

Introduction: One of the goals of the Lunar Vulkan Imaging and Spectroscopy Explorer (Lunar-VISE) mission is to characterize the geotechnical properties of the regolith around the Gruithuisen Domes. A relationship of particular interest is between the reflectivity (albedo) and the porosity of the uppermost. First noted by Hapke [1], the albedo of lunar regolith tends to be inversely proportional to its porosity. Since Lunar-VISE will be the first mission to visit a lunar red spot or non-mare volcanic region, we examine existing orbital measurements of the area in combination with numerical modelling to further constrain this relationship.

Methods: We have been measuring the reflectance of lunar soil from the landings of the Apollo missions in the 1960s to the still-operating Lunar Reconnaissance Orbiter (LRO) launched in 2009. Albedo values from the Apollo mission are particularly unique as we have both in-situ observations and returned samples to analyze. The reflectance of several lunar samples has been measured at the Southwest Research Institute’s ultraviolet reflectance chamber (SWURC). The optical constants obtained from these measurements are then used as input in a Hapke porosity model code. The model [2] calculates the wavelength dependence for LAMP albedo values over a given porosity range. Input parameters used are originally from Shkuratov et al. [3] but are being updated based on SWURC results.

Another benefit to using SWURC is that it was designed to measure wavelengths that directly correspond to those recorded by the Lyman Alpha Mapping Project (LAMP) instrument on board LRO. This far-UV spectrograph measures reflected photon counts which can then be used to make albedo maps of the lunar surface.

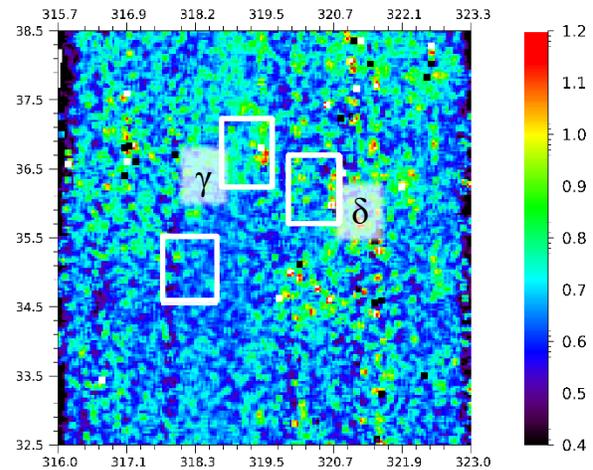


Figure 1: LRO-LAMP Off-Band/On-Band Albedo Ratio map of the Gruithuisen Domes and mare. Map axes are latitude vs longitude in degrees; the variation in longitude is due to projection used. The three white-box regions of interest are the Gamma dome, Delta dome, and nearby mare Sinus Viscositatis.

Preliminary Results: An albedo map of the Gruithuisen domes has been made for LRO-LAMP data spanning 2009-2016, shown in Figure 1. This time period was prior to the permanent opening of the fail-safe door. With the door open, the amount of light being detected increased drastically. A map of the same area for the years 2016-2023 is in progress as the files undergo updated calibration due to the increase in photon counts.

Through using the model to create porosity maps derived from albedo maps, we have a pixel-to-pixel comparison of the relationship between the two variables. We will use LAMP albedo maps and modelled values to compare with ground truth data from the Lunar-VISE mission.

References: [1] Hapke, B. (2008) *Icarus*, 195, 918–926. [2] Byron, B. Porosity maps of the lunar surface derived from LRO-LAMP albedo data [abstract]. In: *Lunar and Planetary Science Conference 2019*. [3] Shkuratov, Y. et al. (1999) *Icarus* 137.2, 235-246.