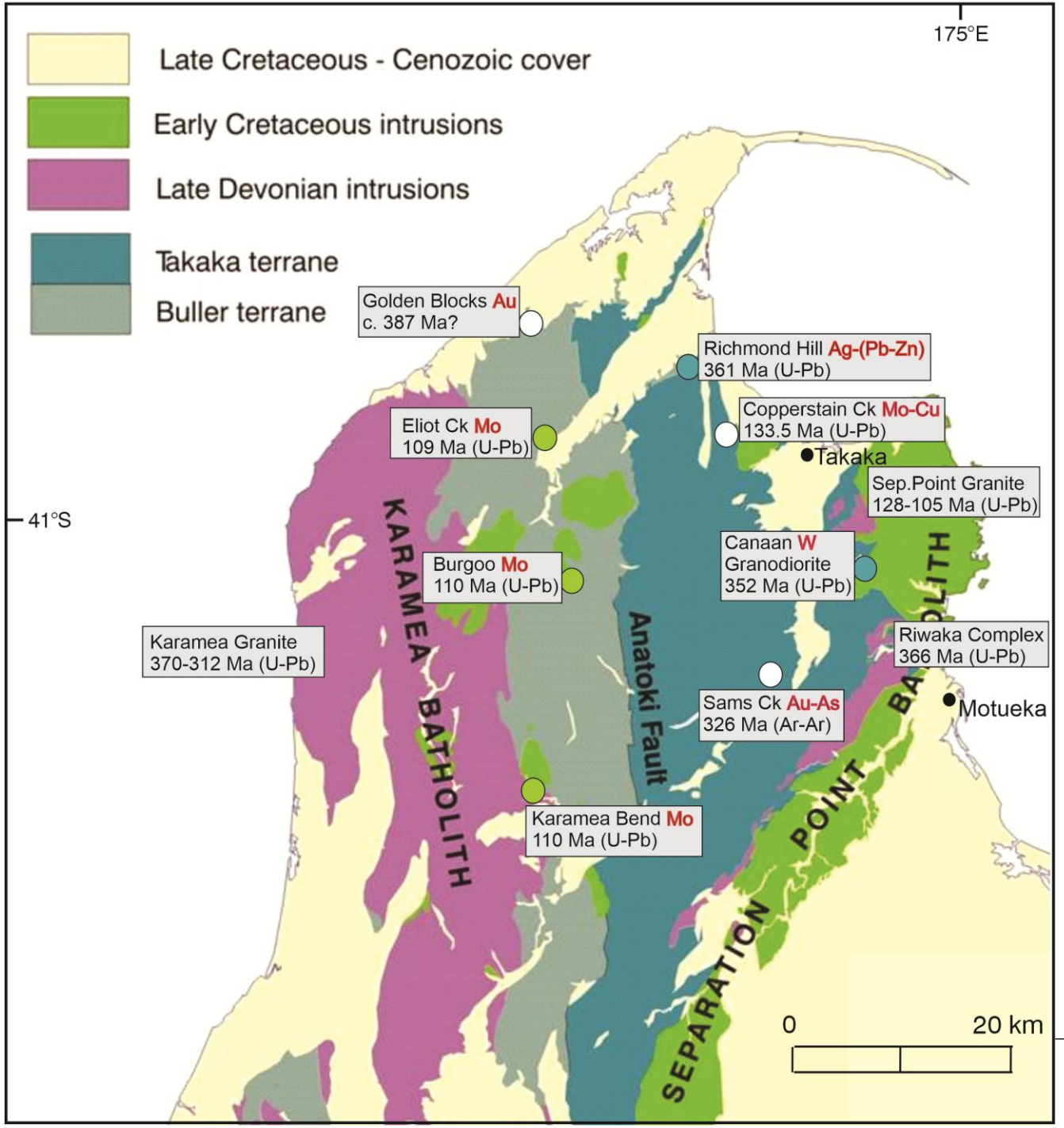
Sams Creek gold deposit: an intermediate-sulfidation epithermal gold system, hosted by a peralkaline granite dike, West Nelson

Bob Brathwaite[1], Kevin Faure[1], Paul Angus[2], Mathew Sagar[1]

[1]Earth Sciences New Zealand, Lower Hutt, New Zealand

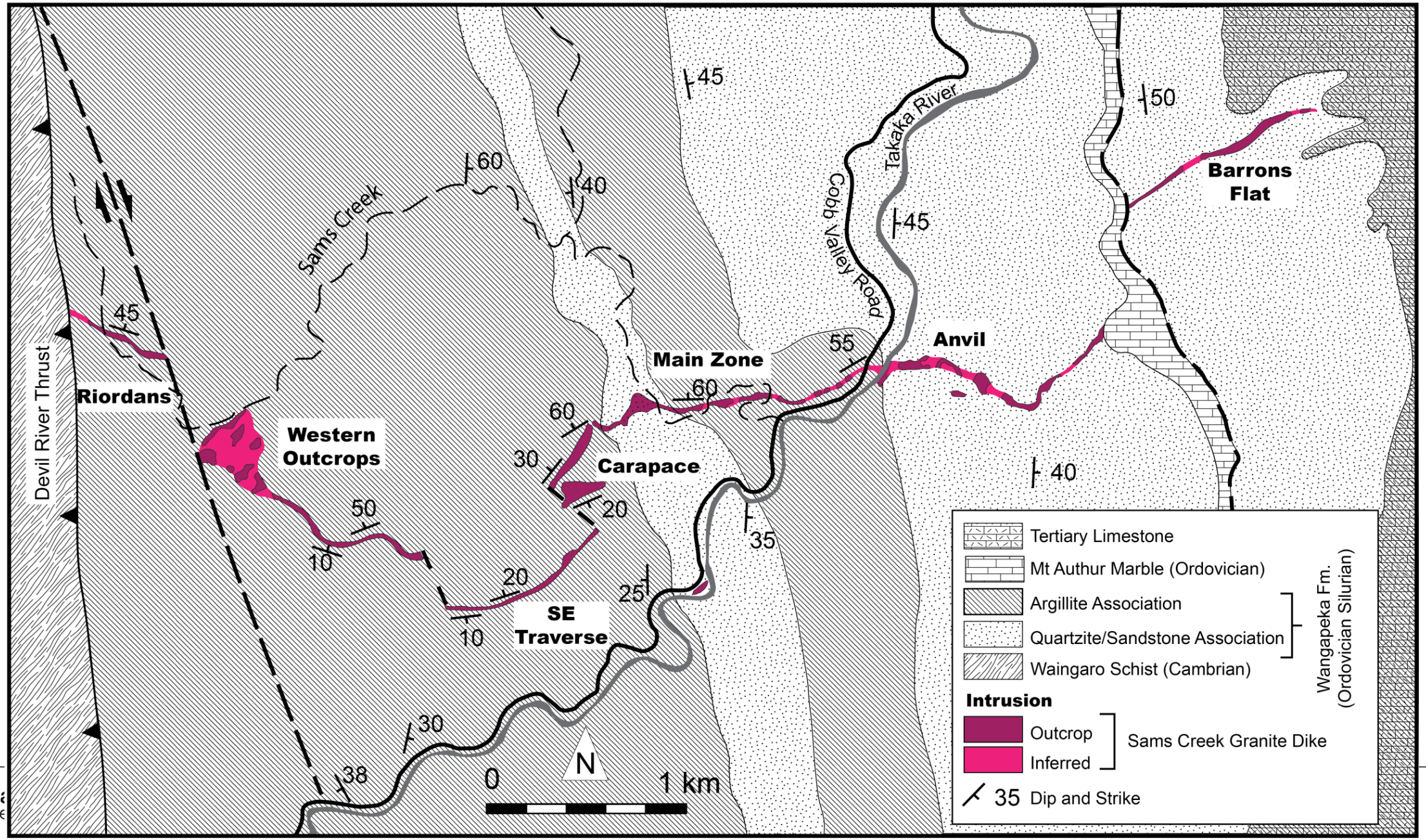
[2]Siren Gold, Dunedin, New Zealand

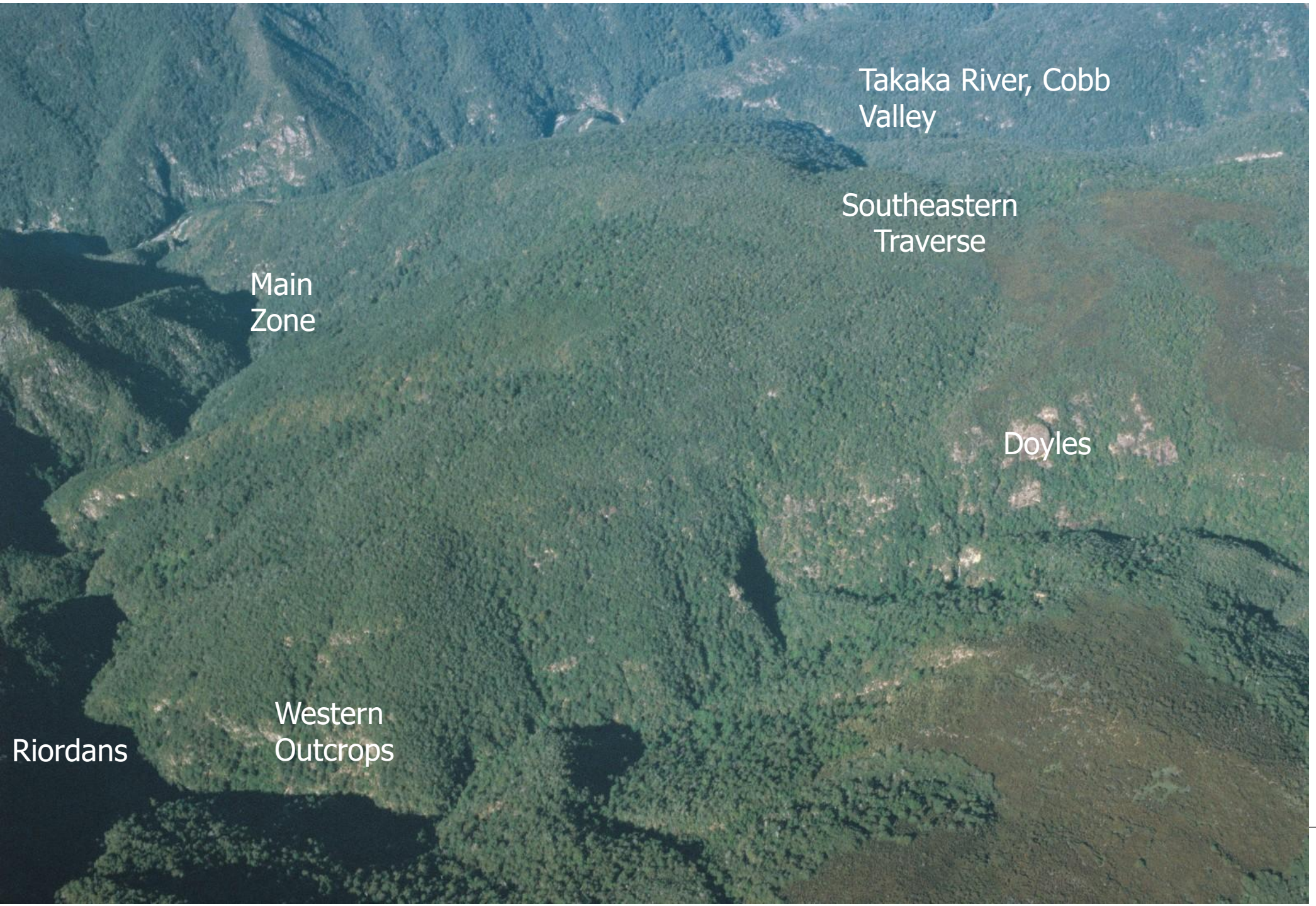
Earth Sciences New Zealand



- Sams Creek granite and associated Au-sulfide mineralisation lie in Lower Paleozoic rocks of the Takaka terrane
- Takaka and Lower Paleozoic Buller terranes intruded by granitoid rocks of the Devonian-Carboniferous Karamea and Foulwind suites, and of the early Cretaceous Separation Point Suite
- Small plutons of Separation Point Suite host porphyry style molybdenum mineralisation

Sams Creek peralkaline granite dike

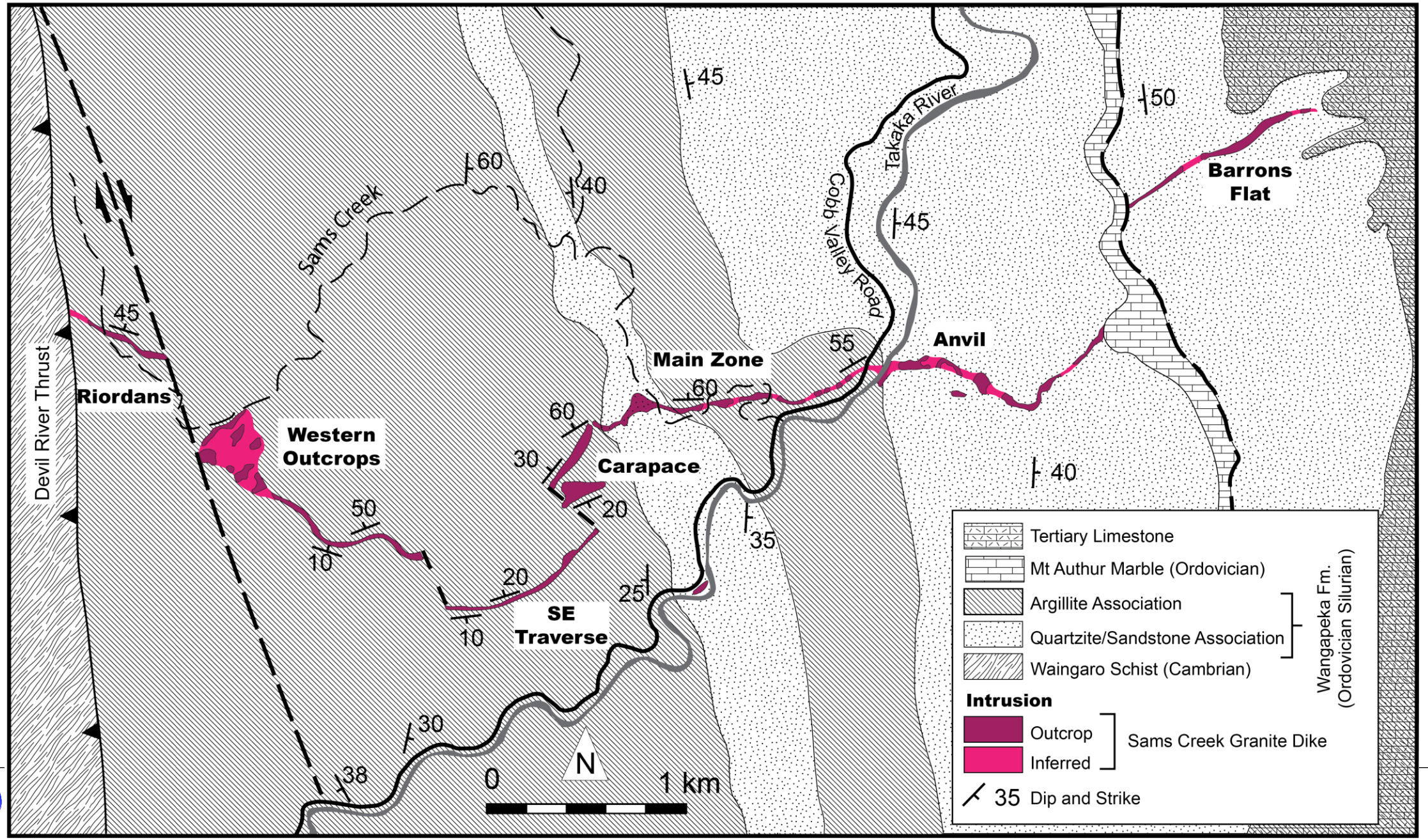


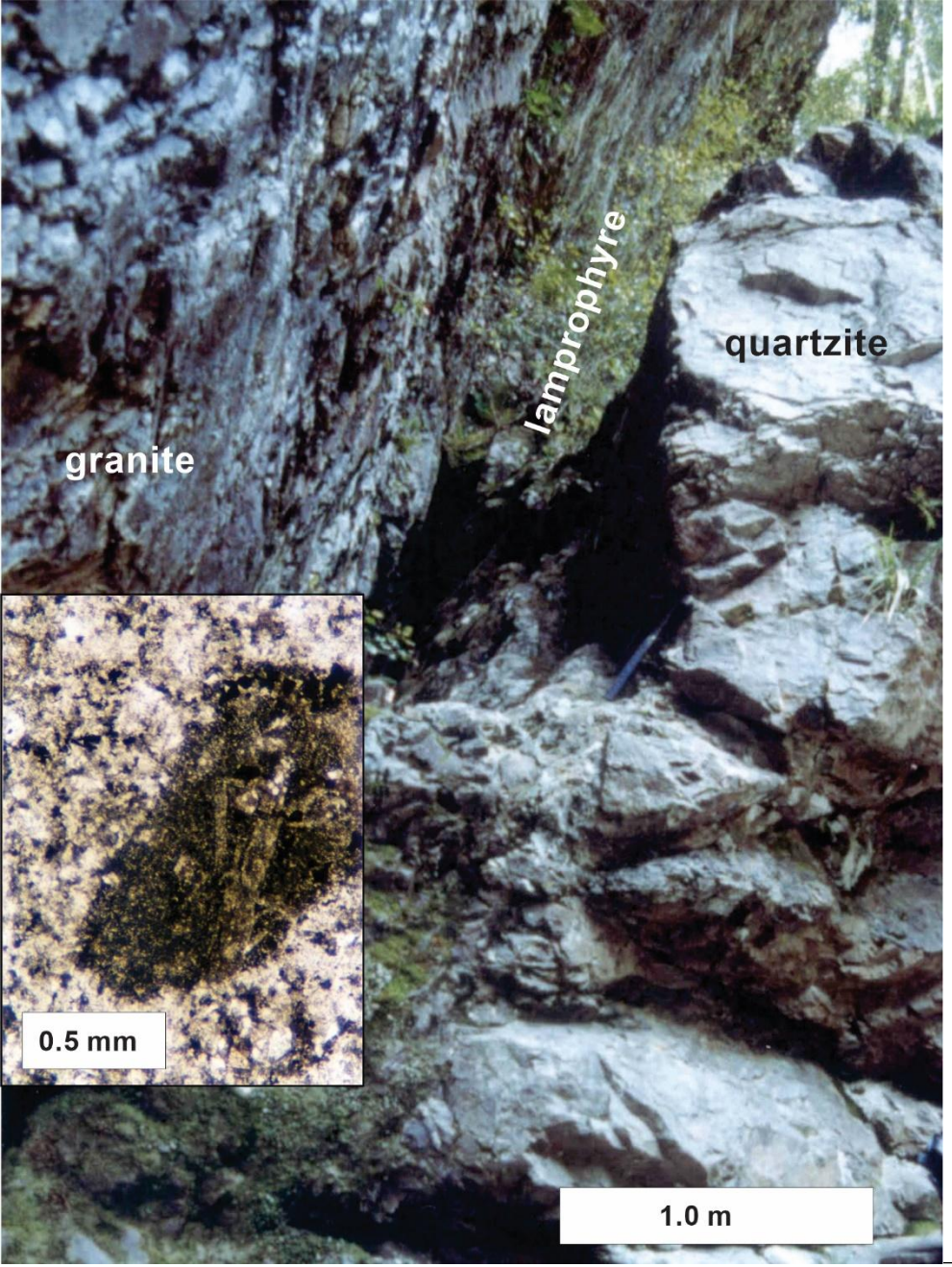

Takaka River, Cobb Valley
Southeastern Traverse
Main Zone
Doyles
Western Outcrops
Riordans

Sams Creek peralkaline granite dike

- Peralkaline ($Na_2O + K_2O > Al_2O_3$), ferroan A-type granite intrudes Ordovician meta-argillites, quartzite and marble
- Thin alkaline lamprophyre (camptonite) dikes occur along contacts with metasediments
- Three phases of deformation: F_1 recumbent folding, F_2 inclined folds about sub-horizontal, N-S trending axes, and F_3 of localised NE to SE trending folds
- Granite dike deformed by F_2 and F_3
- Granite is enriched in LREE, Zr, Nb and U, with lesser enrichment in HREE, lacks primary magmatic zircon, reflecting suppressed zircon saturation in peralkaline melts

Sams Creek peralkaline granite dike





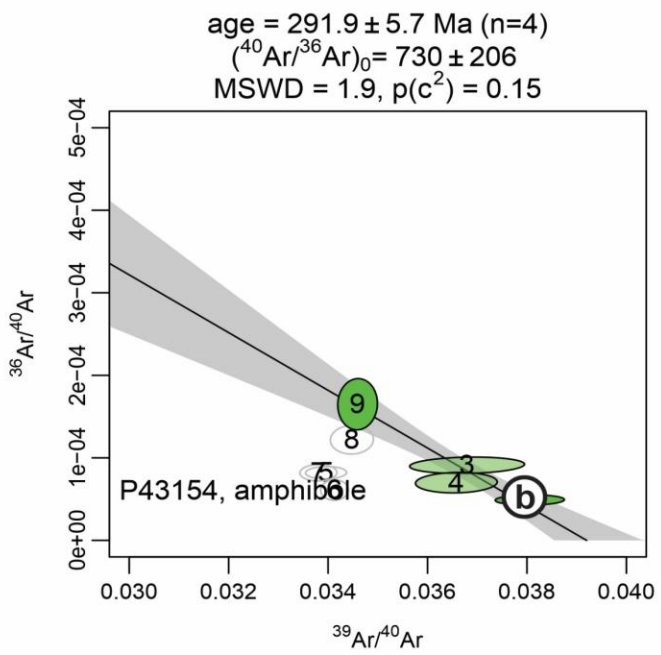
Sams Creek granite-lamprophyre-quartzite contact

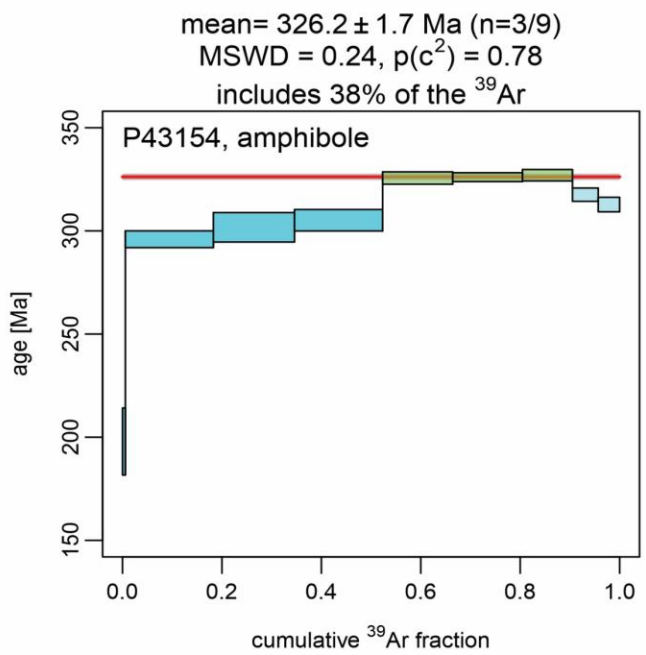
Inclusions of lamprophyre in granite show that the granite was intruded after the lamprophyre



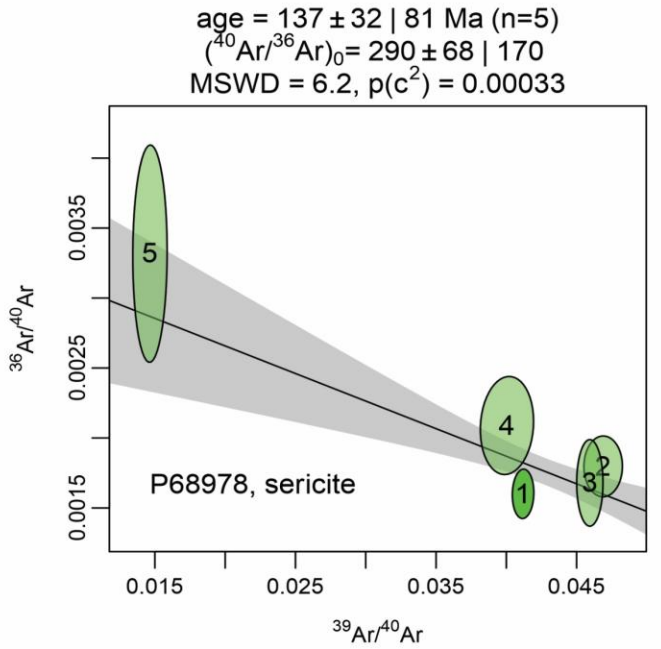
Least altered Sams Creek granite

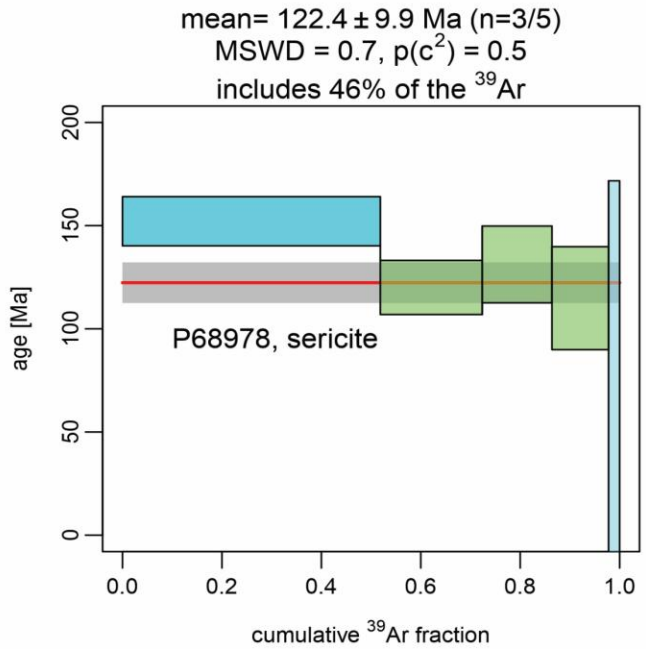
Ar-Ar Geochronology





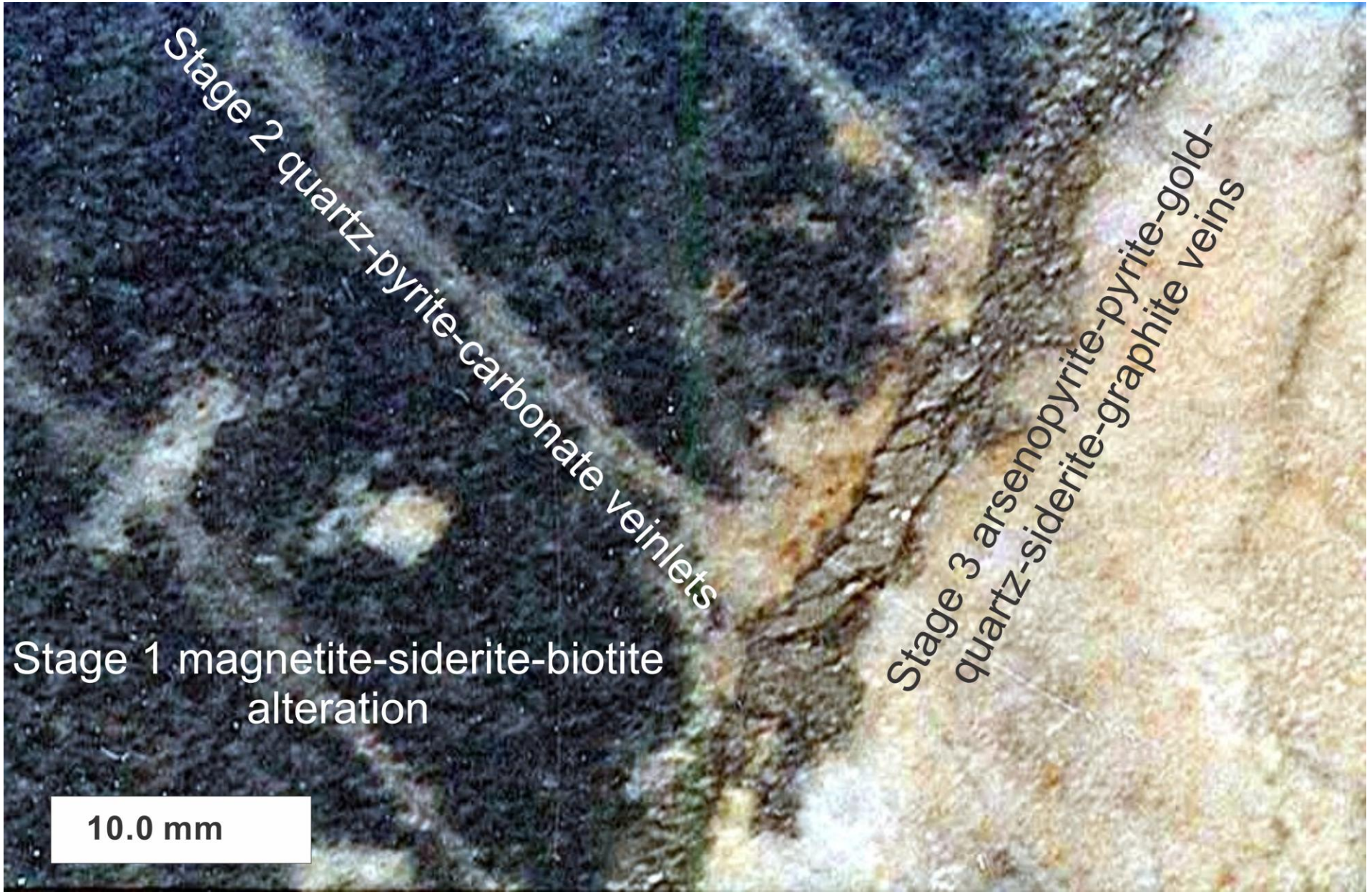
Amphibole from least-altered granite yields an age of 326.2 ± 1.7 Ma, i.e. Carboniferous and correlated with Foulwind Suite



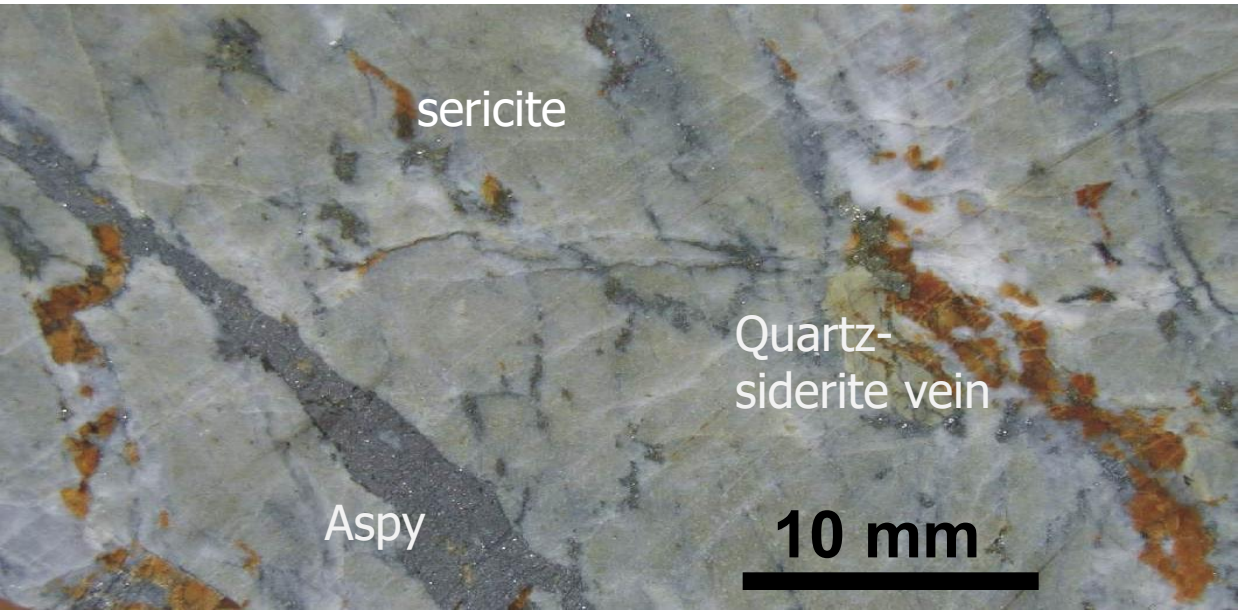


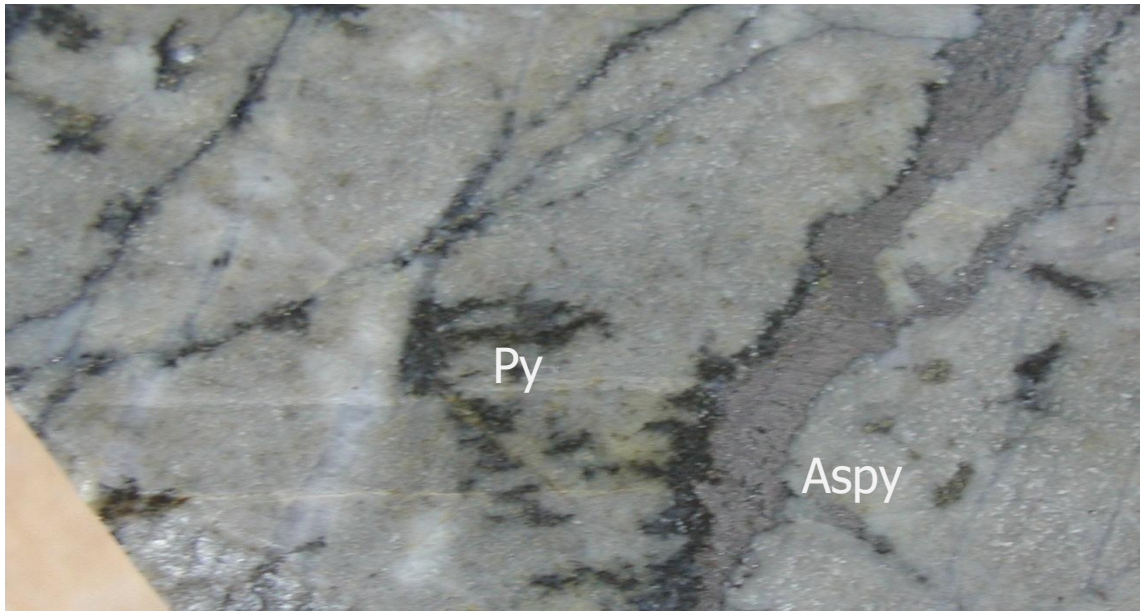
Sericite from Stage 3-4 alteration yields an age of 122.4 ± 9.9 Ma Consistent with U-Pb age of 114 ± 6 Ma from hydrothermal zircon (Phillips 2014), indicating Early Cretaceous mineralisation

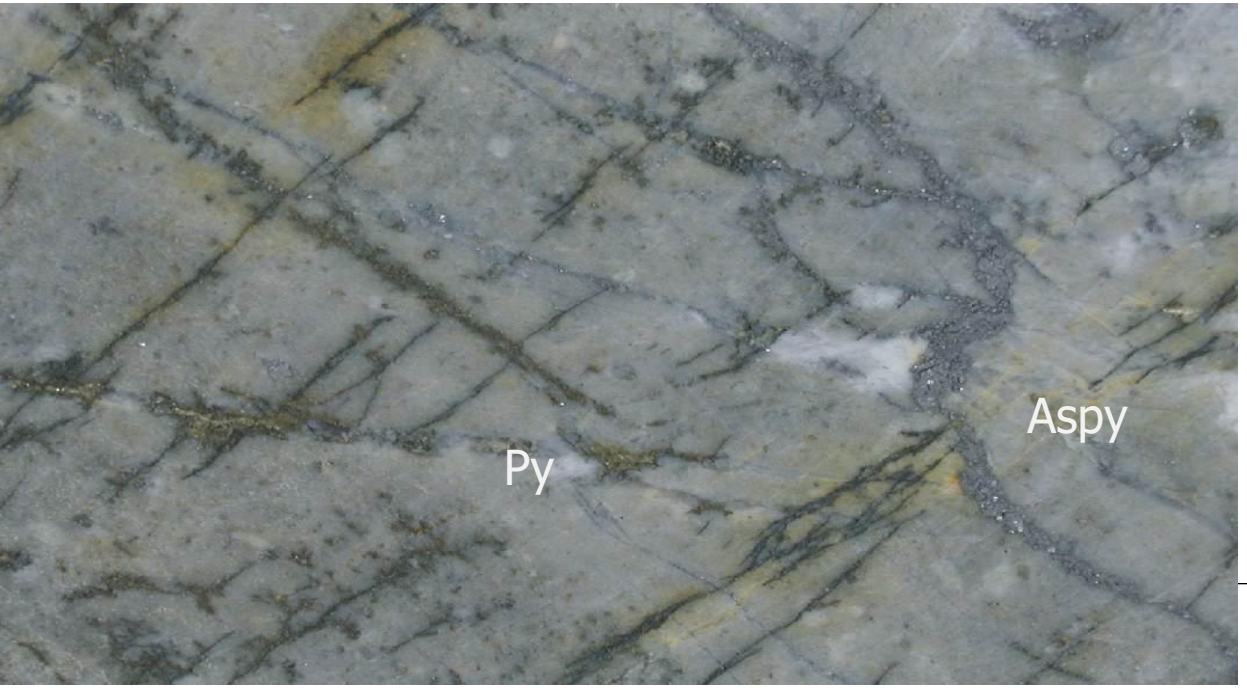
Stages of Alteration and mineralisation



Stages 3-4 Sulfide and quartz-siderite veins in silicified sericitized granite





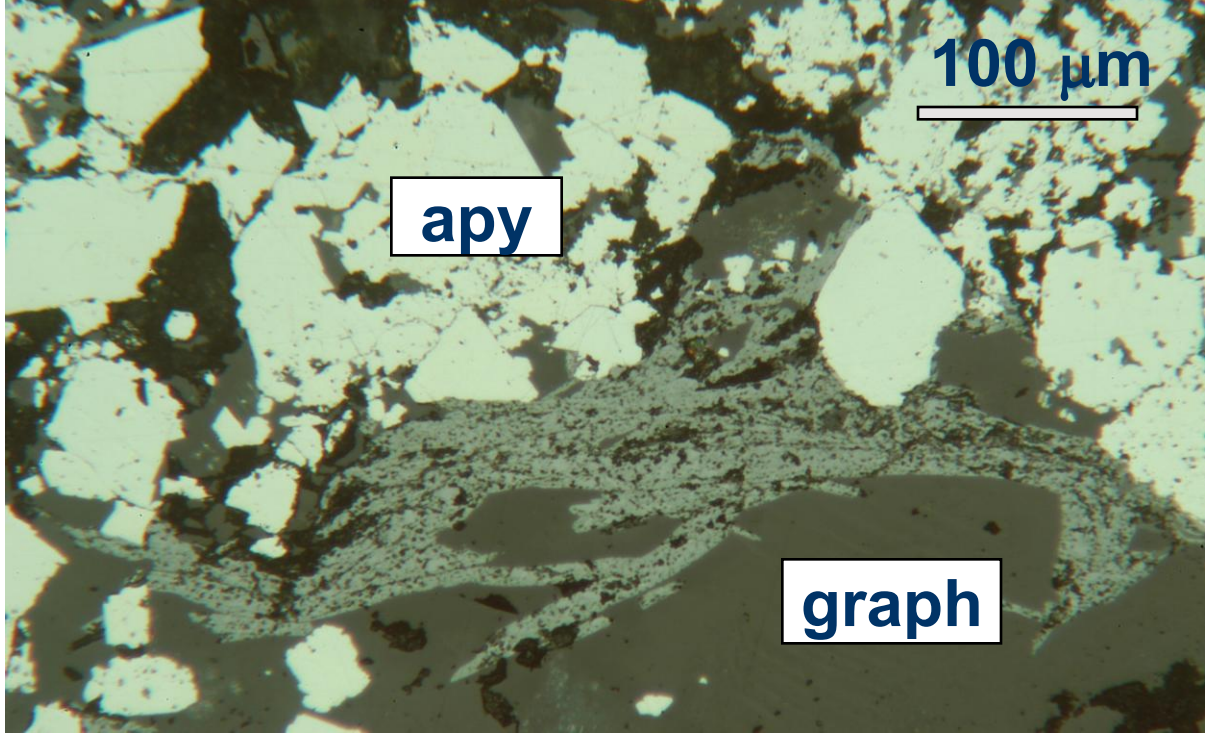


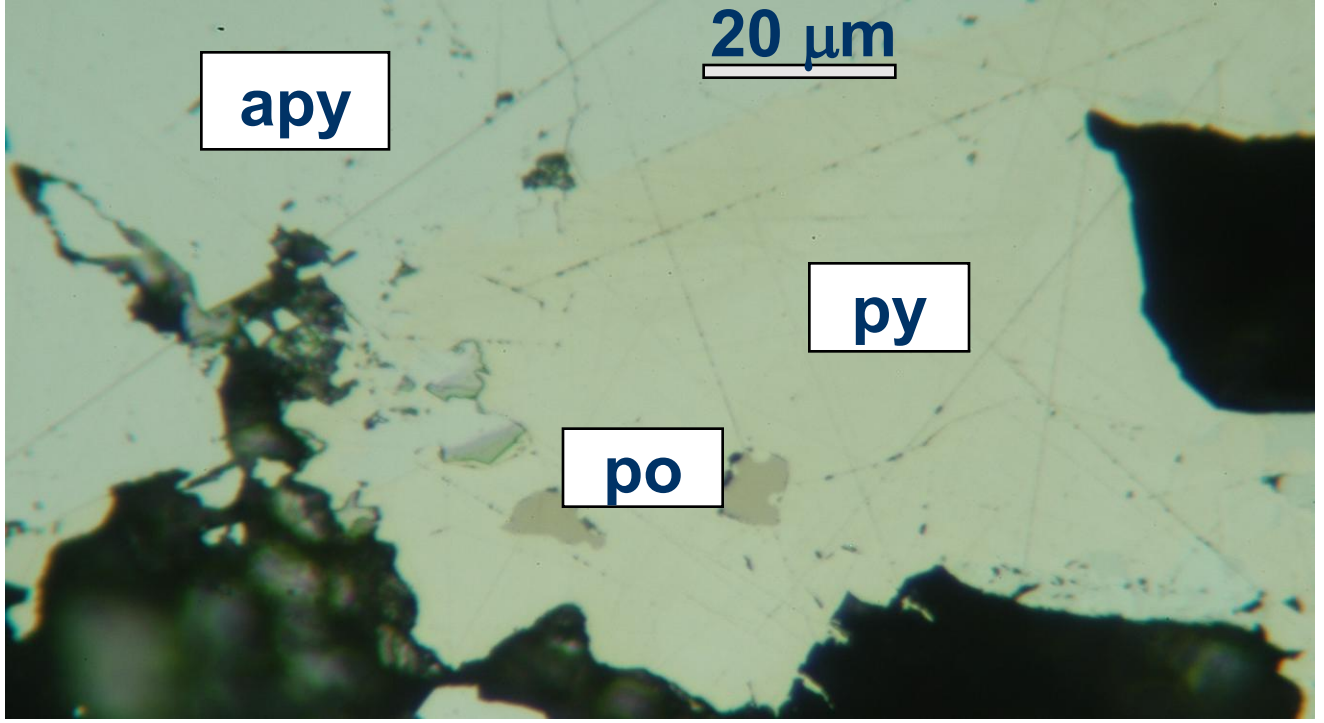


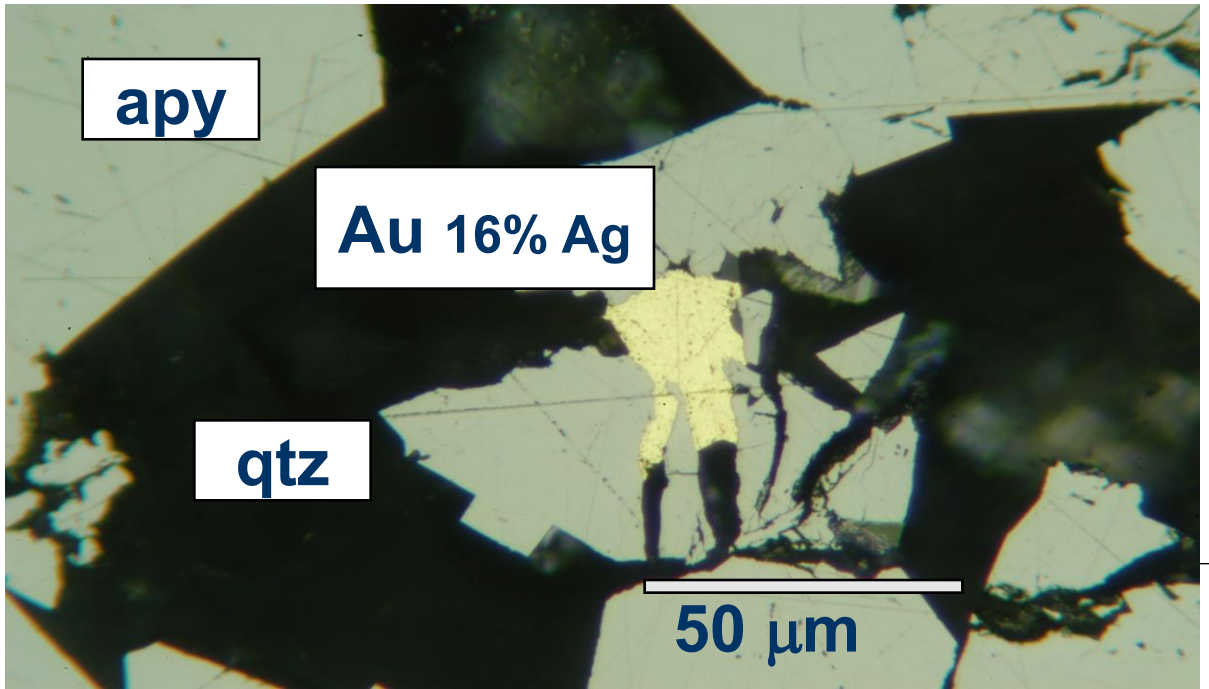
Characteristics of the Mineralisation

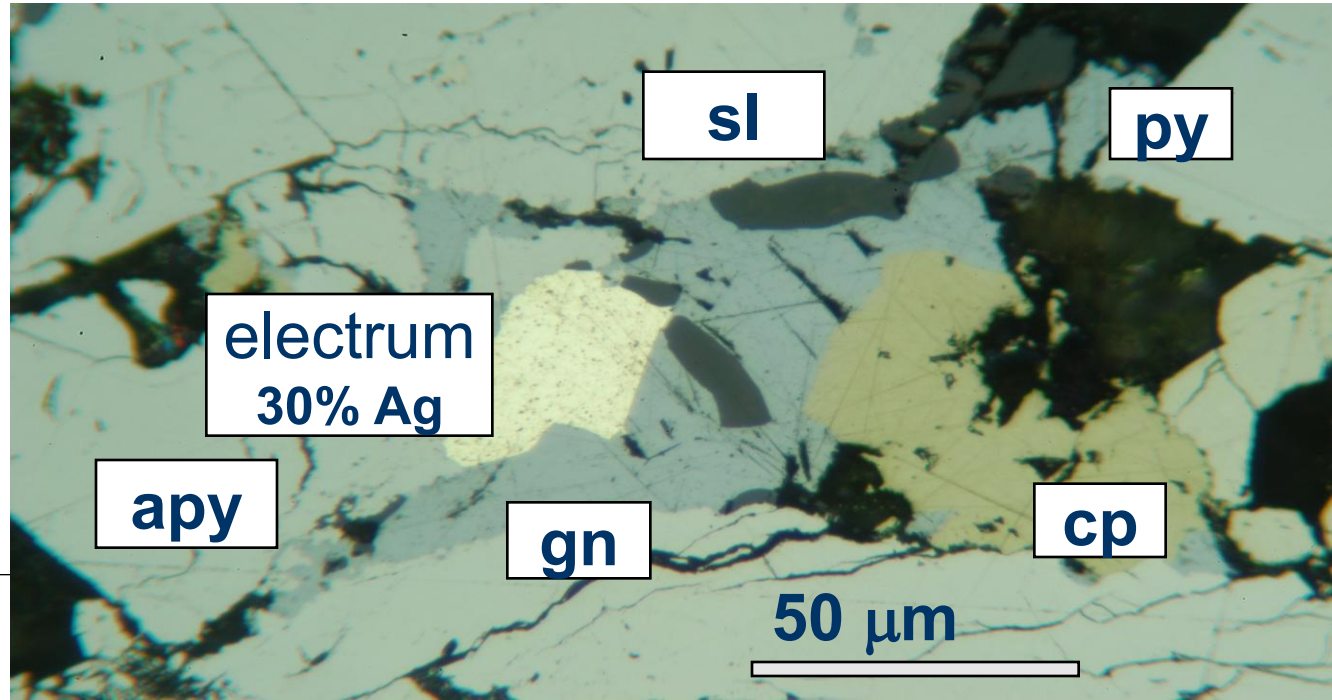
- Four stages of mineralisation/alteration
  - Stage 1 magnetite-siderite-biotite±chalcopyrite – porphyry copper style
  - Stage 2 quartz-pyrite-carbonate
  - Stage 3 arsenopyrite-pyrite-gold-quartz-siderite ± graphite veins
  - Stage 4 gold/electrum bearing arsenopyrite-pyrite-quartz-galena-chalcopyrite-sphalerite veins
- Aqueous fluid inclusions with 1.4 to 8.6 wt% NaCl equiv., and $\delta^{34}S$ values of +5 to +10‰ of sulfide minerals support a magmatic hydrothermal fluid component
- These characteristics are indicative of an intermediate sulfidation, epithermal-style magmatic-hydrothermal system

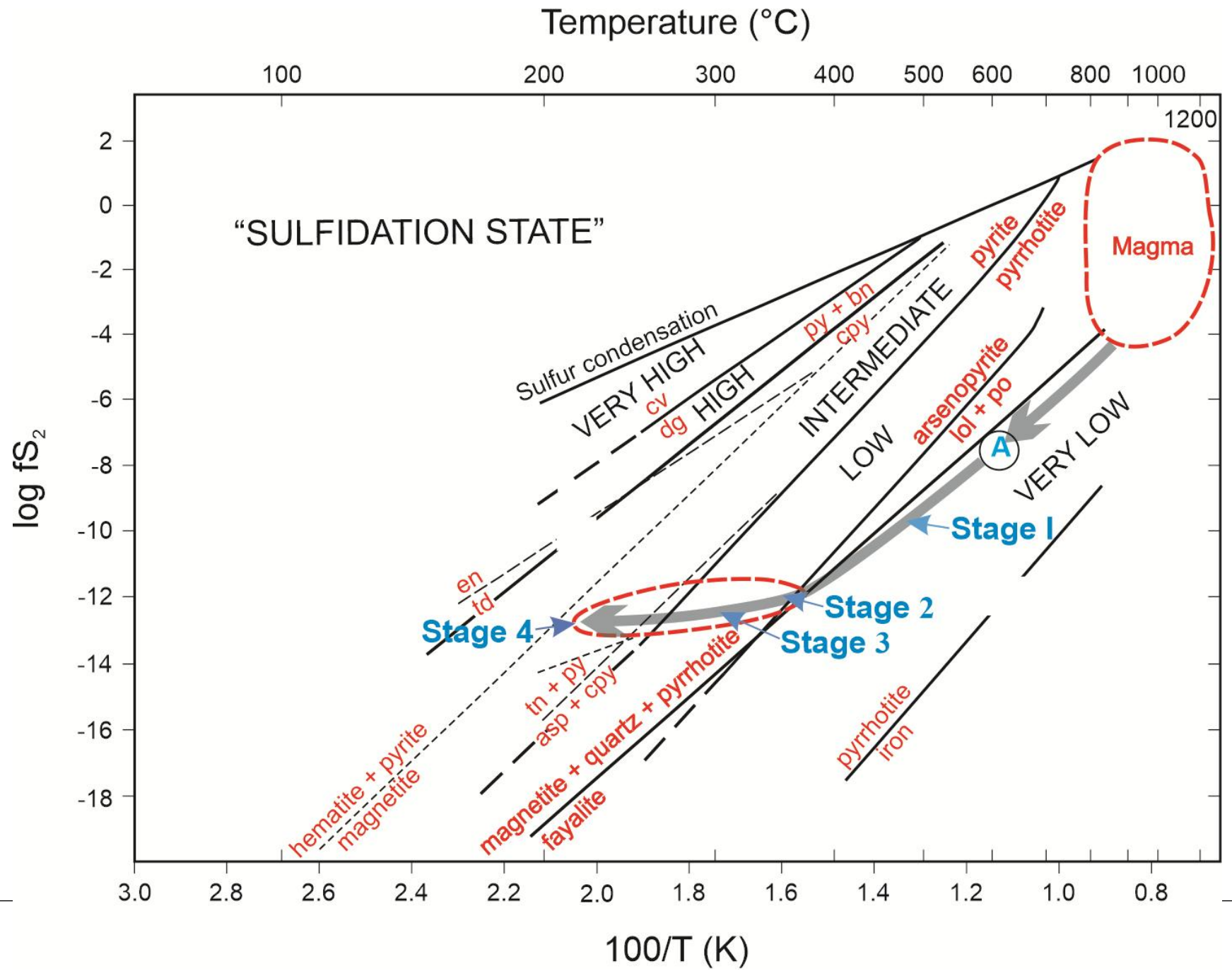
- At Porgera (Papua New Guinea) early magnetite-sulfide-carbonate veins are comparable to Stage 1, and stage II base metal-sulfide-carbonate ± quartz ± gold/electrum veins are comparable to Stage 4


100 µm
apy
graph


20 µm
apy
py
po


apy
Au 16% Ag
qtz
50 µm

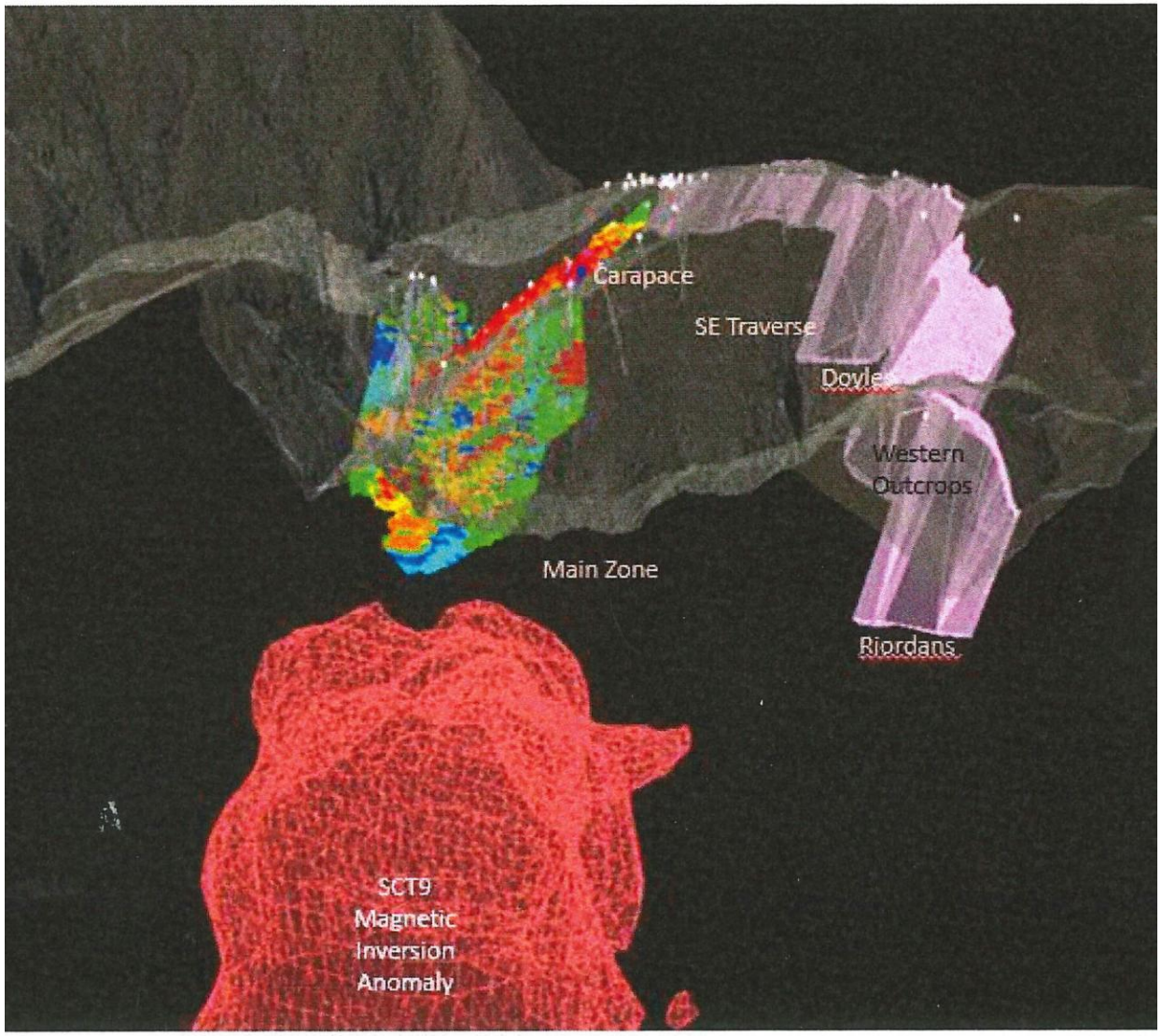

sl
py
electrum
30% Ag
apy
gn
cp
50 µm


Temperature (°C)
100
200
300
400
500
600
800
1000
1200
"SULFIDATION STATE"
Sulfur condensation
VERY HIGH
cv
dg
HIGH
py + bn
cpy
INTERMEDIATE
LOW
pyrite
pyrrhotite
Magma
arsenopyrite
lol + po
A
VERY LOW
Stage I
Stage 2
Stage 3
Stage 4
en
td
tn + py
asp + cpy
magnetite + quartz + pyrrhotite
fayalite
hematite + pyrite
magnetite
pyrrhotite
iron
log fS2
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
100/T (K)

Summary

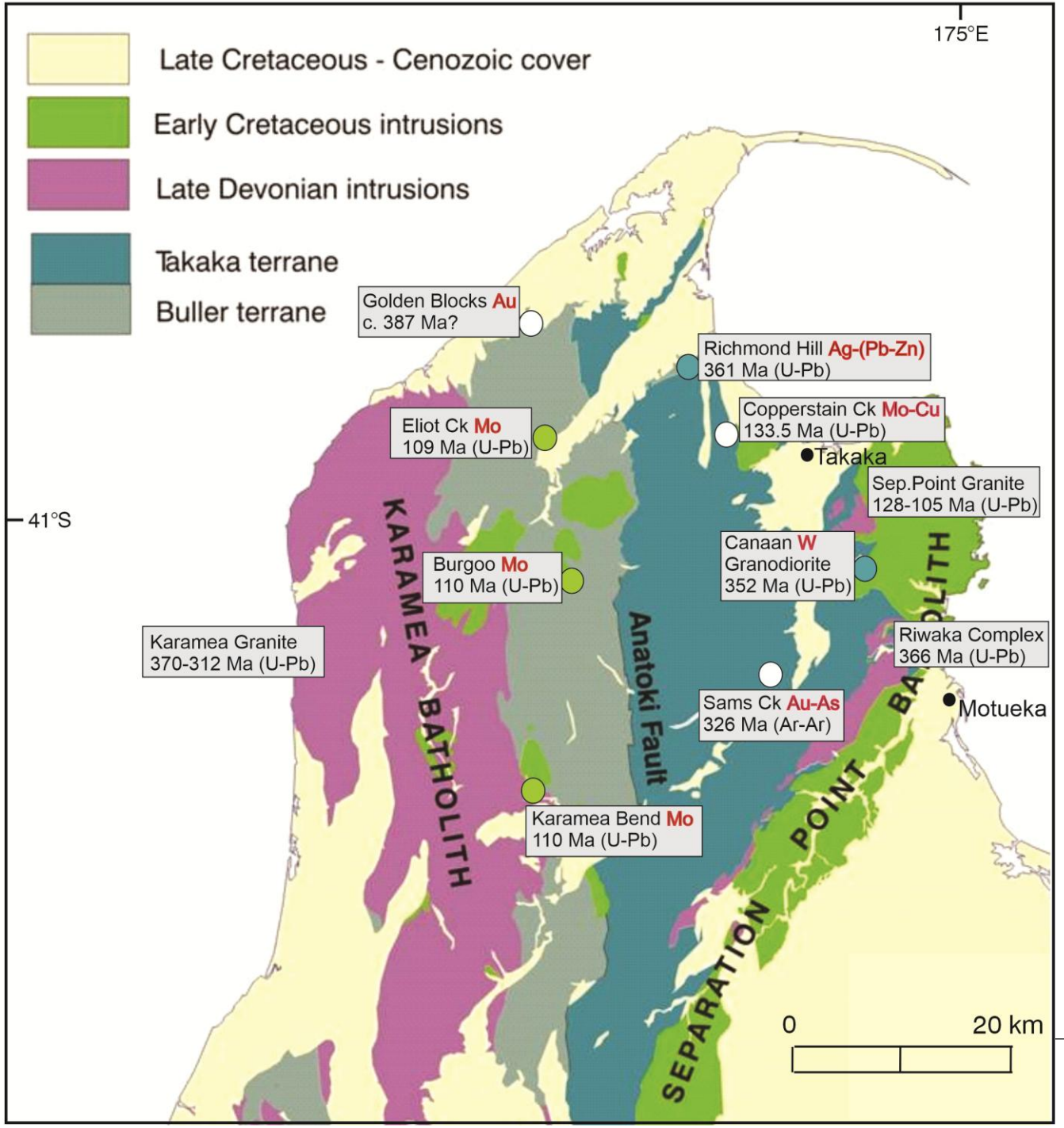
- Sams Creek deposit does not fit within classifications of orogenic or reduced intrusion-related gold deposits
- Instead, it shows features that are more typical of intermediate-sulfidation epithermal systems (Wang et al. 2019), comparable to the carbonate-base metal-gold style of porphyry-related low-sulfidation gold systems of Corbett and Leach (1998)
- The alteration assemblages, sulfide mineralogy, and geochemical associations are compatible with formation in an intermediate-sulfidation environment, although the relative abundance of arsenopyrite and its spatial association with a peralkaline granite host is unusual
- The combined geological, geochemical, and geochronological data support a model in which a Cretaceous hydrothermal system overprinted an older Carboniferous peralkaline granite intrusion

Exploration implications I



3D model image from Siren Gold (ASX February 2025)

- Sams Creek mineralised dike found in early 1980s following 1974 discovery of Au-anomalous boulders. Exploration by CRA, followed by OceanaGold, MOD Resources and Siren Gold
- Resource estimate of indicated and inferred resource of 824,000 oz Au at 2.8 g/t Au, using a 1.0 g/t Au cut-off (Siren Gold, ASX 30 January 2023)
- Association with ferroan peralkaline granite is due to an Fe-rich host rock which reacts with hydrothermal fluids and traps mineralisation
- A magnetic anomaly below Main Zone interpreted as a hidden pluton and potential source of hydrothermal fluids



Exploration implications II

- Early Cretaceous age of alteration is plausibly linked to 128-105 Ma Separation Point Suite magmatism, which has high Sr/Y values of >35, a recognised geochemical indicator of porphyry copper fertility Loucks (2014)
- Potential for similar deposits in the region linked to hidden Separation Suite plutons
- Small plutons of Sep. Point Suite host porphyry style, low grade (<0.1% Mo) molybdenum mineralisation