Automated research of 3.3 μm absorption in some CRISM IR data: Acidalia Mounds, Alba Patera and Orcus Patera.

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Introduction: In the frame of exploiting CRISM IR data for a pixel-based search for features assignable to organic compounds [1,2], we continue our research analyzing CRISM IR data in some specific sites: Acidalia Planitia (Fig.1a, b), Alba Patera (Fig.2c) and Orcus Patera (Fig.2d). These sites were selected considering their structural geology and mineralogy compatible with the presence of methane gas seepages [3] or other hydrocarbon sources. In fact, Acidalia Planitia includes mud-volcano-like mounds structures. Mud-volcanoes on the Earth are expressions of macro-seeps [3]. Alba Patera is enclosed in Tharsis volcanic area. Even if it is currently not active, it could still preserve a little activity in the form of fluid circulation at a depth of few kilometers [4]. Orcus Patera is a singular site: it is not clear if it is a volcanic caldera or an impact crater where ponded bodies of water may have existed during the Amazonian period maybe providing the combination of volcanism and water activity (hydrovolcanism) [5]. In this abstract we show some preliminary results about this investigation on some CRISM data collected in these three sites.

Data and methods: CRISM and HIRISE data were downloaded from the Mars Orbital Data Explorer. We used the geospatial information system (GIS) JMARS tool to spot the exact location in which the CRISM-IR Full Resolution Targeted (FRT) images (for ex. Fig.1b) and HIRISE images (for ex. Fig.1a) were available. CRISM is the hyperspectral imaging spectrometer on the Mars Reconnaissance Orbiter (MRO) that collects images in a spectral range from 0.4 to 4 μm, [6] with a spatial range of 18 m. The High-Resolution Imaging Science Experiment (HIRISE), on board of MRO, is a camera with up to 0.3 m/pixel of resolution [7].

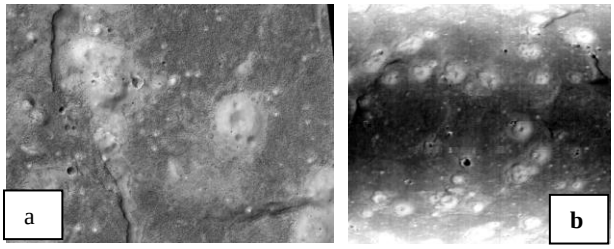

Figure 1 a) ESP_018728_2210_RED, HIRISE image and b) FRT0000D3A1 CRISM image of mounds in Acidalia

The CRISM Analytical Toolkit (CAT) for atmospheric and radiometric correction was used on radiance data. We then created a procedure to isolate possible interesting pixel spectra [1].

The procedure computes the depth of the absorption in the range 3.2-3.4 for each spectrum of the image creating a depth map. It also computes the standard deviation of the depth map itself.

The procedure then selects only those pixels that exceed the threshold set to 5*standard deviation of depth in the depth map [6].

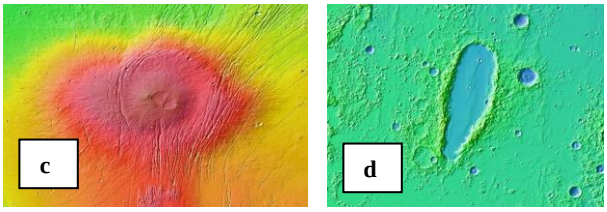

Figure 2 Crops from MOLA Shaded Relief / Colorized Elevation Map of c) Alba Patera and d) Orcus Patera.

Preliminary results and conclusions: The automated procedure for mapping 3.3 μm absorption was used for processing 6 images in Acidalia Planitia, 11 in Alba Patera and 14 in Orcus Patera.

Excluding those pixels below the threshold of 5*std of each image, we found 2 clusters in Acidalia Planitia, 3 in Alba Patera and 2 in Orcus Patera that show absorptions in a range between 3.2-3.4 μm. Nevertheless, the assignment of these absorptions is arduous. Beside the thermal noise of CRISM IR data in the range above 2.7 μm that increases with the degradation over time of the cryogenic cooler of L detector [6], in some images an artefact occurs that simulates an absorption in the investigated range between 3.2 and 3.4 μm. In these images it can be identified as pixel columns for which the corresponding spectra are affected by this "false" absorption. Therefore, we exclude from the interpretation clusters of pixels that appear distributed along columns. This work will be further expanded investigating the remaining clusters from the point of view of local morphology and geological features using HIRISE images.

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References: [1] Manzari etal., preprint DOI: 10.21203/rs.3.rs-103126/v1 [2] Manzari et al., 2020, [3] Oheler and Etiope, 2017, [4] Dohm et al., 2008, [5] Fairen et al., 2005, [6] Murchie et al., 2007a. [7] McEwen, A. S., et al. (2007), Mars Reconnaissance Orbiter's High Resolution Imaging Science Experiment

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