GLOBAL ANALYSIS OF MERCURY'S PITS SURROUNDINGS.

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Introduction: Explosive volcanism was identified at the surface of Mercury from images acquired by the MErcury Surface, Space ENvironment, GEochemistry and Ranging mission [1-5]. Hermean pyroclastic activity is characterized by high-reflectance and red spectral slope deposits with diffuse margins (also named Faculae). Many of the deposits are approximately centered on irregularly shaped rimless pits interpreted as volcanic vents. More than 320 endogenic pits have been recorded at the surface of Mercury [6]. The reflectance spectra measured by the Mercury Atmospheric and Surface Composition Spectrometer (MASCS) in 39 pyroclastic deposits and analyzed by [7] revealed a strong downturn in the ultraviolet (UV). More detailed analyses [8] using MASCS orbits passing through the deposits revealed a variation in spectral properties within the deposits. The spectral anomaly decreases linearly from the volcanic vent to the edge of the deposit [8,9]. This linear decrease was used by [9] to determine the dimensions of 14 pyroclastic deposits on the surface of Mercury. Their study shows that about 65% of the deposits analyzed have a radius greater than that estimated in previous catalogs by visual assessment. Here, we present an extended analysis of pits surroundings [6] in order to better understand and quantify the pyroclastic activity on the planet Mercury.

Methods: This study is conducted within the framework of the Mercury Surface Spectroscopy (MeSS) research group (https://www.cosmos.esa.int/web/esac-science-faculty/mercury-surface-group). A database of more than 4.7 million spectra acquired by the MASCS spectrometer was used for data selection. We first selected the observations made in a 100 km square area around each pits and then adjusted the dimensions of this area if necessary. We determined a confidence level and detection threshold for potential spectral signature of pyroclastic deposit. The confidence level is based on the number of observation, their spatial coverage, and their distribution in the selected area. If the confidence level is too low, we consider that the detection cannot be made or confirmed. On the other hand, we have determined that a spectral anomaly over an area of less than 500 km² (about 10 km radius) is difficult to detect with MASCS given its spatial coverage and spatial resolution. For each area selected, we analyzed the

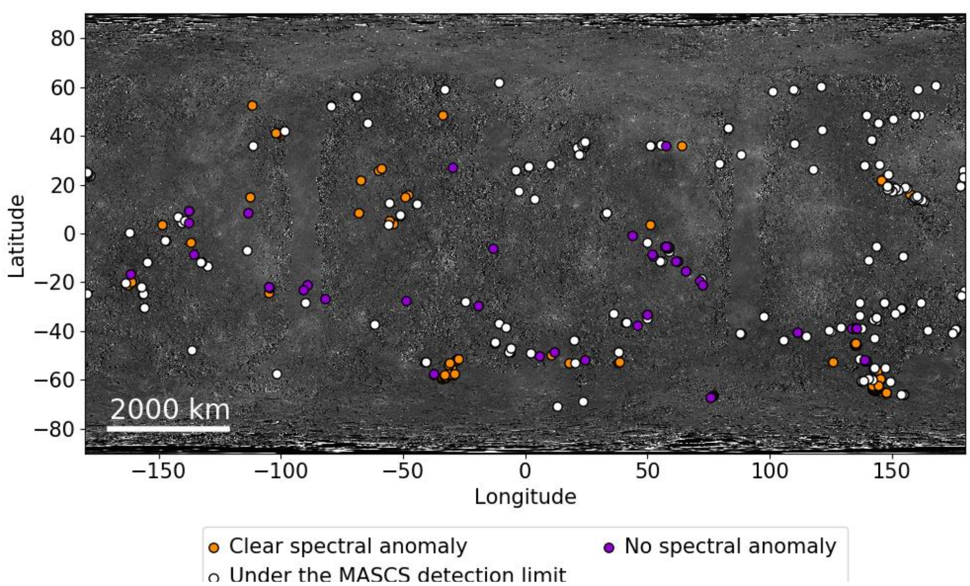

Figure 1. Distribution of endogenic pits [10] on Mercury. Color code indicate whereas a spectral anomaly is detected or not in the reflectance spectra measured by the Mercury Atmospheric and Surface Composition Spectrometer (MASCS). The white dotes represent pits where the MASCS data lacks or the area of the spectral anomaly estimated by [10] is up to 500 km².

visible (VIS) and near-infrared (NIR) slopes [9,10], the UV-downturn [8-10] and the reflectance at 575 and 750 nm.

Preliminary results:
14 % of endogenic pits surroundings do not display a spectral anomaly in the 3 wavelength domains (UV, VIS and NIR). 61% of the selected regions around the pits do not fall within the MASCS detection threshold, mainly (68 %) due to the low spatial coverage of the instrument.
About 25 % of the pits surroundings display a spectral anomaly in the 3 wavelength domains. In their analysis, [9] used the linear decrease of the UV-downturn and the VIS and NIR slopes across a selection of deposits using 3 orbits to determine their radius. Thank to our database, we considerably increased the number of spectra used and the number of spectral parameters. For example, in Nathair facula [10] the number of spectra across the deposit increased from 238 to 2718 (Figure 2). In the case of a simple site (1 or 2 pits), we can determine with an accuracy of 5 km the radius of the deposit (Figure 2). In the case of sites with multiple pits (≥ 2) the superimposition of several circular deposits makes it difficult to determine the radius of each deposit by the method used previously. An in-depth study of each of the sites is necessary.

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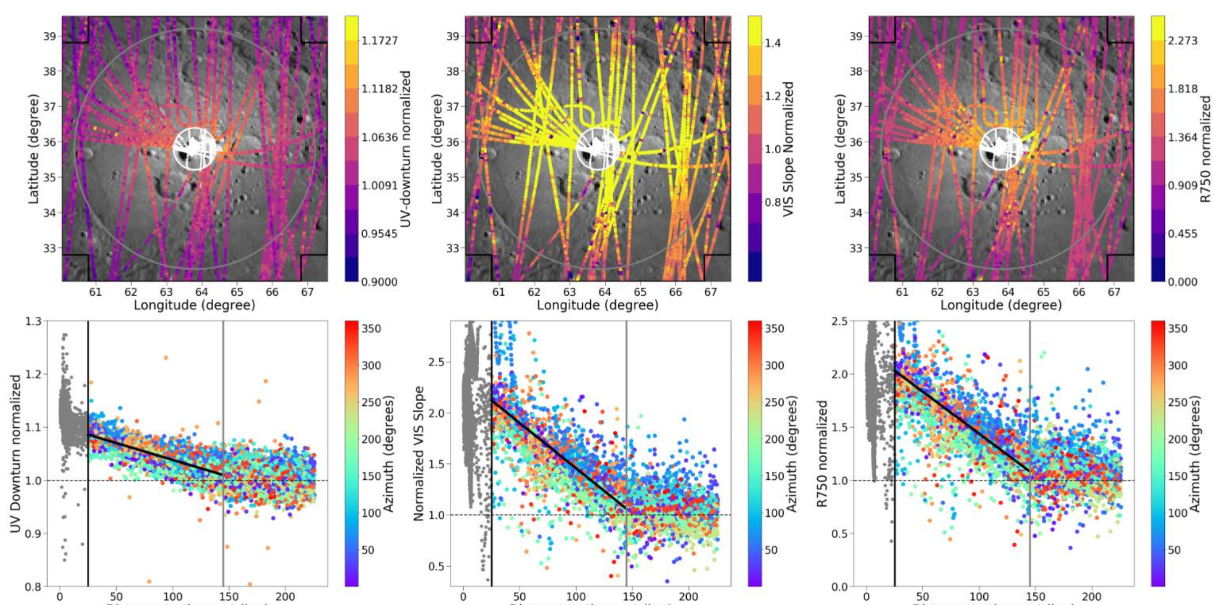

Figure 2. Variability of the spectral parameters across Nathair Facula. Footprints color-coding on the top three panels is based on the strength of spectral parameters. Spectral parameters are normalized by a local mean calculated from spectra acquired in the squares at the 4 corners of the map. North is up, corresponding to azimuth 0 or 360. The lower three panels display the evolution of each spectral parameter with respect to distance from the vent (white circle), color-coded based on the geographical azimuth from the notional vent center. The grey circle in the top panels, and the corresponding vertical line in the lower panels, indicate the distance where the regression line (black) fall closer to the local mean and indicate the radius of the deposit (140 ± 5 km).