EPSC Abstracts
Vol. 11, EPSC2017-283, 2017
European Planetary Science Congress 2017

Colour mapping of the Shakespeare (H-03) quadrangle of Mercury

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Abstract

We will present a colour mapping of the Shakespeare (H-03) quadrangle of Mercury, as well as the spectral analysis and a preliminary correlation between the spectral properties and the geological units. This work is part of an international collaboration between Italian, English and French teams, whose aim is to map Mercury's surface merging geological units and spectral units. The objectives are 1) to integrate color units with morpho-stratigraphic ones for all quadrangles and 2) to define regions of interest in support to the SIMBIO-SYS instrument onboard BepiColombo mission, contributing to its observational strategy.

1. Introduction

The Mercury Dual Imaging System (MDIS) Wide Angle Camera (WAC) onboard MESSENGER spacecraft observed Mercury with 12 different filters, ranging from 433.2 nm to 1012.6 nm. Thus, three major color units have been identified according to the slope and the reflectance of spectra [1]: high-reflectance plains, intermediate terrain, and low-reflectance material. A variation in the abundance of an opaque component depending on the unit is expected to explain this classification. Two minor color units have also been picked out: the red spots which seem to have a pyroclastic origin, and the hollows, related to impact craters.

To map Mercury, the surface has been subdivided into 15 quadrangles. Some of them have already been mapped [2,3]. The H-03 quadrangle, called “Shakespeare”, extends from 22.5° to 65° in latitude and from 180° to 270° in longitude (Figure 1).

2. Data set

Since the images from the filters at 698.8, 947.0 and 1012.6 nm are not enough to cover the quadrangle, we use data from 8 of the 11 available filters (433.2, 479.9, 558.9, 628.8, 748.7, 828.4, 898.8 and 996.2 nm) for the scientific analysis, while filter at 700 nm was used only for calibration.

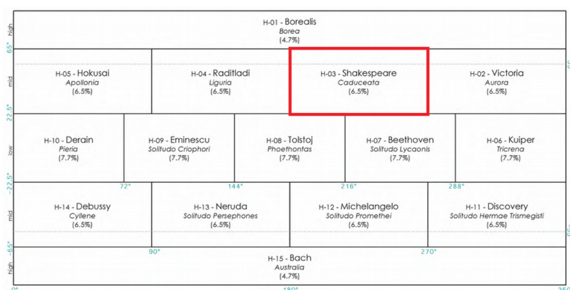

Figure 1: Location of the Shakespeare quadrangle (red rectangle) with respect to the other quadrangles

3. Method

To produce the colour map of Shakespeare, we use the software ISIS provided by USGS. We first download and import MESSENGER raw data of the quadrangle into ISIS format. We georeference the data by using the SPICE kernels for each image. We then perform a radiometric calibration to remove, for instance, the current dark and the flat field, and we project the data using an equirectangular projection. Afterwards, we apply an Hapke photometric correction – the Hapke model parameters for the combined data set [4, table 3]. The photometric correction is used to report the data at standard illumination conditions, such as those frequently used in laboratory (incidence angle i=30°, phase angle φ=30° and emission angle e=0°). Finally, we coregister the images to obtain a mosaic of Shakespeare quadrangle.

4. Results and future works

We will apply techniques of analysis, such as RGB color combinations [5,6], to emphasize differences in composition. Here we show a typical RGB map of

Shakespeare obtained with filters at 996.2, 748.7 and 433.2 nm, respectively (Figure 2). More than 50% of the quadrangle is mapped.

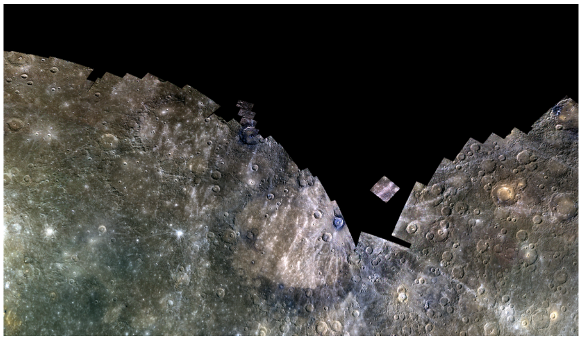

Figure 2: RGB map of the Shakespeare quadrangle (R= 996.2 nm, G=748.7 nm and 433.2 nm)

The geological map of Shakespeare is shown below (Figure 3 ; from [7]).

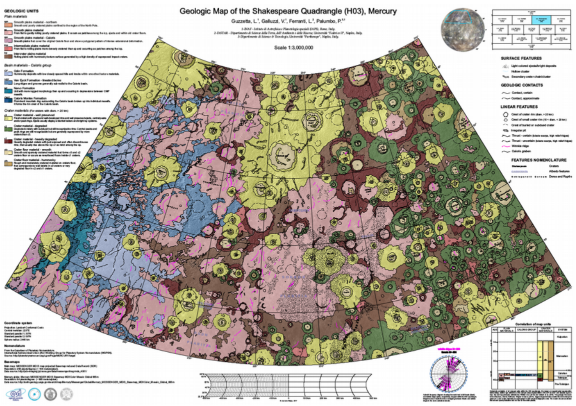

Figure 3: Geological map of the Shakespeare quadrangle

A preliminary comparison show that some color units (Figure 2) correlate to some morpho-stratigraphic ones (Figure 3), e.g. ejecta and bright deposits in Sobkou Planitia and in the cratered regions. A color contrast between West and East parts of the mapped quadrangle can be distinguished, even if this has to be confirmed by a spectral analysis. Indeed, on the RGB map (Figure 2), the East part of Shakespeare seems to be more yellow than the West part, which is consistent with a reddening of this more cratered, so older part of the quadrangle. Thus, East is likely to be more mature, i.e. more degraded by space weathering, than West. This contrast is confirmed on the geological map (Figure 3). Besides, some features like the Akutagawa and Degas craters, which appear really blue on the RGB map (Figure 2), do not show in the geological map (Figure 3) a specific unit separated from crater floor material. This higher spectral variability in specific regions will be investigated.

With the completed quadrangle, we will start to analyze in a more systematic way the spectral variability considering the combination already used in the literature (such as in [5]). Moreover, we will work on the 8 channels spectral variability looking to define some spectral units which could be associated to specific terrains and see how they can be integrated into a planetary geological map. In addition, this spectral analysis will notably help us to investigate which kind of space weathering occurs on Mercury's surface.

Acknowledgements

This work is partly supported by the Centre National d'Etudes Spatiales (CNES).

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