A WOLF IN SHEEP'S CLOTHING: POSSIBLE VOLCANIC ORIGIN OF WOLF CRATER. B. T. Greenhagen[1], J. T. S. Cahill[1], T. D. Glotch[2], B. L. Jolliff[3], S. J. Lawrence[4], J. B. Plescia[1], M. S. Robinson[5], and M. A. Siegler[6], [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD (benjamin.greenhagen@jhuapl.edu), [2]Stony Brook University, Stony Brook, NY, [3]Washington University, St. Louis, MO, [4]Johnson Space Center, Houston, TX, [5]Arizona State University, Tempe, AZ, [6]Planetary Science Institute, based in Dallas, TX.

Introduction: Wolf crater is an irregularly shaped, ~28 km depression in the south-central portion of Mare Nubium on the lunar nearside, centered at -22.904°N and -16.573°E and. 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]. Lunar Reconnaissance Orbiter (LRO) data indicate that the area surrounding Wolf has a composition more similar to highly evolved, non-mare volcanics than typical lunar crustal rocks. We also found that Wolf crater and surroundings appear as an anomaly in Chang'E- 2 Microwave Radiometer (MRM) data. We investigate the geomorphology and composition of the Wolf crater, and discuss implications for the origin of the anomalous terrain.

Geology and Morphology: We use LRO Wide Angle Camera (WAC) and Narrow Angle Camera (NAC) imagery to provide both detailed and context perspectives of the geomorphology. Since we initially presented this work [4], new targeted observations have been made of Wolf crater, including NAC stereo for DTMs, mosaics at various sun angles, and stunning off-nadir "oblique" views (e.g., Figure 2).

Wolf crater is surrounded by a ~ 50 km wide exposure of bright toned massif, which includes numerous smaller craters and dome-like features (Figure 1). The south-southeastern portion of Wolf crater's rim has been obliterated by the ~15 km Wolf B crater. Both Wolf and Wolf B have been filled with mare-like basalts. Wolf G is an ~6 km crater that has heavily modified the northwestern portion of Wolf's rim.

The bright toned massif surrounding Wolf crater rises about 800 m above the surrounding mare; the floor of Wolf lies about 100 m below the surrounding mare and dips southward into Wolf B. A narrow septa of light toned material separates the floor of Wolf from the surrounding mare. The southern margin is linear, trending northeast parallel to other regional tectonic features, suggesting it may represent a fault scarp.

Composition and Thermophysics: This investigation uses LRO Diviner Lunar Radiometer (Diviner) thermal infrared, multispectral images to provide constraints on silicate composition. 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.

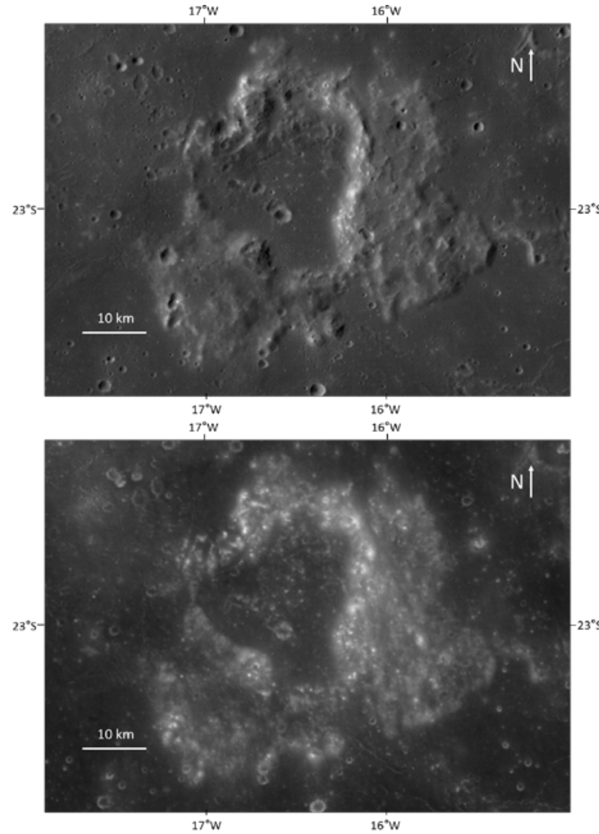

Figure 1: LROC WAC geomorphology (top) and albedo (bottom) maps showing the complex structure of Wolf crater and bright toned massif compared to Mare Nubium basalts.

The Wolf crater complex shows two thermal infrared spectral characteristics common to all high silica non-mare volcanic sites [e.g. 5-8] but dissimilar to pure anorthite sites [e.g. 10]. First, as shown in Figure 3 (top), significant areas of the rim (darkest blue) have photometrically corrected CF values below the value of immature, pure anorthite (7.84 μm). Second, the CI map (Figure 3, bottom) shows significant areas of 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. The strongest silicic composition signal comes from boulder-rich areas that appear to be recent small impacts. It is important to note that the thermal infrared spectral characteristics, while apparent, are somewhat weaker

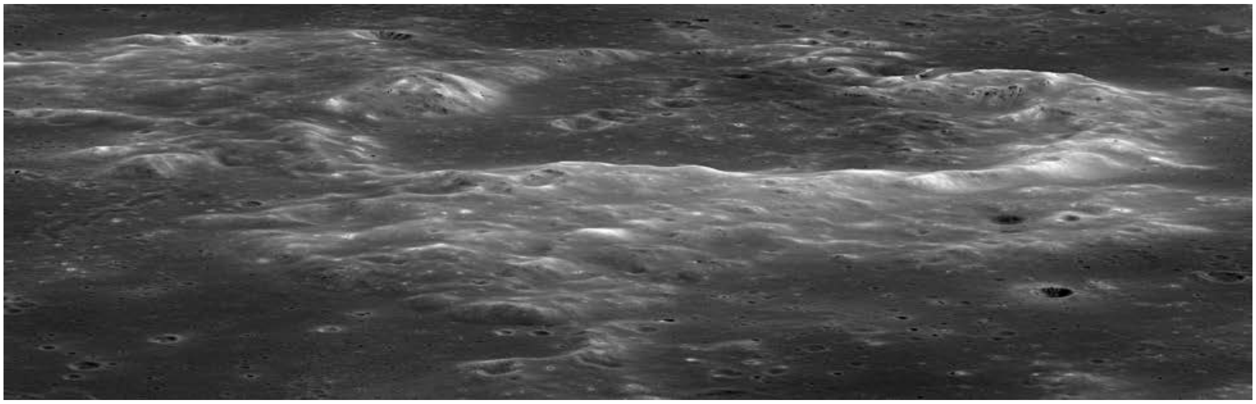

Figure 2: LROC NAC "oblique" off nadir view of Wolf crater looking from the east-southeast towards the west-northwest. Cropped from NAC M1267220207LR (incidence = 34°, emission = 73°, phase = 101°)

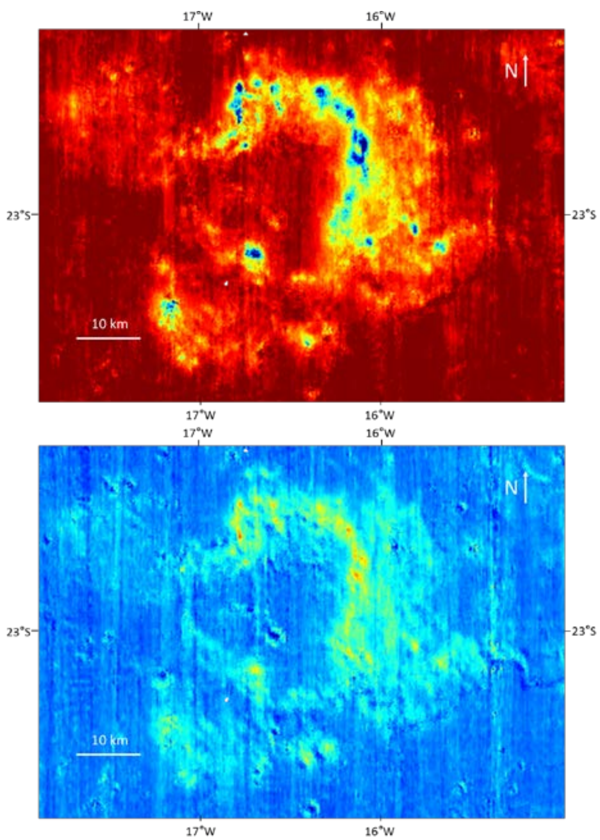

Figure 3: CF map (top) stretched 7.8 to 8.25 and CI map (bottom) stretched -0.15 to 0.1. Darkest blue areas on the CF map and green-yellow-red areas on the CI map are most likely to have highly silicic compositions.

for Wolf crater than previously identified high silicic areas. However, this in of itself also differentiates Wolf from other lunar volcanic complexes.

The region surrounding Wolf crater has also been found to be anomalous in MRM data. When effects of latitude, albedo and titanium are taken into account this area shows higher than expected microwave brightness temperatures. A similar anomaly appears at the Aristarchus plateau. These could either be due to titanium and density dependent increased microwave penetration or enhanced geothermal heat flux.

Discussion and Future Work: The geomorphology of the Wolf crater complex is clearly degraded, and in part flooded with mare lavas, making identification of any potential volcanic structures such as those found at Gruithuisen, Hansteen Alpha, Lassell Massif, and Mairan [5-7] difficult. However, the unusual silicic compositional signature of the crater rim and bright-toned massif generally suggest evolved lithologies not present in primary lunar highlands crust or mare-like basalts. It is possible that the crater forming impact exposed these silicic materials from depth, similar to Aristarchus crater [5], although the distribution of silicic materials here is very different. It is also possible that Wolf crater itself does not have an impact origin and is simply the degraded remnants of a larger volcanic construct more similar to the Compton-Belkovich volcanic complex. Regardless, both the Diviner and MRM data indicate the anomaly extends beyond the rim of Wolf crater and is spread across the light tone massif (and across a large portion of central Mare Nubium in the case of MRM). Finally, because the thermal infrared silicic signature at Wolf crater is weaker than the previously identified non-mare volcanism sites, we must also consider the possibility that the exposures contain a plagioclase dominated lithology distinct from typical highland composition, perhaps with relatively high abundances of Na and/or K.

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