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IDENTIFYING MARTIAN FELDSPATHIC ROCKS WITH VISIBLE NEAR-INFRARED SPECTROSCOPY

Abstract

The presence of feldspathic rocks on the surface of Mars was first reported in 2013 [1] with the study of visible near-infrared (VNIR) reflectance satellite data from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) instrument. Based on earlier studies of terrestrial analog material and of binary powder mixtures in the laboratory, the presence of a broad absorption band around 1.3 μm has been so far interpreted as diagnostic of anorthosites containing more than 90% Ca-plagioclase. Recently, new feldspar detections were made, with CRISM again, in the walls of Valles Marineris, and were interpreted as possible volcanic products [2]. These Martian feldspar detections raise questions about the nature of the rocks involved and the magmatic processes responsible for their formation, as well as the formation of the planet's envelops and their evolution.

Reflectance spectroscopy is a powerful technique that allows to determine the mineralogical composition of the rocks on the surface of the planets using the instrument on board a satellite. In this study, we then compare the data acquired in orbit of Mars with that acquired by the same method in the laboratory. We created a VNIR reference spectral library, using an ASD Fieldspec 4, acquired on entire terrestrial feldspathic rocks of different types: volcanic, plutonic, and metamorphic. The analyzed rock samples contain feldspar minerals of various composition, in various proportions, and with different grain sizes which we expect will influence the spectral response. In parallel to these laboratory studies, previous feldspar detections made with CRISM on Mars [1,2] are being re-analyzed to assess the exact geological context for the detections.

Our results highlight that spectra collected on a range of terrestrial feldspathic whole rocks, including both effusive and cumulative rocks, show diagnostic plagioclase signatures which are similar to the 1.3 μm absorption feature observed on Mars. Therefore, we conclude that this signature is not specific only to nearly pure anorthosites.

Future work includes a detailed petrographic characterization of the analyzed samples to better constrain the feldspar composition and its possible effect on the absorption band position, strength, and shape. Finally, the rock samples will be mapped using a hyperspectral camera to characterize the exact spectral signature of each mineral present in the rocks.

[1] J. Carter et al., 2013
[2] J. Flahaut et al., 2019