Remote Sensing of the Mono Basin and the Long Valley Caldera

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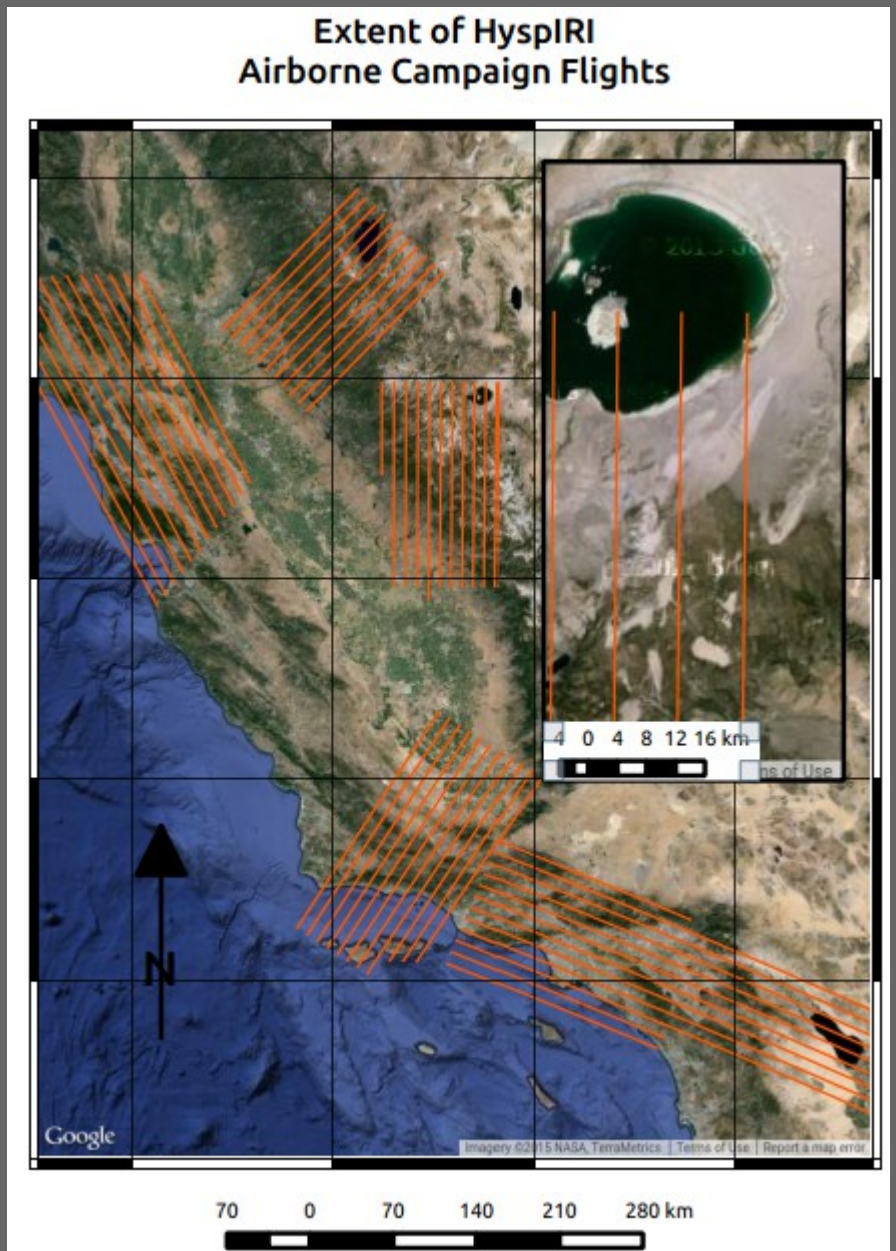
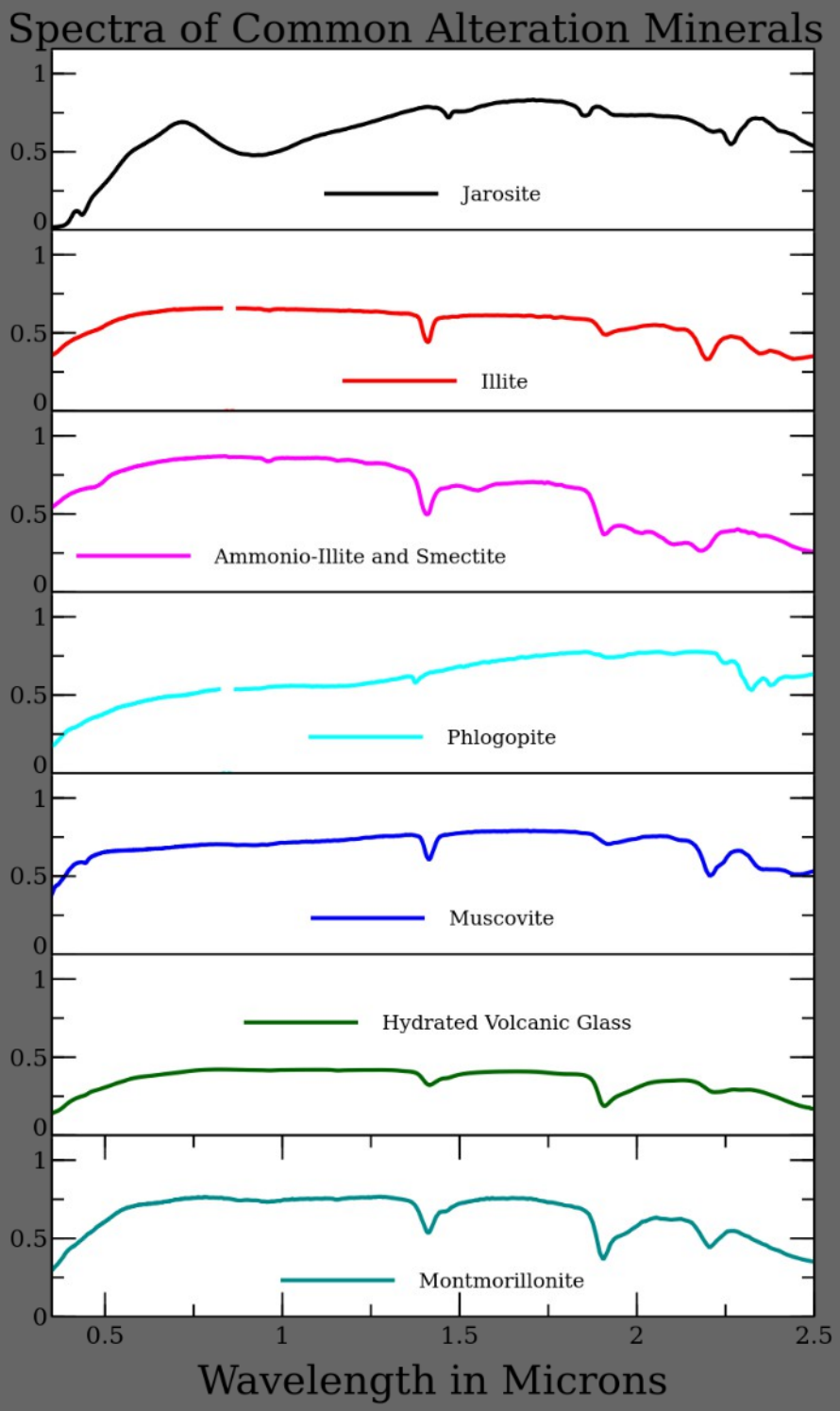
2015 HyspIRI Workshop

Location


Northern Alteration
Mono Craters
Betty Anne Prospect
Mammoth Mt.
Long Valley Caldera


Extent of HyspIRI
Airborne Campaign Flights
-4 0 4 8 12 16 km
N
Google
70 0 70 140 210 280 km



Background

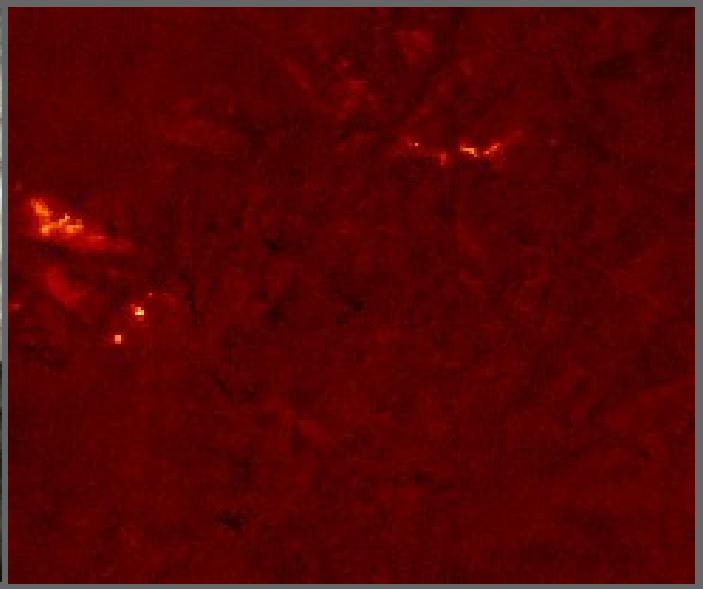
Geothermal alteration minerals show diagnostic features at ~2.21μm

- Questions to answer:
  - What are the limiting factors in detecting these minerals i.e spectral resolution, spatial resolution, spectral mixing?
  - Are there computationally less intensive ways of finding them in a scene?
  - Can alteration be used for determining volcanic hazards

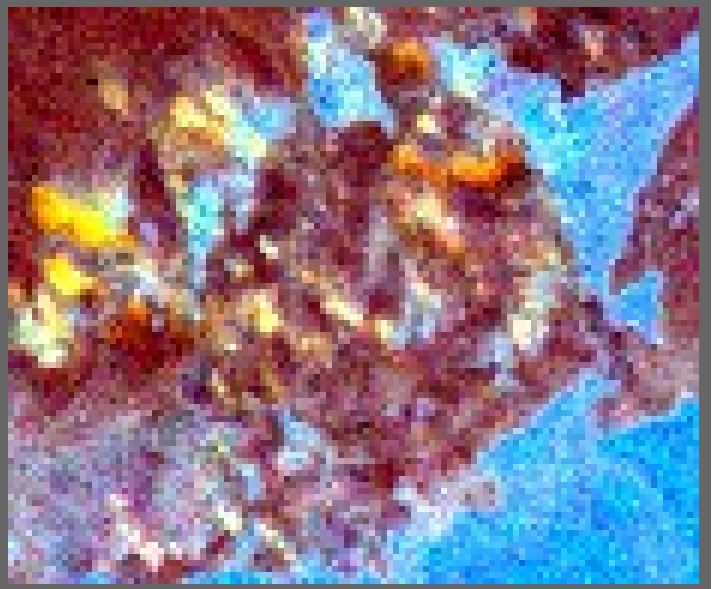
Betty Anne Prospect

- Envi spectral hourglass wizard and DCS revealed alteration to the SE of Mono Lake.
- This alteration area had only been identified in 1 other publication a 1958 Bureau of Mines resource report.
- AVIRIS revealed the alteration to cover a much wider extent than was mentioned in the report.

Visible

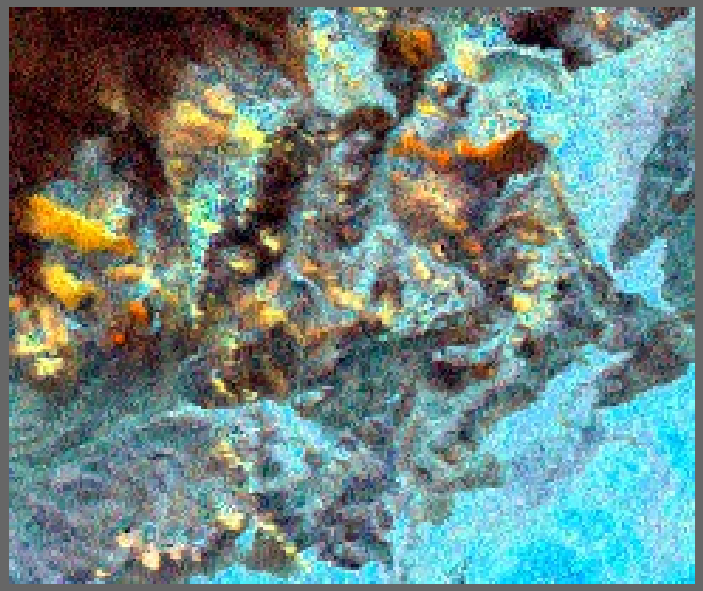


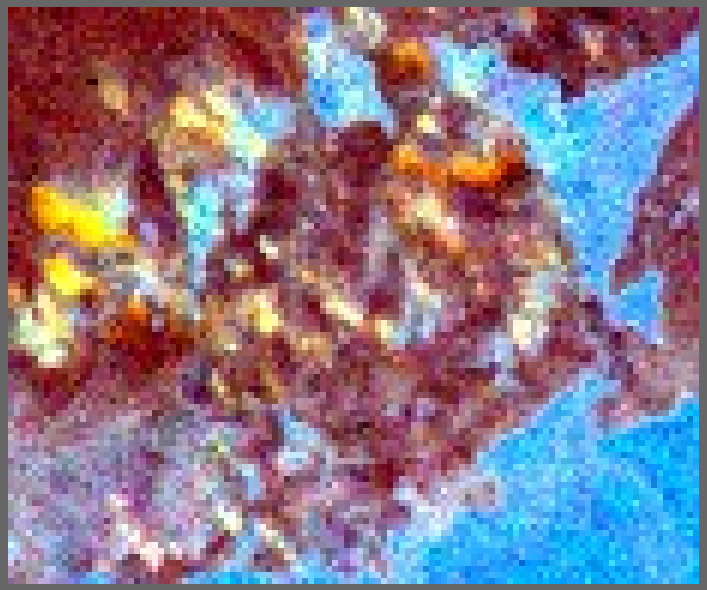
MTMF Endmember (Bright indicates best match)



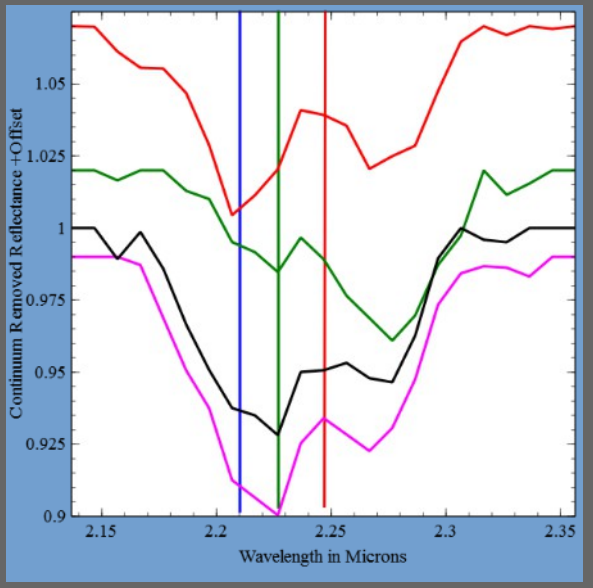
Decorrelation Stretch image

Betty Anne Prospect Continuum Removal Comparison





- A continuum removal from 2.137µm to 2.367µm and band placement at 2.17µm, 2.21, and 2.25 show extent of alteration(Yellows and Oranges) as well as variation within the alteration.
- This alteration is identifiable in both ~15m AVIRIS data and 30m HyspIRI simulated data.



Top: 15m AVIRIS

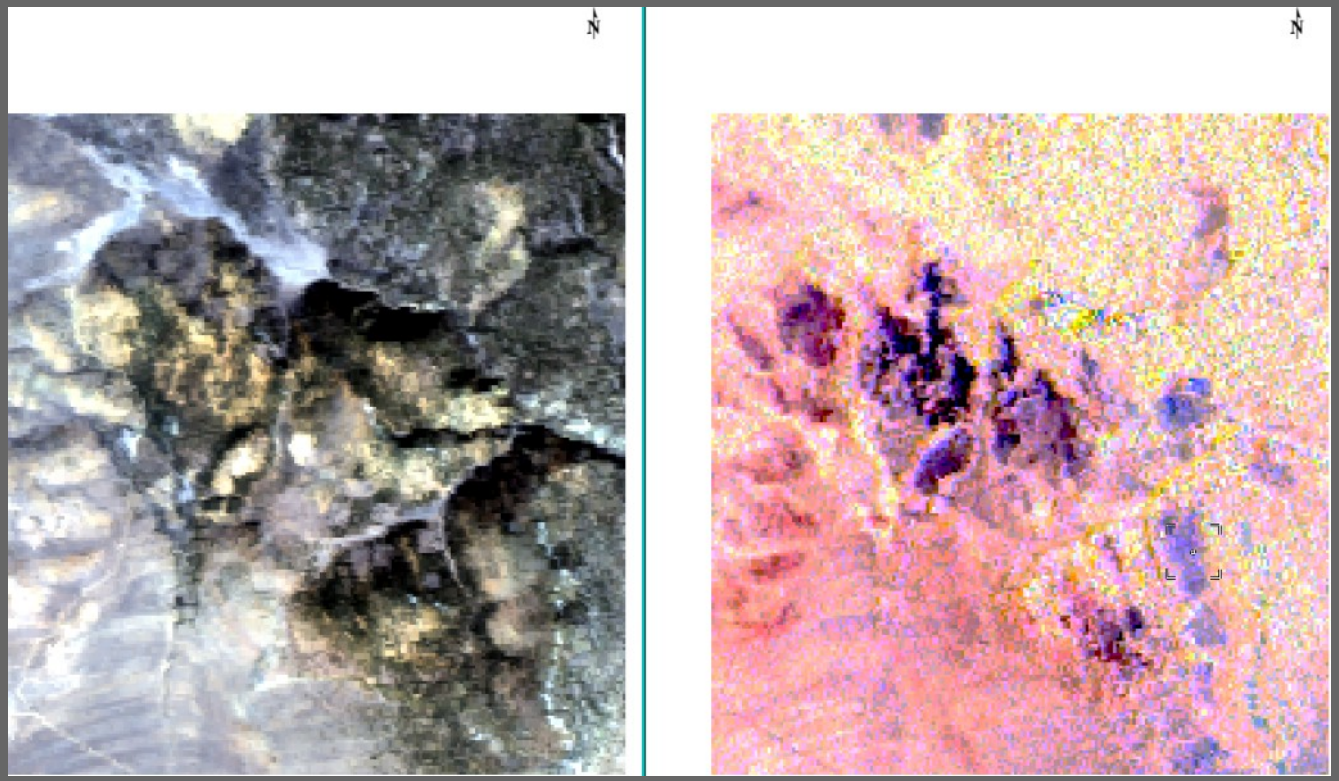
Bottom:30m simulated HypIRI

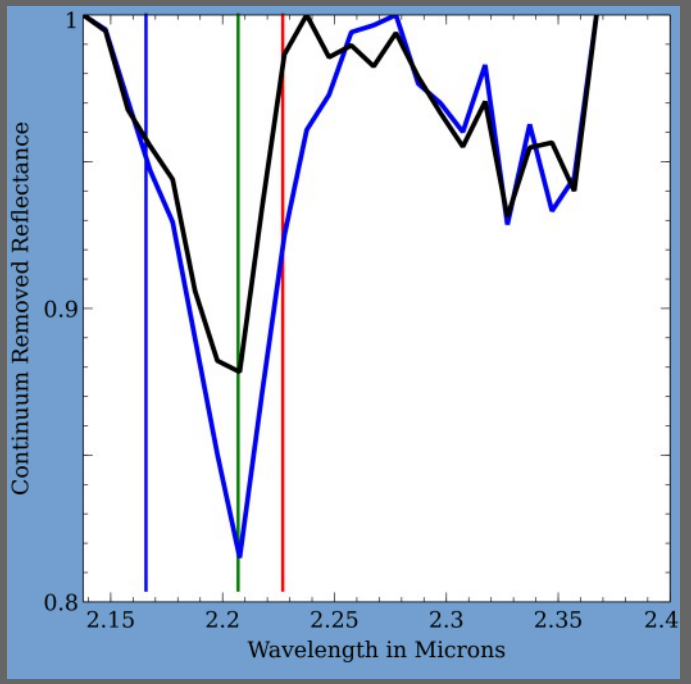
Northern Alteration

Continuum removal from 2.137μm to 2.367μm is able to highlight subtle changes in the 2.21μm due to the Al-OH bond length, an indicator of metamorphic grade (Duke & Lewis, 2010)

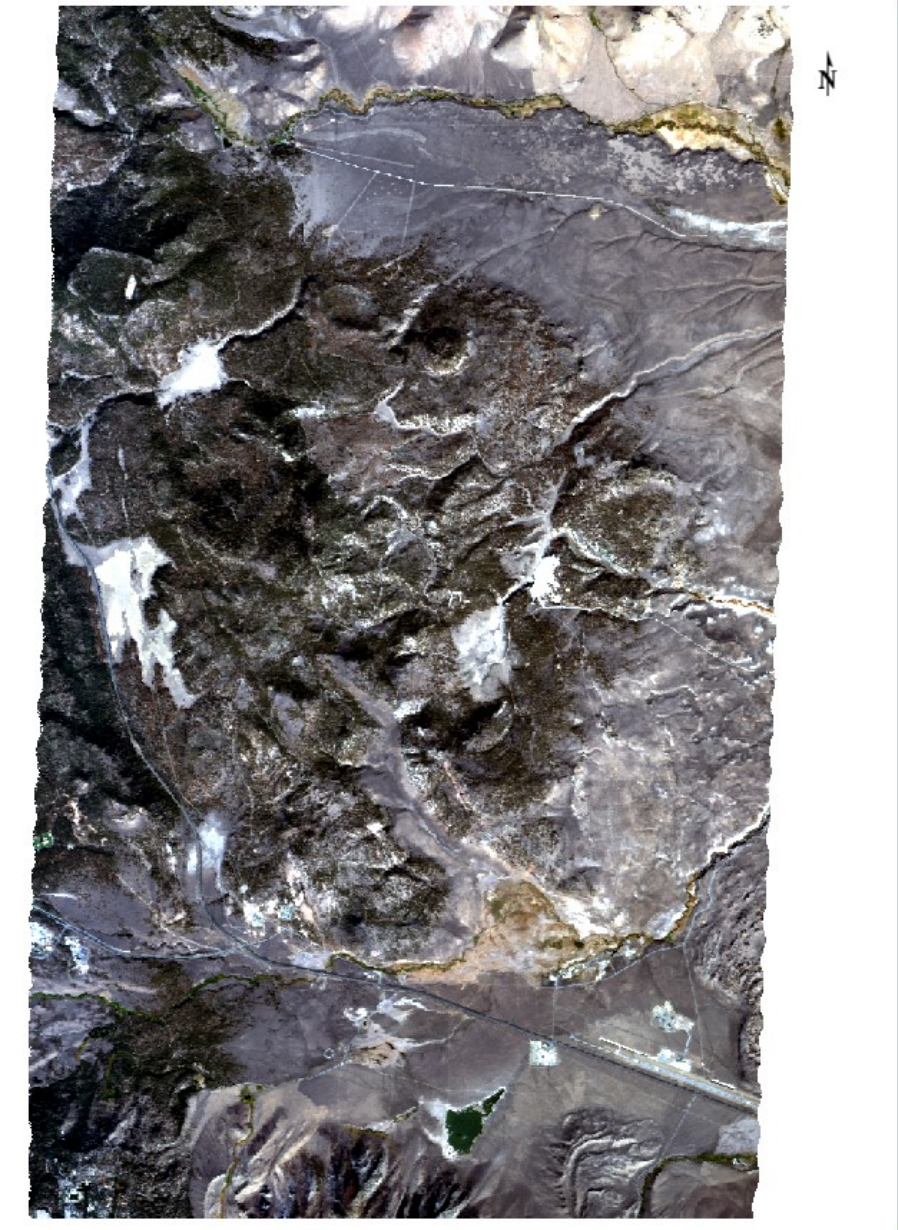
Left: Visible

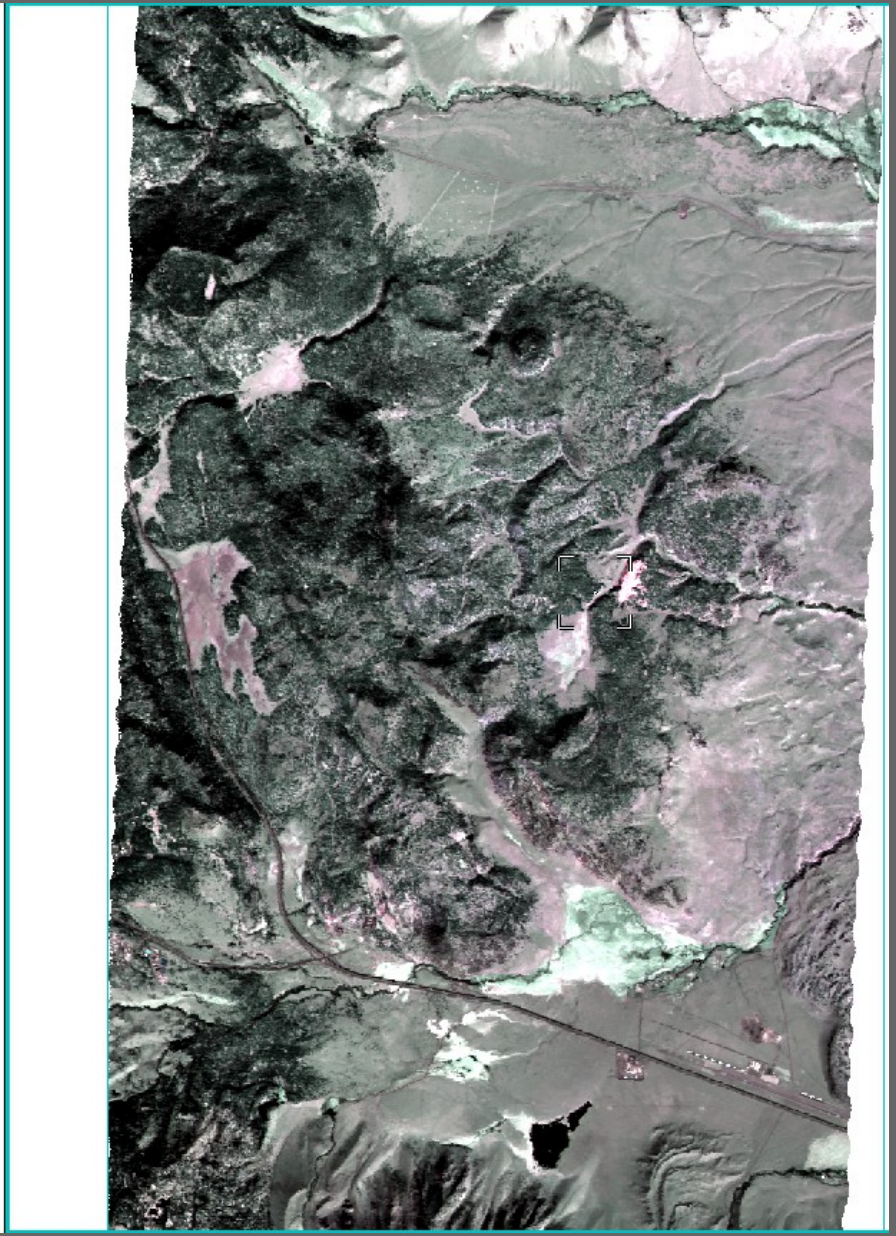
Right: Continuum removed combination



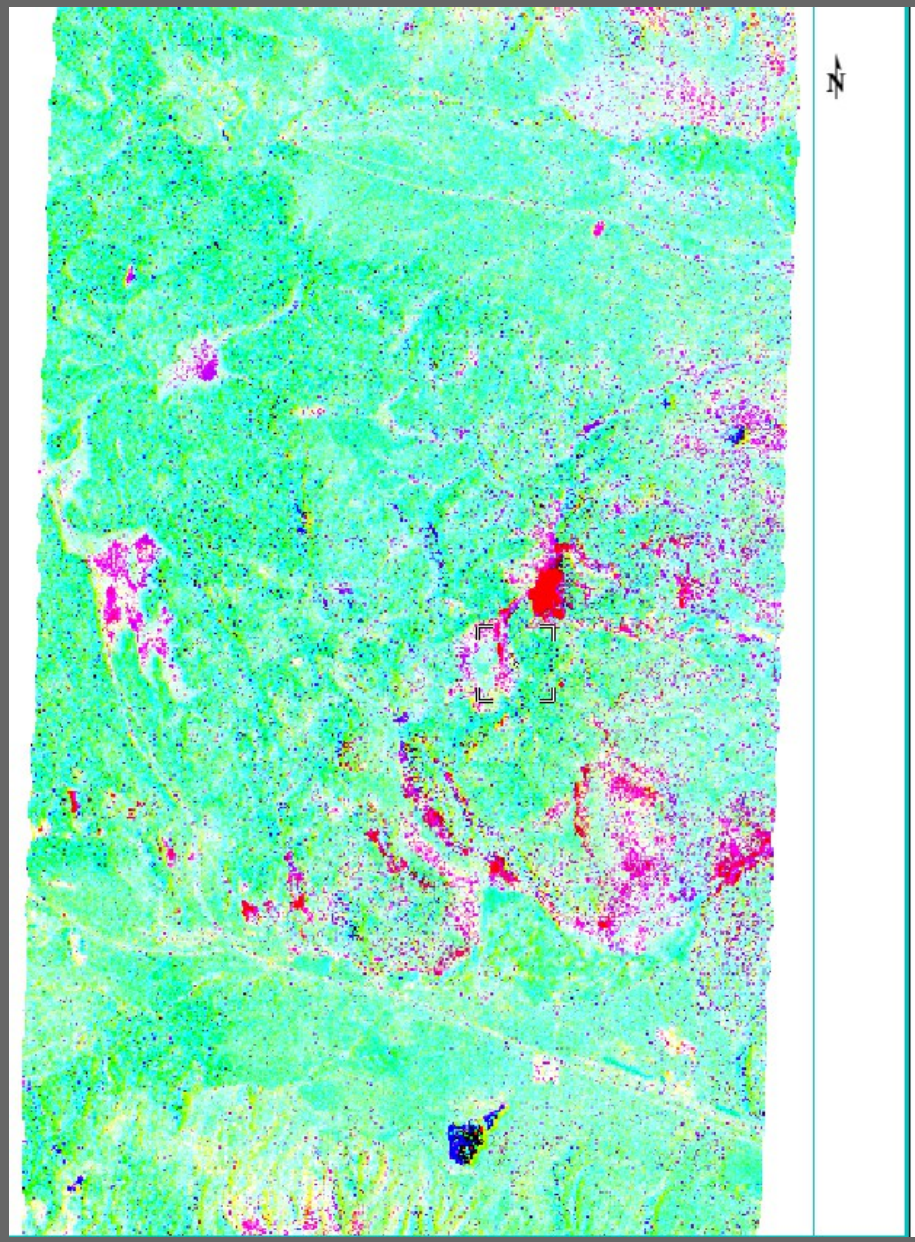


Long Valley Caldera

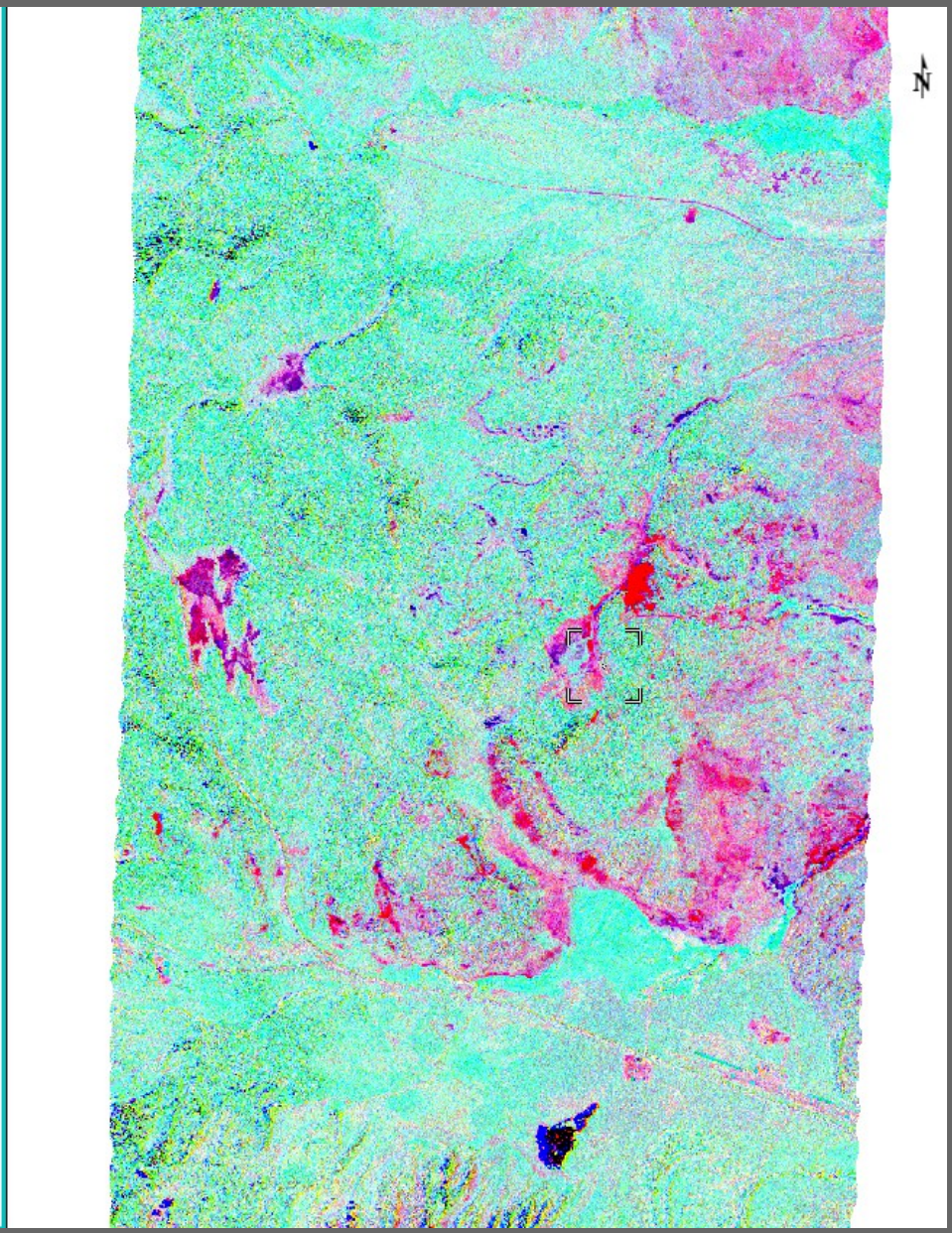




Continuum Removed Band Combination Over Long Valley

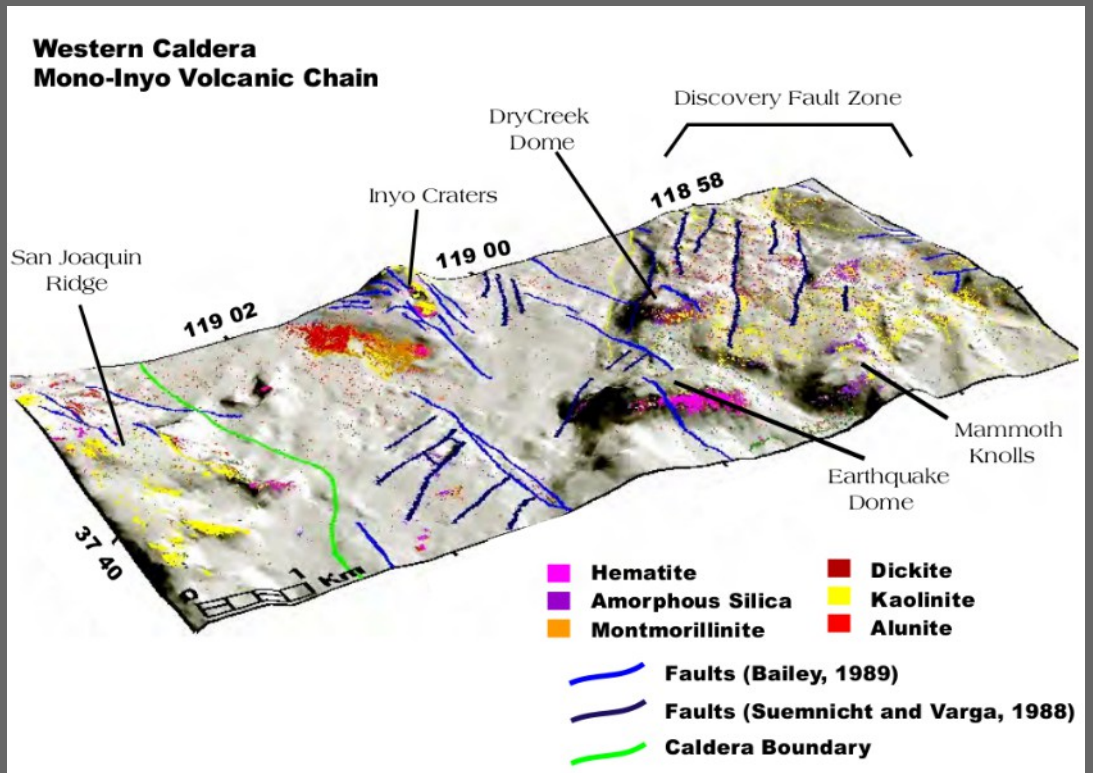


30m simulated HyspIRI

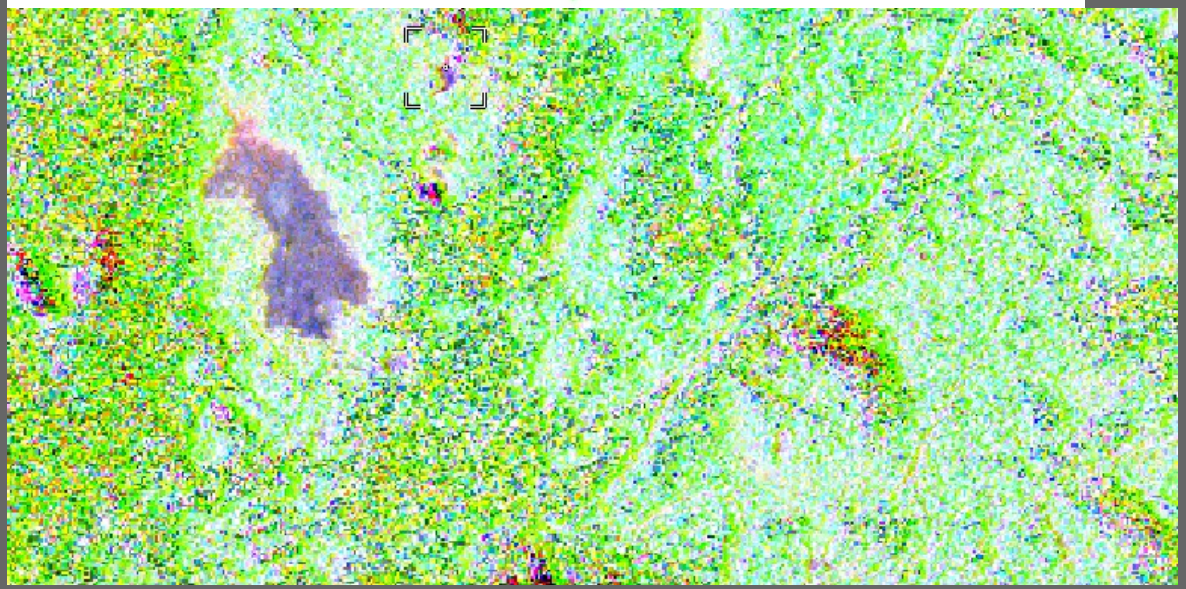


~15m AVIRIS

Discovery Fault Zone, Comparison with HyMap



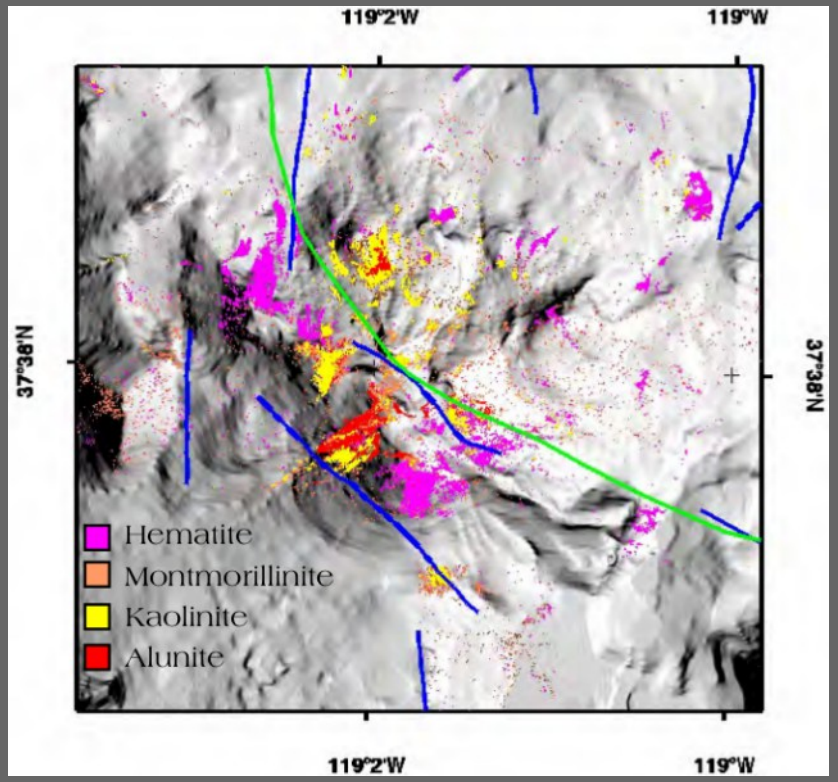
Densely vegetated areas appear to hide alteration that had been identified by Martini (2002) using 4m HyMap data.



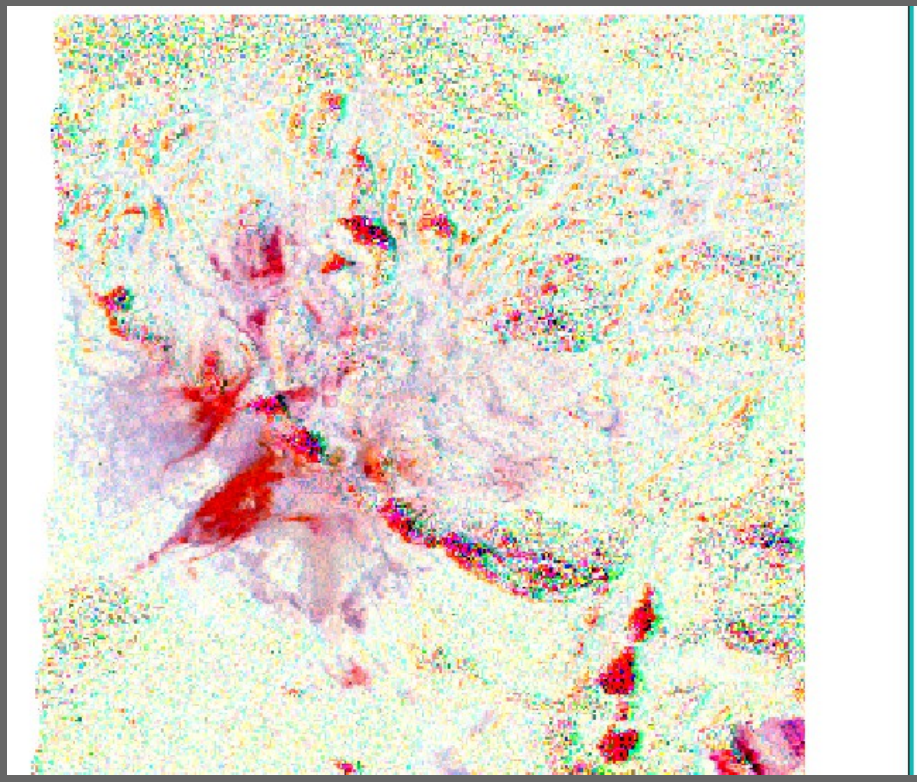
Top: From Martini 2002 showing mapped alteration mineralogy.

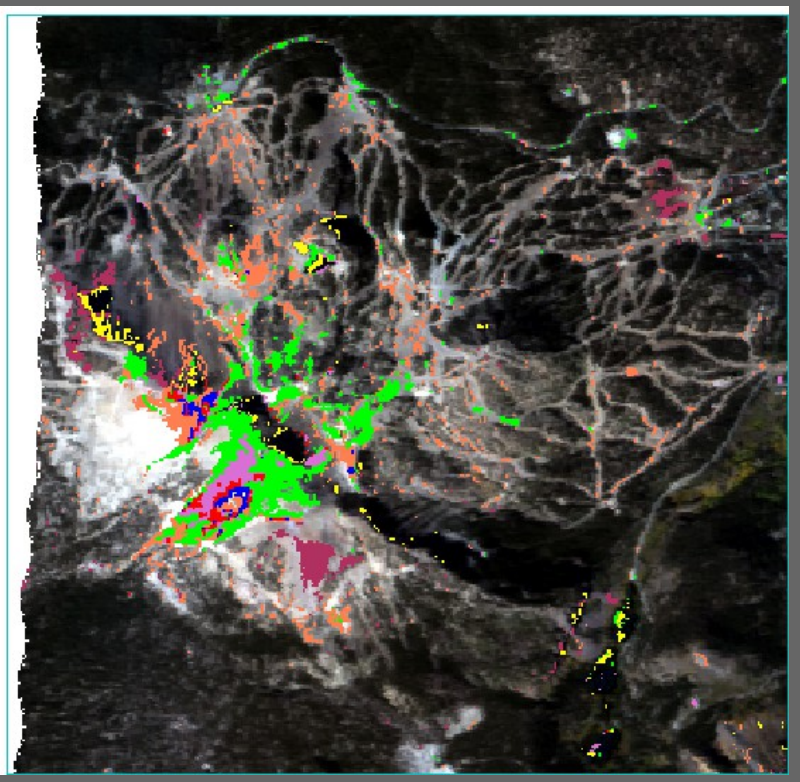
Bottom: Continuum removed band combination showing no alteration.

Mammoth Mountain Further Hymap Comparison

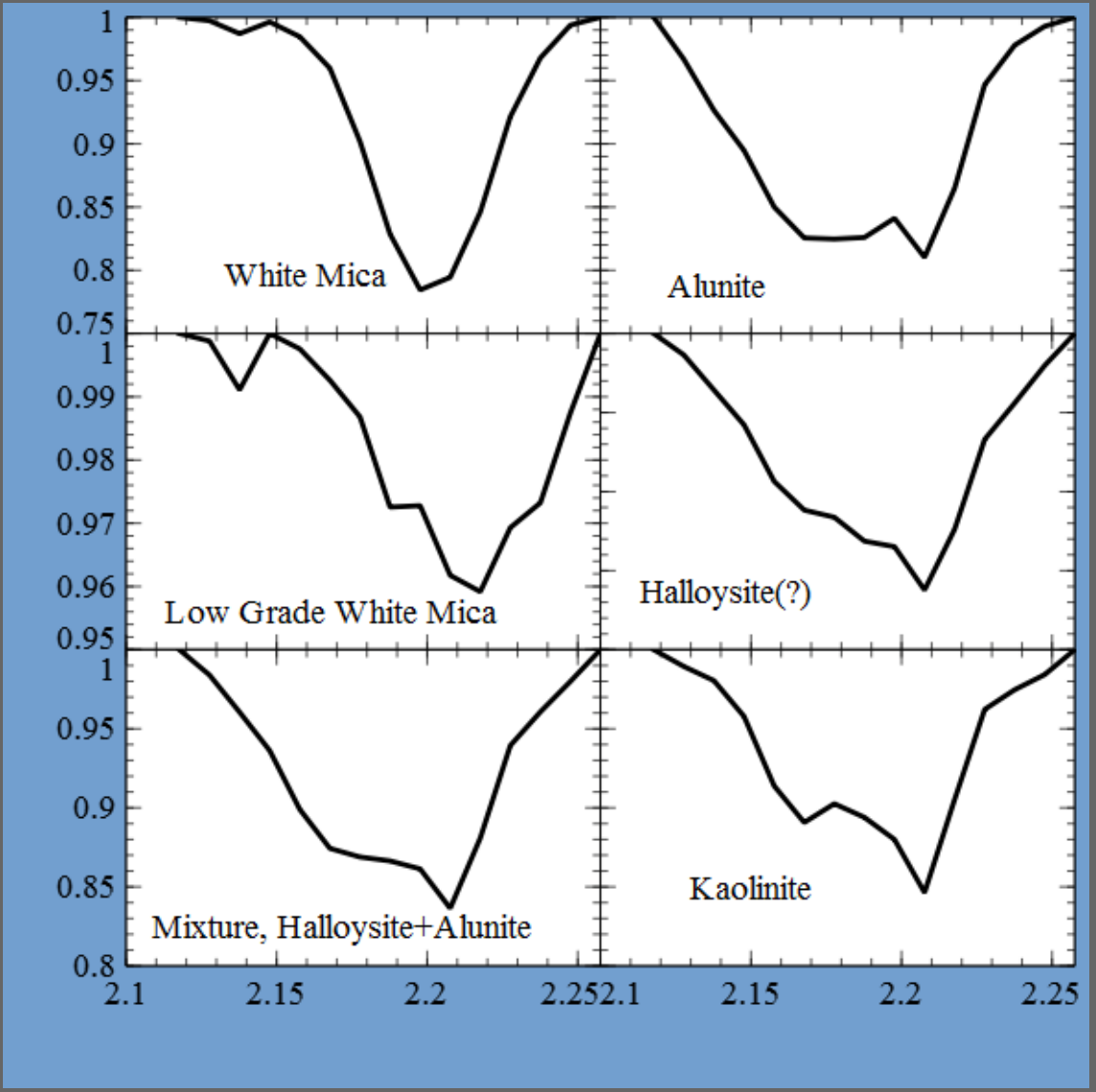


- Comparison of AVIRIS 15m with identifications made by Martini (2002) using 4m HyMap data.
- Alteration zones were identified in AVIRIS data, with more endmembers chosen.



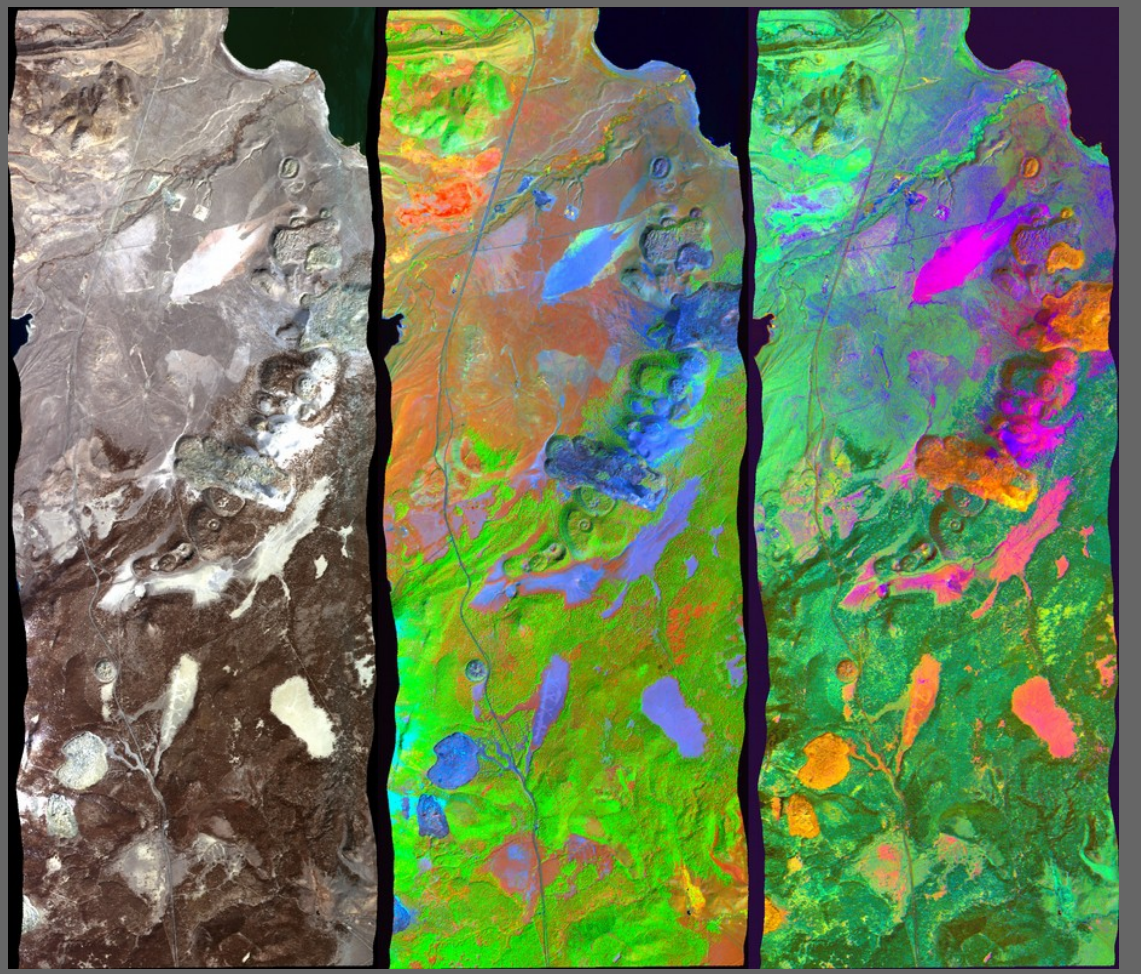


Mammoth Mt. Examples of Identified Minerals

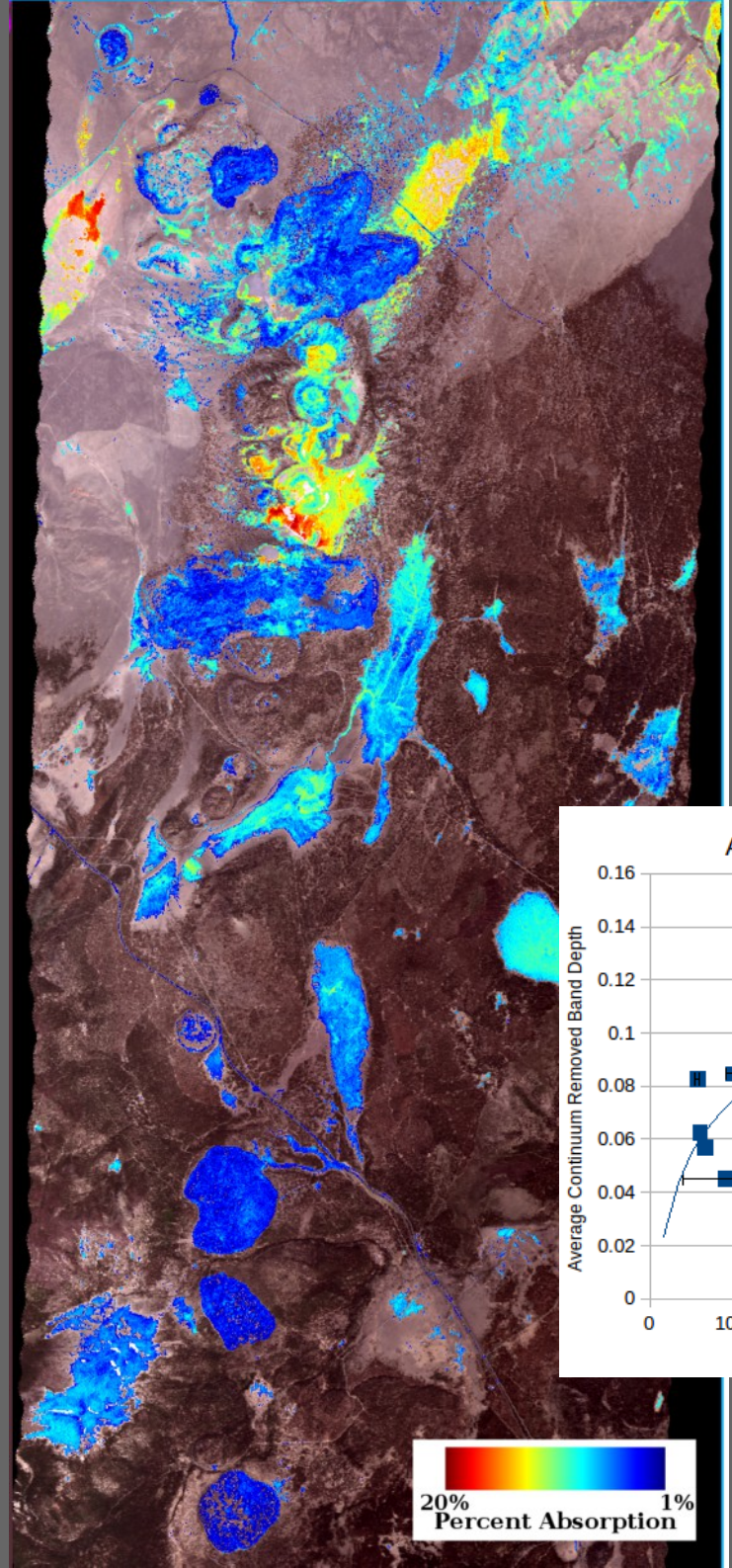


Mono-Inyo Craters

- The Mono-Inyo Craters consists of approximately 30 craters and domes that are currently exposed and erupted over the past 40,000 years.
- These craters show general variations in the 2.21μm Si-OH stretch absorption band.



2.21µm Band Depth Map of Geologic Materials



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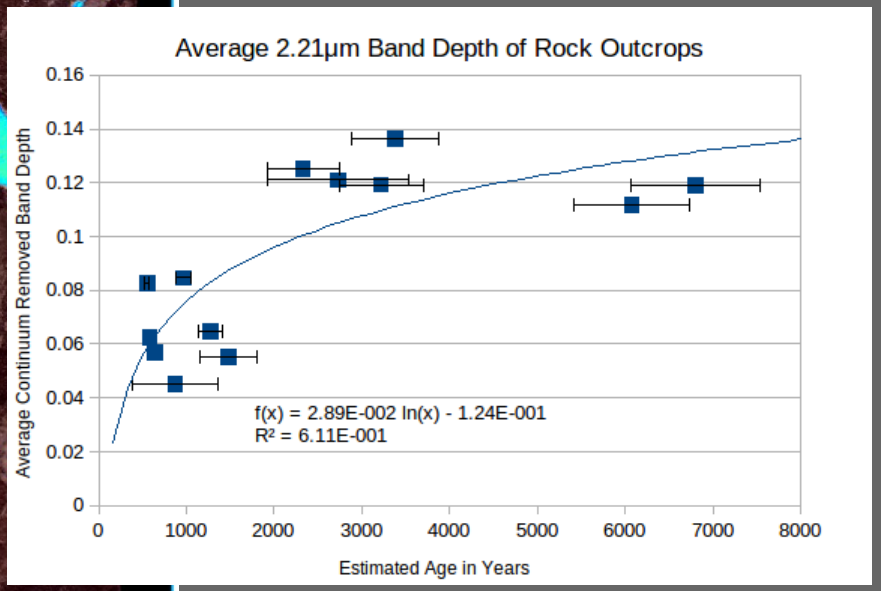
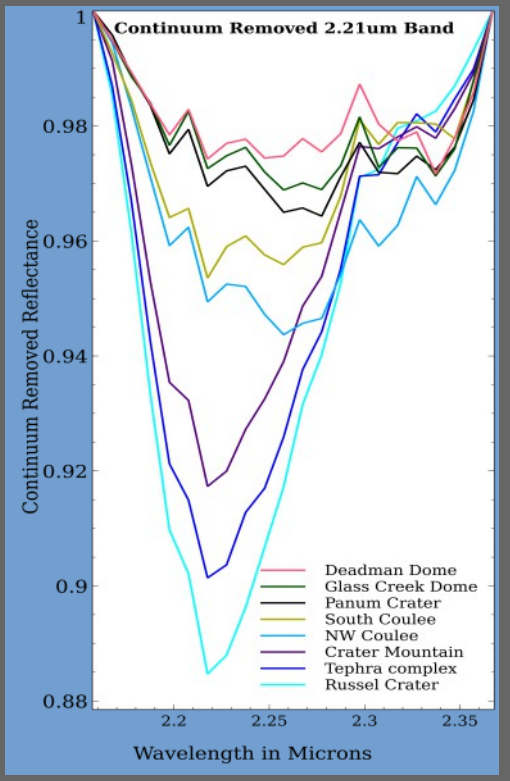
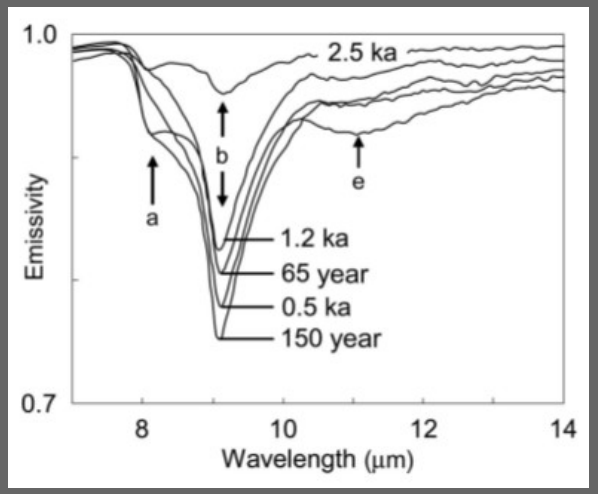
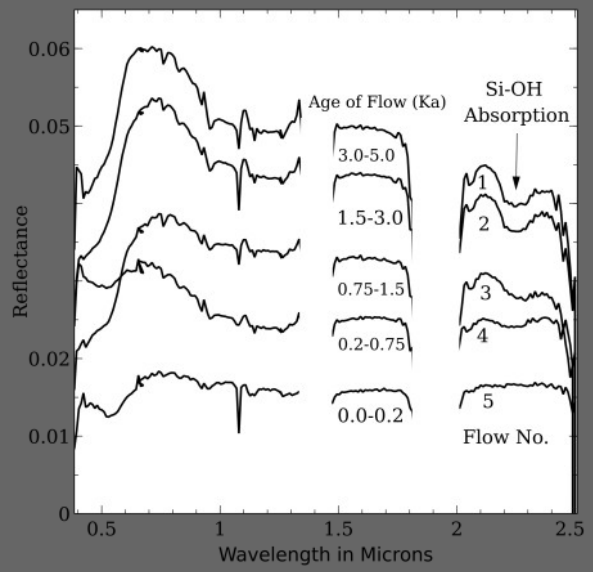


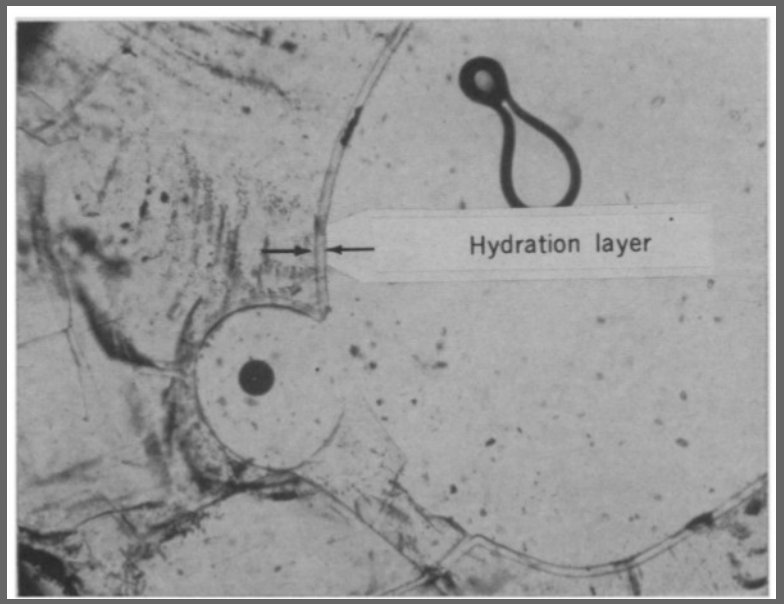


Discussion of 2.21μm Si-OH band



- Other studies have shown spectral variation with age of volcanic materials.
- These variations are attributed to a hydration layer that forms on rocks as they are exposed to the atmosphere.





Top: From Abbot et al., 2013

Bottom: From Swayze, 2001

Right: From Friedman, 1980

Conclusions

- Multiple alteration mineral types, including argillic and QSP that cover small areas are identifiable using ~15m AVIRIS spectra and to a slightly lesser extent in 30m.
- A Continuum Removal from 2.137μm to 2.357μm with proper channel placement highlight alteration minerals in 15m data and to a lesser extent 30m data, and can show subtleties mineral transitions.
- Volcanic materials in the area show an increase in band depth in the 2.21μm Si-OH stretch, as age increases similar changes were shown by Abbot et al. (2013) and Swayze (2001). This could be used as a way to date young volcanic occurrences in remote areas such as the Aleutian Islands or Kamchatka Region.