Using AVIRIS-NG Data to Assess the Impact of Mining Activities on Soils and Water Quality near the Ambaji and Zawar Mines in Gujurat and Rajasthan, India.

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Utilization of AVIRIS-NG Data from an Airborne Campaign in India
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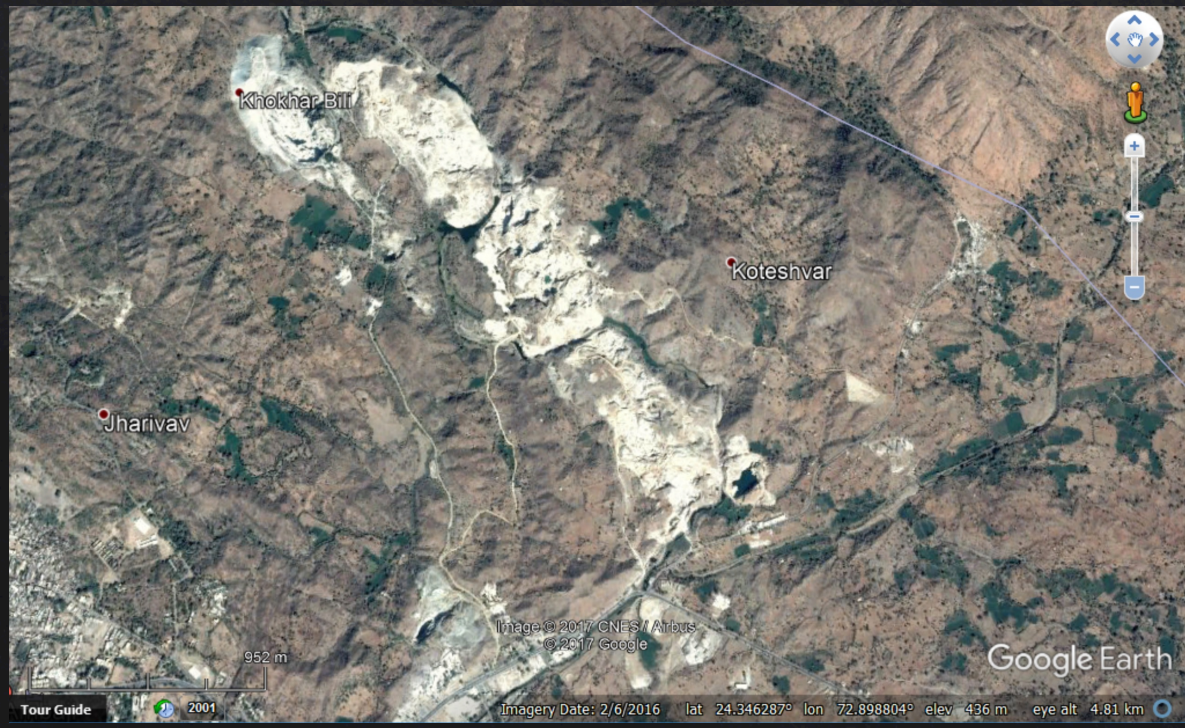
Project Description

- Utilize AVIRIS-NG data to map minerals surrounding a pair of base metal mines in western India
  - Seek any exposures of acid-generating minerals (ala, *Swayze et al.*, 2000)
  - Examine absorption features of clay and iron oxide minerals on down slope flood plains to seek signs of any distortion of the absorption bands caused by the adsorption of trace metals into the mineral structure.
- Mining sites examined are the Ambaji mine in Gujuarat and the Zawar mine in Rajasthan

Ambaji Mine

- Ancient site… mining activity traced back to 2nd century BCE (Shekar, 1983)
- Ambaji is a Cu-Pb-Zn volcanogenic massive sulfide type ore deposit
- Host rocks are Proterozoic-aged metasediments and metavolcanics (Bhagat, 2012)



Zawar Mine

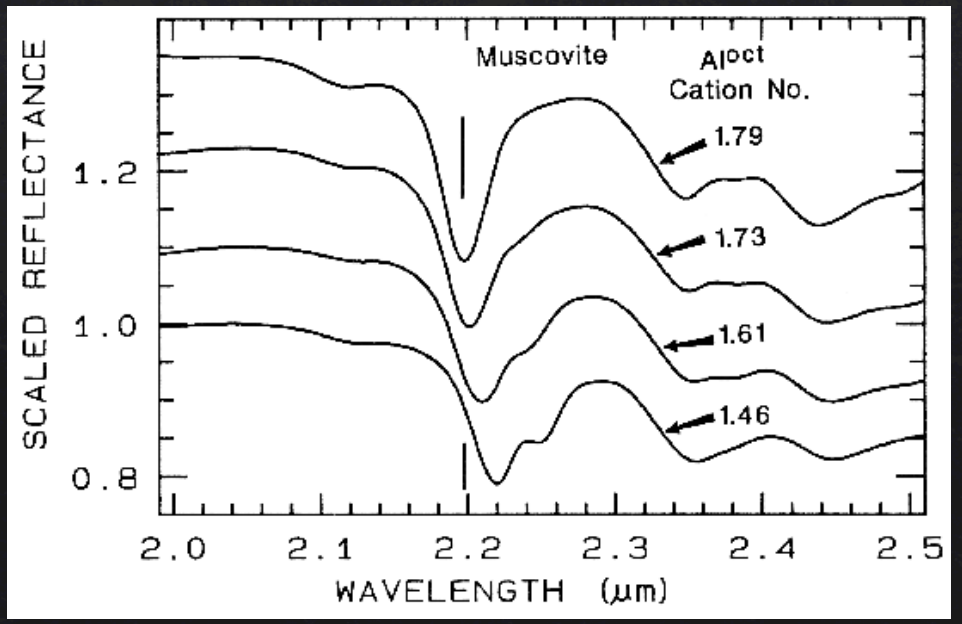
- The Zawar mine is even more ancient with evidence of Zn mining from over 2000 years ago (*Willies et al.*, 1987)
- Zawar ores are hosted in siliceous dolomite Precambrian metasediments of the Aravalli Supergroup (*Mookherjee*, 1964)
- Main ore minerals at Zawar are sphalerite and galena
- Studies of flood plain contamination from Zawar conducted by *Prusty et al.* (1994) and *Sahu et al.* (1994)

Tracking Environmental Effects from Mining

- A significant issue with many mineralized areas is Acid Mine Drainage (AMD)
- AVIRIS data has been used with great success in tracking AMD (e.g., *Farrand*, 1997; *Swayze et al.*, 2000)
- AMD appears to not an issue from Ambaji or Zawar mines due to buffering of pH by carbonates in bedrock.
- However, release of trace metals into the environment is still of concern.

Changes in absorption features based on additions of cations

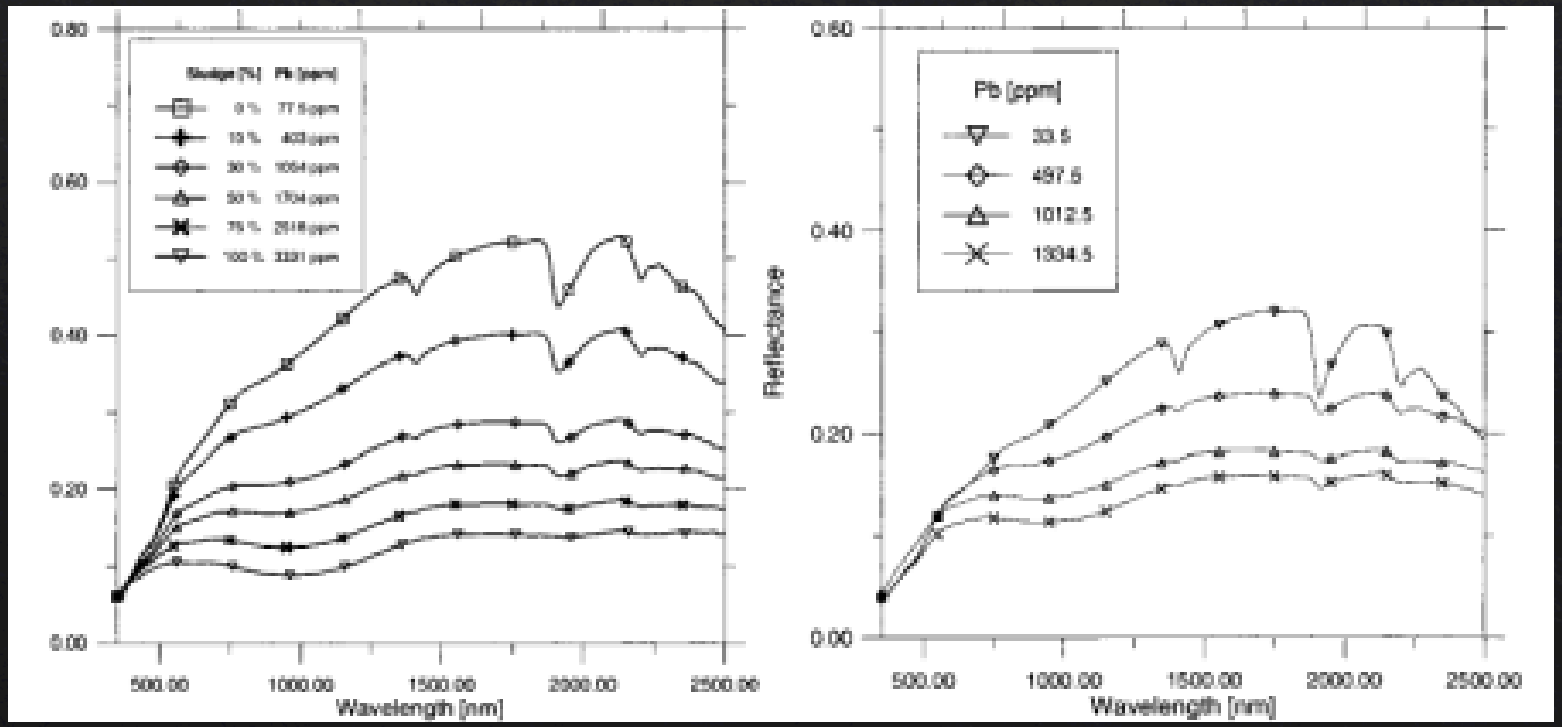
- *Clark* (1999) cited *Swayze* (1997) study on changes in muscovite 2.2 μm absorption band shape based on substitution of Al into muscovite mineral structure
- Same principle can be used when trace metals released by mining are adsorbed into phyllosilicate or Fe oxide or hydroxide mineral structures



From *Clark* (1999) after Swayze (1997)

Past studies using reflectance to track mine contamination

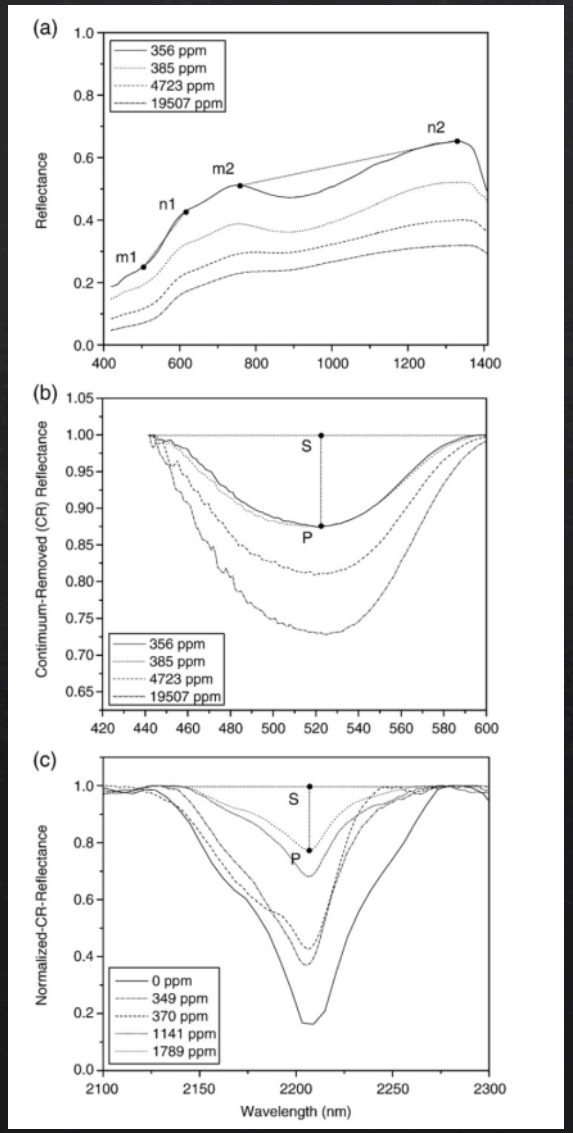
- *Kemper and Sommer* (2002) examined incorporation of lead (Pb) into mineral structures and changes in absorption band shape.



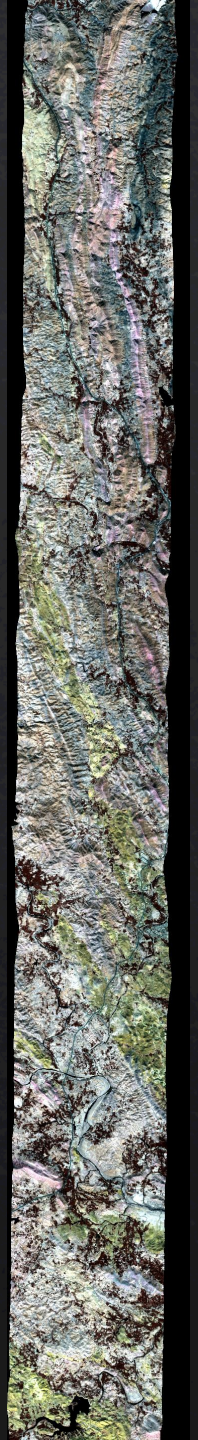
From *Kemper and Sommer* (2002)

Past studies using reflectance to track mine contamination

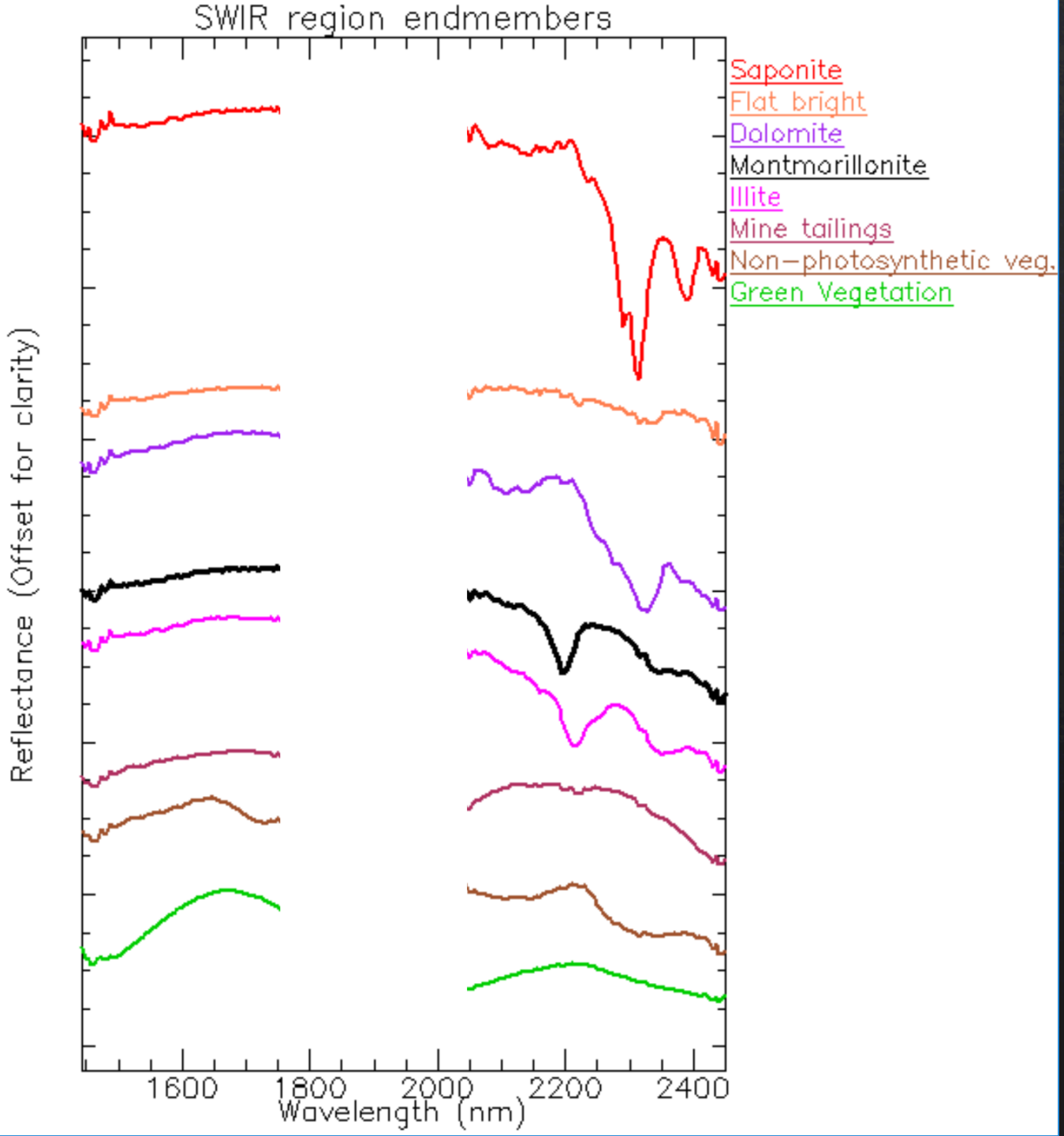
- *Choe et al*. (2008) used field reflectance spectra from Rodalquilar mining area in Spain to correlate with geochemistry

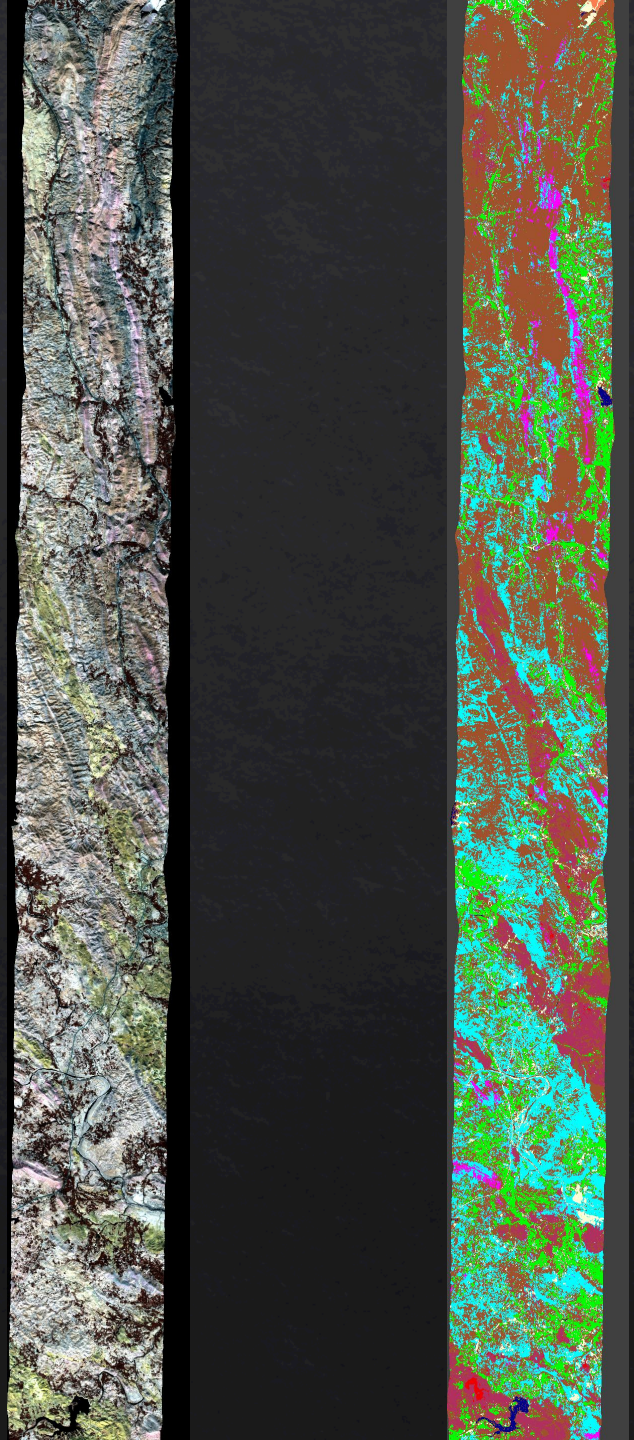


AVIRIS-NG Data Processing



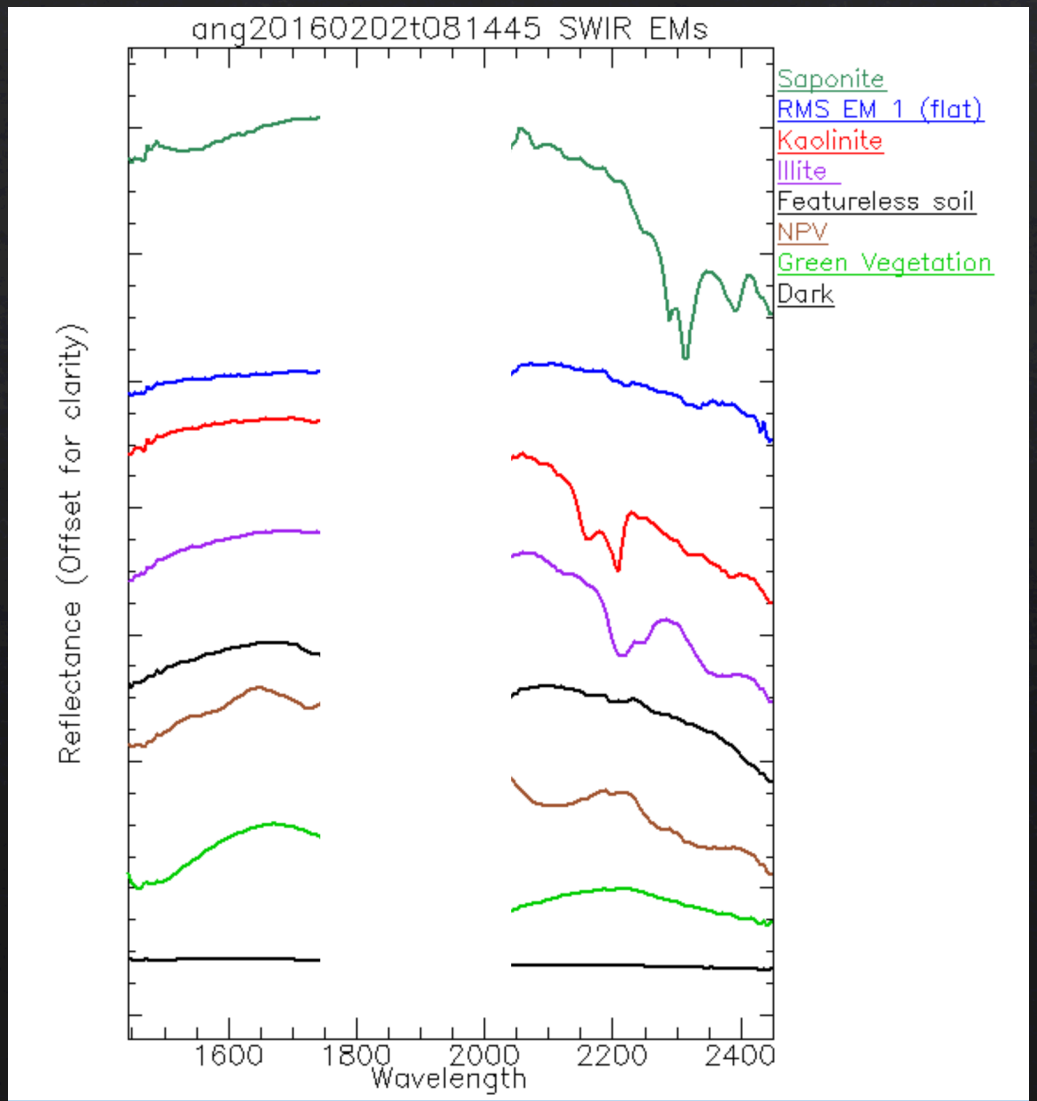
Scene ang20160202t071959
SWIR bands
R = 1700 nm, G = 2210 nm, B = 2310 nm

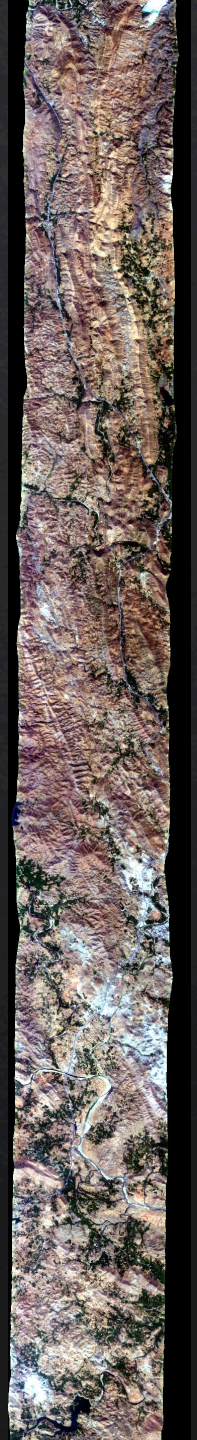

SWIR region endmembers
Saponite
Flat bright
Dolomite
Montmorillonite
Illite
Mine tailings
Non-photosynthetic veg.
Green Vegetation
Reflectance (Offset for clarity)
1600
1800
2000
2200
2400
Wavelength (nm)



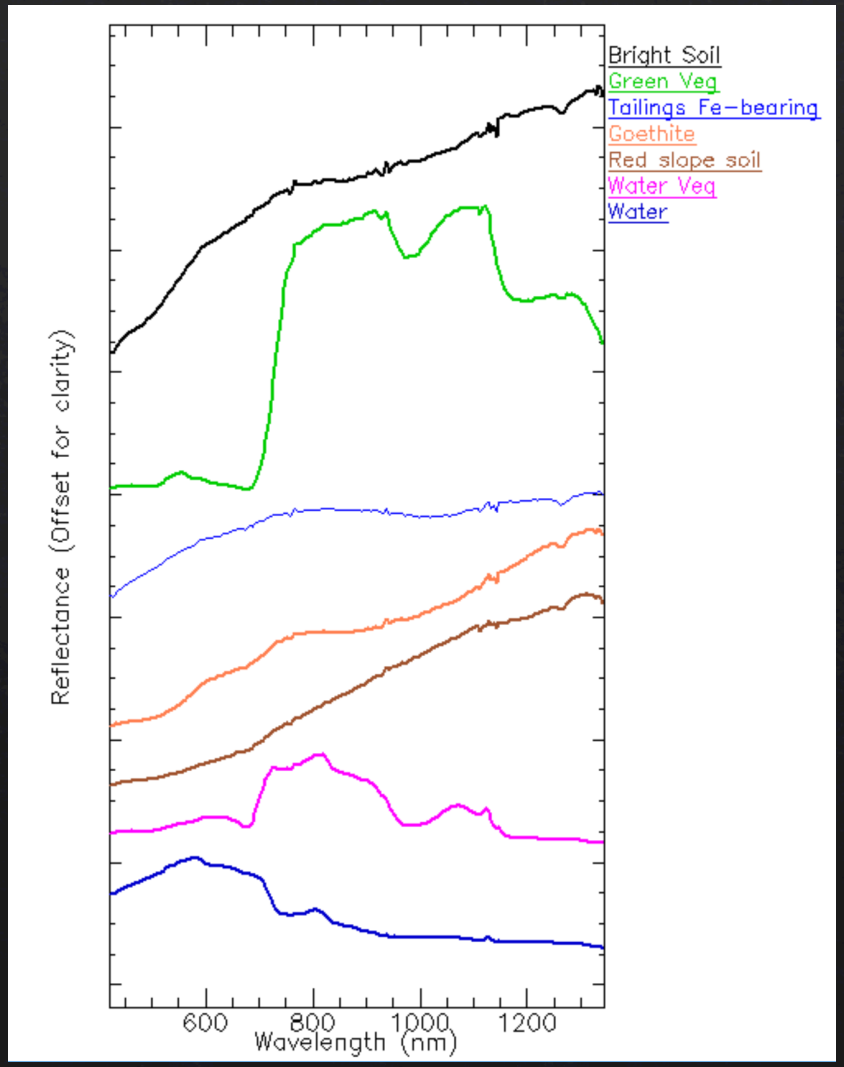
Unclassified
Saponite
Montmorillonite
Green Veg
Bright flat
NPV
Illite
Dolomite
Mine tailings
Water
Masked Pixels

North of Zawar Mine, scene
ang20160202t081445
SWIR bands (1700, 2210, 2310 nm)





Scene ang20160202t071959 VNIR bands
R = 650 nm, G = 550 nm, B = 450 nm



Minerals of Interest

- Past studies indicated that Fe-oxides or hydroxides and/or Fe/Mg or Al-OH clay minerals are susceptible to band shape changes with the uptake of trace metals
- Clays present in the soils near the Zawar mine plus poorly crystalline ferric oxides

Future Activities

- Examine spectral variability in clays and ferric oxides/ hydroxides
- Seeking collaborations with Indian researchers
- Planned field work to collect samples
- Perform laboratory reflectance measurements

Relevance to HyspIRI

- From Rob Green's Monday afternoon talk: "Assessment and Response to Natural and Anthropogenic Hazards" & "Surface Resource Identification and Policy Support"
- While many mines are rather small, there are some with large expanses of surfaces affected by mining

Sudbury Nickel Mine, Ontario, Canada

Summary Points

- Work has begun on mineral mapping on scenes containing the Zawar and Ambaji mines
- Both regions contain minerals with absorption bands that are nominally susceptible to distortion with the adsorption of trace metal cations
- Assessing possible contamination of soils, and, by inference waterways associated with large mining centers is a potential application addressable by HyspIRI

Thanks for your attention!

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