DGGS Geologic and Mineral-Resource Assessment of the Western Wrangellia Terrane, Central Alaska: Initial Progress Report

E. Twelker[1], R.J. Newberry[2], L.K. Freeman[1], K.R. Sicard[1], D.A. Reioux[1], E.N. Bachmann[1]

[1]Alaska Division of Geological & Geophysical Surveys

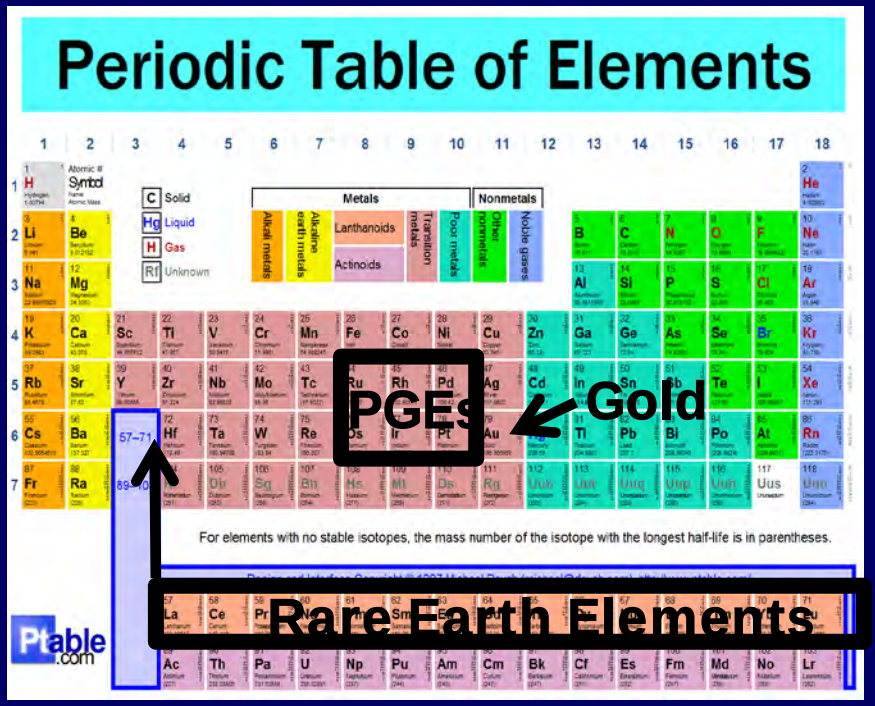
[2]Department of Geology and Geophysics, University of Alaska Fairbanks

Alaska Miners Association – 2013 Annual Convention
November 6, 2013 – Anchorage, Alaska

DGGS Wrangellia Project Location

Why are we interested in PGEs?

(PGEs = Platinum-group elements:
Pt, Pd, Rh, Ir, Os, Ru)



Strategic & Critical Minerals

PGEs essential as catalysts

- Automotive
- Chemical industry
- Your woodstove?

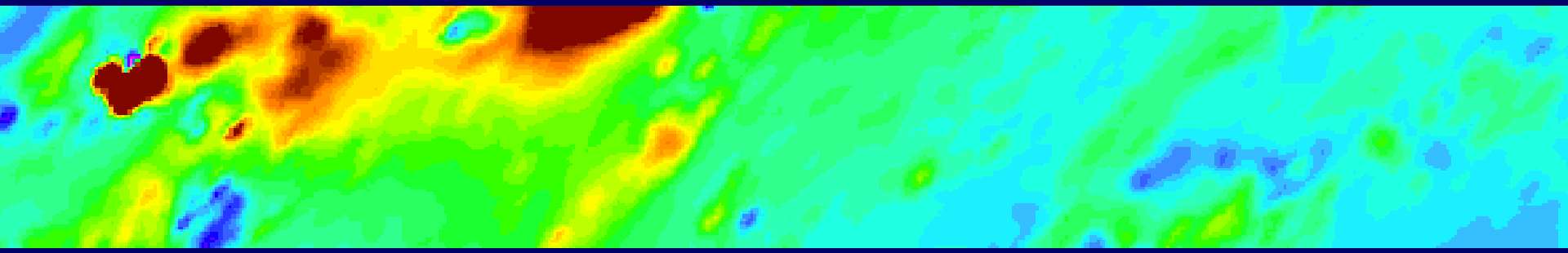
Heavy dependence on foreign sources:

- US Net import reliance: 91% of Pt, 56% of Pd[1]
- Mine production:
  - South Africa + Russia = 92% of Pt, 77% of Pd[1]

[1]USGS 2013 Commodity summary for Platinum-Group Metals

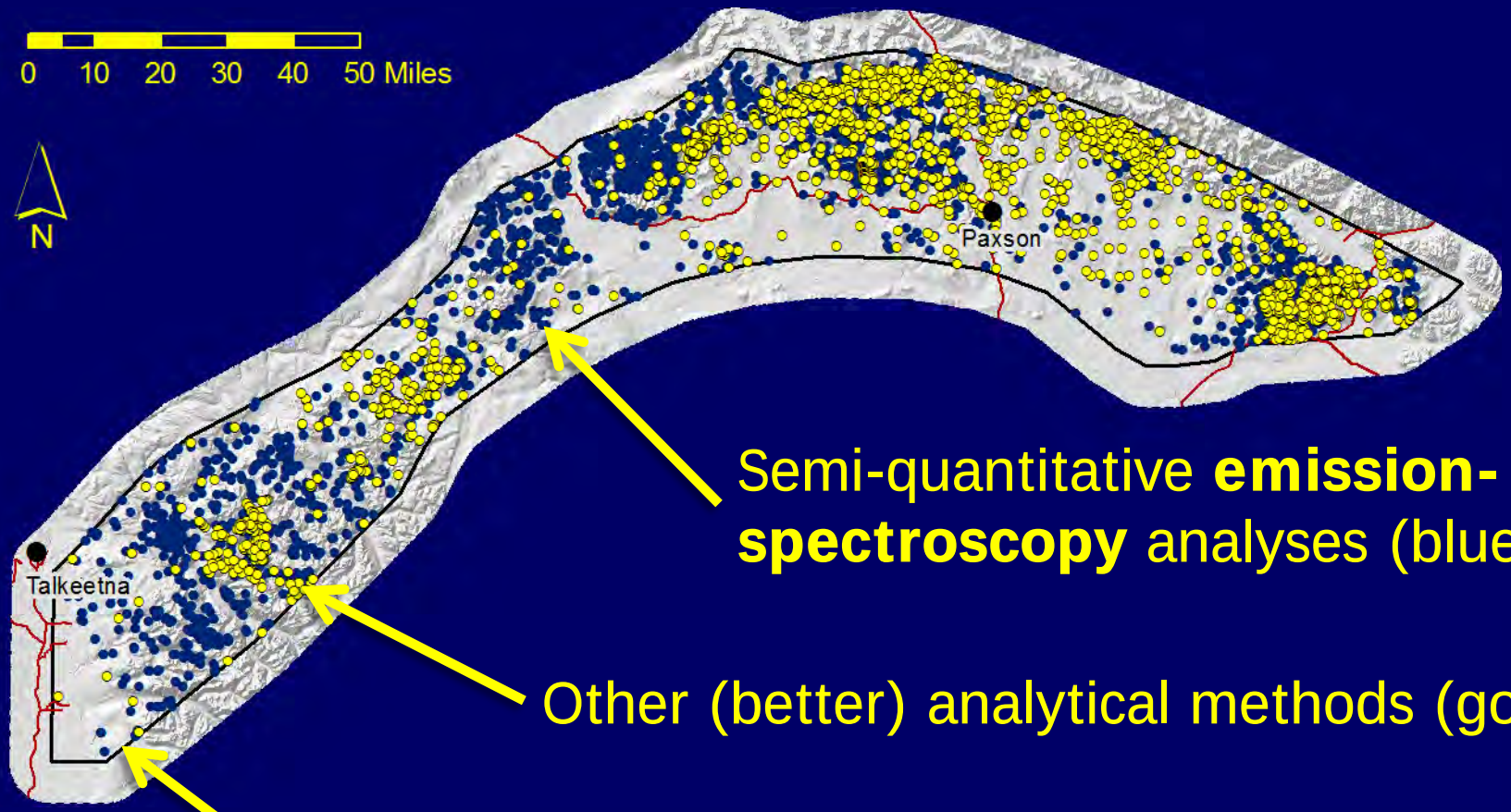
2013 Project Goals

1) Re-analyze available USGS stream sediment pulps with modern techniques:
   - Fire assay Pt, Pd, Au; multi-element ICP
2) Collect additional airborne magnetics and EM data over western Wrangellia
3) Field data collection to evaluate potential of W. Wrangellia for magmatic Ni-Cu-PGE

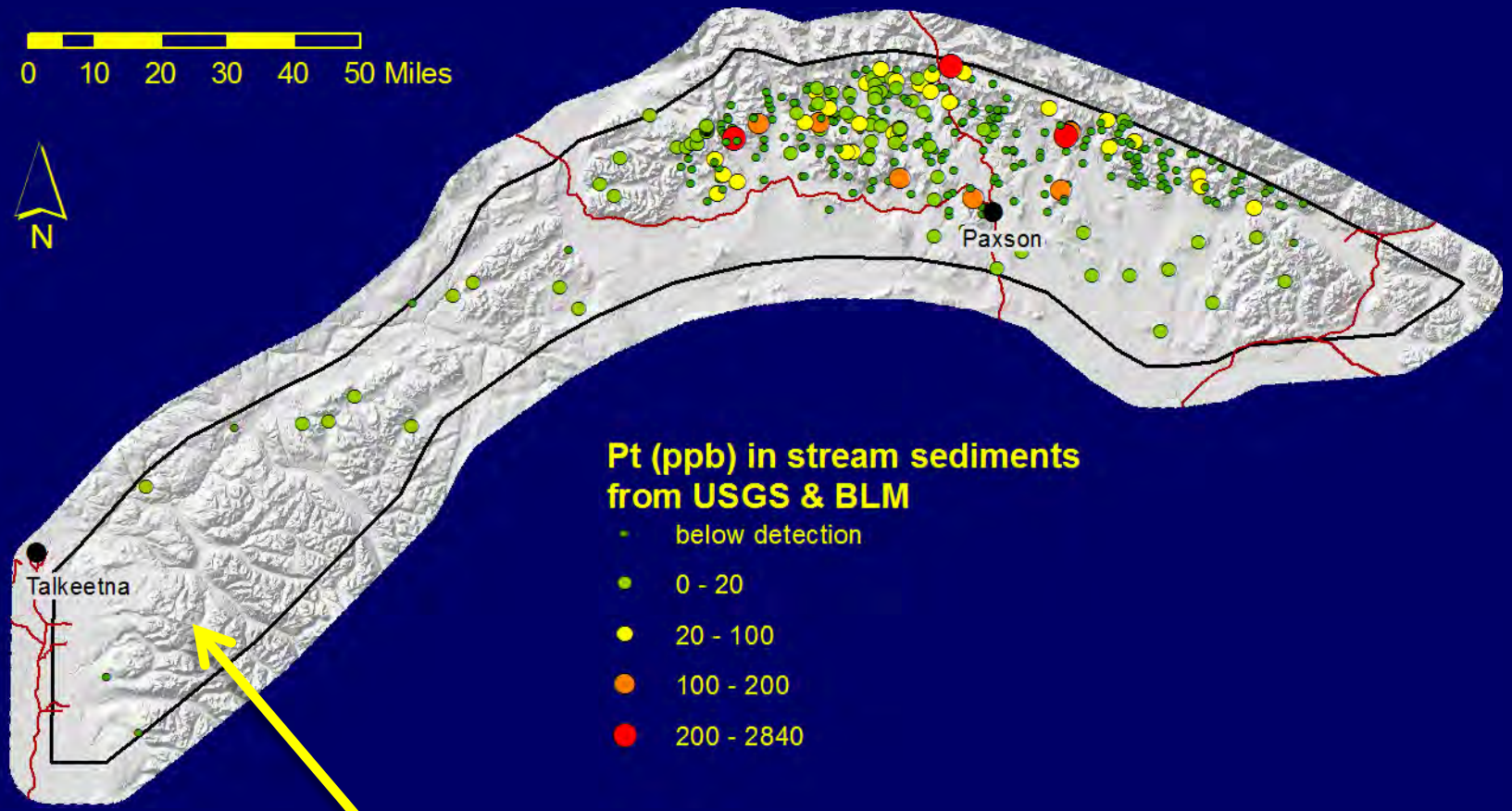


Part 1: Reanalysis of archived pulps

Existing geochemical data coverage (AGDB + DGGS Webgeochem + BLM):

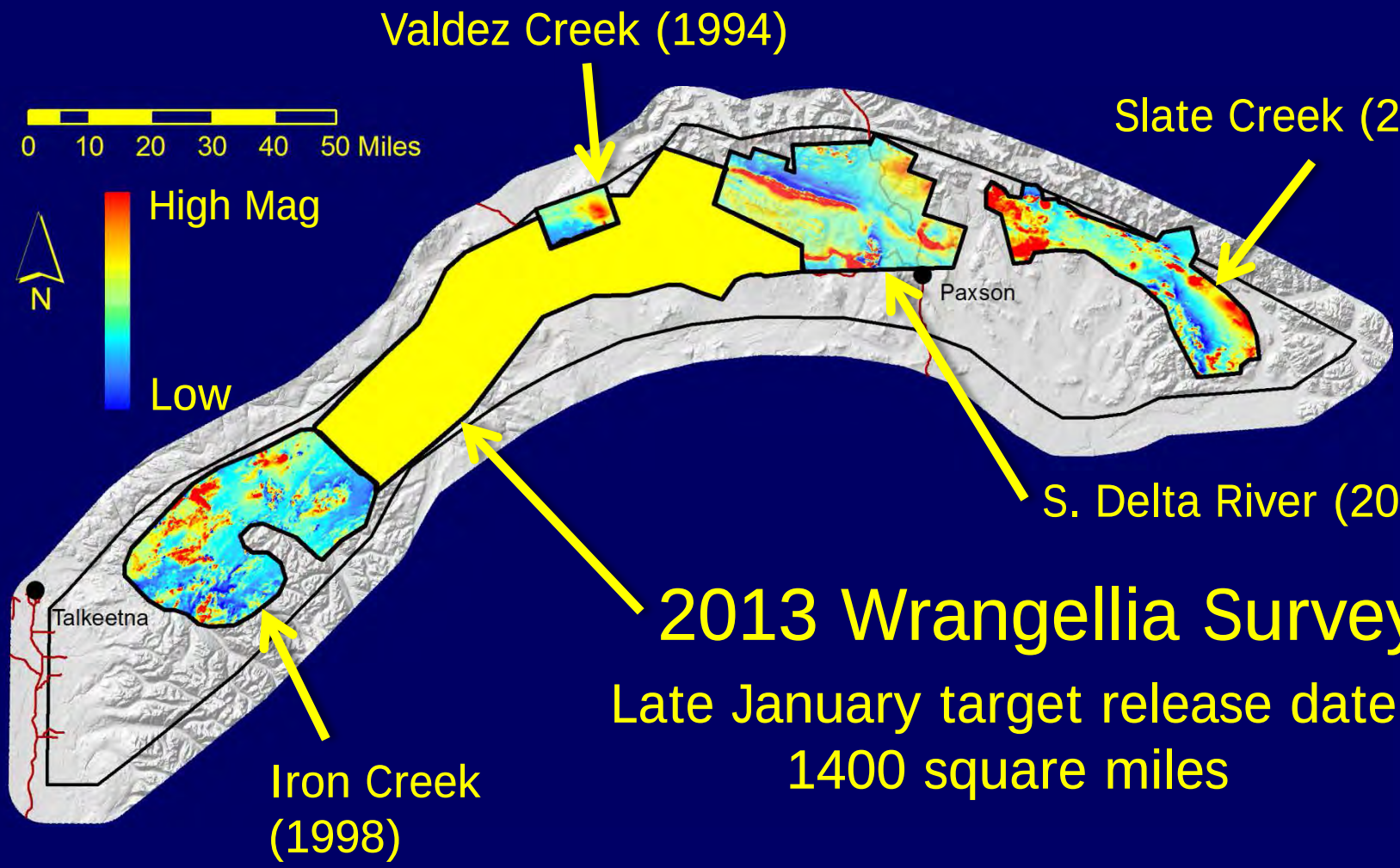


Example: Platinum in stream sediments



Major data gap in western Wrangellia

Part 2: Geophysical Surveys



2013 Wrangellia Survey

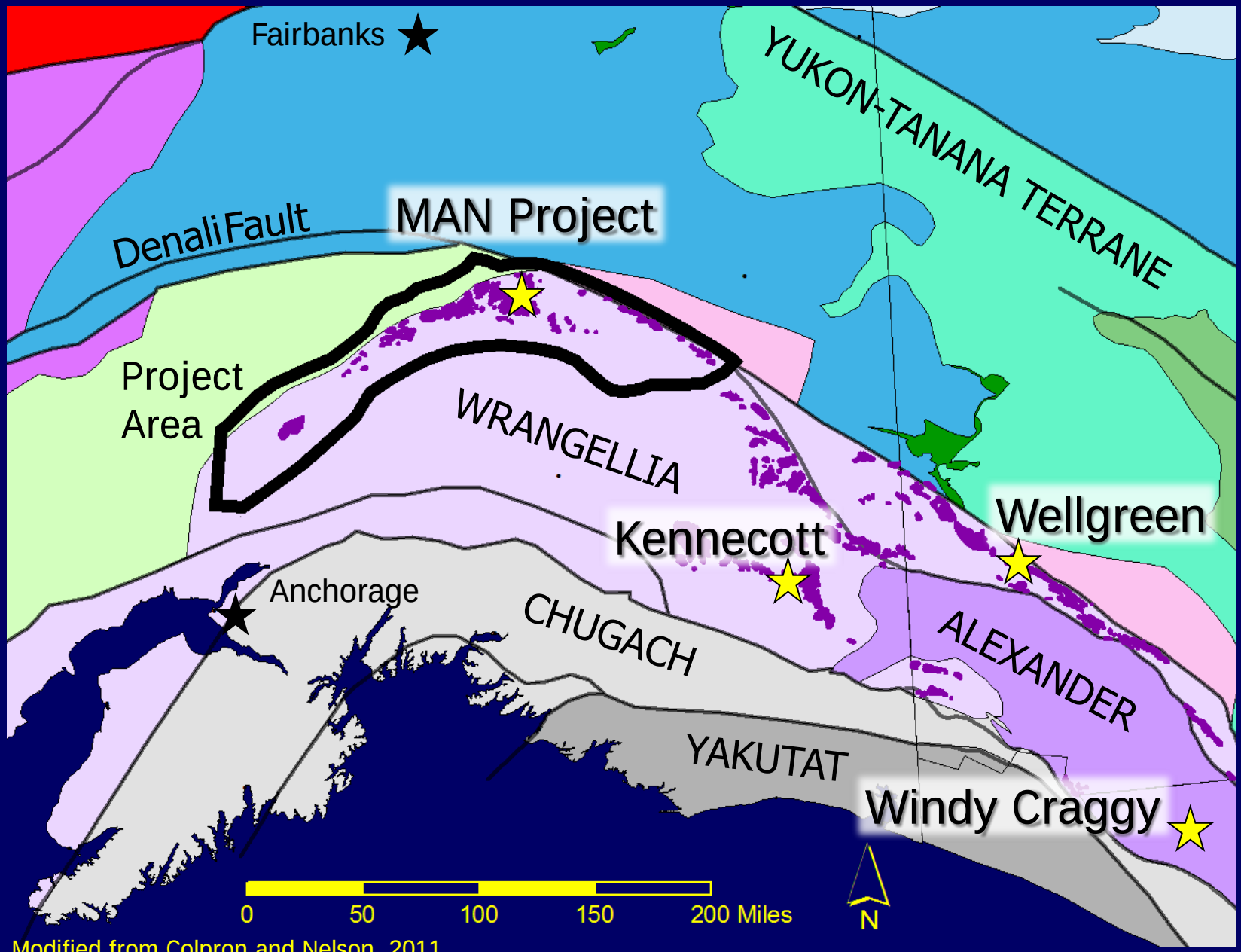
Late January target release date

1400 square miles

Part 3: Geologic Evaluation

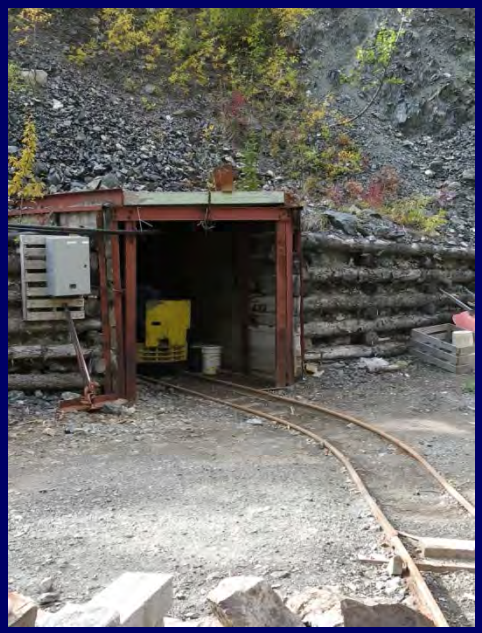
- Compile existing data and develop targets for follow-up fieldwork
- Potential PGE hosts: Known and suspect Late Triassic mafic-ultramafic intrusions
  - Previous mapping and reporting
  - Stream sediment anomalies (e.g. Cr, Ni)
  - Appropriately shaped magnetic highs
- Other important units (e.g. Nikolai Gnst)
- Identify areas that would benefit from a detailed mapping project in 2014

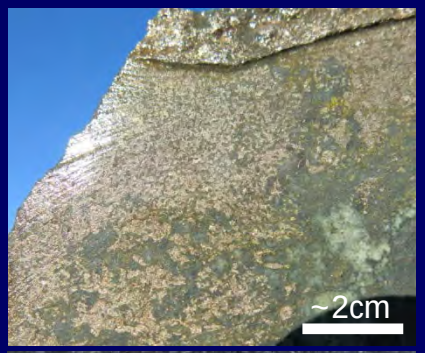
Wrangellia: what is it, and why is it important?

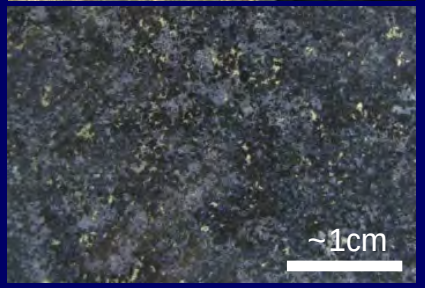


Modified from Colpron and Nelson, 2011

Metallogenesis of Wrangellia

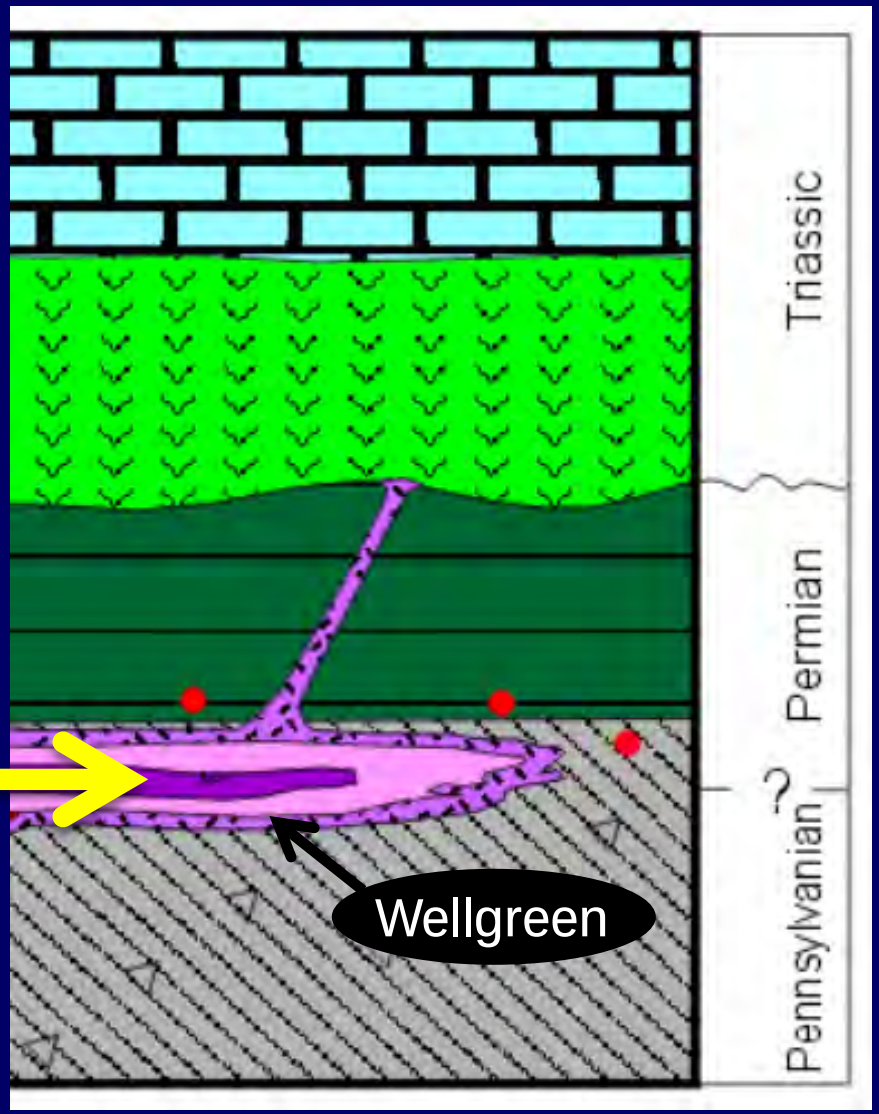






Late Triassic **Mafic** to **ultramafic** intrusions:

- Interpreted as feeders to Nikolai flood basalts
- Dunite-CPXite-gabbro
- Host magmatic Ni-Cu-PGE

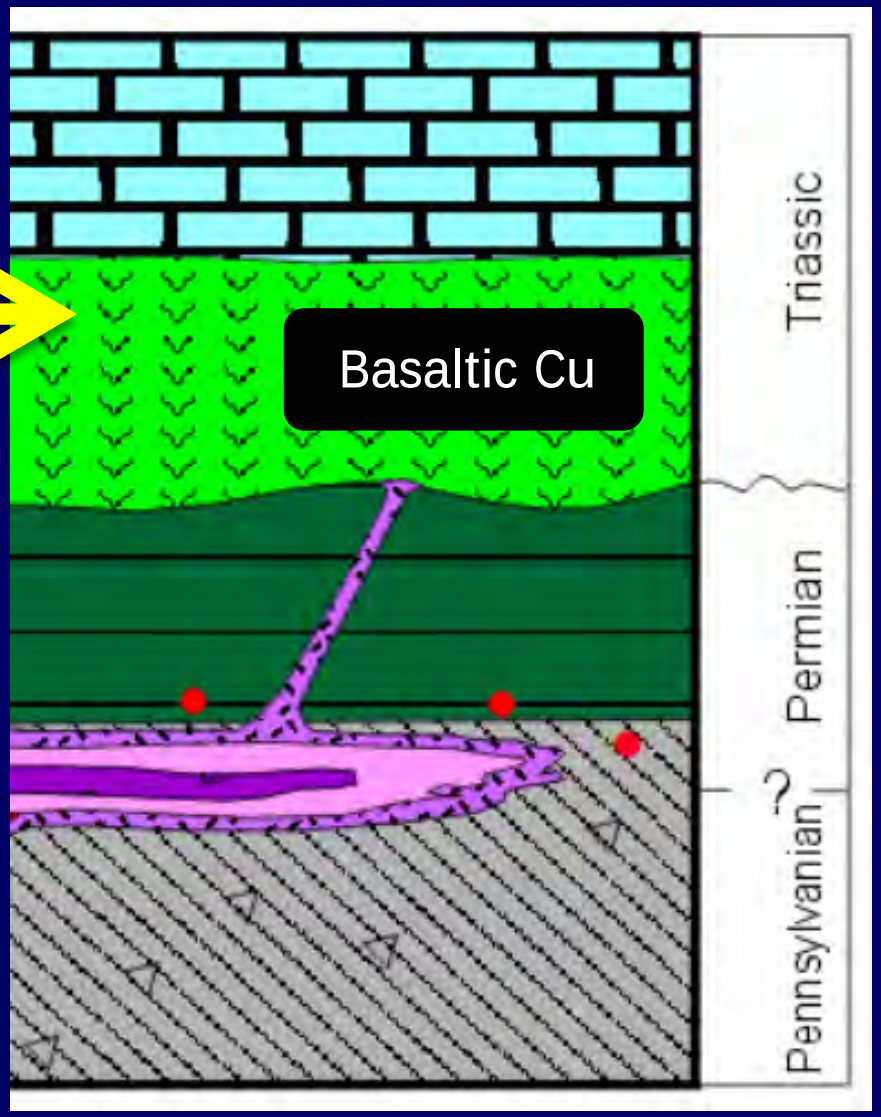


Adapted from Kluane M-UM Complex (Hulbert 1995, GSC OF3057)

Metallogenesis of Wrangellia

Nikolai Greenstone:

- Oceanic flood basalt
- ~3000m thick
- Late Triassic
- Metalliferous: numerous basaltic copper occurrences

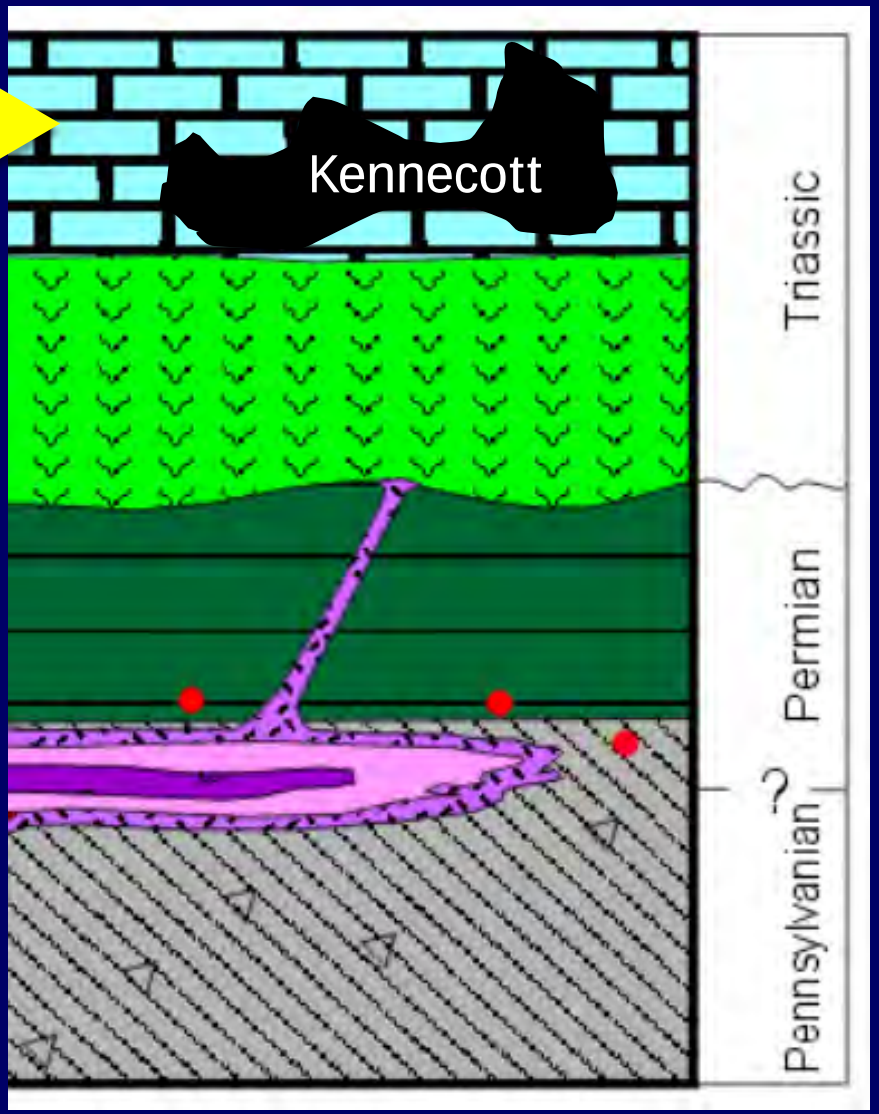


Adapted from Kluane M-UM Complex (Hulbert 1995, GSC OF3057)

Metallogenesis of Wrangellia

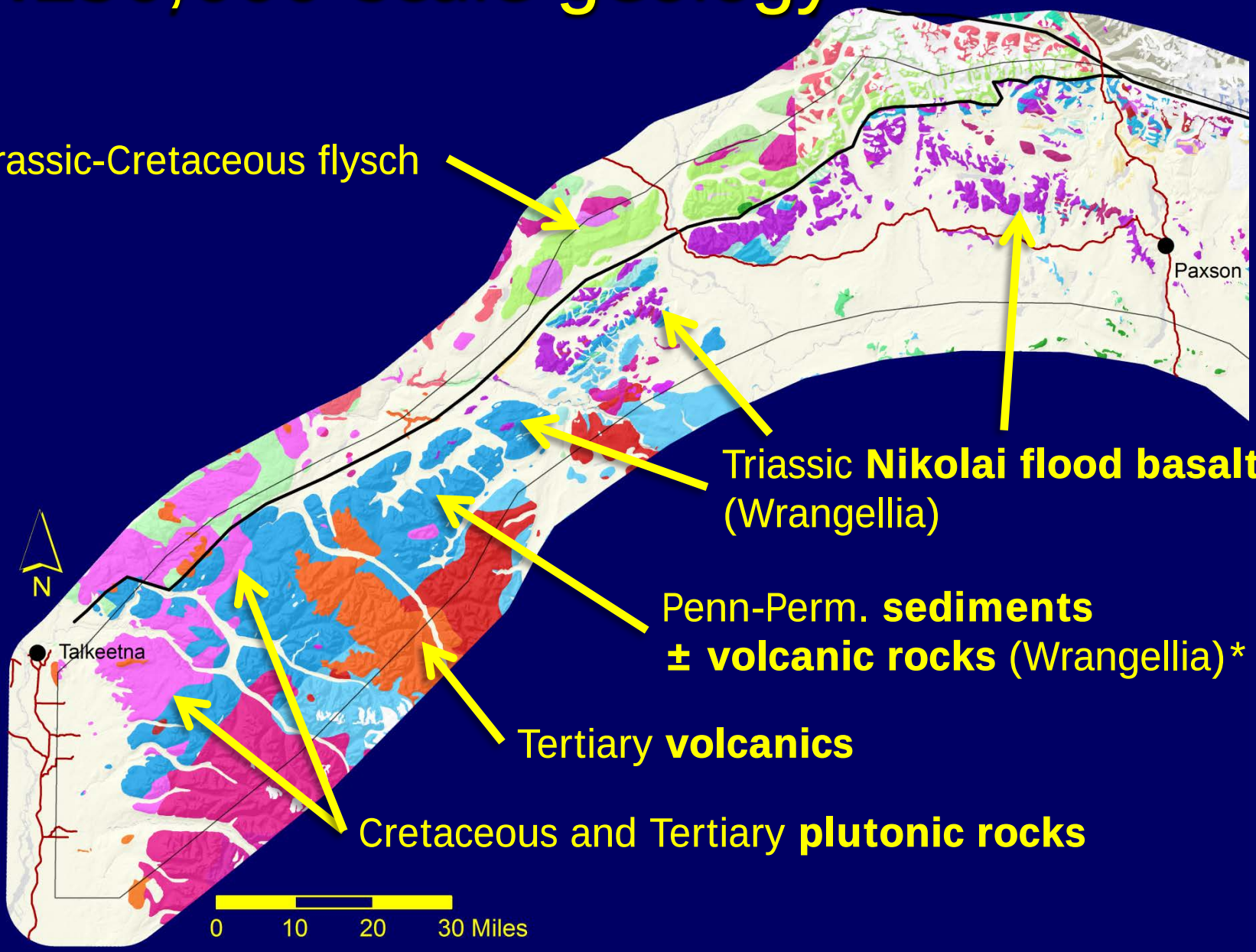
Chitistone and **Nizina** Limestones:

- Conformably overlies Trn
- Hosts of the high grade Kennecott Copper deposit
- Linked to L. Jr-K orogeny



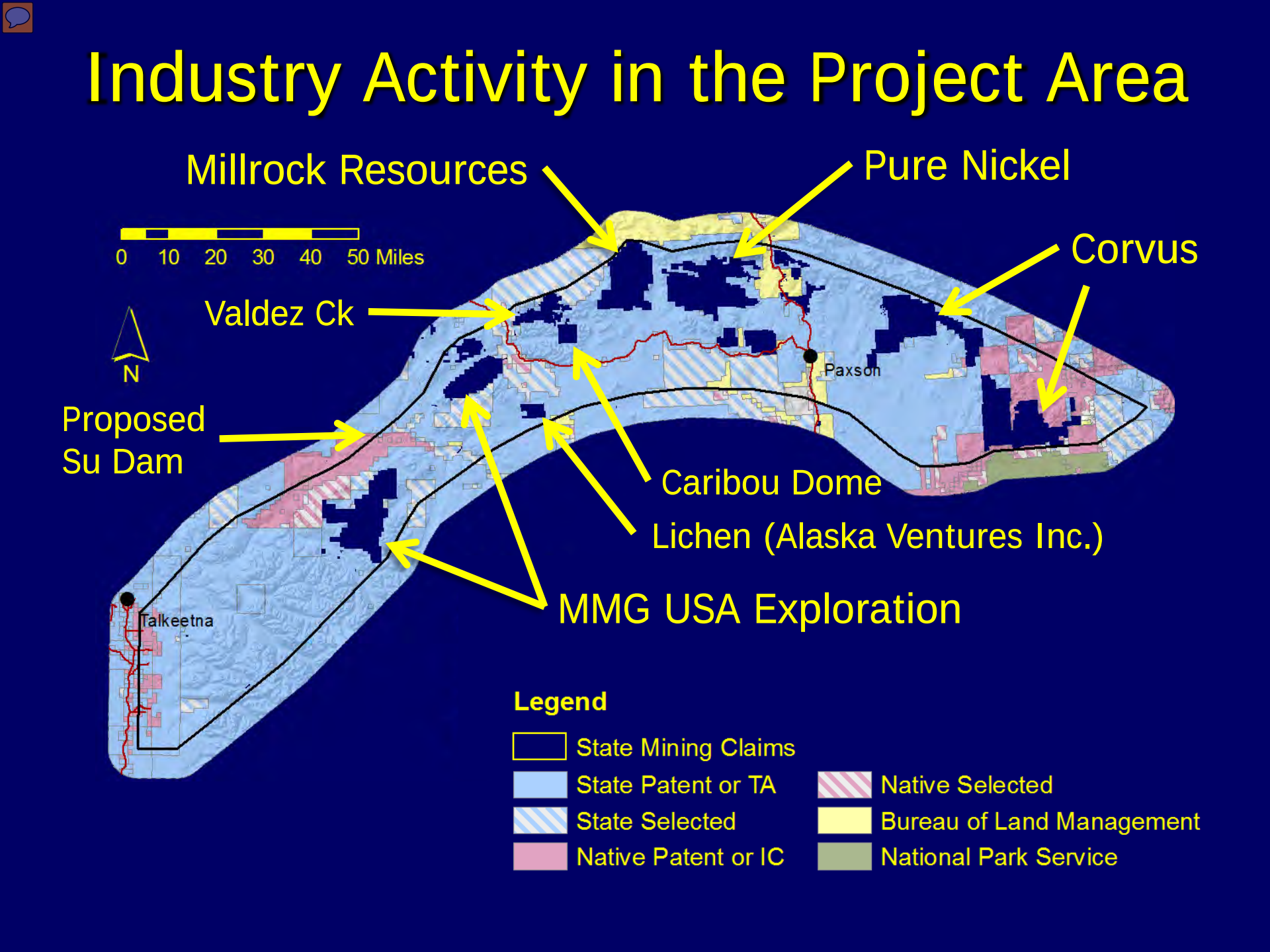
Adapted from Kluane M-UM Complex (Hulbert 1995, GSC OF3057)

1:250,000-scale geology

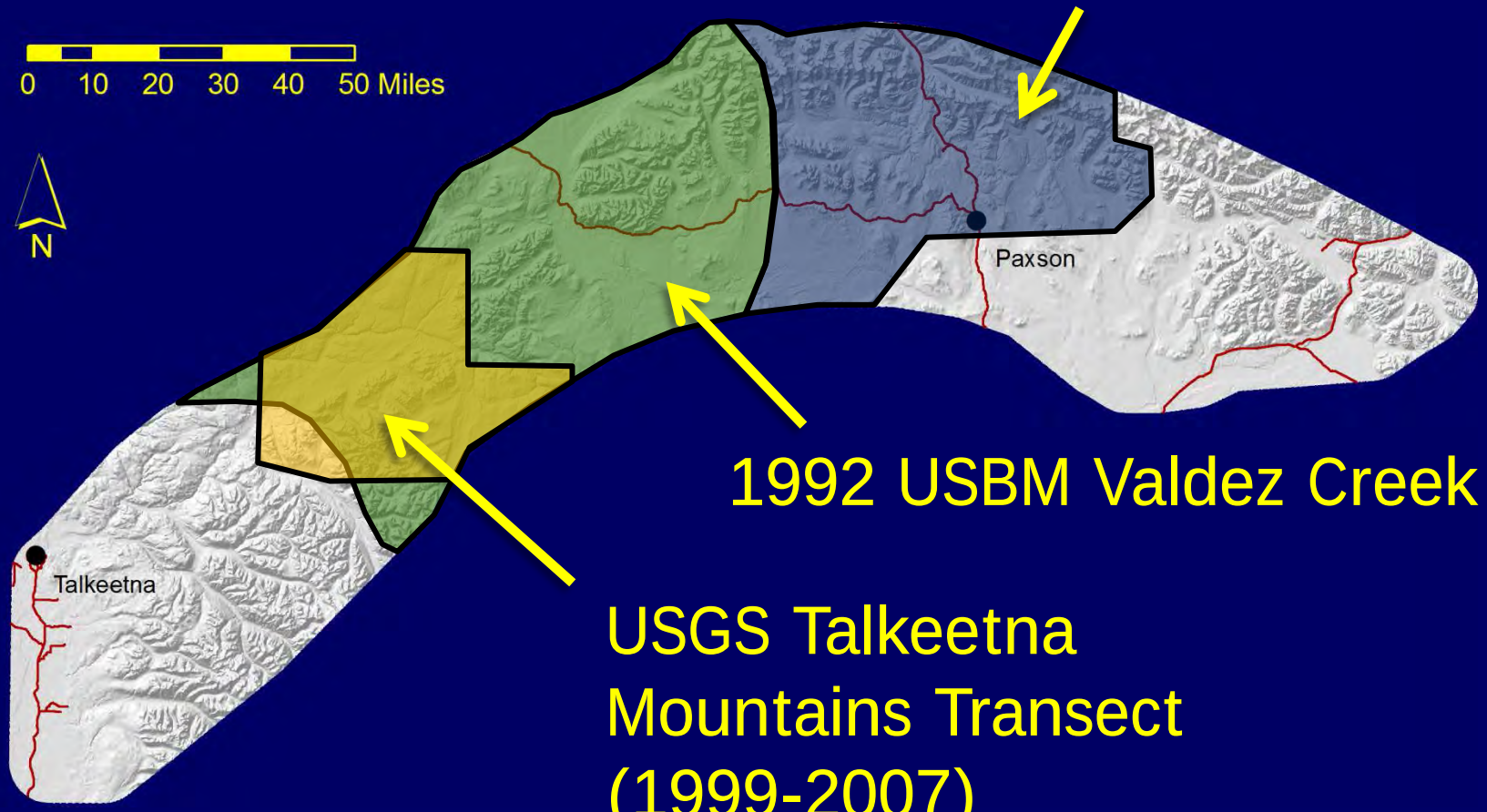


Geology after Wilson and others, 1998

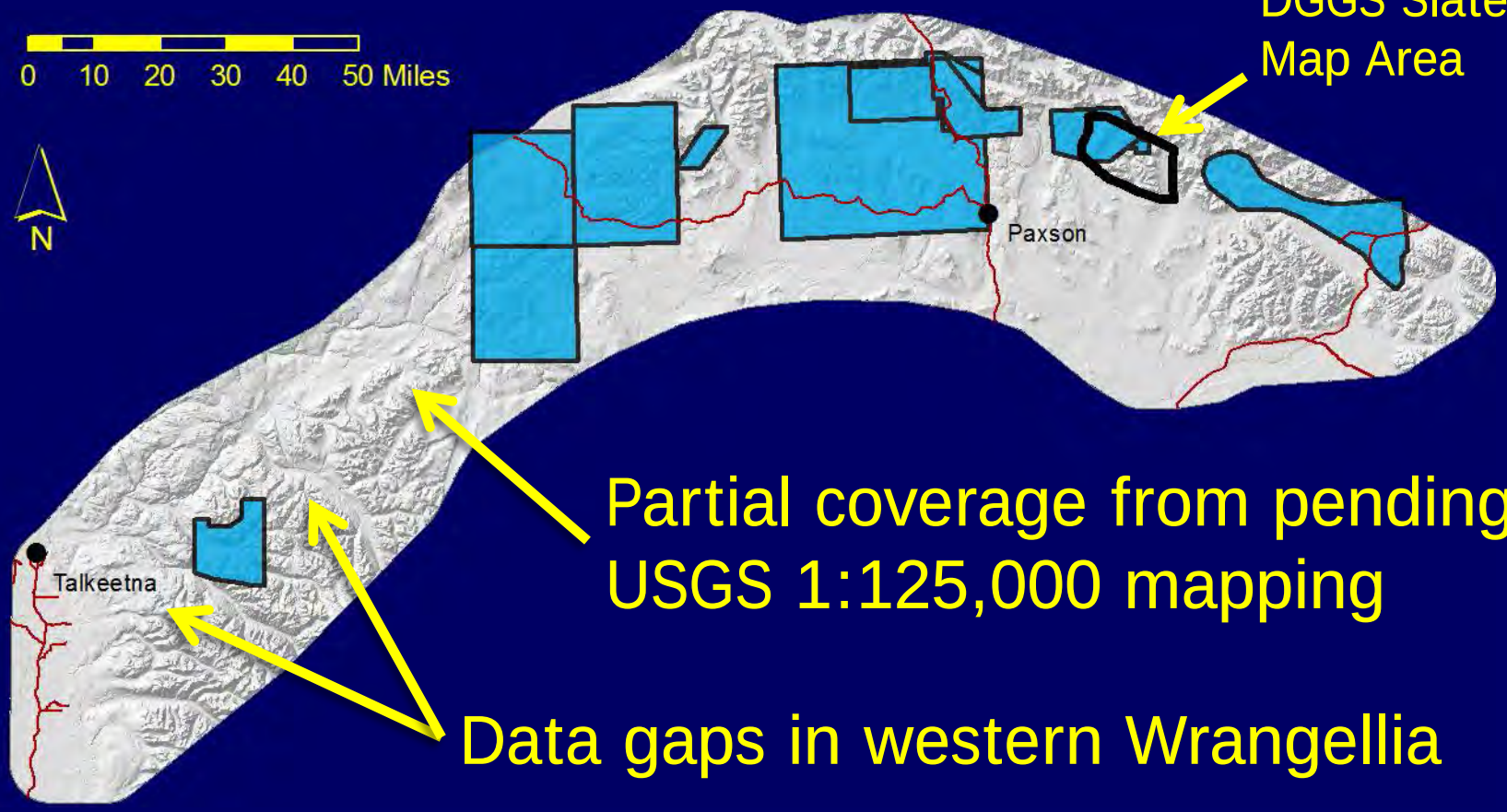
Industry Activity in the Project Area



Previous agency work in the area



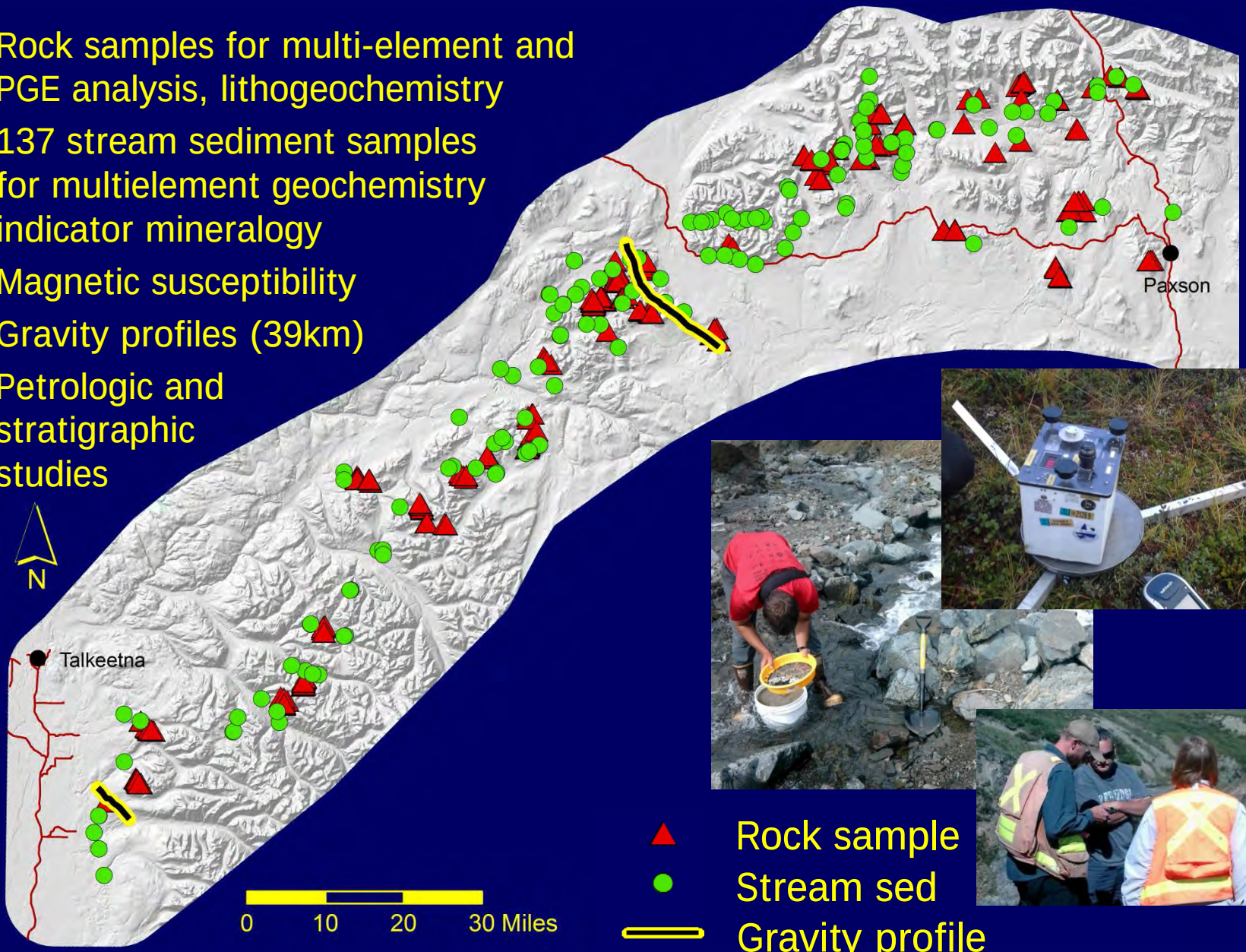
Published detailed geologic mapping



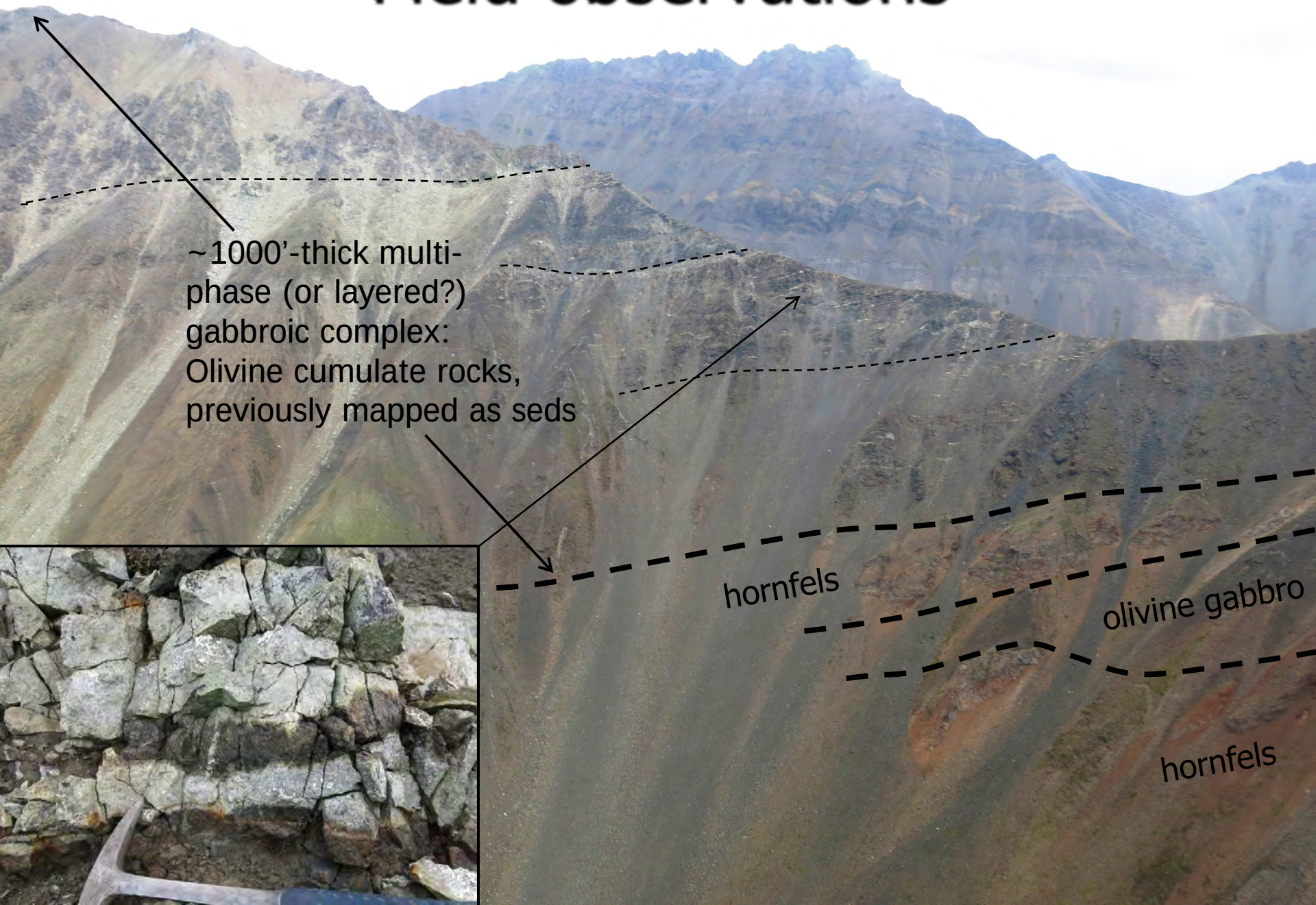
Coming soon via DGGS: inch-to-mile maps by Warren Nokleberg
(Mt Hayes, Gulkana, Nabesna, and Tanacross quadrangles)

2013 Field Program (3 weeks)

- Rock samples for multi-element and PGE analysis, lithogeochemistry
- 137 stream sediment samples for multielement geochemistry indicator mineralogy
- Magnetic susceptibility
- Gravity profiles (39km)
- Petrologic and stratigraphic studies

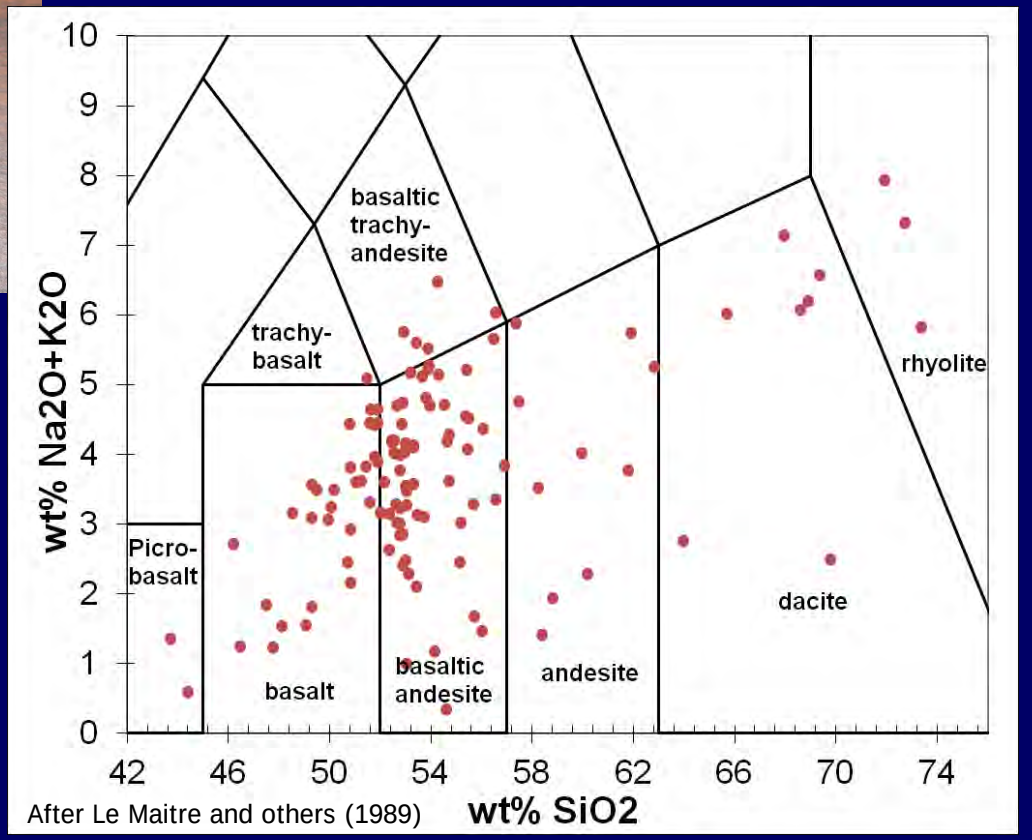


Field observations



Initial results: XRF geochemistry

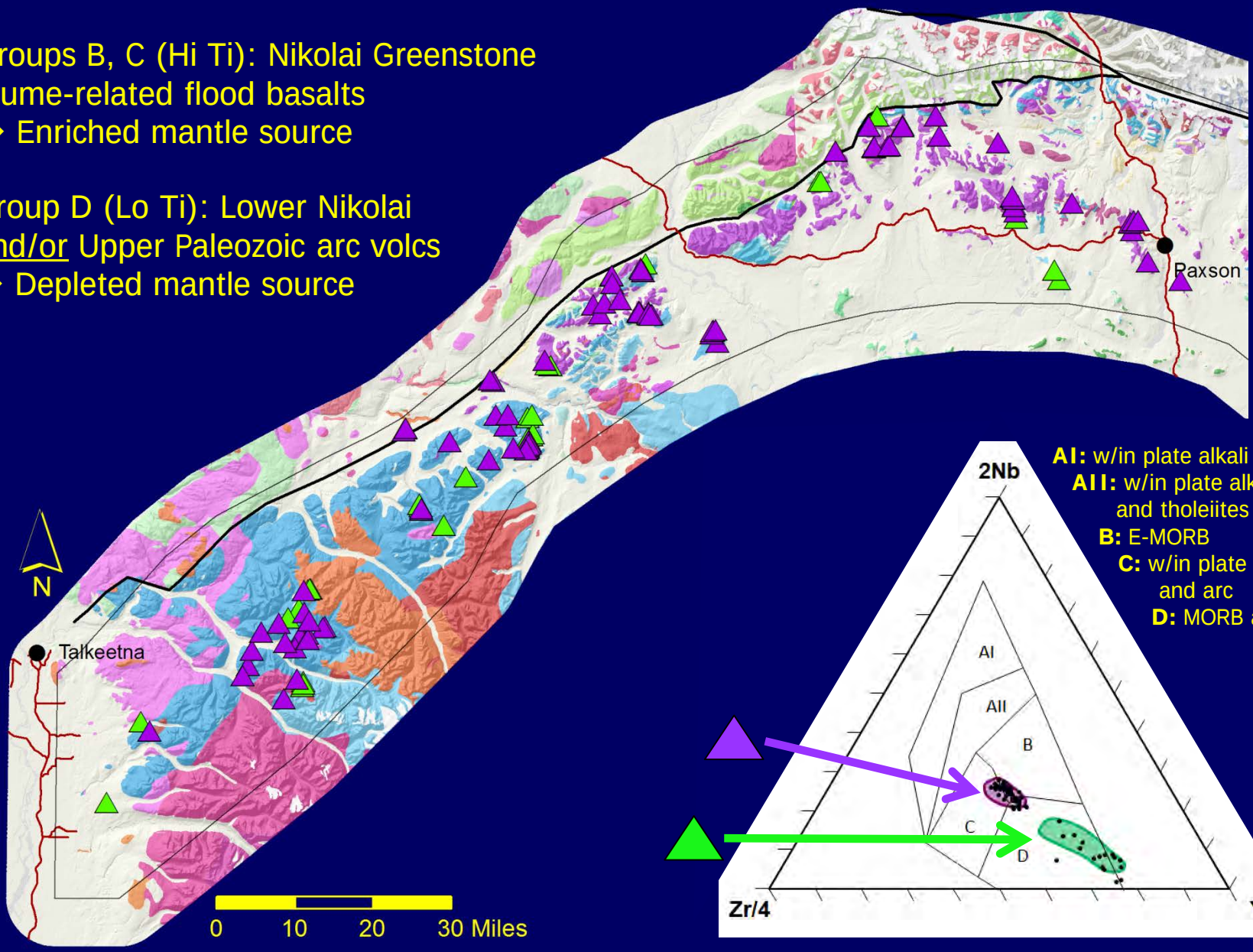
The DGGS uses direct XRF at UAF to get quick, economical major-oxide and trace element analyses of fine-grained rocks



These results support map interpretations and unit descriptions (especially important for volcanics) and will be published as a Raw Data File through DGGS

XRF results: Nikolai Greenstone

- Groups B, C (Hi Ti): Nikolai Greenstone
  Plume-related flood basalts
  → Enriched mantle source
- Group D (Lo Ti): Lower Nikolai
  and/or Upper Paleozoic arc volcs
  → Depleted mantle source



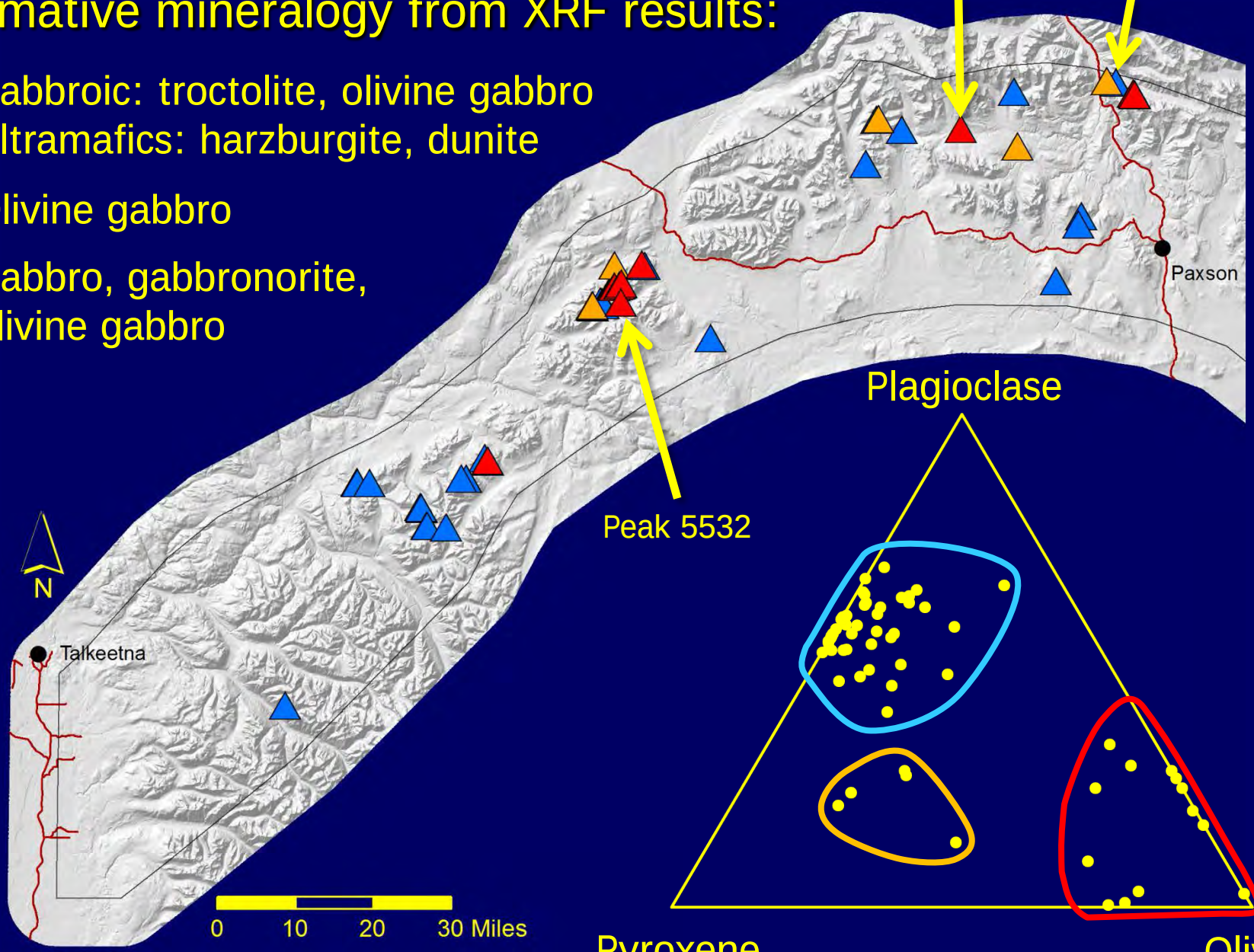
AI: w/in plate alkali
AII: w/in plate alkali and tholeiites
B: E-MORB
C: w/in plate tholeiites and arc
D: MORB and arc

Nikolai data from Greene and others, (2008), diagram after Meshede (1986)

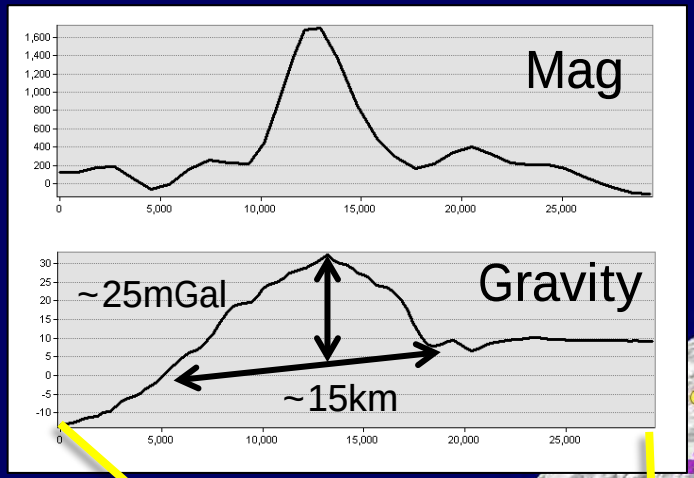
Mafic-Ultramafic intrusions

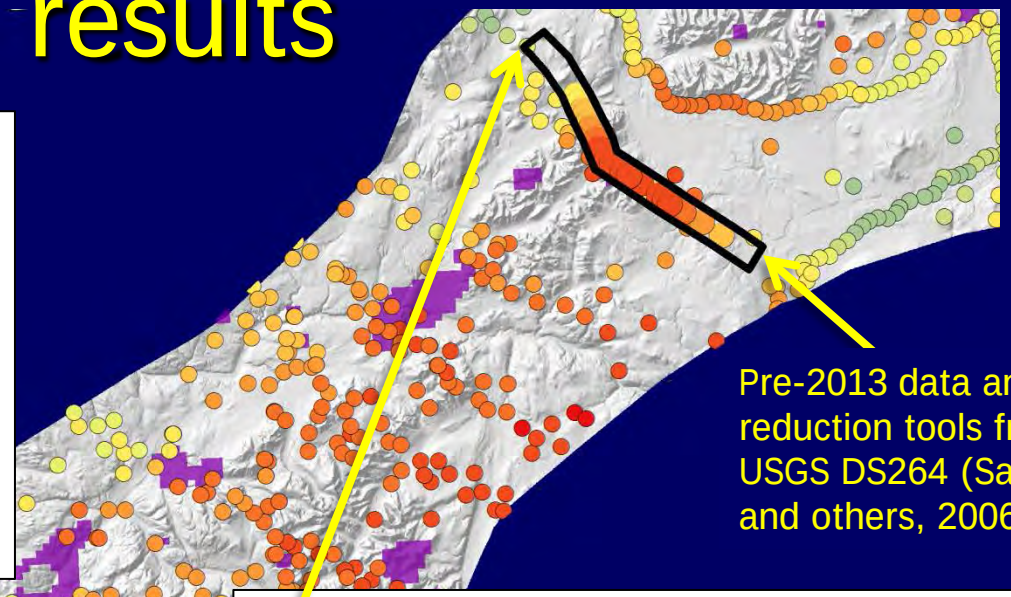
Normative mineralogy from XRF results:

- Gabbroic: troctolite, olivine gabbro
  Ultramafics: harzburgite, dunite
- Olivine gabbro
- Gabbro, gabbronorite, olivine gabbro



Gravity profile results

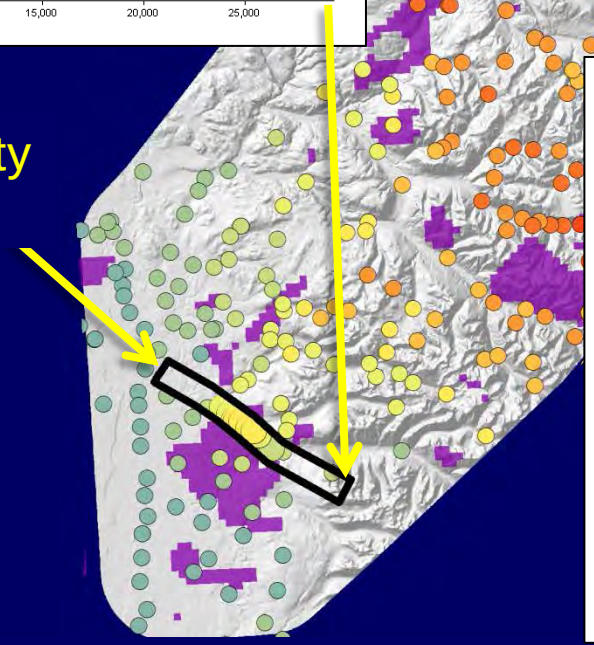




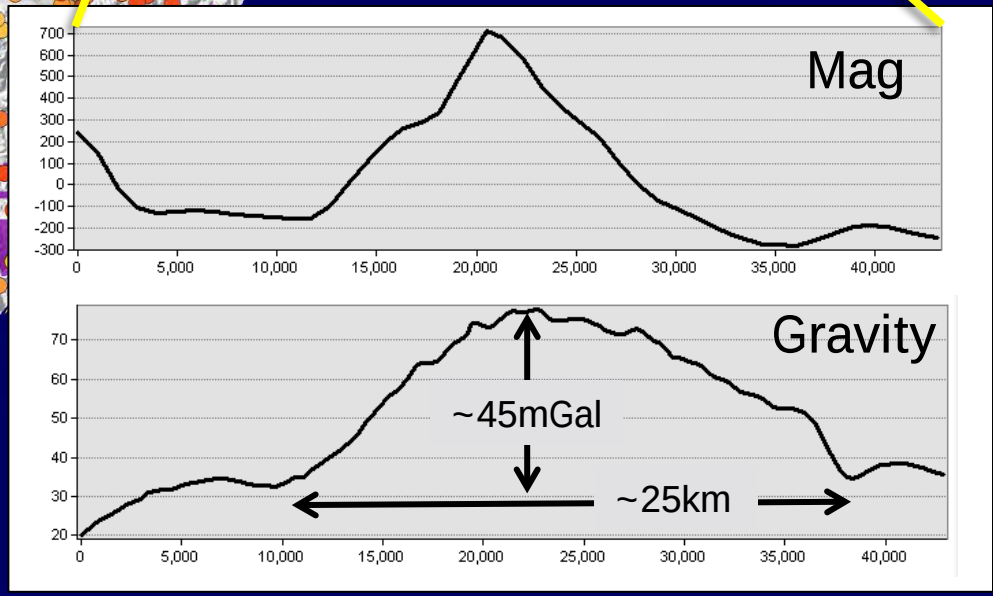
Pre-2013 data and reduction tools from USGS DS264 (Saltus and others, 2006)

Isostatic gravity anomaly:

- 100mGal
- 50
- 0
- -100

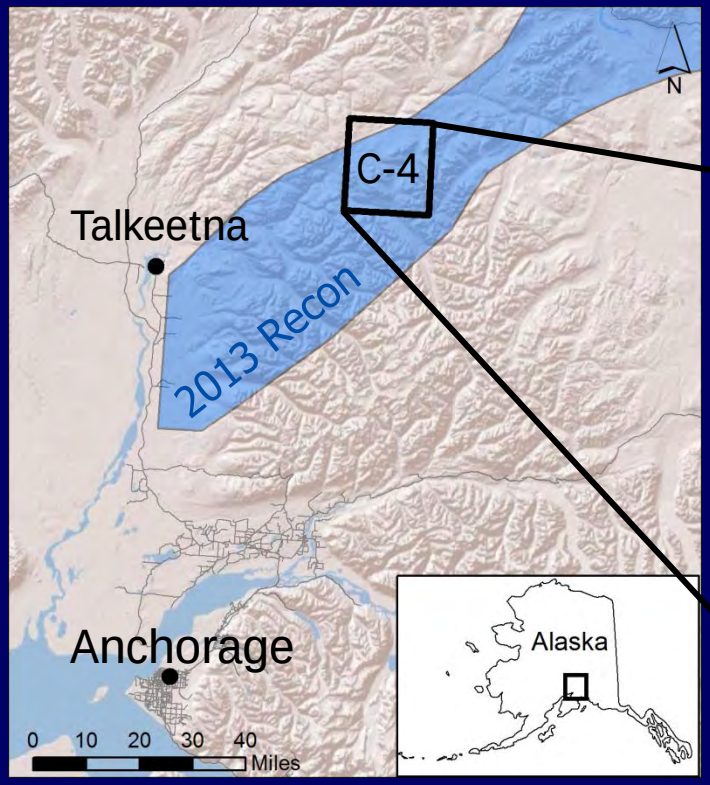


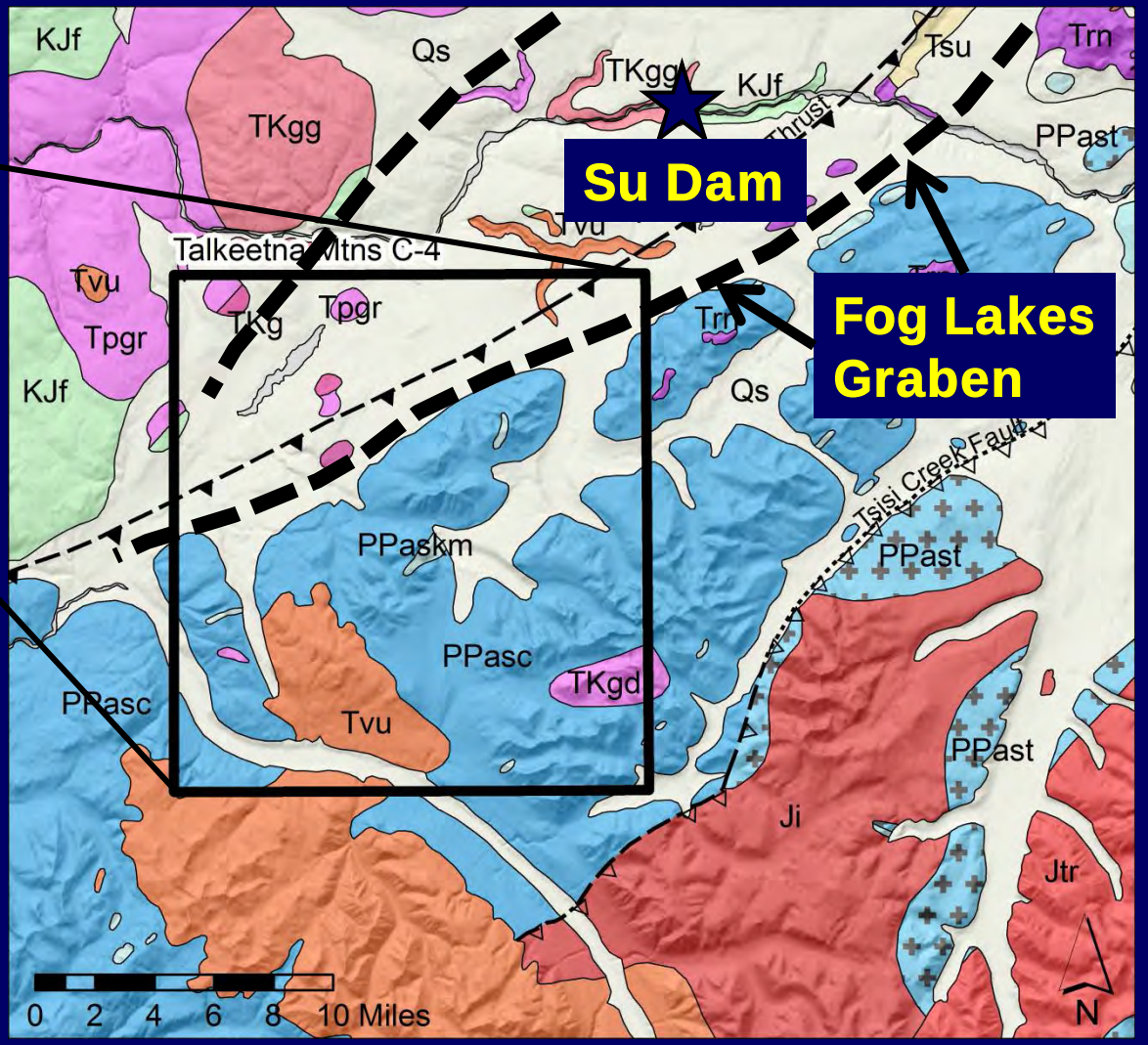
Magnetic anomaly >500nT



Long-wavelength signal = Deep (3km +) source

Proposed 2014 STATEMAP Project:
Talkeetna Mountains C-4





- 1:50,000
- Bedrock & surficial maps
- Structural history
- Ni-Cu-PGE potential

Geology after Wilson and others, 1998

Stay tuned…

- Early 2014 releases:
  - 2013 program geochemistry
  - USGS/USBM reanalysis data
  - Wrangellia geophysical survey
- Spring 2014 releases:
  - Mineralogical data
  - Physical properties data
  - Preliminary interpretive report
- Summer 2014:
  - 1:50,000-scale geologic mapping project in the Talkeetna Mountains (publication spring 2015)

REFERENCES CITED

Barker, J., 1988, Distribution of Platinum-Group Elements in an Ultramafic Complex Near Rainbow Mountain, East-Central Alaska Range: Process Mineralogy VII: The Metallurgical Society, 23p.

Bittenbender, P.E., Bean, K.W., Kurtak, J.M., Deininger, J., 2007, Mineral Assessment of the Delta River Mining District Area, East-central Alaska: BLM Alaska Technical Report 57, 697p.

Colpron, M., and Nelson, J.L., 2011, A digital atlas of terranes for the Northern Cordillera: British Columbia Ministry of Energy, Mines, and Petroleum Resources, GeoFile 2011-11, http://www.empr.gov.bc.ca/Mining/Geoscience/PublicationsCatalogue/GeoFiles/Pages/2011-11.aspx.

Glen, J.M.G., Schmidt, J., Pellerin, L., McPhee, D.K., and O'Neill, J.M., 2007a, Crustal structure of Wrangellia and adjacent terranes inferred from geophysical studies along a transect through the northern Talkeetna Mountains, *in* Ridgway, K.D., Trop, J.M., Glen, J.M.G., and O'Neill, J.M., eds., Tectonic growth of a collisional continental margin—Crustal evolution of southern Alaska: Geological Society of America Special Paper 431, p. 21–42.

Glen, J.M.G., Schmidt, J.M., and Morin, Robert, 2007b, Gravity and magnetic character of south central Alaska—Constraints on geologic and tectonic interpretation, and implications for mineral exploration, *in* Ridgway, K.D., Trop, J.M., Glen, J.M.G., and O'Neill, J.M., eds., Tectonic growth of a collisional continental margin—Crustal evolution of southern Alaska: Geological Society of America Special Paper 431, p. 593–622.

Granitto, M., Bailey, E.A., Schmidt, J.M., Shew, N.B., Gamble, B.M., Labay, K.A., 2011, Alaska Geochemical Database (AGDB)—Geochemical Data for Rock, Sediment, Soil, Mineral, and Concentrate Sample Media: U.S. Geological Survey Data Series 237.

Greene, A.R., Scoates, J.S., and Weis, D., 2008, Wrangellia flood basalts in Alaska—A record of plume–lithosphere interaction in a Late Triassic accreted oceanic plateau: Geochemistry, Geophysics, Geosystems, v. 9, no. 12, DOI: 10.1029/2008GC002092.

Hulbert, L.J., 1995, Geology and metallogeny of the Kluane mafic-ultramafic belt, Yukon Territory, Canada: eastern Wrangellia—a new Ni-Cu-PGE Metallogenic terrane: Geol. Surv. Canada, Open File 3057, 180p.

Kurtak, J.M., Southworth, D.D., Balen, M.D., and Clautice, K.H., 1992, Mineral investigations in the Valdez Creek mining district, south-central Alaska: U.S. Bureau of Mines Open-File Report 1-92, 2 sheets, scale 1:250,000, 695 p.

Le Maitre, R.W., Bateman, P., Dudek, A., Keller, J., Lameyre Le Bas, M.J., Sabine, P.A., Schmid, R., Sorensen, H., Streckeisen, A., Woolley, A.R., Zanettin, B., 1989, A classification of igneous rocks and glossary of terms. Blackwell, Oxford.

MacKevett, E.M., Jr., Cox, D.P., Potter, R.W., and Silberman, M.L., 1997, Kennecott-type deposits in the Wrangell Mountains, Alaska: High-grade copper ores near a basalt–limestone contact, *in* Mineral Deposits of Alaska: Economic Geology Monograph 9, p. 66–89.

Meshede, M., 1986, A method of discriminating between different types of mid-ocean ridge basalts and continental tholeiites with the Nb-Zr-Y diagram: Chemical Geology, v. 56, p. 207-218.

Saltus, R.W., Brown, P.J., Morin, R.L., Hill, P.L., 2006, 2006 Compilation of Alaska Gravity Data and Historical Reports: U.S. Geological Survey Data Series 264.

United States Geological Survey, 2013, Mineral Commodity Summaries 2013: U.S. Geological Survey, Reston Virginia. 198p.

Werdon, M.B., Riehle, J.R., Schmidt, J.M., Newberry, R.J., and Pessel, G.H., 2002, Geologic map of the Iron Creek area, Talkeetna Mountains B-5 Quadrangle, Alaska: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2002-4,1 sheet, scale 1:63,360.

Wilson, F.H., Dover, J.H., Bradley, D.C., Weber, F.R., Bundtzen, T.K., and Haeussler, P.J., 1998, Geologic map of central (interior) Alaska: U.S. Geological Survey Open-File Report 98-133-A, 62 p., 3 sheets.