

PLANETARY TERRESTRIAL ANALOGUES LIBRARY – ROCK COLLECTION AND SPECTRAL DATABASE FOR ANALOGUE STUDIES OF IGNEOUS AND AQUEOUS ENVIRONMENTS ON MARS
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Introduction: Planetary Terrestrial Analogue Library (PTAL) is a newly built collection of rocks from various environments on Earth and multispectral data on these rocks [1]. The collection of physical rock samples consists of 106 specimens from 19 diverse localities on Earth. Each collected rock was analysed by NIR, Raman and LIBS [2,3,4], and all spectral data are freely available in the PTAL library (www.ptal.eu). The primary goal of the rock collection has been to create the PTAL multispectral database that would support interpretation of data returned by Martian orbiters and rovers [5]. Since September 2021, when the database was released, the rocks can serve multiple other scientific purposes. Especially, textural and geochemical studies can be performed on the rocks to address detailed questions about Martian environment and to create connections with similar studies on Martian meteorites.

PTAL sampling sites: The collection consists of rocks analogous to Martian crustal and aqueous environments. The collection comprises igneous rocks that compositionally correspond to Martian basalts and alkali basalts. Within this category exist several tholeiitic basalts from Iceland, as well as ferropicrites from Rum (Scotland), alkali-rich (phonolites) rocks of metasomatism-related origin from Canary Islands and Tenerife, ash-fall deposits from the Granby formation (USA), and serpentinised peridotites from the Leka ophiolite complex (Norway). Individual specimens from each site sample distinct lithologies that record, as far as possible, the variety of processes involved in geological evolution of the analogue environment. For instance, a sequence of intact protolith, serpentinized and serpentinized-carbonatized rocks is sampled from Leka, or a variety of igneous compositions from Canary Islands and Tenerife. PTAL contains also samples from diverse surface alteration environments and from a range of climatic environments, including hot and cold deserts: John Day Formation in Oregon (USA), Dry Valleys in Antarctica, Otago Formation (New Zealand), Jaroso Ravine and Rio Tinto (Spain). PTALs strength is that the collection samples a sequence of alteration products, allowing detailed mineralogical and geochemical comparative analyses within alteration environment to shed light on the potential parallelism of formation processes. Lastly, PTAL includes impactites of various target rocks types: Gardnos, Vredeford, Chesapeake Bay, Vargao Dome and Lonar crater – the relatively fresh terrestrial crater in basaltic rock. Both impact-related and shock-induced metamorphism as well as post-impact hydrothermal activity can be studied in these rocks.

Spectral database: Each analogue rock incorporated into PTAL was characterized by instruments that are typically carried on board of Martian orbiters and rovers. Data collected by NIR spectroscopy, micromeg NIR hyperspectroscopy, Raman and LIBS are freely available in the PTAL database (www.ptal.eu). Since PTAL is a collection of natural rocks and not individual minerals, spectral data on the rocks give full insight into mineralogy and geochemistry as e.g., overlapping vibrational absorption features of minerals are included. As such, PTAL database can be used to identify mixtures of minerals observed in spectra, and because of the complementary characterisation by XRD and optical thin sections. Additional geochemical and petrological data on the PTAL rocks, when combined with spectral results in the PTAL database can serve as a solid base to contextualize features of meteorites with remotely-sensed surface of Mars.

Loans of physical samples for further studies: The amount of the material secured and curated in the PTAL collection enables loans for further characterizations. At the moment, the majority of samples are available in masses sufficient to support loans up to ~2–5 g (including loans for fully destructive procedures required by geochemical and/or isotopic studies). Thin sections can also be loaned for analyses with microbeams. Additionally, loans of the witness samples for non-destructive and non-invasive purposes (imaging, scanning, further spectroscopy characterizations etc.) are possible and, additionally, sampling coordinates can be shared, so that acquisition of more material is possible, if needed.

References: [1] Dypvik et al., 2021. *Planetary and Space Science* 208: 105339. [2] Lantz et al., 2020. *Planetary and Space Science* 189: 104989. [3] Loizeau et al., 2022. *Astrobiology* 22: 263-292. [4] Veneranda et al., 2020. *Journal of Raman Spectroscopy* 51: 1731-1749. [5] Krzesinska et al., 2021. *Astrobiology* 21: 997-1016.