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Analogue Rock Characterization with MicrOmega, within the H2020/PTAL project.

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The PTAL project [1] aims to build an Earth analogues database, the Planetary Terrestrial Analogues Library, to help characterizing the mineralogical evolution of terrestrial bodies, with a focus on Martian analogues (www.PTAL.eu). A set of natural Earth rock samples have been collected, compelling a variety of igneous and sedimentary rocks with variable compositions and levels of alteration. Those samples are characterized with thin section observations and XRD analysis, NIR spectroscopy, Raman spectroscopy and LIBS.

This abstract focuses on the NIR (Near Infrared) spectroscopy analysis performed using the MicrOmega instrument, a NIR hyperspectral microscope (e.g. [2]). The MicrOmega instrument used within the PTAL project is the spare model of the ExoMars rover laboratory. It has a total field of view of 5 mm x 5 mm, with resolution of 20 µm/pixel in the focal plane. It covers the spectral domain from 0.98 µm to ~3.6 µm. Its capabilities enable the identification of grains of different mineralogy in the samples [2].

Each MicrOmega observation produces >65,000 spectra, hence automatic analysis is needed as a first step. After data calibration, a quick-look data analysis based on a set of ~16 spectral parameters based on the detection of single or multiple absorption bands was performed to produce spectral indices maps and average spectra, then guiding the manual analysis in a second step. After spectral endmembers are identified, they are compared to reference spectral libraries to identify the presence of minerals species in the sample. Spectral parameter maps can then be used to map the extent of the identified mineral species on the surface of the sample. Final products of the analyses will feed the online PTAL spectral database, and a paper describing these analyses has recently been submitted to Astrobiology.

Mineral species detected with MicrOmega in the PTAL samples include: Olivine, High Calcium Pyroxene, Low Calcium Pyroxene, Amphiboles, Epidotes, Zeolites, Opals, Phyllosilicates, Oxides and Hydroxides, Carbonates, and Sulfates.

Preliminary comparisons with XRD and Raman analyses show general consistency in the identification of olivine, pyroxene and hydrated phases. As expected, quartz and plagioclase for

example are challenging to be identified in NIR, but MicrOmega shows well the capacity in hydrated minerals identification and qualitative estimation of major and minor mineral species thanks to its spectral-imaging capabilities.

The PTAL spectral database will assist in particular in interpreting in situ data from the next Mars surface missions. The target-rocks in Oxia Planum and Jezero Crater, the landing sites of the next surface missions, have compositional similarities with some samples of the PTAL collection, in particular with the orbital identification of clay minerals and serpentine. The NIR spectrometers on board the rovers will be involved at multiple stages of the surface operations and will be crucial to understand the geologic history of each landing site, and in particular the context of the water alteration of the rocks.

References: [1] Werner et al. (2018) Second International Mars Sample Return, No. 2071, 6060. [2] Pilorget and Bibring (2014) PSS 99, 7-18.

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