Geologic Imaging Spectroscopy of the Mono Basin Region

Presented by Neil C. Pearson
University of Nevada Reno
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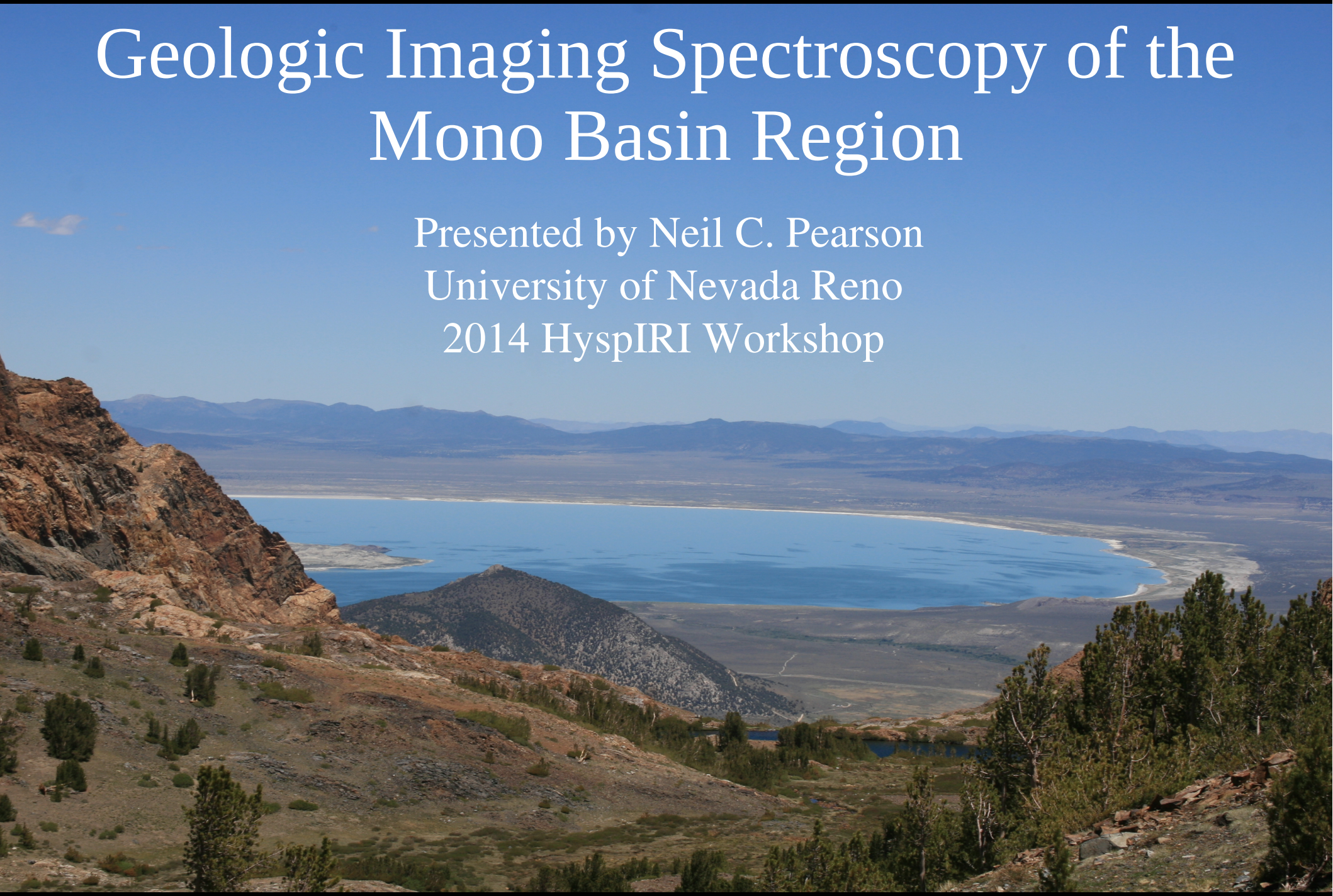
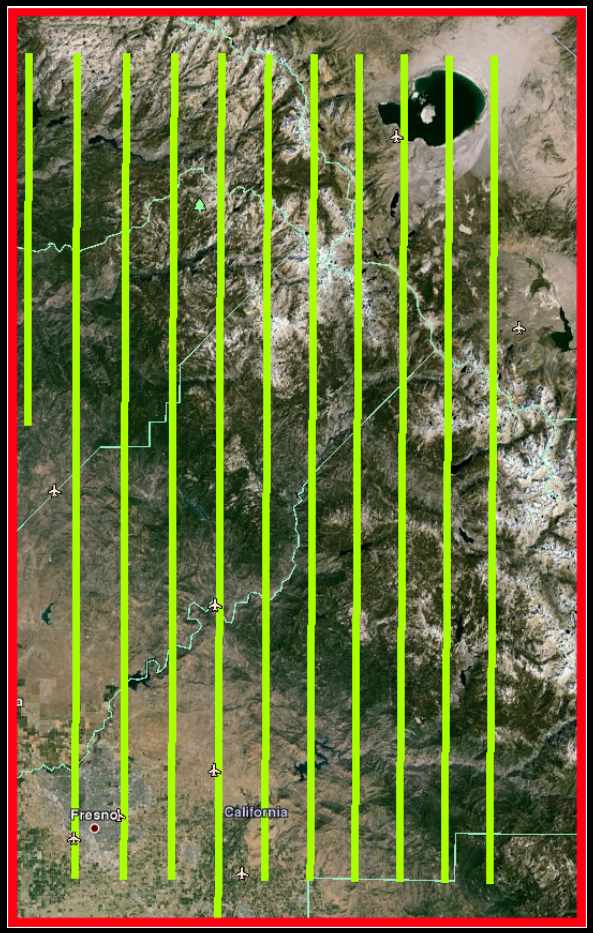


Location and Data

- Using Spring 2013 and Summer 2014 data.
- Spring 2013 shows a better calibration in the NIR.
- Summer 2014 shows better calibration in the SWIR.



Background

- Tectonic extension has lead to high heat flow from the mantle.
- Extension in the area is accommodated by an intrusive magmatic dike that has fueled volcanic eruptions.
- 40 volcanic eruptions in the past 40,000 years with several in the past 1,000 years.
- Heat flow, combined with the alkali nature of Mono Lake has created carbonate tufa.
- Areas in Mammoth Mountain, south of Mono Lake have been developed for geothermal energy and show clay alteration.


Black Point
15Km
Paoha Is.
Lee Vining
395
120
South Beach
Tufa
Mono
Sericite Alteration
Mono Craters
Hundley Kaolinite Pit
Inyo Craters
Casa Diablo
Mammoth Lakes
Hot Creek Geothermal Springs

Tufa and Travertine

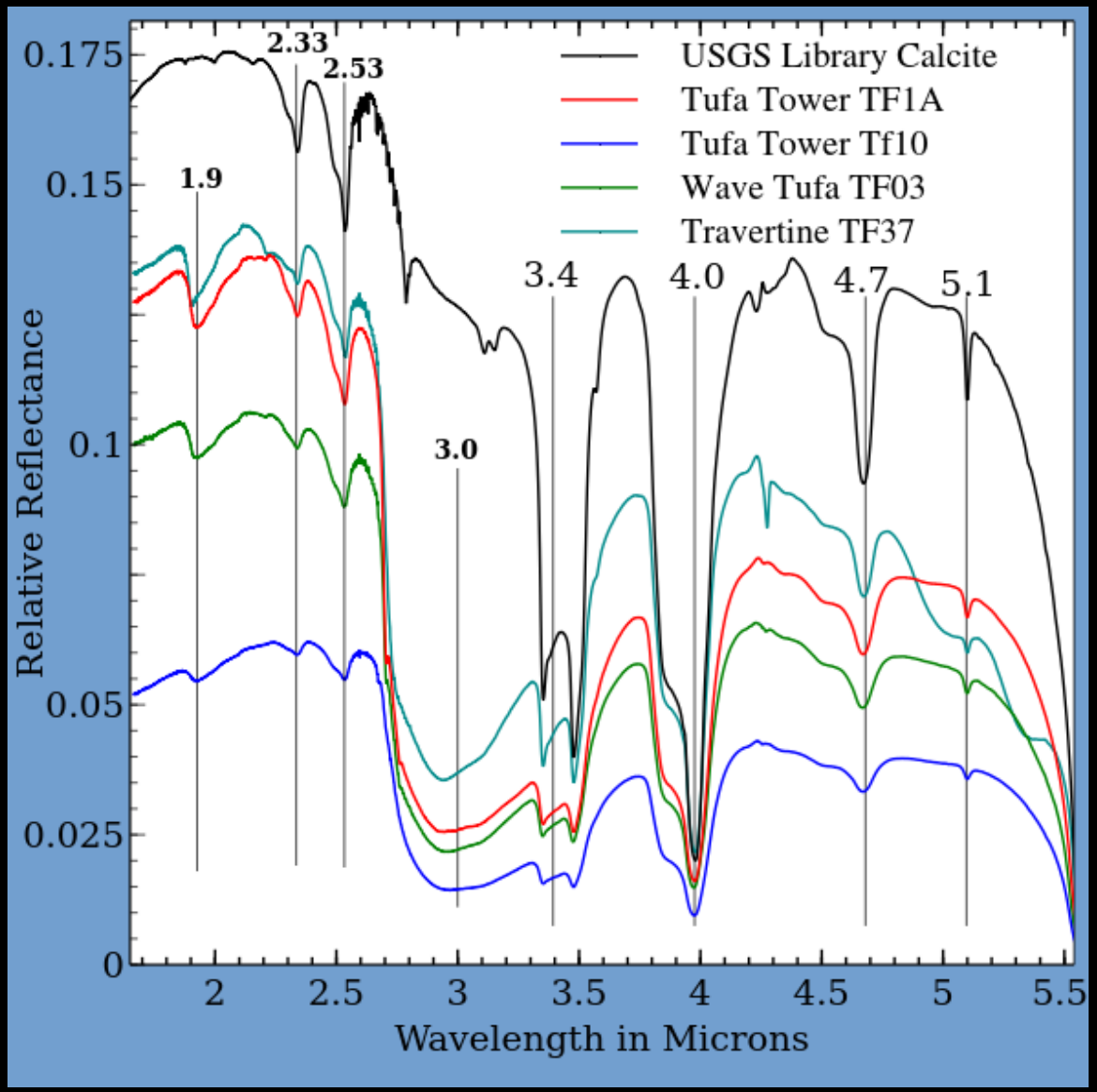
- Primarily composed of calcite that is identified with a 2.33µm and 2.53µm bands.
- Can be formed around springs or by wave action.

Right: Beach Tufa, near South Beach Tufa.

Bottom Left: Spring Tufa with cemented sand, near South Beach Tufa.

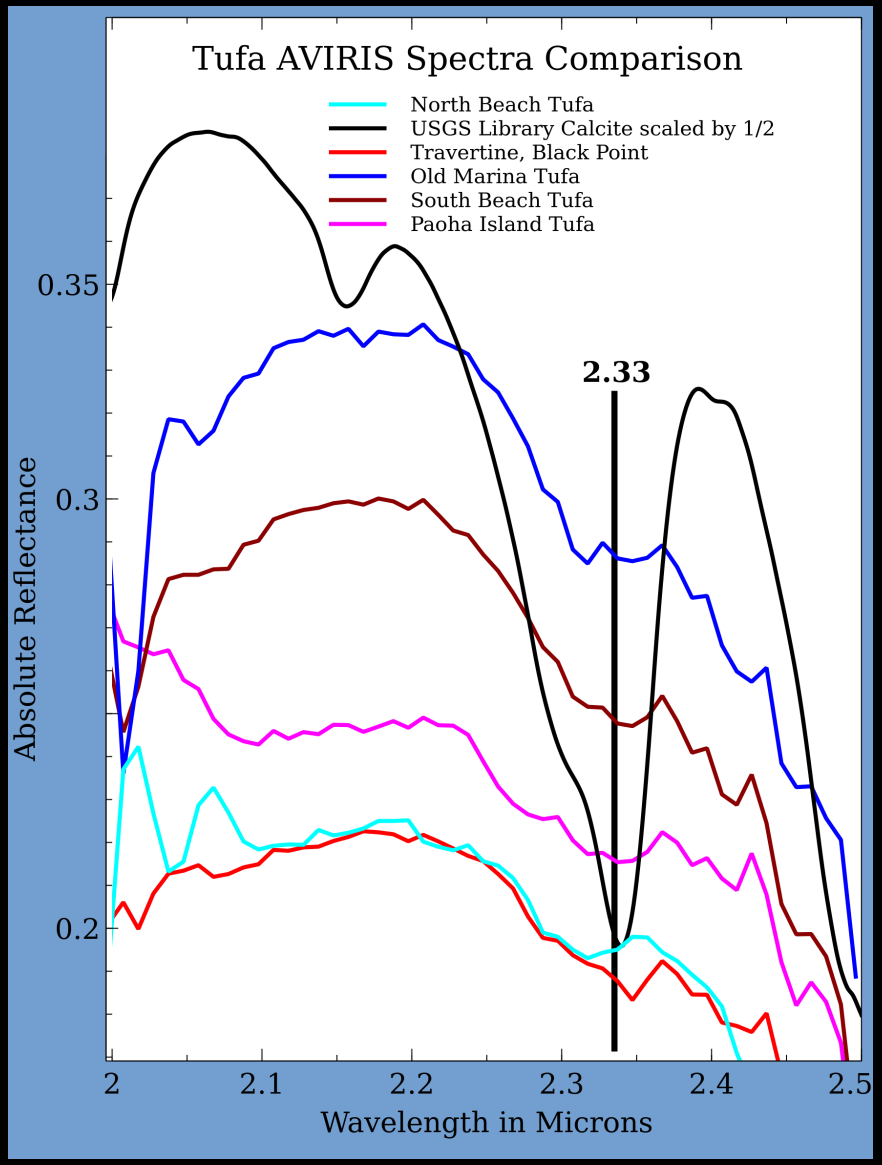
Bottom Right: Travertine, on Black Point

Laboratory Tufa Spectra



- Lab spectra of tufa and travertine show little to no difference in band position based on formation
- Sample TF37 was the only sample that showed a 2.21μm shoulder indicating hydrated silica was mixed with the calcite

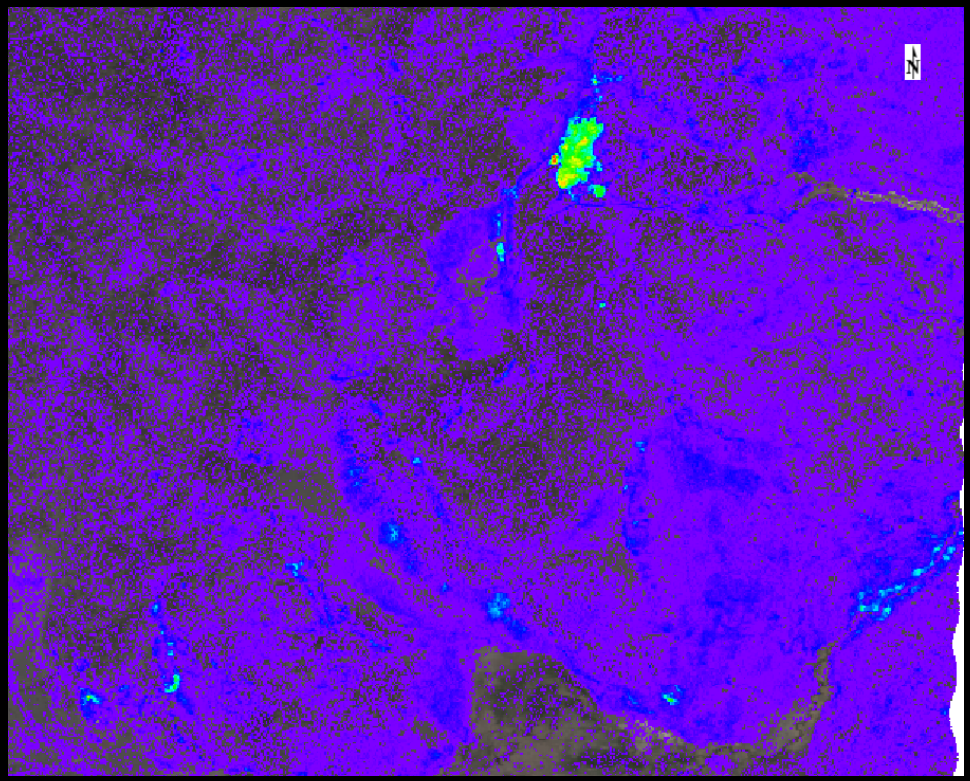
AVIRIS Tufa Spectra



- All tufa mounds show an extremely reduced 2.33μm feature that appear more as a shoulder, rather than a band.

Clay Alteration

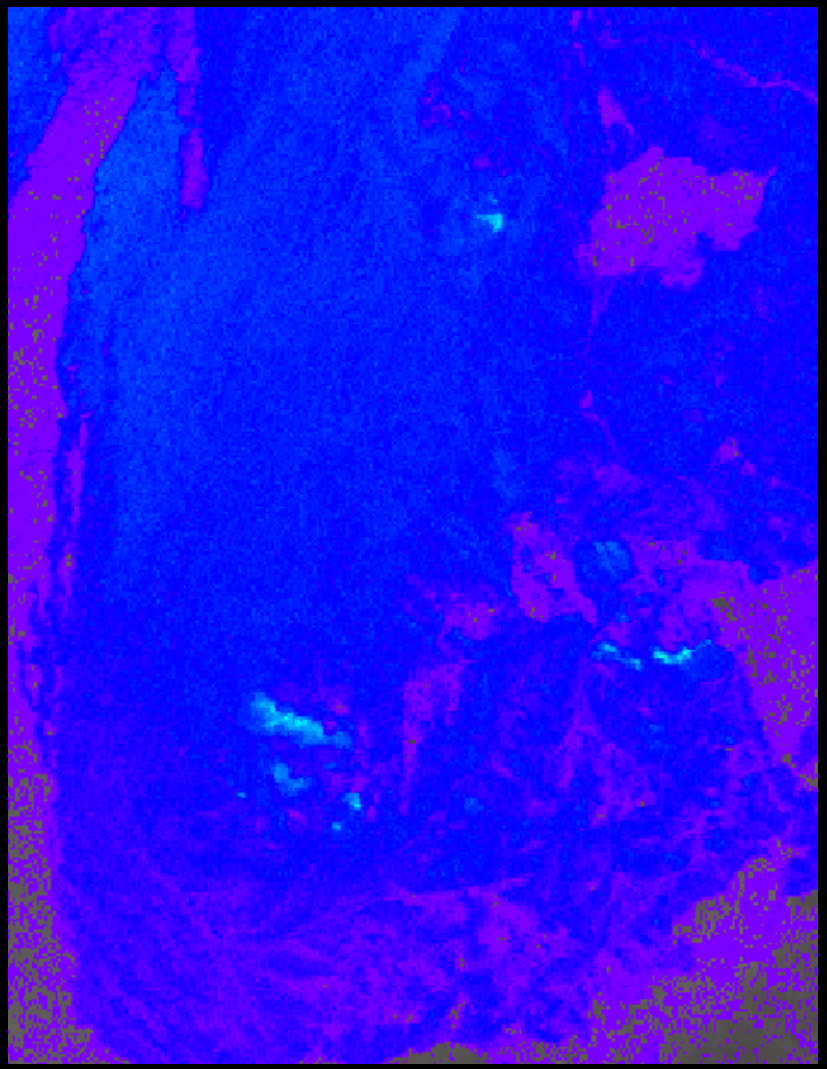
- Clay alteration occurs when high temperature fluids alter country rock.



2.21µm band depth map showing argillic alteration

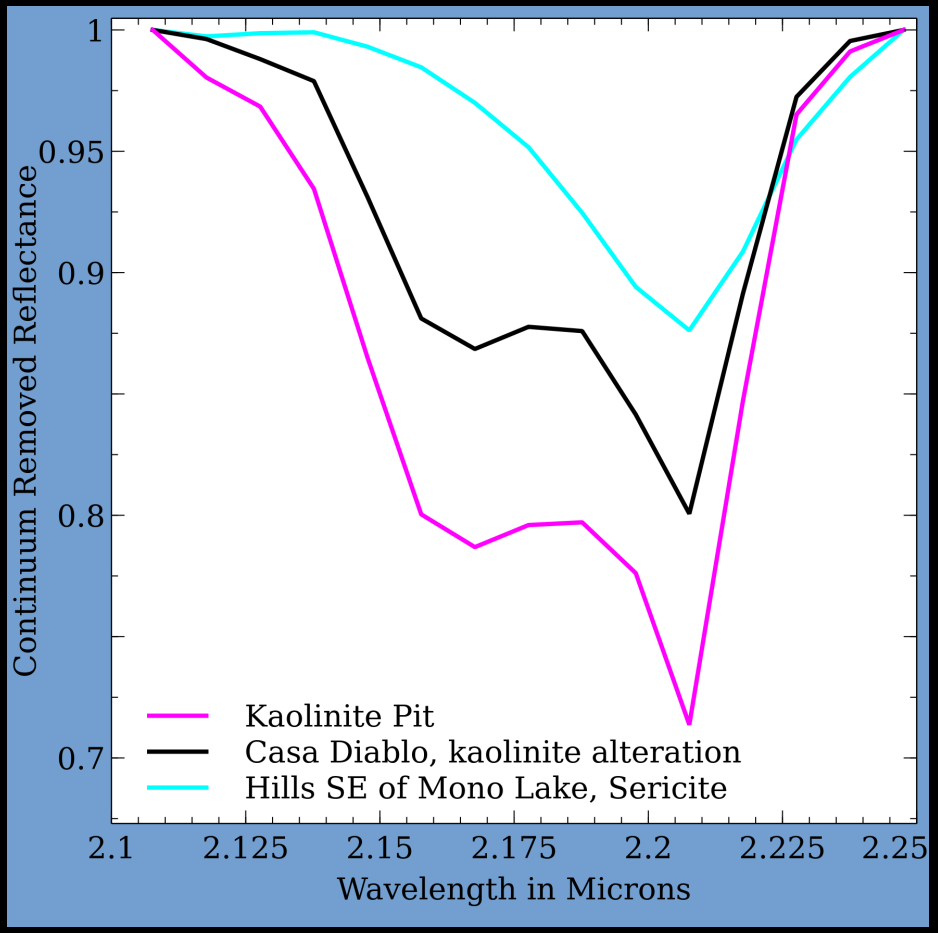
Known examples of alteration near the study area include a kaolinite clay pit, alteration near the Casa Diablo Geothermal Power Plant, and Geothermal Springs at Hot Creek.

Newly Discovered Alteration



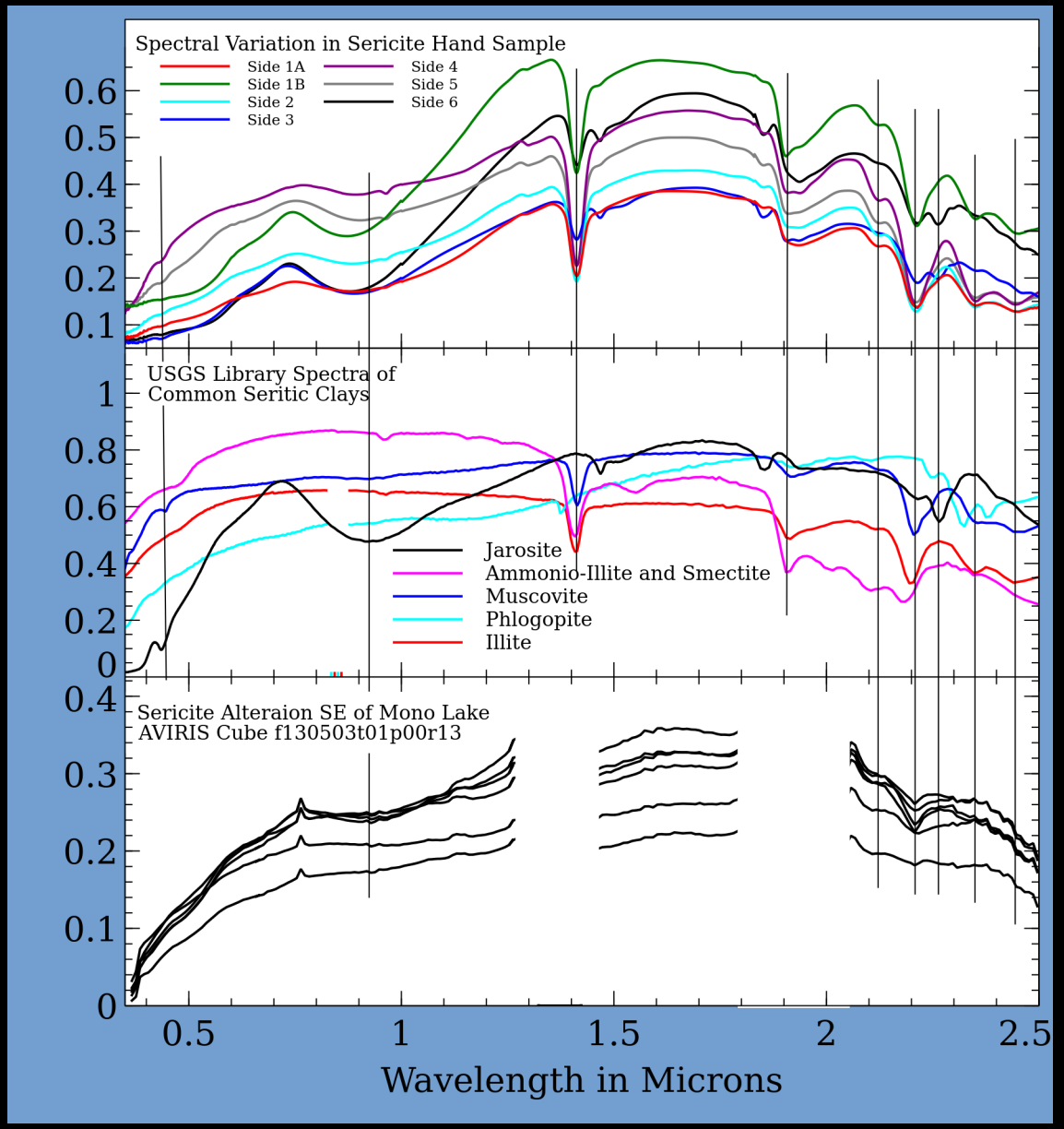
Quartz Sericite Pyrite Alteration, found to the SE of Mono Lake

Spectral Comparison of Alteration Minerals



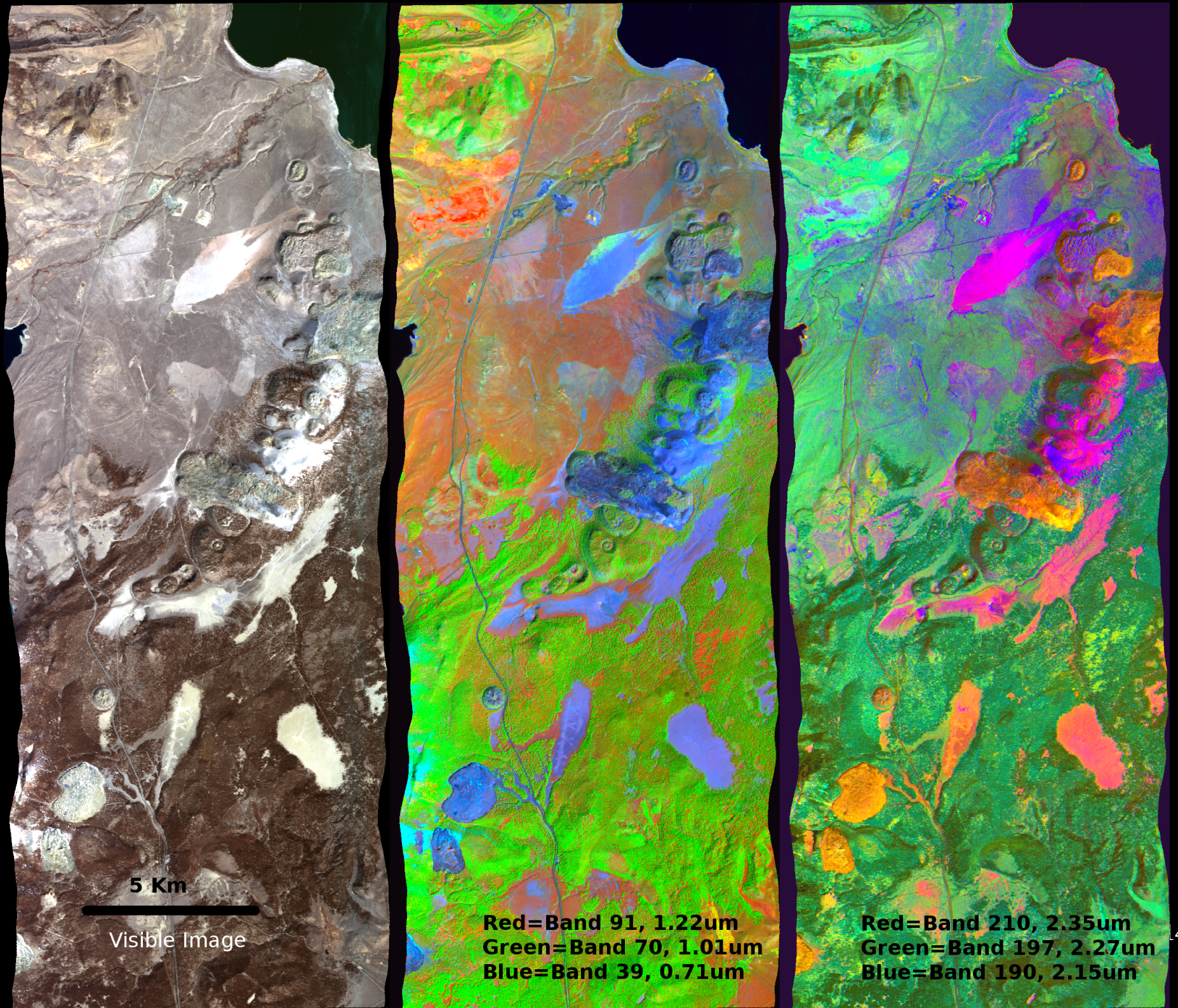
Continuumed removed spectra of the alteration minerals show strong kaolinite absorption from both the Hundley Kaolinite Pit and Casa Diablo. The weaker sericite absorption is shown for comparison.

Sericite Alteration

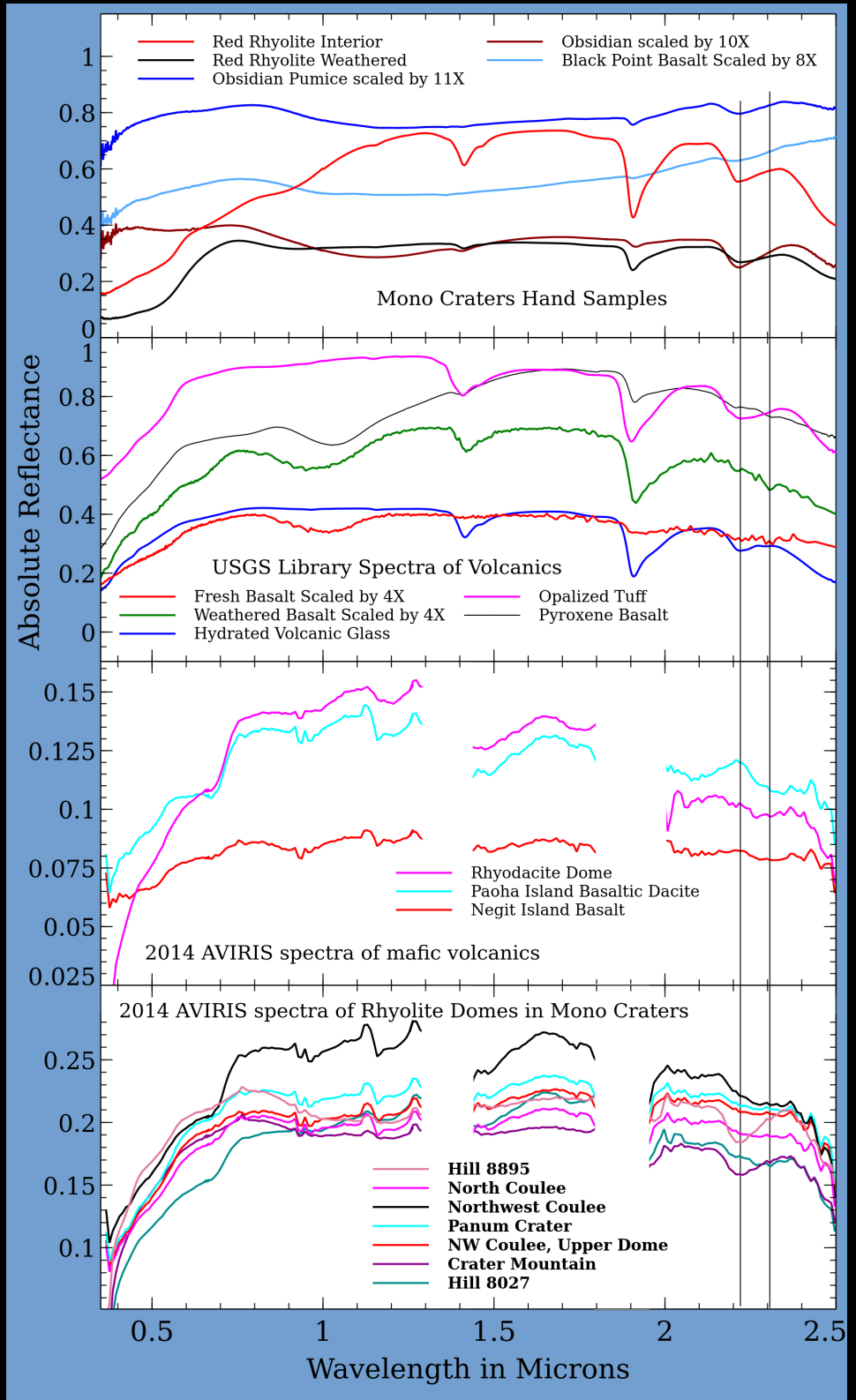


Mono-Inyo Craters

- The Mono-Inyo Craters consists of approximately 30 craters and domes that are currently exposed.
- The majority are rhyolitic with 2 being dacitic to rhyodacitic, 2 basaltic, and 2 showing a mix of rhyolite and dacitic materials.
- These craters show general variations in the 2.21μm Si-OH stretch absorption band.
- Other materials surrounding the craters show a similar feature, suggesting it is material ejected from the craters.

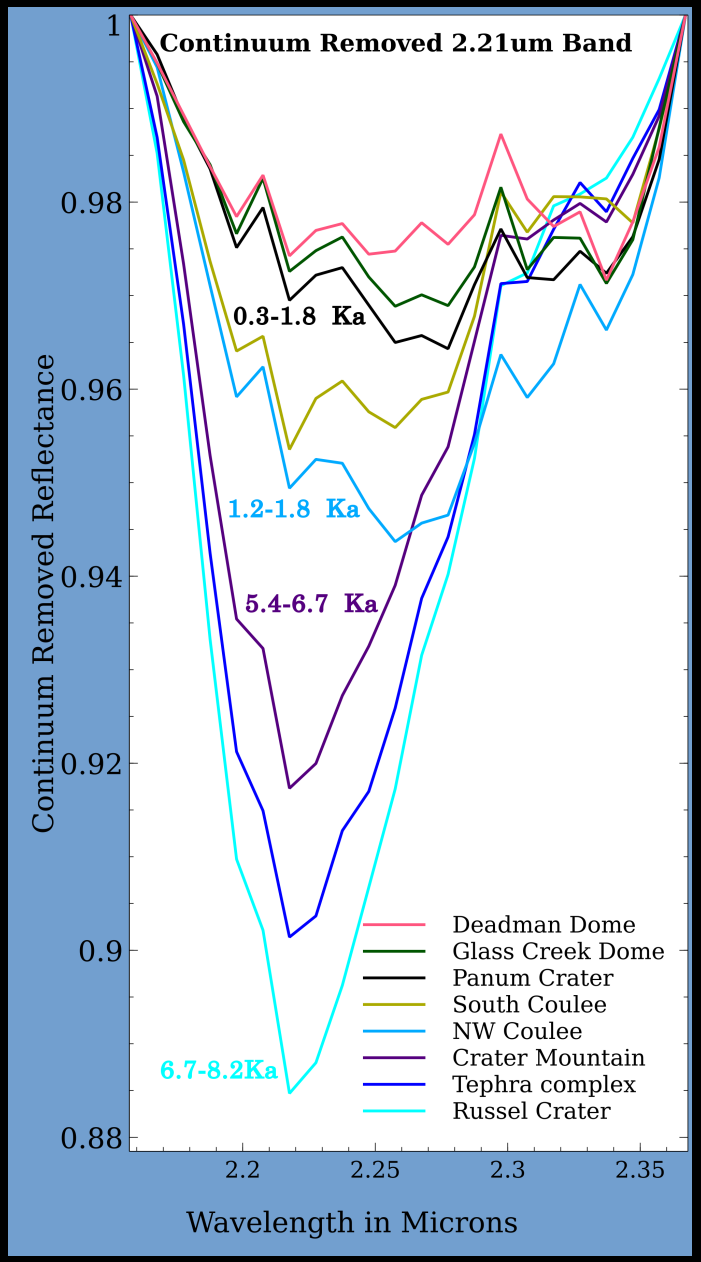

5 Km
Visible Image
Red=Band 91, 1.22um
Green=Band 70, 1.01um
Blue=Band 39, 0.71um
Red=Band 210, 2.35um
Green=Band 197, 2.27um
Blue=Band 190, 2.15um

Color Variation in Panum Crater



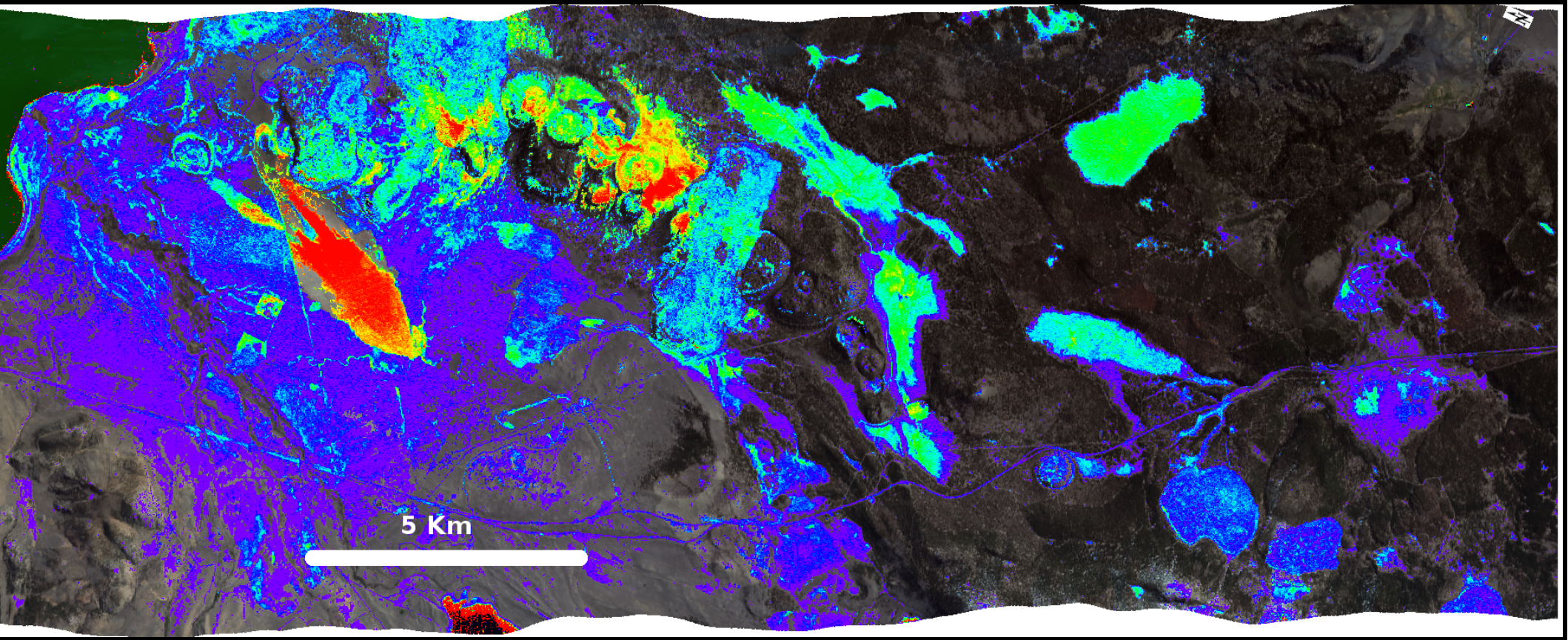
Crater spectra show absorptions at ~2.21µm these absorptions generally shift to longer wavelengths in more mafic volcanics

2.21µm Band Depth Progression



- The 2.21µm band shows a general increase in depth with age in craters and rhyolite flows.
- Younger craters show possible mixing with the 2.25µm C-H stretch in vegetation.
- Older Craters show a reduced ~2.3µm shoulder which could indicate mixing with clays.

2.21µm Band Depth Map of Geologic Materials



Percent Band Depth

1% 12%

Conclusions

- Tufa, a geothermal spring indicator shows a much reduced 2.33μm band compared to laboratory spectra, likely due to areal mixing.
- Multiple alteration mineral types, including argillic and QSP that cover small areas are identifiable using 18m AVIRIS spectra.
- Volcanic materials in the area show a general increase in band depth in the 2.21μm Si-OH stretch, as age increases.

Work to be Done

- Mineral mapping with the Envi Spectral Angle Mapping Algorithm, and USGS Tetracorder Algorithm.
  - Spatial comparison of results
- Laboratory work to verify weathering rind.
- Integration of AVIRIS data with GIS data sets to help map tufa mounds, shorelines, and fault lines and identify unique spectral features near them.
- Thesis write up by May 2015.

Questions