PTAL MULTI-SPECTRAL DATABASE OF PLANETARY TERRESTRIAL ANALOGUES: RAMAN DATA OVERVIEW. M. Veneranda 1, G. Lopez-Reyes1, J. Saiz1, A. Sanz1, J. A. Manrique1, J. Medina1, H. Dypvik2, S. Werner2 and F. Rull1, 1Unidad Asociada UVa-CSIC-Centro de Astrobiologia. C/ Francisco Valles 8, Valladolid (SPAIN), marco.veneranda.87@gmail.com. 2 Department of Geosciences, CEED/GEO, University of Oslo, Norway.

PTAL Database: The Planetary Terrestrial Analog Library (PTAL) [1] is a database in which spectroscopy scientists have gathered spectroscopic data with Raman, LIBS, NIR and XRD techniques, of samples relevant for the analysis and data exploitation of planetary missions such as ExoMars. Thus, the purpose of the PTAL project is to enhance the scientific outcomes that could derive from the study of terrestrial analogues relevant to planetary exploration by providing an extensive multi-spectral database of terrestrial analogues to the scientific community. The PTAL website will provide the opportunity to request physical access to samples, up to 1.3 kg of material was sampled for each analogue. In this way, sample accessibility will enable future users to combine PTAL spectroscopic data with further laboratory analysis. For this purpose, both laboratory and spacecraft-simulator instrumentations have been used to analyse: 1) a large collection of natural geological samples collected from terrestrial analogues sites and 2) artificial samples replicating Martian protoliths composition and altered in the laboratory under controlled physical-chemical conditions.

Raman data, together with the complementary NIR and LIBS analysis, will be supported by XRD data and thin section observations to provide an exhaustive geochemical and mineralogical characterization of the selected samples.

On the technical perspective, the PTAL is designed as presented in Fig. 1. On one hand, the database includes the spectral information that can be accessed via web. On the other hand, the SpectPro tool is an application developed in the framework of the development of the RLS Raman instrument of the ExoMars mission that provides an analytical set of tools capable of analysing the scientific and housekeeping data received from the RLS instrument but also from other sources, with a set of available functions for the comprehensive analysis of spectroscopic data, including operations such as binning of images, baseline removal, filtering, SNR calculation, normalization, a spectra calculator, automated peak detection...

![Figure 1. The PTAL DB technical design](image)

The SpectPro and PTAL teams have worked together to facilitate a direct access from SpectPro to the PTAL database, using the same credentials for access to the PTAL web interface. This connection will boost the capability of the scientist working in a planetary mission (but not only) to perform a fast and comprehensive characterization and identification of the mineral phases present in a sample by comparing the data obtained from the sample with the extensive spectral information included in the PTAL database. This will be possible by profiting from the navigation pane included in SpectPro.

Raman analysis results of the PTAL samples: The interpretation of the over 4500 Raman spectra summarized in this work was mainly focused on the identification of the mineral groups composing the analysed analogue materials (i.e. feldspar, pyroxenes, olivines). Indeed, the PTAL project foresees to promote the use of SpectPro software by the users that will be able to carry out a more refined spectra interpretation by using the SpectPro data processing tools and by performing comparative analysis with standard spectra. As detailed below, the PTAL samples are organized in three main categories:

**Hydrate sulphate minerals:** The mineralogical data collected by the XRD system on board of the Opportunity/NASA rover proved the presence of jarosite (KFe3(OH6(SO4)2) on Meridiani Planum [2]. The identification of hydrous sulphate minerals is one of the strongest evidences in support of the past presence of water on Mars. In this light, the PTAL database includes terrestrial analogue samples collected from geo-
logical sites rich in hydrated sulphates that will help deepen the knowledge about the conditions favouring their mineralization.

**Martian protoliths analogues:** The PTAL database also includes an extensive collection of gabbros and basalts collected from analogue sites with a lithology comparable to Martian protoliths. The comprehensive characterization of these samples will play a crucial role in the selection of the optimal materials to be employed for laboratory alteration experiments. These tests, based on the exposition of the sample to controlled atmospheric conditions, will help obtaining outstanding inferences about the alteration processes that have occurred or are occurring on Mars.

**Impact craters:** The Martian surface shows more than 43000 craters produced by the impact of extraterrestrial bodies with the planetary crust. The mineralogical study of the stratigraphic units composing craters walls and basins can provide important clues regarding the evolution of Martian geology and environment. In the light of the forthcoming ExoMars and Mars2020 missions, five terrestrial craters were considered for the PTAL project so as to evaluate the scientific capabilities of spectroscopic systems in detecting impact-related alteration products [3].

**Conclusions:** This work presents the whole set of Raman data (over 4500 spectra) that have been collected to feed the PTAL database. In a general perspective, it was confirmed that Raman spectroscopy is able to reveal the complex mineralogical composition of a wide variety of terrestrial analogues, providing results in accordance with analytical studies presented in previous works.

Besides the multispectral database, the PTAL project will also provide users with spectra-treatment tools and physical access to the 94 terrestrial analogues. In this sense the PTAL information system aims to become a cornerstone tool for the scientific community interested on deepening the knowledge of geological processes occurred on Mars and other extraterrestrial bodies.

Beyond the PTAL project, the data summarized in this works also helps to shed light on the potential contribution of Raman spectroscopy to the mineralogical characterization of extraterrestrial bodies. On one hand, the characteristic vibrational Raman spectra provided by minerals (and potential biomarkers) are characterized by the presence of very sharp and well separated peaks, which facilitate the proper characterization of the analysed material even in the presence of complex mixtures. On the other hand, being the spot of analysis of micrometric size, a multipoint procedure enables the detection of minor and trace compounds that cannot be easily detected by other techniques.

**Acknowledgements:** This project is funded by the European Research Council (H2020- COMPET-2015 grant 687302) and the Spanish MINECO (grants ESP2014-56138-C3-2-R and ESP2017-87690-C3-1-R).

**References:**