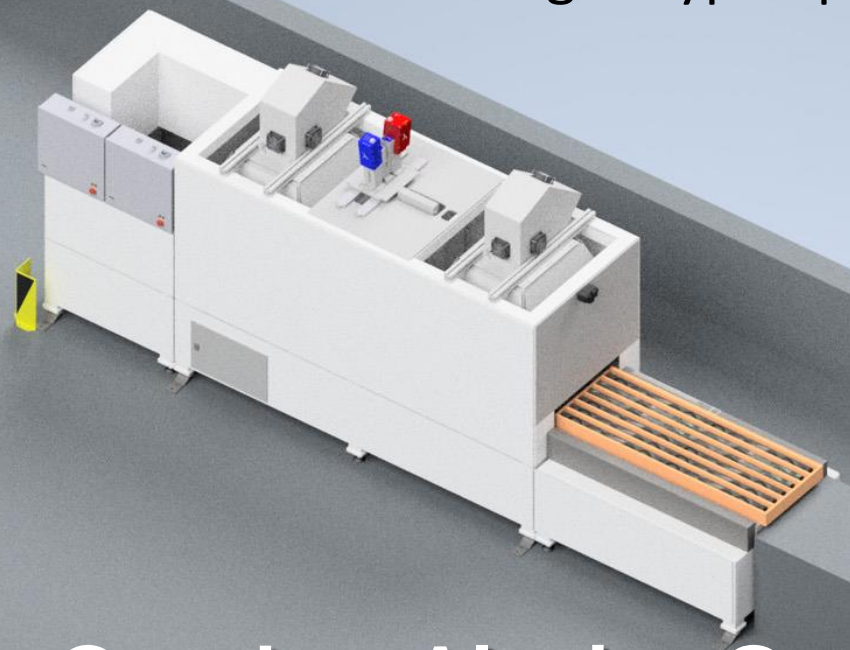
A Hyper-spectacular Occurrence with Fall to Earth

Building a Hyperspectral Savvy Community in Alaska



Kurt Johnson, Curator, Alaska Geologic Materials Center
Alaska Division of Geological & Geophysical Surveys

Alaska Miners Association 2024 Convention
Anchorage, Alaska Nov. 5, 2024

HSI Project: Appreciation

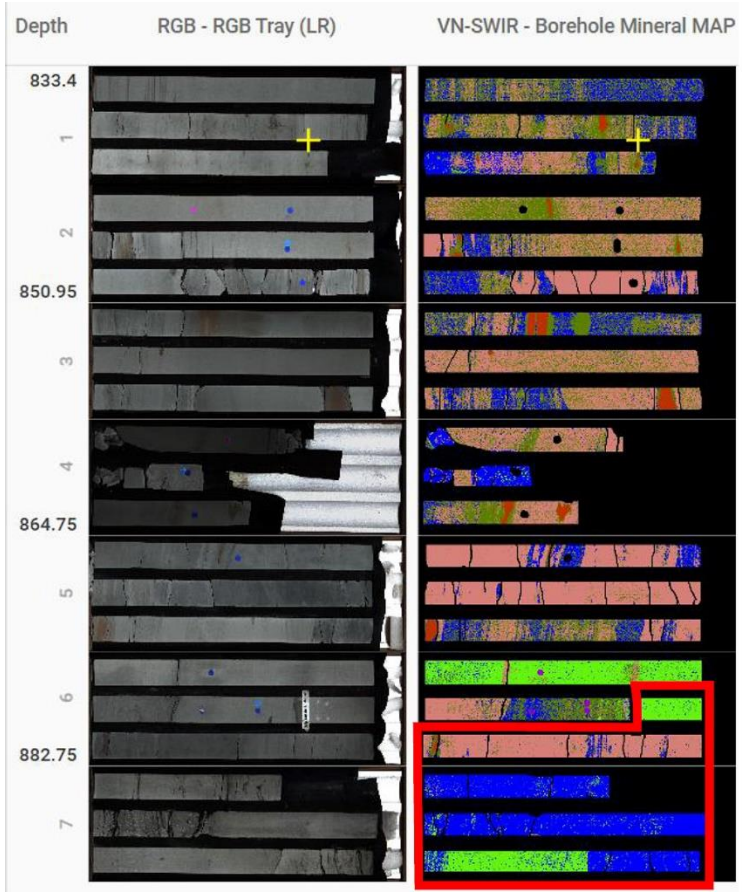
Local organization
- Alaska Geological Society

Funding
- State of Alaska
- National Geological and Geophysical Data Preservation Program (USGS)

Public agencies
- College of North Atlantic
- Australia geological surveys

Senior spectral geologist David Green from Tasmania highlights operation of the HyLogger 3.

Breaking New Ground



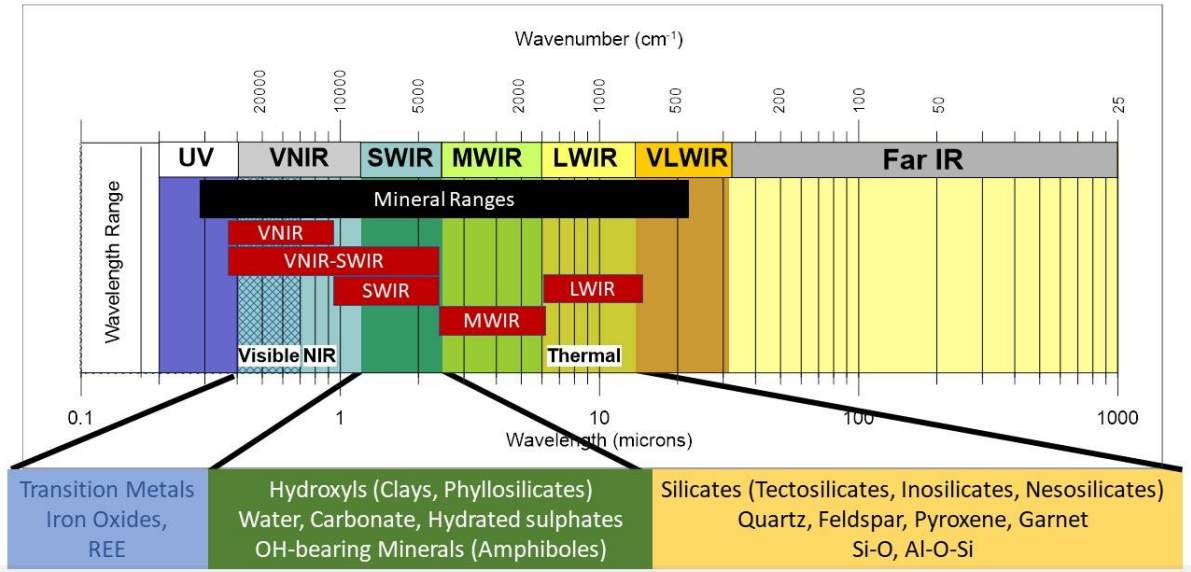
Umiat 18 hydrocarbon signature in blue.

HSI goals

- Cheaper, faster mineralogy logs
- 3D mappable alteration halos and superior vector to mineralization
- Improved petroleum reservoir quality
- Scalable regional geologic models

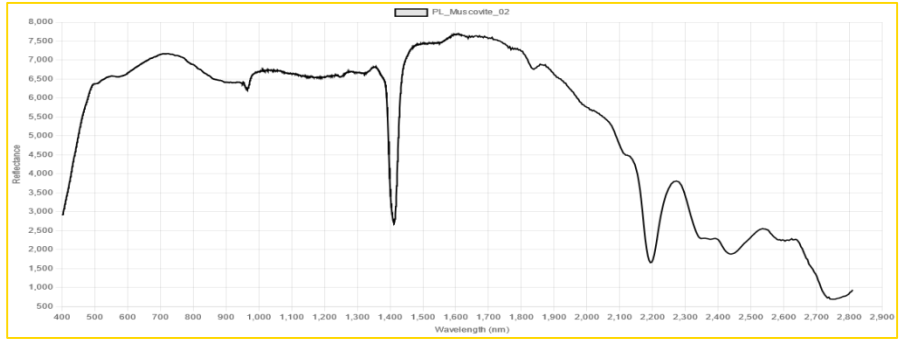
From Photons to Mineralogy

Major infrared spectral bands

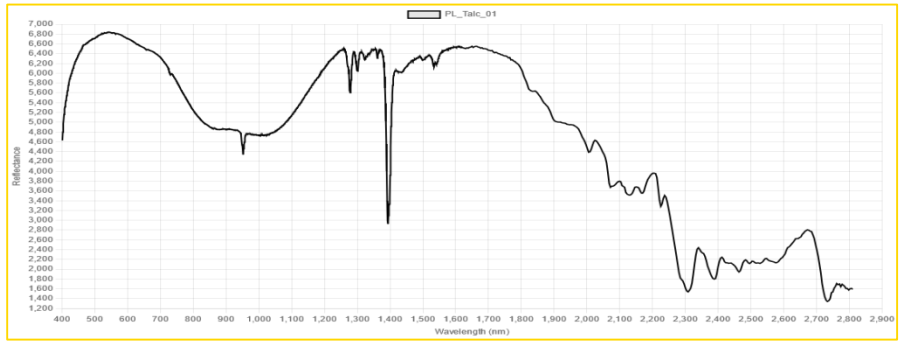


Regions of the Infrared (Terracore 2023).

Mineral absorption fingerprints



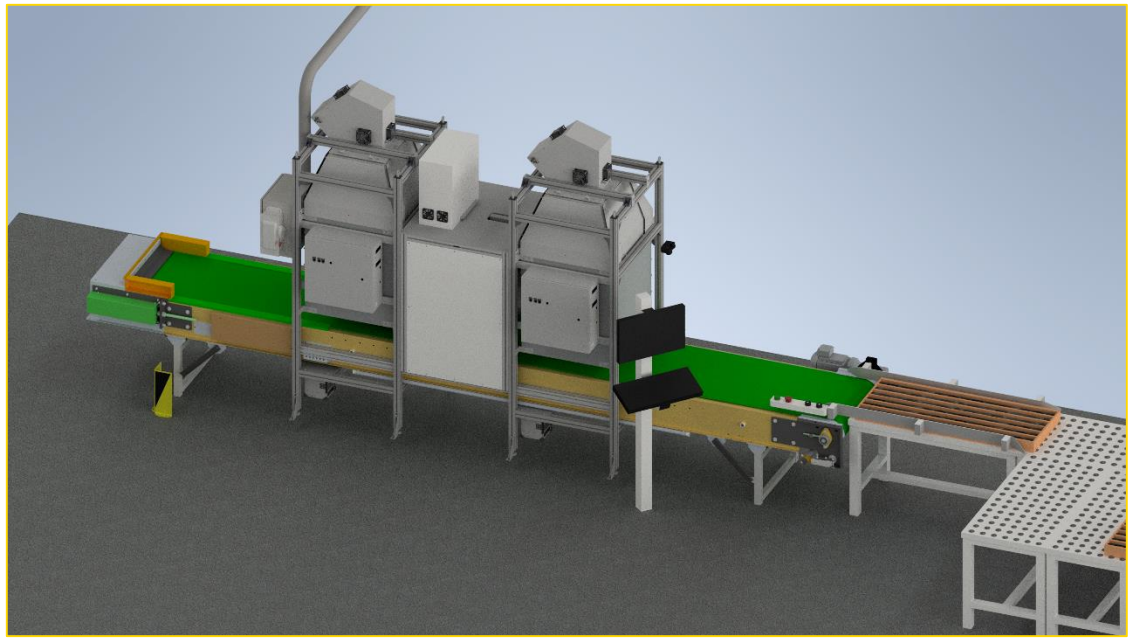
Muscovite (Lypaczewski et al. 2022).



Talc (Lypaczewski et al. 2022).

HSI: GMC Platform Tools

HySpex prototype core scanning platform. Delivery, assembly, testing, and training during April 2025.



IR spectral range from 400 to 12,500 nm.

HySpex

	Spatial	Spectral
○ VNIR-1800	1/3 mm	3.26 nm
○ SWIR-640	1 mm	4.38 nm

Telops

○ HyperCam Mini MWIR	2 mm	*50 nm*
○ HyperCam Mini LWIR	2 mm	*160 nm*

3D laser surface profiler

RGB camera

Prediktera *Breeze Geo*

GMC Core Counts

Total core box count – 95,000

Minerals (first scan priority)

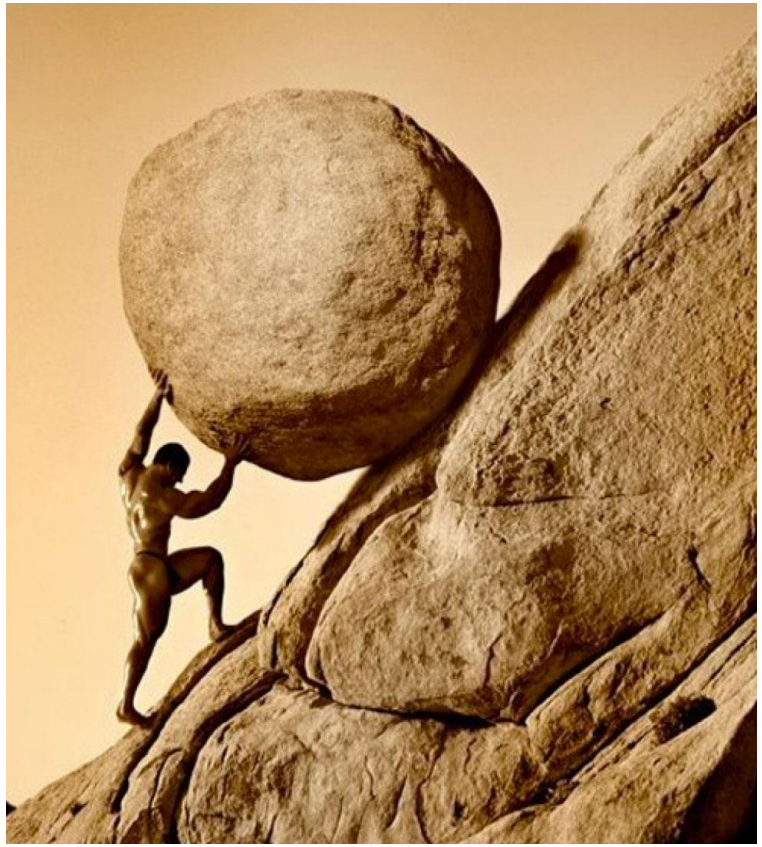
- Boxes – 43,000
- Boreholes – 2,416
- Prospects - 289

Energy

- Boxes – 52,000
- Wells - 512

A small fraction (1.5%) of GMC core collections.

HSI: Challenging Project Metrics



Staff respect.

Moving nearly 80,000 mineral and energy core boxes (~2,5 million pounds)

Scanning up to 75 km of box length in 3.5 years or less

Logging up to 150,000 m of legacy core

Generating a minimum of 600 terabytes of raw data

HSI: Facility Groundwork

Reduce scanning bottlenecks

- Assembled 4,000 core pallets
- Curated 10,000 bad boxes so far

Build HSI team

- Core four-staff team
- Total IT architecture upgrade

A physical, logistical, and technical challenge.

HSI: The Team

Position	Staff
Geo Scientist I	In Recruitment
Geologist II	In OPD
Tech II	In Recruitment
Tech II	To hire
Geo V	Kurt Johnson

- Develop SOP
- Reach sustainable scan rate
- Provide consistent 1st order interpretation

80,000 box ingest process.

HSI: Software Obligations

Revamp applications

- Spectral dataset database integration
- Improve process automation
- Provide FAIR data standards
  - Findable
  - Assessable
  - Interoperable
  - Reusable

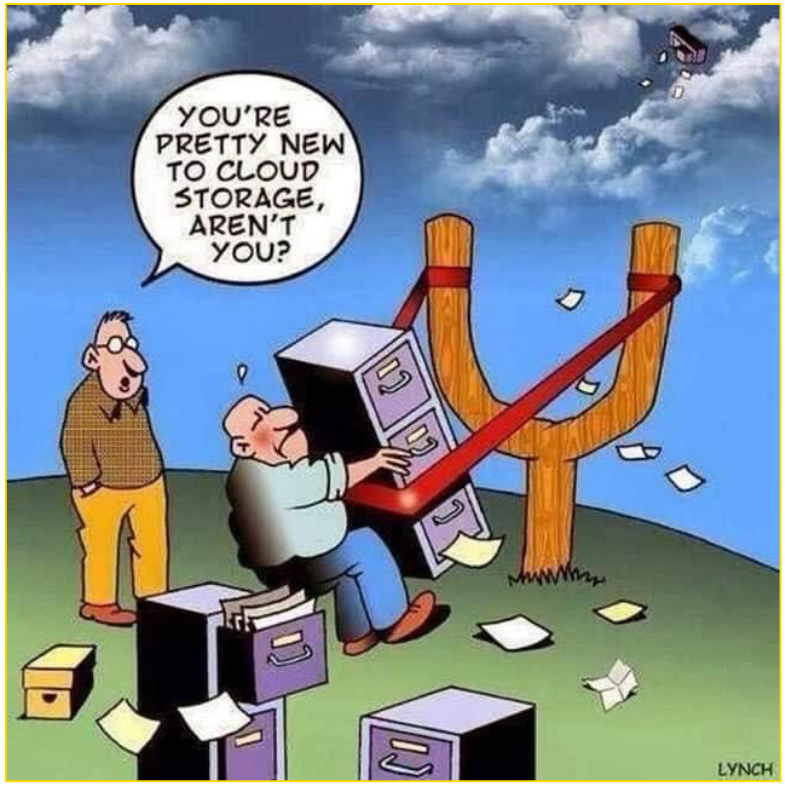
```go
package db

import (
  "fmt"

  "gmc/config"
  "gmc/db/model"
  "gmc/db/pg"
)

type DB interface {
  // Fetches the complete details for a Prospect
  GetProspect(id int, flags int) (*model.Prospect, error)

  // Fetches the complete details for a Borehole
  GetBorehole(id int, flags int) (*model.Borehole, error)

  // Fetches the complete details for an Outcrop
  GetOutcrop(id int, flags int) (*model.Outcrop, error)

  // Fetches the complete details for a Well
  GetWell(id int, flags int) (*model.Well, error)

  // Fetches the complete details for a Shotline
  GetShotline(id int, flags int) (*model.Shotline, error)

  // Fetches the complete details for an Inventory
  GetInventory(id int, flags int) (*model.Inventory, error)

  // Fetches the complete details for an Inventory by barcode
  GetInventoryByBarcode(barcode string, flags int) ([]*model.Inventory, error)

  // Fetches stash for a specific inventory id
  GetInventoryStash(id int) (interface{}, error)
```

Snippet of GMC module Go code.

HSI: Massive Digital Datasets

Amplify GMC IT capacity

- Build massive local storage cluster
- Increase internet bandwidth
- Floating point analysis of very large spectral matrices (GPUs)



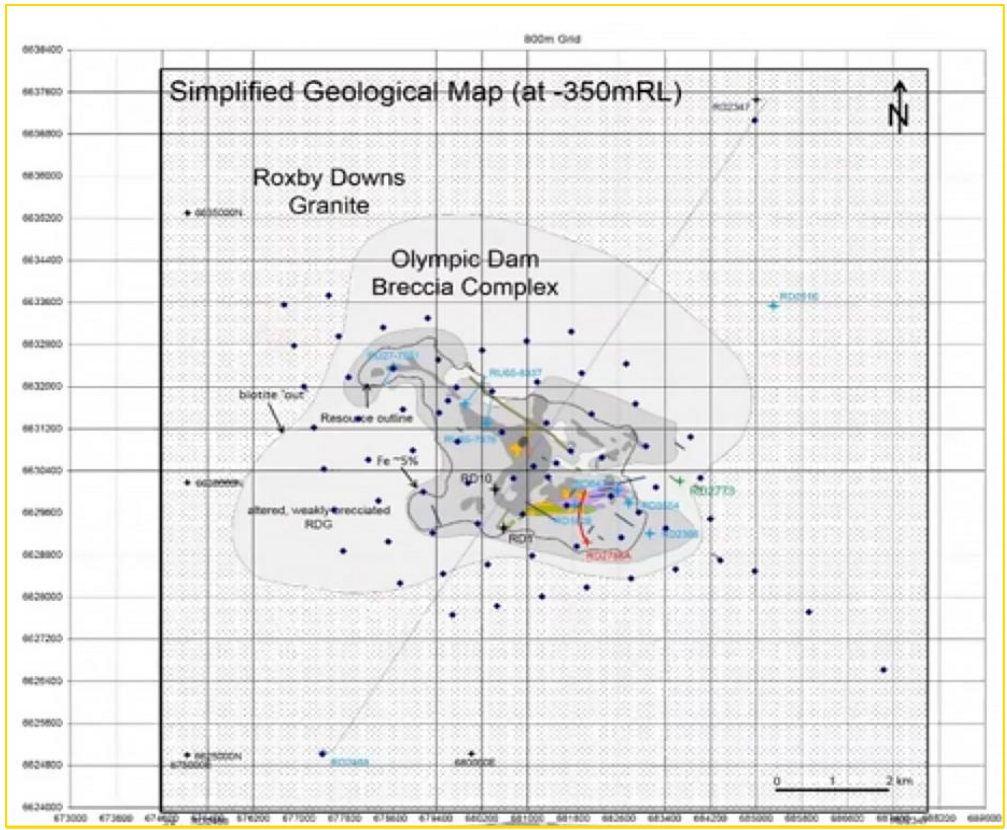
Cloud is wrong storage approach for GMC.

Olympic Dam, South Australia G.S.

HSI example: Olympic Dam, a massive poly-metallic copper, uranium, and gold underground mine.

Published the by the South Australia Geological Survey (Mauger et al., 2020).

From Jessica Stromberg presents *Hyperspectral mineralogy for exploration: More than white mica & chlorite*, 08/18/2021, https://www.youtube.com/watch?app=desktop&v=tplEbdVB95A.

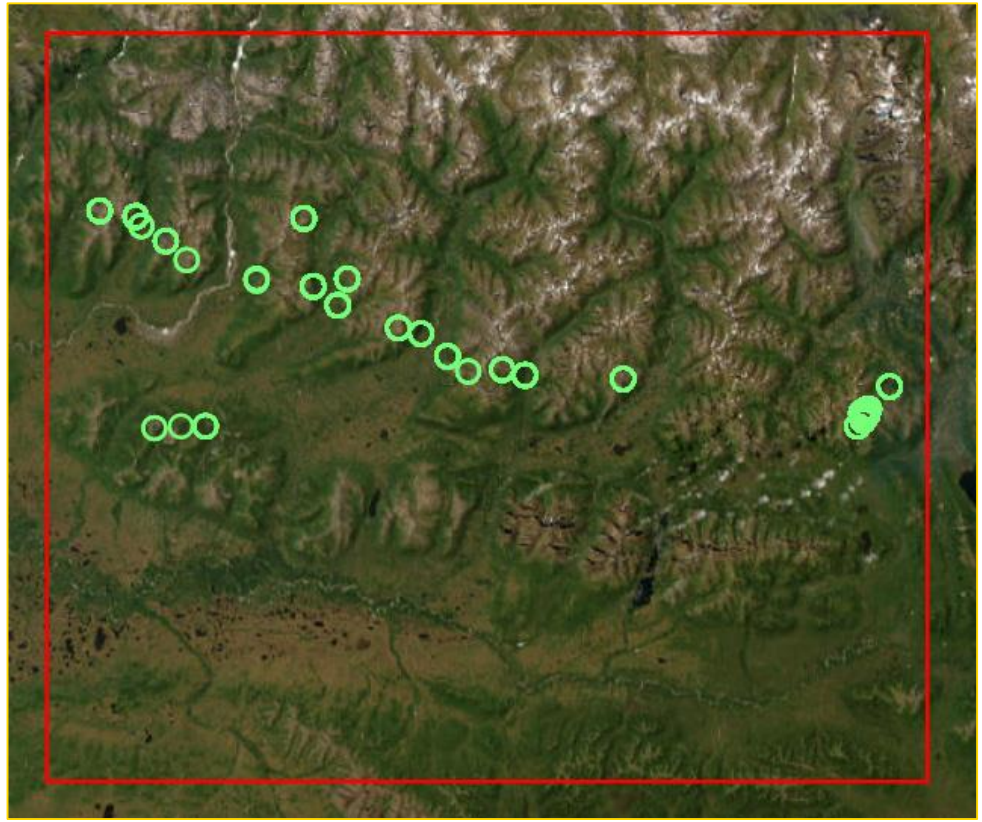


Requires drillhole location metadata.

HSI: Where's That Borehole

Build up metadata research

- Basic information
  - Drill logs
  - Drill collar location
  - Dip
  - Azimuth
- Primary reconnaissance
  - Geochemistry
  - XRF
  - Reports



GMC inventory Ambler District prospect map.

HSI: Build Alaskan Synergy

Workable venues

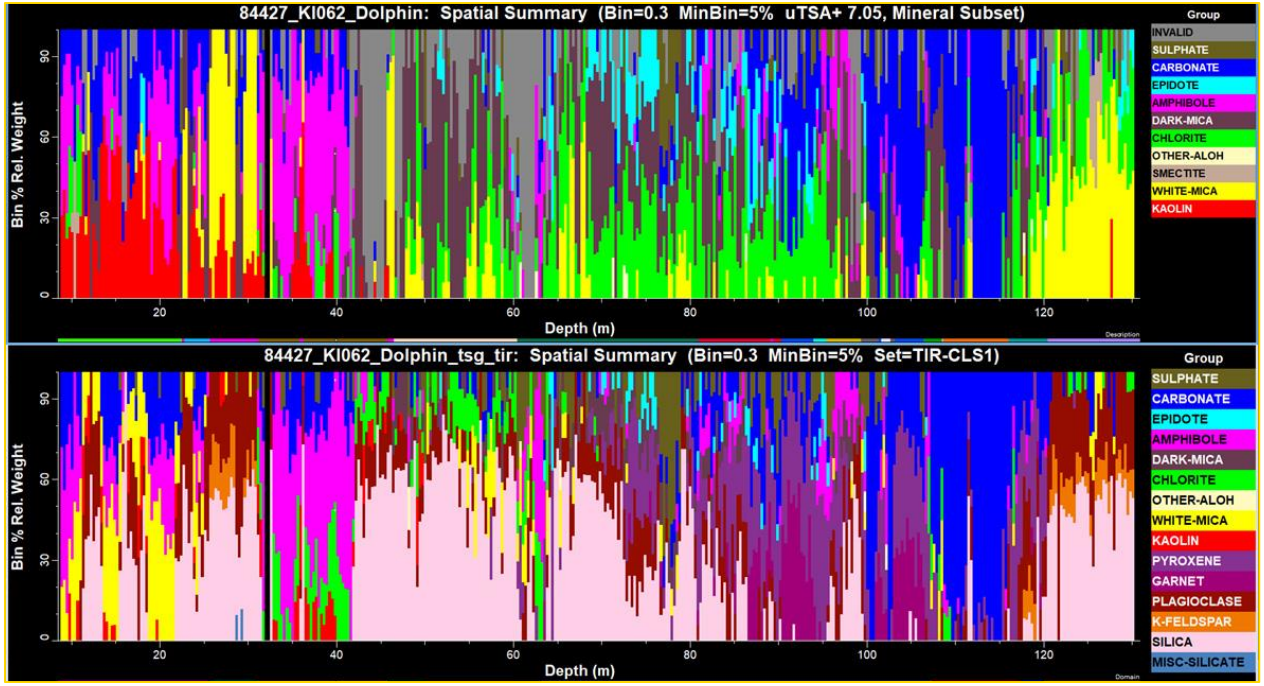
- Seminars / Workshops
- Classes
- One-on-one
- Practicum
- University course
- Postgraduate research
- Cross-cultural mixing

Georgina Gordon inspects drill core from the Geo. Survey of South Australia's Hylogger facility.

HSI: Industry Scanning Options

Initial considerations

- Obtain Federal permission
- Establish fees
- Address proprietary needs
- Define publishing options



The Spectral Geologist borehole mineral group map.

HSI: Community Feedback to GMC

Prioritized scanning schedule

- Prospect
- Deposit type
- Regional

Primary data generation

- Raw datacube
- Reflectance datacube
- Header, white/dark reflectance

First-order synthesis of data

- Relative mineral abundance
- Indices
- Ratios

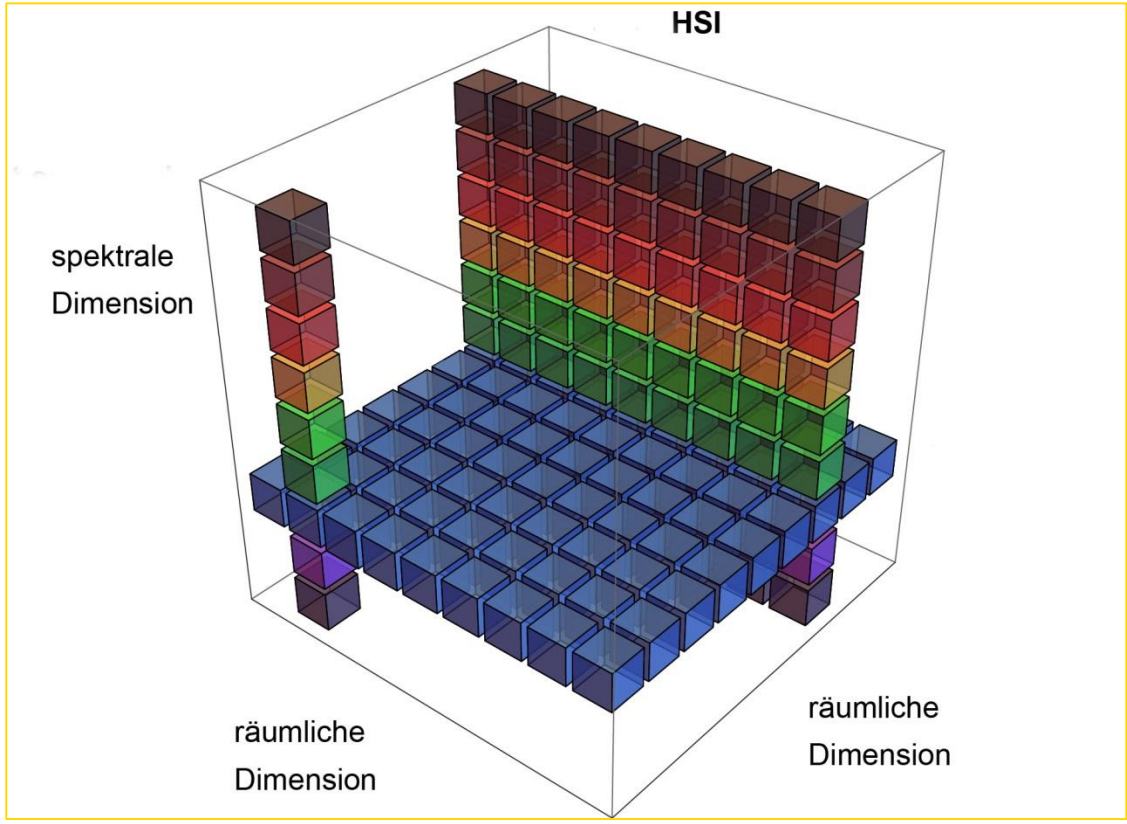
Partner program studies

- Primary hydrogen
- Ni, Co, etc…
- Chemical carbon capture

HSI: Forming a Minerals Forum

So what is a viable pathway to a meaningful public agency and industry dialogue?

- Solicit AMA member ideas
- Tie together with DGGS goals
- Bring together University of Alaska geology programs



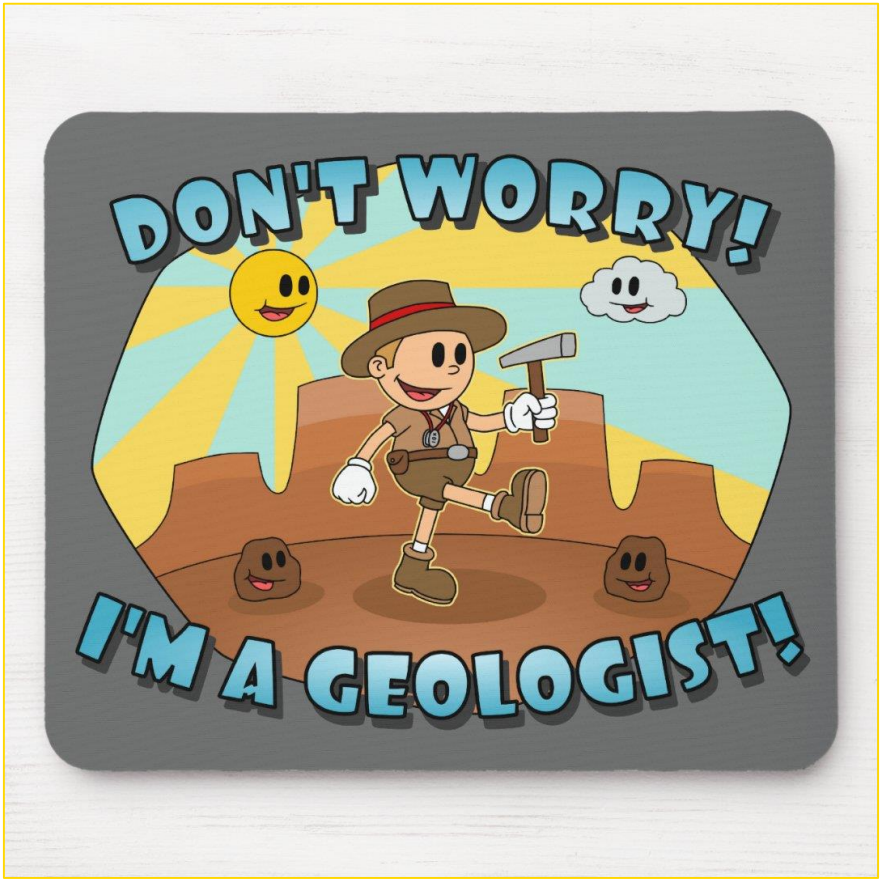
Scanning pathways to build a spectral datacube.

Thinking Forward We Seek Partners

Alaska Geologic Materials Center

kurt.johnson@alaska.gov
Curator

christopher.ramey@alaska.gov
IT Manager



Questions