COMPLEX VOLCANISM AT OPPENHEIMER U FLOOR-FRACTURED CRATER. L.R. Gaddis[1], K. Bennett[2], B. Horgan[3], Marie McBride[3], J. Stopar[4], S. Lawrence[5], J.O. Gustafson[6] and T. Giguere[7]. [1]Astrogeology Science Center, U.S. Geological Survey, Flagstaff, AZ; [2]Northern Arizona Univ., Flagstaff, AZ; [3]Purdue Univ., West Lafayette, IN; [4]Lunar and Planetary Institute, Houston, TX; [5]Johnson Space Center, Houston, TX; [6]Cornell Univ., Ithaca, NY; [7]Univ. Hawaii, Honolulu, HI (lgaddis@usgs.gov).

Introduction: Recent remote sensing studies have identified complex volcanism in the floor-fractured crater (FFC) Oppenheimer U, located in the northwest floor of Oppenheimer crater (35.2°S, 166.3°W, 208 km dia., ***Figure 1***) within the "South Pole - Aitken basin" (SPA) region of the lunar far side [1, 2, 3]. Up to 15 sites of pyroclastic volcanism have been identified in the floor of Oppenheimer crater [4]. Studies of Moon Mineralogy Mapper data (M^3, 0.4-3 µm, 86 bands, [5]) indicated that the pyroclastic deposits are comprised of mixtures of clinopyroxene and iron-rich glass [2], with the Oppenheimer U deposit showing variable composition within the FFC and having the most iron-rich volcanic glass thus far identified on the Moon. Here we examine the floor of Oppenheimer U in more detail and show evidence for possible multiple eruptive vents.

Background: Small pyroclastic deposits (<2000 km^2) such as those at Pre-Nectarian-aged Oppenheimer crater are associated with vents resembling shallow, non-impact craters or irregular depressions [e.g., 6]. More than 100 lunar pyroclastic deposits have been identified and they are of interest partly because they are volatile- and metallic-element (e.g., S, Fe, Ti) enriched remnants of ancient lunar volcanic eruptions [7, 8]. Their compositions and distributions provide information on the early lunar interior [9, 10] and the distribution of possible resources [11].

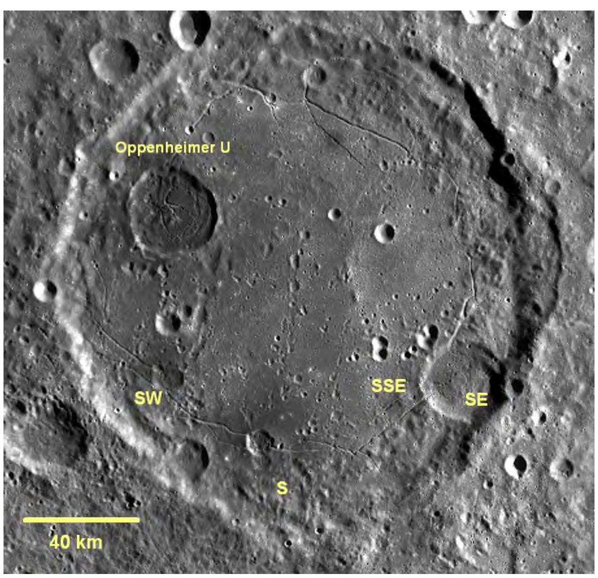

Figure 1. LRO Wide Angle Camera mosaic of Oppenheimer crater. The smaller Oppenheimer U FFC is located in the northwest floor.

The ancient Oppenheimer crater (4.04 Ga; [12]) hosts prominent floor fractures (***Figure 1***) and three Imbrian-aged craters in the floor. The 15 pyroclastic deposits are ~200-1500 km^2 in size [3] and have been estimated to be ~3.98 Ga [13]. Complex compositional relationships within and among the largest pyroclastic deposits such as those in Oppenheimer U crater suggested that they were likely emplaced by more sustained Strombolian-style eruptions occurring after an initial violent Vulcanian-style eruption that incorporated crater floor material [2].

Analysis of Oppenheimer U Crater: Data from the Lunar Reconnaissance Orbiter (LRO) Wide Angle Camera (WAC) [14] and mineral maps such as FeO derived from SELENE Kaguya Multiband Imager (MI) data [15, 16] for Oppenheimer U crater show (***Figure 2***) a relatively flat floor with prominent floor fractures, especially on the east and central portions of the floor. Superimposed on those features is a very dark pyroclastic mantle that covers much of the crater floor and extends up to 10 km to the west beyond the crater rim. The asymmetric distribution of this western material outside the crater is largely influenced by the occurrence to the northwest of a relatively young crater with bright crater rays. The derived FeO map shows the extensive iron-rich composition of this deposit within and outside the crater floor.

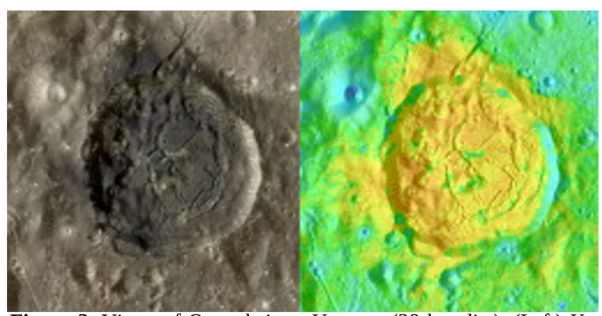

Figure 2. Views of Oppenheimer U crater (38 km dia.). (Left) Kaguya MI mosaic (R=900 nm, G=750 nm, B=415 nm). (Right) Derived FeO (wt. %).

The western floor of Oppenheimer U is disrupted by a complex network of at least 6 irregular depressions (**Figure 3**) and these may have been source vents for multiple eruptions that emplaced the pyroclastic deposits. Topographic data at ~60 m horizontal resolution [17] indicate that these depressions range from ~2 to 4 km wide and up to 5.5 km long. The deepest of these depressions is ~1300 m, and it has an asymmetric profile with a steep (~ 35°) western edge and a more gently sloping interior margin (~27°). No raised rim is recognized in association with any of these depressions.

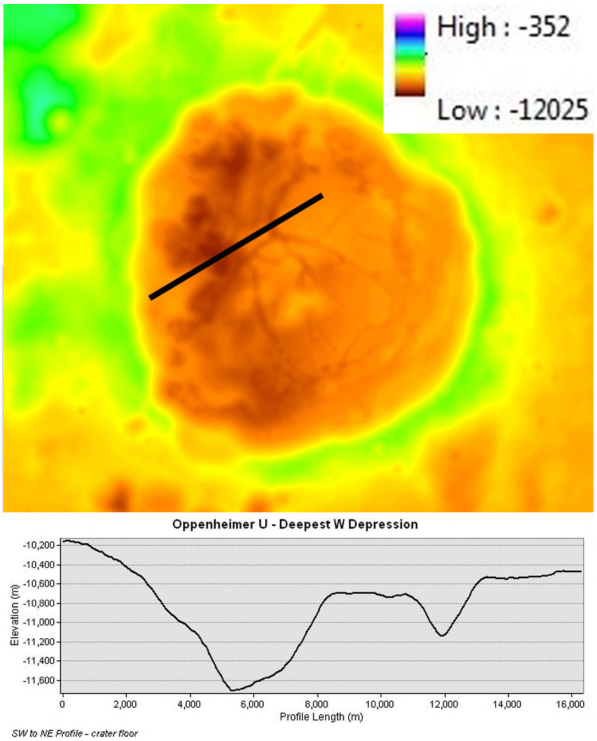

Figure 3. Elevation data for Oppenheimer U [17] showing several irregular depressions in the western crater floor and (bottom) a profile (SW to NE) across the deepest of these.

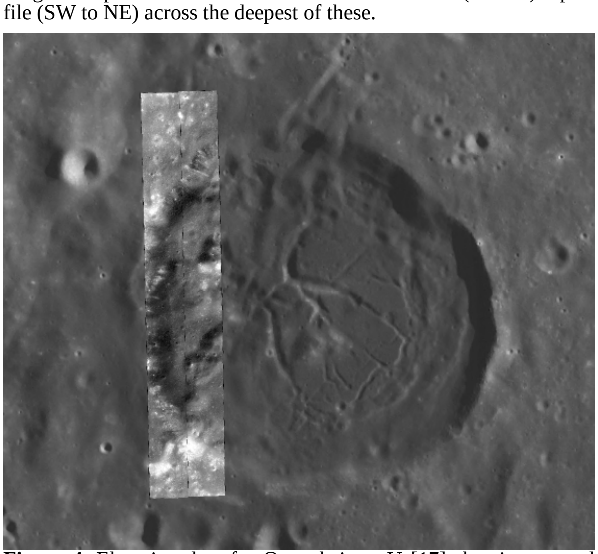

Figure 4. Elevation data for Oppenheimer U [17] showing several irregular depressions in the western crater floor and (bottom) a profile (SW to NE) across the deepest of these.

A preliminary survey of LRO Narrow Angle Camera (NAC) [14] data for this area suggests that there are no small, cone-like features situated on fractures in the floor of Oppenheimer U as compared to other sites such as those in the south-southeast and southeast crater floor. However, NAC data (frame M184632274, inc. angle 43°) reveals (**Figures 4, 5**) the pyroclastic deposit as a very dark unit superimposed on the crater wall with prominent cracks and dark streaks trending downslope toward the floor. The presence of possible cracks in the iron-rich mantling deposit suggests that it may have been emplaced as a hot, semi-liquid material that cooled in place after deposition.

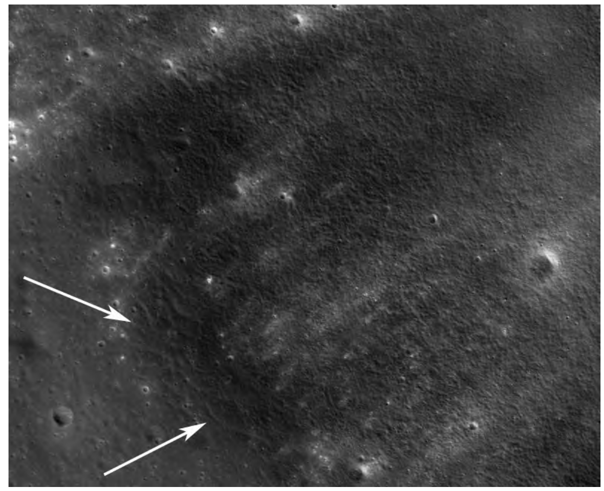

Figure 5. NAC frame M184632274 showing cracks (white arrows) in dark mantling material and streaks of low-albedo material trending downward (to the right) toward the crater floor.

Results and Summary: These observations suggest the presence of a widespread pyroclastic deposit in the floor of Oppenheimer U crater that may have been formed by multiple explosive events at relatively high effusion rates. The presence of multiple vents in the floor of Oppenheimer U crater, their association with relatively large irregular depressions and possible cracks in the mantling deposit supports their origin via a Strombolian style of eruption [2]. Such eruptions are associated with higher magmatic volatile contents and effusion rates than the Vulcanian eruptions more commonly found in the floor of floor-fractured craters such as those at Alphonsus and elsewhere [e.g., 18] and these results confirm previous analyses that indicated a more complex style of volcanism in Oppenheimer crater [2].

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