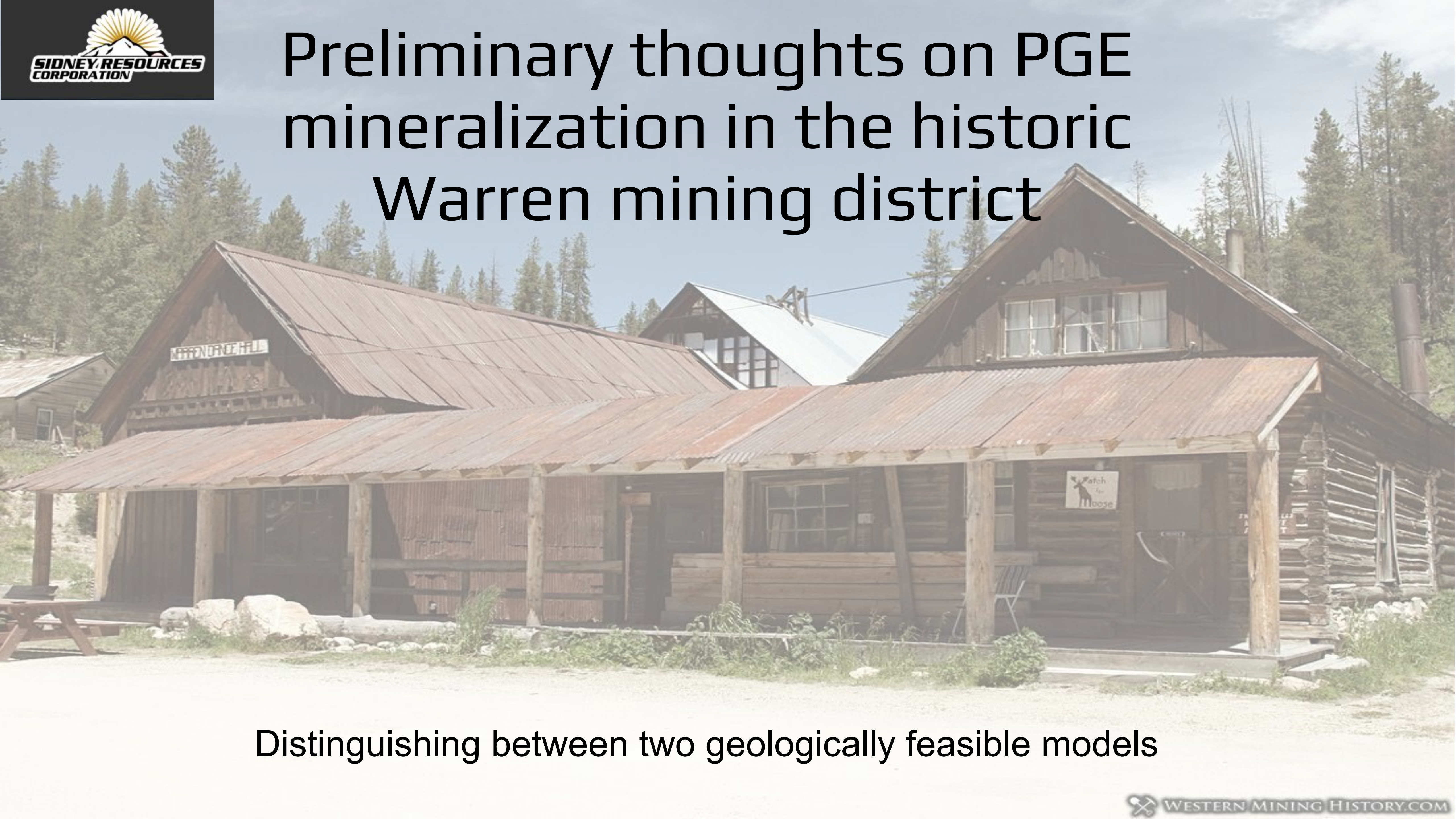
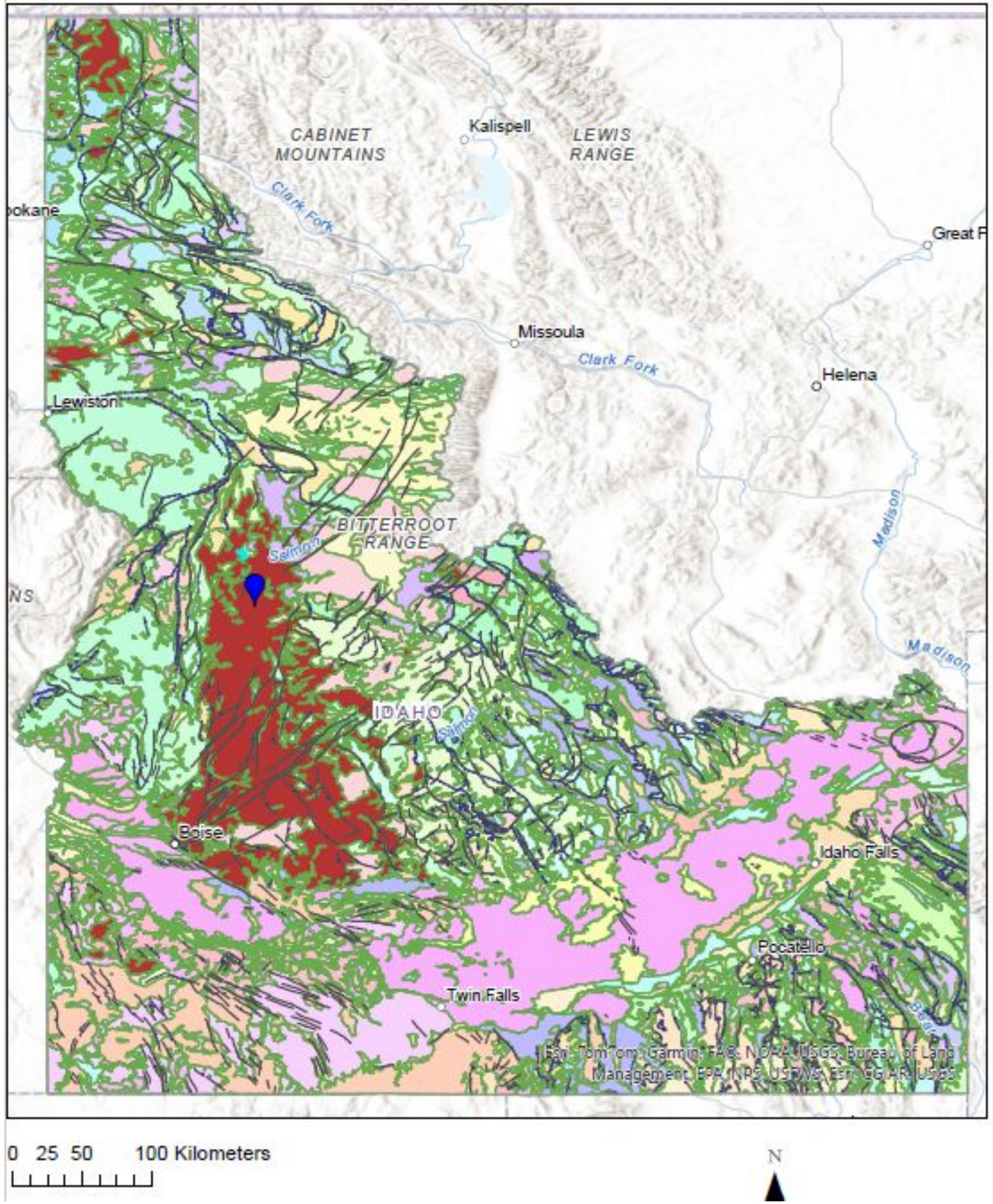
SIDNEY RESOURCES CORPORATION

Preliminary thoughts on PGE mineralization in the historic Warren mining district



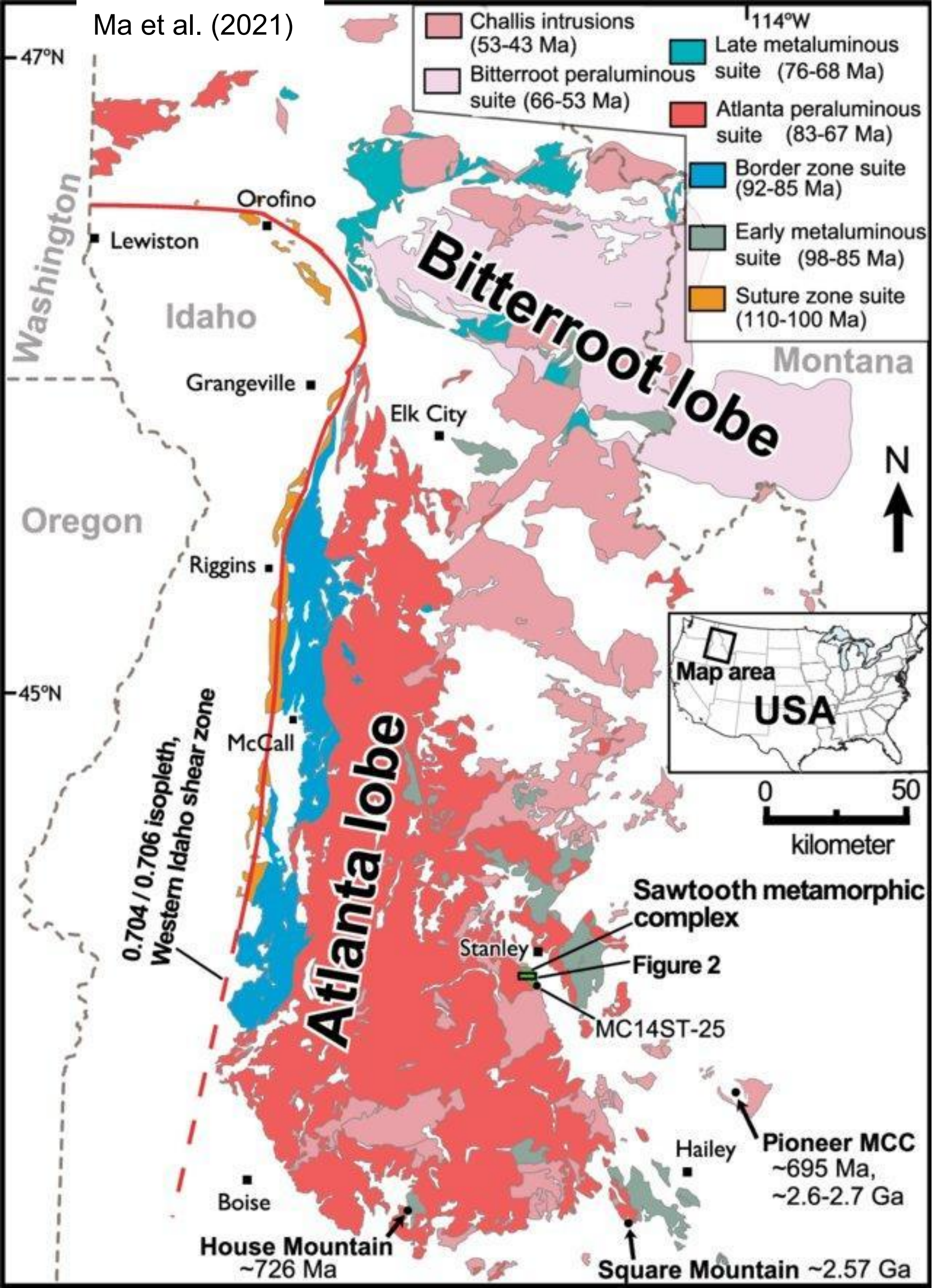
Distinguishing between two geologically feasible models



The Idaho batholith

- Earliest magmatism 98-87 Ma, preserved in western part of the batholith
- Atlanta lobe = 83-67 Ma
- Bitterroot lobe = 66-53 Ma
- SW-NE younging trend coincides with eastward subduction of Farallon plate
- Both lobes compositionally zoned E-W
  - Tonalites to the west reflect melting of mafic upper mantle or subducted oceanic rocks (maybe)
  - Granitic intrusives to the east of the Bitterroot lobe and NW of the Atlanta lobe reflect melting of Belt Supergroup and crystalline metamorphic basement schists and gneisses
  - Country rocks on eastern side of Atlanta Lobe include Paleozoic marine clastic seds

- Warren district located in the Cretaceous Atlanta lobe of the Idaho batholith
- Intruded upper amphibolite facies Precambrian gneiss and the Belt Supergroup

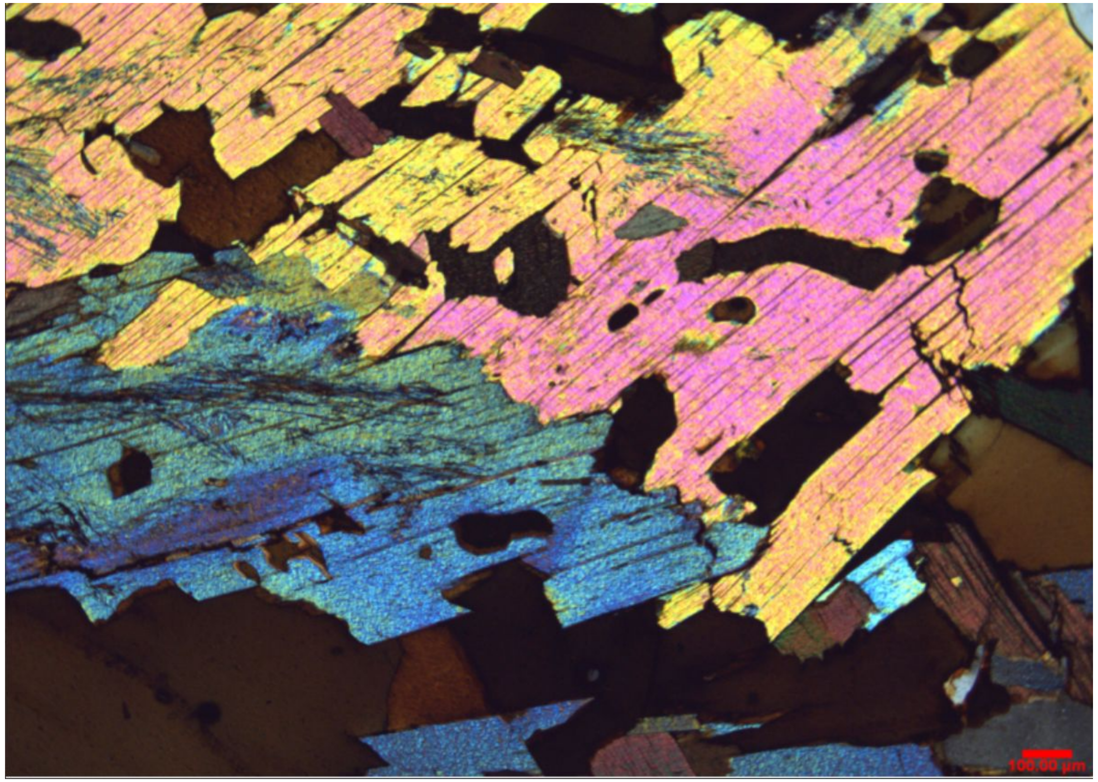


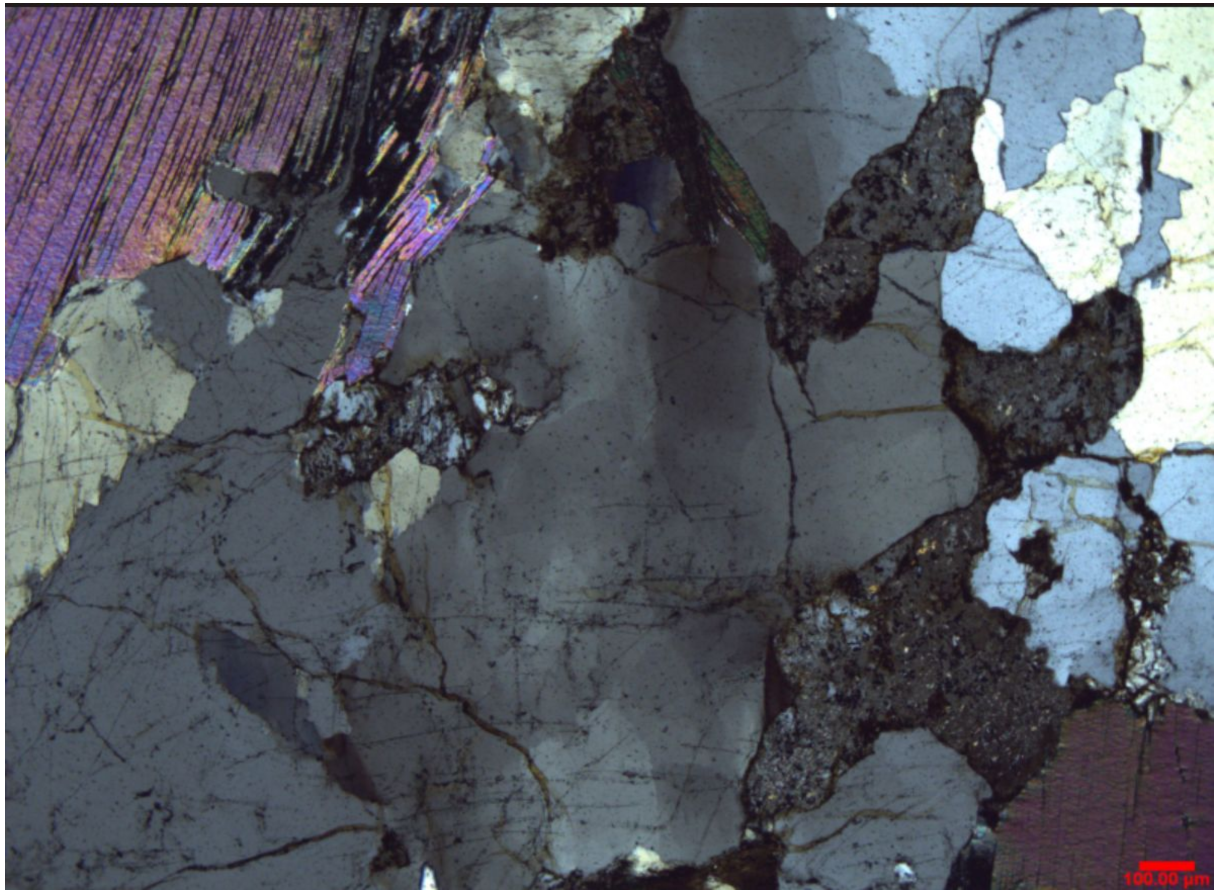
The Atlanta lobe

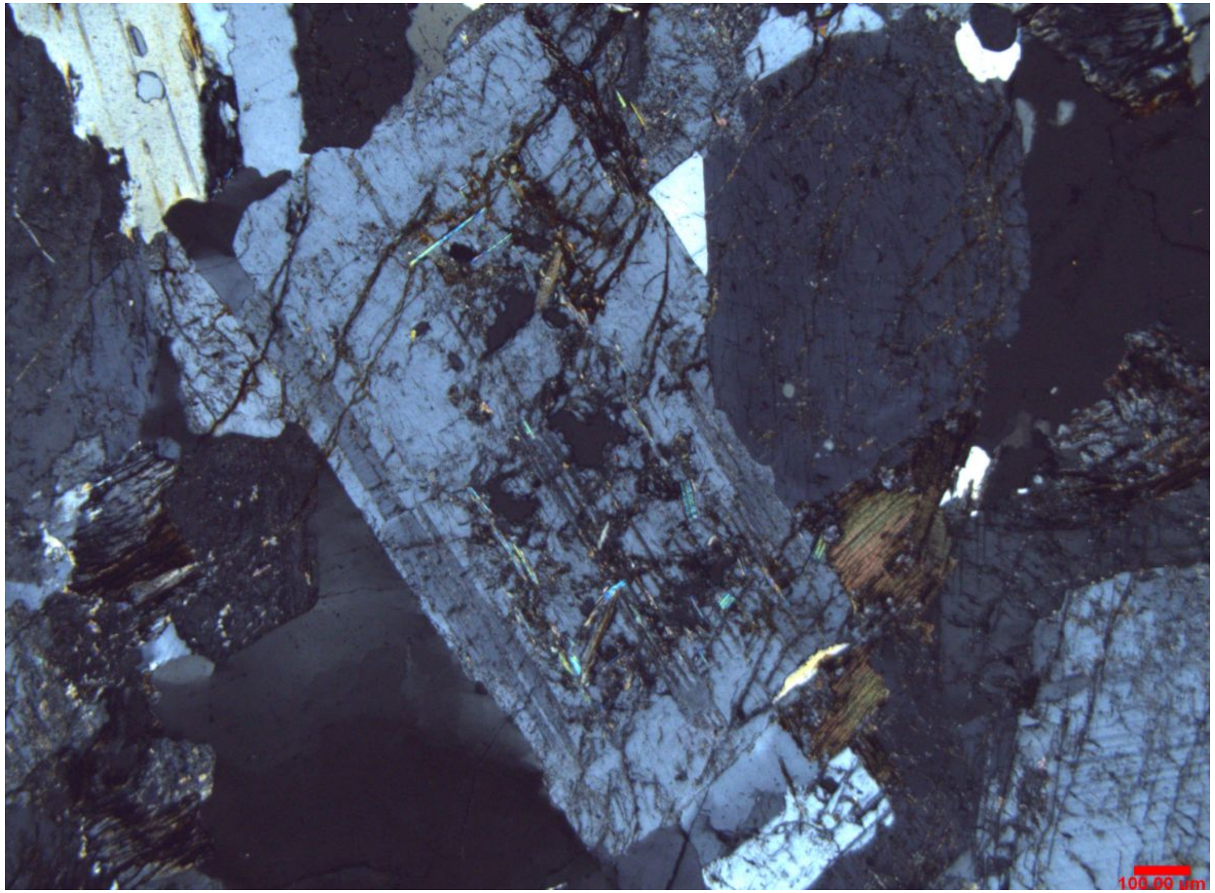
- Tonalite @ western edge
- Msc-bt granite surrounded by bt graniodiorite in core of lobe (volumetric bulk)
- Hb-bt granodiorite, porphyritic granodiorite, and leucogranite also present
- Compositional zoning reflects changes in crustal thickness

Precambrian gneiss

- Sillimanite inclusions in white mica
- Macroscopically gneissic but subhedral biotite are not parallel to subhedral white mica (orthogonal?)







2 mica granite:

- Poorly-developed sericitization of K-feldspar
  - Even poorer sericitization of plagioclase
- Undulatory quartz
  - Typical of a granite
- Euhedral/subhedral white mica and biotite

Structures

- West of McCall is the Western Idaho shear zone
  - Western side of batholith is truncated by a right-lateral oblique shear zones
  - tens of km of displacement
- Eastern side of Bitterroot lobe consists of Bitterroot metamorphic core complex
  - Mylonite zone on eastern edge
  - Eocene hypabyssal basaltic+andesitic dike swarms from Challis magmatic complex pervade both lobes along the Trans-Challis fault zone
  - Eocene granitic plutons intrude Cretaceous granites in the Atlanta lobe (younger than Challis dacites and intrusives)

Historic underground workings

~40 fissure veins

- Lenticular
- Qz lenses up to 3 ft thick
- Trends E-W and dips to the S
- Hosted in the quartz-monzonite

Veins are offset along joints trending NW

- Late lamprophyre preferentially emplaced in these structures

Pamphlet No. 45 September, 1937

STATE OF IDAHO
Barzilla W. Clark, Governor

IDAHO BUREAU OF MINES AND GEOLOGY
A. W. Fahrenwald, Director

GEOLOGY AND ORE DEPOSITS OF THE WARREN MINING DISTRICT
IDAHO COUNTY, IDAHO

By
John C. Reed

Ore

- Au, galena, sphalerite, tetrahedrite, stibnite, pyrite
- Sulfide-poor

Warren mining district

- 30-plus square mile **semi-circular depression** within the Idaho Batholith. This site features layered **stratified mafic igneous mass** within an alkaline QMP Intrusive body and laminated crystalline PC basement rocks, which are highly unusual and consistent with formation during an impact that generated tremendous heat and pressure. The geological evidence strongly supports a significant meteoritic event during the Cretaceous/Tertiary time frame, **further substantiated by the absence of the Paleozoic section in the depression's rim.**

- Extraordinary levels of PGMs, including iridium, osmium, palladium, platinum, ruthenium, and rhodium, as well as elevated levels of chromium, nickel, and elemental iron. The presence of these metals within hydrothermal conduits, confirmed through analytical chemistry by alkaline leach, suggests an extraterrestrial origin. Additionally, the unique composition of the ore concentrate, which includes **elemental iron**, gold, silver, iridium, osmium, palladium, platinum, and rhodium, creates an ingot that is extremely hard and resistant to standard acids and physical manipulation.

Problem: how to get PGE mineralization smack-dab in the middle of the Atlanta lobe ?

Hypothesis 1: meteorite impact deposit

Evidence in favor:

- Semi-circular depression
- Layered mafics
- PGE mineralization

Look for:

- Shatter cones along perimeter
- Pseudotachylite dikes
- Shocked quartz
- Differentiated melt sheet
- Mixing of crustal reservoirs in isotopic signature
  - Absence of mantle signature (e.g., Nd)

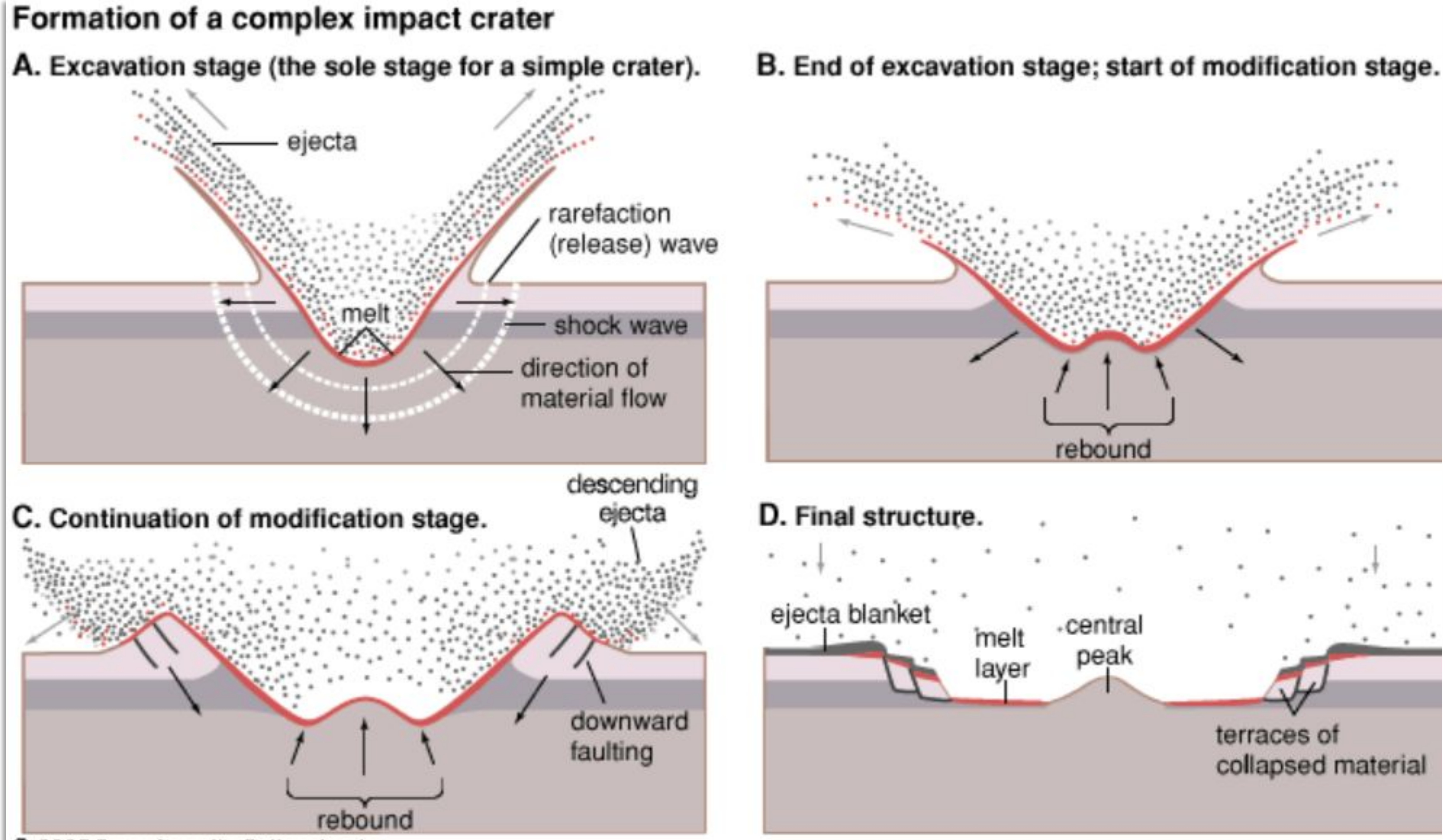
Hypothesis 2: weird porphyry Cu/mesothermal base metal deposit

Evidence in favor:

- Fissure veins in quartz monzonite

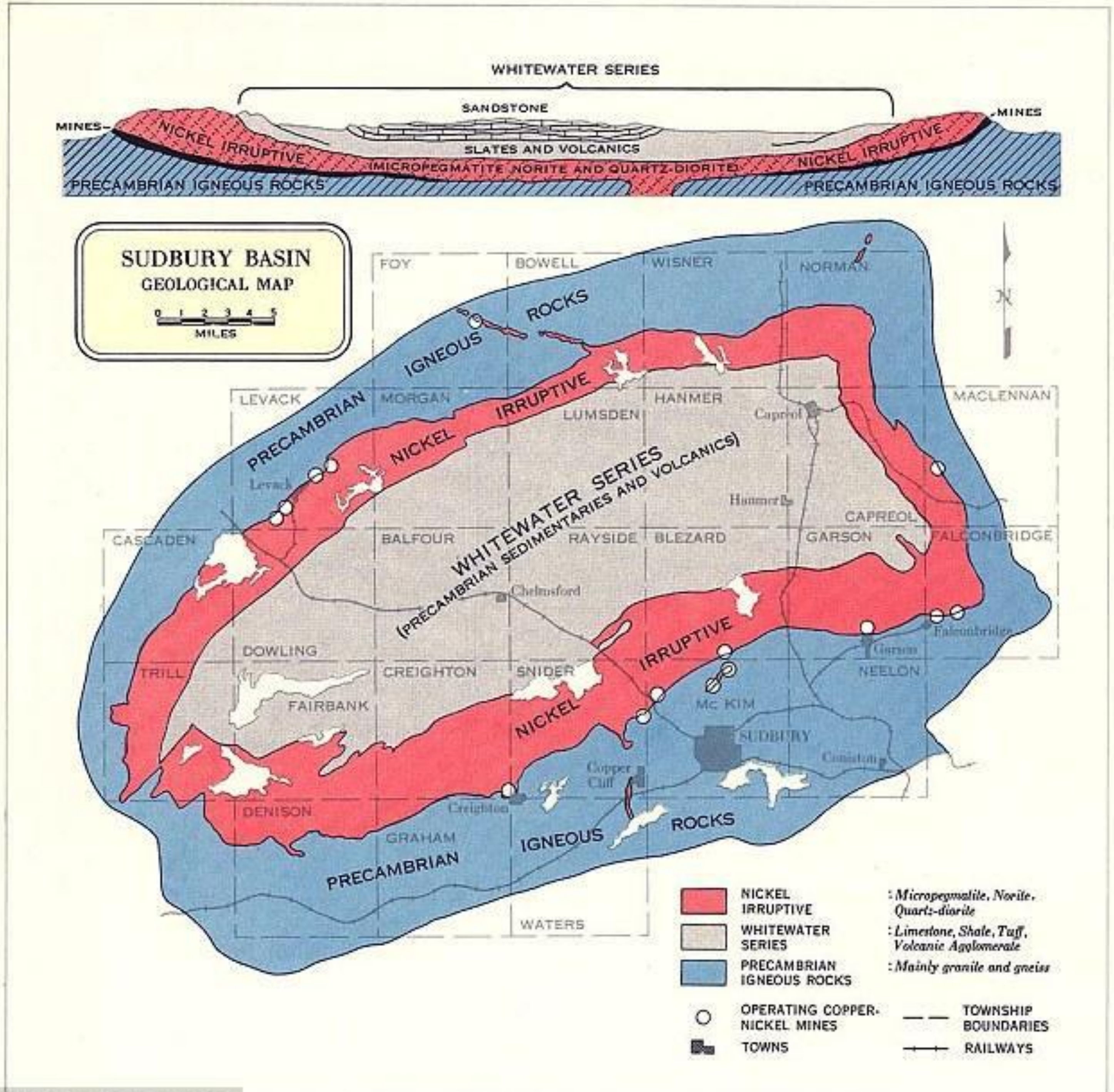
Look for:

- Geochronological evidence linking mineralization to magmatism
- Anomalous Co-Ni concentrations, esp. in pyrite; Te-Se enrichment; Pd-rich
- “typical” porphyry alteration and zoning
  - PGE tellurides or bismuthides as inclusions in cp & bn with early potassic alteration

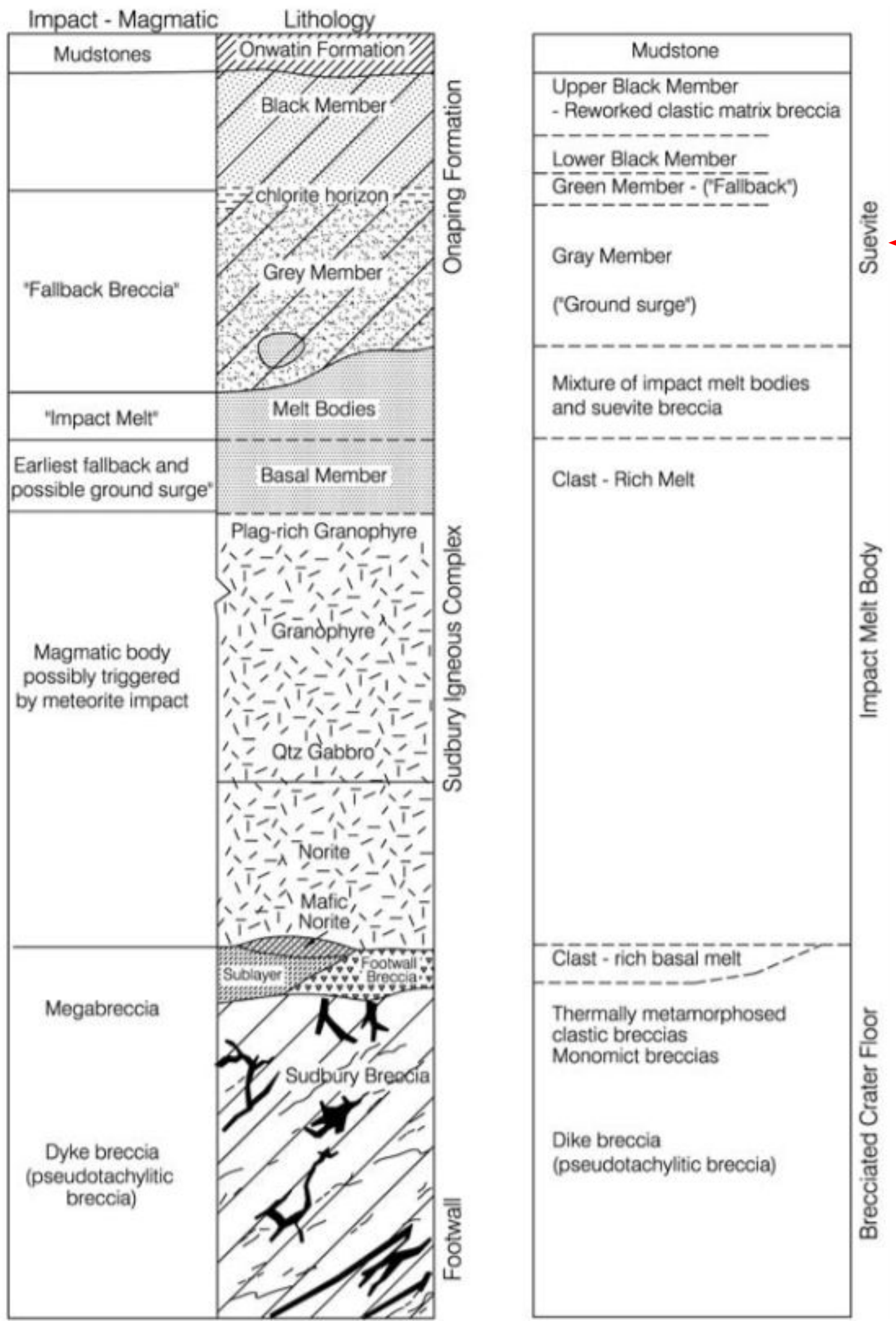


Formation of a complex impact crater
A. Excavation stage (the sole stage for a simple crater).
ejecta
rarefaction (release) wave
melt
shock wave
direction of material flow
B. End of excavation stage; start of modification stage.
rebound
C. Continuation of modification stage.
descending ejecta
downward faulting
rebound
D. Final structure.
ejecta blanket
melt layer
central peak
terraces of collapsed material

Looking north for analogues: Sudbury



- Layered lopolith formed in bottom of Paleoproterozoic impact crater
  - Elliptical, 2.5 km thick Sudbury Igneous Complex
- World-class Ni-Cu sulfide deposits with PGM mineralization; Au
- 15,000 km2 areal extent of impact structure
- Formed in Archean basement and metasedimentary Huronian Supergroup



Economic Mineral Deposits in Impact Structures: A Review

Wolf Uwe Reimold[1], Christian Koeberl[2], Roger L. Gibson[1], and Burkhard O. Dressler[1,3]

Fig. 9. A generalized stratigraphic column for the Sudbury Igneous Complex (SIC) and corresponding interpretation of the various stratigraphic intervals in terms of their impact generation. After Grieve et al. (1991).

More mafic rocks of the SIC at the bottom of the crater and more felsic rocks towards the top

- Sublayer
  - Noritic-quartz diorite with mafic + ultramafic inclusions
  - Sulfide mineralization in mafic/ultramafic inclusions is the main ore
  - Offset dikes: radiate, sometimes concentrically, outward from the SIC
- Norite
- Quartz-gabbro
- Granophyre

Wikimedia

The Sudbury Breccia

- Clast-rich impact pseudotachylite

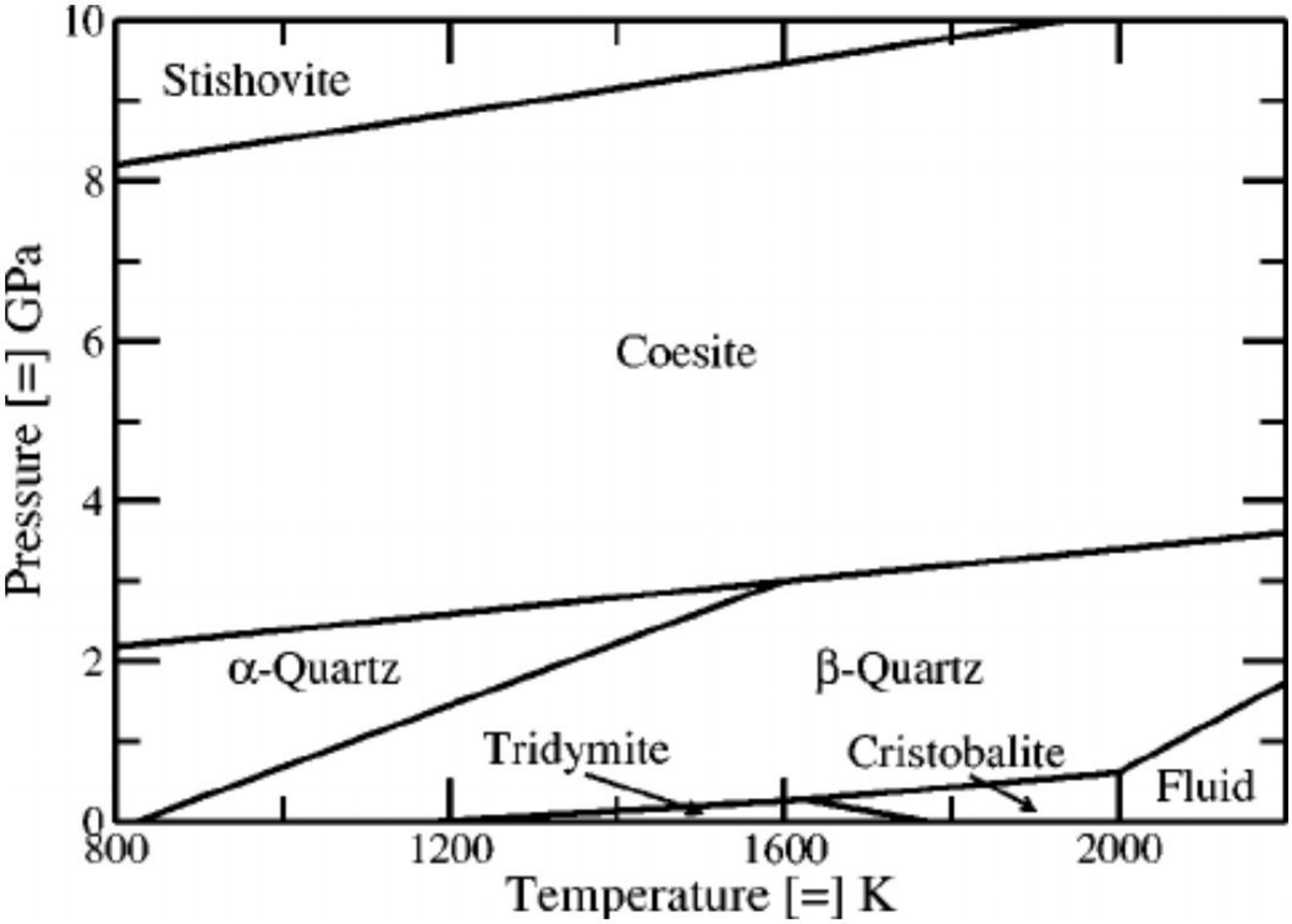

https://www.reddit.com/r/geology/comments/8l2nzu/some_classic_sudbury_shattercones/

Shatter cones

Wikimedia Commons

Planar deformation lamellae (“shocked quartz”)

- Planar zones of glass or high-pressure polymorphs crystallographically oriented in a quartz grain



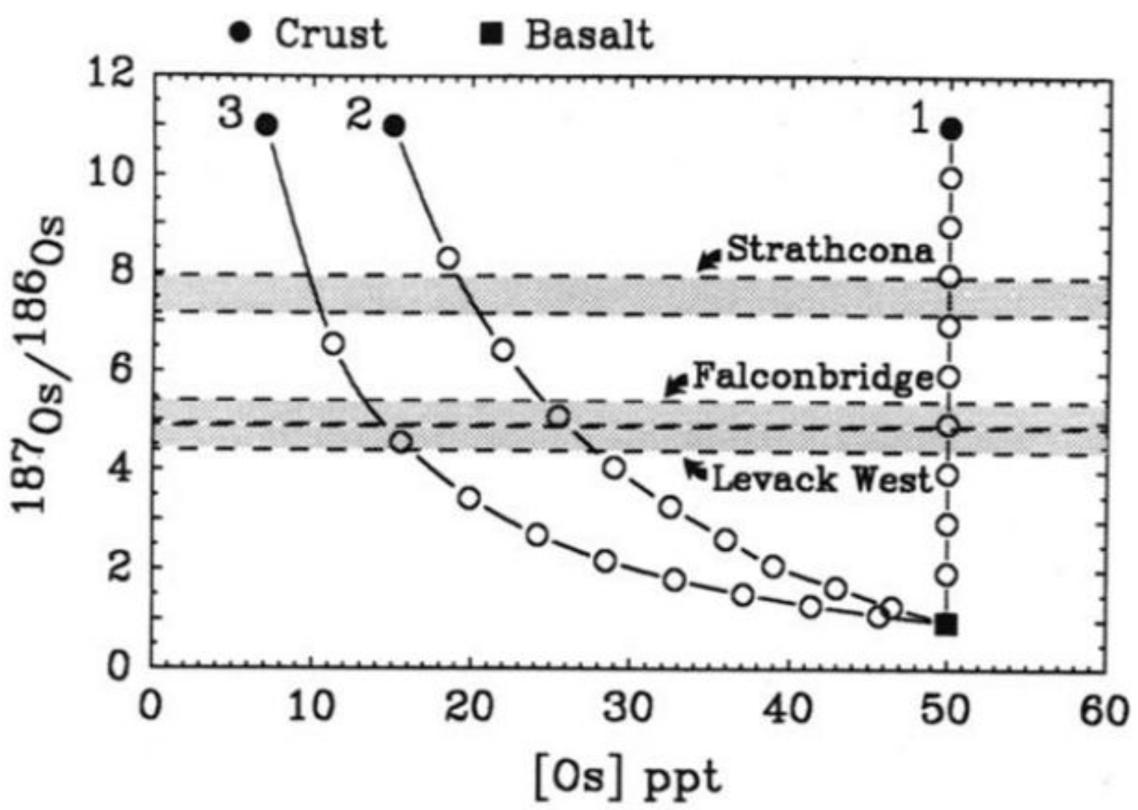
Isotopic evidence for the Sudbury impact hypothesis

SIC and related ores have only a crustal signature

Multiple isotopic systems consistent with derivation from pre-existing crustal material

- Mixing of Huronian basalts in the South Range footwall and Archean gneissic rocks in the North Range footwall

Isotope System	SIC/Ore Signature	Mantle Signature?	Interpretation
Re-Os	High initial $^{187}Os/^{186}Os$	No	Ancient crustal source dominates
Sm-Nd, Pb, Sr, Nd	Homogeneous, crustal-like	No	Complete mixing of crustal melts
PGE, Trace Elements	Crustal ratios	No	Upper and lower crustal derivation



416 *Earth and Planetary Science Letters*, 105 (1991) 416–429
Elsevier Science Publishers B.V., Amsterdam

[CL]

Re-Os isotope systematics of Ni-Cu sulfide ores, Sudbury Igneous Complex, Ontario: evidence for a major crustal component

R.J. Walker [a], J.W. Morgan [b], A.J. Naldrett [c], C. Li [c] and J.D. Fassett [d]

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CAVEAT

These next few intro slides are from a lecture on “typical” porphyry Cu-Mo deposits, in detail they would not necessarily apply to alkalic porphyry deposits with Au lodes and PGE mineralization

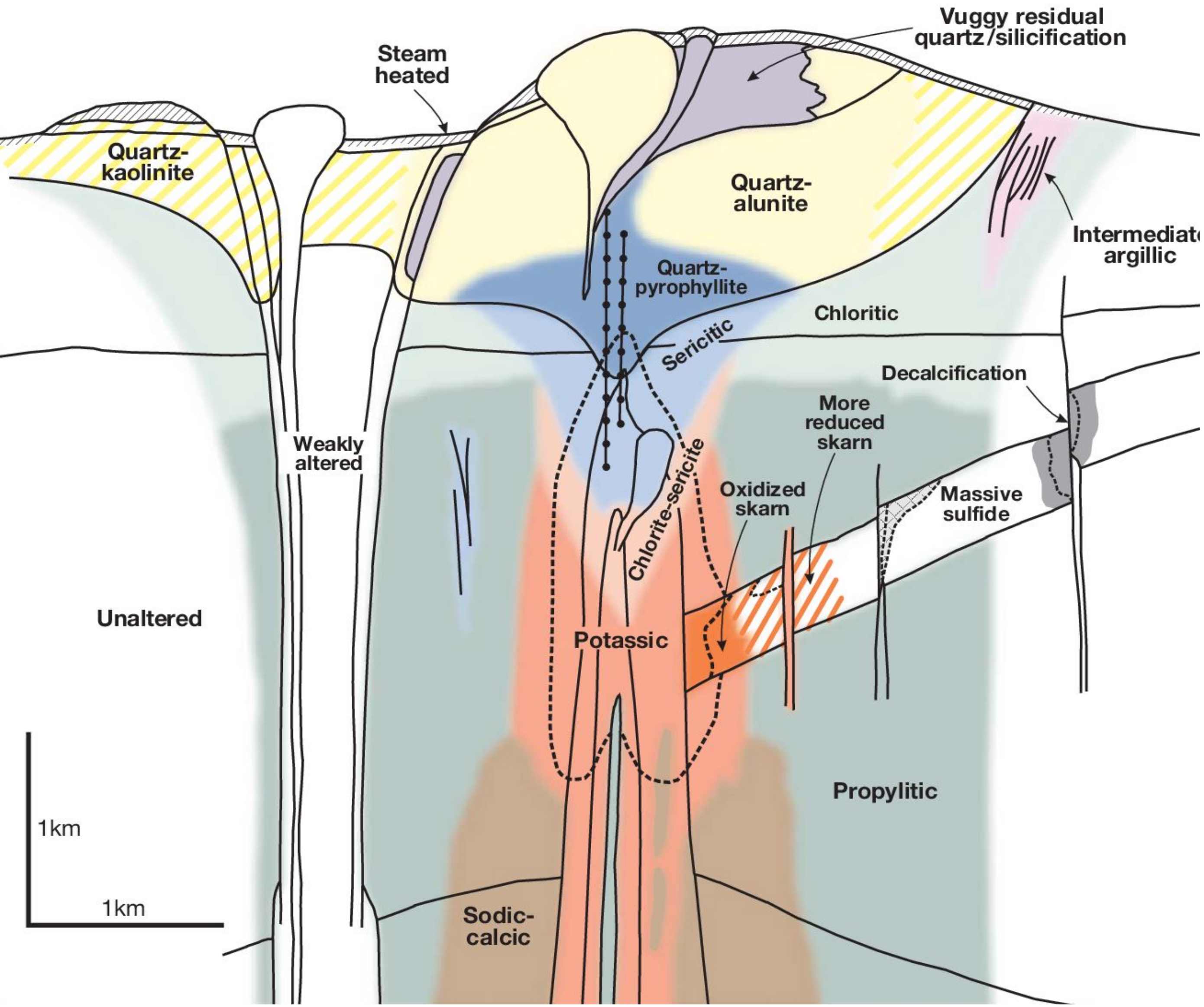
What is a porphyry Cu ± Au ± Mo deposit?

- Large tonnage, low grade **hypogene** (deep) deposits
- Most of the world's Cu and Mo
  - 70% of global Cu
    - 15 MT in 2021
  - ~99% of global Mo and Rh
    - 275 KT Mo in 2021
  - 20% of global Au
    - 5.6 KT in 2021
- Related to subduction zone magmas in the shallow crust
- Large, zoned alteration haloes
- Formation due to exsolution of metal and S-rich aqueous fluids
- Ore deposition due to **second boiling**, cooling, water-rock interaction, and fluid mixing

Lindgren's Classification of Ore Deposits:
Hypogene: formed directly from magma or magmatic fluids
Supergene: shallow re-working of hypogene deposit by surface waters ('secondary mineralization')

First boiling: fluid exsolution due to pressure change
Second boiling: fluid exsolution due to crystallization
Boiling: fluid-gas phase separation

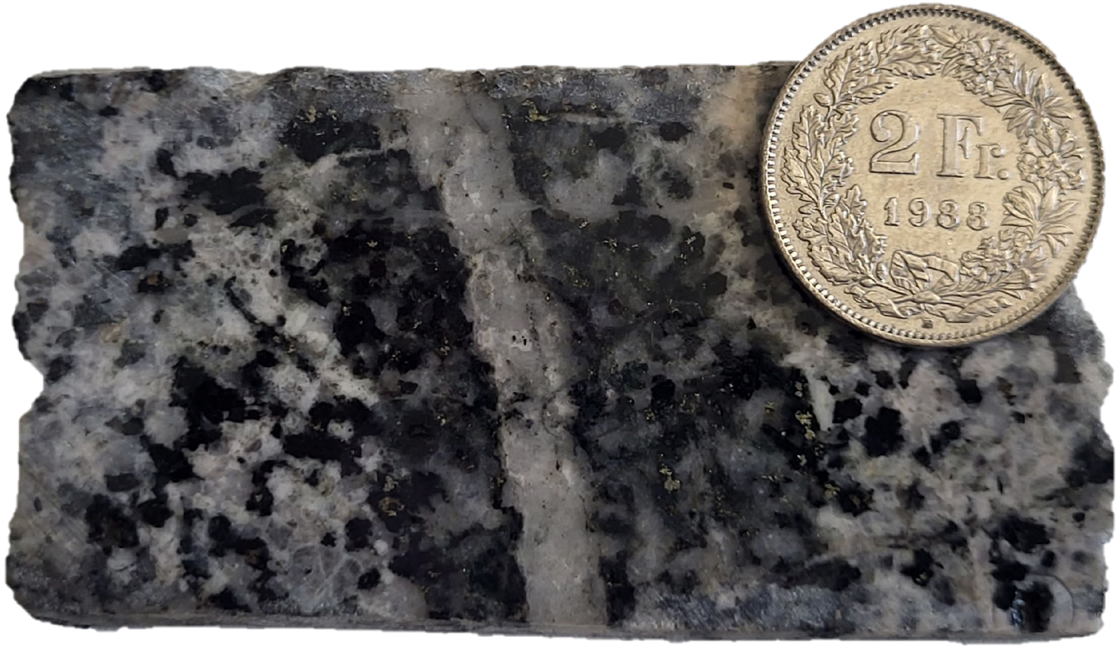
PCDs have characteristic bulls-eye alteration pattern



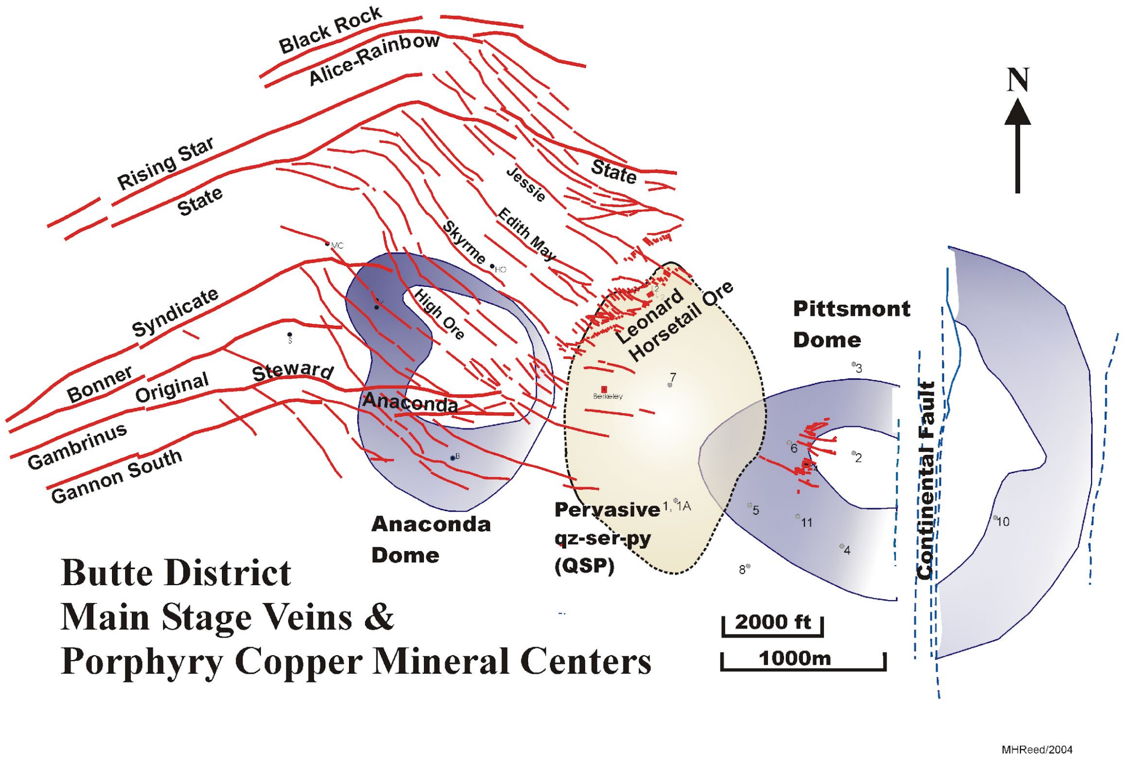
Sillitoe (2010)

- Potassic
- Sodic-calcic
- Propylitic
- Sericitic
- Argillic
- Advanced argillic

Cu ore: **chalcopyrite (cp)**, bornite (bn)
Mo-Rh ore**: molybdenite (mb)**



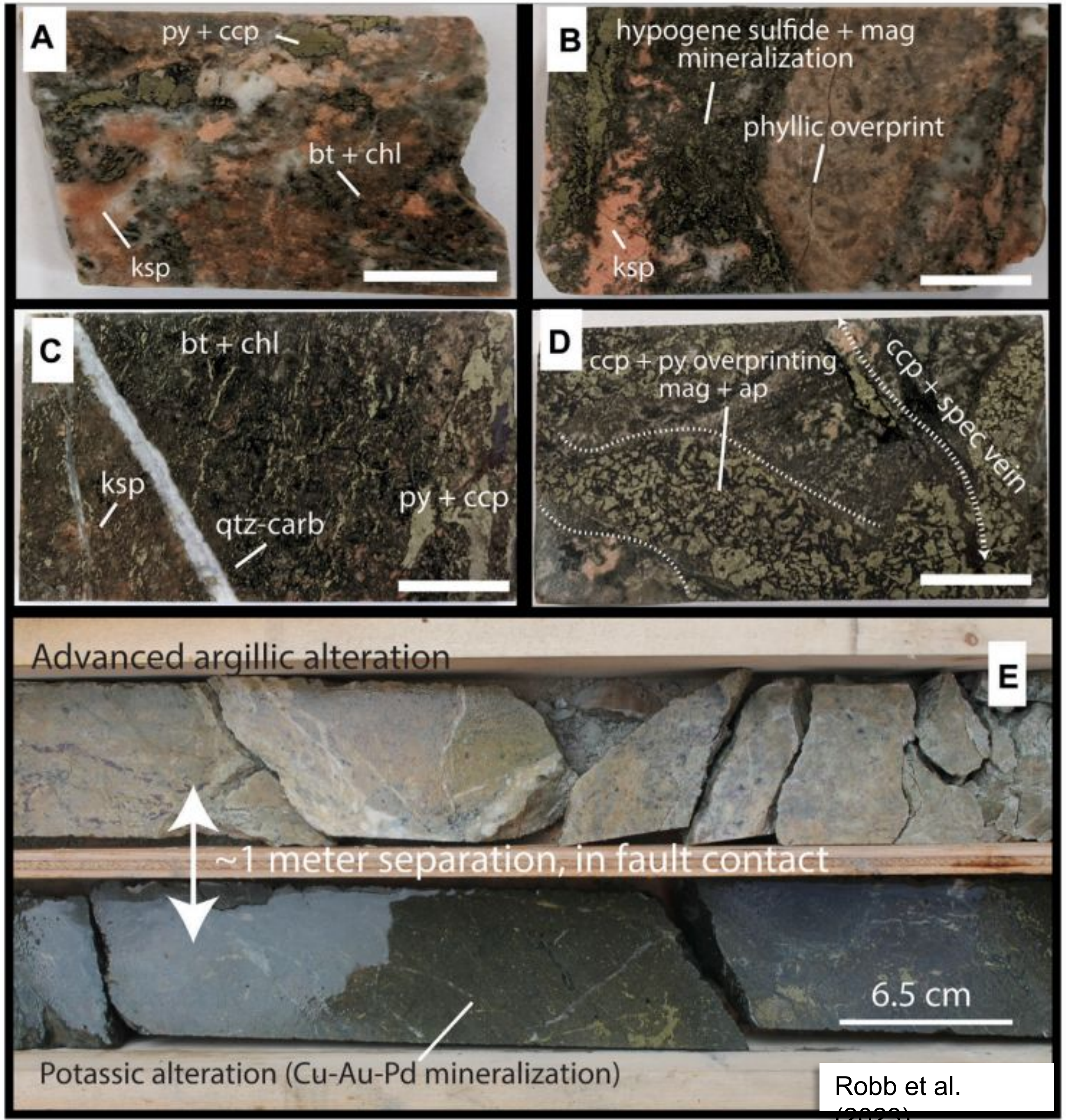
Just as PCDs are zoned in pervasive alteration, so too are they zoned with respect to vein types



Courtesy of J. D

Vertical zoning due to P drop

Lateral zoning due to pH changes (cooling & reaction with host rock)



Robb et al. (2023)

Some alkalic porphyry Cu systems have significant PGE enrichments

- New Afton alkalic Cu-Au (Canada; Robb et al., 2023)
- Skouries (Greece; Park et al., 2016)
- Elatsite (Bulgaria; Augé et al., 2005)
- Santo Tomas II (Philippines; Park et al., 2016)
- Kalmakyr (Uzbekistan; Khalmatov, 2010)
- Galore Creek (Canada, Logan et al., 1994)

Robb et al. (2023)

In these systems, early hypogene PCD sulfides precipitated in potassic alteration host PGE as inclusions

Secondary hydrothermal reworking of PGE-rich base metal sulfides during sericitic alteration* remobilizes the PGE and creates vein-controlled PGE enrichment dominated by PGE minerals (e.g., mertiete-II, isomertieite, temagmite, kotulskite)

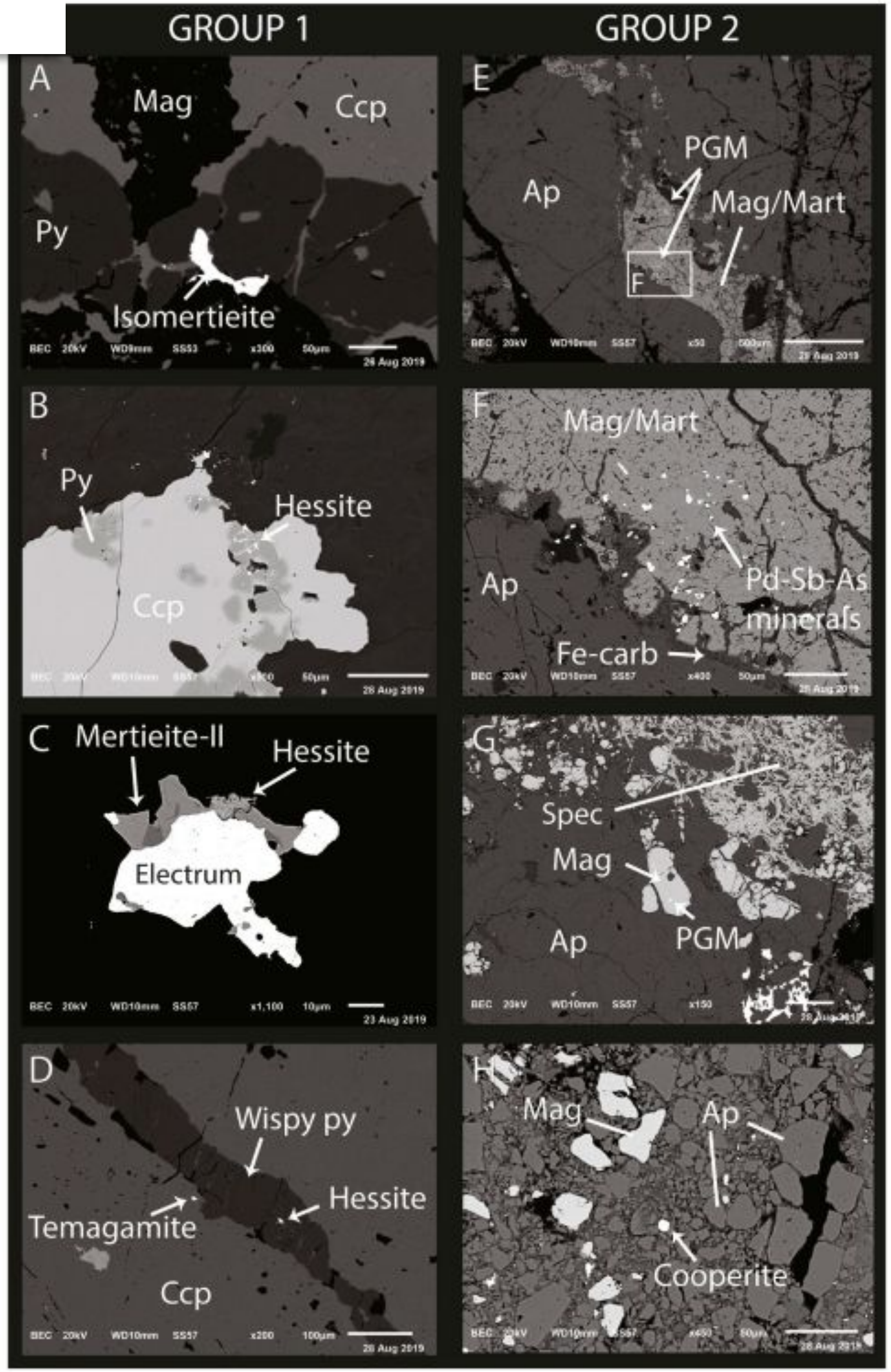


FIGURE 8

SEM-BSE images of platinum-group minerals from sample groups 1 and 2. Mineral abbreviations are: Ap—apatite, Carb—carbonate, Ccp—chalcopyrite, Mag—magnetite, Mart—martite, Py—pyrite, Spec—specularite (hematite). Platinum-group minerals (PGM) in Group 1 samples are associated with sulfide minerals **(A–D)**, often occurring along chalcopyrite-pyrite grain boundaries **(A and B)** and intergrown with electrum and hessite **(B and C)**. Group 2 samples, characterized predominately by the presence of magnetite and apatite **(E–H)**, host their PGM as inclusions in partially martitized magnetite **(E–G)**, in association with Fe-carbonates **(F)** and often near areas of structural modification **(H)**.

Alkalic PCDs w/PGE endowments

Tectonic environment

- Back-arc & extensional settings
- Flat slab subduction
- Post-collisional
  - Alkalic melts form via partial melting of metasomatized lithospheric mantle (Au enrichment)

Extensive brecciations

- Alkalic magmas are very rich in water and other volatiles
- During crystallization, tend to saturate with volatiles at shallow (≤ 2 km) depths
- Enhanced permeability facilitates transport of brines
  - PGE form chloride complexes

Magmatic source characteristics

- Metasomatised mantle enrichment
- High fO_2 in early aqueous fluids

Exploration implication

- Elevated Cu/Au ratios in alkaline host rock
- Co & Ni enrichment in base metal sulfides
- Te & Bi anomalies in soil surveys
- Typical PCD bulls-eye alteration

Strong evidence for both models: need data to test hypotheses

Preliminary field observations!

* Based off of 2 faces and 1.5 days worth of work, so please do not make business decisions based off of these because this is a very small, insignificant amount of data

Anaconda mapping of an underground face in the Upper Lucky Ben (~220 feet into adit from portal)

- Shear-hosted banded quartz veins with intense pervasive white argillic alteration

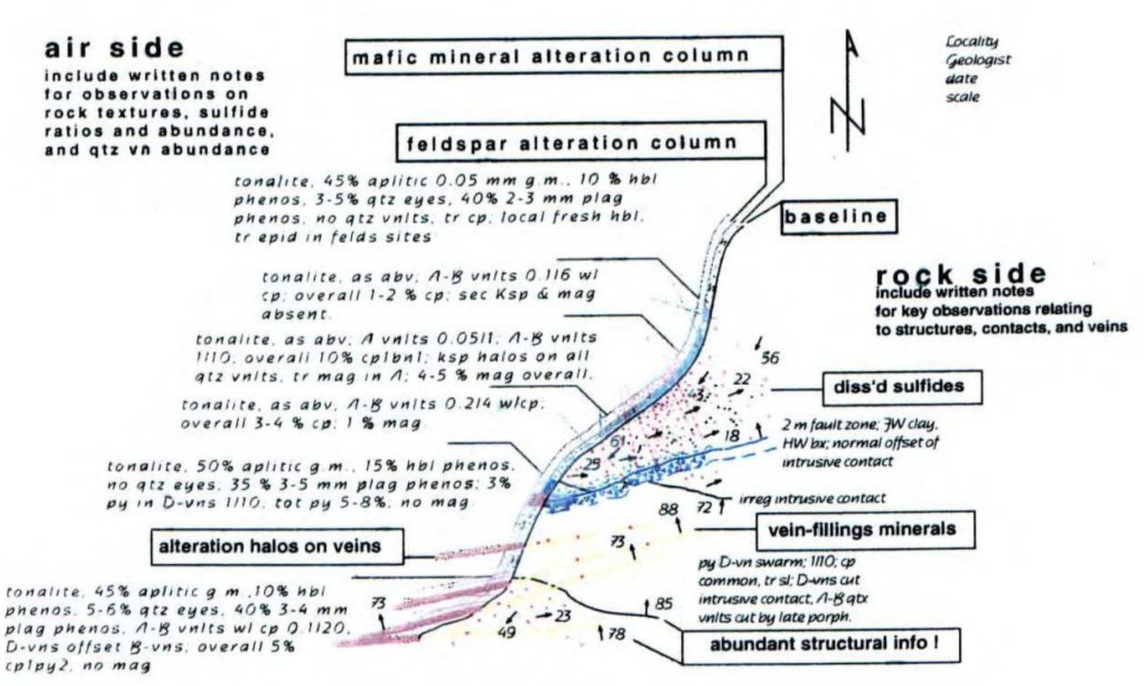
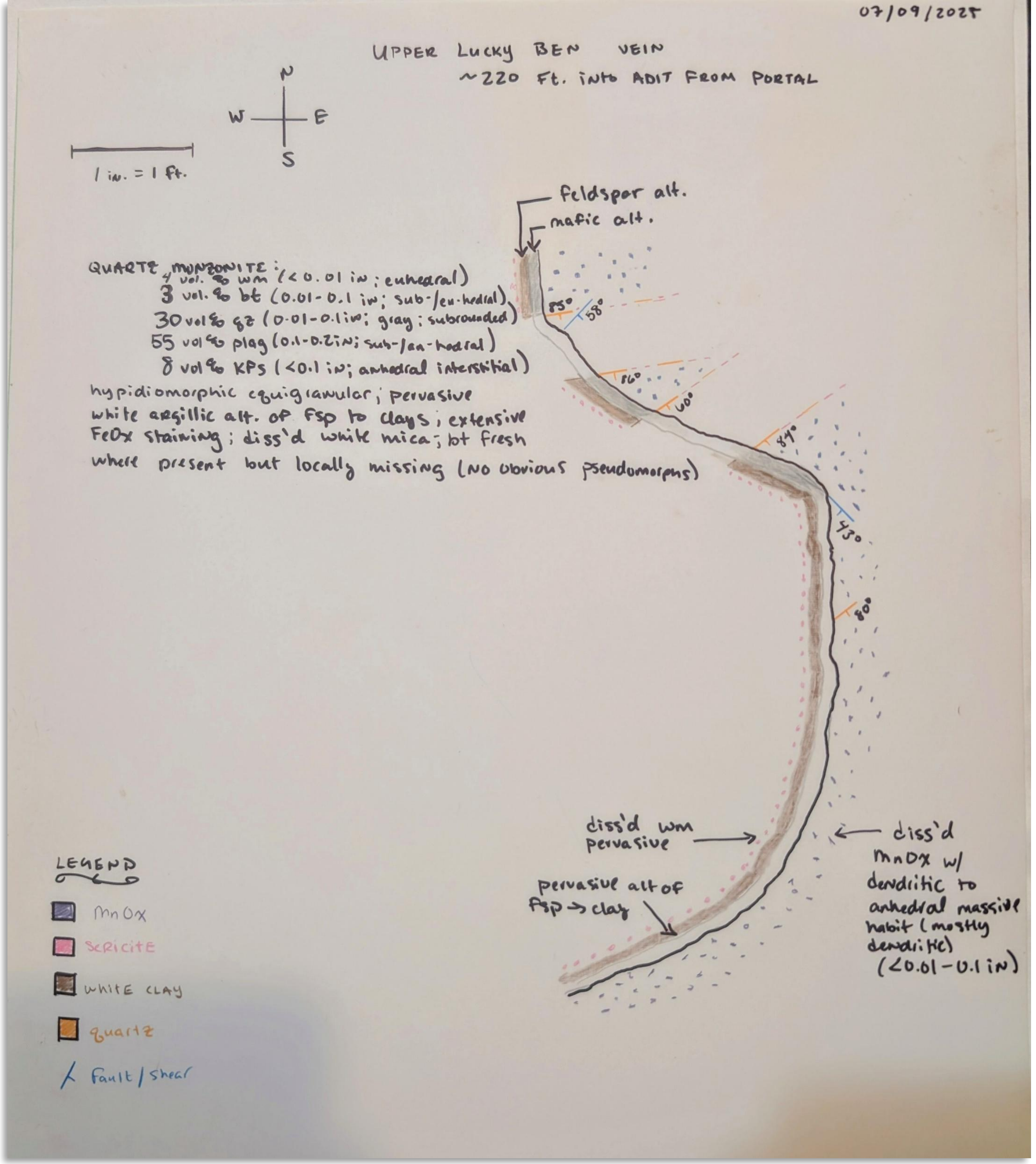
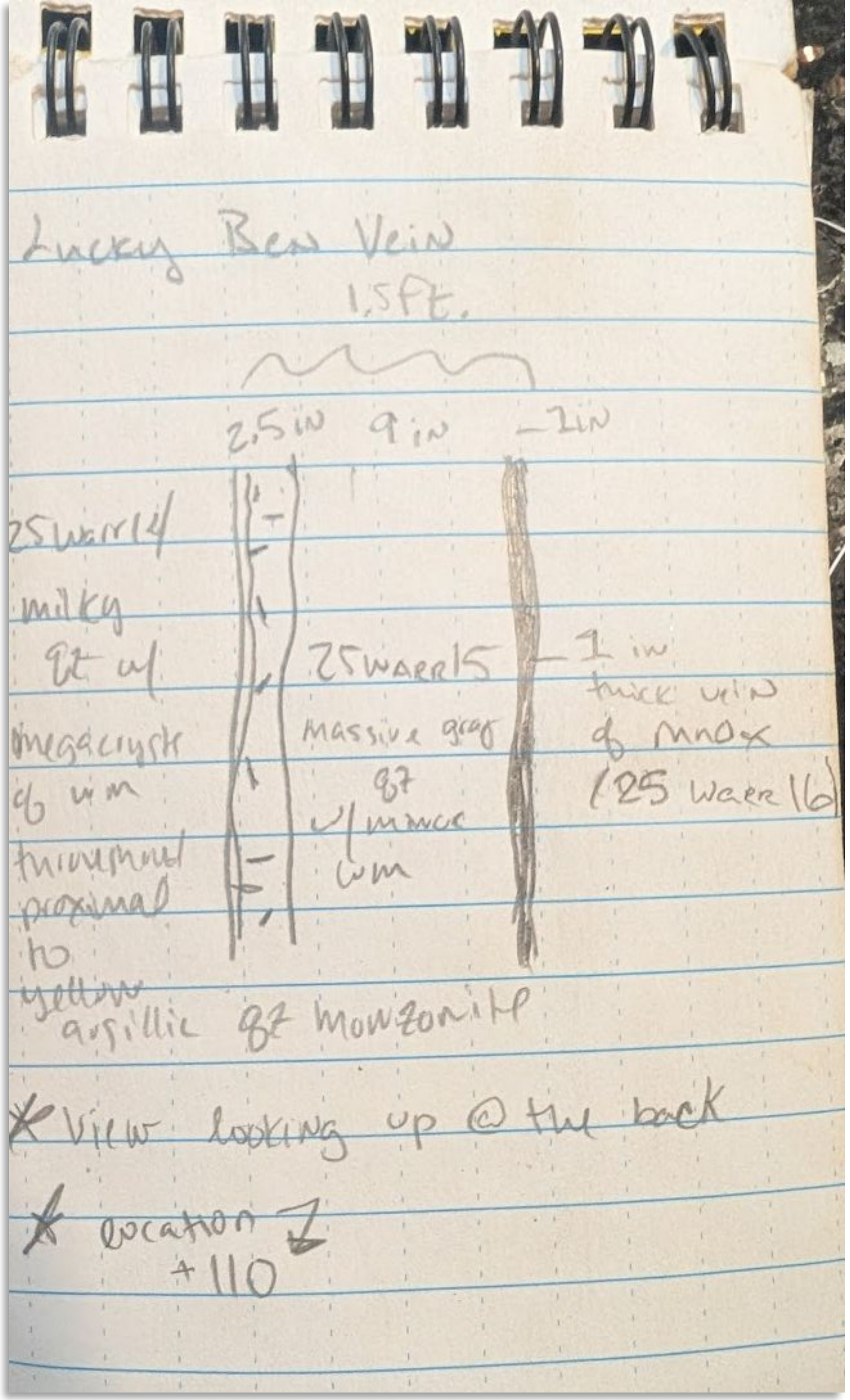


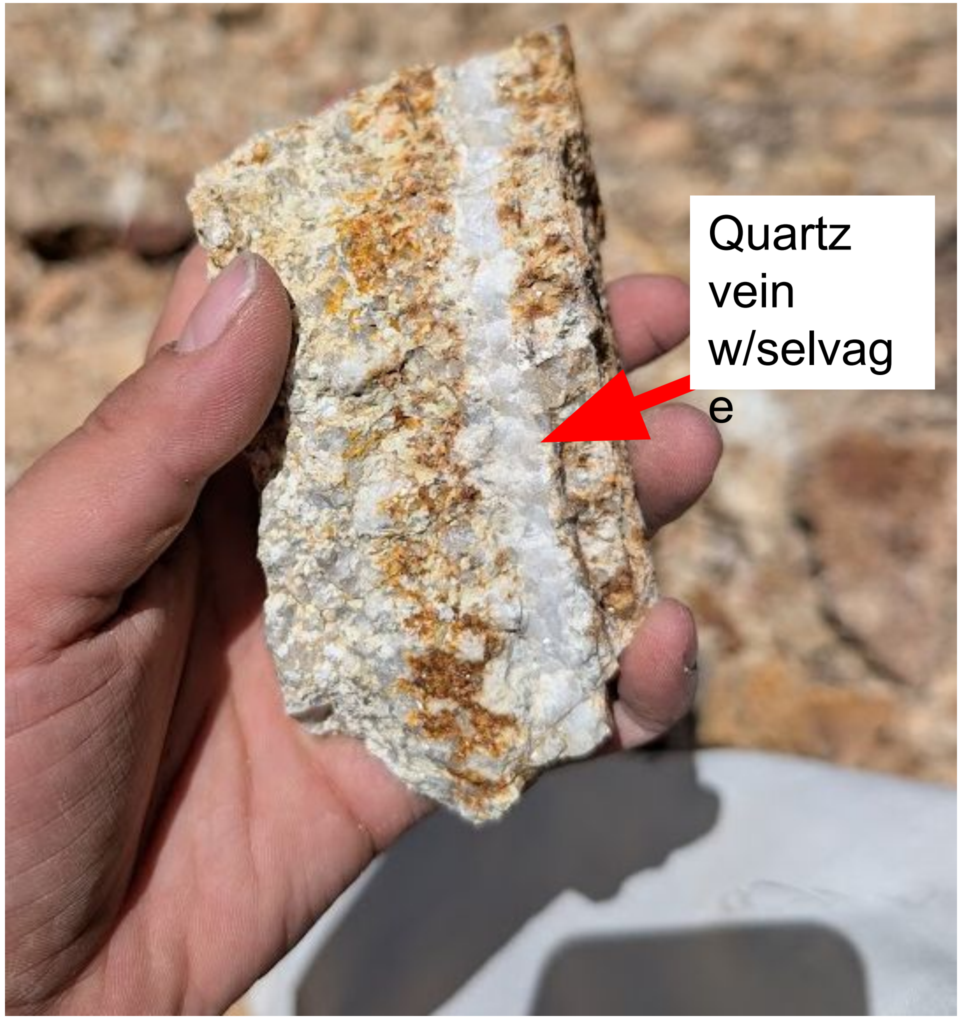
Fig. 1 Bench Map in sulfide-bearing rocks (unoxidized)



All 3 zones of the Lucky Ben vein sampled for thin sections

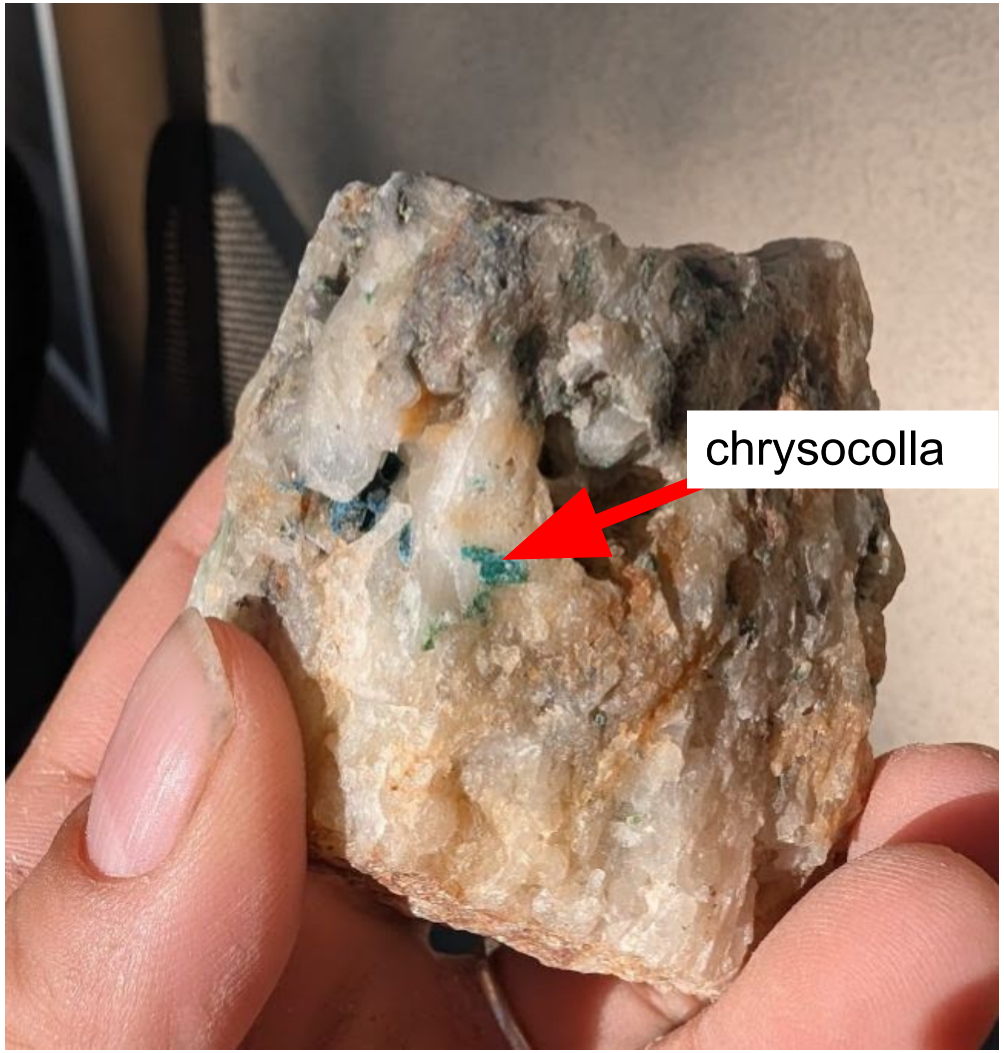


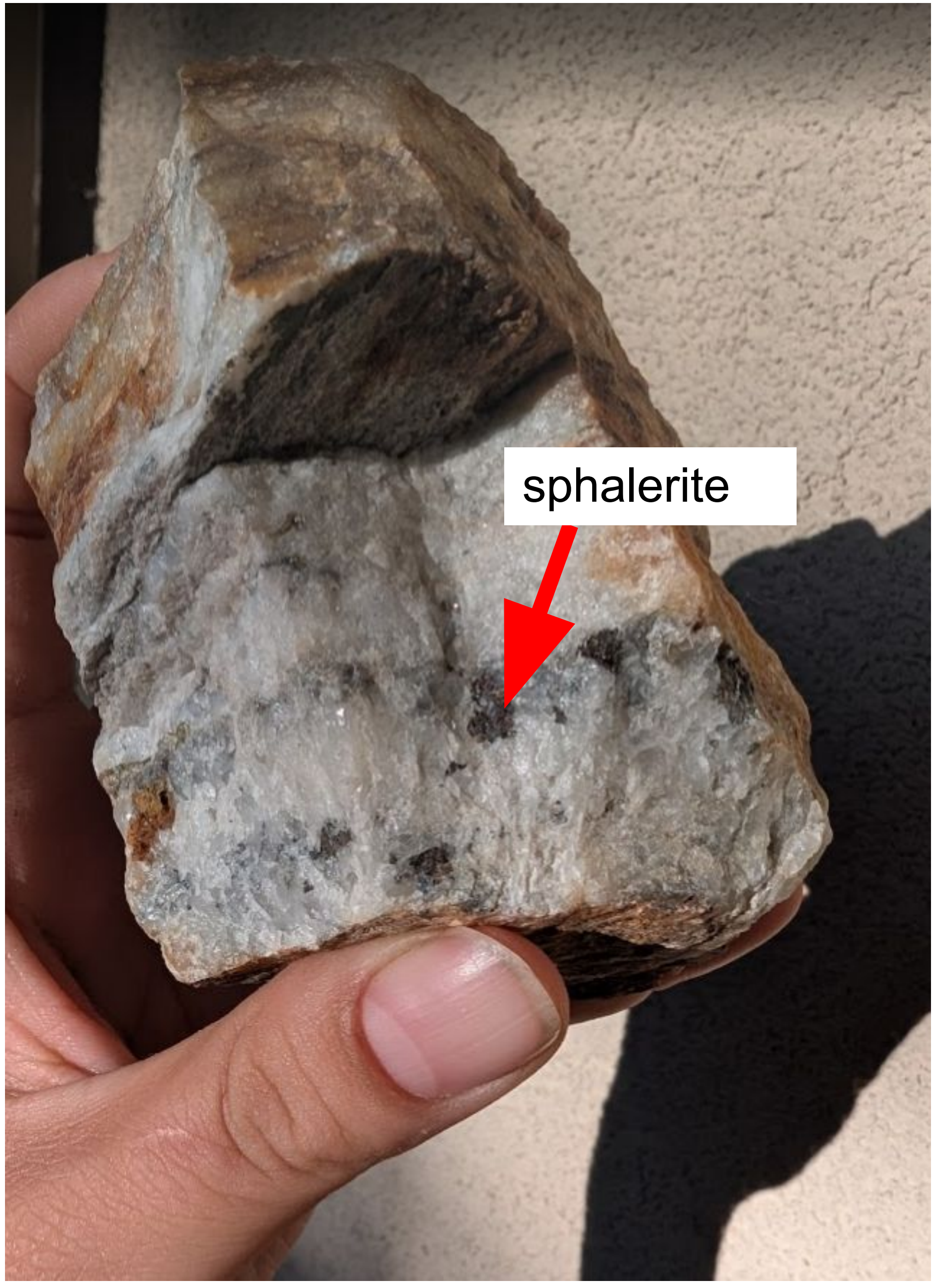
Knot dump



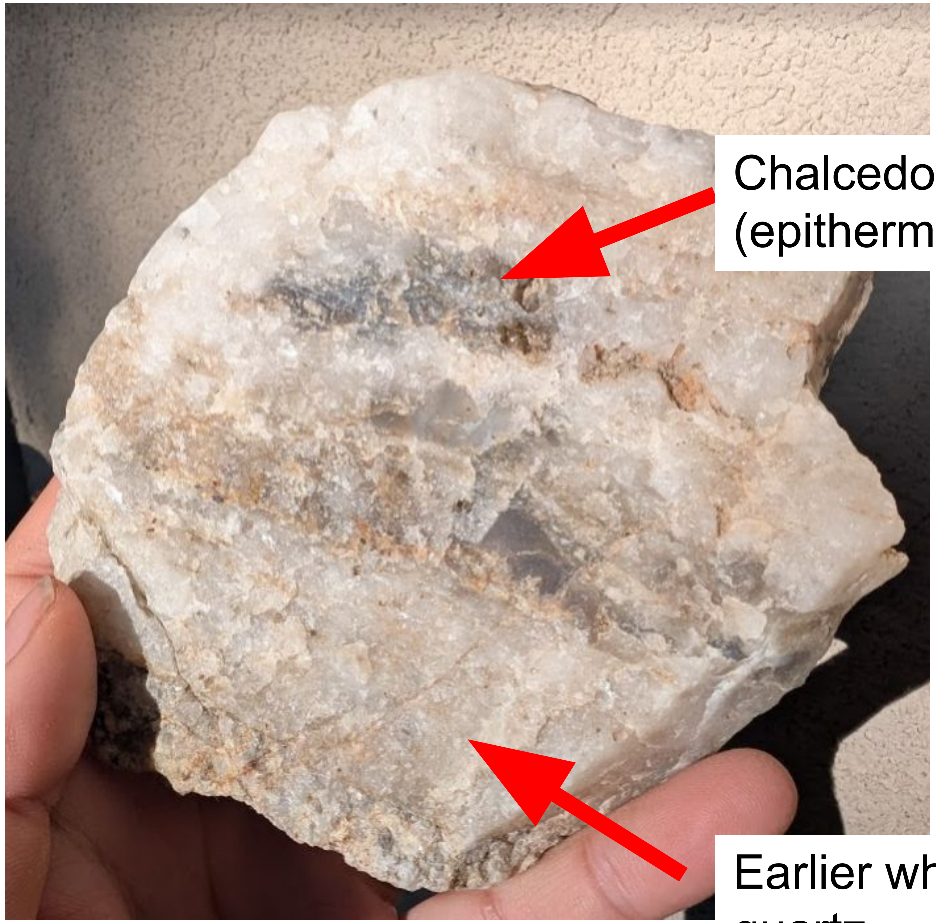
Unity Dump

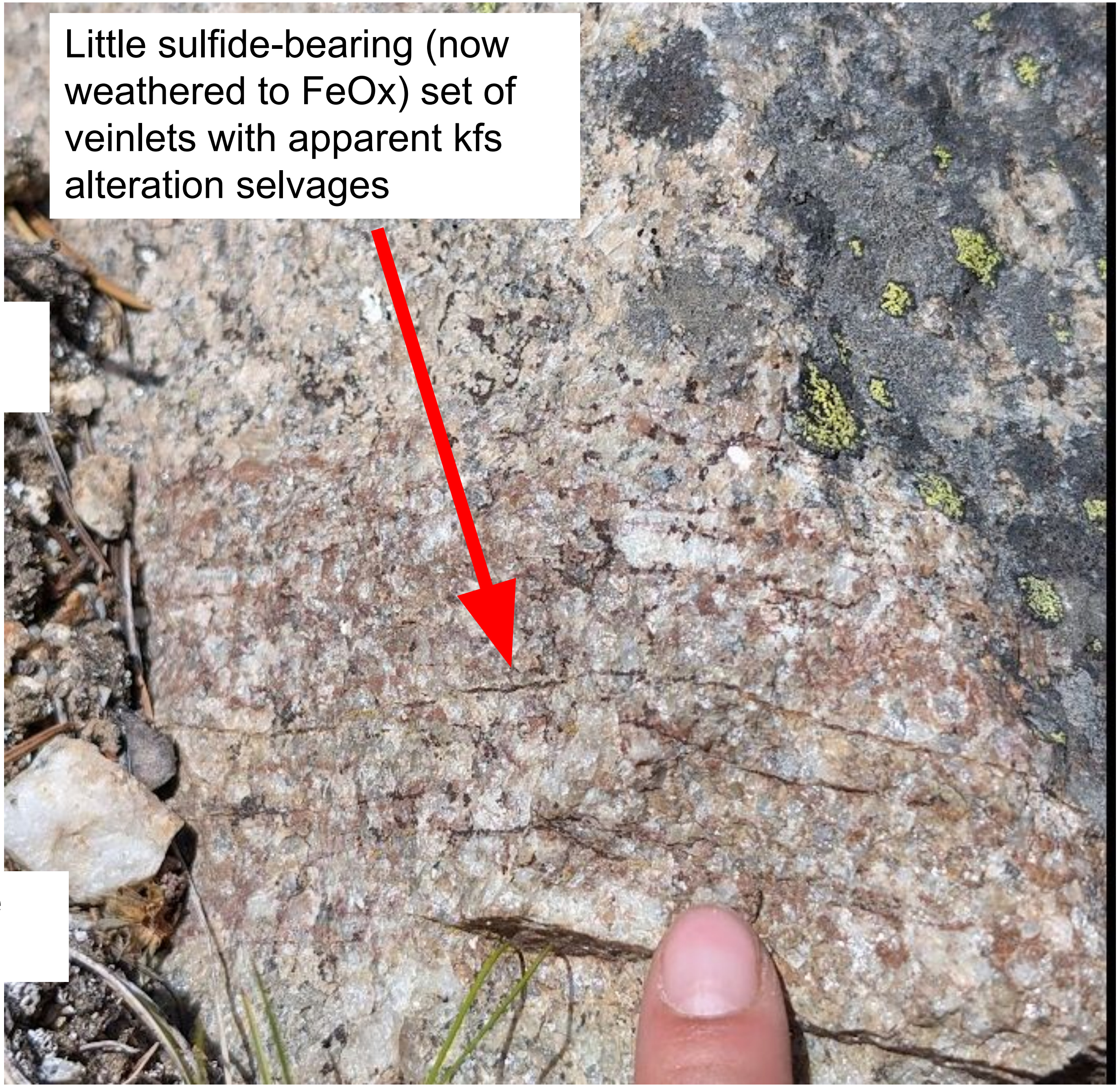
Also a bit of malachite in another sample, unidentified hypogene Cu sulfide



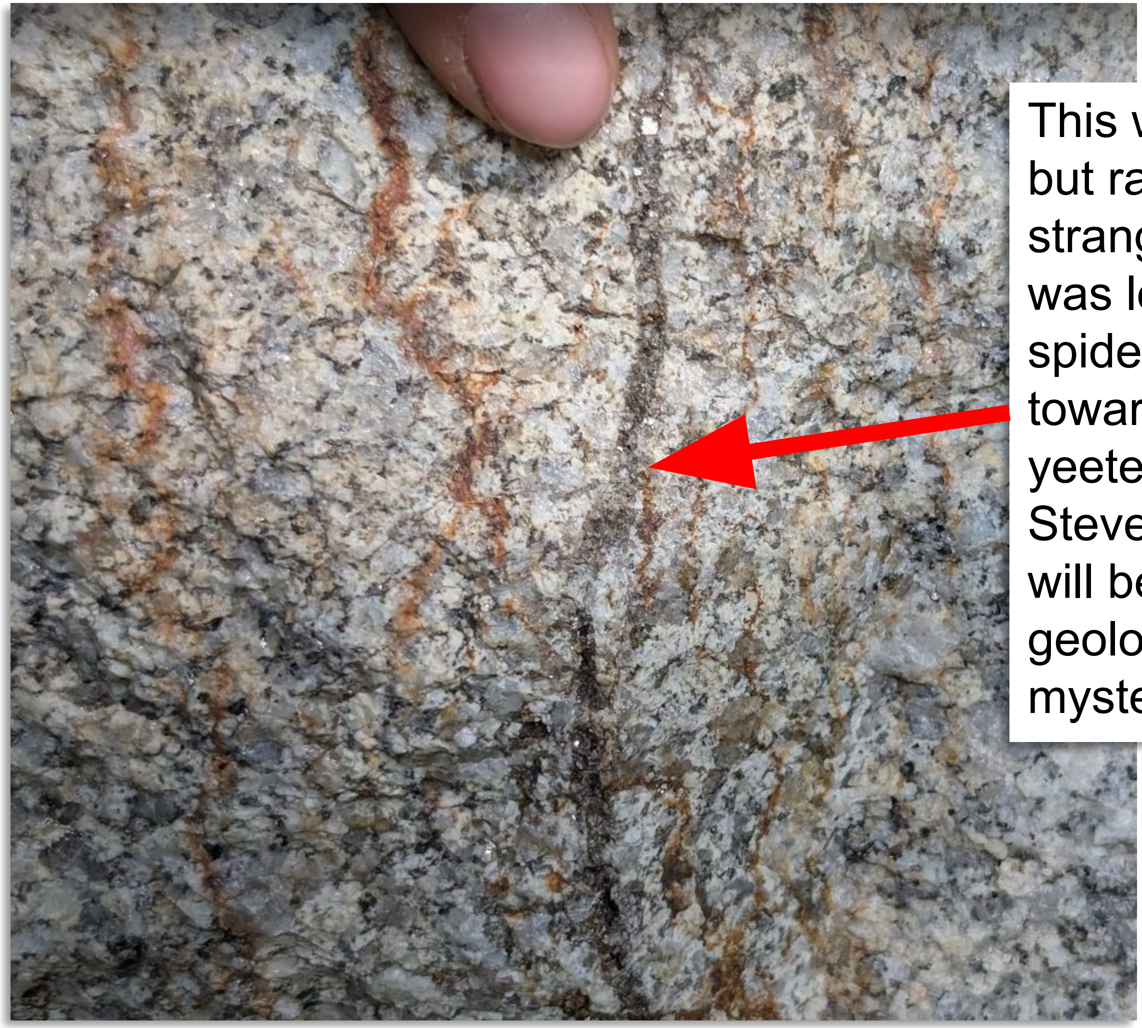


Little Giant Dump





Today Steve and I are going to the contact between the Idaho batholith and the PreCambrian gneisses to look for impact breccia/shocked quartz/shatter cones …
BUT I think it's probably a weird porphyry system



This wasn't a sulfide vein, but rather something stranger. However, while I was looking at it, a giant spider crawled off of it towards my face and I yeeted it into the forest. Steve heard me scream. It will be up to a future geologist to solve the mystery.

Next Steps

Do what Steve says!

- Geophysics survey to identify drilling targets
- Drilling program

UAF Msci Project

- 250k total budget
  - Includes all data + 2 months of my salary over 2 years to supervise
- 35k proposal to EDMAP
- 215k NSF research proposal