INVESTIGATING EVOLVED COMPOSITIONS AROUND WOLF CRATER. B. T. Greenhagen[1], J. T. S. Cahill[1], B. L. Jolliff[2], S. J. Lawrence[3], and T. D. Glotch[4], [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD (benjamin.greenhagen@jhuapl.edu), [2]Washington University, St. Louis, MO, [3]Johnson Space Center, Houston, TX, [4]Stony Brook University, Stony Brook, NY.

Introduction: Wolf crater is an irregularly shaped, approximately 25 km depression in the south-central portion of Mare Nubium on the lunar nearside, centered at 16.573°W and 22.904°S. Although 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], Figure 1. We use data from the Lunar Reconnaissance Orbiter (LRO) to determine that the area surrounding Wolf crater has a composition more similar to highly evolved, non-mare volcanic structures than typical lunar crustal rocks. In this presentation, we 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 on an approximately 50 km bright-toned massif that is elevated relative to the generally flat Mare Nubium (Figures 2-3). 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 (CI), to identify unusual compositions consistent with the high silica contents of granitic or rhyolitic lavas. Ongoing laboratory studies 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 sites [e.g. 5-8] but not pure plagioclase sites [e.g. 10]. First, as shown in Figure 4, maps of the Wolf crater have significant areas (darkest blue) with photometrically corrected CF values below

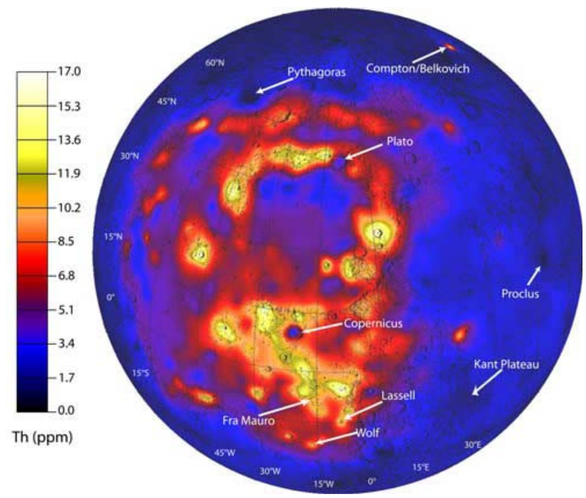

Figure 1: Pixon deconvolved Th abundances indicate Wolf crater as an Th anomaly (figure from [3]).

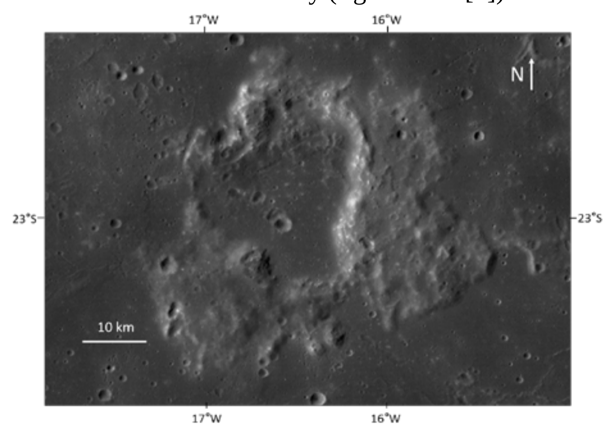

Figure 2: LROC WAC geomorphology map showing the complex structure of Wolf crater and surroundings.

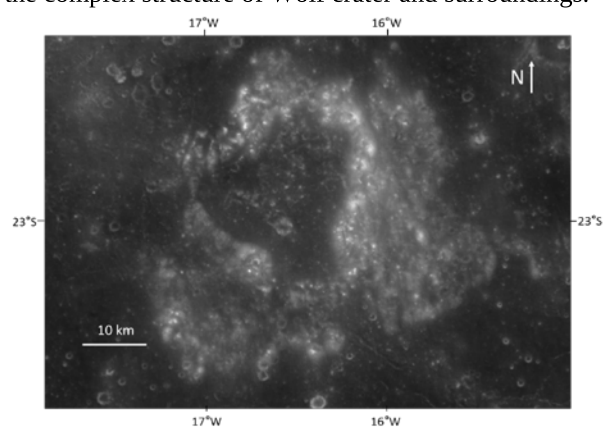

Figure 3: LROC WAC albedo map showing the relatively bright massif compared to Mare Nubium basalts.

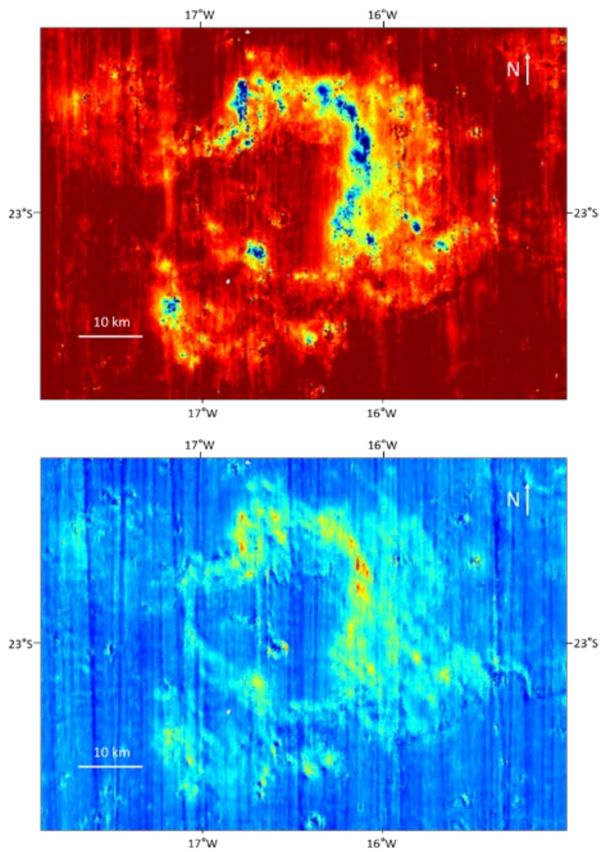

Figure 4: CF map of Wolf crater (top) using a stretch of 7.8 (blue) to 8.25 (red) and CI map (bottom) using a stretch of -0.15 (blue) to 0.1 (red) to highlight the anomalous regions. Darkest blue areas on the CF map and green-yellow-red areas on the CI map are most likely to have highly silicic compositions. The CF data have been photometrically corrected to account for local time and topography.

the value of immature, pure anorthite (7.84 µm). Second, the Wolf crater CI map (Figure 4) shows significant areas with positive values, indicative of CF positions outside the approximately 7.6 to 9 µm range where Diviner is most accurate. Together these data provide strong evidence that the CF position occurs at short wavelengths, less than 7.6 µm, consistent with a silicic composition.

For comparison, we also include CF and CI maps of both the highly silicic Hansteen Alpha and plagioclase-rich Jackson crater (Figure 5). Wolf crater is clearly more similar to Hansteen Alpha; however, the thermal infrared spectral characteristics are somewhat weaker. This could be related to the degraded nature of Wolf crater or a difference in composition.

Discussion and Future Work: The geomorphology of the Wolf crater complex is clearly degraded, and in part flooded with mare lavas, making 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 silicic materials, similar to Aristarchus crater [5]. It is also possible that the complex was not formed by impact crater and is rather the remnants of a larger volcanic caldera structure similar to the Compton-Belkovich volcanic complex [8]. Finally, because the thermal infrared compositional signature at Wolf crater is weaker than the previously identified non-mare volcanism sites, we will also consider the possibility that the exposures contain a plagioclase dominated lithology with relatively high abundances of sodium and/or potassium.

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.

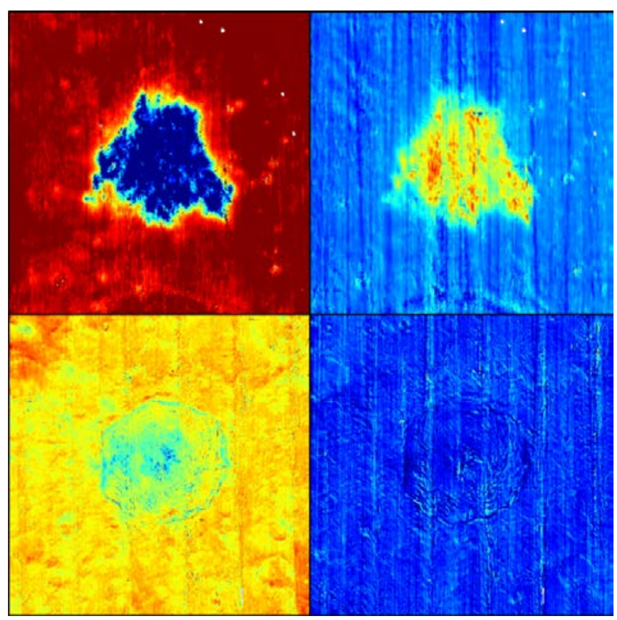

Figure 5: Diviner CF maps (left side) and CI maps (right side) of the approximately 25 km wide Hansteen Alpha (top) and the approximately 71 km diameter Jackson crater (bottom) for comparison to Wolf crater. Figure 5 uses the same color stretches as Figure 4.