New Lunar Non-Polar Highlands Perspectives of Regolith Maturation

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Introduction

Lunar surface maturity is consistently examined using the NIR optical maturity parameter (OMAT) [1]. However, the NIR only provides a perspective of the upper microns of the lunar surface. Recent studies of Lunar Prospector (LP) and Lunar Reconnaissance Orbiter data sets are now demonstrating additional measures of maturity with sensitivities to greater depths (~2 m) in the regolith. These include thermal infrared, S-band radar, and epithermal neutron data sets [2-4].

Previous Work

Interestingly, each of these data sets measured parameter or abundance is directly comparable to OMAT despite each measuring slightly different aspects of the regolith. This is demonstrated by *Lawrence et al*. [3] where LP-measured non-polar highlands epithermal neutrons trend well with albedo, OMAT, and the Christensen Feature (CF). *Lawrence et al*. [3] used these data to derive and map highlands hydrogen (H) which is dominantly a function of H-implantation. With this in mind, areas of enriched-H are mature, while areas of depleted H are immature.

Presented Here

Surface roughness as measured by S-band radar [4], also provides a measure of maturity. In this case, the circular polarization ratio (CPR) is high when rough and immature, and low when smooth and mature. Knowing this, one can recognize areas in the non-polar lunar highlands that show contradictory measures of maturity. For example, while many lunar localities show consistently immature albedo, OMAT, CF, CPR, and H concentrations (e.g., Tycho), others do not (e.g., Orientale).

Summary

To better understand how the lunar regolith is weathering with time we examine ~35 localities in the non-polar highlands.

[1] Lucey et al. (2000) *JGR*, **105**, 20377. [2] Lucey et al. (2013) *LPSC*, **44**, 2890. [3] Lawrence et al. (2015) *Icarus*, j.icarus.2015.01.005. [4] Neish et al. (2013) *JGR*, **118**, 2247.