Hyperspectral Satellite Remote Sensing for District-scale Exploration in the Coastal Cordillera of Northern Chile: Alteration Mapping as a Vector to the Mineralization

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In this study, we propose an application of satellite hyperspectral remote sensing for identifying and mapping specific minerals associated with the surface-exposed hydrothermal and supergene alteration assemblages vectoring to ore deposits in the Coastal Cordillera of northern Chile. The area is the host of several iron, copper, and minor gold, silver, and zinc ore bodies of Early Jurassic to mid-Cretaceous age. Host rocks to the precious and base metal deposits commonly exhibit hydrothermal alteration patterns, characterized by both upward and outward zonation. Supergene alteration of the ore bodies causes oxidized iron-rich blankets. To map the relative abundances and compositions of specific supergene and hydrothermal alteration minerals, which are optically active in the Visible Near (VNIR) to Short Wave Infrared (SWIR) wavelength regions, such as Fe-oxides and hydroxides (hematite-goethite), di- and tri-octahedral phyllosilicates (e.g., micas-kaolinite-chlorite), hydroxyl-bearing sulfates (e.g., alunite) and epidote, a range of band ratios in the region around 900 nm and from 2,100 nm to 2,300 nm, were applied to PRISMA satellite imagery. PRISMA, a hyperspectral spaceborne imaging spectrometer funded by the Italian Space Agency, provides images at a spectral resolution of ∼13 nm in a continuum of 234 spectral bands in the VNIR and SWIR wavelength range (400-2500 nm). Since it covers the mineral-diagnostic wavelength regions at hyperspectral resolution and signal-to-noise ratio (SNR) from ≥ 200:1 (VNIR) to >100:1 (SWIR 2), it has the potential to accurately recognize and map the earth's surface materials, discriminating between different geological targets according to their diagnostic spectral response in each of the narrow bands. The preliminary results assess that PRISMA permits reliable discrimination of alteration minerals associated with hypogene and supergene alteration bands, which may provide useful vectors to prospective mineralized areas. The method can be considered a valuable strategy for cost-effective and safe mineral exploration at regional scale.