# Preliminary Comparison and Accuracy Assessment of Mineral Maps Produced from 1997 AVIRIS Data, Ray Mine, Arizona

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## Introduction

As part of a joint National Aeronautical and Space Administration (NASA) and Environmental Protection Agency (EPA) Advanced Measurement Initiative (AMI) pilot study, Airborne Visible and Infrared Imaging Spectrometer (AVIRIS) mineral maps were created using the ENVI™ software package. Here we describe results of our preliminary accuracy assessment of these mineral maps. The validation is a continuation of work reported by McCubbin and Lang (1999). Ray Mine is an open-pit copper mine that is located approximately 100 km ESE of Phoenix, Arizona. The Jet Propulsion Laboratory's (JPL's) role in the AMI study is to acquire and provide data and perform data calibration and data analysis. In addition, JPL is validating the remotely sensed data and derived products for the site. AVIRIS reflectance data were used for classification of minerals associated with acid mine drainage, mainly the iron sulfate mineral jarosite. Mineral maps based on AVIRIS reflectance data for the Ray Mine site were created using two different classification routines (McCubbin, 1998 and 1999).

## Methods

Accuracy assessment was conducted primarily over a waste rock dumpsite at the mine, which serves as an excellent validation target because it is horizontal and temporally invariant. Field spectra and rock samples were collected at the site, and laboratory spectral and X-ray diffraction (XRD) measurements were performed on the samples (Lang and Baloga, 2000). The laboratory and field spectra were then compared to the AVIRIS reflectance spectra over the calibration site. Using these spectral measurements, Lang and Baloga showed that the AVIRIS data are accurate at the 2% reflectance level. Minerals present at the validation site identified by XRD were goethite, hematite, jarosite, kaolinite, muscovite, plagioclase, and quartz. From a group of pixels over the validation target, the mineral classes were recorded and the associated AVIRIS spectra were extracted.

## Conclusion

The comparison of the two different classifications showed that the partial unmixing yielded results that corresponded to the linear mixtures of library spectra of the minerals determined by XRD. The partial unmixing classifier identified six of the seven minerals present at the validation site. The only mineral not identified was quartz, which has no diagnostic absorption feature within the AVIRIS spectral range. For the map created using Spectral Angle Mapper (SAM), no minerals were identified within the validation site, while at other test sites within the image there were some similarities between the two different maps. The validation site is a relatively homogeneous surface made up of intimate mixtures of all seven minerals. Since the mixture-tuned match filter routine allows for identifying classes within a mixed group of pixels, this may account for the higher correlation with the XRD results. Spectra carry information such as absorption bands, reflectance peaks, and albedo. Classifiers try to use these spectral facts to identify the surface composition, with an important question being how the results of classifiers actually compare to what is on the ground. This investigation is ongoing with additional results expected to be reported in the future.