## Hydrothermal Alteration Zones Wstimated by ASTER Satellite Image and ASD TerraSpec on the Eastern Zone of Cerro de Pasco, Peru

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Remote sensing and field spectroscopy are increasingly vital for mineral exploration in rugged, poorly accessible terrains. In central Peru's Cerro de Pasco region—host to porphyry, polymetallic, and orogenic gold systems across multiple metallogenic epochs—we apply a combined satellite and field-based spectral approach to identify hydrothermal alteration zones as vectors for new exploration.

This study integrates ASTER satellite imagery with spectral data collected using an ASD TerraSpec from representative outcrops to delineate alteration zones associated with mineralized systems. Four complementary techniques were employed: RGB composite mapping of iron oxides and clays, band ratio analysis to detect alteration assemblages, SWIR-based spectral indices, and Spectral Angle Mapper (SAM) classification. The SAM method, combining ASTER data with field-derived spectra, enabled refined discrimination of hydrothermal halos.

Validation of results across all methods highlighted consistent mineralogical zoning, allowing the identification of eleven new exploration targets. These include seven high-sulfidation systems with advanced and intermediate argillic alteration; three porphyry-related systems displaying phyllic, propylitic, and advanced argillic zones; and one stratabound polymetallic system characterized by carbonate-rich phyllic-propylitic assemblages.

Our results demonstrate the effectiveness of integrating satellite spectral data with ground-truthing to delineate mineral alteration in geologically and structurally complex terrains. This workflow enhances early-stage targeting where traditional mapping is constrained and underscores the potential of remote sensing and spectroscopy as strategic tools in exploration programs across the Central Andes.