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Sulfide ore deposits remote detection in the Rio Tinto area, terrestrial analog of Mars

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Data from martian rovers and martian meteorites indicate the presence of ore minerals. There are three spectrometers, CRISM (Compact Reconnaissance Imaging Spectrometer for Mars; spectral range 0.4-3.9 μm) onboard Mars Reconnaissance Orbiter (MRO), as well as OMEGA (Observatoire pour la Mineralogie, l'Eau, les Glaces et l; Activité, 0.4–5.1 μm) and PFS (Planetary Fourier Spectrometer, 1.3–45.0 μm) onboard Mars Express (MEX), that operate in the near infrared (NIR) spectrum and provide information on the mineral composition of Mars. None of them, however is already capable to efficiently identify sulfides. Detecting sulfide ore deposits is difficult in NIR due to spectral interferences with silicates. Because of the limited in-situ measurements by the Opportunity, Spirit, Curiosity, and Perseverance rovers, Mars mineralogical studies must be supported by studies of terrestrial analogs. One example is the Rio Tinto area in Andalusia, Spain, which hosts the largest known volcanogenic massive sulfide deposits on Earth. In this area, we analyzed satellite images in the NIR spectrum and detected pyrite from the orbit. Landsat 8 Collection 2 Level 2 images (30 m/pixel), ASTER L2 Surface Radiance VNIR and Crosstalk Corrected SWIR (09XT; 15-30 m/pixel), and Sentinel 2 of Level 2a (10-20 m/pixel) habe been used. We have tested several RGB band compositions as well as band maths and band rations. For preliminary pyrite identification we have chosen the following solutions: 1) RGB: 7 6 4, RGB: 5 6 7, RGB: 6 3 2 for Landsat 8; 2) RGB: (5 × 6)/7, (4 × 6)/(5 × 2), (5 × 6)/(7 × 2), RGB: 42, 45, 56, RGB: 1 2 3 for ASTER 09XT; 3) RGB 12 11 2 for Sentinel 2a. Within the selected areas, spectral signatures have been checked and compared to the labolatory patterns. The identified pyrite locations will be then investigated during field studies in Rio Tinto area planned to March 16–28,2022.

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