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Color variations on Victoria quadrangle: support for the geological mapping

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Introduction

Mercury is the closest planet to the Sun. Its extreme thermal environment makes it difficult to explore onsite. In 1974, Mariner 10, the first mission dedicated to Mercury, covered 45% of the surface during of the three Hermean flybys [1]. For about 30 years after Mariner 10, no other mission has flown to Mercury. Many unresolved issues need an answer, and in recent years the interest about Mercury has increased. MESSENGER mission contributed to understand Mercury's origin, its surface structure, and the nature of its magnetic field, exosphere, and magnetosphere [1]. The Mercury Dual Imaging System (MDIS) provided a global coverage of Mercury surface with variable spatial resolution. MDIS is equipped with a narrow angle camera (NAC), dedicated to the study of the geology and a wide angle camera (WAC) with 12 filters useful to investigate the surface composition [2]. Mercury has been divided into 15 quadrangles for mapping purposes [3]. The mapping process permits integration of different geological surface information to better understand the planet crust formation and evolution. Merging spectroscopically data is a poorly followed approach in planetary mapping, but it gives additional information about lithological composition, contributing to the construction of a more complete geological map [e.g. 4]. Recently, [5] proposed a first detailed map of all the Victoria quadrangle (H2). Victoria quadrangle is located in a longitude range between 270°E and 360°E and a latitude range of 22.5°N and 65°N, and it was only partially mapped by Mariner 10 data [3].
Here we investigate the lithological variation by using the MDIS-WAC data to produce a set of color map products which could be a support to the geological mapping [5]. The future ESA-JAXA mission to Mercury, BepiColombo, will soon contribute to improve the knowledge of Mercury surface composition and geology thanks to the Spectrometer and Imagers for MPO BepiColombo-Integrated Observatory SYStem (SIMBIO-SYS) [6].

Dataset analysis

To derive the color filter mosaics, we selected the MDIS-WAC data from the PDS-ATLAS database (http://pds-imaging.jpl.nasa.gov /Atlas/). MESSENGER mission had onboard also a punctual hyperspectral spectrometer, MASCS-VIRS [7], but considering that Mercury reflectance spectra does not show absorption features and the MASCS coverage is not global, at least for this first step we do not considered the MASCS spectra for our purposes. We chose images with incidence, emission and phase angles between 0° and 70°, to have a better coverage of the quadrangle. We chose 8 of the 12 filters available according to literature [8, 9] (See Table 1). The data have been photometrically corrected with Hapke method [10], using the parameters derived by [11]. For each filter in this preliminary stage, we create a global mosaic at 200 mpp and co-registered it to the others. Finally we generate a file of the whole quadrangle containing the filter mosaics in order of wavelength.

Victoria quadrangle

The Victoria quadrangle is characterized mainly by intercrater plains material, but it also encompasses

patches of intermediate plains within its central area and smooth plains to the north. The quadrangle is named after its most prominent structure Victoria Rupes (lon ~328°E, lat 35°N-55°N), which is a single east-facing lobate scarp, suggesting east–west compression with the hanging wall transported eastward [5, 12, 13]. In this quadrangle both pyroclastic deposits [14, 15] and hollows [16, 17] have also been recognized. Analyzing the 8 filters cube of all the quadrangle we can highlight the principal and minor spectral units (e.g. [8, 9]).

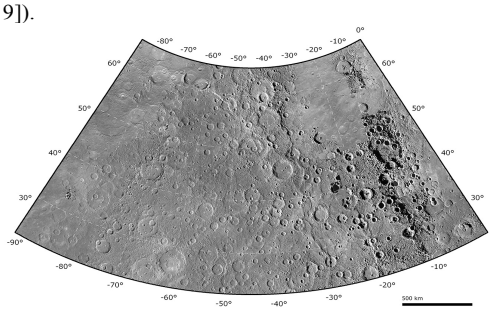

Fig. 1: MESSENGER MDIS 250 mpp mosaic of the Victoria quadrangle. *Credits: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington*

Filters	Wavelength (nm)
F	430
C	480
E	560
D	630
G	750
L	830
J	900
K	1000

Table 1: Filters selected to produce the MDIS-WAC mosaics.

Implications

The color filter mosaic of the quadrangle with a resolution of 200mpp, will allow to correlate the recognized units to the color variation, indicative of different surface lithologies, this will provide a critical analysis of the results derived from classical planetary photo-interpretation. A discussion of the differences between the spectral recognition of those lithologies and the morphologic and tectonic evidences will also improve the interpretation of the surface. Combining different methods for geological interpretation of Mercury's surface is crucial in order to improve planetary geologic mapping results and thus to better understand the origin and evolution of the planet. Moreover this approach could be essential to better define specific targets for the SIMBIO-SYS team.

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