Geochemical Analysis of Ronda Peridotite: Insights into Martian Analogues and Alteration Processes

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In the context of the geochemical characterization of potential Martian analogues on Earth, a peridotite sample from Serranía de Ronda (Málaga, Spain) was analyzed. The peridotites of Ronda are distinguished by the prevalent presence of magnesium-rich minerals, notably olivine and pyroxenes (orthopyroxenes and clinopyroxenes), and their association with igneous rocks of basaltic composition. In addition, this sample is particularly relevant due to its susceptibility to carbonation, serpentinization, and other alteration processes induced by hyperalkaline fluids it may come into contact with. Likewise, the phenomenon of serpentinization not only initiates a cascade of chemical reactions capable of yielding complex organic molecules but also it establishes distinctive geochemical conditions conducive to microbial life.
This study was focused on the geochemical analysis of the interest sample with of three spectroscopic techniques: laser-induced breakdown spectroscopy (LIBS), micro–energy dispersive X-ray fluorescence (µ-EDXRF), and Raman spectroscopy, all these integrated within the SuperCam instrument aboard the Perseverance rover. The elemental composition can provide information about the spatial distribution of hydrothermally altered rocks. Two-dimensional maps were generated for major (Figure 1) and minor elements, from LIBS and µ-EDXRF spectral data. Ratios normally used in the identification of mineral phases present in peridotites, such as olivine and chromites, were also calculated. These data were confirmed from Raman spectra. Finally, regions in the sample with similar spectroscopic characteristics were identified by K-means analysis. The results indicated that certain regions in the sample exhibit a high proportion of chromium and iron, which may suggest the potential presence of spinels such as chromite and other associated minerals. This mathematical approach not only expands the scope of geological analysis but also offers a rapid method for characterizing mineral phases and alteration processes, particularly in contexts involving large data sets.

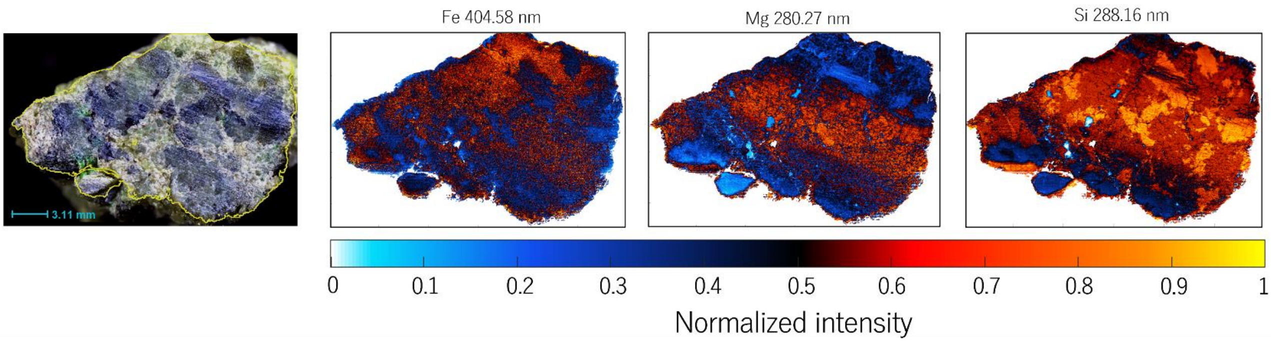

Figure 1. LIBS maps of the main elements in the rock acquired at specific wavelengths. The sampling area is delineated by the yellow line and covers a section of 14.73 mm × 22.75 mm.