Cretaceous to Tertiary magmatism and associated mineralization in the Lime Hills C-1 Quadrangle, Western Alaska Range

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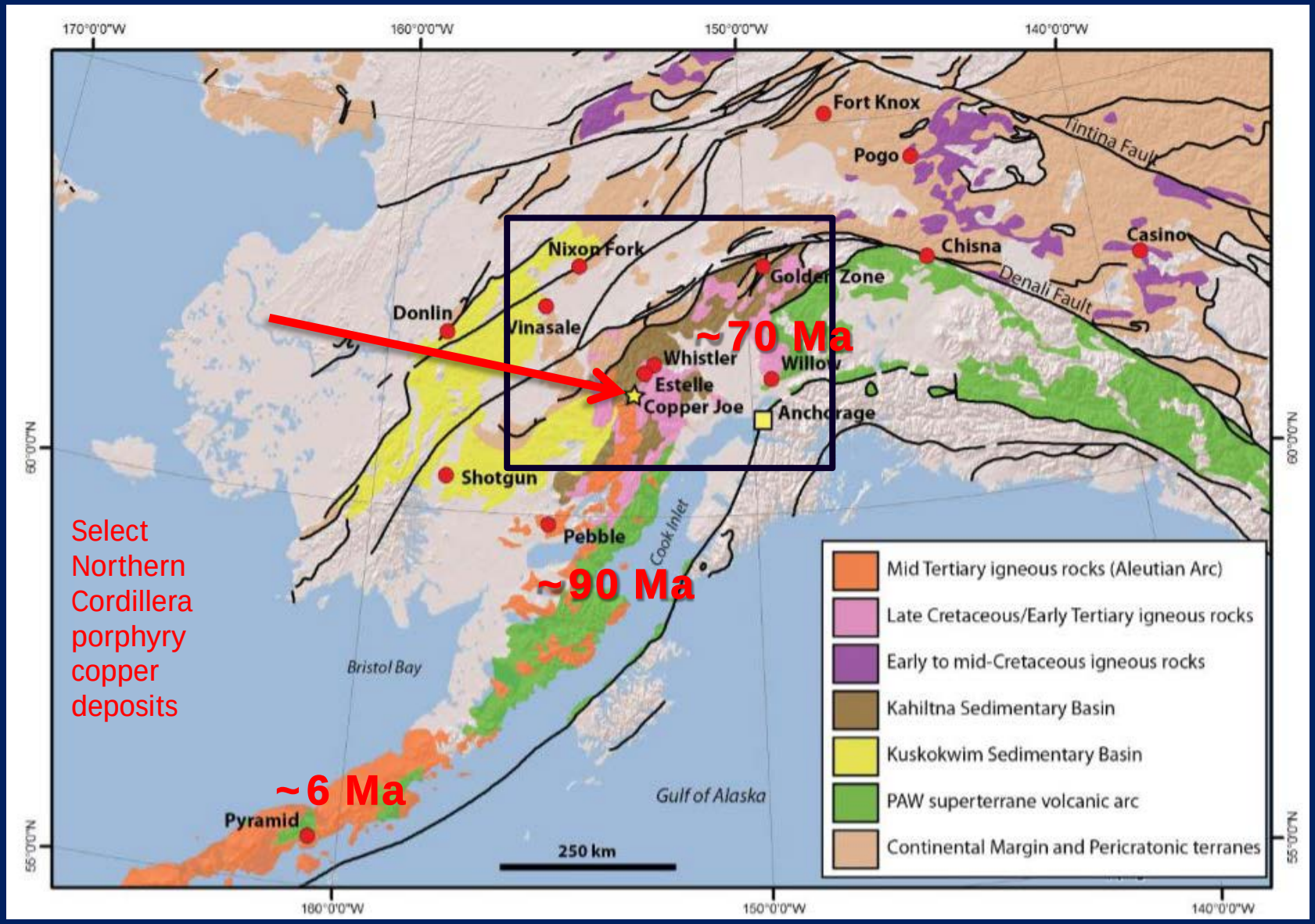
Outline

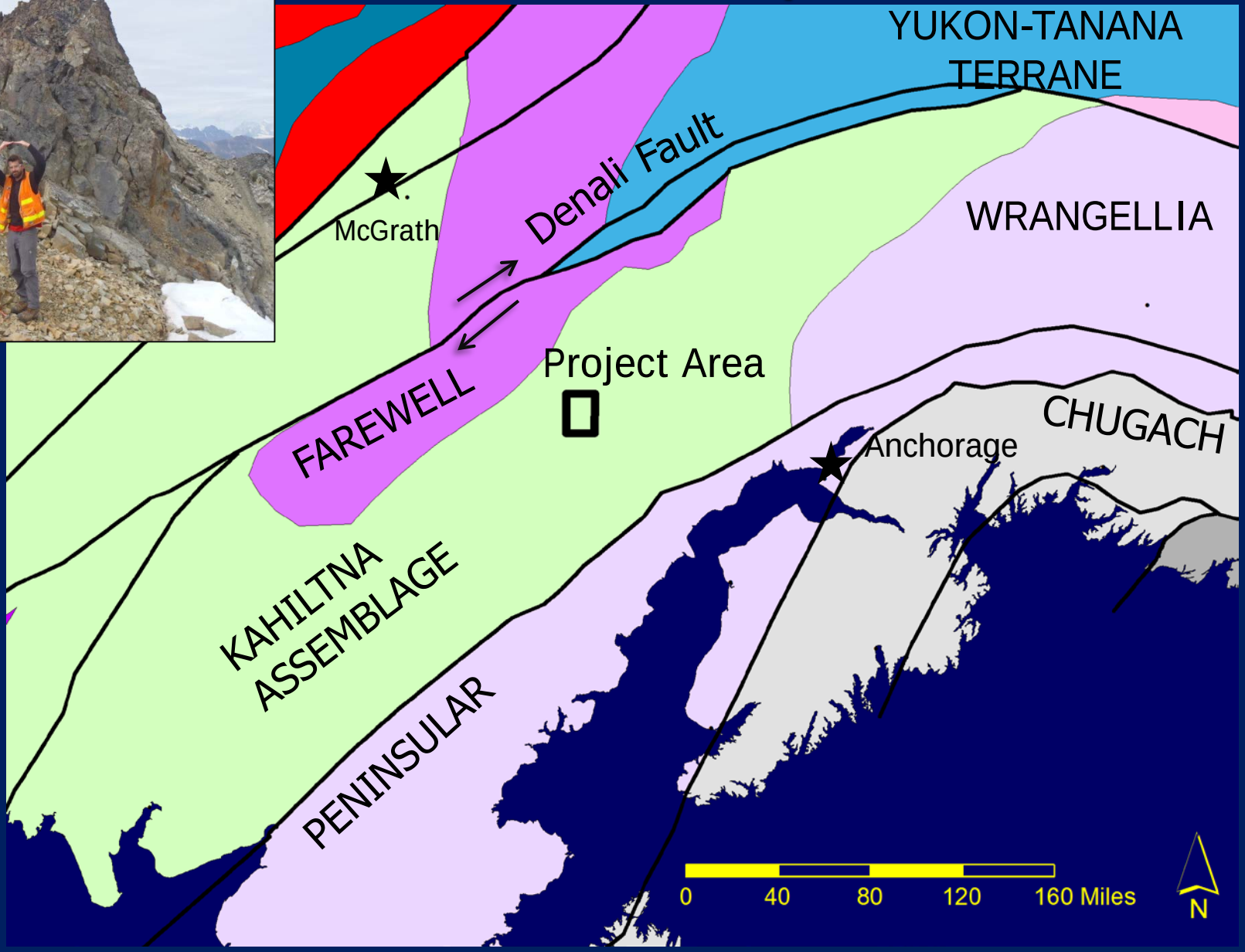
- Location and geology
- Mineralization highlights
- New $^{40}Ar/^{39}Ar$ geochronology
  - With relevant geochemistry
- 3D voxel model of Copper Joe resistivity
- Relationship to Revelation Mountains uplift
- Acknowledgments

Photo by T.C. Wright

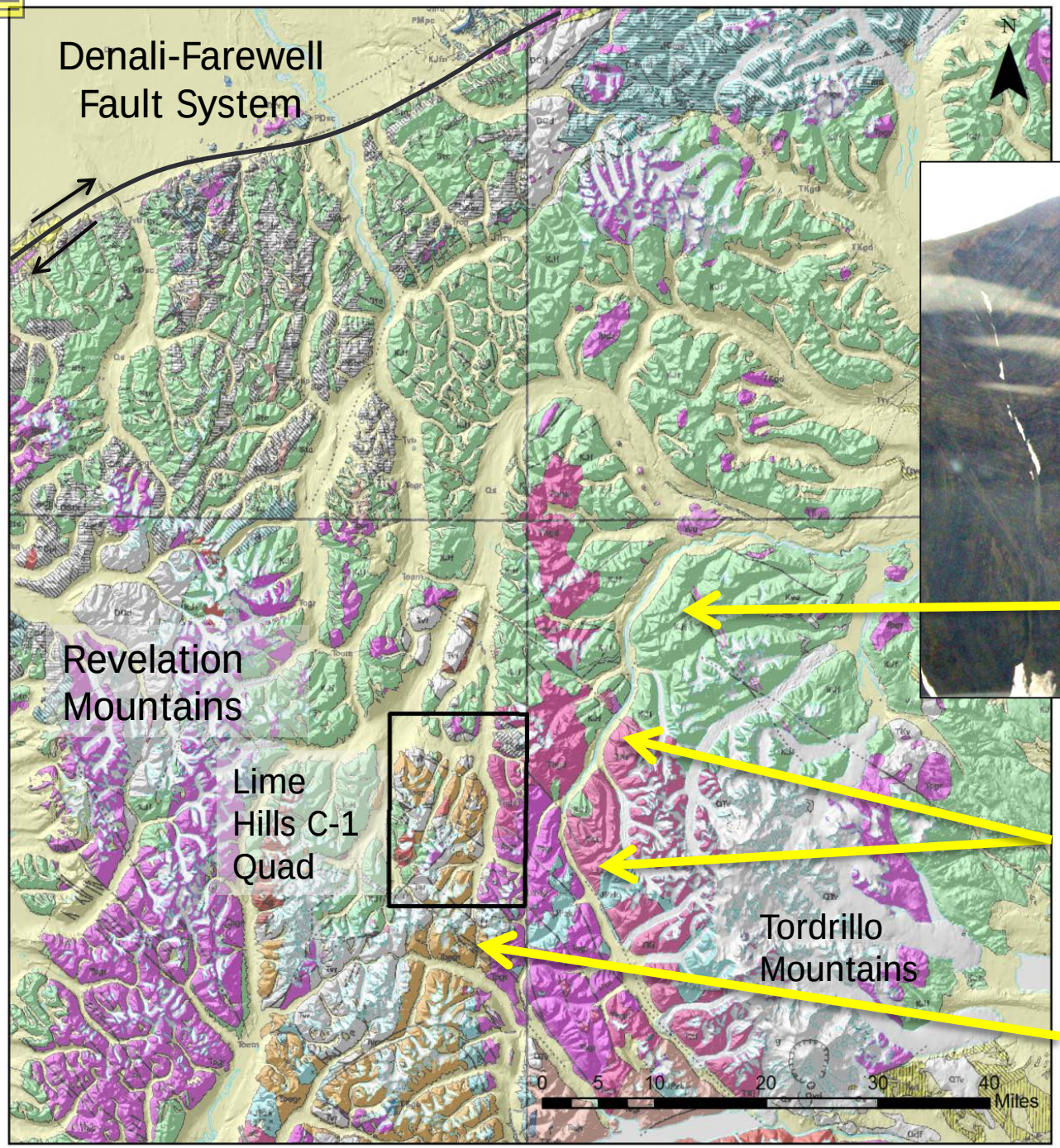
Cretaceous-Tertiary Porphyry Trend

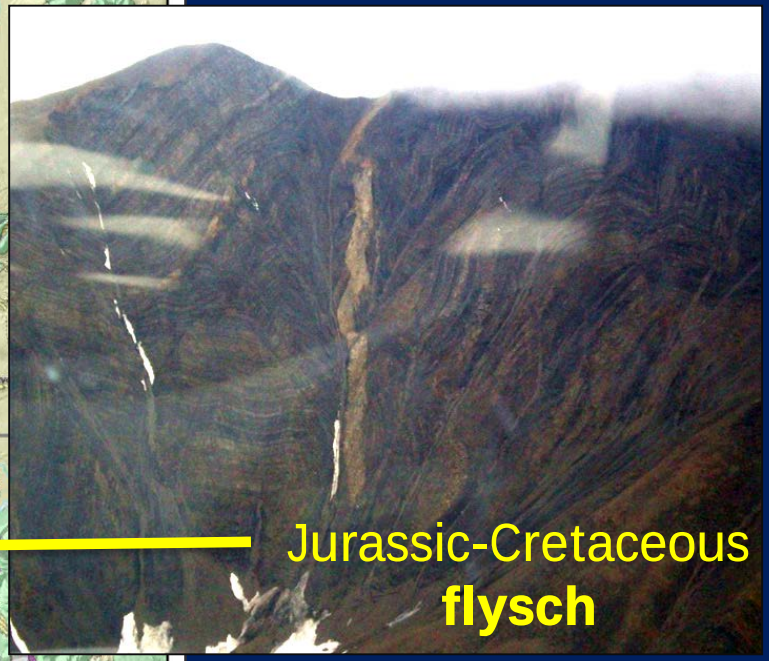


Terrane Map



Modified from Colpron and Nelson, 2011





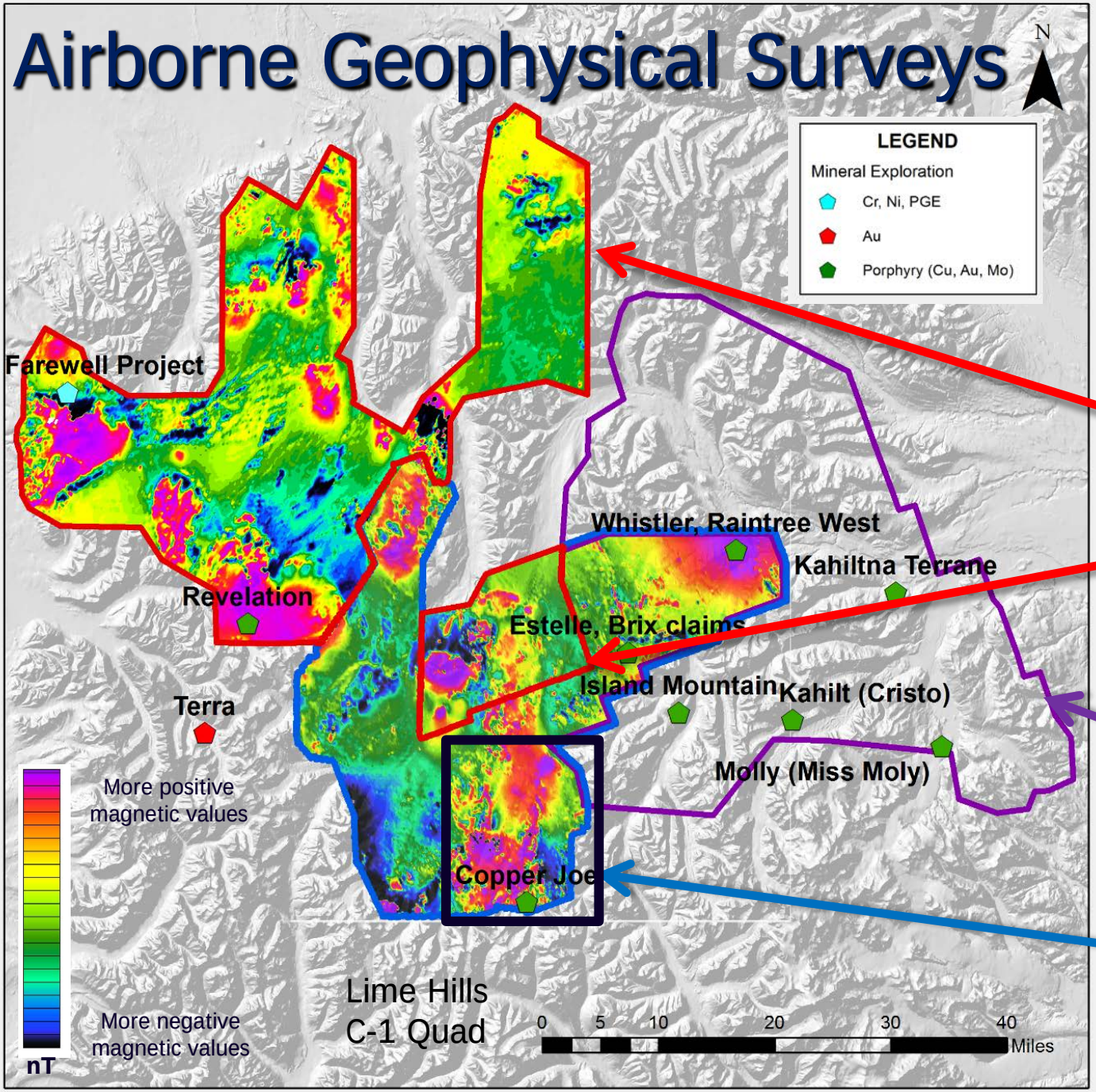
Jurassic-Cretaceous **flysch**

Cretaceous and Tertiary **plutonic rocks**

Tertiary **volcanics**

Map modified from Wilson and others, 1998

Airborne Geophysical Surveys



Farewell
(Burns and others, 2014)

Middle Styx
(Burns and others, 2013)

East Styx
(Released November 2014)

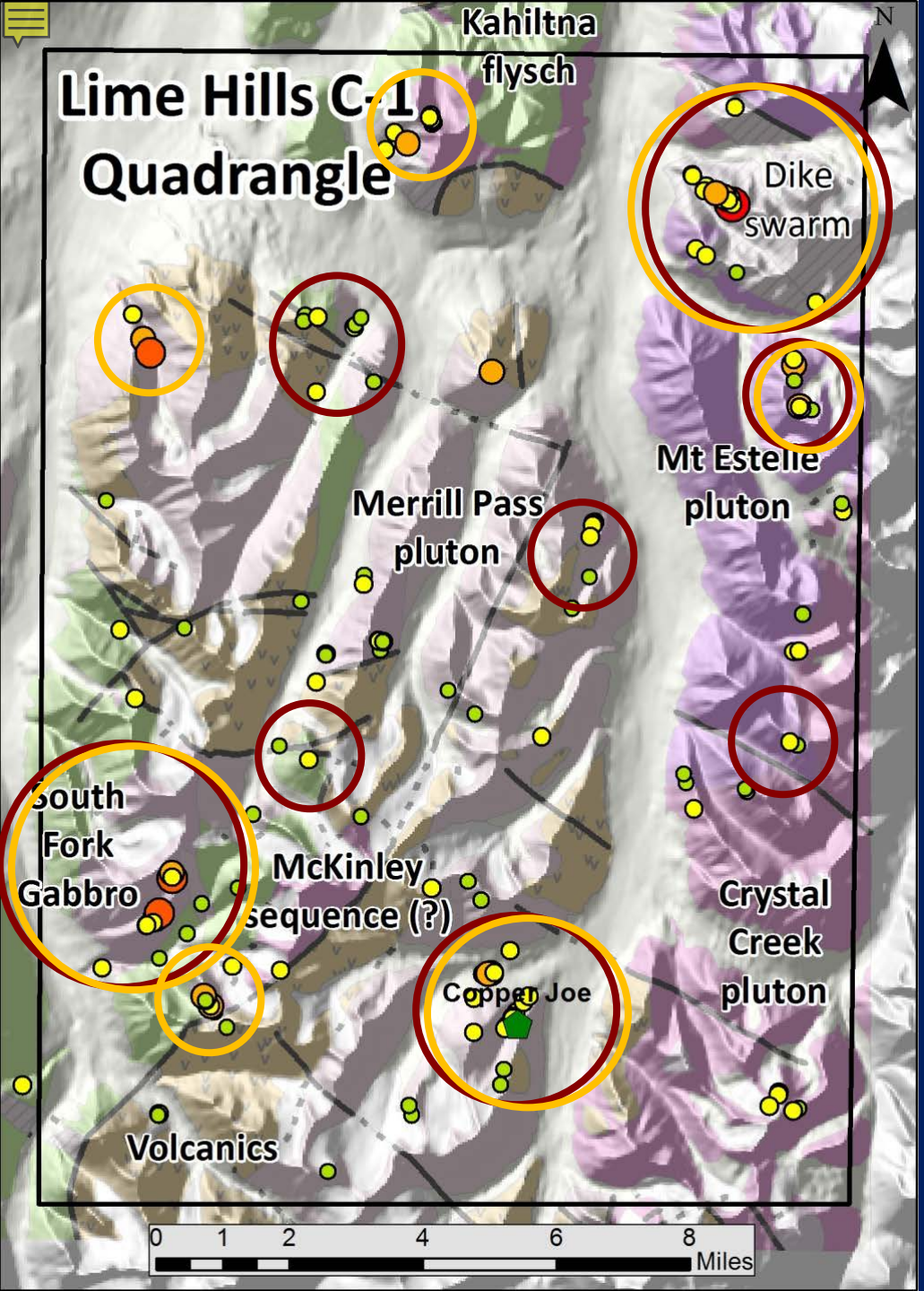
Styx
(Burns and others 2008)

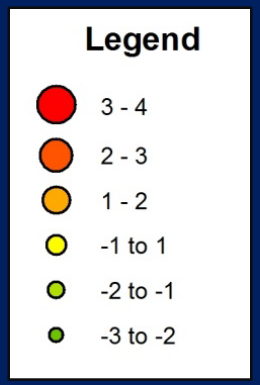
Anomalous Gold Occurrences

Circles = High Gold & Copper occurrences

- Points are colored by standard deviations above or below the mean
- Z = value-mean / std dev

(Actual values are in geochemical reports)





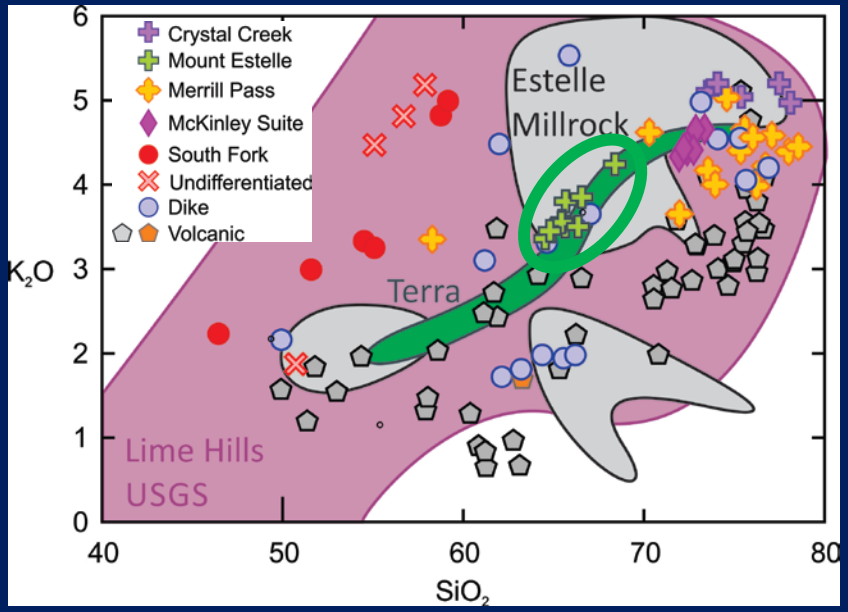
(Map modified from Gamble and others, 2013)

Mount Estelle pluton

~70.1 (U-Pb) to ~66.7 Ma (K-Ar)

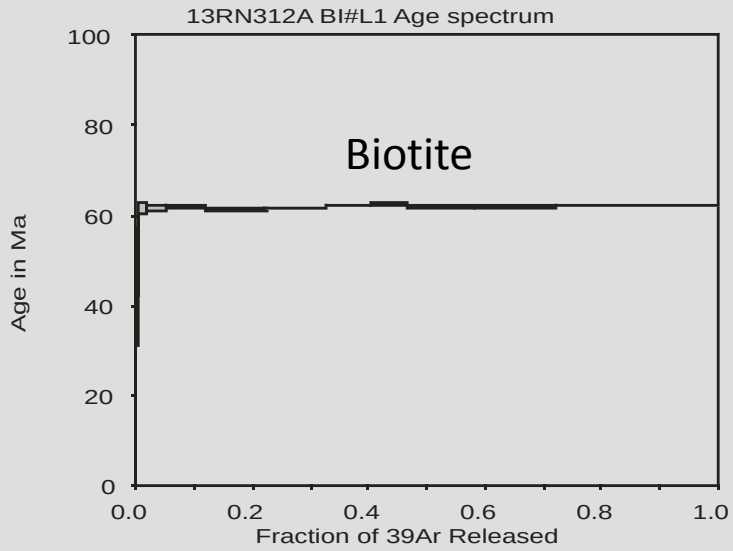
~62 (new $^{40}Ar/^{39}Ar$)

- Biotite-hornblende granodiorite
- Chiefly medium-grained, seriate, hypidiomorphic-granular
- These new ages extend plutonism and highlight continued emplacement in to the upper crust in this composite pluton

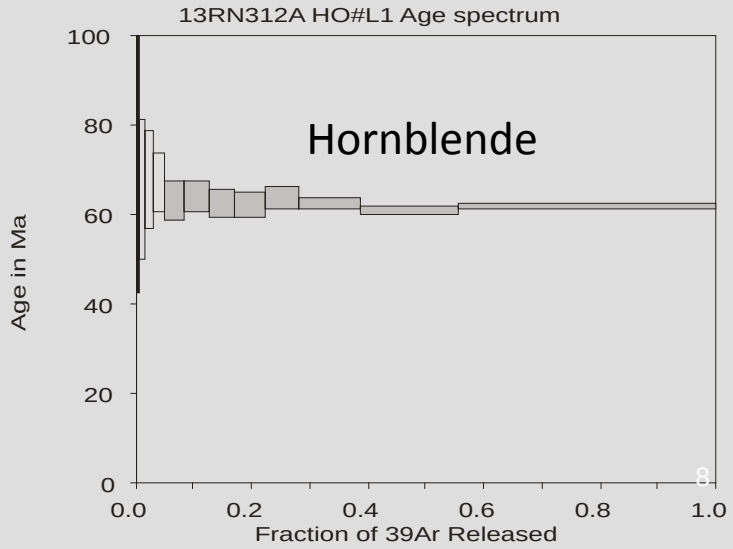


(K-Ar Dates: Reed and Lanphere, 1972)

Magmatic crystallization:
62.0 ± 0.2 Ma



61.8 ± 0.5 Ma



Mount Estelle pluton

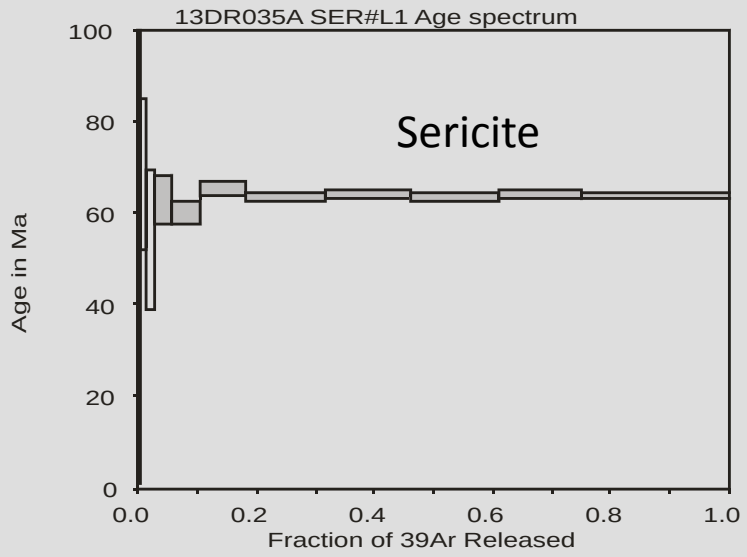
~70.1 (U-Pb) to ~66.7 Ma (K-Ar))

~62 (new $^{40}Ar/^{39}Ar$)

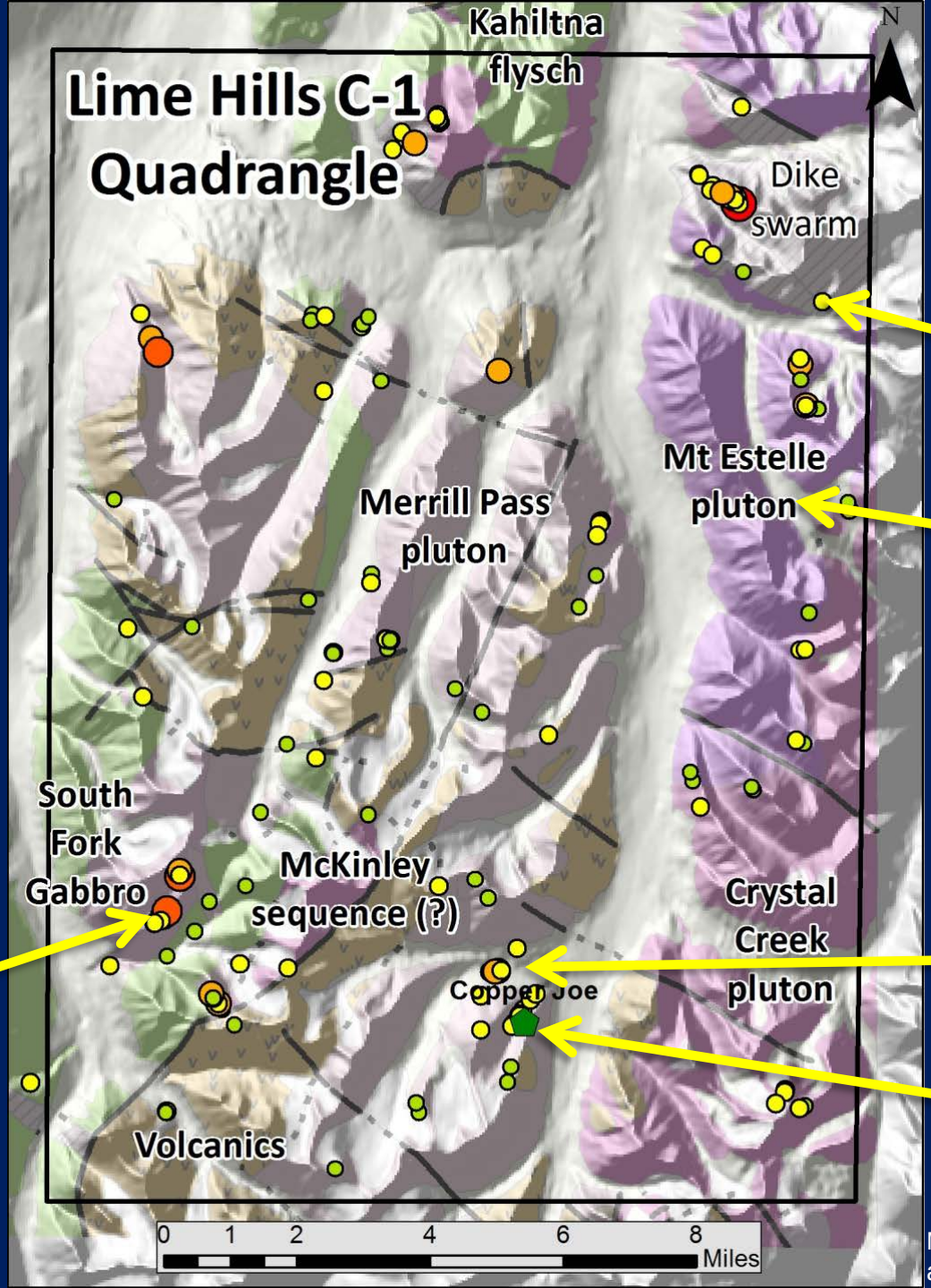
~64 alteration

- Contains aplite and lamprophyre dikes (NW trending) with quartz, arsenopyrite, chalcopyrite, and magnetite veins
- The dated sample had anomalous copper and silver
- Suggests that post ~70 Ma plutons may have mineral potential and that circulation of fertile melt and fluids may have occurred before the composite pluton finished crystallizing

Sericite Alteration: 63.9 ± 0.4 Ma



Age Summary



~64 Ma Sericite

~62 Ma Biotite & Hornblende

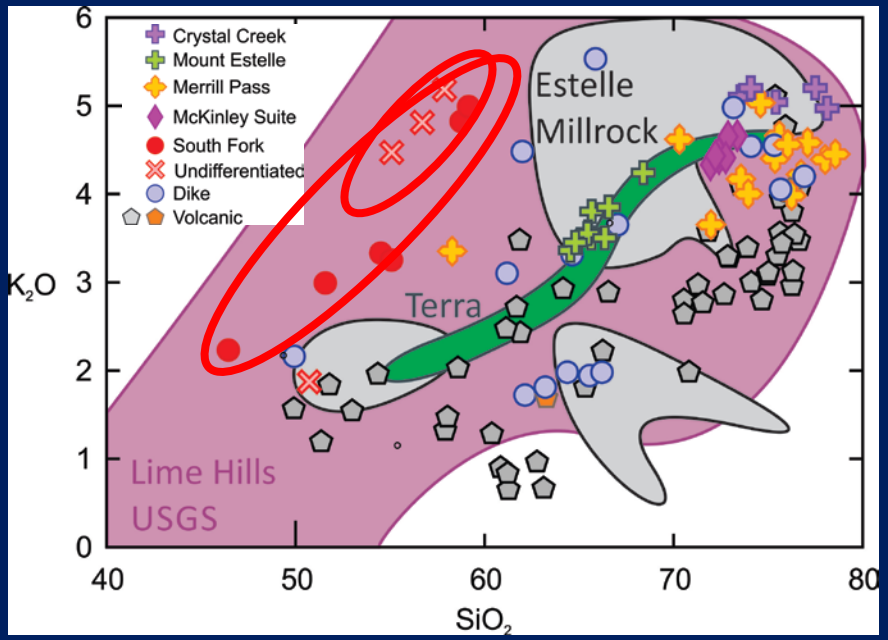
Map modified from Gamble and others, 2013

South Fork pluton

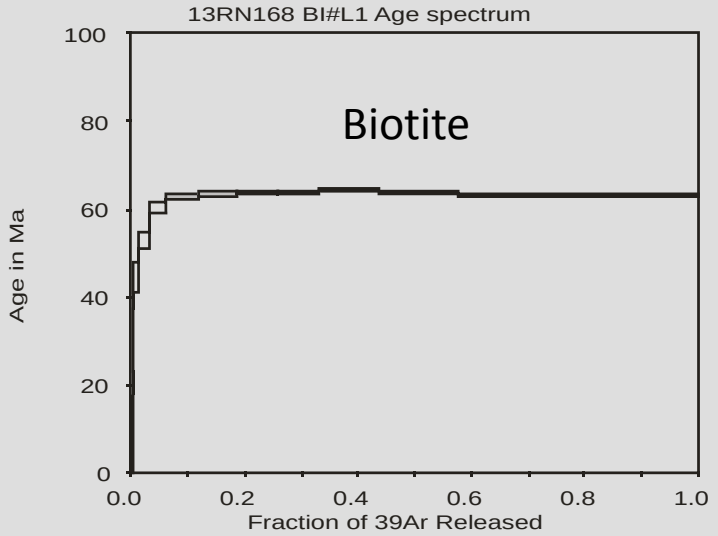
71.4 Ma (K-Ar) (Reed and Lanphere, 1972)

~64 (new $^{40}Ar/^{39}Ar$)

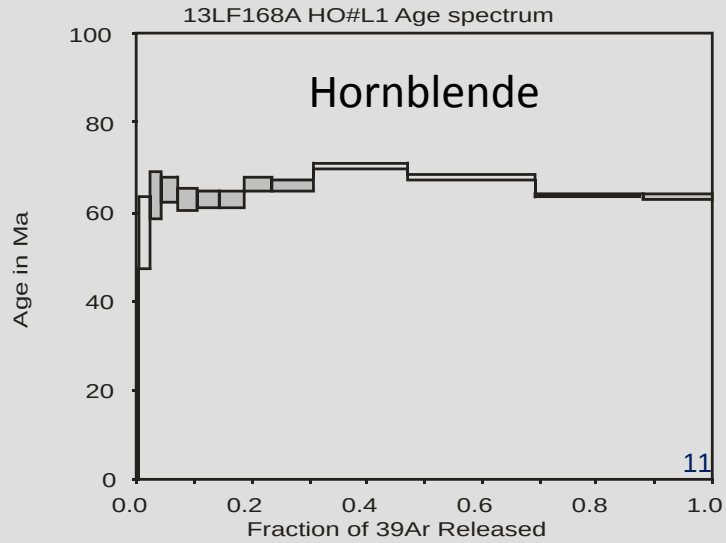
- Hornblende-pyroxene-biotite diorite to gabbro
- Fine- to medium-grained, seriate, hypidiomorphic-granular
- Cu, Au, Ag mineralization



Magmatic crystallization:
63.5 ± 0.4 Ma



63.8 ± 0.4 Ma

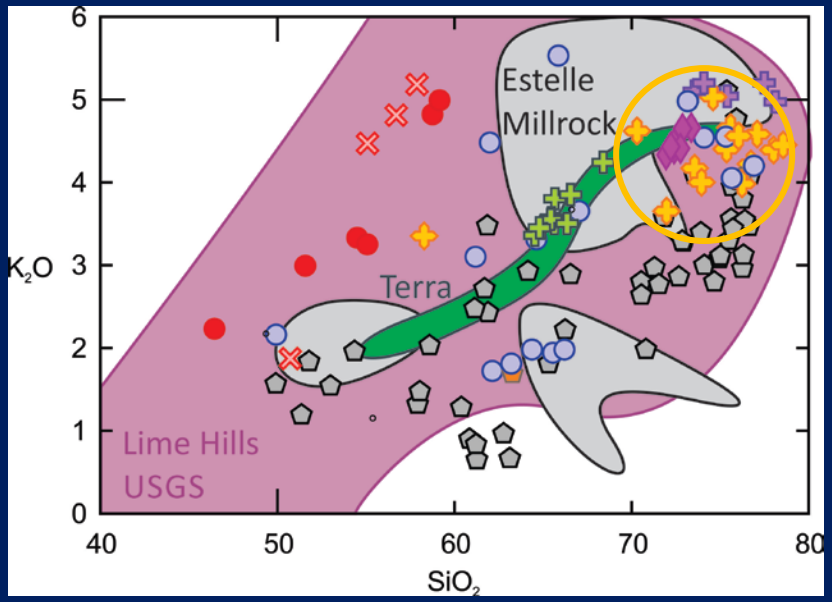


Merrill Pass pluton

~40.0-41.6 Ma ($^{40}Ar/^{39}Ar$) (Reed and Lanphere, 1972)

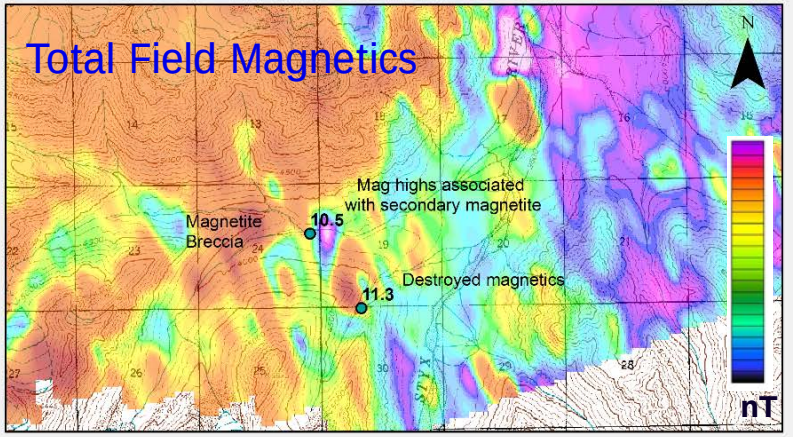
- Biotite granite to granodiorite to alkali-feldspar granite
- Hypidiomorphic granular textures with miarolitic cavities, xenoliths
- Closely related to Tertiary volcanics (~33.6-41.0 Ma)

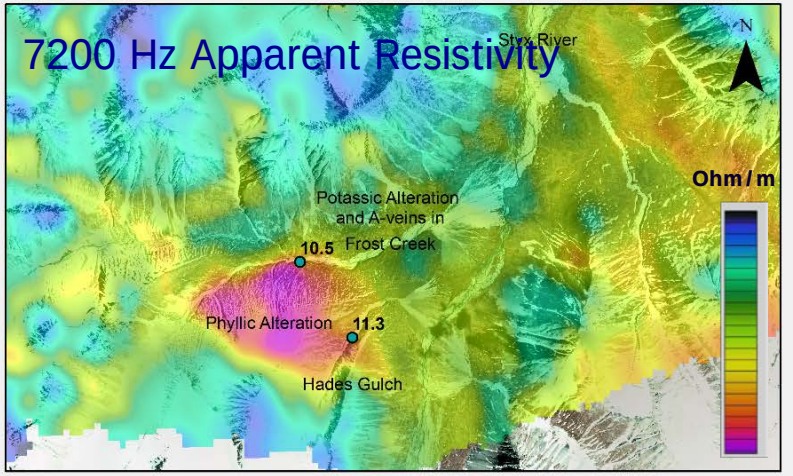
(Looking West)

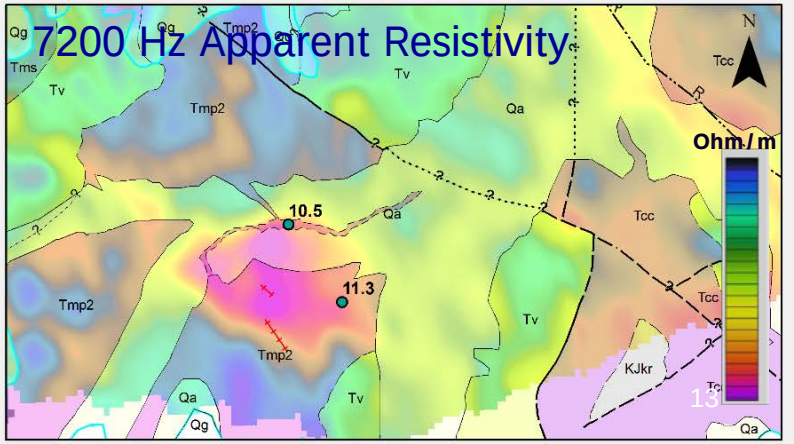


Copper Joe Cu-Au-Mo Porphyry System

- Extensive quartz-sericite pyrite (QSP) alteration with D-veins is expressed as a surface conductor in the 7200 Hz resistivity, corresponding to the phyllic, pyrite-rich zone (QSP zone) of porphyry systems







Young Porphyry Mineralization

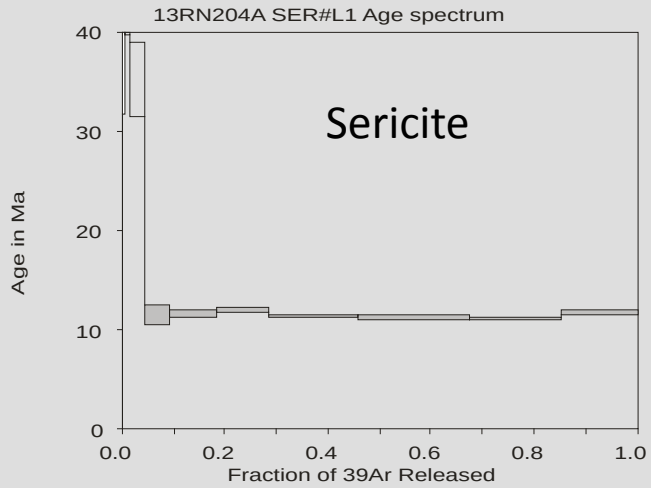
13RN204A

- Pervasive quartz–sericite–pyrite overprint zone with stockwork quartz–molybdenite veinlets

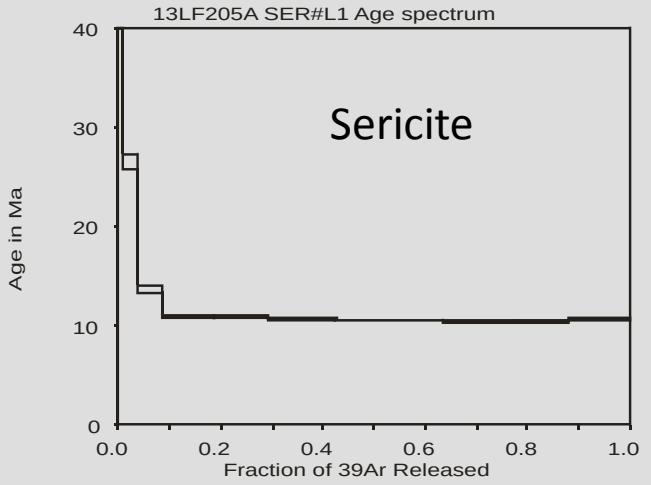
13LF205A

- Pyrite–chalcopyrite–molybdenite-bearing quartz vein
- Suggestive of sustained hydrothermal alteration
- K/Ar data from Kiska support these young ages

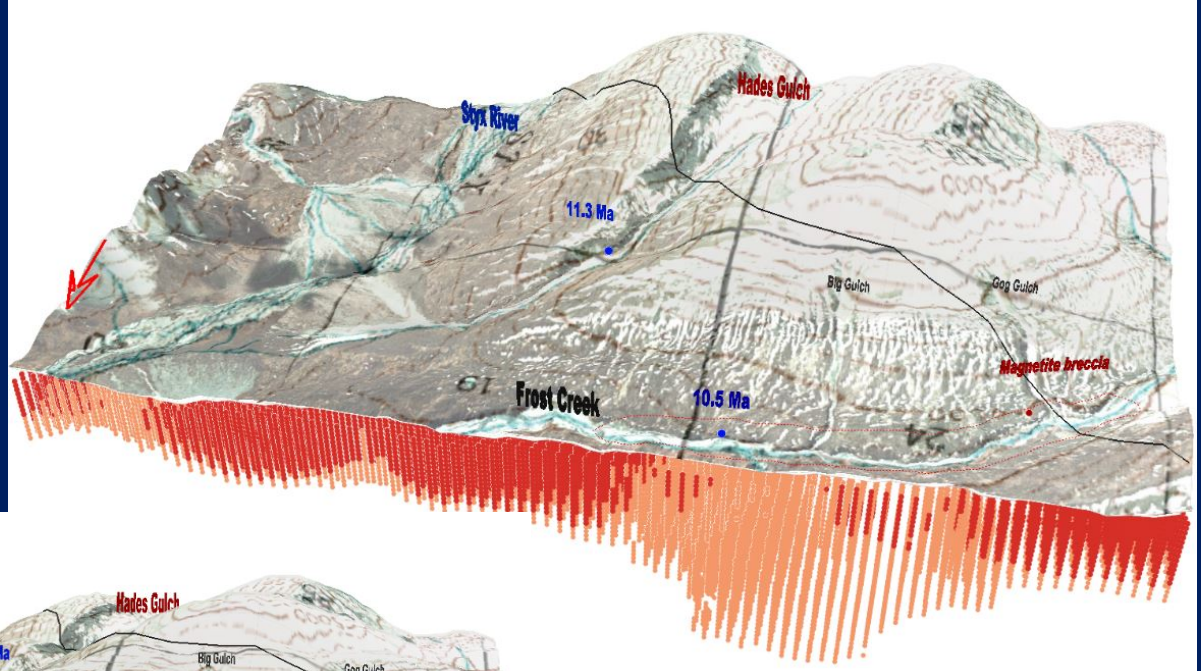
Alteration age:
11.5 ± 0.1 Ma

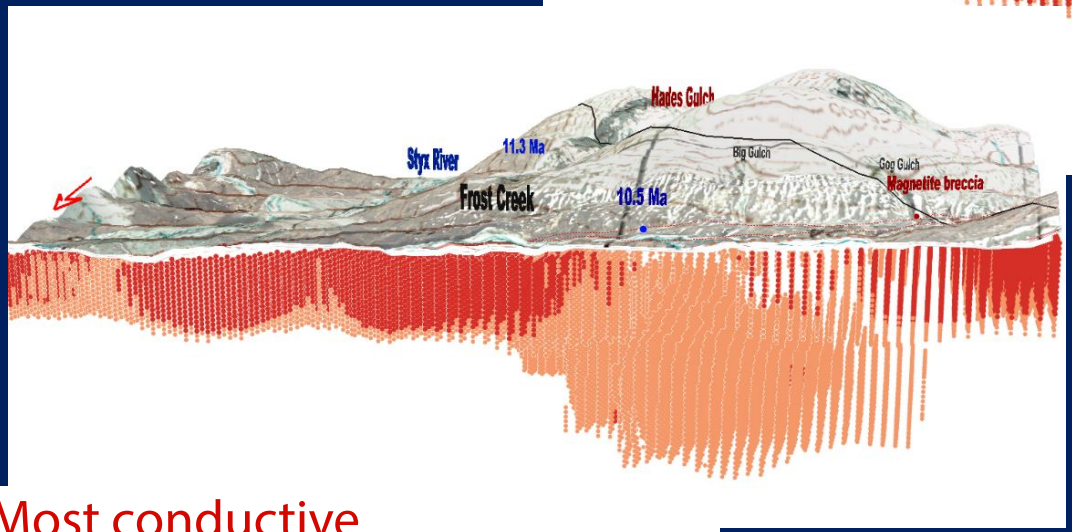


10.7 ± 0.1 Ma



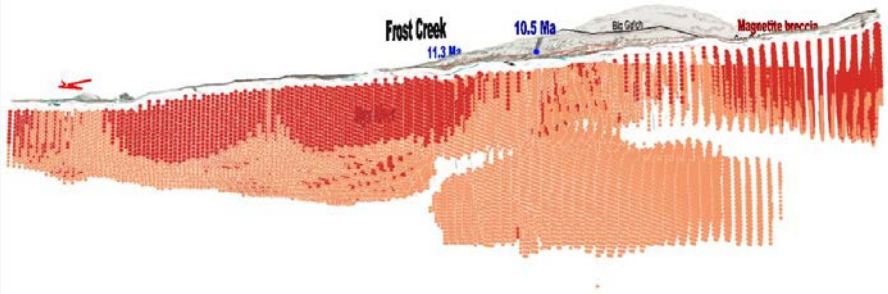
Resistivity Inversion 3D Model





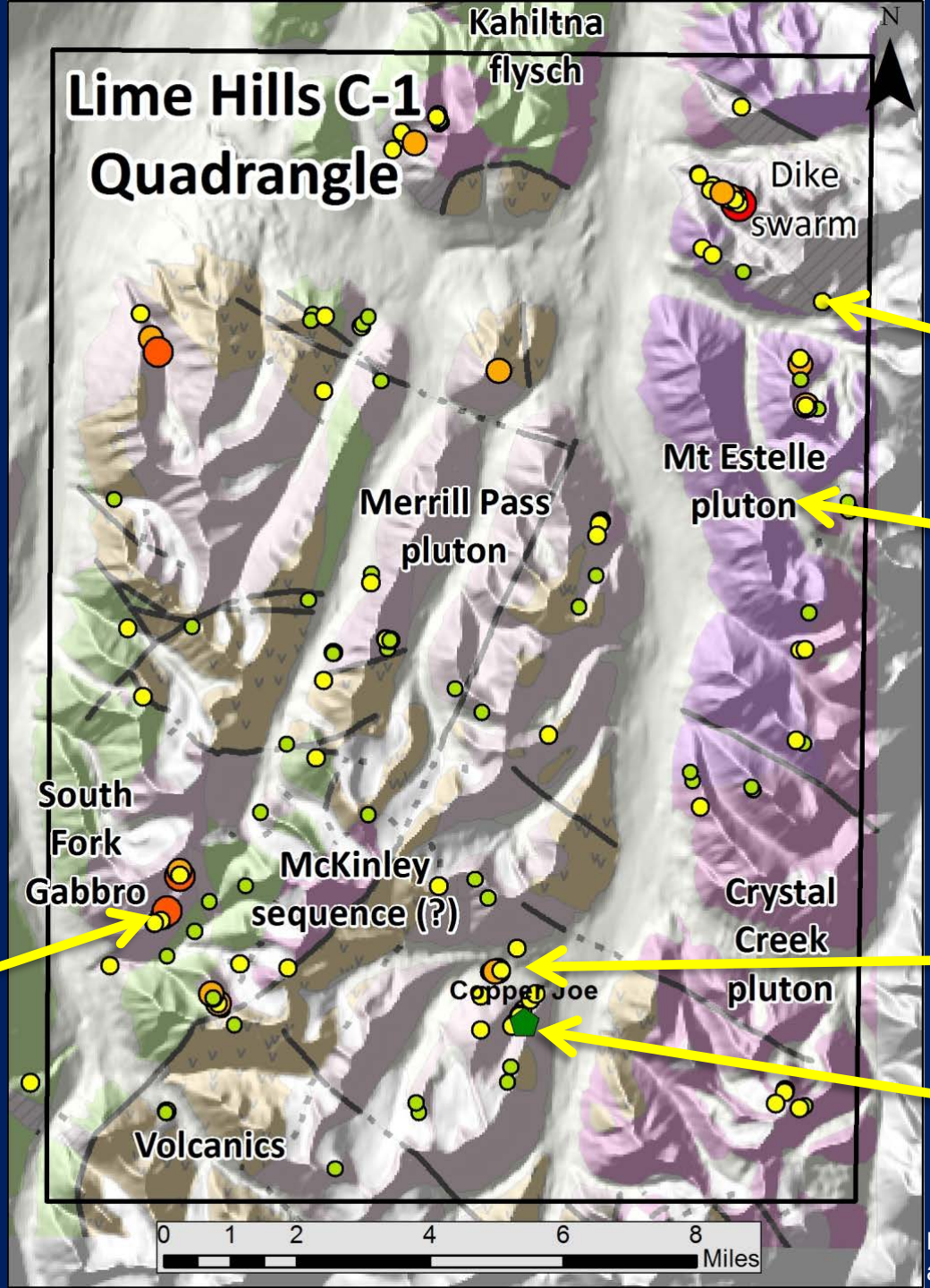
A lower shell of conductive material appears to reach the surface where magnetite breccias and highly magnetic material are found

Red = Most conductive



View in the model is looking to the South, North arrow is at the left of the screen

Age Summary



~64 Ma Sericite

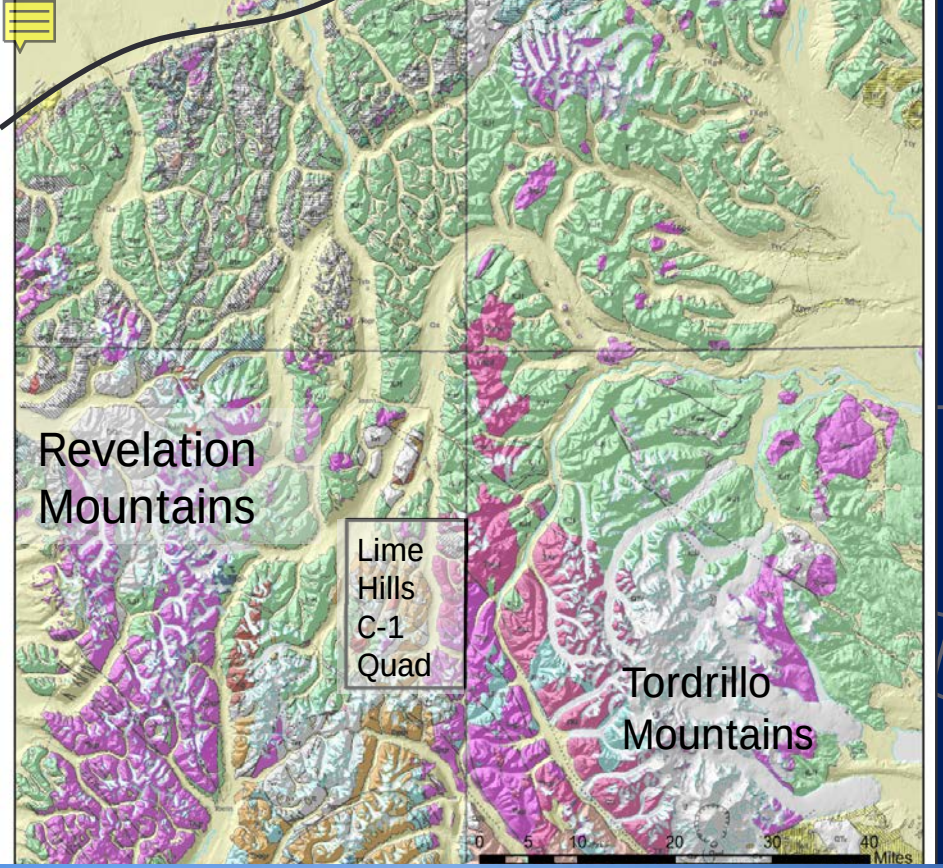
~62 Ma Biotite & Hornblende

~64 Ma Biotite & hornblende

~11.7 Ma Sericite

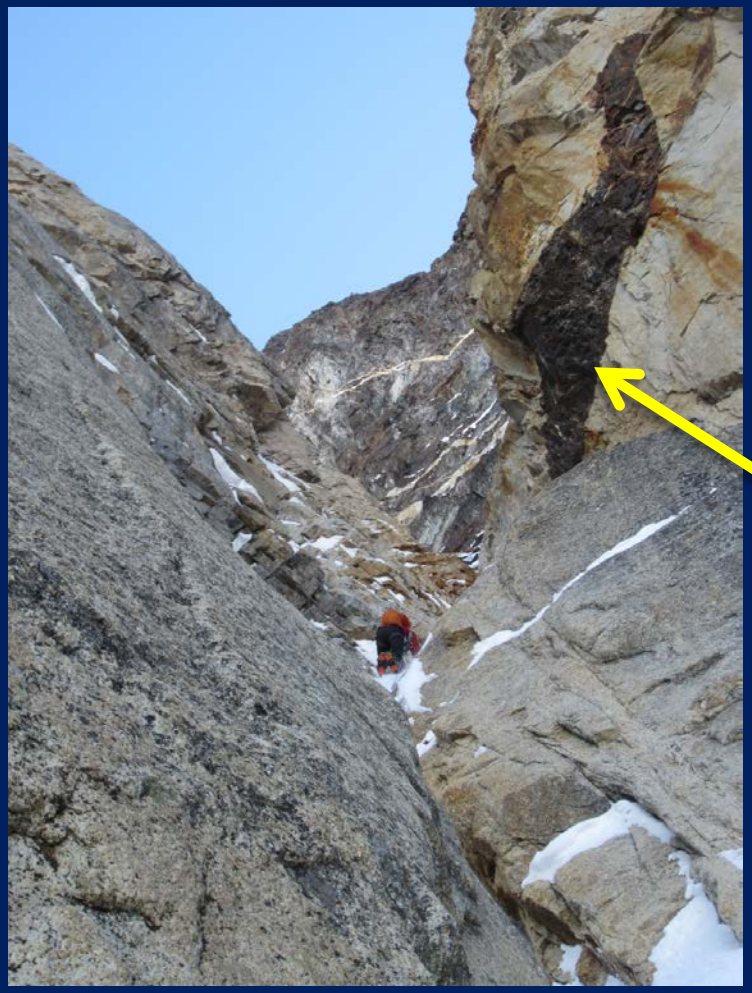
~10.5 Ma Sericite

Map modified from Gamble and others, 2013



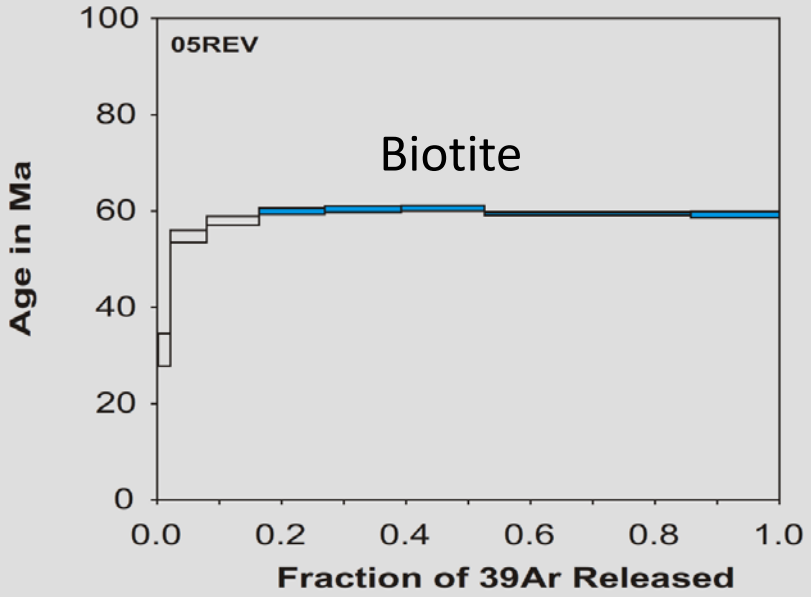
Revelation Mountains

Revelation Mountains

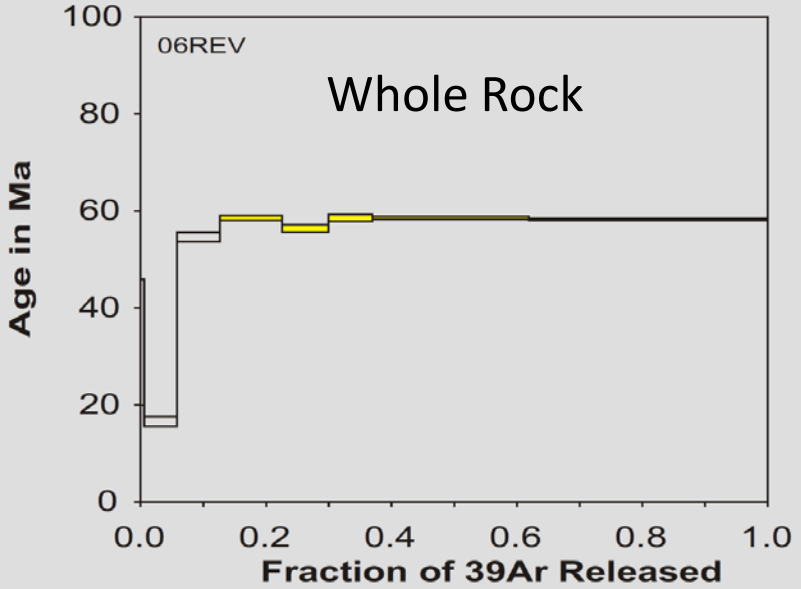


Countless dike swarms: a relative "gold mine" of rocks to work on!

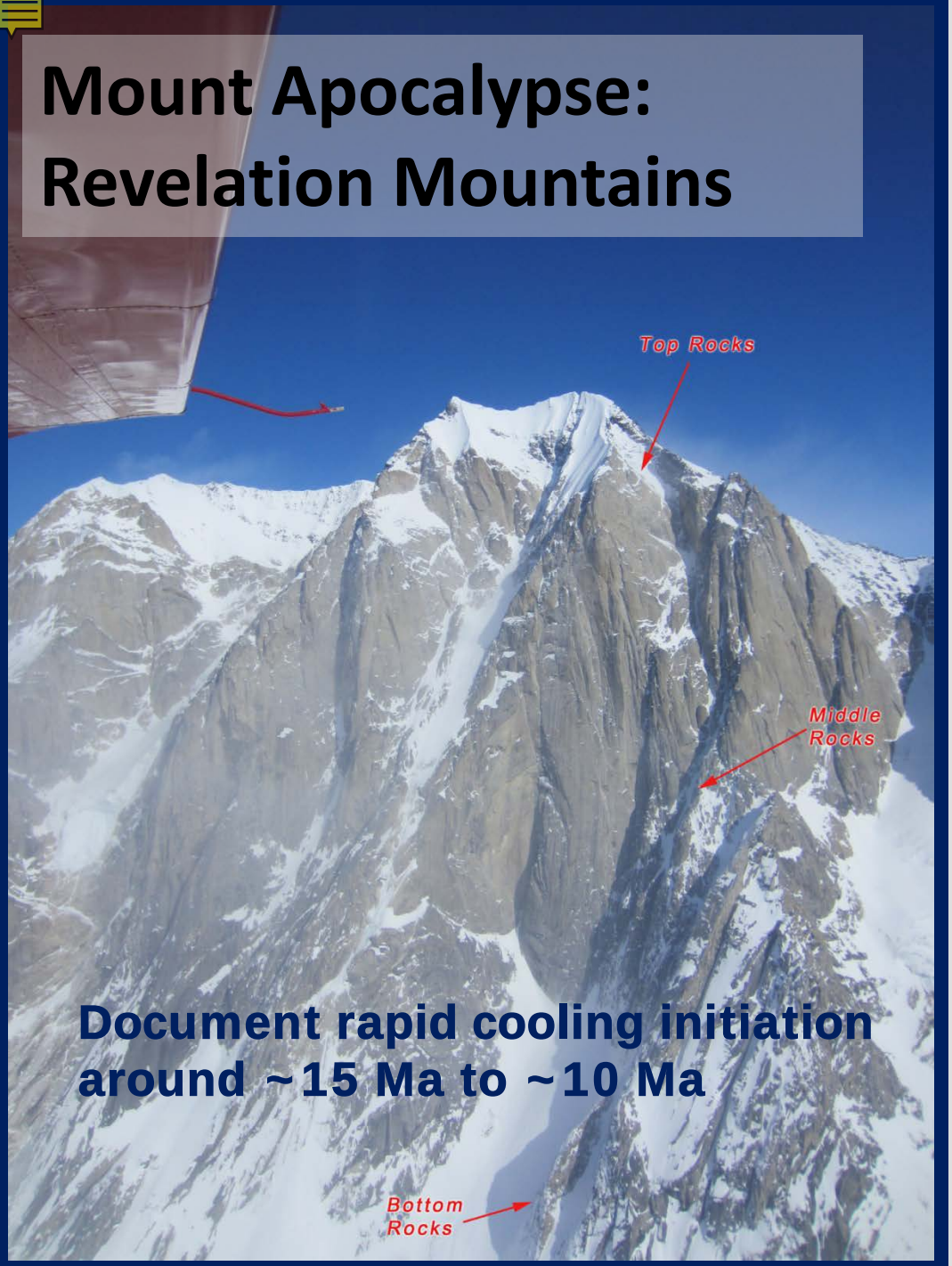
Age of Host Granite: ~60 Ma



Age of Mafic Dike: ~58 Ma

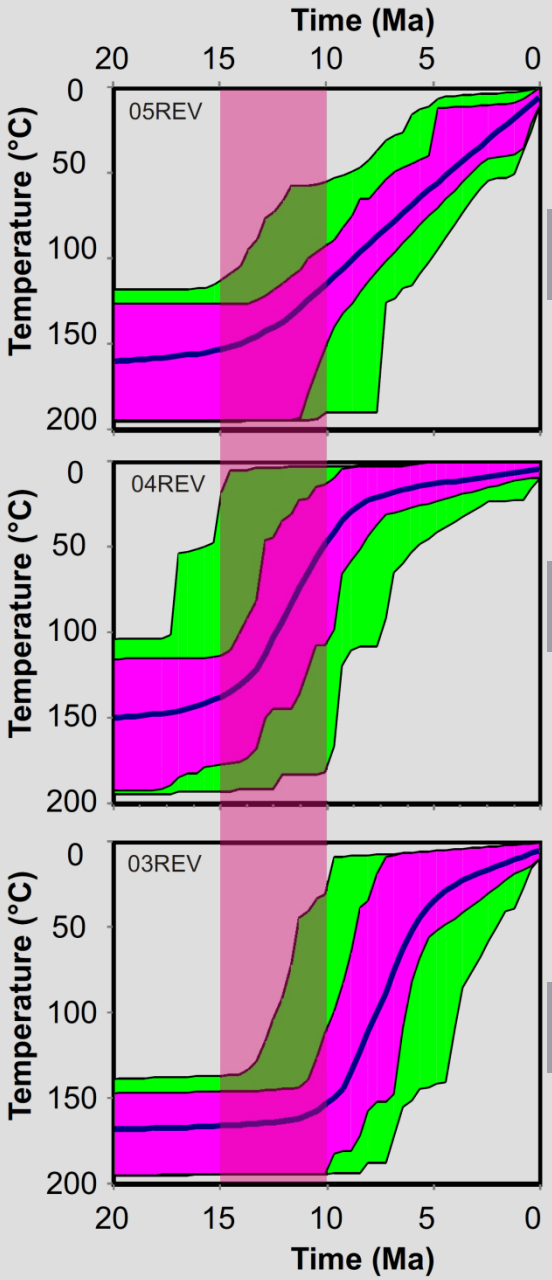


Mount Apocalypse: Revelation Mountains



Document rapid cooling initiation around ~15 Ma to ~10 Ma

HeFTy AFT thermal models

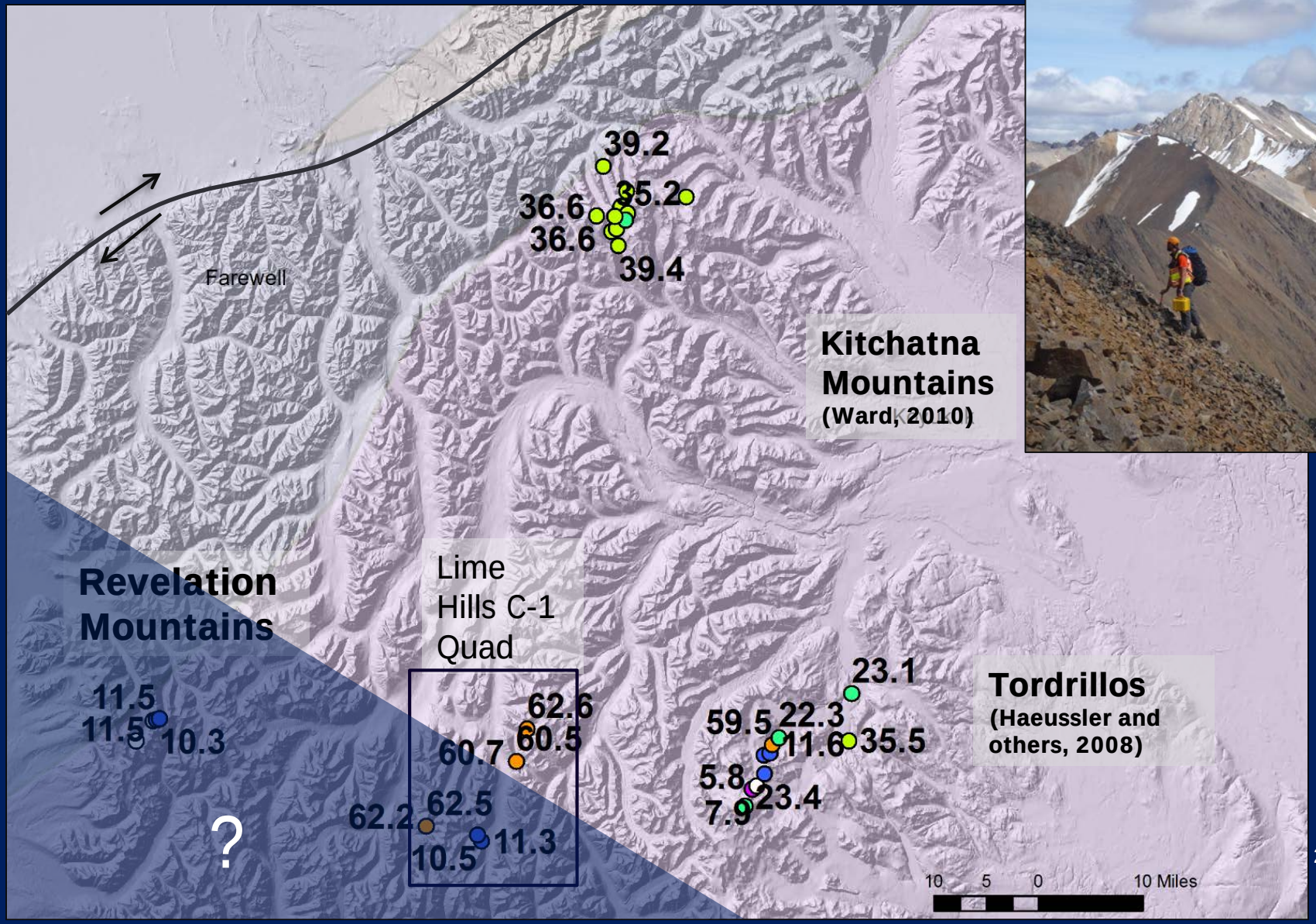


2709 m

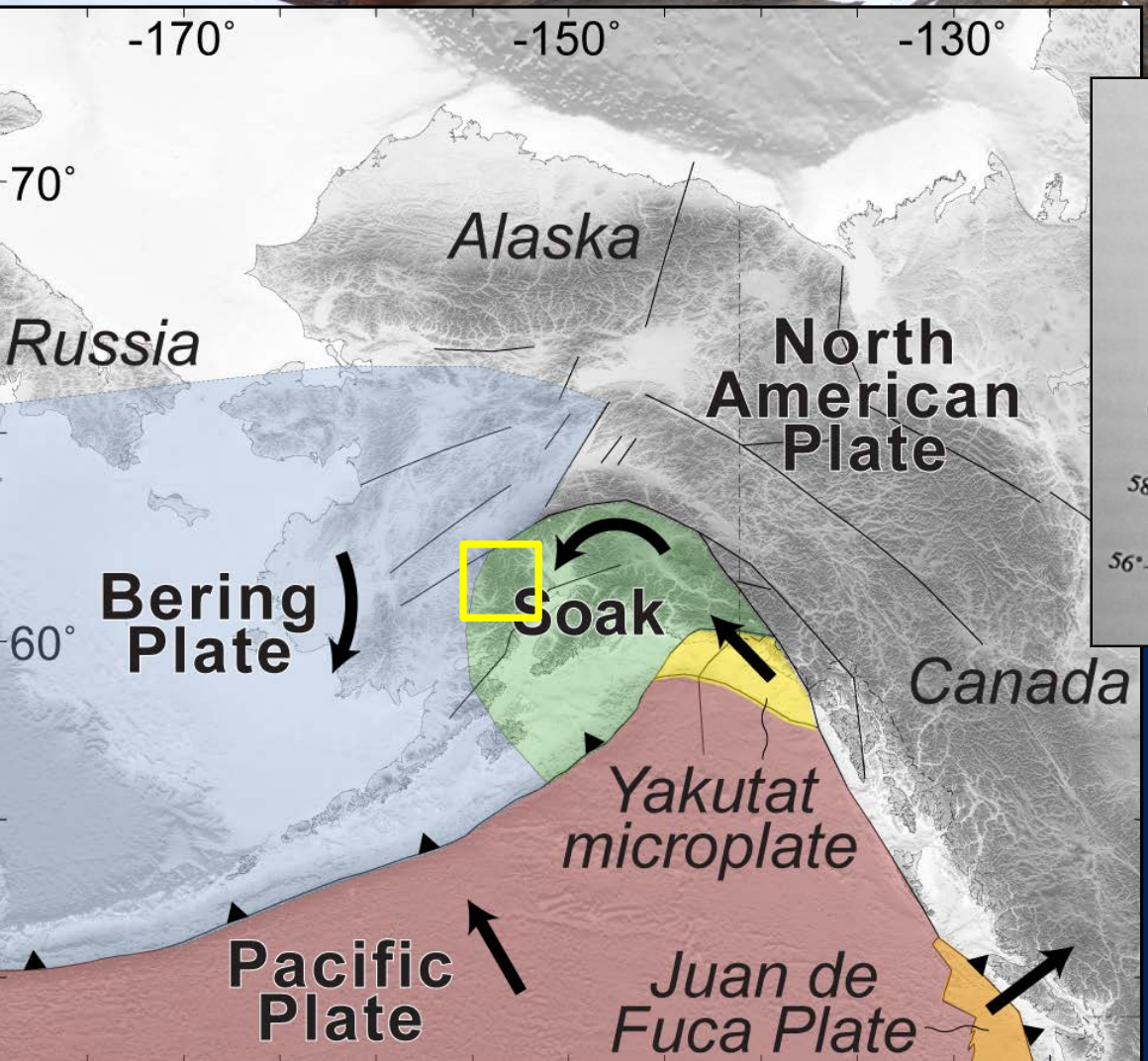
2004 m

1467 m

Young uplift in the Western Alaska Range?



Young Uplift in the Western Alaska Range?



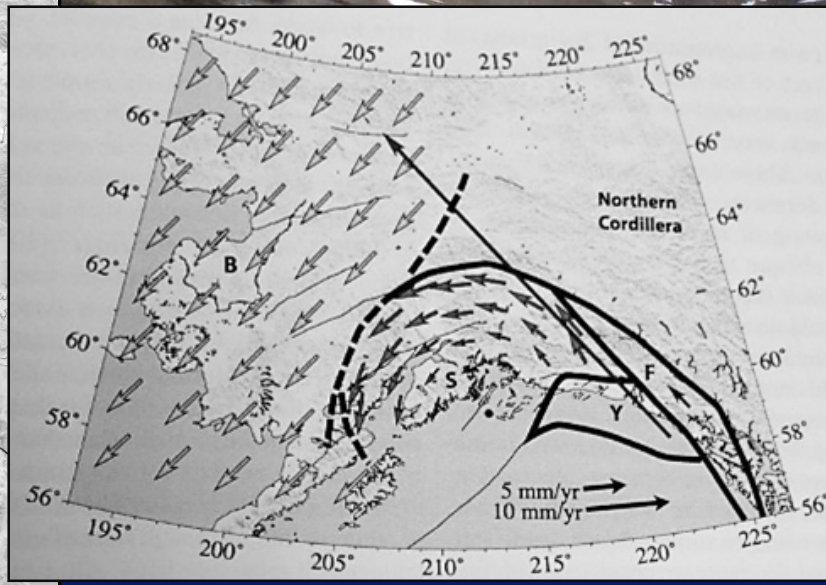


Figure (above) from Freymueller and others (2008), and (left) modified in Finzel and others, (2011)
SOAK=Southern Alaska Block

Conclusions

- New $^{40}Ar/^{39}Ar$ geochronology
  - Extended Mt. Estelle plutonism to the south, highlighting the composite nature
  - Dated new young porphyry system of Copper Joe
- Anomalous Copper and Gold
- 3D voxel model of resistivity
  - Shows a lower shell of conductive material that appears to connect to magnetite breccias at the surface
- Revelation Mountains uplift
  - Suggests a region of rapid uplift and magmatic and hydrothermal alteration in the Western Alaska Range ~11 Ma

Photo by T.C. Wright

Acknowledgments & Future Work

Project has benefited from unpublished data and discussions with geologists of:

- USGS Western Alaska Range Project (WARP) Millrock Resources Inc., Kiska Metals Corp., WestMountain Gold Inc., Alaska Earth Sciences
- Funded by the Alaska State Legislature as part of the ongoing Airborne Geophysical/Geological Mineral Inventory (AGGMI) Program
- Field work: Larry Freeman, Evan Twelker, Rainer Newberry, Erik Bachmann, David Reioux, Colby Wright, Amy Tuzzolino

Future Work

- Geologic map of the Lime Hills C-1 Quadrangle with explanatory text
- U-Pb Geochronology
- Data releases: www.dggs.alaska.gov Contact: karri.sicard@alaska.gov

Stop by the poster session or our booth with further questions

Works Cited p. 1

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