

EXPLOSIVE VOLCANISM ON MERCURY: LATEST RESULTS FROM AN IN-DEPTH ANALYSIS OF THE MASCS VISIBLE AND NEAR-INFRARED OBSERVATIONS.

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Introduction: Volcanism exposed on the surface of a planet is a unique opportunity to explore the various processes that shaped a body, and Mercury is no exception with the confirmation of widespread volcanism on the surface [1,2,3]. Of particular interest in this analysis are the witness of explosive volcanism analysed and described by numerous authors [3,4,5,6,7]. In this analysis, we focus on small scale spectral variability to determine the characteristics of the deposits and constrain their eruptive history.

Analysis: Scientific observations obtained by the MASCS instrument are particularly suitable, although their observational and geometrical constraints are limiting definitive conclusions. We use the latest and final delivery of spectra to the Planetary Data System (PDS) by the MErcury Surface, Space ENvironment, GEochemistry and Ranging (MESSENGER) science team to increase both the number of spectra that can be analysed, and the spatial resolution of the footprints with dedicated observations of some Pyroclastic Deposits (PDs). This aspect is very important to confirm the spectral variability of PDs as a function of distance first noticed by [4], and analyse if this is a common characteristic observed for all PDs on Mercury. Additional calibration steps with respect to the dataset downloaded at the PDS are done using the approach mentioned in [4].

Results: Spectral properties in the visible, ultraviolet and near-infrared indicate that pyroclastic deposits are probably larger than visible in images solely (Figure 1). To measure the extent of the deposits, we confront the spectral properties of the deposits with the average of Mercury (dashed line). The intersection of the two described where Mercury's background is spectrally dominant, and therefore where the pyroclastics deposits become negligible. Although not true for all, extents of pyroclastic deposits estimated from this approach are often doubled in size. The fact that the estimation using this approach is the same in the ultraviolet, visible, and near-infrared strengthens the robustness of the analysis. The implication for the volatile abundances that are necessary for explosive volcanism are important, with a potential underestimation of the amount needed.

Spectral parameters provide a mean for isolating Mercury's pyroclastic deposits with respect to Mercury's average spectral behaviour. The similar spectral behaviour of the visible, ultraviolet and near-infrared domains suggest that physical properties such as grain size could be the controlling factors of the spectral variability observed. Although composition and space weathering are also phenomenon that could modify the spectral slopes, it is not expected to have different wavelengths domain affected in the same way, and with the same absolute values. It is also expected that the high phase angles of the MESSENGER Mercury Atmospheric and Surface Composition Spectrometer (MASCS) observations would be very sensitive to grain size given that light is scattered in peculiar ways at those angle.

With this analysis repeated at several locations on the surface of Mercury, we are able to distinguish intrinsic properties of pyroclastic deposits. We will present the summary of our findings, together with our interpretation that conclude on various eruptive mechanisms and histories for the pyroclastic deposits.

References: [1] Head J. et al. (2011) *Science*. [2] Prockter L. et al. (2010) *Science*. [3] Kerber L. et al. (2011) *PSS*. [4] Besse S. et al, (2015) *JGR*. [4] Goudge T. et al. (2014) *JGR*. [6] Thomas R. et al. (2014) *JGR*. [7] Rothery D. et al. (2014) *EPSL*.

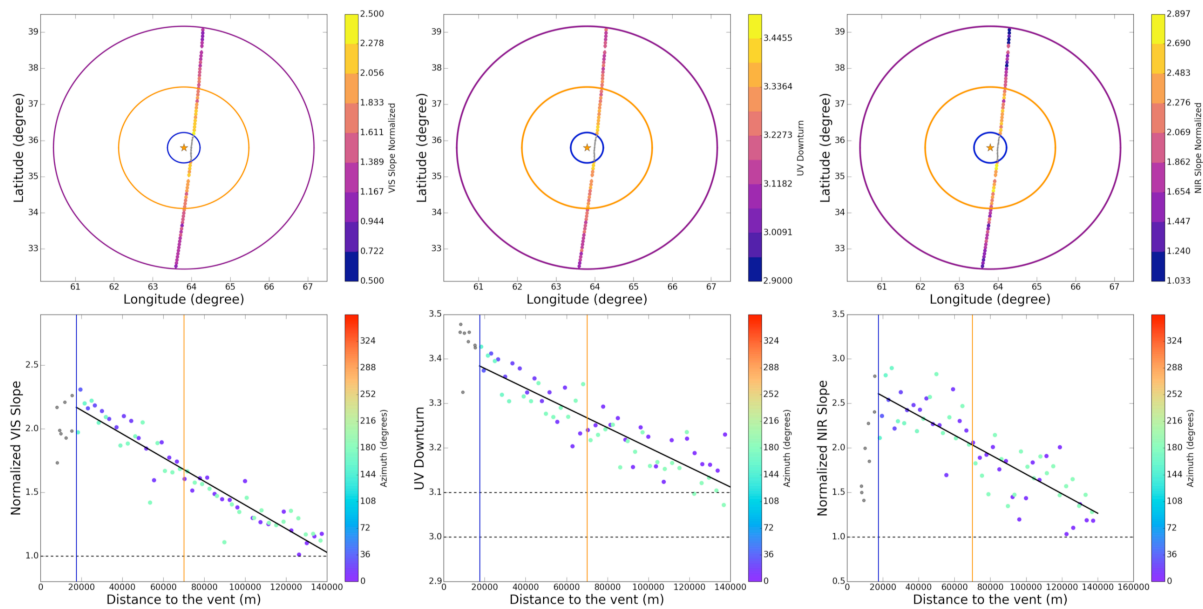


Figure 1. Variability of the spectral parameters along one orbit in NE- Rachmaninoff. The top three panels describe the same footprints of the orbit, the colour code highlights the strength of the slope of the corresponding parameter just below. Bottom left is the normalised VIS-slope as a function of distance, the color code corresponds to the clockwise angular distribution of the footprints with respect to the geographical north. The bottom center is the UV-downturn as a function of distance with the similar color code. The bottom right is the normalised NIR-slope as a function of distance with the similar colour code. The orange and purple circles indicate respectively the original size of the PD, and the one used in this analysis.