WHAT LURKS IN THE MARTIAN ROCKS AND SOIL? INVESTIGATIONS OF SULFATES, PHOSPHATES, AND PERCHLORATES

Natural Fe-bearing oxides and sulfates from the Rio Tinto Mars analog site: Critical assessment of VNIR reflectance spectroscopy, laser Raman spectroscopy, and XRD as mineral identification tools†

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ABSTRACT

We have characterized complex iron- and sulfate-bearing samples from Rio Tinto (Spain) using X-ray diffraction (XRD), visible-near infrared reflectance (VNIR) spectroscopy, and laser Raman spectroscopy (LRS). Samples were collected for this study from the Peña de Hierro region of Rio Tinto because this site represents a natural acidic environment that is a potential analog for such environments on Mars. We report an evaluation of the capabilities of these three techniques in performing detailed mineralogical characterization of potential Mars-like samples from a natural acidic terrestrial environment. Sulfate minerals found in these samples include gypsum, jarosite, and copiapite, and iron hydroxide bearing minerals found include goethite and ferrihydrite. These sulfate and iron hydroxide/oxyhydroxide minerals were detected by XRD, VNIR, and LRS. Minor quartz was identified in some samples by XRD as well, but was not identified using VNIR spectroscopy. Coordinating the results from these three techniques provides a complete picture of the mineralogical composition of the samples. Field instruments were used for this study to mimic the kinds of analyses that could be performed in the field or on martian rovers.

Keywords: Raman, VNIR reflectance, XRD, sulfates, iron, Mars, analog, Rio Tinto