HIGH-GRADING LUNAR SAMPLES FOR RETURN TO EARTH. Carlton Allen[1], Glenn Sellar[2], Jorge Nunez[3], Daniel Winterhalter[2], and Jack Farmer[3]

[1]NASA Johnson Space Center, Houston, TX 77058 carlton.c.allen@nasa.gov [2]Jet Propulsion Laboratory, Pasadena, CA 91109 [3]Arizona State University, Tempe, AZ 85287

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. We are supporting studies to define the "necessary and sufficient" measurements and techniques for high-grading samples at a lunar outpost.

A glovebox, dedicated to testing instruments and techniques for high-grading samples, is in operation at the JSC Lunar Experiment Laboratory. A reference suite of lunar rocks and soils, spanning the full compositional range found in the Apollo collection, is available for testing in this laboratory. Thin sections of these samples are available for direct comparison. The Lunar Sample Compendium, on-line at http://www-curator.jsc.nasa.gov/lunar/compendium.cfm, summarizes previous analyses of these samples. The laboratory, sample suite, and Compendium are available to the lunar research and exploration community.

In the first test of possible instruments for lunar sample high-grading, we imaged 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 [1-3]. The MMI is a fixed-focus digital imaging system with a resolution of 62.5 microns/pixel, a field size 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 (450 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.

The suite of lunar samples includes basalts and breccias with a wide range of textures. Figure 1 is a pseudo-color image of Apollo 14 crystalline breccia 14321, created from images using the red, green, and blue diodes. Figure 2 is a spectral map of the same sample created to aid in mineral and clast identification. 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.

Figure 1. MMI RGB image of crystalline breccia 14321; frame width 40 mm

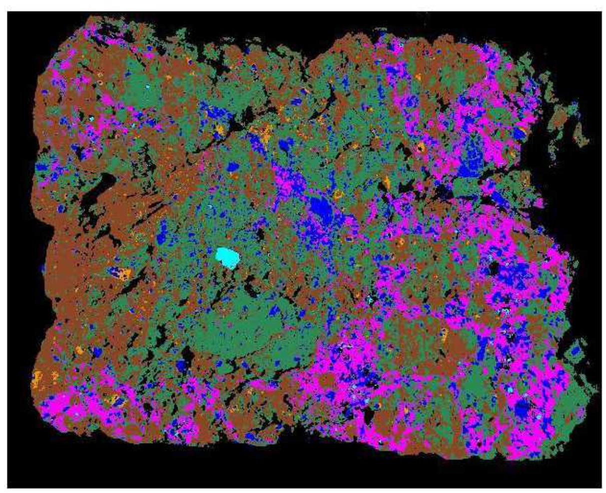

Figure 2. MMI spectral map of crystalline breccia 14321 illustrating mineral and clast identification; frame width 40 mm

References: [1] Nunez J. et al. (2009) *NASA Lunar Science Forum*. [2] Allen C. C. et al. (2009) *NASA Lunar Science Forum*. [3] Nunez J. et al. (2009) *This meeting*.