Preliminary Comparison and Accuracy Assessment Of Mineral Maps Produced From 1997 AVIRIS Data, Ray Mine, AZ

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Introduction:

- Joint NASA/EPA Advanced Measurement Initiative pilot study
- AVIRIS mineral maps created using both ENVI and Tricorder
- 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)

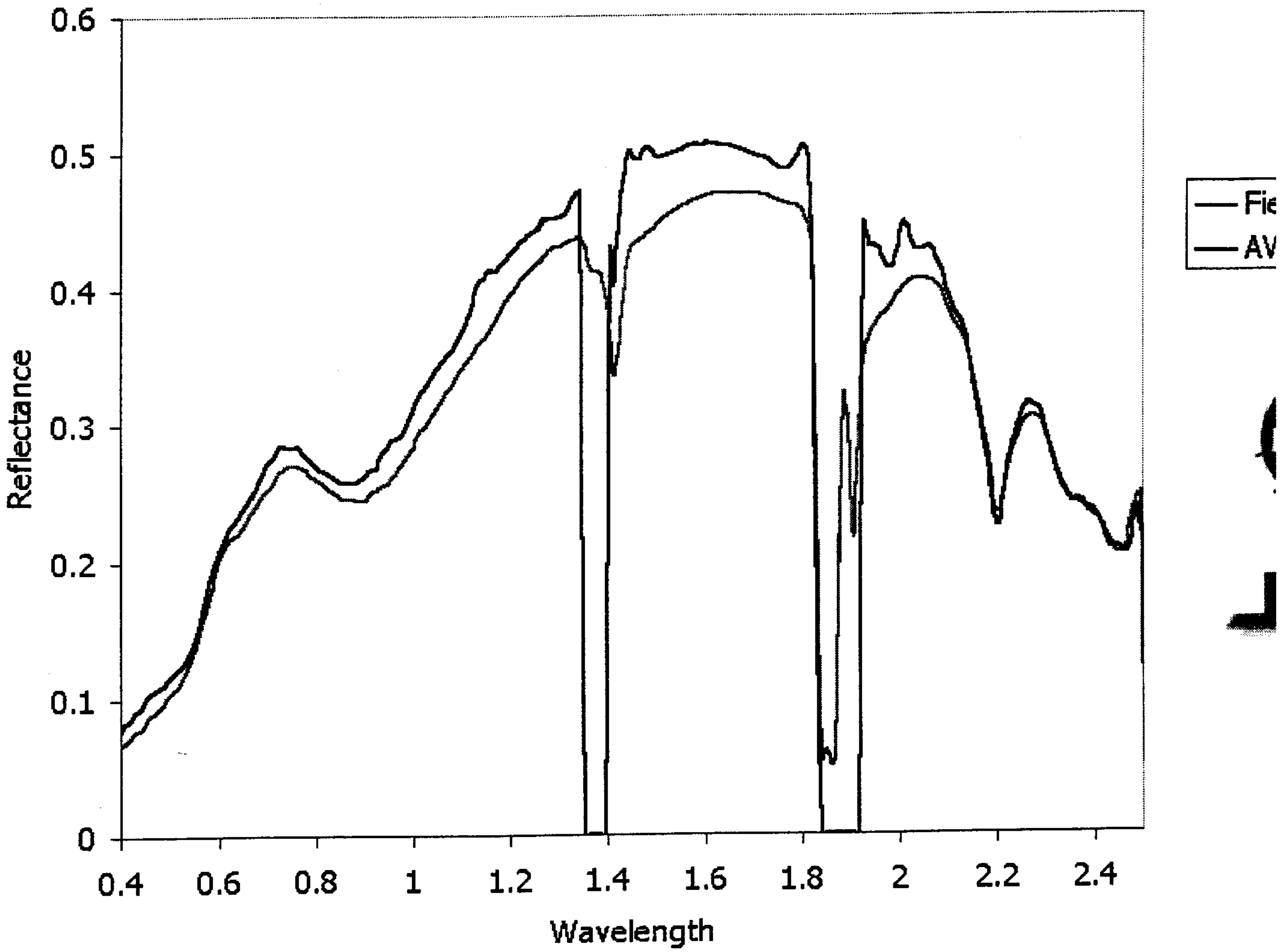
Background:

- Ray Mine is an open pit copper mine
- Located approximately 100 km E-SE of Phoenix, AZ
- JPL's role:
  - provide data, perform calibration and data analysis
  - validate remote sensing data and derived products

- AVIRIS data used for classification of minerals associated with acid mine drainage, mainly jarosite

AVIRIS Reflectance data for Ray Mine:

- Inverted to apparent surface reflectance at the AVIRIS data facility
  - using Robert Green's MODTRAN based method
- Validation work of Lang and Baloga (2000, In Press)
  - Field and lab spectral measurements show that data is accurate at the 2% reflectance level



Three AVIRIS based mineral maps exist:

- Two Different ENVI classifications used by JPL:
  - Spectral Angle Mapper (McCubbin et al, 1998)
  - Partial Unmixing routine (McCubbin and Lang, 1999)
  - Both used a site specific spectral library
    - Based on geologic report by Ransome (1927)
- Tricorder classification by the USGS (Clark, et al 1998)

Both Tricorder and Partial Unmixing:

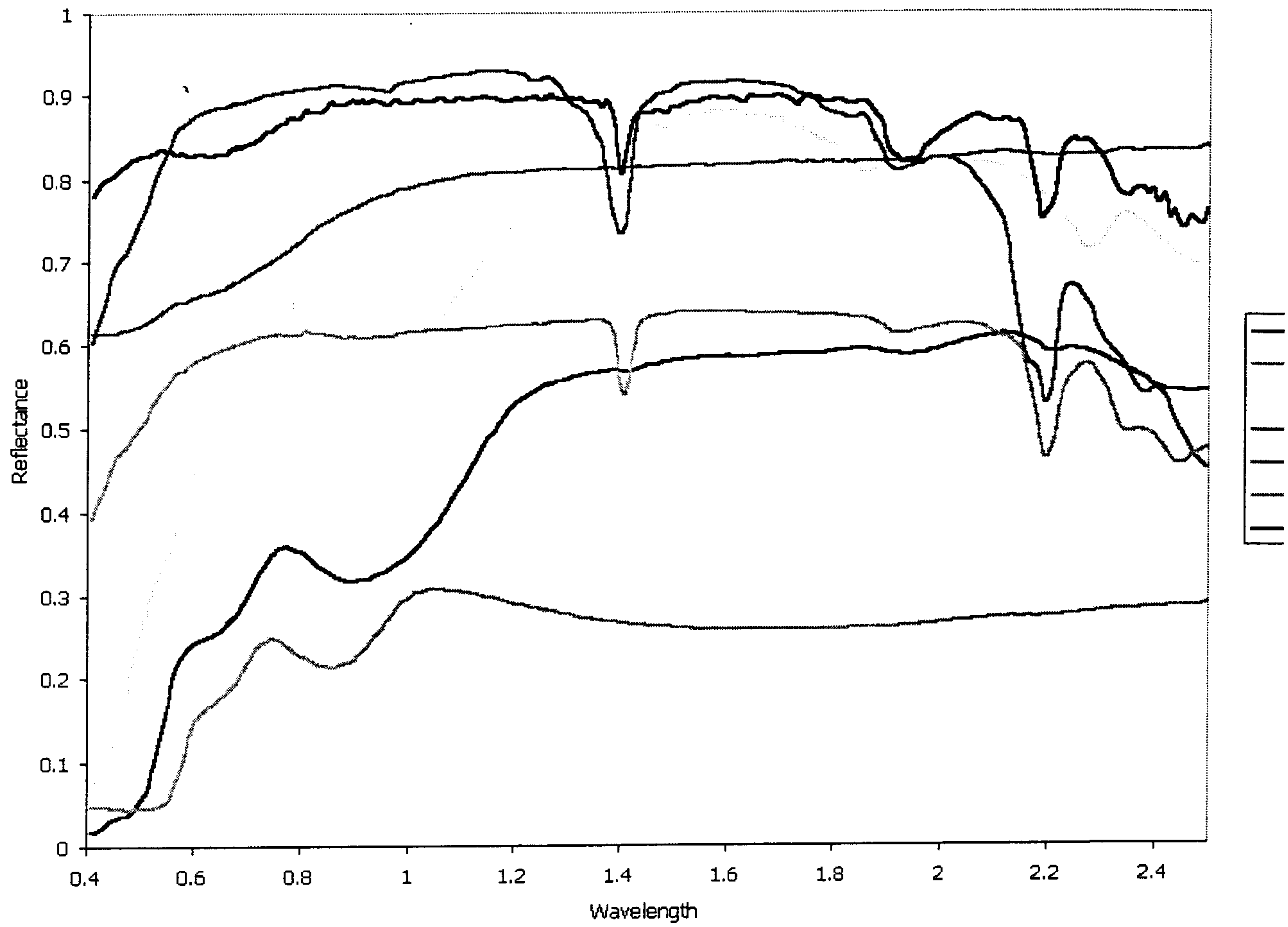
- Divide the full AVIRIS spectrum into short of 1 micron and long of 2 micron
- Used Normalized Data (continuum removed and minimum noise fraction data)
- Albedo information is lost
- Focus on absorption features

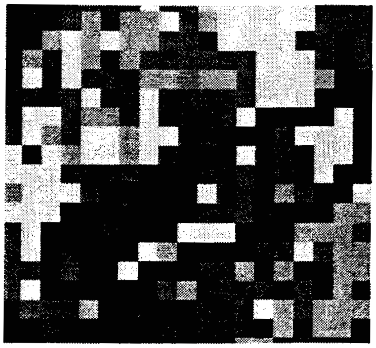
Spectral Angle Mapper:

- Matches vector of image spectra to reference spectra
- Keeps albedo information
- was used over full AVIRIS spectrum

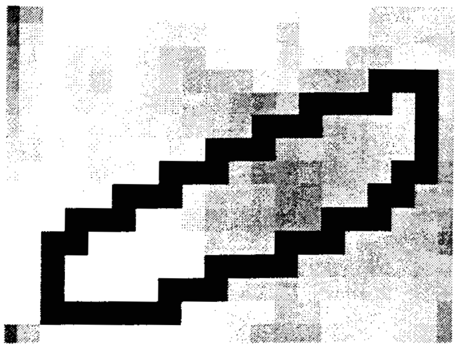
Accuracy Assessment:

- Conducted primarily over a caprock waste site
- Provided an excellent validation target because it is accurately characterized
  - Field (ASD) spectra
  - Laboratory (Beckman) spectra
  - X-Ray Diffraction measurements
- Minerals identified by XRD:
  - quartz, kaolinite, plagioclase, jarosite, muscovite, goethite, and hematite

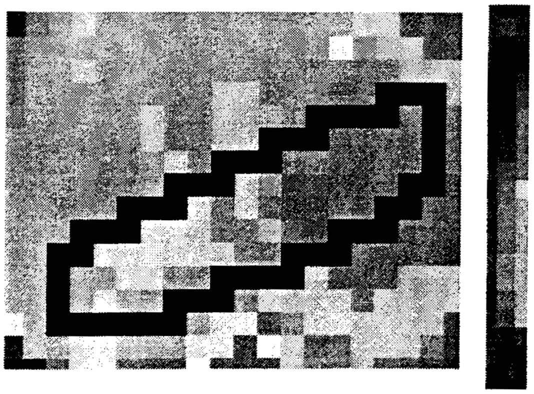

Reflectance
Wavelength
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4



Partial Unmixing



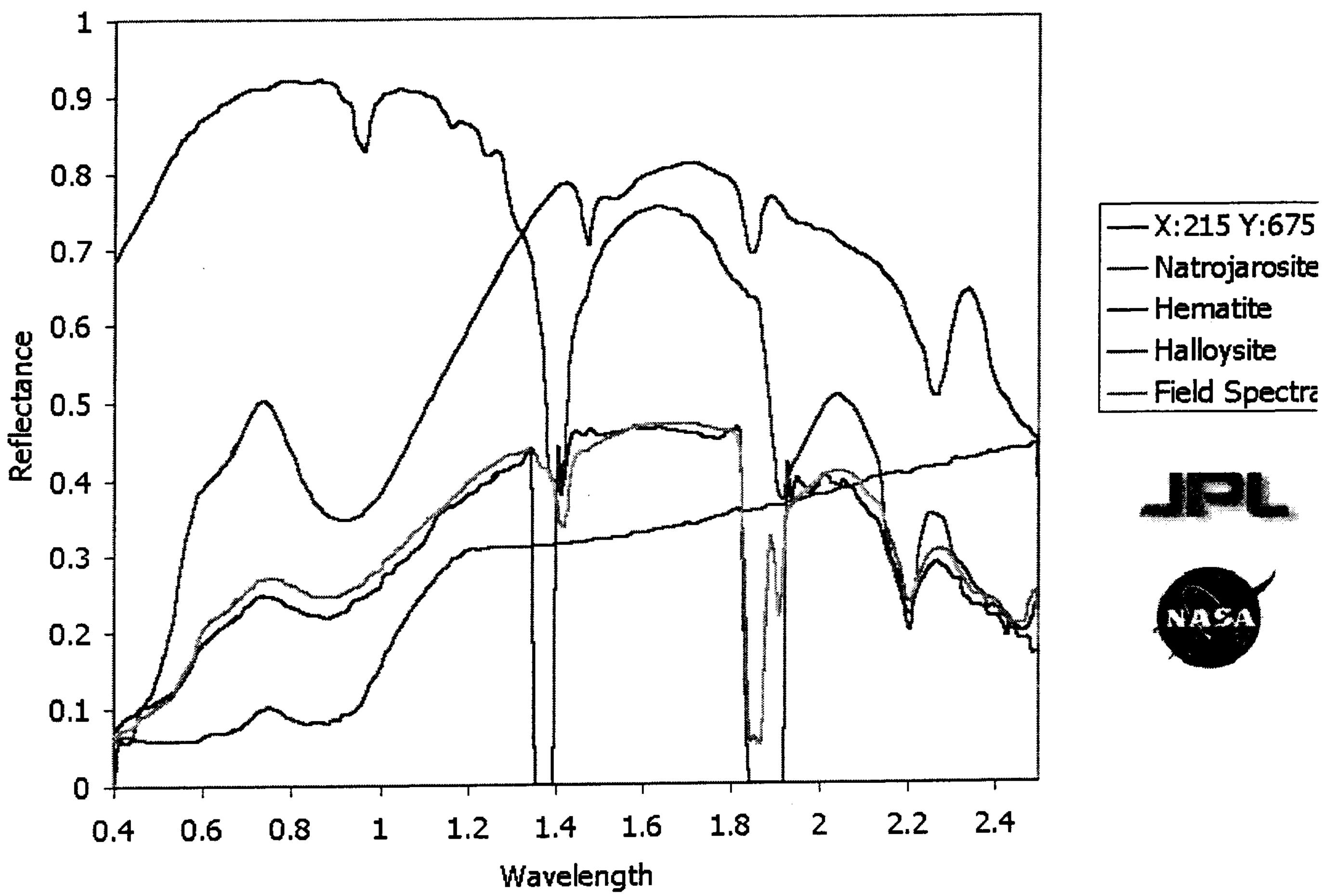
SAM

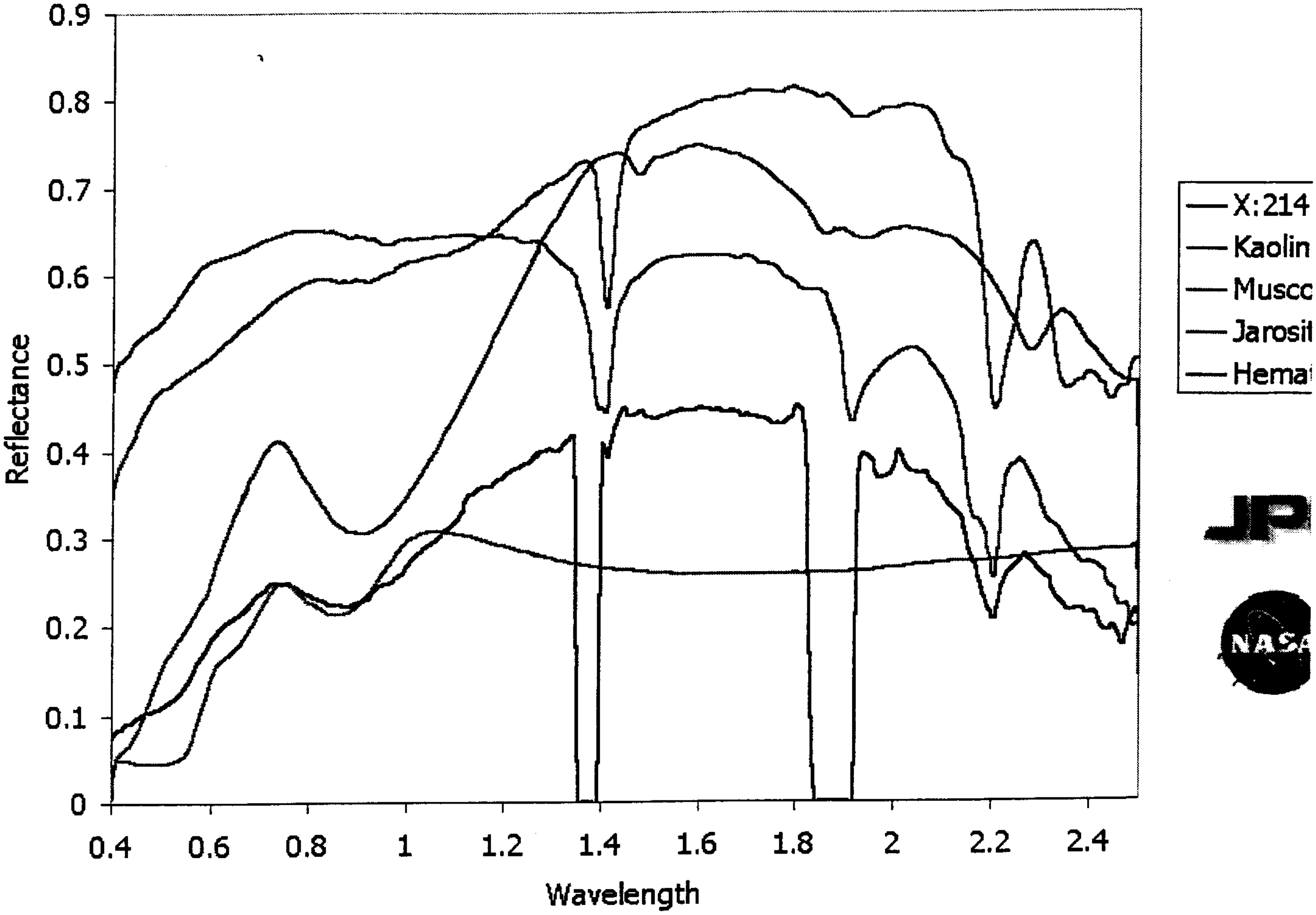


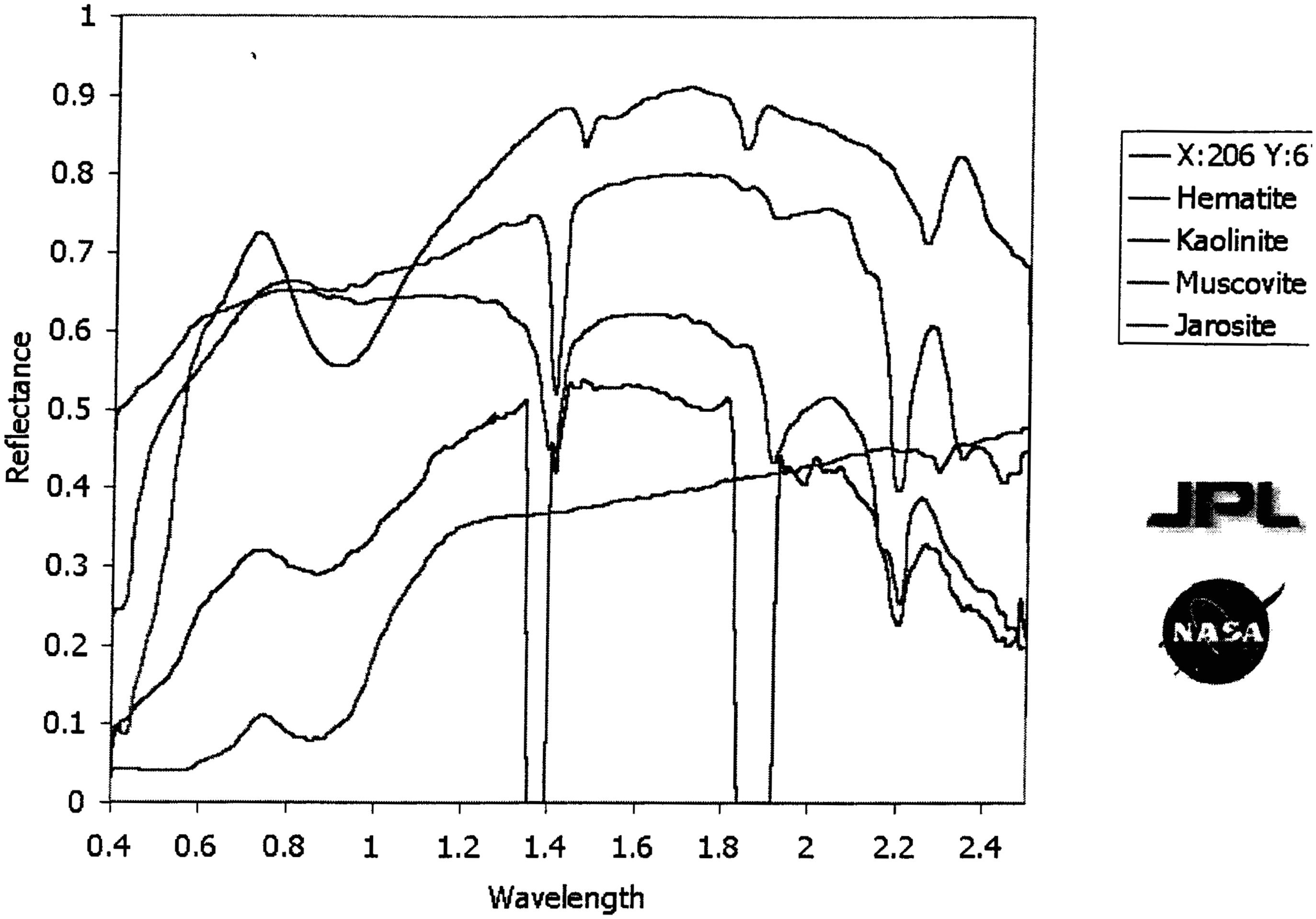
USGS 1 micron

From representative pixels over the validation target:

- Extracted classes and associated spectra
- Validity was determined by comparison of classification results to image and library reference spectra
- Linear mixtures of library spectra of minerals in a given pixel




0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Reflectance
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
Wavelength
X:214
Kaolin
Muscc
Jarosit
Hemai
NASA

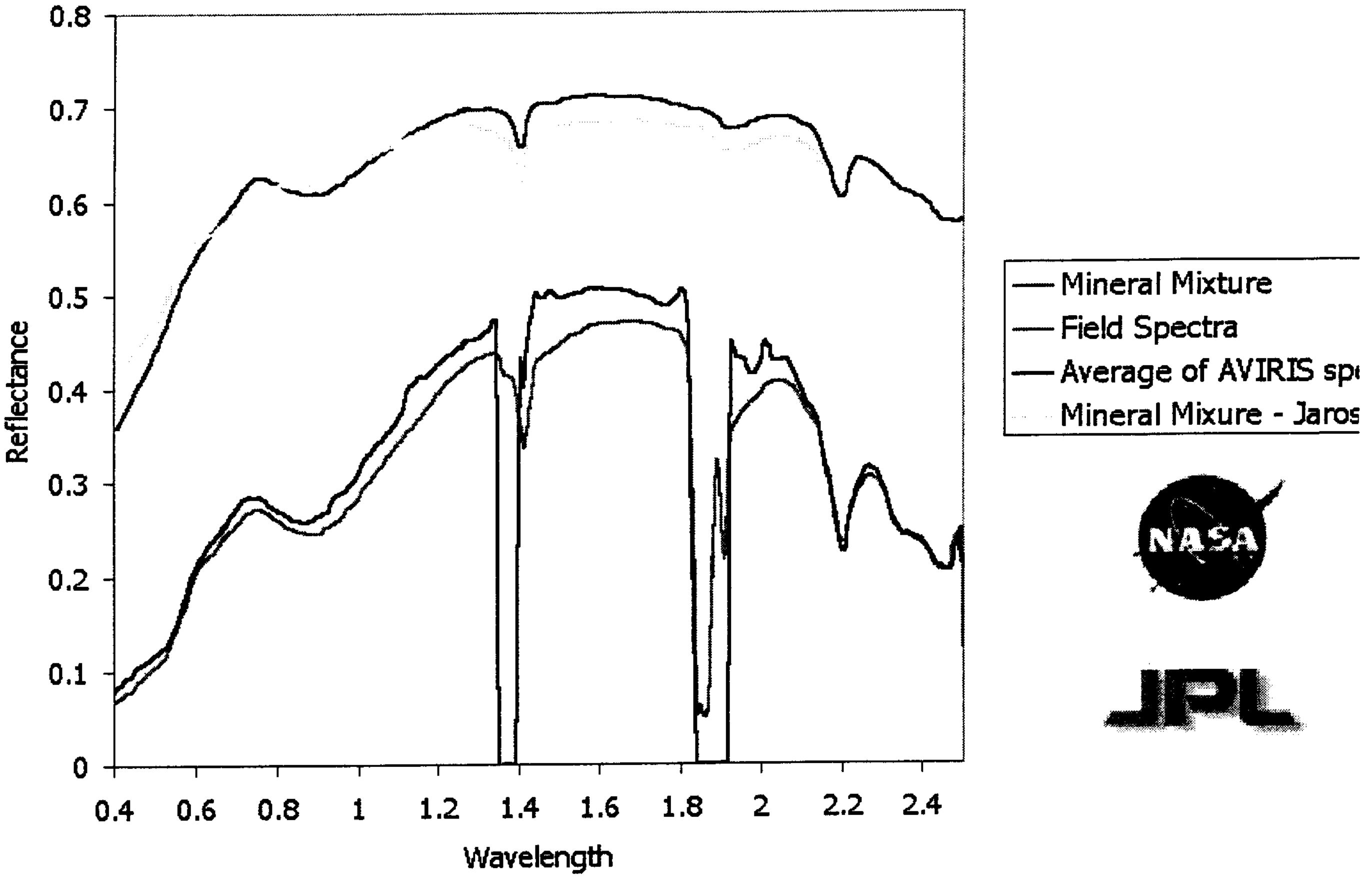


Conclusion:

- Spectra carry facts
  - Absorption features
  - Reflectance Peaks
  - Albedo
- Classifiers try to identify information in the spectra
- How do the results of classifiers compare to the ground
- Not using entire AVIRIS spectrum for classification may lose information from spectra
- Classifiers that ignore albedo may be a disadvantage
- Major differences:
  - Both SAM and Tricorder base classification only on

position of absorption features

- Partial Unmixing is based on mixing model approach
  - Therefore reference spectra may not match image spectra in terms of position of absorption features
- What do the results of the information extracted from the spectra represent:
  - accurate in terms of site mineralogy?
  - how do the mapped classes compare to the actual spectra for the endmember?



Acknowledgments:

- Project Funded by NASA Solid Earth Science and Natural Hazards Program and the Environmental Protection Agency's

Advanced Measurement Initiative

- Principal Investigator Tom Mace (EPA)
- Work was performed at the Jet Propulsion Laboratory under contract with the National Aeronautics and Space Administration