# LUNAR REFERENCE SUITE TO SUPPORT INSTRUMENT DEVELOPMENT & TESTING.

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**Introduction:** Astronauts on long-duration lunar missions will need the capability to "high-grade" their samples – to select the highest value samples for transport to Earth – and to leave others on the Moon. Instruments that may be useful for such high-grading are under development. Instruments are also being developed for possible use on future lunar robotic landers, for lunar field work, and for more sophisticated analyses at a lunar outpost. **The Johnson Space Center Astromaterials acquisition and Curation Office (JSC Curation) will support such instrument testing by providing lunar sample "ground truth".**

**Support to Instrument Testing:** A reference suite of lunar 18 rocks and 4 soils, spanning the compositional and petrographic range found in the Apollo collection, has been selected and approved specifically to support instrument development and testing. A glovebox and laboratory space for testing such instruments are available in the JSC Lunar Experiment Laboratory. Thin sections of the reference suite samples are available at JSC for direct comparison. The Lunar Sample Compendium [1], published on-line at the address: www-curator.jsc.nasa.gov/lunar/compendium summarizes previous analyses of these samples. The laboratory, sample suite, and Compendium are available to the lunar research and exploration community.

**Ground rules for instrument testing on the lunar sample reference suite:**

- **Tests must be non-destructive**
- **Tests may be conducted in the glovebox or on the bench top in the JSC Lunar Experiment Laboratory**
- **The instrument must be transported to JSC for the tests**
- **The investigator must submit a short proposal to the JSC Lunar Sample Curator, describing the proposed tests and previous results on relevant terrestrial samples**
- **For accepted tests JSC will provide samples, testing area, and curator / technician support at no cost. All other costs must be supported by the proposer.**

**First Tests:** In the first tests of possible instruments for lunar sample high-grading, we imaged all 18 lunar rocks and four soils from the reference suite using the Multispectral Microscopic Imager (MMI) developed by Arizona State University and the Jet Propulsion Laboratory [2]. The MMI is a fixed-focus digital imaging system with a resolution of 62.5 µm/pixel, a field-of-view of 40 x 32 mm, and a depth-of-field of approximately 5 mm. Samples are illuminated sequentially by 21 light emitting diodes (LEDs) in discrete wavelengths spanning the visible to shortwave infrared (463 nm to 1750 nm). Measurements of reflectance standards and background allow calibration to absolute reflectance. ENVI-based software is used to produce spectra for specific minerals as well as multi-spectral images of rock textures.

Figures 1-5 are natural-color (R: 641nm, G: 522nm, B: 463nm) images of rock and soil samples in the reference suite. Figure 6 is a color map based on spectral end-members of the sample shown in Figure 5. The spectra from every point in the scene, each consisting of reflectance in the 21 LED wavelengths, were grouped into characteristic spectra which were correlated with specific minerals and clast types.

References: [1] Meyer, C. (2010) *This meeting*. [2] Nunez J. *et al*. (2010) *This meeting*.

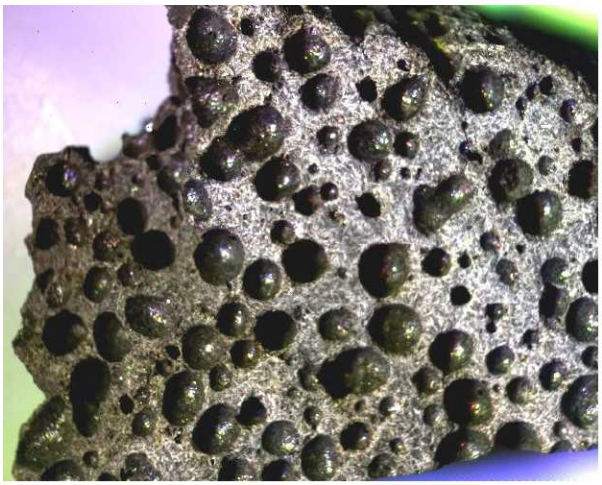

Figure 1. MMI image of vesicular basalt 15556; frame widths in all images 40 mm

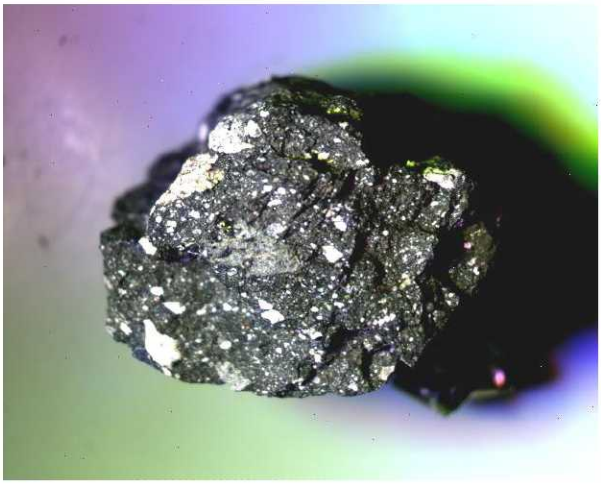

Figure 2. MMI image of soil breccia 15459

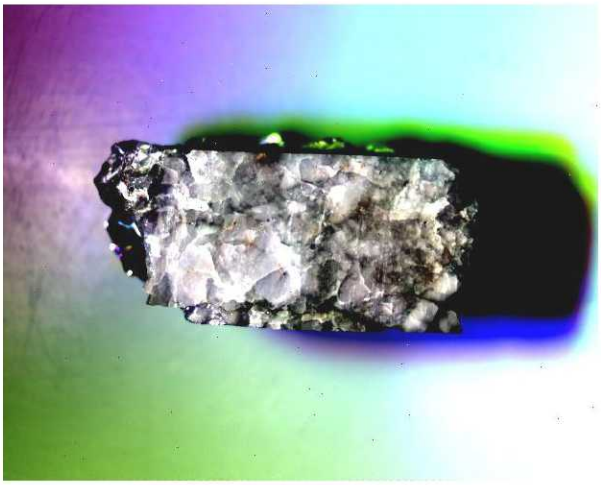

Figure 3. MMI image of melted anorthosite 61016

Figure 4. MMI image of soil 64501

Figure 5. MMI image of crystalline breccia 14321

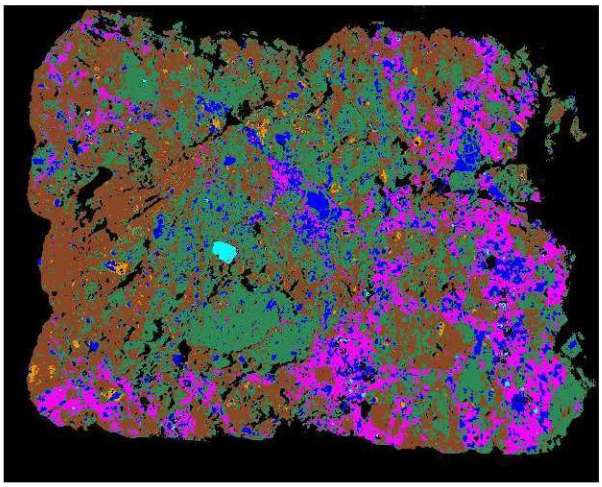

Figure 6. MMI color map based on spectral end-members of crystalline breccia 14321 illustrating mineral and clast identification