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Compositional variations on Mercury: Results from the Victoria quadrangle

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Mercury was recently explored by the MESSENGER mission that orbited around the planet from March 2011 until April 2015 allowing a complete coverage of its surface. The Mercury Dual Imaging System (MDIS), mapped the Hermean surface at different spatial resolutions, due to variable altitude of the spacecraft from the surface. MDIS consists of two instruments: a Narrow Angle Camera (NAC) centered at ∼747nm, which acquired high-resolution images for the geological analysis, and the Wide Angle Camera (WAC), provided with 11 filters dedicated to the compositional analysis, operating in a range of wavelengths between ∼395 and ∼1040 nm.
Mercury's surface has been divided into 15 quadrangles for mapping purposes. Here, we analyze the results obtained by the color composite mosaic of the quadrangle Victoria (H02) located at longitudes 270 ° - 360 ° E, and latitudes 22.5 ° N - 65 ° N. We produced a color mosaic, by using the images relative to the filters with the best spatial coverage. To obtain the 8-color mosaic of the Victoria quadrangle, we calibrated and georefenced the WAC raw images. Afterwards, we applied the Hapke photometric correction by using the parameters derived by Domingue et al. (2015). We projected and coregistered the data, and finally, we produced the mosaic.
To analyze the compositional variations of the Victoria quadrangle, we consider different techniques of analysis, such as specific RGB color combinations and band ratios, which emphasize the different compositional characteristics of the surface. Furthermore, the use of clustering and classification methods allows for recognizing various terrain units, in terms of reflectance and spectral characteristics. In the H02 quadrangle, we observed a dichotomy in the RGB mosaic (R: second principal component (PC2), G: first principal component (PC1), B: 430/1000 nm; see Denevi et al. 2009) between the northern region of the quadrangle, dominated by smooth plains, and the southern part, characterized by intercrater plains. Moreover, we found a variation in terms of spectral slopes and reflectance within specific craters. The application of an unsupervised clustering method, such as the k-mean, to the obtained 8-color mosaic, allowed for identifying terrain units with similar reflectance. The application of this method to selected band ratios (628nm/433nm, 828nm/628nm, 996nm/828nm, 996nm/433nm), emphasizes areas with similar spectral characteristics, such as the Hokusai crater rays. This work, integrated to the 1:3M photo-interpreted geologic maps of Mercury based on MDIS data (Galluzzi et al., 2016), is fundamental for producing a complete and advanced geologic map of Hermean's surface.
Moreover, the identification of regions of interest, and specific localized features, is useful to define possible targets for the SIMBIO-SYS instrument onboard the future BepiColombo mission.

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References: Domingue et al. (2015), Icarus 257, 477–488; Denevi et al. (2009), Science 324 (5927), 613-618; Galluzzi et al. (2016), Journal of Maps 12.