Monitoring water quality & soils at Leviathan Mine, CA

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Overview of Project

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Nearing submission

- Davies, G. E. and W. M. Calvin, Using multi-season airborne hyperspectral imagery to examine mine affected water bodies.
- Davies, G. E. and W. M. Calvin, Mapping acidic mine waste with seasonal airborne hyperspectral imagery at varying spatial scales: An evaluation for application of future spaceborne hyperspectral imagery to hazardous mine waste monitoring.

Publications to Date
There is a good correlation between iron concentration and absorption feature strength in synthetic laboratory solutions. Concentration is somewhat over predicted for natural waters.

Mine Water & Environment
Properties of mine waters in airborne data
Attempted to apply laboratory curves to AVIRIS data.

Concentrations don’t vary significantly across the ponds (pH is between 2 & 3)

Ponds are shallow and drying with time, complicating the signal with turbidity and bottom reflectance.

Focused on spectral shifts from other natural waters in the scenes.
Iron impacted waters have a strongly different peak reflectance than natural waters.

The Leviathan site presented complications from shallow ponds and seasonal drying.

Deeper pit lakes can be monitored for changing acidification (iron concentration) with time, but will need a different location/data set.
Surface Mineralogy at varying spatial scales
Used 2m data collect from 2007 (black); 15m data in 2013 and 2014 (red and blue); HyspIRI 30m (green) and 60m (purple) data products.

Identified six common spectral types.

Field data (dashed) and library (dotted) to support the interpretations.
Maps of these spectral groups are consistent between years and platforms, but show loss of detail at the coarsest spatial resolution.
A simple and rapid analysis tool is to examine the depth of the absorption centered near 900 nm using a continuum removed band depth.

This iron feature depth is consistently high for regions where the potential for acidic soils is high, both in the ponds, but also in the overburden.

These locations are also clearly identified in the 60m simulated data.
Iron sulfate and iron oxides were identified in all data sets and all spatial resolutions.

Wet soils/algae were not identified at 60m resolution.

Some sulfates identified only in 2007 data set may reflect changing surface conditions over time.

Summary of soils
HyspIRI will be useful for the global identification and monitoring of acid soils and mine impacted waters.

Simple band parameters can rapidly identify sites of critical interest.

- Water peak wavelength
- Iron feature depth

Detailed spectral analysis will further refine priority sites for remediation.

- 60m/pixel loses significant detail, especially when mapping subtle mineralogical differences.

Conclusions