PHOTOMETRIC PROPERTIES OF LUNAR REGOLITH SIMULANTS. R. M. Nelson[1], M. D. Boryta[2], [1]Planetary Science Institute, 775 North Mentor Avenue, Pasadena CA 91104, rnelson@psi.edu, [2]Department of Earth Sciences and Astronomy, Mount San Antonio College, Walnut CA 91789

Introduction: For more than a century, remotely-sensed photometric properties of lunar regolith materials have been measured in efforts to understand the nature of lunar regolith texture. The change in reflectance and linear polarization of sunlight reflected from the regolith has often been studied. These photometric variations are related to the phase angle (α) and the angles of incidence (i) and emission (e). The reflectance of particulate materials decreases sharply as α increases from 0°, while the linear polarization decreases, reaching a minimum at an angle of a few degrees; then it increases, becoming positive at about 10°, reaching a maximum at about 130°. The observed differences are related to the physical properties of the regolith: particle shape, size, and albedo.

These reflectance conditions are simulated in the laboratory using a goniometric photopolarimeter (GPP). Our GPP measures the change in intensity of reflectance and in linear polarization of electromagnetic radiation as a function of α. The detailed methodology is described in Nelson et al., 2018.

As humans prepare for the next phase of lunar surface research, we anticipate increased interest in what these remotely sensed reflectance and polarization data can tell us about the physical properties of the surface materials – particularly the microstructure.

Numerous lunar surface analogs have been studied and compared to the reflectance properties of particulate materials returned from the Moon to provide ground truth testing of photometric theories advanced to interpret the nature of the regolith.

We show the reflectance properties of lunar regolith simulants used by researchers in the U.S. and China.

Description of Samples: We analyzed well-sorted separates of Anorthosite and JSC-1, materials that have been widely used as lunar analogs by researchers in the U.S. and China. The anorthosite is that studied by Jaing et al. (2018). The JSC-1 is characterized by McKay et al. (1994)

The samples were ground and sieved into well sorted particle size fractions. The reflectance and polarization phase curves were measured in our GPP. The reflectance phase curves (0°<α<15°) for large and small particle size fractions (normalized at 5°) are shown in Fig 1, and the corresponding linear polarization phase curves are shown in Fig 2.

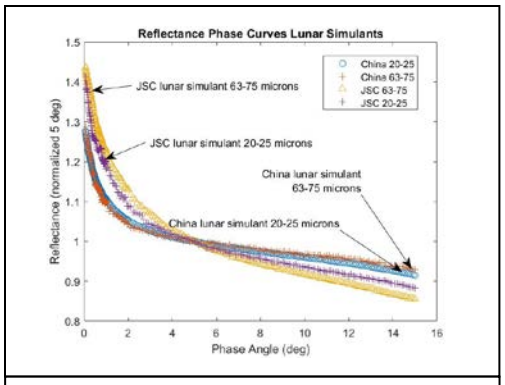

Fig. 1 Reflectance Phase Curves (normalized at 5°) of typical lunar regolith simulants used in the USA and China. The peak of the phase curve and its width are related to particle size

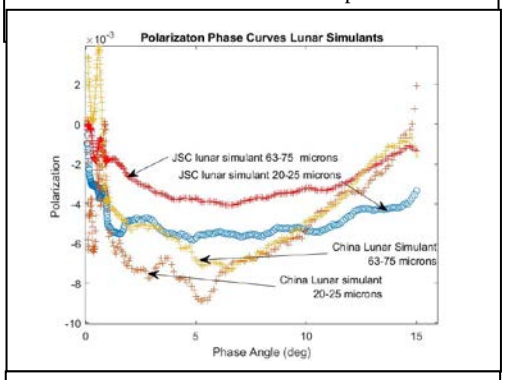

Fig 2. Linear polarization phase curves for the materials shown in Fig. 1. The linear polarization minimum (near 5°) becomes increasingly negative as particle size decreases for the same materials. We observe the highly variable polarization at α ~ 0° in many particulate materials. To our knowledge this is the first report of this behavior. Investigation of linear polarization processes near 0° may provide new understanding of planetary regolith from remote sensing.

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