THE EFFECT OF BURIED ROCKS ON THE APPARENT PHYSICAL PROPERTIES OF THE LUNAR REGOLITH. Zoe A. Landsman[1] and Philip T. Metzger[1], [1]University of Central Florida

Overview: Studies of the physical properties of the lunar regolith improve our understanding of processes that affect the Moon's surface and aid in planning of missions, e.g., site selection and lander specifications. Thermal models can be used to constrain relevant lunar regolith properties, such as the vertical density profile (parameterized by the vertical soil scale height, *H*) and the bulk thermal inertia of the upper regolith. Recent modeling [1] of cooling curves measured by the Lunar Reconnaissance Orbiter's Diviner Lunar Radiometer Experiment indicate that global (latitude ± 60°) lunar regolith properties are relatively uniform, with a global H parameter of 6.8 ± 0.7 cm and global thermal inertia of 55 ± 2 $Jm^2K^{-1}s^{1/2}$.

These results are derived assuming an exponential, monotonically increasing vertical density profile (e.g., [2]). However, data from Apollo drill core and penetrometer experiments suggest the vertical densification profile is 3-4 times less rapid with depth than the best-fit profile derived by [1]. Simulations of diurnal thermal wave using random, non-monotonic soil profiles, result in soil profiles with an apparent *H* parameter consistent with that Apollo data [3]. These results also indicate that inferred *H* parameter systematically decreases at high latitudes (Figure 1). This means the methodology applied to the Diviner data may overpredict the density of regolith toward the poles. Experimental results suggest that thermal cycling can produce compaction near the equation, providing further evidence that the polar regolith may be underdense relative to the equator [3].

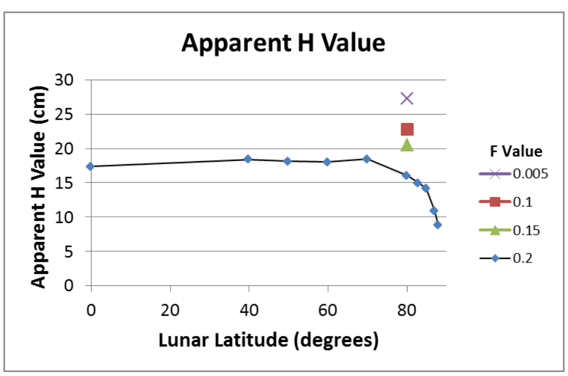

Figure 1: Derived apparent *H* for each latitude, showing the Diviner methodology is biased toward low *H* (more compaction) at the poles. The *F* parameter measures the degree of randomness in the non-monotonic soil profile.

Methodology: Both models discussed include a number of simplifications. The presence of buried rocks, crater rims, and compositional variations affect thermal signatures as measured by Diviner. We are beginning to explore the effects of such complications on apparent regolith properties by developing 1D and 2D (axisymmetric) thermal models that include buried rocks (Figure 2). Previous work [4] indicates that subsurface rock within the diurnal skin depth (~10 cm) of the lunar surface changes the effective thermal inertia. We will vary the size and abundance of buried rocks. We will use both the monotonic, exponential soil profiles, as in [1] and [2], and the random, non-monotonic soil profiles for the regolith components.

Expected Impact: When our model is fully developed, we will test whether the apparent trend of looseness of regolith at the lunar poles is maintained. This model will support planning and interpretation of results from mission to the lunar poles and can be applied to other airless bodies, such as Mercury and asteroids.

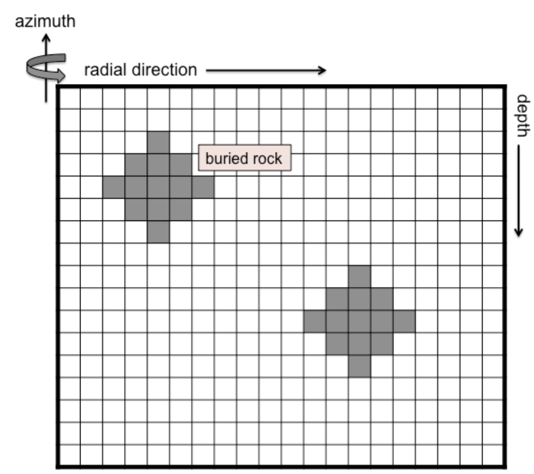

Figure 2: A cartoon cross-section of our 2D, axisymmetric thermal model. Elements with buried rocks have different thermal than surrounding cells containing regolith.

References

[1] Hayne, P. O, et al. (2017) *JGR*, 122, 12, 2371
[2] Vasavada, A. R., et al. (2012) *JGR*, 117, E00H18
[3] Metzger, P. T., et al. (2017) *NESF*2017-122