MULTISPECTRAL ANALYSES OF OLCOTT CRATER WITH RECENT HIGH RESOLUTION DATA.

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Introduction: Olcott crater is a well preserved impact crater located on the farside lunar highlands (22°N, 117°E; D = 81 km) [1]. The crater has well defined morphologic features typical of complex craters. The inner crater floor is filled with smooth and hummocky materials (interpreted as impact melt-rich deposits). The central uplift consists of a partial ring of hills (Fig.1). Ejecta on the eastern and southern sides superimpose nearby older craters. The western half of Olcott crater lies along the edge of the heavily degraded Lomonosov-Flemming basin, which contains cryptomare deposits [2, 3]. The recent release of high resolution multispectral data from the Lunar Reconnaissance Orbiter (LRO), Chandrayaan-1, and Kaguya presents new opportunities to observe and assess both the spectral characteristics and morphology of Olcott crater in great detail. We present here preliminary results from the analyses and synthesis of Clementine, Chandrayaan1-M3, and LRO-Camera data.

We use the results of this study to map and assess the distribution of impact materials, and determine how they may reflect the depths excavated by a crater of this size. Exterior melt deposits (beyond the crater floor) are proposed to be a secondary phase of ejecta emplacement that occurs during the crater modification stage [4]. Therefore, locating and characterizing impact melt deposits relative to impact ejecta at Olcott crater can provide detail on the emplacement mechanisms involved in impact cratering.

Methods: Proximal impact materials are mapped using the LRO – WAC global mosaic and NAC image strips (Fig. 2). We use Clementine UV-VIS data to determine spectral properties of the crater at a regional scale. Maturity of surfaces and mafic content is inferred from the HSV-derived (hue, saturation, value) false color composite image over LRO-WAC data (Fig. 3). Sample spectral profiles are acquired using the 85-band Chandrayaan-1 Moon Mineralogy Mapper (M3) data. Each of the geological units identified in Fig. 2 are sampled to determine preliminary information regarding the spectral characteristics sampled by the Olcott event.

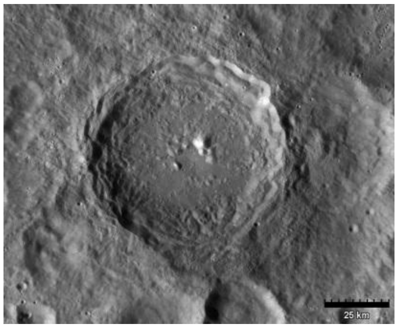

Figure 1: *Context LROC-WAC global mosaic view of the 81 km Olcott crater. Scale bar is 25 km.*

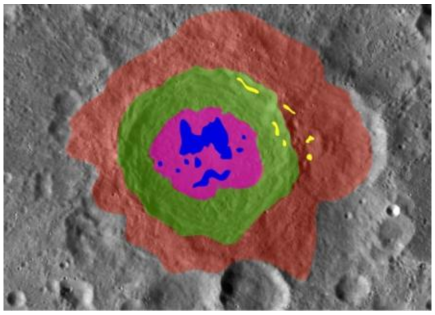

Figure 2: *Preliminary geologic mapping of crater morphology for Olcott crater using LRO Camera images. Red = crater ejecta; green = terraced walls; purple= smooth deposits (impact melt) on crater floor; blue = central uplifts; yellow=identified impact melt deposits (veneers, drapes).*

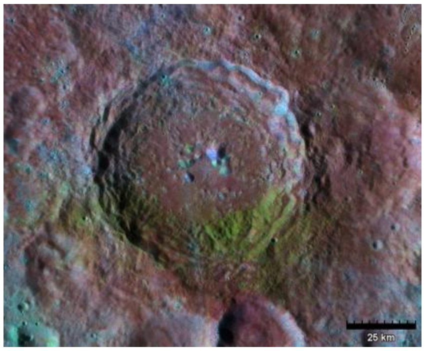

Figure 3: *Clementine derived false colour composite over LRO-WAC mosaic view of Olcott crater. Scale bar = 25km. There is diversity in mafic content throughout the crater, particularly along the southern rim and terrace surfaces.*

Results: The location of Olcott within the lunar highlands on the farside may suggest at first that much of the terrain is predominantly feldspathic. However composite data maps indicate more diversity. From the false colour composite image (Fig. 3), we interpret that much of the region in the image is mature (red shades). The Olcott crater floor is red for much of the area; however there are colour variations discernible at the instrument resolution. Most noted is the strong mafic signature along the southern terraces of the crater (yellow-green shades). The presence of yellow and pale green is indicative of some degree of maturity in the terrain however this is not uniform and furthermore suggests that there is a compositional variation present. In contrast, crater materials along the northern half are low in mafic content. On close inspection there are multiple observations of smaller craters excavating mafic rich materials along the slopes and rim. The total extent of mafic materials along the northern terraces and rim is not fully determined at this point and will be the subject of future work. The central uplift shows variations in mafic content ranging from mafic rich to mafic poor. Some of the hills have the same degree of yellow-green intensity as seen along the southern terraces while the others have no mafic signature (blue shades) and are likely feldspathic, similar to results in [5].

From a morphological perspective, Olcott crater materials can be classified into four visually distinguishable units – 1) hummocky crater ejecta, 2) terraced walls, 3) the crater central uplift, and 4) dark, smooth, relatively crater free materials interpreted to be impact melt-rich materials. Impact melt deposits have been identified both within the crater floor and along terraced and exterior surfaces. Smooth impact melts appear as thin veneers, draped along the terraced walls, over crater ejecta, and flows around hummocky materials (Fig. 4). On the crater floor, melt deposits are smooth and devoid of much subsequent cratering. Much of the central hills material consists of blocky rocks and boulders, with distinguishable roughness, and fragments with high albedo.

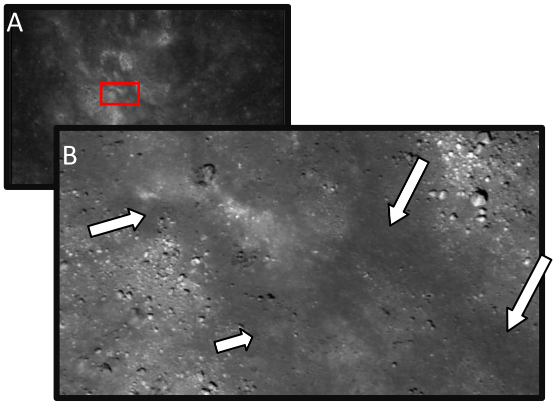

Figure 4*: LROC-NAC M108460950LC (centred ~20.5^{o}N, 117.5^{o}E). This image shows the slope of an uplifted hill. (A) Context view of image tile. Red box outlines location of 4B. (B) Melt deposits (arrows) are dark and smooth compared to the surrounding hummocky materials.*

Preliminary spectral profiles of the morphological units within Olcott suggest the preferences of materials rich in pyroxenes (Fig. 5). Many sites along the southern wall (where iron distribution and false colour maps show strong mafic concentrations) exhibit pyroxene spectra. When compared to lab spectra [6], these appear to be low-Ca pyroxene.

Throughout the remainder of the crater, the ejecta, interior smooth melts, and exterior melt deposits have a similar low-Ca pyroxene signature. There is one instance along the central uplift where a weak plagioclase signal is picked together with low-Ca pyroxene. However, we note that the number of spectra sampled is low at present and therefore the spectral distribution will get more accurate with further sampling.

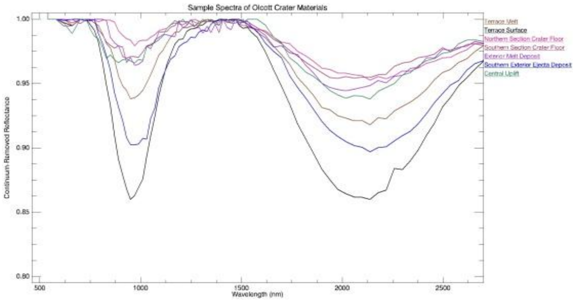

Figure 5*: Sample spectra of identified geologic units within Olcott crater. There is a strong low-Ca pyroxene spectral trend.*

Discussion: Recognizing the proximity of Olcott crater to the Lomonosov – Flemming region may aid in the understanding of the spectral variations observed from both the Clementine derived maps and spectral profiles. Although the crater lies among the lunar highlands, the compositional trends indicate there is a strong mafic presence. This is particularly true along the southern half of Olcott crater. The high mafic signature in Ca-pyroxene spectral profiles from the southern half of the crater is evidence that the Olcott impact event may have excavated mafic rich materials (likely a cryptomare deposit). Identifying the total extent of pyroxene and feldspar rich materials, and determining if these compositions are tied to observed morphologies can assist in our understanding of crater material emplacements.

References: [1] Wilhelms, D.E. and El-Baz, F. (1977). *U.S.G.S. Misc. Inves. Ser. Map* I-948; [2] Giguere, T. A., *et al*. (2003). *JGR*. **108** (E11) 5118; [3] Giguere, T. A. *et al.* (2001). *LPSC XXXII* Abstract# 1516; [4] Osinski, G. R. *et al*. (2011). *EPSL*. **310**, 167-181; [5] Tompkins, S. and Pieters, C. M. (1999). *MAPS*. **34**, 25-41; [6] Klima, R. L. *et al*. (2010). *MAPS*, submitted.