

Basinal Assessment

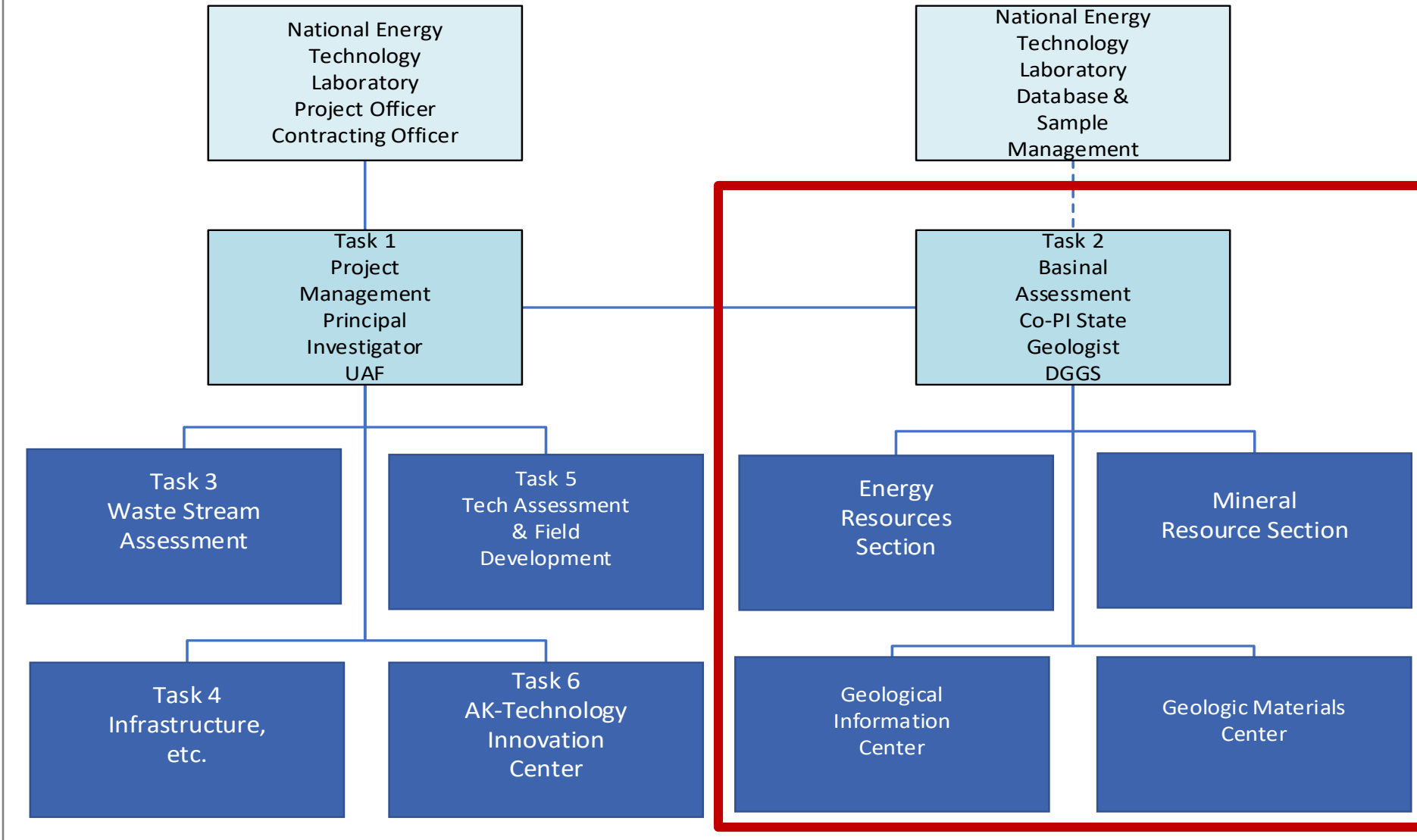
Bringing Alaska's CORE-CM Potential into Perspective



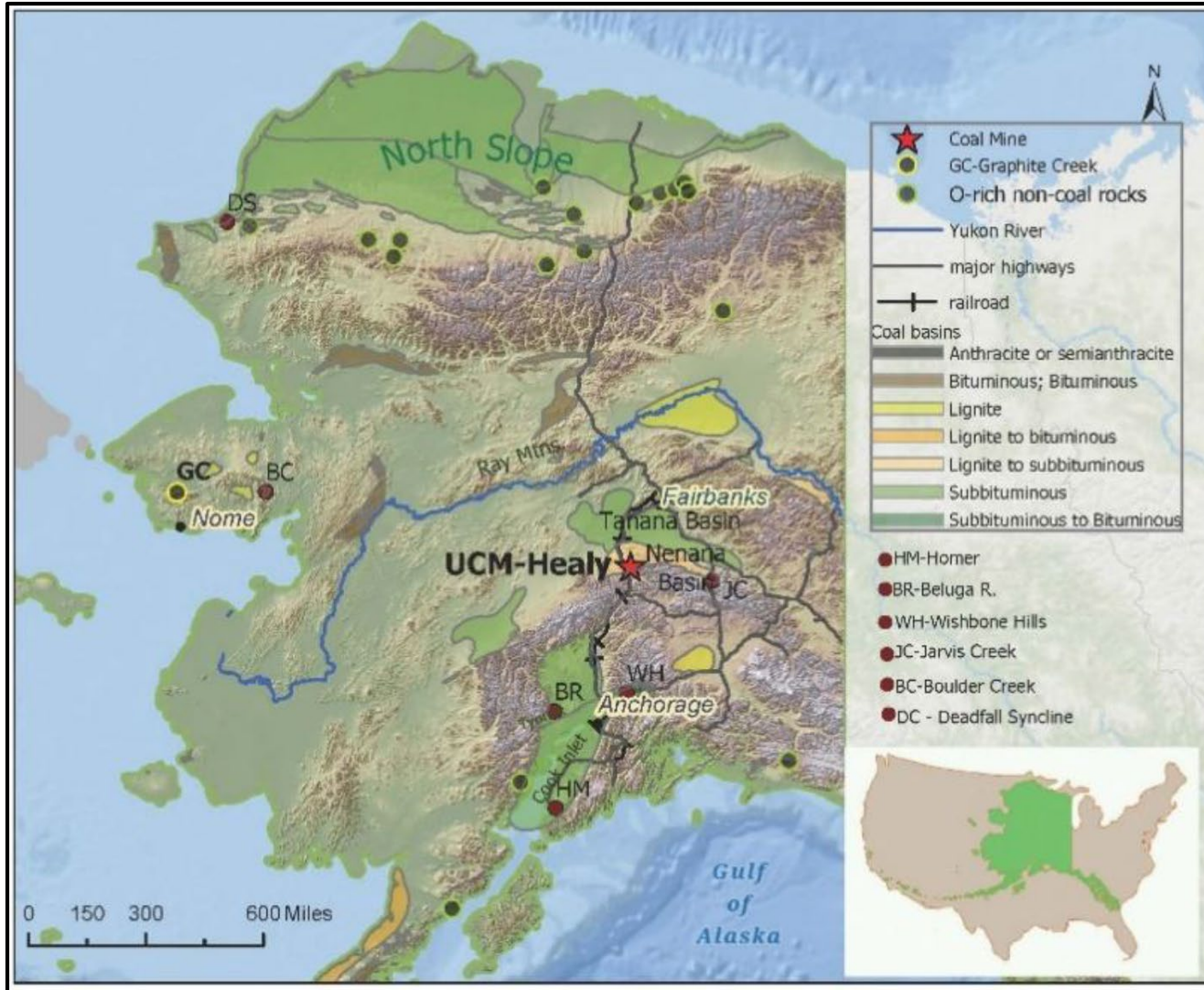
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*Alaska Department of Natural Resources
Division of Geological & Geophysical Surveys*



PROJECT STRUCTURE



ALASKA BASINAL ASSESSMENT



- Alaska hosts an immense amount of carbon ore, including 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
- As such, an essential component of this project is to create a robust statewide dataset on the REE/CM content of carbon-based ores

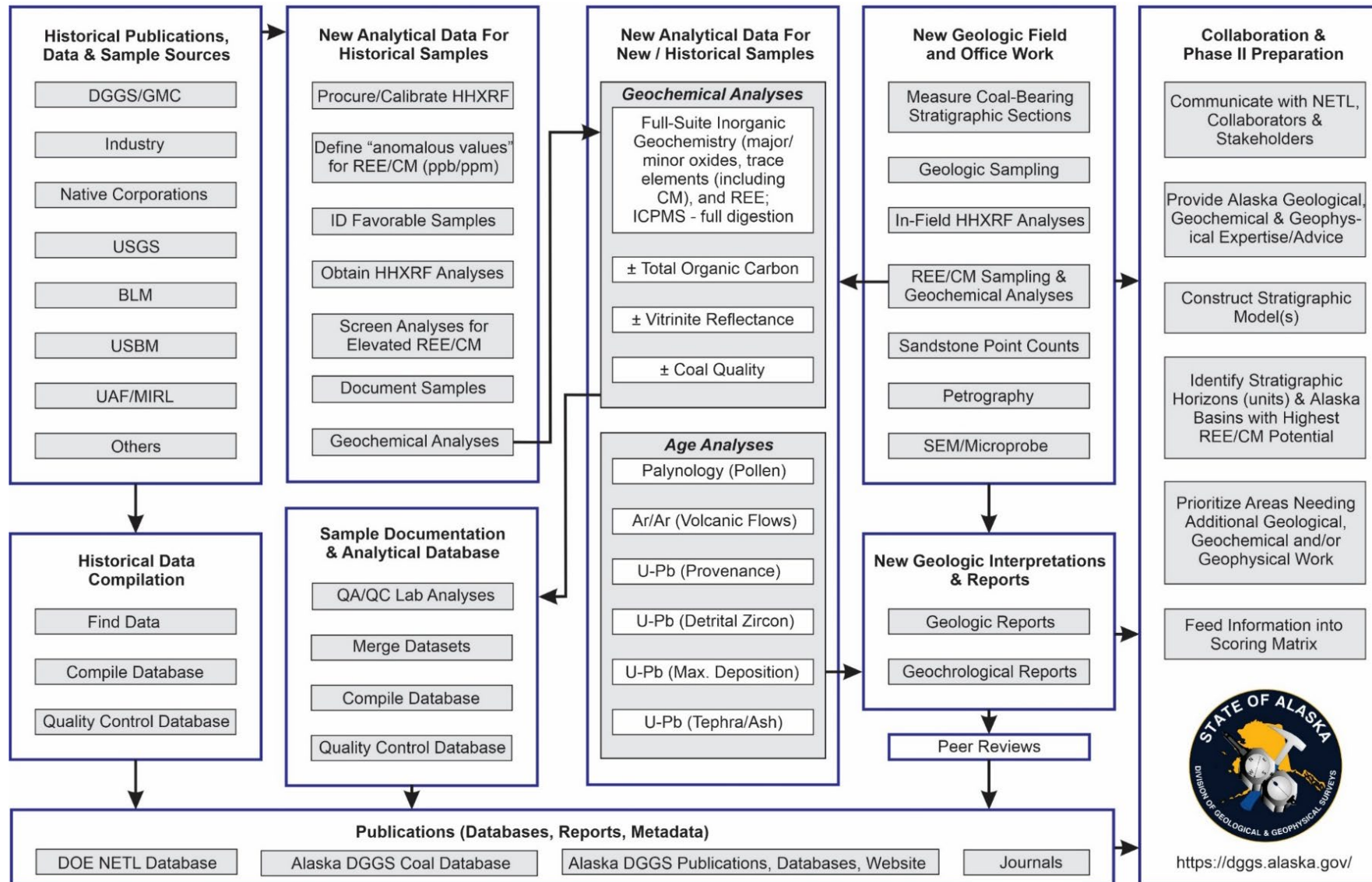
ALASKA BASINAL ASSESSMENT

Three principal sources

- 1) Existing published and unpublished data
- 2) New data from archived legacy samples
- 3) New data from newly acquired field samples



PHASE I WORKFLOW



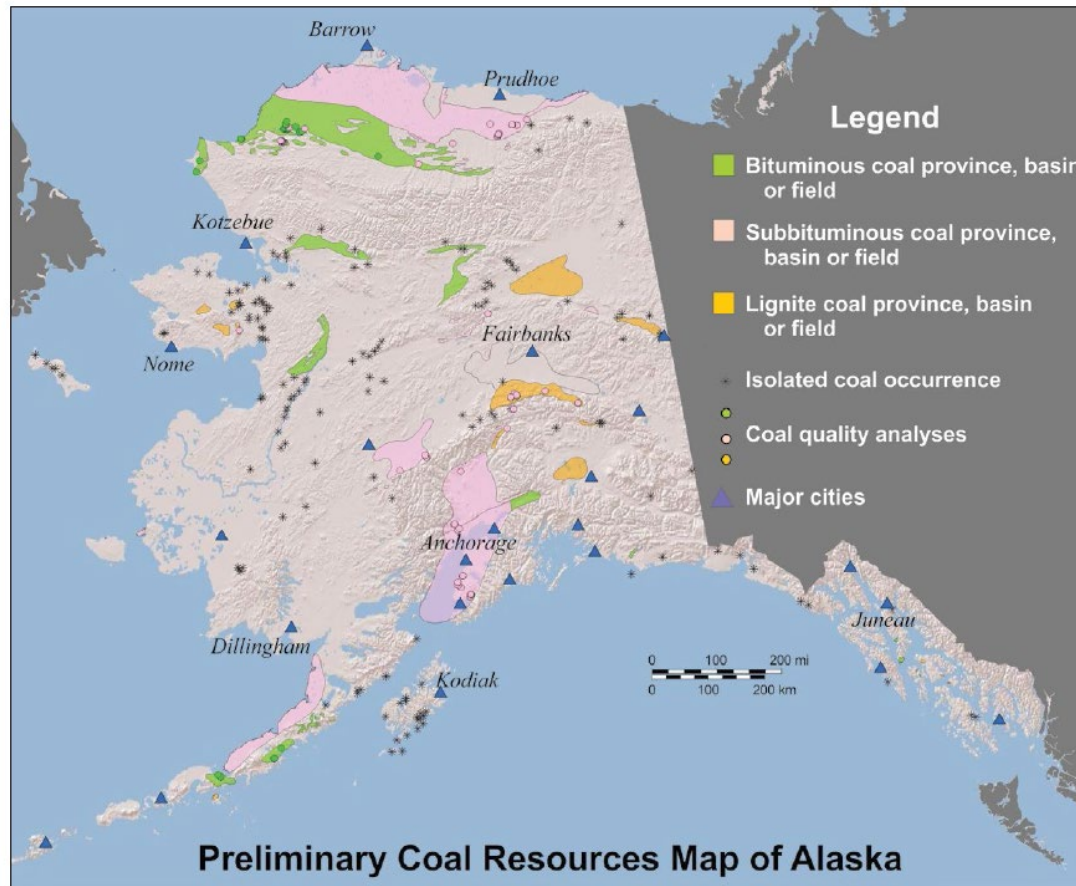
HISTORICAL PUBLICATIONS, DATA & SAMPLE SOURCES



- DGGG/GMC
- Industry
- Native Corporations
- USGS
- BLM
- USBM
- UAF/MIRL
- Others

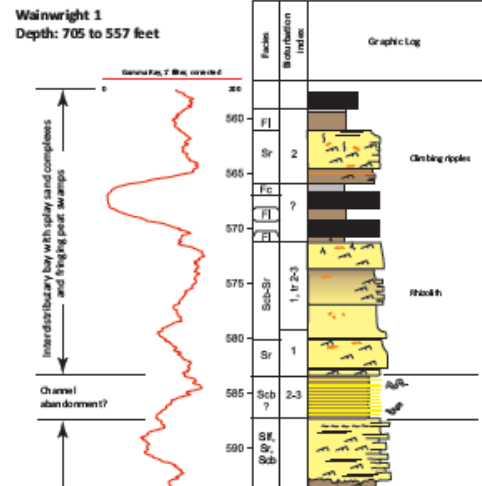
HISTORICAL PUBLICATIONS, DATA & SAMPLE SOURCES

National Coal Resources Data System (NCRDS)



- Cooperative project between the USGS and state geological surveys
- National database of coal data, focusing on the stratigraphy and chemistry of coal
- DGGs has been annually uploading new modern analytical data on Alaska's coal resources

NEW ANALYTICAL DATA FOR HISTORICAL SAMPLES



Geologic Materials Center

- 3096 Alaska energy wells
- 26,500,000 feet of energy strata drilled
- 16,700,000 representative feet of energy core and 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



NEW ANALYTICAL DATA FOR HISTORICAL SAMPLES



Screening Approach for New Data

- Procure and calibrate 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)
- Define “anomalous values” for REE/CM
- Identify favorable core or samples
- Obtain rapid, qualitative elemental data with HH-XRF

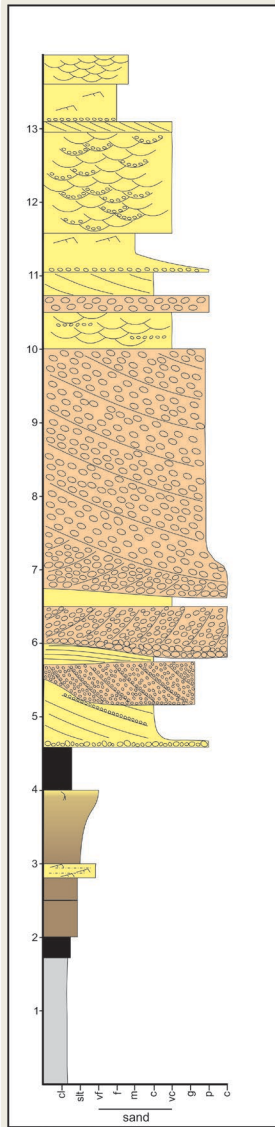
NEW ANALYTICAL DATA



Based on promising HH-XRF results

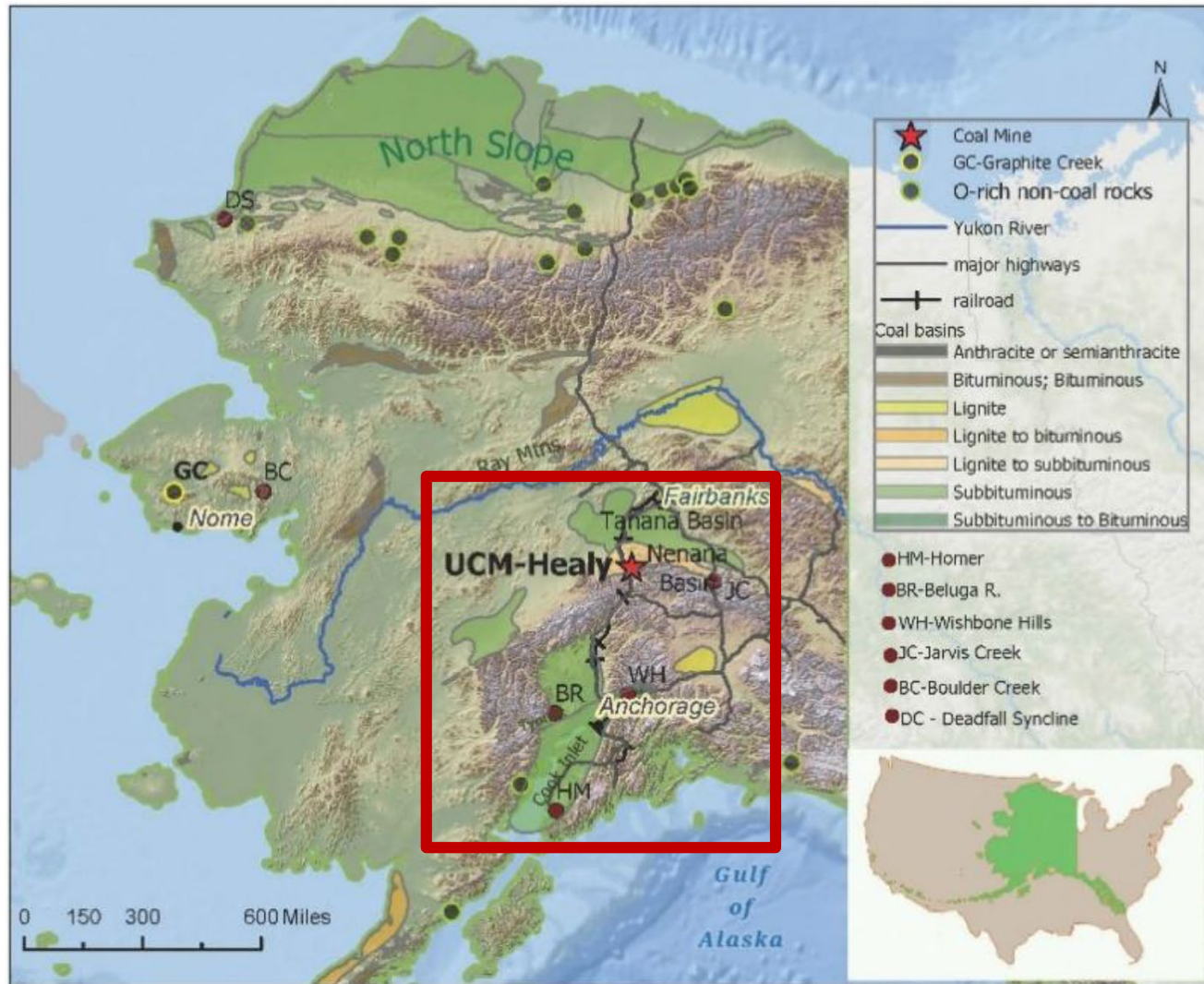
- Submit for inorganic geochemistry via full digestion ICP-MS
 - Major / minor oxides
 - Trace elements (including CM's)
 - REE's
- +/- Total organic carbon
- +/- Vitrinite reflectance
- +/- Coal quality

NEW GEOLOGIC FIELD AND OFFICE WORK



- Based on gap analysis and promising preliminary data, conduct targeted field studies
- Samples for HH-XRF and ICP-MS analyses
- TOC, Ro, CQ analyses
- Measured stratigraphic sections
- SEM/Microprobe
- Geochronology

FOLLOW THE GEOLOGY . . .



- 50+ coal fields deposited in a variety of tectonic settings – which ones might be the most prospective?
- Slow deposition during peat formation results in limited clastic dilution
- Airfall volcanic material is interpreted to be an important control on REE/CM detrital concentrations in coal
- Common mineral phases include phosphates such as monazite and apatite, various titanites, and zircon, among others

CENOZOIC ARC VOLCANISM IN SOUTHERN ALASKA

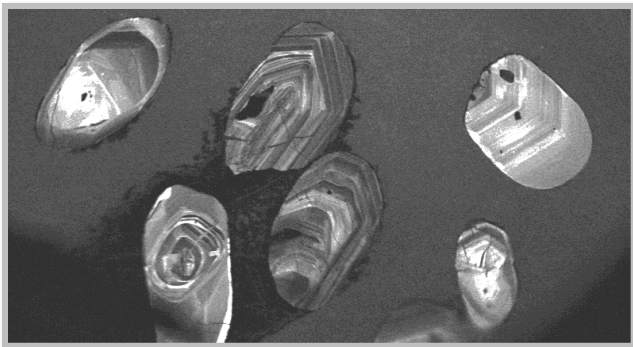
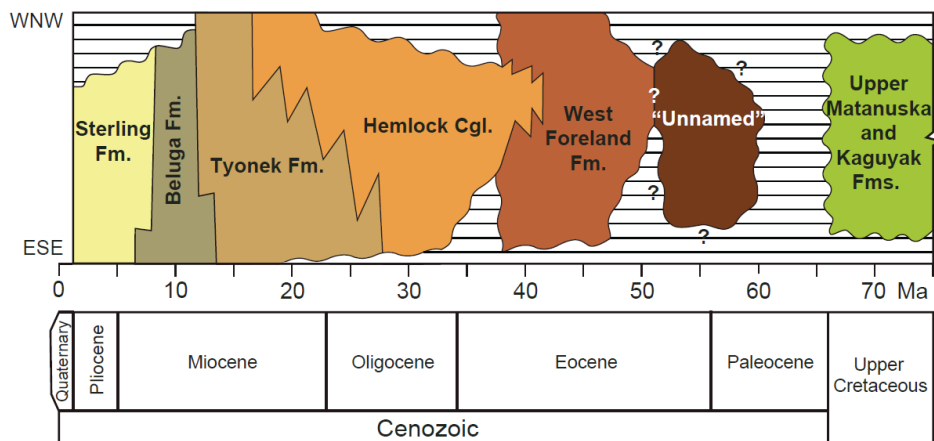
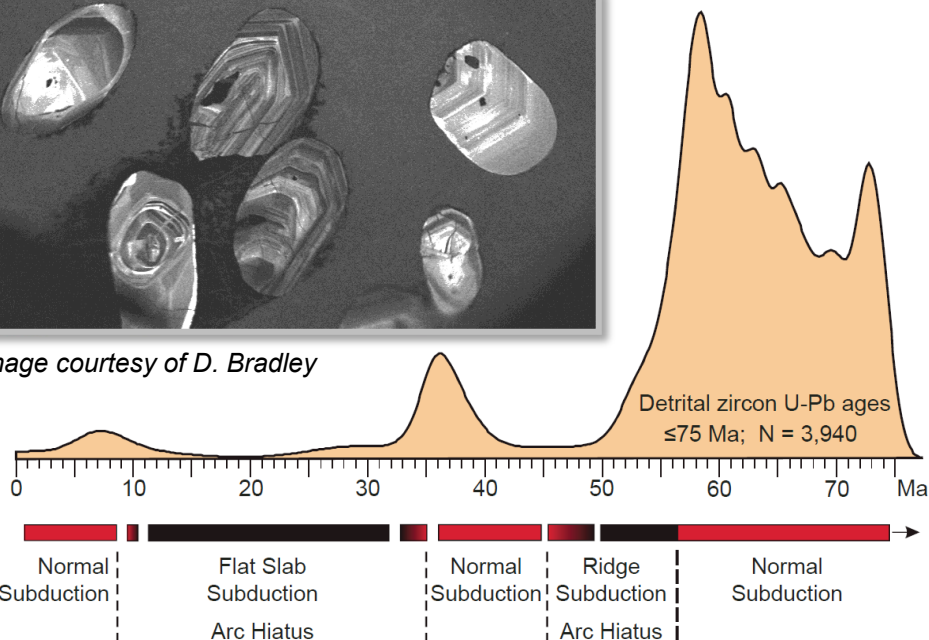


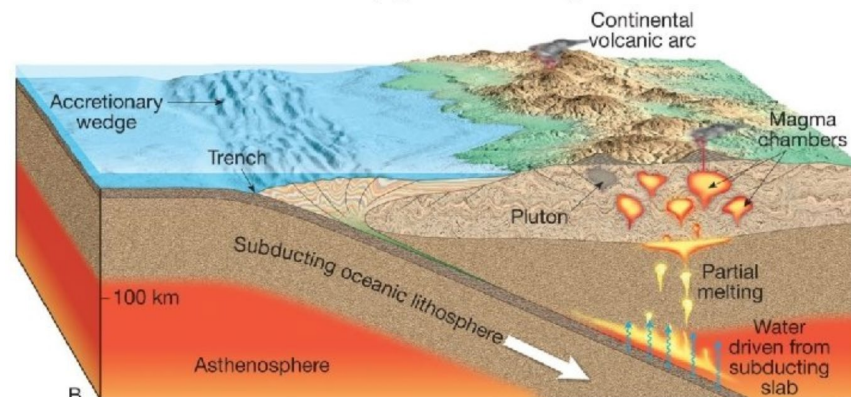
Image courtesy of D. Bradley



Helmold et al., 2018

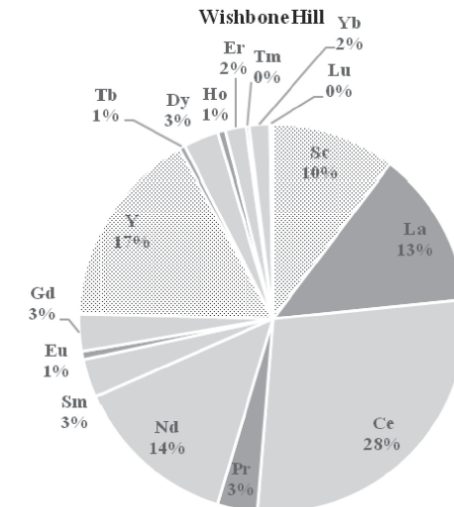
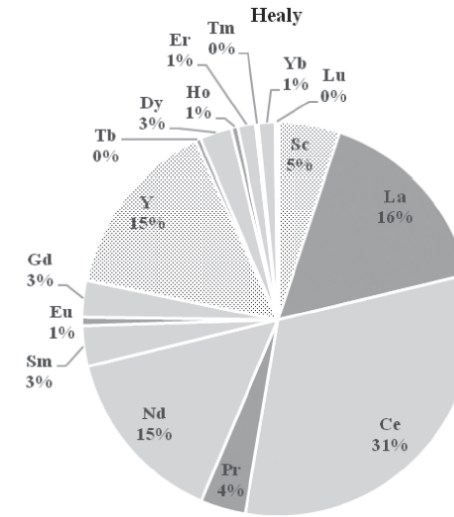
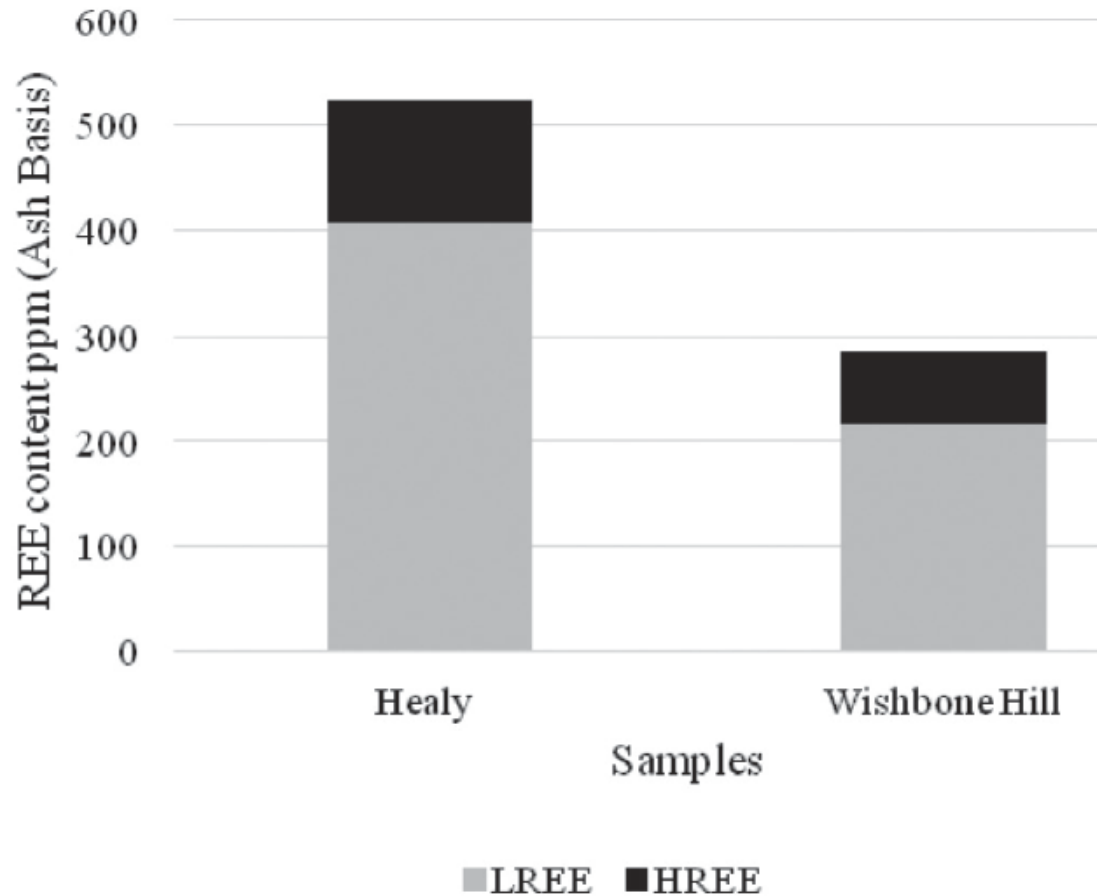
Sedimentary basins provide reliable record of waxing and waning of arc volcanism

- Robust signal of zircon crystallization in the Paleocene and late Eocene
- Notable early to middle Eocene gap coincident with proposed ridge subduction
- Very few Oligocene and Miocene zircons suggesting minimal igneous activity



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PRELIMINARY REE DATA



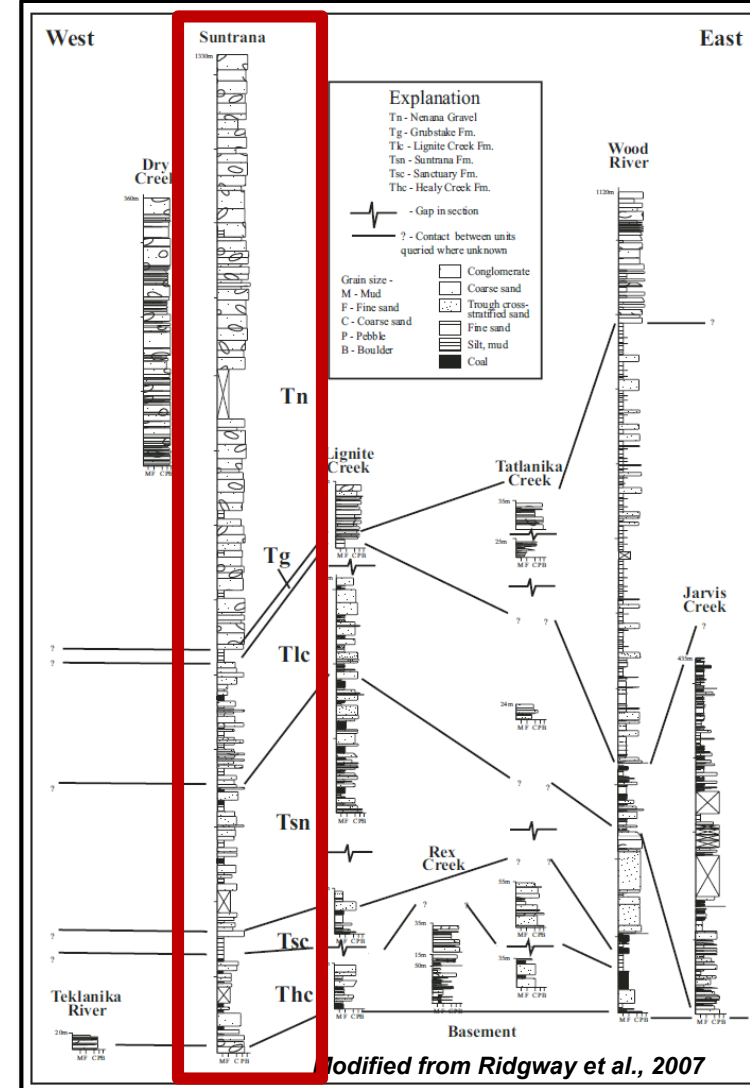
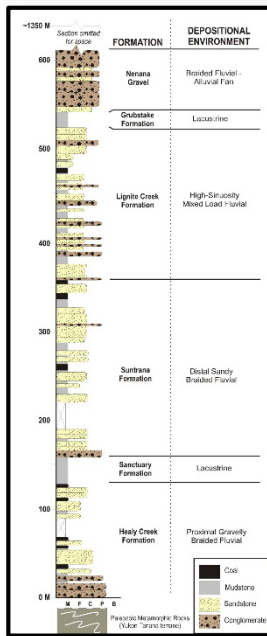
USIBELLI COAL MINE



- Alaska's sole operating coal mine for last 50 years, producing 50+ million tons of coal
- Currently averaging 1-2 million tons/yr depending on circum-Pacific export demand
- Eocene-Miocene section with 30+ coal beds from 2.5 to 30 feet thick
- 7,570-9430 Btu/lb on an as-received basis, 17.8% moisture, 3.5-13.2% ash yield and 0.1-0.3% sulfur

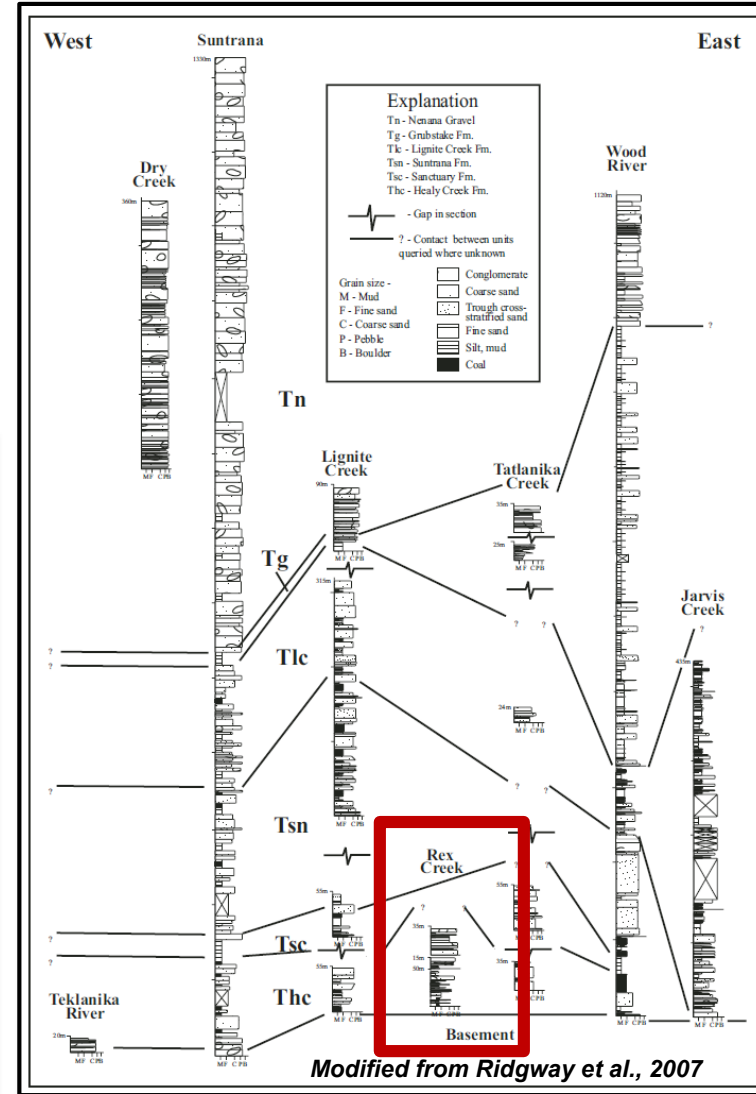
Usibelli.com
Flores et al., 2004
Barnes, 1967

USIBELLI GROUP TYPE SECTION AT SUNTRANA CREEK



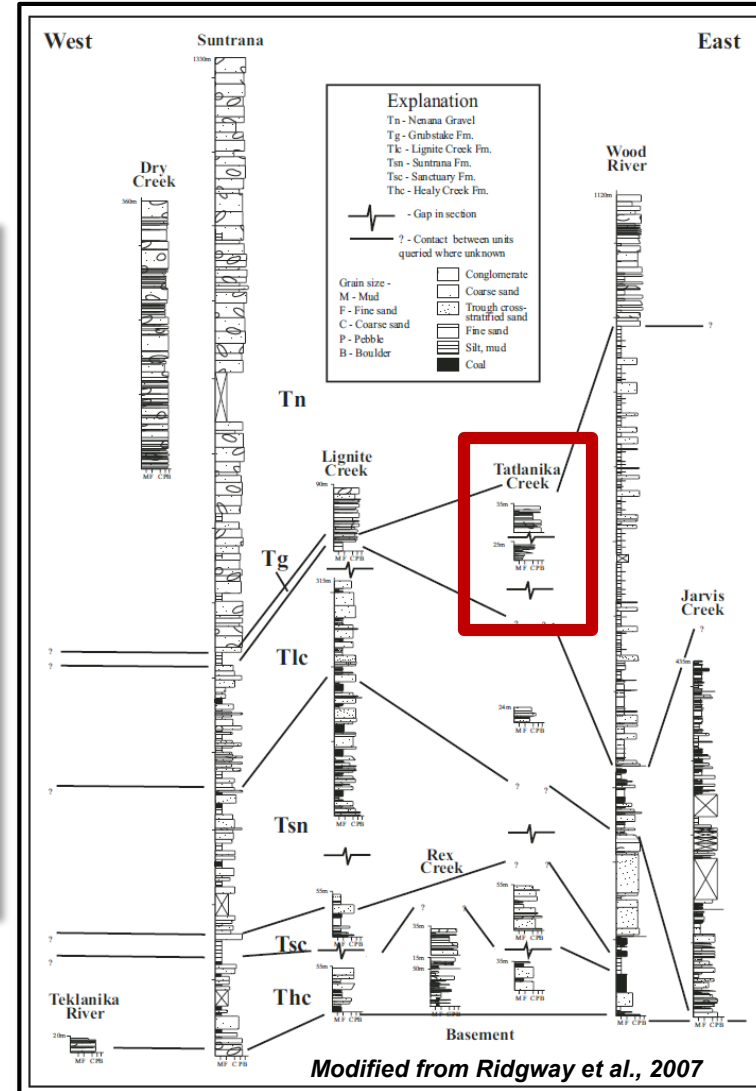
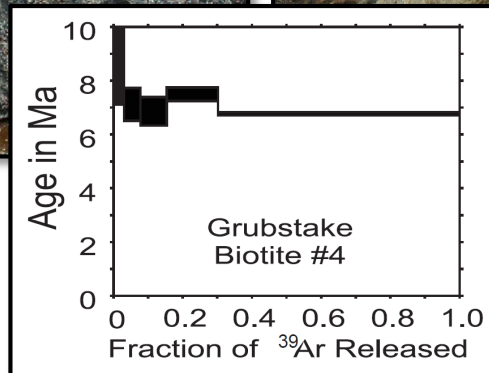
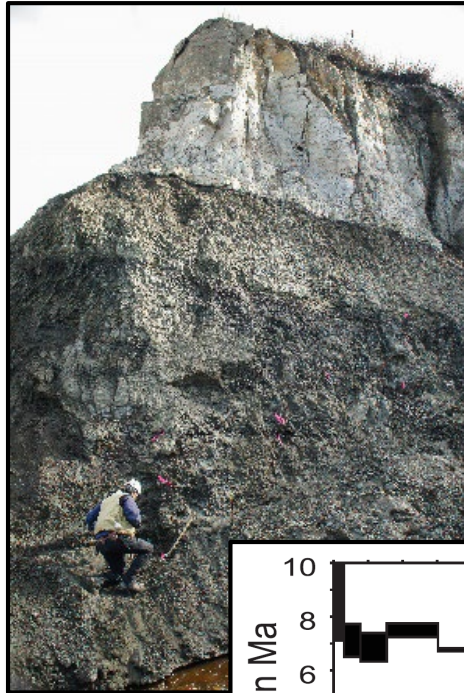
REX CREEK SECTION

- Thick Eocene(?) devitrified tuffs



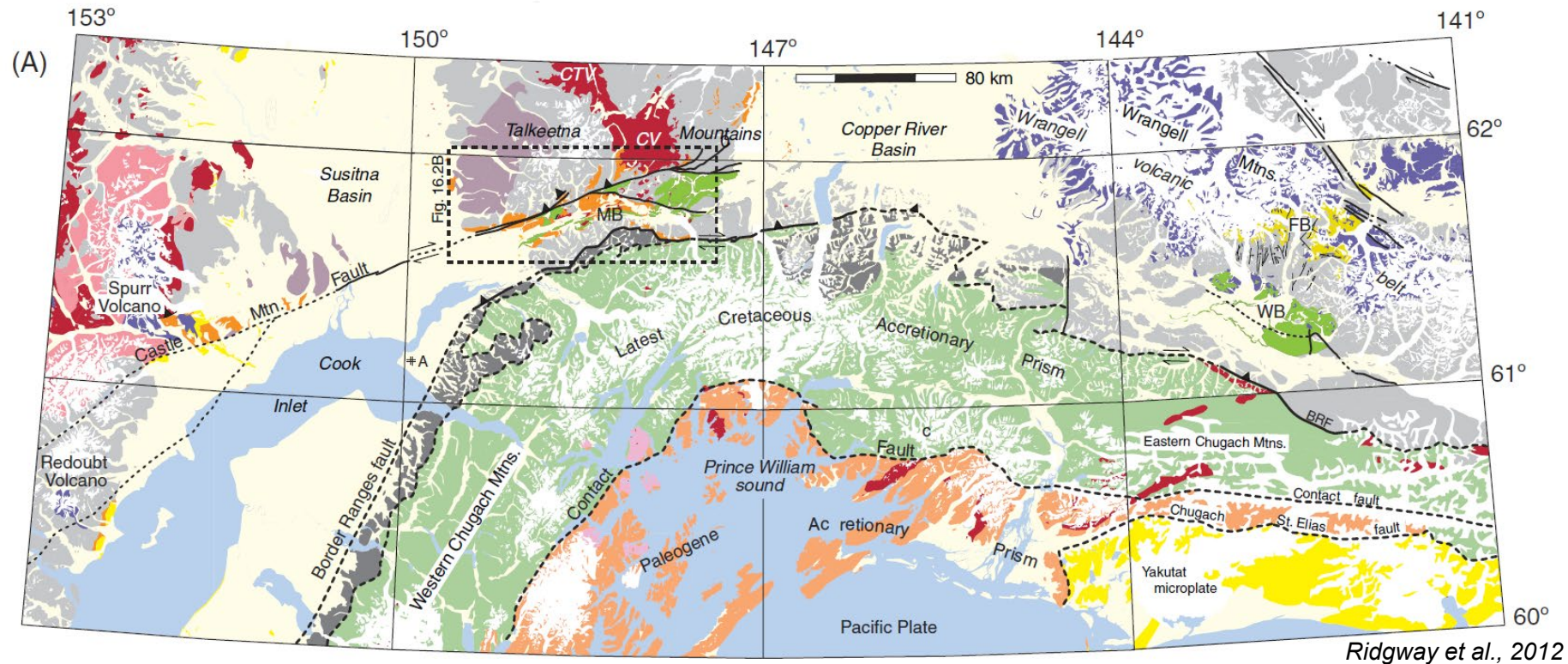
TATLANIKA CREEK SECTION

- Two thick Late Miocene reworked tuff beds that buried large trees in growth position



PALEOGENE FOREARC (MATANUSKA VALLEY AND TYONEK AREAS)

- Thick Paleocene and Eocene coal-bearing sections deposited in a forearc setting
- Basins controlled in part by transtensional tectonics associated with the Castle Mountain fault system

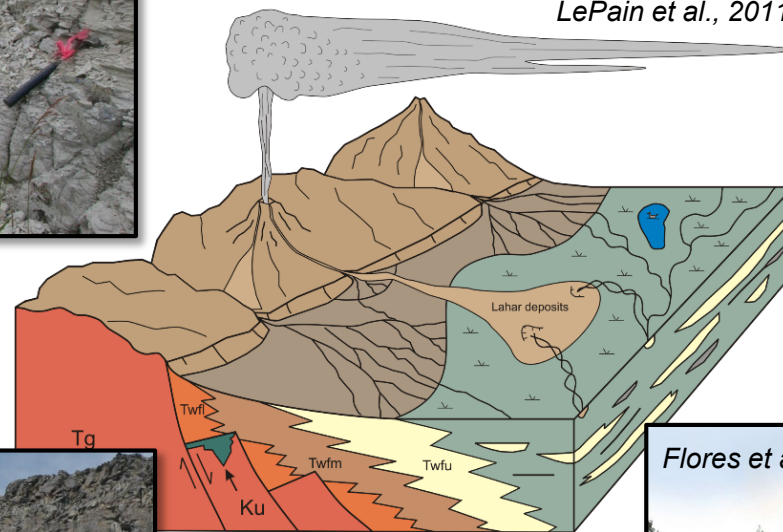


PALEOGENE FOREARC (MATANUSKA VALLEY AND TYONEK AREAS)

Gillis et al., 2022



LePain et al., 2011



- Abundant and thick subbituminous to anthracite coal in the Wishbone Hill district
- Between 1915 and 1970, area produced 7.7×10^6 short tons
- Stratigraphy includes locally abundant and thick airfall and reworked tuff deposits

Ridgway et al, 2012



Flores et al, 2004



DATA DISTRIBUTION



- QA/QC analyses and database
- All sample information and organic and inorganic geochemical data will be captured in DGGS databases and exported to NETL's Energy Data Exchange platform
- Representative sample splits secured for DOE archival
- Additional supporting geologic information (sedimentology, stratigraphy, provenance, geochronology, etc.) will be published in refereed DGGS reports that are freely available on our website

PRIORITY MATRIX

Results feed into team's priority matrix to assist selection of most promising basin(s) for further consideration in Phase II

ID initial criteria for inclusion in the Priority Matrix (Geology-specific)

- Which elements are present
- Abundance/concentration of element
- Mineral phase?
- Layer anomaly vs. high average?
- Likely stratigraphic or areal extent
- How organic rich is carbon ore
- Coal quality
- Thermal maturity

Definition 1	Metric Description	Site 1	Site 2	Site 3	Site 4	Site 5
	Available Data	200	110	100	120	
D1	Cores available to study?	100	55	50	60	
D2	REE-CM in operating mine?	100	55	50	60	
	Mining	500	335	130	385	
M1	Concentrations	400	275	40	225	
M5	Overbuden	100	60	90	160	
	Environmental	500	110	250	300	
E1	Env. Justice	250	55	125	150	
E2	Resue of Waste Streams	250	55	125	150	
	Technology					
T1	Suitable mining technology exist?					
T3	Technology gaps to address					
	Manufacturing Value/Potential					
V1	Carbon-based products					
V2	REE-CM based products					
	Infrastructue & Workforce					
I1	Access (roads, rivers, bridges)					
	Regulatory					
P1	Permits required					
P2						



TEAM MEMBERS & STAKEHOLDERS



EQUIPPED TO DO MORE.



Questions / Discussion . . .



Katmai area – photo by Rocky Reifenstuhl