

Dominant Mineral Mapping of a Major Low-sulfidation Epithermal District Using Newly Acquired AVIRIS-5 Data in the Great Basin, United States

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Low-sulfidation epithermal (LSE) deposits form within 1.5 km of the surface from meteoric water-dominated fluids with near neutral pH and low salinity. These deposits are principally exploited for precious metals and occur along a spectrum from high grade veins with limited endowments to low grade, bulk tonnage with significant endowments.

Major alteration minerals present in LSE systems outside of quartz and adularia are conducive to mapping using imaging spectroscopy. These phases can include kaolinite, alunite, chalcedony, opal, smectite group minerals, illite, and ammonium-bearing minerals. An imaging spectrometer, the Airborne Visible/Infrared Imaging Spectrometer 5 (AVIRIS-5), was flown by the National Aeronautics and Space Administration as part of the US Geological Survey (USGS) Earth Mapping Resources Initiative and is acquiring hyperspectral data across the western US. A subset of the AVIRIS-5 data was evaluated against known deposits within the Beatty district, Nevada. The region is conducive to this remote sensing technique because of the limited vegetation and good bedrock exposures.

Using the USGS Material Identification and Characterization Algorithm (MICA), maps of spectrally dominant minerals were generated using AVIRIS-5 data spanning the 382-2,505 nm region of the electromagnetic spectrum (i.e., reflected sunlight in visible to shortwave infrared wavelengths). A common feature identified across the district were single minerals or mixtures of kaolinite, alunite, smectite, and hydrated silica. These minerals are consistent with potential high level LSE alteration and/or the steam-heated paleosurface environment, but also potentially supergene alteration. Condensation of vapors above a boiling hydrothermal system can create highly acidic fluids that alter the host rocks, which contrast with dilute acidic fluids generated from weathering sulfide minerals. The high spatial (~10 m) and spectral (5 nm) resolutions, and high signal to noise of AVIRIS-5 combined with MICA analysis is useful for generating maps of altered areas that may relate to LSE mineralization.