

Mineral Mapping with AVIRIS-5 and MAKO Airborne Hyperspectral Sensors Using a Porphyry Copper Minerals Systems Framework

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Society and socioeconomic development, clean energy, and national security are reliant on mineral resources. Recently, the two state-of-the-art imaging spectrometers, AVIRIS-5 a visible-shortwave infrared (VSWIR) and MAKO a longwave infrared (LWIR) imaging spectrometers were flown over the Yerington mineral district at ~8 m and ~2 m ground sample distance (GSD). Airborne visible-shortwave infrared (VSWIR) and longwave infrared (LWIR) imaging spectrometers (aka, hyperspectral imaging) are a proven technology for detection of alteration and rock forming minerals, vegetation, along with a host of materials. Historically remote sensing has focused on alteration mineral mapping of single deposit types such as epithermal gold or porphyry copper for mineral exploration. We incorporated a porphyry copper mineral system framework for VSWIR and LWIR hyperspectral analysis in the Yerington mining district as epithermal deposits, copper skarn deposits, iron skarn deposits, and porphyry copper deposits are all present in this mineral district. Hyperspectral analysis of these deposits was focused on 3 different levels of analysis: (1) rapid products focused on spectral features of interest for alteration and primary rock forming minerals; (2) mineral mapping of the different deposits tailored towards the alteration and primary rock minerals using nonnegative least squares (NNLS); (3) mapping mineral compositional variances in feldspars, white micas, garnets, and other minerals in indicative of paleofluid pathways. These results were compared with ground truth geologic and alteration maps for the district and field validation points. Airborne imaging spectra were compared with spectra from field samples that were collected as part of the validation process for both AVIRIS-5 and MAKO. Our results indicate that combined VSWIR and LWIR hyperspectral analysis using mineral systems framework provides enhances understanding of the district when compared to typical airborne VSWIR hyperspectral analysis oriented on single deposits within the system.