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# From Iceland to Mars: Characterizing Potential Regolith Analogs with Reflectance FTIR Spectroscopy

**Background and Rationale** Mars is currently one of the most interesting astrobiological targets, being the focus of numerous exploration missions aimed at searching for traces of possible past life. Although the planet is now characterized by extreme and inhospitable conditions for life, it was once habitable and had an Earth-like environment with similar hydrological, geological, and atmospheric complexity. Studying the oldest rocks on the planet, which are still available on its surface due to the lack of plate tectonics, could reveal traces of past life. (Williford et al. 2018)

**Aims** To support in-situ analyses and future sample return missions, our work aims to characterize a potential regolith analog collected at Lambahraun, Iceland, using reflectance FTIR spectroscopy. Comparing the spectra of these samples with those obtained by the SuperCam instrument onboard the Perseverance rover will help us understand if this regolith sample is a good analog for the Jezero crater soil.

**Materials and Methods** At the INAF-Arcetri Astrobiology Laboratory, we used the Bruker VERTEX 70v FTIR spectrometer equipped with the Harrick Praying Mantis accessory to perform DRIFTS (Diffuse Reflectance Infrared Fourier Transform Spectroscopy) measurements. We acquired laboratory spectra in the range between 8000 cm-1 and 400 cm-1 (1.25 µm – 25 µm) with a resolution of 4 cm-1. The sample compartment was saturated with N2 to reduce atmospheric absorption during the measurements.
The Icelandic samples were collected during the NASA-ESA Mars Sample Return Sample Analogue Campaign at a site selected just south of the original target field based on previous work by Baratoux et al. (2011) and Mangold et al. (2011). The sampled sand sheet was chosen for its similarity to the images of the Jezero crater regolith, and presents fine to medium basaltic sand with some coarser grains. Samples were collected with sterilized tools to keep them organically clean.

**Results** We analyzed the NIR spectra of our samples in the SuperCam range (1.25 µm – 2.6 µm), detecting signals due to the presence of H2O (1.9 µm) and metal–OH bonds (about 1.4 µm, 2.2 µm and 2.3 µm). Comparing the spectra with those acquired by SuperCam at the Observation Mountain (sol 593-606 and sol 632-641), the Granite Peak (sol 594) resembles our LAM 02 A1 sample for slopes and some of the spectral features, revealing the presence in both the samples of water-bearing minerals. The other Martian spectra analyzed had fainter metal–OH features and were more similar to our other samples (LAM 02 A3, LAM 02 F1, LAM 02 J1), with slopes suggesting the predominance of high-calcium pyroxenes.
We then analyzed the MIR spectra of our spectra from 4000 cm-1 to 400 cm-1 (2.5 µm – 25 µm), confirming the basaltic nature of the Icelandic sand by examining the Christiansen Feature and the Reststrahlen Bands. In the region between 4000 cm-1 and 1250 cm-1 we confirmed the presence of water and OH features, while the region between 600 cm-1 and 400 cm-1 revealed the presence of Al-, Mg- and Fe-rich silicates.
The XRD analysis confirmed the presence of basalt in the samples, but did not detect any hydrous minerals: this means that the maximum content of water-bearing minerals in our sample is about 0.5% (the detection limit of the XRD measurement).
Very faint C–H bands were detected between 2900 cm-1 and 2800 cm-1.

**Conclusion** The NIR Icelandic spectra in the SuperCam range showed features and slopes similar to the Martian ones, thus can be used as mineral analogs for the Observation Mountain regolith. MIR spectroscopic data provided a better insight on anhydrous minerals of the Icelandic samples, revealing their basaltic composition, but did not allow for quantitative compositional estimates because of nonlinear mixing effects (Ehlmann et al. 2012). In conclusion, our samples could be used as analogs for a basaltic Martian regolith that is poor in water-bearing minerals and rich in plagioclase.
In addition, the spectra suggest the presence of a very small amount of organic molecules so, as a continuation of this work, the same Icelandic soil samples could be used to perform organic extraction, simulating potential small organic signatures in the samples that will be returned from Mars.

**References**

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