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# Spectral Signature of Lunar Pyroclastic Deposits in Moon Mineralogy (M3) data

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Over 100 pyroclastic deposits, or Dark Mantle Deposits (DMDs) have been identified on the Moon, with areas ranging from 10 km2 to over 50,000 km2. These regions of low-albedo, fine-grained material can vary significantly in composition. Larger DMDs such as those at Taurus-Littrow and Mare Vaporum are known to contain iron- and titanium-rich glass and devitrified beads, while smaller DMDs are typically comprised of iron-bearing mafic minerals such as pyroxene and olivine in juvenile and non-juvenile volcanic components. More recently at the large DMD in Sinus Aestuum, chromite spinel has been discovered. In this project we use spectroscopic data from the Moon Mineralogy Mapper (M3) to characterize the composition of various pyroclastic deposits across the lunar nearside. Using these data, we characterized the 1- and 2 $\mu$m mafic absorption bands for each pyroclastic region of interest, and analyzed the variation in composition between all regions. DMD compositional variations will help us to understand both the origin and mode of emplacement of these deposits. The four regions of interest chosen for this study include pyroclastic deposits in J. Herschel crater (36.6°W, 61.7°N), Alphonsus crater (3°W, 13.6°S), near the Apollo 17 landing site in the Taurus-Littrow valley (30.7°E, 20.2°N), and western Mare Vaporum (7.9°E, 10°N). There is complete or near-complete coverage of M3 data in these regions, including coverage in orbital periods OP1A, OP1B, OP2A, OP2C1, and OP2C3. Additionally, there is coverage over all four regions of interest in OP1B. This configuration allows studies of the DMDs with the same resolution and detector temperature, factors which can drastically change the spectral behavior of the M3 data. Several color composite images were created to highlight surface composition and to characterize the four pyroclastic deposits. The pyroclastic deposits within a given region of interest share similar spectral characteristics, even at sites where the deposits are isolated or discontinuous, such as in Alphonsus crater. At Alphonsus, color images comparing integrated band depths show the pyroclastic materials to be a similar color to the surrounding mare materials; this is expected, since both units contain iron-bearing minerals, which are sensitive to the spectral bands used in the color composite image with respect to the surrounding plagioclase-rich highland terrain. However, examination of the 1 $\mu$m band show the maria are shifted towards shorter wavelengths as compared to the pyroclastic materials, which results from the likely presence of more high-Ca pyroxene in the mare unit.
Preliminary spectral comparisons of the four regions of interests show the pyroclastic deposits following two distinct trends. Spectra of the small DMDs in Alphonsus and J. Herschel craters have similar slopes, while the large DMDs at Taurus-Littrow formation and Mare Vaporum exhibit similar slopes, which are distinct from that of Herschel and Alphonsus in terms of absolute reflectance. This is consistent with the presence of iron- and titanium-rich orange and black beads in the larger DMDs. Ongoing investigations are currently being performed to allow us to determine whether the small DMDs at Alphonsus and J. Herschel contain olivine and/or pyroxene and in what proportions.