Bringing Alaska's CORE-CM Potential into Perspective

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National Energy Technology Laboratory
Resource Sustainability Project Review Meeting
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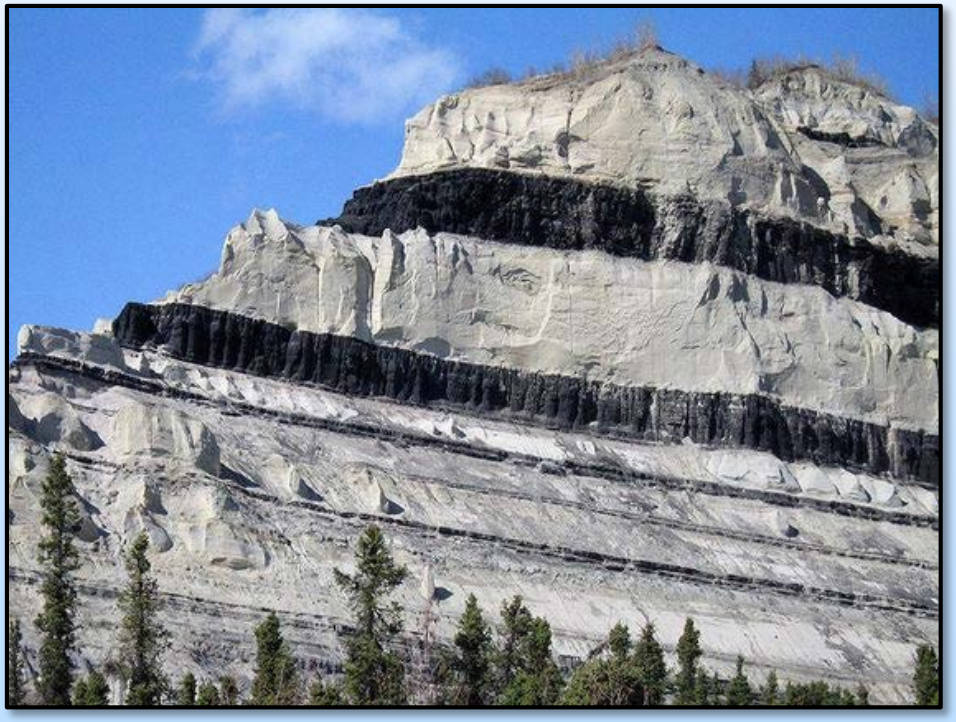
Project Overview

- **Objective:** Document Alaska's CORE-CM potential and work with industry, regulators, and concerned stakeholders to jointly establish a pathway whereby Alaska's CORE-CM resources can be developed

- **Funding**: $1,908,642
  DOE Share: $1,526,908
  Cost Share: $381,734
- **Performance Period**:
  Sept. 1, 2021 – Aug. 31, 2023



Project Participants

STATE OF ALASKA
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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THE STATE of ALASKA
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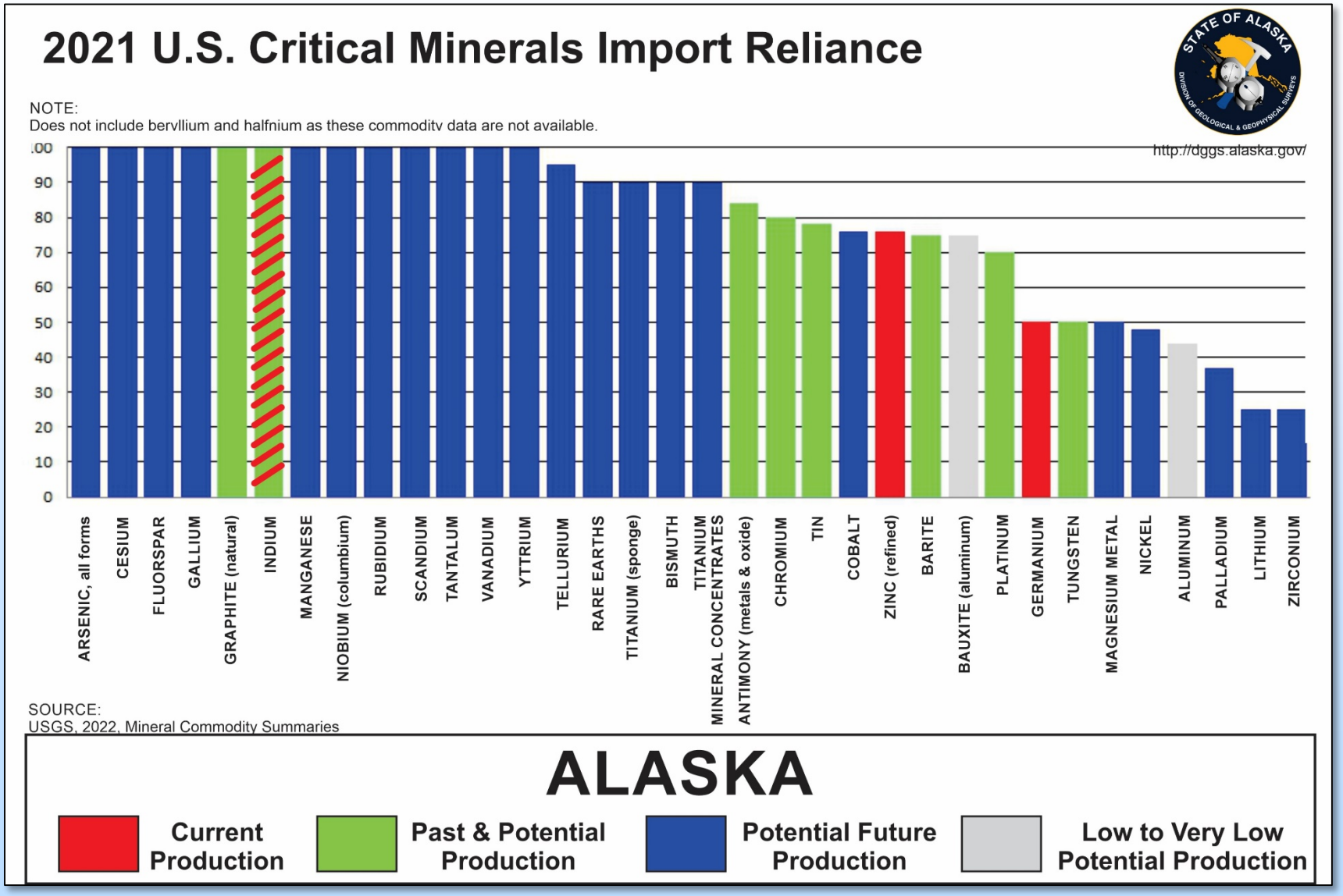
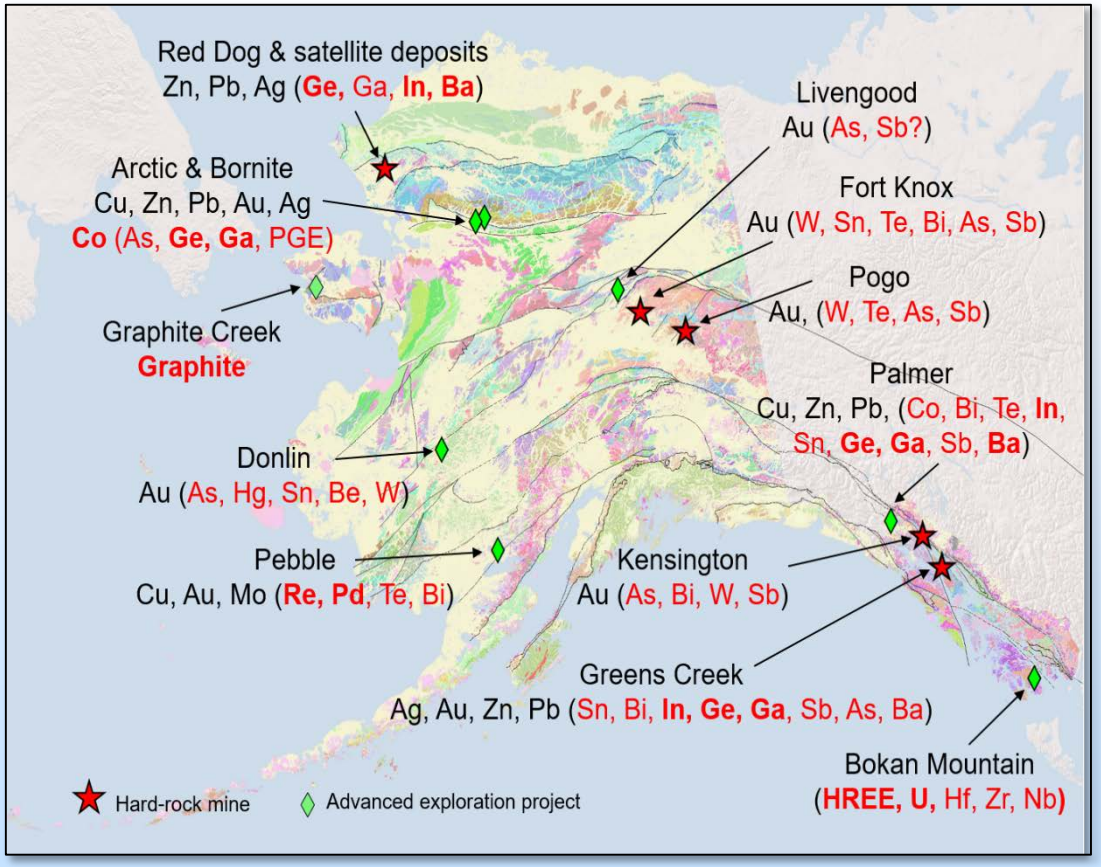
Background—Alaska's Critical Mineral Potential

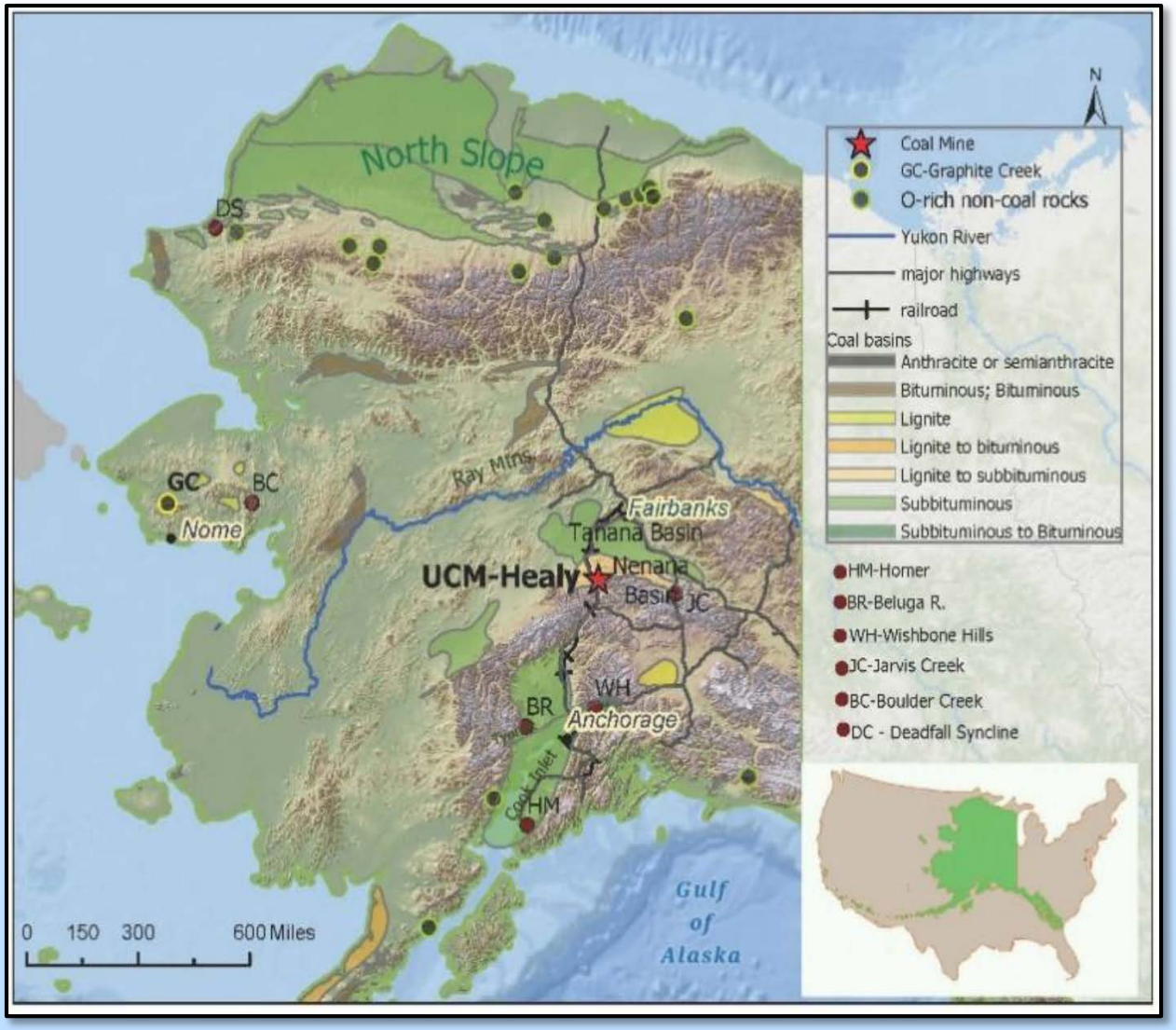


Background—Alaska's Critical Mineral Potential

- Operating hard rock mines either already produce, or have significant potential to produce critical minerals
- Several advanced exploration projects have demonstrated CM potential, including two of our project partners:
  - Graphite One
  - Ucore
- Opportunities are balanced by development challenges due to remoteness and lack of infrastructure in many parts of Alaska



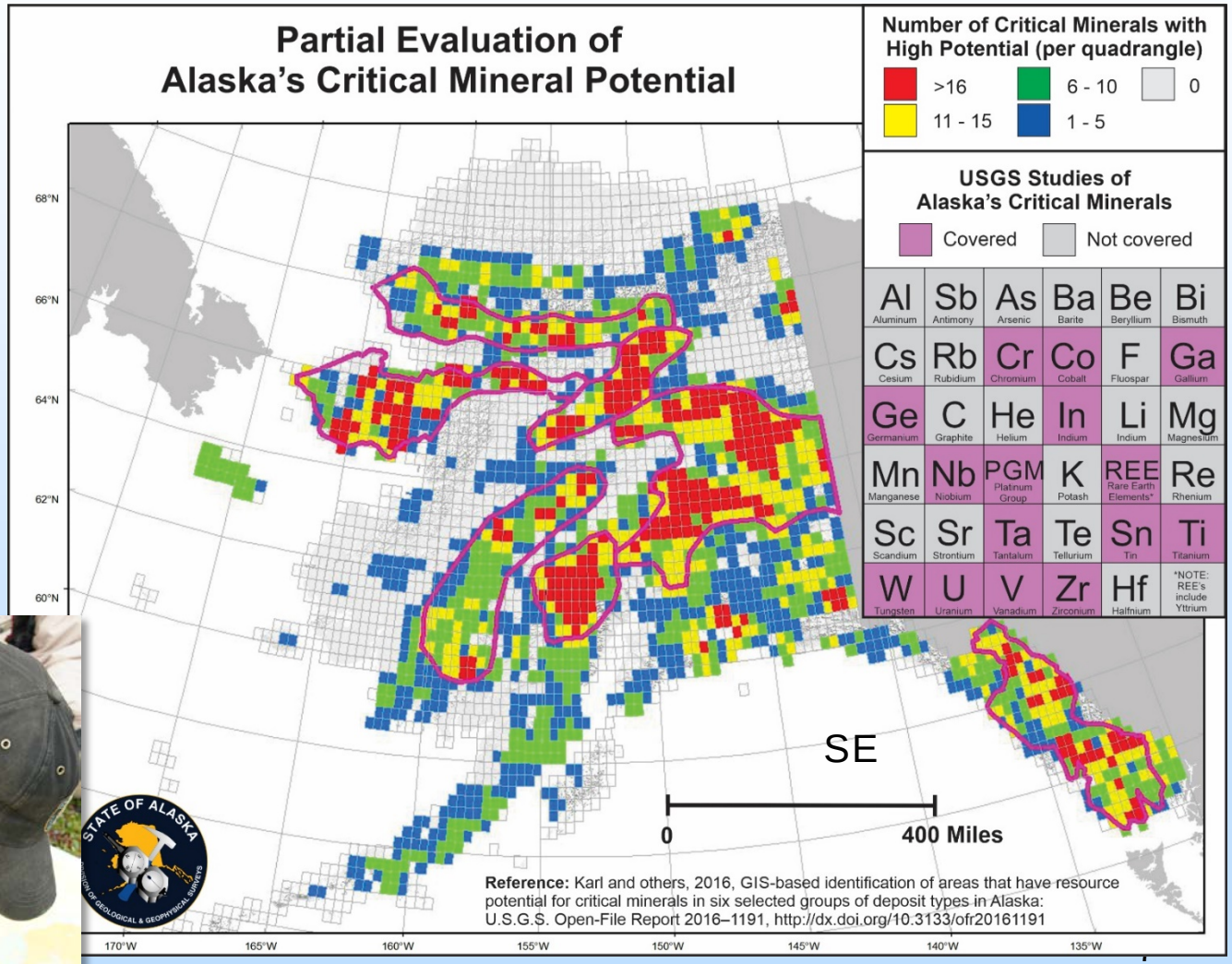
Background—Alaska's Carbon Ore Resource Base



- Alaska hosts an immense amount of carbon ore, including more than 5 trillion short tons of coal – more than half of the estimated coal resource in North America
- Unlike the continental U.S., characterization of carbon ores for their REE/CM content in Alaska's many basins is still in its infancy

Progress and Current Status

- Evaluated regional geology in the context of CM potential
- Considered coal basin geology to high grade assessment



Progress and Current Status

Three principal sources for Basinal Assessment

1) Existing published and unpublished data
   - Federal, State, Native and Industry
     - ✓ QA/QC of DGGS NCRDS data; generally limited due to vintage of geochemical techniques

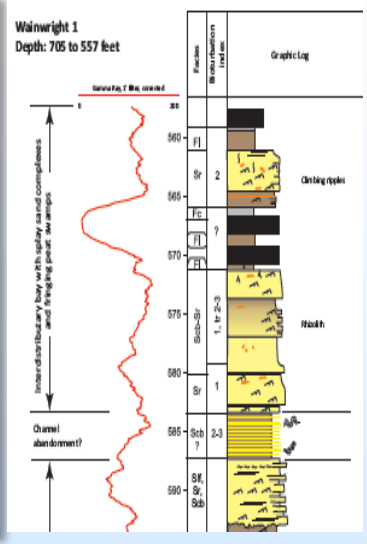
2) New data from archived legacy samples

3) New data from recently acquired field samples

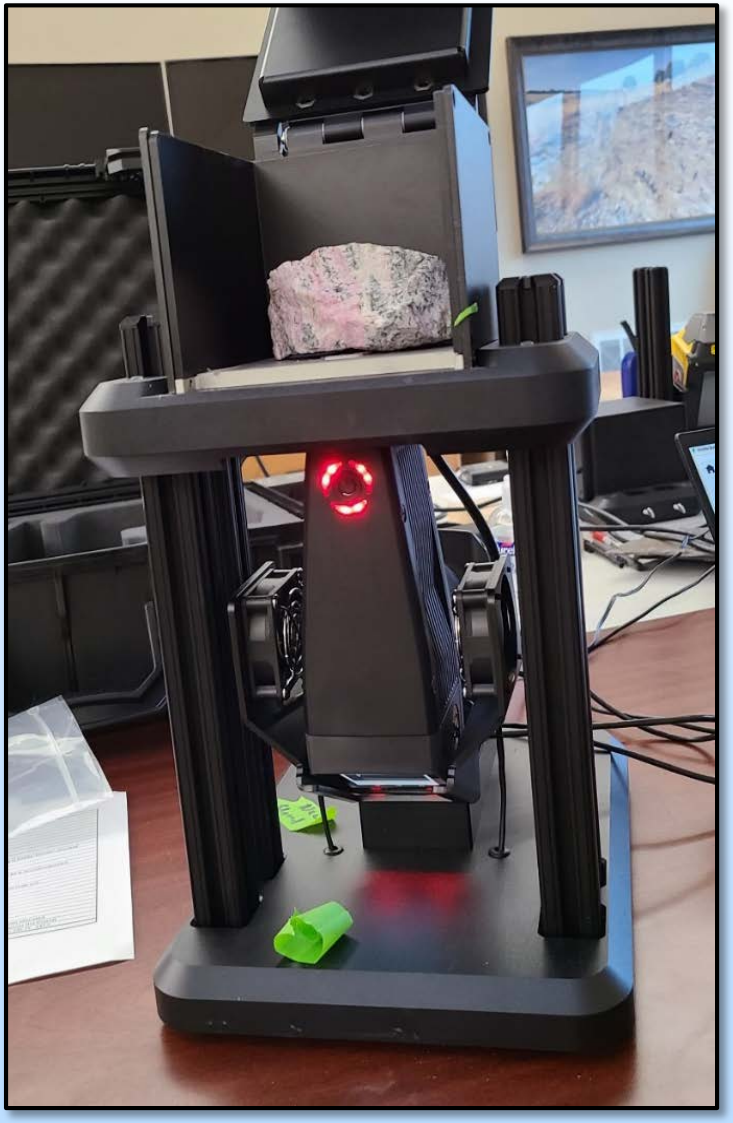
Progress and Current Status

Geologic Materials Center

- 3096 energy wells
- 26,500,000 feet of energy strata drilled
- 16,700,000 representative feet of energy core & cuttings
- 76,000 linear feet of energy core
- 22,000 Alaska minerals boreholes
- 766,000 feet of mineral rock drilled
- 617,000 representative feet of mineral core and cuttings
- 354,000 linear feet of mineral core
- 250,000 processed slides and thin sections
- 507,000 surface samples



Progress and Current Status

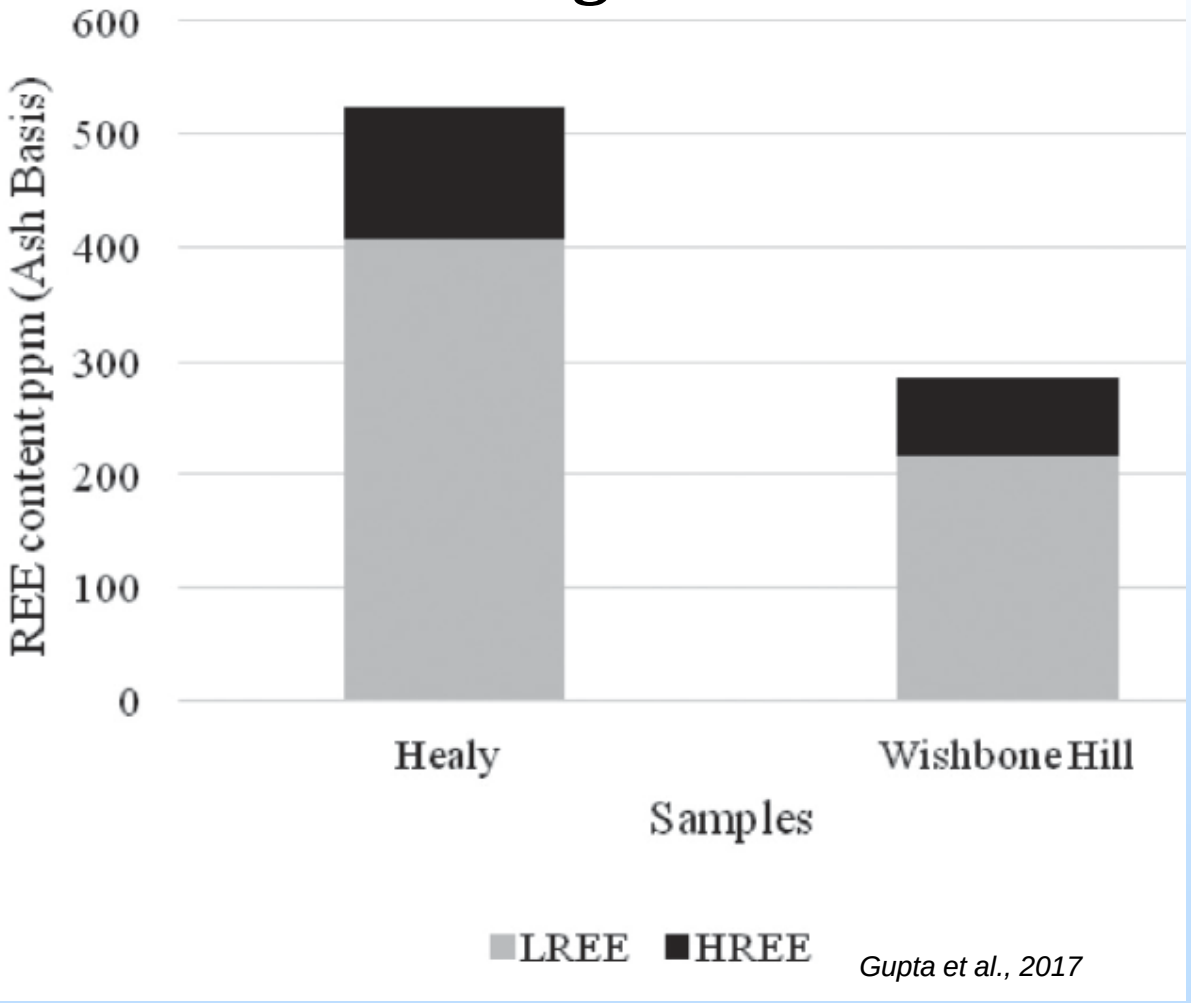


Screening Approach for New Data

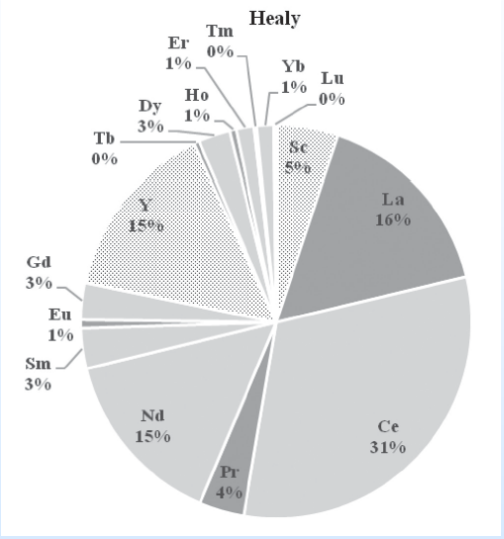
- Procured one of the first SciAps X-555 HH-XRF
  - 55 kV X-ray tube
  - Specifically developed for REE
  - Calibrated for Y, La, Ce, Pr, Nd, Sm, Eu and Gd
  - Excellent detection limits measured on whole rock hand samples (down to lower tens of ppm)
- Identified favorable core and samples at GMC to obtain rapid, qualitative elemental data
- Received training from SciAps
- Working to define “anomalous values” for follow up ICP-MS analysis

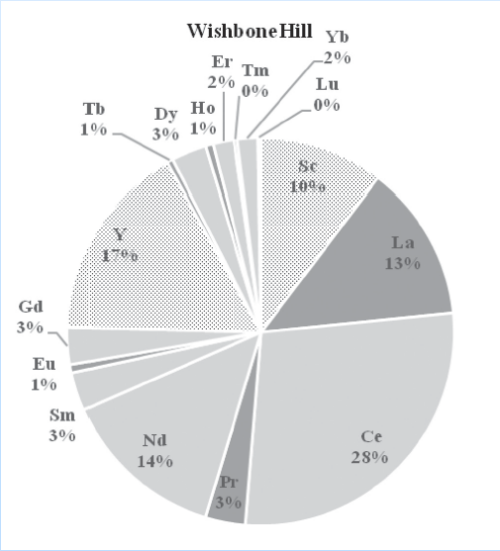
Progress and Current Status

Existing Data



Gupta et al., 2017

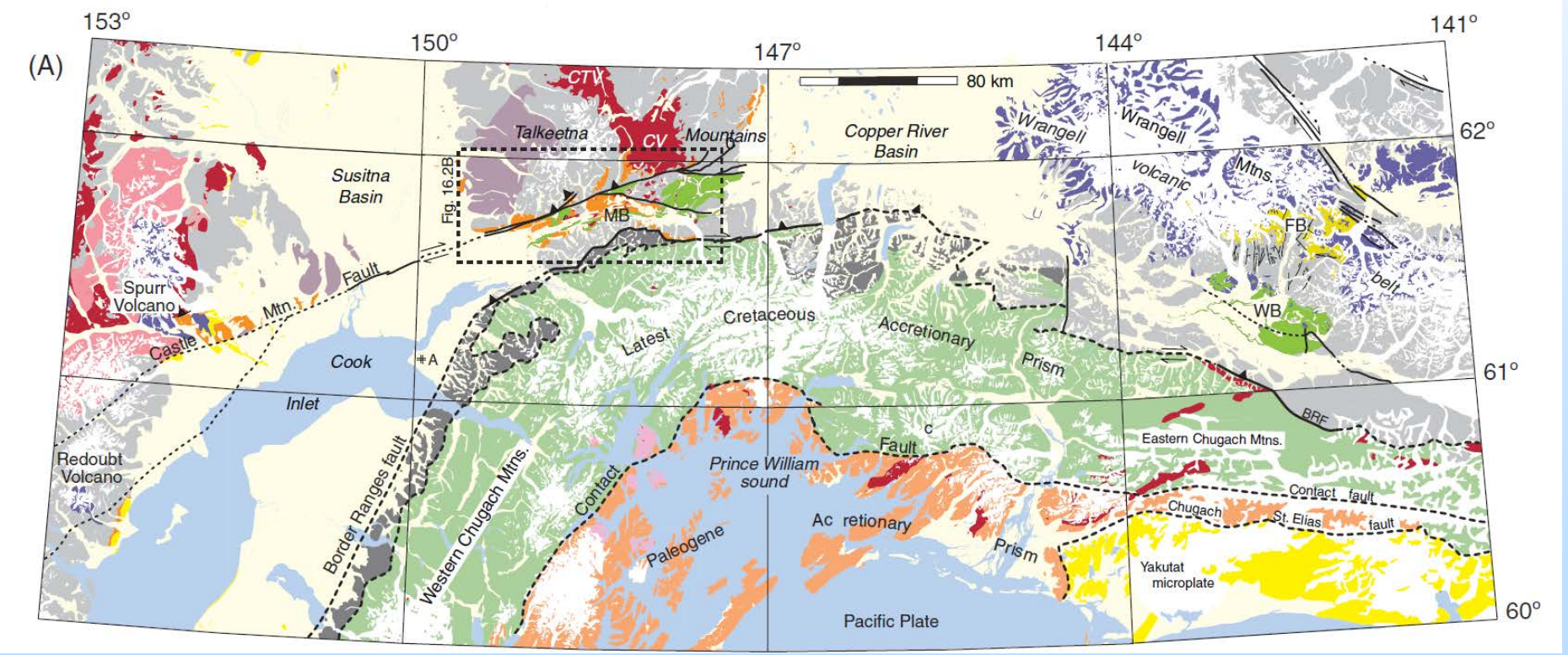




Progress and Current Status

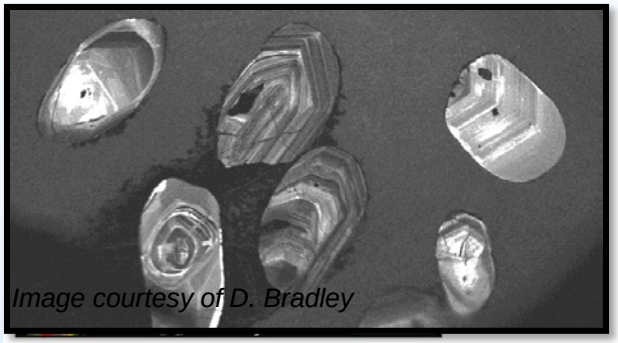
Helicopter Based Geological Field Work

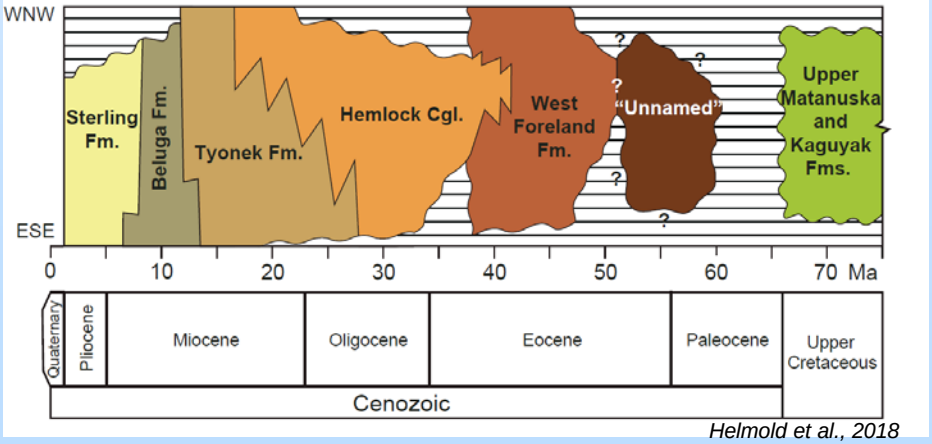
- Collected Upper Cretaceous (Campanian) samples on North Slope
- Conducted reconnaissance work & sampling in the Cenozoic nonmarine basins in southern Alaska (western Susitna, northwestern Cook Inlet & Matanuska Valley)



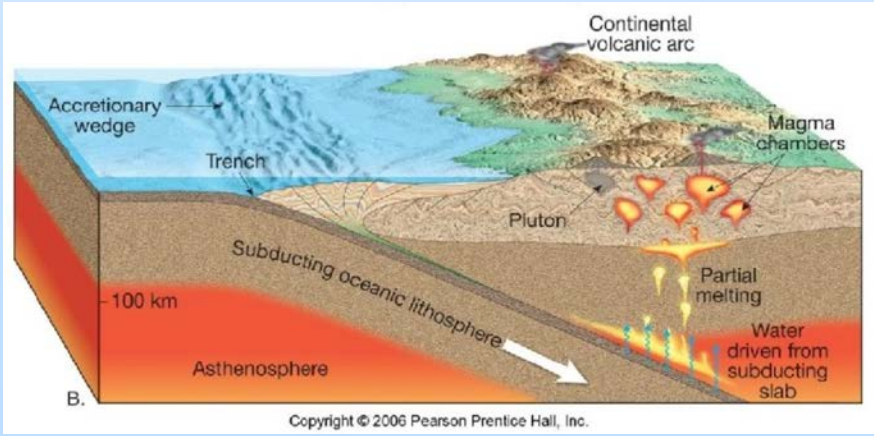
Progress and Current Status

Hypothesis: REE/CM detrital concentrations in coal reflect waxing and waning of arc volcanism and detrital contributions of monazite, apatite, titanite and zircon





Helmold et al., 2018



Progress and Current Status

Usibelli Coal Mine

- Alaska's sole operating coal mine for last 50 years, producing 50+ million tons of coal
- Currently averaging 1-2 million tons/yr
- 7,570 - 9,430 Btu/lb on an as-received basis, 17.8% moisture, 3.5-13.2% ash yield and 0.1-0.3% sulfur

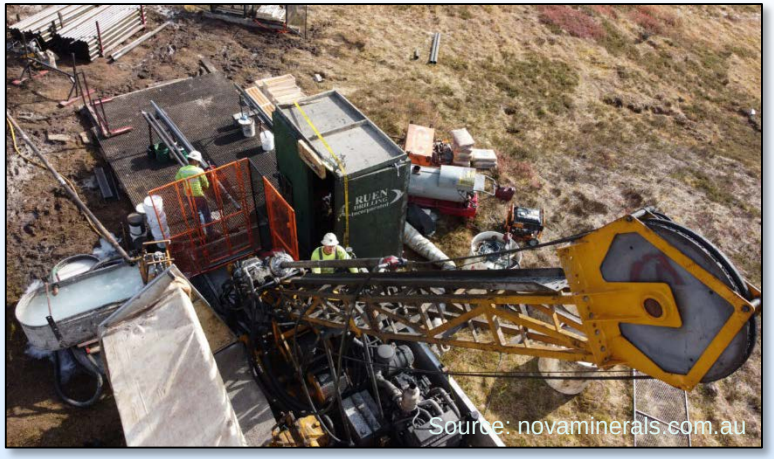
2022 Coring Program

- Drilled 13 holes totaling ~2,000 feet of total borehole depth
- 4" core collected through the mineable seams
- One core is a twin of a 2019 hole that yielded full thickness for targeted intervals to be sent to GMC for detailed analysis
- HH-XRF and ICP-MS data will be compared against available geochemistry

Progress and Current Status

Mine Waste Feedstock

- Expanded project scope to consider REE/CM from hard rock mine waste streams
- Hired experienced minerals geologist to negotiate access to data or min-sep processing splits

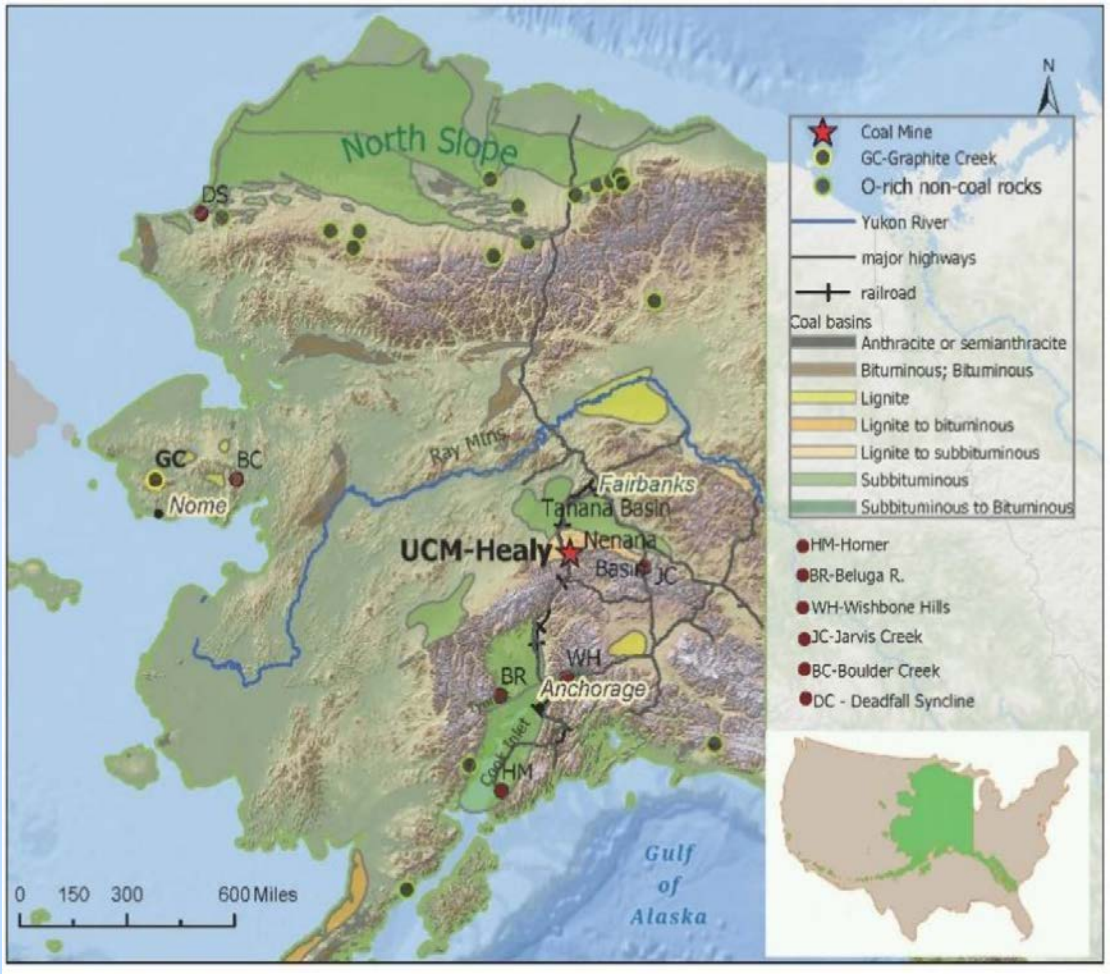


Mineral Separation R&D

- Continued research into microbial bioleaching to extract REE's from coal
- Ongoing experiments on hybrid graphene membrane solvent extraction of REE's

Site Selection Approach

- Alaska's basins ranked utilizing UAA's Institute of Social and Economic Research methodology that considers existing exploration permits and evaluates their progress toward possible development
- Alaska has only one operating coal mine, so we've partnered with them to develop a business plan to co-produce REE-CM
- Development scenarios will be created based on stakeholder inputs



Plans for future testing/development/ commercialization

1) Phase 1: Develop Phase 2 application around our private sector partners and help get them set up in Alaska
   a. Usibelli Coal Mine
   b. Ucore
   c. CVMR
2) Phase 2: Address mine-site technology barriers
   a. Mineral Phase Characterization
      - Mineral Phase Environment
      - Host Phase Environment
   b. Mine Site Separation Technology
   c. Infrastructure to support onsite concentration
   d. Expand to placer mine operations (Alaska's Family Farms)

Plans for future testing/development/ commercialization

The State of Alaska appropriated $7.8 million to the University to support development of the Critical Minerals Industry in Alaska. These funds will be used to compliment the CORE-CM program:

- Head start on the TIC:
  - Hiring expertise & establishing a Separations Lab
  - Looking into initial on-site processing of ores
  - Working to provide assay and density separation services to our mining industry, including purchasing ICP/MS. There is currently no in-state capacity for these services.
- Continuing work on biological mineral extraction and bio-film treatment of mining waste
- Work with partners to apply research findings for non-fuel uses of carbon

Outreach

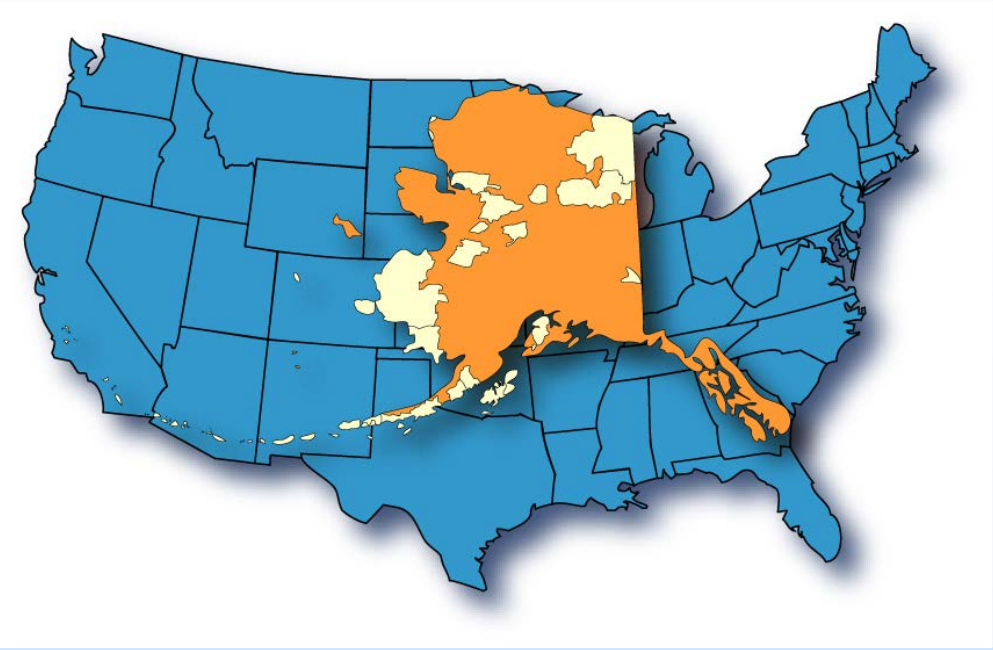
- Sept 2021: UA Board of Regents Presentation
- Jan 5, 2022: Support Industry Alliance (≈75 participants)
- Jan 18, 2022: Initial Stakeholder Meeting (100+ participants)
- Jan 28, 2022: Alaska Miners Association (≈100 participants)
- Feb 4, 2022: Alaska House Finance Committee
- Feb 28, 2022: Alaska Chamber of Commerce Resources Committee
- March 5, 2022: Alaska Miners Association, DGGS (≈100 participants)
- Apr 6 & 19, 2022: Alaska Senate Finance Committee
- Apr 27, 2022: Briefing to Senators Sullivan & Murkowski staffers
- May 20, 2022: Alaska Miners Association Update (≈100 participants)
- May 27, 2022: DOE's Arctic-X Summit, *Carbon Management Panel*
- June 8, 2022: Participated with CVMR in Congressional Briefing
- Aug 22-23, 2022: University of Alaska Conference: Alaska Minerals—A Strategic National Imperative (≈200 participants)

Workforce Development

- MOA between Ucore and University of Alaska Southeast being negotiated to provide workforce training specific to working in Ucore's planned facility
- University of Alaska Fairbanks developing self-paced, non-credit, online courses specific to CORE-CM
- Partnering with Alaska Resource Education to develop a REE/CM component to their curriculum

Summary

- Alaska is BIG and has enormous CORE-CM potential
- Usibelli Coal Mine is a promising target, but more detailed data is needed
- Exploration for these minerals will likely create the opportunity to leverage more abundant commodities (e.g. Au, Cu, Zn, etc.)
- Timeline for development will be determined by infrastructure development



- Continue outreach to maintain momentum started by the CORE-CM award & State investment

Thank You

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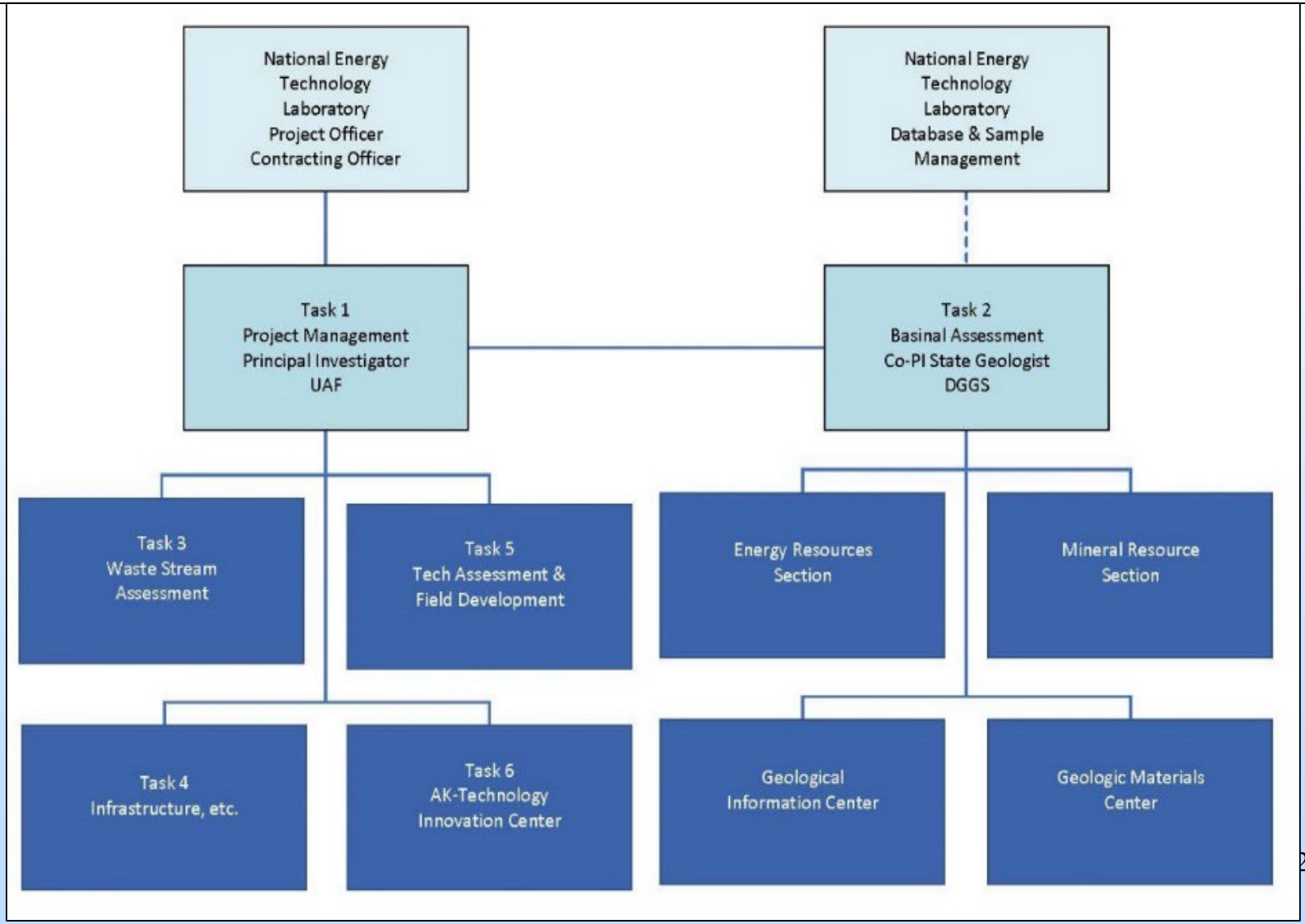
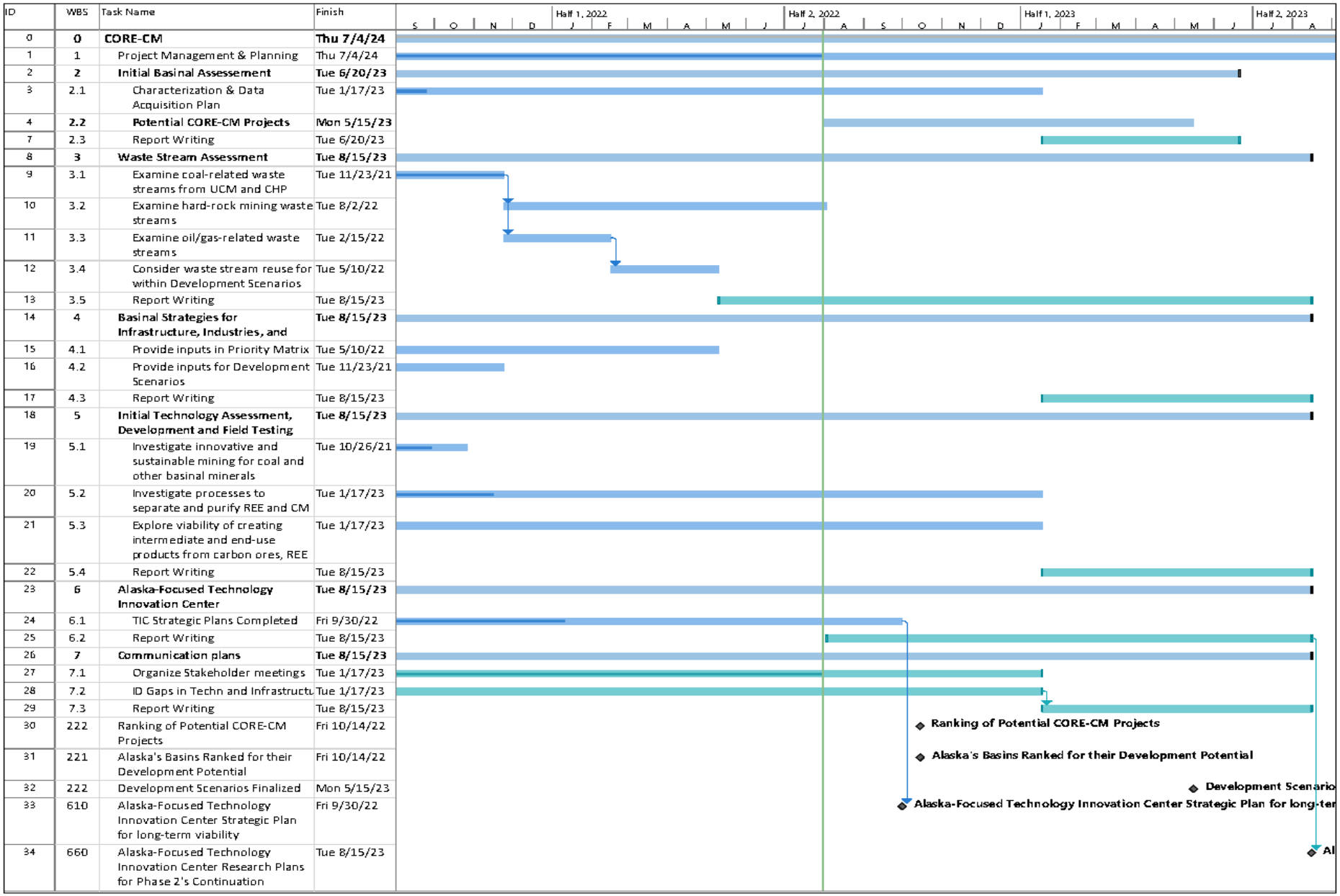
Organization Chart



Gantt Chart



ID	WBS	Task Name	Finish
0	0	**CORE-CM**	**Thu 7/4/24**
1	1	Project Management & Planning	Thu 7/4/24
2	2	**Initial Basinal Assessement**	**Tue 6/20/23**
3	2.1	Characterization & Data Acquisition Plan	Tue 1/17/23
4	2.2	**Potential CORE-CM Projects**	**Mon 5/15/23**
7	2.3	Report Writing	Tue 6/20/23
8	3	**Waste Stream Assessment**	**Tue 8/15/23**
9	3.1	Examine coal-related waste streams from UCM and CHP	Tue 11/23/21
10	3.2	Examine hard-rock mining waste streams	Tue 8/2/22
11	3.3	Examine oil/gas-related waste streams	Tue 2/15/22
12	3.4	Consider waste stream reuse for within Development Scenarios	Tue 5/10/22
13	3.5	Report Writing	Tue 8/15/23
14	4	**Basinal Strategies for Infrastructure, Industries, and**	**Tue 8/15/23**
15	4.1	Provide inputs in Priority Matrix	Tue 5/10/22
16	4.2	Provide inputs for Development Scenarios	Tue 11/23/21
17	4.3	Report Writing	Tue 8/15/23
18	5	**Initial Technology Assessment, Development and Field Testing**	**Tue 8/15/23**
19	5.1	Investigate innovative and sustainable mining for coal and other basinal minerals	Tue 10/26/21
20	5.2	Investigate processes to separate and purify REE and CM	Tue 1/17/23
21	5.3	Explore viability of creating intermediate and end-use products from carbon ores, REE	Tue 1/17/23
22	5.4	Report Writing	Tue 8/15/23
23	6	**Alaska-Focused Technology Innovation Center**	**Tue 8/15/23**
24	6.1	TIC Strategic Plans Completed	Fri 9/30/22
25	6.2	Report Writing	Tue 8/15/23
26	7	**Communication plans**	**Tue 8/15/23**
27	7.1	Organize Stakeholder meetings	Tue 1/17/23
28	7.2	ID Gaps in Techn and Infrastructu	Tue 1/17/23
29	7.3	Report Writing	Tue 8/15/23
30	222	Ranking of Potential CORE-CM Projects	Fri 10/14/22
31	221	Alaska's Basins Ranked for their Development Potential	Fri 10/14/22
32	222	Development Scenarios Finalized	Mon 5/15/23
33	610	Alaska-Focused Technology Innovation Center Strategic Plan for long-term viability	Fri 9/30/22
34	660	Alaska-Focused Technology Innovation Center Research Plans for Phase 2's Continuation	Tue 8/15/23