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

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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 lets 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

Source: Mars and Rowan, 2003

Credits: Haselwimmer, derived from USGS spectral library
Generalization of hydrocarbon seepage (Yang, 1999)

Source: Google Maps

Source: USGS Spectroscopy Lab

Google Maps

AVIRIS mineral map

Cuprite, Nevada
AVIRIS 1995 Data
USGS
Clark & Swayze
Tetracorder 3.3 product

Sulfates
K-Alunite 150c
K-Alunite 250c
K-Alunite 450c
Na52-Alunite 100c
Na40-Alunite 400c
Jarosite
Alunite+Kaolinite and/or Muscovite
Kaolinite group clays
Kaolinite, w.x.l
Kaolinite, p.x.l
Kaolinite-smectite or muscovite
Halloysite
Dickite
Carbonates
Calcite
Calcite +Kaolinite
Calcite + montmorillonite
Clays
Na-Montmorillonite
Nontonite (Fe clay)
other minerals
low-Al muscovite
med-Al muscovite
high-Al muscovite
Chlorite+Musc, Mont
Chlorite
Buddingtonite
Chalcedony: OH Qtz
Pyrophyllite +Alunite

Source: Google Maps

Source: USGS Spectroscopy Lab

2 km
↑ N
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
What if the target is not exposed?

- Use indirect indicators: geomorphology, vegetation, etc.

Source: Hong Y., 2000

Measuring Terrestrial Biosphere

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

- 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

Hyspex VNIR 1600

- Standard Configuration:
  - Flying height: 1600m (800m with FOV expander)
  - 160 spectral bands: 400-1000nm
  - 1600 spatial pixels
  - Pixel size: 0.3m x 0.6m
  - Swath width: 490m
  - Area coverage rate: 70.6 sq km/hr

Source: Clark et al., 2002
Source: Lammoglia & de Souza-Filho, 2011
Credits: Hyspex
Thank You for Your Attention

For more information contact:
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