075	90-250 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.095	90-250 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110725a.095	90-250 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.115	90-250 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.135	90-250 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.155	90-250 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.175	90-250 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].

Millbillillie	PSF 110726a.015	90-250 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.035	90-250 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.055	90-250 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.075	90-250 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.095	90-250 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110727a.015	90-250 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.035	90-250 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.055	90-250 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.075	90-250 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.095	90-250 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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(v) Spectra shot relative to Spectralon at i=0°, e=18° - 250-500 μm powder

Spectra shot relative to Spectralon at i=0°, e=18°.

Millbillillie	PSF 110725a.020	250-500 μm; i=0°, e=18°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.040	250-500 μm; i=0°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.060	250-500 μm; i=0°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.080	250-500 μm; i=0°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110724a.020	250-500 μm; i=18°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.040	250-500 μm; i=15°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.060	250-500 μm; i=15°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.080	250-500 μm; i=15°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110724a.100	250-500 μm; i=15°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110724_HED phases 1].
Millbillillie	PSF 110725a.100	250-500 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.120	250-500 μm; i=30°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.140	250-500 μm; i=30°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.160	250-500 μm; i=30°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110725a.180	250-500 μm; i=30°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110725_HED phases 2].
Millbillillie	PSF 110726a.020	250-500 μm; i=45°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].

Millbillillie	PSF 110726a.040	250-500 μm; i=45°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.060	250-500 μm; i=45°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.080	250-500 μm; i=45°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110726a.100	250-500 μm; i=45°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110726_HED phases 3].
Millbillillie	PSF 110727a.020	250-500 μm; i=60°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.040	250-500 μm; i=60°, e=15°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.060	250-500 μm; i=60°, e=30°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.080	250-500 μm; i=60°, e=45°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].
Millbillillie	PSF 110727a.100	250-500 μm; i=60°, e=60°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110727_HED phases 4].

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16.11.3d. (5) Phase angle + grain size measuerements on German HEDs – ASD spectra

An extensive series of phase angle measurements was conducted on the following HEDs:

JaH626	<45 μm	45-90 μm	90-250 μm	500-1000 μm	Slab
NWA 1836	<45 μm	45-90 μm	90-250 μm	500-1000 μm	Slab
NWA 1942	<45 μm	45-90 μm	90-250 μm	500-1000 μm	Slab
NWA 6477	<45 μm	45-90 μm	90-250 μm	500-1000 μm	Slab
Talampaya	<45 μm	45-90 μm	90-250 μm	500-1000 μm	Slab
Tatahouine	<45 μm	45-90 μm	90-250 μm	500-1000 μm	Slab

For each of these sample types, phase angle measurements were conducted at the following phase angles, with all measurements made relative to Spectralon at i=18° and e=0°:

i°/e°	*i°/e°*	*i°/e°*	*i°/e°*	*i°/e°*
0/18	0/30	0/45	0/60	
18/0	15/15	15/30	15/45	15/60
30/0	30/15	30/30	30/45	30/60
45/0	45/15	45/30	454/45	45/60
60/0	60/15	60/30	60/45	60/60

For the slabs, three different areas were spectrally characterized at i=30° and e=0° to characterize spectral variability across a slab.

Data are present in the following directories/dates:

111014_HED phase whole rock
111021_HED 2
111024_HED3
111024_HED 4
111024_HED 5
111105_HED 6
111118_HED 7
111122_HED 8

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16.11.3d. (6) Grain size measurements on German HEDs – Bruker Vertex 70 FTIR spectra

NWA5751	PSF nwa5751.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA5751	PSF nwa5751 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA5751	PSF nwa5751 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA5751	PSF nwa5751 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA5751	PSF nwa5751 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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NWA5748	PSF nwa5748.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA5748	PSF nwa5748 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA5748	PSF nwa5748 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA5748	PSF nwa5748 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA5748	PSF nwa5748 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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NWA2968	PSF nwa2968.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA2968	PSF nwa2968 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA2968	PSF nwa2968 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA2968	PSF nwa2968 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA2968	PSF nwa2968 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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NWA6013	PSF nwa6013.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA6013	PSF nwa6013 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA6013	PSF nwa6013 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA6013	PSF nwa6013 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA6013	PSF nwa6013 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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Millbillillie	PSF Millbillillie.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Millbillillie	PSF Millbillillie sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Millbillillie	PSF Millbillillie 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.

Millbillillie	PSF Millbillillie 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Millbillillie	PSF Millbillillie 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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NWA6477	PSF nwa6477.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA6477	PSF nwa6477 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA6477	PSF nwa6477 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA6477	PSF nwa6477 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA6477	PSF nwa6477 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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JaH626	PSF jah626.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
JaH626	PSF jah626 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
JaH 626	PSF jah626 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
JaH626	PSF jah626 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
JaH626	PSF jah626 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
++++++		
Talampaya	PSF talampaya.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Talampaya	PSF talampaya sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Talampaya	PSF talampaya 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Talampaya	PSF talampaya 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Talampaya	PSF talampaya 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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NWA1863	PSF nwa1863.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1863	PSF nwa1863 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1863	PSF nwa1863 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1863	PSF nwa1863 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1863	PSF nwa1863 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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NWA1943	PSF nwa1943.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1943	PSF nwa1943 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1943	PSF nwa1943 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1943	PSF nwa1943 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra

		avgd; Bruker Vertex 70.
NWA1943	PSF nwa1943 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
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NWA1942	PSF nwa1942.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1942	PSF nwa1942 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1942	PSF nwa1942 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1942	PSF nwa1942 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
NWA1942	PSF nwa1942 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
++++++		
Tatahouine	PSF tatahouine.dpt	whole rock surface; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Tatahouine	PSF tatahouine sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Tatahouine	PSF tatahouine 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Tatahouine	PSF tatahouine 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
Tatahouine	PSF tatahouine 250-500.dpt	250-500 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
++++++		
PRA04401	PSF pra04401 sub45.dpt	<45 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
PRA04401	PSF pra04401 45-90.dpt	45-90 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.
PRA04401	PSF pra04401 90-250.dpt	90-250 µm; i=30°, e=0°; 1.6-25 µm; 7.71 cm^{-1} resolution; 2500 spectra avgd; Bruker Vertex 70.

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16.11.4d. Samples from NASA Astromaterials Facility

PRA 04401-a	PSF 111122b.005	PRA 04401 howardite (+ CM2 xenoliths), <45 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output, 200 spectra averaged; ASD [Directory: 111122PRA].
PRA 04401-b	PSF 111122b.006	PRA 04401 howardite (+ CM2 xenoliths), 45-90 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output, 200 spectra averaged; ASD [Directory: 111122PRA].
PRA 04401-c	PSF 111122b.007	PRA 04401 howardite (+ CM2 xenoliths), 90-250 µm; 0.35-2.5 µm; i=30°, e=0°; 1 nm output, 200 spectra averaged; ASD [Directory: 111122PRA].

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16.11.5. HED meteorites on loan from Vishnu Reddy (Planetary Science Institute)

NWA7465	PSF 140310a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory: 140310 met mixes). See also section 16.16 for mixtures of NWA 7465 with Chergach H chondrite light (unshocked lithology).
Dhofar 485	PSF 140609.001	aka VMM201; 100% Dhofar 485 howardite; <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).

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16.12d. Ureilites and components

16.12.2d. University of North Dakota samples

mjg227	PSF 091118a.003	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory).
mjg227	PSF 091118a.004	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (091103_Gaffmet directory); repacked and reshot.

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16.12.3d. Ureilites -from Pierre Hudon

ALH77257	RELAB c1ph27	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
ALH77257	RELAB bmr1ph027	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
ALH77257	RELAB bkr3ph027	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
ALH77257	JSC d51020.s11	<75 µm, unknown viewing geometry; 0.35-2.1 µm; 4 nm resol.
++++++		
ALH81101	RELAB c1ph30	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
ALH81101	RELAB bkr3ph030	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
ALH81101	JSC d51014.s11	<75 µm, unknown viewing geometry; 0.35-2.1 µm; 4 nm resol.
++++++		
ALH82130	RELAB c1ph21	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
ALH82130	RELAB bmr1ph021	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
ALH82130	RELAB bkr3ph021	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
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DaG319	RELAB c1ph39	<75 µm, 30°/0°, 0.3-2.6 µm, 5 nm.
DaG319	RELAB bkr3ph039	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
EET87517	RELAB c1ph24	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
EET87517	RELAB bmr1ph024	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
EET87517	RELAB bkr3ph024	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
EET87517	JSC d51019.s11	<75 µm, unknown viewing geometry; 0.35-2.1 µm; 4 nm resol.
++++++		
EET87720	RELAB c1ph37	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
EET87720	RELAB bkr3ph037	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
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EET96042	RELAB c1ph31	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
EET96042	RELAB bkr3ph031	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
EET96042	JSC d51017.s11	<75 µm, unknown viewing geometry; 0.35-2.1 µm; 4 nm resol.
++++++		
Goalpara	RELAB c1ph29	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
Goalpara	RELAB bkr3ph029	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
GRA95205	RELAB c1ph23	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
GRA95205	RELAB bmr1ph023	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
GRA95205	RELAB bkr3ph023	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
GRA95205	JSC d51015.s11	<75 µm, unknown viewing geometry; 0.35-2.1 µm; 4 nm resol.
++++++		
GRO95575	RELAB c1ph25	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.

GRO95575	RELAB bmr1ph025	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
GRO95575	RELAB bkr3ph025	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
GRO95575	JSC d51018.s11	<75 µm, unknown viewing geometry; 0.35-2.1 µm; 4 nm resol.
++++++		
Kenna	RELAB c1ph38	<75 µm, 30°/0°, 0.3-2.6 µm, 5 nm.
Kenna	RELAB bkr3ph038	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
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LEW88201	RELAB c1ph22	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
LEW88201	RELAB bmr1ph022	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
LEW88201	RELAB bkr3ph022	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
META78008	RELAB c1ph20	<75 µm, 30°/0°, 0.3-2.6 µm, 5 nm.
META78008	RELAB bmr1ph020	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
META78008	RELAB bkr3ph020	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
META78008	JSC d51016.s11	<75 µm, unknown viewing geometry; 0.35-2.1 µm; 4 nm resol.
++++++		
MET01085	RELAB c1ph40	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
MET01085	RELAB bkr3ph040	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
Novo Urei	RELAB c1ph28	<75 µm, 30°/0°, 0.3-2.6 µm, 5 nm.
Novo Urei	RELAB bkr3ph028	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
NWA1500	RELAB c1ph18	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
NWA1500	RELAB bmr1ph018	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
NWA1500	RELAB bkr3ph018	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
++++++		
PCA82506	RELAB c1ph26	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
PCA82506	RELAB bmr1ph026	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
PCA82506	RELAB bkr3ph026	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
PCA82506	JSC d51021.s11	<75 µm, unknown viewing geometry; 0.35-2.1 µm; 4 nm resol.
++++++		
Y791538	RELAB c1ph19	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
Y791538	RELAB bmr1ph019	<75 µm, 30°/30°, 2-25 µm, 0.8-121 nm resol., Nicolet.
Y791538	RELAB bkr3ph019	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).
Y791538	RELAB c1ph36	<75 µm, 30°/0°, 0.3-2.6 µm, 5nm.
Y791538	RELAB bkr3ph036	<75 µm, 30°/0°,30°, 0.3-25 µm, 5/0.8-121 nm resol. (RELAB+Nicolet, note change in viewing geometry).

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16.14d. Unknown type

16.14.2d. University of North Dakota samples

mjg131	PSF 090828a.006	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra averaged, ASD, (090814Gaffmet directory).
mjg131	PSF 090828a.007	unsorted powder; i=30°/e=0°, 0.35-2.5 µm, 1 nm output, 1000 spectra

averaged, ASD, (090814Gaffmet directory); repacked and reshot.
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16.15d. Primitive achondrites

16.15.2d. RELAB spectra

EET84302-1	RELAB c1mb32	unsorted (?), 30°/0°, 0.3-2.6µm, 5 nm.
EET84302-2	RELAB c2mb32	unsorted (?), 30°/0°, 0.3-2.6µm, 5 nm.
EET84302-3	RELAB c3mb32	unsorted (?), 30°/0°, 0.3-2.6µm, 5 nm.
EET84302-4	RELAB c4mb32	unsorted (?), 30°/0°, 0.3-2.6µm, 5 nm.
EET84302-5	RELAB c5mb32	unsorted (?), 30°/0°, 0.3-2.6µm, 5 nm.
EET84302-6	RELAB c6mb32	unsorted (?), 30°/0°, 0.3-2.6µm, 5 nm.
EET84302-7	RELAB c7mb32	unsorted (?), 30°/0°, 0.3-2.6µm, 5 nm.

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16.16d. Meteorite Mixtures

16.16.2d. University of North Dakota samples : Ordinary chondrite + eucrite mixtures (directory: feb1207)

och45	PSF feb1207.002	<45µm; 35°/0°; 0.35-2.5 µm; 1nm resol.; 1000 avg.; ASD.
euc045	PSF feb1207.004	<45µm; 35°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avg.; ASD.
03euc045	PSF feb1207.006	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
06euc045	PSF feb1207.008	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
09euc045	PSF feb1207.010	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
12euc045	PSF feb1207.012	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
15euc045	PSF feb1207.014	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
18euc045	PSF feb1207.016	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
20euc045	PSF feb1207.018	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
25euc045	PSF feb1207.020	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
30euc045	PSF feb1207.022	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
35euc045	PSF feb1207.024	<45µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
	++++++	
och4590	PSF feb1207.028	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
euc4590	PSF feb1207.030	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
03euc4590	PSF feb1207.032	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
06euc4590	PSF feb1207.034	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
09euc4590	PSF feb1207.036	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
12euc4590	PSF feb1207.038	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
15euc4590	PSF feb1207.040	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
18euc4590	PSF feb1207.042	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
20euc4590	PSF feb1207.044	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
25euc4590	PSF feb1207.046	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
30euc4590	PSF feb1207.048	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.
35euc4590	PSF feb1207.050	45-90 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avg.; ASD.

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16.16.3d. HED + CM2 carbonaceous chondrite mixtures (for Vesta)

Millbillillie eucrite + Murchison CM2 carbonaceous chondrite

VES001	PSF 110816a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].

VES002	PSF 110816a.003	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].
VES003	PSF 110816a.004	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].
VES004	PSF 110816a.005	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].
VES005	PSF 110816a.006	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].
VES006	PSF 110816a.007	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].
VES007	PSF 110816a.008	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].
VES008	PSF 110816a.009	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].
VES009	PSF 110816a.002	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 110816_meteorite mix].

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16.16.4d. Meteorite and glass from Paul Buchanan (August 2013)

Sample used to produce mixtures of an HED + glass (glass made from the HED). The HED is the howardite EET87503.

MGM01	PSF 130926a.001	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM02	PSF 130926a.003	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM03	PSF 130926a.004	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM04	PSF 130926a.005	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM05	PSF 130926a.009	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM06	PSF 130926a.006	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM07	PSF 130926a.007	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM08	PSF 130926a.008	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM09	PSF 130926a.002	<300 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD. (directory: met glass mix).
MGM02	PSF MGM 02.spec	<300 μm; i=30°, e=0°; 0.4-1.13 μm; ~0.3 nm output; 100 spectra averaged; Maya. (directory: Met/Glass Mix).
MGM03	PSF MGM 03.spec	<300 μm; i=30°, e=0°; 0.4-1.13 μm; ~0.3 nm output; 100 spectra averaged; Maya. (directory: Met/Glass Mix).
MGM04	PSF MGM 04.spec	<300 μm; i=30°, e=0°; 0.4-1.13 μm; ~0.3 nm output; 100 spectra averaged; Maya. (directory: Met/Glass Mix).
MGM05	PSF MGM 05.spec	<300 μm; i=30°, e=0°; 0.4-1.13 μm; ~0.3 nm output; 100 spectra averaged; Maya. (directory: Met/Glass Mix).
MGM06	PSF MGM 06.spec	<300 μm; i=30°, e=0°; 0.4-1.13 μm; ~0.3 nm output; 100 spectra averaged; Maya. (directory: Met/Glass Mix).
MGM07	PSF MGM 07.spec	<300 μm; i=30°, e=0°; 0.4-1.13 μm; ~0.3 nm output; 100 spectra averaged; Maya. (directory: Met/Glass Mix).
MGM08	PSF MGM 08.spec	<300 μm; i=30°, e=0°; 0.4-1.13 μm; ~0.3 nm output; 100 spectra averaged;

Maya. (directory: Met/Glass Mix).
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16.16.5d. NWA 7465 eucrite + Chergach H chondrite (unshocked lithology), <45 µm intimate mixtures

ECM001	PSF 140310a.001	<45 µm (100% NWA 7465 + 0% Chergach light lithology); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140310 met mixes).
ECM002	PSF 140310a.002	<45 µm (95% NWA 7465 + 5% Chergach light lithology); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140310 met mixes).
ECM003	PSF 140310a.003	<45 µm (90% NWA 7465 + 10% Chergach light lithology); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140310 met mixes).
ECM004	PSF 140310a.004	<45 µm (85% NWA 7465 + 15% Chergach light lithology); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140310 met mixes).
ECM005	PSF 140310a.005	<45 µm (80% NWA 7465 + 20% Chergach light lithology); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140310 met mixes).
ECM006	PSF 140310a.006	<45 µm (75% NWA 7465 + 25% Chergach light lithology); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140310 met mixes).
ECM007	PSF 140310a.007	<45 µm (0% NWA 7465 + 100% Chergach light lithology); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140310 met mixes).

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16.16.6d. Dhofar 485 howardite + Bassikounou H5 chondrite – powdered intimate mixtures (for Vishnu Reddy)

Dhofar 485	PSF 140416a.001	<45 µm; 100% Dhofar 485 (howardite, <45 µm); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).
VMM001	PSF 140416a.002	<45 µm; 95% Dhofar 485 (howardite, <45 µm) + 5% Bassikounou (H5 chondrite, <45 µm); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).
VMM002	PSF 140416a. 003	<45 µm; 90% Dhofar 485 (howardite, <45 µm) + 10% Bassikounou (H5 chondrite, <45 µm); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).
VMM003	PSF 140416a.004	<45 µm; 85% Dhofar 485 (howardite, <45 µm) + 15% Bassikounou (H5 chondrite, <45 µm); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).
VMM004	PSF 140416a.005	<45 µm; 80% Dhofar 485 (howardite, <45 µm) + 20% Bassikounou (H5 chondrite, <45 µm); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).
VMM005	PSF 140416a.006	<45 µm; 75% Dhofar 485 (howardite, <45 µm) + 25% Bassikounou (H5 chondrite, <45 µm); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).
VMM006	PSF 140416a.007	<45 µm; 100% Bassikounou (H5 chondrite, <45 µm); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).

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16.16.7d. Dhofar 485 howardite + Chelyabinsk LL5 chondrite – powdered intimate mixtures (for Vishnu Reddy)

Dhofar 485	PSF 140416a.001	<45 µm; 100% Dhofar 485 (howardite; <45 µm). (VMM007/VMM107); i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 200 spectra averaged; 150 W QTH

source; ASD (directory: 140416 VMM).

VMM101 PSF 140416a.008 <45 μm; 95% Dhofar 485 (howardite, <45 μm) + 5% Chelyabinsk (LL5 chondrite, <45 μm); i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).

VMM102 PSF 140416a.009 <45 μm; 90% Dhofar 485 (howardite, <45 μm) + 10% Chelyabinsk (LL5 chondrite, <45 μm); i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).

VMM103 PSF 140416a.010 <45 μm; 85% Dhofar 485 (howardite, <45 μm) + 15% Chelyabinsk (LL5 chondrite, <45 μm); i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).

VMM104 PSF 140416a.011 <45 μm; 80% Dhofar 485 (howardite, <45 μm) + 20% Chelyabinsk (LL5 chondrite, <45 μm) ; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).

VMM105 PSF 140416a.012 <45 μm; 75% Dhofar 485 (howardite, <45 μm) + 25% Chelyabinsk (LL5 chondrite, <45 μm) ; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).

VMM106 PSF 140416a.013 <45 μm; 100% Chelyabinsk (LL5 chondrite, <45 μm) ; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; 150 W QTH source; ASD (directory: 140416 VMM).

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16.16.8d. Chergach: shocked H chondrite – mixtures of light and dark lithologies

Chergach Light (unshocked) and dark (shocked) H chondrite. Also see section 15 (Mixtures) for spectral files of this meteorite for different proportions of the unshocked portion of this meteorite mixed with the NWA 7465 eucrite.

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CMM200 PSF 140310a.008 <45 μm; 100% Chergach dark lithology + 0% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM201 PSF 140310a.009 <45 μm; 90% Chergach dark lithology + 10% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM202 PSF 140310a.010 <45 μm; 80% Chergach dark lithology + 20% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM203 PSF 140310a.011 <45 μm; 70% Chergach dark lithology + 30% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM204 PSF 140310a.012 <45 μm; 60% Chergach dark lithology + 40% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM205 PSF 140310a.013 <45 μm; 50% Chergach dark lithology + 50% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM206 PSF 140310a.014 <45 μm; 40% Chergach dark lithology + 60% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM207 PSF 140310a.015 <45 μm; 30% Chergach dark lithology + 70% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM208 PSF 140310a.016 <45 μm; 20% Chergach dark lithology + 80% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

CMM209 PSF 140310a.017 <45 μm; 10% Chergach dark lithology + 90% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory:

		140310 met mixes).
CMM210	PSF 140310a.018	<45 μm; 0% Chergach dark lithology + 100% Chergach light lithology; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged (directory: 140310 met mixes).

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16.16.9 Mreira: shocked L6 ordinary chondrite – mixtures of light and dark lithologies

See also section 16.7.2 for end member spectra

Mreira	PSF 131001a.001	MM01: 100% dark lithology + 0% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.002	MM02: 95% dark lithology + 5% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.003	MM03: 90% dark lithology + 10% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.004	MM04: 80% dark lithology + 20% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.005	MM05: 70% dark lithology + 30% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.006	MM06: 60% dark lithology + 40% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.007	MM07: 50% dark lithology + 50% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.008	MM08: 40% dark lithology + 60% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.009	MM09: 30% dark lithology + 70% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.010	MM10: 20% dark lithology + 80% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.011	MM11: 10% dark lithology + 90% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.012	MM12: 5% dark lithology + 95% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
Mreira	PSF 131001a.013	MM13: 0% dark lithology + 100% light lithology, <45 μm powder; i=30°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: Mreira Mix).
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Mreira	PSF 131002a.002	MM01: 100% dark lithology + 0% light lithology, <45 μm powder; i=0°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: randoms).
Mreira	PSF 131002a.004	MM07: 50% dark lithology + 50% light lithology, <45 μm powder; i=0°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: randoms).
Mreira	PSF 131002a.003	MM13: 0% dark lithology + 100% light lithology, <45 μm powder; i=0°/e=0°; 0.35-2.5 μm; 1 nm output; ASD; 500 spectra averaged. (Directory: randoms).
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Mreira	PSF 100%D	MM01: 100% dark lithology + 0% light lithology, <45 μm powder; i=0°/e=0°; 0.4-1.13 μm; ~0.3 nm; Maya; 100 spectra averaged. (Directory: 131002 mreira).
Mreira	PSF 50% LD	MM07: 50% dark lithology + 50% light lithology, <45 μm powder; i=0°/e=0°; 0.4-1.13 μm; ~0.3 nm; Maya; 100 spectra averaged. (Directory: 131002 mreira).
Mreira	PSF 100%L	MM13: 0% dark lithology + 100% light lithology, <45 μm powder; i=0°/e=0°; 0.4-1.13 μm; ~0.3 nm; Maya; 100 spectra averaged. (Directory: 131002 mreira).

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16.16.10d. Meteorite mixtures on loan from the Planetary Science Institute (Vishnu Reddy)

Dhofar 485 howardite + Thika L6 chondrite – powdered intimate mixtures (for Vishnu Reddy)

VMM201	PSF 140609.001	100% Dhofar 485 howardite, 0% Thika L6; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).
VMM202	PSF 140609.002	95% Dhofar 485 howardite, 5% Thika L6; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).
VMM203	PSF 140609.003	90% Dhofar 485 howardite, 10% Thika L6; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).
VMM204	PSF 140609.004	85% Dhofar 485 howardite, 15% Thika L6; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).
VMM205	PSF 140609.005	80% Dhofar 485 howardite, 20% Thika L6; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).
VMM206	PSF 140609.006	75% Dhofar 485 howardite, 25% Thika L6; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).
VMM207	PSF 140609.007	50% Dhofar 485 howardite, 50% Thika L6; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).
VMM208	PSF 140609.008	0% Dhofar 485 howardite, 100% Thika L6; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol. 200 spectra avgd.; ASD (directory: 140609vmm200).

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16.16.11a. Meteorite mixtures – University of Winnipeg and Vishnu Reddy

NWA 5748 howardite + Murchison CM2 chondrite (JFB001 sample)

VES300	PSF 120517a.001	100% NWA 5748 howardite, 0% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory: 120517_meteorite mix).
VES301	PSF 120517a.009	0% NWA 5748 howardite, 100% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory: 120517_meteorite mix).
VES302	PSF 120517a.002	95% NWA 5748 howardite, 5% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory: 120517_meteorite mix).
VES303	PSF 120517a.003	90% NWA 5748 howardite, 10% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory: 120517_meteorite mix).
VES304	PSF 120517a.004	80% NWA 5748 howardite, 20% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory: 120517_meteorite mix).
VES305	PSF 120517a.005	70% NWA 5748 howardite, 30% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory: 120517_meteorite mix).
VES306	PSF 120517a.006	60% NWA 5748 howardite, 40% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory: 120517_meteorite mix).
VES307	PSF 120517a.007	50% NWA 5748 howardite, 50% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory: 120517_meteorite mix).
VES308	PSF 120517a.008	40% NWA 5748 howardite, 60% Murchison CM2; both <45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resolution; 200 spectra avgd; ASD (directory:

120517_meteorite mix).
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16.16.12d. Meteorite mixtures from Max Planck Institute (Gunni Thangjam) – October 2014

82 samples in total.
Samples used in the mixtures and abbreviations):

HD:	DaG 779: diogenite-rich howardite
CM:	Jbilet: CM2 carbonaceous chondrite
GL:	Millbillillie glass – glass made from Millbillillie eucrites
HE:	NWA 1929: Eucrite-rich howardite
OL:	Olivine: terrestrial olivine

These abbreviations are used in the mixture descriptions below; numbers following the 2 letter abbreviations refer to the weight percent abundances. The sample/powder preparation of the howardites are done in two ways. Each sample is divided into two halves, and one half is used to prepare samples in just only 0-63 micron size (reference sample), while the other half is used to prepare samples in various grain sizes (0-63, 63-125, 125-250, 250-630).

Sample No./ MPS # Mixture Name	*PSF File ID*	*Spectra description*
a) HE-GL mixtures; 0-63 μm		
1. 2. HE20-GL80	PSF 141201a.010	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
2. 4. HE40-GL60	PSF 141201a.011	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
3. 5. HE50-GL50	PSF 141201a.012	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
4. 6. HE60-GL40	PSF 141201a.013	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
5. 7. HE70-GL30	PSF 141201a.014	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
6. 8. HE80-GL20	PSF 141201a.015	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
7. 9. HE90-GL10	PSF 141201a.016	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
b) HD-GL mixtures; 0-63 μm		
8. 2. HD20-GL80	PSF 141201a.017	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
9. 4. HD40-GL60	PSF 141201a.018	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
10. 5. HD50-GL50	PSF 141201a.019	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
11. 6. HD60-GL40	PSF 141201a.020	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
12. 7. HD70-GL30	PSF 141201a.021	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
13. 8. HD80-GL20	PSF 141201a.022	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
14. 9. HD90-GL10	PSF 141201a.023	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
c) HE-CM2 mixtures; 0-63 μm		
15. 1. HE10-CM90	PSF 141201a.001	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
16. 2. HE20-CM80	PSF 141201a.002	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].

17. 3. HE30-CM70	PSF 141201a.003	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
18. 4. HE40-CM60	PSF 141201a.004	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
19. 5. HE50-CM50	PSF 141201a.005	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
20. 6. HE60-CM40	PSF 141201a.006	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
21. 7. HE70-CM30	PSF 141201a.007	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
22. 8. HE80-CM20	PSF 141201a.008	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
23. 9. HE90-CM10	PSF 141201a.009	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
d) HD-CM2 mixtures; 0-63 μm		
24. 1. HD10-CM90	PSF 141201a.024	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
25. 2. HD20-CM80	PSF 141201a.025	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
26. 3. HD30-CM70	PSF 141201a.026	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
27. 4. HD40-CM60	PSF 141201a.027	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
28. 5. HD50-CM50	PSF 141201a.028	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
29. 6. HD60-CM40	PSF 141201a.029	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
30. 7. HD70-CM30	PSF 141201a.030	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
31. 8. HD80-CM20	PSF 141201a.031	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
32. 9. HD90-CM10	PSF 141201a.032	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
e) HD-OL mixtures; 0-63 μm		
33. 1. HD10-OL90	PSF 141201a.033	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
34. 2. HD20-OL80	PSF 141201a.034	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
35. 3. HD30-OL70	PSF 141201a.035	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
36. 4. HD40-OL60	PSF 141201a.036	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
37. 5. HD50-OL50	PSF 141201a.037	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
38. 6. HD60-OL40	PSF 141201a.038	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
39. 7. HD70-OL30	PSF 141201a.039	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
40. 8. HD80-OL20	PSF 141201a.040	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
41. 9. HD90-OL10	PSF 141201a.041	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 141201 met mix].
f) HE-OL mixtures; 0-63 μm		
42. 1. HE10-OL90	PSF 150107b.001	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
43. 2. HE20-OL80	PSF 150107b.002	<63 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged;

ASD [Directory: 150107 met mix].

44. 3. HE30-OL70	PSF 150107b.003	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
45. 4. HE40-OL60	PSF 150107b.004	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
46. 5. HE50-OL50	PSF 150107b.005	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
47. 6. HE60-OL40	PSF 150107b.006	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
48. 7. HE70-OL30	PSF 150107b.007	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
49. 8. HE80-OL20	PSF 150107b.008	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
50. 9. HE90-OL10	PSF 150107b.009	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].

g) HE-OL mixtures; 63-125 µm

51. 1. HE10-OL90	PSF 150107b.010	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
52. 2. HE20-OL80	PSF 150107b.011	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
53. 3. HE30-OL70	PSF 150107b.012	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
54. 4. HE40-OL60	PSF 150107b.013	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
55. 5. HE50-OL50	PSF 150107b.014	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
56. 6. HE60-OL40	PSF 150107b.015	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
57. 7. HE70-OL30	PSF 150107b.016	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
58. 8. HE80-OL20	PSF 150107b.017	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
59. 9. HE90-OL10	PSF 150107b.018	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].

h) HD-OL mixtures; 63-125 µm

60. 1. HD10-OL90	PSF 150107b.019	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
61. 2. HD20-OL80	PSF 150107b.020	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
62. 3. HD30-OL70	PSF 150107b.021	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
63. 4. HD40-OL60	PSF 150107b.022	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
64. 5. HD50-OL50	PSF 150107b.023	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
65. 6. HD60-OL40	PSF 150107b.024	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
66. 7. HD70-OL30	PSF 150107b.025	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
67. 8. HD80-OL20	PSF 150107b.026	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
68. 9. HD90-OL10	PSF 150107b.027	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].

i) Pure samples

69. 1. HE	PSF 150107b.028	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].

70. 2. HE	PSF 150107b.029	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
71. 3. HE	PSF 150107b.030	125-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
72. 4. HE	PSF 150107b.031	250-630 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
73. 5. HE-all	PSF 150107b.032	<630 µm? ("whole sample/Reference sample, 0-63"; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
74. 1. HD	PSF 150107b.033	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
75. 2. HD	PSF 150107b.034	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
76. 3. HD	PSF 150107b.035	125-250 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
77. 4. HD	PSF 150107b.036	250-630 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
78. 5. HD-all	PSF 150107b.037	<630 µm? ("whole sample/Reference sample, 0-63"); i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
79. 1. CM	PSF 150107b.038	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
80. 1. OL	PSF 150107b.039	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
81. 2. OL	PSF 150107b.040	63-125 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].
82. 1. GL	PSF 150107b.041	<63 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD [Directory: 150107 met mix].

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16.17d. Tektites

16.17.1d. University of Winnipeg samples

TEK001	PSF 090602a.037	<45 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
TEK001	PSF 090602a.038	90-1000 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
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TEK001	PSF 111201a.049	45-90 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
TEK001	PSF 111201a.026	90-1000 µm, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
TEK001	PSF tek001.dpt	<45 µm; 30°/0°; 1.67-25.4 µm; 7.7 cm^{-1} resolution; 2500 spectra averaged; Bruker Vertex 70; directory: HED minerals MidIR_july 2012).
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TEK003	PSF 090602a.039	<45 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
TEK003	PSF 090602a.040	90-1000 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
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TEK004	PSF 100331a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm resampled; 1000 spectra averaged, ASD.
TEK004	PSF 100331a.006	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 2-7 nm resol., 1 nm resampled; 1000 spectra averaged, ASD.
TEK004	PSF 100412b.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD (Directory: 100412_Glassmix).

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16.18d. Impact glasses

16.18.1d. University of Winnipeg samples

SIL130	PSF 090602a.035	<45 μm, i=30°,e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
SIL130	PSF 090602a.036	90-1000 μm, i=30°,e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
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SIL131	PSF 090602a.043	<45 μm, i=30°,e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
SIL131	PSF 090602a.044	90-1000 μm, i=30°,e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.

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16.20d. Laser irradiated meteorites – Jeff Gillis-Davis

16.20.1d. Allende CV carbonaceous chondrite

ASD spectra

Allende fresh	PSF 140502a.001	<150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: Allende Nano Fe).
Allende 5 minutes	PSF 140502a.002	<150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: Allende Nano Fe).
Allende 10 minutes	PSF 140502a.003	<150 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: Allende Nano Fe).

Maya UV spectra

Allende fresh	PSF allende fresh.spec	<150 μm; i=0°, e=0°; 0.2-0.4 μm; ~0.5 nm resolution; 500 spectra avgd.; Maya spectrometer (directory: Nano Fe/allende/maya uv).
Allende 5 minutes	PSF allende 5 min.spec	<150 μm; i=0°, e=0°; 0.2-0.4 μm; ~0.5 nm resolution; 500 spectra avgd.; Maya spectrometer (directory: Nano Fe/allende/maya uv).
Allende 10 minutes	PSF allende 10 min.spec	<150 μm; i=0°, e=0°; 0.2-0.4 μm; ~0.5 nm resolution; 500 spectra avgd.; Maya spectrometer (directory: Nano Fe/allende/maya uv).

Maya visible region spectra

Allende fresh	PSF fresh.spec	<150 μm; i=0°, e=0°; 0.4-1.1 μm; ~0.5 nm resolution; 500 spectra avgd.; Maya spectrometer (directory: Nano Fe/allende/maya uv).
Allende 5 minutes	PSF 5 minutes.spec	<150 μm; i=0°, e=0°; 0.4-1.1 μm; ~0.5 nm resolution; 500 spectra avgd.; Maya spectrometer (directory: Nano Fe/allende/maya uv).
Allende 10 minutes	PSF 10 minutes.spec	<150 μm; i=0°, e=0°; 0.4-1.1 μm; ~0.5 nm resolution; 500 spectra avgd.; Maya spectrometer (directory: Nano Fe/allende/maya uv).

Bruker Vertex 70 FTIR spectra

Allende fresh	PSF fresh i30 e0	<150 μm; i=30°, e=0°; 1.4-25 μm; 4 cm^{-1} resolution; 65700 spectra avgd.; Bruker Vertex 70 FTIR (directory: allende nano).
Allende 5 minutes	PSF 5 minutes i30 e0	<150 μm; i=30°, e=0°; 1.4-25 μm; 4 cm^{-1} resolution; 65700 spectra avgd.; Bruker Vertex 70 FTIR (directory: allende nano).
Allende 10 minutes	PSF 10 minutes i30 e0	<150 μm; i=30°, e=0°; 1.4-25 μm; 4 cm^{-1} resolution; 65700 spectra avgd.; Bruker Vertex 70 FTIR (directory: allende nano).

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16.21. Bennu Analogues for testing OSIRIS-REx mineral detection algorithms

(a) ASD spectra

Bruce	PSF 141023a.001	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).
Natasha	PSF 141023a.002	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).
Clint	PSF 141023a.003	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged;

		ASD (directory: 141023 unknowns).
Peggy	PSF 141023a.004	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).
Nick	PSF 141023a.005	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).
Steve	PSF 141023a.006	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).
Wanda	PSF 141023a.007	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).
Tony	PSF 141023a.008	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).
Bucky	PSF 141023a.009	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).
Selina	PSF 141023a.010	Unsorted; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD (directory: 141023 unknowns).

(b) D&P IR spectra

Bruce	PSF bruce.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Bucky	PSF bucky.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Clint	PSF clint.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Natasha	PSF natasha.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Nick	PSF nick.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Peggy	PSF peggy.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Selina	PSF selina.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Steve	PSF steve.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Tony	PSF tony.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).
Wanda	PSF wanda.rtx	Unsorted; i=30°, e=0°; 1.96-5 μm; ~3 cm^{-1} resolution; 100 spectra averaged; D&P spectrometer (directory: OSIRISRex/DP unknowns).

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16.22d. "Fake" Murchison heating experiments

++++++Unheated+++++

HASB	PSF 140620a.001	<63 μm; i=30°, e=0°; 0.35-2.5 μml 1 nm output; 500 spectra averaged; ASD (Directory: 140620 Pre heating]
HSHU	PSF 140620a.003	<63 μm; i=30°, e=0°; 0.35-2.5 μml 1 nm output; 500 spectra averaged; ASD (Directory: 140620 Pre heating]
HTRO	PSF 140620a.005	<45 μm; i=30°, e=0°; 0.35-2.5 μml 1 nm output; 500 spectra averaged; ASD (Directory: 140620 Pre heating]
HMAG	PSF 140620a.007	<20 nm; i=30°, e=0°; 0.35-2.5 μml 1 nm output; 500 spectra averaged; ASD (Directory: 140620 Pre heating]
WMM	PSF 140620a.009	<63 μm; i=30°, e=0°; 0.35-2.5 μml 1 nm output; 500 spectra averaged; ASD (Directory: 140620 Pre heating]
WMM-pre	PSF 140620a.009	<63 μm; dry sample, pre-Parr bomb dry run sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 140620 Pre heating].

++++++100°C++++++

HASB 100	PSF 140627a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140627 100 300 heating].
HSHU 100	PSF 140627a.003	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140627 100 300 heating].
HTRO 100	PSF 140627a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140627 100 300 heating].
HMAG 100	PSF 140627a.007	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140627 100 300 heating].
WMM 100	PSF 140627a.008	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140627 100 300 heating].
++++++200°C++++++		
HASB 200	PSF 140707a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
HSHU 200	PSF 140707a.003	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
HTRO 200	PSF 140707a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
HMAG 200	PSF 140707a.007	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
WMM 200	PSF 140707a.009	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
++++++300°C++++++		
HASB 300	PSF 140627a.002	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140627 100 300 heating].
HSHU 300	PSF 140627a.002	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140627 100 300 heating].
HTRO 300	PSF 140627a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140627 100 300 heating].
HMAG200 and HWMM200 samples spilled/lost		
++++++400°C++++++		
HASB 400	PSF 140707a.002	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
HSHU 400	PSF 140707a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
HTRO 400	PSF 140707a.006	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
HMAG 400	PSF 140707a.008	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140707a 200 400 Heating].
HWMM 400	PSF 140729a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140729_Heated500].
++++++500°C+++++		
HASB 500	PSF 140729a.003	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140729_Heated500].
HSHU 500	PSF 140729a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140729_Heated500].
HTRO 500	PSF 140729a.005	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140729_Heated500].
HMAG 500	PSF 140729a.006	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140729_Heated500].
HWMM 500	PSF 140729a.002	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140729_Heated500].
++++++600°C++++++		
HASB 600	PSF 140807a.002	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140807 heating 600].
HSHU 600	PSF 140807a.003	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140807 heating 600].

HTRO 600	PSF 140807a.004	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140807 heating 600].
HMAG 600	PSF 140807a.005	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140807 heating 600].
HWMM 600	PSF 140807a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 140807 heating 600].
++++++700°C++++++		
HASB 700	PSF 141104a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141104 heating 700].
HSHU 700	PSF 141104a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141104 heating 700].
HTRO 700	PSF 141104a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141104 heating 700].
HMAG 700	PSF 141104a.003	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141104 heating 700].
HWMM 700	PSF 141104a.005	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141104 heating 700].
++++++800°C++++++		
HASB 800	PSF 141114a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141114 heating 800].
HTRO 800	PSF 141114a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141114 heating 800].
HMAG 800	PSF 141114a.003	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141114 heating 800].
HWMM 800	PSF 141114a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141114 heating 800].
No SHU102 baked (sample cooks off almost completely at ~700°C)		
++++++900°C+++++		
HASB 900	PSF 141202a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141202 HE 900].
HTRO 900	PSF 141202a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141202 HE 900].
HMAG 900	PSF 141202a.003	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141202 HE 900].
HWMM 900	PSF 141202a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141202 HE 900].
No SHU102 baked (sample cooks off almost completely at ~700°C)		
+++++1000°C+++++		
HASB 1000	PSF 141219a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141219 HE 1000].
HTRO 1000	PSF 141219a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141219 HE 1000].
HMAG 1000	PSF 141219a.003	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141219 HE 1000].
HWMM 1000	PSF 141219a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: 141219 HE 1000].
No SHU102 baked (sample cooks off almost completely at ~700°C)		
++++++1100°C – 1st run++++++		
HASB 1100	PSF 141222a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HTRO 1100	PSF 141222a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HMAG 1100	PSF 141222a.003	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HWMM 1100	PSF 141222a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].

No SHU102 baked (sample cooks off almost completely at ~700°C)
++++++1100°C – 2nd run++++++

HASB 1100	PSF 150106a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HTRO 1100	PSF 150106a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HMAG 1100	PSF 150106a.003	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HWMM 1100	PSF 150106a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].

No SHU102 baked (sample cooks off almost completely at ~700°C)
+++++1200°C++++++

HASB 1200	PSF 150108a.001	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HTRO 1200	PSF 150108a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HMAG 1200	PSF 150108a.003	<20 nm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].
HWMM 1200	PSF 150108a.004	<63 µm; i=30°, e=0°; 0.35-2.5 µml 1 nm output; 500 spectra averaged; ASD (Directory: HE 1100 1200].

No SHU102 baked (sample cooks off almost completely at ~700°C)
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16.23d. Parr bomb runs on selected meteorites

This section describes closed system heating experiments (using Teflon-lined Parr bombs) conducted on the following meteorites:

1. Jbilet: 1 gram of meteorite run dry: 200°C for 104 days.
2. Zag: 1 gram of meteorite + 1 gram of distilled deionized water: 200°C for 111 days.
3. Murchison: 1 gram of meteorite + 1 gram of distilled deionized water: 200°C for 111 days.
4. Murchison: 1 gram of meteorite run dry: 200°C for 111 days.
5. WMM (fake Murchison): 1 gram of sample run dry: 200°C for 111 days.
6. WMM (fake Murchison): 1 gram of sample + 1 gram of distilled deionized water: 200°C for 111 days.

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Jbilet-pre dry	PSF 140723a.004	<63 µm, original sample (pre-Parr bomb); i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
Jbilet-post dry	PSF 141107b.012	<63 µm, after 104 days in Parr bomb at 200°C; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].

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Zag-pre wet	PSF 141219a.005	<100 µm, original sample (dry sample , pre-Parr bomb run with water); i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 141219 HE 1000].
Zag-wet post1	PSF 141107b.001	<100 µm, top crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
Zag-wet post2	PSF 141107b.002	<100 µm, bottom crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
Zag-wet post3	PSF 141107b.011	<100 µm, mixed top and bottom crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].

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Murchison-pre wet	PSF 140702a.001-003	<150 µm, three duplicate spectra of sample (dry sample, pre-Parr bomb run with water); i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: Murchison].
Murchison-wet post1	PSF 141107b.003	<150 µm; top crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
Murchison-wet post2	PSF 141107b.004	<150 µm; bottom crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
Murchison-wet post3	PSF 141107b.009	<150 µm; mixed top and bottom crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
+++++		
Murchison-pre dry	PSF 140702a.004-006	<150 µm, three duplicate spectra of sample (dry, pre-Parr bomb dry run sample); i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: Murchison].
Murchison-dry post	PSF 141107b.010	<150 µm; post-Parr bomb dry run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
++++++		
WMM-pre	PSF 140620a.009	<63 µm; dry sample, pre-Parr bomb dry run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: 140620 Pre heating].
WMM-wet post1	PSF 141107b.005	<63 µm; top crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
WMM-wet post2	PSF 141107b.006	<63 µm; bottom crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
WMM-wet post3	PSF 141107b.007	<63 µm; mixed top and bottom crust of post-Parr bomb wet run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].
WMM-dry post	PSF 141107b.008	<63 µm; post-Parr bomb dry run sample; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD [Directory: parr bomb stuff].

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END of 16.

17. Boreal Rocks, Lichens, and Serpentinites

17.1. Contwoyto Lake/Point Lake, NWT
17.2. Pinawa, MB (lichen-related)
17.3. Churchill, MB (lichen-related; peat and ground ice)
17.4. Thompson, MB (lichen-related)
17.5. Serpentinites from the ROM
17.6. East German Creek, MB (lichen-related)
17.7. Archival lichen spectra
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17a. Sample Descriptions - Boreal Rocks, Lichens and Serpentinites

FORMAT: Sample No., description, group membership, [old sample no.].

Sample ID	*Description*

17.1a. Contwoyto Lake/Point Lake, NWT, Canada

(i) Basalts

BOREA01	Basalt (from J. McCorquedale via R. St J. Lambert) [JMP2].
BOREA02	Basalt (from J. McCorquedale via R. St J. Lambert) [JMP10].

(ii) Metamorphosed Group

BOREA03	Crenulated phyllite (metamorphosed mudstone, low-medium greenschist facies) [4PLG006].
BOREA04	Micaceous greywacke (medium greenschist facies) [4PLG007].
BOREA05	Andalusite-cordierite-biotite schist (lower amphibolite grade) [4PLE005].
BOREA06	Cordierite-biotite knotted schist (lower amphibolite grade, related to BOREA04) [5PLT001].

(iii) Banded Iron Formation

BOREA07	Banded iron formation: Magnetite-chert-siderite (lower greenschist facies) [5PLJ009].

(iv) Amphibolite Grade Area

BOREA08	Diorite (amphibolite grade area) [5PLZ003].
BOREA09	Foliated biotite granite (amphibolite grade area) [5PLZ001].
BOREA10	Muscovite pegmatite (amphibolite grade area) [4PLE023].

(v) Volcano-Clastics

BOREA11	Intermediate lapilli metatuff (volcanoclastic) [4PLI010].
BOREA12	Carbonate-bearing more mafic metatuff (volcanoclastic) [4PLI013].
BOREA13	Felsic-pyritic metatuff (volcanoclastic) [4PLI017].

More complete descriptions for all but the basalt samples are provided in Lhotka (1988) and were collected by P. Lhotka from the Contwoyto Lake - Point Lake area in the Northwest Territories.

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17.1.1a. Lichen Sample Descriptions – Contwoyto Lake/Point Lake Suite

FORMAT: Rock sample no., lichen name, source (appearance) [old sample I.D. no.]

Sample ID	Lichen
BOREA01	*Xanthoria elegans* (Link) Th. Fr. (orange, foliose) [JMP2].
BOREA02	*Dimelaena oriena* (Ach.) Norman (yellow-green) [JMP10].

BOREA03 *Tephromela armeniaca* (DC.) Hertel & Rambold (orange and black) [4PLG006].
BOREA05 *Rhizocarpon geographicum* (L.) DC. (yellow-green) [4PLE005].
BOREA05 *Umbilicaria krascheninnikovi* (Savicz) Zahlbr. [4PLE005].
BOREA08 *Buellia stigmaea* Tuck. (orangish) [5PLZ003].
BOREA09 *Arctoparmelia centrifuga* (L.) Hale (yellow-green, foliose) [5PLZ001].
BOREA09 *Melanelia stygia* (L.) Essl. (brown, foliose) [5PLZ001].
BOREA09 *Pseudephebe minuscula* (Nyl. *ex* Arnold) Brodo & D. Hawksw. (Brown, hair-like) [5PLZ001].
BOREA10 *Arctoparmelia centrifuga* (L.) Hale (yellow-green, foliose) [4PLE023].
BOREA10 *Arctoparmelia incurva* (Pers.) Hale (dark yellow-green, foliose) [4PLE023].
BOREA10 *Melanelia stygia* (L.) Essl. (brown, foliose) [4PLE023].
BOREA11 *Lecidea auriculata* Th. Fr. (grey-black) [4PLI010].
BOREA12 *Buellia semitensis* Tuck. (grey) [4PLI013].
BOREA12 *Buellia stigmaea* Tuck. (orangish) [4PLI013].
BOREA12 *Umbilicaria deusta* (L.) Baumg. (black, foliose, at point of rock) [4PLI013].

Lichen descriptions were provided by Janet Marsh of the Department of Biology at the University of Alberta and names follow the format of Egan (1987).

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17.2a. Pinawa, MB Lichen Suite (self-collected Sept, 2003)

LIC001 Lichen-covered granite from Pinawa, MB old dam site.
LIC002 Lichen-covered granite from Pinawa, MB old dam site.
LIC003 Lichen-covered granite from Pinawa, MB old dam site.
LIC004 Lichen-covered granite from Pinawa, MB old dam site.
LIC005 Lichen-covered rock from Pinawa, MB old dam site.
LIC006 Lichen-covered granite from Pinawa, MB old dam site.

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17.3a. Churchill, Manitoba

17.3.1a. Samples collected by Ed Cloutis (May 21, 2008)

Collected May 21, 2008 from vicinity of Churchill Northern Studies Centre.

CHU001 – CHU025 Unsorted, various rock types with different degrees and types of lichen cover.

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CHU026 Quartzite – collected from landscaping of stones at Churchill train station – August 2014.
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17.3.2a. Churchill, Manitoba – August 2010

Samples collected by Genevieve Berard and team of students for lichen spectroscopy project as part of Churchill field course (their sample ID numbers).

S001 Pink-gray granite with abundant yellow, black, and orange lichens; interior broken surface also.
S002 Pink-gray granite with orange lichen, sparse yellow-black lichen; interior broken surface also.
S003 Quartzite (quartz vein) with black-yellow lichen, sparse orange lichen; interior broken surface also.
S004 Quartzite (quartz vein) with red Fe-staining and sparse orange lichen; interior broken surface also.
S005 Quartzite (quartz vein) with black, yellow, and orange lichen; interior broken surface also.
S006 Quartzite (quartz vein) and pink-gray granite with orange lichen and black foliose lichen; interior broken surface also.

S007 Pink-gray granite with orange lichen; interior broken surface also.
S008 Pink-gray granite with white and orange lichen; interior broken surface also.
S009 Gray granite with white/gray foliose lichen, and black crustose lichen; interior broken surface also.
S010 Pink-gray granite with quartz vein and white crustose lichen and sparse orange lichen; interior broken surface also.
S011 Quartzite (quartz vein) with black crustose lichen, and red Fe-staining; interior broken surface also.
S012 Pink granite with brown/green weathered stuff, extensive black and yellow lichens; interior broken surface also.
S013 Pink-gray granite with orange lichen; interior broken surface also.
S014 Gray granite with sparse orange and white lichen; interior broken surface also.
S015 Quartz vein (3 pieces) with sparse orange and black lichens; interior broken surface also.
S016 Pink granite with sparse orange lichen; interior broken surface also.
S017 Quartzite (quartz vein) and granite with black foliose and crustose lichen; interior broken surface also.
S018 Gray-pink granite with black foliose lichen, sparse orange and yellow crustose lichen; interior broken surface also.
S019 Gray granite with black foliose lichen; interior broken surface also.
S020 Gray granite with sparse orange lichen; interior broken surface also.
S021 Gray granite with sparse orange, black and yellow lichens; interior broken surface also.
S022 Pink dolostone with sparse yellow-brown lichen; interior broken surface also.
S023 Pink dolostone with brown weathered surface, and black crustose lichen; interior broken surface also.
S024 Pink-gray granite with black foliose lichen; interior broken surface also.
S025 Gray granite with black foliose lichen, black and yellow crustose lichen; interior broken surface also.
S026 Gray granite with black weathered surface, extensive black lichen, sparse orange lichen; interior broken surface also.
S027 Gray granite with black foliose lichen; interior broken surface also.
S028 Gray granite with black weathered surface, sparse white and black lichen; interior broken surface also.
S029 Gray schist with extensive black-yellow lichen; interior broken surface also.
S030 Gray foliated granite/schist with moderate orange lichen, sparse yellow-black lichen; interior broken surface also.
S031 Gray-white foliated granite/schist with red Fe-oxide surface, sparse white lichen; interior broken surface also.
S032 Pink-gray fine-grained granite with sparse orange, black, and yellow lichens; interior broken surface also.
S033 Gray-white granite and quartzite (quartz vein?)with one Fe-oxide surface, sparse black, orange, and yellow lichens; interior broken surface also.
S034 Pink-gray foliated granite/schist with abundant white and yellow-black lichens; interior broken surface also.
S035 Pink granite pebble with extensive orange lichens and sparse yellow/black/white lichens; no interior broken surface.

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17.3.3a. Churchill – ground ice, permafrost and peat samples

Ground ice, permafrost, and peat were collected proximate to the Churchill Northern Studies Centre (kept frozen) and analyzed by iRaman and UV-induced fluorescence (365 nm) with Maya spectrometer – August 2014.

Hole	*Sample ID*	*Description*
1	1-1	Dirty ice lense (20 cm depth)
1	1-2	Dirty ice lense (24 cm depth)
2	2-1	Frozen peat
2	2-2	Frozen peat
2	2-3	Frozen peat
3	3-1	Frozen peat
3	3-2	Frozen peat
4	4-1	Frozen peat

4	4-2	Frozen peat
4	4-3	Frozen peat
4	4-4	Frozen peat
4	4-5	Frozen peat
4	4-6	Frozen peat
5	5-1	Ice with sand and peat
5	5-2	Clear ground ice
6	6-1	Clear ground ice
6	6-2	Clear ground ice
6	6-3	Clear ground ice
7	7-1	Clear ground ice with sparse root/plant fragments
8	8-1	Clear ground ice
8	8-2	Clear ground ice
Leaf		From shrub outside the Centre
Limestone		Limestone cobble from outside the Centre
Moss		Moss on regolith
Polystyrene		iRaman calibration block
Aluminum boat		Aluminum sample boat
Sugar		Granular sucrose
Sugar Twin		Granular Sugar Twin (sodium cyclamate + fillers?)
Alcohol swab		Propylene alcohol-infused cotton swab

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17.4a. Thompson, Manitoba – lichen on rocks and trees

Lichen samples (on trees and rocks) collected upwind and downwind of Thompson smelter as part of GEOG-4212 project.

17.4.1a. Lichens on rock data

Site	*Lichen/sample description*	*Sample number*	*Distance from smelter:*
1	1T – green/white flakey	1	13.55 km upwind
	1T – bluish/grey flakey	2	13.55 km upwind
2	2T – fluffy green/white	3	5.12 km downwind
3	3Ta – fluffy green/white	4	7.66 km downwind
	3Ta – big cups	5	7.66 km downwind
	3Rb – yellow/green with cups	6	8.32 km downwind
	3Rb – dark brown flakes	7	8.32 km downwind
	3Rb – light brown flakes	8	8.32 km downwind
	3R – dark brown flakes	9	5.1 km downwind
4	4T – green white	10	11.3 km downwind
5	5Ta – dark green	11	14.41 km downwind
	5Tb – white and orange	12	15.27 km downwind
6	6T – crusty sea foam green	13	17.95 km downwind
	6R – grey/blue/green	14	17.42 km downwind
7	7T – some lichen spots (vegetative)	15	12.65 km downwind
	7T – some lichen spots (reproductive)	16	12.65 km downwind

Note: *R: sample on rock; T: sample on tree.*

Compositional data: elemental concentrations determined by flame AAS at UWinnipeg (Doug Goltz)

Sample No.	Ni	Fe	Pb	Cu	Cd

1	13.92	307.37	nd	nd	nd
2	58.11	2868.52	1.57	4.50	nd
3	23.29	777.50	2.14	nd	nd
4	21.85	1330.03	1.16	nd	nd
5	35.29	593.96	1.87	nd	nd
6	53.45	6152.91	2.5	2.46	nd
7	93.59	12148.82	5.12	7.63	nd
8	24.34	2583.31	0.65	2.67	nd
9	59.70	2503.03	1.93	3.23	nd
10	153.34	16511.32	17.33	nd	nd
11	74.45	1829.96	nd	nd	nd
12	55.00	8872.10	6.21	nd	nd
13	21.87	3335.47	1.81	2.32	nd
14	55.82	6357.60	8.16	nd	nd
15	23.90	13322.68	1.26	2.12	nd
16	13.97	863.49	1.09	2.68	nd

Note: *concentrations expressed in µg/g.*

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Site	**Sample ID**	**Sample type**
(up wind)	L6	Little cups from rock (50 08.992 N, 97 20.740 W)
(1)	L10	Crumbly gray/brown from rock (55 49.668 N, 97 58.048 W)
(2)	L16	Gray/green from rock (55 40.620 N, 97 42.494 W)
(3)	L1a	Black spot on rock (55 39.940 N, 97 48.643 W)
(3)	L1b	Black and gray pebbly on rock (55 39.940 N, 97 48.643 W)
(3)	L1c	Yellow spot on rock (55 39.940 N, 97 48.643 W)
(3)	L1d	Bare rock (55 39.940 N, 97 48.643 W)
(3)	L14	Dark brown flakes from rock (55 39.940 N, 97 48.643 W)
(4)	L12a	Yellow/green crusty from rock (55 39.599 N, 97 47.316 W)
(4)	L12b	Yellow/green with cups from rock (55 39.599 N, 97 47.316 W)
(4)	L12c	Black and gray on rock (55 39.599 N, 97 47.316 W)
(4)	L12d	Bare rock (55 39.599 N, 97 47.316 W)
(4)	L12e	Blue/gray on yellow from rock (55 39.599 N, 97 47.316 W)
(4)	L12f	Dark brown from rock (55 39.599 N, 97 47.316 W)
(4)	L12g	Light brown/black from rock (55 39.599 N, 97 47.316 W)
(5)	L15	Gray/blue/green from rock (55 35.482 N, 97 42.432 W)
(6)	L11a	Gray/brown from rock (55 37.217 N, 97 41.596 W)
(6)	L11b	Yellow spot on rock (55 37.217 N, 97 41.596 W)
(6)	L11c	Bare rock (55 37.217 N, 97 41.596 W)

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17.4.2a. Lichens on tree data

Site	**Sample ID**	**Sample type**
(up wind)	L6	Reindeer moss from tree (50 08.992 N, 97 20.740 W)
(1)	L9a	Flaky green/white from tree (55 49.668 N, 97 58.046 W)
(1)	L9b	Flaky black and gray from tree (55 49.668 N, 97.58.046 W)
(2)	L8	Fluffy green and white from tree (55 40.632 N, 97 52.616 W)
(3)	L2a	Lichen on branch (55 36.366 N, 97 50.440 W)
(3)	L2b	White spot on branch (55 36.366 N, 97 50.440 W)
(3)	L2c	Bark on branch (55 36.366 N, 97 50.440 W)
(4)	L7a	Fluffy green and white from tree (55 39.940 N, 97 48.673 W)
(4)	L7b	Big cups from tree (55 39.940 N, 97 48.673 W)
(5)	L17a	Brown flakes from tree (55 39.599 N, 97 47.316 W)

(5)	L17b	Green cups from tree (55 39.599 N, 97 47.316 W)
(6)	L13a	Orange on branch (55 39.214 N, 97 43.060 W)
(6)	L13b	Green/white on branch (55 39.214 N, 97 43.060 W)
(6)	L13c	Bare wood (55 39.214 N, 97 43.060 W)
(7)	L3a	Green lichen from tree (55 39.909 N, 97 42.387 W)
(7)	L3b	White spot on branch (55 39.909 N, 97 42.387 W)
(8)	L5	Crust sea foam green from tree (55 35.655 N, 97 41.928 W)
(9)	L4a	Green spot on branch (55 37.217 N, 97 41.596 W)
(9)	L4b	White/orangish spot on branch (55 37.217 N, 97 41.596 W)
(9)	L4c	Orange spot on branch (55 37.217 N, 97 41.596 W)
(9)	L4d	Bark on branch (55 37.217 N, 97 41.596 W)

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17.5a. Serpentinites from the Royal Ontario Museum (2013)

Note: *Serpentinite collection at the Royal Ontario Museum searched for dark serpentinites that could be good (i.e., dark) analogues for asteroid Bennu (OSIRIS-REx project).*

These samples have been characterized by X-ray diffractometry (Matt Izawa May 2013).

ROM Sample ID	Description	XRD phases
9789	Greenalite	
M6393	Chamosite	
M6394	Serpentinite	
M11342	Thuringite	
M12870	Bavalite var. daphnite	
M56440	Serpentinite	
M56441	Serpentinite	
W68_55A	Serpentinite	

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17.5.1a. Powdered samples (from Matt Izawa June 2013)

Sub-labels refer to amount of time samples powdered in mill

M6394	10s
M6394	15s
M6394	35s
++++++	
M16397	10s
M16397	35-55s
M16397	75-130s
M16397	125-180s
++++++	
W68-35	25s
W68-35	25-50s
W68-35	50-155s
W68-35	125-230s
W68-35	150-255s

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17.6a. Lichen-covered rocks: East German Creek, Manitoba Springs Complex

Collected October 2006.

Sample ID	*Description*
EGC400	Orange lichen on granite.
EGC401	Orange lichen on feldspar-rich granite.
EGC402	Orange lichen on granite.
EGC403	Orange lichen on iron-stained rock (?).
EGC404	Orange lichen on granite.
EGC405	Orange lichen on amphibolite (?).

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17.7a. Archival lichen spectra – previous investigators – digital spectra

17.7.1a. Gauslaa (1984)

Species

Caldonia stellaris
Cetraria nivalis
Parmelia olivacea
Thamnolia vermicularis
Sticta sylvatica
Umbilicaria pustulata
Umbilicaria vellea
Xanthoria parietina
Parmelia perlata
Cetraria hepatizon
Umbilicaria coriacea
Peltigera leucophlebia
Peltigera horizontalis
Alectoria ochroleuca
Cornicularia divergens
Cetraria juniperina
Lobaria amplissima
Haematomma ventosum
Parmelia caperata
Umblicaria spodochroa
Pseudephebe pubescens
Umbilicaria hirsuta
Ambilicaria arctica
Nephroma arcticum

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17.7.2a. Leckie et al. (1988, 1989)

Various species (not well documented) and sample IDs.

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17.7.3a. Rollin et al. (1994)

Rhizocarpon geographicum, haematomma ventosum, fuscidea cyathoides, parmelia saxitalis, and various rock substrates.

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17.7.4a. Steiner and Guterman (1966)

Reindeer moss, lichens on limestone, brown-yellow lichens on yellow-gray rock

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17b. XRD Data - Boreal rocks, lichens and Serpentinites

17.5b. Serpentinites from the Royal Ontario Museum (2013)

Note: *Serpentinite collection at the Royal Ontario Museum searched for dark serpentinites that could be good (i.e., dark) analogues for asteroid Bennu (OSIRIS-REx project).*

These samples have been characterized by X-ray diffractometry (Matt Izawa May 2013).

ROM Sample ID	Description	XRD phases
9789	Greenalite	quartz, siderite, antigorite, nordstrandite, nontronite, annite, vesuvianite, bixbyite
M6393	Chamosite	chamosite, siderite, calcite, goethite
M6394	Serpentinite	clinochlore is best match
M11342	Thuringite	siderite, etc.
M12870	Bavalite var. daphnite	magnetite, hematite, etc.
M56440	Serpentinite	Good match to C chondrite matrix
M56441	Serpentinite	Many phases
W68_55A	Serpentinite	Many phases

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17c. Compositional Data - Boreal rocks, lichens and serpentinites

None

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17d. Spectral Data - Boreal rocks, lichens and serpentinites

Sample	*Facility/File No.*	*Description*

17.1d. Contwoyto Lake/Point Lake area samples

BOREA01	USGS 318	red lichen+weathered surface, IS, 0.35-2.6µm, 1x resol.
BOREA01	USGS 330	interior surface, IS, 0.35-2.6µm, 1x resol.
BOREA01	USGS 342	weathered surface, IS, 0.35-2.6µm, 1x resol.
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BOREA03	USGS 354	interior surface, IS, 0.35-2.6µm, 1x resol.
BOREA03	USGS 366	lichen+weathered surface, IS, 0.35-2.6µm, 1x resol.
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BOREA04	USGS 378	black lichen, IS, 0.35-2.6µm, 1x resol.
BOREA04	USGS 390	weathered surface, IS, 0.35-2.6µm, 1x resol.
BOREA04	USGS 402	interior surface, IS, 0.35-2.6µm, 1x resol.
BOREA04	USGS 414	yellow lichen+weathered surface, IS, 0.35-2.6µm, 1x resol.
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BOREA05	USGS 426	interior surface, IS, 0.35-2.6µm, 1x resol.
BOREA05	USGS 438	lichen+weathered surface, IS, 0.35-2.6µm, 1x resol.
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BOREA06	USGS 450	interior surface, IS, 0.35-2.6µm, 1x resol.
BOREA06	USGS 462	weathered surface, IS, 0.35-2.6µm, 1x resol.
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BOREA07	USGS 474	interior surface, IS, 0.35-2.6µm, 1x resol.
BOREA07	USGS 486	weathered surface, IS, 0.35-2.6µm, 1x resol.
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BOREA08	USGS 498	lichen+weathered surface, IS, 0.35-2.6µm, 1x resol.
BOREA08	USGS 510	interior surface, IS, 0.35-2.6µm, 1x resol.
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BOREA09	USGS 526	weathered surface, IS, 0.35-2.6µm, 1x resol.
BOREA09	USGS 538	lichen+weathered surface, IS, 0.35-2.6µm, 1x resol.
BOREA09	USGS 550	interior surface, IS, 0.35-2.6µm, 1x resol.
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BOREA10	USGS 562	lichen, IS, 0.35-2.6µm, 1x resol.
BOREA10	USGS 610	interior surface, IS, 0.35-2.6µm, 1x resol.
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BOREA11	USGS 622	interior surface, IS, 0.35-2.6µm, 1x resol.
BOREA11	USGS 634	weathered surface, IS, 0.35-2.6µm, 1x resol.
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BOREA13	USGS 646	interior surface, IS, 0.35-2.6µm, 1x resol.
BOREA13	USGS 658	weathered surface, IS, 0.35-2.6µm, 1x resol.

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17.3.2d. Churchill, Manitoba area samples

S001a	PSF 100910a.001	whole rock: black lichen; 0.35-2.5 µm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S001b	PSF 100910a.002	whole rock: green lichen; 0.35-2.5 µm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S001c	PSF 100910a.003	whole rock: orange lichen; 0.35-2.5 µm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S001d	PSF 100910a.004	whole rock: white-gray lichen; 0.35-2.5 µm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S001e	PSF 100910a.005	whole rock: bare rock; 0.35-2.5 µm; i=30°, e=0°; 1 nm output; ASD, 1000

		spectra averaged [Directory: 100910_church1].
S001f	PSF 100910a.006	whole rock: bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S001g	PSF 100930a.006	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S002a	PSF 100910a.007	whole rock: orange lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S002b	PSF 100910a.008	whole rock: bare rock/white lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S002c	PSF 100930a.007	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S003a	PSF 100910a.009	whole rock: green/black lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S003b	PSF 100910a.010	whole rock: bare rock (quartz); 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S003c	PSF 100910a.011	whole rock: bare rock (quartz); 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S003d	PSF 100910a.012	whole rock: bare rock (granite); 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S003e	PSF 100910a.013	whole rock: bare rock (granite); 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S003f	PSF 100930a.008	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S004a	PSF 100910a.014	whole rock: orange lichen/bare quartz); 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S004b	PSF 100910a.015	whole rock: sparse orange lichen/bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S004c	PSF 100910a.016	whole rock: bare rock with sparse black lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S004d	PSF 100910a.017	whole rock: white quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S004e	PSF 100910a.018	whole rock: white quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100910_church1].
S004f	PSF 100930a.009	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
++++++		
S005a	PSF 100913a.022	whole rock: sparse black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S005b	PSF 100913a.023	whole rock: coarse black foliose/shiny rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S005c	PSF 100913a.024	whole rock: green lichen/quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S005d	PSF 100913a.025	whole rock: bare quartz - side; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S005e	PSF 100913a.026	whole rock: bare quartz - side; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S005f	PSF 100930a.010	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S006a	PSF 100913a.027	whole rock: orange lichen - side; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S006b	PSF 100913a.028	whole rock: orange lichen - side; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].

S006c	PSF 100913a.029	whole rock: orange-brown lichen - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S006d	PSF 100913a.030	whole rock: black/gray crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S006e	PSF 100913a.031	whole rock: bare quartz - side; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S006f	PSF 100930a.011	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S007a	PSF 100913a.032	whole rock: orange lichen - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S007b	PSF 100913a.033	whole rock: orange lichen - side; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S007c	PSF 100913a.034	whole rock: bare granite - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S007d	PSF 100913a.035	whole rock: bare granite - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S007e	PSF 100930a.012	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S008a	PSF 100913a.036	whole rock: orange lichen - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S008b	PSF 100913a.037	whole rock: gray lichen - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S008c	PSF 100913a.038	whole rock: gray lichen - side; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S008d	PSF 100913a.039	whole rock: bare granite with sparse orange lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S008e	PSF 100930a.013	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S009a	PSF 100913a.040	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S009b	PSF 100913a.041	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S009c	PSF 100913a.042	whole rock: bare granite with sparse orange lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S009d	PSF 100913a.043	whole rock: bare granite with sparse black lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S009e	PSF 100913a.044	whole rock: bare granite with sparse black lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S009e	PSF 100913a.045	whole rock: bare granite - side; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S009f	PSF 100930a.014	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S010a	PSF 100913a.046	whole rock: black flaky - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S010b	PSF 100913a.047	whole rock: black flaky - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S010c	PSF 100913a.048	whole rock: black flaky - top; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].

S010d	PSF 100913a.049	whole rock: black foliose with granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S010e	PSF 100913a.050	whole rock: bare quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S010f	PSF 100930a.015	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
++++++		
S011a	PSF 100913a.051	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S011b	PSF 100913a.052	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S011c	PSF 100913a.053	whole rock: bare quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S011d	PSF 100913a.054	whole rock: bare quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100913_church1].
S011e	PSF 100930a.016	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
++++++		
S012a	PSF 100914a.058	whole rock: black-green crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S012b	PSF 100914a.059	whole rock: black-green crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S012c	PSF 100914a.060	whole rock: black-gray crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S012d	PSF 100914a.061	whole rock: black-gray crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S012e	PSF 100914a.062	whole rock: granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S012e	PSF 100914a.063	whole rock: granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S012f	PSF 100930a.017	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
++++++		
S013a	PSF 100914a.064	whole rock: orange lichen with some granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S013b	PSF 100914a.065	whole rock: orange-brown lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S013c	PSF 100914a.066	whole rock: granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S013d	PSF 100914a.067	whole rock: granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S013e	PSF 100930a.018	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
++++++		
S014a	PSF 100914a.068	whole rock: granite with orange lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S014b	PSF 100914a.069	whole rock: granite with orange lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S014c	PSF 100914a.070	whole rock: granite with gray lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S014d	PSF 100914a.071	whole rock: granite with gray lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S014e	PSF 100930a.019	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S015a	PSF 100914a.072	whole rock: orange lichen on shiny black; 0.35-2.5 μm; i=30°, e=0°; 1 nm

		output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S015b	PSF 100914a.073	whole rock: orange lichen on quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S015c	PSF 100914a.074	whole rock: black shiny rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S015d	PSF 100914a.075	whole rock: black shiny rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S015e	PSF 100930a.020	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
++++++		
S016a	PSF 100914a.076	whole rock: orange lichen/altered quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S016b	PSF 100914a.077	whole rock: orange lichen/altered quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S016c	PSF 100914a.078	whole rock: gray lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S016d	PSF 100914a.079	whole rock: altered quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S016e	PSF 100914a.080	whole rock: altered quartz; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100914_church1].
S016f	PSF 100930a.021	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
++++++		
S017a	PSF 100920a.001	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S017b	PSF 100920a.002	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S017c	PSF 100920a.003	whole rock: orange/black on granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S017d	PSF 100920a.004	whole rock: orange/black on granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S017e	PSF 100920a.005	whole rock: bare granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S017f	PSF 100930a.022	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S018a	PSF 100920a.006	whole rock: green crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S018b	PSF 100920a.007	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S018c	PSF 100920a.008	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S018d	PSF 100920a.009	whole rock: bare granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S018e	PSF 100930a.023	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S019a	PSF 100920a.010	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S019b	PSF 100920a.011	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S019c	PSF 100920a.012	whole rock: bare granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S019d	PSF 100920a.013	whole rock: bare granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S019e	PSF 100920a.014	whole rock: orange on granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output;

		ASD, 1000 spectra averaged [Directory: 100920_church1].
S019f	PSF 100930a.024	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S020a	PSF 100920a.015	whole rock: orange on granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S020b	PSF 100920a.016	whole rock: orange on granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S020c	PSF 100920a.017	whole rock: orange on granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S020d	PSF 100920a.018	whole rock: bare granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S020e	PSF 100930a.025	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S021a	PSF 100920a.019	whole rock: orange on bare granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S021b	PSF 100920a.020	whole rock: orange on bare granite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S021c	PSF 100920a.021	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S021d	PSF 100920a.022	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S021e	PSF 100920a.023	whole rock: black crustose or gray foliose lichen? – duplicate or mislabelled spectrum; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100920_church1].
S021g	PSF 100930a.026	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S022a	PSF 100921a.001	whole rock: black-yellow lichen on dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S022b	PSF 100921a.002	whole rock: black-yellow lichen on dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S022c	PSF 100921a.003	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S022d	PSF 100921a.004	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S022e	PSF 100921a.005	whole rock: bare dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S022f	PSF 100930a.027	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S023a	PSF 100921a.006	whole rock: yellow crustose lichen on dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S023b	PSF 100921a.007	whole rock: yellow crustose lichen on dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S023c	PSF 100921a.008	whole rock: black-yellow lichen on dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S023d	PSF 100921a.009	whole rock: black-yellow on dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S023e	PSF 100921a.010	whole rock: bare dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S023f	PSF 100921a.011	whole rock: bare dolomite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].

S023g	PSF 100930a.028	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S024a	PSF 100921a.012	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S024b	PSF 100921a.013	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S024c	PSF 100930a.029	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S025a	PSF 100921a.014	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S025b	PSF 100921a.015	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S025c	PSF 100921a.016	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S025d	PSF 100921a.017	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S025e	PSF 100921a.018	whole rock: bare granite + small crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S025f	PSF 100921a.019	whole rock: bare granite + small crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S025g	PSF 100930a.030	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S026a	PSF 100921a.020	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S026b	PSF 100921a.021	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S026c	PSF 100921a.022	whole rock: orange crustose lichen on bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S026d	PSF 100921a.023	whole rock: orange crustose lichen on bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S026e	PSF 100921a.024	whole rock: bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S026f	PSF 100930a.031	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S027a	PSF 100921a.025	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S027b	PSF 100921a.026	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S027c	PSF 100921a.027	whole rock: bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S027d	PSF 100921a.028	whole rock: bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S027e	PSF 100930a.032	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S028a	PSF 100921a.029	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S028b	PSF 100921a.030	whole rock: gray foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output;

		ASD, 1000 spectra averaged [Directory: 100921_church1].
S028c	PSF 100921a.031	whole rock: bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S028d	PSF 100921a.032	whole rock: bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S028e	PSF 100930a.033	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S029a	PSF 100921a.033	whole rock: green/black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S029b	PSF 100921a.034	whole rock: green/black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S029c	PSF 100921a.035	whole rock: bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S029d	PSF 100921a.036	whole rock: bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100921_church1].
S029e	PSF 100930a.034	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S030a	PSF 100922a.001	whole rock: orange lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S030b	PSF 100922a.002	whole rock: orange lichen/bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S030c	PSF 100922a.003	whole rock: green/black lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S030d	PSF 100922a.004	whole rock: bare schist (dark); 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S030e	PSF 100922a.005	whole rock: bare schist (light); 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S030f	PSF 100930a.035	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S031a	PSF 100922a.006	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S031b	PSF 100922a.007	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S031c	PSF 100922a.008	whole rock: orange crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S031d	PSF 100922a.009	whole rock: orange crustose lichen on schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S031e	PSF 100922a.010	whole rock: green/black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S031f	PSF 100922a.011	whole rock: green/black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S031g	PSF 100922a.012	whole rock: bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S031h	PSF 100922a.013	whole rock: bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S031i	PSF 100930a.036	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S032a	PSF 100922a.014	whole rock: black/green crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032b	PSF 100922a.015	whole rock: black/green crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032c	PSF 100922a.016	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output;

		ASD, 1000 spectra averaged [Directory: 100922_church1].
S032d	PSF 100922a.017	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032e	PSF 100922a.018	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032f	PSF 100922a.019	whole rock: black foliose lichen on rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032g	PSF 100922a.020	whole rock: orange crustose lichen on rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032h	PSF 100922a.021	whole rock: orange crustose lichen on rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032i	PSF 100922a.022	whole rock: bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032j	PSF 100922a.023	whole rock: bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S032k	PSF 100930a.037	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S033a	PSF 100922a.024	whole rock: orange crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S033b	PSF 100922a.025	whole rock: orange crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S033c	PSF 100922a.026	whole rock: green/black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S033d	PSF 100922a.027	whole rock: green/black crustose lichen on quartzite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S033e	PSF 100922a.028	whole rock: black foliose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S033f	PSF 100922a.029	whole rock: black crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S033g	PSF 100922a.030	whole rock: bare quartzite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S033h	PSF 100922a.031	whole rock: bare quartzite; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S033i	PSF 100930a.038	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S034a	PSF 100922a.032	whole rock: black/green crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S034b	PSF 100922a.033	whole rock: black/green crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S034c	PSF 100922a.034	whole rock: white crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S034d	PSF 100922a.035	whole rock: white crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S034e	PSF 100922a.036	whole rock: orange lichen on schist (?); 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S034f	PSF 100922a.037	whole rock: bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S034g	PSF 100922a.038	whole rock: bare schist; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100922_church1].
S034h	PSF 100930a.039	whole rock: broken interior surface; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
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S035a	PSF 100930a.001	whole rock: orange lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD,

		1000 spectra averaged [Directory: 100930_church1].
S035b	PSF 100930a.002	whole rock: orange lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
S035c	PSF 100930a.003	whole rock: black/white crustose lichen; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
S035d	PSF 100930a.004	whole rock: white crustose lichen on rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].
S035e	PSF 100930a.005	whole rock: bare rock; 0.35-2.5 μm; i=30°, e=0°; 1 nm output; ASD, 1000 spectra averaged [Directory: 100930_church1].

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17.3.3d. Spectral data: Churchill – ground ice, permafrost and peat samples

(i) iRaman reflectance spectra: 174-4004 cm^{-1} spectral range; 532 nm laser; 3 cm^{-1} spectral resolution; integration times were varied to improve SNR.

Hole, sample ID	*Spectral file*	*Spectra description (also see above)*
Swab	140829alcoholswab	Isopropyl alcohol-infused cotton swab; 2000 msec integration time [Directory: TEST_R32].
Aluminum	140829aluminumboat	Aluminum sample boat; 2000 msec integration time [Directory: TEST_R32].
1, 1-1	140829hole1-1	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
1, 1-1	140829hole1-1b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
1, 1-2	140829hole1-2	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
1, 1-2	140829hole1-2b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
2, 2-1	140829hole2-1	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
2, 2-1	140829hole2-1b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
2, 2-2	140829hole2-2	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
2, 2-2	140829hole2-2b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
2, 2-3	140829hole2-3	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
2, 2-3	140829hole2-3b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
3, 3-1	140829hole3-1	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
3, 3-1	140829hole3-1b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
3, 3-2	140829hole3-2	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
3, 3-2	140829hole3-2b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-1	140829hole4-1	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-1	140829hole4-1b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-2	140829hole4-2	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-2	140829hole4-2b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-3	140829hole4-3	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-3	140829hole4-3b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-4	140829hole4-4	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-4	140829hole4-4b	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-5	140829hole4-5	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-5	140829hole4-5b	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-5	140829hole4-5bint1000	Side B; whole rock; 1000 msec integration time [Directory: TEST_R32].
4, 4-6	140829hole4-6b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
4, 4-6	140829hole4-6int500	Side B; whole rock; 500 msec integration time [Directory: TEST_R32].
5, 5-1	140829hole5-1	Side A; whole rock; 2000 msec integration time [Directory: TEST_R32].
5, 5-1	140829hole5-1b	Side B; whole rock; 2000 msec integration time [Directory: TEST_R32].
5, 5-2	140829hole5-2	Side A; whole rock; 10,000 msec integration time [Directory: TEST_R32].
5, 5-2	140829hole5-2b	Side B; whole rock; 20,000 msec integration time [Directory: TEST_R32].

6, 6-1	140829hole6-1	Side A; whole rock; 20,000 msec integration time [Directory: TEST_R32].
6, 6-1	140829hole6-1b	Side B; whole rock; 20,000 msec integration time [Directory: TEST_R32].
6, 6-2	140829hole6-2	Side A; whole rock; 20,000 msec integration time [Directory: TEST_R32].
6, 6-2	140829hole6-2b	Side B; whole rock; 20,000 msec integration time [Directory: TEST_R32].
6, 6-3	140829hole6-3	Side A; whole rock; 20,000 msec integration time [Directory: TEST_R32].
6, 6-3	140829hole6-3b	Side B; whole rock; 20,000 msec integration time [Directory: TEST_R32].
7, 7-1	140829hole7-1	Whole rock; 5000 msec integration time [Directory: TEST_R32].
8, 8-1	140829hole8-1	Whole rock; 10,000 msec integration time [Directory: TEST_R32].
8, 8-2	140829hole8-2	Whole rock; 20,000 msec integration time [Directory: TEST_R32].
Leaf1	140829leafbrightgreen	Upper side of leaf; 500 msec integration time [Directory: TEST_R32].
Leaf1	140829leafdullgreen	Underside of leaf; 500 msec integration time [Directory: TEST_R32].
Limestone	140829limestone	Whole rock limestone cobble; 2000 msec integration time [Directory: TEST_R32].
Moss1	140829mossbrownsandy	Underside of moss patch; 2000 msec integration time [Directory: TEST_R32].
Moss1	140829mossgreenside	Upper surface of moss patch; 2000 msec integration time [Directory: TEST_R32].
Polystyrene	140829polyinaldish#2	Polystyrene block in aluminum sample boat; 5000 msec integration time [Directory: TEST_R32].
Sugar	140829sugar	Unsorted p[owder; 2000 msec integration time [Directory: TEST_R32].
Sugar Twin	140829twinsugar	Unsorted powder; 2000 msec integration time [Directory: TEST_R32].

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(ii) Maya UV-induced fluorescence spectra. Samples illuminated with 365 nm UV lamp; i=30°, e=0° viewing geometry; 200-1133 nm range; ~0.45 nm spectral resolution.

Hole, sample ID	*Spectral file*	*Spectra description (also see above)*
Sugar	140829-granulatedsugar	Unsorted powder.
Leaf1	140829-leaves	Whole leaf, bright green upper side.
Moss1	140829-moss	Upper surface of moss patch.
Moss1	140829-u-moss	Underside of moss patch.
Swab	140829-swab	Isopropyl alcohol-infused cotton swab.
Aluminum boat	140829-aluminumboat	Aluminum sample boat.
Coffee Mate	140829-coffeemate	Unsorted powder.
Sugar Twin	140829-sugartwin	Unsorted powder.
1, 1-1	hole1.1.side1	Side A; whole rock.
1, 1-1	hole1.1.side2	Side B; whole rock.
1, 1-2	hole1.2.a	Side A; whole rock.
1, 1-2	hole1.2.b	Side B; whole rock.
2, 2-1	hole2.1.a	Side A; whole rock.
2, 2-1	hole2.1.b	Side B; whole rock.
2, 2-2	hole2.2.a	Side A; whole rock.
2, 2-2	hole2.2.b	Side B; whole rock.
2, 2-3	hole2.3.a	Side A; whole rock.
2, 2-3	hole2.3.b	Side B; whole rock.
3, 3-1	hole3.1.a	Side A; whole rock.
3, 3-1	hole3.1.b	Side B; whole rock.
3, 3-2	hole3.2.a	Side A; whole rock.
3, 3-2	hole3.2.b	Side B; whole rock.
4, 4-1	hole4.1.a	Side A; whole rock.

4, 4-1	hole4.1.b	Side B; whole rock.
4, 4-2	hole4.2.a	Side A; whole rock.
4, 4-2	hole4.2.b	Side B; whole rock.
4, 4-3	hole4.3.a	Side A; whole rock.
4, 4-3	hole4.3.b	Side B; whole rock.
4, 4-4	hole4.4.a	Side A; whole rock.
4, 4-4	hole4.4.b	Side B; whole rock.
4, 4-5	hole4.5.a	Side A; whole rock.
4, 4-5	hole4.5.b	Side B; whole rock.
4, 4-6	hole4.6.a	Side A; whole rock.
4, 4-6	hole4.6.b	Side B; whole rock.
5, 5-1	hole5.1.a	Side A; whole rock.
5, 5-1	hole5.1.b	Side B; whole rock.
5, 5-2	hole5.2.a	Side A; whole rock.
5, 5-2	hole5.2.b	Side B; whole rock.
6, 6-1	hole6.1.a	Side A; whole rock.
6, 6-1	hole6.1.b	Side B; whole rock.
6, 6-2	hole6.2.a	Side A; whole rock.
6, 6-2	hole6.2.b	Side B; whole rock.
6, 6-3	hole6.3.a	Side A; whole rock.
6, 6-3	hole6.3.b	Side B; whole rock.
7, 7-1	hole7.1	Whole rock.
8, 8-1	hole8.1	Whole rock.
8, 8-2	hole8.2	Whole rock.

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17.4d. Spectral Data - Thompson, Manitoba: Lichens on rocks and trees

Each sample listed above shot with ASD after 1 week of air drying of sample. Spectra shot from0.35-2.5 μm, 1 nm output, with ASD, directory 111027_lichen)

(i) Spectral Data - Lichens on rocks

Site	Sample ID	PSF Spectral file (ASD)
(up wind)	L6	111025b.019
(1)	L10	111025b.025
(2)	L16	111025b.040
(3)	L1a	111027a.001
(3)	L1b	111027a.002
(3)	L1c	111027a.003
(3)	L1d	110127a.004
(3)	L14	111025b.039
(4)	L12a	111025b.029
(4)	L12b	111025b.030
(4)	L12c	111025b.031
(4)	L12d	110125b.032
(4)	L12e	110125b.033
(4)	L12f	111025b.034
(4)	L12g	111025b.035
(5)	L15	111025b.041
(6)	L11a	110125b.026
(6)	L11b	110125b.027
(6)	L11c	110125b.028

(ii) Spectral Data - Lichens on trees

Site	Sample ID	PSF Spectral file (ASD)
(up wind)	L6	111025b.018
(1)	L9a	111025b.023
(1)	L9b	110125b.024
(2)	L8	111025b.022
(3)	L2a	111027a.005
(3)	L2b	111027a.006
(3)	L2c	111027a.008
(4)	L7a	111025b.020
(4)	L7b	111025a.021
(5)	L17a	111025b.042
(5)	L17b	111025b.043
(6)	L13a	111025b.036
(6)	L13b	111025b.037
(6)	L13c	111025b.038
(7)	L3a	111027a.009
(7)	L3b	111027a.010
(8)	L5	111025b.017
(9)	L4a	111025b.013
(9)	L4b	111025b.014
(9)	L4c	111025b.015
(9)	L4d	111025b.016

Note: *Digital spectra of lichens from previous investigators are also available: Gauslaa, Leckie, Rollin, and Steiner and Guterman.*

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17.5d. Spectral Data - Serpentinites from the Royal Ontario Museum

M16397-10s	PSF 130627a.001	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
M16397-35-55s	PSF 130627a.002	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
M16397-75-13s	PSF 130627a.003	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
M16397-125-180s	PSF 130627a.004	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
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W68-35 – 25s	PSF 130627a.005	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
W68-35 – 25-50s	PSF 130627a.006	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
W68-35 – 50-155s	PSF 130627a.007	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
W68-35 – 125-230s	PSF 130627a.008	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
W68-35 – 150-255s	PSF 130627a.009	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
++++++		
M6394 – 10s	PSF 130627a.010	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
M6394 – 15s	PSF 130627a.011	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).
M6394 – 35s	PSF 130627a.012	unsorted, milled; i=30°, e=0°; 350-2500 nm; 1 nm output; 200 spectra averaged; ASD 9Directory: SerpROM).

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17.7d. Archival lichen spectra – previous investigators – digital spectra

17.7.1a. Gauslaa (1984)

400-1400 nm; 10-100 nm spectral resolution; 24 species, wet and dry, 3 samples of each species.
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17.7.2a. Leckie et al. (1988, 1989)

(a) 402-1097 nm, 5 nm resolution; integrating sphere.
(b) 302-1097 nm, 5 nm resolution; integrating sphere.
(c) 300-1100 nm, 1 nm resolution; integrating sphere.
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17.7.3a. Rollin et al. (1994)

401-2493 nm; 4 nm spectral resolution; GER IRIS biconical; i=45°, e=0°.
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17.7.4a. Steiner and Guterman (1966)

510-830 or 430-830 nm (variable); 20 nm resolution.
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END of 17.

18. Organics

18.1. Coals

18.1a. Coals - Sample Descriptions

FORMAT: *Sample No., [ISPG Sample No.] Rank, (source and original sample I.D.), locality (area/mine) [seam].*

Sample ID	*Description*
COAL01	Frank Slide area, Alberta (self collected), <37µm fraction.
COAL02	Frank Slide area, Alberta (self collected), <500µm fraction.
COAL03	Frank Slide area, Alberta (self collected), 500-1000µm fraction.
COAL10	[10] Lignite: (ISPG #597/88) Bienfait, SK [Estevan seam].
COAL11	[8] Lignite: (ISPG #601/88) Costello, SK [Estevan seam].
COAL12	[15] Sub-bituminous: (ISPG #581/88) Highvale, AB.
COAL13	[17] High Volatility C Bituminous: (ISPG #587/88) Coal Valley, AB [Mynheer/Val D'Or seam].
COAL14	[18] High Volatility C/B Bituminous: (ISPG #914/88) Quinsam, BC [No. 1 seam].
COAL15	[19] High Volatility C/B Bituminous: (ISPG #917/88) Prince Mine, NS [Hub seam].
COAL16	[24] High Volatility A Bituminous: (ISPG #99/89) Phalen Mine, NS [Phalen, raw coal].
COAL17	[25] High Volatility A Bituminous: (ISPG #97/89) Phalen/Lingan Mine, NS [Phalen/Harbour seam].
COAL18	[30] High Volatility A - Medium Volatility Bituminous: (ISPG #577/88) Byron Creek, BC.
COAL19	[??] Medium Volatility Bituminous: (ISPG #579/88) Quintette.
COAL20	[36] Medium Volatility Bituminous: (ISPG #605/88) Line Creek, BC.
COAL21	[41] Low Volatility Bituminous: (ISPG #589/88) Smoky River Coalfield, AB [No. 4 seam].
COAL22	[??] Anthracite: (ISPG #103/89) Mt. Klappan.
COAL30	Lignite; Beulah Zap seam, North Dakota; APCS #8.
COAL31	Subbituminous; Wyodak-Anderson seam, Wyoming; APCS #2.
COAL32	High volatility bituminous; Illinois #6 seam, Illinois, APCS #3.
COAL33	High volatility bituminous; Blind Canyon seam, Utah; APCS #6.
COAL34	High volatility bituminous; Lewiston-Stockton seam, West Virginia; APCS #7.
COAL35	High volatility bituminous; Pittsburgh #8 seam, Pennsylvania; APCS #4.
COAL36	Medium volatility bituminous; Upper Freeport seam, Pennsylvania; APCS #1.
COAL37	Low volatility bituminous; Pocahontas #3 seam, Virginia; APCS #5.
COAL38	Elk Valley, BC, Canada coal pile by side of TransCanada Highway between Frank and Sparwood; collected July 27, 2007.
COAL39	Low-sulphur sub-bituminous coal from central Alberta, Canada; 30 pieces from The Coal Association of Canada.
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C19Bk0	COAL19 unbaked, <45µm fraction.
C19Bk1	COAL19 baked for 1 hour at 450°C (<45µm fraction) [29.95% mass loss].
C19Bk2	COAL19 baked for 2 hours at 450°C (<45µm fraction) [40.16% mass loss].
C19Bk4	COAL19 baked for 4 hours at 450°C (<45µm fraction) [58.67% mass loss].
C19Bk6	COAL19 baked for 6 hours at 450°C (<45µm fraction) [77.50% mass loss].
C19Bk24	COAL19 baked for 24 hours at 410°C (<45µm fraction) [85.17% mass loss].
C19Bk72	COAL19 baked for 72 hours at 450°C (<45µm fraction) [89.46% mass loss].

NOTES:

COAL01, COAL02 and COAL03 are all from the same sample but crushed to different grain sizes.

COAL10 - COAL22 are part of a coal gasification study; some data in Furimsky et al. (1990) and Kalkreuth et al. (1991).

COAL01: Coal from Frank, Alberta- Medium-high volatility bituminous(references: "Alberta Coal"; Patching et al. 1980; Tibbetts 1976). Analyses for coal from Coleman used.

COALS 30-37 are from the Argonne Premium Coal Sample Program (APCS).

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18.1b. XRD Data - Coals

18.1b.1. Analogue XRD files from U of A instrument

Sample	XRD File	Sample	XRD File	Sample	XRD File
COAL01	Z04686	COAL10	Z04860	COAL11	Z04858
COAL12	Z04849	COAL13	Z04854	COAL14	Z04856
COAL15	Z04848	COAL16	Z04847	COAL17	Z04853
COAL18	Z04851	COAL19	Z04852	COAL20	Z04859
COAL21	Z04855	COAL22	Z04850		

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18.1b.2. Coals – NMR Files Available

COAL10

NMR spectrum measured at University of Winnipeg.

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18.1c. Compositional Data - Coals (Part 1)

Sample		Structural Groups (%)				I.R. Spectroscopy		
		Aliphatic		Aromatic		A-factor	C-factor	W_{min}
	f_a (C_q+CH/100)	CH_3	CH/CH_2 (C-O-C, R-OH)	C_q (C=O)	CH			(cm^{-1})
COAL10	0.60	6	34	29(3)	31	0.32	0.48	1613
COAL11	0.58	5	37	26(3)	32	0.31	0.49	1616
COAL12	0.63	10	27	29(2)	34	0.22	0.48	1606
COAL13	0.66	8	26	37	29	0.37	0.35	1607
COAL14	0.63	17	20	34	29	0.36	0.26	1604
COAL15	0.67	9	24	37	30	--	--	--
COAL16	0.69	6	25	39	30	0.37	0.15	1602
COAL17	0.70	8	22	44	26	0.33	0.16	1604
COAL18	0.79	6	15	43	36	0.36	0.21	1598
COAL19	??	??	??	??	??	??	??	??
COAL20	0.76	7	17	40	36	0.33	0.23	1595
COAL21	0.81	4	15	39	42	0.39	0.19	1595
COAL22	??	??	??	??	??	??	??	??

Notes:

f_a = aromaticity factor (signal intensities of protonated and nonprotonated aromatic carbon relative to total carbon from ^{13}C n.m.r. spectroscopy)

Structural group abundances determined from ^{13}C n.m.r. spectroscopy

I.R. Spectroscopy:

A-factor = $(2930+2860 cm^{-1})/(2930+2860+1630 cm^{-1})$, a measure of relative intensities of aliphatic groups (CH_2 and CH_3) versus aromatic C=C) bands.

C-factor = $(1710 cm^{-1})/(1710+1630 cm^{-1})$, a measure of the relative amounts of carboxyl and carbonyl groups versus aromatic (C=C) bands.

W_{min} = position of the C=C band (shifts with increasing rank levels to lower wavelength numbers.

Analyses from Kalkreuth *et al.* (1991).

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18.1c. Compositional Data - Coals (Part 2)

Elemental Compositions (from University of Alberta)

Weight % elements in toluene-soluble fraction.

	Elements (weight percent)					Total	Ratios	
Sample	N	C	H	S	O[1]	N+C+H+S	H/C	O/C
COAL10	0.267	77.836	10.778	0.000	11.119	88.881	1.650	0.107
COAL11	0.246	77.671	10.220	1.897	9.966	90.034	1.568	0.096
COAL14	0.477	79.231	8.202	0.640	11.450	88.550	1.233	0.108
COAL17	0.820	67.717	6.661	12.451	12.351	87.649	1.172	0.137
COAL18	0.777	82.109	6.592	0.000	10.522	89.478	0.957	0.096
COAL19	0.705	81.996	7.794	1.040	8.465	91.535	1.133	0.077
COAL20	0.895	74.916	7.159	0.000	17.030	82.970	1.139	0.171

1. Oxygen by difference.

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18.1c. Compositional Data - Coals (Part 3)

	COAL01	COAL10	COAL11	COAL12	COAL13
Vitrinite Reflectance (%)	n.d.	0.33[5]	0.27[6]	0.44[5]	0.61[6]
VITRINITE					
Texto-ulminite	n.d.	16	15	5	5
Eu-ulminite/Vitrinite A[1]	n.d.	25	25	35	33
Corpocollinite A[2]	n.d.	7	5	3	1
Corpocollinite B[3]	n.d.	1			
Densinite/Vitrinite B[4]	n.d.	31	33	24	32
Vitrodetrinite					
TOTAL VITRINITE	n.d.	80	78	67	71
INERTINITE					
Semifusinite	n.d.	6	9	12	9
Fusinite	n.d.	5	6	6	8
Macrinite	n.d.			<1	<1
Micrinite	n.d.			<1	
Inertodetrinite	n.d.	5	5	12	7
TOTAL INERTINITE	n.d.	16	20	30	24
LIPTINITE					
Sporinite	n.d.	3	2	2	4
Cutinite	n.d.	<1		<1	
Resinite (in situ)	n.d.	<1		1	1
Resinite (detrital)	n.d.				<1
Suberinite	n.d.	1			<1
Liptodetrinite	n.d.				
TOTAL LIPTINITE	n.d.	4	2	3	5

1. Eu-ulminite in coals with reflectance <0.60%
   Vitrinite A in coals with reflectance >0.60%
2. Corpocollinite in eu-ulminite or Vitrinite A
3. Corpocollinite in densinite or vitrinite B
4. Densinite in coals with reflectance <0.60%
   Vitrinite B in coals with reflectance >0.60%
5. Random reflectance
6. Maximum reflectance

n.d. not determined

Data are for maceral analysis (volume %, mineral free basis).
Analyses from Kalkreuth *et al.* (1991).

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18.1c. Compositional Data - Coals (Part 3) (continued)

	COAL14	COAL15	COAL16	COAL17	COAL18
Vitrinite Reflectance (%)	0.70[6]	0.66[6]	0.91[6]	0.95[6]	1.11[6]
VITRINITE					
Texto-ulminite					
Eu-ulminite/Vitrinite A[1]	46	48	37	36	21
Corpocollinite A[2]					
Corpocollinite B[3]					
Densinite/Vitrinite B[4]	36	35	43	43	32
Vitrodetrinite			1		
TOTAL VITRINITE	82	83	81	79	53
INERTINITE					
Semifusinite	5	4	5	3	23
Fusinite	3	4	4	5	6
Macrinite			1	1	2
Micrinite			2	2	1
Inertodetrinite	4	3	2	4	12
TOTAL INERTINITE	13	12	14	15	44
LIPTINITE					
Sporinite	4	5	5	5	2
Cutinite				1	
Resinite (in situ)	1				1
Resinite (detrital)					
Suberinite					
Liptodetrinite					
TOTAL LIPTINITE	5	5	5	6	3

1. Eu-ulminite in coals with reflectance <0.60%
   Vitrinite A in coals with reflectance >0.60%
2. Corpocollinite in eu-ulminite or Vitrinite A
3. Corpocollinite in densinite or vitrinite B
4. Densinite in coals with reflectance <0.60%
   Vitrinite B in coals with reflectance >0.60%
5. Random reflectance
6. Maximum reflectance

Data are for maceral analysis (volume %, mineral free basis).
Analyses from Kalkreuth *et al.* (1991).
++

18.1c. Compositional Data - Coals (Part 3) (continued)

	COAL19	COAL20	COAL21	COAL22
Vitrinite Reflectance (%)	1.16[6]	1.33[6]	1.65[6]	3.95[6]
VITRINITE				
Texto-ulminite				
Eu-ulminite/Vitrinite A[1]	33	26	38	47
Corpocollinite A[2]				
Corpocollinite B[3]				
Densinite/Vitrinite B[4]	29	24	34	25
Vitrodetrinite	1	3		
TOTAL VITRINITE	63	53	72	72
INERTINITE				
Semifusinite	11	24	13	20
Fusinite	9	8	7	7
Macrinite	2	2	<1	
Micrinite	<1			
Inertodetrinite	13	13	8	1
TOTAL INERTINITE	35	47	28	28
LIPTINITE				
Sporinite	2			
Cutinite				
Resinite (in situ)				
Resinite (detrital)				
Suberinite				
Liptodetrinite				
TOTAL LIPTINITE	2	0	0	0

1. Eu-ulminite in coals with reflectance <0.60%
   Vitrinite A in coals with reflectance >0.60%
2. Corpocollinite in eu-ulminite or Vitrinite A
3. Corpocollinite in densinite or vitrinite B
4. Densinite in coals with reflectance <0.60%
   Vitrinite B in coals with reflectance >0.60%

Analyses from Kalkreuth *et al.* (1991).

++

18.1c. Compositional Data - Coals (Part 4)

	COAL01	COAL10	COAL11	COAL12	COAL13
Proximate Analysis (Wt.%)					
Moisture	1.2-5.4	25.2	26.4	12.1	6.1
Ash	11.5-12.0 (~15)	10.2	8.6	9.5	10.5
Volatiles	24.1-26 (~31)	29.6	30.6	32.0	33.7
Fixed Carbon	59.1-61.4 (~69-70)	35.0	34.3	46.4	49.7
Fuel Ratio	n.d.	1.18	1.12	1.45	1.47
Ultimate Analysis (d.b.) (Wt.%)					
C	76.7-77.3	61.9	64.1	66.1	69.7
H	4.3	4.1	4.4	4.0	4.1
N	1.3	1.0	1.1	1.1	1.1
S	0.4-0.5	0.42	0.71	0.05	0.19
O[1]	5.1-5.3	18.9	18.0	18.0	13.7
H/C ratio	n.d.	0.80	0.82	0.73	0.71
Maceral Data[2]					
Vitrinite/huminite[3]	n.d.	80	78	67	71
Petrofactor	n.d.	3.8	3.3	5.9	7.7
Ash Data					
SiO_2	52%				
Al_2O_3	33%				
Fe,Ti,P,Ca,Mg,SO_3,Na,K	<3% each				

	COAL14	COAL15	COAL16	COAL17	COAL18
Proximate Analysis (Wt.%)					
Moisture	n.d.	n.d.	1.5	0.8	1.0
Ash	n.d.	n.d.	28.5	24.1	11.0
Volatiles	n.d.	n.d.	26.4	29.5	24.5
Fixed Carbon	n.d.	n.d.	43.5	45.6	63.5
Fuel Ratio	n.d.	n.d.	1.65	1.55	2.59
Ultimate Analysis (d.b.) (Wt.%)					
C	n.d.	n.d.	58.6	63.2	77.2
H	n.d.	n.d.	3.8	4.1	4.0
N	n.d.	n.d.	1.2	1.3	1.2
S	n.d.	n.d.	2.07	1.89	0.2
O[1]	n.d.	n.d.	5.4	5.2	6.2
H/C ratio	n.d.	n.d.	0.78	0.78	0.62
Maceral Data[2]					
Vitrinite/huminite[3]	n.d.	n.d.	81	79	53
Petrofactor	n.d.	n.d.	10.4	11.0	17.4

[1] by difference
[2] Maceral data in volume percent, mineral-matter free.
[3] Huminite applies for coals with reflectance <0.60; vitrinite >0.60.
[4] For coal from Coleman (near Frank, AB)
n.d. not determined
Analyses from Kalkreuth *et al.* (1991).
++

18.1c. Compositional Data - Coals (Part 4) (continued)

	COAL19	COAL20	COAL21	COAL22
Proximate Analysis (Wt.%)				
Moisture	0.4	1.0	0.5	3.1
Ash	9.6	18.4	6.7	15.6
Volatiles	22.8	20.3	17.7	6.9
Fixed Carbon	67.2	60.3	75.1	74.4
Fuel Ratio	2.90	2.97	4.24	10.8
Ultimate Analysis (d.b.) (Wt.%)				
C	80.9	71.4	84.5	77.2
H	4.0	3.8	3.9	2.2
N	1.0	1.1	1.3	1.0
S	0.4	0.33	0.35	0.42
O[1]	4.1	4.8	3.2	3.1
H/C ratio	0.59	0.65	0.55	0.34
Maceral Data[2]				
Vitrinite/huminite[3]	63	55	72	72
Petrofactor	16.9	21.8	21.6	50.3

	COAL30	COAL31	COAL32	COAL33	COAL34	COAL35	COAL36	COAL37
APCS#	8	2	3	6	7	4	1	5
Elemental[4]								
C	72.9	75.0	77.7	80.7	82.6	83.2	85.5	91.1
H	4.83	5.35	5.00	5.76	5.25	5.32	4.70	4.44
O	20.3	18.0	13.5	11.6	9.8	8.8	7.5	2.5
S	0.80	0.63	4.83	0.62	0.71	2.19	2.32	0.66
Ash	9.7	8.8	15.5	4.7	19.8	9.2	13.2	4.8
Proximate Analyses of as-received coal								
Moisture	32.2	28.1	8.0	4.6	2.42	1.65	1.1	0.7
Vol. matter	30.5	32.2	36.9	43.7	29.4	37.2	27.1	18.5
Fixed C	30.7	33.0	40.9	52.8	52.2	52.0	58.7	76.1
Ash	6.6	6.3	14.3	4.5	19.4	9.1	13.0	4.7

[1] by difference
[2] Maceral data in volume percent, mineral-matter free.
[3] Huminite applies for coals with reflectance <0.60; vitrinite >0.60.
[4] C, H, and O values are given as % and are moisture and ash-free values. Sulphur and ash are in dry %.
Data from Kalkreuth *et al.* (1991) and Argonne Premium Coal Sample program.
++

18.1d. Spectral Data - Coals

Sample	*Facility/File No.*	*Description*
COAL01	RELAB C1SC95	<37µm, 0E/15E, 0.3-2.7µm, 5nm.
COAL01	RELAB C1SC96	<500µm, 0E/15E, 0.3-2.7µm, 5nm.
COAL01	RELAB C1SC97	500-1000µm, 0E/15E, 0.3-2.7µm, 5nm.
COAL01	RELAB N2SC95	<37µm, 30E/30E, 0.9-3.2µm, ~0.3-3.9 nm (Nicolet FTIR).
COAL01	RELAB N1SC95	<37µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL10	RELAB C1CL06	<45µm, 30E/0E, 0.3-2.6µm, 5nm.
COAL10	RELAB N1CL06	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL11	RELAB C1CL07	<45µm, 30E/0E, 0.3-2.6µm, 5nm.
COAL11	RELAB N1CL07	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
COAL11E	RELAB CECL91	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
COAL11E	RELAB MACL91E	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction) (Nicolet FTIR).
++++++		
COAL12	RELAB C1CL03	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL12	RELAB N1CL03	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
COAL12E	RELAB CECL92	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
COAL12E	RELAB MACL92E	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction) (Nicolet FTIR).
++++++		
COAL13	RELAB C1CL04	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL13	RELAB N1CL04	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
COAL13E	RELAB CECL93	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
COAL13E	RELAB MACL93E	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction) (Nicolet FTIR).
++++++		
COAL14	RELAB C1CL09	<45µm, 30E/0E, 0.3-2.6µm, 5nm.
COAL14	RELAB N1CL09	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL15	RELAB C1CL10	<45µm, 30E/0E, 0.3-2.6µm, 5nm.
COAL15	RELAB N1CL10	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL16	RELAB C1CL12	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL16	RELAB N1CL12	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
COAL16E	RELAB CECL16	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
COAL16E	RELAB MACL16E	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction) (Nicolet FTIR).
	++++++COAL16 - grain size series++++++	
COAL16	RELAB cacl53	<37 µm, 30°/0°; 0.3-2.6 µm; 5 nm.
COAL16	RELAB bmr1cl053a	<37 µm; 30°/30°; 2-25 µm; 0.8-120 nm resol., Nicolet.
COAL16	RELAB bkr1cl053a	<37 µm; 30°/0°,30°; 0.3-25 µm; 5,0.6-129 nm resol. Merged RELAB+Nicolet (note change in viewing geometry).
COAL16	RELAB cbcl53	37-63 µm, 30°/0°; 0.3-2.6 µm; 5nm.
COAL16	RELAB bmr1cl053b	37-63 µm; 30°/30°; 2-25 µm; 0.8-120 nm resol., Nicolet.
COAL16	RELAB bkr1cl053b	37-63 µm; 30°/0°,30°; 0.3-25 µm; 5,0.6-129 nm resol. Merged RELAB+Nicolet (note change in viewing geometry).
COAL16	RELAB cccl53	63-125 µm, 30°/0°; 0.3-2.6 µm; 5 nm.
COAL16	RELAB bmr1cl053c	63-125 µm; 30°/30°; 2-25 µm; 0.8-120 nm resol., Nicolet.

COAL16	RELAB bkr1cl053c	63-125 µm; 30°/0°,30°; 0.3-25 µm; 5,0.6-129 nm resol. Merged RELAB+Nicolet (note change in viewing geometry).
COAL16	RELAB cdcl53	125-250 µm, 30°/0°; 0.3-2.6 µm; 5 nm.
COAL16	RELAB bmr1cl053d	125-250 µm; 30°/30°; 2-25 µm; 0.8-120 nm resol., Nicolet.
COAL16	RELAB bkr1cl053d	125-250 µm; 30°/0°,30°; 0.3-25 µm; 5,0.6-129 nm resol. Merged RELAB+Nicolet (note change in viewing geometry).
COAL16	RELAB cecl53	250-500 µm, 30°/0°; 0.3-2.6 µm; 5 nm.
COAL16	RELAB bmr1cl053e	250-500 µm; 30°/30°; 2-25 µm; 0.8-120 nm resol., Nicolet.
COAL16	RELAB bkr1cl053e	250-500 µm; 30°/0°,30°; 0.3-25 µm; 5,0.6-129 nm resol. Merged RELAB+Nicolet (note change in viewing geometry).
COAL16	RELAB cfcl53	500-1000 µm, 30°/0°; 0.3-2.6 µm; 5 nm.
COAL16	RELAB bmr1cl053f	500-1000 µm; 30°/30°; 2-25 µm; 0.8-120 nm resol., Nicolet.
COAL16	RELAB bkr1cl053f	500-1000 µm; 30°/0°,30°; 0.3-25 µm; 5,0.6-129 nm resol. Merged RELAB+Nicolet (note change in viewing geometry).
COAL16	RELAB cgcl53	1000-2000 µm, 30°/0°; 0.3-2.6 µm; 5 nm.
COAL16	RELAB bmr1cl053g	1000-2000 µm; 30°/30°; 2-25 µm; 0.8-120 nm resol., Nicolet.
COAL16	RELAB bkr1cl053g	1000-2000 µm; 30°/0°,30°; 0.3-25 µm; 5,0.6-129 nm resol. Merged RELAB+Nicolet (note change in viewing geometry).
++++++++++++++++++++++++++++++		
COAL17	RELAB C1CL11	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL17	RELAB N1CL11	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL18	RELAB C1CL01	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL18	RELAB N1CL01	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL19	RELAB C1CL02	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL19	RELAB N1CL02	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
	++++++COAL19 baking in air spectra++++++++++	
COAL19Bk0	RELAB c1cl42	<45µm, 30°/0°, 0.3-2.6µm, 5nm.
COAL19Bk0	RELAB lacl42	<45µm, 30°/0°,30°, 0.3-26 µm, 5/0.6-129 nm; merged RELAB + Nicolet at 2.5 µm [note different viewing geometry].
	++++++	
COAL19Bk1	RELAB c1cl43	<45µm, 30°/0°, 0.3-2.6µm, 5nm.
COAL19Bk1	RELAB lacl43	<45µm, 30°/0°,30°, 0.3-26 µm, 5/0.6-129 nm; merged RELAB + Nicolet at 2.5 µm [note different viewing geometry].
	++++++	
COAL19Bk2	RELAB c1cl44	<45µm, 30°/0°, 0.3-2.6µm, 5nm.
COAL19Bk2	RELAB lacl44	<45µm, 30°/0°,30°, 0.3-26 µm, 5/0.6-129 nm; merged RELAB + Nicolet at 2.5 µm [note different viewing geometry].
	++++++	
COAL19Bk4	RELAB c1cl45	<45µm, 30°/0°, 0.3-2.6µm, 5nm.
COAL19Bk4	RELAB lacl45	<45µm, 30°/0°,30°, 0.3-26 µm, 5/0.6-129 nm; merged RELAB + Nicolet at 2.5 µm [note different viewing geometry].
	++++++	
COAL19Bk6	RELAB c1cl46	<45µm, 30°/0°, 0.3-2.6µm, 5nm.
COAL19Bk6	RELAB lacl46	<45µm, 30°/0°,30°, 0.3-26 µm, 5/0.6-129 nm; merged RELAB + Nicolet at 2.5 µm [note different viewing geometry].
	++++++	
COAL19Bk24	RELAB c1cl47	<45µm, 30°/0°, 0.3-2.6µm, 5nm.
COAL19Bk24	RELAB lacl47	<45µm, 30°/0°,30°, 0.3-26 µm, 5/0.6-129 nm; merged RELAB + Nicolet at 2.5 µm [note different viewing geometry].
	++++++	
COAL19Bk72	RELAB c1cl48	<45µm, 30°/0°, 0.3-2.6µm, 5nm.
COAL19Bk72	RELAB lacl48	<45µm, 30°/0°,30°, 0.3-26 µm, 5/0.6-129 nm; merged RELAB + Nicolet at

2.5 µm [note different viewing geometry].

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COAL20	RELAB C1CL08	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL20	RELAB N1CL08	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
COAL20E	RELAB CECL20	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
COAL20E	RELAB MACL20E	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction) (Nicolet FTIR).
++++++		
COAL21	RELAB C1CL05	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL21	RELAB N1CL05	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
COAL21E	RELAB CECL21	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
COAL21E	RELAB MACL21E	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction) (Nicolet FTIR).
++++++		
COAL22	RELAB C1CL13	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL22	RELAB N1CL13	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
COAL22E	RELAB CECL22	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
COAL22E	RELAB MACL22E	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction) (Nicolet FTIR).
++++++		
COAL30	RELAB C1CL30	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL30	RELAB MACL30	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL31	RELAB C1CL31	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL31	RELAB MACL31	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL32	RELAB C1CL32	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL32	RELAB MACL32	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL33	RELAB C1CL33	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL33	RELAB MACL33	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL34	RELAB C1CL34	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL34	RELAB MACL34	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL35	RELAB C1CL35	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL35	RELAB MACL35	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL36	RELAB C1CL36	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL36	RELAB MACL36	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
COAL37	RELAB C1CL37	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
COAL37	RELAB MACL37	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).

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END of 18.1.

18. Organics

18.2. Athabasca Oil Sands

18.2.1. Syncrude lease samples
18.2.2. Encana cores

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18.2.1a. Sample Descriptions - Athabasca Oil Sands

A total of 18 characterized tar sand samples were acquired from various sources for the Athabasca tar sand deposit near Fort McMurray, Alberta. The samples have been labelled sequentially from TAR01 to TAR18. In addition to whole rock samples of each, sample splits were extracted with toluene using a micro-Soxhlet apparatus. The "bitumen-free" fraction was then wet sieved to obtain <45µm and >45µm fractions which have been retained. These fractions have also been subjected to X ray diffraction analysis, elemental analyses (C,H,N,S, and O (by difference)) and nuclear magnetic resonance spectroscopy (at Institute for Biodiagnostics)).

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18.2.1a and 18.2.1c. Athabasca Oil Sands – Compositions (Part 1): Grain sizes and bitumen content

SAMPLE #	*GRAIN SIZE (WT. %)*		*BITUMEN*
	<45µm	*>45µm*	*CONTENT (%)*
TAR01	99.0	0.8	0.2
TAR02	95.6	4.2	0.2
TAR03	24.5	71.7	3.8
TAR04	47.9	47.5	4.6
TAR05	95.0	4.8	0.2
TAR06	3.8	92.8	3.4
TAR07	14.3	72.7	13.0
TAR08	28.9	64.6	6.5
TAR09	5.8	84.7	9.5
TAR10	12.8	78.1	9.1
TAR11	3.9	82.9	13.2
TAR12	2.2	86.1	11.7
TAR13	2.5	84.9	12.6
TAR14	3.6	83.2	13.2
TAR15	4.3	80.6	15.1
TAR16	4.8	81.6	13.6
TAR17	3.5	80.9	15.6
TAR18	1.7	83.6	14.7

Analyses conducted at Syncrude Canada Ltd.

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18.2.1b. XRD Data - Athabasca Oil Sands

18.2.1b.1. Analogue files from U of A instrument

Sample	Fine (<45µm) Fraction	Coarse (>45µm) Fraction	Sample	Fine (<45µm) Fraction	Coarse (>45µm) Fraction
TAR01	Z03158	Z03159	TAR02	Z03160	Z03161
TAR03	Z03162	Z03163	TAR04	Z03164	Z03165
TAR05	Z03166	Z03167	TAR06	Z03168	Z03169
TAR07	Z03173	Z03174	TAR08	Z03175	Z03176
TAR09	Z03177	Z03178	TAR10	Z03179	Z03180
TAR11	Z03181	Z03182	TAR12	Z03183	Z03184
TAR13	Z03185	Z03186	TAR14	Z03187	Z03188
TAR15	Z03189	Z03190	TAR16	Z03191	Z03192
TAR17	Z03193	Z03194	TAR18	Z03195	Z03196

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18.2.1b.2. Athabasca Oil Sands – NMR Data

TAR05
TAR06
TAR07
TAR12
TAR16
TAR17

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18.2.1c. Compositional Data - Athabasca Oil Sands – (Part 2) - Elemental abundances

Analyses performed at the University of Alberta, Department of Chemistry using a light element analyzer.

Sample	*Weight percentages in toluene-soluble fractions*					*Sum*	*Atomic ratios*	
	N	*C*	*H*	*S*	*O*[1]	*(N+C+ +H+S)*	*H/C*	*O/C*
TAR01								
TAR02								
TAR03	0.438	80.481	10.269	3.729	5.083	94.917	1.520	0.047
TAR04	0.424	78.335	9.948	3.916	7.377	92.623	1.513	0.071
TAR05	0.199	*33.973*	4.897	0.720	60.211	39.789	1.717	1.330
TAR06	0.722	81.491	10.056	5.640	2.091	97.909	1.470	0.019
TAR07	0.501	93.236	10.491	4.682	1.090	98.910	1.502	0.010
TAR08	0.493	82.753	10.455	4.063	2.236	97.764	1.505	0.020
TAR09	0.537	79.688	9.912	4.702	5.161	94.839	1.482	0.049
TAR10	0.536	82.579	10.301	4.641	1.943	98.057	1.486	0.018
TAR11	0.561	82.630	10.313	4.489	2.007	97.993	1.487	0.018
TAR12	0.542	81.747	10.152	4.898	2.661	97.339	1.480	0.024
TAR13	0.610	82.695	10.371	4.860	1.464	98.536	1.494	0.013
TAR14								
TAR15	0.586	81.979	10.043	5.022	2.370	97.630	1.460	0.022
TAR16	0.574	82.051	10.198	5.034	2.143	97.857	1.481	0.020
TAR17	0.539	82.332	10.252	5.027	1.850	98.150	1.484	0.017
TAR18	0.557	82.419	10.182	5.028	1.814	98.186	1.472	0.017

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18.2.1d. Spectral Data - Athabasca Oil Sands

Sample	*Facility/File No.*	*Description*
TAR01	RELAB CATS01	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR01	RELAB SATS01	WR, 0E/15E, 0.3-2.7µm, 5nm, smoothed with 5 pt boxcar filter.
TAR01E	RELAB CFTS01	<45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
TAR01	RELAB LAOS24	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
++++++		
TAR02	RELAB CATS02	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR02	RELAB SATS02	WR, 0E/15E, 0.3-2.7µm, 5nm, smoothed with 5 pt boxcar filter.
TAR02	RELAB LAOS25	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
++++++		
TAR03	RELAB CATS03	WR, 0E/15E, 0.3-3.5µm, 5nm.
TAR03	RELAB SATS03	WR, 0E/15E, 0.3-3.5µm, 5nm, smoothed with 5 pt boxcar filter.
TAR03	RELAB CBTS03	WR, 0E/15E, 0.3-0.6µm, 1nm.
TAR03	RELAB LAOS26	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR03	RELAB NCOS26	WR, 30E/0E, 0.3-26µm (RELAB+Nicolet @ 1.7µm), 0.22-65 nm resol.
TAR03	USGS 188	WR, IS, 0.35-2.6µm, 1x resol.
TAR03E	RELAB CFTS03	<45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
TAR03E	RELAB CCTS03	>45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
TAR03E	RELAB CETS03	<45µm crushed, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
TAR03E	RELAB MATS03E	<45µm crushed, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
++++++		
TAR04	RELAB CATS04	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR04	RELAB SATS04	WR, 0E/15E, 0.3-2.7µm, 5nm, smoothed with 5 pt boxcar filter.
TAR04	RELAB LAOS27	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
++++++		
TAR05	RELAB CATS05	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR05	RELAB SATS05	WR, 0E/15E, 0.3-2.7µm, 5nm, smoothed with 5 pt boxcar filter.
TAR05	RELAB LAOS28	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
++++++		
TAR06	RELAB CATS06	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR06	RELAB C1TS06	WR, 30E/0E, 0.3-2.6µm, 5 nm (sample rerun).
TAR06	USGS 204,208	WR, IS, 0.35-2.6µm, 1x resol, 2 spectra.
TAR06	RELAB LAOS29	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR06	RELAB MATS06A	WR, 30E/30E, 1.8-25.9µm, 0.6-129 nm (Nicolet FTIR; sample rerun).
++++++		
TAR07	RELAB CATS07	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR07	RELAB LAOS30	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR07	USGS 196	WR, IS, 0.35-2.6µm, 1x resol.
TAR07E	RELAB CFTS07	<45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
TAR07E	RELAB CCTS07	>45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
++++++		
TAR08	RELAB CATS08	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR08	RELAB LAOS31	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR08	USGS 200	WR, IS, 0.35-2.6µm, 1x resol.
TAR08E	RELAB CETS08	<45µm crushed, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
TAR08E	RELAB MATS08E	<45µm crushed, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
++++++		
TAR09	RELAB CATS09	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR09	RELAB LAOS32	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.

TAR09E	RELAB CCTS09	>45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
++++++		
TAR10	RELAB CATS10	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR10	RELAB C1TS10	WR, 30E/0E, 0.3-2.6µm, 5 nm (sample rerun).
TAR10	RELAB LAOS33	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR10	RELAB MATS10A	WR, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR; sample rerun).
TAR10	RELAB NCOS33	WR, 30E/0E, 0.3-26µm (RELAB+Nicolet @ 1.7µm), 0.22-65 nm resol.
TAR10	USGS 184	WR, IS, 0.35-2.6µm, 1x resol.
TAR10E	RELAB CFTS10	<45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
TAR10E	RELAB CCTS10	>45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
++++++		
TAR11	RELAB CATS11	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR11	RELAB LAOS34	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR11E	RELAB CCTS11	>45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
++++++		
TAR12	RELAB CATS12	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR12	RELAB LAOS35	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR12	USGS 212	WR, IS, 0.35-2.6µm, 1x resol.
++++++		
TAR13	RELAB CATS13	WR, 0E/15E, 0.3-3.5µm, 5nm.
TAR13	RELAB SATS13	WR, 0E/15E, 0.3-3.5µm, 5nm, smoothed with 5 pt boxcar filter.
TAR13	RELAB CBTS13	WR, 0E/15E, 0.3-0.6µm, 1nm.
TAR13	RELAB N3TS13	WR, 30E/30E, 0.9-3.2µm, ~0.3-3.9 nm (Nicolet FTIR).
TAR13	RELAB N1TS13	WR, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
TAR13	RELAB LAOS36	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR13	RELAB NCOS36	WR, 30E/0E, 0.3-26µm (RELAB+Nicolet @ 1.7µm), 0.22-65 nm resol.
TAR13	USGS 192	WR, IS, 0.35-2.6µm, 1x resol.
++++++		
TAR14	RELAB CATS14	WR, 0E/15E, 0.3-2.7µm, 5nm.
++++++		
TAR15	RELAB CATS15	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR15	RELAB LAOS37	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR15E	RELAB CETS15	WR, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
TAR15E	RELAB MATS15E	WR, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
++++++		
TAR16	RELAB CATS16	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR16	RELAB LAOS38	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
++++++		
TAR17	RELAB CATS17	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR17	RELAB LAOS39	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR17	PSF jun0506.003	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
TAR17	PSF ju06062.003	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged? – ASD. Measured in 10-sample disc at end of Mars box run #4 without sapphire window (Directory: jul06062).
TAR17	PSF ajar17	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
TAR17	PSF tjar17	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at end of Mars box run #4 without sapphire window (Directory: jul06062).
TAR17	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
++++++		

TAR18	RELAB CATS18	WR, 0E/15E, 0.3-2.7µm, 5nm.
TAR18	RELAB LAOS40	WR, 30E/30E, 0.9-26µm (Nicolet FTIR), 0.16-65 nm resol.
TAR18E	RELAB CFTS18	<45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.
TAR18E	RELAB CCTS18	>45µm, bitumen free, 0E/15E, 0.3-2.7µm, 5nm.

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18.2.2. Encana Cores (Jennifer Charney project – 2006-2007)

This project involves analysis of oil sand cores provided by Dr. Blair Mattison of Encana. The goal is to assess reflectance spectroscopy for discriminating swelling from non-swelling clays (primary goal) and bitumen content (secondary goal).

Twelve core boxes were provided (splits of six cores), with one set to be retained for further analysis.

18.2.2a. Sample descriptions

Many of the tasks associated with this project have either been completed, or nearing completion. The 6 core boxes provided by Encana had the following identifiers:

Well: *ECA ECOG LEISMER (our box 7)*
LSD: *00/8-15-76-6* *W4m/0*
Core: 11 *Box:4* *of: 5A*
Depth: 379.45 – 386.63 m
Rec: 7.18 m

Well: *ECA-ECOG LEISMER (our box 8)*
LSD: 00/8-15-76-6 *W4m/0*
Core: 9 *Box:5* *of: 6A*
Depth: 364.75 – 371.77 m
Rec: 6.76 m

Well: *ECA-ECOG LEISMER (our box 9)*
LSD: 00/8-15-76-6 *W4M/0*
Core: 9 *Box:6* *of: 6A*
Depth: 364.75 – 371.77 m
Rec: 6.76 m

Well: *AECOG d14 Fisher(our box 1)*
LSD: 14-8-70-3 *W4M*
Core: 3 *Box:4* *of: 6A*
Depth:476.10 – 484.55 m
Rec: 8.10 m

Well: *AECOG – d14 Fisher (our box 2)*
LSD: 14-8-70-3 *W4M*
Core: 3 *Box:5* *of: 6A*
Depth: 476.10 – 484.55 m
Rec: 8.10 m

Well: *AECOG d14 Fisher (our box 3)*
LSD: 14-8-70-3 *W4M*
Core: 3 *Box:6* *of: 6A*
Depth: 476.10 – 484.55 m
Rec: 8.10 m

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18.2.2b. Encana oil sand cores: XRD data

Note that XRD analytical data are available for the spots in the cores analyzed by ASD reflectance spectroscopy and micro-Soxhlet extraction.

First Fisher Core	%Bitumen
OSFC01	0.279276
OSFC02	6.93986
OSFC03	0.589538
OSFC04	7.553016
OSFC05	0.925905
OSF**B**01	12.2191
OSFC06	0.331891
OSFC07	0.769283
OSFB02	12.54184
OSFC08	10.49921

Second Fisher Core	%Bitumen
OSFB03	12.63809
OSFC09	1.511362
OSFB04	10.88026
OSFC10	0.911325
OSFB05	11.31865
OSFC12	0.271695
OSFC13	1.311621
OSFC14	8.874362
OSFC15	0.402415
OSFC16	1.708428

Third Fisher Core	%Bitumen
OSFC17	11.18257
OSFC18	0.440855
OSFC19	0.786492
OSFC20	9.889097
OSFC21	0.164333
OSFC22	11.70714
OSFC23	1.952278
OSFC24	12.14272

First Leismer Core	%Bitumen
OSFL01	11.91925
OSLC01	7.264699
OSLC02	3.172758
OSLC03	12.30903
OSFL02	12.77085
OSLC04	6.06599
OSFL03	12.03266

Second Leismer	%Bitumen

Core	
OSLC05	
OSLC06	14.14539
OSLC07	13.3491
OSFL04	13.5802
OSFL05	11.58487

Third Leismer Core	%Bitumen
OSLC08	
OSLC09	11.11691
OSLC10	
OSLC11	

18.2.2d. Spectral data

Point spectra of selected spots in the cores were acquired by ASD with the following parameters: 2000 spectra averaged; i=0°, e=0° (bifurcated cable). The ASD spectrometer has 2-7 nm resolution and measures from 0.35-2.5 µm

Sample ID	*File*
OSFC01	may2506.000
OSFC02	may2506.001
OSFC04	may2506.002
OSFC05	may2506.003
OSFC03	may2506.004
OSFB01	may2506.005
OSFC06	may2506.006
OSFC07	may2506.007
OSFB02	may2506.008
OSFC08	may2506.009
OSFB03	may2606.000
OSFC09	may2606.001
OSFB04	may2606.002
OSFC10	may2606.003
OSFB05	may2606.004
OSFC11	may2606.005
OSFC12	june106.000
OSFC13	june106.001
OSFC14	june106.002
OSFC15	june106.003
OSFC16	june106.004
OSLC08	june106.005
OSLC09	june106.006
OSLC10	june106.007
OSLC11	june106.008
OSLC05	june106.009
OSLC06	june106.010
OSLC07	june106.011
OSFL04	june106.012
OSFLO5	june106.013
OSFL01	june106.015
OSLC02	june106.016
OSLC01	june106.017
OSFL02	june106.018

OSLC04	june106.019
OSFL03	june106.020
OSFC17	june106.021
OSFC18	june106.022
OSFC19	june106.023
OSFC20	june106.024
OSFC21	june106.025
OSFC22	june106.026
OSFC23	june106.027
OSFC24	june106.028

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END of 18.2.

18. Organics

18.3. Other Organics (Non-coal, non-oil sands)

18.3a. Sample Descriptions - Other Organics

FORMAT: Sample #, description, locality, (source of sample), notes, old sample no.

Sample ID	*Description*
ALB101	Albertite: Albert Mine, New Brunswick, Canada (Minerals Unlimited), also known as DK2 and DARK102. ~20 pieces received Dec. 2013.
ANT101	Anthraxolite: Chelmsford, Balfour County, Ontario, Canada (Minerals Unlimited), also known as DK4 and DARK104. ~10 pieces of various purity received Dec. 2013.
ASP101	Asphaltum: Seefeld, North Tyrol, Austria (Minerals Unlimited), also known as DK1 and DARK101.
CTE101	Coal tar extract: processed material (prepared by, and acquired from, Jeff Bell, University of Hawaii), <37µm size. <37µm powder prepared by dry sieving. Sample left.
GIL101	Gilsonite: Fort Duchesne, Uinta County, Utah, USA (Minerals Unlimited), also known as DK3 and DARK103. ~5 1" pieces received Dec. 2013.
IDR101	Idrialite: Skagg's Springs, Sonoma County, California, USA. Sparse on sandstone; fluorescent (Minerals Unlimited). ~10 small pieces (coatings) received Dec. 2013.
OIL101	Oil sandstone: near Santa Cruz, Santa Cruz County, California, USA (Minerals Unlimited).
OILS10	Oil Shale: Near Rifle, Colorado, USA (Minerals Unlimited), alias DK5, DARK105 and OILS100.
PIG357	Shungite, carbon black (catalog no. 480-10S). 4 ounces. (black/brown group). *See section 19 of this document for data.*
SHU101	Shungite, impure; from "Shungite-store" via Amazon; ~2 kg of earthy chunks (i.e., impure shungite). Received Nov. 19, 2013; more received Jan. 17/15.
SHU102	Shungite, pure glassy material with conchoidal fracturing; ~100 grams from "Shungite-store" via Amazon ("pure" shungite). Received Nov. 19, 2013; more received Jan. 17/15.

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18.3.1a. Other Organics - Miscellaneous Sample Description Notes

ALB101	Utah albertite is predominantly condensed aromatic ring structures (Hunt 1963).
	Relatively free of oxygenated substances and low mineral matter (<10%) (Abraham 1945).
GIL101	Defined as an asphaltite (Abraham 1945).
	Predominantly aromatic, >50% may be non-hydrocarbons (Hunt 1963).
	Insoluble organic matter (the bulk of the organics) can be made soluble upon heating; kerogen is highly aliphatic (straight chain and cyclic), few aromatics or long-chain structures; saturated cyclic material with numerous heteroatoms (cyclic rings of methylene groups) (Yen and Chilingarian 1976).
ANT101	Precambrian material; moderately high ash content (King *et al.* 1963).
	Crystalline structure observed ((King 1963).

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18.3.2a. Alternative mineral names and additional organic names for organic-rich materials

Albertite	Anthraxolite
Asphaltite	Curtisite
Gilsonite	Graphite
Idrialite	Kerite
Pendletonite	Shungite
Thucolite	

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18.3b. XRD Data - Other Organics (non-coal, non-oil sands)

18.3b.1. Analogue files from U of A X-ray diffractometer.

Sample	XRD File
ANT101	Z03957
ASP101	Z03951
ALB101	Z03952
CTE101	Z03157
GIL101	Z03956
OILS10	Z03958

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18.3b.2. University of Manitoba X-ray diffractometer files:

GIL101 (whole rock)
GIL101"E" same sample after extraction and drying with toluene (sample is totally soluble).

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18.3b.3. University of Winnipeg X-ray diffractometer files (November 2013)

SHU101 XRD shows almost all quartz, plus carbon, illite, and albite.
SHU102 XRD shows amorphous humps and minor quartz

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18.3c. Compositional Data - Other Organics (non-coal, non-oil sands) -

18.3c.1. NMR Spectra from National Research Council Institute for Biodiagnostics

GIL101
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18.3c.2. University of Alberta Department of Chemistry light element analyzer

Elemental abundances in toluene-soluble fractions

	Elements (weight percent)					*Total*	*Ratios*	
Sample	*N*	*C*	*H*	*S*	*O*[1]	*N+C+H+S*	*H/C*	*O/C*
ASP101	0.345	72.608	9.662	7.062	10.323	89.667	1.585	0.107
ALB101	1.857	84.158	10.567	0.790	2.628	97.372	1.496	0.023
ANT101								
GIL101	2.686	84.575	10.444	0.570	1.725	98.275	1.471	0.015

1. Oxygen by difference.

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18.3c.3. X-ray fluorescence data - from Stan Mertzman - Franklin and Marshall College

Wt. %	PIG357	SHU101	SHU102
SiO_2	80.09	88.53	1.55
TiO_2	0.31	0.32	0.02
Al_2O_3	5.91	6.00	0.31
FeO	0.80	0.56	0.06
Fe_2O_3	8.44	1.28	0.01
*(Fe_2O_3)**	*(9.33)*	*(1.90)*	*(0.08)*
MnO	0.12	0.02	0.01
MgO	1.73	1.08	0.25
CaO	0.24	0.07	0.15
Na_2O	0.66	0.32	0.07
K_2O	1.70	1.79	0.13
P_2O_5	0.10	0.08	0.02
SO_3	0.06	0.05	0.36
TOTAL	100.25	100.16	2.95
C			~97%
LOI	31.77	34.95	50.99
ppm			
Sr	42	28	101
Zr	85	95	48
V	274	310	755
Ni	148	<1	725
Cr	461	111	156
Co	22	<1	90
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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18.3c. Compositional Data - Other Organics (non-coal, non-oil sands) (Part 1)

ANALYSIS	*ASP101*	*ALB101*	*GIL101*	*ANT101*	*OILS10*
ORGANIC PHASES					
Volatile matter (%)[8]		69.3	85.5	6.5	
				5.3	
Volatile Matter Ratio (Range)[1]					96(36-124)[3]
Carbon Residue Ratio (Range)[2]					29(16-75)[3]
Fixed Carbon	30-55%[4]	25-50%	10-20%	64.7%	
			13.8-18.6%		
Organic Carbon (wt.%)			65.8		11-16[11]
Insoluble non-mineral matter	<5%[4]	85-98%	0-1%		
Organic Matter (wt.%)					13.8%
Bitumen Content			62%		
Spin Density (Ng x 10^{-18})[13]				5.3	
Ash-Free Analyses					
C (Wt.%)		83.4-87.2	85-86	90.2-94.1	
		84.1	85.5	94.1	80.4
			84.1		
H (Wt.%)		9.0-13.2	8.5-10	1.1-5.2	
		9.4	10.5	1.1	10.3
			9.9		
S (Wt.%)		0-1.2	0.3-0.5	0.1	0.6-0.8[11]
			0.4		
			0.1-0.4		
		0.3[7]	0.4[7]	0.4[7]	9.3[10]
			0.3		
N (Wt.%)		0-3.1	2.0-2.8		1.8-2.1[11]
			2.2-3.3		
			2.8		
		2.0	2.7	0.7	9.3[10]
			0.3		
O (Wt.%)		0-2.2	0-2		
			~0-6.5		
			6.5		
		4.2[6]	0.9[6]	3.7[6]	9.3[10]
Analysis (Ash-,S-,N-free)					
C (atom%)		42.1	40.4	85.5	
H (atom%)		56.3	59.3	11.9	
O (atom%)		1.6	0.3	2.6	
Atomic Ratios					
H/C		1.34	1.47	0.14	1.55[11]
		1.24	1.42-1.57		1.48[3]
					(0.92-1.77)[3]
N/C		0.020	0.027	0.006	0.028-0.030[11]
S/C		0.001	0.002	0.002	
O/C		0.037	0.008	0.029	0.05-0.10[11]

18.3c. Compositional Data - Other Organics (non-coal, non-oil sands) (Part 1) (continued)

ANALYSIS	*ASP101*	*ALB101*	*GIL101*	*ANT101*	*OILS10*
Density[9]		1.078	1.037	1.96	
	1.15-1.20[4]	1.075-1.091	1.03-1.10		
			1.02-1.07		
Refractive Index		1.65	1.60	2.06	
			1.59-1.64		
Solubility in CS_2		1.8%	99.2%	0.1%	
			~92-96%		
	45-100%[4]	2-10%	>98%		
Aromaticity (f_a)		0.41	0.30	0.85-1.0	
				1.0	
INORGANIC PHASES					
Carbonate (wt.%)			2.7		
Pyrite (wt.%)				0.86%	
Mineral matter	69.9%[5]	0.1-0.2%	#1%		86.2%
Ash (wt.%)		--	0.2	1.1	
				30	
SPECTRAL DATA					
Absorptivity (a)					
3.42µm		0.72	1.20(s)	--	
7.27µm		0.090	0.157(s)	--	
13.9µm		0.031	0.008	--	
11-14µm		0.52	0.42	--	
5µm		0.14	0.02	1.2	
Aliphatic Carbon					
$^fCH_2$		0.265	0.340	--	
$^fCH_3$		0.086	0.098	--	
$^fC_p/^fCH_2$		0.33	0.06	--	
$^fa+^fCH_2+^fCH_3$		0.76	0.74	--	
Sources of Data	B,C	B,D,E	B,D,E,G	E,F	A,G,H

[1] Wt.% volatile material / Wt. % organic carbon;
[2] Wt. % carbon residue / Wt.% organic carbon;
[3] Results for core from Rio Blanco County, Colorado (Anders and Robinson, 1971);
[4] Results for grahamite (var. asphaltite) (Abraham, 1945);
[5] Composition of mineral matter: 38.2% Ca and Mg carbonates, 6.7% clay, 19.0% silica, 5.9% iron oxides (Abraham, 1960);
[6] By difference;
[7] Corrected for presence of pyrite;
[8] Ash-free;
[9] Density corrected for mineral matter;
[10] S+N+O;
[11] For Colorado Green River oil shale (locality unknown);
[12] Benzene solubles normalized to percentages of benzene insolubles (kerogen);
[13] Spin density (per gram) from ESR data (Yen and Chilingarian 1976);
Sources of data: A = Anders and Robinson (1971); B = Abraham (1945); C = Abraham (1960); D = Hunt *et al.* (1954) and Hunt (1963); E = King *et al.* (1963) and King (1963); F = Mancuso and Seavoy (1981); G = Yen and Chilingar (1976); H = Tissot and Welte (1978).
++

18.3d. Spectral Data - Other Organics (non-coal, non-oil sands)

Sample	*Facility/File No.*	*Description*
ALB101	RELAB C1AB01	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
ALB101	RELAB N2AB01	<45µm, 30E/30E, 0.9-3.2µm, ~0.3-3.9 nm (Nicolet FTIR).
ALB101	RELAB N1AB01	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
ALB101	PIMA dark102a-g	<45µm, Bidirectional, 1.3-2.5µm, 2 nm; hull corrected and uncorrected available [7].
ALB101E	RELAB CEAB01	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
ALB101E	RELAB MAAB01E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction, Nicolet FTIR).
++++++		
ASP101	RELAB C1AS01	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
ASP101	RELAB N2AS01	<45µm, 30E/30E, 0.9-3.2µm, ~0.3-3.9 nm (Nicolet FTIR).
ASP101	RELAB N1AS01	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
ASP101	PIMA dark101a-f	<45µm, Bidirectional, 1.3-2.5µm, 2 nm; hull corrected and uncorrected available [6].
ASP101E	RELAB CEAS01	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
ASP101E	RELAB MAAS01E	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction, Nicolet FTIR).
++++++		
ANT101	RELAB C1AT01	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
ANT101	RELAB N2AT01	<45µm, 30E/30E, 0.9-3.2µm, ~0.3-3.9 nm (Nicolet FTIR).
ANT101	RELAB N1AT01	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
ANT101	PIMA dark104a-e	<45µm, Bidirectional, 1.3-2.5µm, 2 nm; hull corrected and uncorrected available [4].
++++++		
CTE101	RELAB c1sc83	<37µm, 0E/15E, 0.3-2.7µm, 5nm.
	RELAB n2ct01	<45µm, 30E/30E, 0.9-3.2µm, ~0.3-3.9 nm (Nicolet FTIR).
	RELAB n1ct01	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
++++++		
GIL101	RELAB C1GI01	<45µm, 30E/0E, 0.3-2.6µm, 5 nm.
GIL101	RELAB N2GI01	<45µm, 30E/30E, 0.9-3.2µm, ~0.3-3.9 nm (Nicolet FTIR).
GIL101	RELAB N1GI01	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
GIL101	RELAB MAGI01	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR Rerun).
GIL101	PIMA dark103a-g	<45µm, Bidirectional, 1.3-2.5µm, 2 nm; hull corrected and uncorrected available [7].
GIL101	PSF jun0506.002	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
GIL101	PSF jul06062.002	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at end of Mars box run #4 without sapphire window (Directory: jul06062).
GIL101	PSF agil001	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
GIL101	PSF tgil001	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at end of Mars box run #4 without sapphire window (Directory: jul06062).
GIL101	PSF gil101m.rtx	<45 µm?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 15, 2006).
GIL101	PSF gil101n.rtx	whole rock?; i=30°, e=0°?, D&P FTIR, 2-16 µm, no thermal correct, ~1.5 cm^{-1} resol. relative to Infragold; D&P; unknown quality (Dec. 16,

		2006).
GIL101	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
++++++		
OILS10	RELAB N20S13	<45µm, 30E/30E, 0.9-3.2µm, ~0.3-3.9 nm (Nicolet FTIR).
OILS10	RELAB N1OS13	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
OILS10	RELAB CSC104	<45µm, 0E/15E, 0.3-2.7µm, 5nm.
OILS10	RELAB DSC104	<45µm, 30E/30E, 0.3-3.6µm, 5nm from 0.3-1.75µm, 1.2-5nm from 1.75-3.6µm (Nicolet).
OILS10	RELAB RNSC104	<45µm, 30E/30E, 1.0-3.6µm, 0.4-5nm resol., with errors, scaled to RELAB at 2.35µm (Nicolet).
OILS10	PIMA dark105a-h	<45µm, Bidirectional, 1.3-2.5µm, 2 nm; hull corrected and uncorrected available [8].
OILS10	PSF jun0506.001	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
OILS10	PSF jul06062.001	<45 µm; i=0°, e=0° (bifurcated cable); 0.35-2.5 µm; 1 nm output; 2000 spectra averaged – ASD. Measured in 10-sample disc at end of Mars box run #4 without sapphire window (Directory: jul06062).
OILS10	PSF aoils10	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at start of Mars box run #4 without sapphire window (Directory: jun0506inairnw).
OILS10	PSF toils10	<45 µm; i=35°, e=0°; 2-16 µm; 11-72 nm resolution; 100 spectra averaged – D&P FTIR. Measured in 10-sample disc at end of Mars box run #4 without sapphire window (Directory: jul06062).
OILS10	*See also section 22 for spectra acquired under ambient and Mars-like conditions.*	
OILS10E	RELAB CSC113	<45µm, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
OILS10E	RELAB MASC113	<45µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction) (Nicolet FTIR).
++++++		
PIG357	*See section 16 for spectra*	
++++++		
SHU101	PSF 131119a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD. (Directory: 131119 randoms).
SHU102	PSF 131119a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 500 spectra averaged; ASD. (Directory: 131119 randoms).

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END of 18.3.

18. Organics

18.4. Hosterman (USGS) Organic Samples

This sample suite was obtained from John Hosterman of the US Geological Survey. It includes heavy oils, oil sands, oil shales, and bitumens from a wide variety of localities.

18.4a. Sample Descriptions - Hosterman (USGS) Organic Samples

JORDAN

JO-1	Limestone: 26 mi. SE of S end of Dead Sea.
JO-3	Oil shale: A unit, Lajjun.
JO-4	Oil shale: B unit, Lajjun.
JO-5	Oil shale: C unit, Lajjun (?).
JO-6	Oil shale: D unit, Lajjun.
JO-7	Oil shale: Area HZ-12, El-Azraq.
JO-8	Limestone: Area HZ-13, El-Azraq.
JO-9	Natural asphalt (shale): 31.08EN, 35.32EE.

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SEYCHELLES

SE-1	Tar ball: Coetivy Island beach.

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TRINIDAD AND TOBAGO

TT-1	Sandstone: St. Patrick County.

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U.S.A.

AL-1	Sandstone: Colbert County, Alabama.
AL-2	Sandstone: Colbert County, Alabama.
AL-3	Limestone: Colbert County, Alabama.
CA-1	Shale: Santa Barbara County, California.
CA-2	Shale: Santa Barbara County, California.
CA-3	Limestone: Santa Barbara County, California.
CA-4	Shale: San Luis Obispo County, California.
KY-1A	Sandstone: Logan County, Kentucky.
KY-2A	Sandstone: Edmonson County, Kentucky.
OK-1	Sandstone: Murray County, Oklahoma.
OK-2	Sandstone: Carter County, Oklahoma.
OK-5	Sandstone: Carter County, Oklahoma.
TX-1	Sandstone: Maverick County, Texas.
UT-2	Sandstone: Carbon County, Utah.
UT-3	Sandstone: Carbon County, Utah.
UT-4	Sandstone: Uintah County, Utah.
WY-1	Sandstone: Big Horn County, Wyoming.

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VENEZUELA

VE-8	Sandstone: Hamaca area, Anzoategui State.
VE-11	Sandstone: Cerro Negro area, Monagas State.
VE-12	Sandstone: Cerro Negro area, Monagas State.

Further sample information can be obtained from Dr. Richard F. Meyer of the U.S. Geological Survey in Reston, Virginia, 22092 (Mail stop 954) and in Hosterman et al. (1990).

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18.4a.1. Hosterman Samples – Detailed Descriptions

FORMAT: Assigned laboratory sample number
Political entity and geographic location
Sample deposit name
Location [nearest identifiable locality in The Times Atlas of the World]
Reservoir: Geological age and formation (lithology of bed sampled)
Source Bed: Geological age, formation, and kerogen type

JORDAN

JO-1
Jordan
Oil shale about 26 mi E of south end of Dead Sea
31.08EN, 35.95EE
Cretaceous unnamed unit (limestone)
Unknown

JO-3
Jordan
Lajun oil shale deposit (A unit)
31.14EN, 35.52EE [Lajjun or El-Lajun]
Paleocene Lajun Shale
Unknown

JO-4
Jordan
Lajun oil shale deposit (B unit)
31.14EN, 35.52EE [Lajjun or El-Lajun]
Paleocene Lajun Shale
Unknown

JO-5*
Jordan
Lajun oil shale deposit © unit)
31.14EN, 35.52EE [Lajjun or El-Lajun]
Paleocene Lajun Shale
Unknown

JO-6
Jordan
Lajun oil shale deposit (D unit)
31.14EN, 35.52EE [Lajjun or El-Lajun]
Paleocene Lajun Shale
Unknown

JO-7
Jordan
Lajun oil shale, Area HZ-12, Depth 1022.5 (probably meters)
31.50EN, 36.47EE [El-Azraq]
Paleocene Lajun Shale
Unknown

JO-8
Jordan
Lajun oil shale, Area HZ-13, Depth 1081.5 (probably meters)
31.50EN, 36.47EE [El-Azraq]

Paleocene Lajun Shale (limestone bed)
Unknown

JO-9
Jordan
Natural asphalt
31.08EN, 35.32EE
Ordovician (?) (shale)
Unknown
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SEYCHELLES
SE-1
Seychelle Islands
Coetivy Island beach [TAR BALL]
7.00ES, 56.20EE
None
Probably Jurassic-Early Cretaceous shale, type III
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TRINIDAD AND TOBAGO
TT-1
Trinidad, St. Patrick County
Outcrop on the lower part of the Morne L'Enfer Formation at Well D-74, Parrylands area
10.11EN, 61.37EW [Parrylands]
Pliocene Lower Morne L'Enfer Formation (sandstone)
Miocene Cruse Formation, type III
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U.S.A.
AL-1
USA, Alabama, Colbert County
Outcrop, Section 29, T5S, R10W, Martin place, Spring Creek (Shine Springs)
34.40EN, 87.42EW [Russellville]
Upper Mississippian Hartselle Sandstone
Upper Devonian Chattanooga Shale, type II

AL-2
USA, Alabama, Colbert County
Outcrop, Section 22, T5S, R10W, Doss Hollow, Champion Paper
34.30EN, 87.42EW [Russellville]
Upper Mississippian Hartselle Sandstone
Upper Devonian Chattanooga Shale, type II

AL-3
USA, Alabama, Colbert County
Outcrop, SW 1/4, Section 2, T5S, R9W, near town of Margerum
34.44EN, 87.59EW [Cherokee]
Upper Mississippian Pride Mountain Formation (limestone bed)
Upper Devonian Chattanooga Shale, type II

CA-1
USA, California, Santa Barbara County
Mine cut (Airox property) 1000 feet east of Casmalia oil field, west of Santa Maria, California, diatomite, Monterey Formation
34.56EN, 120.25EW [Santa Maria]

Miocene Monterey Formation (diatomaceous shale)
Miocene Monterey Formation, type II

CA-2
USA, California, Santa Barbara County
Gaviota Beach
34.28EN, 120.12-13EW
Miocene Monterey Formation (diatomaceous shale)
Miocene Monterey Formation, type II

CA-3
USA, California, Santa Barbara County
Gaviota Beach
34.28EN, 120.12-13EW
Miocene Monterey Formation (limestone bed/carbonaceous marl)
Miocene Monterey Formation, type II

CA-4
USA, California, San Luis Obispo County
Edna deposit
35.12EN, 120.36EW [Edna]
Miocene Monterey Formation (shale/siltstone)
Miocene Monterey Formation, type II

KY-1A
USA, Kentucky, Logan County
Homer Quadrangle
37.00EN, 86.45EW
Upper Mississippian Chesterian Golconda Formation, Big Clifty Sandstone Member
Upper Devonian Chattanooga Shale, type II

KY-2A
USA, Kentucky, Edmonson County
Indian Creek Quarry, Brownville Quadrangle
34.25EN, 86.25EW
Lower Pennsylvanian Caseyville Formation, Kyrock Member (sandstone bed)
Upper Devonian Chattanooga Shale, type II

OK-1
USA, Oklahoma, Murray County
Sulphur quarry, SW 1/4, SE 1/4 Section 15, T.1 S., R.3 E.
34.31EN, 96.98EW [Sulphur]
Upper Cambrian and Lower Ordovician Arbuckle Formation (sandstone unit)
Upper Devonian Woodford Shale, type II

OK-2
USA, Oklahoma, Carter County
South Woodford deposit, W ½ E ½ Section 2, T.3 S., R.1 W.
34.11EN, 97.08EW [Ardmore]
Lower Pennsylvanian Morrow Formation (Morrowan Series) (sandstone unit)
Upper Devonian Woodford Shale, type II

OK-5
USA, Oklahoma, Carter County
Quarry, South Woodford deposit, W ½ E ½ Section 2, T.3 S, R. 1 W.
34.11EN, 97.08EW [Ardmore]

Lower Pennsylvanian Morrow Formation (Morrowan Series) (sandstone bed)
Upper Devonian Woodford Formation, type II

TX-1
USA< Texas, Maverick County
Conoco 2 Mary R. Saner, depth 1413.5-1414.5 feet (steamed)
28.44EN, 100.31EW [Eagle Pass]
Upper Cretaceous San Miguel Formation (sandstone bed)
Cretaceous marine shales, type II

UT-2
USA, Utah, Carbon County
Sunnyside deposit, sample 74-21, T. 12-14 S., R. 13-15 E., Salt Lake Base Meridian
39.34EN, 110.24EW [Sunnyside]
Eocene Green River Formation (sandstone/ sandy marl)
Eocene Green River and Wasatch Formations, type I

UT-3
USA, Utah, Carbon County
Sunnyside deposit, sample 74-19, T. 12-14 S., R. 13-15 E., Salt Lake Base Meridian
39.34EN, 110.24EW [Sunnyside]
Eocene Green River Formation (sandstone/ sandy marl)
Eocene Green River and Wasatch Formations

UT-4
USA, Utah, Uintah County
Asphalt Ridge NW deposit, T. 4 S., R. 20 E., Salt Lake Base Meridian
40.26EN, 109.32EW [Vernal]
Mesaverde (Upper Cretaceous) Formation, Asphalt Ridge Sandstone Member
Eocene Green River and Wasatch Formations

WY-1
USA, Wyoming, Big Horn County
Trapper Canyon deposit in Big Horn Basin, Sections 32 and 33, T. 52 N., R. 89 W.
44.38EN, 107.50EW
Lower Permian and Upper and Middle Pennsylvanian Tensleep Sandstone
Upper Permian Phosphoria Formation, type II
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VENEZUELA
VE-8
Venezuela, Anzoategui State
Hamaca area, Well C core, Orinoco oil belt
8.39EN, 63.53EW [La Canoa]
Lower Miocene and Upper Oligocene Oficina Formation (sandstone)
Upper Cretaceous Querecual Formation, type II

VE11
Venezuela, Monagas State
Cerro Negro Area, Well A, Depth A2, core, Orinoco oil belt
9.04EN, 62.40EW [Temblador]
Middle Part of Miocene Oficina Formation (sandstone)
Upper Cretaceous Querecual Formation, type II

VE-12
Venezuela, Monagas State

Cerro Negro Area, Well A, Depth A3, core, Orinoco oil belt
9.04EN, 62.40EW [Temblador]
Lower Part of Miocene Oficina Formation (sandstone)
Upper Cretaceous Querecual Formation, type II
*: Only sample number available, all other information extrapolated from other samples.

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18.4b. XRD Data - Hosterman (USGS) Samples

18.4b.1. Analogue XRD files from U of A instrument

Sample	XRD File	Sample	XRD File	Sample	XRD File
Hosterman (USGS) Organic Samples (Foreign)					
JO-1	Z04253	JO-3	Z04255	JO-4	Z04254
JO-5	Z04246	JO-6	Z04252	JO-7	Z04257
JO-8	Z04243	JO-9	Z04247	SE-1	
TT-1	Z04259	VE-8	Z04238	VE-11	Z04256
VE-12					
Hosterman (USGS) Organic Samples (U.S. Samples)					
AL-1	Z04264	AL-2	Z04262	AL-3	Z04251
CA-1	Z04239	CA-2	Z04233	CA-3	Z04244
CA-4		KY-1A	Z04265	KY-2A	Z04263
OK-1	Z04261	OK-2	Z04245	OK-5	Z04242
TX-1	Z04248	UT-2	Z04234	UT-3	Z04260
UT-4		WY-1			

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18.4c. Compositional Data - Hosterman (USGS) Samples (Part 1) – Organic Phases

(i) Analyses from University of Alberta - analyses by light element analyzer in the Department of Chemistry.

Elemental abundances in toluene-soluble fractions.

	Elements (weight percent)					*Total*	*Ratios*	
Sample	*N*	*C*	*H*	*S*	*O*[1]	*N+C+H+S*	*H/C*	*O/C*
USA samples								
AL-1	0.897	84.315	9.755	1.863	3.170	96.830	1.378	0.028
AL-2	0.790	81.796	9.988	1.856	5.570	94.430	1.455	0.051
AL-3	0.848	77.775	8.917	1.439	11.021	88.979	1.366	0.106
CA-1	0.282	73.476	10.238	2.553	13.451	86.549	1.660	0.137
CA-2								
CA-3	1.016	74.706	10.078	5.330	8.870	91.130	1.607	0.089
CA-4	1.080	81.098	10.596	2.547	4.679	95.321	1.557	0.043
KY-1A	0.713	83.135	10.373	1.299	4.480	95.520	1.487	0.040
KY-2	0.801	82.728	9.905	1.624	4.942	95.058	1.427	0.045
KY-2A	0.863	82.734	10.113	1.642	4.648	95.352	1.456	0.042
OK-1	0.701	78.868	9.911	1.391	9.129	90.871	1.497	0.087
OK-2	0.868	78.356	9.329	2.655	8.792	91.208	1.419	0.084
OK-5	0.938	78.892	9.064	2.585	8.521	91.479	1.369	0.081
TX-1	0.411	76.761	8.896	9.868	4.064	95.936	1.381	0.040
UT-2	1.172	79.133	9.393	0.449	9.853	90.147	1.414	0.093
UT-3	0.984	80.451	10.414	0.548	7.603	92.397	1.542	0.071
UT-4	1.135	83.362	10.955	0.940	4.608	95.392	1.585	0.042
WY-1	0.597	79.086	9.887	4.849	5.581	94.419	1.490	0.053
Non-USA samples								
JO-1	0.370	65.370	8.768	11.225	14.267	85.733	1.598	0.164
JO-3	0.631	84.642	11.360	14.485	-11.118	111.118	1.599	-0.099
JO-4	0.516	74.391	10.166	12.811	2.116	97.884	1.628	0.021
JO-5	0.497	70.777	9.493	11.368	7.865	92.135	1.598	0.083
JO-6	0.522	75.581	10.160	9.982	3.755	96.245	1.602	0.037
JO-7	0.928	76.360	9.854	10.636	2.222	97.778	1.538	0.022
JO-8	0.750	72.015	8.906	9.406	8.923	91.077	1.473	0.093
JO-9	0.859	75.921	8.509	8.825	5.886	94.114	1.335	0.058
SE-1	0.338	82.334	12.295	2.756	2.277	97.723	1.779	0.021
TT-1	0.954	81.076	10.175	2.471	5.324	95.676	1.495	0.049
VE-8	0.593	78.948	9.994	4.164	6.301	93.699	1.508	0.060
VE-11	0.696	79.642	10.070	4.078	5.514	94.486	1.507	0.052
VE-12	0.759	81.378	10.104	3.843	3.916	96.084	1.479	0.036

1. Oxygen by difference.

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18.4c. Compositional Data - Hosterman (USGS) Samples (Part 2) – Organic Phases

Wt. %	*JO-1*	*JO-3*	*JO-4*	*JO-5*	*JO-6*
C15+ Organic Phases (Wt.%)					
Saturated HCs	1.2	N.D.	1.4	0.7	1.8
Aromatic HCs	8.4	N.D.	6.2	8.6	11.1
NSO Compounds	13.2	N.D.	15.0	15.9	23.2
Asphaltenes	39.6	N.D.	60.0	59.6	54.0
Column Holdup	37.6	N.D.	17.5	15.2	9.8
Sat./Arom. ratio	0.15	0.22	0.22	0.08	0.16
Total Bitumen					
C15+: Normalized Percent					
Saturated HCs	2.0	N.D.	1.7	0.8	2.0
Aromatic HCs	13.4	N.D.	7.5	10.2	12.4
NSO Compounds	21.1	N.D.	18.2	18.8	25.7
Asphaltenes	63.5	N.D.	72.7	70.3	59.9
Percent Recovery	50.9	72.5	82.5	84.8	90.2

Wt.% for samples JO-1,4,5,6 are semi-normalized (i.e., total 100% with column holdup).
N.D. = Cannot determine, asphaltene removed.
Source of data: R.F. Meyer pers. comm. (1995)

Wt. %	*JO-7*	*JO-8*	*JO-9*	*SE-1*	*TT-1*
C15+ Organic Phases (Wt.%)					
Saturated HCs	1.2	1.7	N.A.	11.4	0.84
Aromatic HCs	21.8	17.5	N.A.	7.6	2.91
NSO Compounds	13.5	14.1	N.A.	5.2	1.92
Asphaltenes	39.6	60.9	N.A.	38.1	1.39
Column Holdup	23.9	5.8	N.A.	37.6	
Sat./Arom. ratio	0.05	0.10	N.A.	1.50	0.29
Total Bitumen					7.83
C15+: Normalized Percent					
Saturated HCs	1.5	1.8	N.A.	18.3	
Aromatic HCs	28.7	18.5	N.A.	12.2	
NSO Compounds	17.7	15.0	N.A.	8.4	
Asphaltenes	52.1	64.7	N.A.	61.1	
Percent Recovery	76.1	94.2	N.A.	62.4	90.1

Wt.% for samples JO-7, 8, and SE-1 are semi-normalized (i.e., total 100% with column holdup).
N.A. = Not analysed.
Source of data: R.F. Meyer pers. comm. (1995)

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18.4c. Compositional Data - Hosterman (USGS) Samples (Part 2) – Organic Phases (continued)

Wt. %	*AL-1*	*AL-2*	*AL-3*	*CA-1*	*CA-2*
C15+ Organic Phases (Wt.%)					
Saturated HCs	N.D.	N.D.	N.D.	1.44	0.06
Aromatic HCs	N.D.	N.D.	N.D.	3.28	0.03
NSO Compounds	N.D.	N.D.	N.D.	2.21	0.05
Asphaltenes	N.D.	N.D.	N.D.	1.62	0.05
Column Holdup	N.D.	N.D.	N.D.		
Sat./Arom. ratio	0.85	0.82	0.59	0.44	1.94
Total Bitumen				9.23	0.19
C15+: Normalized Percent					
Saturated HCs	N.D.	N.D.	N.D.		
Aromatic HCs	N.D.	N.D.	N.D.		
NSO Compounds	N.D.	N.D.	N.D.		
Asphaltenes	N.D.	N.D.	N.D.		
Percent Recovery	78.2	64.3	74.2	92.6	100.0

N.D. = Not determined, asphaltenes removed
Source of data: R.F. Meyer pers. comm. (1995)

Wt. %	*CA-3*	*CA-4*	*KY-1(A)*	*KY-2(A)*	*OK-1*
C15+ Organic Phases (Wt.%)					
Saturated HCs	0.05	1.93	1.24	0.88	0.37
Aromatic HCs	0.07	2.74	2.14	1.67	1.33
NSO Compounds	0.28	2.04	1.21	1.52	1.53
Asphaltenes	0.11	2.32	1.50	2.75	1.12
Column Holdup					
Sat./Arom. ratio	0.73	0.71	0.58	0.53	0.28
Total Bitumen	0.70	9.73	6.27	7.74	4.38
C15+: Normalized Percent					
Saturated HCs					
Aromatic HCs					
NSO Compounds					
Asphaltenes					
Percent Recovery	72.8	92.8	97.3	88.2	99.2

Source of data: R.F. Meyer pers. comm. (1995)

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18.4c. Compositional Data - Hosterman (USGS) Samples (Part 2) – Organic Phases (continued)

Wt. %	*OK-2*	*OK-5*	*TX-1*	*UT-2*	*UT-3*
C15+ Organic Phases (Wt.%)					
Saturated HCs	0.66	1.06	0.40	0.14	1.68
Aromatic HCs	0.58	1.08	2.85	0.27	2.42
NSO Compounds	0.90	2.08	1.28	0.52	1.27
Asphaltenes	9.08	9.30	3.04	3.74	2.33
Column Holdup					
Sat./Arom. ratio	1.13	0.99	0.14	0.51	0.69
Total Bitumen	11.89	14.43	7.87	5.18	10.99
C15+: Normalized Percent					
Saturated HCs					
Aromatic HCs					
NSO Compounds					
Asphaltenes					
Percent Recovery	91.2	80.7	96.2	90.1	70.0
Source of data: R.F. Meyer pers. comm. (1995)					

Wt. %	*UT-4*	*WY-1*	*VE-8*	*VE-11*	*VE-12*
C15+ Organic Phases (Wt.%)					
Saturated HCs	1.33	N.A.	13.0	9.3	8.6
Aromatic HCs	1.32	N.A.	22.4	20.1	13.5
NSO Compounds	2.48	N.A.	21.2	15.1	13.2
Asphaltenes	2.57	N.A.	23.6	23.1	29.8
Column Holdup		N.A.	19.8	32.4	34.9
Sat./Arom. ratio	1.01	N.A.	0.58	0.46	0.64
Total Bitumen	9.37	N.A.			
C15+: Normalized Percent					
Saturated HCs		N.A.	16.2	13.8	13.3
Aromatic HCs		N.A.	28.0	29.7	20.8
NSO Compounds		N.A.	26.5	22.3	20.2
Asphaltenes		N.A.	29.4	34.2	45.8
Percent Recovery	82.2	N.A.	80.2	67.6	65.1

Wt.% for samples VE-8,11,12 are semi-normalized (i.e., total 100% with column holdup).
N.A. = Not analysed.
Source of data: R.F. Meyer pers. comm. (1995)
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18.4c. Compositional Data - Hosterman (USGS) Samples (Part 3)

Wt. %	*TT-1*	*CA-1*	*CA-2*	*CA-3*	*CA-4*
***MINERAL CONTENT*[1]**					
Quartz	68.5	61.6	63.3	20.8	76.4
Cristobalite	--	10.0	11.0	--	--
Feldspar	18.5	11.6	15.2	10.8	22.1
Calcite	--	--	--	27.7	--
Dolomite	--	2.9	--	1.9	--
Siderite	--	--	--	10.5	--
Pyrite	--	5.9	6.5	8.0	--
Heulandite	--	--	--	17.5	--
Kaolinite	5.8	2.0	--	--	0.3
Illite	3.3	2.2	1.6	0.9	0.6
Mixed	1.9	--	--	--	--
Chlorite	2.0	--	--	--	--
Smectite	--	3.8	2.4	1.9	0.6
ORGANIC PHASES					
Available HCs[2]	11.96	14.37	2.80	3.87	12.34
Asphaltene[3]	19.7	18.9	24.7	22.2	25.6
Saturated HCs[4]	11.9	16.9	30.9	9.7	21.4
Aromatic HCs[4]	41.2	38.4	16.0	13.2	30.3
Polar Compounds[4,5]	27.2	25.8	28.4	54.9	22.6
Ni (ppm)	118	55	N.D.	228	132
V (ppm)	230	160	N.D.	N.D.	63

[1] Normalized to 100%; calculated semiquantitatively by X-ray diffraction
[2] Sample elutriated with benzene as well as Soxhlet extraction with chloroform
[3] Eluted fraction combined with iso-octane at room temperature, precipitate was asphaltene
[4] Remaining sample (after asphaltene determination) elutriated on an alumina-silica gel column
[5] Resins included with N-S-O compounds as polar compounds

N.D. = not determined
-- = not present
Source of data: Hosterman *et al.* (1990)
++

18.4c. Compositional Data - Hosterman (USGS) Samples (Part 3) (continued)

Wt. %	*KY-1A*	*KY-2A*	*OK-1*	*OK-2*	*OK-5*
MINERAL CONTENT[1]					
Quartz	89.0	80.4	94.9	95.5	96.0
Cristobalite	--	--	--	--	--
Feldspar	4.0	7.4	1.5	--	--
Calcite	--	--	--	--	--
Dolomite	--	--	--	--	--
Siderite	--	--	--	--	--
Pyrite	--	--	--	--	--
Heulandite	--	--	--	--	--
Kaolinite	6.9	11.6	1.2	4.4	4.0
Illite	0.1	0.6	1.5	0.1	tr.
Mixed	--	--	0.9	--	--
Chlorite	--	--	--	--	--
Smectite	--	--	--	--	--
ORGANIC PHASES					
Available HCs[2]	8.24	7.02	4.52	17.56	26.62
Asphaltene[3]	24.6	40.3	25.7	80.9	68.8
Saturated HCs[4]	20.4	13.0	8.6	5.8	7.9
Aromatic HCs[4]	35.1	24.5	30.6	5.2	8.0
Polar Compounds[4,5]	19.9	22.2	35.2	8.1	15.4
Ni (ppm)	70	72	63	111	101
V (ppm)	150	210	210	60	380

[1] Normalized to 100%; calculated semiquantitatively by X-ray diffraction
[2] Sample elutriated with benzene as well as Soxhlet extraction with chloroform
[3] Eluted fraction combined with iso-octane at room temperature, precipitate was asphaltene
[4] Remaining sample (after asphaltene determination) elutriated on an alumina-silica gel column
[5] Resins included with N-S-O compounds as polar compounds

N.D. = not determined
-- = not present
Source of data: Hosterman *et al.* (1990)
++

18.4c. Compositional Data - Hosterman (USGS) Organics (Part 3) (continued)

Wt. %	*TX-1*	*UT-2*	*UT-3*	*UT-4*	*WY-1*
MINERAL CONTENT[1]					
Quartz	81.6	48.3	65.8	91.3	83.4
Cristobalite	--	--	--	--	--
Feldspar	8.3	32.7	24.0	8.2	5.9
Calcite	--	3.0	--	--	8.9
Dolomite	--	15.5	4.0	--	1.8
Siderite	--	--	--	--	--
Pyrite	--	--	1.3	--	--
Heulandite	--	--	--	--	--
Kaolinite	9.9	--	0.9	0.4	--
Illite	--	0.5	4.0	0.1	--
Mixed	0.2	--	--	--	--
Chlorite	--	--	--	--	--
Smectite	--	--	--	--	--
ORGANIC PHASES					
Available HCs[2]	11.42	10.56	15.12	11.38	15.35
Asphaltene[3]	40.1	80.2	30.2	33.4	15.5
Saturated HCs[4]	5.3	2.9	21.8	17.3	7.5
Aromatic HCs[4]	37.7	5.7	31.5	17.2	41.5
Polar Compounds[4,5]	17.0	11.2	16.5	32.1	35.5
Ni (ppm)	29	44	58	67	45
V (ppm)	97	N.D.	95	25	130

[1] Normalized to 100%; calculated semiquantitatively by X-ray diffraction
[2] Sample elutriated with benzene as well as Soxhlet extraction with chloroform
[3] Eluted fraction combined with iso-octane at room temperature, precipitate was asphaltene
[4] Remaining sample (after asphaltene determination) elutriated on an alumina-silica gel column
[5] Resins included with N-S-O compounds as polar compounds

N.D. = not determined
-- = not present
Source of data: Hosterman *et al.* (1990)
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18.4d. Spectral Data - Hosterman (USGS) Samples

Sample	*Facility/File No.*	*Description*
JORDAN		
JO-1	RELAB C1LI02	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
JO-1	RELAB N1LI02	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-1	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].
JO-1E	RELAB CELI02	<45µm crushed, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
JO-1E	RELAB MALI02E	<45µm crushed, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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JO-3	RELAB C1OS14	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
JO-3	RELAB N1OS14	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-3	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
	++++++	
JO-4	RELAB C1OS15	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
JO-4	RELAB N1OS15	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-4	PIMA A,C,D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].
JO-4E	RELAB CEOS15	<45µm crushed, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
JO-4E	RELAB MAOS15E	<45µm crushed, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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JO-5	RELAB C1OS16	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
JO-5	RELAB N1OS16	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-5	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
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JO-6	RELAB C1OS17	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
JO-6	RELAB N1OS17	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-6	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
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JO-7	RELAB C1OS18	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
JO-7	RELAB N1OS18	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-7	RELAB N2OS18	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-7	PIMA A,C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [2].
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JO-8	RELAB C1SL02	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
JO-8	RELAB N1SL02	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-8	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].
JO-8E	RELAB CESL02	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
JO-8E	RELAB MASL02E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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JO-9	RELAB C1LI03	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
JO-9	RELAB N1LI03	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
JO-9	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].

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SEYCHELLE ISLANDS

SE-1	RELAB C1TB01	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
SE-1	RELAB N1TB01	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
SE-1	RELAB MATB01	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
SE-1	PIMA B-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].

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TRINIDAD AND TOBAGO

TT-1	RELAB C1SS26	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
TT-1	RELAB N1SS26	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
TT-1	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
TT-1E	RELAB CESS26	WR, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
TT-1E	RELAB MASS26E	WR, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).

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VENEZUELA

VE-8	RELAB C1SS27	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
VE-8	RELAB N1SS27	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
VE-8	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
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VE-11	RELAB C1SS28	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
VE-11	RELAB N1SS28	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
VE-11	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
VE-11E	RELAB CESS28	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
VE-11E	RELAB MASS28E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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VE-12	RELAB C1SS29	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
VE-12	RELAB N1SS29	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
VE-12	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
VE-12E	RELAB CESS29	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
VE-12E	RELAB MASS29E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).

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UNITED STATES OF AMERICA

AL-1	RELAB C1SS05	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
AL-1	RELAB N1SS05	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
AL-1	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].
AL-1E	RELAB CESS34	WR, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
AL-1E	RELAB MASS34E	WR, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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AL-2	RELAB C1SS06	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
AL-2	RELAB N1SS06	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
AL-2	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm;

		hull corrected and uncorrected spectra available [3].
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AL-3	RELAB C1LI04	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
AL-3	RELAB N1LI04	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
AL-3	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
AL-3E	RELAB CELI04	WR, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
AL-3E	RELAB MALI04E	WR, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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CA-1	RELAB C1DS01	<125µm, 30E/0E, 0.3-2.6µm, 5 nm.
CA-1	RELAB N1DS01	<125µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
CA-1	PIMA A-E	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [5].
CA-1E	RELAB CEOS24	<45µm crushed, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
CA-1E	RELAB MAOS24E	<45µm crushed, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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CA-2	RELAB C1DS02	<125µm, 30E/0E, 0.3-2.6µm, 5 nm.
CA-2	RELAB N1DS02	<125µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
CA-2	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].
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CA-3	RELAB C1LI01	<125µm, 30E/0E, 0.3-2.6µm, 5 nm.
CA-3	RELAB N1LI01	<125µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
CA-3	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
CA-3E	RELAB CELI01	<45µm crushed, 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
CA-3E	RELAB MALI01E	<45µm crushed, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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CA-4	RELAB C1SL01	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
CA-4	RELAB N1SL01	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
CA-4	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
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KY-1A	RELAB C1SS07	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
KY-1A	RELAB N1SS07	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
KY-1A	PIMA A-E	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [5].
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KY-2A	RELAB C1SS08	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
KY-2A	RELAB N1SS08	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
KY-2A	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
KY-2AE	RELAB CESS08	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
KY-2AE	RELAB MASS08E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
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OK-1	RELAB C1SS15	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
OK-1	RELAB N1SS15	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
OK-1	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].
OK-1E	RELAB CESS15	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
OK-1E	RELAB MASS15E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction;

		Nicolet FTIR).
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OK-2	RELAB C1SS16	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
OK-2	RELAB N1SS16	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
OK-2	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
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OK-5	RELAB C1SS17	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
OK-5	RELAB N1SS17	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
OK-5	PIMA A,C-E	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
	++++++	
TX-1	RELAB C1SS09	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
TX-1	RELAB N1SS09	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
TX-1	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].
TX-1E	RELAB CESS09	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
TX-1E	RELAB MASS09E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
	++++++	
UT-2	RELAB C1SS18	<125µm, 30E/0E, 0.3-2.6µm, 5 nm.
UT-2	RELAB N1SS18	<125µm, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
UT-2	PIMA A-C,E-F	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [5].
UT-2E	RELAB CESS18	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
UT-2E	RELAB MASS18E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).
	++++++	
UT-3	RELAB C1SS19	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
UT-3	RELAB N1SS19	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
UT-3	PIMA A-E	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [5].
	++++++	
UT-4	RELAB C1SS20	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
UT-4	RELAB N1SS20	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
UT-4	PIMA A-D	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [4].
	++++++	
WY-1	RELAB C1SS30	unsorted, 30E/0E, 0.3-2.6µm, 5 nm.
WY-1	RELAB N1SS30	unsorted, 30E/30E, 1.8-25.9µm, ~0.6-129 nm (Nicolet FTIR).
WY-1	PIMA A-C	<45 µm; bidirectional (PIMA has internal light source), 1.3-2.5µm, 2 nm; hull corrected and uncorrected spectra available [3].
WY-1E	RELAB CESS30	WR (?), 30E/0E, 0.3-2.6µm, 5 nm (toluene insoluble fraction).
WY-1E	RELAB MASS30E	WR (?), 30E/30E, 1.8-25.9µm, ~0.6-129 nm (toluene insoluble fraction; Nicolet FTIR).

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END of 18.4.

18. Organics

18.5. Synthetic Organics

This suite includes a wide variety of synthetic mostly polycyclic aromatic hydrocarbons.

18.5a. Sample Descriptions - Synthetic Organics

FORMAT: Sample #, description, locality, (source of sample), notes, old sample no. {manufacturer information}.

ORG001	Naphthalene 99+%; Aldrich #18,450-0. 250 g ordered. {Flammable, toxic, cancer suspect agent, irritant, target organs: eyes, lungs, blood, kidneys}.
ORG002	Anthracene, 99%; Aldrich #14,106-2. 25 g ordered. {Photosensitizer; irritant}.
ORG003	Phenanthrene 99.5%+; Aldrich #26,087-8. 1 g ordered. {harmful solid, irritant, photosensitizer, possible mutagen, handle and store under nitrogen}.
ORG004	Phenanthrene 98%; Aldrich #P1,140-9. 25 g ordered. {Harmful solid; irritant; photosensitizer; possible mutagen {handle and store under nitrogen according to above}}.
ORG005	1,2-Benzanthracene 99%; Aldrich #B220-9. 500 mg ordered. {cancer suspect agent, poison, mutagen}.
ORG006	2,3-Benzanthracene 98%; Aldrich #B240-3. 500 mg ordered. {irritating dust}.
ORG007	Chrysene 98%; Aldrich #42,507-9. 1 g ordered. {cancer suspect agent, mutagen, store under nitrogen}.
ORG008	Chrysene 95%; Aldrich #C8,000-8. 1 g ordered. {cancer suspect agent, mutagen}.
ORG009	*Pyrene 99%; Aldrich #42,642-3. 5 g ordered. Not available.*
ORG010	Pyrene 98%; Aldrich #18,551-5. 100 g ordered. {harmful solid, avoid contact and inhalation}.
ORG011	Pentacene; Aldrich #P180-2. 100 mg ordered. {keep refrigerated}.
ORG012	Benzo [a] pyrene 97%; Aldrich #B1,008-0. 3x100 mg ordered. {cancer suspect agent, mutagen, teratogen, target organ: skin, lungs}.
ORG013	Perylene 99+%; Aldrich #P1,120-4. 1 g ordered. {no warning}.
ORG014	Naphtho [2,3-a] pyrene 98%; Aldrich #38,094-6. 500 mg ordered. {harmful solid, avoid contact and inhalation}.
ORG015	Coronene sublimed 99%; Aldrich #33,535-5. 100 mg ordered. {harmful solid}.
ORG016	Triphenylene 98%; Aldrich #T8,260-0. 2x250 mg ordered.{no warning}.
ORG017	1- Methylanthracene 97%; Aldrich #33,357-3. 3x100 mg ordered. {no warning}.
ORG018	9- Methylanthracene 98%; Aldrich #M2,960-6. 1 g ordered. {no warning}.
ORG019	7- Methylbenzo [a] pyrene 98%; Aldrich #38,090-3. 500 mg ordered. {harmful solid, avoid contact and inhalation}.
ORG020	9,10- Dimethylanthracene 99%; Aldrich #D14,670-6. 1g ordered. {possible mutagen}.
ORG021	7,12- Dimethylbenz [a] anthracene 98+%; Aldrich #21,626-7. 1 g ordered. {toxic, mutagen, cancer suspect agent}.
ORG022	Dimethylnaphthalene mixture of isomers; Aldrich #11,241-0. 250 g ordered. [liquid]. {no warning}.
ORG023	1- Ethylnaphthalene 99+%; Aldrich #25,090-2. 1 g ordered. [liquid]. {no warning}.
ORG024	2- Ethylnaphthalene 99+%; Aldrich #E4,000-5. 5 g ordered. [liquid] {no warning}.
ORG025	2- Ethylanthracene 98%; Aldrich #21,466-3. 1 g ordered. {no warning}.
ORG026	1-Acenaphthenol 99%; Aldrich #A40-6. 1 g ordered. {no warning}.
ORG027	9- Phenanthrol tech.; Aldrich #21,128-1. 1 g ordered. {irritant, air sensitive}.
ORG028	9-Phenylanthracene 98%; Aldrich #P1,800-4. 1 g ordered. {no warning}.
ORG029	9,10- Diphenylanthracene 97%; Aldrich #D20,500-1. 1 g ordered. {no warning}.
ORG030	Decacyclene (unknown grade); Aldrich #D20-0. 5 g ordered. {no warning}.
ORG031	Acenaphthene 99%; Aldrich #21,537-6. 100 g ordered. {irritant}.
ORG032	9,10-Dihydroanthracene 97%; Aldrich #12,617-9. 5 g ordered. {no warnings}.
ORG033	9,10- Dihydrophenanthrene 94%; Aldrich #D10,600-3. 5 g ordered.{no warning}.
ORG034	Fluorene zone-refined 99%; Aldrich #41,819-6. 1 g ordered. {no warning}.
ORG035	Fluoranthene 99%; Aldrich #42,394-7. 5 g ordered. {harmful solid, possible mutagen, store under nitrogen}.
ORG036	2-Acetylfluorene 98%; Aldrich #A1,620-3. 5 g ordered. {no warning}.
ORG037	2- Acetylphenanthrene 98%; Aldrich #A1,920-2. 1 g ordered. {no warning}.

ORG038 Phenanthrene - 9 - carboxaldehyde 97%; Aldrich #P1,160-3. 2.5 g ordered. {no warning}.
ORG039 1- Acetylpyrene 97%. Aldrich #39,142-5. 1 g ordered. {no warning}.
ORG040 Benzothiazole 96%; Aldrich #10,133-8. 100 g ordered. [liquid]. {toxic, irritant}.
ORG041 Dibenzothiophene 99%; Aldrich #34,783-3. 1 g ordered. {toxic}.
ORG042 9- Anthracenecarbonitrile 97%; Aldrich #15,276-5. 5 g ordered. {harmful solid, avoid skin contact}.
ORG043 9- Nitroanthracene 97%; Aldrich #N1,020-9. 1 g ordered. {no warning}.
ORG044 Carbazole 96%; Aldrich #C310-3. 1 g ordered. {irritant, possible carcinogen}.
ORG045 9- Cyanophenanthrene 97%; Aldrich #C9,360-6. 5 g ordered. {harmful solid, irritant, avoid contact and inhalation}.
ORG046 Dibenzothiophene sulfone 97%; Aldrich #D3,240-7. 5 g ordered. {no warning}.
ORG047 9(10 *H*)-Acridone 99%; Aldrich #15,021-5. 1 g ordered. {irritant}.
ORG048 2- Aminoanthracene 96%; Aldrich #A3,880-0. 1 g ordered. {possible carcinogen/mutagen, irritant}.
ORG049 Phenothiazine 98+%; Aldrich #P1,483-1. 25 g ordered. {Toxic; photosensitizer; sensitizer; possible mutagen; readily absorbed through skin; irritant; *light sensitive*}.
ORG050 Phenoxathiin 97%; Aldrich #21,882-0. 5 g ordered. {no warning}.
ORG051 Phenoxazine 99+%; Aldrich #P1,485-8. 1 g ordered. {no warning}.
ORG052 Perinaphthenone 97%; Aldrich #P1,080-1. 1 g ordered. {no warning}.
ORG053 Xanthene 99%; Aldrich #X20-1. 5 g ordered. {sensitizer, avoid contact and inhalation}.
ORG054 Xanthone 97%; Aldrich #D60-0. 25 g ordered. {Sensitizer; avoid contact and inhalation}.
ORG055 Dihydrocoumarin 99%; Aldrich #D10,480-9. 5 g ordered. [liquid] {irritant, harmful liquid}.
ORG056 Anthrone 97%; Aldrich #31,989-9. 25 g ordered. {Irritant; photosensitizer}.
ORG057 Anthraquinone 97%; Aldrich #A9,000-4. 50 g ordered. {irritant}.

ORG058 Sodium diphenylamine-4-sulfonate [$C_{12}H_{10}NNaO_3S$]. Aldrich #24,296-9; 10 grams. *For iron wet chemistry titration.*

ORG059 Disodium EDTA [$Na_2C_{10}H_{16}O_8$] (synthetic); UW Chemistry stores?
ORG060 Sodium citrate [$Na_3C_6H_5O_7 – 2H_2O$] (synthetic); UW Chemistry stores?
ORG061 Trisodium citrate [$Na_3C_6H_5O_7$] (synthetic); UW Chemistry stores *(same as ORG060?).*

PIG019 Synthetic carmine (alum lake of carminic acid). received. See Pigments section *(for pigments project).*
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18.5d. Spectral Data - Synthetic organics

(a) Reflectance spectra

Format: Sample ID; Lab and file; measurement details.

Sample ID	*Facility/File No.*	*Description*
ORG001	PSF 090831b.001	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
++++++		
ORG002	PSF 090831b.002	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG002	PSF org002crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG002	PSF org002sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG003	PSF 090831b.003	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG003	PSF org003crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG003	PSF org003sub250	<250 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG004	PSF 090831b.004	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG004	PSF org004crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG004	PSF org004sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG005	PSF 090831b.005	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG005	PSF org005crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG005	PSF org005sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG006	PSF 090831b.006	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG006	PSF org006crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG006	PSF org006sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG007	PSF 090831b.007	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG007	PSF org007crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG007	PSF org007sub90	<90 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG008	PSF 090831b.008	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG008	PSF org008crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on

		Buck spectrometer); 6 minute integration; Aug. 09.
ORG008	PSF org008sub90	<90 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG010	PSF 090831b.009	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG010	PSF org010crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG010	PSF org010sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG011	PSF 090831b.010	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG011	PSF org011sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG012	PSF 090831b.011	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG012	PSF org012crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG013	PSF 090831b.012	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG013	PSF org013crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG013	PSF org013sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG014	PSF 090831b.013	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG014	PSF org014crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG014	PSF org014sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG015	PSF 090831b.014	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG015	PSF org015sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG016	PSF 090831b.015	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG016	PSF org016crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG016	PSF org016sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG017	PSF 090831b.016	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG017	PSF org017sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG018	PSF 090831b.017	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG018	PSF org018crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.

ORG018	PSF org018sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG019	PSF 090831b.018	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG019	PSF org019crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG019	PSF org019sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG020	PSF 090831b.019	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG020	PSF org020crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG020	PSF org020sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG025	PSF 090831b.020	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG025	PSF org025crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG025	PSF org025sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG026	PSF 090831b.021	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG026	PSF org026crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG026	PSF org026sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG027	PSF 090831b.022	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG027	PSF org027crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG027	PSF org027crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG027	PSF org027sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG028	PSF 090831b.023	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG028	PSF org028crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG028	PSF org028sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG029	PSF 090831b.024	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG029	PSF org029crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG029	PSF org029sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG030	PSF 090831b.026	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.

ORG030	PSF org030crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG030	PSF org030sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG031	PSF 090831b.027	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG031	PSF org031crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG031	PSF org031sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG032	PSF 090831b.028	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG032	PSF org032crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG032	PSF org032sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG034	PSF 090831b.029	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG034	PSF org034crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG034	PSF org034sub90	<90 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG035	PSF 090831b.030	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG035	PSF org035crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG035	PSF org035sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG036	PSF 090831b.031	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG036	PSF org036crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG036	PSF org036sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG037	PSF 090831b.032	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG037	PSF org037crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG037	PSF org037sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG038	PSF 090831b.033	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG038	PSF org038crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG038	PSF org038sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG039	PSF 090831b.034	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.

ORG039	PSF org039crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG039	PSF org039sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG041	PSF 090831b.035	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG041	PSF org041crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG041	PSF org041sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG042	PSF 090831b.036	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG042	PSF org042crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG042	PSF org042sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG043	PSF 090831b.037	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG043	PSF org043crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG043	PSF org043sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG044	PSF 090831b.038	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG044	PSF org044crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG044	PSF org044sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG045	PSF 090831b.039	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG045	PSF org045crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG045	PSF org045sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG046	PSF 090831b.040	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG046	PSF org046crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG046	PSF org046sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG047	PSF 090831b.042	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG047	PSF org047crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG047	PSF org047sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG048	PSF 090831b.043	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.

ORG048	PSF org048crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG048	PSF org048sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG049	PSF 090831b.044	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG049	PSF org049crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG049	PSF org049sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG050	PSF 090831b.045	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG050	PSF org050crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG050	PSF org050sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG051	PSF 090831b.046	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG051	PSF org051crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG051	PSF org051sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG052	PSF 090831b.047	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG052	PSF org052crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG052	PSF org052sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG053	PSF 090831b.048	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG053	PSF org053crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG053	PSF org053sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG054	PSF 090831b.050	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG054	PSF org054crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG054	PSF org054sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG056	PSF 090831b.051	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.
ORG056	PSF org056crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG056	PSF org056sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
++++++		
ORG057	PSF 090831b.052	<45 µm; i=30°/e=0°; 0.35-2.5 µm; 1 nm output, 500 spectra averaged; ASD.

ORG057	PSF org057crushed	unsorted powder; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.
ORG057	PSF org057sub45	<45 µm; i=30°, e=30°; 4 cm^{-1} resolution; 2.5-16.7 µm (EasiDiff on Buck spectrometer); 6 minute integration; Aug. 09.

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(b.1) Raman spectra – 532 nm (iRaman)

Raman shift: 174-4004 cm^{-1}; 100% laser power= 100 mW; ~4 cm^{-1} resolution; i=0°/e=0°.

ORG001	PSF org001	unsorted powder; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
++++++		
ORG002	PSF org002	<45 µm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG002	PSF org002	unsorted powder; 2 sec integration time; 50% laser power (directory: 120820synthetic_organics).
++++++		
ORG003	PSF org003	<250 µm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG003	PSF org003	unsorted powder; 2 sec integration time; 100% laser power (directory: 120820synthetic_organics).
++++++		
ORG004	PSF org004	<45 µm; 2 sec integration time; 30% laser power (directory: 120726synthetic_organics).
ORG004	PSF org004	unsorted powder; 2 sec integration time; 20% laser power (directory: 120820synthetic_organics).
++++++		
ORG005	PSF org005	<45 µm; 2 sec integration time; 5% laser power (directory: 120726synthetic_organics).
+++++		
ORG006	PSF org006	<45 µm; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
++++++		
ORG007	PSF org007	<90 µm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG007	PSF org007	unsorted powder; 2 sec integration time; 50% laser power (directory: 120820synthetic_organics).
++++++		
ORG008	PSF org008	<90 µm; 2 sec integration time; 50% laser power (directory: 120726synthetic_organics).
ORG008	PSF org008	unsorted powder; 2 sec integration time; 10% laser power (directory: 120820synthetic_organics).
++++++		
ORG010	PSF org010	<45 µm; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
++++++		
ORG012	PSF org012	unsorted powder; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
++++++		
ORG013	PSF org013	unsorted powder; 2 sec integration time; 2% laser power (directory: 120726synthetic_organics).
ORG013	PSF org013	<45 µm; 1 sec integration time; 2% laser power (directory: 120820synthetic_organics).
++++++		
ORG014	PSF org014	unsorted powder; 2 sec integration time; 5% laser power (directory:

		120726synthetic_organics).
++++++		
ORG015	PSF org015	<45 μm; 2 sec integration time; 5% laser power (directory: 120726synthetic_organics).
++++++		
ORG016	PSF org016	<45 μm; 2 sec integration time; 2% laser power (directory: 120726synthetic_organics).
++++++		
ORG017	PSF org017	unsorted powder; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
++++++		
ORG018	PSF org018	<45 μm; 1 sec integration time; 2% laser power (directory: 120726synthetic_organics).
ORG018	PSF org018	unsorted powder; 2 sec integration time; 2% laser power (directory: 120820synthetic_organics).
++++++		
ORG019	PSF org019	unsorted powder; 2 sec integration time; 2% laser power (directory: 120726synthetic_organics).
++++++		
ORG020	PSF org020	<45 μm; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
ORG020	PSF org020	unsorted powder; 2 sec integration time; 2% laser power (directory: 120820synthetic_organics).
++++++		
ORG021	PSF org021	unsorted powder; 2 sec integration time; 5% laser power (directory: 120726synthetic_organics).
++++++		
ORG025	PSF org025	<45 μm; 2 sec integration time; 20% laser power (directory: 120726synthetic_organics).
++++++		
ORG026	PSF org026	unsorted powder; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
++++++		
ORG027	PSF org027	<45 μm; 65 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG027	PSF org027	unsorted powder; 2 sec integration time; 100% laser power (directory: 120820synthetic_organics).
++++++		
ORG028	PSF org028	unsorted powder; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
++++++		
ORG029	PSF org029	<45 μm; 2 sec integration time; 50% laser power (directory: 120726synthetic_organics).
ORG029	PSF org029	unsorted powder; 2 sec integration time; 2% laser power (directory: 120820synthetic_organics).
++++++		
ORG031	PSF org031	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
++++++		
ORG032	PSF org032	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
++++++		
ORG034	PSF org034	unsorted powder; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
++++++		
ORG035	PSF org035	<45 μm; 2 sec integration time; 80% laser power (directory:

		120726synthetic_organics).
ORG035	PSF org035	unsorted powder; 2 sec integration time; 50% laser power (directory: 120820synthetic_organics).
++++++		
ORG036	PSF org036	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG036	PSF org036	unsorted powder; 2 sec integration time; 10% laser power (directory: 120820synthetic_organics).
++++++		
ORG037	PSF org037	unsorted powder; 2 sec integration time; 50% laser power (directory: 120726synthetic_organics).
++++++		
ORG038	PSF org038	<45 μm; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
ORG038	PSF org038	unsorted powder; 2 sec integration time; 2% laser power (directory: 120820synthetic_organics).
++++++		
ORG039	PSF org039	<45 μm; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
ORG039	PSF org039	unsorted powder; 2 sec integration time; 2% laser power (directory: 120820synthetic_organics).
++++++		
ORG041	PSF org041	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
++++++		
ORG042	PSF org042	<45 μm; 2 sec integration time; 50% laser power (directory: 120726synthetic_organics).
++++++		
ORG043	PSF org043	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG043	PSF org043	unsorted powder; 2 sec integration time; 100% laser power (directory: 120820synthetic_organics).
++++++		
ORG044	PSF org044	unsorted powder; 2 sec integration time; 50% laser power (directory: 120726synthetic_organics).
++++++		
ORG045	PSF org045	<45 μm; 2 sec integration time; 20% laser power (directory: 120726synthetic_organics).
++++++		
ORG046	PSF org046	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG046	PSF org046	unsorted powder; 2 sec integration time; 100% laser power (directory: 120820synthetic_organics).
++++++		
ORG047	PSF org047	<45 μm; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
ORG047	PSF org047	unsorted powder; 2 sec integration time; 2% laser power (directory: 120820synthetic_organics).
++++++		
ORG048	PSF org048	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG048	PSF org048	unsorted powder; 2 sec integration time; 50% laser power (directory: 120820synthetic_organics).
++++++		
ORG049	PSF org049	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).

ORG049	PSF org049	unsorted powder; 2 sec integration time; 50% laser power (directory: 120820synthetic_organics).
++++++		
ORG050	PSF org050	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
ORG050	PSF org050	unsorted powder; 2 sec integration time; 10% laser power (directory: 120820synthetic_organics).
++++++		
ORG051	PSF org051	unsorted powder; 2 sec integration time; 10% laser power (directory: 120820synthetic_organics).
++++++		
ORG052	PSF org052	<45 μm; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
ORG052	PSF org052	unsorted powder; 2 sec integration time; 2% laser power (directory: 120820synthetic_organics).
++++++		
ORG053	PSF org053	unsorted powder; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).
++++++		
ORG054	PSF org054	<45 μm; 2 sec integration time; 10% laser power (directory: 120726synthetic_organics).
++++++		
ORG056	PSF org056	<45 μm; 2 sec integration time; 5% laser power (directory: 120726synthetic_organics).
++++++		
ORG057	PSF org057	<45 μm; 2 sec integration time; 100% laser power (directory: 120726synthetic_organics).

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(b.2) Raman spectra – 785 nm (Rockhound)

Raman shift:200-2000 cm^{-1}; ~7 cm^{-1} resolution; i=0°/e=0°.

ORG002	PSF org002	<45 μm; 2 sec integration time; 100% laser power; 20 spectra averaged (directory: 40102 (03/18/2013)).
++++++		
ORG046	PSF org046	<45 μm; 2 sec integration time; 100% laser power; 20 spectra averaged (directory: 40102 (03/18/2013)).
++++++		
ORG050	PSF org050	<45 μm; 2 sec integration time; 5% laser power (directory: 120726synthetic_organics).

++

(c) UV spectra – Maya spectrometer

Measured with deuterium and QTH lamps – usable range (200-~400 nm for deuterium; ~400-1130 nm for QTH) spectra merged at 400 nm; bifurcated cable (i=e=0°); ~0.4 nm sampling interval, ~1.85 nm spectral resolution; 600 msec integration time; 200 spectra averaged (Directory: 130927pah uv reflectance)

ORG001	PSF org001	
ORG002	PSF org002	
ORG002	PSF org002	*Directory: 140419 UV reflectance; run as end member for mixture set (section 15.26)*
ORG003	PSF org003	
ORG004	PSF org004	
ORG005	PSF org005	

ORG006	PSF org006
ORG008	PSF org008
ORG010	PSF org010
ORG011	PSF org011
ORG012	PSF org012
ORG014	PSF org014
ORG015	PSF org015
ORG016	PSF org016
ORG017	PSF org017
ORG018	PSF org018
ORG019	PSF org019
ORG020	PSF org020
ORG021	PSF org021
ORG026	PSF org026
ORG027	PSF org027
ORG028	PSF org028
ORG029	PSF org029
ORG030	PSF org030
ORG031	PSF org031
ORG032	PSF org032
ORG035	PSF org035
ORG036	PSF org036
ORG037	PSF org037
ORG038	PSF org038
ORG041	PSF org041
ORG042	PSF org042
ORG043	PSF org043
ORG044	PSF org044
ORG045	PSF org045
ORG046	PSF org046
ORG047	PSF org047
ORG048	PSF org048
ORG049	PSF org049
ORG050	PSF org050
ORG051	PSF org051
ORG052	PSF org052
ORG053	PSF org053
ORG054	PSF org054
ORG056	PSF org056
ORG057	PSF org057
ORG058	PSF org058
ORG059	PSF org059
ORG060	PSF org060
ORG061	PSF org061

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END of 18.5.

19. Pigments – Art Analysis

19a. Sample Descriptions - Pigments

Note: *Includes synthetic and naturally-occurring samples, and various artists' materials.*
Note: *PIGxxx data are provided in this section (PIGxxx samples are listed in relevant mineral sections). Non-PIGxxx data are provided in relevant mineral sections of this document and just listed in this section).*

Sample ID *Description*

19.1a. Natural samples of historical pigments:

See relevant sections of this document for sample info, analytical data, spectral data.

(i) Non-PIGxxx samples

ASP101 Asphaltum: Seefeld, North Tyrol, Austria (Minerals Unlimited), also known as DK1 and DARK101. *See section 18.3 of this document.*

CHL103 Paratacamite: Mason Pass, Lyon County, Nevada, USA ($Cu_2^{+2}(OH)_3Cl$) (Minerals Unlimited). *See section 7 of this document.*

CHL104 Atacamite: Chuquicamata, Chile ($Cu_2^{+2}(OH)_3Cl$) (Minerals Unlimited). *See section 7 of this document.*

CHL105 Atacamite: San Manuel, Arizona, USA ($Cu_2^{+2}(OH)_3Cl$) (Smithsonian Institution MNMH #154535). *See section 7 of this document.*

CHL106 Paratacamite: Chiquicamata, Chile ($Cu_2^{+2}(OH)_3Cl$) (Smithsonian Institution MNMH #B8667). *See section 7 of this document.*

CHL107 Atacamite: Atacama, Chile ($Cu_2^{+2}(OH)_3Cl$) (Smithsonian Institution MNMH #17691). *See section 7 of this document.*

CHY101 Chrysocolla: Inspiration, Gila County, Arizona, USA ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$ (Minerals Unlimited). *See section 3 of this document.*

CHY102 Chrysocolla: Gila County, Arizona, USA ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$) (Smithsonian Institution MNMH #87288). *See section 3 of this document.*

CHY103 Chrysocolla: Copper Queen Mine, Bisbee, Cochise County, Arizona, USA; ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$) (Smithsonian Institution MNMH #104956). *See section 3 of this document.*

CIN101 Cinnabar: Arcana Creek, near Aleknagic, Alaska, USA (HgS) (Minerals Unlimited). *See section 10 of this document.*

CIN102 Cinnabar: New Almaden, California, USA (HgS) (Smithsonian Institution #C458). *See section 10 of this document.*

CIN103 Cinnabar: Idria, Carinthia, Austria (HgS) (Smithsonian Institution MNMH #78539-1). *See section 10 of this document.*

CLI101 Clinochlore (chlorite): near Murphys, Calaveras County, California, USA $(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$ (Minerals Unlimited). *See section 3 of this document.*

CLI102 Clinochlore (chlorite): Cornwall, Pennsylvania, USA ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$) (Smithsonian Institution MNMH #R14987). *See section 3 of this document.*

CLI103 Clinochlore (chlorite): Lane Quarry, Westfield, Massachusetts, USA ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$) (Smithsonian Institution MNMH #106730). *See section 3 of this document.*

CRB102 Aragonite + calcite: Washington County, Utah, USA [$CaCO_3$] (Minerals Unlimited). {Silky white compact masses, some rock}. Lots of sample and <45 and 45-90µm sizes made (dry sieved). *See section 5 of this document.*

CRB109 Calcite: locality unknown (University of Alberta GEOL330 laboratory collection #A152), originally PLG112, then CAL101. Some <45 and 45-90µm sample available (few grams) (dry sieved). *See section 5 of this document.*

CRB110 Calcite: locality unknown (University of Alberta GEOL330 laboratory collection # unknown),

[$CaCO_3$] with pyroxene PYX104, originally CAL102. <45µm sample made (dry sieved). *See section 5 of this document.*

CRB111 Calcite: Cascade Mountain, Essex County, New York, USA (Minerals Unlimited), [$CaCO_3$] w/ pyroxene PYX121, originally CAL103. Only <45µm sample made (dry sieved). *See section 5 of this document.*

CRB112 Calcite: Pendleton County, West Virginia, USA (Ward's), originally CAL110, [$CaCO_3$]. Lots of sample available, only <45µm size made (dry sieved). *See section 5 of this document.*

CRB116 Calcite: Oklahoma, USA [$CaCO_3$] (National Museum of Nature, Ottawa). *See section 5 of this document.*

CRB118 Calcite: Chihuahua, Mexico [$CaCO_3$] (Manitoba Rock and Mineral Show). *See section 5 of this document.*

CRB119 Mostly Aragonite: Goodsprings, Clark County, Nevada, USA [$CaCO_3$] (Minerals Unlimited). *See section 5 of this document.*

CRB120 Aragonite: near Silverton, Briscoe County, Texas, USA [$CaCO_3$] (Minerals Unlimited). *See section 5 of this document.*

CRB122 Calcite: near Yeso, De Baca County, New Mexico, USA [$CaCO_3$] (Minerals Unlimited). *See section 5 of this document.*

CRB123 Aragonite: Molina de Aragon, Guadalajara, Spain (Minerals Unlimited). *See section 5 of this document.*

CRB124 Aragonite: Erzberg Eisenwurz, Stiermark, Austria [$CaCO_3$] (Smithsonian Institution MNMH #B10111). *See section 5 of this document.*

CRB125 Aragonite: Stiermark, Austria [$CaCO_3$] (Smithsonian Institution MNMH #B16198). *See section 5 of this document.*

CRB501 Malachite: Copper Queen Mine, Bisbee, Cochise County, Arizona, USA ($Cu_2^{2+}(CO_3)(OH)_2$) (Minerals Unlimited). *See section 5 of this document.*

CRB502 Cerussite: Tsumeb, Namibia ($PbCO_3$) (Minerals Unlimited). {Pure mineral is white, but mine is black, probably due to impurities(?)}. Also called white lead. *See section 5 of this document.*

CRB503 Azurite: Juanita Mine, Magdalena, Socorro County, New Mexico, USA ($Cu_3^{+2}(CO_3)_2(OH)_2$ (with limonite, malachite, and clay) (Minerals Unlimited). *See section 5 of this document.*

CRB504 Azurite: locality unknown ($Cu_3^{+2}(CO_3)_2(OH)_2$ (acquired at 2001 Manitoba Rock and Mineral Show). *See section 5 of this document.*

CRB505 Hydrocerussite: Langban, Varmland, Sweden ($Pb_3(CO_3)_2(OH)_2$) (Smithsonian Institution MNMH #B8107). *See section 5 of this document.*

CRB506 Cerussite: Mammoth Mine, Wallace, Idaho, USA ($PbCO_3$) (Smithsonian Institution MNMH #96778). *See section 5 of this document.*

CRB507 Cerussite: Lone Elm, near Joplin, Missouri, USA ($PbCO_3$) (Smithsonian Institution MNMH #C2130-1). *See section 5 of this document.*

CRB508 Malachite: Canton, Georgia, USA ($Cu_2^{2+}(CO_3)(OH)_2$) (Smithsonian Institution MNMH #78806). *See section 5 of this document.*

CRB509 Malachite: El Cobre Mine, Zacatecas, Mexico ($Cu_2^{2+}(CO_3)(OH)_2$) (Smithsonian Institution MNMH #143514). *See section 5 of this document.*

CRB510 Azurite: Guangdong, China ($Cu_3^{+2}(CO_3)_2(OH)_2$) (Smithsonian Institution MNMH #145930). *See section 5 of this document.*

CRB511 Azurite: Chessy, Lyon, Rhone, France ($Cu_3^{+2}(CO_3)_2(OH)_2$) (Smithsonian Institution MNMH #148829). *See section 5 of this document.*

CRC001 Crocoite: Tasmania, Australia ($PbCrO_4$). From Sue Atkinson. *See section 14 of this document.*

CRC002 Crocoite: Beresowsk, Urals, USSR ($PbCrO_4$) (Smithsonian Institution MNMH #B11577). *See section 14 of this document.*

CRC003 Crocoite: Dundas, Tasmania, Australia ($PbCrO_4$) (Smithsonian Institution MNMH #C4606-6). *See section 14 of this document.*

CRO101 Cronstedtite: 411 level, Llallagua, Bolivia (on hisingerite) (Smithsonian NMNH #193910). [$Fe^{+2}_2 Fe^{+3}(SiFe^{+3})O_5(OH)_4$]. *See section 3 of this document.*

CRO102 Cronstedtite: Herja, Crisana-Maramures, Romania (Smithsonian NMNH #R7807-4). [$Fe^{+2}_2 Fe^{+3}(SiFe^{+3})O_5(OH)_4$]. *See section 3 of this document.*

GLA103 Glauconite: Villers-sur-Mer, Calvados, France (Smithsonian NMNH #46447). [$(K,Na)(Fe^{+3},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2$]. *See section 3 of this document.*

GLA104 Glauconite: Bighorn Mountain, Wyoming (8000 feet), Wyoming (Smithsonian NMNH #97839). $[(K,Na)(Fe^{+3},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2]$. *See section 3 of this document.*

GRE101 Greenockite: San Bernardino County, California, USA (CdS) (Smithsonian Institution MNMH #156721) (yellow pigment). *See section 10 of this document.*

GRP101 Graphite: Ratnapura District, Sri Lanka (Excalibur Mineral Co.). <37, <45 and 45-90µm powders made by crushing and dry sieving (?). Sample left. *See section 1 of this document.*

GRP102 Graphite: synthetic "amorphous" graphite (Johnson Matthey, #10130A), -300 mesh, 99.5% pure. <45µm powder by dry sieving. Sample left. *See section 1 of this document.*

GRP103 Graphite: Dillon, Beaverhead County, Montana (Minerals Unlimited), with schist. <45µm sample by crushing and dry sieving (?). Sample left. *See section 1 of this document.*

GRP104 Graphite: Seathwaite Mine, Borrowdale, Cumbria, England (David Shannon Minerals). <45µm sample by crushing and dry sieving (?). Sample left. *See section 1 of this document.*

GRP105 Graphite: 3R - Spitzkoppe, Namibia (David Shannon Minerals). <45 and >45µm samples by crushing, dry sieving (?) and dissolution of host carbonate with HCl. Sample left. *See section 1 of this document.*

GRP106 Graphite: Madagascar (University of Winnipeg mineral collection #M100-6). <45µm sample by crushing and dry sieving (?). Sample left. *See section 1 of this document.*

GRP107 Graphite: South Dakota (University of Winnipeg mineral collection #M100-5). <45µm sample by crushing and dry sieving (?). Sample left. *See section 1 of this document.*

HAU101 Hauyne: Ariccia, near Rome, Italy; in rock: $((Na,Ca)_{4-8}Al_6Si_6(O,S)_{24}(SO_4,Cl)_{1-2})$ (Minerals Unlimited; blue, white, gray, sometimes green). *See section 2.8 of this document.*

HAW101 Hawleyite: Eureka County, Nevada, USA (CdS) (Smithsonian Institution MNMH #120642) (yellow pigment). *See section 10 of this document.*

HEM101 Hematite: (Dick Morris sample HMS3; from Pfizer; produced by calcination of iron salts) [See Morris et al., JGR 90, pp. 3126-3144 (1985) for description]. <140 nm powder provided. (ideally "-Fe_2O_3). *See section 9.6 of this document.*

HEM102 Hematite: Bouse, Arizona, USA ("-Fe_2O_3) (Tyson's Fine Minerals). *See section 9.6 of this document.*

HEM103 Hematite: locality unknown ("-Fe_2O_3) (National Museum of Nature, Ottawa). *See section 9.6 of this document.*

JAD001 “Jade”: locality unknown, probably British Columbia [could be nephrite (tremolite-actinolite $(Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$ (more probable); or jadeite - a pyroxenoid $(NaAlSi_2O_6)$] (acquired from 2001 Manitoba Rock and Mineral Show) (for pigments project - although not a pigment). *See section 2.11 of this document.*

KAO101 Kaolinite: locality unknown $[Al_4(Si_4O_{10})(OH)_8]$ (University of Alberta GEOL330 laboratory collection Drawer 23, ascension 13). *See section 3 of this document.*

KAO102 Kaolinite (china clay): Edgar, Florida, USA $[Al_4(Si_4O_{10})(OH)_8]$ (Ward's # 46 E 0995). *See section 3 of this document.*

KAO103 Kaolinite (well ordered), Washington County, Georgia, USA $[Al_4(Si_4O_{10})(OH)_8]$ (Source Clay Minerals Repository #KGa-1b) (came as <45µm powder). *See section 3 of this document.*

KAO104 Kaolinite (poorly ordered), Warren County, Georgia, USA $[Al_4(Si_4O_{10})(OH)_8]$ (Source Clay Minerals Repository #KGA-2) (came as <45µm size powder). *See section 3 of this document.*

LCA101 Carbon lampblack: synthetic (Johnson Matthey, #14237A), <0.021µm size. Powder by dry sieving. Sample left. *See section 1 of this document.*

MIN101 Minium: 30 miles south of Tucson, Arizona, USA $(Pb_2^{2+}Pb^{4+}O_4)$ (Smithsonian Institution). *See section 9.6 of this document.*

MIN102 Minium: Del Pratt shaft, BHP Mine, Broken Hill, New South Wales, Australia (Smithsonian Institution). *See section 9.6 of this document.*

NOS101 Nosean: Laacher See, Eifel, Kaiserstuhl, Rheinland, Germany $(Na_8Al_6Si_6O_{24}(SO_4)\cdot H_2O$ (small black crystals in phonolite; member of sodalite group. (For pigment project - present in lapis lazulli according to Bacci). (Minerals Unlimited), but my sample is black. *See section 2.8 of this document.*

OOH001 Bauxite: Guyana (Minerals Unlimited). Lots of sample; made <45 and 45-90µm fractions (dry sieve). Sample is predominantly gibbsite. *See section 6 of this document.*

OOH002 Bauxite: Pulaski County, Arkansas, USA (Minerals Unlimited). Lots of sample, made <45 and 45-90µm fractions (dry sieve). Sample is predominantly gibbsite. *See section 6 of this document.*

OOH004 Gibbsite: Minas Gerais, Brazil (Minerals Unlimited) $[Al(OH)_3]$ (Minerals Unlimited). A couple of

grams (DHZ: white, pale pink, pale green, grey, light brown; MU: white, compact radial fibrous masses). Couple of grams of <45 and 45-90µm made (dry sieve), a couple of grams left. *See section 6 of this document.*

ORP101 Orpiment: Getchell Mine, near Golconda, Humboldt County, Nevada, USA (As_2S_3) (Minerals Unlimited) (light sensitive). *See section 10 of this document.*

ORP102 Orpiment: Felsobanya, Romania (As_2S_3) (Smithsonian Institution MNMH #R13305). *See section 10 of this document.*

ORP103 Orpiment: Manhattan, Nevada, USA Romania (As_2S_3) (Smithsonian Institution MNMH #155082). *See section 10 of this document.*

PHS101 Apatite: Jacupiranga Mine, Sao Paulo State, Brazil (Nature's Treasures), with magnetite MAG101; originally labelled as olivine OLV014; aka APA102. *See section 4 of this document.*

PHS104 Apatite: Wilson's Corner, Quebec, Canada (Dr. David Garske #AL14b), originally PYX004; location of sample presently unknown; aka APA104. *See section 4 of this document.*

PRL101 Pyrolusite: Lake Valley, Sierra County, New Mexico, USA; in rock. ($-$Mn^{+4}O_2$) (Minerals Unlimited). Black pigment affected by Raman heating - Smith and Clark). *See section 9.6 of this document.*

QUA101 Quartz: locality unknown (National Museum of Nature, Ottawa). *See section 2.11 of this document.*

REA101 Realgar: Getchell Mine, near Golconda, Humboldt County, Nevada, USA (AsS) (Minerals Unlimited) (light sensitive). *See section 10 of this document.*

REA102 Realgar: Cavnic, Crisana-Maramures, Romania (AsS) (Smithsonian Institution MNMH #159151). *See section 10 of this document.*

REA103 Realgar: Basses Alps, France (AsS) (Smithsonian Institution MNMH #B551). *See section 10 of this document.*

RUT101 Rutile: near Roseland, Nelson County, Virginia, USA (Minerals Unlimited) (ideally TiO_2). *See section 9.6 of this document.*

RUT102 Rutile: Kragero, Telemark, Norway (Minerals Unlimited) (ideally TiO_2). *See section 9.6 of this document.*

SPT127 Gypsum (var. selenite): Utah, USA [$CaSO_4 \cdot 4H_2O$] (University of Winnipeg collection M168-39) (see sulphates section). *See section 8 of this document.*

SPT128 Anhydrite: locality unknown [$CaSO_4$] (University of Winnipeg collection M170-1) (see sulphates section). *See section 8 of this document.*

SPT145 Anglesite: Excepcion Mine, Villa Ahumada, Chihuahua, Mexico ($PbSO_4$) (Minerals Unlimited) (see sulphates section). *See section 8 of this document.*

SPT146 Barite: Castle Dome, Yuma County, Arizona, USA ($BaSO_4$) (Minerals Unlimited) (see sulphates section). *See section 8 of this document.*

SPT147 Anglesite: Tsumeb, Namibia ($PbSO_4$) (Smithsonian Institution MNMH #163581) (see sulphates section). *See section 8 of this document.*

SPT148 Anglesite: Italy ($PbSO_4$) (Smithsonian Institution MNMH #B10901) (see sulphates section). *See section 8 of this document.*

SPT150 Lazurite: Afghanistan ($(Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$) (Minerals Unlimited) (see sulphates section). *See section 8 of this document.*

SPT151 Lazurite: locality unknown ($(Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$) (purchased at 2001 Manitoba Rock and Mineral Show) (see sulphates section). *See section 8 of this document.*

SPT152 Lazurite: Chile ($(Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$) (Smithsonian Institution MNMH #126134) (see sulphates section). *See section 8 of this document.*

SPT153 Lazurite: Cordicleres, Argentina ($(Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$) (Smithsonian Institution MNMH #C2677) (see sulphates section). *See section 8 of this document.*

TAL101 Talc: Esmeralda County, Nevada, USA ($Mg_3Si_4O_{10}(OH)_2$) (Minerals Unlimited) (see clays section). *See section 3 of this document.*

TAL102 Talc: $3MgO \cdot 4SiO_2 \cdot H_2O$. Aldrich: 42,043-3: 25 grams. Synthetic? Also labelled as PIG006 (see clays section). *See section 3 of this document.*

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19.2a. Synthetic samples of historical pigments and associated materials (PIGxxx and ARTxxx):

19.2a.1. Acquired prior to 2007

PIG001 Aluminum hydroxide: $(Al(OH)_3)$. Aldrich 23,918-6: 500 g. Synthetic version of gibbsite. Also known as White lake. [Label warning: Irritant! Absorbs CO_2 from air!]. *Also see section 6 of this document.*

PIG002 Calcium sulfate: $CaSO_4$. Aldrich 23,713-2: 100 grams. Synthetic version of anhydrite. [Label warning: Irritating dust! Hygroscopic!]. *Also see section 8 of this document.*

PIG003 Barium sulfate: $BaSO_4$. Aldrich 24,335-3: 100 grams. Synthetic version of barite. [Label warning: none]. *Also see section 8 of this document.*

PIG004 Calcium carbonate: $CaCO_3$. Aldrich 23,921-6: 100 grams. Synthetic version of calcite. Also known as calcium carbonate and whiting. [Label warning: Severe irritant! Hygroscopic! Keep tightly closed!]. *Also see section 5 of this document.*

PIG005 Calcium sulfate dihydrate: $CaSO_4 \cdot 2H_2O$. Aldrich 25,554-8: 100 grams. Synthetic version of gypsum. [Label warning: Irritating dust! Hygroscopic!]. *Also see section 8 of this document.*

PIG006 Talc: $3MgO \cdot 4SiO_2 \cdot H_2O$. Aldrich: 42,043-3: 25 grams. Synthetic? Also labelled as TAL102. [Label warning: Harmful solid! Target organ: lungs!]. *Also see section 3 of this document.*

PIG007 Titanium (IV) oxide - anatase: TiO_2. Aldrich 24,857-6: 100 grams. Synthetic version of anatase. [Label warning: Harmful dust! Possible carcinogen!]. *Also see section 9.6 of this document.*

PIG008 Titanium (IV) oxide - predominantly rutile. Aldrich 20,475-7: 25 grams. Synthetic version of rutile? [Label warning: Harmful dust! Possible carcinogen!]. *Also see section 9.6 of this document.*

PIG009 Lead (II) carbonate, basic: $(PbCO_3)_2 \cdot Pb(OH)_2$. Aldrich 24,358-2: 100 grams. Synthetic version of hydrocerussite (cerussite is less commonly used). Also known as flake white. [Label warning: Harmful solid! Reproductive hazard! Target organ: blood, kidneys! Target organ: nerves! Avoid contact and inhalation!]. *Also see section 6 of this document.*

PIG010 Zinc oxide: ZnO. Aldrich 25,160-7: 100 grams. Also known as zinc white and Chinese white. Natural analogue never used as a pigment. Natural variety called zincite (usually contains Mn and is red). [Label warning: Harmful dust! Irritant! Avoid inhalation!]. *Also see section 9.6 of this document.*

PIG011 Antimony (III) oxide: Sb_2O_3. Aldrich 37,925-5: 10 grams. [Label warning: Cancer suspect agent! Mutagen! Target organ: eyes! Severe irritant! Avoid contact and inhalation!]. *Also see section 9.6 of this document.*

PIG012 Cadmium sulfide: CdS. Aldrich 20,818-3: 100 grams. No natural analogue? [Label warning: Danger, contains cadmium; cancer hazard; avoid creating dust; can cause lung and kidney disease. Mutagen! Irritant! Cancer suspect agent! Target organs: kidneys, lungs! Handle with gloves in hood!]. *Also see section 10 of this document.*

PIG013 Cadmium selenide: CdSe. Aldrich 24,460-0: 10 grams. No natural analogue? [Label warning: Danger: contains cadmium! Cancer hazard! Avoid creating dust! Can cause lung and kidney disease! Cancer suspect agent! Possible mutagen! Target organs: kidney, lungs, liver! Moisture-sensitive! Store under N_2!]. *Also see section 10 of this document.*

PIG014 Lead oxide: Pb_3O_4. (red lead oxide). Aldrich 24,154-7: 5 grams. No natural analogue? [Label warning: Oxidizer! Irritant! Reproductive hazard! Harmful dust! Avoid inhalation! Target organs: blood, kidneys, nerves!]. *Also see section 9.6 of this document.*

PIG015 Mercury (II) sulfide: HgS [red]. Aldrich 24,356-6: 50 grams. Synthetic version of vermilion/cinnabar. [Label warning: Highly toxic! Neurologic hazard! Readily absorbed through skin! Target organ: kidneys, G.I. system! Irritant! Protect from light!]. *Also see section 10 of this document.*

PIG016 Mercury (II) sulfide: HgS [black]. Aldrich 40,073-4: 50 grams. Synthetic version of vermilion/cinnabar. Need to determine why this version is black and the other is red. [Label warning: Highly toxic! Irritant! Target organ: kidneys, nerves! Target organ: G.I. system! Readily absorbed through skin! Protect from light!]. *Also see section 10 of this document.*

PIG017 Lead (II) chromate: $PbCrO_4$. Aldrich 43,443-4: 25 grams. Also known as chrome red. Natural version is crocoite. [Label warning: Cancer suspect agent! Mutagen! Irritant! Target organs: lungs, blood! Oxidizer! Target organs: kidneys, nerves! Avoid contact and inhalation! Reproductive hazard]. *Also see section 14 of this document.*

PIG018 Iron (III) oxide, hydrated: FeO(OH). Aldrich 37,125-4: 50 grams. Synthetic version of goethite. [Warning label: none]. *Also see section 6 of this document.*

PIG019 Carmine: alum lake of carminic acid. Aldrich 19,970-2: 5 grams. Natural variety produced from insects. [Label warning: none].

PIG020 Barium chromate: $BaCrO_4$. Aldrich 40,105-6: 250 grams. Also known as barium yellow and lemon yellow. [Label warning: Irritant! Hygroscopic! Mutagen! Oxidizer! Toxic! Cancer suspect agent! Target organ: lungs, kidneys!]. *Also see section 14 of this document.*

PIG021 Lead (II) sulfate: $PbSO_4$. Aldrich 30,773-4: 100 grams. Natural version is anglesite. [Label warning: Harmful solid! Irritant! Target organ: blood, kidneys! Target organ: nerves! Reproductive hazard! Avoid contact and inhalation!]. *Also see section 8 of this document.*

PIG022 Lead (II) oxide: PbO. Aldrich 40,298-2: 5 grams. Also known as massicot and litharge. [Label warning: Reproductive hazard! Target organ: blood, kidney, nerves! Possible mutagen/teratogen! Harmful dust! Avoid inhalation!]. *Also see section 9.6 of this document.*

PIG023 Chromium (III) oxide: Cr_2O_3. Aldrich 39,370-3: 100 grams. Also known as permanent green. [Label warning: Harmful solid! Irritant! Sensitizer! Hygroscopic!]. *Also see section 9.6 of this document.*

PIG024 Copper (II) carbonate, basic: $CuCO_3 \cdot Cu(OH)_2$. Aldrich 20,789-6: 25 grams. Also known as green verditer; natural variety is malachite. [Label warning: Toxic! Irritant!]. *Also see section 5 of this document.*

PIG101 Synthetic litharge (PbO) (Smithsonian Institution MNMH #93589) (red pigment). *Also see section 9.6 of this document.*

PIG201 Manganese (IV) oxide: MnO_2. Synthetic: 100 grams: -60 +230 mesh; 99%+. Aldrich #243442. Black pigment, affected by Raman laser heating. Ideally want beta MnO_2 (pyrolusite). *See Smith and Clark (2001) art Raman article for context.* [Label warning: Oxidizing, harmful; harmful by inhalation and if swallowed; avoid contact with eyes; target organs: central nervous system, lungs]. *Also see section 9.6 of this document.*

PIG202 Calcium hydroxide: $Ca(OH)_2$. Synthetic: Sigma Aldrich #23-923-2 (100 g), 95%+. *Context: Ann Massing - unknown application but art related.* Corrosive, causes burns. *Also see section 6 of this document.*

PIG203 Aluminum sulfate: $Al_2(SO_4)_3 \cdot XH_2O$ (X=14-18). Synthetic: Alfa Aesar #36294 (lot K15L39), 98-102%, 250 g. Alunogen synthetic. [Label warning: Irritates skin and eyes]. Not a pigment. *Also see section 8 of this document.*

PIG204 Calcium oxalate: $CaC_2O_4 \cdot H_2O$. Synthetic: Alfa Aesar #32430 (lot #H21N04), 99%; 100 g. Synthetic weddelite; *weathering product of statuary (Smith and Clark, Reviews in Conservation, vol. 2, (2001), pp. 92-106.* [Label warning: Irritates lungs, eyes, skin]. (also ART003). Not a pigment – weathering product on marble. *Also see section 5 of this document.*

PIG205 Sodium sulfate decahydrate: $Na_2SO_4 \cdot 10H_2O$. Synthetic: Aldrich #403008 - batch 04031KO. 99+%. Synthetic mirabilite. Not a pigment. *Also see section 8 of this document.*

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19.2a.2. New samples from Natural Pigments (Naturalpigments.com) - October 3 and 13, 2006

PIG300 Natural yellow oxide (catalog no. 430-44S). 100 grams. (white/yellow/orange group).

PIG301 Italian dark ochre (catalog no. 431-43S). 100 grams. (white/yellow/orange group).

PIG302 Chrome yellow (catalog no. 437-11S). 4 ounces. (white/yellow/orange group).

PIG303 Gold ochre (catalog no. 430-31S). 4 ounces. (white/yellow/orange group).

PIG304 Yellow jarosite (catalog no. 430-17S). 100 grams. (white/yellow/orange group). *Also listed in section 8 of this document.*

PIG305 Jarosite (catalog no. 430-15S). 100 grams (white/yellow/orange group). *Also listed in section 8 of this document.*

PIG306 Yellow ochre light - claire jaune (catalog no. 430-41S). 4 ounces. (white/yellow/orange group).

PIG307 Yellow ochre dark (Ochre jaune dark; yellow ochre deep; jaune fon..) (catalog no. 430-42S). 4 ounces. (white/yellow/orange group).

PIG308 Orpiment (catalog no. 430-20S). 10 grams; 0.35 ounces. (white/yellow/orange group). *Also listed in section 10 of this document.*

PIG309 Cinnabar, warm (catalog no. 450-10S). 10 grams. (red/orange group). *Also listed in section 10 of this document.*

PIG310 Indian red (natural red oxide) (catalog no. 450-51S). 100 grams. (red/orange group).

PIG311 Spanish red (contains natural iron oxide) (catalog no. 450-44S). 100 grams. (red/orange group).

PIG312 Hematite (contains natural iron oxide) (catalog no. 450-31S). 100 grams. (red/orange group). *Also listed in section 9.6 of this document.*

PIG313 Hematite Crimean (catalog no. 450-34S). 100 grams. (red/orange group). *Also listed in section 9.6 of this document.*

PIG314 Violet hematite; violet caput mortem (cold hematite) (catalog no. 450-32S). 100 grams. (red/orange group). *Also listed in section 9.6 of this document.*

PIG315 Cold green earth - glauconite (catalog no. 420-30S). 100 grams. (green/blue group). *Also listed in section 3 of this document.*

PIG316 Celadonite - green earth (catalog no. 420-26S). 100 grams. (green/blue group). *Also listed in section 3 of this document.*

PIG317 Nicosia green earth - glauconite (catalog no. 421-31S). 2 jars of 100 grams, 1 in Historical Pigment Set. (green/blue group). *Also listed in section 3 of this document.*

PIG318 Dioptase, fine grade (catalog no. 420-10S). 10 grams. (green/blue group). *Also listed in section 3 of this document.*

PIG319 Vivianite, blue ochre (catalog no. 410-20S). 10 grams. (green/blue group). *Also listed in section 4 of this document.*

PIG320 Indigo, no. 1 quality (catalog no. 415-11B). 100 grams. (green/blue group).

PIG321 German vine black (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set); other jar part of Historical Pigment Set; catalog no. 481-11S; 4 ounces. (black/brown group). *Also listed in section 1 of this document.*

PIG322 Yellow ochre (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set). (white/yellow/orange group).

PIG323 Hematite (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set). (red/orange group). *Also listed in section 9.6 of this document.*

PIG324 Red ochre (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set). (red/orange group).

PIG325 Glauconite (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set). (green/blue group). *Also listed in section 3 of this document.*

PIG326 Umber (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set). (black/brown group).

PIG327 Italian brown ochre (catalog no. 361-50S). 100 grams. (white/yellow/orange group).

PIG328 Sienna, Light Luberon (catalog no. 460-33S). 100 grams. (white/yellow/orange group).

PIG329 Zinc oxide (catalog no. 475-31S). 4 ounces. (white/yellow/orange group). *Also listed in section 9.6 of this document.*

PIG330 Titanium white/titanium dioxide (catalog no. 475-21S). 2 jars of 100 grams each. (white/yellow/orange group). *Also listed in section 9.6 of this document.*

PIG331 Cerussite, natural lead white (catalog no. 470-10S). 50 grams. (white/yellow/orange group). *Also listed in section 8 of this document.*

PIG332 Goethite, brown ochre (catalog no. 460-50B). 100 grams. (red/orange group). *Also listed in section 6 of this document.*

PIG333 Cyprus burnt umber (catalog no. 461-44S). 4 ounces. (red/orange group).

PIG334 Red Sartorius Earth (catalog no. 451-41S). 100 grams. (red/orange group).

PIG335 Cyprus Raw Umber Medium (catalog no. 461-42S). 4 ounces. (red/orange group).

PIG336 Cyprus Burnt Umber, Warm (catalog no. 461-45S). 100 grams. (red/orange group).

PIG337 Sienna, Luberon Raw (catalog no. 460-32S). 100 grams. (red/orange group).

PIG338 Sienna Burnt Luberon (catalog no. 460-34S). 100 grams. (red/orange group).

PIG339 Umber, Burnt Luberon (catalog no. 460-44S). 100 grams. (red/orange group).

PIG340 Umber, Luberon Raw (catalog no. 460-42S). 100 grams. (red/orange group).

PIG341 Ochre, Luberon Red (catalog no. 450-52S). 4 ounces. (red/orange group).

PIG342 Ercolano Red (catalog no. 451-43S). 100 grams. (red/orange group).

PIG343 Cyprus Raw Umber Light (catalog no. 461-41S). 4 ounces. (red/orange group).

PIG344 Italian Burnt Umber Warm (catalog no. 461-49S). 100 grams. (red/orange group).

PIG345 Mummy (iron oxide) (Mummy brown) (catalog no. 460-22S).4 ounces. (red/orange group).

PIG346 Raw Sienna (catalog no. 460-30S). 100 grams. (red/orange group).

PIG347 Cochineal, premium Chilean (catalog no. 455-32S). 4 ounces. (red/orange group).

PIG348 Minium, red lead (Surik) (catalog no. 457-10S). 50 grams. (red/orange group). *Also listed in section 9.6 of this document.*

PIG349 Azurite, coarse (catalog no. 410-11S). 10 grams. (green/blue group). *Also listed in section 5 of this*

document.

PIG350 Malachite, medium (catalog no. 420-21S). 10 grams. (green/blue group). *Also listed in section 5 of this document.*

PIG351 Lazurite, Baikal (lapis lazuli) (catalog no. 410-17S). 10 grams. (green/blue group). *Also listed in section 2.11 of this document.*

PIG352 Lapis lazuli, premium grade lazurite (catalog no. 410-19S). 10 grams. (green/blue group). *Also listed in section 2.11 of this document.*

PIG353 Lapis Lazuli, standard grade lazurite (catalog no. 410-18S). 10 grams. (green/blue group). *Also listed in section 2.11 of this document.*

PIG354 Malachite, fine grade (catalog no. 420-20S). 5 vials of 10 grams each = 50 grams. (green/blue group). *Also listed in section 5 of this document.*

PIG355 Roman Black (catalog no. 481-13S). 100 grams. (black/brown group).

PIG356 Cassel Brown Earth (catalog no. 481-12S). 100 grams. (black/brown group).

PIG357 Shungite, carbon black (catalog no. 480-10S). 4 ounces. (black/brown group). *Also listed in section 18.3 of this document.*

PIG358 Pyrolusite, Mineral brown black (catalog no. 480-20S). 100 grams. (black/brown group). *Also listed in section 9.6 of this document.*

PIG359 Natural black oxide (catalog no. 480-30S). 100 grams. (black/brown group).

PIG360 Lamp black (catalog no. 480-50B). 200 grams. (black/brown group). *Also listed in section 1 of this document.*

PIG361 Madder root (catalog no. 455-22S). 2 x 100 gram bag = 200 grams. (red/orange group).

PIG362 Alkanet root (catalog no. 455-12S). 100 gram bag. (red/orange group).

PIG363 Brazilwood sawdust (catalog no. 455-15S). 100 gram bag. (red/orange group).

PIG364-370 See below.

PIG371 Verona Green Earth (Historical Pigment Set; catalog no. 421-26S), 100 grams. (green/blue group).

PIG372 Malachite (Historical Pigments Set, catalog no. 420-20G), 100 grams. (green/blue group). *Also listed in section 5 of this document.*

PIG373 Lazurite (Historical Pigment Set, catalog no. 410-18G), 100 grams. (green/blue group). *Also listed in section 2.11 of this document.*

PIG374 Lemon Ochre (Historical Pigment Set; catalog no. unknown), 100 grams. (white/yellow/orange group).

PIG375 Italian Yellow Earth (Historical Pigment Set; catalog no. unknown), 100 grams. (white/yellow/orange group).

PIG376 Italian Raw Sienna (Historical Pigment Set; catalog no. unknown), 100 grams. (white/yellow/orange group).

PIG377 Venetian Red (Historical Pigment Set, catalog no. 451-44B), 100 grams. (red/orange group).

PIG378 Italian Burnt Sienna (Historical Pigment Set); catalog no. unknown), 100 grams. (red/orange group).

PIG379 Pozzuoli Red (Historical Pigment Set; catalog no. unknown), 100 grams. (red/orange group).

PIG380 Italian Burnt Umber (Historical Pigment Set, catalog no. unknown), 100 grams. (black/brown group).

PIG381 Italian Raw Umber Green (Historical Pigment Set; catalog no. 461-47S), 100 grams. (green/blue group).

PIG382 Italian Raw Umber (Historical Pigment Set; catalog no. unknown), 100 grams. (black/brown group).

PIG383 Cyprus Raw Umber, Dark (Historical Pigment Set; catalog no. 461-43S), 100 grams. (black/brown group).

PIG384 Realgar; originally mislabelled as PIG309 (Natural Pigments #450-20S), 10 grams (red-orange group). *Also listed in section 10 of this document.*

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19.2a.3. Other materials: non-pigments (also from Natural Pigments) – received October 2006

PIG364 Pumice (catalog no. 510-13PUMLB). 500 gram bag. (other materials).

PIG365 Spike oil (natural source: Lavendula latifola). (catalog no. 510-420SP02). 2 fluid ounce bottle. (other materials)

PIG366 Refined linseed oil (natural source: Linum usitatissimum) (catalog no. 510-410RL08). 8 fl. oz. bottle. (other materials).

PIG367 Bodied oil, medium viscosity stand oil (catalog no. 510-410ST08). 8 fl. oz. bottle. (other materials)

PIG368 Copal painting medium (catalog no. 510-35COP05). unknown size bottle. (other materials).
PIG369 Damar crystals (catalog no. 510-33DMR01). 11 ounce can. (other materials)
PIG370 Terpentine (catalog no. 520-1TRPT08). 16 ounce can. (other materials).

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19.2a.4. Pigments/artists materials from Heaton Cooper Studios - received October 3, 2006

Black/brown/blue pigments:
PIG400 Daler-Rowney willow charcoal thick sticks; 4 packs of 5sticks each.
PIG401 Wurzburg Black (Davy's gray): natural slate + clay, 2 jars - each 100 grams.
PIG402 Derwent graphite sticks: natural graphite: 5 sticks.
PIG403 Roberson traditional Prout's Brown Ink: 2 bottles - each 30 ml.
PIG404 Kremer sepia ink, genuine: 2 bottles - each 20 ml.
PIG405 Kremer bistre ink: 1 bottle - 20 ml.

Red pigments:
PIG406 Natural sanguine; red drawing chalk from Tuscany; native iron oxide with clay: 2 jars, each 100 grams. (red/orange group).
PIG407 Sanguine Koh-i-Noor chalk/charcoal round stick: 4 sticks. (red/orange group).
PIG408 Cretacolor Sanguine dry pencil (wax-free); 1 pencil. (red/orange group).

Mixed sets:
PIG409 Cretacolor Basic Drawing Set: 2 sets of 6 pencils: sanguine, sepia, white pastel, charcoal, Nero, graphite; 2 sets.
PIG410 Cretacolor chunky pastels boxed set: 12 sticks; 1 set.
PIG411 Lyra Rembrandt Special Fine Art Pencil Set: tin of 12; chalk-based, grease-free; 1 set.
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19.2a.5. Pigments/artists supplies from Blot's Pen and Ink Supplies – received October 13, 2006

PIG500 French Sepia Ink; 2 bottles, 30 ml each. (Label info: "French Sepia Ink is a traditional shellac based ink with a transparent satin finish. Thin with water if required. Apply with a brush or pen.").
PIG501 Prout's Brown Ink; 2 bottles, 30 ml each. (Label info: "Traditional ink. Lightfast and non-waterproof. Vandyke crystals, ammonium carbonate and water. Apply with a brush or pen".).
PIG502 Iron Gall Ink; 4 bottles, 30 ml each. (Label info: "Arts and Creative Materials Institute Certified. Conforms to ASTM D 4236. This ink, made to a medieval recipe, for use with 'dip pens', will flow freely and darken on drying. Wash with water".).
PIG503 Higgins Sepia Ink; 1 bottle, 73.9 ml; 2.5 fl. oz.
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19.2a.6. Pigments/artists supplies acquired by Jennifer Charney - Nov. 2006

PIG600 Charcoal sticks; source unknown.
PIG601 Yellow ochre; Stevenson Artists-Quality Pure Pigments; 2 ounces.
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19.2a.7. Pigments/artists supplies from Silverpoint Web – received Nov. 28, 2006

PIG700 New Tradition mechanical stylus with silver 0.035" 3x hardened sterling silver point (3" long). Also 3 replacement points, also 3" long.
PIG701 Ground kit: Old Masters Formula Silverpoint Ground "Kit"; makes approximately 32 ounces of excellent ground.
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19.2a.8. Pigments/artists materials from Alfa Aesar – received December 11, 2006 - For oxalate study

ART001 Sodium oxalate, ACS 99.5+% (Alfa Aesar stock #41759; 50 grams) [$Na_2C_2O_4$].
ART002 Oxalic acid, anhydrous, 98% (Alfa Aesar stock #44410; 50 grams) [HO_2CCO_2H].
ART003 Calcium oxalate: $CaC_2O_4 \cdot H_2O$. Synthetic: Alfa Aesar #32430 (lot #H21N04), 99%; 100 g. Synthetic weddelite; weathering product of statuary (Smith and Clark, Reviews in Conservation, vol. 2, (2001), pp. 92-106. Irritates lungs, eyes, skin. (also PIG204).

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19.2a.9. Pigments/artists materials from Sigma Aldrich - received June 2007 – for oxalate study

ART004 Sodium oxalate, ACS 99.5% Reagent (Sigma-Aldrich #223433; 100 grams).
ART005 Calcium chloride dihydrateCS 99+% (Sigma-Aldrich #223506; 25 grams).
ART006 Dimethyl oxalate, 99% (Sigma-Aldrich #135623; 100 grams).

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19.2a.10. Other pigments

PIG702 India Ink, super black. Speedball; 1 bottle: 2 fl. oz (59.2 ml). (Label info: "Arts and Creative Materials Institute Certified. Conforms to ASTM D 4236. Permanent/Waterproof, 100% carbon black pigment".).

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19.2a.11. Other materials and bases

GOAT01 Goatskin parchment from France ("Medium sized goat skin valued for its thinness and sheen. Classic goat pattern is ideal for all applications). From Talas (www.talasonline.com): catalogue number TLP026001.
PAPYRUS01 Light-coloured papyrus from King Tut Shop (12 sheets, 30 x 40 cm).
PAPYRUS02 Dark-coloured papyrus from King Tut Shop (12 sheets, 30 x 40 cm).

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19.3a. Sorted by approximate colour groups (see above for details)

19.3.1a. By colour group – White pigments

++++++*Non-PIGxxx samples*++++
CRB102 *Aragonite [$CaCO_3$].*
CRB109 *Calcite [$CaCO_3$].*
CRB110 *Calcite [$CaCO_3$].*
CRB111 *Calcite [$CaCO_3$].*
CRB112 *Calcite [$CaCO_3$].*
CRB116 *Calcite [$CaCO_3$] (mislabelled; XRD shows pure calcite).*
CRB118 *Calcite [$CaCO_3$] (mislabelled; XRD shows pure calcite).*
CRB119 *Mostly aragonite [$CaCO_3$], some quartz and calcite.*
CRB120 *Aragonite [$CaCO_3$].*
CRB122 *Calcite [$CaCO_3$], minor dolomite (mislabelled as aragonite).*
CRB123 *Aragonite [$CaCO_3$], plus bit of calcite..*
CRB124 *Aragonite [$CaCO_3$].*
CRB125 *Aragonite [$CaCO_3$].*
CRB502 *Cerussite ($PbCO_3$) (white when pure, mine is black), (aka white lead).*
CRB505 *Hydrocerussite ($Pb_3(CO_3)_2(OH)_2$).*
CRB506 *Cerussite ($PbCO_3$).*
CRB507 *Cerussite ($PbCO_3$).*
KAO101 *Kaolinite [$Al_4(Si_4O_{10})(OH)_8$].*
KAO102 *Kaolinite (china clay) [$Al_4(Si_4O_{10})(OH)_8$].*

KAO103 *Kaolinite (well ordered), [Al_4 (Si_4O_{10})($OH)_8$].*
KAO104 *Kaolinite (poorly ordered), [Al_4 (Si_4O_{10})($OH)_8$].*
OOH001 *Bauxite; predominantly gibbsite ($Al(OH)_3$).*
OOH002 *Bauxite; predominantly gibbsite ($Al(OH)_3$).*
OOH004 *Gibbsite ($Al(OH)_3$).*
PHS101 *Apatite ; white ?*
PHS104 *Apatite ; white ?*
QUA101 *Quartz (SiO_2).*
RUT101 *Rutile (ideally TiO_2 and white when pure).*
RUT102 *Rutile (ideally TiO_2, and white when pure).*
SPT127 *Gypsum (var. selenite) [$CaSO_4 \cdot 4H_2O$].*
SPT128 *Anhydrite [$CaSO_4$].*
SPT145 *Anglesite ($PbSO_4$).*
SPT146 *Barite ($BaSO_4$).*
SPT147 *Anglesite ($PbSO_4$).*
SPT148 *Anglesite ($PbSO_4$).*
TAL101 *Talc ($Mg_3Si_4O_{10}(OH)_2$).*
TAL102 *Talc ($3MgO \cdot 4SiO_2 \cdot H_2O$); synthetic?*
+++++ PIGxxx samples+++++
PIG001 *Aluminum hydroxide: ($Al(OH)_3$); synthetic version of gibbsite. Also known as White lake.*
PIG002 *Calcium sulfate: $CaSO_4$; synthetic version of anhydrite.*
PIG003 *Barium sulfate: $BaSO_4$; synthetic version of barite.*
PIG004 *Calcium carbonate: $CaCO_3$; synthetic version of calcite (aka whiting).*
PIG005 *Calcium sulfate dihydrate: $CaSO_4 \cdot 2H_2O$; synthetic version of gypsum.*
PIG006 *Talc: $3MgO \cdot 4SiO_2 \cdot H_2O$; synthetic?*
PIG007 *Titanium (IV) oxide: TiO_2; synthetic version of anatase.*
PIG008 *Titanium (IV) oxide - predominantly rutile; synthetic version of rutile?*
PIG009 *Lead (II) carbonate, basic: $(PbCO_3)_2 \cdot Pb(OH)_2$; synthetic hydrocerussite (aka flake white).*
PIG010 *Zinc oxide: synthetic ZnO; (aka zinc white and Chinese white). Natural never used as a pigment.*
PIG011 *Antimony (III) oxide: synthetic Sb_2O_3.*
PIG021 *Lead (II) sulfate: $PbSO_4$; natural version is anglesite.*
PIG202 *Calcium hydroxide: $Ca(OH)_2$; synthetic*
PIG329 *Zinc oxide (catalog no. 475-31S). 4 ounces.*
PIG330 *Titanium white/titanium dioxide (catalog no. 475-21S). 2 jars of 100 grams each.*
PIG331 *Cerussite, natural lead white (catalog no. 470-10S). 50 grams.*
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19.3.2a. By colour group – yellow/ pale orange pigments

+++++Non-PIGxxx samples +++++
GRE101 *Greenockite (CdS).*
HAW101 *Hawleyite (CdS).*
ORP101 *Orpiment (As_2S_3) (light sensitive).*
ORP102 *Orpiment (As_2S_3).*
ORP103 *Orpiment (As_2S_3).*
+++++ PIGxxx samples ++++
PIG020 *Barium chromate $BaCrO_4$. (aka barium yellow and lemon yellow).*
PIG022 *Lead (II) oxide: PbO; aka massicot and litharge.*
PIG300 *Natural yellow oxide (catalog no. 430-44S). 100 grams.*
PIG301 *Italian dark ochre (catalog no. 431-43S). 100 grams.*
PIG302 *Chrome yellow (catalog no. 437-11S). 4 ounces.*
PIG303 *Gold ochre (catalog no. 430-31S). 4 ounces.*
PIG304 *Yellow jarosite (catalog no. 430-17S). 100 grams.*
PIG305 *Jarosite (catalog no. 430-15S). 100 grams*
PIG306 *Yellow ochre light - claire jaune (catalog no. 430-41S). 4 ounces.*
PIG307 *Yellow ochre dark (Ochre jaune dark; yellow ochre deep; jaune fon..) (catalog no. 430-42S). 4 ounces.*

PIG308 Orpiment (catalog no. 430-20S). 10 grams; 0.35 ounces.
PIG322 Yellow ochre (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set).
PIG327 Italian brown ochre (catalog no. 361-50S). 100 grams.
PIG328 Sienna, Light Luberon (catalog no. 460-33S). 100 grams.
PIG374 Lemon Ochre (Historical Pigment Set; catalog no. unknown), 100 grams.
PIG375 Italian Yellow Earth (Historical Pigment Set; catalog no. unknown), 100 grams.
PIG376 Italian Raw Sienna (Historical Pigment Set; catalog no. unknown), 100 grams.
PIG384 Realgar (catalog no. 420-20S), 10 grams.
PIG601 Yellow ochre; Stevenson Artists-Quality Pure Pigments; 2 ounces.
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19.3.3a, By colour group - Red/orange pigments:

+++++ Non-PIGxxx samples +++++
CIN101 Cinnabar (HgS).
CIN102 Cinnabar (HgS).
CIN103 Cinnabar (HgS).
CRC001 Crocoite ($PbCrO_4$).
CRC002 Crocoite ($PbCrO_4$).
CRC003 Crocoite ($PbCrO_4$).
HEM101 Hematite: synthetic; <140 nm powder provided. (ideally "-Fe_2O_3).
HEM102 Hematite ("-Fe_2O_3).
HEM103 Hematite ("-Fe_2O_3).
MIN101 Minium ($Pb_2^{2+}Pb^{4+}O_4$).
MIN102 Minium ($Pb_2^{2+}Pb^{4+}O_4$).
REA101 Realgar (AsS) (light sensitive).
REA102 Realgar (AsS).
REA103 Realgar (AsS).
+++++ PIGxxx samples +++++
PIG012 Cadmium sulfide: CdS.
PIG014 Lead oxide: Pb_3O_4. (red lead oxide). No natural analogue?
PIG015 Mercury (II) sulfide: HgS [red]; synthetic version of vermilion/cinnabar.
PIG016 Mercury (II) sulfide: HgS [black]; synthetic version of vermilion/cinnabar.
PIG017 Lead (II) chromate: $PbCrO_4$; aka chrome red; natural version is crocoite.
PIG018 Iron (III) oxide, hydrated: FeO(OH); synthetic version of goethite.
PIG019 Carmine: alum lake of carminic acid; natural variety produced from insects.
PIG101 Synthetic litharge (PbO).
PIG309 Cinnabar, warm (catalog no. 450-10S). 10 grams.
PIG310 Indian red (natural red oxide) (catalog no. 450-51S). 100 grams.
PIG311 Spanish red (contains natural iron oxide) (catalog no. 450-44S). 100 grams.
PIG312 Hematite (contains natural iron oxide) (catalog no. 450-31S). 100 grams.
PIG313 Hematite Crimean (catalog no. 450-34S). 100 grams.
PIG314 Violet hematite; violet caput mortem (cold hematite) (catalog no. 450-32S). 100 grams.
PIG323 Hematite (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set).
PIG324 Red ochre (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set).
PIG332 Goethite, brown ochre (catalog no. 460-50B). 100 grams.
PIG333 Cyprus burnt umber (catalog no. 461-44S). 4 ounces.
PIG334 Red Sartorius Earth (catalog no. 451-41S). 100 grams.
PIG335 Cyprus Raw Umber Medium (catalog no. 461-42S). 4 ounces.
PIG336 Cyprus Burnt Umber, Warm (catalog no. 461-45S). 100 grams.
PIG337 Sienna, Luberon Raw (catalog no. 460-32S). 100 grams.
PIG338 Sienna Burnt Luberon (catalog no. 460-34S). 100 grams.
PIG339 Umber, Burnt Luberon (catalog no. 460-44S). 100 grams.
PIG340 Umber, Luberon Raw (catalog no. 460-42S). 100 grams.
PIG341 Ochre, Luberon Red (catalog no. 450-52S). 4 ounces.
PIG342 Ercolano Red (catalog no. 451-43S). 100 grams.

PIG343 *Cyprus Raw Umber Light (catalog no. 461-41S). 4 ounces.*
PIG344 *Italian Burnt Umber Warm (catalog no. 461-49S). 100 grams.*
PIG345 *Mummy (iron oxide) (Mummy brown) (catalog no. 460-22S).4 ounces.*
PIG346 *Raw Sienna (catalog no. 460-30S). 100 grams.*
PIG347 *Cochineal, premium Chilean (catalog no. 455-32S). 4 ounces.*
PIG348 *Minium, red lead (Surik) (catalog no. 457-10S). 50 grams.*
PIG361 *Madder root (catalog no. 455-22S). 2 x 100 gram bag = 200 grams.*
PIG362 *Alkanet root (catalog no. 455-12S). 100 gram bag.*
PIG363 *Brazilwood sawdust (catalog no. 455-15S). 100 gram bag.*
PIG377 *Venetian Red (Historical Pigment Set, catalog no. 451-44B), 100 grams.*
PIG378 *Italian Burnt Sienna (Historical Pigment Set); catalog no. unknown), 100 grams.*
PIG379 *Pozzuoli Red (Historical Pigment Set; catalog no. unknown), 100 grams.*
PIG406 *Natural sanguine; red drawing chalk from Tuscany; native iron oxide with clay: 2 jars, each 100 grams.*
PIG407 *Sanguine Koh-i-Noor chalk/charcoal round stick: 4 sticks.*
PIG408 *Cretacolor Sanguine dry pencil (wax-free); 1 pencil.*
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19.3.4a. By colour group – Green/blue pigments:

+++++ Non-PIGxxx samples +++++
CHL103 *Paratacamite ($Cu_2^{+2}(OH)_3Cl$).*
CHL104 *Atacamite ($Cu_2^{+2}(OH)_3Cl$).*
CHL105 *Atacamite ($Cu_2^{+2}(OH)_3Cl$).*
CHL106 *Paratacamite ($Cu_2^{+2}(OH)_3Cl$).*
CHL107 *Atacamite ($Cu_2^{+2}(OH)_3Cl$).*
CHY101 *Chrysocolla ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$).*
CHY102 *Chrysocolla ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$).*
CHY103 *Chrysocolla ($(Cu^{+2},Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$).*
CLI101 *Clinochlore (chlorite) ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$).*
CLI102 *Clinochlore (chlorite) ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$).*
CLI103 *Clinochlore (chlorite) ($(Mg,Fe^{+2})_5Al(Si_3Al)O_{10}(OH)_8$).*
CRB501 *Malachite ($Cu_2^{2+}(CO_3)(OH)_2$).*
CRB503 *Azurite ($Cu_3^{+2}(CO_3)_2(OH)_2$).*
CRB504 *Azurite ($Cu_3^{+2}(CO_3)_2(OH)_2$).*
CRB508 *Malachite ($Cu_2^{2+}(CO_3)(OH)_2$).*
CRB509 *Malachite ($Cu_2^{2+}(CO_3)(OH)_2$).*
CRB510 *Azurite ($Cu_3^{+2}(CO_3)_2(OH)_2$).*
CRB511 *Azurite ($Cu_3^{+2}(CO_3)_2(OH)_2$).*
CRO101 *Cronstedtite ($[Fe^{+2}_2 Fe^{+3}(SiFe^{+3})O_5(OH)_4]$).*
CRO102 *Cronstedtite ($[Fe^{+2}_2 Fe^{+3}(SiFe^{+3})O_5(OH)_4]$).*
GLA103 *Glauconite ($[(K,Na)(Fe^{+3},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2]$).*
GLA104 *Glauconite ($[(K,Na)(Fe^{+3},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2]$).*
HAU101 *Hauyne ($((Na,Ca)_{4-8}Al_6Si_6(O,S)_{24}(SO_4,Cl)_{1-2}$).*
NOS101 *Nosean ($Na_8Al_6Si_6O_{24}(SO_4) \cdot H_2O$; present in lapis lazulli.*
SPT150 *Lazurite ($((Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$).*
SPT151 *Lazurite ($((Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$).*
SPT152 *Lazurite ($((Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$).*
SPT153 *Lazurite ($((Na,Ca)_{7-8}(Al,Si)_{12}(O,S)_{24}[(SO_4),Cl_2,(OH)_2]$).*
+++++ PIGxxx samples +++++
PIG023 *Chromium (III) oxide: Cr_2O_3; aka permanent green.*
PIG024 *Copper (II) carbonate, basic: $CuCO_3 \cdot Cu(OH)_2$; aka green verditer; natural variety is malachite.*
PIG315 *Cold green earth - glauconite (catalog no. 420-30S). 100 grams.*
PIG316 *Celadonite - green earth (catalog no. 420-26S). 100 grams.*
PIG317 *Nicosia green earth - glauconite (catalog no. 421-31S). 2 jars of 100 grams, 1 in Historical Pigment Set.*

PIG318 Dioptase, fine grade (catalog no. 420-10S). 10 grams.
PIG319 Vivianite, blue ochre (catalog no. 410-20S). 10 grams.
PIG320 Indigo, no. 1 quality (catalog no. 415-11B). 100 grams.
PIG325 Glauconite (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set).
PIG349 Azurite, coarse (catalog no. 410-11S). 10 grams.
PIG350 Malachite, medium (catalog no. 420-21S). 10 grams.
PIG351 Lazurite, Baikal (lapis lazuli) (catalog no. 410-17S). 10 grams.
PIG352 Lapis lazuli, premium grade lazurite (catalog no. 410-19S). 10 grams.
PIG353 Lapis Lazuli, standard grade lazurite (catalog no. 410-18S). 10 grams.
PIG354 Malachite, fine grade (catalog no. 420-20S). 5 vials of 10 grams each = 50 grams.
PIG371 Verona Green Earth (Historical Pigment Set; catalog no. 421-26S), 100 grams.
PIG372 Malachite (Historical Pigments Set, catalog no. 420-20G), 100 grams.
PIG373 Lazurite (Historical Pigment Set, catalog no. 410-18G), 100 grams.
PIG381 Italian Raw Umber Green (Historical Pigment Set; catalog no. 461-47S), 100 grams.
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19.3.5a. By colour group - Brown/black pigments:

+++++ Non-PIGxxx samples +++++
ASP101 Asphaltum (complex organic).
GRP101 Graphite (C).
GRP102 Graphite: synthetic "amorphous" graphite (C).
GRP103 Graphite (C).
GRP104 Graphite (C).
GRP105 Graphite (C).
GRP106 Graphite (C).
GRP107 Graphite (C).
LCA101 Carbon lampblack: synthetic C; <0.021µm size.
PRL101 Pyrolusite (β-$Mn^{+4}O_2$).
+++++ PIGxxx samples +++++
PIG013 Cadmium selenide: CdSe. No natural analogue?
PIG201 Manganese (IV) oxide: MnO_2. Synthetic
PIG321 German vine black (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set); other jar part of Historical Pigment Set; catalog no. 481-11S; 4 ounces.
PIG326 Umber (catalog no. 601-1101). 30 ml, 1 ounce. (part of Introductory Pigment Sampler set).
PIG355 Roman Black (catalog no. 481-13S). 100 grams.
PIG356 Cassel Brown Earth (catalog no. 481-12S). 100 grams.
PIG357 Shungite, carbon black (catalog no. 480-10S). 4 ounces.
PIG358 Pyrolusite, Mineral brown black (catalog no. 480-20S). 100 grams.
PIG359 Natural black oxide (catalog no. 480-30S). 100 grams.
PIG360 Lamp black (catalog no. 480-50B). 200 grams.
PIG380 Italian Burnt Umber (Historical Pigment Set, catalog no. unknown), 100 grams.
PIG382 Italian Raw Umber (Historical Pigment Set; catalog no. unknown), 100 grams.
PIG383 Cyprus Raw Umber, Dark (Historical Pigment Set; catalog no. 461-43S), 100 grams.
PIG400 Daler-Rowney willow charcoal thick sticks; 4 packs of 5sticks each.
PIG401 Wurzburg Black (Davy's gray): natural slate + clay, 2 jars - each 100 grams.
PIG402 Derwent graphite sticks: natural graphite: 5 sticks.
PIG403 Roberson traditional Prout's Brown Ink: 2 bottles - each 30 ml.
PIG404 Kremer sepia ink, genuine: 2 bottles - each 20 ml.
PIG405 Kremer bistre ink: 1 bottle - 20 ml.
PIG500 French Sepia Ink; 2 bottles, 30 ml each.
PIG501 Prout's Brown Ink; 2 bottles, 30 ml each.
PIG502 Iron Gall Ink; 4 bottles, 30 ml each.
PIG503 Higgins Sepia Ink; 1 bottle, 73.9 ml; 2.5 fl. oz.
PIG600 Charcoal sticks; source unknown.
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19.3.6a. By colour group - Other samples:

JAD001 *"Jade" [could be nephrite (tremolite-actinolite ($Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$ or jadeite ($NaAlSi_2O_6$)].*
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19.3.7a. Mixed sets:

PIG409 *Cretacolor Basic Drawing Set: 2 sets of 6 pencils: sanguine, sepia, white pastel, charcoal, Nero, graphite; 2 sets.*
PIG410 *Cretacolor chunky pastels boxed set: 12 sticks; 1 set.*
PIG411 *Lyra Rembrandt Special Fine Art Pencil Set: tin of 12; chalk-based, grease-free; 1 set.*
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19.3.8a. Other materials:

ART001 *Sodium oxalate, ACS 99.5+% (Alfa Aesar stock #41759; 50 grams) [$Na_2C_2O_4$].*
ART002 *Oxalic acid, anhydrous, 98% (Alfa Aesar stock #44410; 50 grams) [HO_2CCO_2H].*
ART003 *Calcium oxalate: $CaC_2O_4{\cdot}H_2O$. Synthetic: Alfa Aesar #32430 (lot #H21N04), 99%; 100 g. Synthetic weddelite; weathering product of statuary (Smith and Clark, Reviews in Conservation, vol. 2, (2001), pp. 92-106. Irritates lungs, eyes, skin. (also PIG204).*
ART004 *Sodium oxalate, ACS 99.5% Reagent (Sigma-Aldrich #223433; 100 grams).*
ART005 *Calcium chloride dihydrateCS 99+% (Sigma-Aldrich #223506; 25 grams).*
ART006 *Dimethyl oxalate, 99% (Sigma-Aldrich #135623; 100 grams).*
PIG364 *Pumice (catalog no. 510-13PUMLB). 500 gram bag.*
PIG365 *Spike oil (natural source: Lavendula latifola). (catalog no. 510-420SP02). 2 fluid ounce bottle.*
PIG366 *Refined linseed oil (natural source: Linum usitatissimum) (catalog no. 510-410RL08). 8 fl. oz. bottle.*
PIG367 *Bodied oil, medium viscosity stand oil (catalog no. 510-410ST08). 8 fl. oz. bottle.*
PIG368 *Copal painting medium (catalog no. 510-35COP05). unknown size bottle.*
PIG369 *Damar crystals (catalog no. 510-33DMR01). 11 ounce can.*
PIG370 *Terpentine (catalog no. 520-1TRPT08). 16 ounce can.*

PIG700 *New Tradition mechanical stylus with silver 0.035" 3x hardened sterling silver point (3" long). Also 3 replacement points, also 3" long.*
PIG701 *Ground kit: Old Masters Formula Silverpoint Ground "Kit"; makes approximately 32 ounces of excellent ground.*
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19.4a. Inked parchment and papyrus.

19.4a.1. Inked documents (July 15-16). Done in triplicate

See Mineral Database - Images for details.

Panels labelled along left side as follows:

- Upper left edge: 1-8 notches denoting pigment used:
    1. PIG404 – Sepia ink
    2. PIG405 – Bistre ink
    3. PIG403 - Prout's brown
    4. PIG502 – Iron gall ink
    5. PIG402 – Graphite sticks
    6. PIG400 – Willow charcoal sticks
    7. PIG700 – Silver point
    8. PIG702 – India ink

- Middle left edge: 1-3 notches denoting paper type:

1. Goatskin parchment (GOAT01)
2. Light-coloured papyrus (PAPYRUS1)
3. Dark-coloured papyrus (PAPYRUS02)

Lower left edge denotes which triplicate: 1 – 3notches:

1. A triplicate
2. B triplicate
3. C triplicate

Total number of templates: 3 paper types x 3 triplicates x 8 inks = 48 sheets.
Note: some templates done on light table. Dark papyrus too opaque to allow tracing.

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19.4a.2. Squares for basic spectral properties

8 inks x 3 papers x 2 applications (heavy or light).
For light application, ink initially applied heavily and immediately blotted off.

Paper labelling along left side (heavily inked side) as follows:

Upper left notches: paper type (as above)
Lower left: 1 notch = first set of pigments; from top to bottom: pigments 1 – 3 as above
2 notches: second set of pigments; from top to bottom: pigments 4 – 6 as above
3 notches: third set of pigments; from top to bottom: pigments 7 – 8 as above.

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19d. Spectral Data - Pigments

NOTE: *Non-PIGxxx spectral data are (also) provided in their respective mineral sections – see section 19a above for details of locations of (additional) spectral files.*

19.1d. Pigments

Sample	*Facility/File No.*	*Description*
(i) Non-PIGxxx mineral samples		
CHL105	PSF pig1307.040	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
CHL105	PSF 080128a.010	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CHY101	PSF 080128a.011	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CIN102	PSF pig1307.036	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
CIN102	PSF 080128a.012	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CLI101	PSF 080128a.013	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
CLI101	PSF 100413a.011	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (directory: 100412_Carbon_black).
++++++		
CRB112	PSF pig1307.033	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
CRB112	PSF 080128a.014	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CRB120	PSF pig1307.035	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
CRB120	PSF 080128a.015	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CRB506	PSF pig1307.032	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
CRB506	PSF 080128a.016	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CRB508	PSF 080128a.017	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CRB510	PSF 080128a.018	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CRC002	PSF 080128a.019	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
CRO101	PSF pig1307.038	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
CRO101	PSF 080128a.020	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
GLA103	PSF 080129a.001	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).

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HEM101	PSF 080129a.002	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
KAO102	PSF 080129a.003	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
LCA101	PSF 080129a.004	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
MIN101	PSF 080129a.005	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
OOH004	PSF pig1307.037	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD (aka pig1311).
OOH004	PSF 080129a.006	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
ORP101	PSF 080129a.007	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
REA102	PSF 080129a.008	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
SPT127	PSF 080129a.009	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
SPT128	PSF 080129a.010	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
SPT145	PSF 080129a.011	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
SPT146	PSF pig1307.034	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD (aka pig1311).
SPT146	PSF 080129a.012	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
SPT148	PSF 080129a.013	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
SPT151	PSF 080129a.014	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
TAL101	PSF pig1307.039	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD (aka pig1311).
TAL101	PSF 080129a.015	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).

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(ii) Artists' materials

Raw Linseed	PSF 080129a.016	Raw linseed oil painted onto glass slide. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
Boiled linseed	PSF 080129a.017	Boiled linseed oil painted onto glass slide. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
++++++		
Glass slide	PSF 080122a.001	clear glass slide for paint on glass slide reflectance study. i=30°, e=0°; 0.35-

		2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
Two slides	PSF 080122a.033	Two slides on, or glued to, each other? i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).

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(iii) PIGxxx samples

PIG001	RELAB caec01	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG001	RELAB laec01	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG001	PSF pig1307.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG001	PSF 080122a.002	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG002	RELAB caec02	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG002	RELAB laec02	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG002	PSF pig1307.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG002	PSF 080122a.003	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG003	RELAB caec03	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG003	RELAB laec03	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG003	PSF pig1307.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG003	PSF 080122a.004	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG004	RELAB caec04	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG004	RELAB laec04	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG004	PSF pig1307.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG004	PSF 080122a.005	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG005	RELAB caec05	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG005	RELAB laec05	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG005	PSF pig1307.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG005	PSF 080122a.006	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG006	RELAB caec06	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG006	RELAB laec06	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG006	PSF pig1307.011	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG006	PSF 080122a.007	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG007	RELAB caec07	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG007	RELAB laec07	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG007	PSF pig1307.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG007	PSF 080122a.008	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output;

		1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG008	RELAB caec08	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG008	RELAB laec08	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG008	PSF pig1307.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG008	PSF 080122a.009	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG009	RELAB caec09	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG009	RELAB laec09	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG009	PSF pig1307.014	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG009	PSF 080122a.010	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG010	RELAB caec10	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG010	RELAB laec10	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG010	PSF pig1307.015	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG010	PSF 080122a.011	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG011	RELAB caec11	<45µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG011	RELAB laec11	<45µm; 30°/0° & 30°/30°; 0.3-26µm; 5nm / 1.2-129 nm; merged at 2.5µm (RELAB+Nicolet) note different viewing geometries.
PIG011	PSF pig1307.016	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG011	PSF 080122a.012	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG012	PSF pig1307.017	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG012	PSF 080122a.013	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG013	PSF pig1307.018	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG013	PSF 080122a.014	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG014	PSF pig1307.019	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG014	PSF 080122a.015	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG015	PSF pig1307.020	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG015	PSF 080122a.016	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG016	PSF pig1307.021	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG016	PSF 080122a.017	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG017	PSF pig1307.022	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG017	PSF 080122a.018	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG018	PSF pig1307.023	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG018	PSF 080122a.019	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output;

		1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG019	PSF pig1307.024	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG019	PSF 080122a.020	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
PIG019	PSF PIG019	unsorted; *Measured with deuterium and QTH lamps – usable range (200-~400 nm for deuterium; ~400-1130 nm for QTH) spectra merged at 400 nm; bifurcated cable (i=e=0°); ~0.4 nm sampling interval, ~1.85 nm spectral resolution; 600 msec integration time; 200 spectra averaged (Directory: 130927pah uv reflectance)*
++++++		
PIG020	PSF pig1307.025	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG020	PSF 080122a.021	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG021	RELAB c1ec13	<45 µm, 30°/0°, 0.3-2.6µm, 5 nm.
PIG021	RELAB bkr2ec013	<45 µm; 30°/0°,30°; 0.3-50 µm; 1.2-475 nm resolution; merged RELAB+ Nicolet at 2.55 µm; note different viewing geometry.
PIG021	RELAB bkr1ec013	<45 µm; 30°/0°,30°; 0.3-50 µm; 0.7-475 nm resolution; merged RELAB+ Nicolet at 1.3 µm; note different viewing geometry.
PIG021	PSF pig1307.026	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG021	PSF 080122a.024	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG022	PSF pig1307.027	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG022	PSF 080122a.025	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG023	PSF pig1307.028	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG023	PSF 080122a.027	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG024	PSF pig1307.029	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG024	PSF 080122a.028	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG101	PSF 080122a.029	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG201	PSF pig1307.030	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG201	PSF 080122a.031	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG202	PSF pig1307.031	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG202	PSF 080708.pig202	<45 µm; 0°/0° (bifurcated cable), 200-400 nm, 0.3 nm resol., 500 spectra averaged; Ocean Optics.
PIG202	PSF 080122a.032	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG204	RELAB c1ec14	<45 µm, 30°/0°, 0.3-2.6 µm, 5 nm.
PIG204	RELAB bmr1ec014	<45 µm, 30°/30°, 1.67-25 µm, 0.6-129 nm.
PIG204	RELAB bkr1ec014	<45 µm; 30°/0°,30°; 0.3-25 µm; 5, 0.6-129 nm resolution; merged RELAB+ Nicolet at 1.71 µm; note different viewing geometry.
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PIG300	PSF pig1910.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG300	PSF 080122a.034	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output;

		1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG301	PSF pig1910.002	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG301	PSF 080122a.035	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG302	PSF pig1910.003	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG302	PSF 080122a.036	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080122 pigment mix).
++++++		
PIG303	PSF pig1910.004	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG303	PSF 080123a.001	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG304	PSF pig1910.005	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG304	PSF 080123a.002	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG305	PSF pig2210.001	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG305	PSF 080123a.003	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG306	PSF pig2210.002	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG306	PSF 080123a.004	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG307	PSF pig2210.003	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG307	PSF 080123a.039	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG308	PSF pig2210.004	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG308	PSF 080123a.040	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG309	PSF pig1910.005	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG309	*PSF pig2210.008*	*<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD; this spectrum is likely the one for PIG309; two different samples originally labelled as PIG309.*
PIG309	PSF 080123a.041	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG310	PSF pig2210.009	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG310	PSF 080123a.042	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG311	PSF pig2210.010	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG311	PSF 080123a.013	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG312	PSF pig2210.011	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG312	PSF 080123a.014	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG313	PSF pig2210.012	<45 µm; 30°/0°; 0.35-2.5 µm;1 nm resol.; 1000 avgd; ASD.
PIG313	PSF 080123a.015	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).

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PIG314	PSF pig2210.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG314	PSF 080123a.016	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG315	PSF pig2210.014	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG315	PSF 080123a.017	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG316	PSF pig2210.015	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG316	PSF 080123a.018	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
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PIG317	PSF pig2210.016	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG317	PSF 080123a.019	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG318	PSF pig2210.017	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG318	PSF 080123a.020	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG319	PSF pig0911.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG319	PSF pig0911.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG319	PSF 080123a.021	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG320	PSF pig0911.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG320	PSF pig0911.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG320	PSF 080123a.022	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG321	PSF pig0911.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG321	PSF 080123a.023	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG322	PSF pig0911.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG322	PSF 080123a.024	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG323	PSF pig0911.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG323	PSF 080123a.025	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG324	PSF pig0911.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG324	PSF 080123a.026	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG325	PSF pig0911.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG325	PSF 080123a.027	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG326	PSF pig0911.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG326	PSF 080123a.028	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG327	PSF pig0911.011	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PIG327	PSF 080123a.029	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG328	PSF pig0911.015	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG328	PSF 080123a.030	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG329	PSF pig0911.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG329	PSF 080123a.031	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG330	PSF pig0911.014	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG330	PSF 080123a.037	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG331	PSF pig0911.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG331	PSF 080123a.038	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080123 pigment mix).
++++++		
PIG332	PSF pig0911.016	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG332	PSF 080124b.001	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
++++++		
PIG333	PSF pig0911.017	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG333	PSF 080124b.002	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG334	PSF pig0911.018	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG334	PSF 080124b.003	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG335	PSF pig0911.019	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG335	PSF 080124b.004	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
++++++		
PIG336	PSF pig0911.020	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG336	PSF 080124b.005	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
++++++		
PIG337	PSF pig0911.021	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG337	PSF 080124b.006	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG338	PSF pig0911.022	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG338	PSF 080124b.007	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG339	PSF pig0911.023	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG339	PSF 080124b.008	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG340	PSF pig0911.024	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG340	PSF 080124b.009	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG341	PSF pig0911.025	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PIG341	PSF 080124b.010	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG342	PSF pig0911.026	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG342	PSF 080124b.011	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG343	PSF pig0911.027	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG343	PSF 080124b.012	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG344	PSF pig0911.028	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG344	PSF 080124b.013	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
++++++		
PIG345	PSF pig1211.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG345	PSF 080124b.014	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG346	PSF pig1211.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG346	PSF 080124b.015	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG347	PSF pig1211.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG347	PSF 080124b.016	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG348	PSF pig1211.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG348	PSF 080124b.017	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG349	PSF pig1211.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG349	PSF 080124b.018	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG350	PSF pig1211.006	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG350	PSF 080124b.019	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG351	PSF pig1211.007	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG351	PSF 080124b.020	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080124 pigment mix).
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PIG352	PSF pig1211.008	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
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PIG353	PSF pig1211.009	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
++++++		
PIG354	PSF pig1211.010	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG354	PSF 080125a.011	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG355	PSF pig1211.011	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG355	PSF 080125a.012	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG356	PSF pig1211.012	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

PIG356	PSF 080125a.013	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG357	PSF pig1211.013	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG357	PSF 080125a.014	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG358	PSF pig1211.014	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG358	PSF 080125a.015	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG359	PSF pig1211.015	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG359	PSF 080125a.016	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG360	PSF pig1211.016	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG360	PSF 080125a.018	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG361	PSF pig1211.017	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG361	PSF 080125a.019	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG362	PSF pig1211.018	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG362	PSF 080128a.002	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
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PIG363	PSF pig1211.019	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG363	PSF 080128a.003	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
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PIG366	PSF 080129a.019	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
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PIG366A	PSF 080129a.018	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080129 pigment mix).
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PIG371	PSF pig1211.020	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG371	PSF 080125a.020	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG372	PSF pig1211.021	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG372	PSF 080125a.021	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG373	PSF pig1211.022	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG373	PSF 080125a.022	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).

++++++***PIG373 – phase angle measurements – all relative to Spectralon at i=13°, e=0°***+++++++

PIG373	PSF 101001a.003	<45 µm; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.012	<45 µm; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).

PIG373	PSF 101001a.021	<45 µm; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.030	<45 µm; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.039	<45 µm; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.048	<45 µm; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.057	<45 µm; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.067	<45 µm; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.077	<45 µm; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
PIG373	PSF 101001a.086	<45 µm; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 µm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
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PIG374	PSF pig1211.023	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG374	PSF 080125a.023	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG375	PSF pig1211.025	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG375	PSF 080125a.024	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG376	PSF pig1211.026	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG376	PSF 080125a.025	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG377	PSF pig1211.027	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG377	PSF 080125a.026	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG378	PSF pig1211.028	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
PIG378	PSF 080125a.027	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080125 pigment mix).
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PIG379	PSF pig1307.001	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG379	PSF 080128a.001	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
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PIG380	PSF pig1307.002	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG380	PSF 080128a.004	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
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PIG381	PSF pig1307.003	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG381	PSF 080128a.006	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output;

		1000 spectra averaged; ASD (Directory: 080128 pigment mix).
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PIG382	PSF pig1307.004	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG382	PSF 080128a.007	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
++++++		
PIG383	PSF pig1307.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD (aka pig1311).
PIG383	PSF 080128a.008	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).
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PIG384	PSF pig2210.005	<45 µm; 30°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD; this spectrum is likely the one for PIG384; two different samples originally labelled as PIG309 *(see PIG309)*.
PIG384	PSF 080128a.009	<45 µm mixed with linseed oil. i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD (Directory: 080128 pigment mix).

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19.4.2.1d. Pigments on goatskin and papyrus: Baseline spectra: July 22, 2013 (inks applied July 18, 2013)

Spot description		***Spectral file***	
1-1a:	Goatskin, PIG404, heavy coat	130722a.001	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-1b:	Goatskin, PIG404, light coat	130722a.002	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-1c:	Goatskin, PIG405, heavy coat	130722a.003	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-1d:	Goatskin, PIG405, light coat	130722a.004	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-1e:	Goatskin, PIG403, heavy coat	130722a.005	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-1f:	Goatskin, PIG403, light coat	130722a.006	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-1g:	Goatskin, blank spot	130722a.007	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
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1-2a:	Light papyrus, PIG404, heavy coat	130722a.008	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-2b:	Light papyrus, PIG404, light coat	130722a.009	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-2c:	Light papyrus, PIG405, heavy coat	130722a.010	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-2d:	Light papyrus, PIG405, light coat	130722a.011	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-2e:	Light papyrus, PIG403, heavy coat	130722a.012	ASD; i=30°, e=0°; 0.35-2.5 µm; 1 nm output;

			1000 spectra averaged; directory: 130722 pigments.
1-2f:	Light papyrus, PIG403, light coat	130722a.013	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-2g:	Light papyrus, blank spot	130722a.014	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
++++++			
1-3a:	Dark papyrus, PIG404, heavy coat	130722a.015	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-3b:	Dark papyrus, PIG404, light coat	130722a.016	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-3c:	Dark papyrus, PIG405, heavy coat	130722a.017	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-3d:	Dark papyrus, PIG405, light coat	130722a.018	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-3e:	Dark papyrus, PIG403, heavy coat	130722a.019	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-3f:	Dark papyrus, PIG403, light coat	130722a.020	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
1-3g:	Dark papyrus, blank spot	130722a.021	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
++++++			
2-1a:	Goatskin, PIG502, heavy coat	130722a.022	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-1b:	Goatskin, PIG502, light coat	130722a.023	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-1c:	Goatskin, PIG402, heavy coat	130722a.024	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-1d:	Goatskin, PIG402, light coat	130722a.025	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-1e:	Goatskin, PIG400, heavy coat	130722a.026	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-1f:	Goatskin, PIG400, heavy coat	130722a.027	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-1g:	Goatskin, blank spot	130722a.028	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
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2-2a:	Light papyrus, PIG502, heavy coat	130722a.029	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.

2-2b:	Light papyrus, PIG502, light coat	130722a.030	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-2c:	Light papyrus, PIG402, heavy coat	130722a.031	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-2d:	Light papyrus, PIG402, light coat	130722a.032	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-2e:	Light papyrus, PIG400, heavy coat	130722a.033	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-2f:	Light papyrus, PIG400, light coat	130722a.034	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
2-2g:	Light papyrus, blank spot	130722a.035	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130722 pigments.
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2-3a:	Dark papyrus, PIG502, heavy coat	130723a.036	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
2-3b:	Dark papyrus, PIG502, light coat	130723a.037	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
2-3c:	Dark papyrus, PIG402, heavy coat	130723a.038	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
2-3d:	Dark papyrus, PIG402, light coat	130723a.039	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
2-3e:	Dark papyrus, PIG400, heavy coat	130723a.040	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
2-3f:	Dark papyrus, PIG400, light coat	130723a.041	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
2-3g:	Dark papyrus, blank spot	130723a.042	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
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3-1a:	Goatskin, PIG700, heavy coat	130723a.043	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-1b:	Goatskin, PIG700, light coat	130723a.044	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-1c:	Goatskin, PIG702, heavy coat	130723a.045	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-1d:	Goatskin, PIG702, light coat	130723a.046	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-1g:	Goatskin, blank spot	130723a.047	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.

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3-2a:	Light papyrus, PIG700, heavy coat	130723a.048	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-2b:	Light papyrus, PIG700, light coat	130723a.049	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-2c:	Light papyrus, PIG702, heavy coat	130723a.050	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-2d:	Light papyrus, PIG702, light coat	130723a.051	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-2g:	Light papyrus, blank spot	130723a.052	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.

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3-3a:	Dark papyrus, PIG700, heavy coat	130723a.053	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-3b:	Dark papyrus, PIG700, light coat	130723a.054	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-3c:	Dark papyrus, PIG702, heavy coat	130723a.055	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-3d:	Dark papyrus, PIG702, light coat	130723a.056	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.
3-3g:	Dark papyrus, blank spot	130723a.057	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130723 pigments.

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19.4.2.2d. First re-shoot: September 9, 2013 (inks applied July 18, 2013)

Spot description		***Spectral file***	
1-1a:	Goatskin, PIG404, heavy coat	130909a.002	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-1b:	Goatskin, PIG404, light coat	130909a.003	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-1c:	Goatskin, PIG405, heavy coat	130909a.004	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-1d:	Goatskin, PIG405, light coat	130909a.005	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-1e:	Goatskin, PIG403, heavy coat	130909a.006	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-1f:	Goatskin, PIG403, light coat	130909a.007	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.

1-1g:	Goatskin, blank spot	130909a.008	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
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1-2a:	Light papyrus, PIG404, heavy coat	130909a.009	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-2b:	Light papyrus, PIG404, light coat	130909a.010	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-2c:	Light papyrus, PIG405, heavy coat	130909a.011	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-2d:	Light papyrus, PIG405, light coat	130909a.012	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-2e:	Light papyrus, PIG403, heavy coat	130909a.013	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-2f:	Light papyrus, PIG403, light coat	130909a.014	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-2g:	Light papyrus, blank spot	130909a.015	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
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1-3a:	Dark papyrus, PIG404, heavy coat	130909a.016	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-3b:	Dark papyrus, PIG404, light coat	130909a.017	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-3c:	Dark papyrus, PIG405, heavy coat	130909a.018	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-3d:	Dark papyrus, PIG405, light coat	130909a.019	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-3e:	Dark papyrus, PIG403, heavy coat	130909a.020	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-3f:	Dark papyrus, PIG403, light coat	130909a.021	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
1-3g:	Dark papyrus, blank spot	130909a.022	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
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2-1a:	Goatskin, PIG502, heavy coat	130909a.023	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-1b:	Goatskin, PIG502, light coat	130909a.024	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-1c:	Goatskin, PIG402, heavy coat	130909a.025	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909

			pigments.
2-1d:	Goatskin, PIG402, light coat	130909a.026	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-1e:	Goatskin, PIG400, heavy coat	130909a.027	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-1f:	Goatskin, PIG400, heavy coat	130722a.028	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-1g:	Goatskin, blank spot	130909a.029	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
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2-2a:	Light papyrus, PIG502, heavy coat	130909a.030	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-2b:	Light papyrus, PIG502, light coat	130909a.031	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-2c:	Light papyrus, PIG402, heavy coat	130909a.032	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-2d:	Light papyrus, PIG402, light coat	130909a.033	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-2e:	Light papyrus, PIG400, heavy coat	130909a.034	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-2f:	Light papyrus, PIG400, light coat	130909a.035	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-2g:	Light papyrus, blank spot	130909a.036	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
++++++			
2-3a:	Dark papyrus, PIG502, heavy coat	130909a.037	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-3b:	Dark papyrus, PIG502, light coat	130909a.038	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-3c:	Dark papyrus, PIG402, heavy coat	130909a.039	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-3d:	Dark papyrus, PIG402, light coat	130909a.040	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-3e:	Dark papyrus, PIG400, heavy coat	130909a.041	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-3f:	Dark papyrus, PIG400, light coat	130909a.042	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
2-3g:	Dark papyrus, blank spot	130909a.043	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909

			pigments.
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3-1a:	Goatskin, PIG700, heavy coat	130909a.044	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
3-1b:	Goatskin, PIG700, light coat	130909a.045	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
3-1c:	Goatskin, PIG702, heavy coat	130909a.046	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
3-1d:	Goatskin, PIG702, light coat	130909a.047	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
3-1g:	Goatskin, blank spot	130909a.048	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130909 pigments.
++++++			
3-2a:	Light papyrus, PIG700, heavy coat	130910b.001	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
3-2b:	Light papyrus, PIG700, light coat	130910b.002	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
3-2c:	Light papyrus, PIG702, heavy coat	130910b.003	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
3-2d:	Light papyrus, PIG702, light coat	130910b.004	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
3-2g:	Light papyrus, blank spot	130910b.005	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
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3-3a:	Dark papyrus, PIG700, heavy coat	130910b.006	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
3-3b:	Dark papyrus, PIG700, light coat	130910b.007	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
3-3c:	Dark papyrus, PIG702, heavy coat	130910b.008	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
3-3d:	Dark papyrus, PIG702, light coat	130910b.009	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.
3-3g:	Dark papyrus, blank spot	130910b.010	ASD; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; directory: 130910 pigments.

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END of 19.

20. Analogue Sites

20.1. East German Creek Area – MB, Canada

20.1.1. East German Creek Springs Complex
20.1.2. Salt Point Springs Area
20.1.3. McArdle Salt Works
20.1.4. Mafeking Quarry

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Sample ID *Description*

20.1a.1. East German Creek Springs Complex

20.1.1a.1. East German Creek Springs Complex - samples collected August 24-26, 2005

SS001	East German Creek area: Soil sample from Cauldron C - top orange layer: 0-2 mm depth.
SS002	East German Creek area: Soil sample from Cauldron C - medium black layer: 2-3 mm depth.
SS003	East German Creek area: Soil sample from Cauldron C - lower gray-brown granular layer; >3 mm depth.
SS004	East German Creek area: “Kona Beach” orange and red clasts.
SS005	East German Creek area: “Kona Coast” outliers and surficial sand.
SS006	East German Creek area: Black pool ridge - salt encrusted grunge.
SS007	East German Creek area: NW side of “North Bay” - crudded rocks.
SS009	East German Creek area: “blueberries”.
SS010	East German Creek area: 3 weathered limestone rocks and associated “blueberries”.
SS011	East German Creek area: “middle Stooge pot”: fresh gray surficial sediment.
SS012	East German Creek area: Big cauldron pool and adjacent crust.
SS013	East German Creek area: Surficial soil with “blueberries”.
SS016	East German Creek area: Barrenlands: “blueberries” and underlying pavement (picture 5).
SS017	East German Creek area: various clasts collected on day 1.
SS018	East German Creek area: “interlake area between 3 Stooges pots: a) red crust; b) black crust.
SS019	East German Creek area: “Pit F” - 10 metres SW of Big Cauldron; surficial “crust”.
SS020	East German Creek area: “North Stooge pit” - surficial orange crust.
SS021	East German Creek area: SW corner of site; nearly buried rock, only small ridge exposed.
SS022	East German Creek area: W side of “badlands”; crusty brain, pot nearest Big Cauldron.
SS023	East German Creek area: “Pot 2", sample 1: orange-red crust.
SS024	East German Creek area: “Pot 2", sample 2: brown-red clasts.
SS025	East German Creek area: “Pot 2", sample 3: “bleached” clasts.
SS026	East German Creek area: “Spatter cone 1", sediment 0-0.5 cm depth.
SS027	East German Creek area: “Spatter cone 1", sediment 1-3 cm depth.
SS028	East German Creek area: “”Kona Coast” surficial “sand” and associated clasts.
SS029	East German Creek area: Lone pot sample 1 - “blueberries”.
SS030	East German Creek area: Lone pot sample 2: brainy crust.
SS031	East German Creek area: “Spatter cone 2": orange sediment: 0-3 mm depth.
SS032	East German Creek area: Barely active pot on E side of site: 8" depth.
SS033	East German Creek area: Trench - orange soil.
SS034	East German Creek area: Excavated pot: channel fill.
SS035	East German Creek area: tufa sample.
SS036	East German Creek area: tufa sample.
SS037	East German Creek area: tufa sample.
SS038	East German Creek area: reddish tufa sample.
SS039	East German Creek area: weathered fossiliferous limestone sample.

SS040 East German Creek area: weathered fossiliferous limestone sample.
SS041 East German Creek area: weathered fossiliferous limestone sample.
SS042 East German Creek area: weathered fossiliferous limestone sample.
SS043 East German Creek area: precipitated orange-stained carbonate.
SS044 East German Creek area: weathered sponge or coral fossil.
SS045 East German Creek area: reprecipitated, orange-stained limestone.
SS046 East German Creek area: weathered fossiliferous limestone.
SS047 East German Creek area: weathered fossiliferous limestone.
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EGC100 SS010 and SS1 - Clasts and blueberries, day 1.
EGC101 SS017 - various clasts, day 1.
EGC102 SS007 - various crudded rocks NW side of North Bay.
EGC103 SS018 - 3 Stooges interlake region, a) red crust b) brains.
EGC104 SS021 - SW corner of site, gnarly bedrock, only ripe deposit.
EGC105 SS032 - barely active pot, east side, 1' 8" down.
EGC106 various clasts, day 1.
EGC107 SS013 - surficial soil.
EGC108 SS009 - blueberries, day 1.
EGC109 SS012 - Big cauldron, crust adjacent to pool, day 1.
EGC110 SS011 - middle Stooge pool; fresh sediment from inside pool.
EGC111 SS023 - Pot 2, sample 1, orange-red crust.
EGC112 SS024 - Pot 2, sample 2, brown-red clasts and soil.
EGC113 SS025 - pot 2, sample 3, bleached clasts.
EGC114 SS001 - Cauldron C, 0-2 mm, top orange layer.
EGC115 SS002 – Cauldron C, ~2-3 mm deep, medium-black layer.
EGC116 SS003 - Cauldron C, >3 mm deep, lower gray granular layer.
EGC117 SS006 - Blackpool ridge, salt encrusted grunge.
EGC118 SS016 - Picture 5, barren lands, blueberries and underlying pavement.
EGC119 SS019 - 10 metres SW of big cauldron, crust adjacent to pool.
EGC120 SS020 - North Stooge, orange sediment.
EGC121 SS022 - West side of badlands crusty brain, pot nearest big cauldron.
EGC122 SS026 - Spatter cone 1 sediment, 0-0.5 cm depth.
EGC123 SS027 - Spatter cone 1 sediment, ~1-3 cm depth.
EGC124 SS029 - Lone pot, sample 1 blueberries.
EGC125 SS030 - Lone pot, sample 2, surface pavement.
EGC126 SS031 - Spatter cone 2 sediment, 0-3 mm depth.
EGC127 SS033 - Trench, orange soil.
EGC128 SS034 - Excavated pot, channel fill.

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<u>20.1.1a.2. East German Creek Springs Complex – collected August 2006</u>

EGC200 ASD001 - Red soil (ASD field spectrum shot).
EGC201 ASD002 - Yellow soil (ASD field spectrum shot).
EGC202 ASD003 - Brown soil (ASD field spectrum shot).
EGC203 ASD005 - White brains (ASD field spectrum shot).
EGC204 ASD007 - Brown pavement (ASD field spectrum shot).
EGC205 ASD008 - Black brains (ASD field spectrum shot).
EGC206 ASD009 - buff soil (ASD field spectrum shot).
EGC207 ASD010 and ASD011 - buff sand (ASD field spectrum shot).
EGC208 ASD012 - Trench “1” in red sand - first layer, 0-3 mm depth, red sand layer (ASD field spectrum shot).
EGC209 ASD013 - Trench “1” in red sand - second layer, 3-7 mm depth (ASD field spectrum shot).
EGC210 ASD014 - Trench “1” in red sand - third layer, 7 mm - 4 cm depth (ASD field spectrum shot).
EGC211 ASD015 - Trench “1” in red sand - fourth layer, >4 cm depth (ASD field spectrum shot).

EGC212 ASD016 - Trench “2" by big cauldron - first layer, 0-1 mm depth (ASD field spectrum shot).
EGC213 ASD017 - Trench “2" by big cauldron - second layer, 1 mm - 3 cm depth (red fine soil) (ASD field spectrum shot).
EGC214 ASD018 - Trench “2" by big cauldron - third layer: >3 cm depth (yellow fine-grained soil) (ASD field spectrum shot).
EGC215 ASD019 - Black anoxic layer at edge of big cauldron (~ 2 mm depth) (ASD field spectrum shot).
EGC216 ASD020 - Rock #1: White etched limestone (ASD field spectrum shot of weathered/exposed surface).
EGC217 ASD021 - Rock #2: Yellow etched limestone (ASD field spectrum shot of weathered/exposed surface).
EGC218 ASD022 - Rock #3: Iron-stained, etched buff limestone (ASD field spectrum shot of weathered/exposed/stained surface).
EGC219 ASD023 - Rock #4: Gray travertine (ASD field spectrum shot of weathered/exposed surface).
EGC220 ASD024 - Rock #5: Rainbow, pitted limestone ((ASD field spectrum shot of weathered/exposed surface).
EGC221 ASD025 - Rock #6: Red-stained limestone (ASD field spectrum shot of weathered/exposed surface).
EGC222 ASD026 - Rock #7: Brown-stained limestone (ASD field spectrum shot of weathered/exposed surface).
EGC223 Rock A: reddish limestone with adhering soil (not shot with ASD in field).
EGC224 Rock B: Pitted gray limestone (not shot with ASD in field).
EGC225 Rock C: Brownish pitted limestone (not shot with ASD in field).
EGC226 Rock D: Reddish pitted limestone (not shot with ASD in field).
EGC227 Unnamed rock: orange limestone (not shot with ASD in field).
EGC228 Unnamed rock banded fossilized coral with algal band stain (not shot with ASD in field).
EGC229 Unnamed rock: red-yellow stained limestone (not shot with ASD in field).
EGC230 Unnamed rock Orange-brown stained limestone (not shot with ASD in field).
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20.1.1a.3. East German Creek Springs Complex – collected October 2006

EGC300 Transect 1, point B - surface soil: finer red sand. (Point A is Pit 2 surface). Shot field spectrum with D&P spectrometer. 5 metres south of point A.
EGC301 Transect 1, point C - surface soil: very fine buff silt. Shot field spectrum with D&P spectrometer. 4 metres south of point B.
EGC302 Transect 1, point D - surface soil: less red medium sand. Shot field spectrum with D&P spectrometer. 0.5 metres south of point C.
EGC303 Transect 1, point E - surface soil: buff silt. Shot field spectrum with D&P spectrometer. 4 metres south of point D.
EGC304 Transect 1, point F - surface soil travertine and buff silt; 50% of each in field of view. Shot field spectrum with D&P spectrometer. 2 metres south of point E.
EGC305 Transept 1, point G - surface soil. 1 metre south of point E.
EGC306 Transect 1, point H - surface soil: red-brown brains. Shot field spectrum with D&P spectrometer. 5 metres south of point G.
EGC307 Transect 1, point I - surface soil red brains. Shot field spectrum with D&P spectrometer. 7 metres south of point H.
EGC308 Transect 1, point J - surface soil: brown silt. Shot field spectrum with D&P spectrometer. Same location as point I.
EGC309 Transect 1, point K - surface soil: black brains. Shot field spectrum with D&P spectrometer. 4 metres south of points I and J.
EGC310 Transect 1, point L - surface soil: brown brains. Shot field spectrum with D&P spectrometer. 3 metres south and 3 metres east of point K.
EGC311 Transect 1, point M - surface soil: white brains. Shot field spectrum with D&P spectrometer. 3 metres south of point K.
EGC312 Transect 1, point N - surface soil: red silt with brains? Shot field spectrum with D&P spectrometer. 6 metres south of point M.
EGC313 Transect 1, point O - surface soil: red delta (recently abandoned channel). Shot field spectrum with D&P spectrometer. 15 metres west of point N.
EGC314 Pit 1 (50 cm north of edge of big cauldron), sample 1: 0-1 mm depth red soil.

EGC315 Pit 1 (50 cm north of edge of big cauldron), sample 2: 1-2 mm depth; anaerobic black layer.
EGC316 Pit 1 (50 cm north of edge of big cauldron), sample 3: 2-15 mm depth; medium brown sand.
EGC317 Pit 1 (50 cm north of edge of big cauldron), sample 4: >15 mm depth; yellow gray soil.
EGC318 Pit 2 (70 metres west of big cauldron). Sample 1: red sand, 0-1 mm depth.
EGC319 Pit 2 (70 metres west of big cauldron). Sample 2: light brown sand, 1-2 mm depth.
EGC320 Pit 2 (70 metres west of big cauldron). Sample 3: black-gray sand, 2-3 mm depth.
EGC321 Pit 2 (70 metres west of big cauldron). Sample 4: medium brown sand, 4 mm - 6 cm depth.
EGC322 Pit 2 (70 metres west of big cauldron). Sample 5: reddish gravel/sand, 6-30 cm depth.
EGC323 Pit 2 (70 metres west of big cauldron). Sample 6: yellow silt, >30 cm depth
EGC324 Pit 2 (70 metres west of big cauldron). Sample 6a: gray silt, >30 cm depth, deeper than sample 6.
EGC325 Pit 2 (70 metres west of big cauldron). Sample 6b: gray silt, >30 cm depth, deeper than sample 6a.
EGC326 Travertine pavement 1 - gray.
EGC327 Travertine pavement 2 - brown.
EGC328 Travertine pavement 3 - brown-gray.
EGC329 Travertine pavement 4 - red.
EGC330 Pit 3 - 4 cm down, orange-red soil.
EGC331 Downstream creek rock 1 - black pitted.
EGC332 Downstream creek rock 2 - black pitted.
EGC333 Downstream creek rock 3 - red-orange smooth.
EGC334 Downstream creek rock 4 - orange, pitted.
EGC335 Downstream creek rock 5 - white pitted.
EGC336 Downstream creek rock 6 - white pitted.
EGC337 Downstream creek rock 7 - red and green.
EGC338 Downstream creek rock 8 - orange, green, white banded.
EGC339 Downstream creek rock 9 - orange and white pitted, banded.
EGC340 Downstream creek rock 10 - orange, cracked.
EGC341 Old red delta deposit.
EGC342 Orange pitted rock.
EGC343 White pitted rock.
EGC344 Pit #1 excavated profile, ~6 cm thick.
EGC345 Pit #2 excavated profile, ~6 cm thick.
EGC346 Pit #3 excavated profile, ~4 cm thick.
EGC347 Pit #4 excavated profile, ~4 cm thick.
EGC348 Pit #5 excavated profile, ~4 cm thick.
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20.1.1a.4. East German Creek Springs Complex – August 7, 2007

EGC500 Gypsum/halite(?) encrusted brick at N end of site near end of delta (near north creek site NC6).
EGC501 Travertine surface layer, 50 metres east of Big Cauldron.
EGC502-517 Travertine "cinders" from summit of Big Cauldron, ~1 metre north of cauldron rim.
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20.1.1a.5. East German Creek Springs Complex - outflow channel transect – sediment samples – collected August 7, 2007

Samples have air dried since summer 2008.

Sample IDs: NCx.1: stream bottom
NCx.2: side of stream
NCx.3: bank of stream

Sampling done along outflow creek (flowing along north side of site) starting at Big Cauldron).

NC1 52' 45.101" N, 100' 52.937" W – water sample collected: NC1
NC1.2 Edge of Big Cauldron – orange sediments

NC1.3	Shoreline of Big Cauldron – orange sediments
NC2	52’ 45.106 N, 100’ 52.929” W; 25 metres downstream from Big Cauldron – water sample collected” NC2; 2 photos taken.
NC2.1	Orange-brown sediments
NC2.2	Orange-brown sediments
NC3	52” 45.107” N, 100’ 52.910” W; 50 metres downstream from Big Cauldron – water sample collected.
NC3.1	50m from Big Cauldron – reddish sediments
NC3.2	50 m from Big Cauldron – brown-red sediments
NC4	52’ 45.127” N, 100’ 52.888” W; 100 metres downstream from Big Cauldron – water sample collected.
NC4.1	Orange sediments
NC4.3	White-brown crusts and fragments
NC5	52’ 45.147” N, 100’ 52.868” W; 150 metres downstream from Big Cauldron – water sample collected.
NC5.1	Orange-brown sediments
NC5.3	Orange-brown sediments
NC6	52’ 45.191” N, 100’ 52.838” W; 250 metres downstream from Big Cauldron – water sample collected.
NC6.1	Brown sediments
NC6.2	Grey-green, brown sediments (“Brick!”)
NC6.3	White-brown crust
NC7	52’ 45.211” N, 100’ 52.859” W; 300 metres downstream from Big Cauldron – water sample collected.
NC7.1	Orange-brown-white sediments
NC7.2	Brown sediments
NC7.3	Grey/brown/orange sediments
NC8	52’ 45.219” N, 100’ 52.896” W; 350 metres downstream from Big Cauldron – water sample collected.
NC8.1	Grey sediments
NC8.2	Grey sediments
NC8.3	Brown sediments
NC9	52’ 45.225” N, 100’ 52.936” W; 400 metres downstream from Big Cauldron – water sample collected.
NC9.1	Orange-brown sediments
NC9.2	Grey-green, brown sediments
NC10	52’ 45.234” N, 100’ 52.978” W; 450 metres downstream from Big Cauldron – water sample collected.
NC10.1	Brown-orange sediments
NC10.2	Brown/orange sediments
NC11	52’ 45.239” N, 100’ 53.022” W; 500 metres downstream from Big Cauldron – water sample collected.
NC11.1	Brown/orange sediments
NC11.2	Grey-green, brown sediments
NC12	52’ 45.254” N, 100’ 53.093” W; 600 metres downstream from Big Cauldron – water sample collected.
NC12.1	Grey-brown sediments
NC12.2	Grey-brown sediments
NC13	52’ 45.258” N, 100’ 53.136” W; 650 metres downstream from Big Cauldron – water sample collected.
NC13.1	Brown sediments
NC13.2	Brown sediment
NC14	52’ 45.266” N, 100’ 53.169” W; 700 metres downstream from Big Cauldron – junction of north and south outflow channels – water sample collected.
NC14.1	Sediment-covered cobbles
NC15	52’ 45.285” N, 100’ 53.179” W; 750 metres downstream from Big Cauldron – water sample collected.
NC15.1	Brown-covered cobble
NC15.2	Grey-brown sediments
NC16	52’ 45.312” N, 100’ 53.206” W; 810 metres downstream from Big Cauldron – water sample collected; north channel of outflow creek.
NC16.1	Brown-orange sediments
NC16.2	Green sediments
NC17	52’ 45.324” N, 100’ 53.237” W; 860 metres downstream from Big Cauldron – water sample collected.
NC17.1	Brown-orange cobbles
NC17.2	Brown-green sediments
NC18	52’ 45.343” N, 100’ 53.247” W; 910 metres downstream from Big Cauldron – water sample collected.
NC18.1	Sediment-covered cobbles

NC19 52’ 45.353” N, 100’ 53.230” W; 960 metres downstream from Big Cauldron – water sample collected.
NC19.1 Sediment-covered cobbles

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20.1.1a.5.1. East German Creek Springs Complex - GPS Coordinates of active springs – August 7, 2007

Big Cauldron 52’ 45.098” N, 100’ 52.938” W. 2 m accuracy.
Spring 2 52’ 45.098” N, 100’ 52.950” W. 3 m accuracy.
Spring 3 52’ 45.094” N, 100’ 52.951” W. 3 m accuracy.
Spring 4 52’ 45.091” N, 100’ 52.950” W. 3 m accuracy.
Spring 5 52’ 45.093” N, 100’ 52.946” W. 3 m accuracy.
Spring 6 52’ 45.091” N, 100’ 52.942” W. 2 m accuracy.
Spring 7 52’ 45.085” N, 100’ 52.939” W. 3 m accuracy.
Spring 8 52’ 45.071” N, 100’ 52.946” W. 3 m accuracy.
Spring 9 52’ 45.085” N, 100’ 52.958” W. 3 m accuracy.
Spring 10 52’ 45.083” N, 100’ 52.971” W. 3 m accuracy.
Spring 11 52’ 45.073” N, 100’ 52.963” W, 4 m accuracy.
Spring 12 52’ 45.065” N, 100’ 52.965” W. 4 m accuracy.
Spring 13 52’ 45.076” N, 100’ 52.968” W. 4 m accuracy.
Spring 14 52’ 45.076” N, 100’ 52.978” W. 3 m accuracy.
Spring 15 52’ 45.079” N, 100’ 52.975” W. 3 m accuracy.
Spring 16 52’ 45.088” N, 100’ 52.969” W. 3 m accuracy.
Spring 17 52’ 45.092” N, 100’ 52.971” W. 3 m accuracy.
Spring 18 52’ 45.094” N, 100’ 52.967” W. 3 m accuracy.
Spring 19 52’ 45.094” N, 100’ 52.967” W. 3 m accuracy.
Spring 20 52’ 45.096” N, 100’ 52.963” W. 3 m accuracy.
Spring 21 52’ 45.102” N, 100’ 52.962” W. 3 m accuracy.
Spring 22 52’ 45.101” N, 100’ 52.958” W. 3 m accuracy; twin springs.
Spring 23 52’ 45.101” N, 100’ 52.957” W. 3 m accuracy.
Spring 24 52’ 45.102” N, 100’ 52.954” W. 4 m accuracy.
Spring 25 52’ 45.104” N, 100’ 52.950” W. 3 m accuracy.
Spring 26 52’ 45.104” N, 100’ 52.948” W. 3 m accuracy.
Spring 27 52’ 45.124” N, 100’ 52.916” W. 3 m accuracy.
Spring 28 52’ 45.125” N, 100’ 52.963” W. 4 m accuracy.
Spring 29 52’ 45.121” N, 100’ 52.977” W. 4 m accuracy.
Spring 30 52’ 45.121” N, 100’ 52.981” W. 4 m accuracy; twin springs.
Spring 31 52’ 45.120” N, 100’ 52.984” W. 4 m accuracy.
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20.1.1a.6. East German Creek Springs Complex – May 11-13, 2010 (EGC600 series)

EGC600 Orange surficial loose sediments from edge of Big Cauldron (Station 100512EGC1).
EGC601a,b a: Buff-gray sediments (expected silica-rich) from below orange surficial layer (EGC600), ~1-2 mm down, from edge of Big Cauldron (Station 100512EGC1). B: coarser orange sediments, 2 mm below surface layer, from edge of Big Cauldron.
EGC602 Sediments at station 2 (~40 m from Big Cauldron along outflow channel); from bottom of stream (Station 00512EGC2).
EGC603 Rocks/pebbles at station 2 (~40 m from Big Cauldron along outflow channel); from bottom of stream (Station 00512EGC2).
EGC604 Sediments at station 3 (~90 m from Big Cauldron along outflow channel); from bottom of stream (Station 00512EGC3).
EGC605 Rocks/pebbles at station 3 (~90 m from Big Cauldron along outflow channel); from bottom of stream (Station 00512EGC3).
EGC606 Sediments at station 4 (~130 m from Big Cauldron along outflow channel); from bottom of stream (Station 00512EGC4).

EGC607 Rocks/pebbles at station 4 (~130 m from Big Cauldron along outflow channel); from bottom of stream (Station 00512EGC4).
EGC608 Rocks/pebbles and sediments from bottom of outflow channel at station 6 (downstream from Big Cauldron along outflow channel) (Station 00512EGC6).
EGC609 Rocks/pebbles and sediments from bottom of outflow channel at station 7 (~340 m downstream from Big Cauldron along outflow channel) (Station 00512EGC7).
EGC610 Rocks/pebbles and sediments from bottom of outflow channel at station 8 (downstream from Big Cauldron along outflow channel) (Station 00512EGC8).
EGC611 Rocks/pebbles and sediments from bottom of outflow channel at station 9 (downstream from Big Cauldron along outflow channel) (Station 00512EGC9).
EGC612 Rocks/pebbles and sediments from bottom of outflow channel at station 10 (downstream from Big Cauldron along outflow channel) (Station 00512EGC10).
EGC613 Rocks/pebbles and sediments from bottom of outflow channel at station 11 (~720 m downstream from Big Cauldron along outflow channel) (Station 00512EGC11).
EGC614 Rocks from shore (not in channel) at station 11 (~720 m downstream from Big Cauldron along outflow channel) (Station 00512EGC11).
EGC615 Rocks/pebbles and sediments from bottom of outflow channel at station 12 (~820 m downstream from Big Cauldron along outflow channel) (Station 00512EGC12).
EGC616 Rocks from shore (not in channel) at station 11 (~820 m downstream from Big Cauldron along outflow channel) (Station 00512EGC12).
EGC617 Surface orange-yellow sediments from around recently inactive spring south of Big Cauldron.
EGC618 Subsurface (~1-5 mm below surface orange-yellow sediments) yellow and black (anoxic) sediments from around recently inactive spring south of Big Cauldron.
EGC619 Nine pieces of limestone with various types of coatings and surface textures from shore (above water) at Station 100512EGC10.
EGC620 Surficial “blueberries” from flats west of Big Cauldron (form essentially a monolayer).

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20.1.1a.7. East German Creek Springs Complex – precipitates from water samples at 2010 field visit

Samples evaporated in air and precipitate recovered.

EGC EVAP1 Bulk precipitate; station 1.
EGC EVAP2 Bulk precipitate; station 2.
EGC EVAP3 Bulk precipitate; station 3.
EGC EVAP4 Bulk precipitate; station 4.
EGC EVAP6 Bulk precipitate; station 6.
EGC EVAP7 Bulk precipitate; station 7.
EGC EVAP8 Bulk precipitate; station 8.
EGC EVAP9 Bulk precipitate; station 9.
EGC EVAP10 Bulk precipitate; station 10.
EGC EVAP11 Bulk precipitate; station 11.
EGC EVAP12 Bulk precipitate; station 12.
EGC EVAP1 Large single crystal; station 1.
EGC EVAP1 Large single crystal.; station 2.
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20.1.1a.8. East German Creek Springs Complex – sediments and rocks from outflow creek – May 2010

EGC2-s1 Brown and red sediments from eddy in outflow creek at Station 2.
EGC3-s1 Sediments from outflow creek at Station 3.
EGC3-r1 Exposed rocks in outflow creek at Station 3.
EGC4-s1 Sediments from outflow creek at Station 3.
EGC6-s1 Sediments from outflow creek at Station 3.
EGC7-s1 Sediments from outflow creek at Station 3.

EGC8-s1 Sediments from outflow creek at Station 3.
EGC9-s1 Sediments from outflow creek at Station 3.
EGC10-s1 Sediments from outflow creek at Station 3.
EGC11-s1 Sediments from outflow creek at Station 3.
EGC11-s2 Sediments from shore of outflow creek, and rocks, at Station 3.
EGC12-s1 Sediments from outflow creek at Station 3.
EGC12-s2 Sediments from shore of outflow creek, and rocks, at Station 3.

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20.1.1a.9. East German Creek Springs Complex – water samples from outflow channel – Sept. 25, 2011

EGCW01 Water sample 1 (1 litre bottle), 0 metres from Big Cauldron (station 1).
EGCW02 Water sample 2 (1 litre bottle), 40 metres from Big Cauldron (station 2).
EGCW03 Water sample 1 (1 litre bottle), 90 metres from Big Cauldron (station 3).
EGCW04 Water sample 1 (1 litre bottle), 130 metres from Big Cauldron (station 4).
EGCW06 Water sample 1 (1 litre bottle), 270 metres from Big Cauldron (station 6).
EGCW07 Water sample 1 (1 litre bottle), 340 metres from Big Cauldron (station 7).
EGCW08 Water sample 1 (1 litre bottle), 450 metres from Big Cauldron (station 8).
EGCW09 Water sample 1 (1 litre bottle), 550 metres from Big Cauldron (station 9).
EGCW10 Water sample 1 (1 litre bottle), 650 metres from Big Cauldron (station 10).
EGCW11 Water sample 1 (1 litre bottle), 720 metres from Big Cauldron (station 11).
EGCW12 Water sample 1 (1 litre bottle), 820 metres from Big Cauldron (station 12).

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20.1.1a.10. East German Creek Springs Complex: Sediment "Bricks" for surface spectra – collected September 25, 2011

Note: "bricks" of samples excavated at site with surface textures preserved for larger-scale spectral analysis. "Brains" are likely algal mats.

BRICK1 On crest of Big Cauldron, 2 metres east of central vent: iron-stained carbonate concretions ("pavement").
BRICK2 10 metres WSW of Big Cauldron: red-stained "brains".
BRICK3 10 metres W of Big Cauldron: white-encrusted "brains".
BRICK4 50 metres WSW of Big Cauldron: black "brains".
BRICK5 80 metres W of Big Cauldron: light-medium brown fine-grained outwash sediments.
BRICK6 90 metres W of Big Cauldron: red-stained, medium grained outwash sediments.
BRICK7 20 metres W of Big Island "neck": black "brains" on buff-coloured sediments.
BRICK8 75 metres W of Big Island "neck": typical red-brown fine- to medium-grained outwash sediments.
BRICK9 Near Station 8: gray film, flat algal mat (~150 m WNW of Big Island).
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20.1.2a. Sample Descriptions - Salt Point Springs Area

20.1.2a.1. Salt Point Springs Area - samples collected October 21, 2011

SP001 Cemented calcite oolites from spring mound – north Salt Point spring complex (Mound 5).
SP002-004 Three gypsum-encrusted carbonate disks from area of Mound 13.

Water samples:

Mound 6a Water sample from flowing mound (250 ml collected).
Mound 6b Water sample from flowing mound (250 ml collected).

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20.1.3a. Sample Descriptions - McArdle Salt Works

20.1.3a.1. McArdle Salt Works - samples collected August 24-26, 2005

SS101 McArdle Saltworks area: brainy crust.
SS102 McArdle Saltworks area?: clasts and sediments.
SS103 McArdle Saltworks area: "brains".
SS104 McArdle Saltworks area: 50 metres from Red Deer River outflow: banded rock: black at/above waterline; red above that; buff-orange at highest point.
++++++
EGC150 SS101 - McArdle Salt Works, crust.
EGC151 SS102 - McArdle crusted rocks.
EGC152 SS103 - McArdle brains.
EGC153 SS104 - McArdle outflow to Red Deer River, banded rock black at/above water line, red above that, buff/orange at highest level.
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20.1.4a. Sample Descriptions - Mafeking Quarry (North Quarry)

20.1.4a.1. Mafeking Quarry - samples collected August 24-26, 2005

SS201 North Mafeking Quarry: wall of solution channel closest to access road from the south quarry (left hand side).

SS300-303 Four silica nodules from Mafeking quarry solution chimney SC-18 (gathered June 21, 2009).
SS400 Quartz-lined fracture from "second" carbonate reef – 8 km along secondary highway to East German Creek salt springs.
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EGC140 SS201 - Mafeking North Quarry, walls of solution channel.

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20.1.4a.2. Mafeking Quarry – March 2008 - solution chimney samples from Steve Grasby (GSC)

Samples received from Steve Grasby – March 2008 (GSC – Calgary)

SC1C Silica nodule from SC-1C solution chimney
SC5S Silica nodule from SC-5S solution chimney
SC16S Silica nodule from SC-16S solution chimney
SC17S Silica nodule from SC-17S solution chimney
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20.1.4a.3. Mafeking Quarry - samples self-collected - June 2008.

SC-9 Sample of chimney infill (blue clay and powdered silica sinter) collected from solution chimney #9 – June 13, 2008 by Cloutis et al.
SC-18-1 Silica nodule (larger) from solution chimney SC-19 (collected June 21/09).
SC-18-2 Silica nodule from solution chimney SC-19 (collected June 21/09).

SC-18-3 Silica nodule from solution chimney SC-19 (collected June 21/09).
SC-18-4 Silica nodule from solution chimney SC-19 (collected June 21/09).
SC-18-5 Silica nodule from solution chimney SC-19 (collected June 21/09).
SC-18-6 Silica nodule from solution chimney SC-19 (collected June 21/09).
SC-18-7 Silica nodule from solution chimney SC-19 (collected June 21/09).
SC-18-8 Silica nodule from solution chimney SC-19 (collected June 21/09).
SC-18-9 Silica nodule from solution chimney SC-19 (collected June 21/09).
SC-18-10 Silica nodule from solution chimney SC-19 (collected June 21/09).
SC-18-20 "Host" silica (?) sand of silica nodules from solution chimney SC-19 (collected June 21/09).
SC-18-21 Clay lining of solution chimney SC-19 (collected June 21/09).
SC-19-1 Silica nodule from solution chimney SC-19 (collected June 21/09). Was SC-19-1.
SC-19-2 Silica nodule from solution chimney SC-19 (collected June 21/09). Was SC-19-2.
SC-19-3 Silica nodule from solution chimney SC-19 (collected June 21/09). Was SC-19-3

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20.1.4a.4. Mafeking Quarry – May 11-13, 2010 (MAF600 series)

MAF600 Five silica nodules from solution chimney SC-9 with adhering green-blue clay.
MAF601 Larger irregular silica nodule from south of SC-9 (loose).
MAF602 Silica nodule on way to SC-9.
MAF603 Large half of silica nodule (loose), found near SC-9, with adhering blue-green clay.

++

20.1.4a.5. Mafeking Quarry – September 25, 2011 (MAF700 series)

MAF700 Fist-sized silica nodule from spoil pile on west wide of North Quarry.
MAF701 Boulder from solution chimney (found loose) with rounded quartz (?) precipitated crystals lining walls.
MAF702 Fist-sized silica nodule from spoil pile on west side of North Quarry.
MAF703 Fist-sized silica nodule from spoil pile on west side of North Quarry.
MAF704 Friable interior iron-stained silica nodule from spoil pile on west side of North Quarry.

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20.1.4a.6. Mafeking Quarry – May 21, 2013 (MAF710 series)

(see also FOS018)
MAF800 Broken softball-size silica nodule on walk to solution chimney 9.

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20.1b. XRD Data - East German Creek Area

20.1b. XRD Data - East German Creek Area

20.1.1b.1. East German Creek Springs area - Quantitative XRD from Steve Grasby (GSC)

From Steve Grasby - Geological Survey of Canada (January 2007) - quantitative XRD

Sample	*Gypsum*	*Quartz*	*Calcite*	*Dolomite*	*Halite*	*Others (all in %)*	
EGC119	79		20		1		
EGC200	15	2	57		26		
EGC201	22	1	62		15		
EGC202	31	4	61		4		
EGC203	45	trace	41		14		
EGC204	trace		trace	96		4	
EGC205	13	2	56		29		
EGC206	13	5	53		29		
EGC207	26	12	48	3	11		
EGC208	trace		trace	91	1	8	
EGC212	17	trace	69		14		
EGC213	3	2	78	2	14		graphite?-1
EGC214			94		6		
EGC218		71	trace	29			
EGC317a	trace		trace	96	2	2	
EGC329		3	88	3	6		
EGC336			100				

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20.1.1b.2. East German Creek samples: University of Manitoba XRD analysis – November 2011

BRICK1 Calcite only crystalline phase identified; some minor peaks unmatched.
BRICK2 Calcite (major), halite (major), gypsum (major) identified.
BRICK3 Calcite (major), halite (major), gypsum (major) identified.
BRICK4 Calcite (major), halite (major), gypsum (major) identified.
BRICK5 Calcite (major) and minor aragonite only crystalline phases identified.
BRICK6 Calcite (major) and halite (major) identified.
BRICK7 Calcite (major), halite (major), gypsum (minor) identified.
BRICK8 Calcite (major), halite (major), gypsum (minor), quartz (minor) identified.
BRICK9 Halite (major), calcite (major), gypsum (moderate) identified.

EGC119 (<45 μm) Major gypsum, calcite, and halite identified (subsample crushed for XRD). [10 m SW of Big Cauldron, crust adjacent to pool].
EGC200 (<45 μm) Gypsum, calcite, halite, and minor quartz identified (subsample crushed for XRD). [Red soil].
EGC201 (<45 μm) Gypsum, halite, calcite, and minor quartz identified (subsample crushed for XRD). [Yellow soil].
EGC202 (<45 μm) Gypsum, calcite, halite, and minor quartz identified (subsample crushed for XRD). [Brown soil].
EGC203 (<45 μm) Major gypsum, calcite, halite, and minor quartz identified (subsample crushed for XRD). [White brains].
EGC204 (<45 μm) Major calcite, moderate halite, moderate calcite, and minor quartz identified (subsample crushed for XRD). [Brown pavement].
EGC205 (<45 μm) Calcite, gypsum, halite, and minor quartz identified (subsample crushed for XRD). [Black brains].
EGC206 (<45 μm) Calcite, gypsum, halite, and minor quartz identified (subsample crushed for XRD). [Buff soil].
EGC207 (<45 μm) Calcite, gypsum, halite, and quartz identified (subsample crushed for XRD). [Buff sand].
EGC208 (<45 μm) Major calcite, moderate halite, minor dolomite, and minor quartz identified (subsample crushed

for XRD). [Trench 1 in red sand; first layer 0-3 mm, red sand layer].

EGC212 (<45 μm) Calcite, halite, gypsum, and minor quartz identified (subsample crushed for XRD) [Trench 2 by Big Cauldron, 1st layer, 0-1mm depth].

EGC213 (<45 μm) Major calcite, halite, minor gypsum, minor dolomite, minor quartz, and minor graphite (?) identified (subsample crushed for XRD) [Trench 2 by Big Cauldron, 2nd layer, 1mm-3cm depth; red fine soil].

EGC214 (<45 μm) Calcite and halite identified, plus one low-angle unidentified peak (subsample crushed for XRD). [Trench 2, >3cm deep, yellow, fine-grained soil].

EGC218 (<45 μm) Quartz, dolomite, and calcite peaks identified (subsample crushed for XRD). [Iron-stained, etched buff limestone].

EGC317 (<45 μm) Calcite, minor gypsum, minor halite, minor dolomite, and minor quartz identified 9Subsample crushed for XRD) [Pit 1, sample 4, >15 mm depth; yellow-gray soil].

EGC329 (<45 μm) Calcite, dolomite, minor halite, and minor quartz identified (subsample crushed for XRD). [Red travertine pavement].

EGC336 (<45 μm) Only dolomite identified (subsample crushed for XRD). [Downstream creek white pitted rock].

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20.1.1b.2. East German Creek Springs area: Quantitative XRD analysis from Steve Grasby Nov. 2011

	EGC600*	EGC601	EGC601B	EGC602	EGC604	EGC606	EGC608	EGC609*	EGC610
Quartz		2	1	1	1	1	3	5	6
Plag			tr						
K-feld									
Muscov									tr
Diopside	tr								
Calcite	83	80	94	87	95	95	95	92	92
Dolomite	1	9	1	1	1	1	2	3	2
Halite	15	10	4	11	3	3			
Gypsum	1								
Sylvite									
Pyrite		1				tr			
G of F	1.77	2.55	2.46	2.41	2.41	2.49	2.45	2.25	2.75

	EGC611*	EGC612*	EGC613	EGC615	EGC617	EGC618	EGC620
Quartz	9	6	21	3	2	4	
Plag			2	1	tr	1	
K-feld			tr	tr	tr		
Muscov	tr						
Diopside							
Calcite	84	86	61	90	80	80	96
Dolomite	7	8	16	6	7	9	2
Halite					11	6	2
Gypsum							
Sylvite							
Pyrite							
G of F	2.39	2.39	3.44	2.62	2.25	2.39	2.19

G of F: goodness of fit. tr: trace. * - smear mount

++++++++++++++++++

All EGC-xx-xx

	07-01	07-02	07-03	07-04	07-05*	07-06	07-07	07-08	07-09
Quartz									
Plag									
K-feld									
Muscov									
Diopside									
Calcite									
Dolomite									
Halite	92	92	93	89	90	85	90	91	93
Gypsum	8	8	7	11	9	15	10	9	7
Sylvite					1				
Pyrite									
G of F	3.22	2.33	2.85	2.36	2.19	2.07	1.93	2.03	2.85

G of F: goodness of fit. tr: trace. * - smear mount

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All EGC-xx-xx

	07-10	07-11	07-123	07-13	07-14	07-15	07-16	07-17	07-18	07-19
Quartz										
Plag										
K-feld										
Muscov										
Diopside										
Calcite								1		
Dolomite										
Halite	88	90	92	93	92	86	93	93	94	90
Gypsum	12	9	8	7	8	14	7	6	6	9
Sylvite		1							tr	1
Pyrite										
G of F	2.19	2.59	3.02	2.45	2.74	2.36	2.19	2.49	2.75	2.15

G of F: goodness of fit. tr: trace. * - smear mount

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All EGC-evap-xxxx

	1	1-1000	2	2-1000	3-1000	4-1000	6-1000*	7-1000*	8-1000*
Quartz			1						
Plag									
K-feld									
Muscov									
Diopside									
Calcite		tr	1				3	1	2
Dolomite						1			
Halite	97	91	86	98	91	90	94	93	95
Gypsum	3	9	12	2	9	9	3	5	2
Sylvite								1	1
Pyrite									
G of F	1.97	3.32	3.26	2.05	3.74	2.88	3.42	3.51	2.86

G of F: goodness of fit. tr: trace. * - smear mount

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All EGC-evap-xxxx

	9-1000*	10-1000*	11-1000*	12-1000*
Quartz				
Plag				
K-feld				
Muscov				
Diopside				
Calcite	2	3	1	2
Dolomite				
Halite	95	93	97	95
Gypsum	2	3	1	3
Sylvite	1	1	1	tr
Pyrite				
G of F	3.07	3.28	3.17	3.43

G of F: goodness of fit. tr: trace. * - smear mount
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	GSQ008 <45	GSQ008 90-1000	GYP202 <45*	GYP202 90-1000	GYP204 <45*	GYP204 90-1000	GYP281 <45	GYP281 90-1000
Quartz	2	2	35	45	3	tr	7	17
Plag			1					
K-feld	1	1	2	1				
Muscov								
Chlorite								
Calcite	2		1			3		
Dolomite	78	86	61	54				
Halite	1							
Gypsum	16	12			92	94	93	83
Anhydrite					5	3	tr	tr
Celestite								
G of F	2.91	2.92	3.69	2.59	4.07^	3.69	3.85	3.15

G of F: goodness of fit. tr: trace.
* - smear mount
^ - SEM: S, Ca and traces of Si, O, no phosphorus.
+++++++++++++++++++

20.1.1b.2. East German Creek Springs area: Quantitative XRD analysis from Steve Grasby Nov. 2011

	GYP613	GYP613	GYP650	GYP650
Gr. size (µm)	<45	90-1000	<45	90-1000
Quartz		3	22	27
Plag				
K-feld			1	1
Muscov	5	5		
Chlorite	10	10		
Calcite			tr	
Dolomite	78	68	77	72
Halite				
Gypsum	5	6		
Anhydrite				
Celestite	2	8		
G of F	4.42[a]	3.09[b]	2.48	2.79

G of F: goodness of fit. tr: trace. * - smear mount
[a] – High 14.8 Angstrom peak, Montmorillonite/hydrobiotite? Possible ML?
[b] – High 14.8 Angstrom peak. Montmorillonite/hydrobiotite?
++

20.1.4b. XRD Data - Mafeking Quarry area

20.1.4b.1. Mafeking Quarry samples: University of Manitoba XRD analysis – November 2011

SC-9 (Clay lining in solution chimney #9 at Mafeking quarry). XRD shows major quartz, minor siderite, and minor kaolinite, plus some noise (amorphous component?) in the spectrum. From Raven Sharma – U of M: Nov. 2011.

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20.1.4b.2. Mafeking Quarry area: Quantitative XRD analysis from Steve Grasby Nov. 2011

Mafeking silica nodules and clay

	SC-18-01 <45	SC-18-01 90-1000	SC-18-20 <45*	SC-18-20 90-1000	SC-18-21 <45	SC-18-21 90-1000
Quartz	100	100	100	100	62	74
Plag			tr		4	4
K-feld					6	4
Muscov					22	12
Kaolinite						
Chlorite					7	6
Dolomite	tr					
G of F	2.94	2.79	2.96	2.32[a]	4.38	4.91[b]

G of F: goodness of fit. tr: trace.

* - smear mount

[a] – "Will make a good quartz standard!"

[b] – Illite. Clinochlore to be verified

++

20.1c. Compositional Data - East German Creek Area

20.1.4c. Compositional Data - XRF analysis of Mafeking Quarry samples

Wt. %	SC-5S	MAF700
SiO_2	97.63	97.92
TiO_2	0.02	0.02
Al_2O_3	1.27	0.35
*(Fe_2O_3)**	*(0.23)*	*(0.41)*
Fe_2O_3	0.04	0.24
FeO	0.17	0.15
MnO	0.01	0.00
MgO	0.16	0.01
CaO	0.36	0.39
Na_2O	0.01	0.00
K_2O	0.03	0.04
P_2O_5	0.02	0.01
SO_3		0.24
TOTAL	99.72	99.39
LOI	0.82	0.68
ppm		
Sr	80	1195
Zr	15	48
V	33	4
Cr	26	18
Co	5	27
Ni		20
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

++

20.1.4c. XRF analysis of Mafeking Quarry samples - XRF Analyses (continued)

Wt. %	SC-9
SiO_2	92.52
TiO_2	0.02
Al_2O_3	0.52
*(Fe_2O_3)**	*(3.88)*
FeO	3.04
Fe_2O_3	0.50
MnO	1.868
MgO	0.33
CaO	0.61
Na_2O	0.11
K_2O	0.08
P_2O_5	0.03
SO_3	0.02
TOTAL	99.988
LOI	3.64
ppm	
Sr	30
Zr	18
V	39
Co	20
Cr	<1
Cu	355
Ni	3
Source	Mertzman
Analysis	XRF

* - All Fe expressed as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

++=

20.1d. Spectral Data - East German Creek area

Sample ID *Facility/File No.* *Description*

20.1.1d. East German Creek Springs Complex - Available Spectral Files

All are whole rock or soil spectra unless otherwise indicated.

"egc1" indicates prepared samples.
"egc2" indicates no sample preparation performed – raw soils or rock surfaces

EGC Brick3	PSF 111201a.004	surface; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
EGC Brick3	INO	whole rock; i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
++++++		
EGC2-s1	PSF 100715a.001	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC3-s1	PSF 100715a.002	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
EGC3-r1	PSF 100715a.003	small rocks(?) (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC4-s1	PSF 100715a.004	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC6-s1	PSF 100715a.005	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC7-s1	PSF 100715a.006	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC8-s1	PSF 100715a.007	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC9-s1	PSF 100715a.008	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC10-s1	PSF 100715a.009	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC11-s1	PSF 100715a.010	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
EGC11-s2	PSF 100715a.011	sediments/rocks (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC12-s1	PSF 100715a.012	sediments (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
EGC12-s2	PSF 100715a.013	sediments/rocks (air-dried); 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100715_EGCseds].
++++++		
EGC106	PSF egc2.052	red various clasts; 35°/0°; 0.35-2.5 μm; 500 avg., 1 nm resol., ASD.
EGC106	PSF egc2.053	orange various clasts; 35°/0°; 0.35-2.5 μm; 500 avg., 1 nm resol., ASD.
EGC106	PSF egc2.054	buff various clasts; 35°/0°; 0.35-2.5 μm; 500 avg., 1 nm resol., ASD.

++++++		
EGC119	PSF egc1.010	Big Cauldron crust, white stuff; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC119	PSF egc2.026	Big Cauldron crust, white stuff; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC119	PSF egc2.027	Big Cauldron crust, white stuff; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC200	PSF egc1.011	red soil, surficial; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC200	PSF egc2.009	piece 1; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC200	PSF egc2.010	piece 2; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC201	PSF egc1.013	yellow soil, surficial; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC201	PSF egc2.011	piece 1, red side up; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC201	PSF egc2.012	piece 2, red side up; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC201	PSF egc2.013	piece 2, white side up; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC202	PSF egc1.005	brown soil, surficial; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC202	PSF egc2.014	“1.0000”?; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC202	PSF egc2.015	“2.0000”?; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC203	PSF egc1.015	white brains, surficial; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC203	PSF egc2.016	white side; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC203	PSF egc2.017	brown side; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC204	PSF egc1.014	brown pavement, surficial; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC204	PSF egc2.022	larger; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC204	PSF egc2.023	smaller; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC205	PSF egc1.008	black brains, surficial; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC205	PSF egc2.004	same, in a sample cup; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC206	PSF egc1.016	buff soil, surficial; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC206	PSF egc2.008	same, in a sample cup; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC207	PSF egc1.007	buff sand, surficial; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC207	PSF egc2.006	same, in a sample cup; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC208	PSF egc1.009	Trench 1, red sand, 0-3 mm depth; 35°/0°; 0.35-2.5 µm; 500avg., 1 nm, ASD.
EGC208	PSF egc2.001	no description; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC212	PSF egc1.001	Trench 2, by Big Cauldron, surface, 0-1 mm depth; 35°/0°; 0.35-2.5 µm; 500avg., 1 nm, ASD.
EGC212	PSF egc2.002	same, in a sample cup; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC213	PSF egc1.001	Trench 2, by Big Cauldron, layer 1, 1-30 mm depth; 35°/0°; 0.35-2.5 µm; 500avg., 1 nm, ASD.
EGC213	PSF egc2.005	same, in a sample cup; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC214	PSF egc1.002	Trench 2, by Big Cauldron, layer 2, >30 mm depth; 35°/0°; 0.35-2.5 µm; 500avg., 1 nm, ASD.
EGC214	PSF egc2.007	same, in a sample cup; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC218	PSF egc1.004	iron-stained limestone; 35°/0°; 0.35-2.5 µm; 500avg., 1 nm, ASD.
EGC218	PSF egc2.028	red layer; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC218	PSF egc2.029	red layer; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC218	PSF egc2.030	red area; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC219	PSF egc2.038	rock #4, grey top; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.

EGC219	PSF egc2.039	rock #4, grey top; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC219	PSF egc2.040	rock #4, reddish bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC221	PSF egc2.047	rock #6, reddest flat area; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC221	PSF egc2.048	rock #6, reddest mottled area; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC222	PSF egc2.058	rock #7, dark red; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC222	PSF egc2.059	rock #7, lighter red; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC317	PSF egc1.003	Pit #1, by Big Cauldron, sample 4, >15 mm depth; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC317	PSF egc2.003	same, in a sample cup; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC329	PSF egc1.006	Travertine pavement; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC329	PSF egc2.024	red layer; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC329	PSF egc2.025	red layer; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC331	PSF egc2.044	Black rock in creek: black area; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC331	PSF egc2.045	Black rock in creek: silver area; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC331	PSF egc2.046	Black rock in creek: brown bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC333	PSF egc2.049	Red rock in creek: reddest top; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC333	PSF egc2.050	Red rock in creek: lighter area; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC333	PSF egc2.051	Red rock in creek: black on bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC334	PSF egc2.035	Orange rock in creek; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC334	PSF egc2.036	Orange rock in creek: orange surface; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC334	PSF egc2.037	Orange rock in creek: grey bottom ridge; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC335	PSF egc2.031	White topped rock in creek; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC335	PSF egc2.032	White topped rock in creek: white top; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC335	PSF egc2.033	White topped rock in creek: dark beige bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC335	PSF egc2.034	White topped rock in creek: white bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC336	PSF egc1.017	White limestone rock in creek; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC336	PSF egc2.018	White limestone rock in creek: white surface; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC336	PSF egc2.019	White limestone rock in creek: white surface; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC336	PSF egc2.020	White limestone rock in creek: white surface; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC336	PSF egc2.021	White limestone rock in creek: beige bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC339	PSF egc2.055	Orange-topped rock in creek; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC339	PSF egc2.056	Orange-topped rock in creek: grey on orange top; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC339	PSF egc2.057	Orange-topped rock in creek: grey bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.

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EGC340	PSF egc2.060	Orange-topped rock in creek; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC340	PSF egc2.061	Orange-topped rock in creek: red top; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC340	PSF egc2.062	Orange-topped rock in creek: beige/orange/red bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
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EGC342	PSF egc2.041	Orange pitted rock: top orange; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC342	PSF egc2.042	Orange pitted rock: top orange; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC342	PSF egc2.043	Orange pitted rock: grey bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC343	PSF egc2.063	White pitted rock: white area; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC343	PSF egc2.064	White pitted rock: black tips on top; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
EGC343	PSF egc2.065	White pitted rock: brown bottom; 35°/0°; 0.35-2.5 µm; 500 avg., 1 nm res., ASD.
++++++		
EGC620	PSF 111201a.051	unsorted grains; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
EGC620	PSF 111201a.028	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
++++++		
EGC EVAP1	PSF 100719a.001	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
++++++		
EGC EVAP2	PSF 100719a.002	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
++++++		
EGC EVAP3	PSF 100719a.003	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
++++++		
EGC EVAP4	PSF 100719a.004	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
++++++		
EGC EVAP6	PSF 100719a.005	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
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EGC EVAP7	PSF 100719a.006	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
++++++		
EGC EVAP8	PSF 100719a.007	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
++++++		
EGC EVAP9	PSF 100719a.009	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
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EGC EVAP10	PSF 100719a.008	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
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EGC EVAP11	PSF 100719a.010	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
++++++		
EGC EVAP12	PSF 100719a.012	<1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].
++++++		
EGC EVAP1x	PSF 100719a.013	large single crystal; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra

averaged; ASD [directory: 100719_EGC_evap].

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EGC EVAP2x PSF 100719a.014 large single crystal; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD [directory: 100719_EGC_evap].

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20.1.1.1d. East German Creek Springs Complex – Field spectra (October 2, 2006)

Shot with D&P spectrometer in the field. Weather was partially overcast, necessitating frequent shots of reflectance standard (crinkled aluminum foil). Spectrometer located 32" above ground, providing a 2.5" field of view; 100 spectra shot to improve signal to noise.

EGC300 Transect 1, point B - surface soil: finer red sand. (Point A is Pit 2 surface). Shot field spectrum with D&P spectrometer. 5 metres south of point A.

EGC301 Transect 1, point C - surface soil: very fine buff silt. Shot field spectrum with D&P spectrometer. 4 metres south of point B.

EGC302 Transect 1, point D - surface soil: less red medium sand. Shot field spectrum with D&P spectrometer. 0.5 metres south of point C.

EGC303 Transect 1, point E - surface soil: buff silt. Shot field spectrum with D&P spectrometer. 4 metres south of point D.

EGC304 Transect 1, point F - surface soil travertine and buff silt; 50% of each in field of view. Shot field spectrum with D&P spectrometer. 2 metres south of point E.

EGC305 Transept 1, point G - surface soil. 1 metre south of point E.

EGC306 Transect 1, point H - surface soil: red-brown brains. Shot field spectrum with D&P spectrometer. 5 metres south of point G.

EGC307 Transect 1, point I - surface soil red brains. Shot field spectrum with D&P spectrometer. 7 metres south of point H.

EGC308 Transect 1, point J - surface soil: brown silt. Shot field spectrum with D&P spectrometer. Same location as point I.

EGC309 Transect 1, point K - surface soil: black brains. Shot field spectrum with D&P spectrometer. 4 metres south of points I and J.

EGC310 Transect 1, point L - surface soil: brown brains. Shot field spectrum with D&P spectrometer. 3 metres south and 3 metres east of point K.

EGC311 Transect 1, point M - surface soil: white brains. Shot field spectrum with D&P spectrometer. 3 metres south of point K.

EGC312 Transect 1, point N - surface soil: red silt with brains? Shot field spectrum with D&P spectrometer. 6 metres south of point M.

EGC313 Transect 1, point O - surface soil: red delta (recently abandoned channel). Shot field spectrum with D&P spectrometer. 15 metres west of point N.

EGC314 Pit 1 (50 cm north of edge of big cauldron), sample 1: 0-1 mm depth red soil.

EGC315 Pit 1 (50 cm north of edge of big cauldron), sample 2: 1-2 mm depth; anaerobic black layer.

EGC316 Pit 1 (50 cm north of edge of big cauldron), sample 3: 2-15 mm depth; medium brown sand.

EGC317 Pit 1 (50 cm north of edge of big cauldron), sample 4: >15 mm depth; yellow gray soil.

EGC318 Pit 2 (70 metres west of big cauldron). Sample 1: red sand, 0-1 mm depth.

EGC319 Pit 2 (70 metres west of big cauldron). Sample 2: light brown sand, 1-2 mm depth.

EGC320 Pit 2 (70 metres west of big cauldron). Sample 3: black-gray sand, 2-3 mm depth.

EGC321 Pit 2 (70 metres west of big cauldron). Sample 4: medium brown sand, 4 mm - 6 cm depth.

EGC322 Pit 2 (70 metres west of big cauldron). Sample 5: reddish gravel/sand, 6-30 cm depth.

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20.1.4d. Mafeking Quarry - Available Spectral Files

MAF603 PSF 100804a.001 whole rock surface, inner dark ring; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd.; ASD (directory: 100804_mafekingsilica).

MAF603 PSF 100804a.002 whole rock surface, second white ring; i=30°, e=0°; 0.35-2.5 μm; 1 nm output;

		1000 spectra avgd.; ASD (directory: 100804_mafekingsilica).
MAF603	PSF 100804a.003	whole rock surface, third dark ring; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd.; ASD (directory: 100804_mafekingsilica).
MAF603	PSF 100804a.004	whole rock surface, outer white ring; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd.; ASD (directory: 100804_mafekingsilica).
MAF603	PSF 100804a.005	whole rock surface, grey-green crust on other side; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd.; ASD (directory: 100804_mafekingsilica).
MAF603	PSF 100804a.006	whole rock surface, white rock – other side; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd.; ASD (directory: 100804_mafekingsilica).
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SC-5S	PSF 090602a.045	<45 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
SC-5S	PSF 090602a.046	90-1000 µm, i=30°,e=0°, 0.35-2.5 µm, 1 nm output, 100 avg., ASD.
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SC-9	PSF 080618a.025	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SC-9	PSF 080618a.026	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD.
SC-9	PSF 080618a.027	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot.
SC-9	PSF 080619a.005	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; air dried for 24 hours.
SC-9	PSF 080619a.006	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot; air dried for 24 hours.
SC-9	PSF 080619a.007	whole rock; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 200 spectra averaged, ASD; different spot; air dried for 24 hours.
SC-9	PSF 080913a.050	white sinter, unsorted; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 500 spectra averaged, ASD; air dried for many days.
SC-9	PSF 080913a.051	blue clay, unsorted; 30°/0°; 0.35-2.5 µm, 2-7 nm resol., 1 nm resampled; 500 spectra averaged, ASD; air dried for many days.
SC-9	PSF 090121a.015	whiter portion, <45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SC-9	PSF 090121a.016	whiter portion, 90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
SC-9	PSF 111201a.015	whole rock; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
SC-9	INO SC9	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
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SC17S	PSF 080913a.056	<45 µm; 30°/0°; 0.35-2.5 µm,2-7 nm resol., 1 nm resampled; 500 spectra averaged, ASD.
SC18-20	PSF 100724a.005	90-1000 µm; 30°/e°; 0.35-2.5 µm; 2-7 nm resolution, 1 nm output; 1000 spectra averaged; ASD (directory: 100724_Gypsumville).
SC18-20	PSF 100724a.006	<45 µm; 30°/e°; 0.35-2.5 µm; 2-7 nm resolution, 1 nm output; 1000 spectra averaged; ASD (directory: 100724_Gypsumville).
SC18-21	PSF 100724a.007	90-1000 µm (clay lining solution chimney); 30°/e°; 0.35-2.5 µm; 2-7 nm resolution, 1 nm output; 1000 spectra averaged; ASD (directory: 100724_Gypsumville).
SC18-21	PSF 100724a.008	<45 µm (clay lining solution chimney); 30°/e°; 0.35-2.5 µm; 2-7 nm resolution, 1 nm output; 1000 spectra averaged; ASD (directory: 100724_Gypsumville).
SC18-01	PSF 100724a.009	90-1000 µm; 30°/e°; 0.35-2.5 µm; 2-7 nm resolution, 1 nm output; 1000 spectra averaged; ASD (directory: 100724_Gypsumville).
SC18-01	PSF 100724a.010	<45 µm; 30°/e°; 0.35-2.5 µm; 2-7 nm resolution, 1 nm output; 1000 spectra averaged; ASD (directory: 100724_Gypsumville).
SC18-21	PSF 100723a.016	surface (clay lining solution chimney; whole rock); 30°/e°; 0.35-2.5 µm; 2-7 nm resolution, 1 nm output; 1000 spectra averaged; ASD (directory:

		100724_Gypsumville).
SC18-21	PSF 100723a.017	surface (clay lining solution chimney; whole rock); 30°/e°; 0.35-2.5 μm; 2-7 nm resolution, 1 nm output; 1000 spectra averaged; ASD (directory: 100724_Gypsumville).

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END of 20.1.

20. Analogue Sites

20.2. Gypsumville - Lake St. Martin Crater area, MB, Canada

20.2.1. Gypsumville gypsum quarries (north, middle, and south)
20.2.2. Gypsumville aggregate pit
20.2.3. Impact melt areas
20.2.4. Central uplift area
20.2.5. The Big Rock area
20.2.6. White Elephant gypsum open pit mine
20.2.7. Drill cores from Manitoba Geological Survey
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Sample ID *Description*

20.2.1a. Gypsumville gypsum quarries area

20.2.1a.1. Gypsum boulders collected August 2006 from middle quarry

SPT200-208 See section 8 for sample descriptions, analytical data and spectra.
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20.2.1a.2. Collected October 2006

GYP001 Red/pink-stained bedded gypsum/anhydrite. South quarry area (collected Oct./06).
GYP002 Pitted/bedded gypsum/anhydrite. South quarry area (collected Oct./06).
GYP003 Minor pink stained gypsum/anhydrite. South quarry area (collected Oct./06).
GYP004 Red stained gypsum/anhydrite. South quarry area (collected Oct./06).
GYP005 Pitted and stained gypsum/anhydrite. South quarry area (collected Oct./06).
GYP006 Pitted and fractured gypsum/anhydrite. South quarry area (collected Oct./06).
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20.2.1a.3. Collected August 6, 2007

GYP101-104 Gypsum and anhydrite bedded samples – collected within quarry area (sent to Cornell, 08/07)
GYP105 Gypsum-selenite boulder; middle quarry (most sent to Cornell, 08/07).
GYP106 Interbedded gypsum-red clay – multiple pieces; south end of south quarry (most sent to Cornell, 08/07).
GYP107 Pink-stained anhydrite layer; multiple pieces. North quarry area.
GYP108 Gypsum-selenite boulder; middle quarry.
GYP109 Massive anhydrite boulder; middle quarry.
GYP110 Massive anhydrite boulder; middle quarry (most sent to Cornell, 08/07).
GYP111 Massive anhydrite boulder; middle quarry.
GYP112 Red-stained anhydrite/gypsum; south quarry?
GYP113 Selenite; middle quarry.
GYP114 Selenite with minor red interbeds; middle quarry.
GYP115 Anhydrite with minor red interbed; middle quarry.
GYP116 Anhydrite with minor red interbeds; middle quarry.
GYP117 Selenite crystal; middle quarry (sent to Cornell, 08/07).
GYP118 Selenite crystal; middle quarry (sent to Cornell, 08/07).
GYP119 Satin spar – fibrous gypsum; middle quarry.
GYP120 Laminated selenite crystals; middle quarry (sent to Cornell, 08/07).
GYP121-125 Red interbedded gypsum/anhydrite; unknown quarry locality; 5 major pieces.

GYP126 Massive anhydrite boulder; middle quarry.
GYP127-130 Massive, partially weathered anhydrite/gypsum; south quarry at head of Warpath Trail; 4 major pieces.
GYP131-139 Red interbedded gypsum/anhydrite; middle quarry; 9 major pieces.
GYP140 Massive bedded anhydrite/gypsum boulder; middle quarry.
GYP141 Red stained anhydrite, middle quarry (sent to Cornell, 08/07).
GYP142 Massive selenite; middle quarry.
GYP143 Pink-stained anhydrite/gypsum; middle quarry.
GYP144 Orange-stained anhydrite/gypsum; middle quarry.
GYP145 Minor red-stained anhydrite/gypsum; middle quarry.
GYP146 Bladed selenite aggregate; middle quarry (sent to Cornell, 08/07).
GYP147 Bladed selenite boulder with green algal staining; middle quarry.
GYP148 Bladed selenite boulder with green algal staining; middle quarry.
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20.2.1a.4. Collected August 15, 2007

GYP150 Piece of anhydrite boulder, middle quarry.
GYP151 Piece of selenite mass, middle quarry.
GYP152 Red-stained gypsum/anhydrite bed, 2 metres from top, middle quarry.
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20.2.1a.5. Collected June 16, 2008

GYP153-155 Three gypsum samples with interesting surface weathered textures; south quarry.
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20.2.1a.6. Collected September 24, 2011 from recent stockpile at north end of South Quarry.

GYP160 Pink-purple stained gypsum boulder.
GYP161 White, fine-grained rock.
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20.2.1a.7. Collected June 5, 2012 from south and middle quarries for cryptoendoliths

(i) South quarry
GYQ001 Part of boulder with endoliths
GYQ002 Part of boulder with endoliths
GYQ003 Boulder with endoliths
GYQ004 Boulder with endoliths
GYQ005 Part of boulder with endoliths
GYQ006 Part of boulder with endoliths
GYQ007 Part of boulder with endoliths
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(ii) Middle quarry by pond (north end of quarry)

GYQ008 Top layer of boulder by pond (north end of middle quarry); lots of blue
GYQ009 Part of boulder with endoliths
GYQ010 Part of boulder with endoliths
GYQ011 Part of boulder with endoliths
++

20.2.1a.8. South quarry area - collected May 11-13, 2010 (GYP600 series)

GYP600 Surface-exposed gypsum sample, south quarry flats; for microtexture study.
GYP601 Submerged sample in larger pool (Pool 2; south quarry); for cryptoendolith layers (brown over green).
GYP602 Surface-exposed sample, south quarry flats, by Pool 2; for microtexture study.

GYP603 Surface-exposed sample by larger pool (Pool 2; south quarry); for cryptoendolith study (clear layering on one part of the sample).
GYP604 Weathered and red-stained gypsum sample from new stockpile in south quarry area (for microtexture and colouring study).
GYP605 Submerged gypsum from Pool 2 (larger pool; south quarry); weathered surface texture and cryptoendoliths.
GYP606 Surface rock from north end of Pool 2 (larger pool; south quarry); for cryptoendoliths.
GYP607 Surface rock from Pool 2 (larger pool; south quarry) area; for surface microtexture.
GYP608 Surface rock from Pool 2 (larger pool) area; for surface microtexture.
GYP609 Surface rock from Pool 2 (larger pool) area; for surface microtexture.
GYP610 Surface rock from Pool 2 (larger pool) area; for surface microtexture.
GYP611 Surface rock from Pool 2 (larger pool) area; for cryptoendoliths.
GYP612 Surface rock from Pool 2 (larger pool) area; for cryptoendoliths; 1 large piece and two smaller pieces (612a and 612b).
GYP613 Surface rock from new stockpile in south quarry area; solid pieces and interlayer purple fine-grained material scraped off gypsum boulders.
GYP614 Surface rock from new stockpile in south quarry area; solid pieces and interlayer purple fine-grained material scraped off gypsum boulders.
GYP615 Surface rock from new stockpile in south quarry area; piece with interlayer purple fine-grained material.
GYP616 Surface rock from new stockpile in south quarry area; pieces with interlayer purple fine-grained material; 1 large piece and 5 smaller pieces.
GYP617 Selenite (coarse-grained gypsum blades), from Pool 2 (larger pool) south quarry area; a bit of cryptoendolith on them; 2 large pieces.
GYP618 One larger pieces and many fragments of gypsum pieces from south quarry; for microtexture.
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20.2.1a.9. South quarry area - collected May 2013

GYQ099 Endolith-bearing gypsum boulder
6RB Endolith-bearing gypsum boulder

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20.2.2a. Gypsumville Aggregate Pit

Note: located a few hundred metres south of Rawluk's store along dirt road.

20.2.2a.1. Collected June 21, 2007 from aggregate pit

GSQ001-005 Samples from aggregate pit, Gypsumville – possible carbonate impact breecias and impact melts.
GSQ006 Sample from aggregate pit, Gypsumville – conglomerate? containing possible large limestone impact breccia/melt.
GSQ007 Samples from aggregate pit, Gypsumville, miscellaneous samples of conglomerate(?).
GSQ008 Sample from aggregate pit, Gypsumville, conglomerate (?) containing multi-hued possible limestone impact breccia/melt.
GSQ008,1 Unshocked carbonate clast from GSQ008.
GSQ009 Sample from aggregate pit, Gypsumville, possible limestone impact t breccia/melt.
GSQ010 Sample from aggregate pit, Gypsumville, possible gneissic granite impact product.
++

20.2.2a.2. Collected August 6, 2007

GYP201 Carbonate breccia?
GYP202 Granite (sent to Cornell, 08/07). Note: there is a shocked carbonate with the same sample ID.
GYP203 Red-stained selenite?
GYP204 Red- and purple-stained selenite?

GYP205	Carbonate breccia?
GYP206	Brecciated mass (sent to Cornell, 08/07).
GYP207	Gneissic granite?
GYP208	Gneissic granite?
GYP209	Brecciated mass with carbonate breccia (sent to Cornell, 08/07).
GYP210	Carbonate breccia?
GYP211	Brecciated mass with trachyandesite? (sent to Cornell, 08/07).
GYP212	Brecciated mass with trachyandesite?
GYP213	Brecciated mass with trachyandesite?
GYP214	Trachyandesite
GYP215	Carbonate breccia?
GYP216	Trachyandesite?
GYP217	Brecciated mass?
GYP218	Carbonate breccia?
GYP219	Trachyandesite (sent to Cornell, 08/07).
GYP220	Carbonate breccia
GYP221	Carbonate breccia
GYP222	Carbonate breccia
GYP223	Trachyandesite + carbonate breccia
GYP224	Trachyandesite + carbonate breccia
GYP225	Carbonate breccia?
GYP226	Massive breccia
GYP227	Carbonate breccia
GYP228	Gneissic granite + breccia?
GYP229	Trachyandesite?
GYP230	Brecciated trachyandesite (?) in breccia?
GYP231	Red interbedded anhydrite/gypsum; from aggregate pit?
GYP232	Anhydrite/gypsum; from aggregate pit?
GYP233	Anhydrite/gypsum, with weathered surface and green algal staining; from aggregate pit?
GYP234	Anhydrite/gypsum; from aggregate pit?
GYP235	Anhydrite/gypsum with green algal staining; 2 pieces; from aggregate pit?
GYP236	Massive breccia
GYP237	Breccia with weathered trachyandesite(?), gneissic granite(?) and carbonate breccia(?) (sent to Cornell, 08/07).
GYP238	carbonate breccia
GYP239	Red-stained selenite?
GYP240	Carbonate breccia
GYP241	Gneissic granite(?) in carbonate breccia(?)
GYP242	Carbonate breccia
GYP243	Trachyandesite (?) in breccia
GYP244	Gneissic granite (?) in breccia
GYP245	Carbonate breccia
GYP246	Carbonate breccia
GYP247	Carbonate breccia
GYP248	Trachyandesite (?) in breccia
GYP249	Carbonate breccia
GYP250	Carbonate breccia
GYP251	Carbonate breccia
GYP252	Carbonate breccia
GYP253	Gneissic granite (?) in carbonate breccia
GYP254	Trachyandesite (?) in carbonate breccia
GYP255	Carbonate breccia
GYP256	Carbonate breccia
GYP257	Gneissic granite (?) in breccia
GYP258	Fragments and small samples from original sample bag containing GYP240-257

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20.2.2a.3. Collected August 15, 2007

GYP260 Possible carbonate breccias – multiple pieces
GYP280 Trachyandesite – multiple pieces
GYP281 Gypsum from aggregate pit
GYP282 Gypsum from aggregate pit
GYP283 Gypsum from aggregate pit
GYP284 Gypsum from aggregate pit
GYP285 Gypsum from aggregate pit
GYP286 Gypsum from aggregate pit
GYP287 Gypsum from aggregate pit
GYP288 Gypsum from aggregate pit
GYP289 Gypsum from aggregate pit – 4 fragments of 1 piece
GYP290 Gypsum from aggregate pit
GYP291 Gypsum from aggregate pit
++

20.2.2a.4. Collected June 16, 2008

GYP292-296 Carbonate breccias
GYP297-298 Discoloured gypsum from aggregate pit.
++

20.2.2a.5. Collected April 27/09

STM050-059 Gypsum nodules, various
STM060-069 Gypsum nodules, various
STM070 Piece of red bed with gypsum nodule and carbonate melt(?)
STM071 Gypsum cemented breccia
STM072 Gypsum nodule in breccia
STM073-076 Four pieces of gypsum nodule
STM077-082 Six pieces of gypsum nodule
STM083-098 Various pieces of red beds and gypsum nodules
STM099 Breccia from red beds
++

20.2.2a.6. Collected September 24, 2011

GYP450 Piece from aggregate pit – possible melted carbonate fragments; sample is in 4 pieces.
GYP451-456 Six small pieces of gypsum nodules and possible carbonate melt.
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20.2.2a.7. Collected May 20, 2013

GYP330 Trachyandesite with partially consumed granite nodule in conglomerate.
STM889 Trachyandesite with partially consumed granite inclusions.
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20.2.2a.8. Collected May 11-13, 2010 (GYP600 series)

GYP650-657 Eight pieces of presumed carbonate impact melt, from Gypsumville aggregate pit.
GYP658 Gypsum nodule from Gypsumville aggregate pit.
GYP659 Impact melt with embedded clasts from Gypsumville aggregate pit.
GYP660 Slab of red bed with various clasts from Gypsumville aggregate pit.
GYP661-672 Eleven pieces of impact melt from Gypsumville aggregate pit.

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20.2.3a. Impact melt areas

Coordinates: 14 U 0537839 5744075 (from Jack Dubois, Apr. 8/08).

20.2.3a.1. Collected June 21, 2007 from impact melt area

GMR001 Trachyandesite melt rock with granitic inclusions – large sample; collected at southernmost exposure along Warpath Trail.
GMR002-016 Trachyandesite melt rocks, some with granitic inclusions and zeolitic amygdules; collected at southernmost exposure along Warpath Trail.
GMR017-020 Trachyandesite melt rocks (smaller), some with granitic inclusions and zeolitic amygdules; collected at southernmost exposure along Warpath Trail.
GMR021-024 Trachyandesite melt rocks (smaller), some with granitic inclusions and zeolitic amygdules; collected at southernmost exposure along Warpath Trail.

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20.2.4a. Central Uplift Area

Two areas of central uplift bedrock are exposed within a few hundred metres of each other. The southern exposure is ~1 mile north on cut line (Jaworski Road?) located 6 miles east of Gypsumviile; the second is located an additional ~1 mile north (northern exposure).

20.2.4a.1. Collected August 15, 2007

GYP270 Possible granite breccias from central uplift – multiple pieces
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20.2.4a.2. Southernmost exposure - collected Aug. 15, 2007 with Gordon Osinski

(~1 mile north of highway along cutline) (aka "White Elephant" – a total misnomer; there is an actual White Elephant gypsum ridge)

GYP300-305 Intensely brecciated and unlayered granite
GYP306-315 Intensively brecciated and/or layered gneissic granite (smaller pieces) (315 sent to Cornell, 08/07).
GYP316 Trachyandesite erratic (?) at outcrop
GYP317 Large boulder of gneissic granite
GYP318-325 Brecciated and gneissic granite (325 sent to Cornell, 08/07).
++

20.2.4a.3. Southernmost exposure - collected June 16, 2008

GMR025-026 Granite/gneiss breccia with interesting intergrowth textures (collected June 16, 2008).
++

20.2.4a.4. Southernmost exposure - collected April 19, 2009

STM001-021 Fragments of gneissic (shocked granite), vermiform gneiss, samples with impact melt veins.
++

20.2.4a.5. Northernnmost exposure - collected Aug. 15, 2007 with Gordon Osinski

(~2 miles north of highway along cutline (~1 mile north of main exposure (aka "White Elephant 2" – a total misnomer, there is an actual White Elephant gypsum ridge)

GYP350-372 Brecciated and gneissic (and somewhat more weathered) pieces: ~23 in total.

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20.2.5a. The Big Rock area

Note: *consists of an uplifted block of unshocked to mildly shocked Precambrian granites on the east rim of the crater. The site was partially excavated in 2011 and 2012 for aggregate for road building, exposing fresh surfaces.*

20.2.5a.1. Collected June 21, 2009.

GYP200 Shocked granite "erratic" found at The Big Rock site.
GYP201 Impact melt from Gypsumville aggregate pit.
GYP202 Shocked carbonate from Gypsumville aggregate pit.
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20.2.5a.2. Collected Aug. 15/07 with Gordon Osinski of CSA

GYP400 Massive granite from north end of outcrop
GYP401 Massive granite, from top of main outcrop
GYP402 Massive granite, perhaps with slickensided surfaces, bottom part of main outcrop (6 pieces)
GYP403 Massive granite (from granite vein?)
GYP404 Lower host rock
GYP405 Higher country rock
GYP406 Granite pegmatite vein, centre of exposure

STP030 Lighter coloured granite country rock at top of hill just north of "Big Rock" cliff.
SPT031 Darker coloured granite country rock – face of Big Rock.
STP032-049 Various pieces of pegmatitic, quartz and feldspar filled vein cutting through darker country rock on face of Big Rock.
STM891 Dark granite country rock.
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20.2.5a.3. Collected September 24, 2011

Note: Big Rock was being blasted and removed for aggregate prior to Sept. 24/11 visit.

STP050 Fresh granite with pink-purple feldspar megacrysts from The Big Rock.
STP051 Medium-grained fresh granite from The Big Rock.
STP052 Finer-grained fresh granite from The Big Rock.
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20.2.5a.4. Collected May 20, 2013

Note: further blasting and quarrying has revealed area to the north of pre-existing Big Rock that shows evidence of alteration (such as more pervasive iron staining, fracture filling, alteration/weathering/dissolution, and partially altered granites (sericitized?).

STP053 Partially bleached granite nodule with thick fracture fill deposits (crystalline, brown); 6 pieces.
STP054 Partially bleached granite.
STP055 Mildly bleached granite.

STP056	Iron-stained and partially-altered granite with iron oxyhydroxide staining in weathered-out vesicles (9 pieces).
STP057	Foliated/gneissic and partially altered granite (3 pieces).
STP058	Partially bleached (sericitized?) granite (3 larger pieces and a number of smaller fragments).
SPT059	Unaltered, finer-grained granite.
SPT060	Unaltered, coarser-grained granite.

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20.2.6a. White Elephant gypsum open pit mine

20.2.6a.1. September 18-19. 2010 site visit

GWE001	Surficial gypsum nodule for weathered surface texture.
GWE002	Large selenite crystals with algal staining.
GWE003	Surficial gypsum nodule for weathered surface texture.
GWE004	Surficial gypsum nodule for weathered surface texture.
GWE005	Gypsum slab for weathered surface texture and massive microcrystalline texture.
GWE006	Gypsum nodule for weathered surface texture.
GWE007	Gypsum nodule for weathered surface texture.
GWE008	Two gypsum nodules for weathered surface texture and cryptoendoliths.
GWE009	Gypsum nodule for weathered surface texture and cryptoendoliths.
GWE010	Fracture fill in gypsum – reprecipitated gypsum?

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20.2.7a. Lake St. Martin Drill cores – from Manitoba Geological Survey

20.2.7a.1. Sampled Nov. 2012

LSM-1a	Hole LSM-1; 33-42 foot interval (from mid-point): trachyandesite – light brown-green, vesicle-free.
LSM-3a	Hole LSM-33; 40 foot depth: anhydrite – blue-gray, some banding.
LSM-3b	Hole LSM-3; ~61 foot depth; anhydrite – blue-gray, some banding.
LSM-3c	Hole LSM-3; ~71 foot depth; anhydrite – blue-gray, some banding.
LSM-3d	Hole LSM-3; ~115 foot depth; glauberite – whitish powder; disaggregated in drill core box.

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20.2.7a.2. Sampled Feb. 7, 2013

The following descriptions are of the intervals we sampled:

LSM-1 is comprised of the Trachyandesite melt sheet, from 0-214 feet. The top of the hole is very fine grained pale grey-greenish. Some spots are quite rusty. The core progressively becomes darker purple/reddish towards the base, eventually a somewhat sharp change from grey to purple occurs at ~160 feet. The contact between the melt sheet and underlying carbonates occurs at ~214 feet – lots of odd rock here, very different from the rest of the core. There is much calcite (much more at the base) and green/grey clay-coating throughout the core. The ID of the green stuff wasn't constrained in the core logs (I have enough for XRD). Samples taken represent the melt sheet, as well as perceived alteration (hydrothermal?) products.

LSM-M8 is a granitic breccia with much injected melt material with flow texture. Greenish-white calcite present.

LSM-M9 is a weathered limestone underneath highly altered/shocked granitic breccia. The section we sampled has

visible pyrite and a black mineral that was not constrained in the core logs.

LSM-14 is microcrystalline brecciated carbonate. Some portions of the core were clearly melted, with many vesicules and clear flow lines. There are some calcite inclusions, with much of the same green mineral present in LSM-1.

SAMPLE	***Depth (feet)***
LSM-1b	3
LSM-1c	6
LSM-1d	11
LSM-1e	14
LSM-1f	23
LSM-1g	25
LSM-1h	29
LSM-1i	33
LSM-1j	33
LSM-1k	42
LSM-1l	43
LSM-1m	45
LSM-1n	55
LSM-1o	61
LSM-1p	66
LSM-1q	73
LSM-1r	73
LSM-1s	83
LSM-1t	85
LSM-1u	93
LSM-1v	95
LSM-1w	104
LSM-1x	109
LSM-1y	112
LSM-1z	114
LSM-1aa	122
LSM-1ab	127
LSM-1ac	131
LSM-1ad	134
LSM-1ae	145
LSM-1af	147
LSM-1ag	148
LSM-1ah	152
LSM-1aj	159
LSM-1ak	165
LSM-1al	167
LSM-1am	169
LSM-1an	175
LSM-1ao	180
LSM-1ap	182
LSM-1aq	182
LSM-1ar	183
LSM-1as	187
LSM-1at	193
LSM-1au	197
LSM-1av	198
LSM-1aw	199
LSM-1ax	202
LSM-1ay	203
LSM-1az	205

LSM-1ba	207
LSM-1bb	208
LSM-1bc	212
LSM-1bd	222
LSM-1be	232
LSM-1bf	238
LSM-1bg	242
LSM-1bh	249
LSM-1bi	252
LSM-1bj	268
LSM-1bk	272
LSM-1bl	274
LSM-1bm	275
LSM-1bn	275
LSM-1bo	284
LSM-1bp	288
LSM-1bq	291
LSM-1br	294
LSM-14a	75
LSM-14b	54
LSM-14c	80
LSM-14d	95
LSM-14e	121
LSM-14f	128
LSM-14g	132
LSM-14h	165
LSM-14i	172
LSM-14j	179
LSM-14k	185
LSM-M9a	266
LSM-M9b	269
LSM-M9c	285
LSM-M9d	292
LSM-M8a	205
LSM-M8b	207
LSM-M8c	210
LSM-M8	213

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20.2c. Compositional Data - Gypsumville - St. Martin Crater area

20.2c.1. Analysis of St. Martin crater impact melt (from literature sources)

Analysis from Simonds and McGee (Proc. LPSC 10, pp. 2493-2518 (1979)).

Wt. %	Range for three pseudotachylites	Clast-poor impact melts (range)
SiO_2	53.87 – 70.62	63.76-66.29
TiO_2	0.35-0.70	0.35-0.49
Al_2O_3	13.99-17.10	15.11-15.83
Cr_2O_3	0.00	0.00
FeO*	2.84-7.94	2.84-3.49
MnO	0.05-0.27	0.02-0.06
MgO	1.41-4.02	2.35-3.37
CaO	2.27-6.03	4.77-5.66
Na_2O	3.23-4.40	4.03-4.43
K_2O	3.19-5.66	2.96-3.79
P_2O_5	0.07-0.22	0.11-0.14
Mo	0.07-0.94	0.03-0.42
Total	98.68-100.67	99.29-100.12

* - all Fe reported as FeO.

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20.2c. Compositional Data - Gypsumville - St. Martin Crater area (continued)

20.2c.2. Gypsumville - Lake St. Martin samples - Sample Analyses by XRF

Wt. %	GYP160	GYP160	GYP161	GYP161	GYP250	GYP316	GYP317
SiO_2	2.07	1.94	0.00	0.00	11.54	63.01	54.44
TiO_2	0.01	0.00	0.00	0.00	0.04	0.41	0.71
Al_2O_3	0.25	0.29	0.00	0.01	1.98	17.88	16.51
FeO				0.38		0.19	0.86
Fe_2O_3				0.20		4.09	9.06
*(Fe_2O_3)**	*(0.33)*	*(0.64)*	*(0.06)*	*(0.62)*	*(1.19)*	*(4.30)*	*(10.02)*
MnO	0.01	0.02	0.00	0.01	0.19	0.03	0.18
MgO	1.14	1.12	0.04	0.05	32.96	2.28	5.02
CaO	41.66	39.70	42.71	43.88	50.23	3.19	7.14
Na_2O	0.03	0.04	0.04	0.01	0.26	3.82	3.85
K_2O	0.03	0.02	0.00	0.00	0.60	4.81	1.93
P_2O_5	0.02	0.03	0.02	0.02	0.05	0.23	0.35
SO_3	53.58	55.22	56.78	54.85	0.08	0.07	0.06
TOTAL	99.13	99.02	99.65	99.45	99.12	100.03	100.21
LOI	20.64	18.67	20.87	15.79	24.85	4.04	2.75
ppm							
Sr	5491	8160	1930	5334	308	676	708
Zr	146	149	58	119	79	419	166
V	7	31	11	28	52	101	230
Ni	1	<2	1	<2	<2	35	<2
Cr	5	<2	6	<2	<2	64	74
Co	22	<2	13	<2	<2	<1	5
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.2c. Compositional Data - Gypsumville - St. Martin Crater area (continued)

20.2c.2. Gypsumville - St. Martin Crater - Sample Analyses by XRF (continued)

Wt. % Depth	LSM-1-3ft	LSM1-202	LSM14-165ft	LSM14-172ft	STM003	STM030	STM889
SiO_2	66.89	65.25	0.00	7.42	63.01	72.05	66.01
TiO_2	0.47	0.39	0.00	0.05	0.55	0.41	0.39
Al_2O_3	14.21	15.00	0.06	2.09	16.35	14.52	16.70
FeO	1.21	0.93	0.03	0.59	0.36	0.93	0.25
Fe_2O_3	2.04	2.36	00.3	0.18	6.06	1.46	3.24
*(Fe_2O_3)**	*(3.38)*	*(3.39)*	*(0.06)*	*(0.84)*	*(6.46)*	*(2.49)*	*(3.52)*
MnO	0.06	0.06	0.03	0.05	0.08	0.05	0.06
MgO	2.97	3.39	0.54	33.62	2.67	0.71	3.20
CaO	4.75	3.81	99.36	54.89	3.74	1.90	2.52
Na_2O	3.53	3.82	0.05	0.21	3.31	4.05	3.22
K_2O	3.50	4.68	0.00	0.36	3.64	3.76	3.91
P_2O_5	0.15	0.14	0.01	0.05	0.19	0.13	0.14
SO_3	0.05	0.06	0.06	0.14	0.06	0.07	0.07
TOTAL	99.96	99.99	100.17	99.72	100.06	100.14	99.74
LOI	2.53	2.77	43.61	44.25	3.18	0.67	6.11
ppm							
Sr	520	431	191	181	652	369	525
Zr	98	218	51	67	200	358	204
V	96	99	30	51	149	69	100
Ni	<2	5	<2	<2	25	13	18
Cr	65	63	<2	<2	110	87	79
Co	<2	<2	<2	<2	<1	<1	3
Rb	75						
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.2c. Compositional Data - Gypsumville - St. Martin Crater area (continued)

20.2c.2. Gypsumville - St. Martin Crater - Sample Analyses by XRF (continued)

Wt. %	STM-001	STM-001 Vein	STM-891
SiO_2	60.14	59.83	63.19
TiO_2	0.50	0.55	1.31
Al_2O_3	17.25	16.69	14.55
FeO	0.35	0.24	2.65
Fe_2O_3	6.39	7.13	4.84
*(Fe_2O_3)**	*(6.78)*	*(7.40)*	*(7.79)*
MnO	0.09	0.10	0.11
MgO	2.94	2.99	1.69
CaO	5.28	5.47	3.18
Na_2O	3.92	3.94	4.04
K_2O	3.19	2.90	2.92
P_2O_5	0.22	0.25	0.59
SO_3	0.07	0.08	0.06
TOTAL	100.38	100.20	99.43
LOI	2.90	3.76	1.30
ppm			
Sr	820	695	490
Zr	133	162	667
V	150	168	144
Ni	10	12	3
Cr	68	69	43
Co	10	8	4
Rb	50	49	137
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.2c.3. Gypsumville - Lake St. Martin - Sample Analyses - electron microprobe

Phases analyzed by electron microprobe by M. Izawa (Feb. 2014)

GYP316: plagioclase
STM003: plagioclase, magnetite
STM030: K-feldspar, plagioclase, magnetite, biotite.
STM889: pyroxene, plagioclase, magnetite.

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20.2d. Spectral Data - Gypsumville – St. Martin Crater (alphabetical order)

(a) ASD reflectance spectra

Sample ID	*Facility/File No.*	*Description*
GMR001	PSF 080129b.008	whole rock, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GMR001	PSF 080129b.009	whole rock, zeolite nodule; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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GMR002	PSF 080129b.010	whole rock, shocked? granite clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GMR002	PSF 090728a.001	<45µm; 30°/0°; 0.35-2.5 µm,1 nm output, 1000 spectra averaged; ASD.
++++++		
GSQ007A	PSF 080129b.011	whole rock, limestone? nodule; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GSQ007A	PSF 080129b.012	whole rock, red clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GSQ007A	PSF 080129b.013	whole rock, unaltered limestone? clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GSQ007A	PSF 080129b.014	whole rock, dark spot; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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GSQ008,1	PSF 100725a.003	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GSQ008,1	PSF 100725a.004	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GSQ008,1	PSF 100723a.013	whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100723_deathchamber].
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GSQ009A	PSF 080129b.015	whole rock, carbonate breccia?, lighter area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GSQ009A	PSF 080129b.016	whole rock, carbonate breccia?, orange area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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GYP202	PSF 100725a.005	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP202	PSF 100725a.006	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP202	PSF 100723a.011	whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100723_deathchamber].
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GYP204	PSF 100724a.003	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP204	PSF 100724a.004	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP204	PSF 100723a.015	whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100723_deathchamber].
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GYP232	PSF 080129b.025	whole rock, clean gypsum, white area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GYP232	PSF 080129b.026	whole rock, clean gypsum, grubbier area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.

GYP232	PSF 080129b.027	whole rock, clean gypsum, white area on side of sample; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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GYP281	PSF 100724a.001	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP281	PSF 100724a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP281	PSF 100723a.014	whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100723_deathchamber].
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GYP290	PSF 080129b.028	whole rock, pink/altered gypsum, pink area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GYP290	PSF 080129b.029	whole rock, pink/altered gypsum, whiter area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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GYP291	PSF 080129b.030	whole rock, pink/altered gypsum, pink area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GYP291	PSF 080129b.031	whole rock, pink/altered gypsum, white/yellow area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GYP291	PSF 080129b.032	whole rock, pink/altered gypsum, yellower area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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GYP306	PSF 080129b.019	whole rock, granite breccia/melt rock, red area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GYP306	PSF 080129b.020	whole rock, granite breccia/melt rock, white area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GYP306	PSF 080129b.021	whole rock, granite breccia/melt rock, other surface red area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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GYP307	PSF 080129b.022	whole rock, granite breccia/melt rock, trachyandesite area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GYP307	PSF 080129b.023	whole rock, granite breccia/melt rock, pink feldspar area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
GYP307	PSF 080129b.024	whole rock, granite breccia/melt rock, white area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++		
GYP401	PSF 080129b.017	whole rock, clean weathered surface; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged; larger piece.
GYP401	PSF 080129b.018	whole rock, clean weathered surface; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged; smaller piece.
++++++		
GYP613	PSF 100725a.001	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP613	PSF 100725a.002	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
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GYP650	PSF 100725a.007	90-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP650	PSF 100725a.008	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100724_Gypsumville].
GYP650	PSF 100723a.012	whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm spectral output; 1000 spectra averaged; ASD [directory: 100723_deathchamber].

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(b) ASD reflectance spectra - For Rebecca Wilks LSM shock study

(i) <45 μm powders

STM030	PSF 130423a.001	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
STM891	PSF 130423a.002	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
STM889	PSF 130423a.003	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
LSM-1-202	PSF 130423a.004	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
LSM-1-3	PSF 130423a.005	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
GYP317	PSF 130423a.006	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
LSM-14-172	PSF 130423a.007	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
GYP250	PSF 130423a.008	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
STM003-coarse	PSF 130423a.009	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
STM003-fine	PSF 130423a.010	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
LSM-14-165	PSF 130423a.011	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
STM001	PSF 130423a.012	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].
STM001-vein	PSF 130423a.013	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130423a].

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(ii) Whole rocks

LSM-1-3	PSF 130314b.005	whole rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130301B].
STM891	PSF 130314.026	whole rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130314].

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STM003a	PSF 130214b.004	whole rock – gneissic side; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130214b].
STM003b	PSF 130214b.005	whole rock – finer gneiss; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130214b].
STM003c	PSF 130214b.006	whole rock – gray band; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130214b].
STM003d	PSF 130214b.007	whole rock – brown crystal; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130214b].

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STM031a	PSF 130208.012	whole rock – weathered side; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130208].
STM031b	PSF 130208.013	whole rock – fresh side; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130208].
STM030	PSF 130208.030	whole rock – country rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130208].

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STM030	PSF 130214.021	whole rock – Precambrian granite; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130214].
STM891	PSF 130214.026	whole rock – Precambrian granite; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130214].

LSM-14-165ft	PSF 130315a.003	whole rock – yellow crystal; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130315a].
LSM-14-165ft	PSF 130315a.004	whole rock – flat side; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130315a].
LSM-14-165ft	PSF 130301a.005	whole rock – darker brown blotchy flat bottom; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130315a]; maybe 130315a.005?
LSM-14-165ft	PSF 130301a.006	whole rock – clear crystals; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130315a]; maybe 130315a.006?.
LSM-14-165ft	PSF 130301a.007	whole rock – outside of core lying flat; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130315a]; maybe 130315a.007?.
LSM-14-165ft	PSF 130301a.008	whole rock – lighter brown, blotchy; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130315a]; maybe 130315a.008?.
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GYP250a	PSF 130301a.001	whole rock – carbonate melt, flat pointed side; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130301a].
GYP250b	PSF 130301a.002	whole rock – carbonate melt, pinkish area, opposite side; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130301a].
GYP250c	PSF 130301a.003	whole rock – carbonate melt, yellow area; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130301a].
GYP250d	PSF 130301a.004	whole rock – carbonate melt, probably not carbonate; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130301a].
STM889a	PSF 130301a.005	whole rock – granite melt, flat side; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130301a].
STM889b	PSF 130301a.006	whole rock – granite melt, redder area; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130301a].
STM889c	PSF 130301a.007	whole rock – granite melt, dark pocketed area; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 500 spectra averaged; ASD [Directory: 130301a].

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(b) Bruker Vertex 70 reflectance spectra

(i) <45 μm powders

STM030	PSF stm030	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
STM891	PSF stm891	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
STM889	PSF stm889	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
LSM-1-202	PSF lsm-1-202	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
LSM-1-3	PSF lsm-1-3	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
GYP317	PSF gyp317	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
LSM-14-172	PSF lsm-14-172	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
GYP250	PSF gyp250	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
STM003 coarse	PSF stm003 coarse	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
STM003 fine	PSF stm003 fine	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
LSM-14-165	PSF lsm-14-165	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
STM001	PSF stm001	<45 μm; i=30°, e=0°; 1-25 μm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker

Vertex 70 [Directory: 130426_powder]

STM001 vein PSF stm001 vein <45 µm; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]

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(ii) Whole rocks

STM889 PSF stm889 (1) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

GYP317 PSF gyp317 (2) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

STM001a PSF stm001 (3) whole rock: vein and a little bit of banding; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

STM001b PSF stm001 (4) whole rock: banding only; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

LSM-1-3 PSF lsm-1-3 (5) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

LSM-14-165 PSF lsm-14-165 (6) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

STM891 PSF stm891 (7) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

LSM-14-172 PSF lsm-14-172 (8) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

STM003a PSF stm003 (9) whole rock: coarse texture; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

STM003b PSF stm003 (10) whole rock: fine texture; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

GYP250 PSF gyp250 (11) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

LSM-1-202 PSF lsm-1-202 (12) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

STM030 PSF stm030 (13) whole rock; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130428_WholeRock]

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20.2d.1. Sample spectra for cryptoendolith study – ASD reflectance spectra

GYP601,1 PSF 100615a.002 top (exposed surface) of rock; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD [directory: 100615_crypto].

GYP601,2 PSF 100615a.004 brown spot in interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 µm; 1 nm STM030PSF stm030 <45 µm; i=30°, e=0°; 1-25 µm; 2 cm^{-1} resolution; 1500 spectra averaged; Bruker Vertex 70 [Directory: 130426_powder]
output; 1000 spectra avgd; ASD [dir: 100615_crypto].

GYP601,3 PSF 100615a.005 green spot in interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

GYP601,4 PSF 100615a.006 green and brown spot in interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

GYP601,5 PSF 100617a.001 brown spot #1 on broken interior surface of rock; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

GYP601,6 PSF 100617a.003 brown spot #2 on broken interior surface of rock; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

GYP601,7 PSF 100617a.002 green spot on broken interior surface of rock; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

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GYP605,1 PSF 100615a.007 top (exposed) surface of rock; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000

spectra avgd; ASD [dir: 100615_crypto].

GYP605,2	PSF 100615a.008	green spot in interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

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GYP606,1	PSF 100615a.009	blue and green spot in interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP606,2	PSF 100615a.010	brown spot in interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

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GYP611,1	PSF 100615a.011	orange spot/crust on exterior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP611,2	PSF 100615a.012	green spot/crust on exterior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP611,3	PSF 100615a.013	orange spot on interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP611,4	PSF 100615a.014	green spot on interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP611,5	PSF 100615a.015	white spot on interior (broken) surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP611,6	PSF 100615a.016	blue spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP611,7	PSF 100615a.017	green spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

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GYP612,1	PSF 100616a.001	blue spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612,2	PSF 100616a.002	blue/greenish spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612,3	PSF 100616a.003	blue thin line on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612,4	PSF 100616a.004	brown spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612,5	PSF 100616a.005	white spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612,6	PSF 100617a.004	green spot on broken interior surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612,7	PSF 100617a.005	dirty green spot on broken interior surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

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GYP612a,1	PSF 100616a.006	green spot with brown on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612a,2	PSF 100616a.007	“white, top of green” spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

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GYP612b,1	PSF 100616a.008	orange spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612b,2	PSF 100616a.009	green and brownish spot on interior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].
GYP612b,3	PSF 100616a.010	white (top) spot on exterior? surface of rock; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra avgd; ASD [dir: 100615_crypto].

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<u>20.2d.2. Endolith reflectance spectra - ASD</u>

Reflectance spectra measured on endoliths on various gypsum samples before (live) and after)dead) exposure of samples to Mars box environments (low carbon dioxide pressure for ~40 days). See Stromberg et al. 2014 for

details.

Blue spot 1, Live gypsum	PSF 120223a.001	surface: blue spot on live gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
Blue spot 2, Live gypsum	PSF 120223a.002	surface: blue spot on live gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
Blue spot 3, Live gypsum	PSF 120223a.004	surface: blue spot on live gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
Blue spot 4, Live gypsum	PSF 120223a.006	surface: blue spot on live gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
Orange spot 1, Live gypsum	PSF 120223a.005	surface: orange spot on live gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
Orange spot 2, Live gypsum	PSF 120223a.007	surface: orange spot on live gypsum – very faint spot; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
Green spot 1, Live gypsum	PSF 120223a.008	surface: green spot on live gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
Green spot 2, Live gypsum	PSF 120223a.009	surface: green spot on live gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
Green spot 3, Live gypsum	PSF 120223a.010	surface: green spot on live gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; ASD (directory: 120223_reflectance).
GYPPM Green band, Dead gypsum	PSF 120223a.011	surface: green band on dead gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120223_reflectance).
GYPPM Brown spot, Dead gypsum	PSF 120223a.012	surface: brown spot on dead gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120223_reflectance).
GYPPM Orange spot, Dead gypsum	PSF 120223a.013	surface: orange spot on dead gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120223_reflectance).
GYPPM Crust, Dead gypsum	PSF 120223a.014	surface: crust on dead gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120223_reflectance).
GYPPM Green band 2, Dead gypsum	PSF 120223a.015	surface: green band on dead gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120223_reflectance).
GYPPM Orange band 2, Dead gypsum	PSF 120223a.016	surface: orange band on dead gypsum; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120223_reflectance).
GYP605 green cryptos, gypsum	PSF 120223a.017	surface: green cryptos on gypsum samples; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm

		output; post vacuum oven exposure?; ASD (directory: 120223_reflectance).
GAB003 Cooked grains (A98)	PSF 120229a.002	500-1000 μm; Cooked gypsum samples, A98; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120229_reflectance).
GAB003 Cooked grains (A21)	PSF 120229a.003	45-90 μm; Cooked gypsum samples, A21; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120229_reflectance).
GAB003 Cooked grains (A22)	PSF 120229a.004	90-250 μm; Cooked gypsum samples, A22; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120229_reflectance).
GAB003 Cooked grains (A27)	PSF 120229a.005	250-500 μm; Cooked gypsum samples, A27; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120229_reflectance).
GAB003 Uncooked grains (A27UC)	PSF 120229a.006	250-500 μm; Uncooked gypsum samples, A27UC; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120229_reflectance).
GAB003 Uncooked grains (A98UC)	PSF 120229a.007	500-1000 μm; Uncooked gypsum samples, A98UC; i=30°, e=0°; 350-2500 nm; 500 spectra averaged; 1 nm output; post vacuum oven exposure; ASD (directory: 120229_reflectance).

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20.2d.3. Endolith fluorescence spectra

Fluorescence induced with 405 nm UV laser; fluorescence spectra measured with Ocean Optics S2000 spectrometer.

Gypsum rock, Blue spot	PSF GypsumBlue1	surface – blue spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Gypsum rock, Blue spot	PSF GypsumBlue2	surface – blue spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Gypsum rock, Blue spot	PSF GypsumBlue3	surface – blue spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Gypsum rock, Blue spot	PSF GypsumBlue4	surface – blue spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Gypsum rock, Orange spot	PSF GypsumOrange1	surface – orange spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Gypsum rock, Orange spot	PSF GypsumOrange2	surface – orange spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Gypsum rock, Green spot	PSF GypsumGreen1	surface – green spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Gypsum rock, Green spot	PSF GypsumGreen2	surface – green spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).

Gypsum rock, Green spot	PSF GypsumGreen3	surface – green spot; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Dead gypsum, Green band	PSF DeadGypsumGreenBand1	surface – green band, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Dead gypsum, Brown spot	PSF DeadGypsumBrownSpot2	surface – brown spot, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Dead gypsum, Orange spot	PSF DeadGypsumOrangeSpot1	surface – orange spot, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Dead gypsum, White crust	PSF DeadGypsumCrust1	surface – white spot, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Dead gypsum, Another orange spot	PSF DeadGypsumOrange2	surface – another orange spot, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Dead gypsum, Green spot, visible	PSF Deadgypsumgreen2	surface – green spot - visible, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
GYP605, Green cryptos	PSF GYP605	surface – green cryptos, after vacuum oven exposure?; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
GYPPM Orange cryptos	PSF GYPPMorange cryptos	surface – orange cryptos, after vacuum oven exposure?; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Cooked gypsum grains (A98)	PSF A98_GAB003	500-1000 μm, sample A98, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Cooked gypsum grains (A21)	PSF A21_GAB003	45-90 μm, sample A21, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Cooked gypsum grains (A22)	PSF A22_GAB003	90-250 μm, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Cooked gypsum grains (A27)	PSF A27_GAB003	250-500 μm, after vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).
Uncooked gypsum grains (A27UC)	PSF A27UC_GAB003	250-500 μm, prior to vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).

Uncooked gypsum grains (A98UC)	PSF A98UC_GAB003	500-1000 μm, prior to vacuum oven exposure; i=30°, e=0°; 400-860 nm; ~0.3 nm resolution; Ocean Optics S2000 (Directory: Destop/Tesia/ Fluorescence).

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20.2d.4. Endoliths – 532 nm Raman spectra

Collected with 532 nm iRaman instrument: broken surfaces; i=0°/e=0°; 174-4000 cm^{-1}; ~4 cm^{-1} resolution; 100 spectra averaged; 50 mW laser (directory: 140131).

GYQ099	PSF gyq099 2	Gypsum top cover	100% laser power; 1398 msec integration time; 20 spectra averaged.
GYQ099	PSF gyq099 3	Dark green layer 1	100% laser power; integration time not recorded; 2 spectra averaged.
GYQ099	PSF gyq099 4	Dark green layer 2	100% laser power; 65 msec integration time; 2 spectra averaged.
GYQ099	PSF gyq099 5	Orange layer 1	100% laser power; 729 msec integration time; 20 spectra averaged.
GYQ099	PSF gyq099 6	Orange layer 2	100% laser power; 578 msec integration time; 20 spectra averaged.
GYQ099	PSF gyq099 7	Green-blue layer 1	100% laser power; 259 msec integration time; 20 spectra averaged.
GYQ099	PSF gyq099 8	Green-blue layer 2	100% laser power; 195 msec integration time; 20 spectra averaged.
GYQ099	PSF gyq099 9	Dark orange surface coating 1	100% laser power; 5984 msec integration time; 20 spectra averaged.
GYQ099	PSF gyq099 10	Dark orange surface coating 2	100% laser power; 578 msec integration time; 20 spectra averaged.
6RB	PSF 6rb 10	Gypsum top crust	100% laser power; 2312 msec integration time; 20 spectra averaged.
6RB	PSF 6rb 11	Orange layer	100% laser power; integration time not recorded; 20 spectra averaged.
6RB	PSF 6rb 12	Dark green 1	100% laser power; 428 msec integration time; 20 spectra averaged.
6RB	PSF 6rb 13	Dark green 2	100% laser power; 595 msec integration time; 20 spectra averaged.

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GYQ007	PSF 130307_gyq007 endolith (130307 directory)
GYQ008	PSF 130307_gyq008 endolith (130307 directory)
GYQ009	PSF 130307_gyq009 endolith (130307 directory)
GYQ009	PSF 130307_gyq009 blue endolith (130307 directory)
GYQ011	PSF 130307_gyq011 endolith (130307 directory)

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20.2d.4.1. Endoliths – 785 nm Raman spectra

Collected with 785 nm Rockhound Raman instrument: broken surfaces; i=0°/e=0°; 200-2000 cm^{-1}; ~7 cm^{-1} resolution..

GYQ001	PSF gyq001 endolith (130307 directory).
GYQ007	PSF gyq007 endolith (130307 directory).
GYQ008	PSF gyq008 endolith (130307 directory).
GYQ011	PSF gyq011 endolith (130307 directory).

++

20.2d.5. Raman spectra - Lake St. Martin Crater samples

Sample ID *Facility/File No.* *Description*

(a) 532 nm iRaman – whole rock samples: carbonates: 20 spectra averaged; granites: 5 spectra averaged.
Collected with 532 nm iRaman instrument: whole rock surfaces; i=0°/e=0°; 174-4000 cm^{-1}; ~4 cm^{-1} resolution; 50 mW laser (directory: TEST_R32; 130307iraman).

LSM-14-128	130307iraman_001	Flat yellow area.
++++++		
STM890	130307iraman_002	Feldspar, pink.
STM890	130307iraman_003	Biotite spot, saturated; 2 averages.
STM890	130307iraman_004	Biotite spot, saturated; 5 averages.
STM890	130307iraman_005	Gray-black area.
STM890	130307iraman_006	Orange edge; blue spectra; ERROR.
STM890	130307iraman_007	Orange edge.
STM890	130307iraman_008	Quartz spot.
STM890	130307iraman_009	Biotite spot.
++++++		
STM030	130307iraman_010	Primarily white with dark (black) mineral.
STM030	130307iraman_011	Primarily pink, step-like fracture area.
STM030	130307iraman_012	Quartz, pink, black equal mix.
++++++		
LSM-1-202	130307iraman_013	Flat side; greenish with dark purple dots.
LSM-1-202	130307iraman_014	Flat side, purple only.
LSM-1-202	130307iraman_015	Top of core, green spot.
LSM-1-202	130307iraman_016	Flat portion, white spot.
++++++		
LSM-1-3	130307iraman_017	Top half, broken.
LSM-1-3	130307iraman_018	End circular complete, flat portion.
LSM-1-3	130307iraman_019	Broken surface; dark brown; flat.
LSM-1-3	130307iraman_020	Crystal oval deposit.
LSM-1-3	130307iraman_021	Pink crystal above oval.
LSM-1-3	130307iraman_022	Dark nodule on curved side.
++++++		
STM891	130307iraman_023	Fresh side.
STM891	130307iraman_024	Weathered side.
STM891	130307iraman_025	Pink.
STM891	130307iraman_026	Biotite spot.
++++++		
LSM-14-172	130307iraman_027	Flow lines.
LSM-14-172	130307iraman_028	Smooth brown (light).
LSM-14-172	130307iraman_029	Rough brown (dark).
LSM-14-172	130307iraman_030	Rusty spot.
++++++		
LSM-14-165	130307iraman_031	Flat white surface.
LSM-14-165	130307iraman_032	Rough bottom; dark brown.
LSM-14-165	130307iraman_033	Curved surface; light divided.
LSM-14-165	130307iraman_034	Crystal deposit in deepest portion; 5 averages.
++++++		
STM889	130307iraman_035	Smooth dark surface.
STM889	130307iraman_036	Pinkish surface.
STM889	130307iraman_037	Darker reddish spot.
STM889	130307iraman_038	Yellow spotting.
++++++		
GYP250	130307iraman_039	Red knob.
GYP250	130307iraman_040	Yellow spot.

GYP250	130307iraman_041	Green line (endolith?).
GYP250	130307iraman_042	Whitish bumpy area.
GYP250	130307iraman_043	Pick with dark dots.
GYP250	130307iraman_044	White chalky edge.
++++++		
STM003	130307iraman_045	Gray band.
STM003	130307iraman_046	Fine gneiss.
STM003	130307iraman_047	Light band.
STM003	130307iraman_048	dark band.
STM003	130307iraman_050	Black spot surrounded by red.
STM003	130307iraman_051	Quartz? edge.
+++++		
STM001	130307iraman_052	Flat dark red surface.
STM001	130307iraman_053	Red vein centre.

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(b) 532 nm iRaman – powdered samples: carbonates: 20 spectra averaged.
Collected with 532 nm iRaman instrument: powdered samples; i=0°/e=0°; 174-4000 cm^{-1}; ~4 cm^{-1} resolution; 50 mW laser (directory: TEST_R32 (collected 13/04/24)).

STM030	TEST_R32.0	
STM891	TEST_R32.2	
STM899	TEST_R32.3	
LSM-1-202	TEST_R32.4	
LSM-1-3	TEST_R32.5	
GYP317	TEST_R32.6	
LSM-14-172	TEST_R32.7	
GYP250	TEST_R32.8	
STM003	TEST_R32.9	Coarse.
STM003	TEST_R32.10	Fine.
LSM-14-165	TEST_R32.11	
STM001	TEST_R32.12	
STM001	TEST_R32.13	Vein.

++

(c) 785 nm Rockhound Raman – whole rock samples: 5 spectra averaged unless otherwise indicated.
Collected with 785 nm Delta Nu Rockhound Raman: whole rock surfaces; i=0°/e=0°; 100-2000 cm^{-1}; ~4 cm^{-1} resolution; laser on low power setting (directory: 130315).

LSM-1-3	130315_001	Broken brown side.
LSM-1-3	130315_002	Broken brown side; baseline 200.
LSM-1-3	130315_003	Top bluish spot.
LSM-1-3	130315_004	Top bluish spot; baseline 200.
LSM-1-3	130315_005	Pink crystal.
LSM-1-3	130315_006	Pink crystal; baseline 180.
++++++		
LSM-1-202	130315_007	Flat purple centre.
LSM-1-202	130315_008	Flat purple centre; baseline 180.
LSM-1-202	130315_010	Flat green spot.
LSM-1-202	130315_011	Flat green spot; baseline 160.
LSM-1-202	130315_013	Dark green dot on end.
LSM-1-202	130315_014	Dark green dot on end; baseline 200.
++++++		
STM001	130315_016	Flat dark red/purple; 10 averages.
STM001	130315_017	Flat dark red/purple; 10 averages; baseline 150.
STM001	130315_019	Red intrusion vein; 20 averages.

STM001	130315_020	Red intrusion vein; 20 averages; baseline 100.
++++++		
STM030	130315_022	
STM030	130315_023	Baseline 150.
++++++		
GYP250	130315_024	Yellow area.
GYP250	130315_025	Yellow area; baseline 100.
GYP250	130315_026	Green spotting.
GYP250	130315_027	Green spotting; baseline 150.
++++++		
STM889	130315_029	Pinkish melt edge, flat.
STM889	130315_030	Pinkish melt edge, flat; baseline 200.
STM889	130315_031	Dark brown, flat.
STM889	130315_032	dark brown, flat; baseline 200.
++++++		
STM891	130315_034	Fresh side, 1 average.
STM891	130315_035	Fresh side, 10 averages.
STM891	130315_036	Fresh side; baseline 150.
STM891	130315_037	Weathered.
STM891	130315_038	Weathered; baseline 200.

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(d) 785 nm Rockhound Raman – powdered samples.

Collected with 785 nm delta Nu Rockhound Ramant: whole rock surfaces; i=0°/e=0°; 100-2000 cm^{-1}; ~4 cm^{-1} resolution; laser on low power setting (directory: 130425).

STM030	130425_001	20 averages.
STM030	130425_002	20 averages; baseline 150.
STM891	130425_004	20 averages.
STM891	130425_005	20 averages; baseline 180.
STM889	130425_007	20 averages.
STM889	130425_008	20 averages; baseline 150.
LSM-1-202	130425_010	20 averages.
LSM-1-202	130425_011	20 averages; baseline 180.
LSM-1-3	130425_013	20 averages.
GYP317	130425_015	20 averages.
GYP317	130425_016	20 averages; baseline 170.
LSM-14-172	130425_018	20 averages.
LSM-14-172	130425_019	20 averages; baseline 150.
GYP250	130425_021	20 averages.
GYP250	130425_022	20 averages; baseline 100.
STM003	130425_023	Coarse; 20 averages.
STM003	130425_024	Coarse; 20 averages; baseline 150.
STM003	130425_026	Fine; 20 averages.
STM003	130425_027	Fine; 20 averages; baseline 150.
LSM-14-165	130425_029	20 averages.
LSM-14-165	130425_030	20 averages; baseline 150.
STM001	130425_032	20 averages.
STM001	130425_033	20 averages; baseline 150.
STM001	130425_034	Vein; 20 averages.
STM001	130425_035	Vein; 20 averages; baseline 100.

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20.2d.5. Endoliths – 785 nm Raman spectra

Collected with 785 nm Delta Nu Rockhound instrument: broken surfaces; i=0°/e=0°; 200-2000 cm^{-1}; ~7 cm^{-1} resolution; 20 spectra averaged; 100? mW laser; 1000 spectra averaged; all acquired with laser on high power (directory: 140131).

GYQ099	PSF gyq099 2	Gypsum top crust
GYQ099	PSF gyq099 3	Blue-green layer
GYQ099	PSF gyq099 4	Dark green layer 1
GYQ099	PSF gyq099 5	Orange layer
GYQ099	PSF gyq099 6	Dark orange coating
6RB	PSF 6rb 7	Gypsum top crust
6RB	PSF 6rb 8	Dark green layer
6RB	PSF 6rb 9	Orange layer

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20.2d.6. Endoliths – 405 nm UV-induced fluorescence reflectance spectra

Using 50 mW? Wicked Laser laser.All spectra collected with Maya (Ocean Optics) spectrometer: broken rock surfaces; i=0°, e=0°; 200-1100 nm; ~0.47 nm resolution; 13 msec integration time; 500 spectra averaged.

GYQ099	PSF gyq099 2	Gypsum top cover
GYQ099	PSF gyq099 3	Dark green layer 1
GYQ099	PSF gyq099 5	Golden layer
GYQ099	PSF gyq099 7	Green-blue layer 1
GYQ099	PSF gyq099 9	Dark orange surface coating 1
6RB	PSF 6rb 10	Gypsum top crust
6RB	PSF 6rb 11	Dark orange 1
6RB	PSF 6rb 12	Dark orange 2
6RB	PSF 6rb 13	Dark green 1

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20.2d.7. Thermal emission spectra (80°C; 200 – 4000 cm^{-1}, 2 cm^{-1} spectral resolution) and interpretation

Josh Bandfield (University of Washington (UW) – September 2013

GYP250	UW (grain size?)	Contains some silicates and carbonates (not sure if sulphates would be identifiable even if dominant).
LSM14172	UW (grain size?)	Contains some silicates and carbonates (not sure if sulphates would be identifiable even if dominant).
STM001	UW (grain size?)	Appears to be mostly silica (very weak features).
STM001 (vein)	UW (grain size?)	Fine particulate silicates with plagioclase transparency feature).
STM003 (coarse)	UW (grain size?)	Fine particulate silicates with plagioclase transparency feature).

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END of 20.2.

20. Analogue Sites

20.3. Impact Products - Tasmania and Sudbury, ON, Canada

20.3a. Sample Descriptions - Impact Products - Tasmania and Sudbury, ON, Canada

Sample ID	*Description*
IMP001	Impactite, (var. Darwin Glass): Mount Darwin, Tasmania, Australia (S. Atkinson).
IMP002	Melt Rock: Impact Melt Rock: Sudbury, Ontario (Collector's Marketing Group)
IMP003	Fallback Breccia: Sudbury, Ontario (Collector's Marketing Group)

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20.3c. Compositional Data - Impact Products - Tasmania and Sudbury, ON, Canada

Wt. %	IMP001
SiO_2	84.25
TiO_2	0.58
Al_2O_3	8.41
Fe_2O_3	0.25
FeO	2.38
*(Fe_2O_3)**	*(2.90)*
MnO	0.03
MgO	1.40
CaO	0.28
Na_2O	0.13
K_2O	1.92
P_2O_5	0.09
TOTAL	99.72
%LOI	
ppm	
Sr	33
Zr	418
V	70
Cr	193
Co	3
Source	Mertzman
Analysis	XRF/WC (June 2009)

* - all Fe as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.3d. Spectral Data - Impact Products - Tasmania and Sudbury, ON, Canada

Sample	*Facility/File No.*	*Description*
IMP001	PSF 090602a.041	<45 μm, i=30°,e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.
IMP001	PSF 090602a.042	90-1000 μm, i=30°,e=0°, 0.35-2.5 μm, 1 nm output, 100 avg., ASD.

++

END of 20.3.

20. Analogue Sites

20.4. Eagle Butte Crater, AB, Canada

This is an identified impact structure in SW Alberta.

20.4a. Eagle Butte Crater, Alberta, Canada - Sample Descriptions

Sample ID	*Description*
CRA01	Rock from glacial drift covering central dome of Eagle Butte impact crater, Alberta (collected June 2005).
CRA02	Rock from glacial drift covering central dome of Eagle Butte impact crater, Alberta (collected June 2005).
CRA03	Rock from glacial drift covering central dome of Eagle Butte impact crater, Alberta (collected June 2005).
CRA04	Rock from glacial drift covering central dome of Eagle Butte impact crater, Alberta (collected June 2005).
CRA10	Possible shatter cone in sandstone from glacial drift in Eagle Butte impact crater, Alberta (collected by Mark Zalcik ~2001).
CRA11	Possible shatter cone in sandstone from glacial drift in Eagle Butte impact crater, Alberta (collected by Mark Zalcik ~2001).

++

20.4d. Spectral Data - Eagle Butte Crater, Alberta

Sample	*Facility/File No.*	*Description*
CRA10	PSF 080129b.004	whole rock, average area; 30°/0°; 0.35-2.5 µm, 1 nm output, ASD, 200 spectra averaged.
++++++		
CRA11-001	PSF 080129b.001	whole rock, average area; 30°/0°; 0.35-2.5 µm, 1 nm output, ASD, 200 spectra averaged.
CRA11	PSF 080129b.002-003	whole rock, average area, other surface; 30°/0°; 0.35-2.5 µm, 1 nm output, ASD, 200 spectra averaged; same spectrum saved twice.

++

END of 20.4.

20. Analogue Sites

20.5. Poplar Bay, MB, Canada

This was identified as a possible impact crater on the basis of its circular shape and gravity anomaly.

20.5a. Sample Descriptions - Poplar Bay, MB, Canada

No evidence of an impact crater origin seen during two field visits.

Sample ID	*Description*
CRA101	Bedrock fragment (granite) from Poplar Bay, Lac du Bonnet, Manitoba possible impact crater; no evidence of shock in the sample (south shore) (self collected 2005).
CRA102	Bedrock fragment from Poplar Bay, Lac du Bonnet, Manitoba possible impact crater; no evidence of shock in the sample (south shore) (self collected 2005).
CRA103	Bedrock fragment from Poplar Bay, Lac du Bonnet, Manitoba possible impact crater; no evidence of shock in the sample (south shore) (self collected 2005).
CRA104	Bedrock fragment from Poplar Bay, Lac du Bonnet, Manitoba possible impact crater; no evidence of shock in the sample (south shore) (self collected 2005).
CRA105	Bedrock fragment from Poplar Bay, Lac du Bonnet, Manitoba possible impact crater; no evidence of shock in the sample (south shore) (self collected 2005).
CRA106	Bedrock fragment from Poplar Bay, Lac du Bonnet, Manitoba possible impact crater; no evidence of shock in the sample (south shore) (collected Aug. 15/07).
CRA107	Bedrock fragment from Poplar Bay, Lac du Bonnet, Manitoba possible impact crater; no evidence of shock in the sample (south shore) (collected Aug. 15/07).

++

END of 20.5

20. Analogue Sites

20.6. Haughton Crater, Devon Island, NT, Canada

20.6.1. Samples provided by Richard Leveille
20.6.2. Samples provided by Gordon Osinski - temporary loan
20.6.3. Haughton Crater - GO samples: Samples to retain at U of W
++

20.6.1a. Samples provided by Richard Leveille – Canadian Space Agency summer 2007.

20.6.1a.1. Haughton Crater - RL samples - Sample descriptions

Sample ID	*Description*
HMP06-02	Haughton sample (unshocked)
HMP06-10-1	Haughton sample (unshocked)
HMP06-11-2	Haughton sample (unshocked)
HMP06-13	Haughton sample (unshocked)
HMP06-14-2	Haughton sample (unshocked)
HMP06-21b-4	Haughton sample (unshocked)

XRD and XRF data available for samples.
++

20.6.1b. XRD Data - Haughton Crater - RL samples

Quantitative XRD phase abundances.

XRD	**HMP06-02**		**XRD**	**HMP06-10-1**
Quartz	5.49%		quartz	12.86%
Gypsum	75.17%		gypsum	32.81%
Goethite	8.35%		anhydrite	0.32%
Calcite	1.13%		goethite	9.95%
Dolomite	2.11%		jarosite	33.62%
FeFe2(SO4)4(H2O)14	1.96%	roemerite	dolomite-Fe	1.51%
Fe(SO4)(H2O)4	0.75%	rozenite	$Fe_2(SO_4)_2(OH)_5H_2O$	7.80%
Mg(SO4)(H2O)6	1.58%	hexahydrite	$Fe(SO_4)(OH)(H_2O)_2$	0.81%
Kaolinite	1.96%		$FeSO_4(H_2O)_4$	0.32%
Chlorite	0.00%		kaolinite	0.00%
Mica	0.45%		**Total**	**100.00%**
amphibole	1.05%			
Total	**100.00%**			

XRD	**HMP06-11-2**	**XRD**	**HMP06-13**	**XRD**	**HMP06-14-2**	**XRD**	**HMP06-21b-4**
quartz	13.79%	quartz	11.80%	Quartz	9.44%	quartz	7.82%
gypsum	58.94%	gypsum	70.08%	Gypsum	65.33%	gypsum	66.67%
anhydrite	0.57%	anhydrite	0.54%	anhydrite	0.31%	anhydrite	0.57%
hematite	0.31%	hematite	0.24%	Hematite	0.15%	hematite	0.17%
calcite	0.63%	calcite	0.90%	Calcite	0.26%	calcite	0.57%

dolomite	12.03%	dolomite	9.81%	Dolomite	11.79%	dolomite	15.65%
goethite	10.26%	goethite	4.09%	Goethite	6.97%	goethite	0.85%
jarosite	2.46%	jarosite	1.32%	Jarosite	5.03%	jarosite	6.92%
Mica	0.38%	mica	0.36%	Mica	0.26%	pyrite	0.51%
Pyrite	0.63%	pyrite	0.84%	Pyrite	0.46%	rozenite	0.28%
Total	**100.00%**	**Total**	**99.98%**	**Total**	**100.00%**	Total	100.01%

XRF	**HMP06-02**	**XRF**	**HMP06-10-1**	**XRF**	**HMP06-11-2**
Na2O	0.26	Na2O	1.19	Na2O	
MgO	0.97	MgO	0.40	MgO	0.70
Al2O3	1.72	Al2O3	1.14	Al2O3	1.68
SiO2	5.36	SiO2	3.73	SiO2	5.88
SO3	24.00	SO3	16.38	SO3	18.68
Cl	0.07	Cl	0.06	Cl	0.05
K2O	0.50	K2O	0.37	K2O	0.60
CaO	15.12	CaO	5.04	CaO	11.98
TiO2	0.09	TiO2	0.07	TiO2	0.11
MnO		MnO		Cr2O3	
Fe2O3	17.49	Fe2O3	28.40	MnO	
		CoO	0.05	Fe2O3	41.92
Total	**65.57**	**Total**	56.8219	**Total**	81.63

XRF	**HMP06-13**	**XRF**	**HMP06-14-2**	**XRF**	**HMP06-21b-4**
Na2O		Na2O	0.22	Na2O	
MgO	0.70	MgO	0.57	MgO	0.59
Al2O3	2.19	Al2O3	1.33	Al2O3	1.10
SiO2	6.48	SiO2	4.66	SiO2	4.84
P2O5	0.07	P2O5		P2O5	0.00
SO3	23.33	SO3	21.83	SO3	25.44
Cl	0.00	Cl	0.04	Cl	
K2O	0.82	K2O	0.54	K2O	1.47
CaO	15.00	CaO	14.34	CaO	15.98
TiO2	0.14	TiO2	0.09	TiO2	0.08
Cr2O3		Cr2O3		Cr2O3	
MnO	0.03	MnO	0.01	MnO	0.01
Fe2O3	29.72	Fe2O3	37.79	Fe2O3	28.75
Total	78.51	**Total**	81.42	**Total**	78.26

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20.6.1d. Spectral Data - Haughton samples - RL samples

(a) ASD spectra

Sample	*Facility/File No.*	*Description*
HMP06-10-2 ++++++	PSF feb0907.002	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
HMP06-02 ++++++	PSF feb0907.003	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
HMP06-11-2 ++++++	PSF feb0907.004	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
HMP06-13	PSF feb0907.005	<45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.

++++++
HMP06-21b-4 PSF feb0907.006 <45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
++++++
HMP06-10-1 PSF feb0907.007 <45 µm; 35°/0°; 0.35-2.5 µm; 1 nm resol.; 1000 avgd; ASD.
++

(a) D&P 102F FTIR spectra (directory: mar 09 2007)

HMP06-02 PSF HMP06-02 <45 µm; 35°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
HMP06-13 PSF HMP06-13 <45 µm; 35°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
HMP06-10/1 PSF HMP06-10/1 <45 µm; 35°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
HMP06-10/2 PSF HMP06-10/2 <45 µm; 35°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
HMP06-11/2 PSF HMP06-11/2 <45 µm; 35°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
HMP06-21b/4 PSF HMP06-21b/4 <45 µm; 35°/0°; 2-16 µm; ~1.5 cm^{-1} resol.; 100 avg; D&P.
++

20.6.2. Samples provided by Gordon Osinski - temporary loan

20.6.2a. Haughton Crater - GO samples - Sample descriptions

Sample ID	*Description*
HMP99-093	Carbonate: clast from melt breccias; black carbonate. Shock level: shatter cones. *Sample not provided.*
HMP01-050	Carbonate: Thumb Mountain Formation; outside crater. Shock level: none. XRF done; fluid inclusion slide available. TOC done. Polished thin section available.
HMP02-102	Sulfate: post-impact hydrothermal selenite. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Polished thin section available.
HMP02-119	Carbonate: Impact melt breccia. XRF done.
HMP02-136	Carbonate: Eleanor River Formation central uplift. “Note shatter cone surfaces”. Shock level: shatter cones. Organics, TOC done.
HMP04-006	Sulfate? (but listed under carbonates): Sulfate clast from impact melt breccia (IMB). Shock level: melt?. “Unknown sample” no slide.
HMP04-007	Sulfate: sulfate clast (white) from impact melt breccia (IMB). Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Polished thin section available.
HMP04-008	Sulfate: sulfate clast (brecciated) from impact melt breccia (IMB). Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Polished thin section available.
HMP04-032	Sulfate: sulfate clast from impact melt breccia (IMB). Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Polished thin section available.
HMP04-034	Sulfate: sulfate clast from impact melt breccia (IMB). XRF done; fluid inclusion slide available. Polished thin section available.
HMP04-040	Sulfate: sulfate clast from impact melt breccia (IMB). Fluid inclusion slide available. Polished thin section available.
HMP04-040	Two samples that look different labelled the same
HMP04-041	Sulfate: sulfate clast from parautochthonous breccias. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Polished thin section available.
HMP04-042	Sulfate: sulfate clast from parautochthonous breccias. XRF done; fluid inclusion slide available.
HMP04-053	Sulfate: Bay Fiord Formation sulfate from central uplift. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Image #04-012. Polished thin section available.
HMP05-010	Carbonate: Middle member of Allen Bay Formation. XRF available. TOC done. Polished thin section available.
HMP05-021	Carbonate: Ballistic ejecta; Thumb Mountain Formation. Shock level: low. XRF available. Polished thin section available.
HMP05-024	Carbonate: carbonate clast from impact melt breccia (IMB). XRF available. Polished thin section available.
HMP05-026	Carbonate: impact melt breccia. XRF available.
HMP05-035	Sulfate: Bay Fiord Formation Member A: sulphates. Shock level: outside crater. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Image #05-034-038. Polished thin section available.
HMP05-037	Sulfate: Bay Fiord Formation Member A: sulphates. Shock level: outside crater. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. *Sample not provided.* Polished thin section available.
HMP05-038	Sulfate: Bay Fiord Formation Member A: sulphates. Shock level: outside crater. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Image #05-040-043. Polished thin section available.
HMP05-039	Sulfate: Bay Fiord Formation Member A: collapse breccia. Shock level: outside crater. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Polished thin section available.
HMP05-040	Sulfate: Bay Fiord Formation Member A: sulphates. Shock level: outside crater. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Image #05-044. *Sample not provided.* Polished thin section available.
HMP05-042	Sulfate: Bay Fiord Formation Member A: sulphates. Shock level: outside crater. Semi-quantitative XRD available (see below). XRF done; fluid inclusion slide available. Image #05-046,047.

Polished thin section available.
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20.6.2a.1. Haughton Crater - GO samples: Double polished slides for fluid inclusion work (temporary loan from G. Osinski)

(sections can be removed from slides with acetone)
"FI" indicates presence of fluid inclusions (?)

04-007
04-007 FI
04-008 FI
04-032 FI
04-034 FI
04-040
04-040 FI
04-041 FI
04-042 FI
04-053 FI
05-035 FI
HMP-05-037 FI
HMP-05-038 FI
05-039 FI
05-040 FI
05-042 FI
Blank FI
++

20.6.2b. XRD Data - Haughton Crater - GO samples

20.6.2b.1. Haughton Crater - GO samples - phases identified by XRD (data from G. Osinski, March '08)

Ordered by XRD Lab Sample ID.

Gordon Osinski Sample ID	XRD Lab Sample ID	Phases identified by semi-quantitative XRD	
04-034	*06-007*		
	06-009	91.0%	quartz, low
		9.0%	gypsum
	06-010	99%	quartz, low
		<1%	quartz
		1%	Mg calcite ($Mg_{0.03}Ca_{0.97}CO_3$)
		<1%	dolomite
		<1%	gismondine
	06-011	89%	gypsum
		4.0%	goethite
		6.0%	calcite
		1.0%	quartz
	06-012	96%	gypsum
		3%	calcite
		1%	goethite
		<1%	quartz
	06-015	100%	quartz
	06-016	97%	quartz
		3%	Mg calcite
		<1%	dolomite

		<1%	gismondine
	06-017	92%	quartz
		3%	calcite
		<1%	Mg calcite
		5%	amorphous material
	06-018	68%	quartz
		32%	Mg calcite
		<1%	dolomite
		<1%	gismondine
	06-019	95%	quartz
		4%	Mg calcite
		1%	dolomite
		<1%	gismondine
	06-020	94%	quartz
		6%	Mg calcite
		<1%	dolomite
		<1%	gismondine
++++++			
02-102	*06-035*	100%	gypsum
		<1%	quartz
++++++			
04-007	*06-036*	100%	gypsum
		<1%	quartz
		<1%	gismondine
++++++			
05-035	*06-037*	97%	gypsum
		3%	quartz, low
		<1%	quartz
		<1%	gismondine
++++++			
05-037	*06-038*	95%	gypsum
		5%	dolomite
		<1%	quartz
		<1%	quartz
++++++			
04-032	*06-039*	100%	gypsum
		<1%	quartz
		<1%	gismondine
++++++			
05-038	*06-040*	84%	gypsum
		3%	quartz, low
		8%	dolomite
		5%	gismondine
++++++			
04-008	*06-041*	80%	gypsum
		20%	quartz
++++++			
04-040	*06-042*	99%	gypsum
		1%	dolomite
		<1%	gismondine
++++++			
05-039	*06-043*	100%	gypsum
		<1%	quartz, low
++++++			
04-041	*06-044*	100%	gypsum
		<1%	quartz, low

		<1%	quartz
		<1%	gismondine
++++++			
05-040	*06-045*	69%	gypsum
		30%	dolomite
		1%	quartz, low
		<1%	gismondine
	06-046	5%	gypsum
		6%	quartz, low
		38%	dolomite
		3%	gismondine
++++++			
05-042	*06-047*	96%	gypsum
		2%	dolomite
		1%	quartz, low
		<1%	quartz
		<1%	gismondine
	06-048	99%	gypsum
		<1%	dolomite
		1%	quartz, low
		<1%	quartz
		<1%	gismondine
++++++			
04-053	*06-049*	97%	gypsum
		3%	dolomite
		<1%	quartz, low
		<1%	quartz
		<1%	gismondine

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20.6.2c. Haughton Crater - GO samples -Sample Analyses

20.6.2c.1. XRF results for HMP samples from Gordon Osinski

Wt. %	02-102	04-007	04-008	04-032	04-034	04-040	04-041
SiO_2	0.27	0.20	21.29	0.32	0.57	0.37	0.94
TiO_2	0.014	0.014	0.012	0.014	0.013	0.012	0.020
Al_2O_3	0.02	<d/l	<d/l	0.05	0.08	0.02	0.18
Fe_2O_3*	0.02	0.04	0.10	0.06	0.09	0.02	0.12
MnO	0.006	0.003	0.004	<d/l	0.004	0.003	<d/l
MgO	0.01	0.02	0.08	0.11	0.66	0.11	0.08
CaO	32.11	32.00	25.83	31.90	32.23	31.95	31.26
Na_2O	0.03	0.03	0.05	0.03	0.03	0.03	0.06
K_2O	0.01	0.01	0.01	0.01	0.01	0.01	0.08
P_2O_5	0.009	0.010	0.010	0.008	0.012	0.010	0.010
CO_2							
SO_3	46.35	45.20	33.18	45.75	40.83	46.64	53.44
ppm							
BaO	<d/l	29	<d/l	133	143	<d/l	137
Co	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l
Cr_2O_3	<d/l	<d/l	37	<d/l	<d/l	<d/l	18
Ni	11	14	11	13	12	13	18
Br	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l
Cl	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l
F	960	990	1040	940	1000	960	1040
LOI (wt. %)	67.55	67.35	52.36	67.31	66.05	67.14	66.62
TOTAL	100.05	99.69	99.76	99.83	99.77	99.68	99.39

* - all Fe reported as Fe_2O_3.
d/l = detection limit.

Wt. %	04-053	05-035	05-037	05-038	05-039	05-040	05-042
SiO_2	1.02	2.89	0.14	4.79	0.35	1.64	1.13
TiO_2	0.013	0.013	0.010	0.044	0.009	0.020	0.017
Al_2O_3	0.03	0.03	0.03	0.78	0.03	0.21	0.13
Fe_2O_3*	0.03	0.05	0.03	0.19	0.05	0.45	0.12
MnO	0.004	0.004	0.004	0.005	0.003	0.018	0.006
MgO	0.98	0.16	2.49	0.96	0.12	4.57	0.87
CaO	31.77	31.32	31.51	30.38	32.27	31.24	31.71
Na_2O	0.04	0.03	0.02	0.05	0.06	0.04	0.08
K_2O	0.01	0.01	<d/l	0.47	0.01	0.04	0.02
P_2O_5	0.008	0.010	0.009	0.015	0.011	0.013	0.012
CO_2							
SO_3	49.51	41.34	41.45	38.18	53.55	39.98	53.06
ppm							
BaO	<d/l	<d/l	<d/l	83	<d/l	<d/l	<d/l
Co	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l
Cr_2O_3	27	25	<d/l	22	27	<d/l	16
Ni	17	11	13	11	12	12	13
Br	<d/l	<d/l	<d/l	<d/l	<d/l	1/0	<d/l
Cl	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l	<d/l
F	1540	1030	1020	1630	990	1060	1020
LOI (wt. %)	65.89	65.25	65.55	61.96	66.90	61.72	65.71
TOTAL	99.80	99.77	99.79	99.66	99.82	99.96	99.81

* - all Fe reported as Fe_2O_3.
d/l = detection limit.
++

20.6.2c.2. Haughton Crater - samples from GO - Analytical data: Electron microprobe

Phases analyzed by electron microprobe by M. Izawa (Feb. 2014):

HMP05-026: dolomite, mixed groundmass, calcite+quartz.
++

20.6.2c.3. Haughton Crater - samples from GO - Sample Analyses

Sample analyzed by XRF and wet chemistry: Stan Mertzman, Franklin and Marshall College.

Wt. %	HMP-05-026
SiO_2	19.89
TiO_2	0.10
Al_2O_3	2.97
FeO	0.19
Fe_2O_3	0.96
*(Fe_2O_3)**	*(1.17)*
MnO	0.02
MgO	15.84
CaO	58.66
Na_2O	0.12
K_2O	0.59
P_2O_5	0.04
SO_3	0.29
TOTAL	99.69
LOI	37.20
ppm	
Sr	523
Zr	90
V	42
Ni	15
Cr	17
Co	<1
Source	Mertzman
Analysis	XRF/WC

[a] All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.6.2d. Spectral data - Haughton Crater - samples from GO

Sample	*Facility/File No.*	*Description*
HMP01-050	PSF 080129b.066	whole rock, exterior surface, crystalline area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP01-050	PSF 080129b.067	whole rock, cut surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++		
HMP02-119	PSF 080129b.075	whole rock, broken exterior? surface, big bland clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP02-119	PSF 080129b.076	whole rock, broken exterior? surface, gray clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP02-119	PSF 080129b.077	whole rock, broken exterior? surface, white clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP02-119	PSF 080129b.078	whole rock, broken exterior? surface, "average" area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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HMP02-136	PSF 080129b.072	whole rock, cone surface, lighter area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP02-136	PSF 080129b.073	whole rock, cone surface, darker area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP02-136	PSF 080129b.074	whole rock, other cone surface, average lighter area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++		
HMP03-021	PSF 080129b.057	whole rock, exterior surface, average gray area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP03-021	PSF 080129b.058	whole rock, cut surface, average gray area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++		
HMP04-006	PSF 080129b.041	whole rock, exterior surface, lighter area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-006	PSF 080129b.042	whole rock, exterior surface, darker area adjacent to first spot; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-006	PSF 080129b.043	whole rock, exterior ("underside") surface, gray area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-006	PSF 080129b.044	whole rock, exterior ("underside") surface, gray crest; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-006	PSF 080129b.045	whole rock, exterior ("underside") surface, black area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-006	PSF 080129b.046	whole rock, exterior surface, in the "cave" – crystalline area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++		
HMP04-008	PSF 080129b.035	whole rock, exterior surface; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-008	PSF 080129b.036	whole rock, cut surface; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++		
HMP04-034	PSF 080129b.053	whole rock, exterior surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-034	PSF 080129b.054	whole rock, cut surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++		
HMP04-040	PSF 080129b.055	whole rock, exterior surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-040	PSF 080129b.056	whole rock, cut surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol.,

ASD, 200 spectra averaged.
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HMP04-041 PSF 080129b.047 whole rock, epoxied? exterior surface; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-041 PSF 080129b.048 whole rock, cut surface, gray clast area1; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-041 PSF 080129b.049 whole rock, cut surface, gray clast area2; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-041 PSF 080129b.050 whole rock, cut surface, gray clast area3; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-041 PSF 080129b.051 whole rock, cut surface, whiter vein area1; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-041 PSF 080129b.052 whole rock, cut surface, whiter vein area2; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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HMP04-053 PSF 080129b.037 whole rock, exterior surface, white spot; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-053 PSF 080129b.038 whole rock, exterior surface, adjacent gray spot; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-053 PSF 080129b.039 whole rock, cut surface, gray spot; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP04-053 PSF 080129b.040 whole rock, exterior surface, whiter spot; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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HMP05-010 PSF 080129b.059 whole rock, exterior surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++
HMP05-024 PSF 080129b.068 whole rock, exterior surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-024 PSF 080129b.069 whole rock, exterior other surface, darker area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-024 PSF 080129b.070 whole rock, exterior other surface, lighter area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-024 PSF 080129b.071 whole rock, cut surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++
HMP05-026 PSF 080129b.060 whole rock, broken exterior? surface, mostly gray clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-026 PSF 080129b.061 whole rock, broken exterior? surface, next to gray clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-026 PSF 080129b.062 whole rock, broken exterior? other surface, white clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-026 PSF 080129b.063 whole rock, broken exterior? other surface, adjacent dark clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-026 PSF 080129b.064 whole rock, broken exterior? other surface, big gray-white clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-026 PSF 080129b.065 whole rock, broken exterior? other surface, smaller gray clast; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
++++++++
HMP05-038 PSF 080129b.033 whole rock, exterior surface; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP05-038 PSF 080129b.034 whole rock, cut surface, gray area away from veins; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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20.6.3a. Haughton Crater - GO samples: Samples to retain at U of W

20.6.3a. Sample Descriptions – Haughton Crater – GO Samples

Sample ID	*Description*
HMP001	Shock-blackened carbonate with shatter cone features.

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20.6.3d.Haughton Crater - GO samples: samples to retain at University of Winnipeg samples -- Spectral files

Sample	*Facility/File No.*	*Description*
HMP001	PSF 080129b.079	whole rock, cone surface, dark area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP001	PSF 080129b.080	whole rock, cone surface, lighter area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
HMP001	PSF 080129b.081	whole rock, black bottom away from cone striations; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.

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END of 20.6

20. Analogue Sites

20.7. Mistastin crater, NL, Canada

20.7a. Sample Descriptions - Mistastin Crater, NL, Canada

Samples from Cassandra Marion, Memorial University – July 2007

Sample ID	*Description*
CM065	Melt rock; has XRF, ICPMS data.
W05-60	Melt rock.
W05-67	Anorthosite – target rock; taken several km east of crater, should be unshocked.
W05-41	Anorthosite: very shocked anorthosite from Horseshoe island, centre of the crater.
CM010	Granodiorite – target rock; from Steep Creek, mildly shocked? trace element and dating on zircons done on this sample.

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20.7c. Compositional Data - Mistastin Crater, NL, Canada

20.7c.1. Analytical data from Cassandra Marion.

Wt.%	CM010	CM065	W05-41	W05-60	W05-67
Na_2O	2.15	4.091	3.57	3.76	4.20
MgO	0.22	1.337	1.32	1.60	2.99
Al_2O_3	11.59	22.137	25.01	20.74	26.70
SiO_2	75.56	55.968	52.79	56.03	53.00
P_2O_5	0.07	0.223	0.22	0.23	0.05
S (ppm)	--	16.903	395	298	311
Cl (ppm)	--	383.465	343	67	72
K_2O	4.95	1.463	0.71	1.76	0.52
CaO	1.14	7.623	9.69	6.93	9.77
Sc (ppm)	-8.17	2.953	8	12	12
TiO_2	0.32	0.712	0.37	0.83	0.21
V (ppm)	-2.74	53.74	19.37	48.61	26.21
Cr (ppm)	-0.55	19.46	10.07	20.97	103.09
MnO	0.03	0.051	0.03	0.07	0.06
Fe_2O_3T[1]	2.39	4.669	2.15	5.76	4.15
Ba (ppm)[2]	2694	694	572	1115	318
Ce (ppm)[2]	93	77	<LD	111	<LD
Ni (ppm)	--	0.98	10.86	11.42	14.78
Cu (ppm)	--	--	8.88	11.73	13.11
Zn (ppm)	--	--	<LD	16.40	<LD
Ga (ppm)	--	--	25.39	19.18	20.21
As (ppm)	--	--	<LD	<LD	<LD
Rb (ppm)	--	--	3.26	31.09	1.15
Sr (ppm)	--	--	722.42	564.40	732.41
Y (ppm)	--	--	5.58	18.30	1.78
Zr (ppm)	--	--	38.70	311.75	18.99
Nb (ppm)	--	--	2/47	10.90	1.05
Pb (ppm)	--	--	<LD	8.41	<LD
Th (ppm)	--	--	<LD	<LD	<LD
U (ppm)	--	--	<LD	<LD	<LD
TOTAL	98.72	98.398	96.19	98.05	101.89
LOI (wt.%)	0.75	1.18	3.33	0.88	0.32

Analyses from Cassandra Marion – Memorial University (May 2008).
[1] All Fe reported as Fe_2O_3. [2] Decimal places ignored. LD – lower detection limit?
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20.7c. Compositional Data - Mistastin Crater, NL, Canada (continued)

20.7c.2. Mistastin Crater, NL, Canada - Sample Analyses - XRF analyses

Wt. %	W05-41	W05-41	CM065
SiO_2	55.48	55.52	56.44
TiO_2	0.25	0.39	0.75
Al_2O_3	26.09	26.84	22.33
FeO	0.54	0.31	2.32
Fe_2O_3	1.45	1.19	2.47
*(Fe_2O_3)**	*(2.05)*	*(1.53)*	*(5.05)*
MnO	0.04	0.040	0.08
MgO	0.79	0.40	1.44
CaO	9.62	9.60	7.92
Na_2O	4.87	4.79	4.44
K_2O	0.73	0.710	1.49
P_2O_5	0.24	0.084	0.27
SO_3	0.05	0.40	0.07
TOTAL	100.21	100.30	100.28
LOI	2.47	2.59	1.35
ppm			
Sr	840	830	676
Zr	85	92	242
V	67	17	87
Ni	5	<2	15
Cr	31	15	94
Co	<2	8	<1
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

[a] All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.7c.3. Mistastin Crater, NL, Canada - Sample Analyses: Electron microprobe

Phases analyzed by electron microprobe by M. Izawa (Feb. 2014):

CM065: ilmenite, pyroxene, plagioclase, magnetite.
W05-41: magnetite, ilmenite, plagioclase.

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20.7d. Spectral Data - Mistastin Crater, NL, Canada

Sample	*Facility/File No.*	*Description*
CM010	PSF 080129b.087	whole rock, weathered surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
CM010	PSF 080129b.088	whole rock, broken surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
CM010	PSF 080129b.089	whole rock, cut surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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CM065	PSF 300807a.001	<45 µm; 35°/0°; 0.35-2.5 µm,1 nm resol., ASD.
CM065	PSF 080129b.082	whole rock, weathered surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
CM065	PSF 080129b.083	whole rock, cut surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
CM065	PSF 080129b.084	whole rock, broken surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
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W05-41	PSF 300807a.002	<45 µm; 35°/0°; 0.35-2.5 µm,1 nm resol., ASD.
W05-41	PSF 080129b.085	whole rock, broken surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
W05-41	PSF 080129b.086	whole rock, cut surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
W05-41	PSF 111201a.036	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
W05-41	PSF 111201a.007	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
W05-41	INO	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 4 sets of spectra acquired.
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W05-60	PSF 300807a.003	<45 µm; 35°/0°; 0.35-2.5 µm,1 nm resol., ASD.
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W05-67	PSF 300807a.004	<45 µm; 35°/0°; 0.35-2.5 µm,1 nm resol., ASD.
W05-67	PSF 080129b.090	whole rock, least altered weathered surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
W05-67	PSF 080129b.091	whole rock, broken surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
W05-67	PSF 080129b.092	whole rock, cut surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
W05-67	PSF 111201a.037	<45 µm; i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
W05-67	PSF 111201a.008	whole rock, i=30, e=0; 0.35-2.5 µm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
W05-67	INO W05-67	whole rock; i=30, e=0; 0.9-2.5 µm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.

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END of 20.7.

20. Analogue Sites

20.8. West Hawk Lake, MB, Canada

This is a few km wide impact crater in Precambrian rocks on the Manitoba-Ontario border.

20.8a. Sample Descriptions - West Hawk Lake, MB, Canada

Sample ID	*Description*
WHL001-004	Basalt (4 pieces) first moraine east of West Hawk Lake beach (Aug. 15/07)
WHL005-008	Basalt (4 pieces) first road cut east of West Hawk Lake beach (Aug. 15/07).

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END of 20.8.

20. Analogue Sites

20.9. Frank Slide, AB, Canada

This is a large manmade landslide in SE Alberta.

20.9a. Sample Descriptions - Frank Slide, AB, Canada

Sample ID	*Description*
FSA001	Slickensided limestone; collected at rest stop on south side of highway; July 23, 2007.
FSA002	Slickensided limestone; collected at rest stop on south side of highway; July 23, 2007.

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20.9d. Spectral Data - Frank Slide, AB, Canada

Sample	*Facility/File No.*	*Description*
FSA001	PSF 080129b.005	whole rock, slickensided surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged; bad spectrum.
FSA001	PSF 080129b.006	whole rock, slickensided surface, average area; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.
FSA001	PSF 080129b.007	whole rock, fractured surface away from slickensided surface; 30°/0°; 0.35-2.5 µm, 1 nm resol., ASD, 200 spectra averaged.

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END of 20.9.

20. Analogue Sites

20.10. Saline Lakes, SK, Canada

20.10.1. Ceylon Lake, Saskatchewan
20.10.2. Chaplin, SK, Canada
20.10.3. West Coteau Lake, SK, Canada
20.10.4. Chappice Lake, SK, Canada
20.10.5. Freefight Lake, SK, Canada
20.10.6. Ingebright Lake, SK, Canada
20.10.7. Muskiki Lake, SK, Canada
20.10.8. Manito Lake, SK, Canada
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20.10a. Sample Descriptions - Saline Lakes, SK, Canada

Sample ID *Description*

20.10.1a. Ceylon Lake, Saskatchewan

Samples collected July 20, 2007 from the south end of the salt lake (Ceylon Salt Lake) located a few km SW of Ceylon, Saskatchewan. Samples collected from shoreline.

CSL001	Unsorted whitish crust – powder; no texture preserved.
CSL002	Unsorted whitish crust – powder; no texture preserved.
CSL003	White crust, texture preserved.
CSL004	White crust, texture preserved.
CSL005	White crust, texture preserved.
CSL006	White crust, texture preserved.
CSL006Bk	After heating to 950°C for 1 hour for XRF (Mertzman).
CSL007	White crust, texture preserved.
CSL007Bk	After heating to 950°C for 1 hour for XRF (Mertzman).
CSL008	White crust, texture preserved
CSL008Bk	After heating to 950°C for 1 hour for XRF (Mertzman).
CSL009	White crust with subsurface green algal layer; texture preserved.
CSL010	White crust, texture preserved.
CSL008/010s	Supplemental material for CSL008 and 010.

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20.10.2a. Chaplin, SK, Canada

Samples collected from south side of Highway 1 on shore of Chaplin Lake from stockpile. Samples collected July 2004.

SPT158	Sulfate - mirabilite (Glauber's salt) - Chaplin, Saskatchewan (self collected) ($Na_2SO_4 \cdot 10H_2O$) (July 2004).
SPT158Bk	After heating to 950°C for 1 hour for XRF (Mertzman).

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20.10.3a. West Coteau Lake, SK, Canada

Samples collected from northwest shore of West Coteau Lake in July 2005.

SPT200	Sulfate deposit - dry surface of west end of West Coteau Lake, Saskatchewan, Canada (collected July 2005).

SPT200Bk After heating to 950°C for 1 hour for XRF (Mertzman).

SPT201 Sulfate deposit - dry surface of west end of West Coteau Lake, Saskatchewan, Canada (collected July 2005).
SPT201Bk After heating to 950°C for 1 hour for XRF (Mertzman).
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20.10.4a. Chappice Lake, SK, Canada

Samples collected by Bill Last (University of Manitoba sometime in the 1980s-2000s).

Chappice-1 Evaporite sample from lake bed.
Chappice-1Bk After heating to 950°C for 1 hour for XRF (Mertzman).
Chappice-2 Evaporite sample from lake bed.
Chappice-2Bk After heating to 950°C for 1 hour for XRF (Mertzman).
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20.10.5a. Freefight Lake, SK, Canada

Samples collected by Bill Last (University of Manitoba sometime in the 1980s-2000s).

Freefight-1 Evaporite sample from lake bed.
Freefight-1Bk After heating to 950°C for 1 hour for XRF (Mertzman).
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20.10.6a. Ingebright Lake, SK, Canada

Samples collected by Bill Last (University of Manitoba sometime in the 1980s-2000s).

Ingebright-1 Evaporite sample from lake bed.
Ingebright-1Bk After heating to 950°C for 1 hour for XRF (Mertzman).
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20.10.7a. Muskiki Lake, SK, Canada

Muskiki-1 Evaporite sample collected by Bill Last of the University of Manitoba sometime in the 1980s-2000s.
Muskiki-2 Shoreline sediments collected June 20, 2013 by E. Cloutis; period of very high water level.
Muskiki-3 Nearshore water sample collected June 20, 2013 by E. Cloutis; period of very high water level.
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20.10.8a. Manito Lake, SK, Canada

Samples collected by Bill Last (University of Manitoba sometime in the 1980s-2000s).

Manito-1 Evaporite sample from lake bed.
Manito-1Bk After heating to 950°C for 1 hour for XRF (Mertzman).
Manito-2 Evaporite sample from lake bed.
Manito-2Bk After heating to 950°C for 1 hour for XRF (Mertzman).
Manito-3 Evaporite sample from lake bed.
Manito-3Bk After heating to 950°C for 1 hour for XRF (Mertzman).
Manito-4 Evaporite sample from lake bed.
Manito-4Bk After heating to 950°C for 1 hour for XRF (Mertzman).
Manito Island Evaporite sample from lake bed.
Manito S.I. Evaporite sample from lake bed.
Manito S.I.-Bk After heating to 950°C for 1 hour for XRF (Mertzman).
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20.10c. Compositional Data - Saline Lakes, SK, Canada

20.10.1c. Ceylon Lake, SK, Canada samples - Analyses.

Wt.%	CSL002	CSL004	CSL005	CSL006	CSL007	CSL008	CSL009	CSL010
SiO_2	2.73	0.04	0.00	0.00	0.00	0.00	0.00	0.00
TiO_2	0.02	0.01	0.00	0.00	0.01	0.01	0.00	0.00
Al_2O_3	0.38	0.06	0.00	0.00	0.00	0.00	0.01	0.00
*(Fe_2O_3)**	*(0.22)*	*(0.52)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.46)*	*(0.00)*	*(0.00)*
MnO	0.009	0.016	0.006	0.006	0.006	0.026	0.007	0.005
MgO	0.74	0.32	1.33	0.24	0.38	0.42	0.64	0.50
CaO	0.67	0.34	0.16	0.16	0.16	0.33	0.66	0.25
Na_2O	41.42	43.70	40.38	44.47	44.65	44.87	41.60	42.59
K_2O	0.191	0.054	0.231	0.104	0.145	0.250	0.130	0.088
P_2O_5	0.024	0.020	0.023	0.015	0.014	0.019	0.025	0.019
SO_3	53.85	55.20	56.66	55.45	55.02	53.96	56.16	55.58
Cl	0.00	0.00	0.42	0.00	0.04	0.00	0.09	0.11
TOTAL	100.254	100.280	99.212	100.445	100.427	100.345	99.322	99.142
LOI	2.23	1.67	4.14	1.18	1.44	1.81	3.12	1.76
ppm								
Rb	4	<2	3	<2	6	8	<2	<2
Sr	55	62	48	45	49	80	145	58
Zr	48	27	27	25	23	26	32	23
V	21	19	18	14	21	21	18	17
Ni	<2	50	<2	<2	<2	100	10	<2
Cr	10	6	10	15	14	15	16	13
Co	10	15	<2	<2	<2	13	14	3
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.

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20.10c. Compositional Data - Saline Lakes, SK, Canada (continued)

20.10.2c. Chaplin, SK, Canada samples - Analyses.

Wt.%	SPT158
SiO_2	1.94
TiO_2	0.03
Al_2O_3	0.45
*(Fe_2O_3)**	*(0.14)*
MnO	0.008
MgO	0.10
CaO	0.30
Na_2O	42.27
K_2O	0.175
P_2O_5	0.023
SO_3	55.14
Cl	0.00
TOTAL	100.573
LOI	0.74
ppm	
Rb	2
Sr	36
Zr	31
V	22
Ni	<2
Cr	13
Co	<2
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.

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20.10c. Compositional Data - Saline Lakes, SK, Canada (continued)

20.10.3c. West Coteau Lake, SK, Canada samples - Analyses.

Wt.%	SPT200	SPT201
SiO_2	4.30	4.29
TiO_2	0.05	0.05
Al_2O_3	0.87	0.89
*(Fe_2O_3)**	*(0.37)*	*(0.37)*
MnO	0.018	0.018
MgO	1.17	1.17
CaO	1.87	1.87
Na_2O	39.81	39.81
K_2O	0.386	0.384
P_2O_5	0.051	0.052
SO_3	50.83	51.89
Cl	0.00	0.00
TOTAL	99.719	100.789
LOI	9.34	5.02
ppm		
Rb	20	5
Sr	266	264
Zr	56	52
V	21	25
Ni	20	15
Cr	32	25
Co	18	10
Source	Mertzman	Mertzman
Analysis	XRF	XRF

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.

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20.10c. Compositional Data - Saline Lakes, SK, Canada (continued)

20.10.4c.Chappice Lake, SK, Canada samples - Analyses.

Wt.%	Chappice-1	Chappice-2
SiO_2	9.07	44.82
TiO_2	0.02	0.11
Al_2O_3	0.84	3.20
*(Fe_2O_3)**	*(0.19)*	*(0.53)*
MnO	0.039	0.037
MgO	1.76	1.99
CaO	85.40	49.20
Na_2O	1.48	1.52
K_2O	0.264	0.752
P_2O_5	0.157	0.079
SO_3	0.55	0.31
Cl	0.00	0.00
TOTAL	99.768	99.242
LOI	42.35	27.64
ppm		
Rb	5	10
Sr	5695	3152
Zr	172	196
V	14	31
Ni	<2	<2
Cr	6	30
Co	<2	<2
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.

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20.10c. Compositional Data - Saline Lakes, SK, Canada (continued)

20.10.5c. Freefight Lake, SK, Canada samples - Analyses.

Wt.%	Freefight-1
SiO_2	29.19
TiO_2	0.17
Al_2O_3	2.73
*(Fe_2O_3)**	*(0.61)*
MnO	0.041
MgO	50.79
CaO	11.87
Na_2O	1.58
K_2O	0.794
P_2O_5	0.071
SO_3	2.12
Cl	0.00
TOTAL	99.966
LOI	45.69
ppm	
Rb	11
Sr	970
Zr	277
V	33
Ni	3
Cr	45
Co	<2
Source	Mertzman
Analysis	XRF/WC

[a] All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.

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20.10c. Compositional Data - Saline Lakes, SK, Canada (continued)

20.10.6c. XRF data for Ingebright Lake samples (from Stan Mertzman May 2013).

Wt.%	Ingebright-1
SiO_2	15.51
TiO_2	0.25
Al_2O_3	3.23
*(Fe_2O_3)**	*(2.09)*
FeO	0.24
Fe_2O_3	1.82
MnO	0.031
MgO	11.49
CaO	26.08
Na_2O	7.04
K_2O	0.676
P_2O_5	0.104
SO_3	32.21
Cl	0.52
TOTAL	99.218
LOI	27.43
ppm	
Rb	13
Sr	853
Zr	65
V	49
Ni	10
Cr	60
Co	7
Source	Mertzman
Analysis	XRF/WC

[a] All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.

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20.10c. Compositional Data - Saline Lakes, SK, Canada (continued)

20.10.7c. Muskiki Lake, SK, Canada samples - Analyses.

Wt.%	Muskiki-1
SiO_2	0.00
TiO_2	0.01
Al_2O_3	0.00
*(Fe_2O_3)**	*(0.00)*
MnO	0.008
MgO	27.18
CaO	0.11
Na_2O	21.12
K_2O	0.254
P_2O_5	0.013
SO_3	50.34
Cl	0.89
TOTAL	99.929
LOI	35.79
ppm	
Rb	3
Sr	45
Zr	22
V	22
Ni	2
Cr	19
Co	8
Source	Mertzman
Analysis	XRF/WC

[a] All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.

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20.10c. Compositional Data - Saline Lakes, SK, Canada (continued)

20.10.8c. Manito Lake, SK, Canada samples - Analyses.

Wt.%	Manito-1	Manito-2	Manito-3	Manito-4	Manito Is.	Manito S.I.
SiO_2	7.48	6.85	9.56	82.79	11.03	58.59
TiO_2	0.03	0.05	0.05	0.16	0.06	0.49
Al_2O_3	0.74	0.67	2.09	6.58	1.04	5.22
*(Fe_2O_3)**	*(2.19)*	*(1.67)*	*(1.05)*	*(0.80)*	*(0.30)*	*(2.07)*
FeO	0.39	0.51	0.71			0.76
Fe_2O_3	1.76	1.20	0.26			1.23
MnO	0.147	0.092	0.138	0.048	0.020	0.110
MgO	2.50	27.10	1.96	1.05	1.12	8.50
CaO	84.41	62.32	82.41	5.70	2.41	21.58
Na_2O	0.87	0.35	0.96	1.80	35.16	1.59
K_2O	0.145	0.049	0.274	1.400	0.482	1.044
P_2O_5	0.169	0.261	0.264	0.054	0.058	0.101
SO_3	0.62	0.27	0.840	0.230	46.080	0.260
Cl	0.00	0.00	0.000	0.000	2.194	0.000
TOTAL	99.304	99.778	99.598	100.610	99.943	99.561
LOI	41.97	44.90	41.03	5.12	7.84	20.35
ppm						
Rb	5	<2	5	25	4	25
Sr	3965	8571	2237	468	141	1027
Zr	135	276	91	136	60	570
V	24	35	40	52	23	68
Ni	<2	<2	<2	<2	<2	<2
Cr	15	15	13	35	25	100
Co	<2	<2	<2	<2	<2	<2
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

[a] All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.

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20.10d. Spectral Data - Saline Lakes, SK, Canada

Note: *for ASD spectra, resolution is between 2 and 7 nm, with 1.4 nm steps that are internally resampled to provide data with 1 nm steps.*

Sample	*Facility/File No.*	*Description*
CSL002	PSF 080730a.024	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL002	PSF 130226a.001	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
CSL002	PSF 130226a.002	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
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CSL003	PSF 080730a.025	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL003	PSF 130226a.003	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
CSL003	PSF 130226a.004	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
++++++		
CSL004	PSF 080730a.026	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL004	PSF 130226a.005	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
CSL004	PSF 130226a.006	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
++++++		
CSL005	PSF 080730a.027	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL005	PSF 130226a.007	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
CSL005	PSF 130226a.008	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
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CSL006	PSF 080730a.028	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL006	PSF 130226a.009	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
CSL006	PSF 130226a.010	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
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CSL007	PSF 080730a.029	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL007	PSF 130226a.011	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
CSL007	PSF 130226a.012	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
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CSL008	PSF 080730a.030	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL008	PSF 130226a.013	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
CSL008	PSF 130226a.014	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
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CSL009	PSF 080730a.031	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL009	PSF 130226a.015	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
CSL009	PSF 130226a.016	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
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CSL010	PSF 080730a.032	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
CSL010	PSF 130226a.017	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory:

		130226_Salts].
CSL010	PSF 130226a.018	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
++++++		
SPT158	PSF 080730a.002	unsorted powder; 0.35-2.5 µm, 30°/0°; 1000 spectra averaged; ASD.
SPT158	PSF 130226a.025	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
SPT158	PSF 130226a.026	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
+++++++		
SPT200	PSF 130226a.027	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
SPT200	PSF 130226a.028	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
+++++++		
SPT201	PSF 130226a.029	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
SPT201	PSF 130226a.030	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
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Muskiki	PSF 130328a.001	whole rock; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Ingebright	PSF 130328a.002	whole rock; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito Island	PSF 130328a.003	whole rock; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito 1	PSF 130328a.004	whole rock: side 1, yellow crust; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito 1	PSF 130328a.005	whole rock; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito 4	PSF 130328a.006	whole rock; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito 3	PSF 130328a.007	whole rock: white coating; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito 3	PSF 130328a.008	whole rock: yellow gray; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito 2	PSF 130328a.009	whole rock: dark; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito 2	PSF 130328a.010	whole rock: white rock; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito 2	PSF 130328a.011	whole rock: crust, pinkish white; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito S.I.	PSF 130328a.012	whole rock: top; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Manito S.I.	PSF 130328a.013	whole rock: bottom; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Chappice 1	PSF 130328a.014	whole rock: top; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Chappice 1	PSF 130328a.015	whole rock: bottom; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Chappice 1	PSF 130328a.016	whole rock: crust; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Chappice 2	PSF 130328a.017	whole rock: top; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Chappice 2	PSF 130328a.018	whole rock: bottom; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].

Chappice 2	PSF 130328a.019	whole rock: iron crust; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Freefight	PSF 130328a.020	whole rock: top; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].
Freefight	PSF 130328a.021	whole rock: bottom; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130328_SamSalts].

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END of 20.10.

20. Analogue Sites

20.11. Ormiston, SK, Canada

This is a saline lake in south-central Saskatchewan that was mined for Na-sulfates. It has many similarities to other Saslatchewan saline lakes (see previous section).

20.11a. Sample Descriptions - Ormiston, SK, Canada

Samples collected July 20, 2007 from Ormiston Mine, now abandoned, located just south of Ormiston, Saskatchewan, Canada. Samples collected from western base of pile.
White material is generally confined to the uppermost surface of the pile in this location.

Sample ID	*Description*
ORM001	Unsorted white material from Ormiston Mining pile.
ORM002	Same as ORM001, less pure.
ORM002Bk	After heating to 950°C for 1 hour for XRF (Mertzman).

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20.11c. Compositional Data – Ormiston, SK, Canada

Wt.%	ORM001	ORM002
SiO_2	1.32	10.94
TiO_2	0.02	0.13
Al_2O_3	0.31	2.19
*(Fe_2O_3)**	*(0.14)*	*(3.16)*
FeO		0.32
Fe_2O_3		2.80
MnO	0.010	0.116
MgO	0.25	2.05
CaO	0.61	3.78
Na_2O	42.68	35.02
K_2O	0.053	0.617
P_2O_5	0.018	0.047
SO_3	55.04	41.72
Cl	0.00	0.00
TOTAL	100.458	99.767
LOI	1.08	5.94
ppm		
Rb	<2	15
Sr	45	141
Zr	30	79
V	21	34
Ni	<2	400
Cr	15	35
Co	<2	30
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

[a] All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

XRF data from Stan Mertzman, Franklin and Marshall College - May 2013.
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20.11d. Spectral Data: Ormiston, SK

ORM001	PSF 130226a.021	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
ORM001	PSF 130226a.022	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
+++++++		
ORM002	PSF 130226a.023	<45 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].
ORM002	PSF 130226a.024	45-1000 µm; 30°/0°; 0.35-2.5 µm; 500 spectra averaged; ASD [Directory: 130226_Salts].

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END of 20.11.

20. Analogue Sites

20.12. Bird River Sill, MB, Canada

The Bird River sill is a chromium/chromite-bearing deposit, located east of Lac du Bonnet, MB, Canada.

20.12a. Sample Descriptions - Bird River Sill, MB, Canada

Sample ID	*Description*
BRS001-030	Multiple pieces of chromite-bearing layers, serpentinized zones, and host basalt (collected Aug. 15/07; ~100 m in from Hwy 315).
BRS031-039	Multiple pieces of chromite-bearing layers, serpentinized zones, and host basalt (collected Aug. 15/07; ~100 m in from Hwy 315).

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END of 20.12.

20. Analogue Sites

20.13. Hecla Island, MB, Canada

Two former quarries on the island were sampled to investigate the spectral properties of blasting associated with quarrying on the spectral properties of lichens. Other sites were sampled to determine the spectrum-altering effects of iron oxyhydroxides and lichens on the spectral reflectance properties of limestone.

20.13.1. Limestone quarry
20.13.2. Limestone samples
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20.13a. Sample Descriptions – Hecla Island, MB, Canada

Sample ID *Description*

20.13.1a. Sample Descriptions - Hecla Island, MB, Canada - Limestone Quarry

Hecla Island Provincial Park, Manitoba hosts the remains of limestone quarries where explosives were used to quarry the rock; the remains of many of these blast holes (characterized by radial fracture patterns) are still evident. Samples were collected from the quarry on the north shore of the island.

HEC001 Samples proximate to blast hole in old quarry along north shore of Hecla Island. Site shows radial fractures. All samples include at least one surface of the blast hole. All samples from <5 cm from blast hole. HEC001b: wall of blast hole, HEC001f: fractured (by the blast) surface.
HEC002 Samples at least 15 cm from blast hole.
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20.13.2a. Sample Descriptions- Hecla Island, Manitoba limestone samples

Samples were collected for examining the effects of weathering, iron staining, and lichen cover on the spectral properties of limestone. Samples were collected in an abandoned limestone quarry on the south shore of the island.

LST001 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surface with abundant orange and black lichen.
LST002 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surfaces, one with sparse black lichen, one with some iron oxide staining.
LST003 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surface with sparse orange and rare black lichen.
LST004 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surfaces with no apparent alteration and very minor lichen.
LST005 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surfaces with some iron staining.
LST006 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surface with abundant iron staining.
LST007 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surface with abundant iron staining.
LST008 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surface with red and black lichen.
LST009 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surface with red and black lichen.
LST010 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surface with abundant black lichen.

LST011 Limestone: South shore “Quarry” site, Hecla Island, Manitoba, Canada. Weathered surface with abundant black lichen.

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20.13d. Spectral Data - Hecla Island, MB, Canada

20.13.1d. Hecla Island, MB, Canada - Limestone Quarry - Available spectra

Sample	*Facility/File No.*	*Description*
HEC001b	PSF 090127a.014	whole rock, point 1, 0°/0°, bifurcated cable 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD.
HEC001b	PSF 090127a.017	whole rock, point 2, 0°/0°, bifurcated cable 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD.
HEC001f	PSF 090127a.015	whole rock, point 1, 0°/0°, bifurcated cable 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD.
HEC001f	PSF 090127a.016	whole rock, point 2, 0°/0°, bifurcated cable 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD.
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HEC002	PSF 090127a.018	whole rock, point 1, 0°/0°, bifurcated cable 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD.
HEC002	PSF 090127a.019	whole rock, point 2, 0°/0°, bifurcated cable 0.35-2.5 µm, 1 nm output, 1000 averaged, ASD.

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END of 20.13.

20. Analogue Sites

20.14. Central Manitoba and San Gold Mines, MB, Canada

Central Manitoba is an abandoned mine site (located on Highway 305 east of Bissett near Nopiming Park).
San Gold Mine is an active gold mine located in town of Bissett.

20.14a. Sample Descriptions – Central Manitoba and San Gold Mines, MB, Canada

Sample ID	*Description*

20.14.1a. Central Manitoba Mine, MB, Canada - Sample Descriptions

20.14.1a.1. Central Manitoba samples collected June 15, 2008

CMB1	Orange-red surficial sediments in gully closest to westernmost discharge pipe location (“gully 1). Top of ridge: 52° 45.101’ N 100° 52.934’ W 265 m elevation.
CMB2	Same location as CMB1; 20 cm depth (“gully 1”).
CMB3	Gully just east of CMB1 gully; surficial gray sediments (“gully 2”). 52° 45.100’ N 100° 52.934’ W.
CMB4	“Gully 2”; surficial orange-red sediments 3 metres northwest of CMB3 location (toward “blue pond”).
CMB5	Surficial bluish sediments on flats 5 metres from “blue pond” toward “green pond”. 50° 54.285’ N 095° 20.399 W.
CMB6	Same location as CMB5, 1 metre depth.
CMB7	Surficial light red sediments just south of “green pond”. 50° 54.317’ N 095° 20.366’ W.
CMB8	Surficial light red sediments, west of “green pond”. 50° 54.323’ N 095° 20.391’ W
CMB9	Surficial light red sediments, just downstream of second discharge pipe (west of first discharge pipe). 50° 54.318’ N 095° 20.561’ W.
CMB10	Same approximate location as CMB3 (“gully 2”); gray-green (brochantite?) surficial sediments.
CMB11-20	Gangue rock samples from spoil piles.
CMB21-28	Copper green stained surface rocks; various locations in tailings area.
CMB29	Efluorescence off concrete wall of old mine building.

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20.14.1a.2. Central Manitoba samples collected June 14, 2013

Note: remediation of the site begun prior to site visit – ponds drained, partial filling of site with fill and topsoil; demolition of old mine workings begun.

CMB100	Surficial "brick" of sediments near old tailings pipe outlet.
CMB101	Surface crust (white precipitates) near old tailings pipe outlet.
CMB102	Dark massive quartz country rock with minor pyrite inclusions.
CMB103	Fine surficial dry dust from remediation access road on S side of site.
CMB104	White and dark massive quartz from waste rock pile (2 pieces).
CMB105	Schistose country rock with saccharine quartz vein.
CMB106	Surface sediments (red) near old tailings pipe outlet (on the "peninsula").
CMB107	Subsurface sediments (gray) distal from old tailings pipe outlet.

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20.14.2a. San Gold Mine, MB, Canada - Sample Descriptions

20.14.2a.1. San Gold Mine samples collected June 14, 2013-06-19

SAN001	Fresh fine-grained discharged mine tailings (2 bags).
SAN002	Country rock used to construct tailings pond wall (dacite?) (3 pieces).
SAN003	Quartz and quartz-veined country rock (dacite?) use to construct tailings pond wall (8 pieces).

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20.14c. Central Manitoba and San Gold Mines, MB, Canada - Sample Analyses

Wt. %	CMB9
SiO_2	86.56
TiO_2	0.26
Al_2O_3	3.14
FeO	1.25
Fe_2O_3	3.50
*(Fe_2O_3)**	*(4.89)*
MnO	0.02
MgO	1.10
CaO	2.01
Na_2O	0.62
K_2O	0.31
P_2O_5	0.02
SO_3	1.08
TOTAL	100.01
LOI	3.24
ppm	
Sr	21
Zr	30
V	66
Ni	35
Cr	95
Co	29
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.14d. Spectral Data - Central Manitoba and San Gold Mines, MB, Canada

Sample	*Facility/File No.*	*Description*
CMB1	PSF 080730a.010	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
CMB1	PSF 111201a.033	Unsorted powder; 0.35-2.5 μm; 30°/0°; 200 spectra averaged; ASD (directory 111201_optech).
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CMB2	PSF 080730a.011	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
CMB3	PSF 080730a.012	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
CMB4	PSF 080730a.013	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
CMB5	PSF 080730a.014	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
CMB6	PSF 080730a.015	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
CMB7	PSF 080730a.016	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
CMB8	PSF 080730a.017	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
CMB9	PSF 080730a.018	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.
++++++		
CMB10	PSF 080730a.019	unsorted powder; 0.35-2.5 μm, 30°/0°; 1000 spectra averaged; ASD.

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END of 20.14.

20. Analogue Sites

20.15. Iceland

20.15.1. Geysir - geyser deposits
20.15.2. Other localities (samples from Bjarni Gautason)
20.15.3. Hveragerdi - hot spring field
20.15.4. Dagmalafell (aka Midfell) - pillow lavas
20.15.5. Kvensodull - basaltic sand dunes
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20.15.1a. Sample Descriptions - Geysir, Iceland

20.15.1a.1. Samples collected by Melissa Rice (Cornell U), Aug. 23/08

Geysir-01	Brown-stained coarsely laminated sinter
Geysir-02	Buff-coloured sinter fragments
Geysir-03	Multi-hued fragmental sinter pieces
Geysir-04	Red-stained and buff coloured sediments (wet)
Geysir-05	Variously-coloured coarse sinter fragments
Geysir-06	Variously-coloured coarse sinter fragment
Geysir-07	Red-stained coarse sinter fragment

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20.15.1a.2. Samples collected by Ed Cloutis: August 29-31, 2009.

ICE001	Silicified leaf on red/white silica sinter; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE002	Sinter: abundant silicified plant fragments; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE003	Massive lithified sinter with some red staining; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE004	Massive lithified sinter with some red staining; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE005	Sinter: abundant silicified plant fragments; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE006	Sinter: some lithified layers; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE007	Sinter: abundant silicified plant fragments and some lithified layers and red staining; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE008	Sinter: abundant silicified plant fragments; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE009	Sinter: partially lithified, abundant red staining; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE010	Sinter: abundant silicified plant fragments, some red staining; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE011	Sinter: partially lithified, with basalt fragments?; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE012	Sinter: partly lithified and silicified plant fragments; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE013	Sinter: partly lithified and abundant silicified plant fragments; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE014	Sinter: abundant silicified plant fragments; dormant geyser mound ~100 m north of active field, Geysir, Iceland.
ICE015	Sinter: abundant silicified plant fragments; dormant geyser mound ~100 m north of active field, Geysir, Iceland.

ICE016 Sinter: abundant silicified plant fragments – white and gray; dormant geyser mound ~100 m north of active field; Geysir, Iceland.
ICE017 Sinter: abundant silicified plant fragments – while and light brown with some orange staining; dormant geyser mound ~100 m north of active field; Geysir, Iceland.

ICE120 Red oxidized basaltic cinders. Landscape fill at summer house: Haukadalur (100 m from Geysir), Iceland. (2 pieces).
ICE130 Partially bleached basaltic pebble: Landscape fill at summer house: Haukadalur (100 m from Geysir), Iceland. (2 pieces).
ICE131 Partially bleached basaltic pebble: Landscape fill at summer house: Haukadalur (100 m from Geysir), Iceland. (2 pieces).
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20.15.2a. Sample Descriptions - Various Localities - Samples from Bjarni Gautason (August 2009)

ICE101 Þelamork Eyjafjördur, Iceland. Opal (?); silica sinter on vegetation (white crust on beige groundmass). Hand sample plus powder in vial; site located near Akurayeri.
ICE102 Opal-CT; Reykjanes Gullbringusýsla, Iceland. NÍ610. (Massive, white, laminated, low density sample).
ICE103 Opal: Hveravellir Kjölur, Iceland. NÍ 14181. (Pure white fragments with beige coating).
ICE104 Smectite (?): Arnarnes Eyjafjördur, Iceland; submarine hydrothermal vent. (`Massive laminated beige low density, friable sample plus powder in vial).
ICE105 Opal: Sinter on surface (loose): Fremrinámur ketildyngja; NÍ 24322; N 65.42929° -16.63637° A. (Mostly white massive sinter).
ICE106 Opal-A white fibrous opal: Engidalur Krýsuvik Gullbringusýsla, Iceland. NÍ 1727. (White, fibrous, acicular, laminated sample).
ICE107 Opal (?), silica sinter (light coloured). Uxahver (UX-1) N-Iceland. (Beige powder in vial).
ICE108 Opal (?), silica sinter (dark coloured). Uxahver (UX-2) N-Iceland (Brown powder in vial).
ICE109 Opal-A: Hverin Eini, Reykjanes, Iceland (light colour under ML [ML stands for Medieval Layer – it refers to a tephra layer from an eruption believed to have occurred in 1226; this is a thick silica sinter and the tephra layer occurs within it, so this sample is from below the tephra layer]). Confirmed by XRD from Gautason – October 2009.
ICE110 Opal-A: Hverin Eini, Reykjanes, Iceland (darker sample above ML [ML stands for Medieval Layer – it refers to a tephra layer from an eruption believed to have occurred in 1226; this is a thick silica sinter and the tephra layer occurs within it, so this sample is from above the tephra layer]) Confirmed by XRD from Gautason – October 2009.
ICE111 Container labelled Selvallafjall. Unknown sample; may be one on Bjarni's list; i.e., "Opal (?) silica sinter (extinct) N 64° 19.178' WO 20° 17.581'. Beinhóll, Haukadalur S-Iceland". It is located on Reykjanes not far from the Hverinn eini site. XRD indicates that this sample is carbonate: Gautason – October 2009.
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Unnumbered 3 Container labelled Selvallafjall.

The two vials are Ast-1 from Arnarnes (or Arnarnesstrytur); this is the submarine hot spring that forms cones of smectite when hot water mixes with cold sea water. The other sample is from Thelamork an extinct hydrothermal hot spring site just outside Akureyri. I have bigger pieces of these two samples and on the latter one you can possibly see imprints of vegetation. An Excel sheet of sample descriptions is also available.
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20.15.3a. Sample Descriptions - Hveragerdi, Iceland

Collected by Ed Cloutis - August 30, 2009.

ICE132 Red/orange/yellow stained basalt: Hveragerdi, vents on east side of creek, N. of town on University campus.
ICE133 Red/orange laminated sinter on basalt: Hveragerdi, vents on east side of creek, N. of town on University campus.
ICE134 Multi-hued sinter on basalt: Hveragerdi, vents on east side of creek, N. of town on University campus.
ICE135 Yellow (sulphur)-coated sinter: Hveragerdi, vents on east side of creek, N. of town on University campus.

ICE136 Multi-hued sinter on basalt: Hveragerdi, vents on east side of creek, N. of town on University campus.
ICE137 Brown and white sinter on basalt: Hveragerdi, vents on east side of creek, N. of town on University campus.
ICE138 White and brown sinter on partially bleached basalt: Hveragerdi, vents on east side of creek, N. of town on University campus.
ICE139 White and yellow sinter on basalt: Hveragerdi, vents on east side of creek, N. of town on University campus. (2 pieces).
ICE140 Partially bleached basalt: Hveragerdi, vents on east side of creek, N. of town on University campus.
++++++
ICE150 Orange-yellow stained sinter: Hveragerdi geyser vents in town – adjacent to active vent.
ICE151 Red-black-brown stained sinter: Hveragerdi geyser vents in town – adjacent to active vent.
ICE152 Red-stained sinter: Hveragerdi geyser vents in town – adjacent to active vent.
ICE153 White sinter: Hveragerdi geyser vents in town – adjacent to active vent.
ICE154 Pink stained sinter: Hveragerdi geyser vents in town – adjacent to active vent.
ICE155 Orange-yellow stained sinter: Hveragerdi geyser vents in town – adjacent to active vent.
ICE156 Orange-brown stained sinter: Hveragerdi geyser vents in town – adjacent to active vent.
ICE157 Orange-yellow-red stained sinter: Hveragerdi geyser vents in town – adjacent to active vent.
+++++
ICE160 Brown-stained and partially bleached basalt: Hveragerdi geyser vents in town – adjacent to active vent.
ICE161 Partially-bleached basalt with some glassy coating: Hveragerdi geyser vents in town – adjacent to active vent.
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20.15.4a. Sample Descriptions - Pillow lavas from Dagmalafell (aka Midfell)

Collected by Ed Cloutis - August 31, 2009.

ICE170 Multiple samples, most with glassy rinds; some are samples of olivine-bearing basalt. Collected within and at base of quarry on east side of Dagmalafell (August 31, 2009).
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20.15.5a. Sample Descriptions - Kvensodull - Basaltic sand dunes

Black volcanic sand from the surface of a dune at Kvensodull, Iceland. Samples are taken at 100, 200, and 300 m along the profile across the dune. Samples sent from Birbeck College, UK for spectral analysis (for Briony Horgan?).

Birbeck Sample ID	*Description*
Kv100	100 metres along the profile across the dune.
Kv200	200 metres along the profile across the dune.
Kv300	300 metres along the profile across the dune.

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20.15b. XRD Data - Iceland

20.15b.2. Various localities

Analysis by David Bish - Indiana University

ICE102 Beautiful opal-CT, better ordered than many (from Dave Bish – December 2011).
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20.15c. Compositional Data - Iceland

20.15c.1. Geysir, Iceland samples - Sample analyses

Wt. %	Geysir-02	Geysir-04
SiO_2	97.72	82.54
TiO_2	0.06	2.34
Al_2O_3	0.99	12.25
*(Fe_2O_3)**	*(0.30)*	*(1.55)*
FeO		0.54
Fe_2O_3		0.95
MnO	0.008	0.018
MgO	0.17	0.36
CaO	0.53	0.30
Na_2O	0.27	0.32
K_2O	0.18	0.11
P_2O_5	0.02	0.03
SO_3	0.04	0.03
TOTAL	100.288	99.848
LOI	6.46	8.55
ppm		
Sr	46	37
Zr	19	128
V	33	131
Co	<1	5
Cr	<1	225
Cu	375	310
Ni	<1	<1
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.15c. Compositional Data - Iceland (continued)

20.15c.1. Geysir - Sample Analyses (ICE003)
20.15c.4. Dagmalafell (aka Midfell)

Wt. %	ICE003	ICE170
SiO_2	98.97	46.39
TiO_2	0.03	0.75
Al_2O_3	0.26	14.36
FeO	0.13	8.39
Fe_2O_3	-0.02	1.64
*(Fe_2O_3)**	*(0.12)*	*(10.96)*
MnO	0.00	0.17
MgO	0.03	12.97
CaO	0.17	13.39
Na_2O	0.06	1.35
K_2O	0.05	0.02
P_2O_5	0.01	0.03
SO_3	0.00	0.00
TOTAL	99.69	100.39
LOI	4.71	0.68
ppm		
Sr	8	113
Zr	17	26
V	6	259
Ni	<1	710
Cr	27	953
Co	15	73
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.15c. Compositional Data - Iceland (continued)

20.15c.2. Various localities

Wt. %	ICE102
SiO_2	99.30
TiO_2	0.01
Al_2O_3	0.07
*(Fe_2O_3)**	*(0.31)*
FeO	
Fe_2O_3	
MnO	0.003
MgO	0.06
CaO	0.08
Na_2O	0.07
K_2O	0.00
P_2O_5	0.01
TOTAL	99.913
LOI	5.82
ppm	
Sr	13
Zr	10
V	5
Co	<1
Cr	35
Ni	5
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.15c.1. Analytical data: Electron microprobe

20.15c.4.1. Dagmalafell (aka Midfell)

Phases analyzed by electron microprobe by M. Izawa (Feb. 2014):

ICE170: olivine, matrix, diopside, chromite.

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20.15d. Spectral Data - Iceland (alphabetical order)

Sample	*Facility/File No.*	*Description*
Geysir-01	PSF 080913a.025	whole rock, whiter area, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
Geysir-01	PSF080913a.026	whole rock, buff area, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
++++++		
Geysir-02	PSF080913a.027	whole rock, brightest white chip, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
Geysir-02	PSF 090121a.001	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
Geysir-02	PSF 090121a.002	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
++++++		
Geysir-03	PSF080913a.028	whole rock, biggest slab, smoother surface, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
Geysir-03	PSF080913a.029	whole rock, biggest slab, rough side, whiter area, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
++++++		
Geysir-04	PSF080913a.030	whole rock, cleanest, whitest clump, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
Geysir-04	PSF 090121a.003	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
Geysir-04	PSF 090121a.004	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output spectral sampling interval; 1000 spectra averaged, ASD instrument.
Geysir-04	PSF 111201a.041	<90 μm; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
Geysir-04	PSF 111201a.012	whole rock, i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
++++++		
Geysir-05	PSF080913a.031	whole rock, biggest whitest piece, rougher side, whitest spot, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
Geysir-05	PSF080913a.032	whole rock, biggest whitest piece, smoother side, whitest spot, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
++++++		
Geysir-06	PSF080913a.033	whole rock, concave (“mountain”) side, whiter slope, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
Geysir-06	PSF080913a.034	whole rock, convex (“valley”) side, whiter slope, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
++++++		
Geysir-07	PSF080913a.035	whole rock, whiter side, whiter spot, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
Geysir-07	PSF080913a.036	whole rock, red side, redder spot, i=0°, e=0° (bifurcated cable), 0.35-2.5 μm, 1 nm output sampling interval, 500 spectra averaged, ASD.
++++++		
ICE102	PSF 100522a.003	whole rock; i=30,e=0; 0.35-2.5 μm; 1 nm output, 1000 spectra averaged, ASD [Directory: 100522a.003].
ICE102	PSF 091203a.001	<45 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203ICE].
ICE102	PSF 091211a.001	<45 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091211ICE; reshoot].
ICE102	PSF 091203a.002	45-90 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged,

		ASD [Directory 091203ICE].
ICE102	PSF 091211a.002	45-90 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091211ICE; reshoot].
ICE102	PSF 091203a.003	90-1000 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091203ICE].
ICE102	PSF 091211a.003	90-1000 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091211ICE; reshoot].
ICE102	PSF 091211a.004	90-1000 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091211ICE; reshoot].
ICE102	PSF 091211a.005	90-1000 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091211ICE; reshoot].
ICE102	PSF 091211a.006	90-1000 μm dry sieved; i=30,e=0; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD [Directory 091211ICE; reshoot].
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ICE130	PSF 101201a.001	whole rock surface – gray spot on exposed surface – spot indicated by red marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
ICE130	PSF 101201a.002	whole rock surface – gray spot on exposed surface – spot indicated by green marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
++++++		
ICE134	PSF 101201a.003	whole rock surface – light beige spot on exposed surface – spot indicated by blue marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
ICE134	PSF 101201a.004	whole rock surface – light beige spot on exposed surface – spot indicated by yellow marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
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ICE140	PSF 101201a.005	whole rock surface – light brown spot on exposed surface – spot indicated by green marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
ICE140	PSF 101201a.006	whole rock surface – light brown spot on exposed surface – spot indicated by blue marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
ICE140	PSF 101201a.007	whole rock surface – light brown spot on exposed surface – spot indicated by red marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
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ICE160	PSF 101201a.010	whole rock surface – gray/white surface – spot indicated by blue marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
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ICE161	PSF 101201a.011	whole rock surface – light gray spot on exposed surface – spot indicated by green marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
ICE161	PSF 101201a.012	whole rock surface – light gray spot on exposed surface – spot indicated by red marker on sample; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
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ICE170a	PSF 090929b.001	<45 μm – glassy exterior crust; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD.
ICE170a	PSF 090929b.002	45-90 μm – glassy exterior crust; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD.
ICE170b	PSF 090929b.003	<45 μm – crystalline interior; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 100 spectra averaged, ASD.
ICE170b	PSF 090929b.004	45-90 μm – crystalline interior; i=30°/e=0°; 0.35-2.5 μm; 1 nm output, 100

spectra averaged, ASD.

ICE170	PSF 111201a.040	<45 μm; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
ICE170	PSF 111201a.010	whole rock, i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
ICE170	INO ICE170	whole rock; i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
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KV100	PSF 100801a.001	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD. [directory: 100801_brionysamples].
KV100	PSF 100801a.004	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD. [directory: 100801_brionysamples].
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KV200	PSF 100801a.002	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD. [directory: 100801_brionysamples].
KV200	PSF 100801a.005	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD. [directory: 100801_brionysamples].
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KV300	PSF 100801a.003	<45 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD. [directory: 100801_brionysamples].
KV300	PSF 100801a.006	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD. [directory: 100801_brionysamples].

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END of 20.15.

20. Analogue Sites

20.16. Navajo Sandstone iron concretions

20.16a. Sample Descriptions - Navajo Sandstone iron concretions

Sample ID	*Description*
NAV001	"Moqui marble" – ironstone concretion – base of Navajo Sandstone formation, Utah, USA (from Discovery Gemstones Ltd. – Edmonton, AB, Canada; July 2009).

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END of 20.16.

20. Analogue Sites

20.17. Greece

20.17.1. Methana Peninsula
20.17.2. Kiato Beach
20.17.3. Santorini
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20.17a. Sample Descriptions – Greece

Sample ID	*Description*

20.17.1a. Sample Descriptions - Methana Peninsula (August 2009)

GRC001	Dacite-rhyodacite, Methana town square monument site.
GRC002	Dacite-rhyodacite, lightly altered; Methana town square monument site.
GRC003	Dacite-rhyodacite: leached with silica sinter on one side: Thiafi Bay beach, north end.
GRC004	Dacite-rhyodacite: partially leached and altered: Thiafi Bay beach, north end.
GRC005	Dacite-rhyodacite: sulphur-stained (?) yellowish altered sample: Thiafi Bay beach, north end.
GRC006	Dacite-rhyodacite: heavily leached: Thiafi Bay beach, north end.
GRC007	Dacite-rhyodacite: darker (gray-black) (altered?) sample: Thiafi Bay beach, north end.
GRC008	Dacite-rhyodacite: leached with sulphur deposits: Thiafi Bay beach, north end.
GRC009	Dacite-rhyodacite: pervasively leached: Thiafi Bay beach, north end.
GRC010	Dacite-rhyodacite: bleached with silica sinter on one side: Thiafi Bay beach, north end.
GRC011	Dacite-rhyodacite: pervasively bleached and etched surface with silica sinter?: Thiafi Bay beach, north end.
GRC012	Dacite-rhyodacite: lightly (red-brown) altered sample: Thiafi Bay beach, north end.
GRC013	Dacite-rhyodacite: pervasively bleached and friable: Thiafi Bay beach, north end.
GRC014	Dacite-rhyodacite: pervasively bleached and friable, with sulphur staining (?): Thiafi Bay beach, north end.
GRC015	Dacite-rhyodacite: miscellaneous pieces of friable samples, unsorted: Thiafi Bay beach, north end.
GRC016	Dacite-rhyodacite: bleached: Thiafi Bay beach, north end.

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20.17.2a. Sample Descriptions - Kiato Beach (August 2009)

GRC100	Pumice balls, collected on Kiato beach, Greece (August 2009).

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20.17.3a. Sample Descriptions - Santorini (August 2011)

GRC100	Poorly consolidated ash. Road cut along road from Kamari Beach to Pyrgos, Santorini, Greece (collected August, 2011).
GRC101	Thermally welded (and altered) basaltic (?) flows and pumice: Red Beach, Santorini, Greece (collected August 2011).
GRC102	Poorly consolidated ash. Road cut along road from Kamari Beach to Pyrgos, Santorini, Greece (collected August, 2011).
GRC103-105	Basalt pebbles, Kamari Beach, Santorini, Greece (collected August 2011).

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20.17c. Compositional Data - Greece samples

20.17c.1. Methana Peninsula samples - Sample Analyses

Wt.%	GRC007
SiO_2	63.05
TiO_2	0.50
Al_2O_3	17.14
FeO	3.43
Fe_2O_3	1.24
*(Fe_2O_3)**	*(5.05)*
MnO	0.14
MgO	2.79
CaO	6.27
Na_2O	3.33
K_2O	1.94
P_2O_5	0.11
SO_3	0.05
TOTAL	100.37
LOI	1.67
ppm	
Sr	332
Zr	178
V	149
Ni	20
Cr	64
Co	<1
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.17d. Spectral Data - Greece samples

(a) ASD reflectance data: 0.35-2.5 μm

Sample	*Facility/File No.*	*Description*
GRC004a	PSF 100517a.001	Light granite-looking exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
GRC004b	PSF 100517a.002	Tan solid exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
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GRC005a	PSF 100517a.003	Tan yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
GRC005b	PSF 100517a.004	White spots exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
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GRC006	PSF 100517a.005	White crumbly exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
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GRC008a	PSF 100517a.006	White bleached exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
GRC008b	PSF 100517b.001	Darker exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
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GRC011a	PSF 100517b.002	Smooth spot on sexterior urface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
GRC011b	PSF 100517b.003	Rough exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
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GRC012	PSF 100517b.004	Tan/dark vesicular exterior surface; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (directory: 100430_surface).
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GRC001	PSF 130301a.001	Exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC002	PSF 130301a.002	Exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC002_zeo	PSF 130301a.003	Zeolites on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC003_y	PSF 130301a.004	Yellow leached exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC003_w	PSF 130301a.005	White exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC004_p	PSF 130301a.006	Pink exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC004_b	PSF 130301a.007	Brown exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC004_w	PSF 130301a.008	White exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC005_g	PSF 130301a.009	Gray exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC005_gy	PSF 130301a.010	Gray-yellow exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC005_y	PSF 130301a.011	Yellow exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC006_w	PSF 130301a.012	White bleached exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).

GRC006_pb	PSF 130301a.013	Pink-brown unaltered interior (?) general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC007_l	PSF 130301a.014	Light exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC007_d	PSF 130301a.015	Dark exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC008_w	PSF 130301a.016	White bleached exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC008_y	PSF 130301a.017	Yellow unaltered interior (?) general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC009	PSF 130301a.018	Exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC010_d	PSF 130301a.019	Dark exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC010	PSF 130301a.020	White altered exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC011_d	PSF 130301a.021	Dark grey inner interior (?) general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC011_y	PSF 130301a.022	Yellow exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC012	PSF 130301a.023	Exterior general surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130301_tori).
GRC001_p	PSF 130304a.001	Pink spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC001_bl	PSF 130304a.002	Black spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC001_w	PSF 130304a.003	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC002_w	PSF 130304a.004	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC002_p	PSF 130304a.005	Pink spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC003_y	PSF 130304a.006	Yellow spot on leached exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC003_w	PSF 130304a.007	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC004_p	PSF 130304a.008	Pink spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC004_b	PSF 130304a.009	Brown spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC004_w	PSF 130304a.010	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC005_g	PSF 130304a.011	Gray spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC005_yg	PSF 130304a.012	Yellow-gray spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC005_yw	PSF 130304a.013	Yellow-white spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC006_b	PSF 130304a.014	Brown spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC006_w	PSF 130304a.015	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC007_bl	PSF 130304a.016	Black spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC007_w_incl	PSF 130304a.017	White inclusions spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).

GRC007_b	PSF 130304a.018	Brown spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC008_y	PSF 130304a.019	Yellow spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC008_b_spots	PSF 130304a.020	Brown spots on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC008_w	PSF 130304a.021	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC008_g	PSF 130304a.022	Gray spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC009_w	PSF 130304a.025	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC010_yw	PSF 130304a.026	Yellow-white spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC010_w	PSF 130304a.027	White spot on altered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC010_g	PSF 130304a.028	Gray spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC011_y	PSF 130304a.029	Yellow spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC011_w	PSF 130304a.030	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC011_g	PSF 130304a.031	Gray spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC012_p	PSF 130304a.032	Pink spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC012_bl	PSF 130304a.033	Black spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC013_b_spots	PSF 130304a.034	Brown spots on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC013_w	PSF 130304a.035	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC014_y	PSF 130304a.036	Yellow spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC014_dy	PSF 130304a.037	Dark yellow spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC014_w	PSF 130304a.038	White spot on alterted exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC015_y1	PSF 130304a.039	Yellow 1 spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC015_y2	PSF 130304a.040	Yellow 2 spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC015_w	PSF 130304a.041	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC015_g	PSF 130304a.043	Gray spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC016_d	PSF 130304a.044	Dark spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC016_med	PSF 130304a.045	Medium-toned spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC016_w	PSF 130304a.046	White spot on exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130304_tori).
GRC002 45-850	PSF 130418a.001	45-850 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC002 <45	PSF 130418a.002	<45 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).

GRC013 45-850	PSF 130418a.003	45-850 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC013 <45	PSF 130418a.004	<45 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC014a 45-850	PSF 130418a.005	45-850 μm powder of altered yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC014a <45	PSF 130418a.006	<45 μm powder of altered yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC014b 45-850	PSF 130418a.007	45-850 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC014b <45	PSF 130418a.008	<45 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC014c 45-850	PSF 130418a.009	45-850 μm powder of altered whitish outer exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC014c <45	PSF 130418a.010	<45 μm powder of altered whitish outer exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC003a 45-850	PSF 130418a.011	45-850 μm powder of yellow leached exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC003a <45	PSF 130418a.012	<45 μm powder of yellow leached exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC003b 45-850	PSF 130418a.013	45-850 μm powder of outer white exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC003b <45	PSF 130418a.014	<45 μm powder of outer white exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC005a 45-850	PSF 130418a.015	45-850 μm powder of yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC005a <45	PSF 130418a.016	<45 μm powder of yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC005b 45-850	PSF 130418a.017	45-850 μm powder of gray-yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC005b <45	PSF 130418a.018	<45 μm powder of gray-yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC006a 45-850	PSF 130418a.019	45-850 μm powder of outer bleached exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC006a <45	PSF 130418a.020	<45 μm powder of outer bleached exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC006b 45-850	PSF 130418a.021	45-850 μm powder of interior (?) surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC006b <45	PSF 130418a.022	<45 μm powder of interior (?) surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC008a 45-850	PSF 130418a.023	45-850 μm powder of bleached outer exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC008a <45	PSF 130418a.024	<45 μm powder of bleached outer exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC008b 45-850	PSF 130418a.025	45-850 μm powder of unaltered interior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130418_methana).
GRC008b <45	PSF 130426a.017	<45 μm powder of unaltered interior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC001 45-850	PSF 130426a.020	45-850 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC001 <45	PSF 130426a.021	<45 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC004b 45-850	PSF 130426a.026	45-850 μm powder of unaltered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC004b <45	PSF 130426a.027	<45 μm powder of unaltered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).

GRC004a 45-850	PSF 130426a.028	45-850 μm powder of altered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC004a <45	PSF 130426a.029	<45 μm powder of altered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC007b 45-850	PSF 130426a.030	45-850 μm powder of white exterior surface (iunclusions); i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC007b <45	PSF 130426a.031	<45 μm powder of shite exterior surface (inclusions); i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC007a 45-850	PSF 130426a.032	45-850 μm powder of brown exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC007a <45	PSF 130426a.033	<45 μm powder of brown exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC007c <45	PSF 130426a.034	45-850 μm powder of black exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC009a 45-850	PSF 130426a.005	45-850 μm powder of bleached outside exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC009a <45	PSF 130426a.006	<45 μm powder of bleached outside exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC009b 45-850	PSF 130426a.007	45-850 μm powder of interior (?) surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC009b <45	PSF 130426a.008	<45 μm powder of interior (?) surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC010a 45-850	PSF 130426a.011	45-850 μm powder of white altered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC010a <45	PSF 130426a.012	<45 μm powder of white altered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC010b 45-850	PSF 130426a.013	45-850 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC010b <45	PSF 130426a.014	<45 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC011a 45-850	PSF 130426a.001	45-850 μm powder of yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC011a <45	PSF 130426a.002	<45 μm powder of yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC011b 45-850	PSF 130426a.003	45-850 μm powder of gray interior (?) surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC011b <45	PSF 130426a.004	<45 μm powder of gray interior (?) surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC012a 45-850	PSF 130426a.022	45-850 μm powder of altered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC012a <45	PSF 130426a.023	<45 μm powder of altered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC012b 45-850	PSF 130426a.024	45-850 μm powder of unaltered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC012b <45	PSF 130426a.025	<45 μm powder of unaltered exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC015b 45-850	PSF 130426a.015	45-850 μm powder of yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC015b <45	PSF 130426a.016	<45 μm powder of yellow exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC015a 45-850	PSF 130426a.018	45-850 μm powder of white exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC015a <45	PSF 130426a.019	<45 μm powder of white exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).
GRC016 45-850	PSF 130426a.009	45-850 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250

spectra averaged; ASD (directory: 130426_torimethana).

GRC016 <45 PSF 130426a.010 <45 μm powder of exterior surface; i=30°, e=0°; 0.35-2.5 μm; 250 spectra averaged; ASD (directory: 130426_torimethana).

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(b) Bruker Vertex 70 FTIR reflectance data: 10,000 – 400 cm^{-1} (1-25 μm)

GRC005a <45 PSF AA_1 <45 μm powder of yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC005b 45-850 PSF AA_2 45-850 μm powder of gray-yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC005b <45 PSF AA_3 <45 μm powder of gray-yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC006a 45-850 PSF AA_4 45-850 μm powder of outer bleached exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC006a <45 PSF AA_5 <45 μm powder of outer bleached exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC006b 45-850 PSF AB_1 45-850 μm powder of interior (?) surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC006b <45 PSF AB_2 <45 μm powder of interior (?) surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC008a 45-850 PSF AB_4 45-850 μm powder of bleached outer exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC008a <45 PSF AB_4 <45 μm powder of bleached outer exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC008b 45-850 PSF AA_5 45-850 μm powder of bleached outer exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC003a 45-850 PSF AE_1 45-850 μm powder of outer yellow leached exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC003a <45 PSF AE_2 <45 μm powder of outer yellow leached exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC003b 45-850 PSF AE_3 45-850 μm powder of outer white exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC003b <45 PSF AE_4 <45 μm powder of outer white exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC005a 45-850 PSF AE_5 45-850 μm powder of yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC002 45-850 PSF A_1 45-850 μm powder of exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC002 <45 PSF A_2 <45 μm powder of exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).

GRC013 45-850 PSF A_3 45-850 μm powder of exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra

			averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).
GRC013 <45	PSF	A_4	<45 μm powder of exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).
GRC014a 45-850	PSF	S_1	45-850 μm powder of altered yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).
GRC014a <45	PSF	S_2	<45 μm powder of altered yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).
GRC014b 45-850	PSF	S_3	45-850 μm powder of whole rock exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).
GRC014b <45	PSF	S_4	<45 μm powder of whole rock exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).
GRC014c 45-850	PSF	S_5	45-850 μm powder of altered outer whitish exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).
GRC014c <45	PSF	S_6	<45 μm powder of altered outer whitish exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR1.xls).
GRC003a 45-850	PSF	AE_1	45-850 μm powder of outer yellow leached exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC003a <45	PSF	AE_2	<45 μm powder of outer yellow leached exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC003b 45-850	PSF	AE_3	45-850 μm powder of outer white exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC003b <45	PSF	AE_4	<45 μm powder of outer white exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC005a <45	PSF	AE_5	<45 μm powder of yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC005a 45-850	PSF	AE_5	45-850 μm powder of yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC009a 45-850	PSF	Q_1	45-850 μm powder of outer bleached exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC009a <45	PSF	Q_2	<45 μm powder of outer bleached exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC009b 45-850	PSF	Q_3	45-850 μm powder of interior (?) surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC009b <45	PSF	Q_4	<45 μm powder of interior (?) surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC016 45-850	PSF	Q_5	45-850 μm powder of exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC016 <45	PSF	Q_6	<45 μm powder of exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR2.xls).
GRC007b 45-850	PSF	A2_1	45-850 μm powder of white exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory:

			FTIR3.xls).
GRC007b	<45	PSF A2_2	<45 μm powder of white exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC007a	<45	PSF A2_3	<45 μm powder of brown exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC007c	<45	PSF A2_4	<45 μm powder of black exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC004b	<45	PSF AA2_1	<45 μm powder of unaltered exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC004a	45-850	PSF AA2_2	45-850 μm powder of altered exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC004a	<45	PSF AA2_3	<45 μm powder of altered exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC007c	45-850	PSF AA2_4	45-850 μm powder of black exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC008b	<45	PSF AB2_1	<45 μm powder of unaltered interior (?) surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC015a	45-850	PSF AB2_2	45-850 μm powder of white exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC015a	<45	PSF AB2_3	<45 μm powder of white exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC001	45-850	PSF AB2_4	45-850 μm powder of exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC001	<45	PSF AB2_5	<45 μm powder of exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC010a	45-850	PSF AG_1	45-850 μm powder of white altered exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC010a	<45	PSF AG_2	<45 μm powder of white altered exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC010b	45-850	PSF AG_3	45-850 μm powder of base rock exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC010b	<45	PSF AG_4	<45 μm powder of base rock exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC015b	45-850	PSF AG_5	45-850 μm powder of yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC015b	<45	PSF AG_6	<45 μm powder of yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).
GRC011a	45-850	PSF R_1	45-850 μm powder of outside yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).

GRC011a <45 PSF R_2 <45 μm powder of outside yellow exterior surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).

GRC011b 45-850 PSF R_3 45-850 μm powder of gray interior (?) surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).

GRC011b <45 PSF R_4 <45 μm powder of gray interior (?) surface; i=30°, e=0°; 1-25 μm; 1500 spectra averaged; 2 cm^{-1} resolution. Bruker Vertex 70 (directory: FTIR3.xls).

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20.17.d.1. Greece samples - Thermal Emission Spectra

Thermal emission spectra (80°C; 200 – 4000 cm^{-1}, 2 cm^{-1} spectral resolution) and interpretation - Josh Bandfield – June 2013and September 2013

Sample	*Grain size*	*Interpretation*
GRC001	(45-1000 μm)	Appears more like volcanic glass than the other samples.
++++++		
GRC002	(<45 μm)	Plagioclase transparency feature appears to be present. Spectrum is typical of fine particulate silicates but is different from STM001 and STM003.
GRC002a	(45-1000 μm)	Mostly silica
++++++		
GRC003a	(45-1000 μm)	Mostly silica
GRC003b	(45-1000 μm)	Mostly silica
++++++		
GRC004a	(45-1000 μm)	Mostly silica.
GRC004a	(<45 μm)	Fine particulate silicates (plag feature appears to be present).
++++++		
GRC005a	(45-1000 μm)	Mostly silica
GRC005b	(45-1000 μm)	Mostly silica
++++++		
GRC006a	(45-1000 μm)	Mostly silica
GRC006b	(45-1000 μm)	Mostly silica
++++++		
GRC008a	(45-1000 μm)	Amorphous component is present (spectrum seems questionable).
GRC008b	(45-1000 μm)	Mostly silica
++++++		
GRC009a	(45-1000 μm)	This has a significant crystalline component (plag, px, etc.) and to first order looks like unweathered intermediate volcanics.
GRC009b	(45-1000 μm)	Mostly silica.
GRC009b	(<45 μm)	Mostly silica.
++++++		
GRC010a	(<45 μm)	Fine particulate silicates (difficult to interpret spectral features).
GRC010b	(45-1000 μm)	Mostly silica.
GRC010b	(<45 μm)	Fine particulate silicates (silica feature is present).
++++++		
GRC011a	(45-1000 μm)	Not sure what this is, appears amorphous
GRC011a	(<45 μm)	Probably mostly silica (low quality spectrum).
GRC011b	(45-1000 μm)	Mostly silica
++++++		
GRC013	(45-1000 μm)	This appears to be more like volcanic glass than other samples maybe with a crystalline component
++++++		
GRC014a	(<45 μm)	Appears to be mostly crystalline intermediate volcanics.
GRC014b	(<45 μm)	Appears to be mostly crystalline intermediate volcanics (perhaps higher amorphous

silica content).

++++++

GRC015a	(45-1000 μm)	Seems to have a significant component (but no quartz)

++++++

GRC016	(45-1000 μm)	Carbonate (dominated by fine particulates, Mg.Ca?).
GRC016	(<45 μm)	Mostly fine particulate carbonate.

++

END of 20.17.

20. Analogue Sites

20.18. Serpentinites – QC, Canada

20.18.1. Thetford Mines area
20.18.2. Jeffrey Mine Area, Asbestos, QC, Canada
20.18.3. Norbestos Mine, QC, Canada
20.18.4. Local Geology Sites, Asbestos - Thetford Mines Area, QC, Canada
++++++++++++++++++++++++++++++++++
The Jeffrey and Norbestos Mines were used for CSA rover field trials in 2011 and 2012.
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20.18a. Sample Descriptions – Serpentinites – QC, Canada

Sample ID *Description*

20.18.1a. Sample Descriptions - Thetford Mines Area, QC, Canada

(i) Samples received from Michel Lamothe (January 2010).

ASB001	Serpentinized harzburgite (ultramafic) from Ordovician ophiolite of southern Quebec (La Brompton and Thedford Mines area).
ASB002	Carbonate-bearing serpentinized ultramafic from Ordovician ophiolite of southern Quebec (La Brompton and Thetford Mines area).

Note from Michel Lamothe: "Lavoie and Cousineau (1995) J of Sed Res have confirmed that these alterations are from salty (marine?) waters. Alain (Tremblay) and his PhD student Stephane de Souza will be happy to give you more information."

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20.18.2a. Sample Descriptions - Jeffrey Mine Area, Asbestos, QC, Canada

ASB1xx series: road barricade of waste rock: road just south of main mine entrance in Asbestos, PQ (June 2, 2010).

ASB100-102	3 pebbles of serpentinite.
ASB103	Blue- sheened rock; probably from this locality
ASB104	Massive fibrous antigorite (?); maybe from this locality

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ASB2xx series: spoil piles on N. side of road between spoil piles N. of open pit mine in Asbestos (June 2, 2010).

ASB200	Fibrous chrysotile - 2 pieces
ASB201	Serpentine cobble with possible magnesium carbonate coating.
ASB202	Surface weathered sediment deposits at north spoil piles.
ASB203	Massive serpentinite cobble.
ASB204	Phlogopite-bearing (rodingite?) cobble.
ASB205	Rhodochrosite (?) + serpentinite cobble.
ASB206	Possible Mg-carbonate deposit on boulder.
ASB207	Red-orange weathered surface (pyroaurite/oxalate?) on serpentinite cobble.
ASB208	Magnesite (?) + serpentinite cobble.
ASB209	Massive albite/magnesium carbonate (?) cobble.

ASB210	Serpentinite pebble.
ASB211	Serpentinite + Mg-carbonate (?) cobble.
ASB212	Serpentinite cobble.
ASB213	Serpentinite cobble with chrysotile veins.
ASB214	Serpentinite cobble with buff-coloured weathered surface (may not be from this locality - loose in duffle bag).
ASB215	Albite (?) cobble.
ASB216	Serpentinite cobble with chrysotile veins.
ASB217	Serpentinite cobble with red-brown weathering.
ASB218	Serpentinite cobble with phlogopite? grains.
ASB219-225	Various serpentinite nodules with chrysotile veins.
ASB226	Albite (?) crystal with serpentinite vein.
ASB227	Serpentinite-rich "muck" surficial alluvial deposit.
ASB228	Serpentinite tabular/acicular crystal mass.
ASB229	Serpentinite cobble with brown weathering/alteration deposits
ASB230	Various pebbles of serpentinite with possible Mg-carbonates.
ASB231	Serpentinite + quartz (?) vein.

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ASB250 and higher series: spoil piles on N. side of road north of Jeffrey Mine in Asbestos (Sept. 15, 2013).

ASB250	White fibrous delaminated material weathered from serpentinite boulder (many fragments).
ASB251	Weathered light-coloured asbestos vein-bearing serpentinite (1 large and many small pieces).
ASB252	Weathered, lighter-coloured delaminated fibrous serpentinite (many loose fragments).
ASB253	Partially weathered pyroxenite (?) cobble.
ASB254	Light-coloured and green weathered fibrous serpentinite (1 cobble and fragments).
ASB255	Light green weathered serpentinite with minor asbestos veins and white-coloured weathered surfaces (1 cobble).
ASB256	Light green and brown interior weathered serpentinite cobble.
ASB257	Massive dark green serpentinite with one face of light green tabular serpentine, one face with light grey thin weathering products (1 cobble).
ASB258	Very dark green-black serpentinite with glassy and matte faces and minor white weathering products on one face (possible Ceres, Bennu analogue) (1 cobble) (see also ASB265, 267, 268, 269).
ASB259	Dark and light green massive serpentinite with light green veins (1 broken cobble and a few fragments).
ASB260	Light and dark green-black serpentine with glassy, striated faces and light green striated, tabular light green vein faces (1 broken cobble).
ASB261	Three fragments of larger boulder: Dark green serpentinite with numerous asbestos veins, minor powdery white weathering products on some faces and some red-brown weathered faces.
ASB262	Three fragments of larger boulder: Massive dark green- grey/black serpentinite cobble with light green weathered face altered to ~2 mm depth.
ASB263	Fretwork texture serpentinite: dark green veins with orange-red clasts.
ASB264	Fretwork texture serpentine: orange and light green veins enclosing dark green serpentine clasts (1 pebble).
ASB265	Dark green-black serpentinite cobble with minor veining (possible Ceres, Bennu analogue); see also ASB258, 267, 268, 269).
ASB266	Mottled light green and dark green-black weathered serpentinite; variable thickness of weathered rind; grey to black interior. One broken face has mostly complete white "reaction front" between light green exterior and dark gray interior.
ASB267	Dark green-black massive serpentinite; matte and slickensided surfaces (possible Ceres, Bennu analogue); 1 broken cobble. See also ASB258, 265, 268, 269.
ASB268	Dark green-grey-black massive serpentinite; with glassy and matte surfaces and small light green "clasts". Possible Ceres, Bennu analogue. See also ASB258, 265, 267, 269.
ASB269	Dark green-grey-black massive serpentinite with glassy and matte surfaces and small light green "clasts". Possible Ceres, Bennu analogue. See also ASB258, 265, 267, 268.
ASB270	Dark gray schist (1 cobble).

ASB271	Black-white mottled quartz+mica+?-bearing rock; weak foliation and minor quartz veining (1 cobble).
ASB272	Foliated quartz+mica+? Rock with a few minor serpentinite veins (1 cobble).
ASB273	Massive quartz+mica+? Rock with buried in soil endolith ring (1 cobble).
ASB274	White, mottled black/white, and pink syenite? (alkali feldspar + mica at least?) (1 cobble).
ASB275	Syenite (? – pink areas); green areas – altered serpentinite/pyroxenite probably. 1 large cobble.
ASB276	Albitite (?): while albite-rich rock with soil line green endolith ring, and minor mica-bearing green serpentinite (?) (1 cobble).
ASB277	Syenite (?): while with minor pale green mineral (microcline?).
ASB278	Quartz cobble with veins/stringers of brown material and green material (altered pyroxenite?). 1 larger cobble.
ASB279	Albitite + quartz + syenite (?) cobble (large enclaves of each). 1 large cobble.

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20.18.3a. Sample descriptions - Norbestos Mine, QC, Canada

20.18.3a.1. Norbestos Mine - June 2, 2010 site visit

ASB3xx: Norbestos Mine (abandoned), east of Asbestos, QC (June 2, 2010)

GPS coordinates: UTM19 279481 E 5077808 N (la petite mine Norbestos)

ASB300	Loose sediments in alluvial fan, base of tailings pile.
ASB301-302	Two pieces of serpentinite covered with white precipitate (Mg-carbonate?) from tailings pile.
ASB303	Variously altered serpentinite, with black, brown, beige precipitates; black may be tochilinite?
ASB304	Serpentinite covered with white precipitate (Mg-carbonate?) from tailings pile.
ASB305	Serpentinite covered with white precipitate (Mg-carbonate?) from tailings pile.
ASB306	Serpentinite covered with white precipitate (Mg-carbonate?) and black adhering fragments (tochilinite?) from tailings pile.
ASB307	Serpentinite with chrysotile vein and black adhering rock (tochilinite?), from tailings pile.

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30.18.3a.2. Samples collected May 2, 2012 during rover deployment site reconnaissance

ASB310	Magnesite-coated serpentinite.
ASB311	Magnesite-coated serpentinite.
ASB312	Magnesite-coated serpentinite; heavily veined.
ASB313	Magnesite-coated serpentinite
ASB314	Magnesite-coated serpentinite
ASB315	Magnesite-coated serpentinite
ASB316	Magnesite-coated serpentinite
ASB317	Magnesite-coated serpentinite
ASB320	Asbestos-veined serpentinite
ASB321	Black and green, veined, partly altered, slickensided serpentinite.
ASB322	Heavily iron-stained serpentinite
ASB323	Serpentinite boulder – multi-coloured
ASB324	Massive acicular serpentinite.
ASB325	Massive, acicular serpentinite.
ASB326	Massive, acicular serpentinite.
ASB327	Massive, acicular serpentinite.
ASB328	Massive, acicular serpentinite.
ASB329	Two-tone serpentinite pebble.
ASB330	Partially-weathered serpentinite boulder
ASB331	Quartz pebble with minor serpentinite.
ASB332	Massive serpentinite boulder, some weathering, veining, fracture fill.

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20.18.3a.3. Jeffrey Mine, Asbestos, QC rover trials – June 2011

Note: ASD and Raman spectra acquired of rocks collected at rover sampling points – rock samples stored at UWinnipeg.

Day 1: 10 sample collected (?), 11 Raman spectra acquired of the samples in the field; 10 ASD spectra collected of whole rocks and <45 μm powder.

Day 1 rover traverse sampling sites:

Site 1	0 metres from starting point
Site 2	5 metres from starting point
Site 3	10 metres from starting point
Site 4	15 metres from starting point
Site 5	20 metres from starting point
Site 6	25 metres from starting point
Site 7	30 metres from starting point
Site 8	35 metres from starting point
Site 9	40 metres from starting point
Site 10	45 metres from starting point

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Day 2: 8 samples collected; 8 Raman spectra acquired of the samples in the field.

Day 2 rover traverse sampling sites:

Site 1	0 metres from starting point
Site 2	1 metres from starting point
Site 3	2 metres from starting point
Site 4	0 metres from starting point – station 2
Site 5	1 metres from starting point – station 2
Site 6	2 metres from starting point – station 2
Site 7	3 metres from starting point – station 2
Site 8	4 metres from starting point – station 2

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Day 3: 10 samples collected; 10 Raman spectra acquired of the samples in the field.

Day 3 rover traverse sampling sites:

Site 1	0 metres from starting point
Site 2	1 metres from starting point
Site 3	2 metres from starting point
Site 4	3 metres from starting point
Site 5	4 metres from starting point
Site 6	5 metres from starting point
Site 7	6 metres from starting point
Site 8	7 metres from starting point
Site 9	8 metres from starting point

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20.18.3a.4. Samples from Jennifer Ronholm (McGill – October 2013).

Endolith 1	Small chip with green endolith layer – possibly quartz syenite.
Endolith 2	2 fragments, one white, one white adjoining serpentinite; possibly quartz syenite. Both contain green endolith layer.
Endolith 4	1 piece quartz syenite (?) with discontinuous green endolith layer.
Endolith 5	1 piece, white with orange discontinuous endolith layer. Possibly quartz

	syenite?
Woolite Sample 3	Light green serpentinite, tabular fragments (antigorite?).
Colonized Little Rocks Sample 1	Small syenite (?) + serpentinite fragments with occasional green endolithic patches.
Microbial Mat Biomineralization Sample 5	Wet brown algal mat (?), with hard mineral precipitate on top.
Iron Precipitate Sample 2	Brown wet clump with vegetative fragments.
W endoliths	Three sandstones fragments plus abraded-off powders from University Valley, Antarctica (collected by Jackie Goordial). Orange-red exterior surfaces with black endolith bands ~2 mm wide and 2 mm from exterior faces, separating lighter-coloured (buff) interior. The bands are due to melanized fungi rather than cyanobacteria.

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20.18.4a. Sample Descriptions - Local Geology Sites, Asbestos - Thetford Mines Area, QC, Canada

ASB4xx series: Colline Belmina, west of Colleraine (June 3, 2010)

GPS coordinates: UTM19308779 E 5093160 N (Belmina (serpentinite near Alpha Base))

ASB400	Massive dunite (weathered serpentinized), cobble.

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ASB5xx series: Harzburgite exposure behind house on Vimy Ridge (June 3, 2010)

ASB500-510	Various fragments from harzburgite outcrop.
ASB511-513	Harzburgite pieces

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ASB6xx series: Normandie Mine tailings pile just north of Vimy Ridge (June 3, 2010).

GPS coordinates: UTM19 313290 E 5099666 N (Mine Normandie (tailing near road))

ASB600	Tailings pile muck - surficial alluvial deposit.
ASB601	Serpentinite boulder with chrysotile veins and orange weathering/precipitates.
ASB602-603	Dark veins in serpentinite; 2 pebbles.
ASB604	Light green weathered serpentinite cobble with some light brown weathering.
ASB605	Surficial weathering sludge.
ASB606	Serpentinite cobble with brown-orange weathering/precipitates.
ASB607-608	Serpentinite pebbles with brown-orange weathering/precipitates.

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ASB7xx series: Pillow basalt outcrop near Thetford Mines (June 3, 2010)

GPS coordinates: UTM19 327238 E 5097111 N (Carrière Saint-Francoise (boninite-basalt))

ASB700	Fragments of chilled margin (weathered)
ASB701	Partially weathered pillow basalt fragment.

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ASB8xx series: Pillow basalts in quarry near Thetford Mines (June 3, 2010)

GPS coordinates: UTM19 327191 E 5097738 N (Lave coussin)

ASB800	Fragment of pillow basalt

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ASB9xx series : East Broughton, QC talc mine (June 3, 2010)

ASB900-901	Two pieces of serpentinite with weathered surfaces
ASB902	Numerous fragments of weathered talc
ASB903	Bladed/weathered serpentinite fragment

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20.18b. XRD Data - Serpentinites, QC, Canada

(i) Analyses at University of Winnipeg with Bruker D8.

ASB258	Chrysotile, lizardite, magnetite, antigorite (UWinnipeg Bruker D8 XRD).
ASB265	Chrysotile, lizardite, magnetite (UWinnipeg Bruker D8 XRD).
ASB267	Magnetite, lizardite, antigorite (UWinnipeg Bruker D8 XRD).

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20.18c. Compositional Data – Serpentinites – QC, Canada (alphabetical order)

Wt. %	ASB003	ASB203	ASB230[a]	ASB327
SiO_2	40.48	38.02	37.80	47.26
TiO_2	0.02	0.02	0.01	0.00
Al_2O_3	0.52	0.29	0.33	0.34
FeO	2.22	2.85	4.15	0.18
Fe_2O_3	8.96	9.00	13.03	3.14
*(Fe_2O_3)**	*(11.43)*	*(12.17)*	*(17.64)*	*(3.34)*
MnO	0.15	0.18	0.14	0.059
MgO	45.41	48.79	44.05	48.01
CaO	0.50	0.26	0.07	0.04
Na_2O	0.08	0.06	0.07	0.05
K_2O	0.01	0.00	0.00	0.000
P_2O_5	0.01	0.00	0.01	0.002
SO_3	0.00	0.10	0.06	0.34
TOTAL	98.61	99.89	100.18	99.441
LOI	15.87	16.63	14.72	13.67
ppm				
Sr	100	41	101	91
Zr	62	22	55	29
V	41	21	71	16
Ni	3980	2540	2485	650
Cr	6450	795	768	88
Co	144	117	117	62
Source	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

a - Whole rock sample – rocky material plus fluffy phases.

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20.18c. Compositional Data – Serpentinites – QC, Canada (alphabetical order)

Wt. %	ASB258	ASB265	ASB267
SiO_2	44.17	43.05	43.07
TiO_2	0.01	0.02	0.02
Al_2O_3	1.13	0.62	1.08
FeO	3.19	2.74	3.35
Fe_2O_3	7.50	11.20	9.74
*(Fe_2O_3)**	*(11.05)*	*(14.25)*	*(13.46)*
MnO	0.18	0.18	0.22
MgO	42.53	41.32	40.99
CaO	0.08	0.12	0.37
Na_2O	0.07	0.07	0.07
K_2O	0.00	0.00	0.00
P_2O_5	0.14	0.03	0.20
SO_3			
TOTAL	99.36	99.66	99.48
LOI	11.94	11.83	11.77
ppm			
Sr	77	76	76
Zr	25	33	25
V	83	109	117
Ni	1268	972	1833
Cr	6043	3524	3133
Co	114	187	137
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

a - Whole rock sample – rocky material plus fluffy phases.

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20.18c. Compositional Data – Serpentinites – QC, Canada (alphabetical order)

Wt. %	ASB003	ASB203	ASB230[a]	ASB327	ASB601	ASB902
SiO_2	45.66	44.41				
TiO_2	0.02	0.02				
Al_2O_3	0.51	0.97				
FeO	0.33	4.22				
Fe_2O_3	5.71	1.85				
*(Fe_2O_3)**	*(6.08)*	*(6.54)*				
MnO	0.08	0.17				
MgO	46.27	35.79				
CaO	0.05	10.54				
Na_2O	0.05	0.06				
K_2O	0.00	0.00				
P_2O_5	0.01	0.01				
SO_3	0.00	0.21				
TOTAL	98.73	98.72				
LOI	13.32	20.92				
ppm						
Sr	18	2026				
Zr	14	56				
V	41	12				
Ni	3575	2013				
Cr	2842	1025				
Co	112	80				
Source	Mertzman	Mertzman				
Analysis	XRF/WC	XRF/WC				

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

a - Whole rock sample – rocky material plus fluffy phases.

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20.18d. Spectral Data - Serpentinites, QC, Canada

Sample	*Facility/File No.*	*Description*

20.18.1d. Thetford Mines Area, QC, Canada

ASB001	PSF 100304c.001	<45 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 100304c).
ASB001	PSF 100304c.002	90-1000 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 100304c).
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ASB002A	PSF 100304c.003	green phase, <45 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 100304c).
ASB002A	PSF 100304c.004	green phase, 90-1000 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 100304c).
ASB002B	PSF 100304c.005	white phase, <45 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 100304c).
ASB002B	PSF 100304c.006	white phase, 90-1000 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 100304c).
ASB002C	PSF 100304c.007	red phase, <45 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 100304c).
ASB002C	PSF 100304c.008	red phase, 90-1000 μm dry sieved; 30°/0°; 0.35-2.5 μm; 1 nm output; 1000 spectra averaged; ASD (directory: 100304c).
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20.18.2d.1. Jeffrey Mine, Asbestos, QC area – point spectra – spectral files

(i) Point spectra on whole rocks for ASB100-ASB230. Note: also have accompanying photos of spots shot available. "Dot" indicates point in photo where spectrum as acquired.

ASB100-102	PSF 110217a.001	green spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
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ASB103	PSF 110217a.002	blue spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
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ASB104	PSF 110217a.003	green spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
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ASB200	PSF 110217a.004	average spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
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ASB201	PSF 110217a.005	light blue spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
ASB201	PSF 110217a.006	gray spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
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ASB202	PSF 110217a.007	no description, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
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ASB203	PSF 110217a.008	light green spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
ASB203	PSF 110217a.009	dark green spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
ASB203	PSF 110217a.010	black spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).

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ASB204	PSF 110217a.011	average spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).

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ASB205	PSF 110217a.012	pink spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).

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ASB206	PSF 110217a.013	no description, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).

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ASB207	PSF 110217a.014	brown spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
ASB207	PSF 110217a.015	brown spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
ASB207	PSF 110217a.016	reticulated surface spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
ASB207	PSF 110217a.017	host rock spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).
ASB207	PSF 110217a.018	blue-gray spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110217_asb).

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ASB209	PSF 110218a.003	white spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB209	PSF 110218a.004	white spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).

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ASB210	PSF 110218a.005	average spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).

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ASB211	PSF 110218a.006	white spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).

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ASB212	PSF 110218a.007	green waxy spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB212	PSF 110218a.008	host rock spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).

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ASB213	PSF 110218a.009	vein rock spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB213	PSF 110218a.010	7.5 mm from vein (see above description) spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB213	PSF 110218a.011	15 mm from vein (see above description) spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).

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ASB214	PSF 110218a.012	blue spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB214	PSF 110218a.013	blue spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB214	PSF 110218a.014	weathered spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB214	PSF 110218a.015	host rock spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).

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ASB215	PSF 110218a.016	average spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200

		spectra averaged; ASD (directory 110218_asb).
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ASB216	PSF 110218a.017	vein spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB216	PSF 110218a.018	vein spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB216	PSF 110218a.026	other spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB216	PSF 110218a.027	other spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
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ASB217	PSF 110218a.028	red spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB217	PSF 110218a.029	white fluffy spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB217	PSF 110218a.030	host rock spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
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ASB218	PSF 110218a.031	medium green spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB218	PSF 110218a.032	white tip spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
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ASB219-225	PSF 110218a.033	spot 1, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB219-225	PSF 110218a.034	spot 2, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB219-225	PSF 110218a.035	spot 3, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB219-225	PSF 110218a.036	spot 4, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
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ASB227	PSF 110218a.037	no description, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
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ASB228	PSF 110218a.038	green spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
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ASB229	PSF 110218a.039	brown spot, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB229	PSF 110218a.040	brown spot, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB229	PSF 110218a.041	white spot, green dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB229	PSF 110218a.042	white spot, yellow dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB229	PSF 111201a.001	whole rock, non-rusty surface, yellow dot; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
ASB229	PSF 111201a.002	whole rock, rusty surface, blue dot; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
ASB229	INO	whole rock; i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 3 spectra acquired.
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ASB230	PSF 110218a.043	spot 1, red dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).
ASB230	PSF 110218a.044	spot 2, blue dot, whole rock; 30°/0°; 0.35-2.5 μm; 1 nm output; 200 spectra

averaged; ASD (directory 110218_asb).

ASB230	PSF 110218a.045	spot 3, green dot, whole rock; 30°/0°; 0.35-2.5 µm; 1 nm output; 200 spectra averaged; ASD (directory 110218_asb).

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ASB258	PSF 131020a.007	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131020_serpentinites).
ASB258	PSF 131021a.007	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131021serps).

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ASB265	PSF 131020a.003	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131021serps).
ASB265	PSF 131021a.003	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131020_serpentinites).

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ASB267	PSF 131020a.001	<45 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131020_serpentinites).
ASB267	PSF 131021a.001	45-1000 µm; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100 W QTH light; ASD; 500 spectra averaged (directory: 131021serps).

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<u>20.18.2d.2. Comparison of wet versus dry serpentinite samples</u>

(variously saved as 110603a or 110602a)

ASB217	PSF 110603a.001	dry, dark green surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100W QTH light; 200 spectra averaged; ASD (directory: 110602_wet).
ASB217	PSF 110603a.002	wet, dark green surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100W QTH light; 200 spectra averaged; ASD (directory: 110602_wet).
ASB217	PSF 110603a.003	dry, whitish surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100W QTH light; 200 spectra averaged; ASD (directory: 110602_wet).
ASB217	PSF 110603a.004	wet, whitish surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100W QTH light; 200 spectra averaged; ASD (directory: 110602_wet).
ASB230	PSF 110603a.006	dry blue surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100W QTH light; 200 spectra averaged; ASD (directory: 110602_wet).
ASB230	PSF 110603a.007	wet blue surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 100W QTH light; 200 spectra averaged; ASD (directory: 110602_wet).

+++++ *Measured with plant probe*+++++

ASB213	PSF 110603a.012	dry, dark green and orange surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB213	PSF 110603a.013	wet, dark green and orange surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB213	PSF 110603a.014	dry, white vein region; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB213	PSF 110603a.015	wet, white vein region; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB227	PSF 110603a.016	dry, fibrous muck; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB227	PSF 110603a.017	wet, fibrous muck; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB216	PSF 110603a.018	dry, green and white vein region; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).

ASB216	PSF 110603a.019	wet, green and white vein region with small puddle; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB216	PSF 110603a.020	wet, green and white vein region, puddle wiped up; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB219-225	PSF 110603a.021	dry, black and white vein region; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB219-225	PSF 110603a.022	wet, black and white vein region, with small pubble; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).
ASB219-225	PSF 110603a.023	wet, black and white vein region, small puddle wiped up; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; measured with ASD plant probe; 500 spectra avgd; ASD (directory: 110602_wet).

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<u>20.18.2d.2-a. In-lab Raman spectra with BWTek iRaman instrument</u>

<u>Raman spectra: iRaman 532 instrument</u>; 50 mW power, collection spot size ~80 µm; ~1 mm beam diameter; *sampling volume: ~5 mm^3; 174-4004 cm^{-1} range; 20 spectra averaged.*

Legend: DH: David Hewson (operator); ITP: integration time powder (varying integration times for the same sample); P: powder; IT: integration time solid: varying integration time for the same sample); nothing: solid. Colours refer to points on the sample that wer highlighted using coloured stickers and not the colour of the sample at that point. For integration time of solid surfaces, all were auto-integrated and if there was no appropriate integration time, the maximum (65535 msec) was used). The spectra lebelled "TT" were used to examine how changing integration times changed the data. The colours refer to locations on the rock that were specified using colour stickers (not the colour of the rock).

<u>Sample</u>	*<u>PSF File</u>*	*<u>Description</u>*
<u>i) Powdered samples</u>		
ASB200	DH-ITP-200-Red-100.txt	Powdered sample – red spot; 100 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-200.txt	Powdered sample – red spot; 200 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-300.txt	Powdered sample – red spot; 300 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-400.txt	Powdered sample – red spot; 400 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-500.txt	Powdered sample – red spot; 500 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-600.txt	Powdered sample – red spot; 600 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-700.txt	Powdered sample – red spot; 700 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-800.txt	Powdered sample – red spot; 800 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-900.txt	Powdered sample – red spot; 900 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-1000.txt	Powdered sample – red spot; 1000 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-1100.txt	Powdered sample – red spot; 1100 msec integration time; 100% laser power.
ASB200	DH-ITP-200-Red-1200.txt	Powdered sample – red spot; 1200 msec integration time; 100%

		laser power.
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ASB203	DH-ITP-203-Red-2000.txt	Powdered sample – red spot; 2000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-4000.txt	Powdered sample – red spot; 4000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-6000.txt	Powdered sample – red spot; 6000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-8000.txt	Powdered sample – red spot; 8000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-10000.txt	Powdered sample – red spot; 10000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-12000.txt	Powdered sample – red spot; 12000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-14000.txt	Powdered sample – red spot; 14000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-16000.txt	Powdered sample – red spot; 16000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-18000.txt	Powdered sample – red spot; 18000 msec integration time; 100% laser power.
ASB203	DH-ITP-203-Red-20000.txt	Powdered sample – red spot; 20000 msec integration time; 100% laser power.
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ASB901	DH-ITP-901-Green-10000.txt	Powdered sample – green spot; 10000 msec integration time; 100% laser power.
ASB901	DH-ITP-901-Green-20000.txt	Powdered sample – green spot; 20000 msec integration time; 100% laser power.
ASB901	DH-ITP-901-Green-30000.txt	Powdered sample – green spot; 30000 msec integration time; 100% laser power.
ASB901	DH-ITP-901-Green-40000.txt	Powdered sample – green spot; 40000 msec integration time; 100% laser power.
ASB901	DH-ITP-901-Green-50000.txt	Powdered sample – green spot; 50000 msec integration time; 100% laser power.
ASB901	DH-ITP-901-Green-60000.txt	Powdered sample – green spot; 60000 msec integration time; 100% laser power.
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ASB300	DH-P-300-Red-47873.txt	Powdered sample – red spot; 47873 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-P-203-Red-47390.txt	Powdered sample – red spot; 47390 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-P-203-Yellow-65535.txt	Powdered sample – yellow spot; 45535 msec integration time (auto-exposure); 100% laser power.
ASB330	DH-P-330-Red-65535.txt	Powdered sample – red spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB902	DH-P-902-Yellow-32955.txt	Powdered sample – yellow spot; 32955 msec integration time (auto-exposure); 100% laser power.
XXX	DH-P-XXX-Red-65535.txt	Powdered sample – red spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB901	DH-P-901-Green-65535.txt	Powdered sample – green spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-P-203-Green-65535.txt	Powdered sample – green spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB902	DH-P-902-Green-65535.txt	Powdered sample – red spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB326	DH-P-326-Red-6850.txt	Powdered sample – red spot; 6850 msec integration time (auto-exposure); 100% laser power.

ASB901	DH-P-901-Red-65535.txt	Powdered sample – red spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB323	DH-P-323-Red-65535.txt	Powdered sample – red spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB306	DH-P-306-Red-65535.txt	Powdered sample – red spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB601	DH-P-601-Red-65535.txt	Powdered sample – red spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB330	DH-P-330-Green-65535.txt	Powdered sample – green spot; 65535 msec integration time (auto-exposure); 100% laser power.
ASB605	DH-P-605-Red-32676.txt	Powdered sample – red spot; 32676 msec integration time (auto-exposure); 100% laser power.
ASB902	DH-P-902-Red-382323.txt	Powdered sample – red spot; 38232 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-P-900-Green-4218.txt	Powdered sample – green spot; 4218 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-P-900-Yellow-65535.txt	Powdered sample – yellow spot; 65535 msec integration time (auto-exposure); 100% laser power.
Woody	DH-P-Woody-Yellow-65535.txt	Powdered sample – "Woody" – yellow spot; 65535 msec integration time (auto-exposure); 100% laser power.
Woody	DH-P-Woody-Green-65535.txt	Powdered sample – "Woody" - green spot; 65535 msec integration time (auto-exposure); 100% laser power.

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b) Rock surface sample spectra

ASB203	DH-203-Green-65535-B	Rock surface, green spot, 65535 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-203-Red-19871-B	Rock surface, red spot, 19871 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-203-Yellow-65535-B	Rock surface, yellow spot, 65535 msec integration time (auto-exposure); 100% laser power.
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ASB300	DH-300-Red-65535	Rock surface, red spot, 65535 msec integration time (auto-exposure); 100% laser power.
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ASB306	DH-306-Red-65535	Rock surface, red spot, 65535 msec integration time (auto-exposure); 100% laser power.
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ASB323	DH-323-Red-65535-B	Rock surface, green spot, 65535 msec integration time (auto-exposure); 100% laser power.
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ASB326	DH-326-Red-25045	Rock surface, red spot, 25045 msec integration time (auto-exposure); 100% laser power.
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ASB330	DH-330-Green-26748-B	Rock surface, green spot, 26748 msec integration time (auto-exposure); 100% laser power.
ASB330	DH-330-Red-65535-B	Rock surface, red spot, 65535 msec integration time (auto-exposure); 100% laser power.
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ASB601	DH-601-Red-65535-B	Rock surface, red spot, 65535 msec integration time (auto-exposure); 100% laser power.
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ASB605	DH-605-Red-14924	Rock surface, red spot, 14924 msec integration time (auto-exposure); 100% laser power.
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ASB900	DH-900-Green-483-B(1)	Rock surface, green spot, 483 msec integration time (auto-

		exposure); 100% laser power.
ASB900	DH-900-Green-958-B(2)	Rock surface, green spot, 958 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-900-Red-1106-B(1)	Rock surface, red spot, 1106 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-900-Red-1106-B(2)	Rock surface, red spot, 1106 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-900-Yellow-65535-B	Rock surface, yellow spot, 65535 msec integration time (auto-exposure); 100% laser power.
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ASB901	DH-901-Green-65535-B	Rock surface, green spot, 65535 msec integration time (auto-exposure); 100% laser power.
ASB901	DH-901-Red-65535	Rock surface, red spot, 65535 msec integration time (auto-exposure); 100% laser power.
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ASB902	DH-902-Green-65535 (2)	Rock surface, green spot, 65535 msec integration time (auto-exposure); 100% laser power.
ASB902	DH-902-Green-65535	Rock surface, green spot, 65535 msec integration time (auto-exposure); 100% laser power.
ASB902	DH-902-Red (1)	Rock surface, red spot, 28020 msec integration time (auto-exposure); 100% laser power.
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ASB203	DH-IT-203-Red-10000-B	Rock surface, red spot, 10000 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-IT-203-Red-12000-B	Rock surface, red spot, 12000 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-IT-203-Red-14000-B	Rock surface, red spot, 14000 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-IT-203-Red-16000-B	Rock surface, red spot, 16000 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-IT-203-Red-18000-B	Rock surface, red spot, 18000 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-IT-203-Red-2000-B	Rock surface, red spot, 2000 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-IT-203-Red-4000-B	Rock surface, red spot, 4000 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-IT-203-Red-6000-B	Rock surface, red spot, 6000 msec integration time (auto-exposure); 100% laser power.
ASB203	DH-IT-203-Red-8000-B	Rock surface, red spot, 8000 msec integration time (auto-exposure); 100% laser power.
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ASB900	DH-IT-900-Red-100-B	Rock surface, red spot, 100 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-1000-B	Rock surface, red spot, 1000 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-1100-IT of 1078	Rock surface, red spot, 1100 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-200-B	Rock surface, red spot, 200 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-300-B	Rock surface, red spot, 300 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-400-B	Rock surface, red spot, 400 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-500-B	Rock surface, red spot, 500 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-600-B	Rock surface, red spot, 600 msec integration time (auto-exposure);

		100% laser power.
ASB900	DH-IT-900-Red-700-B	Rock surface, red spot, 700 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-800-B	Rock surface, red spot, 800 msec integration time (auto-exposure); 100% laser power.
ASB900	DH-IT-900-Red-900-B	Rock surface, red spot, 900 msec integration time (auto-exposure); 100% laser power.
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ASB901	DH-IT-901-Green-10000-B	Rock surface, green spot, 10000 msec integration time (auto-exposure); 100% laser power.
ASB901	DH-IT-901-Green-20000-B	Rock surface, green spot, 20000 msec integration time (auto-exposure); 100% laser power.
ASB901	DH-IT-901-Green-30000-B	Rock surface, green spot, 30000 msec integration time (auto-exposure); 100% laser power.
ASB901	DH-IT-901-Green-40000-B	Rock surface, green spot, 40000 msec integration time (auto-exposure); 100% laser power.
ASB901	DH-IT-901-Green-50000-B	Rock surface, green spot, 50000 msec integration time (auto-exposure); 100% laser power.
ASB901	DH-IT-901-Green-60000-B	Rock surface, green spot, 60000 msec integration time (auto-exposure); 100% laser power.
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Woody	DH-Woody-Green-43246-B	Rock surface, green spot, 43246 msec integration time (auto-exposure); 100% laser power.
Woody	DH-Woody-Red-65535-B	Rock surface, red spot, 65535 msec integration time (auto-exposure); 100% laser power.
Woody	DH-Woody-Yellow-65535-B	Rock surface, yellow spot, 65535 msec integration time (auto-exposure); 100% laser power.
ASBxxx	DH-XXX-Red-65535-B	Rock surface, red spot, 65535 msec integration time (auto-exposure); 100% laser power.

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20.18.2d.3. Field spectra at Jeffrey Mine, Asbestos, QC, Canada

20.18.2d.3.1. In field Raman spectra

Day 1 rover traverses – Raman spectra:

Raman1	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman2	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman3	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman3b	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman4	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman5	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman6	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman7	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman8	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman9	whole rock, exposed surface; EnWave MPB Raman spectrometer.
Raman10	whole rock, exposed surface; EnWave MPB Raman spectrometer.

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Day 2 rover traverses – Raman spectra

2raman1	whole rock, exposed surface; EnWave MPB Raman spectrometer.
2raman2	whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman3	whole rock, exposed surface; EnWave MPB Raman spectrometer.
2raman4	whole rock, exposed surface; EnWave MPB Raman spectrometer.
2raman5	whole rock, exposed surface; EnWave MPB Raman spectrometer.
2raman6	whole rock, exposed surface; EnWave MPB Raman spectrometer.

2raman7 whole rock, exposed surface; EnWave MPB Raman spectrometer.
2raman8 whole rock, exposed surface; EnWave MPB Raman spectrometer.
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Day 3 rover traverses – Raman spectra
3raman1 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman2 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman3 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman4 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman5 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman6 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman7 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman8 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman9 whole rock, exposed surface; EnWave MPB Raman spectrometer.
3raman10 whole rock, exposed surface; EnWave MPB Raman spectrometer.
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20.18.2d.3.2. In field ASD (reflectance) spectra

Day 1 rover traverses – ASD spectra
Site 1 PSF 110606a.002 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 2 PSF 110606a.003 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 3 PSF 110606a.004 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 4 PSF 110606a.005 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 5 PSF 110606a.006 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 6 PSF 110606a.008 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 7 PSF 110606a.009 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 8 PSF 110606a.010 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 9 PSF 110606a.011 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
Site 10 PSF 110606a.012 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day1\Data].
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Day 2 rover traverses – ASD spectra
Site 1 PSF asd2.001 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day2\Data].
Site 2 PSF asd2.002 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day2\Data].
Site 3 PSF asd2.003 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day2\Data].
Site 4 PSF asd2.005 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day2\Data].
Site 5 PSF asd2.006 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day2\Data].
Site 6 PSF asd2.007 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day2\Data].
Site 7 PSF asd2.008 whole rock surface; i=30°, e=0°; 0.35-2.5 µm; 5 nm resol.; 500 spectra

averaged; ASD [Directory: Asbestos\Day2\Data].
Site 8 PSF asd2.009 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day2\Data].
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Day 3 rover traverses – ASD spectra
Site 1 PSF asd3.001 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
Site 2 PSF asd3.002 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
Site 3 PSF asd3.003 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
Site 4 PSF asd3.004 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
Site 5 PSF asd3.005 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
Site 6 PSF asd3.006 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
Site 7 PSF asd3.007 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
Site 8 PSF asd3.008 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
Site 9 PSF asd3.009 whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 5 nm resol.; 500 spectra averaged; ASD [Directory: Asbestos\Day3\Data].
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20.18.2d.4. Field spectra at Norbestos Mine, near Asbestos, QC, Canada – June 2012

20.18.2d.4.1. In field Raman spectra

Raman spectra: iRaman 532 instrument; 50 mW power, collection spot size ~80 μm; ~1 mm beam diameter; sampling volume: ~5 mm^3; 174-4004 cm^{-1} range; 20 spectra averaged.

Spectra collected in the field during rover deployment at Norbestos mine of targets examined by the rover. Some spectra collected at various distance (given) from feature (fracture) of interest.

TargetID
Day 2 Target 1: 0 cm
Day 2 Target 1: 12 cm
Day 2 Target 1: 24 cm
Day 2 Target 4
Day 3 Landing Point (test)
Day 3 Target 1
Day 3 Target 2
Day 3 Target 3
Day 3 Target 5
Day 4 Target C
Day 4 Target B
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20.18.2d.4.2. In field ASD reflectance spectra

ASD spectra: 0.35-2.5 μm; 200 spectra averaged; collected in ambient sunlight. Distances indicate distance from fracture that point spectra were acquired.

Day 2 Target 1: 0 cm PSF fd2 d2a.000

Day 2 Target 1: 12 cm	PSF fd2 d2a.001
Day 2 Target 1: 24 cm	PSF fd2 d2a.002
Day 2 Target 4	PSF 120608a.003
Day 3 Landing Point (test)	PSF fd2 d2a.000 (same spectrum as Day 2 Target 1: 0 cm; why?)
Day 3 Target 1	PSF 120619a.000
Day 3 Target 2	PSF 120619a.001
Day 3 target 3	PSF 120619a.002
Day 3 Target 5	PSF 120619a.003
Day4 Target C	PSF fd2-d4.002
Day 4 Target B	PSF fd2-d4.003

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END of 20.18

20. Analogue Sites

20.19. Morin Anorthosite Area, QC, Canada

Located NW of Montreal, includes ilmenite deposits.

20.19.1. Waste transfer station and LaFarge quarry in St. Adele (anorthosite)
20.19.2. Mt. Baldy quarry remains in reclaimed pit
20.19.3. Ivry ilmenite pit
20.19.4. Road cut at entrance to St. Jerome from Highway 15
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20.19a. Sample Descriptions – Morin Anorthosite Area, QC, Canada

20.19.1a. MAI0xx: Waste transfer station and LaFarge quarry in St. Adele (anorthosite) – June 4, 2010

MAI000-003	Four cobbles of coarse-grained anorthosite – sorted cobble pile at site.
MAI004	Larger cobble of anorthosite from sorted cobble pile at site.
MAI005	Larger cobble of anorthosite from sorted cobble pile at site.
MAI006-008	Three larger cobbles of coarse-grained anorthosite.
MAI009	Garnetiferous gabbro – St. Adele waste transfer station
MAI010-012	Three pieces of ferrogabbro – St. Adele waste transfer station
MAI013	Garnetiferous gabbro – St. Adele waste transfer station
MAI014	Coarse-grained anorthosite rich-stone – Lafarge pit

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20.19.2a. MAI1xx: Mt. Baldy quarry remains in reclaimed pit – June 4, 2010

GPS coordinates: UTM19 567963 E 5091904 N (Baldie tailings)

MAI100	Coarse anorthosite small cobble.

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20.19.3a. MAI2xx: Ivry ilmenite pit – June 4, 2010

GPS coordinates: UTM19 548882 E 5102990 N (Ivry pit)

MAI200	Loose ilmenite-rich sand and small fragments
MAI201	Small ilmenite stone
MAI202	Small ilmenite stone
MAI203	Ilmenite cobble with one weathered surface
MAI204	Less-fresh ilmenite stone
MAI205	Fresh, coarse-grained ilmenite stone
MAI206	Fresh, coarse-grained ilmenite cobble – 1 partial weathered surface
MAI207	Fresh, medium-grained ilmenite stone
MAI208	Fresh, coarse-grained ilmenite stone
MAI209	Partially weathered medium-grained ilmenite stone
MAI210	Fresh, coarse-grained ilmenite cobble
MAI211	Partially weathered ilmenite cobble with adhering host anorthosite
MAI212	Fresh medium-grained ilmenite stone with one weathered surface
MAI213	Coarse-grained, fresh ilmenite stone
MAI214	Coarse-grained, fresh ilmenite stone with one partial weathered surface
MAI215	Partially weathered medium-grained ilmenite cobble

MAI216 Fresh and weathered coarse-grained ilmenite cobble
MAI217 Fresh, coarse-grained ilmenite stone
MAI218 Medium grained ilmenite with adhering anorthosite stone
MAI219 Fresh, medium-grained ilmenite stone
MAI220 Miscellaneous broken-off fragments and small rocks
MAI221 Coarse-grained anorthosite cobble from Ivry pit
MAI222 Coarse-grained anorthosite cobble with some ilmenite
MAI223 Coarse-grained anorthosite stone
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20.19.4a. MAI3xx: Road cut at entrance to St. Jerome from Highway 15 - August 3, 2010

MAI300 Gabbro? + magnetite?
MAI301 Fine-grained anorthosite?
MAI302 Banded gabbro? + magnetite?
MAI303 Fine-grained anorthosite?
MAI304 Banded gabbro? + magnetite?
MAI305 Banded gabbro? + magnetite?
MAI306 Pyroxenite?
MAI307 Pyroxenite?
MAI308 Pyroxenite? + magnetite?
MAI309 Pyroxenite? + magnetite?
MAI310 Gabbro with ilmenite lens
MAI311 Anorthositic gabbro ?
MAI312 Coarse pyroxenite with ilmenite stringers
MAI313 Fine-grained anorthosite with weathered opaques?
MAI314 Foliated gabbro?
MAI315 Coarse-grained gabbro with ilmenite?
MAI316 Coarse-grained gabbro?

MAI350 Pyroxenite + garnet
MAI351 Fine-grained pyroxenite + minor opaques?
MAI352 Fine-grained pyroxenite + minor opaques?
MAI353 Light coloured anorthosite?
MAI354 Light-coloured anorthosite + minor opaque stringers
MAI355 Light-coloured anorthosite?
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20.19c. Compositional Data - Morin Anorthosite Area, QC, Canada

Wt. %	MAI001	MAI203
SiO_2	45.85	4.64
TiO_2	3.12	45.05
Al_2O_3	16.92	2.76
FeO	7.66	26.78
Fe_2O_3	5.93	12.71
*(Fe_2O_3)**	*(14.44)*	*(42.47)*
MnO	0.14	0.13
MgO	2.95	2.14
CaO	10.56	1.02
Na_2O	3.67	0.39
K_2O	0.68	0.15
P_2O_5	2.01	0.10
SO_3	0.00	0.10
TOTAL	100.34	99.22
LOI	0.89	0.40
ppm		
Sr	637	46
Zr	82	209
V	192	1560
Ni	25	210
Cr	31	495
Co	22	90
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - all Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.19c.1. Compositional data: Electron microprobe

Phases analyzed by electron microprobe by M. Izawa (Feb. 2014):

MAI001: plagioclase, pyroxene, ilmenite, magnetite.
MAI201: magnetite, ilmenite, plagioclase, biotite, hercynite.

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20.19d. Spectral Data - Morin Anorthosite Area, QC, Canada

Sample	*Facility/File No.*	*Description*
MAI200	PSF 111201a.038	<1000 μm; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
MAI200	PSF 111201a.009	whole rock, i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
MAI200	INO	whole rock; i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 2 sets of spectra acquired.
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MAI221	PSF 111201a.006	whole rock; i=30, e=0; 0.35-2.5 μm; ASD; 1 nm output; 200 spectra averaged (Directory: 111201_optech).
MAI221	INO	whole rock; i=30, e=0; 0.9-2.5 μm; INO Ocean Optics spectrometer; 6.5 nm output; 50 sets of 20 dark, 20 target spectra; 3 sets of spectra acquired.

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END of 20.19

20. Analogue Sites

20.20. Algal mats – Gypsumville, East German Creek, MB, Canada

Algal mats collected at Gypsumville (in southern lake) for desiccation runs.
Algal mats and filaments collected at East German Creek – surficial mats ("brains") and algal stringers and floating mats at various springs., also for desiccation runs.

Samples collected May 2010 during field visit.
Samples exposed to low pressures and UV irradiation for 44 days.

20.20a. Sample Descriptions – Algal Mats – Gypsumville, East German Creek, MB, Canada

Sample ID	*Description*
A-GY001	Gypsumville floating algal mat collected from small pond near main lake at southeast end of quarry.
A-EG100	East German Creek "black brains".
A-EG101	East German Creek "white brains"
A-EG001s	Surface sediment from sample station EGC1 = Big Cauldron.
A-EG001a	Algal stringer from 2010 sample station EGC1 = Big Cauldron.
A-EG005	Algal mat from 2010 sample station EGC5.
A-EG006	Algal mat from 2010 sample station EGC6.
A-EG008	Algal mat from 2010 sample station EGC8
A-EG010	Algal mat from 2010 sample station EGC10.
A-EG012	Algal mat from 2010 sample station EGC12.

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20.20d. Spectral Data – Algal Mats – Gypsumville, East German Creek, MB, Canada

Spectral Files – unaltered samples

Sample	*Facility/File No.*	*Description*
A-GY001	PSF 100519a.001	Upper mat surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG100	PSF 100519a.002	Upper surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG101	PSF 100519a.003	Upper surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG001s	PSF 100519a.004	surface sediments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG001a	PSF 100519a.006	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG005	PSF 100519a.007	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG006	PSF 100519a.008	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG008	PSF 100519a.009	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG010	PSF 100519a.010	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].
A-EG012	PSF 100519a.012	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100519_algal mats].

Spectral Files – samples after 44 days in chamber

A-GY001	PSF 100723a.001	Upper mat surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG100	PSF 100723a.002	Upper surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG101	PSF 100723a.003	Upper surface; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG001s	PSF 100723a.004	surface sediments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG001a	PSF 100723a.005	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG005	PSF 100723a.006	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG006	PSF 100723a.007	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG008	PSF 100723a.008	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG010	PSF 100723a.009	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].
A-EG012	PSF 100723a.010	algal mat/filaments; i=30°, e=0°; 0.35-2.5 µm; 1 nm output; 1000 spectra averaged; ASD [directory: 100723_death_chamber].

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END of 20.20

20. Analogue Sites

20.21. Axel Heiberg Island, NWT, Canada

There are a number of cold spring deposits on Axel Heiberg Island that are possible Mars spring analogues and sites of extremophiles.

20.21a. Sample Descriptions - Axel Heiberg Island, NWT, Canada

(i) Gypsum Hill area

CRB131 Calcite: Axel Heiberg Island (vicinity of springs) (from Mike Craig, Aug. 09). [see Carbonates section].

GH-001 Gypsum crust from Gypsum Hill – possible cryptoendoliths. Received from Helen Vrionis at McGill (Nov. 2010).

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20.21d. Spectral Data - Axel Heiberg Island, NWT, Canada

Sample	*Facility/File No.*	*Description*
GH-001a	PSF 101201a.013	whole rock surface – brown spot in centre; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
GH-001a	PSF 101201a.014	whole rock surface – brown spot on edge; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
GH-001b	PSF 101201a.015	whole rock surface – underside of coral-looking surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
GH-001b	PSF 101201a.016	whole rock surface – top centre of coral-looking surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].
GH-001b	PSF 101201a.017	whole rock surface – top edge of coral-looking surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged, ASD [directory: 101201_iceland].

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END of 20.21.

20. Analogue Sites

20.22. Smoking Hills, Cape Bathurst, NWT, Canada

20.22a. Sample Descriptions - Smoking Hills, Cape Bathurst, NWT, Canada

Samples collected by HMSC Amundsen and Schools on Board students – October 2011. Consist of baked (autoignition of sulphur-rich lignite) Cretaceous mudstones.

Sample ID	*Description*
SH001-010	Two large and many smaller fragments of red Cretaceous mudstones
SH011	One bagged (wet) red Cretaceous mudstone.

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20.22b. XRD Data - Smoking Hills, Cape Bathurst, NWT, Canada

SH009	XRD shows quartz and hematite definitely, plus a number of unidentified peaks and some baseline noise (indicative of amorphous component?) and low angle scattering (indicative of clays?).

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20.22d. Spectral Data - Smoking Hills, Cape Bathurst, NWT, Canada

Sample	*Facility/File No.*	*Description*
SH009	PSF 11118b.001	<45 µm, 0.35-2.5 µm, i=30°/e=0°; ASD, 200 spectra averaged [Directory: 111118_stuff].

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END of 20.22.

20. Analogue Sites

20.23. Nova Scotia, Canada

20.23.1. St Croix gypsum cliff (Rock Road) and Sweet's Corner gypsum quarry (near Windsor)
20.23.2. Blomidon Provincial Park
20.23.3. Huntington Point, NS (near Hall's Harbour – Bay of Fundy)

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Samples of interest include gypsum deposits with endoliths, as well as zeolite-bearing basalts.

20.23a. Sample Descriptions – Nova Scotia, Canada

Sample ID *Description*

20.23.1a. St Croix gypsum cliff (Rock Road) and Sweet's Corner gypsum quarry (near Windsor) – Sample Descriptions.

Samples collected July 29, 2012 with David Garbary from St. FX University

NS-001	Endolith bearing gypsum boulder (from cliff at S end of exposure by access road) (WIN-011).
NS-002	Endolith bearing gypsum from cliff face (from cliff at S end of exposure by access road (WIN-010).
NS-010	Endoliths in gypsum boulder – entrance to gypsum quarry at Sweet's Corner, near Windsor (WIN-001)
NS-011	Dark layer with flame structures in wall of gypsum quarry – Sweet's Corner near Windsor (WIN-004).
NS-012	Gray and white gypsum boulder with some endoliths – boulder at entrance to gypsum quarry at Sweet's Corner, near Windsor (WIN-002).
NS-013	Massive selenite with minor iron oxide staining – loose piece found at entrance to gypsum quarry at Sweet's Corner, near Windsor (WIN-003).

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20.23.2a. Blomidon Provincial Park – Sample Descriptions

Samples collected August 2, 2012

NS-101	Iron-stained zeolite-bearing basalt cobble (Blomidon Fmn) (beach area).
NS-102	Quartz-veined basalt (beach area).
NS-103	Vesicular basalt with zeolite-filled vugs (Blomidon Fmn) (beach area).
NS-104	Fractured basalt with laminated quartz vein filling (beach area).
NS-105	Partially (water?) bleached vesicular basalt (beach area).
NS-106	Vesicular basalt with zeolite-filled vugs (Blomidon Fmn) (beach area).
NS-107	Vesicular basalt with zeolite-filled vugs (Blomidon Fmn) (beach area).
NS-108	Quartz-veined igneous rocks (beach area) – multiple separate samples.
NS-109	Basalt cobble (beach area).
NS-110	Poorly consolidated sediments – base of fmn (beach area).
NS-111	Jasperized nodule (beach area).

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20.23.3a. Huntington Point, NS (near Hall's Harbour – Bay of Fundy) - Sample Descriptions

Samples collected August 2, 2012

NS-201	Zeolitized basalt cobbles from beach area.
NS-202	Basalt from beachside outcrop.
NS-203	Pillow (?) basalt from outcrop: Brow Mountain Road turnoff on highway 358 to Hall's Harbour

(Blomidon Fmn).

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20.23c. Compositional Data - Nova Scotia, Canada

Wt. %	NS-103
SiO_2	52.56
TiO_2	1.33
Al_2O_3	14.59
FeO	5.61
Fe_2O_3	6.38
*(Fe_2O_3)**	*(12.61)*
MnO	0.17
MgO	6.38
CaO	9.26
Na_2O	2.41
K_2O	0.68
P_2O_5	0.16
SO_3	0.06
TOTAL	100.21
LOI	8.12
ppm	
Sr	315
Zr	158
V	356
Ni	85
Cr	175
Co	17
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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END of 20.23.

20. Analogue Sites

20.24. Newfoundland and Labrador, Canada

20.24.1. Copper Mine, Brook Fall, near York Harbour, NL, Canada
20.24.2. Cedar Cove, near Lark Harbour, NL, Canada
20.24.3. Lark Harbour, NL, Canada
20.24.4. Tablelands Ophiolite – Gros Morne Park, NL, Canada
20.24.5a. Myers Minerals, Pasadena, NL, Canada
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20.24a. Sample Descriptions - Newfoundland and Labrador, Canada

Sample ID *Description*

20.24.1a. Copper Mine, Brook Fall, near York Harbour, NL, Canada - Sample descriptions

Abandoned copper mine – rocks collected at mine entrance (Aug. 2012)

NL-001 – 004 4 dense, dark slickensided rocks.
NL-005 possible pure orthopyroxenite
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20.24.2a. Cedar Cove, near Lark Harbour, NL (Aug. 2012)

Samples collected August 2012 from base of cliffs and along beach.

NL-010 Possible rhyolite
NL-011 Possible epidote-quartz (scree slope on N side of cove).
NL-012 Brecciated possible ultramafic (scree slope on N side of cove).
NL-013 Brecciated/fractured possible ultramafic (scree slope on N side of cove).
NL-014 Possible altered vesicular basalt (scree slope on N side of cove).
NL-015 Possible ultramafic with calcite veining/inclusions (scree slope on N side of cove).
NL-016 Weathered limestone (cove beach).
NL-017 Foliated calcite (?) (scree slope on N side of cove).
++

20.24.3a. Lark Harbour, NL, Canada - Sample Descriptions

Samples collected on beach (Aug. 2012)

NL-030 Weathered vesicular basalt
NL-031 Weathered, partially-bleached basalt.
NL-032 Exterior weathered peridotite with 2 textural types.
++

20.24.4a. Tablelands Ophiolite – Gros Morne Park, NL, Canada - Sample Descriptions

Samples collected Aug. 6, 2012

NL-101 Probable fossil spring terrace deposit (travertine?). Collected along walking trail to Winterhouse Brook from parking lot.
NL-102 Possible magnesium carbonate deposits on serpentinite. Collected along walking trail to Winterhouse Brook from parking lot.

NL-103 Fresh travertine deposits from Winterhouse Creek spring (49° 27.976'N, 057° 57.422' W, 232 m elevation).
NL-104 Serpentinized peridotite with waxy-looking, pale green serpentinite fracture fill. Collected along walking trail to Winterhouse Brook from parking lot.
NL-105 Fossil spring terrace deposit (travertine?). Collected along walking trail to Winterhouse Brook from parking lot.
NL-106 Desiccated algal mats in dry pond (former spring?) collected along walking trail to Winterhouse Creek from parking lot.
NL-107 Gabbro cobble with weathered surface. Collected along walking trail to Winterhouse Brook from parking lot.
NL-108 Fresh travertine deposits from Winterhouse Creek spring.
NL-109 Fossil spring terrace deposit (travertine?). Collected along walking trail to Winterhouse Brook from parking lot; 3 cobbles.
NL-110 Gabbro cobble with weathered surface. Collected along walking trail to Winterhouse Brook from parking lot.
NL-111 Gabbro/serpentinized cobble with weathered surface and red fracture fill. Collected along walking trail to Winterhouse Brook from parking lot.
NL-112 Weathered/fractured serpentinite cobble. Collected along walking trail to Winterhouse Brook from parking lot.
NL-113 Weathered/fractured serpentinite cobble. Collected along walking trail to Winterhouse Brook from parking lot.
NL-114 Weathered/fractured serpentinite cobble with red oxyhydroxide staining. Collected along walking trail to Winterhouse Brook from parking lot.
NL-115 Small peridotite (serpentinized) cobble. Collected along walking trail to Winterhouse Brook from parking lot.
NL-116 Fine-grained wind-blown sediments. Collected along walking trail to Winterhouse Brook from parking lot.

WHC-1 water sample from travertine spring pool at Winterhouse Creek, Tablelands.

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20.24.5a. Myers Minerals, Pasadena, NL, Canada - Sample Descriptions

Offcuts and scrap pieces from their shop (Aug. 2012)

NL-201 White marble slice from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-202 White marble slice from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-203 White marble drill core slice from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-204 White marble drill core piece from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-205 Gray marble slice from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-206 Gray marble slice from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-207 Gray marble drill core slice from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-208 Gray marble slice from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-209 Gray marble drill core slice from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).
NL-210 Gray marble slice with one polished face from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).

NL-211 Gray marble slice with one polished face from west coast of island (e.g., western White Baie, southwest of Deer Lake, and around Corner Brook).

NL-212 Green marble slice with one polished face and weathering rind from Baie Verte Peninsula (called virginite; composed mostly of bruennerite; collected on the Baie Verte Peninsula, NL).

NL-213 Green marble slice with one polished face from Baie Verte Peninsula (called virginite; composed mostly of bruennerite; collected on the Baie Verte Peninsula, NL).

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20.24c. Compositional Data - Newfoundland and Labrador, Canada

Wt. %	NL-105	NL-110	NL-116
SiO_2	26.33	44.13	47.78
TiO_2	0.01	0.00	0.17
Al_2O_3	1.06	1.17	2.79
FeO	0.79	1.47	1.97
Fe_2O_3	4.37	7.44	8.24
*(Fe_2O_3)**	*(5.25)*	*(9.07)*	*(10.43)*
MnO	0.06	0.14	0.16
MgO	23.21	43.94	36.27
CaO	43.36	0.69	0.68
Na_2O	0.06	0.07	0.31
K_2O	0.04	0.01	0.35
P_2O_5	0.02	0.01	0.03
SO_3	0.00	0.07	0.07
TOTAL	99.40	99.30	99.04
LOI	30.55	11.84	12.24
ppm			
Sr	103	110	61
Zr	76	76	93
V	54	84	60
Ni	1479	4067	3270
Cr	1195	3198	3496
Co	24	119	105
Source	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.24c.1. Analytical data: Electron microprobe

Phases analyzed by electron microprobe by M. Izawa (Feb. 2014):

NL-110: olivine, serpentine, diopside, chromite.

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END of 20.24.

20. Analogue Sites

20.25. Monteregian Hills Kimberlites/polymict breccias, QC, Canada

Source of localities: "Monteregian Hills: Diatremes, kimberlite, lamprohyres and intrusive breccias west of Montreal" by D.P. Gold. International Geological Congress, 24th Session, Excursion B-10 Guidebook.

20.25a. Sample Descriptions - Monteregian Hills Kimberlites/polymict breccias, QC, Canada

Sample ID	*Description*
QC-001	Kimberlitic breccias with various pristine and unaltered inclusions. Collected from beach ~30 m N of Stop 1 in guidebook.
QC-010	Kimberlitic/basaltic breccias and various samples. Collected from beach ~100 m NW of Stop 1 in guidebook.
QC-020	Kimberlite cobbles collected from Stop 1 in guidebook (kimberlite hill and quarry).
QC-030	Anorthosite rubble used as slope stabilization material. Roadside of Oka site (Stop 3 in guidebook – Monastery Pipe at La Trappe).
QC-040	Outcrop samples from creek just west of Oka Monastery – stop 3 in Guidebook. Possible ijolaite and alnoite.
QC-050	Pieces of a boulder from creek at Como (Ile Cadieux) monticellite mica peridotite pipe, with numerous inclusions (Stop 2 in the guidebook).
QC-060	Weathered, rust-coloured coarse-grained rock (ultramafic?).

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END of 20.25.

20. Analogue Sites

20.26. Charlevoix Impact Structure, QC, Canada

Source of localities: "A Crypto-Explosion Structure at Charlevoix and the St. Urbain Anorthosite", by Dennis W. Roy, Jehan Rondot, and Robert F. Dymek. International Geological Congress 24th Session. Excursion B-06.

20.26a. Sample Descriptions - Charlevoix Impact Structure, QC, Canada

Sample ID	*Description*
20.26.1a. Stop 7 in Guidebook – edge of granite-anorthosite contact (47° 43.320' N 70° 41.929' W)	
CHX-000	Garnet-bearing anorthosite?
CHX-001	Loose cobble: Shocked granite?
CHX-002	Loose cobble: Shocked granite?
CHX-003	Loose cobble: Shocked granite?
CHX-004	Loose cobble: shocked granite? + epidote?
CHX-005	Anorthosite.
CHX-006	Anorthosite (+ epidote?).
CHX-007	Shocked granite – 4 pieces.
CHX-008	Shocked granite.
++	
20.26.2a. Stop 8 in guidebook – anorthosite	
CHX-009a	Garnet-bearing anorthosite cobble.
CHX-009b	Foliated anorthosite? cobble.
CHX-009c	Violet-coloured anorthosite cobble.
CHX-009d	Violet-coloured anorthosite with opaques.
CHX-009e	Strongly foliated anorthosite.
CHX-010	Weakly foliated gabbro (?).
++	
20.26.3a. Near stop 12 in guidebook (47° 33.904' N 70° 23.572' W) - anorthosite	
CHX-011	Multiple loose ilmenite and anorthosite cobbles at edge of cut line leading to mine.
CHX-011a	Garnet-bearing anorthosite.
++	
20.26.4a. Stop 4 in guidebook (47° 33.904' N 70° 23.572' W) – shatter cone outcrop	
CHX012	Multiple samples with shatter cone surfaces from outcrop.
CHX013	Loose cobble of shocked? anorthosite? (with slickensides?).
++	

20.26c. Compositional Data - Charlevoix Impact Structure, QC, Canada

Wt. %	CHX-009
SiO_2	57.79
TiO_2	0.11
Al_2O_3	26.26
FeO	0.20
Fe_2O_3	0.13
*(Fe_2O_3)**	*(0.35)*
MnO	0.01
MgO	0.14
CaO	8.01
Na_2O	6.38
K_2O	0.89
P_2O_5	0.03
SO_3	0.06
TOTAL	100.03
LOI	0.43
ppm	
Sr	1383
Zr	93
V	31
Ni	10
Cr	60
Co	<1
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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20.26c.1. Analytical data: Electron microprobe

Phases analyzed by electron microprobe by M. Izawa (Feb. 2014):

CHX-009: plagioclase, pyroxene, ilmenite.

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END of 20.26.

20. Analogue Sites

20.27. Dome Mine, ON, Canada

Project for Jessica Stromberg at University of Western Ontario (2012 – 2013)
Samples received (on loan) January 23, 2012

20.27a. Sample Descriptions - Dome Mine, ON, Canada

Sample ID	*Description*
30b	East ankerite; grey ankerite with quartz veining and yellowish weathering; powdered sample is representative of the bulk composition of the whole rock sample (powder and solid sample received).
31.1	West ankerite; black veining associated with quartz; powdered sample is primarily black veining (powder and solid sample received).
31.2	West ankerite; grey ankerite; powdered sample is representative of the bulk composition of the whole rock sample (powder and solid sample received).
35b.1	West ankerite; milky white quartz cream/yellowish coloured areas; powdered sample is representative of the bulk composition of the whole rock sample (powder and solid sample received).
35b.2	West ankerite; grey ankerite with yellowish weathering and minor quartz veining; powdered sample is representative of the bulk composition of the whole rock sample (powder and solid sample received).
39b	Interflow sediment; dark black/grey, sulfide-rich, highly weathered (sulphides-orange/red); powdered sample is representative of the bulk composition of the whole rock sample (powder and solid sample received).
46a	Center ankerite; grey ankerite with yellowish weathering and small quartz veining; powder sample is representative of the bulk composition of the whole rock sample (powder and solid sample received).

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20.27.d. Dome Mine: Spectral Data

Sample	*Facility/File No.*	*Description*
(a) ASD spectra		
30b	PSF 120119a.001	unsorted, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
31.1	PSF 120119a.002	unsorted, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
31.2	PSF 120119a.003	unsorted, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
35b.1	PSF 120119a.004	unsorted, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
35b.2	PSF 120119a.013	unsorted, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
39b	PSF 120119a.014	unsorted, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
46a	PSF 120119a.015	unsorted, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
30b	PSF 120119a.005	whole rock surface, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
31.1	PSF 120119a.006	whole rock surface, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
31.2	PSF 120119a.007	whole rock surface, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].

35b.1	PSF 120119a.008	whole rock surface, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
35b.2	PSF 120119a.010	whole rock surface, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
39b	PSF 120119a.011	whole rock surface, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].
46a	PSF 120119a.012	whole rock surface, 0.35-2.5 μm, i=30°/e=0°; 2-7 nm resol.; 200 spectra averaged; ASD [Directory: 120125_DAMP].

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(b) Bruker Vertex 70 FTIR reflectance spectra

30b	PSF 30 b	unsorted, 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
31.1	PSF 31.1	unsorted, 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
31.2	PSF 31.2	unsorted, 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
35b.1	PSF 35 b.1	unsorted, 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
35b.2	PSF 35 b.2	unsorted, 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
39b	PSF 39 b	unsorted, 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
46a	PSF 46 a	unsorted, 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
30b	PSF WR 30 b	whole rock surface; 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
31.1	PSF WR 31.1	whole rock surface; 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
31.2	PSF WR 31.2	whole rock surface; 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
35b.1	PSF WR 35 b.1	whole rock surface; 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
35b.2	PSF WR 35 b.2	whole rock surface; 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
39b	PSF WR 39 b	whole rock surface; 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].
46a	PSF WR 46 a	whole rock surface; 1.6-25 μm, i=30°/e=0°; 7.7 cm^{-1} resol.; 2500 spectra averaged; Bruker Vertex 70 [Directory: 120125_DAMP/DPT].

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END of 20.27.

20. Analogue Sites

20.28. International Space Analogue Rockstore (ISAR)

Samples received November 2012 for spectral reflectance analysis.

20.28a. ISAR - Sample Descriptions

Old ISAR Sample ID	*New ISAR sample ID*	*Sample description*
06AU01-3	06AU01	Banded iron formation: Kitty's Gap outcrop, Pilbara, Australia.
07SA20-3	07ZA20	Basalt: Komatii River outcrop, Barberton, South Africa.
09ET01-3	09IT01	Basalt: Etna, Sicilia, Italy.
09SV02-3	09SJ02	Dunite: Sverefjell outcrop, Svalbard, Norway; associated with 09SV05-4 and 09SV15-4 (dunite xenoliths in basalt).
09SV05-4	09SJ05	Carbonate: Sverefjell outcrop, Svalbard, Norway; associated with 09SV02-3 and 09SV15-4 (carbonate in basaltic rock).
09SV15-4	09SJ15	Basalt: Sverefjell outcrop, Svalbard, Norway; associated with 09SV02-3 and 09SV05-4.
09TE08-4	09IC08	Phonolite: El Tiede Volcano, Tenerife, Canary Islands, Spain.
10SA09-3	10ZA09	Komatiite: Komatii River, Barberton, South Africa.
11CA02-3	11CA02	Komatiite: Dundonald outcrop, Ontario, Canada.
11CY04-3	11CY04	Carbonate: Katydata outcrop, Nicosia district, Cyprus.
99SA01-3	99ZA01	Chert: Buck Reef Chert, Barberton, South Africa.

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20.28c. Compositional Data - ISAR Samples - Analytical data available from ISAR

06AU01	XRD, Mossbauer, IR transmission for low iron (06AU01-1) and high iron (06AU01-2) parts (from ISAR site).
07ZA20	XRD, Mossbauer, IR transmission (from ISAR site).
09IT01	XRD, Mossbauer, IR transmission, Raman (from ISAR site).
09SJ02	XRD, Mossbauer, IR transmission, Raman, multiple spots by microprobe (from ISAR site).
09SJ05	XRD, Mossbauer, IR transmission, Raman, multiple spots by microprobe (from ISAR site).
09IC08	Mossbauer, Raman, electron microprobe (from ISAR site).
10ZA09	XRD, Mossbauer, IR transmission (from ISAR site).
11CA02	Raman, EDXS, microprobe (from ISAR site).

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20.28c.1. Analytical Data from ISAR - Elemental Abundances

From ISAR web site and Bost et al. (2013) and e-mail from Frederic Foucher (March 2013).

ISAR ID	06AU01-1	06AU01-2	07ZA20-1	07ZA20	07ZA20
Type	BIF	BIF	Komatiite	Basalt	Basalt
	Low Fe	High Fe			
Wt. %	Content part	content part		plagioclase	pyroxene
SiO_2	85.13	85.19	43.02	62.024	49.597
Al_2O_3	0.18	0.17	15.66	14.651	15.008
Fe_2O_3[1]	12.50	12.61	16.41		
FeO[2]				5.32	11.571
MnO	0.28	0.28	0.26	0.046	0.259
MgO	<l.d.	<l.d.	5.45	2.809	4.571
CaO	<l.d.	<l.d.	9.14	3.394	4.412
Na_2O	<l.d.	<l.d.	2.88	7.838	4.866
K_2O	<l.d.	<l.d.	0.30	0.142	0.364
TiO_2	0.0050	0.0040	2.18	0.095	2.178
P_2O_5	0.082	0.077	0.23	0.167	0.071
Cr_2O_3				0.028	0
Cl				0.026	0.013
LOI	0.90	0.80	4.38		
Total	99.07	99.14	99.90		
Source:	ISAR site ICP	ISAR site ICP	ISAR site ICP	Bost et al. (2013) EMPA	Bost et al. (2013) EMPA

Note: many other elemental abundances also available from ICP-MS analyses (see ISAR web site). EMPA = electron microprobe analysis.

1. All Fe reported as Fe_2O_3?
2. All Fe reported as FeO?

<l.d. = lower than detection limit.

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20.28c.1. Analytical Data from ISAR - Elemental Abundances (continued)

ISAR ID	09IC08	09IC08	09IC08
Type	Phonolite	Phonolite	Phonolite
Wt. %	Amphibole	Plagioclase	Apatite
SiO_2	51.692	61.372	0.528
Al_2O_3	1.931	20.419	0.015
Fe_2O_3[1]			
FeO[2]	8.81	0.549	0.265
MnO	0.612	0.105	0.056
MgO	13.654	0.472	0.023
CaO	22.097	3.011	54.161
Na_2O	0.985	7.759	0.163
K_2O	0	3.084	0
TiO_2	0.911	0.078	0
P_2O_5	0.222	0.066	41.14
Cr_2O_3	0	0	0
Cl	0	0	0.238
LOI			
TOTAL			
Source:	Bost et al. (2013) EMPA	Bost et al. (2013) EMPA	Bost et al. (2013) EMPA

Note: many other elemental abundances also available from ICP-MS analyses (see ISAR web site). EMPA = electron microprobe analysis.

1. All Fe reported as Fe_2O_3?
2. All Fe reported as FeO?

See: Bost et al. (2013).

<l.d. = less than detection limit.

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20.28c.1. Analytical Data from ISAR - Elemental Abundances (continued)

ISAR ID	09IT01-1	09IT01	09IT01	09SJ02-1	09SJ02-1	09SJ02	09SJ02
Type	Basalt	Basalt	Basalt	Dunite	Dunite	Dunite	Dunite
Wt.%		olivine	diopside	Basaltic part	Dunite part	enstatite	olivine
SiO_2	48.09	41.228	48.307	44.13	43.65	56.137	40.711
Al_2O_3	11.30	0.021	12.032	13.91	3.51	3.520	0
Fe_2O_3[1]	10.43			10.73	9.89		
FeO[2]		9.166	10.283			6.579	10.262
MnO	0.18	0.071	0.052	0.15	0.14	0.143	0.125
MgO	12.06	51.158	9.025	9.85	37.84	34.833	1.002
CaO	12.67	0.256	15.198	10.44	3.33	0.168	0.003
Na_2O	1.82	0.034	1.709	4.64	0.35	0.093	0
K_2O	0.95	0.024	1.180	2.00	0.04	0	0
TiO_2	1.02	0	1.304	2.20	0.14	0.098	0.005
P_2O_5	0.29	0.05	0.428	0.87	0.051	0	0
Cr_2O_3		0.044	0.015			0.197	0.05
Cl		0	0.113			--	--
LOI	1.47			0.77	0.22		
TOTAL	100.27			99.68	99.17		
Source:	ISAR site	Bost et al. (2013)	Bost et al. (2013)	ISAR site	ISAR site	Bost et al. (2013) EMPA	Bost et al. (2013) EMPA

Note: many other elemental abundances also available from ICP-MS analyses (see ISAR web site). EMPA = electron microprobe analysis.

1. All Fe reported as Fe_2O_3?
2. All Fe reported as FeO?

<l.d. = lower than detection limit.

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20.28c.1. Analytical Data from ISAR - Elemental Abundances (continued)

ISAR ID	09SJ05-1	09SJ-15	09SJ15	09SJ15	09SJ15
Type	Carbonate	Basalt	Basalt	Basalt	Basalt
Wt. %			Olivine	plagioclase	pyroxene
SiO_2	7.77		40.071	49.478	42.159
Al_2O_3	2.18		0.06	19.025	9.87
Fe_2O_3[1]	3.05				
FeO[2]			15.094	6.984	8.459
MnO	0.061		0.08	0.182	0.128
MgO	28.46		46.088	2.225	10.744
CaO	14.41		0.242	4.628	22.751
Na_2O	0.50		0.003	7.19	0.627
K_2O	0.23		0.028	4.667	0.088
TiO_2	0.40		0.003	2.198	5.286
P_2O_5	0.17		0.105	1.015	0.330
Cr_2O_3					
Cl					
LOI	42.32		0	0.205	0
TOTAL	99.54				
Source:	ISAR site ICP	ISAR site ICP	Bost et al. (2013) EMPA	Bost et al. (2013) EMPA	Bost et al. (2013) EMPA

Note: many other elemental abundances also available from ICP-MS analyses (see ISAR web site). EMPA = electron microprobe analysis.

1. All Fe reported as Fe_2O_3?
2. All Fe reported as FeO?

<l.d. = lower than detection limit.

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20.28c.1. Analytical Data from ISAR - Elemental Abundances (continued)

ISAR ID	10ZA09-1	10ZA09	10ZA09
Type	Komatiite	Komatiite	Komatiite
Wt. %		pyroxene	clays
SiO_2	44.69	52.46	44.405
Al_2O_3	3.88	3.803	1.047
Fe_2O_3[1]	12.00		
FeO[2]		8.457	10.526
MnO	0.16	--	--
MgO	24.10	20.756	20.756
CaO	4.73	10.611	0.204
Na_2O	0.33	0.732	0.069
K_2O	0.03	0.045	0.004
TiO_2	0.34	0.369	0.06
P_2O_5	<l.d.	0.149	0
Cr_2O_3		0.668	0.123
Cl		0.013	0
LOI	8.54		
TOTAL	98.79		
Source:	ISAR site	Bost et al. (2013)	Bost et al. (2013)

Note: many other elemental abundances also available from ICP-MS analyses (see ISAR web site).
1. All Fe reported as Fe_2O_3?
2. All Fe reported as FeO?
See: Bost et al. (2013).
<l.d. = less than detection limit.
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20.28c.1. Analytical Data from ISAR - Elemental Abundances (continued)

ISAR ID	11CA02-1	11CA02	11CA02	11CY04-1
Type	Komatiite	Komatiite	Komatiite	Carbonate
Wt. %		Amphibole	Clays	
SiO_2	42.89	48.322	32.562	22.22
Al_2O_3	6.64	6.052	12.937	5.67
Fe_2O_3[1]	10.27			3.18
FeO[2]		8.115	10.84	
MnO	0.17	0.018	0.086	0.035
MgO	23.59	16.073	26.138	7.76
CaO	7.83	17.105	0.064	26.09
Na_2O	0.07	0.158	0.137	0.97
K_2O	0.02	0.001	0.166	0.43
TiO_2	0.34	0.387	0.023	0.21
P_2O_5	0.05	0.247	0.089	0.04
Cr_2O_3		0.386	0.022	
Cl		0.012	0.02	
LOI	7.52			32.66
TOTAL	99.39			99.26
Source:	ISAR site	Bost et al. (2013)	Bost et al. (2013)	Foucher (pers. comm.)

Note: many other elemental abundances also available from ICP-MS analyses (see ISAR web site).
1. All Fe reported as Fe_2O_3?
++

20.28d. Spectral Data - ISAR Samples

Sample	*Facility/File No.*	*Description*
06AU01-3	PSF 140326a.003	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
06AU01-3	PSF 140326a.013	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
07SA20-3	PSF 140326a.009	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
07SA20-3	PSF 140326a.019	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
09ET01-3	PSF 140326a.002	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
09ET01-3	PSF 140326a.012	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
09SV02-3	PSF 140326a.010	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
09SV02-3	PSF 140326a.020	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
09SV05-4	PSF 140326a.021	whole rock surface; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
09SV15-4	PSF 140326a.005	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
09SV15-4	PSF 140326a.015	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
09TE08-4	PSF 140326a.004	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
09TE08-4	PSF 140326a.014	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
10SA09-3	PSF 140326a.008	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
10SA09-3	PSF 140326a.018	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
11CA02-3	PSF 140326a.001	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
11CA02-3	PSF 140326a.011	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
11CY04-3	PSF 140326a.006	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
11CY04-3	PSF 140326a.016	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
++++++		
99SA01-3	PSF 140326a.007	<90 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).
99SA01-3	PSF 140326a.017	90-1000 μm; i=30°, e=0°; 0.35-2.5 μm; 1 nm spectral output; 200 spectra averaged; ASD (directory: 140326 ISAR).

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END of 20.28.

20. Analogue Sites

20.29. Meriden, CT, USA - Pillow Basalts

Locality: *Quarried rock face behind Target store in Meriden. Consists of slightly altered pillow basalts and massive basalts emplaced in sediments. Visited June 1-5, 2013.*

Three main faces exposed. South face shows contact with sediments. Western face is the longest (directly behind the building) and has the pillow lava-sediment contact exposed in the SW corner. Towards the north it grades to more massive basalts. The northern wall has heavily zeolitized and vesicular basalts (mostly massive but some pillows) and seems to be the most altered toward the east corner.

20.29a. Sample Descriptions - Meriden, CT, USA Pillow Basalts

Sample ID	*Description*
MER001	Jasper (red quartz) from vein on north wall toward west corner.
MER002	Pillow basalt fragment showing outer devitrified coating and weathering rind (collected at NW corner of wall).
MER003	Pillow basalt fragment showing outer devitrified coating and weathering rind (collected at NW corner of wall).
MER004	Basalt with elongated red and white vesicle fill (N or W wall).
MER005	Pillow basalt fragment showing outer devitrified coating and weathering rind and some white vesicle fill (collected at NW corner of wall?).
MER006	Vein fill – tabular and bladed crystals (W or N wall; 3 pieces).
MER007	Amethyst and quartz vein fill (N wall).
MER008	Vein fill – quartz (W or N wall).
MER009	Vein fill: tabular/bladed crystals and concretionary layers (W wall)
MER010	Vein or vesicle fill: accretionary tubules (W wall).
MER011	Vein fill: smoky quartz crystals and ovoid zeolite (?).
MER012	Massive white/pale green vein filling (N or W wall).
MER013	Altered pillow basalt and minor vein fill. (W wall).
MER014	Vegetation replaced by quartz? Plant stems with banded layers; some hollow.
MER015	Vein fill: banded concretions and quartz crystals (W wall).
MER016	Vein fill: wedge-shaped with banding (W wall).
MER017	Vesicular basalt with (mostly) green vesicle fill (N wall; 4 pieces).
MER018	Basalt with slickensided (?) face (W or N wall).
MER019	Vein fill: quartz and pale green mineral (N wall).
MER020	Altered (chloritized/bleached?) material with veins filled with brown/white quartz? (W or N wall; 2 pieces).
MER021	Altered (chloritized/bleached) material with quartz (white/brown) crystals (W or N wall; 4 pieces).
MER022	Vesicular basalt with dark green vesicle fill (N wall?).
MER023	Basalt with some glassy internal surfaces (N wall).
MER024	Bleached basalt with dark green vesicle fill (N wall).
MER025	Vein fill: quartz and green crystals (prehnite?; N wall).
MER026	Vein filling: quartz crystals and pale yellow crystals (prehnite?; N wall; 2 pieces).
MER027	Quartz fragments and quartz vein fill (5 pieces).
MER028	Chloritized basalt with shiny surfaces and dark green vesicle fill.
MER029	Various small fragments.
MER030	Basalt with numerous filled veins (quartz, amethyst).
MER031	Quartz vein fill with ovoids, layered elongated circular concretions.
MER032	Chloritized basalt with quartz-filled veins (2 pieces).
MER033	Basalt with alteration coronas and altered/slickensided surface.
MER034	Fragmented basalt with vein filling and quartz? tabular crystals (2 pieces).

MER035	Silicified plant remains (?) (W wall).
MER036	Vesicular iron-stained basalt with pale-green (mostly) vesicle fill (N wall) (2 pieces).
MER037	Vesicular basalt with elongated and variably filled vesicles (N wall; 2 pieces).
MER038	Small (2 cm) volcanic bomb (?) or small flow (N wall).
MER039	Thermally altered sediments, <1 m from basalt contact (S wall).
MER040	Vesicular basalt with dark green vesicle fill (N wall).
MER041	"Typical" massive, slightly altered basalt (N wall).
MER042	"Typical" massive, relatively unaltered basalt (N wall).
MER043	"Typical" massive, relatively unaltered basalt (N. wall).
MER044	Crystalline quartz vein fill (N. wall; 3 pieces).
MER045	Vesicular basalt with dark green vesicle fill, also showing rind alteration and bleaching (N. wall; 3 pieces).
MER046	Chloritized (?) basalt showing shiny surfaces (volcanic bombs or small flows).
MER047	Section from base of basalt flow through underlying sediments (SW corner of outcrop).

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END of 20.29.

20. Analogue Sites

20.30. Big Spring Hill Provincial Park, AB, Canada

- *Park located north of Calgary and west of Airdrie, AB.*
- *Site is characterized by a wide variety of tufa (calcium carbonate) mounds, both active and fossil.*
- *Site visited and samples collected August 29, 2013*

20.30a. Sample Descriptions - Big Spring Hill Provincial Park, AB, Canada

Sample ID	*Description*
BSH001	Tufa cobble hammered off second fossil mound from parking lot; contains endolithic (green) layer.
BSH002	Tufa cobble picked up from ground near second fossil mound.
BSH003-010	Smaller tufa cobbles and fragments from near second fossil mound.
BSH011	Tufa cobble picked out of outflow stream closer to active source (beyond picnic area)
BSH012	Tufa cobble picked out of outflow stream closer to active source (beyond picnic area).

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20.30b. XRD Data - Big Spring Hill Provincial Park, AB, Canada

(i) XRD Results (U of W Bruker D8 quick scans – Oct. 2013)

BSH003	Calcite and quartz

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20.30c. Compositional Data - Big Spring Hill Provincial Park, AB, Canada

Wt. %	BSH-012
SiO_2	12.93
TiO_2	0.05
Al_2O_3	1.83
FeO	1.21
Fe_2O_3	-0.78
*(Fe_2O_3)**	*(0.56)*
MnO	0.02
MgO	1.31
CaO	81.97
Na_2O	0.12
K_2O	0.27
P_2O_5	0.12
SO_3	0.07
TOTAL	99.25
LOI	46.11
ppm	
Sr	666
Zr	102
V	44
Ni	2
Cr	15
Co	<1
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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END of 20.30.

20. Analogue Sites

20.31. British Columbia, Canada

20.31.1. Qualicum Bay, Vancouver Island, BC, Canada
20.31.2. Esquimault Lagoon, Victoria, BC, Canada
20.31.3. Gonzalez Bay, Victoria, BC, Canada
20.31.4. Witty's Lagoon Park, near Victoria, BC, Canada

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20.31. Sample Descriptions - British Columbia, Canada

Sample ID	*Description*

20.31.1a. Qualicum Bay, Vancouver Island, BC, Canada (August 2013)

BC001	Clam shells and fragments for possible vaterite.

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20.31.2a. Esquimault Lagoon, Victoria, BC, Canada (August 2013)

BC002	Clam shells and fragments for possible vaterite.

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20.31.3a. Gonzalez Bay, Victoria, BC, Canada (August 2013)

BC003	Radiolarian chert vein material and country rock. Site 8 in Yorath (2005).
BC004	Radiolarian chert vein material and country rock. Site 8 in Yorath (2005).

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20.31.4a. Witty's Lagoon Park, near Victoria, BC, Canada (August 2013)

BC005	Pillow basalts, Witty's Lagoon Park Oceanside outcrop. Site 9 in Yorath (2005).

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20.31b. XRD Data - British Columbia, Canada

(i) XRD Results (U of W Bruker D8 quick scans – Oct. 2013)

Sample	*Phases(s) Identified*
BC001a (shell)	Aragonite
BC001b (growth on shell – barnacles)	Calcite
BC002	Aragonite

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END of 20.31.

20. Analogue Sites

20.32. Rift Valley, Oloomirani, Kenya

30.32a. Sample Descriptions - Rift Valley, Looomirani, Kenya

- *Rocks from local quarry used as base fill for new school construction (acquired April 2014).*

Kenya1	Iron oxide-stained (red) weathered granite? (quartz, feldspar, amphibole, mica?)
Kenya2	Iron oxide-stained (red) weathered granite? (quartz, feldspar, mica); more mica-rich.
Kenya3	Medium gray basalt with sparse black (pyroxene?) and white (plagioclase?) phenocrysts; some exterior weathering.
Kenya4	Medium gray basalt with white mica phenocrysts and adhering dirt.

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END of 20.32.

21. Fossils

21a. Sample Descriptions - Fossils

Various fossil-bearing samples accumulated over time.

Sample ID	*Description*
FOS001	Crinoid stem; locality unknown (Mineral Society of Manitoba), 1 specimen.
FOS002	Brachiopod, Manitoba (Mineral Society of Manitoba); 4 specimens.
FOS003	Horn coral, Manitoba (Mineral Society of Manitoba); 3 specimens.
FOS004	Petrified wood; locality unknown (Mineral Society of Manitoba),1 specimen.
FOS005	Dinosaur bone, Alberta (Minerals Society of Manitoba); 2 specimens.
FOS006	Shark teeth, 1 from Florida, 1 from unknown locality (Mineral Society of Manitoba), 2 specimens.
FOS007	Massive coral sample.
FOS008	Horn coral, locality unknown.
FOS009	Mystery soft-bodied smear on rock.
FOS010	Plant fossils in shale, Red Deer River valley, near Red Deer, Alberta, Canada.
FOS011	Brachiopod?, locality unknown.
FOS012	Brachiopod?, locality unknown.
FOS013	Graptolites; locality unknown.
FOS014	Belemnite; locality unknown.
FOS015	Clam, locality unknown.
FOS016	Petrified wood; locality unknown.
FOS017	Big-ass snail shell fossil; locality unknown.
FOS018	Marine fossiliferous limestone from Mafeking North Quarry (May 2013).
FOS019	Marine fossiliferous limestone: Devonian reef on road to East German Creek springs (May 2013).
FOS020	Marine fossiliferous limestone: Devonian reef on road to East German Creek springs (May 2013).
FOS021	Belemnite fragment; unknown locality.
FOS022	Leaf impression fossils in shale; red Deer River valley, Red Deer, AB, Canada.
FOS023	Fossilized (with Fe-staining) clam shell – Manitoba, Canada

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END of 21.

22. Environment Chamber Runs

22.1. Runs performed in summer 2006

During the summer of 2006 five suites of between 8 and 9 mineral samples were exposed to simulated Mars surface conditions for periods ranging up to 40 days in mini-ME environment chamber. They were subjected sequentially to the following conditions:

1. Approximate Mars surface pressures of dry CO_2 (5 Torr; 660 Pa)
2. 5 Torr (660 Pa) pressure with UV irradiation from 2-25W deuterium lamps.
3. MilliTorr (a few Pa) pressures of dry CO_2 (between 8 and 20 milliTorr)
4. MilliTorr (a few Pa) pressures plus UV irradiation.

Samples were placed in a multi-well aluminum sample holder (with ten 8 mm diameter sample wells) and measured relative to pressed halon in one of the wells (for the ASD measurements) or a Labsphere 1" diameter diffuse gold standard also viewed through an identical sapphire window of the same path length, but in air (for the D&P measurements).

Data quality in the 5th run was particularly poor for the ASD measurements due to instrument performance issues.

The sample spectra were measured periodically during the exposures through a 10 mm thick sapphire window, which provides good transparency from ~200 nm up to about 4 µm. The sapphire window did cause some scattered light issues which resulted in high overall reflectance for the samples and absorption bands that were more subdued than the spectra measured in air. The scattered light also introduced some spectral artifacts due to the aluminum sample holder and environment chamber; these are most noticeable as small bands near 0.62-0.65 microns and a frequent upturn in reflectance below ~0.5 microns.

The difference in atmosphere between the samples in the chamber and the diffuse gold standard also caused the appearance of carbon dioxide bands near 4.2-4.3 microns. D&P data beyond about 5 microns are unreliable because of scatter from the sapphire window and other issues, such as poor output from the light source at longer wavelengths.

ASD spectra were corrected for the jumps where detectors switch over at 1000 and 1830 nm. Spectra were also normalized at 1250 nm; this region was chosen because it is outside of major mineral absorption bands. The normalization also allows relative spectral differences to be better highlighted. A number of the mineral samples showed visible shrinkage during the course of the run (likely due to loss of water). This shrinkage probably accounts for some of the changes in absolute reflectance over the course of the runs for some of the minerals.

Samples were cooled to ~15° C by circulating water into the small environment chamber (mini-ME). During the latter part of run 2 (milliTorr plus UV irradiation) the water flow was drastically reduced during one weekend, resulting in excessive sample heating (perhaps to at least 40°C) and visible darkening (burning?) of some of the samples. During run 5, a slow leak developed allowing samples to slowly return to ambient pressures toward the end of the run.

Reflectance spectra were measured without the sapphire window in place at the start and end of each run.

The experimental conditions for each of the 5 runs are provided below:

Run #	*Sample ID*	*Sample type*	*Grain size (µm)*	*Sample class*
1	CLI101	Clinochlore	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	NON101	Nontronite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	SRP104	Serpentine	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	CRB118	Calcite	<45	Carbonate. *See also section 5 for additional spectra acquired ambient conditions.*
	CRB118	Calcite	90-180	Carbonate. *See also section 5 for additional spectra acquired ambient conditions.*
	SPT116	Jarosite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT127	Gypsum	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT143	Hexahydrite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
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2	SPT117	Copiapite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT121	Fibroferrite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT128	Anhydrite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT129	Alunite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT137	Paracoquimbite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT139	Rhomboclase	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT141	Kieserite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT144	Szomolnokite	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	CHM102	Chamosite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
++++++				
3	SPT127	Gypsum	<45	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
	SPT143	Hexahydrite	<45	Sulfate. *See also section 8 for additional*

				spectra acquired ambient conditions.
	BER102	Berthierine	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	CRO101	Cronstedtite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	GLA103	Glauconite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	HIS001	Hisingerite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	SAP101	Saponite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	BEI101	Beidellite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	HAL001	Halloysite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
++++++				
4	TAR17	Oil sand	unsorted	Organic. *See also section 18.2 for additional spectra acquired ambient conditions.*
	GIL101	Gilsonite	<45	Organic. *See also section 18.3 for additional spectra acquired ambient conditions.*
	OILS10	Oil shale	<45	Organic. *See also section 18.3 for additional spectra acquired ambient conditions.*
	OOH012	Diaspore	<45	Hydroxide. *See also section 6 for additional spectra acquired ambient conditions.*
	OOH003	Goethite	<45	Hydroxide. *See also section 6 for additional spectra acquired ambient conditions.*
	MON101	Montmorillonite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	CRB114	Magnesite	<45	Carbonate. *See also section 5 for additional spectra acquired ambient conditions.*
	CRB215	Hydromagnesite	<45	Carbonate. *See also section 5 for additional spectra acquired ambient conditions.*
	PAL101	Palagonite	<45	Amorphous. *See also section 12 for additional spectra acquired ambient conditions.*
++++++				
5	NON101	Nontronite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
	CRB105	Huntite	<45	Carbonate. *See also section 5 for additional spectra acquired ambient conditions.*
	MIN002	Minnesotaite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient*

			conditions.
GRE001	Greenalite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*
ZEO110	Thomsonite	<45	Zeolite. *See also section 2.10 for additional spectra acquired ambient conditions.*
CRB108	Siderite	<45	Carbonate. *See also section 5 for additional spectra acquired ambient conditions.*
PRT101	Pyrite	<45	Sulfide. *See also section 10 for additional spectra acquired ambient conditions.*
MAG112	Magnetite	<45	Oxide. *See also section 9.2 for additional spectra acquired ambient conditions.*
KAO101	Kaolinite	<45	Phyllosilicate. *See also section 3 for additional spectra acquired ambient conditions.*

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The duration of each run is shown below:

Run #	Days at 660 Pa	Days at 660 Pa + UV	Days at few Pa	Days at few Pa + UV	Lowest pressure (Pa)
1	14	9	25	0	1.0
2	9	11	9	7	1.3
3	9	10	10	0	2.6
4	11	10	10	0	2.6

As mentioned, reflectance spectra with both the ASD and D&P spectrometers were acquired every one to few days over the course of the experiments. Dates of spectral acquisition are provided below. All the samples in the sample disk were spectrally characterized with both instruments on these dates.

ASD spectra were acquired with a bifurcated cable, providing approximately 1=0° and e=0°; spectral resolution varies between 2 and 7 nm; spectral range: 0.35-2.5 μm. For Runs 1-5, 2000 spectra were averaged to improve signal to noise.

Run/Date Notes

Run 1

Nov. 15/05 (directory: nov1505)
Spectra measured in air, no sapphire window

Nov. 16/05 (directory: nov1605)
Spectra measured in air, no sapphire window; D&P spectra only.

Nov. 22/05 (directory: nov22051)
Spectra measured in air, through sapphire window; D&P spectra only.

Nov. 22/05 (directory: nov 22052)
Spectra measured in air, through sapphire window; D&P spectra only.

Nov. 22/05 (directory: nov22053)
Spectra re-measured in air, through sapphire window; D&P spectra only.

Nov. 23/05 (directory: ASD: nov2305; D&P: nov2305mor, nov2305aft)

First 660 Pa measurement after pumpdown.
Nov. 24/05 (directory: ASD: nov2405; D&P: nov2405)
At 660 Pa
Nov. 25/05 (directory: ASD: nov2505; D&P: nov2505)
At 660 Pa
Nov. 26/05 (directory: ASD: nov2605; D&P: nov2605)
At 660 Pa
Nov. 27/05 (directory: ASD: nov2705; D&P: nov2705)
At 660 Pa
Nov. 28/05 (directory: ASD: nov2805; D&P: nov2805)
At 660 Pa
Nov. 29/05 (directory: ASD: nov2905; D&P: nov2905)
At 660 Pa
Nov. 30/05 (directory: ASD: nov3005; D&P: nov3005)
At 660 Pa
Dec. 01/05 (directory: ASD: dec0105; D&P: dec0105)
At 660 Pa
Dec. 02/05 (directoyr: ASD: dec0205; D&P: dec0205)
At 660 Pa
Dec. 07/05 (directory: ASD: dec0705; D&P: dec0705)
Last 660 Pa measurement, then UV turned on; light source bulb replaced.
Dec. 09/05 (directory: ASD: dec0905; D&P: dec0905)
At 660 Pa plus UV irradiation
Dec. 12/05 (directory: ASD: dec1205; D&P: dec1205)
At 660 Pa plus UV irradiation
Dec. 15/05 (directory: ASD: dec1505; D&P: dec1505)
Last 660 Pa plus UV irradiation measurement; UV then turned off and pressure reduced to 1.0 Pa.
Dec. 16/05 (directory: ASD: dec1605; D&P: dec1605)
At 1.0 Pa
Dec. 19/05 (directory: ASD: dec1905; D&P: dec1905)
At 1.0 Pa
Dec. 21/05 (directory: ASD: dec2105; D&P: dec2105)
At 1.0 Pa
Dec. 23/05 (directory: ASD: dec2305; D&P: dec2305)
At 1.0 Pa
Dec. 28/05 (directory: ASD: dec2805; D&P: dec2805)
At 1.0 Pa
Dec. 30/05 (directory: ASD: dec3005; D&P: dec3005)
At 1.0 Pa
Jan. 09/06 (directory: ASD: jan0906; D&P: jan0906)
At 1.0 Pa
Jan. 10/06 (directory: ASD: jan1006; D&P: jan1006)
Pressure returned to 660 Pa right before measurement; last measurements.
++++++++++++++++++++++++++++++

Run 2

Mar. 21/06 (directory: ASD: mar2106; D&P: mar2106airrefnw)
Spectra measured in air, no sapphire window

Mar. 22/06 (directory: ASD: mar2206; D&P: mar2206wwref)
Spectra measured in air through sapphire window.

Mar. 22/06 (directory: ASD: mar2206; D&P: mar2206)
First 660 Pa measurement after pumpdown.

Mar. 23/06 (directory: ASD: mar2306; D&P: mar2306)
At 660 Pa

Mar. 24/06 (directory: ASD: mar2406; D&P: mar2406)
At 660 Pa

Mar. 25/06 (directory: ASD: mar2506; D&P: mar2506)
At 660 Pa

Mar. 28/06 (directory: ASD: mar2806; D&P: mar2806)
At 660 Pa

Mar. 29/06 (directory: ASD: mar2906; D&P: mar2906)
At 660 Pa

Mar. 30/06 (directory: ASD: mar3006; D&P: mar3006)
At 660 Pa

Mar. 31/06 (directory: ASD: mar3106; D&P: mar3106)
Last 660 Pa measurement, then UV turned on

Apr. 03/06 (directory: ASD: apr0306; D&P: apr0306)
At 660 Pa plus UV irradiation

Apr. 04/06 (directory: ASD: apr0406; D&P: apr0406)
At 660 Pa plus UV irradiation

Apr. 06/06 (directory: ASD: apr0606; D&P: apr0606)
At 660 PA plus UV irradiation

Apr. 07/06 (directory: ASD: apr0706; D&P: apr0706)
At 660 Pa plus UV irradiation

Apr. 11/06 (directory: ASD: apr1106; D&P: apr1106)
Last 660 Pa plus UV irradiation measurement; UV then turned off and pressure reduced to 1.3 Pa.

Apr. 11/06 (directory: ASD: apr11062; D&P: apr11062)
At 1.3 Pa

Apr. 12/06 (directory: ASD: apr1206; D&P: apr1206)
At 1.3 Pa

Apr. 13/06 (directory: ASD: apr1306; D&P: apr1306)
At 1.3 Pa

Apr. 17/06 (directory: ASD: apr1706; D&P: apr1706)
At 1.3 Pa

Apr. 18/06 (directory: ASD: apr1806; D&P: apr1806)
At 1.3 Pa

Apr. 19/06 (directory: ASD: apr1906; D&P: 1pr1906)
At 1.3 Pa; UV turned on after measurements

Apr. 20/06 (directory: ASD: apr2006; D&P: apr2006)

At 1.3 Pa plus UV irradiation
Apr. 22/06 (directory: ASD: apr2206; D&P: apr2206)
At 1.3 Pa plus UV irradiation
Apr. 26/06 (directory: ASD: apr2606; D&P: apr2606)
At 1.3 Pa plus UV irradiation
Apr. 26/06 (directory: ASD: apr26062; D&P: apr26062; unsmoothed spectra: apr0406ns)
Spectra measured in air, no sapphire window
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Run 3

May 01/06 (directory: ASD: may0106; D&P: may0106)
Spectra measured in air, no sapphire window
May 02/06 (directory: ASD: may0206a; D&P: may0206inairww)
Spectra measured in air through sapphire window
May 02/06 (directory: ASD: may0206; D&P: may0206)
First 660 Pa measurement after pumpdown.
May03/06 (directory: ASD: may0306; D&P: may0306)
At 660 Pa
May 05/06 (directory: ASD: may0506; D&P: may0506)
At 660 Pa
May 09/06 (directory: ASD: may0906; D&P: may0906)
At 660 Pa
May 10/06 (directory: ASD: may1006; D&P: may1006)
Last 660 Pa measurement, then UV turned on
May 11/06 (directory: ASD: may1106; D&P: may1106)
At 660 Pa plus UV irradiation
May 12/06 (directory: ASD: may1206; D&P: may1206)
At 660 Pa plus UV irradiation
May 15/06 (directory: ASD: may1506; D&P: may1506)
At 660 Pa plus UV irradiation
May 16/06 (directory: ASD: may1606; D&P: may1606)
At 660 Pa plus UV irradiation
May 17/06 (directory: ASD: may1706; D&P: may1706)
At 660 Pa plus UV irradiation
May 18/06 (directory: ASD: may1806; D&P: may1806)
At 660 Pa plus UV irradiation
May 19/06 (directory: ASD: may1906; D&P: may1906)
At 660 Pa plus UV irradiation
May 20/06 (directory: ASD: may2006; D&P: may2006)
Last 660 Pa plus UV irradiation measurement; UV then turned off and pressure reduced to 2.6 Pa.
May 20/06 (directoy: ASD: may2006062; D&P: may20062)
At 2.6 Pa
May 23/06 (directory: ASD: may2306; D&P: may2306)
At 2.6 Pa

May 24/06 (directory: ASD: may2406; D&P: may2406)
At 2.6 Pa
May 27/06 (directory: ASD: may2706; D&P: may2706)
At 2.6 Pa
May 29/06 (directory: ASD: may2906; D&P: may2906)
At 2.6 Pa
May 30/06 (directory: ASD: may3006; D&P: may3006)
Last 2.6 Pa measurement, then samples exposed to air
May 30/06 (directory: ASD: may30062; D&P: may30062)
Measured in air through sapphire window; last measurements
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Run 4

June 05/06 (directory: ASD: jun0506inairnw; D&P: jun0506inairnw)
Spectra measured in air, no sapphire window
June 05/06 (directory: ASD: jun0506inairww; D&P: jun0506inairww)
Spectra measured in air through sapphire window
June 06/06 (directory: ASD: jun0606; D&P: jun0606)
First 660 Pa measurement after pumpdown.
June 07/06 (directory: ASD: jun0706; D&P: jun0706)
At 660 Pa
June 09/06 (directory: ASD: jun0906; D&P: jun0906)
At 660 Pa
June 13/06 (directory: ASD: jun1306; D&P: jun1306)
At 660 Pa
June 14/06 (directory: ASD: jun1406; D&P: jun1406)
At 660 Pa
June 16/06 (directory: ASD: jun1606; D&P: jun1606)
Last 660 Pa measurement, then UV turned on
June 17/06 (directory: ASD: jun1706; D&P: jun1706)
At 660 Pa plus UV irradiation
June 20/06 (directory: ASD: jun2006; D&P: jun2006)
At 660 Pa plus UV irradiation
June 22/06 (directory: ASD: jun2206; D&P: jun2206)
At 660 Pa plus UV irradiation
June 24/06 (directory: ASD: jun2406; D&P: jun2406)
At 660 Pa plus UV irradiation
June 26/06 (directory: ASD: jun2606; D&P: jun2606)
Last 660 Pa plus UV irradiation measurement; UV then turned off and pressure reduced to 2.6 Pa.
June 26/06 (directory: ASD: jun26062; D&P: jun26062)
At 2.6 Pa
June 27/06 (directory: ASD: jun2706; D&P: jun2706)
At 2.6 Pa
June 30/06 (directory: ASD: jun3006; D&P: jun3006)

At 2.6 Pa
July 04/06 (directory: ASD: jul0406; D&P: jul0406)
At 2.6 Pa
July 05/06 (directory: ASD: jul0506; D&P: jul0506)
At 2.6 Pa
July 06/06 (directory: ASD: jul0606; D&P: jul0606)
Last 2.6 Pa measurement, then samples exposed to air
July 06/06 (directory: ASD: jul06062; D&P: jul06062)
Measured in air, no sapphire window; last measurements
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Run 5
July 11/06 (directory: D&P: jul1106inairnw)
Spectra measured in air, no sapphire window
July 13/06 (directory: ASD: jul1306inairnw)
Spectra measured in air, no sapphire window
July 14/06 (directory: D&P: jul1406inairww)
Spectra measured in air through sapphire window
July 18/06 (directory: ASD: jul1806inairww)
Spectra measured in air through sapphire window
July 18/06 (directory: ASD: jul1806; D&P: jul1806)
First 660 Pa measurement after pumpdown (on same day).
July 19/06 (directory: ASD: jul1906; D&P: jul1906)
At 660 Pa
July 21/06 (directory: ASD: jul2106; D&P: jul2106)
At 660 Pa
July 25/06 (directory: ASD: jul2506; D&P: jul2506)
At 660 Pa
ASD data acquisition abandoned after July 25/06 due to instrument problems; D&P data collection continued.

July 28/06 (directory: D&P: jul2806)
Last 660 Pa measurement, then UV turned on
July 29/06 (directory: D&P: jul2906)
At 660 Pa plus UV irradiation
July 31/06 (directory: D&P: jul3106)
At 660 Pa plus UV irradiation
Aug. 04/06 (directory: D&P: aug0406)
At 660 Pa plus UV irradiation
Aug. 09/06 (directory: D&P: aug0906)
Last 660 Pa plus UV irradiation measurement; UV then turned off and pressure reduced to 2.6 Pa.
Aug. 09/06 (directory: D&P: aug09062)
At 2.6 Pa
Aug. 10/06 (directory: D&P: aug1006)
At 2.6 Pa

Aug. 11/06 (directory: D&P: aug1106)
At 2.6 Pa
Aug. 14/06 (directory: D&P: aug1406)
At 2.6 Pa
Aug. 17/06 (directory: D&P: aug1706)
At 2.6 Pa
Aug. 18/06 (directory: D&P: aug1806)
At 2.6 Pa
Aug. 19/06 (directory: D&P: aug1906)
Last 2.6 Pa measurement
Sep. 08/06 (directory: D&P: sep0806)
Increase pressure to 660 Pa, then measure spectra.
Oct. 16/06 (directory: D&P: oct1606)
Slow leak causes pressure to creep up to ambient, then measure spectra.
Nov. 02/06 (directory: D&P: nov0206)
Measured in air through sapphire window.
Nov. 03/06 (directory: D&P: nov0306)
Measured in air, no sapphire window.
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Rather than list all available spectra, they can be inferred from measurement dates.

Note: Run #5 ASD data are noisy and generally unreliable due to calibration issues with the ASD spectrometer that appeared during this run.

22.2. Run 6: August 2008 – September 9, 2010

A sixth run was started in August 2008, designed to examine longer-term exposure of various minerals. This run was focused on various iron sulphates (for Melissa Rice at Cornell University) and zeolites (for Jim Crowley of the USGS).

ASD spectra were acquired with a bifurcated cable, providing approximately 1=0° and e=0°; spectral resolution varies between 2 and 7 nm; spectral range: 0.35-2.5 µm; 1000 spectra were averaged to improve signal to noise. No D&P IR spectra were acquired.

The samples used (all <45 µm size powders) were:

Sample ID	*Sample type*	*Grain size (µm)*	*Sample class*
SPT139	Rhomboclase	<45 µm	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
SPT125	Copiapite	<45 µm	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
SPT126	Coquimbite	<45 µm	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
SPT121	Fibroferrite	<45 µm	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
SIL203	Silica sinter	<45 µm	Silica-rich. *See also section 2.11 for additional*

			spectra acquired ambient conditions.
SPT120	"Hydronium" jarosite	<45 µm	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
PIG205	Na-sulfate decahydrate	<45 µm	Sulfate. *See also section 8 for additional spectra acquired ambient conditions.*
ZEO201	Chabazite	<45 µm	Zeolite. *See also section 2.10 for additional spectra acquired ambient conditions.*
ZEO200	Heulandite	<45 µm	Zeolite. *See also section 2.10 for additional spectra acquired ambient conditions.*

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Measurements were made on the following days (directory, base finename):

Aug. 1, 2008 (runsix 080801: 080801a)	In air, no window
Aug. 6, 2008 (runsix 080806; 080806a)	In air, with window
Aug. 6, 2008 (runsix080806: 080806b)	At 5 Torr
Aug. 7, 2008 (runsix 080807: 080807b)	At 5 Torr
Aug. 11, 2008 (runsix 080811: 080811a)	At 5 Torr
Aug. 15, 2008 (runsix 080815: 080815a)	At 5 Torr
Aug. 22, 2008 (runsix 080822: 080822a)	At 5 Torr
Aug. 29, 2008 (runsix 080829: 080829a)	At 5 Torr
Sep. 13, 2008 (080913a)	At 5 Torr
Oct. 10, 2008 (080913a)	At 5 Torr
Nov. 5, 2008 (080913a)	At 5 Torr
Dec. 30, 2008 (081222a)	At 5 Torr
Mar. 9, 2009 (090309a)	At 5 Torr
Apr. 21, 2009 (090421 asd: 090421a)	At 5 Torr
Apr. 22, 2009	Added UV irradiation (one 25 W deuterium bulb)
Apr. 30, 2009 (090430a)	At 5 Torr plus UV
May 27, 2009 (090527a)	At 5 Torr plus UV (died after 40 days?)
Jul. 22, 2009 (090722a)	At 5 Torr
Aug. 20, 2009 (090820a)	At 5 Torr
Oct. 22, 2009 (091022a)	At 5 Torr
Dec. 18, 2009 (091218_minimars: 091218a)	At 5 Torr
Jan. 5, 2010 (100105_mini_mars: 100105a)	At 5 Torr
Mar. 2, 2010 (100302_mini_mars; 100302a)	At 5 Torr
Mar. 22, 2010 (100322_mini_mars: 100322a)	At 5 Torr plus UV (applied March 21, 2010)
Mar. 23, 2010 (100323_mini_mars: 100323a)	At 5 Torr plus UV
Mar. 24, 2010 (100324_mini_mars: 100324a)	At 5 Torr plus UV
Mar. 25, 2010 (100325_mini_mars: 100325a)	At 5 Torr plus UV
Mar. 26, 2010 (100326_mini_mars: 100326a)	At 5 Torr plus UV
Mar. 29, 2010 (100326_mini_mars: 100329a)	At 5 Torr plus UV
Apr. 5, 2010 (100405_mini_mars: 100405a)	At 5 Torr plus UV
Apr. 12, 2010 (100412_mini_mars: 100412a)	At 5 Torr plus UV
Apr. 19, 2010 (100419_mini_mars: 100419a)	At 5 Torr plus UV
Apr. 26, 2010 (100426_mini_mars: 100426a)	At 5 Torr (UV unknown)

May 18, 2010 (100518_mini_mars: 100518a)	At 5 Torr (UV unknown)
May 19, 2010	UV turned off (6:00 pm)
May 28, 2010 (100528_mini_mars: 100528a)	At 5 Torr, no UV
Jun. 10, 2010 (100610_mini_mars: 100610a)	At 5 Torr, no UV
Sep. 8, 2010 (100908_mini_mars: 100908a)	At 5 Torr, no UV
Sep. 9, 2010 (100909_mini_mars: 100909a)	At 1000 Torr, no UV, window on
Sep. 9, 2010 (100909_mini_mars: 100909b)	At 1000 Torr, no UV, window off, relative to halon in puck
Sep. 9, 2010 (100909_mini_mars: 100909c)	At 1000 Torr, no UV, window off; relative to Spectralon disk

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END of 22.

23. Miscellaneous Samples

Sample ID	*Description*
MIS001	Geode; locality unknown.
MIS002	Sandstone from old facing of Wesley Hall, University of Winnipeg, 2005.
MIS010	Buff coloured limestone chip from Gimli, Manitoba waterfront pathway (2006)
MIS011	Yellow-orange coloured limestone chip from Gimli, Manitoba waterfront pathway (2006).
MIS012	Red coloured limestone chip from Gimli, Manitoba waterfront pathway (2006).
MIS013	Iron concretions (Hondo, Texas; from Sue Atkinson).
MIS014	Gold-bearing quartz – Hollinger Mine.
MIS015	Quartz vein in conglomerate – locality unknown.
MIS016	Banded agate slice – locality unknown.
MIS017	Columnar calcite – cave wall in Greece.
MIS018	Mica-bearing pegmatite – northern Ontario
MIS019	Quartz-bearing gneiss – locality unknown.
MIS020	Fossiliferous limestone drill core section – locality unknown.
MIS021	Massive columnar calcite from cave wall, Greece.
MIS022	Total mystery – opaque, black, glassy something or other.
MIS023	Finely banded purple quartzite – locality unknown.
MIS024	Banded massive quartzite, locality unknown.
MIS025	Oxidized railroad spike, Calgary, Alberta, Canada.
MIS026	Biotite-quartz-garnet schist, 3 samples; East German Creek, Manitoba, Canada (2005).
MIS027	Hornblendite?; East German Creek, Manitoba, Canada (2005).
MIS028-036	Series of variously coloured pebbles from Kiato Beach, Greece (Aug. 09).
MIS037	Limestone: Mt. Boron summit; Nice France (collected July 2011).
MIS038	Massive sulfide – northern Ontario, Canada
MIS039	Massive sulfide – northern Ontario, Canada
MIS040	Massive sulfide? – northern Ontario, Canada
MIS041	Cave limestone – Velo, Greece
MIS042	Red granite – NL, Canada.
MIS043	Graded/bedded sandstone, Blomidon Park, NS, Canada.
MIS044	red jasper, Blomidon Park, NS, Canada.
MIS045	Greenstone (?) Inuit carving – locality unknown.
MIS046	Amphobilite/greenstone (?) Inuit carving; locality unknown.
MIS047	Banded limestone, Bay of Fundy, Nova Scotia (probably).
MIS048	Pink granite; shoreline rip rap at Seven Sisters Dam, MB, Canada.
MIS049	Black and white granite; shoreline rip rap at Seven Sisters Dam, MB, Canada.
MIS050	Gneiss – glacial erratic from East German Creek, MB, Canada
MIS051	Massive quartzite cobble (Highway 93 roadcut outside of Jasper, AB, Canada).
MIS052	Massive quartzite cobble with weathered surface (Highway 93 roadcut outside of Jasper, AB, Canada).
MIS053	Massive quartzite cobble (Highway 93 roadcut outside of Jasper, AB, Canada).
MIS054	Massive quartzite cobble (Highway 93 roadcut outside of Jasper, AB, Canada).
MIS055	Schist cobble (Highway 93 roadcut outside of Jasper, AB, Canada).
MIS056	Sandblasting slag; sandblasting grit – produced from copper smelting slag. Made by a company called Opta Minerals Inc. This is what their website says: "Ebony grit is produced from metallurgical slags and provides fast blast-cleaning rates. Three grades are available to suit most common blasting operations. The hardness and high density of Ebony grit give it a high resistance to fracture with very low dust formation during blasting, as well as faster blast-cleaning speed when compared to local slag abrasives. This abrasive is commonly used for restoration of heavily painted steel bridges, ships and water towers. Ebony grit is a disposable high-density blasting slag made from a by-product of copper production. Ebony grit distinguishes from light-weight blasting slag, due to its high density property. Typically, the majority of its composition is iron oxide and silicon dioxide, formed when molten slag is quenched in cold water. This cooling process fractures the slag into coarse and angular particles, making it an ideal blasting slag with optimal blasting properties. And this is off of Princess Auto's website: Ebony grit is produced from a by-product of the manufacturing of copper. Typically it is composed of ferrosilicate (Fayalite, Fe2SiO4) material and oxides, formed when the molten slag is quenched in cold water. This cooling process fractures

the slag into coarse and angular particles, making it an ideal blasting slag with optimal blasting properties.
MIS057 Gneiss: pebble-size piece showing small-scale folding.
MIS058 Brecciated quartz-filled vein deposit – cave in Velo Greece.
MIS059 Pink granite chunk – locality unknown.
MIS060 Fragment of large iron concretion with interior quartz filling and brecciated texture – Manitoba, Canada.
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23.1. Samples from International Space Analogue Rockstore (ISAR) – Nov. 2012 (see section 20.28)

06AU01-3 Banded iron formation: Kitty's Gap outcrop, Pilbara, Australia.
07SA20-3 Basalt: Komatii River outcrop, Barberton, South Africa.
09ET01-3 Basalt: Etna, Sicilia, Italy.
09SV02-3 Dunite: Sverefjell outcrop, Svalbard, Norway; associated with 09SV05-4 and 09SV15-4.
09SV05-4 Carbonate: Sverefjell outcrop, Svalbard, Norway; associated with 09SV02-3 and 09SV15-4.
09SV15-4 Basalt: Sverefjell outcrop, Svalbard, Norway; associated with 09SV02-3 and 09SV05-4.
09TE08-4 Phonolite: El Tiede Volcano, Tenerife, Canary Islands, Spain.
10SA09-3 Komatiite: Komatii River, Barberton, South Africa.
11CA02-3 Komatiite: Dundonald outcrop, Ontario, Canada.
11CY04-3 Carbonate: Katydata outcrop, Nicosia district, Cyprus.
99SA01-3 Chert: Buck Reef Chert, Barberton, South Africa.
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23.2. Sample Descriptions: From Mike Gaffey (Feb. 2007)

5.1. Fiber from PYX (“fiberous material from PYX02")
5.3. “Red stuff” (“red stuff (from olivine collectoras”))
5.6. HW PYX? (“Hawaiian pyroxene & stuff; (Black stuff is sand from Hilo”))
5.7. Worm turds (green) (“obviously: green stuff”)
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23.3. Sample Descriptions - Baltimore weathering sandstone

BAL001 Old St. Paul's Church, corner of N. Charles Street and Saratoga, Baltimore, MD, USA. Weathered sandstone chip flaking off south facing base sandstone block. Collected Sept. 2013. Two main pieces collected. Delamination is perpendicular to bedding planes and parallel to stone face.

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23b. XRD Data - Miscellaneous samples

MIS056 Uof W Bruker D8 Trace shows mostly amorphous, broad peaks; phases identified: fayalite-manganoan forsterite; magnesium manganese silicate; magnesium manganese iron silicate.

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23c. Compositional Data - Miscellaneous samples

Wt. %	MIS056
SiO_2	36.82
TiO_2	0.47
Al_2O_3	4.14
FeO	43.49
Fe_2O_3	3.37
*(Fe_2O_3)**	*(51.70)*
MnO	0.11
MgO	1.18
CaO	2.52
Na_2O	0.88
K_2O	0.93
P_2O_5	0.23
SO_3	0.34
TOTAL	99.32
LOI	3.59
ppm	
Sr	142
Zr	164
V	88
Ni	5
Cr	505
Co	220
Source	Mertzman
Analysis	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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23d. Spectral Data - Miscellaneous samples

Sample	*Facility/File No.*	*Description*
MIS056	PSF 131114a.001	<45 µm 0.35-2.5 µm; 30°/0°; 1 nm output, 500 spectra averaged; ASD (Directory: 131114).

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END of 23.

24. Marble: Greece

24.1. Marble supplier – Kiato
24.2. Paros Island
24.3. Sifnos Island
24.4. Pelloponese
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24a. Sample Descriptions – Marbles, Greece

Sample ID	*Description*

24.1a. MBG = Samples from Contacts in Kiato – Commercial marble supplier (July 2006)

MBG001	Marble: Cut "marble" slab from Ioannina, Greece (pink limestone?). (From my contact in Kiato, Greece).
MBG002	Marble: Cut marble slab from Drama, in Thrace, Greece. White slab. (From my contact in Kiato, Greece).
MBG003	Marble: Cut marble slab from Volakas, Drama, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG004	Marble: Cut "marble" slab from Epidavros, Karnazi, Greece. Breccia, multi-coloured slab, one side polished. (From my contact in Kiato, Greece).
MBG005	Marble: Cut marble slab from Mt. Pentelli, Greece. (From my contact in Kiato, Greece).
MBG006	"Marble", red breccia from Eretria, Greece. (From my contact in Kiato, Greece).
MBG007	Marble, cut marble slab from Mt. Pentelli, Greece. (From my contact in Kiato, Greece).
MBG008	"Marble": brownish breccia from Epidavros, Greece. (From my contact in Kiato, Greece).
MBG009	Marble: White marble slab from Thassos, Greece. (From my contact in Kiato, Greece).
MBG010	Marble: white marble offcut from marble store dump pile on island of Paros between ancient quarries and main town – self collected.
MBG011	Marble: white marble offcut from marble store dump pile on island of Paros between ancient quarries and main town – self collected.
MBG012	Marble: Cut marble slab from Volakas, Drama, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG013	Marble: Cut marble slab from island of Naxos, Greece. White slab. (From my contact in Kiato, Greece).
MBG014	Marble: Cut marble slab from island of Naxos, Greece. White slab. (From my contact in Kiato, Greece).
MBG015	Marble: Cut marble slab from Kavalas, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG016	Marble: Cut marble slab from Mt. Pentelli, Greece. White slab. (From Mike Papoutsis contact in Athens, Greece).
MBG017	Marble: Cut marble slab from Verona, Greece(?). White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG018	Marble: Cut marble slab from Ioannina, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG019	Marble: Cut marble slab from Nestou(?), Drama, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG020	Marble: Cut marble slab from Ayiae/Ariae, Ayia E?, Drama, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG021	Marble: Cut marble slab from Dionysos, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG022	Marble: Cut marble slab from island of Naxos, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG023	Marble: Cut marble slab from Mt. Pentelli, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).

MBG024 Marble: Cut marble slab from Mt. Pentelli, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG025 Marble: Cut marble slab from Ayia Marina, Attica, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG026 Marble: Cut marble slab from island of Thasos, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG027 Marble: Cut marble slab from Liveri(?), Attica, Greece. Gray and white slab. (From John Raftopoulos contact in Kiato, Greece).
MBG028 "Marble": Cut "marble" slab from Verona, Greece?. Amphibolite? Gray and green slab. (From John Raftopoulos contact in Kiato, Greece).
MBG029 Marble: Cut marble slab from Dionysos, Greece. White slab. (From John Raftopoulos contact in Kiato, Greece).
MBG030 "Marble": Cut marble/breccia slab from Ethessis, Greece. Multihued breccia slab. (From my contact in Kiato or John Raftopoulos contact in Kiato, Greece).

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24.2a. Paros samples – July 2006

(i) Paros Island – First Quarry - near church (1st quarry sampled). North-facing outcrop (0.9 m wide by 1.2 m high) Sampled up (01-05); sampling abandoned after sample #5 due to hardness. July 2006.
Too hard to sample across the top.
Included both weathered and interior surface.
37º 04.762' N 25º 11.887' E

MPIA1-01 Point 1, quarry "A", north-facing outcrop. Base of outcrop.
MPIA1-02 Point 2, quarry "A", north-facing outcrop. 3" up from base (sample 1).
MPIA1-03 Point 3, quarry "A", north-facing outcrop. 6" up from base (sample 1); weathered surface scraped off.
MPIA1-04 Point 4, quarry "A", north-facing outcrop. 9" up from base (sample 1).
MPIA1-05 Point 5, quarry "A", north-facing outcrop. 12" up from base (sample 1).
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(ii) Paros Island – First Quarry, near church (1st quarry sampled). North-facing outcrop near first outcrop – sampling of first outcrop abandoned after sample 5 due to hardness of outcrop). Sampled parallel to bedding planes (07-20; west to east), parallel to bedding planes (21-28; north to south), perpendicular to bedding planes (29-35; top to bottom). July 2006.

MPIA1-07 Point 7, quarry "A", other N-facing outcrop. Starting point.
MPIA1-08 Point 8, quarry "A", other N-facing outcrop; 17 cm E of point 7.
MPIA1-09 Point 9, quarry "A", other N-facing outcrop; 33 cm E of point 8.
MPIA1-10 Point 10, quarry "A", other N-facing outcrop; 31 cm E of point 9.
MPIA1-11 Point 11, quarry "A", other N-facing outcrop; 17 cm E of point 10.
MPIA1-12 Point 12, quarry "A", other N-facing outcrop; 32 cm E of point 11.
MPIA1-13 Point 13, quarry "A", other N-facing outcrop; 15 cm E of point 12.
MPIA1-14 Point 14, quarry "A", other N-facing outcrop; 29 cm E of point 13.
MPIA1-15 Point 15, quarry "A", other N-facing outcrop; 8 cm E of point 14.
MPIA1-16 Point 16, quarry "A", other N-facing outcrop; 11 cm E of point 15.
MPIA1-17 Point 17, quarry "A", other N-facing outcrop; 15 cm E of point 16.
MPIA1-18 Point 18, quarry "A", other N-facing outcrop; 17 cm E of point 17.
MPIA1-19 Point 19, quarry "A", other N-facing outcrop; 12 cm E of point 18.
MPIA1-20 Point 20, quarry "A", other N-facing outcrop; 6 cm E of point 19.

MPIA1-21 Point 21 quarry "A", other N-facing outcrop; 5 cm S of point 20.
MPIA1-22 Point 22, quarry "A", other N-facing outcrop; 8 cm S of point 21.
MPIA1-23 Point 23, quarry "A", other N-facing outcrop; 8 cm S of point 22.
MPIA1-24 Point 24 quarry "A", other N-facing outcrop; 10 cm S of point 23.

MPIA1-25 Point 25, quarry “A”, other N-facing outcrop; 11 cm S of point 24.
MPIA1-26 Point 26, quarry “A”, other N-facing outcrop; 8 cm S of point 25.
MPIA1-27 Point 27, quarry “A”, other N-facing outcrop; 14 cm S of point 26.
MPIA1-28 Point 28, quarry “A”, other N-facing outcrop; 19 cm S of point 27.

MPIA1-29 Point 29, quarry “A”, other N-facing outcrop; 3 cm below point 20.
MPIA1-30 Point 30, quarry “A”, other N-facing outcrop; 11 cm below point 29.
MPIA1-31 Point 31, quarry “A”, other N-facing outcrop; 9 cm below point 30.
MPIA1-32 Point 32, quarry “A”, other N-facing outcrop; 7 cm below point 31.
MPIA1-33 Point 33, quarry “A”, other N-facing outcrop; 6 cm below point 32.
MPIA1-34 Point 34, quarry “A”, other N-facing outcrop; 11 cm below point 33.
MPIA1-35 Point 35, quarry “A”, other N-facing outcrop; 7 cm below point 34.

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(iii) Paros Island – First Quarry, near church. Various samples

MPIA1-36 Marble, isotopes with distance from contact.
MPIA1-37 Marble: scuzzy, weathered-coating.
MPIA1-38 Marble, laminated/coloured.
MPIA1-40 Marble, lichen-covered.
MPIA1-41 Marble, lichen-covered.
MPIA1-42 Marble, coarse-grained.
MPIA1-43 Marble, fine-grained.
MPIA1-44 Marble, coarse-grained/darker effects.
MPIA1-45 Marble, weathered surface.

MPI-001 Marble, main square in Paroikia (capital of Paros). Probably from active quarry over the hill east of old quarries.

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(iv) Paros Island, Second Quarry in traditional area, further downhill from first quarry.
Sampled from blasted out block of inferior quality. Sampled edges along blast holes. Refer to photomosaic for locations.

MPIB1-01 Marble, 31 cm from left edge of block, 9 cm long, lower lip of hole 6.
MPIB1-02 Marble, 56 cm from left edge of block, 9 cm long, lower lip of hole 6.
MPIB1-03 Marble, 30 cm from left edge of block, 9 cm long, lower lip of hole 5.
MPIB1-04 Marble, 61 cm from left edge of block, 7 cm long, lower lip of hole 3.
MPIB1-05 Marble, 76 cm from left edge of block, 9 cm long, lower lip of hole 3.
MPIB1-06 Marble, 105 cm from left edge of block, 9 cm long, lower lip of hole 3.
MPIB1-07 Marble, 57 cm from left edge of block, 8 cm long, upper lip of hole 4.
MPIB1-08 Marble, 65 cm from left edge of block, 5 cm long, upper lip of hole 4.
MPIB1-09 Marble, 79 cm from left edge of block, 5 cm long, upper lip of hole 4.
MPIB1-10 Marble, unknown locality on block?
MPIB1-11 Marble, 107 cm from left edge of block, 6 cm long, upper lip of hole 4.
MPIB1-12 Marble, 74 cm from left edge of block, 4 cm long, upper lip of hole 5.
MPIB1-13 Marble, 40 cm from left edge of block, 10 cm long, lower lip of hole 5.
MPIB1-14 Marble, 50 cm from left edge of block, 6 cm long, lower lip of hole 5.
MPIB1-15 Marble, 36 cm from left edge of block, 7 cm long, upper lip of hole 6.
MPIB1-16 Marble, 43 cm from left edge of block, 9 cm long, upper lip of hole 6.
MPIB1-17 Marble, 53 cm from left edge of block, 8 cm long, upper lip of hole 6.
MPIB1-18 Marble, 40 cm from left edge of block, 5 cm long, lower lip of hole 6.
MPIB1-19 Marble, 65 cm from left edge of block, 7 cm long, lower lip of hole 6.
MPIB1-20 Marble, 23 cm from left edge of block, 11 cm long, upper lip of hole 7.

MPIB1-21 Marble, 34 cm from left edge of block, 14 cm long, upper lip of hole 7.
MPIB1-22 Marble, 57 cm from left edge of block, 9 cm long, upper lip of hole 7.
MPIB1-23 Marble, 48 cm from left edge of block, 8 cm long, upper lip of hole 7.
MPIB1-24 Marble, 28 cm from left edge of block, 7 cm long, lower lip of hole 7.
MPIB1-25 Marble, 69 cm from left edge of block, 5 cm long, lower lip of hole 7.
MPIB1-26 Marble, 28 cm from left edge of block, 7 cm long, upper lip of hole 8.
MPIB1-27 Marble, 68 cm from left edge of block, 8 cm long, upper lip of hole 8.
MPIB1-28 Marble, 71 cm from left edge of block, 21cm long, upper lip of hole 9.

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(v) Paros island, old, rediscovered quarry area, west of traditional quarry area.
NPIC1 37º 04.880' N 25º 11.935'E July 2006.

MPIC1-01 Marble, with weathered surface. South side of hell pit.
MPIC1-02 Marble, darker, east of vertical contact wall.
MPIC1-04 Marble, white, from other (south) side of cauldron.

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24.3a. Sifnos, Greece – July 2006

Sifnos island, Greece (not a traditional marble quarry source).

MSIA1 = area 1, Camarres bay, NW shore near church
(MSIA1-91-94 given numbers here but were collected unsorted)

MSIA1-01 Massive amphibolite
MSIA1-02 Possible hematite nodule – pigment?
MSIA1-03 Massive calcite
MSIA1-04 Amphibolite + K-feldspar
MSIA1-05 Chlorite/amphibole
MSIA1-06 Crystal of ? from chlorite schist.
MSIA1-07 Crystal of ? from chlorite schist
MSIA1-08 Amphibolite + chlorite
MSIA1-09 Chlorite/amphibole
MSIA1-10 Low-grade marble
MSIA1-11 Low-grade marble
MSIA1-12 Low-grade marble
MSIA1-13 Low-grade marble

MS1A1-91 Marble, incised valleys in Camarres bay near church.
MS1A1-92 Marble, incised valleys in Camarres bay near church.
MS1A1-93 Marble nodule?, incised valleys in Camarres bay near church.
MS1A1-94 5 pieces of vein filling, incised valleys in Camarres bay near church.
MS1A1-95 Quartz and calcite veins, 12" apart, Camarres bay near church.

MSIA2 = area 2, near Agia Silvestros

MSIA2-01 Volcanic breccia? Agia Silvestros area.
MSIA2-02 Volcanic rock with crystals of? Agia Silvestros area.
MSIA2-03 Volcanic breccia? Nodule. Agia Silvestros area.
MSIA2-04 Calcite ? crystal. Agia Silvestros area.

MSIA2-05 Brecciated quartz vein filling. Agia Silvestros area.

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24.4.a Marble samples - Pelloponese: August 2009

MBG100 Marble from base of quarry: Ano Karnezeika, Greece (on road from Korinth to Spetses).
MBG101 Marble from base of quarry: Stavropothi, Greece (on road from Korinth to Spetses).
MBG102 Purple brecciated limestone: country rock: Stavropothi, Greece (road cut from Korinth to Spetses).
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END of 24.

25. Elkford BC, Canada (Kimberlite)

Samples collected at base of Crossing Creek, ~5 mi. north of Elkford, BC, July 23, 2007.

25a. Sample Descriptions – Elkford, BC, Canada kimberlite

Sample ID	*Description*
ELK001	Reddish sandstone with aggregates.
ELK002	Foliated whitish sample.
ELK003	Vesicular carbonate-rich (?) breccia/conglomerate.
ELK004	Vesicular carbonate-rich (?) breccia/conglomerate.
ELK005	Brecciated carbonate-rich carbonatite (?)
ELK006	Brecciated rock with black aggregates and whitish phenocrysts.
ELK007	Dark gray-black foliated sample.
ELK008	Whitish phenocrystic sample.
ELK009	Whitish sample with white veins
ELK010	Whitish phenocrystic sample.
ELK011	Foliated and brecciated white-gray sample with black phenocrysts.
ELK012	Brecciated (?) limestone with black inclusions.
ELK013	Brecciated (?) limestone with black inclusions.

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END of 25.

26. Vegetation

26.1. Oak and elm leaves- dry vs. fresh
26.2. Horsetails
26.3. Leaf stacks – transmittance and reflectance – September 2013 (Gen Berard)
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Sample Descriptions - Vegetation

Sample ID *Description*

26.1a. Sample Description - Oak and elm leaves

Dry vs. fresh (August 2009)

Note: stack of leaves made and allowed to air dry over time – same piles shot each time.

ELM001 Dry American elm leaves – stack of 8 leaves (Aug. 12/09) (from previous winter).
ELM002 Fresh American elm leaves – stack of 8 leaves (first shot Aug. 12/09).
OAK001 Dry bur oak leaves – stack of 8 leaves (Aug. 12/09) (from previous winter).
OAK002 Fresh bur oak leaves – stack of 8 leaves (first shot Aug. 12/09).
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26.2a. Sample Descriptions - Horsetails

Note: Horsetails contain a high proportion (~20%) of silica micronodules.

HOR001 Horsetails: collected just east of Highway 6, Manitoba, 30 minutes north of St. Martin Junction (lat. ~52° 15') along access road to freshwater spring (September 26, 2011).
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26.3a. Sample Descriptions - Leaf stacks

Transmittance and reflectance – September 2013 (Gen Berard)

- Four tree species (paper birch, Manitoba maple, American elm, black ash) used.
- Measured transmittance with ASD spectrometer of increasing leaves in a stack, with leaves separated by 1.5" diameter O-rings. Distance between probe and light source kept constant.
- Measured reflectance with ASD spectrometer (0°/0°) of increasing leaves in a stack, with leaves separated by 1.5" diameter O-rings. Distance between probe and first leaf upper surface, and between bottom of last leaf and black table top kept constant. Spectralon shot at start and end of run. Therefore data may be unusable for many things.
- Same leaves in same order used for reflectance and transmittance.
- Measurements stopped when no more discernible change seen in spectra.

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26d. Spectral Files - Vegetation

26.1d. Spectral Files - Oak and elm leaves

Sample	*Facility/File No.*	*Description*
ELM001	PSF 090812a.002	stack of 8 leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output, 500 spectra averaged; ASD.
ELM002	PSF 090812a.004	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 3 hours after collected.
ELM002	PSF 090812a.005	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 3 hours after collected.
ELM002	PSF 090812a.008	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 4 hours after collected.
ELM002	PSF 090812a.009	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 4 hours after collected.
ELM002	PSF 090812a.012	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 6 hours after collected.
ELM002	PSF 090812a.013	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 6 hours after collected.
ELM002	PSF 090813b.001	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 25 hours after collected.
ELM002	PSF 090813b.002	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 25 hours after collected.
ELM002	PSF 090814a.001	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 49 hours after collected.
ELM002	PSF 090814a.002	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 49 hours after collected.
ELM002	PSF 090817a.001	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 5 days after collected.
ELM002	PSF 090817a.002	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 5 days after collected.
ELM002	PSF 090824a.001	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 12 days after collected.
ELM002	PSF 090824a.002	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 12 days after collected.
ELM002	PSF 090826a.001	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 14 days after collected.
ELM002	PSF 090826a.002	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 14 days after collected.
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OAK001	PSF 090812a.003	stack of 8 leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output, 500 spectra averaged; ASD.
OAK002	PSF 090812a.006	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 3 hours after collected.
OAK002	PSF 090812a.007	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 3 hours after collected.
OAK002	PSF 090812a.010	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 4 hours after collected.
OAK002	PSF 090812a.011	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 4 hours after collected.
OAK002	PSF 090812a.014	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 6 hours after collected.
OAK002	PSF 090812a.015	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 6 hours after collected.

OAK002	PSF 090813b.003	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 25 hours after collected.
OAK002	PSF 090813b.004	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 25 hours after collected.
OAK002	PSF 090814a.003	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 49 hours after collected.
OAK002	PSF 090814a.004	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 49 hours after collected.
OAK002	PSF 090817a.003	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 5 days after collected.
OAK002	PSF 090817a.004	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 5 days after collected.
OAK002	PSF 090824a.003	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 12 days after collected.
OAK002	PSF 090824a.004	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 12 days after collected.
OAK002	PSF 090826a.003	stack of 8 leaves – front of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 14 days after collected.
OAK002	PSF 090826a.004	stack of 8 leaves – back of leaves; i=30°,e=0°; 0.35-2.5 µm, 1 nm output; 500 spectra averaged; ASD. Shot 14 days after collected.

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<u>26.3d. Spectral Files - Leaf stacks – transmittance and reflectance</u>

<u>September 2013 (Gen Berard)</u>

- Four tree species (paper birch, Manitoba maple, American elm, black ash) used.
- Measured transmittance with ASD spectrometer of increasing leaves in a stack, with leaves separated by 1.5" diameter O-rings. Distance between probe and light source kept constant.
- Measured reflectance with ASD spectrometer (0°/0°) of increasing leaves in a stack, with leaves separated by 1.5" diameter O-rings. Distance between probe and first leaf upper surface, and between bottom of last leaf and black table top kept constant. Spectralon shot at start and end of run. Therefore data may be unusable for many things.
- Same leaves in same order used for reflectance and transmittance.
- Measurements stopped when no more discernible change seen in spectra.
- ***<u>Note:</u> all distances (probe to first leaf, probe to background) not kept constant for reflectance measurements – therefore data are of limited utility.***

<u>26.3d.1. Transmittance spectral files:</u>

<u>1. Paper birch</u>

1 leaf	PSF 120907a.052	0.35-2.5 µm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
2 leaves	PSF 120907a.053	0.35-2.5 µm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
3 leaves	PSF 120907a.054	0.35-2.5 µm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
4 leaves	PSF 120907a.055	0.35-2.5 µm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
5 leaves	PSF 120907a.056	0.35-2.5 µm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
6 leaves	PSF 120907a.057	0.35-2.5 µm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
7 leaves	PSF 120907a.058	0.35-2.5 µm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

8 leaves	PSF 120907a.059	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

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2. Manitoba maple

1 leaf	PSF 120907a.045	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
2 leaves	PSF 120907a.046	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
3 leaves	PSF 120907a.047	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
4 leaves	PSF 120907a.048	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
5 leaves	PSF 120907a.049	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
6 leaves	PSF 120907a.050	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
7 leaves	PSF 120907a.051	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

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3. American elm

1 leaf	PSF 120907a.037	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
2 leaves	PSF 120907a.038	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
3 leaves	PSF 120907a.039	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
4 leaves	PSF 120907a.040	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
5 leaves	PSF 120907a.041	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
6 leaves	PSF 120907a.042	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
7 leaves	PSF 120907a.043	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
8 leaves	PSF 120907a.044	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

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4. Black ash

1 leaf	PSF 120907a.029	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
2 leaves	PSF 120907a.030	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
3 leaves	PSF 120907a.031	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
4 leaves	PSF 120907a.032	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
5 leaves	PSF 120907a.033	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
6 leaves	PSF 120907a.034	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
7 leaves	PSF 120907a.035	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
8 leaves	PSF 120907a.036	0.35-2.5 μm, i=0°, e=180° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

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26.3d.2. Reflectance spectral files:

1. Paper birch

1 leaf	PSF 120907a.001	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
2 leaves	PSF 120907a.002	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
3 leaves	PSF 120907a.003	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
4 leaves	PSF 120907a.004	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
5 leaves	PSF 120907a.005	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
6 leaves	PSF 120907a.006	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

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2. Manitoba maple

1 leaf	PSF 120907a.007	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
2 leaves	PSF 120907a.008	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
3 leaves	PSF 120907a.009	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
4 leaves	PSF 120907a.010	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
5 leaves	PSF 120907a.011	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
6 leaves	PSF 120907a.012	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

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3. American elm

1 leaf	PSF 120907a.013	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
2 leaves	PSF 120907a.014	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
3 leaves	PSF 120907a.015	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
4 leaves	PSF 120907a.016	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
5 leaves	PSF 120907a.017	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
6 leaves	PSF 120907a.018	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
7 leaves	PSF 120907a.019	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

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4. Black ash

1 leaf	PSF 120907a.020	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
2 leaves	PSF 120907a.021	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
3 leaves	PSF 120907a.022	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
4 leaves	PSF 120907a.023	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

5 leaves	PSF 120907a.024	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
6 leaves	PSF 120907a.025	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
7 leaves	PSF 120907a.026	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).
8 leaves	PSF 120907a.027	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 100 W QTH light (ASD spectrometer).

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26.3d.3. Reshoot of black ash with constant distance between probe and b;ack background: spectral reflectance

Note: *distance from probe to leaf varied, therefore data are of limited value. Shot October 2013.*

White ref.	PSF 131006a.000	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
Black backgd.	PSF 131006a.001	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
Spectralon	PSF 131006a.002	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
1 leaf	PSF 131006a.003	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
2 leaves	PSF 131006a.004	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
3 leaves	PSF 131006a.005	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
4 leaves	PSF 131006a.006	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
5 leaves	PSF 131006a.007	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
6 leaves	PSF 131006a.008	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
7 leaves	PSF 131006a.009	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
Spectralon	PSF 131006a.010	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
1 leaf	PSF 131006a.011	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
2 leaves	PSF 131006a.012	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
3 leaves	PSF 131006a.013	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
4 leaves	PSF 131006a.014	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
5 leaves	PSF 131006a.015	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
6 leaves	PSF 131006a.016	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
7 leaves	PSF 131006a.017	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).
Spectralon	PSF 131006a.018	0.35-2.5 μm, i=0°, e=0° (bifurcated cable); 1000 spectra averaged; 50 W QTH light (ASD spectrometer).

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END of 26.

27. Acid Dissolution Experiments

Acid dissolution of various basaltic/andesitic samples undertaken to attempt to simulate possible acid dissolution of volcanic rocks in the northern plains of Mars, for Briony Horgan – Cornell University, July-August 2010 (Run 1) and Nov. 2010 – July 2011 (Run 2).

27.1. Run 1: Basalts, andesite
27.2. Run 2: Basalts, andesite, anorthosite
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27a. Sample Descriptions – Acid Dissolution Experiments

Sample ID *Description*

27.1a. Sample Descriptions – Acid Dissolution Experiments – Run 1 (Jul. – Aug. 2010)

BAS101	Glassy basalt, Kilauea caldera, HI, USA. a: 500-1000 μm powder; b: fresh interior broken surface; c: exterior dull surface.
BAS205	Columbia River basalt, WA, USA. a: 500-1000 μm powder; b: cut interior surface; c: natural exterior surface.
BSB101	Black Sand Beach, HI, USA. a: 500-1000 μm powder.
HAY012	Hayden Butte, Tempe, AZ, USA. a: 500-1000 μm powder; b: cut interior surface; c: natural exterior surface.
ICE170	Pillow basalt glassy rind, Iceland. a: 500-1000 μm powder; b: cut interior surface; c: natural exterior surface.

Spectra measured at start (prior to acid bath), after 4, 8, 11, 18, and 27 days. Acid bath consisted of diluted sulphuric acid to provide a consistent pH. Two different concentrations were used – Acid A and Acid B.
++

27.2a. Sample Descriptions - Run 2 (Nov. 2010 - ~July 2011)

In the second acid bath run, reference spectra of all the samples used in the dissolution experiments were acquired at the start of the run. The conditions were largely the same as the first run – two strengths of acid and 500-1000 μm and whole rock samples where available. In addition, each time the samples were removed from the acid baths for spectral measurements, a few grains of the 500-1000 μm and a small chip of the whole rock sample was set aside for future analyses if required.

BAS101	Glassy basalt, Kilauea caldera, HI, USA. a: 500-1000 μm powder; b: fresh interior broken surface; c: exterior dull surface.
BAS205	Columbia River basalt, WA, USA. a: 500-1000 μm powder; b: cut interior surface; c: natural exterior surface.
BSB101	Black Sand Beach, HI, USA. a: 500-1000 μm powder.
HAY012	Hayden Butte, Tempe, AZ, USA. a: 500-1000 μm powder; b: cut interior surface; c: natural exterior surface.
MAI221	Anorthosite, Ivry pit - abandoned ilmenite mine; Quebec, Canada. a: 500-1000 μm powder.
ICE170	Pillow basalt glassy rind, Iceland. a: 500-1000 μm powder; b: cut interior surface; c: natural exterior surface.

On January 10, 2011, an additional sample (plagioclase feldspar – PLG130) was added to the experiment, as both 500-1000 μm and whole rock.
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27d. Spectral Data – Acid Dissolution Experiments

27.1d. Spectral Data – Acid Dissolution Experiments – Run 1 (2010)

Spectra were measured as follows with an ASD spectrometer: i=30°; 0.35-2.5 μm spectral range; 1 nm output; 1000 spectra averaged. Data types and dates of measurements as follows:

Note: spectra of samples also measured prior to putting in acid baths (baseline spectra).

Sample	***Grain size***	***Acid bath type***
BAS101a	500-1000 μm	A
BAS101b	Interior broken surface	A
BAS101c	Exterior dull surface	A
BAS101a	500-1000 μm	B
BAS101b	Interior broken surface	B
BAS101c	Exterior surface	B
++++++		
BAS205a	500-1000 μm	A
BAS205b	Interior cut surface	A
BAS205c	Exterior dull surface	A
BAS205a	500-1000 μm	B
BAS205b	Interior cut surface	B
BAS205c	Exterior surface	B
++++++		
BSB101a	500-1000 μm	A
BSB101a	500-1000 μm	B
++++++		
HAY012a	500-1000 μm	A
HAY012b	Interior cut surface	A
HAY012c	Exterior dull surface	A
HAY012a	500-1000 μm	B
HAY012b	Interior cut surface	B
HAY012c	Exterior surface	B
++++++		
BAS205a	500-1000 μm	A
BAS205b	Interior cut surface	A
BAS205c	Exterior dull surface	A
BAS205a	500-1000 μm	B
BAS205b	Interior cut surface	B
BAS205c	Exterior surface	B
++++++		
ICE170a	500-1000 μm	A
ICE170b	Interior broken surface	A
ICE170c	Exterior glassy surface	A
ICE170a	500-1000 μm	B
ICE170b	Interior broken surface	B
ICE170c	Exterior glassy surface	B
++++++		

Spectra were acquired on the following dates:

Days in acid	***Directory/ file basename***
0 days (baseline)	100628_acid_basalt (100628a)
4 days	100629_acid_basalt (100628a and 100629a)
8 days	100702_acid_basalt (100702a)
11 days	100705_acid_basalt (100705a)
18 days	100713_acid_basalt (100713a)
27 days (end of run)	100722_acid_basalt (100722a and 100722b)

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27.2d. Spectral Data – Acid Dissolution Experiments – Run 2 (November 2010)

In the second acid bath run, reference spectra of all the samples used in the dissolution experiments were acquired at the start of the run. The conditions were largely the same as the first run – two strengths of acid and 500-1000 μm and whole rock samples where available. In addition, each time the samples were removed from the acid baths for spectral measurements, a few grains of the 500-1000 μm and a small chip of the whole rock sample was set aside for future analyses if required.

On January 10, 2011, an additional sample (plagioclase feldspar – PLG130) was added to the experiment, as both 500-1000 μm and whole rock.

Spectra were measured as follows with an ASD spectrometer: i=30°; 0.35-2.5 μm spectral range; 1 nm output; 200 spectra averaged. Data types and dates of measurements as follows:

Note: spectra of samples also measured prior to putting in acid baths (baseline spectra).

Sample	***Grain size***	***Acid bath type***
BSB101	500-1000 μm	Acid A
BSB101	500-1000 μm	Acid B
++++++		
MAI221	500-1000 μm	Acid A
MAI221	500-1000 μm	Acid B
++++++		
HAY012	500-1000 μm	Acid A
HAY012	500-1000 μm	Acid B
HAY012	interior cut surface	Acid A
HAY012	interior cut surface	Acid B
HAY012	exterior weathered surface	Acid A
HAY012	exterior weathered surface	Acid B
++++++		
ICE170	500-1000 μm	Acid A
ICE170	500-1000 μm	Acid B
ICE170	interior cut surface	Acid A
1CE170	interior cut surface	Acid B
ICE170	exterior weathered surface	Acid A
ICE170	exterior weathered surface	Acid B
+++++		
BAS101	500-1000 μm	Acid A
BAS101	500-1000 μm	Acid B
BAS101	interior cut surface	Acid A
BAS101	exterior weathered surface	Acid A
++++++		
BAS205	500-1000 μm	Acid A
BAS205	500-1000 μm	Acid B
BAS205	interior cut surface	Acid A
BAS205	interior cut surface	Acid B
BAS205	exterior weathered surface	Acid A
BAS205	exterior weathered surface	Acid B
++++++		
PlG130	500-1000 μm	Acid A
PlG130	500-1000 μm	Acid B
PlG130	interior sut surface	Acid A
PlG130	interior sut surface	Acid B

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Spectra were acquired on the following dates:

Days in acid	***Date***	***Directory/file basename***
0 days (baseline)	Nov. 8, 2010	101108_acid (101108a)
Day 1	Nov. 10, 2010	101110_acid (101110a)
Day 2	Nov. 11, 2010	101111_acid (101111a)
Day 3	Nov. 12, 2010	101112_acid (101112a)
Day 4	Nov. 13, 2010	101113_acid (101113a)
Day 6	Nov. 15. 2010	101115_acid (101115a)
Day 8	Nov. 17, 2010	101117_acid (101117a)
Day 10	Nov. 19, 2010	101119_acid (101119a)
Day 13	Nov. 23, 2010	101123_acid (101123a)
Day 16	Nov. 26, 2010	101126_acid (101126a)
Day 20	Nov. 30, 2010	101130_acid (101130a)
Day 23	Dec. 3, 2010	101203_acid (101203a)
Day 29	Dec. 9, 2010	101209_acid (101209a)
Note: there is an ~6 dya hiatus (Dec. 9-14) when the samples were not in acid; therefore calendar days and days in acid do not correspond 1:1.		
Day 36	Dec. 21, 2010	101221_acid (101221a)
Day 43	Dec. 29, 2010	101229_acid (101229a)
Day 50	Jan. 5, 2011	110105_acid (110105a)
PLG130 added to acid baths	Jan. 10, 2011	110114_acid (110105a)
Day 59 (4 days for plag)	Jan. 14, 2011	110114_acid (110114a)
Day 69 (14 days for plag)	Jan. 25, 2011	110125_acid (110125a)
Day 101 (46 days for plag)	Mar. 31, 2011	110331_acid (110331a)
Day 122 (67 days for plag)	Apr. 21, 2011	110421_acid (110421a)
Day 213 (158 days for plag)	July 21, 2011	110721_acid (110721a)

Day 213 was last day of run.

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END of 27.

28. Phase Angle Measurements

Phase angle measurements of various materials have been conducted in two (or three) ways to be able to better interpret remote sensing date. One way is to measure spectra of samples and standards at the same viewing geometry (for a range of viewing geometries), which is relevant to things like the Mars Exploration Rovers. The second way is to measure spectra of samples relative to a fixed viewing geometry for the samples. This is more relevant to applications such as asteroid spectroscopy.

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Samples for which phase angle measurements include, **but are not limited to**:

OLV003 (olivine)	*all relative to Spectralon at i=30°, e=0°. See section 2.2 of this document.*
OLV003 (olivine)	*relative to Spectralon at i=13°, e=0°. See section 2.2 of this document.*
PYX032(orthopyroxene)	*all relative to Spectralon at i=13°, e=0°. See section 2.1 of this document.*
PIG373 (lazurite – silicate)	*all relative to Spectralon at i=13°, e=0°. See section 19 of this document.*
MJG197 (H6 chondrite – Lancon)	*all relative to Spectralon at i=13°, e=0°. See section 16 of this document.*
MJG141 (L6 chondrite – Pavlograd)	*all relative to Spectralon at i=13°, e=0°. See section 16 of this document.*
MJG231 (Eucrite – Moama)	*all relative to Spectralon at i=13°, e=0°. See section 16 of this document.*
MJG103 (LL6 chon. – Dhurmsala)	*all relative to Spectralon at i=13°, e=0°. See section 16 of this document.*
MJG003 (CI chondrite – Alais)	*all relative to Spectralon at i=13°, e=0°. See section 16 of this document.*
Millbillillie (eucrite)	*multiple grain sizes at multiple angles. See section 16 of this document.*
NWA2968 (diogenite)	*multiple grain sizes at multiple angles. See section 16 of this document.*
NWA5748 (howardite)	*multiple grain sizes at multiple angles. See section 16 of this document.*
NWA5751 (howardite)	*multiple grain sizes at multiple angles. See section 16 of this document.*
NWA 6013 (diogenite)	*multiple grain sizes at multiple angles. See section 16 of this document.*

5-10 different series
Palagonite (PAL102x). . *See section 12 of this document.*
SA-51: Basalt powder. *See section 11 of this document.*
SA-51: Basalt chip. *See section 11 of this document.*
PYX032 (orthopyroxene) . *See section 2.1 of this document.*
MET101 (meteoritic metal) . *See section 16 of this document.*
PYX032 powder (June 28, 2006) . *See section 2.1 of this document.*

See relevant sections of this document for these and other spectra not listed here.

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28d. Spectralon – phase angle measurements – all relative to Spectralon at i=13°, e=0°

Spectralon	PSF 101001a.009	Disk; i=13°, e=0° (13° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
Spectralon	PSF 101001a.018	Disk; i=30°, e=0° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
Spectralon	PSF 101001a.027	Disk; i=60°, e=0° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
Spectralon	PSF 101001a.036	Disk; i=0°, e=30° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
Spectralon	PSF 101001a.045	Disk; i=30°, e=30° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory

		101001_angles).
Spectralon	PSF 101001a.054	Disk; i=60°, e=30° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
Spectralon	PSF 101001a.064	Disk; i=-30°, e=60° (30° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
Spectralon	PSF 101001a.074	Disk; i=0°, e=60° (60° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
Spectralon	PSF 101001a.083	Disk; i=30°, e=60° (90° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles).
Spectralon	PSF 101001a.095	Disk; i=60°, e=60° (120° phase angle) relative to Spectralon at i=13°, e=0°; 0.35-2.5 μm; 1 nm output; 250 avgd spectra; ASD (directory 101001_angles). Done after replacing light source.

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END of 28.

29. Dust Spectra

This section includes spectra of fine-grained materials measured in support of the MATMOS and MoonDust projects, where we are interested in the spectral properties and spectrum-altering effects of dust.

29.1. Dust on sapphire window (for MoonDust)

This project involves understanding the spectrum-altering effects of dust on lunar components.

The experimental procedure involves a vertically-mounted 50W light source shining down through a 20 mm Edmunds sapphire window toward a vertically-mounted ASD pick-up probe. Different fine-grained materials were scattered onto the window by dry sieving through an appropriately sized sieve. Dust volumes are roughly known by weighing the sapphire window after each dust coating. Dust was sieved onto the sapphire window, the window was gently tapped to promote adhesion and loose materials were gently blown off the window prior to spectral measurements.

Sample ID *Description*

29.1a. Sample Descriptions - Dust on sapphire window

Samples used:

ILM201	Synthetic ilmenite, <45 μm
PLG108	Plagioclase feldspar (<90 μm)
PYX016	Clinopyroxene (<90 μm)
UWM1	University of Winnipeg mare simulant (<90 μm)
UWH1	University of Winnipeg highland simulant (<90 μm)
NPI150(1)	Nanophase iron impregnated silica gel, 150 nm pore size, high concentration (1N ferric nitrate)
NPI150(2)	Nanophase iron impregnated silica gel, 150 nm pore size, low concentration (0.1N ferric nitrate)
NPI22(1)	Nanophase iron impregnated silica gel, 22 nm pore size, high concentration (1N ferric nitrate)
NPI22(2)	Nanophase iron impregnated silica gel, 22 nm pore size, low concentration (0.1N ferric nitrate)

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29.2. Various "dusts" for MATMOS, terrestrial dust spectral sensing project (2012 – 2013)

ATD-001	Arizona Test Dust (<3 micron sample).
C-479994	Coal fly ash from Stephen Grasby, Geological Survey of Canada.
CHA-001	Bottom ash from residential fireplace. Run by Stan Mertzman. Phases identified: calcite, carbonate apatite, natrite, enstatite, digenite.
CSS-001	Caribbean sea salt (Tulum, Mexico; collected March 2013).
FAN-001	Parkade exhaust fan particulates (Colony Square, Winnipeg, MB).
KFE-001	K-feldspar – from Churchill, MB, Canada granite.
LOE-001	Wind blown silt – Manitoba loess (from Jim Bamburak – Manitoba Geological Survey).
MSH-001	Mt. St. Helen's volcanic ash. (aka MSH-ASH).
SS-001	Sea salt from evaporated water from Victoria Harbour, Victoria, BC, Canada.

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29b. XRD Data – Dust samples

Data acquired at University of Winnipeg unless otherwise indicated.

CHA-001	Run by Stan Mertzman. Phases identified: calcite, carbonate apatite, natrite, enstatite, digenite.
CSS-001	Caribbean sea salt (Tulum, Mexico; collected March 2013).
FAN-001	Parkade exhaust fan particulates (Colony Square, Winnipeg, MB).
KFE-001	K-feldspar – from Churchill, MB, Canada granite.

LOE-001	Wind blown silt – Manitoba loess (from Jim Bamburak – Manitoba Geological Survey).
MSH-001	Mt. St. Helen's volcanic ash. (aka MSH-ASH).
SS-001	Sea salt from evaporated water from Victoria Harbour, Victoria, BC, Canada.

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29c. Compositional Data – Dust samples

Wt. %	ATD-001	C-479994	CHA-001	CSS-001	FAN-001	LOE-001
SiO_2	78.28	56.50	13.14	0.09	14.50	86.65
TiO_2	0.35	0.52	0.08	0.00	0.15	0.09
Al_2O_3	9.95	22.46	2.55	0.03	3.36	7.50
*(Fe_2O_3)**	*(2.65)*	*(4.51)*	*(0.77)*	*(0.10)*	*(2.06)*	*(0.76)*
FeO	0.31	1.17	0.20		0.29	0.46
Fe_2O_3	2.31	3.21	0.55		1.74	0.25
MnO	0.07	0.04	0.04	0.00	0.04	0.02
MgO	1.65	1.36	15.41	3.74	12.42	0.25
CaO	2.77	7.97	43.57	0.73	28.81	0.97
Na_2O	1.77	4.54	0.71	42.21	18.24	1.85
K_2O	2.642	1.381	17.139	0.783	1.276	1.612
P_2O_5	0.109	0.481	4.715	0.014	0.091	0.057
Cl	0.00	0.00	0.50	52.03	18.98	0.00
SO_3	0.07	0.10	0.44	0.15	0.09	0.06
TOTAL	100.311	99.862	99.064	99.877	100.021	99.819
LOI	3.64	0.39	23.87	83.08	29.76	0.16
ppm						
Sr	303	1743	1872	167	255	275
Zr	214	362	93	56	83	100
V	84	109	47	18	36	54
Ni	7	10	<2	<2	<2	10
Cr	106	67	<2	<2	4	61
Co	<1	<1	<1	<1	<1	<1
Rb	102	40	90	30	25	40
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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29c. Compositional Data – Dust samples (continued)

Wt. %	KFE-001	CSS-001
SiO_2	67.80	0.00
TiO_2	0.00	0.00
Al_2O_3	17.38	0.00
*(Fe_2O_3)**	*(0.16)*	*(0.03)*
FeO		
Fe_2O_3		
MnO	0.01	0.00
MgO	0.01	3.78
CaO	0.24	0.85
Na_2O	2.75	39.08
K_2O	11.259	0.821
P_2O_5	0.014	0.019
Cl	0.00	54.26
SO_3	0.05	1.54
TOTAL	99.673	100.380
LOI	1.14	34.89
ppm		
Sr	385	178
Zr	71	58
V	35	23
Ni	5	<2
Cr	36	<2
Co	<1	<1
Rb	370	50
Source	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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29d. Spectral Data - Dust and dust coatings

29d.1. Spectral files – Dust on sapphire window

Sample	*Facility/File No.*	*Description*
ILM201x	PSF 110127a.000	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
ILM201a	PSF 110127a.001	<45 μm; 0.6 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
ILM201b	PSF 110127a.002	<45 μm; 1.4 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
ILM201c	PSF 110127a.003	<45 μm; 3.5 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
ILM201d	PSF 110127a.004	<45 μm; 24.0 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
++++++		
PLG108x	PSF 110127a.005	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
PLG108a	PSF 110127a.006	<90 μm; 1.1 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
PLG108b	PSF 110127a.007	<90 μm; 2.4 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
PLG108c	PSF 110127a.008	<90 μm; 4.0 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
PLG108d	PSF 110127a.009	<90 μm; 8.3 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
++++++		
PYX016x	PSF 110127a.010	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
PYX016a	PSF 110127a.011	<90 μm; 1.3 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
PYX016b	PSF 110127a.012	<90 μm; 3.6 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
PYX016c	PSF 110127a.013	<90 μm; 7.5 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
++++++		
UWM1x	PSF 110127a.014	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
UWM1a	PSF 110127a.015	<90 μm; 2.0 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
UWM1b	PSF 110127a.016	<90 μm; 4.0 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
UWM1c	PSF 110127a.018	<90 μm; 9.0 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
++++++		
UWH1x	PSF 110127a.019	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
UWH1a	PSF 110127a.020	<90 μm; 1.5 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
UWH1b	PSF 110127a.021	<90 μm; 3.6 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
UWH1c	PSF 110127a.022	<90 μm; 7.2 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
++++++		
NPI150(1)x	PSF 110127a.023	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].

NPI150(1)a	PSF 110127a.024	<90 μm; 1.2 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI150(1)b	PSF 110127a.025	<90 μm; 3.8 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI150(1)c	PSF 110127a.026	<90 μm; 8.2 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust]. *(spectrum was higher transmission than previous one).*
NPI150(1)d	PSF 110127a.027	<90 μm; 19.6 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
++++++		
NPI150(2)x	PSF 110127a.028	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI150(2)a	PSF 110127a.029	<90 μm; 2.0 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI150(2)b	PSF 110127a.030	<90 μm; 5.6 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI150(2)c	PSF 110127a.031	<90 μm; 7.9 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
++++++		
NPI22(1)x	PSF 110127a.032	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI22(1)a	PSF 110127a.033	<90 μm; 1.4 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI22(1)b	PSF 110127a.034	<90 μm; 3.8 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI22(1)c	PSF 110127a.035	<90 μm; 8.4 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
++++++		
NPI22(2)x	PSF 110127a.036	Blank sapphire window – no dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI22(2)a	PSF 110127a.037	<90 μm; 1.1 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI22(2)b	PSF 110127a.038	<90 μm; 4.6 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].
NPI22(2)c	PSF 110127a.039	<90 μm; 8.5 mg dust; i=0°, e=180°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged; ASD [directory: 110127_dust].

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END of 29.

30. Samples for LIBS Analysis (from CSA)

Samples received from Alex Koujelev at Canadian Space Agency (February 2012). Being used for LIBS system development.

Samples include standard samples from Brammer Standard Geological Materials (and Ward's?).

Name		Part number (Brammer)	Comment
Alumosilicate	Sediment	*CRM No. 3486-86 (ASSO)	In a pressed tablet form
Andesite73302		GBW 07104 (NCS DC73302)	In a pressed tablet form
AndesiteAGV2		US AGV-2	In a pressed tablet form
AndesiteJA1		JA-1	In a pressed tablet form
AndesiteJA2		JA-2	In a pressed tablet form
AndesiteJA3		JA-3	In a pressed tablet form
AnhydriteAN		GUW AN	In a pressed tablet form
Anorthosite2120		VS 2120-81	In a pressed tablet form
AnorthositeMO11		VS MO11	In a pressed tablet form
AnorthositeANG		VS MO10	In a pressed tablet form
AragoniteAK		UNS AK	In a pressed tablet form
BasaltBCR2		US BCR-2	In a pressed tablet form
BasaltBHVO2		US BHVO-2	In a pressed tablet form
BasaltJB2		JB-2	In a pressed tablet form
BlackSoil		*CRM No. 2507 (ASSO)	In a pressed tablet form
Borax		*AN30 (CERAM)	In a pressed tablet form
Coulsonite	Spinel	NCS DC 19003A	In a pressed tablet form
CuMo	Metal alloy	*USZ 3-85 (Central Geological Laboratory)	In a pressed tablet form
Dolomite71306		GBW 07114 (NCS DC71306)	In a pressed tablet form
FlintClay		*97b (National Bureau of Standards)	In a pressed tablet form
GabbroJGb2		JGb-2	In a pressed tablet form
Gabbro71304		GBW 07112 (NCS DC71304)	In a pressed tablet form
Granite		JG-2	In a pressed tablet form
GranodioriteJG1a		JG-1a	In a pressed tablet form
GranodioriteGSP2		US GSP-2	In a pressed tablet form
GreySoil	Soil	*CRM No. 2504 (ASSO)	In a pressed tablet form
HornblenditeJH1		JH-1	In a pressed tablet form
Ilmenite		SARM 59	In a pressed tablet form
IronOre		NCS DC 11013	In a pressed tablet form
Kaolin		GBW 03121 (NCS DC60122)	In a pressed tablet form
KFeldspar		GBW 03116 (NCS DC61102)	In a pressed tablet form
MnOre		CMSI 1691 (NCS DC47005)	In a pressed tablet form
Obsidian		SRM 278	In a pressed tablet form

Olivine		DH 4912	In a pressed tablet form
OrthoGabbro		VS MO7	In a pressed tablet form
PeridotiteJP1		JP-1	In a pressed tablet form
Pyroxenite		SARM 5	In a pressed tablet form
QuartzSARM49		SARM 49	In a pressed tablet form
QuartzQLO1		US QLO-1	In a pressed tablet form
RedClay		*CRM 5372-90 (ASSO)	In a pressed tablet form
RedSoil		*CRM No. 2501 (ASSO)	In a pressed tablet form
Rhyolite71305		GBW 07113 (NCS DC71305)	In a pressed tablet form
RockFer2		*FeR-2 (Geological Survey of Canada)	In a pressed tablet form
RutileSX58		DH 5803	In a pressed tablet form
Sediments (CGHM-4)		*CRM No. 3486-86 (Breitlaender)	In a pressed tablet form
Shale		*Sco-1 (United States Geological Survey)	In a pressed tablet form
Sillimanite		BCS 309	In a pressed tablet form
Serpentinite		SARM 47	In a pressed tablet form
SyeniteJSy1		JSy-1	In a pressed tablet form
SyeniteSARM2		SARM 2	In a pressed tablet form
Talc		BCS 203a	In a pressed tablet form
UBRockDC72301		GBW 07101 (NCS DC72301)	In a pressed tablet form
Wollastonite		GBW 03123 (NCS DC60124)	In a pressed tablet form
hand sample1	**Talc	ActLabs	In rock form
hand sample3	**Calcite	ActLabs	In rock form
hand sample4	**Fluorite	ActLabs	In rock form
hand sample6	**Potash feldspar	ActLabs	In rock form
hand sample10	**Galena	ActLabs	In rock form
hand sample15	**Hematite	ActLabs	In rock form
hand sample16	**Chromite	ActLabs	In rock form
hand sample17	**Pyrite	ActLabs	In rock form
hand sample27	**Chalcopyrite	ActLabs	In rock form
hand sample32	**Pyrolusite	ActLabs	In rock form
hand sample37	**Barite	ActLabs	In rock form
hand sample41	**Gypsum	ActLabs	In rock form
hand sample42	**Kyanite	ActLabs	In rock form
hand sample44	**Augite	ActLabs	In rock form
hand sample48	**Plagioclase feldspar	ActLabs	In rock form
hand sample50	**Olivine	ActLabs	In rock form
hand sample51	**Epidote	ActLabs	In rock form
hand sample53	**Dolomite	ActLabs	In rock form
hand sample54	**Kaolinite	ActLabs	In rock form
hand sample57	**Granite	ActLabs	In rock form
hand sample62	**Andesite	ActLabs	In rock form

hand sample63	**Syenite	ActLabs	In rock form
hand sample64	**gabbro	ActLabs	In rock form
hand sample65	**Basalt	ActLabs	In rock form
hand sample66	**Rhyolite	ActLabs	In rock form
hand sample67	**Obsidian	ActLabs	In rock form
hand sample72	**Limestone	ActLabs	In rock form
hand sample74	**Sandstone	ActLabs	In rock form
hand sample82	**Travertine	ActLabs	In rock form

Part number (Brammer)	Al2O3	CaO	FeO	K2O	MgO	MnO	Na2O	SiO2	TiO2	P2O5	C
*CRM No. 3486-86 (ASSO)	0.1129	0.0052	0.0524	0.0221	0.0048	0.0011	0.0167	0.7054	0.0062	0.0028	NA
GBW 07104 (NCS DC73302)	0.1617	0.052	0.0729	0.0189	0.0172	0.000598	0.0386	0.6062	0.00287	0.000928	0.03470
US AGV-2	0.1691	0.052	0.0669	0.0288	0.0179	0.000994	0.0419	0.593	0.0105	0.0048	NA
JA-1	0.1522	0.057	0.0707	0.0077	0.0157	0.00157	0.0384	0.6397	0.0085	0.00165	0.00027
JA-2	0.1541	0.0629	0.0621	0.0181	0.076	0.00108	0.0311	0.5642	0.0066	0.00146	0.00014
JA-3	0.1556	0.0624	0.066	0.0141	0.0372	0.00104	0.0319	0.6227	0.007	0.00116	0.00006
GUW AN	~ 0.00023	0.407	0.00014	0.00013	0.0034	~ 0.00002	0.00032	~ 0.0022	~ 0.00003	NA	0.00650
VS 2120-81	0.2278	0.1006	0.1092	0.0076	0.021	0.00076	0.0404	0.5177	0.0187	0.0014	0.00360
VS MO11	0.2742	0.1095	0.0174	0.0065	0.0049	0.00037	0.0439	0.5346	0.0018	0.00041	0.00000
VS MO10	0.298	0.159	0.0336	0.0013	0.018	0.0004	0.0163	0.463	0.0022	0.0001	0.00130
UNS AK	0.0011	0.549	0.0013	0.00037	0.0011	2.57E-05	0.00047	0.0064	NA	0.00029	0.43000
US BCR-2	0.135	0.0712	0.138	0.0179	0.0359	0.001963	0.0316	0.541	0.0226	0.0035	NA
US BHVO-2	0.135	0.114	0.123	0.0052	0.0723	0.001666	0.0222	0.499	0.0273	0.0027	NA
JB-2	0.1464	0.0982	0.1425	0.0042	0.0462	0.00218	0.0204	0.5325	0.0119	0.00101	0.00028
*CRM No. 2507 (ASSO)	0.0981	0.016	0.0348	0.0242	0.0095	0.00079	0.0081	0.7149	0.0074	0.0018	NA
*AN30 (CERAM)	0.0741	0.13	0.0018	0.0113	0.0022	NA	0.0867	0.518	0.0003	NA	NA
NCS DC 19003A	0.044	0.0105	0.754333	NA	0.0317	0.00364	NA	0.0396	0.1296	5.04E-05	NA
*USZ 3-85 (Central Geological Laboratory)	0.1635	0.0029	0.0395	0.0368	0.0071	0.0002	0.0159	0.6702	0.0047	NA	NA
GBW 07114 (NCS DC71306)	0.001	0.3002	0.0021	0.00038	0.218	0.0001	0.0003	0.0062	0.00015	0.00006	0.46770
*97b (National Bureau of Standards)	0.3924	0.00035	0.0118	0.0062	0.0018	0.00006	0.00066	0.424	0.024	0.00045	NA
JGb-2	0.2348	0.141	0.0669	0.00059	0.0618	0.0013	0.0092	0.4647	0.0056	0.00017	NA
GBW 07112 (NCS DC71304)	0.1414	0.0986	0.2326	0.0015	0.0525	0.00193	0.0211	0.3569	0.0769	0.00028	0.00120
JG-2	0.1247	0.007	0.0097	0.0471	0.00037	0.00016	0.0354	0.7683	0.00044	0.00002	0.00004
JG-1a	0.143	0.0213	0.02	0.0396	0.0069	0.00057	0.0339	0.723	0.0025	0.00083	NA
US GSP-2	0.149	0.021	0.049	0.0538	0.0096	NA	0.0278	0.666	0.0066	0.0029	NA
*CRM No. 2504 (ASSO)	0.1148	0.1147	0.046	0.0209	0.0299	0.00089	0.0164	0.5265	0.0064	0.0017	NA
JH-1	0.0566	0.1502	0.1027	0.0053	0.1673	0.0019	0.0071	0.4818	0.0067	0.00099	NA

SARM 59	0.0061	0.0005	0.503	NA	0.0056	0.0105	NA	0.0075	0.488	NA	NA
NCS DC 11013	0.0074	0.0099	0.464392	0.00165	0.0286	0.00093	0.00065	0.4827	0.00043	0.001237	NA
GBW 03121 (NCS DC60122)	0.3141	0.00052	0.005	0.0034	0.0012	0.000032	0.00015	0.5455	0.0069	0.00099	0.00026
GBW 03116 (NCS DC61102)	0.1863	0.0076	0.0019	0.096	0.00054	NA	0.0369	0.6626	0.00048	NA	NA
CMSI 1691 (NCS DC47005)	0.03	0.036	0.032026	0.0046	0.0144	0.577893	0.00048	0.2224	0.001	0.001856	NA
SRM 278	0.1415	0.00983	0.0204	0.0416	0.0023	0.00052	0.0484	0.7305	0.00245	0.00036	0.00050
DH 4912	0.00432	0.00081	0.0507	0.00014	0.4918	0.00096	NA	0.416	0.00002	NA	0.00054
VS MO7	0.176	0.1462	0.1235	0.0075	0.0646	0.0015	0.0205	0.4079	0.0339	0.0108	0.00030
JP-1	0.0066	0.0055	0.0837	0.00003	0.446	0.00121	0.00021	0.4238	0.00006	0.00002	NA
SARM 5	0.0418	0.0266	0.127	0.0009	0.2533	0.00022	0.0037	0.511	0.002	0.000206	0.00080
SARM 49	~ 0.0005	~ 0.0001	NA	~ 0.0001	~ 0.0005	~ 0.0001	~ 0.0005	0.996	~ 0.0001	NA	NA
US QLO-1	0.162	0.0317	0.0435	0.036	0.01	NA	0.042	0.656	0.0062	0.0025	NA
*CRM 5372-90 (ASSO)	0.1597	0.0303	0.0943	0.0279	0.0317	0.0177	0.035	0.488	0.0098	0.0072	0.01000
*CRM No. 2501 (ASSO)	0.1701	0.0017	0.0786	0.0098	0.0092	0.00051	0.0015	0.5918	0.0156	0.001	NA
GBW 07113 (NCS DC71305)	0.1296	0.0059	0.0322	0.0543	0.0016	0.0014	0.0257	0.7278	0.003	0.00045	0.00520
*FeR-2 (Geological Survey of Canada)	0.0522	0.0216	0.395	0.01306	0.0208	0.00125	0.00506	0.4896	0.00188	0.0027	0.00058
DH 5803	0.00668	0.00131	0.0122	0.00067	NA	* 0.00056	0.00021	0.0306	0.9156	0.00077	0.00025
*CRM No. 3486-86 (Breitlaender)	0.1129	0.0052	0.0524	0.0221	0.0048	0.0011	0.0167	0.7054	0.0062	0.0028	NA
*Sco-1 (United States Geological Survey)	0.137	0.0262	0.0513	0.0277	0.0272	0.000529	0.009	0.628	0.0063	0.0021	NA
BCS 309	0.611	0.0022	0.0151	0.0046	0.0017	NA	0.0034	0.341	0.0192	NA	NA
SARM 47	0.0109	~ 0.001	0.0414	~ 0.0002	0.4209	0.0006	~ 0.0005	0.363	~ 0.0001	~ 0.0002	NA
JSy-1	0.2317	0.0025	0.00084	0.0482	0.00016	0.000024	0.1074	0.6002	0.000015	0.00014	0.00034
SARM 2	0.1734	0.0068	0.014	0.1535	0.0046	0.000103	0.0043	0.6363	0.000442	0.0012	0.00090
BCS 203a	0.003	0.0025	0.0022	0.00005	0.3208	NA	0.0002	0.597	0.0001	0.0013	NA
GBW 07101 (NCS DC72301)	0.0067	0.001	0.069	0.0001	0.4103	0.00068	0.00008	0.3434	0.00008	0.00004	0.00580
GBW 03123 (NCS DC60124)	0.0039	0.4039	0.0038	0.0014	0.0095	0.00096	0.00052	0.505	0.00022	0.00052	NA
ActLabs	0.0008	0.0003	0.0113	< 0.0001	0.3188	0.00025	0.0001	0.6283	0.00002	< 0.0001	NA
ActLabs	0.0007	0.5503	0.0007	< 0.0001	0.0003	0.00046	0.0002	0.0022	0.00002	< 0.0001	0.43400
ActLabs	0.0006	0.7189	0.0004	< 0.0001	0.0003	0.00003	0.0002	0.0029	0.00002	0.0002	NA

ActLabs	0.1817	0.0017	0.0045	0.139	0.0002	0.00006	0.0159	0.6347	0.00002	0.0042	NA
ActLabs	0.0005	0.001	0.0004	0.0001	0.0004	< 0.00001	0.0002	0.0017	0.00001	0.0002	NA
ActLabs	0.0192	0.0541	0.6218	0.0036	0.0082	0.00025	0.0015	0.1401	0.00101	0.0408	NA
ActLabs	0.106	0.0025	0.2846	< 0.0001	0.1262	0.00155	0.0002	0.0592	0.00512	0.0005	NA
ActLabs	0.0007	< 0.0001	0.6312	0.0005	< 0.0001	0.00017	0.0001	0.0291	0.00002	0.0002	NA
ActLabs	0.0102	0.0006	0.3933	0.0065	0.0007	0.00016	0.0003	0.0527	0.00036	0.0004	NA
ActLabs	0.0015	0.0035	0.01	0.0033	0.0004	0.5754	0.0009	0.252	0.00005	0.0002	NA
ActLabs	0.0003	0.0004	0.0012	< 0.0001	0.0001	0.00012	< 0.0001	0.0053	< 0.00001	0.0002	NA
ActLabs	0.0035	0.3228	0.0018	0.0004	0.0008	0.00012	0.0014	0.0117	0.00019	< 0.0001	NA
ActLabs	0.3308	0.0008	0.0077	0.0019	0.0002	0.00004	0.0005	0.6296	0.00055	0.0012	NA
ActLabs	0.0081	0.2269	0.1125	0.0001	0.1211	0.00298	0.0045	0.5351	0.00027	< 0.0001	NA
ActLabs	0.2	0.0114	0.0056	0.0261	0.0003	0.00005	0.0906	0.6632	0.00003	< 0.0001	NA
ActLabs	0.0012	0.0012	0.0808	0.0001	0.4585	0.0011	0.0002	0.3922	0.00003	< 0.0001	NA
ActLabs	0.1803	0.1956	0.1266	0.0046	0.0051	0.00472	0.0005	0.445	0.00441	0.0013	NA
ActLabs	0.0004	0.3066	0.0078	< 0.0001	0.2126	0.00849	0.0001	0.0015	< 0.00001	0.0001	0.46500
ActLabs	0.3726	0.0006	0.0016	0.0004	0.0004	0.00002	0.0002	0.4691	0.00314	0.0003	NA
ActLabs	0.1395	0.0162	0.0222	0.0508	0.0049	0.00027	0.0335	0.7055	0.00337	0.0008	NA
ActLabs	0.1643	0.078	0.0889	0.0098	0.0596	0.00135	0.0384	0.5357	0.01199	0.0034	NA
ActLabs	0.1412	0.0282	0.0333	0.0448	0.016	0.00046	0.0344	0.6491	0.00375	0.0021	NA
ActLabs	0.1458	0.087	0.0869	0.0047	0.0908	0.00144	0.0268	0.5324	0.00819	0.0015	NA
ActLabs	0.1284	0.1025	0.0986	0.0204	0.0767	0.00163	0.0221	0.507	0.00832	0.0025	NA
ActLabs	0.128	0.0016	0.0167	0.0435	0.0004	0.00034	0.0408	0.7664	0.0003	< 0.0001	NA
ActLabs	0.1296	0.0088	0.0146	0.0415	0.0014	0.00044	0.0367	0.7601	0.00108	< 0.0001	NA
ActLabs	0.0006	0.5645	0.0006	0.0001	0.0039	0.00004	0.0002	0.0035	0.00002	0.0003	NA
ActLabs	0.0269	0.0015	0.0197	0.0045	0.0012	0.00013	0.0005	0.9428	0.00126	0.0009	NA
ActLabs	0.0009	0.5748	0.0006	0.0002	0.0005	0.00002	0.0003	0.0028	0.00001	< 0.0001	NA

Grain size information from Brammer:

AragoniteAK:	>0.09 mm	2.60%
	0.071-0.09 mm	2.10%
	0.040-0.71 mm	3.80%
	<0.040 mm	91.50%
AnhydriteAN:	>0.315 mm	trace
	0.2-0.315 mm	trace
	0.1-0.2 mm	2.00%
	0.09-0.1 mm	1.00%
	0.063-0.090 mm	trace
	<0.063 mm	97.00%
FeR-2	average 0.07 mm	
Ilmenite:	<75 μm: 99.20%	
Iron ore:	0.160-0.071 mm	
Manganese ore:	180-200 mesh	
Obsidian:	<200 mesh	
Olivine:	<0.125 mm	
Pyroxenite:	<75 μm: 98%	
Quartz SARM49:	<75 μm: 99%	
Red clay:	<10mcm	61%
	10-20 mcm	19%
	20-30 mcm	10%
	40-50 mcm	3%
	50-60 mcm	2%
	60-70 mcm	1%
	70-80 mcm	0%
	>80 mcm	0%
Rutile	<0.125 mm	
Serpentine:	<75 μm:	99%
Sulfide ore:	200 mesh	
Syenite SARM2:	<75 μm:	98%

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END of 30.

31. Mercury Analogues

31. Sample from Anne Sprague for Mercury - 2008

31a. Sample Descriptions: Mercury – Anne Sprague

Sample: **Sprague1** – plagioclase-rich rock

31d. Spectral Data: Mercury – Anne Sprague

Sample	*Facility/File No.*	*Description*
Sprague1	PSF 080613a.001	<25 μm; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.002	25-63 μm; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.003	63-125 μm; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.004	125-250 μm; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.005	250-500 μm; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.006	rock face 1; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.007	rock face 2; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.008	rock face 3; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.009	<25 μm; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
Sprague1	PSF 080613a.010	25-63 μm; i=30°, e=0°; 0.35-2.5 μm; 1000 spectra averaged; ASD (Directory: 080613a.wb3).
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Sprague1	PSF 080624.plag25	<25 μm; i=0°, e=0° (bifurcated cable); 200-400 nm usable range (corrected to DUV mirror); 500 spectra avgd; 90 msec integ. time; Ocean Optics S2000 spectrometer (directory: 080624).
Sprague1	PSF 080624.plag25 63	25-63 μm; i=0°, e=0° (bifurcated cable); 200-400 nm usable range (corrected to DUV mirror); 500 spectra avgd; 90 msec integ. time; Ocean Optics S2000 spectrometer (directory: 080624).
Sprague1	PSF 080624.plag63 125	63-125 μm; i=0°, e=0° (bifurcated cable); 200-400 nm usable range (corrected to DUV mirror); 500 spectra avgd; 90 msec integ. time; Ocean Optics S2000 spectrometer (directory: 080624).
Sprague1	PSF 080624.plag 125 250	125-250 μm; i=0°, e=0° (bifurcated cable); 200-400 nm usable range (corrected to DUV mirror); 500 spectra avgd; 90 msec integ. time; Ocean Optics S2000 spectrometer (directory: 080624).
Sprague1	PSF 080624.plag 250 500	250-500 μm; i=0°, e=0° (bifurcated cable); 200-400 nm usable range (corrected to DUV mirror); 500 spectra avgd; 90 msec integ. time; Ocean Optics S2000 spectrometer (directory: 080624).
Sprague1	PSF 080624. rock face 1	whole rock face (1); i=0°, e=0° (bifurcated cable); 200-400 nm usable range (corrected to DUV mirror); 500 spectra

		avgd; 90 msec integ. time; Ocean Optics S2000 spectrometer (directory: 080624).
Sprague1	PSF 080624.rock face 2	whole rock face (2); i=0°, e=0° (bifurcated cable); 200-400 nm usable range (corrected to DUV mirror); 500 spectra avgd; 90 msec integ. time; Ocean Optics S2000 spectrometer (directory: 080624).
Sprague1	PSF 080624.rock face 3	whole rock face (3); i=0°, e=0° (bifurcated cable); 200-400 nm usable range (corrected to DUV mirror); 500 spectra avgd; 90 msec integ. time; Ocean Optics S2000 spectrometer (directory: 080624).

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END of 31.

32. Glove Box Samples (Air-sensitive)

This section includes samples that were received in sealed containers (packed under various controlled atmospheres) and opened in a glove box that was purged with dry nitrogen (passed through Drierite) to remove moisture and with Chemisorb in the glove box to absorb carbon dioxide. Humidity, oxygen, and carbon dioxide levels were monitored during the experiment. This run was conducted in October 2012.

The integrity of the glove box was also monitored by periodically measuring reflectance spectra of a sample of nanophase iron (IRO102) left exposed in the glove box for the duration of the run (including one dedicated IRO102 monitoring run), as well as a sample of calcium sulphide (CAS001).

Various spectrometers were installed in the glove box prior to sealing it up, to enable spectral measurements in this controlled environment. Instruments used during this run include the lab's ASD FieldSpecPro HR spectrometer, Ocean Optics S2000 UV-vis spectrometer, BWTek iRaman 532 nm Raman spectrometer, and D&P 102F FTIR spectrometer; the latter two were only used to characterize the Apollo lunar samples. Mineral mixtures involving nanophase iron and nanophase iron-impregnated silica gels were all produced in the glove box.

32a. Glove box samples - Sample descriptions

The spectral data are provided in the various relevant sections of this document. Samples that were characterized in this run (and relevant section in this document) include:

- Apollo Lunar Regolith Samples: section 13
- Mixtures with nanophase iron and nanophase iron-impregnated silica gel: section 15.25
- Synthetic graphite (GRP200) and carbon black (LCA101): section 1
- Synthetic carlsbergite (CAR001; CrN): section 10.3
- Synthetic calcium sulphide (CAS001; CaS): section 10.7
- Synthetic titanium nitride (TIN101; TiN): section 10.3

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- Nanophase iron (IRO102; 50 nm particle size): section 10.1
- Nanophase iron (IRO103; 10 μm particle size): section 10.1
- Nanophase iron-impregnated silica gel (SGE101A; 22A pore size): section 12.5
- Nanophase iron-impregnated silica gel (SGE105A; 150A pore size): section 12.5

The last 4 materials were also used to produce intimate mixtures with the following materials (descriptions and spectra of the mixtures provided in section 15.25 of this document):

- Cherokee Springs LL6 chondrite (section 16)
- FJS-1 JAXA lunar mare simulant (section 12)
- OLV003 olivine (section 2.2)
- PLG108 plagioclase feldspar (section 2.3)
- PYX016 spectral type B clinopyroxene (section 2.1)
- PYX042 orthopyroxene (section 2.1)

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32d. Glove box samples – spectral data

ASD spectra: i=30°, e=0°; 0.35-2.5 μm; 1 nm output; 200 spectra averaged (directory: 121016GLOVE BOX).

CAS001	PSF 121016a.081	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
CAS001	PSF 121016a.121	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
CAS001	PSF 121016a.124	unsorted; 30º/0º; 0.352.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD.
+++++++		
IRO102	PSF 121016a.015	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.031	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.065	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.075	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.077	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.094	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.109	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.123	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.156	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.160	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.161	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.163	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
IRO102	PSF 121016a.164	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; re-measured periodically while in glove box.
++++++		
IRO102a	PSF 121016a.167	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; 0 minutes after opening.
IRO102b	PSF 121016a.168	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; 5 minutes after opening.
IRO102c	PSF 121016a.169	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; 10 minutes after opening.
IRO102d	PSF 121016a.170	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; 20 minutes after opening.
IRO102e	PSF 121016a.172	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; 18 minutes after opening.
IRO102f	PSF 121016a.193	<50 nm; 30º/0º; 0.35-2.5 µm; 1 nm resol.; opened in glove box; 200 avgd.; ASD; 40 minutes after opening.

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END of 32.

33. Biologically-Precipitated Minerals

The goal of this work is to induce precipitation of minerals (biomineralization) by various extremophile isolates from Axel Heiberg Island, NWT, Canada.

33.1. From Jen Ronholm (McGill U – received July 2013)

33.1.1. Induced carbonate precipitation samples.
33.1.2. Induced gypsum precipitation samples

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33.1.1. Induced carbonate precipitation.

Vials of precipitates (<1 gram) from extremophiles that we are hoping to induce carbonate precipitation in, and phase(s) identified by XRD. Samples also subjected to ~30 days of Mars-like conditions (10 mbar of CO2 in vacuum oven (no heating)).

33.1.1a,b. Sample descriptions and XRD Data – Induced carbonate precipitation samples

*Well**	*Sample ID*	*Phases present by XRD*[1]
A1	CRB120 Aragonite (as control)	
A2	PIG004 (synthetic calcite)	
A3	CRB131 (calcite)	
A4	CRB125 (aragonite)	
A5	F4A5	Calcite, aragonite
B1	F4A1	Calcite
B2	F4B10	Calcite
B3	F4D7	Calcite
B4	F4C7	Calcite
B5	F4B12	Calcite
C1	DP10	Calcite
C2	JG1	Calcite
C3	F4A9	Calcite
C4	F4A3	Calcite
C5	F4B3	Calcite
D1	F4C3	Calcite
D2	DP17	Calcite
D3	F4D9	Calcite
D4	DP21	Calcite
D5	DP1	Calcite
E1	F2A11	Calcite
E2	F1A9	Calcite
E3	JG9	Calcite, vaterite
E4	F2C11	Calcite?, but peaks are offset.
E5	F2A12	???; possibly calcite but peaks are offset.
F1	JG12	???; possibly calcite but peaks are offset and extra peak present.
F2	CRBS01(99% ^{13}C=-enriched synthetic $CaCO_3$; as control); additional peak present (unidentified)	
F3	Gold powder (as reflectance standard)	
F4	Packed halon (as reflectance standard)	
F5	Empty	

* - Well indicates position in sample holder (multi-well).
[1] – XRD identifications by Matt Izawa at University of Western Ontario by micro-XRD.
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File name changes (suggested by Lyle Whyte):

Original	*New*
JG9	JG9
F1A9	oc825
F4A1	ofe 4.2
F4A9	ofe 10.25
F4A5	ofe 7.23
F4B3	ofe 1.1
F4B10	ofe 10.10
F4B12	ofe 3.1
F4C7	ofe 8.9
F4D7	eur3 7.19
F4D9	cy7
F4C3	ofe 1.3
JG12	JG12
F4A3	ofe 9.29
F2A11	cy5
F2C11	eur3 9.01.3
JG1	JG1

++

33.1.1d. Spectral files

The bioprecipitated samples were spectrally characterized before and after exposure of the samples to Mars-like conditions (low-pressure CO_2 atmosphere) by the following techniques:

1. Reflectance spectroscopy (0.35-2.5 μm) with ASD spectrometer.
2. 365 nm UV-induced fluorescence spectra with 365 nm UV lamp and Maya spectrometer.
3. 405 nm UV-induced fluorescence spectra with 405 nm UV laser and Maya spectrometer.
4. 532 nm Raman reflectance spectra with BWTek iRaman instrument.
5. 785 nm Raman reflectance spectra with Delta Nu Rockhound instrument.

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Acquisition conditions are as follows:

1. i=30°, e=0°; 0.35-2.5 μm spectral range; spectra resolution varies between 2 and 7 nm which the instrument internally resamples and interplotes to prove output data with 1 nm spacings. 500 spectra were acquired to improve signal to noise ratio.
2. samples were illuminated (at 30° incidence angle) with a 365 nm UV light source. Reflectance spectra were acquired with an Ocean Optics Maya spectrometer with a spectral resolution of 0.42-0.48 nm, from 200 to 1132 nm. Data were recorded as counts relative to dark.
3. samples were illuminated (at 30° incidence angle) with a 405 nm UV laser. Reflectance spectra were acquired with an Ocean Optics Maya spectrometer with a spectral resolution of 0.42-0.48 nm, from 200 to 1132 nm. Data were recorded as counts relative to dark.
4. Spectra were recorded as counts from 174 to 4004 cm^{-1} with ~3 cm^{-1} spectral resolution.
5. Spectra were recorded as counts from 100 to 2000 cm^{-1} with ~1 cm^{-1} spectral resolution.

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33.1.2a. Sample Descriptions - Induced gypsum precipitation.

Vials of precipitates (<1 gram). Extremophiles that we are hoping to induce gypsum precipitation.

Vial ID
DP1
DP4
DP10
DP21
F1-F9
F1-G2
F1-G6
F1-G9
F1-G11
F2-E2
F2-F0
F2-G2
F2-G3
F2-H3
F3-C8
F3-D11
F10-F3
F11-F3
F12-F3

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END of 33.

34. Simulated Mars Heating Experiments

34.1. Samples heated in CO_2 atmosphere

To compare the effects of low pressure CO_2 exposure to heating induced by impacts on Mars, the samples from the first 6 Mars box runs were heated to three different temperatures in CO_2 , at pressures of between 20 and 100 millibars, and spectrally characterized by ASD in air and through a sapphire window. (The samples were removed from the vacuum oven for the spectral measurements and then put back in the chamber for the next temperature interval). The samples were packed into the same 10-well 1.5" diameter sample cup that was used for the original experiments. Spectra were acquired with the ASD spectrometer using the same bifurcated probe as was used for the Mars box runs, providing a viewing geometry of i=e=0°.

See Section 22 for sample descriptions.

Spectra were measured in the following ways:

Room temperature (start of run)	No window
Room temperature (start of run)	Through sapphire window
100°C (after 7 days)	No window
100°C (after 7 days)	Through sapphire window
175°C (after 7 additional days – 14 days total)	No window
175°C (after 7 additional days – 14 days total)	Through sapphire window
300°C (after 7 additional days – 21 days total)	No window
300°C (after 7 additional days – 21 days total)	Through sapphire window

Run #	*Sample ID*	*Sample type*	*Grain size (µm)*	*Sample class*
1	CLI101	Clinochlore	<45	Phyllosilicate
	NON101	Nontronite	<45	Phyllosilicate
	SRP104	Serpentine	<45	Phyllosilicate
	CRB118	Calcite	<45	Carbonate
	SPT116	Jarosite	<45	Sulfate
	SPT127	Gypsum	<45	Sulfate
	SPT143	Hexahydrite	<45	Sulfate
++++++				
2	SPT117	Copiapite	<45	Sulfate
	SPT121	Fibroferrite	<45	Sulfate
	SPT128	Anhydrite	<45	Sulfate
	SPT129	Alunite	<45	Sulfate
	SPT137	Paracoquimbite	<45	Sulfate
	SPT139	Rhomboclase	<45	Sulfate
	SPT141	Kieserite	<45	Sulfate
	SPT144	Szomolnokite	<45	Sulfate
	CHM102	Chamosite	<45	Phyllosilicate
++++++				
3	SPT127	Gypsum	<45	Sulfate
	SPT143	Hexahydrite	<45	Sulfate
	BER102	Berthierine	<45	Phyllosilicate
	CRO101	Cronstedtite	<45	Phyllosilicate

	GLA103	Glauconite	<45	Phyllosilicate
	HIS001	Hisingerite	<45	Phyllosilicate
	SAP101	Saponite	<45	Phyllosilicate
	BEI101	Beidellite	<45	Phyllosilicate
	HAL001	Halloysite	<45	Phyllosilicate
++++++				
4	TAR17	Oil sand	unsorted	Organic
	GIL101	Gilsonite	<45	Organic
	OILS10	Oil shale	<45	Organic
	OOH012	Diaspore	<45	Hydroxide
	OOH003	Goethite	<45	Hydroxide
	MON101	Montmorillonite	<45	Phyllosilicate
	CRB114	Magnesite	<45	Carbonate
	CRB215	Hydromagnesite	<45	Carbonate
	PAL101	Palagonite	<45	Amorphous
++++++				
5	NON101	Nontronite	<45	Phyllosilicate
	CRB105	Huntite	<45	Carbonate
	MIN002	Minnesotaite	<45	Phyllosilicate
	GRE001	Greenalite	<45	Phyllosilicate
	ZEO110	Thomsonite	<45	Zeolite
	CRB108	Siderite	<45	Carbonate
	PRT101	Pyrite	<45	Sulfide
	MAG112	Magnetite	<45	Oxide
	KAO101	Kaolinite	<45	Phyllosilicate
++++++				
6	SPT139	Rhomboclase	<45	Sulfate
	SPT125	Copiapite	<45	Sulfate
	SPT126	Coquimbite	<45	Sulfate
	SPT121	Fibroferrite	<45	Sulfate
	SIL203	Silica sinter	<45	Silica
	SPT120	“Hydronium” jarosite	<45	Sulfate
	PIG205	Na-sulfate decahydrate	<45	Sulfate
	ZEO201	Chabazite	<45	Zeolite
	ZEO200	Heulandite	<45	Zeolite

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END of 34.

35. Coal-Fired Power Plant Materials: AB, Canada

Samples are from the Genesee Power Plant(s) in Alberta, Canada. Plant consists of three units (Genesee 1, 2, and 3). 1 and 2 have been decommissioned; 3 is still active.

Coal is mined proximate to the plant (low-sulfur, sub-bituminous).
Genesee 1 and 2 coal was combined with carbon (during combustion?).
Genesee 3 coal is combined with lime (during combustion?).
Samples (acquired July 29, 2013) from plant management.

35a. Sample Descriptions – Coal-Fired Power Plant Materials, AB, Canada

Sample ID	*Description*
CPP01	Coal (feedstock), partially crushed and wetted; "Coal 7A".
CPP02	Bottom ash; Genesee Power Plant 1 and 2; Silo A.
CPP03	Fly ash, raw; Genesee Power Plants 1 and 2, Silo A.
CPP04	Fly ash; Genesee Power Plant 3.
CPP05	Bottom ash; Genesee Power Plant 3.

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35c. Compositional data – Coal-Fired Power Plant Materials, AB, Canada

Wt. %	CPP01	CPP02	CPP03	CPP04	CPP05
SiO_2	12.01	60.54	59.17	59.35	60.11
TiO_2	0.51	0.70	0.75	0.64	0.74
Al_2O_3	7.58	22.82	22.61	20.96	22.95
FeO	0.28	1.72	1.61	2.28	1.48
Fe_2O_3	1.42	2.78	2.42	1.68	3.01
*(Fe_2O_3)**	*(1.73)*	*(4.69)*	*(4.21)*	*(4.21)*	*(4.65)*
MnO	0.05	0.09	0.06	0.05	0.08
MgO	0.17	1.41	1.55	1.55	1.44
CaO	3.35	6.68	6.83	8.35	6.78
Na_2O	0.74	1.97	2.60	2.44	2.13
K_2O	0.23	1.34	1.50	1.53	1.35
P_2O_5	0.03	0.06	0.07	0.07	0.06
SO_3	0.24	0.09	0.11	0.35	0.06
TOTAL	26.64	100.39	99.46	99.50	100.35
C	~73%				
LOI	79.97	40.53	0.57	0.07	11.78
ppm					
Sr	692	820	940	778	885
Zr	310	309	311	275	320
V	41	206	125	120	112
Ni	<2	10	15	8	10
Cr	31	35	70	48	47
Co	<1	<1	5	<1	1
Source	Mertzman	Mertzman	Mertzman	Mertzman	Mertzman
Analysis	XRF/WC	XRF/WC	XRF/WC	XRF/WC	XRF/WC

* - All Fe reported as Fe_2O_3.

Note: Source and Analysis: Mertzman. Analyses by Stan Mertzman at Franklin and Marshall College (see Mertzman, 2000). Analysis done by XRF. Total is expressed on a volatile (LOI)-free basis and with all Fe reported as Fe_2O_3. Where both FeO and Fe_2O_3 are reported, FeO was determined by wet chemistry (WC) and Fe_2O_3 was taken as difference between total Fe and FeO. LOI: loss on ignition = % weight loss after heating sample in air for 60-90 minutes.

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35d. Spectral data – Coal-fired Power Plant Materials, AB, Canada

(i) ASD data:

CPP01	PSF 131016b.001	<45 μm; i=30°, e=0°; 350-2500 nm; 1 nm output; 1000 spectra averaged; ASD (directory: 131016_coals).
CPP02	PSF 131016b.007	<45 μm; i=30°, e=0°; 350-2500 nm; 1 nm output; 1000 spectra averaged; ASD (directory: 131016_coals).
CPP03	PSF 131016b.008	unsorted, mostly <45 μm; i=30°, e=0°; 350-2500 nm; 1 nm output; 1000 spectra averaged; ASD (directory: 131016_coals).
CPP04	PSF 131016b.009	<45 μm; i=30°, e=0°; 350-2500 nm; 1 nm output; 1000 spectra averaged; ASD (directory: 131016_coals).
CPP05	PSF 131016b.010	unsorted, mostly <45 μm; i=30°, e=0°; 350-2500 nm; 1 nm output; 1000 spectra averaged; ASD (directory: 131016_coals).

(ii) Maya data:

CPP01	PSF cpp001.spec	<45 μm; i=30°, e=0°; 400-1130 nm; ~0.5 nm resolution; 1000 spectra averaged; Maya spectrometer (directory: 121016_coals).
CPP02	PSF cpp002.spec	<45 μm; i=30°, e=0°; 400-1130 nm; ~0.5 nm resolution; 1000 spectra averaged; Maya spectrometer (directory: 121016_coals).
CPP03	PSF cpp003.spec	unsorted, mostly <45 μm; i=30°, e=0°; 400-1130 nm; ~0.5 nm resolution; 1000 spectra averaged; Maya spectrometer (directory: 121016_coals).
CPP04	PSF cpp004.spec	<45 μm; i=30°, e=0°; 400-1130 nm; ~0.5 nm resolution; 1000 spectra averaged; Maya spectrometer (directory: 121016_coals).
CPP05	PSF cpp005.spec	unsorted, mostly <45 μm; i=30°, e=0°; 400-1130 nm; ~0.5 nm resolution; 1000 spectra averaged; Maya spectrometer (directory: 121016_coals).

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END of 35.

36. Underdense regolith simulations

To try and determine what the spectral properties of underdense regolith (for example on the Moon or low-gravity bodies, like asteroids) may be like, we are making pressed discs of different materials mixed with varying amounts KBr, pressed into pellets. The surface of the pellet is roughened to provide a diffuse surface and reflectance spectra are shot with a pure powder sample located underneath the disk.

36a. Sample Descriptions - Underdense regolith simulations

131020a.001 ASB267 serpentinite; <45 μm powder.
131023a.001 KBr pellet on Spectralon – pellet surface not roughened
131023a.002 50% ASB267 (<45 μm) + 50% KBr on top of KBr disk – sample pellet surface not roughened up.
131023a.003 Blank KBr pellet on ASB267 powder (45-1000 μm) – pellet surface not roughened up.
131023a.004 50% ASB267 (<45 μm) + 50% KBr on top of ASB267 powder (45-1000 μm) – sample pellet surface not roughened up.
131023a.005 ASB267 (45-1000 μm) powder – not a full sample cup; powder surface not roughened up.
131023a.008 KBr pellet on Spectralon – pellet surface roughened up.
131023a.009 50% ASB267 (<45 μm) + 50% KBr on top of KBr disk – sample pellet surface roughened up.
131023a.006 Blank KBr pellet on ASB267 powder (45-1000 μm) – pellet surface roughened up.
131023a.007 50% ASB267 (<45 μm) + 50% KBr on top of ASB267 powder (45-1000 μm) – sample pellet surface roughened up.

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36d. Spectral Data - Underdense regolith simulations

131020a.001	PSF 131020a.001	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131020_serpentinites).
131023a.001	PSF 131023a.001	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).
131023a.002	PSF 131023a.002	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).
131023a.003	PSF 131023a.003	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).
131023a.004	PSF 131023a.004	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).
131023a.005	PSF 131023a.005	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).
131023a.008	PSF 131023a.008	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).
131023a.009	PSF 131023a.009	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).
131023a.006	PSF 131023a.006	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).
131023a.007	PSF 131023a.007	i=30°, e=0°; 0.35-2.5 μm; 2-7 nm sampling interval; 200 spectra averaged; ASD (directory: 131023_under dense regolith).

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END of 36.

B. References

Abraham, H. (1945) *Asphalts and Allied Substances, Volume 1, 5th Edition*; Van Nostrand, New York, NY.

Abraham, H. (1960) *Asphalts and Allied Substances, Volume 1. Historical Review and Natural Raw Materials*; Van Nostrand, Princeton, NJ.

Alberta Coal (date?) PR Document.

Allen, C.C., R.V. Morris, D.J. Lindstrom, M.M. Lindstrom, and J.P. Lockwood (1997) JSC Mars-1a: Martian regolith stimulant. Lunar and Planetary Science 28, abstract #1797.

Allen, C.C., K.M. Jager, R.V. Morris, D.J. Lindstrom, M.M. Lindstrom, and J.P. Lockwood (1998) Martian soil simulant available for scientific, educational study; *EOS,* **79 (34),** August 25, 1998, 405. 408-409.

Anders, D.E., and W.E. Robinson (1971) Compositional Variations of the Organic Material of Green River Oil Shale - Colorado No. 1 Core; *U.S. Bureau of Mines Report of Investigations* **7492,** 32pp.

Atkinson, S. (1989), Elemental analysis of Columbia River Basalts (unpublished data).

Atkinson, S.S. (1990) *Geochemical and Isotopic Study of the Roza Member Feeder System, Columbia River Basalt Group;* M.Sc. thesis, University of Alberta, Edmonton, AB, 112 pp.

Banin, A., F.X. Han, I. Kan, and A. Cicelsky (1997) Acidic volatiles and the Mars soil; *Journal of Geophysical Research, 102,* 13,341-13,356.

Battler, M.M., and J.G. Spray (2009) The Shawmere anorthosite and OB-1 as lunar highland regolith simulants. Planetary and Space Science, in press.

Bost, N., F. Westall, C. Ramboz, F. Foucher, D. Pullan, A. Meunief, S. Petit, I. Fleischer, G. Klingelhofer, and J.L. Vago (2013) Mission to Mars: Characterization of Mars analogue rocks for the International Space Analogue Rockstore (ISAR). Planetary and Space Science 82-83, 113-127.

Buchwald, V.F. (1975) *Handbook of Iron Meteorites,* University of California Press, Horse Creek: pp. 661-664; Hoba: pp. 647-650; Tucson: pp. 1235-1244; Odessa: pp. 937-942; Canyon Diablo: pp. 381-407; North Chile: pp. 917-931.

Cherniak, D.J. (2001) Pb diffusion in Cr diopside, augite, and enstatite, and consideration of the dependence of cation diffusion in pyroxene on oxygen fugacity. Chemical Geology, 177, 381-397.

Connolly, B.D., I.S. Puchtel, R.J. Walker, R. Arevalo Jr., P.M. Piccoli, G. Byerly, C. Robin-Popeuil, and N. Arndt (2011) Highly siderophile element systematics of the 3.3 Ga Weltevreden komatiites, South Africa: Implications for early Earth history. *Earth and Planetary Science Letters, 311,* 253-263.

Deer, W.A., R.A. Howie, and J. Zussman (1966) An Introduction to the Rock-Forming Minerals; Longman Group, Essex, England.

DHZ-1A: Deer, W.A., R.A. Howie, and J. Zussman (1997). *Rock-Forming Minerals. Volume 1A. Orthosilicates. Second Edition;* The Geological Society. London, UK.

Earley, J.W., B.B. Osthaus, and I.H. Milne (1953) Purification and properties of montmorillonite; *American Mineralogist* **38,** 707-724.

Egan, R.S. (1987) A fifth check-list of the lichen-forming, lichenicolous and allied fungi of the continental United

States and Canada; *The Bryologist* **90(2)**, 77-173.

Furimsky, E., A.D. Palmer, W.D. Kalkreuth, A.R. Cameron, and G. Kovacik (1990) Prediction of coal reactivity during combustion and gasification by using petrographic data; *Fuel Processing Technology* **25,** 135-151.

Gautason, B. (1988) Uppruni Plagioklasbasalts; *B.Sc. Thesis*, University of Reykjavik, Iceland.

Hosterman, J.W., R.F. Meyer, C.A. Palmer, M.W. Doughten, and D.E. Anders (1990) Chemistry and Mineralogy of Natural Bitumens and Heavy Oils and Their Reservoir Rocks from the United States, Canada, Trinidad and Tobago, and Venezuela; *U.S. Geological Survey Circular* **1047**, 19pp.

Hower, J., and T.C. Mowatt (1966) The mineralogy of illites and mixed-layer illite/montmorillonites; *American Mineralogist* **51,** 825-854.

Hunt, J.M. (1963) Composition and origin of the Uinta Basin bitumens; *Utah Geological and Mineralogical Survey Bulletin* **54,** 249-273.

Hunt, J.M., F. Stewart, and P.A. Dickey (1954) Origin of hydrocarbons of Uinta Basin, Utah; *Bulletin of the American Association of Petroleum Geologists* **38,** 1671-1698.

Kalkreuth, W., M. Steller, I. Wieschenkämper, and S. Ganz (1991) Petrographic and chemical characterization of Canadian and German coals in relation to utilization potential, 1. Petrographic and chemical characterization of feedcoals; *Fuel* **70,** 683-694.

King, L.H. (1963) On the Origin of Anthraxolite and Impsonite; *Mines Branch Research Report* **R116**; Department of Mines and Technical Surveys, Ottawa, ON, 9pp.

King, L.H., F.E. Goodspeed, and D.S. Montgomery (1963) A Study of Sedimented Organic Matter and Its Natural Derivatives; *Mines Branch Research Report* **R114**; Department of Mines and Technical Surveys, Ottawa, ON, 68pp.

Lhotka, P. G. (1988) Geology and Geochemistry of Gold-Bearing Iron Formation in the Contwoyto Lake-Point Lake Region, NWT, Canada; *Ph.D. Dissertation*, University of Alberta, Edmonton, Alberta, Canada, 265 pp.

Maaskant, P., J.J.M.M.M. Coolen, and E.A.J. Burke (1980) Hibonite and coexisting zoisite and clinozoisite in a calc-silicate granulite from southern Tanzania ; *Mineralogical Magazine* **43,** 995-1003.

Mancuso, J.J., and R.E. Seavoy (1981) Precambrian coal or anthraxolite: A source for graphite in high-grade schists and gneisses; *Economic Geology* **76,** 951-954.

McGuire, A.V., C.A. Francis, and M.D. Dyar (1992) Mineral standards for electron microprobe analysis of oxygen. American Mineralogist, 77, 1087-1091.

McKay, D.S., J.L. Carter, W.W. Boles, C.C. Allen, and J.H. Allton (1994) JSC-1: A new lunar soil stimulant. Engineering, Construction and Operations in Space IV, pp. 857-866. [http://ares.jsc.nasa.gov/HumanExplore/Exploration/EXLibrary/DOCS/EIC050.HTML]

Mermut, A.R., and A.F. Cano (2001) Baseline studies of the Clay Minerals Society course clays: Chemical analyses of major elements; *Clays and Clay Minerals* **49,** 381-386.

Morris, R.V., D.C. Golden, J.F. Bell III, T.D. Shelfer, A.C. Scheinost, N.W. Hinman, G. Furniss, S.A. Mertzman, J.L. Bishop, D.W. Ming, C.C. Allen, and D.T. Britt (2000) Mineralogy, composition, and alteration of Mars Pathfinder rocks and soils: Evidence from multispectral, elemental, and magnetic data on terrestrial analogue, SNC meteorite, and Pathfinder samples; *Journal of Geophysical Research, 105,* 1757-1817.

Palace, C. (1950) Fayalite at Rockport, Massachusetts. American Mineralogist 35, 877-881.

Patching, T.H., J.M. Harrison, I. Mackay, and R.A.D. Beck (1980) *Western Canada's Coal: The Sleeping Giant*; Canada West Foundation, Calgary, Alberta, D.W. Friesen and Sons Ltd., 207 pp.

Peters, G.H., W. Abbey, G.H. Bearman, G.S. Mungas, J.A. Smith, R.C. Anderson, S. Douglas, and L.W. Beegle (2008) Mojave Mars simulant – Characterization of a new geologic Mars analogue. *Icarus 197*, 470-479.

Pringle, I.C. (1975) An occurrence of hydrothermal fayalite in the epicrustal rocks of the Bushveld Igneous Complex; *Mineralogical Magazine* **40**, 418-419.

Puchtel, I.S., A.W. Hofmann, M. Mezger, A.A. Shchipansky, V.S. Kulikov, and V.V. Kulikova. Petrology of a 2.41 Ga remarkably fresh komatiitic basalt lave lake in Lion Hills, central Vetreny Belt, Baltic Shield. *Contributions to Mineralogy and Petrology, 124*, 273-290.

Puchtel, I.S., R.J. Walker, A.D. Brandon, and E.G. Nisbet (2009) Pt-Re-Os and Sm-Nd isotope and HSE and REE systematics of the 2.7 Ga Belingwe and Abitibi komatiites. *Geochimica et Cosmochimica Acta 73*, 6367-6389.

Schultz, L.G. (1969) Lithium and potassium absorption, dehydroxylation temperature, and structural water content of aluminous smectites; *Clays and Clay Minerals* **17,** 115-149.

Sheffer, A.A., H.J. Melosh, B.M. Jarnot, and D.S. Lauretta (2003) Reduction of silicates at high temperature: Fulgurites and thermodynamic modeling. Lunar Planet. Sci. 34, abstract #1467.

Sheffer, A.A., M.D. Dyar, and E.C. Sklute (2006) Lightning strike glasses as an analogue for impact glasses: ^{57}Fe Mössbauer spectroscopy of fulgurites. Lunar Planet. Sci. 37, abstract #2009.

Singer, R.B. (1981) Near-infrared spectral reflectance of mineral mixtures: Systematic combinations of pyroxenes, olivine, and iron oxides; *Journal of Geophysical Research* **86,** 7967-7982.

Sunshine, J.M., and C.M. Pieters (1993) Estimating modal abundances from the spectra of natural and laboratory pyroxene mixtures using the modified Gaussian model; *Journal of Geophysical Research* **98,** 9075-9087.

Tibbetts, T.E. (1976) *Evaluation of Canadian Commercial Coals - Saskatchewan, Alberta and British Columbia - 1975*; CANMET Report **76-41**, Canada Centre for Mineral and Energy Technology.

Tissot, B.P., and D.H. Welte (1978) *Petroleum Formation and Occurrence*, Springer-Verlag, Berlin, 538 pp.

Yen, T.F., and G.V. Chilingar (1976) Introduction to oil shales, in *Oil Shale (Developments in Petroleum Science, 5)* (T.F. Yen and G.V. Chilingar, Eds.); Elsevier, Amsterdam.

Yorath, C. (2005) The Geology of Southern Vancouver Island: Revised 2005. Harbour Publishing, Madeira Park, BC.

Zwaan, P.C. (1996) Enstatite, cordierite, kornuperine, and scapolite with unusual properties from Embilipitiya, Sri Lanka. Gems and Geomology 32 (4), 262-269.

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END of References.