SILICIC VOLCANISM IDENTIFIED BY THE DIVINER LUNAR RADIOMETER EXPERIMENT.

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Introduction: The Lunar Reconnaissance Orbiter Diviner Lunar Radiometer Experiment (Diviner) has been used to detect and characterize a number of silicic volcanic constructs on the Moon [1-6]. These regions include Hansteen Alpha, the Gruithuisen domes, the Mairan domes, the Compton-Belkovich volcanic complex, and the Lassel Massif. An additional detection of silicic material in the Aristarchus central peak and ejecta suggests the excavation of a silicic pluton.

Non-mare volcanism had long been suspected at several locations on the Moon based on unique reddening in visible/near-infrared (VNIR) spectra, and geomorphologic consistency with viscous lava flows [7-10]. Additional evidence for the unique composition of these regions includes their association with high Th abundances and low FeO contents mapped by the Lunar Prospector Gamma Ray Spectrometer [4, 11-12]. Here, we review the contribuions made by Diviner to the understanding of these important features.

Diviner Concavity Index: Diviner is an infrared radiometer that includes three narrow band channels centered at 7.8, 8.25, and 8.55 µm that are used to characterize the silicate Christiansen feature (CF), an emissivity maximum that is indicative of bulk silicate composition [2, 13-14]. The emissivities of these three "8 µm channels" are used to model the emissivity maximum as a parabola, the maximum of which is taken to be the CF position. Materials with high silica contents including SiO_2 polymorphs and alkali feldspars have CF positions outside of the region that can be characterized by the Diviner CF channels. Instead of defining a concave down parabola, the 8 µm channels display a concave-up spectral shape. Because the concave-up spectral shape is unique to highly silicic materials (with the notable exception of fayalitic olivine), we have defined an index to map the concavity of the Diviner 8 µm channels [1, 4-6] (Figure 1).

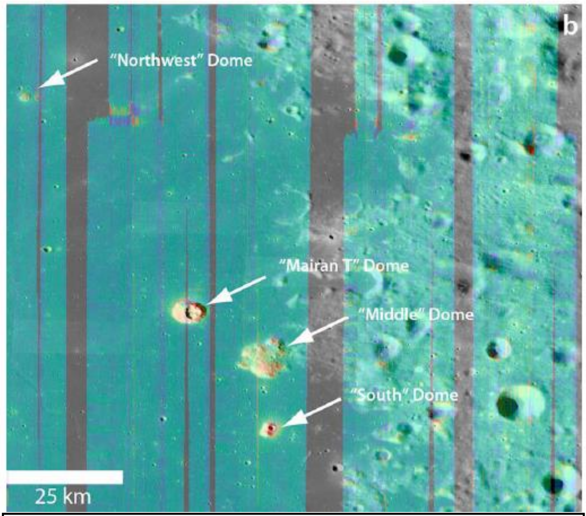

Figure 1. Diviner concavity index overlaid on LROC WAC images of the Mairan dome region [4]. Green and blue indicate mare and highland compositions. Yellow, orange, and red shades indicate an enhanced silica content consistent with dacitic or rhyolitic composition.

Implications for Lunar Volcanism and Future Exploration: Global mapping of Diviner data at 32 pixels per degree has not indicated the presence of evolved silicic lavas beyond those discussed by [1-6]. Nevertheless, it is clear that silicic magmas are volumetrically more important than suggested by the Apollo sample suite. Granitic clasts exist among the Apollo samples and exhibit textures consistent with formation via silicate liquid immiscibility [15]. The relatively large volumes of magma required to form the features observed by Diviner have led others to suggest a basaltic underplating mechanism [1, 11, 16]. Studies of silicic clasts in the Apollo sample suite have identified quartz as the only SiO_2 phase [17], although these likely intitially formed as tridymite or cristobalite [18], the high temperature SiO_2 polymorphs commonly seen in extrusive silicic rocks. This suggests that the Apollo suite may have sampled the class of silicic volcanic deposits identified by Diviner. One or more of these sites should be considered high priority targets for future exploration and sample return.

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