INVESTIGATING EVOLVED COMPOSITIONS AROUND WOLF CRATER.

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Introduction: Wolf crater is an irregularly shaped, approximately 25 km crater in the south-central portion of Mare Nubium on the lunar nearside. While not previously identified as a lunar "red spot" [e.g. 1,2], Wolf crater was identified as a Th anomaly by Lawrence and coworkers [3]. We have used data from the Lunar Reconnaissance Orbiter (LRO) to determine the area surrounding Wolf crater has composition more similar to highly evolved, non-mare volcanic structures than typical lunar crustal lithology. In this presentation, we will investigate the geomorphology and composition of the Wolf crater and discuss implications for the origin of the anomalous terrain.

Geology and Morphology: This investigation uses Lunar Reconnaissance Orbiter Camera, Wide Angle Camera (WAC) and Narrow Angle Camera (NAC) imagery to provide both detailed and context perspectives of the geomorphology.

Wolf crater is the largest crater in an overall complex, which includes numerous craters and dome-like features in an approximately 50 km bright-colored massif that is elevated relative to the generally flat Mare Nubium (Figures 1-2). The south-southeastern portion of the Wolf crater's rim has been obliterated by the approximately 15 km Wolf B crater. Both Wolf and Wolf B have been filled with mare basalts. Wolf G is an approximately 6 km crater that has heavily modified the northwestern portion of Wolf crater's rim.

Composition: This investigation uses LRO Diviner Lunar Radiometer (Diviner) thermal infrared, multispectral images to provide constraints on silicate composition. Diviner has three narrowband spectral channels centered at 7.81, 8.28, and 8.55 μm designed to characterize the shape and position of the Christiansen Feature (CF), a mid-infrared compositional indicator [4]. Previous work [5-8] has demonstrated the utility of Diviner-derived data products, especially the concavity index, to identify unusual compositions consistent with the high silica contents of granitic or rhyolitic lavas. Ongoing laboratory investigations seek to produce more quantitative constraints on these compositions [9].

The Wolf crater complex shows two thermal infrared spectral characteristics common amongst high silica non-mare volcanism locations [e.g. 5-8] but not pure plagioclase sites [10]. First, as shown in Figure 3A, maps of the Wolf crater have significant areas (darkest blue) with CF values below the value of immature, pure anorthite (7.84 μm). Second, the concavity index map (Figure 4A) shows significant areas with positive values. Hansteen Alpha is shown for comparison in Figures 3B and 4B. Together these data indicate that the CF position occurs at short wavelengths, and suggest a highly silicic composition.

Discussion and Future Work: The geomorphology of the Wolf crater complex is clearly degraded, which makes identification of individual volcanic structures difficult. However, many of the compositional anomalies are associated with the crater rim and smaller impact craters, which is fundamentally different from the dome-style features found at Gruithuisen, Hansteen Alpha, Lassell Massif, and Marian [5-7]. It is possible that the crater forming impact exposed materials similar to Aristarchus [5]. It is also possible that the complex was not formed by impact crater and is rather the remnants of a larger volcanic caldera complex similar to Compton Belkovich [8]. Finally, we note that the thermal infrared compositional signature at Wolf crater is weaker than the previously identified non-mare volcanism sites. As such, we will also consider plagioclase dominated lithology with relatively high abundances of sodium and/or potassium.

Figure 1: LROC WAC geomorphology map showing the complex structure of Wolf crater and surrounding area.

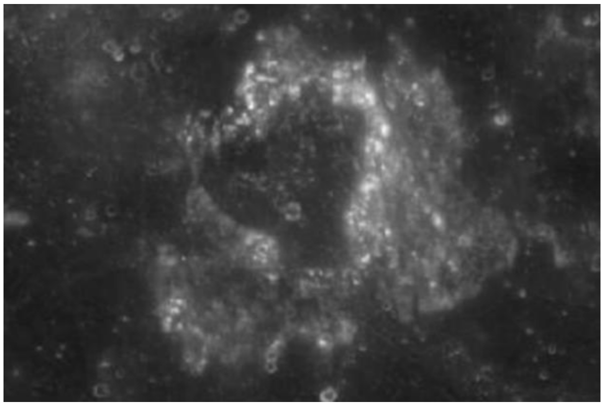

Figure 2: LROC WAC albedo map showing the relatively bright massif compared to typical Mare Nubium basalts.

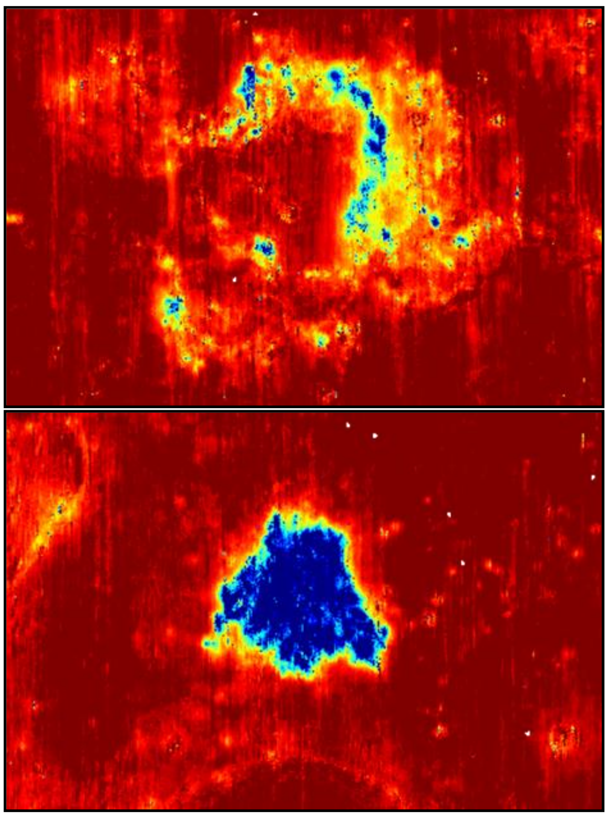

Figure 3: Diviner CF maps of Wolf (top - A) and Hansteen Alpha (bottom - B) using a stretch of 7.8 (blue) to 8.25 (red) to highlight the anomalious regions. Darkest blue areas are most likely to have highly silicic compositions. These data have been photometrically corrected to account for local time and topography.

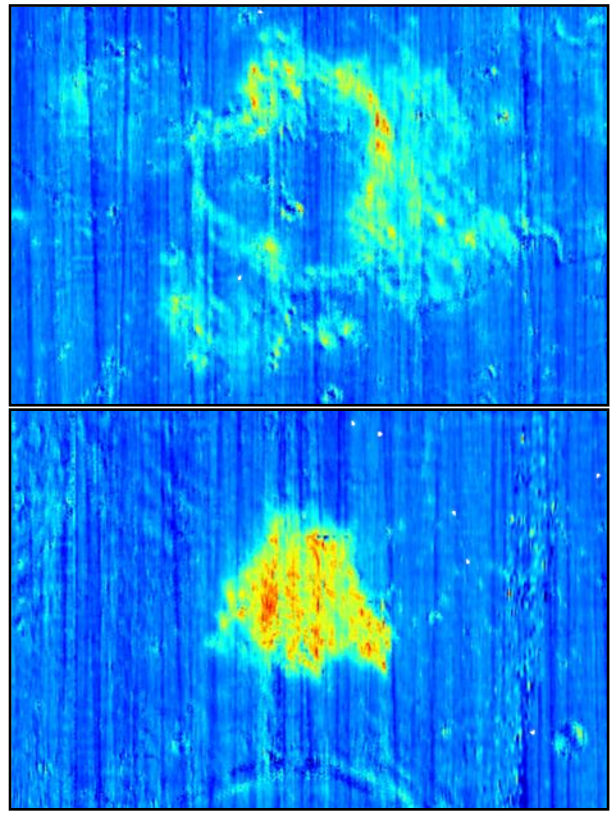

Figure 3: Diviner concavity index maps of Wolf (top - A) and Hansteen Alpha (bottom - B) using a stretch of 7.8 (blue) to 8.25 (red) to highlight the anomalious regions. Green-yellow-red areas are most likely to have highly silicic compositions.

References: [1] Whitaker, E.A. (1972) *Moon*, ***4***, 348. [2] Malin, M. (1974) *Earth Planet. Sci. Lett.*, ***21***, 331. [3] Lawrence, D.J. et al. (2007) *GRL*, ***34***, L03201. [4] Greenhagen, B.T. et al. (2010) *Science*, ***329***, 1507. [5] Glotch, T.D. et al. (2010) *Science*, ***329***, 1510. [6] Glotch, T.D. et al. (2011) *GRL*, ***38***, L21204. [7] Ashley, J.W. (2016) *Icarus*, ***273***, 248. [8] Jolliff, B.L. et al. (2011) *Nature Geosci.*, ***4***, 566. [9] Glotch, T. D. et al. (2017) *48th LPSC*. [10] Donaldson Hanna, K.L. et al. (2014) *JGR*, ***119***, 1516.