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Spectral variations on H-2 Victoria quadrangle on Mercury: the case of Hokusai rays

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1. Introduction

Analysis of the Victoria quadrangle (H-2) on Mercury, performed by using multi-spectral mosaics from MESSENGER MDIS-WAC data, highlights a number of peculiar features (e.g. pyroclastic deposits, vents, smooth plains and crater ray systems). Here, we focus on the most widespread ray system on Mercury, the one related to the Hokusai impact crater (diameter = 96 km; 57.8°N, 16.8°E) [1, 2, 3, 4] (Figure 1), located in the namesake quadrangle (H-5) [5]. Hokusai ray system extends as far as 7000 km from the crater center, and is distributed about the cavity with the largest concentration of rays located toward the southwest [1]. On Mercury's surface, several other crater ray systems other than Hokusai have been detected (e.g. Debussy, Degas and Kuiper). Furthermore, similar ray systems have also been observed on other bodies of the Solar System, such as the Moon, Mars and the icy satellites, in particular Ganymede [6]. Tens of craters with ray system have been observed on the Moon, while Mars and Mercury have a comparable number. Unlike Ganymede, on Mercury, no correlation between longitude and ray crater distribution has been observed, although the longest rays are located around 0° longitude [6]. The presence of rays indicates that Hokusai is a young crater, formed during the Kuiperian system. This system extends from the present day to 100-300 Myr [1], placing an upper limit on Hokusai's age. The ratio of ray length to crater diameter for Hokusai's ten longest rays is approximately 55 to 1, a value that is anomalously high compared even with the outliers in previous measurements [7, 8, 1]. Here, we investigate Hokusai ray composition by considering multispectral data from the MDIS-wide angle camera onboard MESSENGER.

2. Dataset description

The Mercury Dual Imaging System (MDIS) [9], mapped the Hermean surface at different spatial resolutions, due to the variable spacecraft altitude. MDIS consists of two instruments: a Narrow Angle Camera (NAC) centered at ~747 nm, 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 [9]. 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 region of interest, we calibrated and georeferenced the WAC raw images. Afterwards, we applied the Hapke photometric correction by using the parameters derived by [10]. We projected and coregistered the data, and finally, we produced the mosaic. Subsequently, we consider different techniques of analysis, such as band ratio, RGB color combination and classification methods, to derive the spectral behavior of Hokusai ray system.

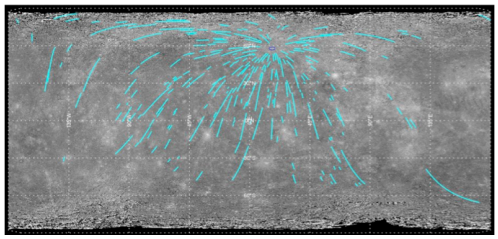

Figure 1: Hokusai crater ray map shown in [1], which displays their distribution over a large part of Mercury's surface

3. Results

The spectral analysis of Victoria quadrangle, highlights spectral variations mostly in correspondence of the Hokusai rays. Applying different techniques of analysis, such as band ratio

(Figure 2) and classification methods to selected spectral ratios (628nm/433nm, 828nm/628nm, 996nm/828nm, 996nm/433nm), we can identify region with different spectral characteristics. Fist results obtained by using K-mean [11] clustering method allow for identifying three classes: one for Hokusai rays, one for the intercrater plains [12], widespread within the quadrangle and one for the smooth plains in the north-western part of H-2. Since Mercury spectra are mainly characterized by spectral slope variations, our results allow for defining areas with different behaviour in terms of this specific spectral parameter. The spectral slope is a useful parameter to investigate surface properties, being associated, for example, with terrain's maturity and variation in particle size or terrain's roughness [13, 14]. Lower spectral slope can be associated with young terrains, while higher spectral slope values are typical of older terrains (e.g. [14]). Here, we found that Hokusai rays belong to the class characterized by lower spectral slope, according with the younger age of this structure. The smooth plain region has higher spectra slope, while the intercrater plains areas present intermediate values. In future work, we will continue the analysis of the Hokusai ray system also outside Victoria quadrangle, comparing it with other similar features both on Mercury and on other bodies of the Solar System. The identification and the study of regions of interest on Mercury is useful to define possible targets for the SIMBIO-SYS instrument onboard the future BepiColombo mission.

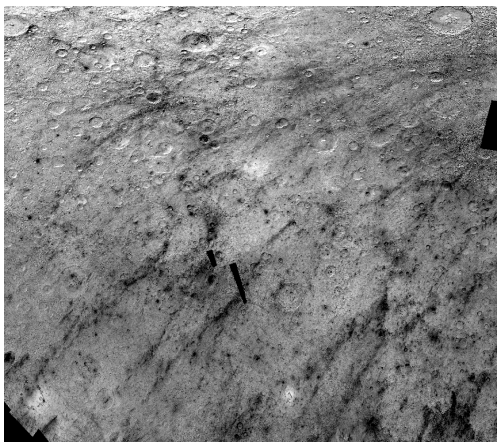

Figure 2: Portion of the Victoria quadrangle that encompasses Hokusai rays. The image obtained by MDIS-WAC data displaying the ratio between the filters at 996 nm and 558 nm. This ratio emphasizes Hokusai rays, which appear darker than the rest of the quadrangle, indicating lower reflectance at longer wavelengths.

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References

[1] C. M. Ernst et al., 47th LPSC, abstract #1374, 2016.

[2] Harmon, J.K. et al. (2007) *Icarus*, *187*, 374–405.

[3] Z. Xiao et al., Bridging the Gap III, abstract #1064, 2015.

[4] Z. Xiao et al., Geophys. Res. Lett., 43, 7424-7432, doi:10.1002/2016GL069868, 2016

[5] D. A. Rothery et al., 48th LPSC, abstract #1406, 2017

[6] J. Szczeszek et al., 47th LPSC, abstract #3024, 2016.

[7] Gault, D.E. and Wedekind, J.A. *Proc. Lunar Planet. Sci. Conf., 9,* 3843–3875, 1978

[8] Herrick, R.R. and Forsberg Taylor, N.K. *Meteorit. Planet. Sci., 38*, 1551–1578, 2003.

[9] S. E. Hawkins III et al., pp 247-338. Doi: 10.1007/978-0-387-77214-1_9, Springer, 2007-

[10] D. Domingue et al., Icarus 257 (2015) 477–488. Doi: http://dx.doi.org/10.1016/j.icarus.2014.11.027, 2015.

[11] J. B. MacQueen, Proceedings of 5-th Berkeley Symposium on Mathematical Statistics and Probability, Berkeley, University of California Press, 1:281-297, 1967

[12] V. Galluzzi et al., Journal of Maps, 2016.

[13] R. Clark, John Wiley and Sons, Inc A. Rencz, Editor New York, 1999

[14] K. Stephan et al., An investigation of the bluish material on Ceres.GRL 44, 1660–1668, 2017.