Remote Hyperspectral Mapping and Monitoring of Acid Rock Drainage, Brukunga, South Australia.

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Acid rock drainage (ARD) from sulfidic mine waste is a major environmental threat to the health of nearby natural environments, agriculture and population especially where low pH surface and groundwaters mobilize increased metal concentrations. Unfortunately, the scale of this problem is now only becoming apparent years after the closure of many of these mines. Therefore, low cost, accurate, spatially comprehensive methods for assessing the extent of an affected area as well as the effectiveness of any subsequent containment and remediation programs is clearly necessary. Hyperspectral remote sensing has the potential to be such a tool.

To evaluate this potential, HyMap hyperspectral airborne scanner data were collected from the abandoned Brukunga pyrite mine in South Australia in April 1998 and April 1999. The processing of the HyMap data focused on mapping the distribution and abundances of ARD related minerals, including: jarosite; gypsum; goethite; hematite; and kaolinite. A variety of methods were used to extract this information, including Partial Unmixing and derivatives of fitted polynomials based on empirical relationships.

Jarosite is known to precipitate at pH 2 though is less stable at higher pH values. Prior to the HyMap campaign, local workers had thought jarosite was only developed in a few "contained" locations that were part of current remediation programs. However, the processed HyMap imagery showed that jarosite was developed over a much wider area including most of the exposed mine benches. This wider distribution of jarosite, together with the other HyMap generated mineral maps, were subsequently validated in the field.

The comparisons of the mineral maps derived from the two dates of HyMap acquisition showed good spatial correlation, except for a few notable exceptions that were later confirmed in the field as "real". However, it was not possible to directly compare the measured mineral abundances from these two dates. This problem is related to "errors" in data reduction (including better correction for atmospheric aerosol scattering and molecular absorption) and pronounced scene-dependency of current information extraction methods.

CSIRO is continuing its ARD research including: establishing the relationships between spectral behavior (at VNIR-SWIR-TIR wavelengths), mineralogy, pH and metal mobility; collecting and evaluating airborne hyperspectral data from other ARD effected mines sites found in different climatic conditions in Australia; understanding the impact of ARD on local vegetation; and developing more accurate, data reduction and scene-independent methods for extracting mineral abundances, which are necessary if remote hyperspectral data are to be routinely used for monitoring purposes.