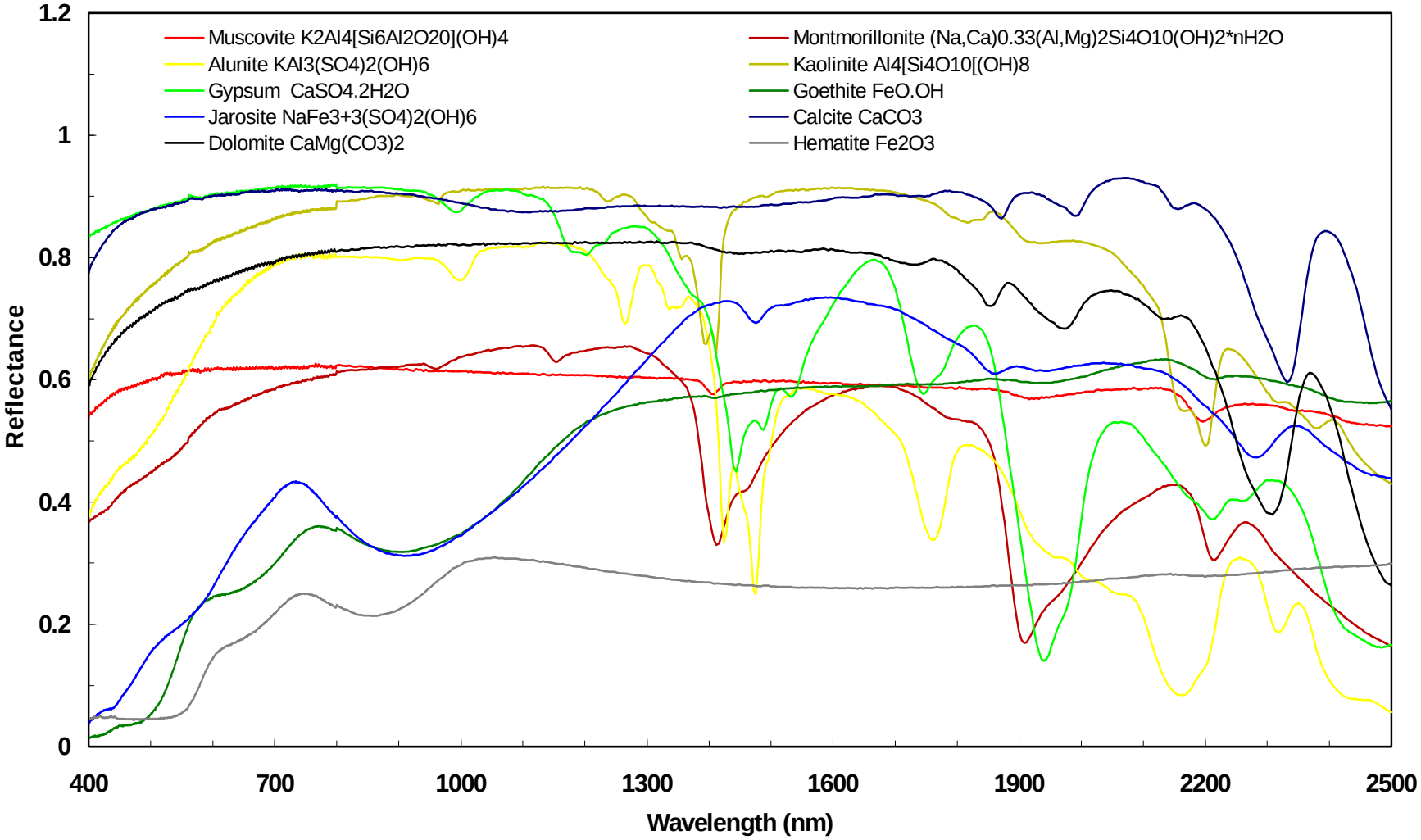
VQ6. Earth Surface Rock/Soil and Shallow Acquatic Bottom Composition (RG, HD)

- What is the composition of the exposed terrestrial rock/soil and shallow aquatic bottom surface and how does compositional understanding this relate to hazards, resources and understanding of change?

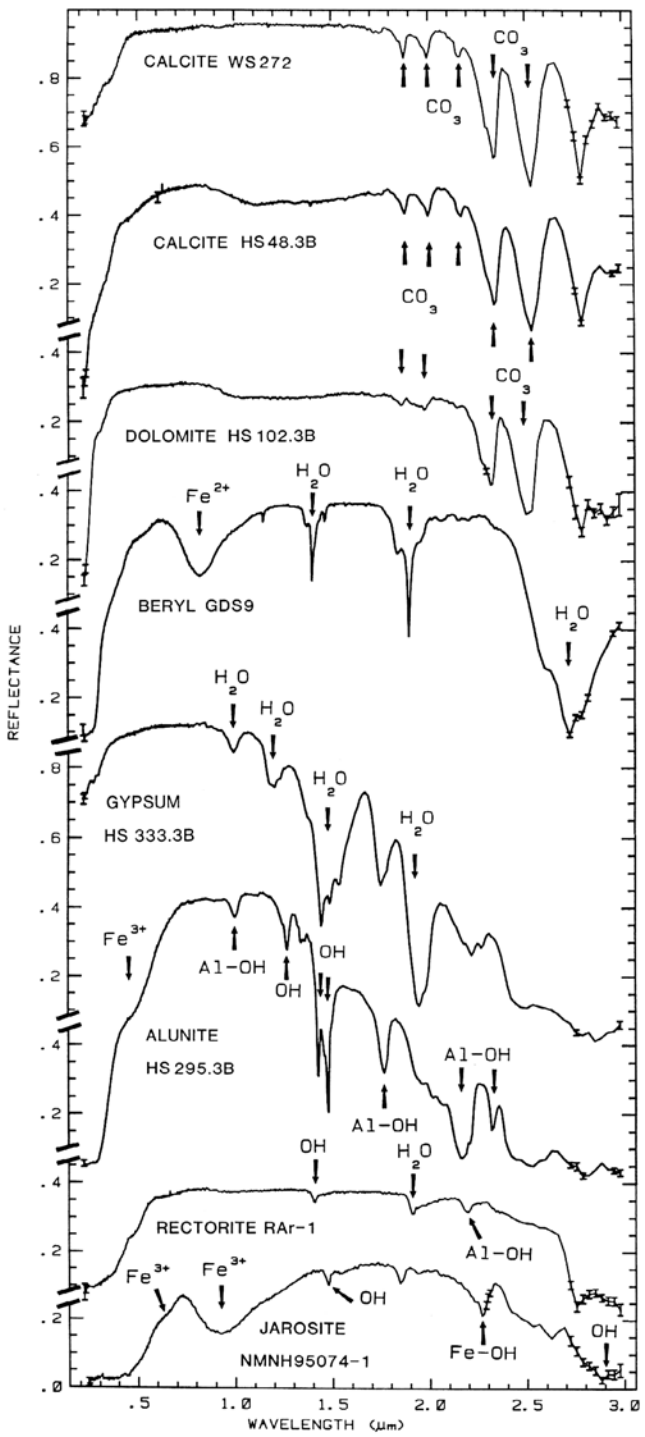
VQ6. Earth Surface and Shallow Water Bottom Composition (RG, HD)

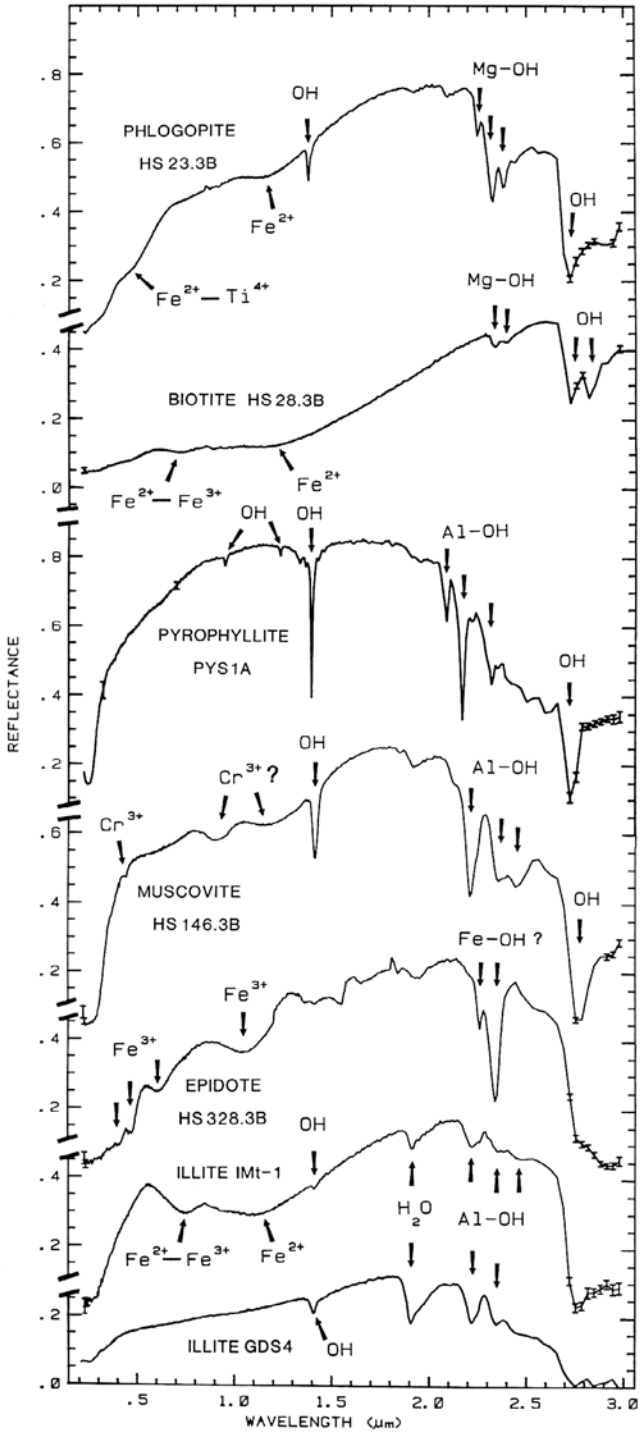
- What is the distribution of the primary minerals and mineral groups on the exposed terrestrial surface? [DS 218]
- What is the bottom composition (sand, rock, mud, coral, algae,SAV, etc) of the shallow water regions of the Earth?
- What fundamentally new concepts for mineral and hydrocarbon research will arise from uniform and detailed global geochemistry of the exposed rock/soil surface [DS227]
- What changes occur in shallow coastal and inland aquatic environments? [DS 25]
- Can measurements of rock and soil composition be used to understand and mitigate hazards? [DS227]

Mineral Spectral Signatures in the Solar Reflected Spectrum



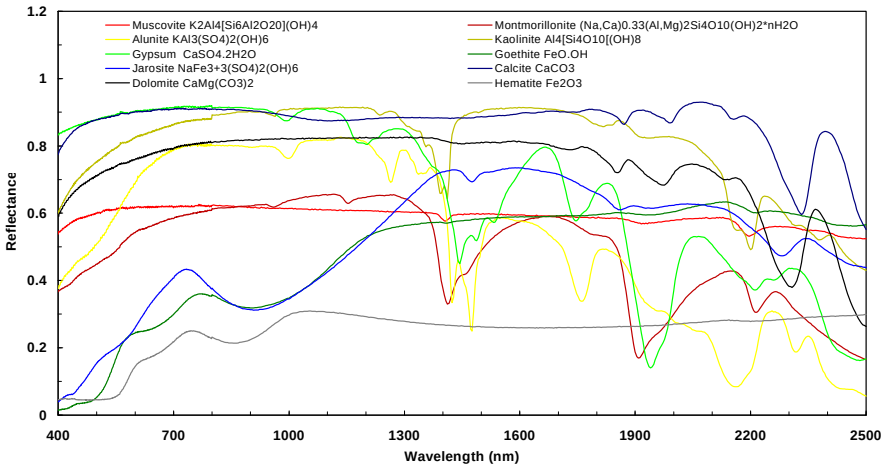
Geochemistry link to spectral signatures

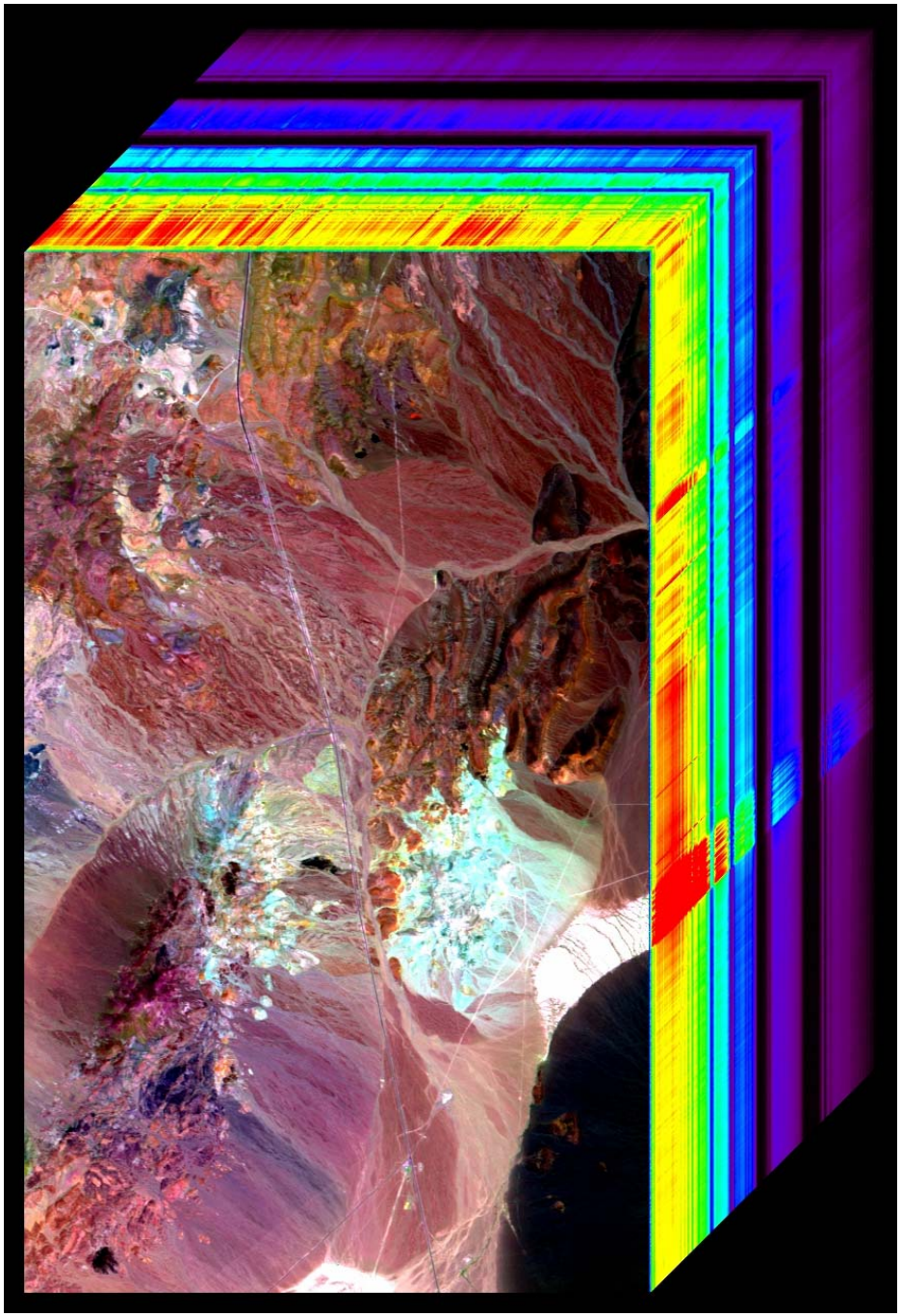




Spectral Imaging Cube of Cuprite, NV measured by NASA's Airborne Visible/Infrared Imaging Spectrometer (AVIRIS)

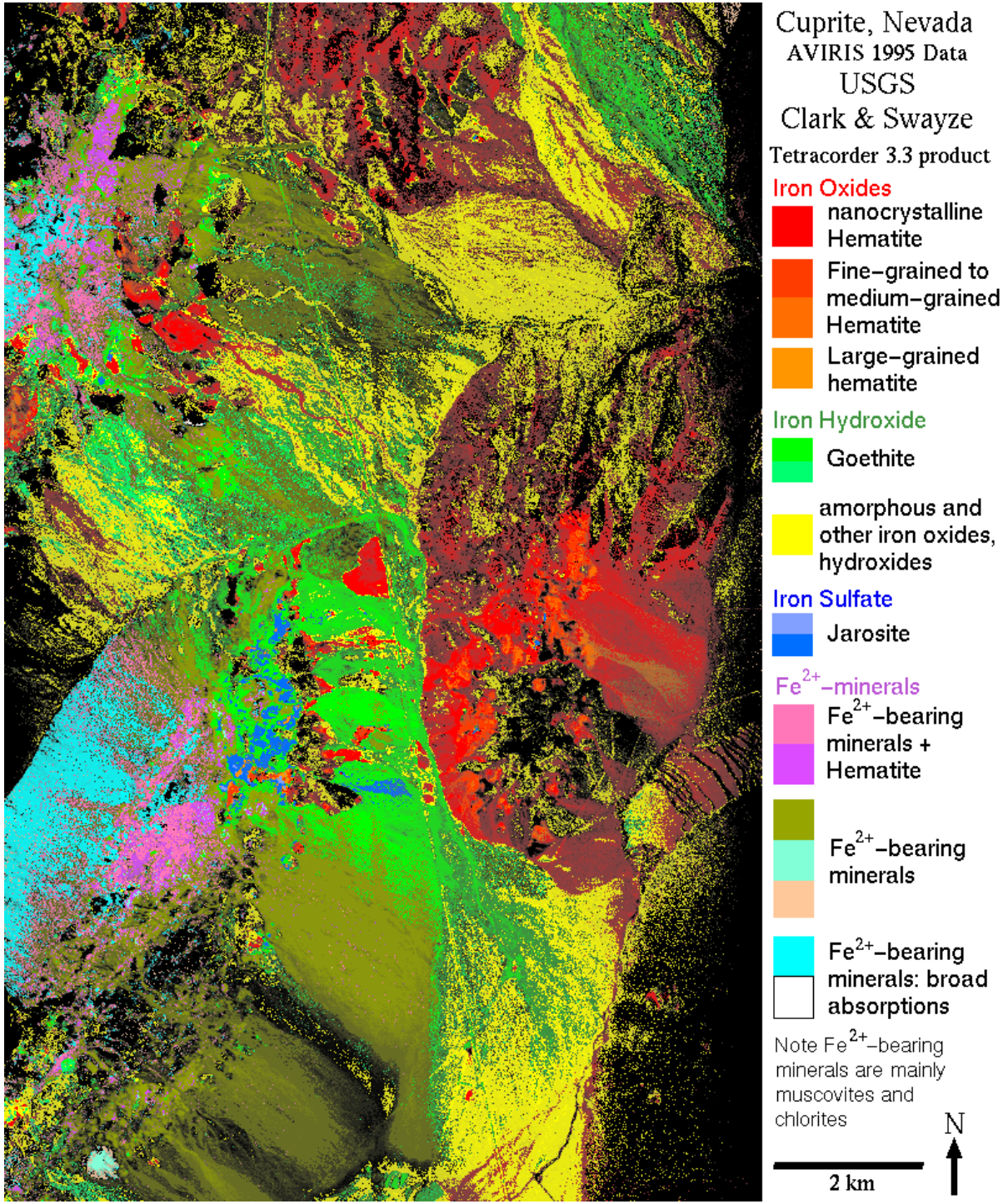
A complete solar spectrum is measured for each spatial point.





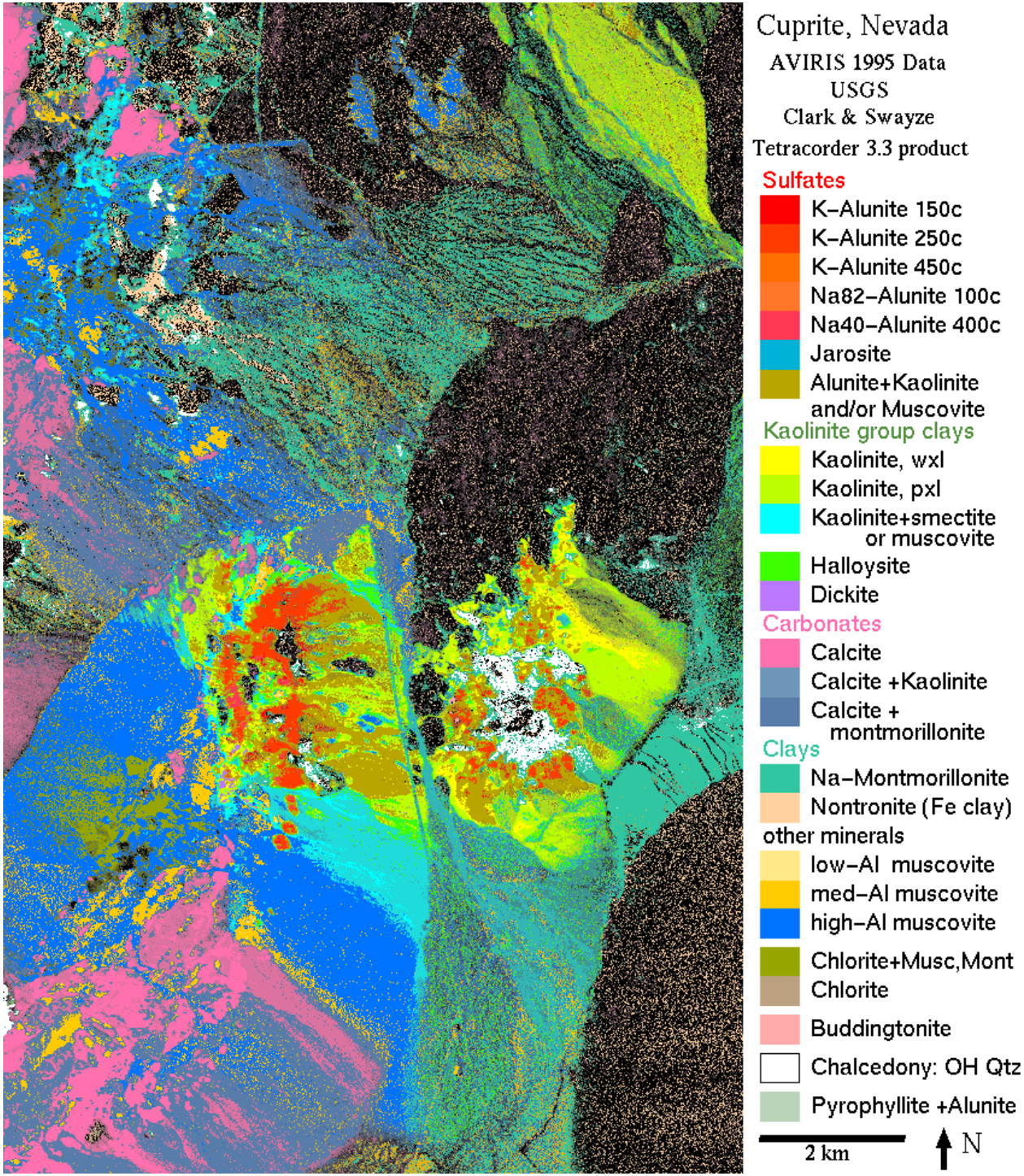
1 micron region mineral map from AVIRISDr.

Roger Clark and Dr. Gregg Swayze, USGS

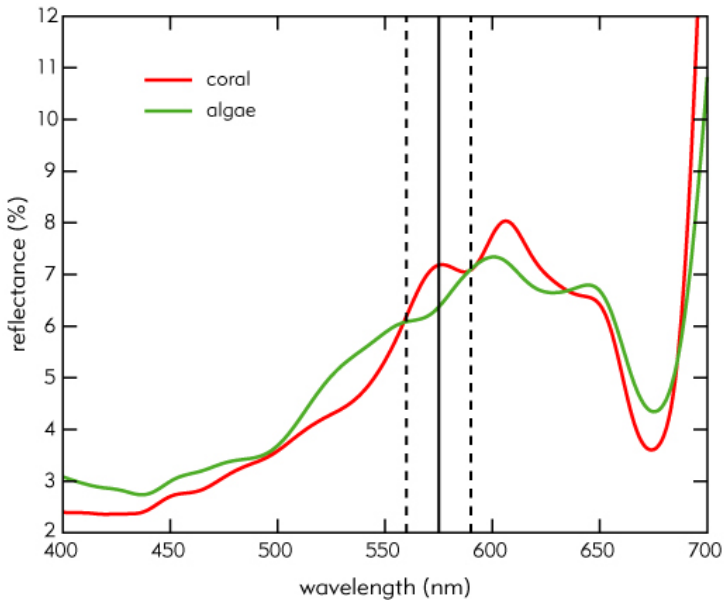


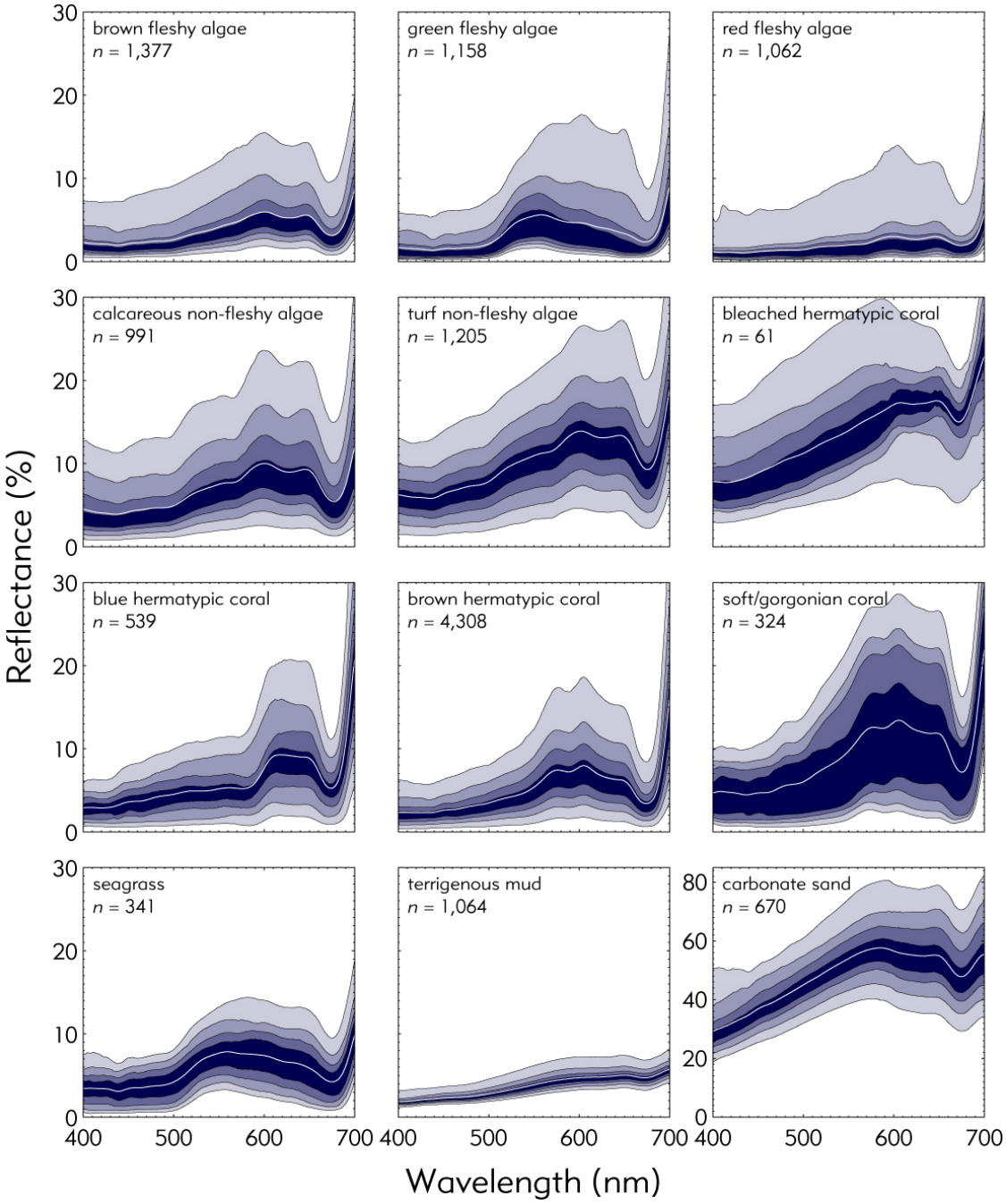
2 micron region mineral map from AVIRIS

Dr. Roger Clark and Dr. Gregg Swayze, USGS

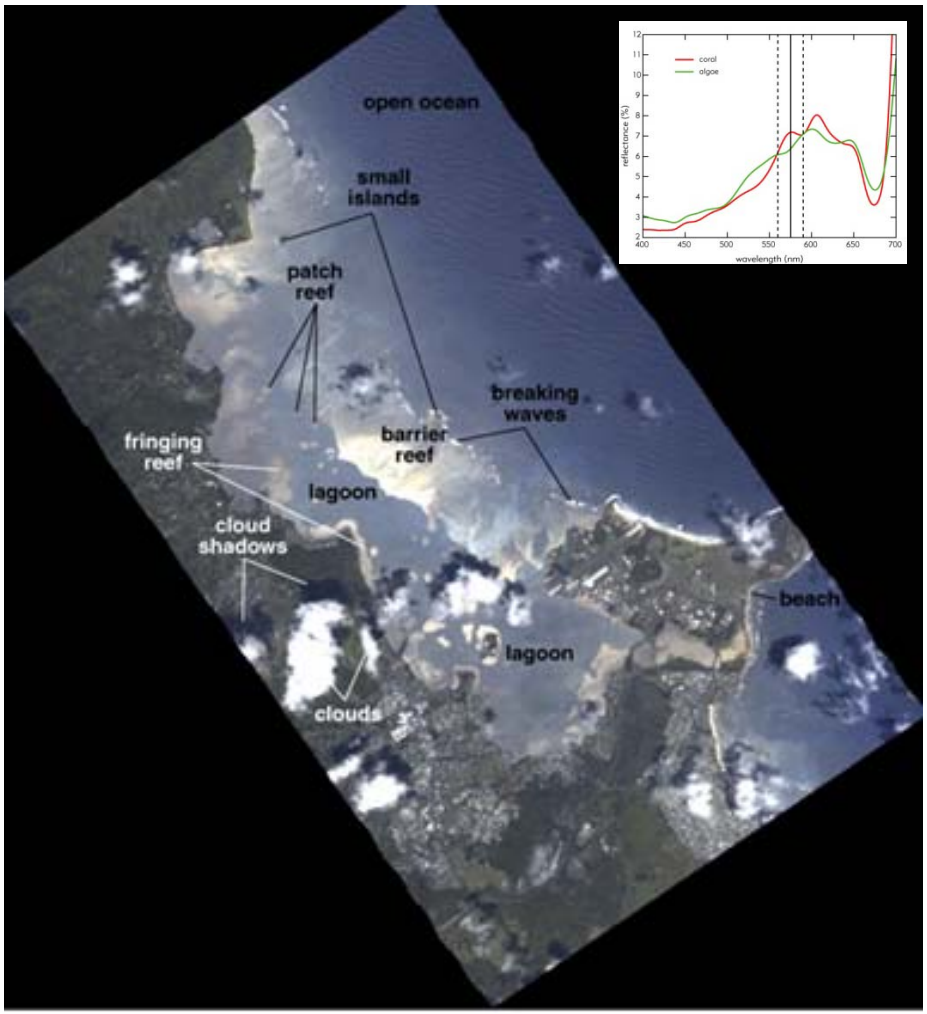


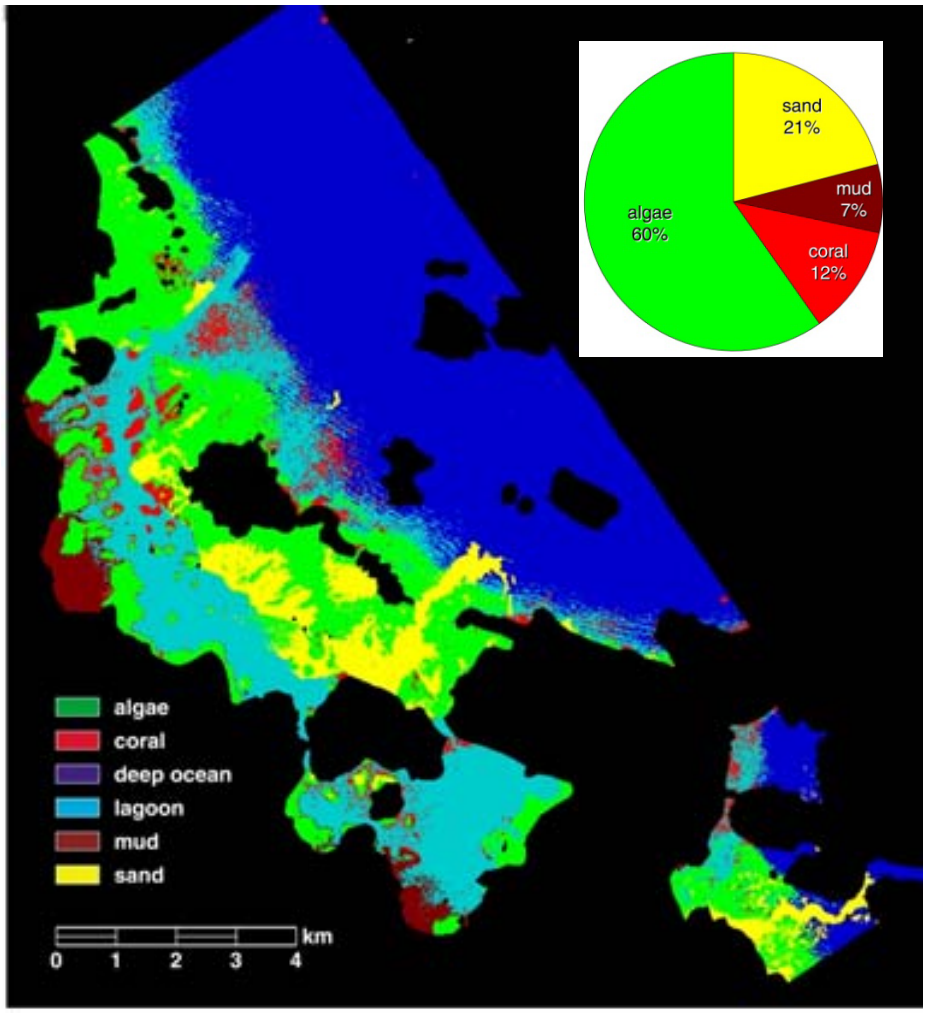
In Situ Spectral Measurements of Shallow Water Bottom Composition (E. Hochberg, Nova Southeastern University, FL)



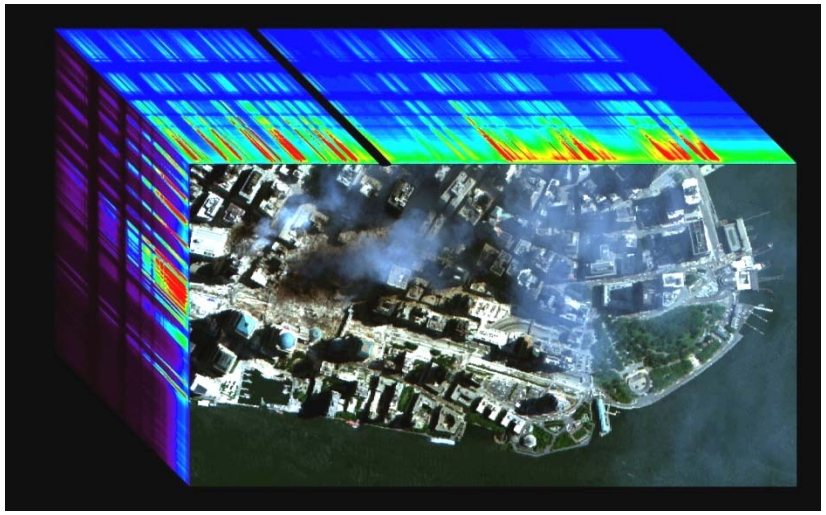


LDF analysis of AVIRIS measurements for shallow water bottom composition, Kaneohe Bay, HI (E. Hochberg, Nova Southeastern University, FL)



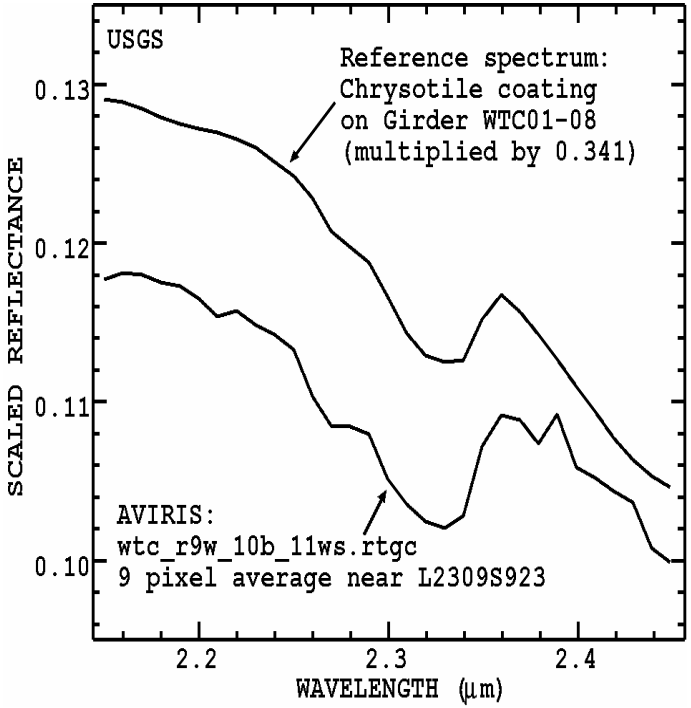


WTC Hazards from AVIRIS 010916

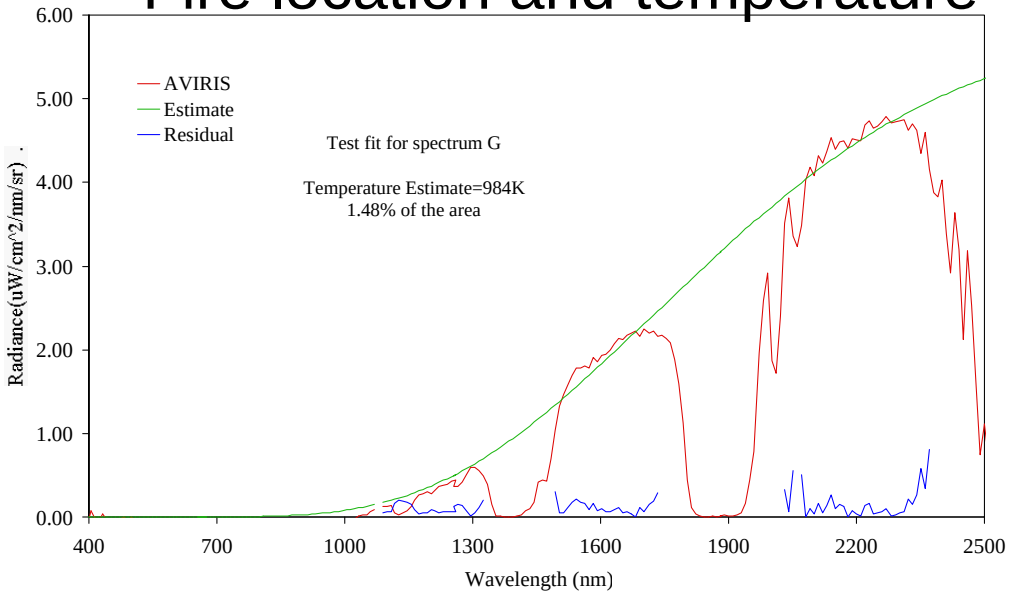


Debris composition and dispersal

Asbestos

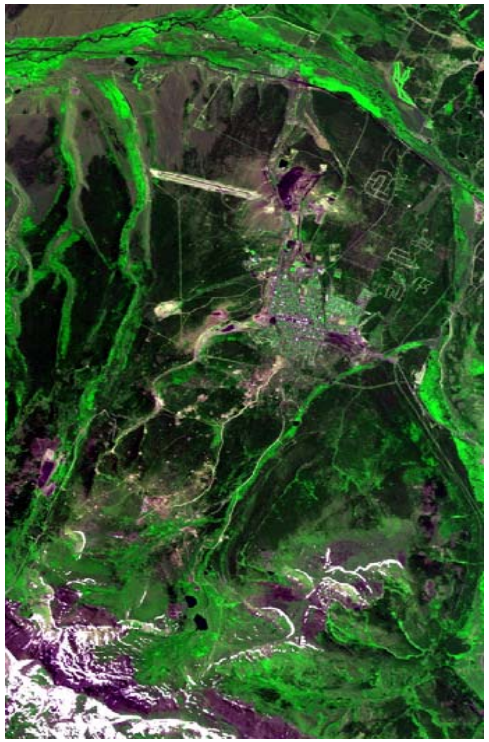


Fire location and temperature

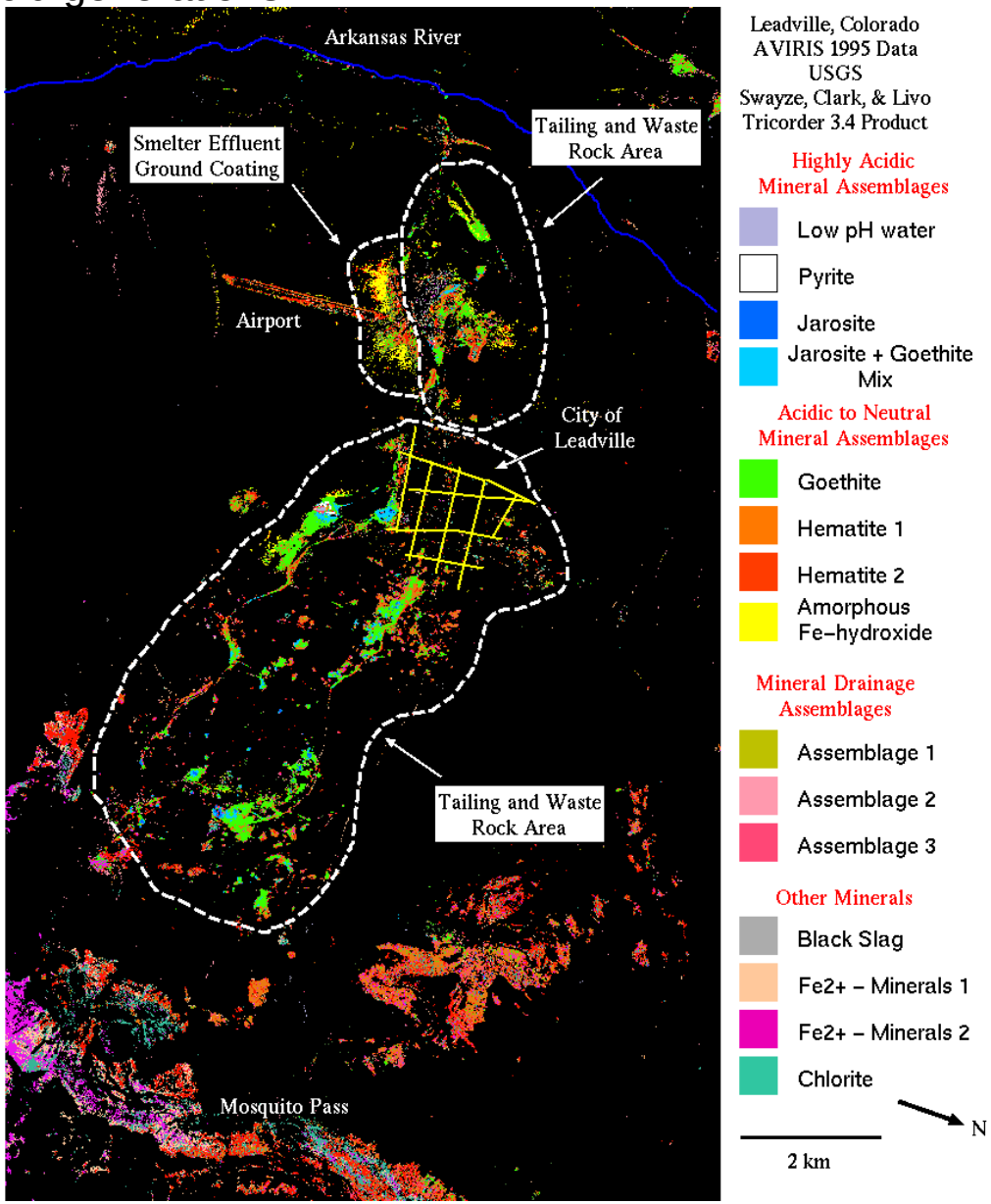


Mapping Superfund Hazards at Leadville, CO

AVIRIS Leadville, CO Image



Surface mineral/geochemistry related to acid generations

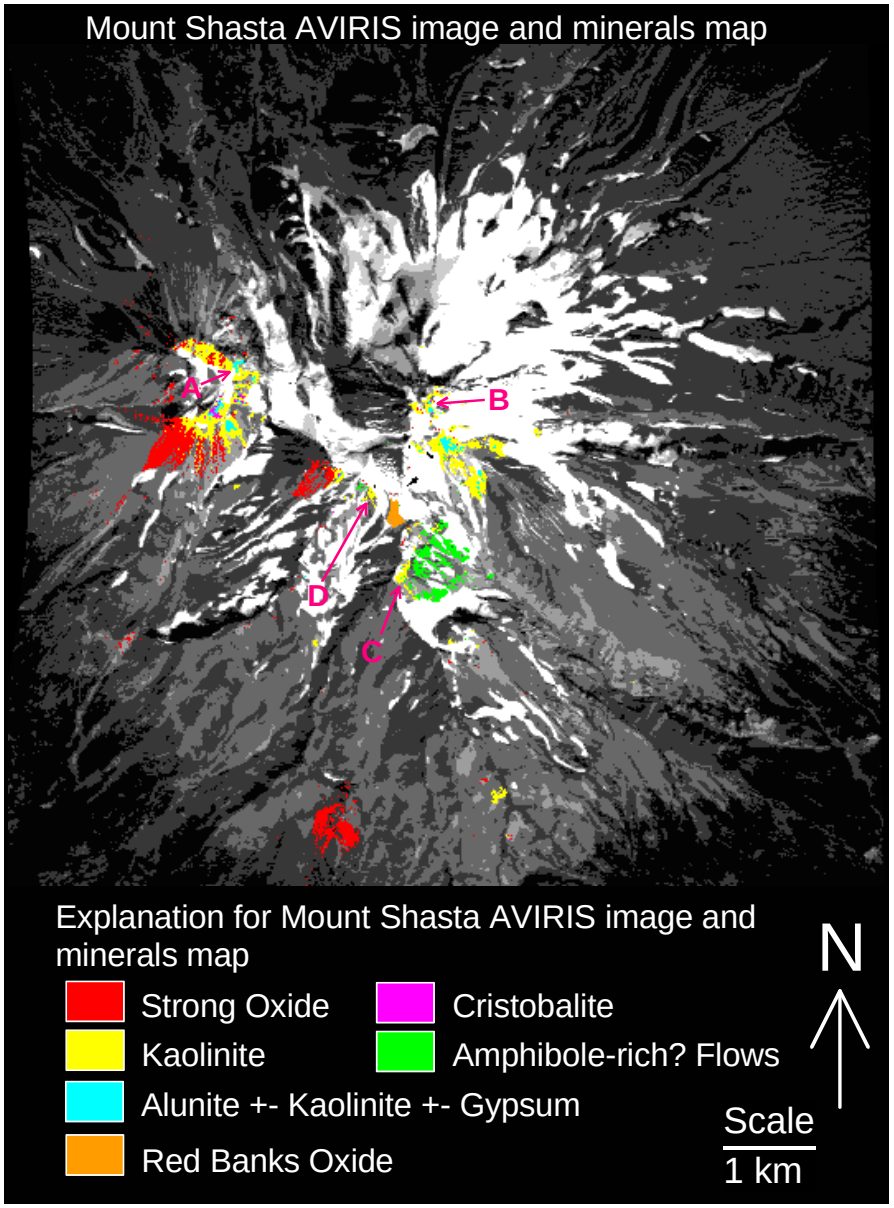


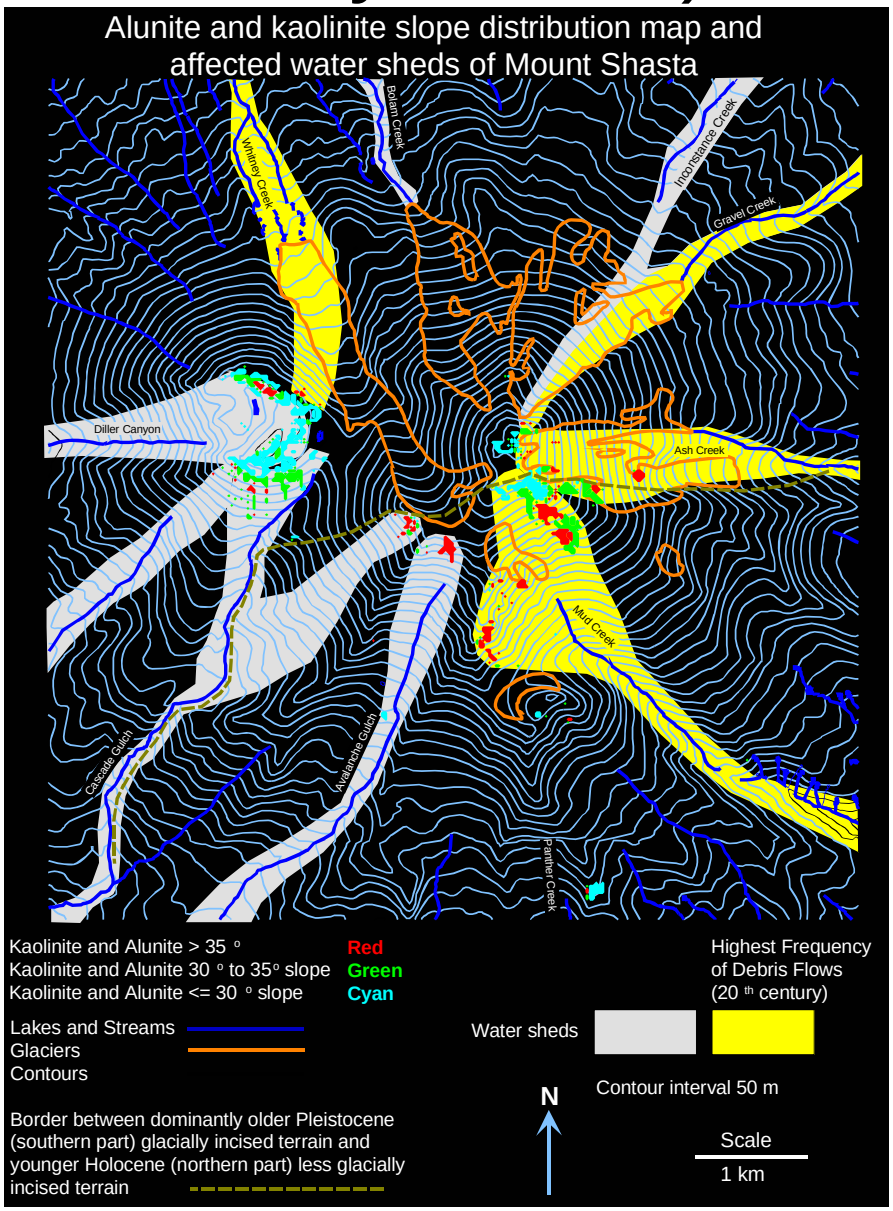
Comment from EPA regarding us of imaging spectroscopy measurement for acid mine hazard remediation

I am writing to convey the support of my office and staff for the AVIRIS program. Remote sensing data collected by NASA/JPL with the Airborne Visible-Infrared Imaging Spectrometer (AVIRIS) instrument of the California Gulch NPL Site near Leadville, Colorado has provided information aiding in the to remediation of heavy metal contamination at this site. AVIRIS data was collected in July of 1995 and was calibrated and mapped using the Tricorder algorithm at the USGS. Similar work was done at the Summitville NPL site and is beginning in the Upper Animas Basin. This work has resulted in, and will continue to produce significant cost savings in site investigations and cleanup activities.

Use of the AVIRIS data and technology has provided an estimated $2 million dollar saving in site investigation study expenditures. The AVIRIS technology has also resulted in shortening of the site investigation process by an estimated 2 ½ years.

Mt Shasta, CA: AVIRIS used to assess volcano debris flow hazard (J. Crowley, USGS)





Key Thoughts

The temporal repeat for the VSWIR at the equator is 19 days

The baseline requirements are closely tied to the Decadal Survey and vetted with two years of science study groups.

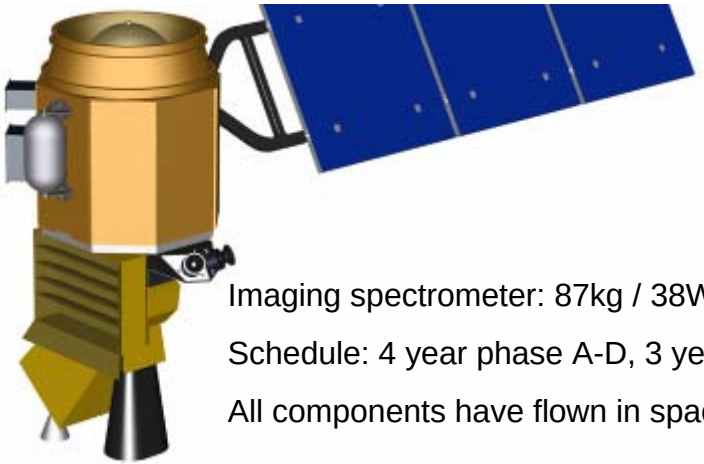
- Requirement growth is to be avoided.
- Requirement clarification is good.

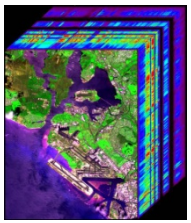
Objectives of the VSWIR breakout sessions:

- Refine, strengthen and prioritize the science questions.
- Assure the science questions are clearly answerable with the VSWIR science measurements.
- Bring the Science Traceability Matrices forward from current 1st draft

Specify specific products, algorithms, portions of the spectrum used

HyspIRI Imaging Spectroscopy (VSWIR) Science Measurements





Imaging spectrometer: 87kg / 38W

Schedule: 4 year phase A-D, 3 years operations

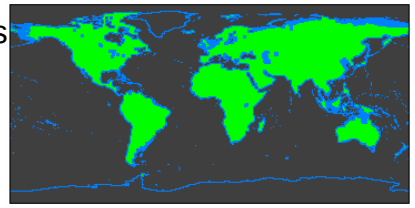
All components have flown in space

Science Questions:

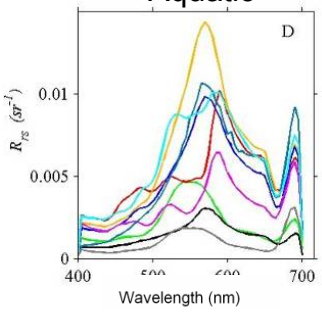
- *What is the composition, function, and health of land and water ecosystems?*
- *How are these ecosystems being altered by human activities and natural causes?*
- *How do these changes affect fundamental ecosystem processes upon which life on Earth depends?*

Measurement:

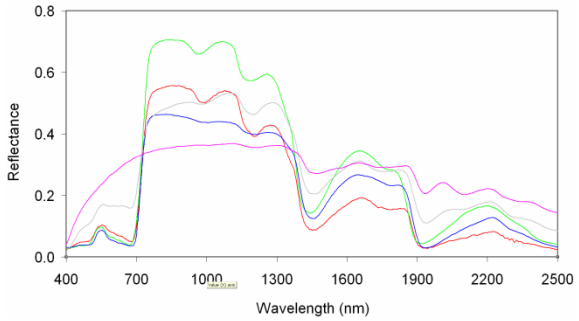
- 380 to 2500 nm in 10nm bands
- Accurate location 60m spatial
- 19 days revisit
- Global land and shallow water



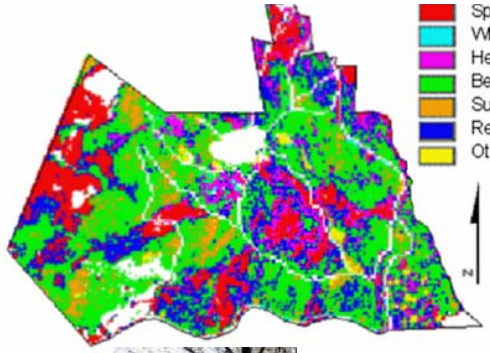
Aquatic

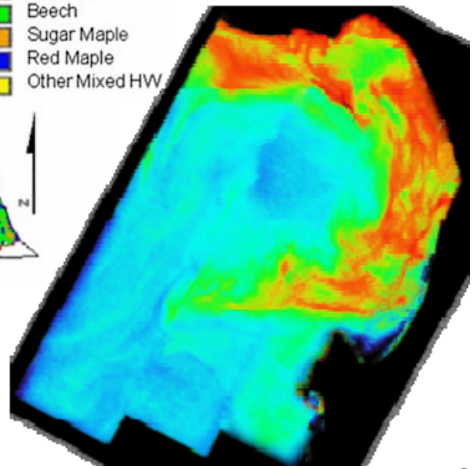


Terrestrial



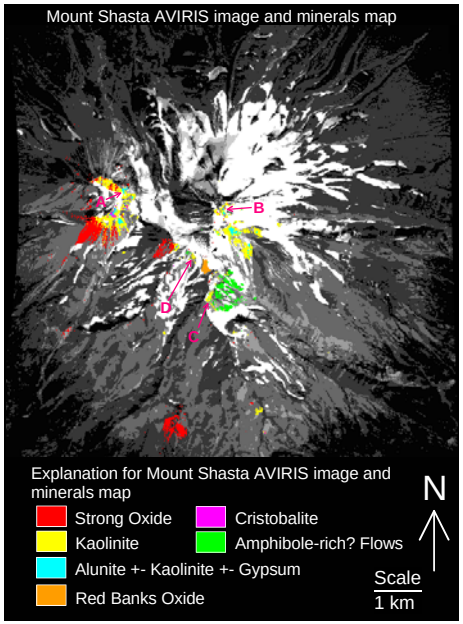
Map of dominant tree species, Bartlett Forest, NH

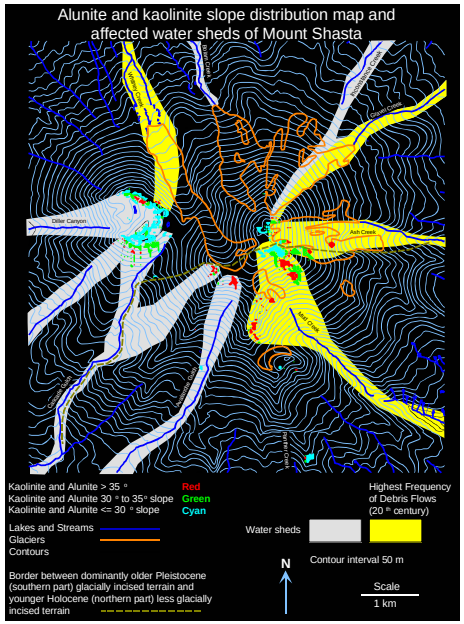


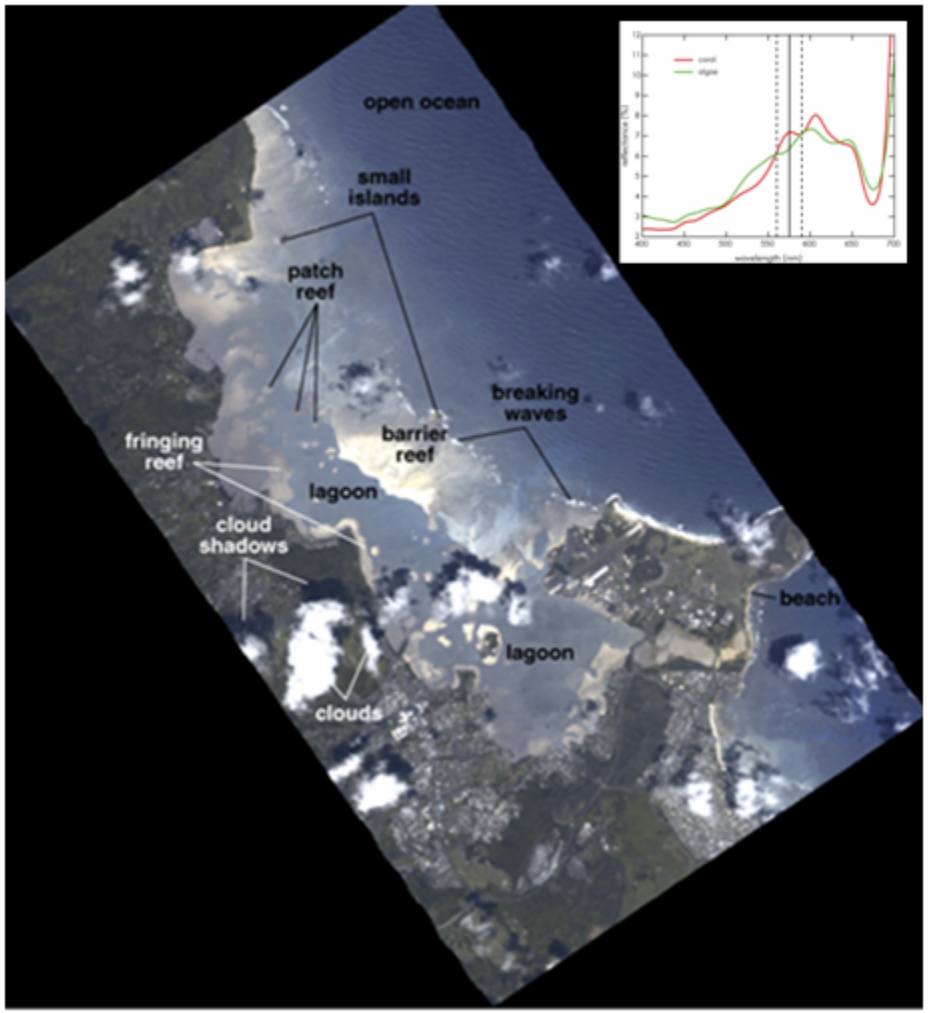


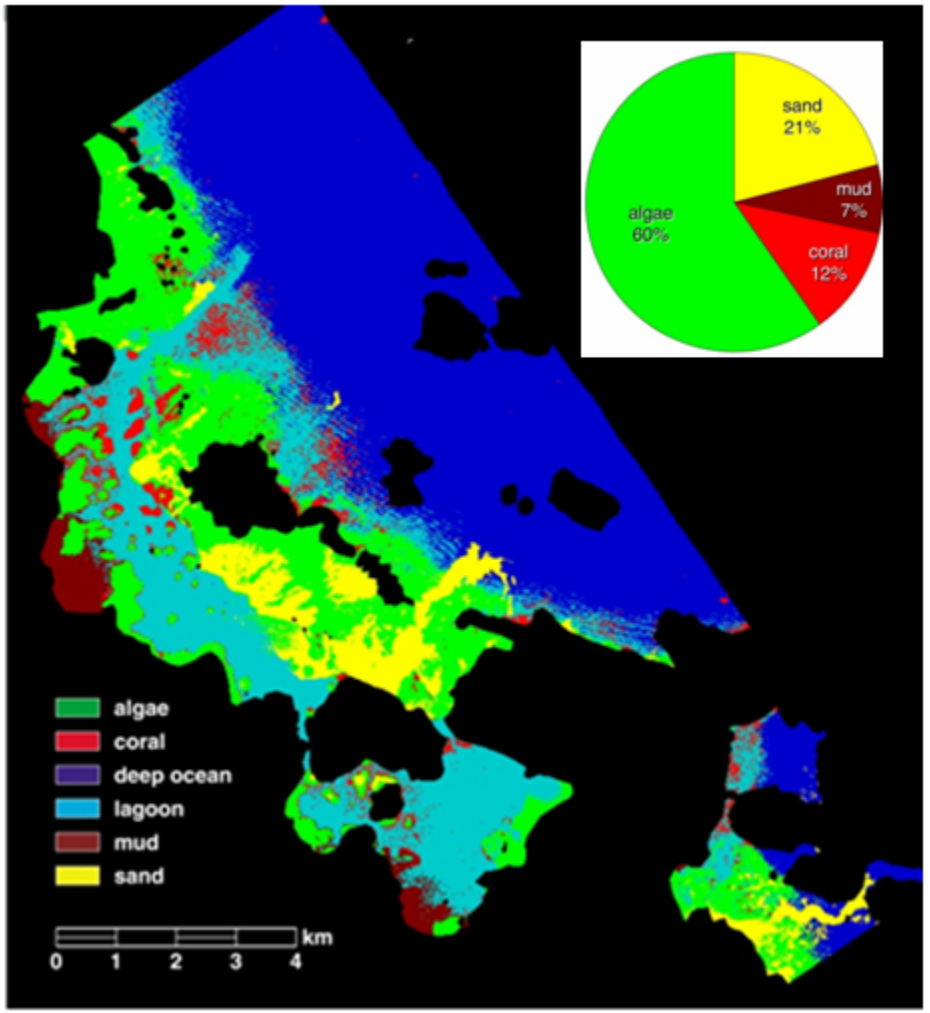
Red tide algal bloom in Monterey Bay, CA

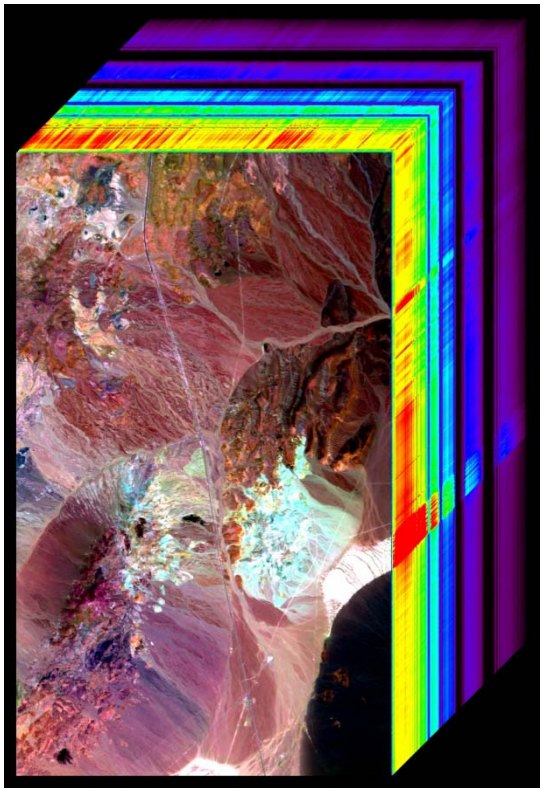
Back Up

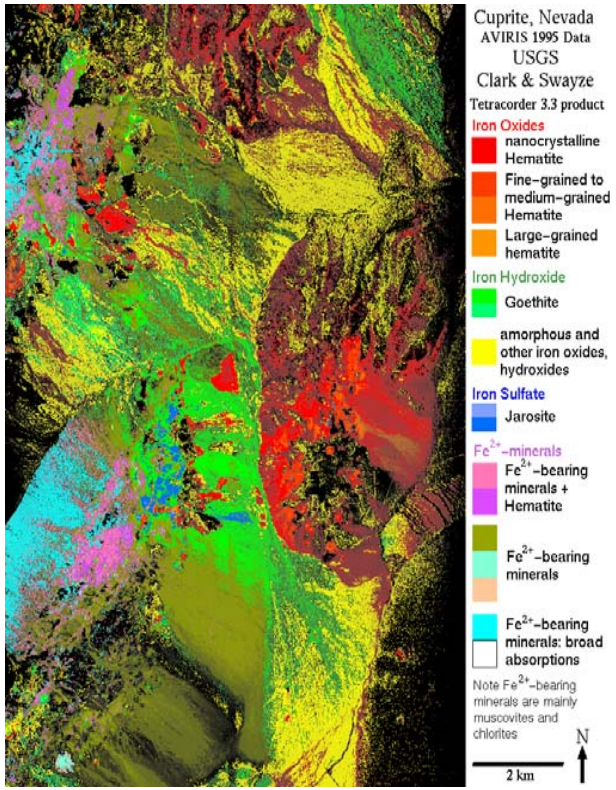

Mount Shasta AVIRIS image and minerals map
A
B
C
D
Explanation for Mount Shasta AVIRIS image and minerals map
Strong Oxide
Kaolinite
Alunite +- Kaolinite +- Gypsum
Red Banks Oxide
Cristobalite
Amphibole-rich? Flows
N
Scale
1 km

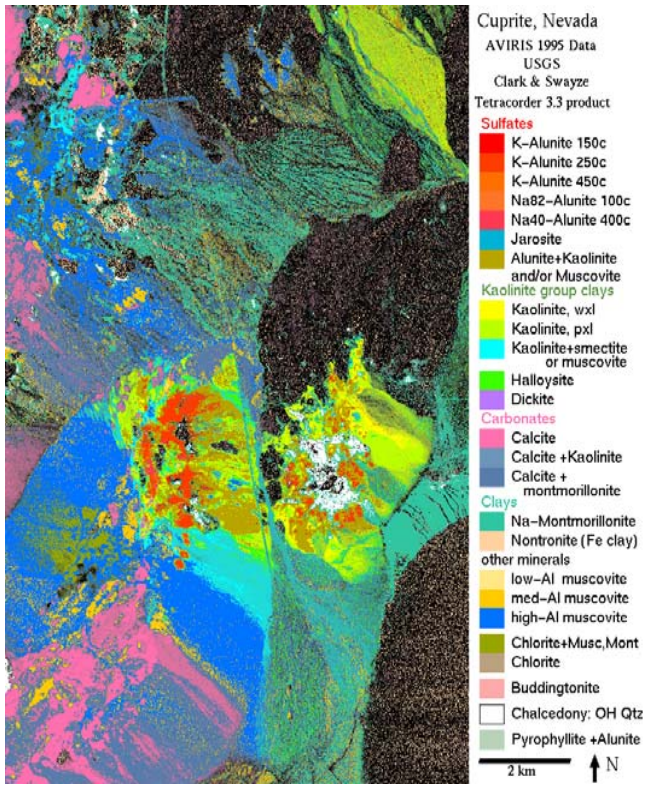

Alunite and kaolinite slope distribution map and affected water sheds of Mount Shasta
Diller Canyon
Ash Creek
Kaolinite and Alunite > 35 °
Kaolinite and Alunite 30 ° to 35° slope
Kaolinite and Alunite <= 30 ° slope
Red
Green
Cyan
Lakes and Streams
Glaciers
Contours
Water sheds
Highest Frequency of Debris Flows (20th century)
Contour interval 50 m
Border between dominantly older Pleistocene (southern part) glacially incised terrain and younger Holocene (northern part) less glacially incised terrain
N
Scale
1 km

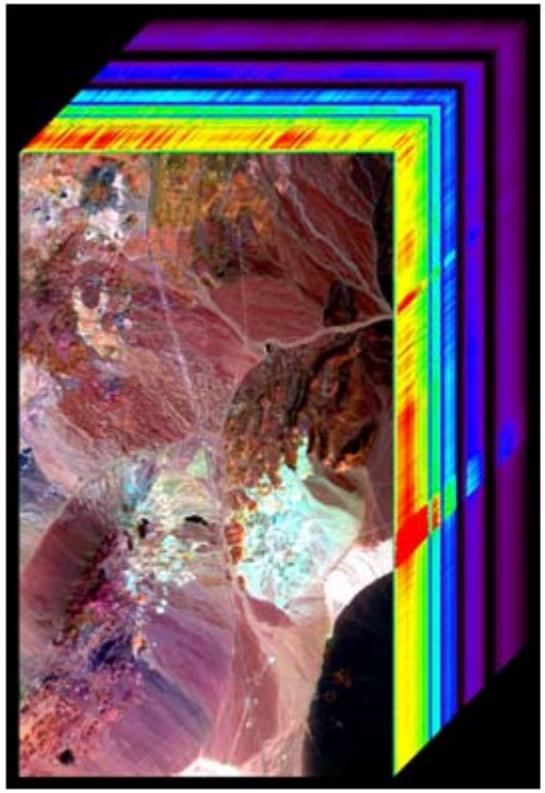

open ocean
small islands
patch reef
breaking waves
barrier reef
fringing reef
lagoon
cloud shadows
beach
lagoon
clouds
coral
algae
wavelength (nm)

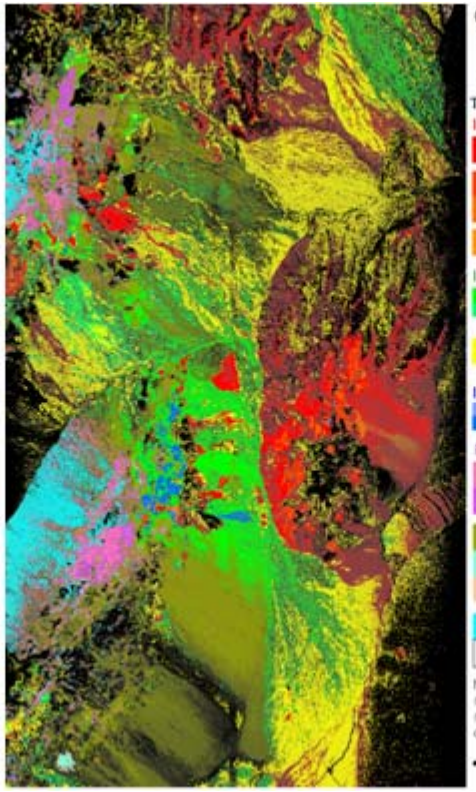

sand 21%
mud 7%
coral 12%
algae 60%
algae
coral
deep ocean
lagoon
mud
sand
km
0 1 2 3 4




Cuprite, Nevada
AVIRIS 1995 Data
USGS
Clark & Swayze
Tetracorder 3.3 product
Iron Oxides
nanocrystalline Hematite
Fine-grained to medium-grained Hematite
Large-grained hematite
Iron Hydroxide
Goethite
amorphous and other iron oxides, hydroxides
Iron Sulfate
Jarosite
Fe2+-minerals
Fe2+-bearing minerals + Hematite
Fe2+-bearing minerals
Fe2+-bearing minerals: broad absorptions
Note Fe2+-bearing minerals are mainly muscovites and chlorites
N
2 km


Cuprite, Nevada
AVIRIS 1995 Data
USGS
Clark & Swayze
Tetracorder 3.3 product
Sulfates
K-Alunite 150c
K-Alunite 250c
K-Alunite 450c
Na82-Alunite 100c
Na40-Alunite 400c
Jarosite
Alunite+Kaolinite and/or Muscovite
Kaolinite group clays
Kaolinite, wxl
Kaolinite, pxl
Kaolinite+smectite or muscovite
Halloysite
Dickite
Carbonates
Calcite
Calcite +Kaolinite
Calcite + montmorillonite
Clays
Na-Montmorillonite
Nontronite (Fe clay)
other minerals
low-Al muscovite
med-Al muscovite
high-Al muscovite
Chlorite+Musc,Mont
Chlorite
Buddingtonite
Chalcedony: OH Qtz
Pyrophyllite +Alunite
2 km
N

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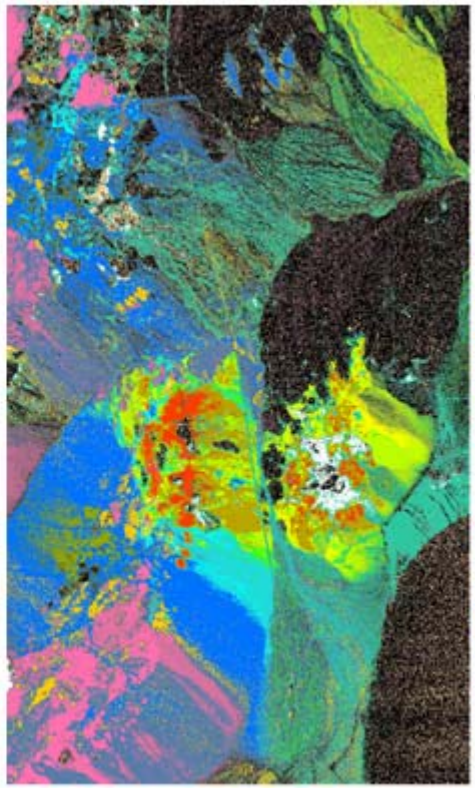
2 km
N


Cuprite, Nevada
AVIRIS 1995 Data
USGS
Clark & Swayze
Tetracorder 3.3 product
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Dickite
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Calcite
Calcite +Kaolinite
Calcite + montmorillonite
Clays
Na-Montmorillonite
Nontronite (Fe clay)
other minerals
low-Al muscovite
med-Al muscovite
high-Al muscovite
Chlorite+Musc,Mont
Chlorite
Buddingtonite
Chalcedony: OH Qtz
Pyrophyllite +Alunite
2 km
N

2 micron region mineral map from AVIRIS

Dr. Roger Clark and Dr. Gregg Swayze, USGS