Finalizing the TREX Fine-Particle Spectral Library of Minerals (UV-VNIR-MIR in Reflectance, Emission, Raman) and Preparing to Receive Meteorite Samples

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Introduction: Humans will be visiting airless bodies that likely will have a dusty component to their surface materials. This dust poses a hazard to missions (e.g., degrading hardware, affecting astronaut health, affecting trafficability, etc.). In order to study dusty surfaces of airless bodies in the solar system using remote sensing, the TREX SSERVI team (trex.psi.edu) is developing a comprehensive spectral library focused on fine-particle (<10 um) planetary materials measured over UV-VNIR-MIR (~0.2 to 25 um).

We are finalizing our analyses of terrestrial minerals (Table 1) as proxies to the minerals that might be found on target surfaces, and are awating a suite of meteorites from NASA JSC (Table 2).

Table 1

TERRESTRIAL MINERALS:	
Forsterite Globe SSERVI	Spinel ARSAA
Forsterite SC SSERVI	Pyrite SA-25G
Bytownite CB SSERVI	Oldhamite AA-14
Labradorite - Chihuaha SSERVI	Palygorskite PFI-1
Diopside - Herschel SSERVI	Hectorite SHCa-1
Augite - Harcourt SSERVI	Na Montmorillonite SWy-3
Albite AL-1	Ca Montmorillonite STx-1b
Anorthite AN-G	Kaolinite KGa-1b
Labradorite ARSAA	Nontronite NAu-2
Enstatite Zen-1	Serpentine UB-N
Hematite AA-30	Serpentine SMS-16
Hematite SA-500G	Phlogopite Mica-Mg
Ilmenite AA-30	Zinnwaldite ZW-C
Fe metal AA-70	Graphite AA-30

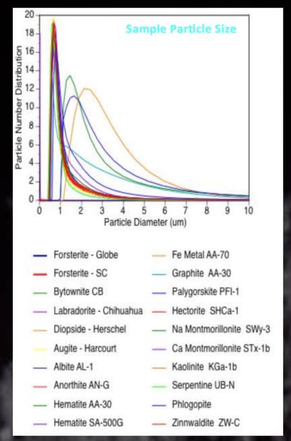
Table 2

METEORITES (approved but not yet received): ID	CLASS
~~ALH 84007~~ Denied	aubrite
~~EET 99402~~ Denied	brachenite
ALH 83100	CM chondrite
MIL 090001	CR2
EET 79002	diogenite
LAP 10014	EL6
EET 83227	eucrite (polymict)
WSG 95300	H3.3
LEW 8703	H5 (might sub w/ L6)
LAR 12326	howardite
MIL 07010	L impact melt
RKP 79015	mesosiderite
PCA 82506	urelite

Particle size: We verified that our samples are fine enough to imitate "dust". Our goal was to study samples <10-um in diameter; however, using a Malvern Mastersizer particle size analyzer, we determined our terrestrial mineral samples to be <<10 um. Our measured samples are dominated by particles that are typically 0.5 to 3 um in diameter, with more than 90% of the entire sample suite at <<10 um.

Particles this size behave spectrally differently than coarser particles, especially in the MIR and under vacuum conditions.

It is possible that there is some cohesion of the particles during the spectral measurements, but the spectra are characteristic of <10 um "dust".



Results: We are measuring our samples in multiple labs. We have been addressing the quality of the data through lab modifications (e.g., hardware, calibration), and our lab comparisons are improving. The spectra shown here represent the UV-VNIR reflectance data from 3 labs -- DLR, PSI, and UW. There are some explainable differences. For example, for the phyllosilicate minerals, the DLR data are slightly different because they were aquired under vacuum conditions (PSI and UW were ambient), suggesting some dehydration. Also, the hematite AA30 sample altered so that none of the spectra are similar. Other minor differences can be attributed to how the samples were put into the sample cups at each of the labs and other data acquisition differences.

We are acquiring XRD data to verify the mineralogy of each sample and identify possible contaminants.

Currently we are developing UV standards for distribution to the TREX labs in order to better address and expand the spectral range, and generate data that are reproducible among the labs. We are expecting to extend our UV measurements into the far UV (~0.12 um).

As the spectra are finalized, we are creating "Frankenspectra", i.e., a representative spectrum of each mineral made using the best segments of the spectra. Each Frankenspectrum should best represent the spectral behavior of each mineral across the entire UV-MIR range.

MIR and Raman analyses:
All of the mineral samples were analyzed in reflectance (ambient P and T) and emission (80 C at ambient P; at 150 and 300 C in vacuum). They also were analyzed using Raman spectroscopy. However, the acquired spectra are too plentiful for clarity of this poster.

Meteorite work:
TREX will receive meteorites when JSC is open again Table 2). Using all the participating spectroscopy labs, meteorite thick sections will be measured from UV through MIR. Meteorites samples also will be processed to <10 um particles, and they will be measured in all the participating labs. Additional Raman and MB analyses will be done.

All mineral and meteorite spectra (individual lab spectra and the "Frankenspectra") will be archived in the Geosciences PDS node.

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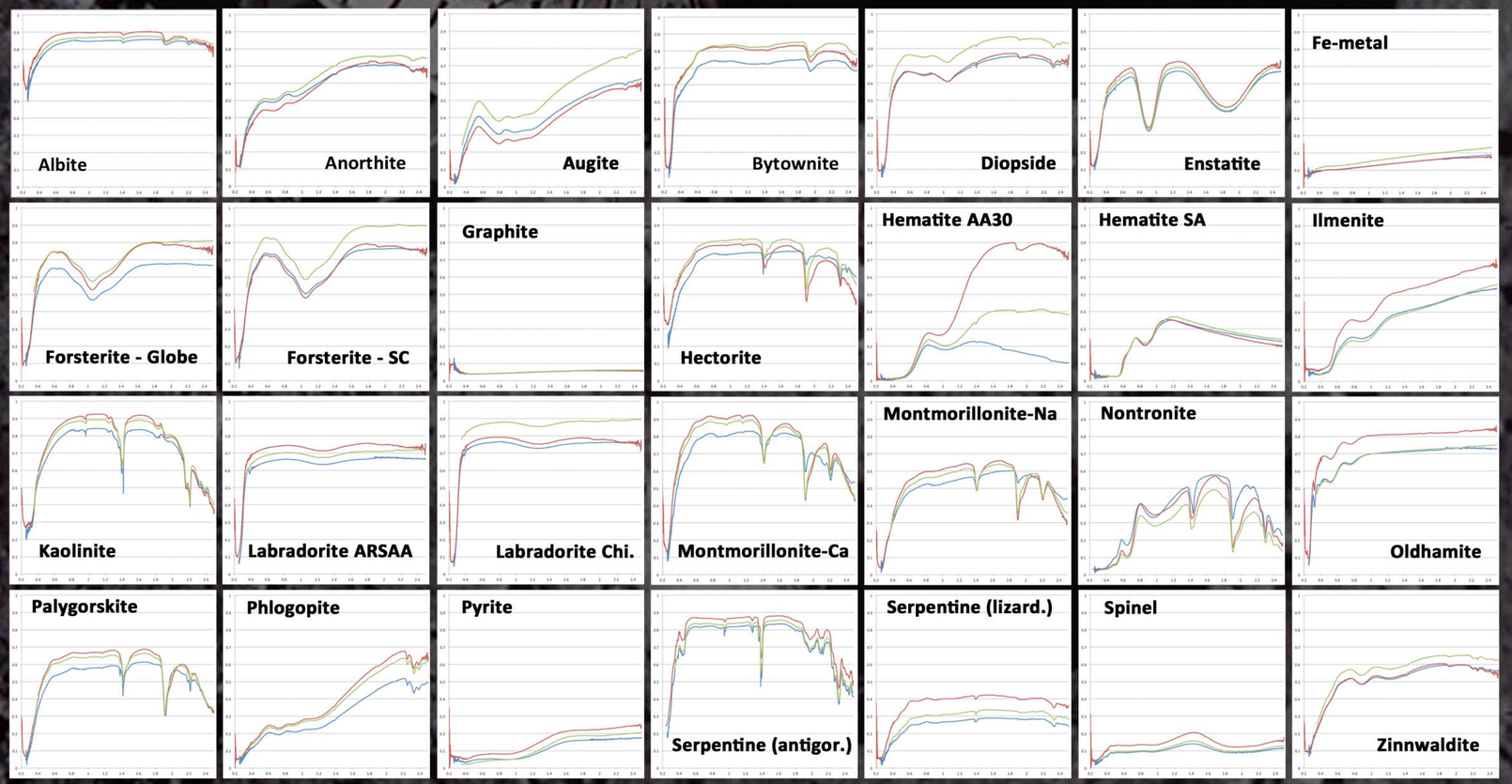

Spectra from DLR (BLUE), PSI (RED), and U. Winnipeg (GREEN)