Hydrothermal Alteration Zones Estimated by ASTER Satellite Image and ASD Terraspec on the Eastern Zone of Cerro de Pasco, Perú

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The research area is located in the Pasco Region of Peru, covering an area of 2,570 km² and geologically on the eastern zone of the polymetallic deposits associated with a Miocene volcanic diatremes belt. This investigation aims to target new hydrothermal alteration zones by interpretation of an ASTER satellite image.

The geological, tectonic, and structural setting of the studied area creates a suitable environment for formation of hydrothermal systems. With the presence of a mountain system with low vegetation cover, it is suitable to use an ASTER VNIR-SWIR multispectral image. The analysis and procedures on the satellite image were compared with SWIR spectral signatures obtained from the ASD TerraSpec in the mine sites of the investigated area; this allowed us to define areas of enhanced lithological and alteration signatures defining new exploration zones.

Four spectral techniques were used to identify hydrothermal alteration zones. The first technique involved mapping clay minerals and iron oxides using the combination of RGB bands. The second technique used band ratios to determine mineral alteration associations. The third technique used SWIR spectral indexes to corroborate the spectral results. Finally, the last technique was spectral mapping using the Spectral Angle Mapper (SAM) method, which needs a special procedure because it uses both field data obtained from hand samples using the ASD TerraSpec and spectral signatures from ASTER image.

The application of this last technique permitted us to corroborate the mineral alteration zones obtained with previous methods and also to refine the hydrothermal alteration halos based on mineralogical associations characteristic of mineral deposits. Taking into consideration the metallogenetic, geological, and structural environment, ten new exploration zones were defined: seven for high-sulfidation polymetallic systems with advanced argillic and intermediate argillic alteration, and three for porphyry systems with phyllic, intermediate argillic, advanced argillic, and propylitic alteration.