**INVESTIGATING LUNAR SILICIC VOLCANISM AT LASSELL MASSIF USING DIVINER EMISSIVITY SPECTRAL PROPERTIES.** K. A. Shirley[1], T. D. Glotch[2], and N. Bowles[1], [1]Atmospheric, Oceanic, and Planetary Physics Department, University of Oxford, Oxford, UK (katherine.shirley@physics.ox.ac.uk), [2]Geosciences Department, Stony Brook University, Stony Brook, New York, USA.

**Introduction:** Several regions on the lunar surface have been identified as red spots: spectroscopically distinct areas characterized by deep ultraviolet absorptions, high albedo, and low FeO and $TiO_2$ concentrations [1-4]. Some of these regions show evidence of more evolved volcanism than is typical for the Moon based on spectral and spectroscopic studies [e.g. 5-7].

Here we use the Diviner Lunar Radiometer Experiment dataset to examine the Lassell Massif to further examine the utility of the MIR in interpreting the composition and variability of materials at these volcanic regions. Diviner uses its narrow bands (3, 4 & 5) centered at 7.8, 8.25, and 8.55 µm to identify the Christiansen Feature (CF), which directly indicates the silica polymerization of a material [8]. Because the red spots exhibit anomalously short CF values outside of these 3 bands, we use concavity (*c*) and slope (*I*) indices to better constrain spectral shapes. The *c* index describes the concavity between bands 3 and 5, where positive values indicate a concave up shape. The *I* index indicates the slope between bands 3 and 4. Positive *I* values are indicative of more polymerized materials, and both positive *c* and *I* values indicate the most silicic materials.

The Lassell Massif has been well characterized and shown to be a region of explosive silicic volcanism with volcanic features dominating the southern half of the massif (Fig. 1, southern area of black ROI) [7]. Where [7] used only the Diviner CF values, here, we seek to use the Diviner indices to further examine the variations across the massif and to compare the resulting spectral analysis to laboratory data of terrestrial volcanic rocks. We build off of laboratory work presented in [9&10], in which we examine the spectra of obsidian, pumice, and rhyolite, which are several possible materials that may comprise the red spots.

**Methods:** Diviner CF value, *c* index, and *I* index datasets were generated covering 13.5 - 15.5°S, 8-10°W to encompass the Lassell Massif and part of the surrounding Mare Nubium (Fig. 1). Regions of Interest (ROIs) were drawn using LOLA elevation and slope maps to create an overall ROI for the elevated region (shown in black) and several regions within that ROI to investigate variation across the massif. We attempted to avoid steep slopes in the ROIs by limiting to areas of <20°; however, this was not always possible when investigating the hummocky region or the putative volcanic source areas (north pit, possible cone). Two ROIs were also included of the surrounding mare for comparison (large regions outside of the black ROI).

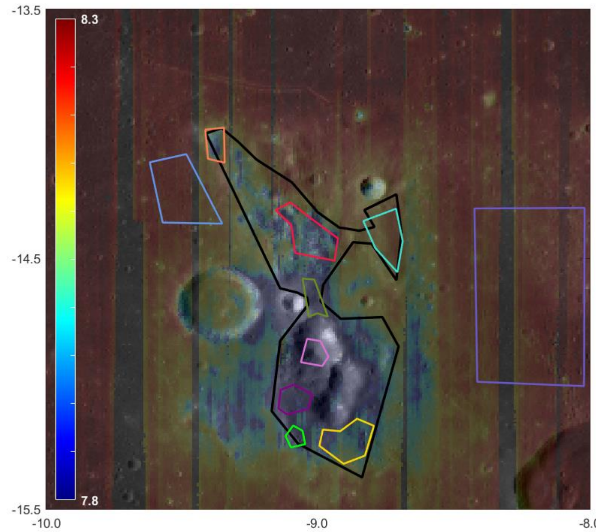


*Figure 1. CF value overlain on LROC WAC mosaic for the Lassell Massif. Dark blue indicates low CF values which correspond to more felsic composition and red higher CF values/more mafic composition. The ROIs were drawn to encompass the whole elevated region (black), smaller regions within the massif, and regions of the surrounding Mare Nubium.*

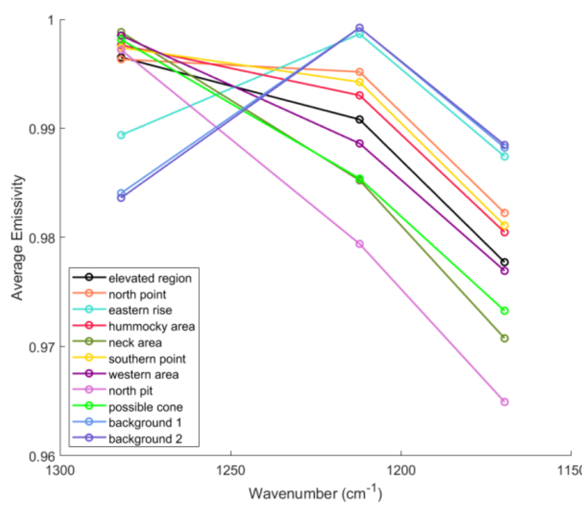


*Figure 2. Averaged emissivity spectra for each ROI (colors correspond to Fig.1). The spectra show a clear shift to steeper spectral shape as they approach the volcanic sources (north pit, possible cone).*

**Results/Discussion:** Figure 2 shows an average of the spectra at each ROI. We can clearly see the surrounding mare are distinct from the elevated volcanic

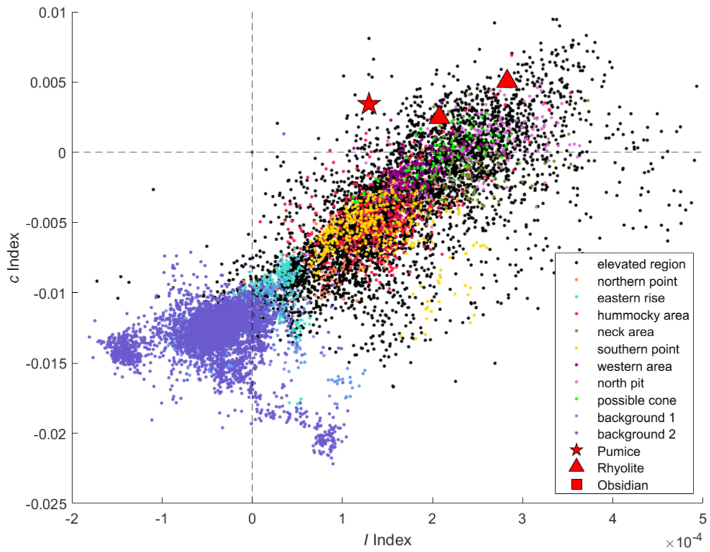


*Figure 3. Comparison of the slope and concavity indices for the Lassell Massif ROIs (colors correspond to Fig.1). Positive values for both indicate highly silicic or evolved materials only seen in the possible collapsed caldera and cone (north pit, pink; possible cone, green). Scaled index values of the laboratory spectra are shown, but only large grain sizes (>125 µm size fractions) for rhyolite and pumice fall within the values for Lassell Massif. Obsidian and smaller grain sizes exhibit more positive values.*

region with the exception of the 'eastern rise' (cyan), which also exhibits a mafic spectrum. Within the elevated region, there is a steady steepening progression of the spectral slope in the ROIs moving south toward the volcanic sources.

While the CF values generally agree with this assessment, there is higher uncertainty associated with CF values at such short frequencies; therefore, the indices are more reliable. Figure 3 shows a comparison of spectral concavity to slope using the same color scheme for the ROIs. Also plotted are the indices for terrestrial rhyolite, pumice, and obsidian measured under simulated lunar environment conditions [10]. Only large (>125 µm) size fractions of rhyolite and pumice fall within the Lassell trends, all other datapoints having much higher positive values.

Positive index values for both concavity and slope indicates highly evolved and/or glassy material [5], which only the possible volcanic source and directly adjacent ROIs (possible cone, north pit, neck area) exhibit. The decreasing trend in index values moving away from the volcanic sources could indicate a natural progression or variability in the eruption composition.

Additionally, the laboratory comparison could indicate the area is more like a rhyolitic terrestrial volcano, though compositional analysis by [7] indicates a mixed lithology and suggests several periods of activity. Further investigation is needed to best approximate the effects on spectra for a more comparable dataset.

It is of note that these constructs are old, ~4 Ga and may have experienced mixing due to the later mare emplacement and cratering processes as morphology suggests events of mass wasting [7]. The material will have experienced space weathering, one of the significant effects of which on emissivity spectra is the decrease in albedo because it alters the thermal gradient in the regolith. Space weathered soils tend to have CF values shifted slightly to longer frequencies and lower spectral contrast [e.g. 10-12], which will change the *c* and *I* indices.

Future work will look into the effects of felsic-mafic regolith mixing as well as the influence of space weathering on our interpretation of these datasets. Additional laboratory measurements combined with new spectral data from upcoming missions such as Lunar Trailblazer [13] will allow us to better constrain and quantify the composition of silicic terrains on the Moon.

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