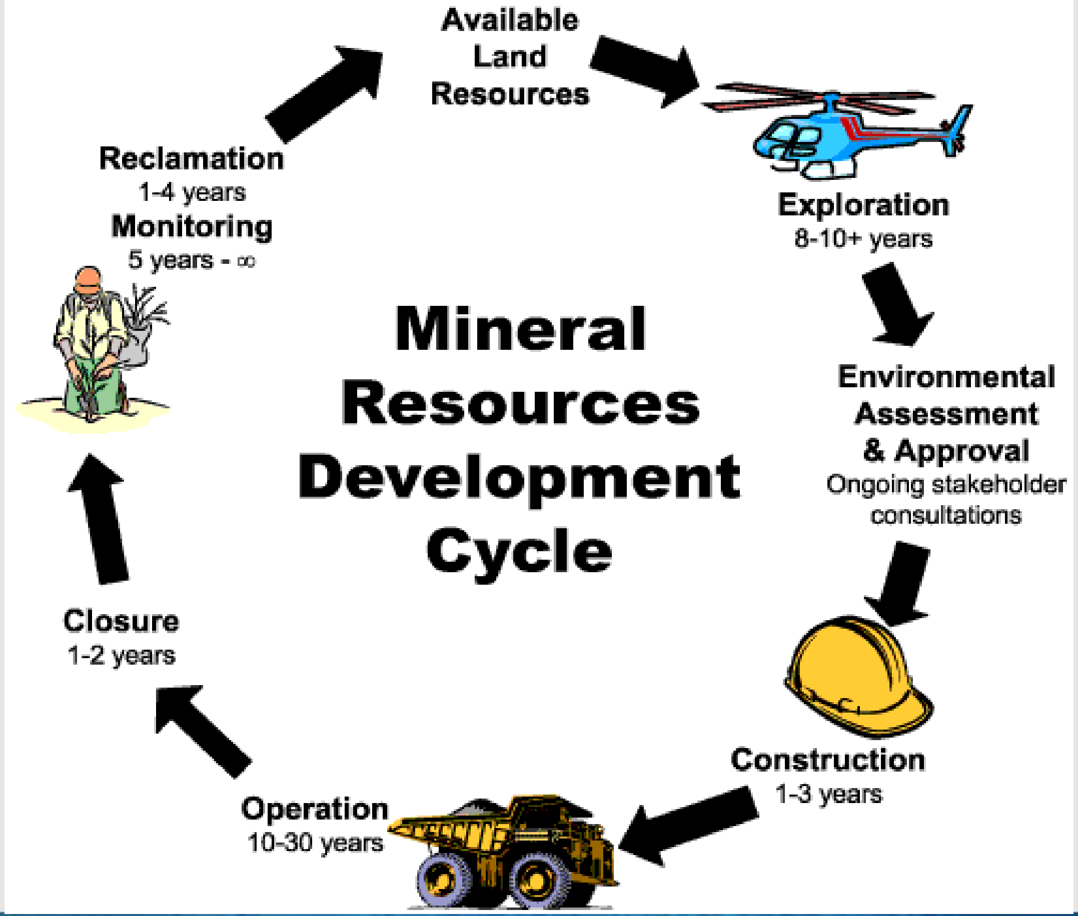
Mineral and Mining Research at UAF

Mark Myers, Vice Chancellor for Research
University of Alaska Fairbanks

UAF Has Research Expertise That Spans the Mining Cycle



UAF Mining and Mineral Expertise

Mining Engineering
Mine Design
Rajive Ganguli (MGE)

Ventilation
Sukumar Bandopadhyay (MGE)

Ground Control
Gang Chen (MGE)
Scott Huang (MGE)

Mine Safety
Gang Chen
Sukumar Bandopadhyay (MGE)
Rajive Ganguli (MGE)
Dennis Steffy (UAS, MAPTS)

Mine Systems
Rajive Ganguli (MGE)
Sukumar Bandopadhyay (MGE)

Mine Technology
Wireless
Dejan Raskovic (ECE)
Data & Algorithms
Rajive Ganguli (MGE)
Vikas Sonwalker (ECE)
Jason McNeely (ECE)
Energy
Rich Weis (ECE)
Billy Muhando (INE)

Mineral Processing
Dan Walsh (MIRL)
Steve Lin (MIRL)

Resource Estimation
Exploration / Geology
Anupma Prakash (GEO)
Rainer Newberry (GEO)
Mary Keskinen (GEO)
Bernie Coakley (GEO)
Paul Metz (MGE)
Cathy Hanks (GEO/PETE)

Resource Modeling
Rajive Ganguli (MGE)

Mineral Economics
Economics
Paul Metz (MGE)
Doug Reynolds (ECON)
Junho Baek (ECON)

Policy
Gary Kofinas (NRM)
Julie Joly (NRM)

Arctic / Cold Climate

Yuri Shur (CEE)
Margaret Darrow (MGE)
John Zarling (CEM)
Kenji Yoshikawa (INE)

Vo-Tech / Training

Diesel Mech
Brian Rencher (CTC)

Process Tech
Brian Ellingson (CTC)

MSHA Training
Dennis Steffy (UAS, MAPTS)

Permitting Issues
Mine Waste Management
Dave Barnes (CEE)
Sarah Hayes (CHEM)
Tom Trainor (CHEM)
Bill Schnabel (WERC)

Ecology
Falk Huetmann (BIO)
Anne Beaudreau (FISH)
Ginny Eckert (FISH)
Sarah Trainor - Human Dimensions
Katey Anthony - Lake Ecosystems
Matthew Wooller - Biology
Kenji Yoshikawa - Permafrost

Societal Impacts
Ralph Gabrielli (RUR DEV)
Anna Berge (LING)
Maribeth Murray (NORS)
Susan Todd (NRM)
Sarah Trainor (INE)
Phil Loring - Human Impacts

Water
Bill Schnabel – WERC
Debu Misra - Hydrology
Ronnie Danaan - Hydrology
Doug Kane - Hydrology
Anna Liljedahl – Hydrology
Horacio Toniolo – Hydrology

Modeling of Impacts
Tom Heinrichs - Remote Sensing
Scott Rupp - Climate Modeling

UAF Facilities

A well-equipped coal laboratory is devoted to research and service activities on the characterization, petrography, distribution, and preparation of Alaska's coals.

The laboratory facilities at MIRL include:

- Mineral Processing Lab
- Hydrometallurgy Lab
- Electrochemistry Lab
- Analytical Lab
- Coal Lab

UAF's Advanced Instrumentation Laboratory.

- CAMECA SX-50 Electron Microprobe
- Atomic Force Microscope
- Transmission Electron Microscope
- Scanning Electron Microscope
- X-Ray Fluorescence Spectrometer
- X-Ray Diffraction
- Fourier Transform Infrared Spectrometer
- Inductively Coupled Plasma Mass Spectrometer

UAF Mineral Partnerships with State Agencies

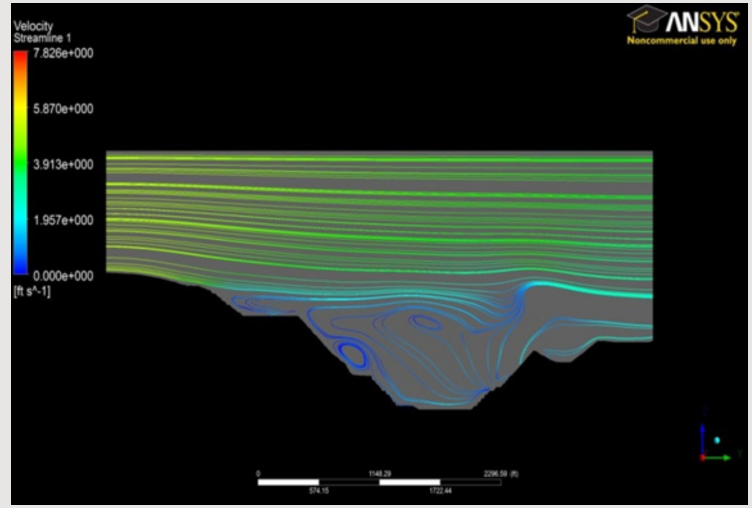
- DGGS Partnership
  - Exploration program
    - Mapping
  - Mineral processing studies
    - DGGS is currently using MIRL facilities for Ray Mountain rare earth study
- DNR/DEC/Other
  - Permitting
  - Land Selection
- DCCED
  - Targeted research to spur economic development
  - Intellectual Property

MIRL Capabilities:

Mineral Processing

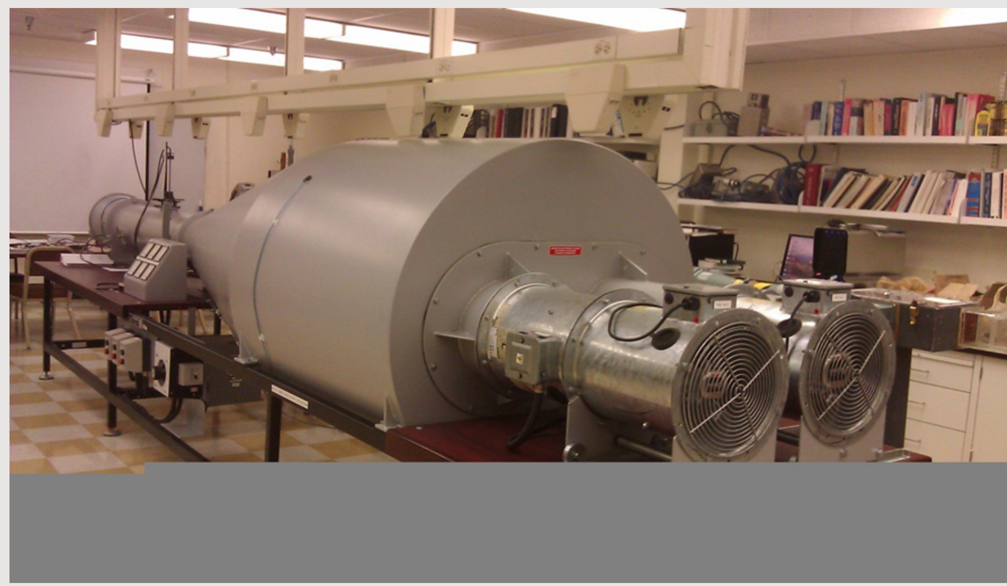
- Coal
- Metal/non-metal

- Comminution
- Flotation
- Separation
- Solvent extraction
- Electrowinning



Ventilation

- Coal
- Mine Ventilation Networks
- Simulation



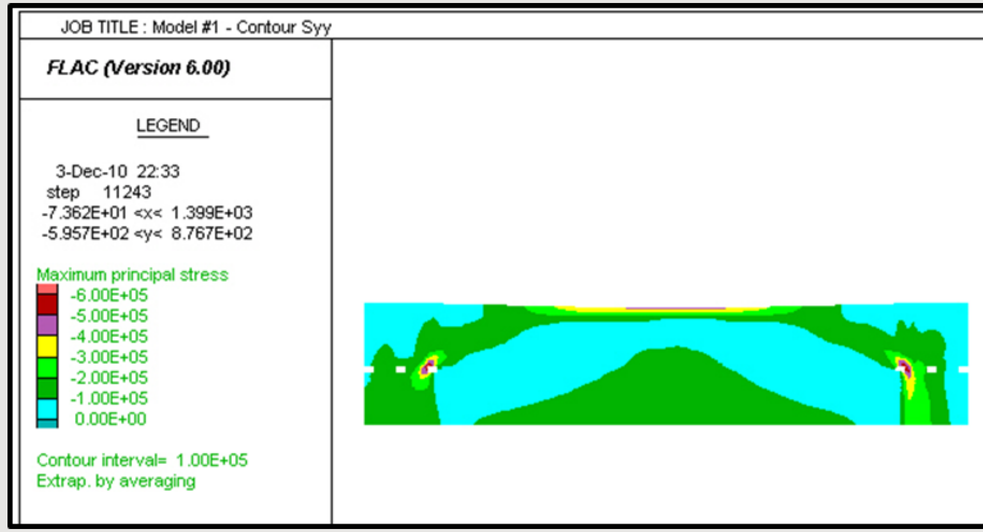
MIRL Capabilities:

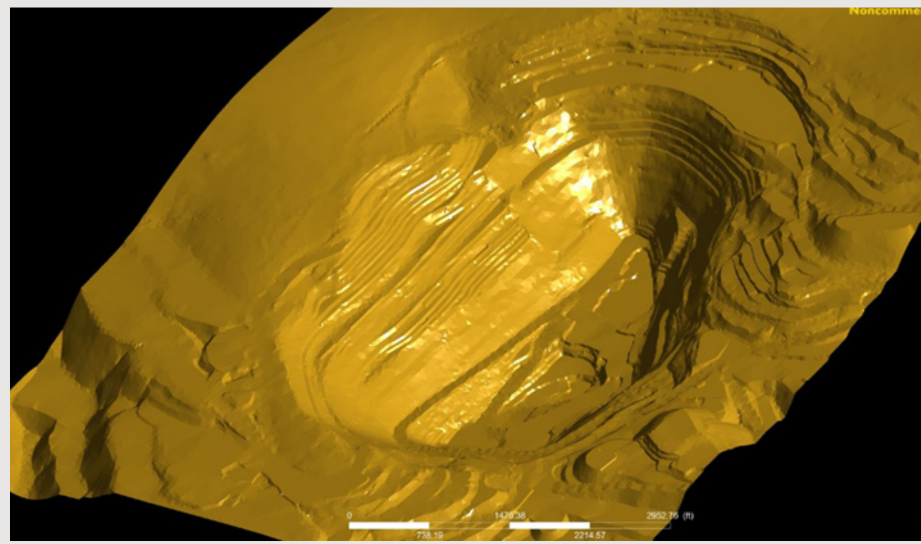
Strata Control

- Rock testing
  - Frozen sample testing
- Slope Stability
- Frozen Ground Engineering
- Finite element modeling
- Basic Geotech

Mine Design

- Reserve Estimation
- Block Modeling
- 3D Mine Design





MIRL Capabilities:

Hydrology

- Underground hydrology
- Contaminant flow through soils
- Soil Properties
- Hydrological Properties

Other

- Mineral Economics
- Exploration Geophysics
- GIS
- Soil Engineering
- Coal Gasification
- Silver Fox Mine
- Computational / Software development

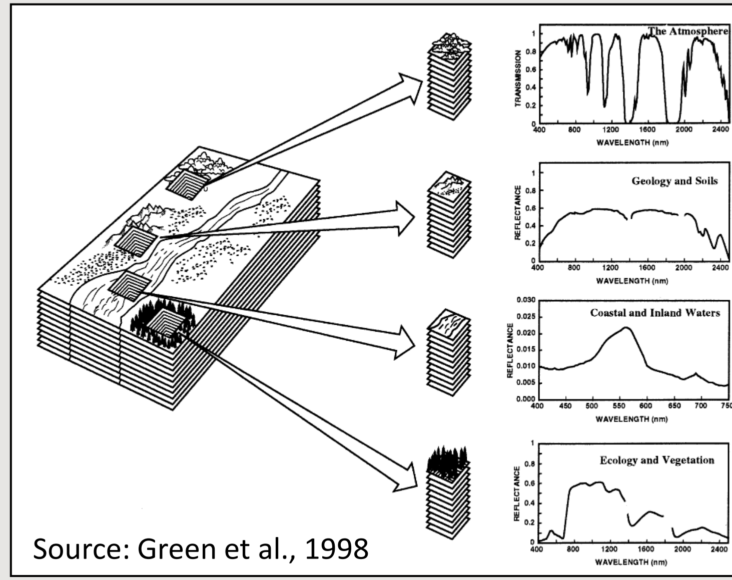
UAF investing in new approaches to Mineral Exploration

What is Hyperspectral Mapping?

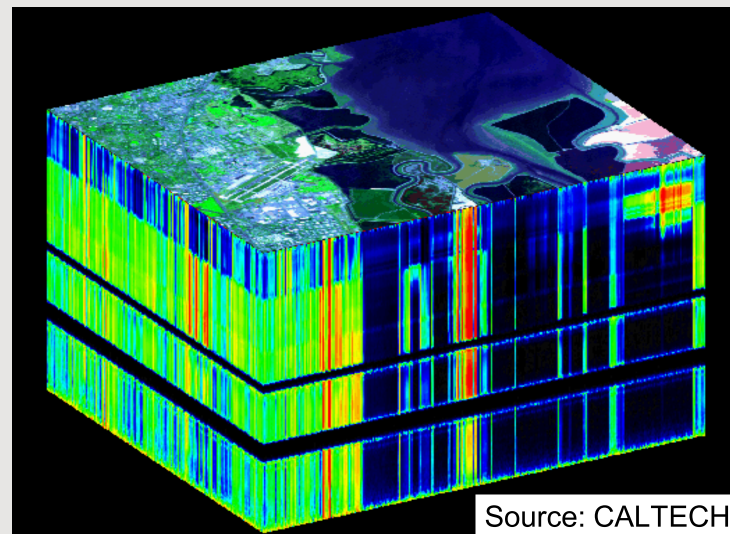
- We use images acquired in 100s of narrow spectral regions (visible, infrared, thermal portion of the spectrum) to figure out in which parts of the spectrum the target is absorbing energy and where it is reflecting.

- This absorption and reflection pattern (known as the spectral signature) is diagnostic for different materials

- We use these spectral signatures to identify minerals, rocks, hydrocarbons, vegetation species, material types, etc.

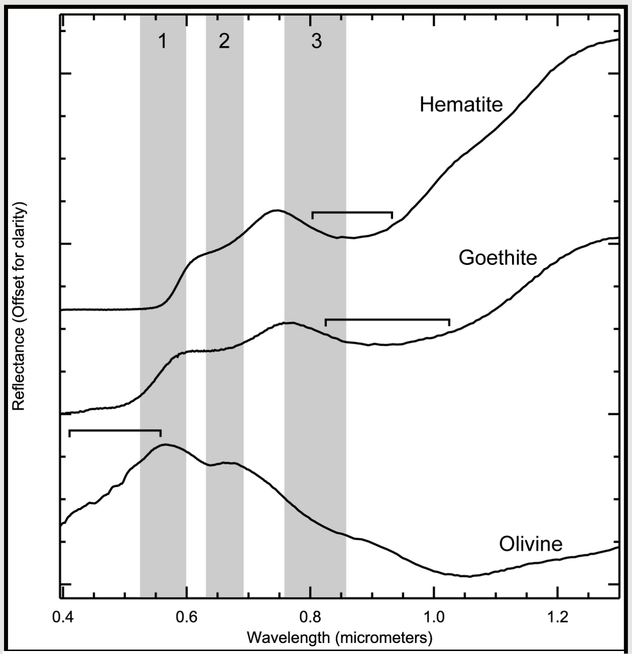


Source: Green et al., 1998

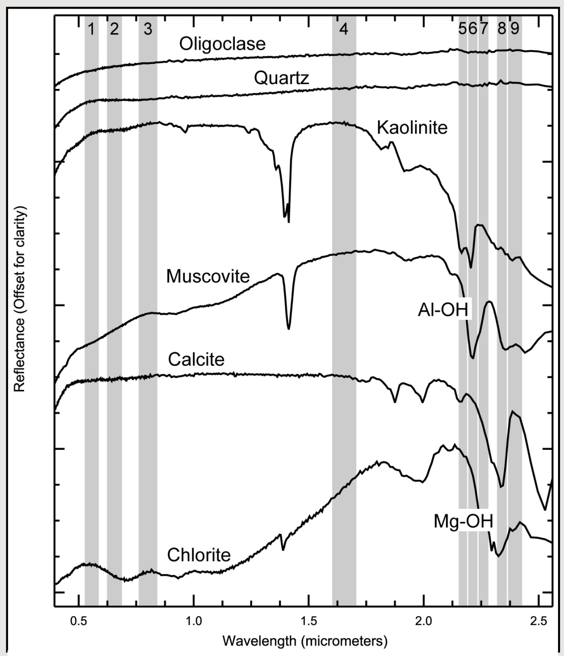

Source: CALTECH

Minerals Mapping

- Technology let's us get down to the level of identifying mineral chemistry !!!!.
  - Iron-bearing minerals display most absorption features in visible to near-infrared
  - Minerals displaying SWIR absorption features include clays, phyllosilicates, carbonates
  - Minerals display diagnostic emission features in TIR



Credits: Haselwimmer, derived from USG spectral library



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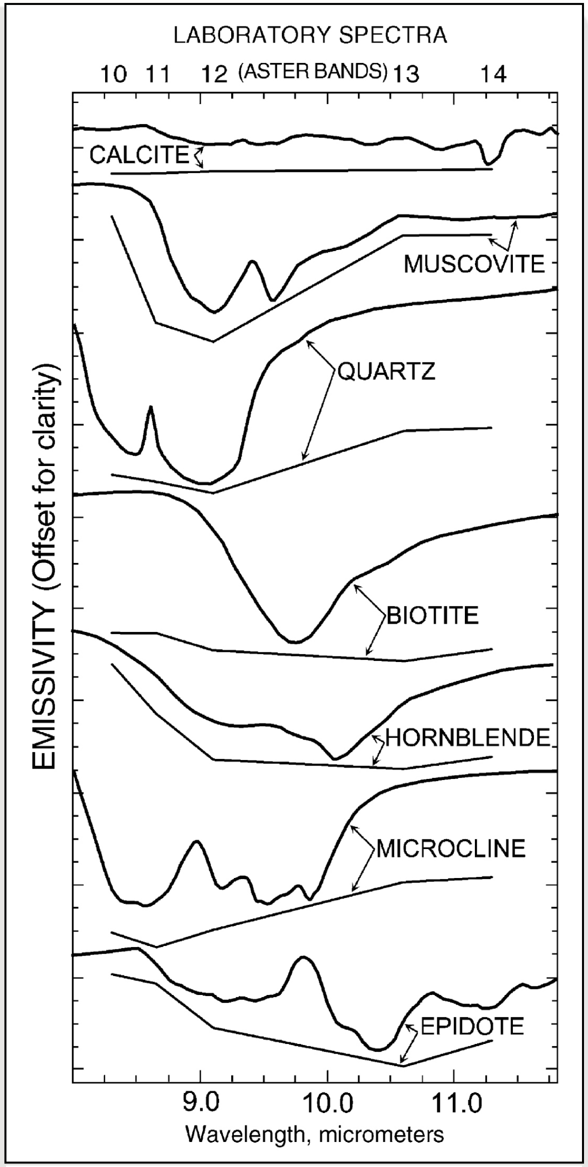
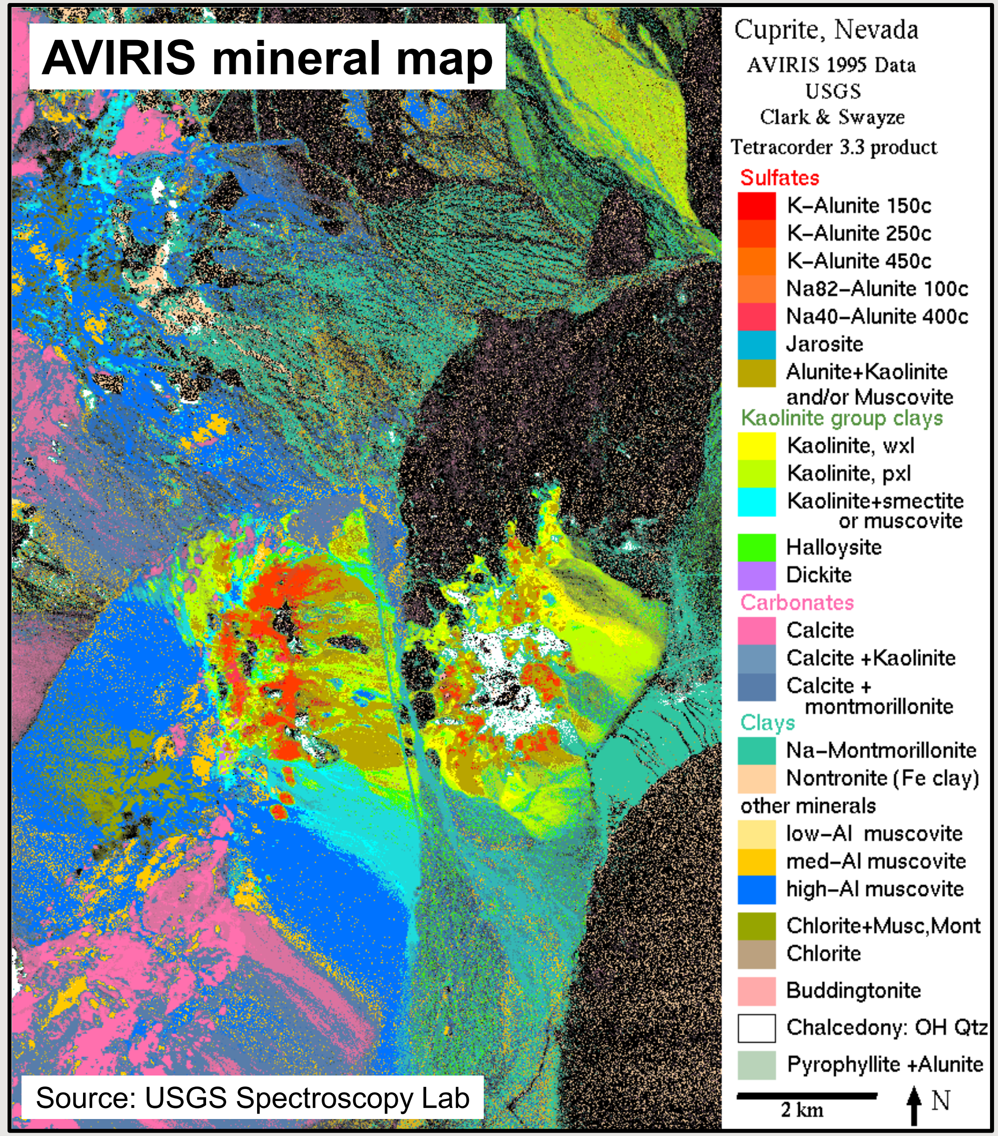


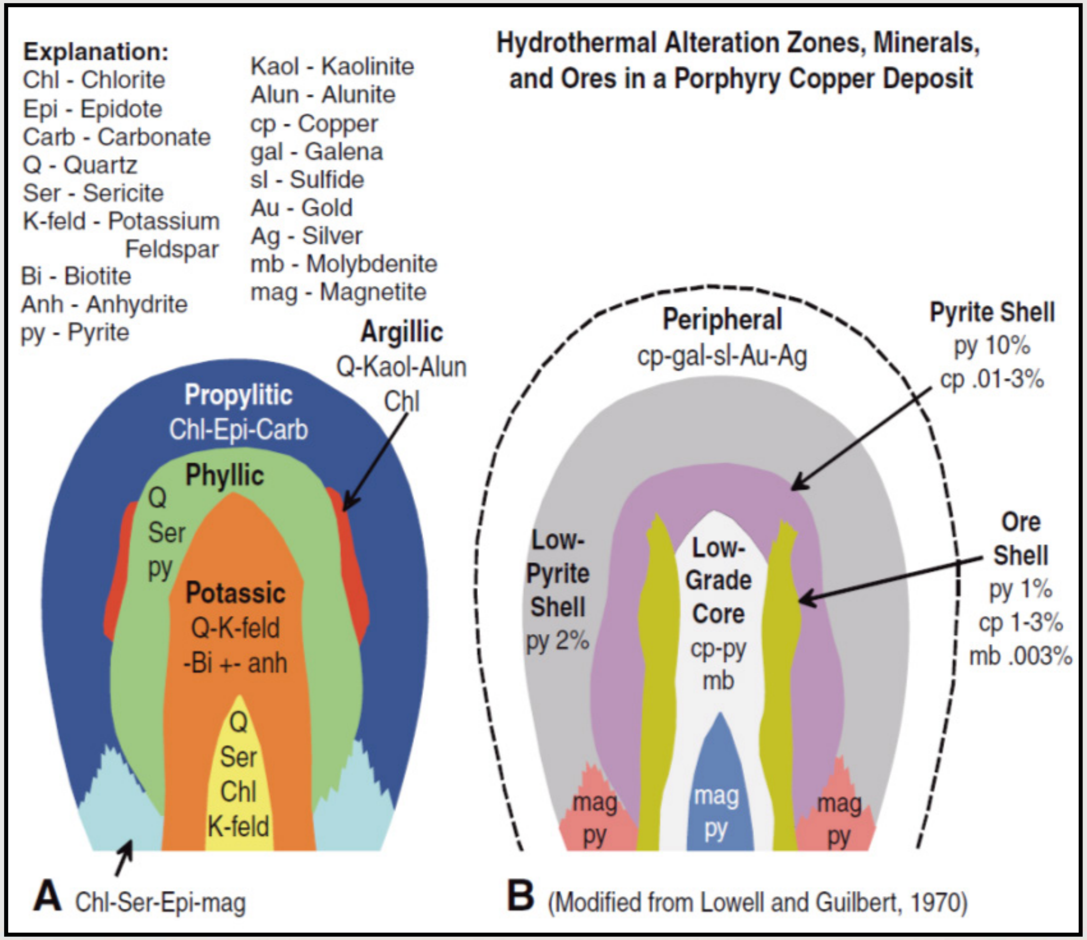
Source: Mars and Rowan, 2003



Generalization of hydrocarbon seepage (Yang, 1999)

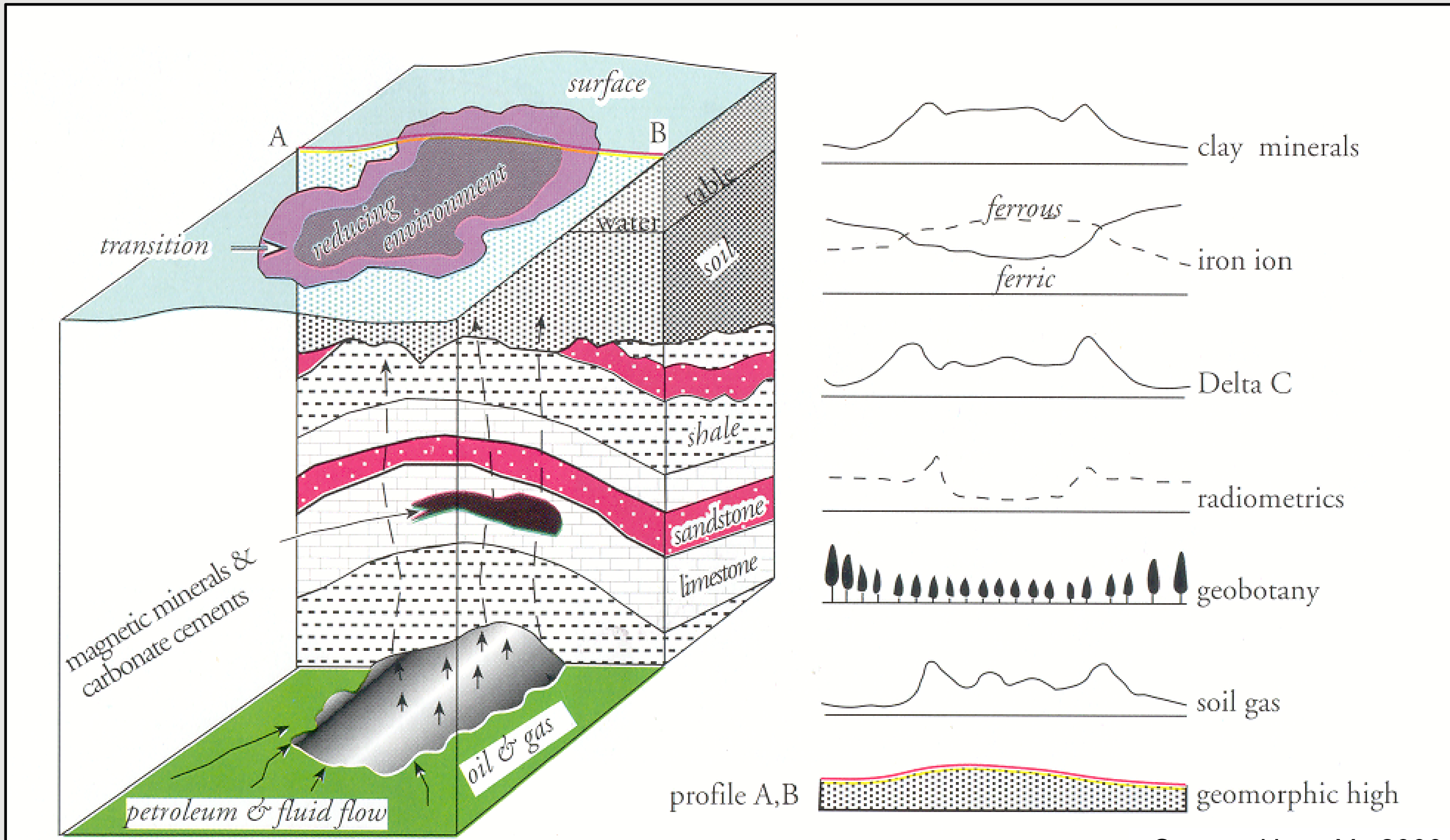
Minerals Mapping

- Hydrothermal alteration of rocks produces characteristic zoned assemblages of minerals that can provide targets for mineral exploration



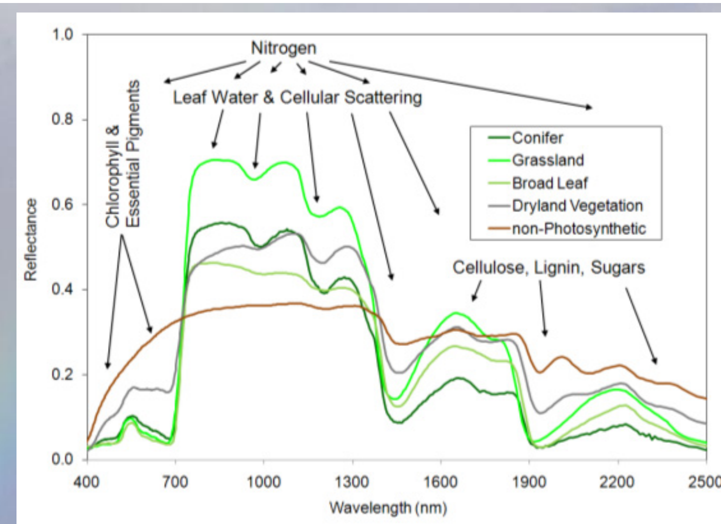
What if the target is not exposed ?

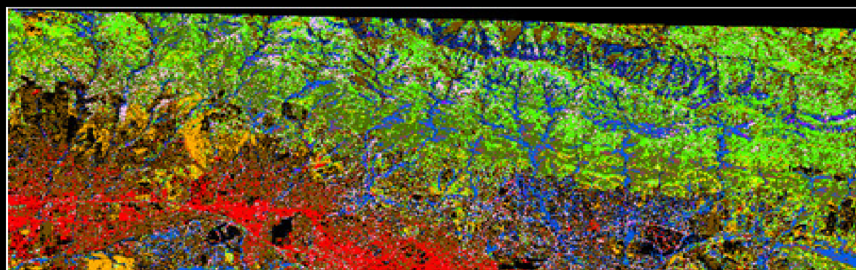
- Use indirect indicators: geomorphology, vegetation, etc.



Source: Hong Y., 2000

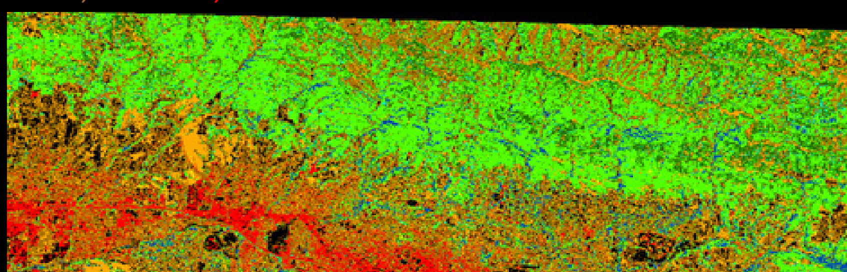
Measuring Terrestrial Biosphere





Species Map

chamise, sagebrush, manzanita, mustard, bigpod ceanothus, redheart ceanothus, grass, coast live oak, scrub oak, California bay, yucca, soil, urban, unclassified



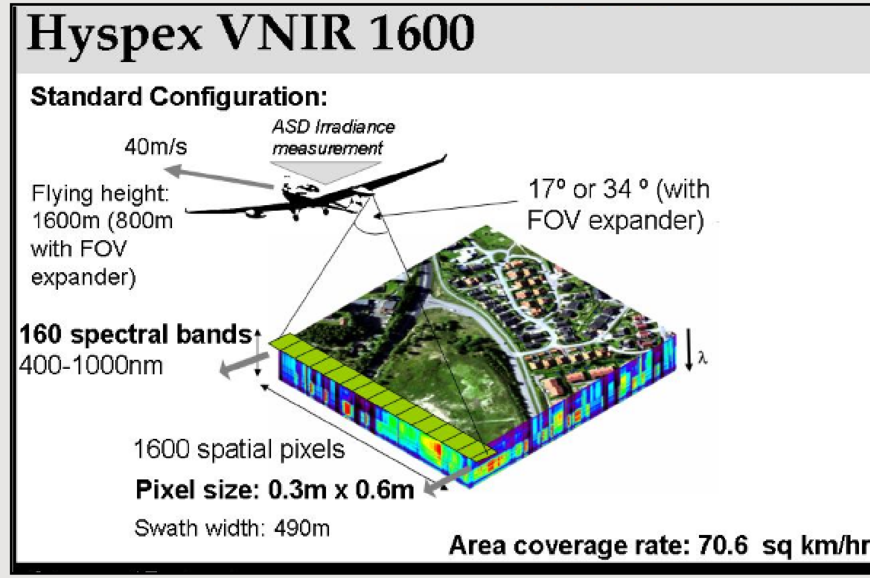
Functional Type Map

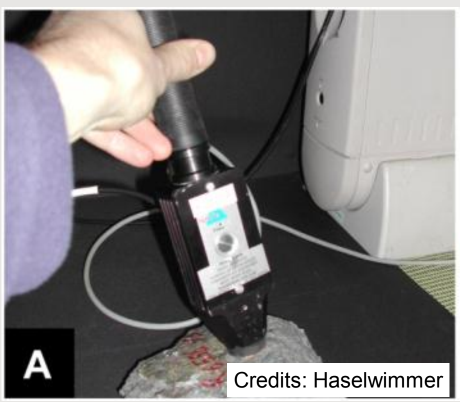
Annual grass, annual herb, Evergreen broadleaf shrub, evergreen broadleaf tree, evergreen needleleaf shrub, evergreen succulent, soil, urban, unclassified

Credits: Dr. Roberts, HyspIRI 2002

Our capacity at UAF

- We have in-house expertise in
  - understanding Alaska specific needs
  - hyperspectral data acquisition
  - scaling: from field to satellite scale
  - data processing & product generation
- We need to invest in
  - partnership
  - new hyperspectral sensors
  - trained workforce for data processing
  - building Alaska specific spectral libraries

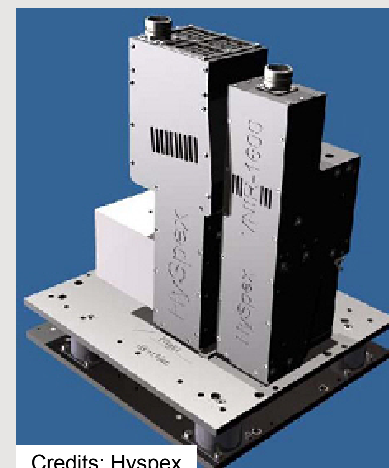




Credits: Haselwimmer

Source: Lammoglia & de Souza-Filho, 2011


Source: Clark et al., 2002



Credits: Hyspex

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Thank You for Your Attention

For more information contact:
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