REFERENCE IMAGES FROM THIN SECTIONS OF LUNAR REGOLITH. Doug Rickman[1] and Jennifer Edmunson[2], [1]NASA/MSFC/Earth Science Office (320 Sparkman, Huntsville, AL 35802 doug.rickman@nasa.gov), [2] BAE Systems Inc. (308 Voyager Way NW, Huntsville AL 35806, Jennifer.E.Edmunson @NASA.gov).

Introduction: The specialist literature about the lunar regolith is massive. It is also highly focused on specific topics and effectively impenetrable to most non-geologists. Both characteristics of the literature present substantial hurdles to scientists and engineers interested in the regolith In the author's experience it neither surprising or unusual to find serious misconceptions about lunar-type materials outside of the lunar research community. Education of professionals who are non-geologists but interested in the regolith is impeded by a lack of some basic resources. One asset that has been missing is simply detailed images of the regolith "soil". While a few websites [1-3] offer imagery of specific features, these are of course selected to illustrate specific features. It is almost impossible for a non-specialist to reason from these what "normal" or "typical" regolith looks like.

Further, access to lunar material is highly restricted. And as publications rarely do not provide other than highly focused and narrowly tailored data, there is little potential for workers without personal access to sample to do any work with lunar material.

To address both problems the authors have begun to make high resolution optical micrographs of entire thin sections of lunar regolith.

Methodology: Given the particle size distributions and complex textures typical of lunar regolith, the petrographic microscope is an excellent tool. It permits visual examination of particle size, composition, shape, orientations and textures. For non-geologists the imagery is relatively easy to understand given minimal explanation and it is extremely rich in information.

For this work three thin sections: 60009 6020, 60009 6028 and 68001 6031 were used. All are from Apollo 16 double drive tube cores. [4] Each thin section was photographed in R,G,B at 16 bit/color. Spatial resolution was 1.48 μm per pixel. Given this spatial resolution, 74 - 96 individual photomicrographs (tiles) were needed to cover each thin section. Images were acquired using three modalities: plain, polarized light, with crossed nicols, and with reflected light. For reflected light the system was not perfectly configured, resulting in an uneven incident illumination distribution across each tile. This unevenness was modeled and corrected using ImageJ [5-6] and macros written for the purpose. The photomerge function in Photoshop was used to composite the individual tiles into a single image, 700 – 900 MB in size. After compositing the functions used to convert from 16 bits per pixel to 8 bits for display were adjusted to correct for illumination color and camera white balance, and differential spectral sensitivity of the camera detector.

The digital data will be publically available through the NASA Technical Reports Server (NTRS).

Analysis: These data can be used to visually demonstrate the typical features of the lunar regolith. Characteristic features, such as the extremely fine particle size, lack of sorting, complex and variable lithics, internal particle textures, glasses and agglutinates are readily identified in context.

Analytically, the data can be used for studies previously not practical without direct access to both the samples and the necessary equipment to make the desired measurements. For example, these are three thin sections now being processed to extract particle shape data.

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References: [1] LPI (acc. 10/31/2012) http://www.lpi.usra.edu/lunar/samples/atlas/thin_sections/. [2] LPI (acc. 10/31/2012) http://www.lpi.usra.edu/lunar/samples/atlas/virtual_microscopes/. [3] Hollocher, K. (acc. 10/30/2012) "Moon Rocks: Lunar Geology and Petrology." http://mierva.union.edu/hollochk/c_petrology/moon_rocks/index.htm. [4] Meyer, C. (2007 & 2011) Lunar Sample Compendium http://curator.jsc.nasa.gov/lunar/compendium.cfm. [5] Rasband, W.S. (2013) ImageJ, NIH, Bethesda, MD, http://imagej.nih.gov/ij/. [6] OptiNav, Inc. Polynomial_Shading_Corrector http://www.optinav.com/imagej.html.