COMPOSITIONS OF PYROCLASTIC DEPOSITS IN FLOOR-FRACTURED OPPENHEIMER CRATER.
L.R. Gaddis1, J. Laura1,2, B. Horgan3, K. Bennett4, B.R. Hawke5, and T. Giguere5,6. 1Astrogeology Science Center, U.S. Geological Survey, Flagstaff, AZ; 2Department of Geography, Arizona State University, Tempe, AZ; 3Dept of Earth, Atmospheric, and Planetary Sciences, Purdue University, West Lafayette, IN; 4School of Earth and Space Exploration, Arizona State University, Tempe, AZ. 5Univ. Hawaii, Honolulu, HI; 6Intergraph Corp., P.O. Box 75330, Kapolei, HI. (lgaddis@usgs.gov).

Introduction: We analyzed the compositions of pyroclastic units in Oppenheimer crater (35.2°S, 166.3°W, 208 km dia., Figure 1) using data from SELENE “Kaguya” [1]. This study compares compositions of the western and southern floor deposits examined using 9-band color data from the Multiband Imager (MI MAP; 5 visible wavelength or VIS channels at 415-1000 nm, ~20 m/pixel, 4 near-infrared or NIR channels at 1000-1550 nm, ~67 m/pixel) with those of the southern floor previously studied [2] with data from Moon Mineralogy Mapper (M3, 0.43-3 μm, 86 bands, [3]). M3 coverage does not extend to the western edge of Oppenheimer; this analysis adds a study of the deposits of Oppenheimer U (northwest floor) and in the southwest (SW).

Pyroclastic deposits on the Moon are typically very dark and appear to mantle underlying units [e.g., 4-7]. Smaller deposits (<2000 km²) such as those at Oppenheimer are associated with vents resembling shallow, non-impact craters or irregular depressions. The lunar pyroclastic deposits are of interest partly because they are volatile- and metallic-element (e.g., S, Fe, Ti) enriched remnants of ancient lunar volcanic eruptions [8, 9]. Their compositions and distributions provide information on the early lunar interior [10, 11] and the distribution of possible resource materials [12]. Studies of pyroclastic deposits with telescopic and Clementine color (ultraviolet-VIS) data demonstrated their compositional heterogeneity and expanded our understanding of the wide variety of deposit types [7, 13, 14]. Numerous previously unrecognized small pyroclastic deposits continue to be discovered [15, 16] and studied [17] with new data such as those from M3 and the Lunar Reconnaissance Orbiter Cameras (Narrow Angle Cameras, 0.5 to 1.0 m/pixel [18]).

Oppenheimer Pyroclastics: Seven small pyroclastic deposits were identified [19] in the floor of Pre-Nectarian Oppenheimer crater (4.04 Ga; [20]), and these deposits are associated with vents located along fractures in the crater floor (Figure 1) and within 3 Imbrian-aged craters in the floor. The deposits are ~200-1500 km² in size [6], and were likely emplaced by explosive, vulcanian-style eruptions [21]. Analyses of Clementine data for Oppenheimer pyroclastics suggested that their compositions were dominated by mafic minerals (e.g., pyroxene) in fragmented basalts [22]. In MI color data (Figure 2) the Oppenheimer pyroclastic units resemble high-Fe and -Ti pyroclastics at Rima Bode, Mare Vaporum and Sinus Aestuum on the near side.

Figure 1. MI-MAP mosaic (bands 3, 2, 1 as RGB) of Oppenheimer crater (yellow circle). White circles mark the locations of known pyroclastic deposits [21]. Red boxes mark “new” deposits [after 16]. Green Xs mark the locations of spectra in this study.

Figure 2. False-color MI-MAP mosaic of Oppenheimer crater floor (R=750/415, G=750/950, B=415/750). Pyroclastic units are deep blue. A younger crater ray (light blue, at right) is also shown.

Previous Work: Previous M3 results [2] used band center and asymmetry of the 1- and 2-micron bands to map lithology at Oppenheimer, focusing on...
identifying pyroxenes, glass, and mixtures. Results indicated that crater floor spectra have band centers of 0.91-0.94 and 2.05-2.10 μm, consistent with low-calcium pyroxene (LCP) mixed with minor high-calcium pyroxene (HCP). Pyroclastic deposit spectra for the southern floor units [Figure 1, including the south-central (S), south-southeast (SSE), and southeast (SE) units] have band centers of 0.95-1.1 and 1.95-2.10 μm, consistent with an LCP-glass mixture. The larger S deposit shows higher and more extensive glass concentrations than the SSE and SE deposits. Their results suggested that olivine (which does not have a 2 μm band and has a highly asymmetric 1 μm band) is not present in any of the pyroclastics because of both the shift to lower wavelengths of the 2 μm band (without a decrease in band depth) and the low asymmetries of the 1 μm band in these deposits.

**Results:** MI-MAP spectra (Figure 3) address only the 1 μm bands, and show that crater floor spectra have a band center of ~0.95 μm (consistent with LCP mixed with HCP). This composition of the floor of Oppenheimer crater is consistent with the general iron enhancement observed throughout the basin, likely due to the existence of LCP-bearing materials (i.e., norite) across the South Pole–Aitken basin interior [23]. Pyroclastic units, especially those of Oppenheimer U, SW and S, have broad bands centered at ~1.0 μm or slightly longer, indicating the presence of a major component such as iron-rich glass. The Oppenheimer U deposit has the broadest band, suggesting that it has a relatively large fraction of this glass component. The smaller deposits (SSE and SE) have bands centered near ~1.0 μm and these may be mixtures of glass and LCP. This would be consistent with the relative thinness of these deposits and the possibility that crater floor material is contributing to the spectra. The MI-MAP spectra show compositions that are generally consistent with previous work and support an iron-bearing glass-rich composition for the pyroclastic deposits in Oppenheimer crater. We are working with the Kaguya Spectral Profiler data [24] to further characterize these deposits.

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**References:**


**Figure 3.** MI MAP spectra of Oppenheimer crater units. (Left) Reflectance spectra, not offset. (Right) Continuum-removed spectra of a subset of the units representing the range of compositions observed.