
Proximal Hyperspectral Sensing for the Characterization of High-Sulfidation Epithermal Deposits: The Allumiere Quarry Test Site (Central Italy)

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The Allumiere quarry is located northwest of Rome (Italy) in the Pliocene-Pleistocene Tolfa volcanic district and is locally known for the occurrence of an alunite+kaolinite mineralization intensely exploited from the 15th century onward. This mineralization is hosted in a lava dome and is considered to be genetically related to post-volcanic hydrothermal activity, which has produced a widespread structurally controlled alteration spanning from vuggy silica and advanced argillic to intermediate argillic. The main minerals characterizing these zones are quartz, alunite- and kaolinite-group minerals, and smectite. The hypogene assemblage was lately affected by supergene alteration, characterized by Fe-oxyhydroxides, jarosite, and other accessory phases. All these minerals are optically active in the visible-near (VNIR) to short-wave infrared (SWIR) range. In this study, we report the preliminary results of the hyperspectral analyses at proximal scale carried out on the distinct alteration facies using the Headwall Photonics nano- and micro-hyperspectral cameras, which cover the spectral range between 400 and 2,500 nm, with 270 (VNIR) to 166 (SWIR) spectral bands. The hyperspectral data have been processed by applying feature extraction indexes for determining the relative abundances of Fe-oxyhydroxides (hematite and goethite), by using the 900 nm absorption feature and hydroxyl-bearing minerals (white mica, smectite, kaolin group minerals, sulphates) and their compositional variations. The high-resolution hyperspectral data allowed us to (1) discriminate among kaolinite polytypes (kaolinite, dickite, and halloysite) based on the position of the OH absorption feature in the region around 1,380 to 1,400 nm, (2) discriminate alunite from natroalunite due to the wavelength shift of the 1,480-nm absorption feature, and (3) detect smectite through the double absorption feature deeper at 1900 and 2200 nm.

This relatively fast and cost-effective method represents a cutting-edge tool for the identification and characterization of potential exploration targets and can be used either in the laboratory or in the field.