ANALYSIS OF MANTLED LUNAR DOMES, RILLE FLANKS, AND ANOMALOUS REGIONS. W. H. Farrand[1]. [1]Space Science Institute, Boulder, CO, farrand@spacescience.org.

Introduction: Earth-based radar studies have detected a number of lunar domes and areas along some rilles with low circular polarization ratios (CPR) values [1-3]. Such a low CPR response is indicative of loose, disaggregated materials such as those in a pyroclastic mantle [1, 2]. Pyroclastic mantles are sometimes observed to be associated with one or more domes in a dome field, but not with others. This suggests that pyroclastic volcanism is only sometimes present as lunar domes are formed. These pyroclastic deposits may represent a different class of lunar pyroclastic deposit (LPD) distinct from the more well-known iron-rich regional and localized LPDs [4-6]. These mantled dome and rille areas are being examined using a variety of spectral and photometric approaches.

Areas and Data Examined: Among the areas being examined are areas atop Mons Rümker and in the Marius Hill; however, in this presentation the focus is on several smaller locations including the domes Manilius-1, and Yangel-1 and the Rima Calippus rille (Fig. 1). Also considered are the Cauchy-5 dome, Rima Hyginus and Rima Birt rilles as well as the Tacquet formation of southern Mare Serenitatis, cited in [2] as being a mantled region but not listed as an LPD by [5] or [6].

The datasets examined in this study include SELENE Kaguya Multiband Imager (MI), LROC NAC images, LROC WAC derived data products, and Chandrayaan-1 Moon Mineralogy Mapper (M^3) data.

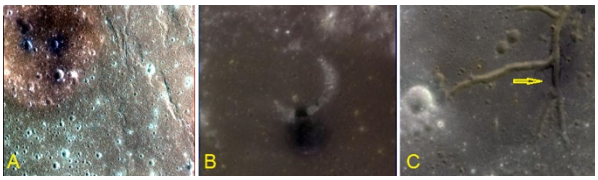

Fig. 1. SELENE Kaguya MI images of **A**. Manilius-1, **B**. Yangel-1, and **C**. Rima Calippus. Arrow in C indicates dark mantle deposit.

Distinctness of Yangel-1: As noted by [7] the Yangel-1 dark mantle is optically immature as is indicated by the MI 750/415 nm ratio (**Fig. 2 A, B**). This is in contrast to other dark mantles examined such as that along Rima Hyginus (**Fig. 3 A, B**).

Yangel-1 is also chemically distinct in that it has higher TiO_2 content than surrounding materials as indicated by a LROC WAC 321/415 nm ratio (**Fig. 4C**). Other dark mantles examined are not overly distinct with regards to TiO_2 content versus their surroundings.

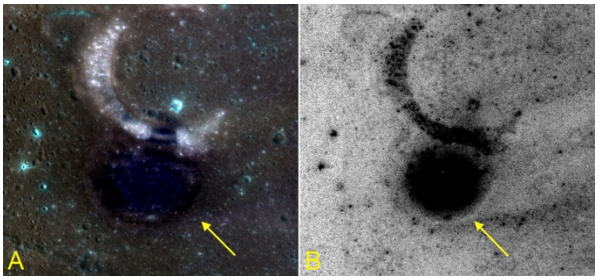

Fig. 2. A. MI composite of 950, 750, and 415 nm bands over Yangel-1 with dark mantle indicated by arrow. B. Ratio of MI 750/415 nm bands, low values of mantle indicate optical immaturity.

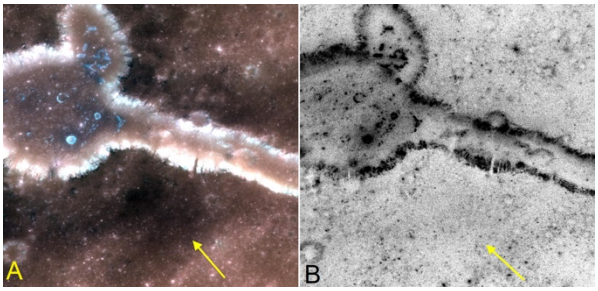

Fig. 3. A. MI composite of 950, 750, and 415 nm bands over Rima Hyginus with dark mantle indicated by arrow. **B**. Ratio of MI 750/415 nm bands, dark mantle is just as mature as surrounding plains.

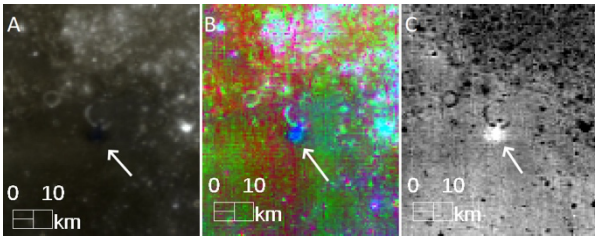

Fig. 4. A. Subsection of WAC multispectral mosaic, bands 7, 4, and 1, centered at 16.5°N, 3.25°E over Yangel-1 (indicated by arrow). **B**. Decorrelation stretch of A. with Yangel 1 standing out in blue. **C**. Ratio of 321/415 nm bands. Materials with higher TiO_2 content are brighter.

Tacquet Formation: The Tacquet formation (TF) of southern Mare Serenitatis, first mapped by [8] identified by [2] as low in radar CPR values, indicative of a mantled surface, also stands out in LROC WAC multispectral data (**Fig. 5**). It also stands out in a M^3 scene covering part of the TF in a composite of principal components analysis (PCA) bands (**Fig. 6**). Analysis is ongoing of M^3 and Kaguya Spectral Profiler (SP) spectra to fully characterize the spectral character of the TF.

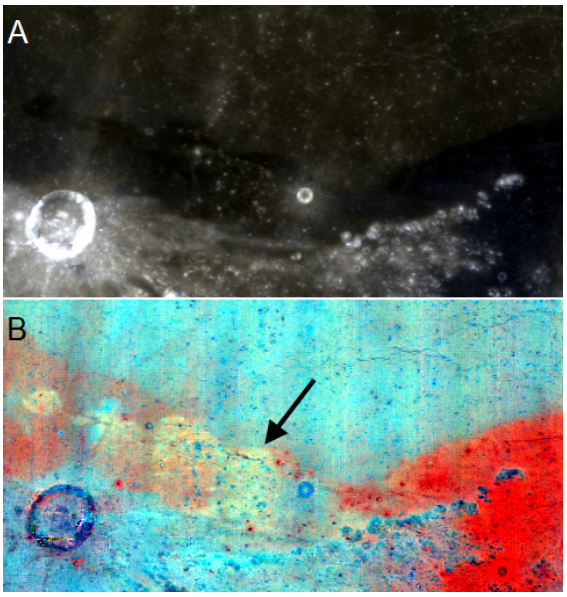

Fig. 5. A. WAC bands 6, 4, 1 composite over southern Mare Serenitatis. **B**. Same area in composite of ratios of WAC bands 2/3 (360/415 nm), 4/3 (566/415 nm), and 7/1 (689/321 nm). Tacquet formation is yellow and indicated by arrow.

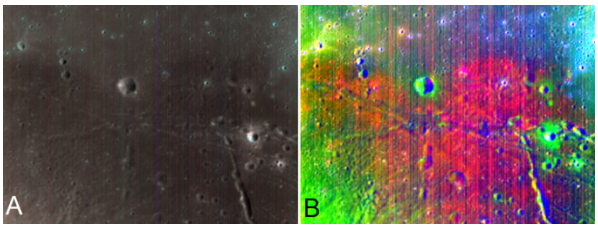

Fig. 6. A. M^3 bands 19, 9 and 4 (950, 750, and 580 nm) over southern Mare Serenitatis and the TF. **B**. PCA band composite 5, 1, 3 highlighting TF in red.

Photometric Analysis of Mantled Areas: The photometric response of mantled areas and LPDs in general has not been investigated in great detail. In [9] differing photometric responses were observed among small localized LPDs in Lavoisier crater. In [10], anomalies in maps of the steepness of the phase function, η, was found amongst several localized LPDs. Work is on-going on investigating the mantled regions discussed here using both mapping of η and also using phase-ratio images [11].

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References: [1] Campbell B.A. et al. (2009) JGR, 114, E01001, doi:10.1029/2008JE003253. [2] Carter L.M. et al. (2009) JGR, 114, E11004, doi:10.1029/2009JE003406. [3] Campbell B.A. et al. (2014) JGR, 119, 313-330. [4] Hawke B.R. et al. (1989) Proc. Lunar Planet. Sci. Conf. 19th, 127-135. [5] Gaddis, L.R. (1985) Icarus, 61, 461-489. [6] Weitz C.M. et al. (1998). [7] Lena R. and Fitzgerald B. (2014) Planet. and Space Sci., 92, 1-15. [8] Carr M.C. (1966) U. S. Geol. Surv. Misc. Geol. Invest. Map, I-489. [9] Souchon A.L. et al. (2013) Icarus, 225, 1-14. [10] Kaydash V. et al. (2009) Icarus, 202, 393-414. [11] Kaydash V. et al. (2012) J. of Quant. Spectroscopy & Radiative Transfer, 113, 2601-2607.