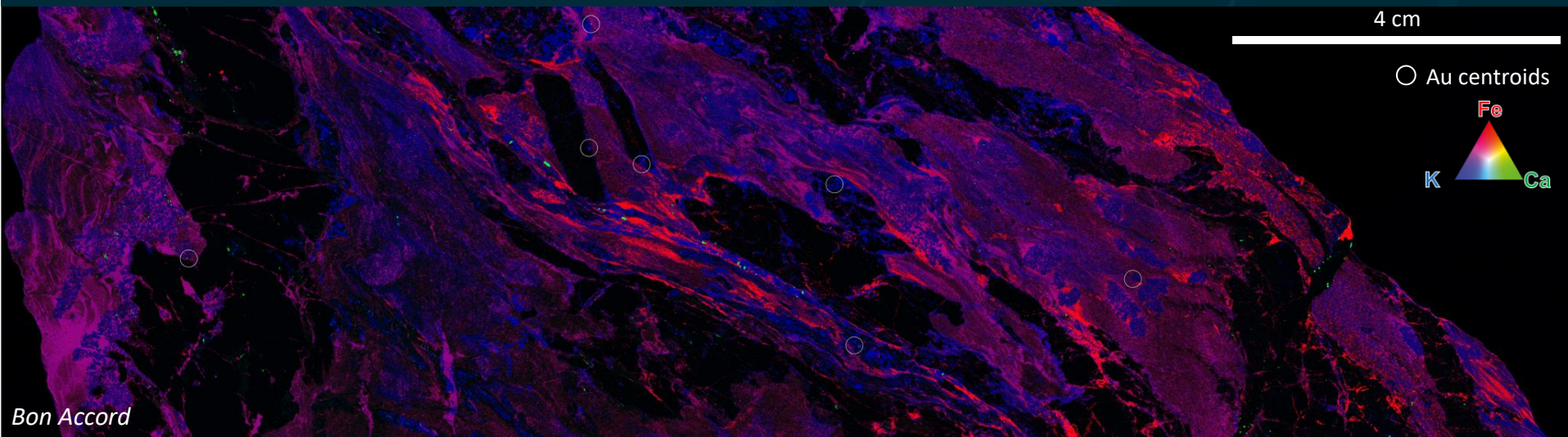


Intrusion Related Gold vs Orogenic Gold – NE Victoria



Bon Accord

Coralie Siégel, Fariba Kohan Pour, Helen McFarlane, Cameron Cairns and Ross Cayley

With contributions from Zsanett Pinter, Michael Verrall, Jacob Walmsley, Colin McRae and James Lewis

MinEx CRC - Project 7.1



OUR SPONSORS

Majors, METS and Survey Participants



Geological Survey of
Western Australia



Government of South Australia
Department for
Energy and Mining



Australian Government
Geoscience Australia

Australian Government
Department of Industry,
Science and Resources

Cooperative Research
Centres Program

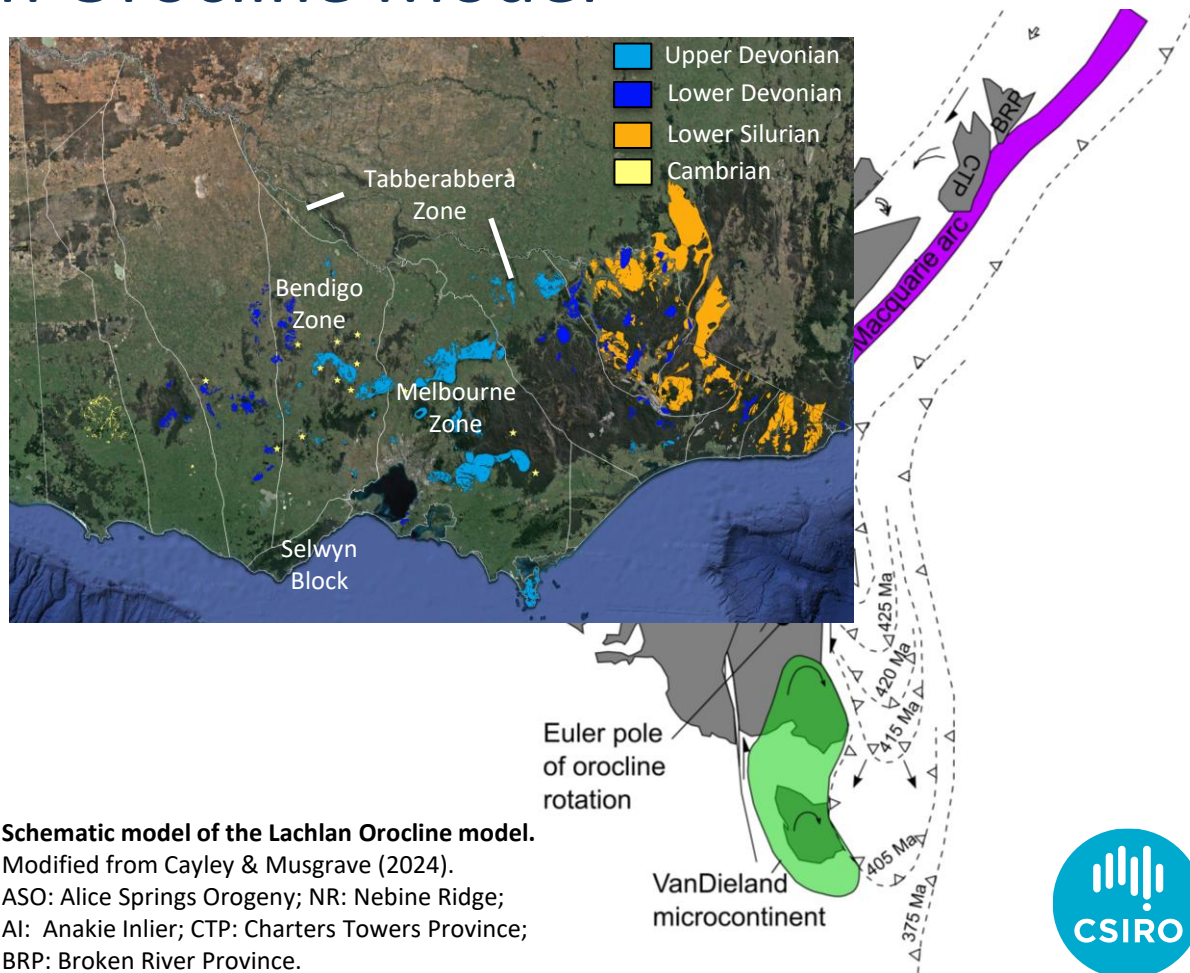
OUR SPONSORS

Research Participants and Affiliates

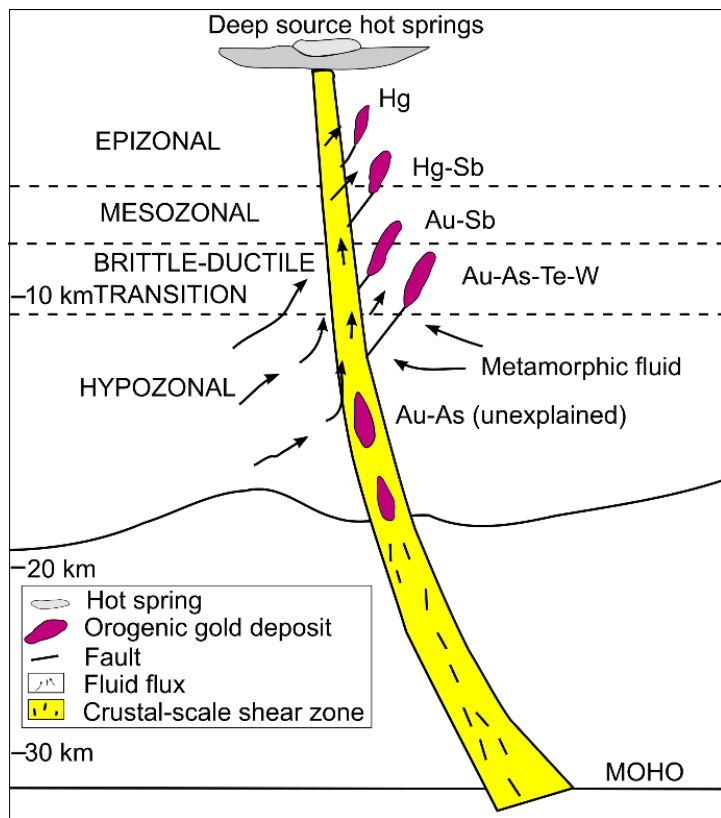


Lachlan Orocline Model

- Lachlan Orocline model of Cayley & Musgrave (2015) suggests the Tabberabbera Zone is a possible along-strike extension to the Bendigo Zone instigating a renewed interest for gold exploration in the northern Tabberabbera Zone
- Gold exploration historically focused on the Western Lachlan Orogen

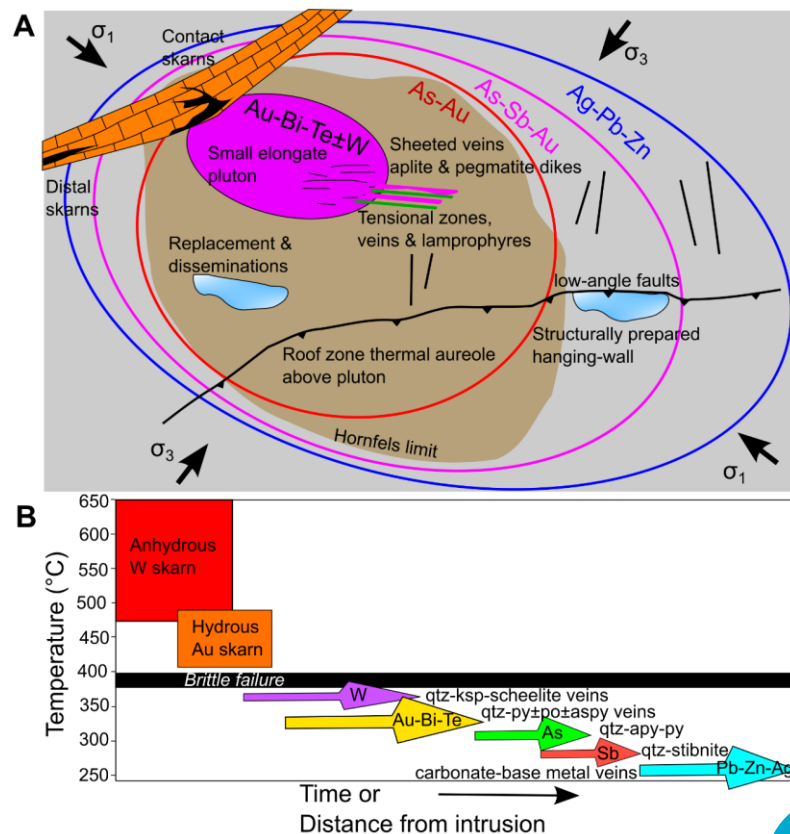


Orogenic gold



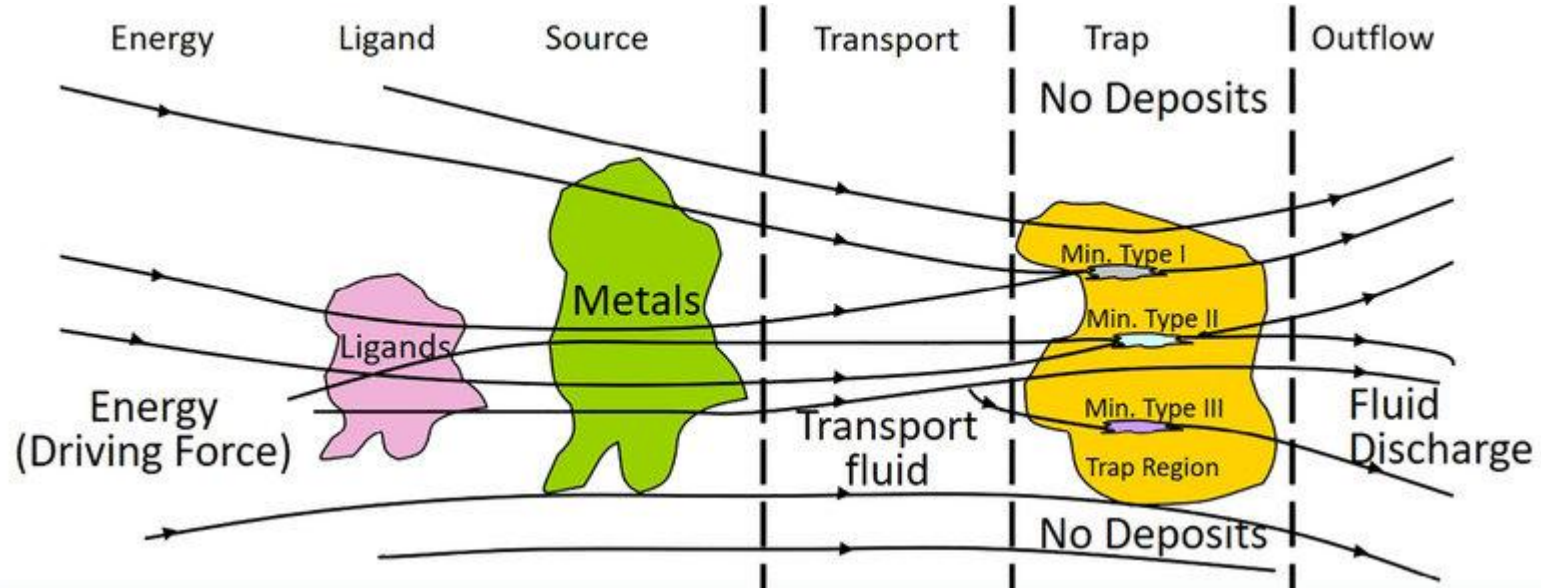
after Groves et al., 2020

Intrusion-related gold



after Hart, 2007

Mineral System



Knox-Robinson and Wyborn (1997)

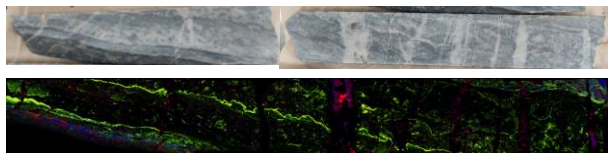
Analytical approach

Micro



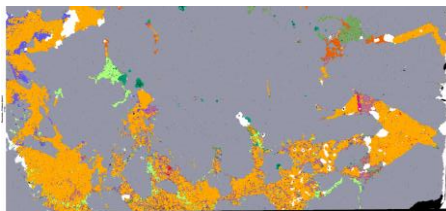
Micro XRF Maia mapper
1/2 meter cores

Compositional maps



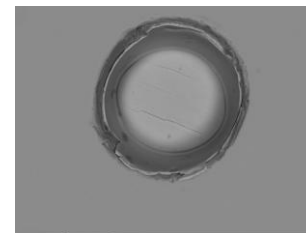
TIMA & SEM-EDS-CL
25mm polished rounds (PR)
Polished thin-sections (PTS)

Automated mineralogy, compositional maps,
cathodoluminescence



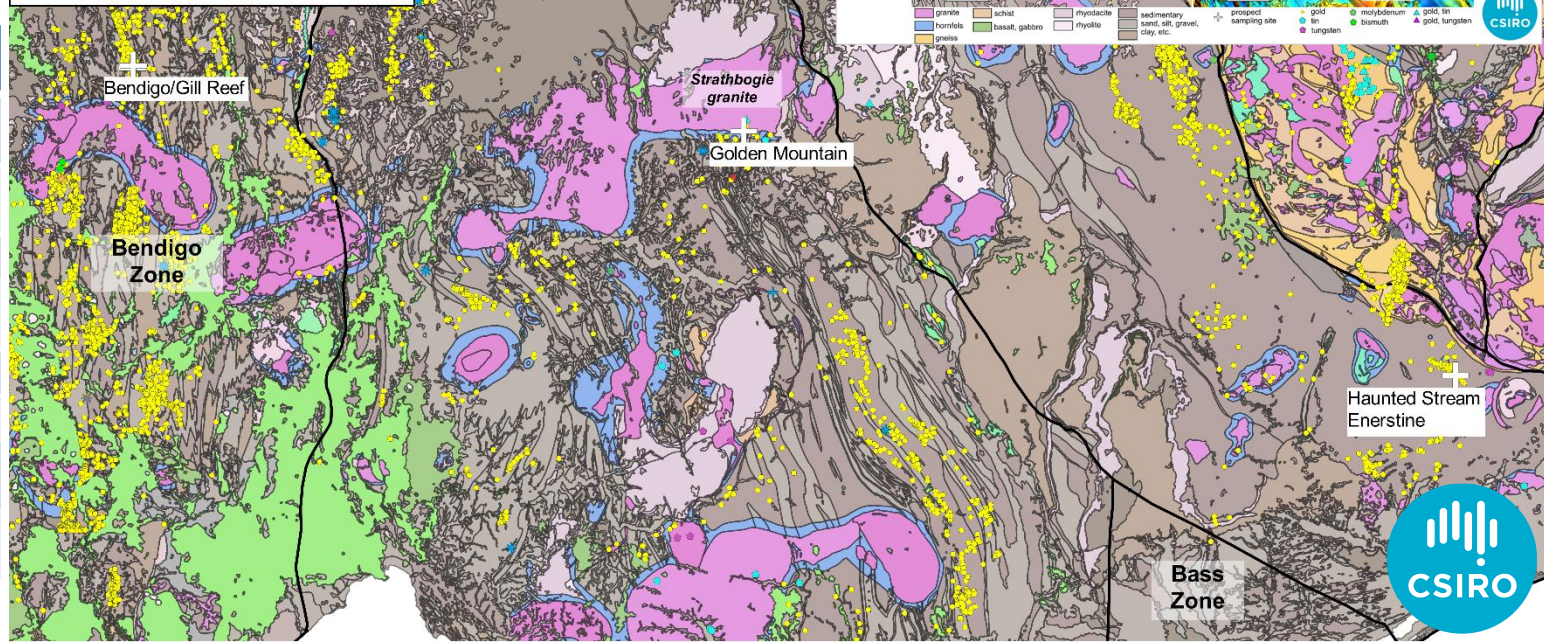
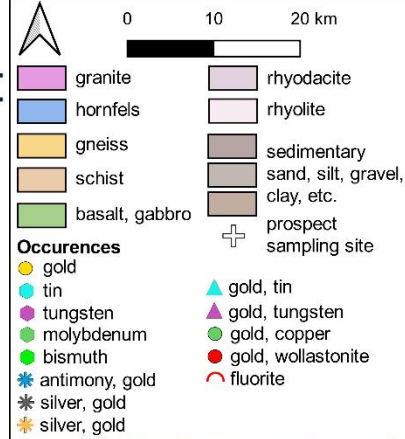
LA-ICP-MS
Minerals in PR and PTS

U-Pb dating of apatite



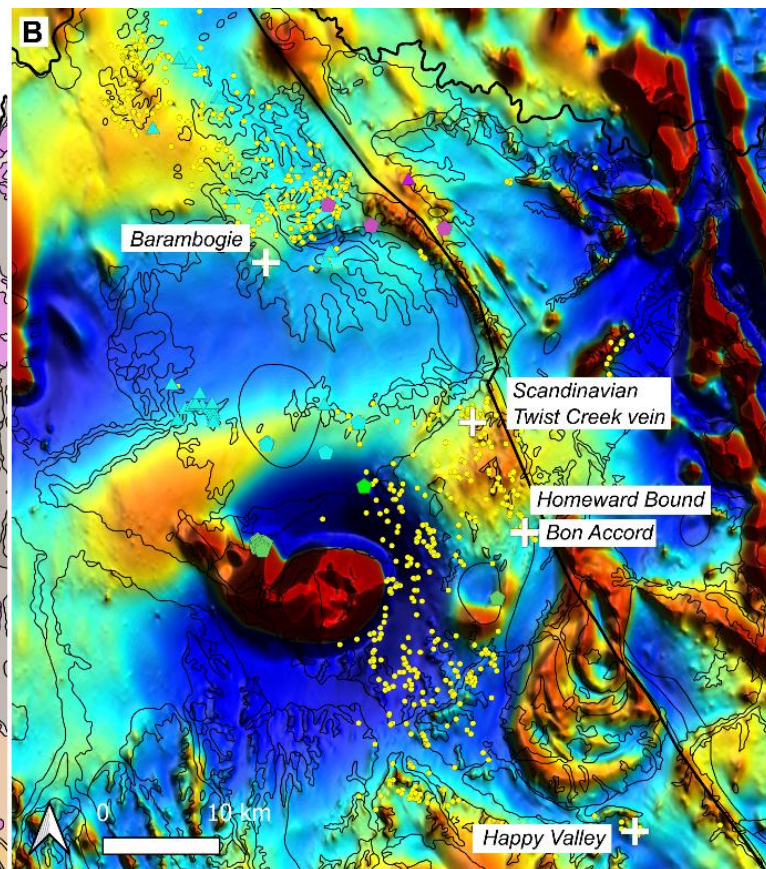
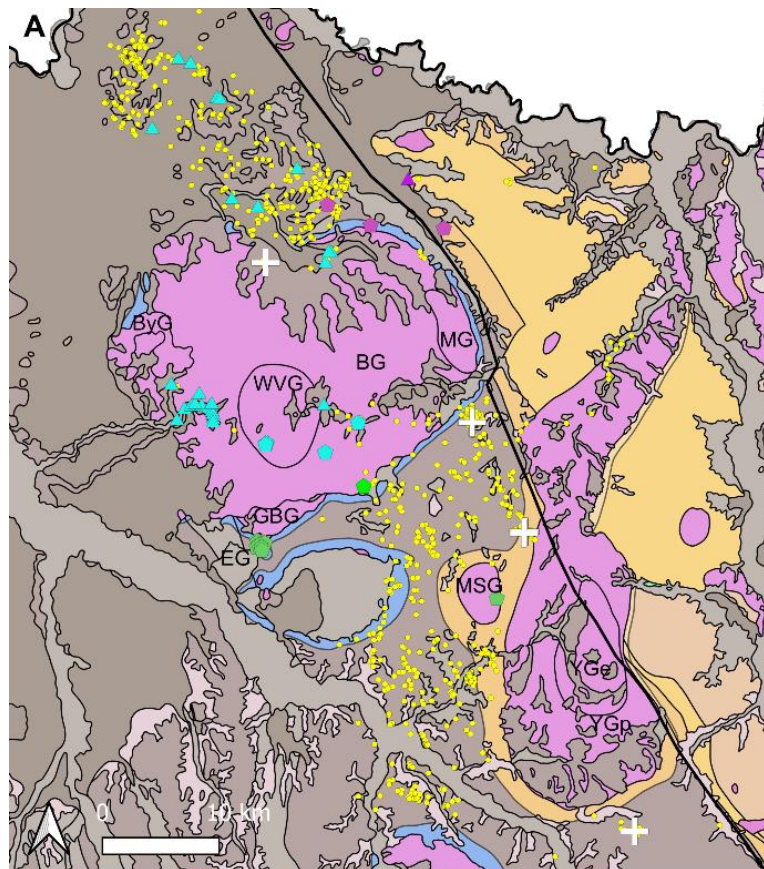
31 samples from 8 prospects/mines

Most samples are from the hornfels, metamorphosed Pinnak sandstone

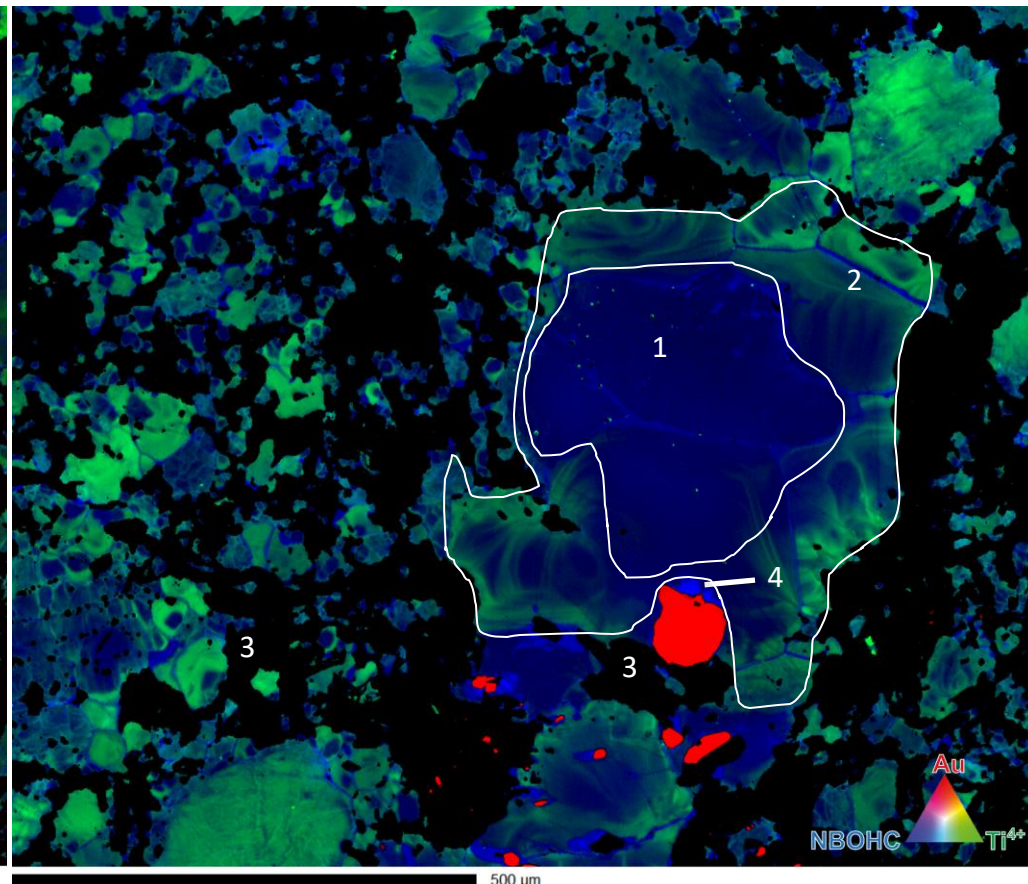
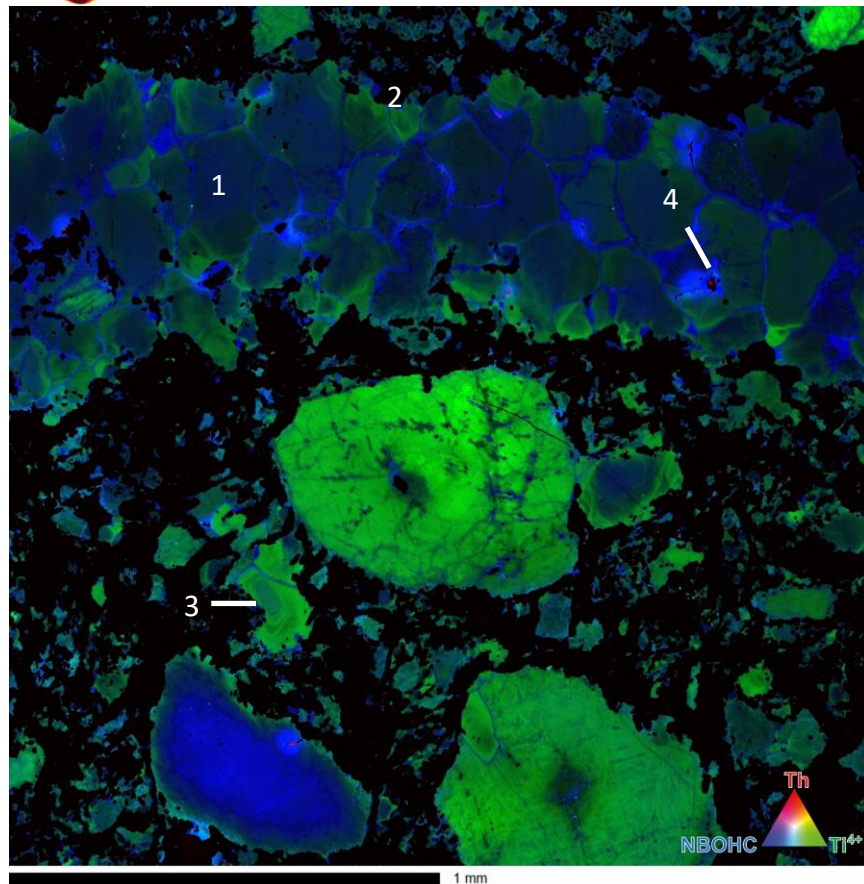


Prospect name	Nearby granite	N
Golden Mountain	Strathbogie	3
Homeward Bound	Yackandandah	2
Bon Accord		1
Happy Valley	Beechworth	5
Twist Creek		2
Barambogio	Orogenic gold	5
Bendigo/Gill Reef		9
Haunted Stream	Dead Bird Suite	4

Prospects near Beechworth & Yackanhandah granites

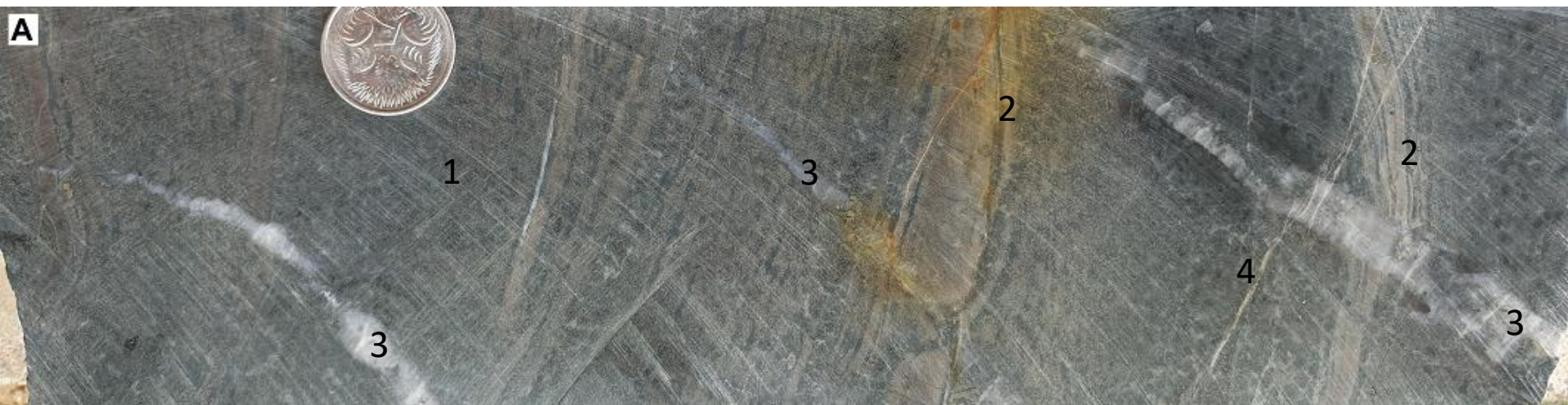


Barambogie

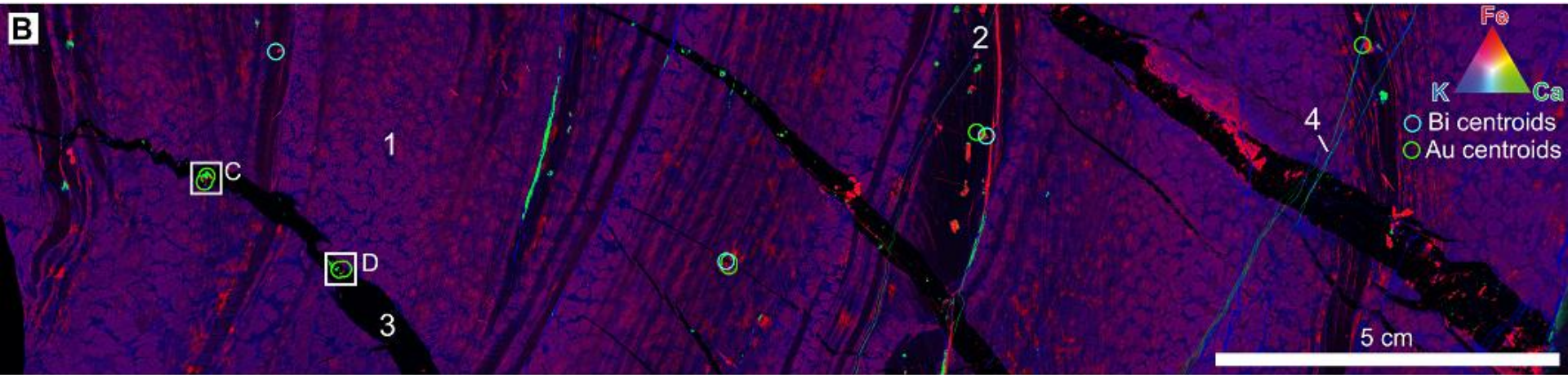


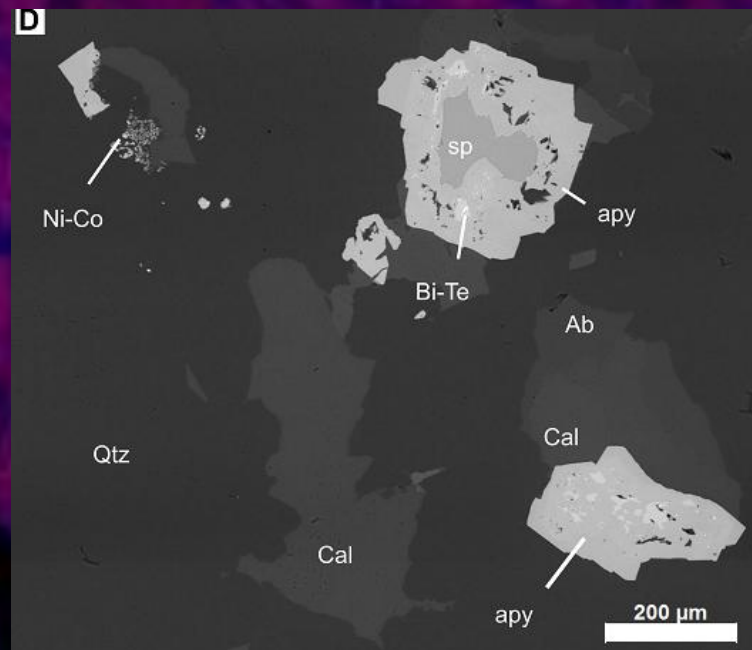
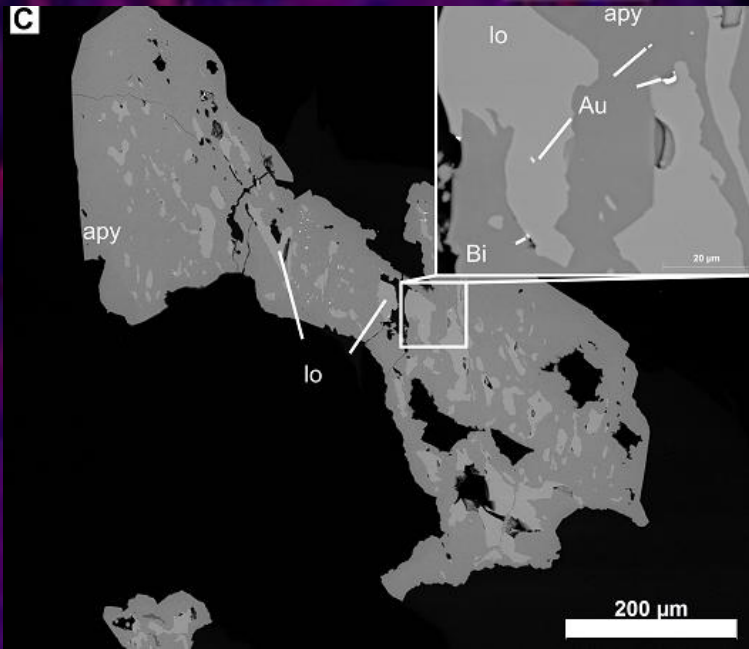
Cathodoluminescence in quartz and WDS analyses at Barambogie illustrating a complex history: 1. low temp quartz; 2. high-temp quartz; 3. Dissolution of quartz and precipitation of silicates associated with gold deposition; 4. Late-stage Th-coffinite precipitated along grain boundaries illustrated by radiation damage in quartz (elevated NBOHC: Non-bridging oxygen hole centres)

Barambogie



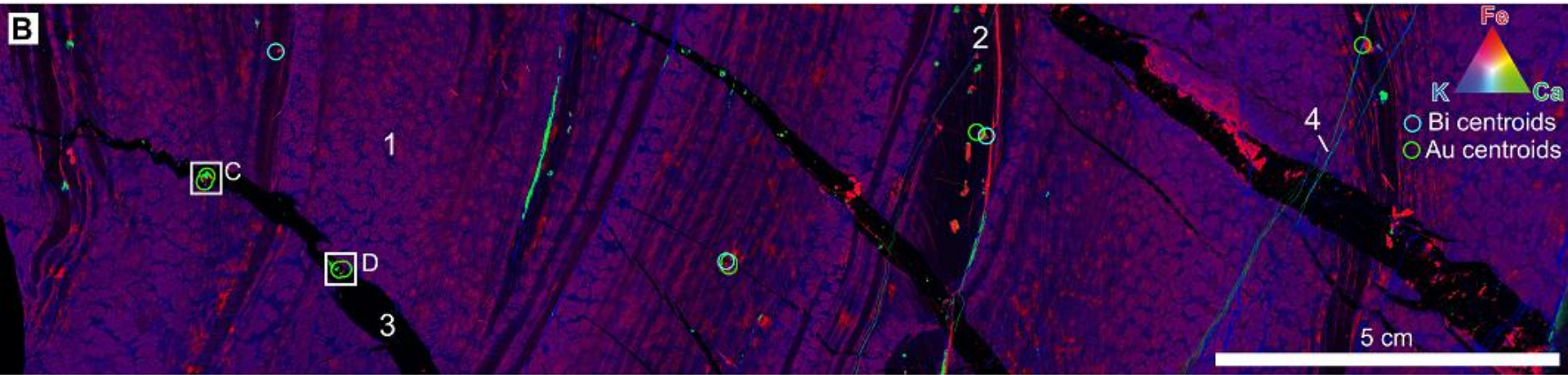
Barambogie

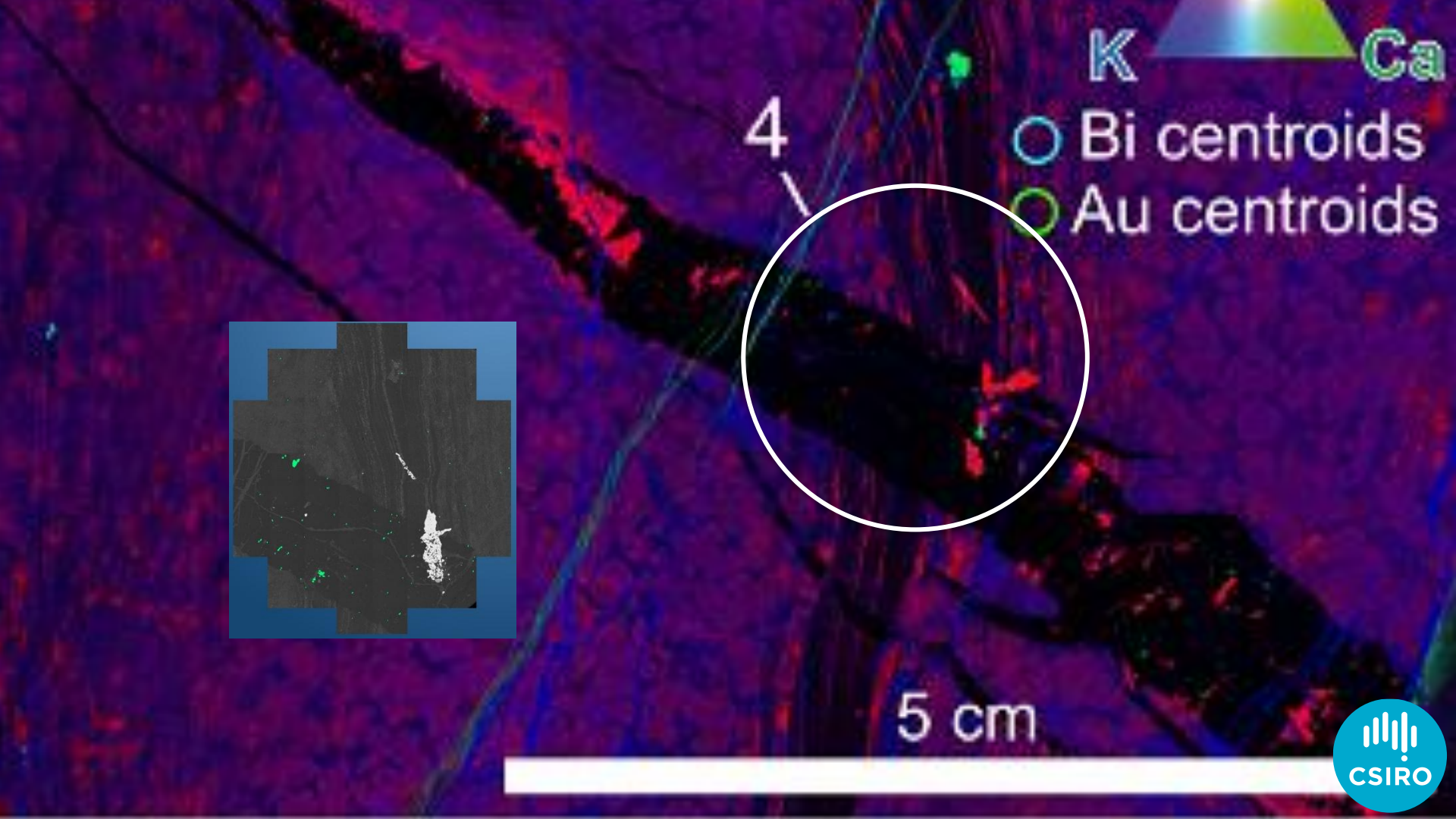




3

Barambogie





Apatite in quartz veins

Barambogie

395.8 +/- 2.2 | 3.2 Ma (n=121)

$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.8645 \pm 0.0023 \mid 0.0034$

MSWD = 2.2

384.8 +/- 5.9 | 8.9 Ma (n=15)

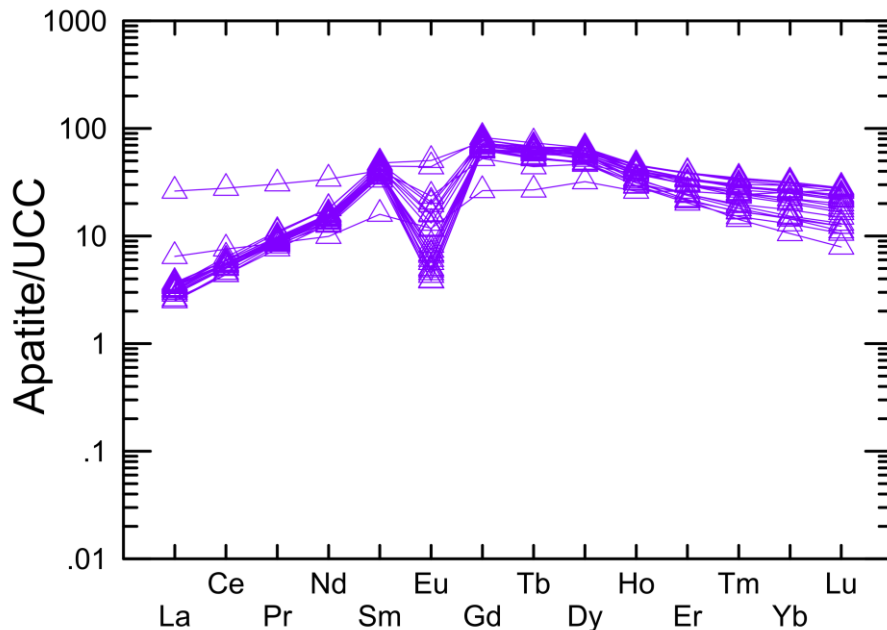
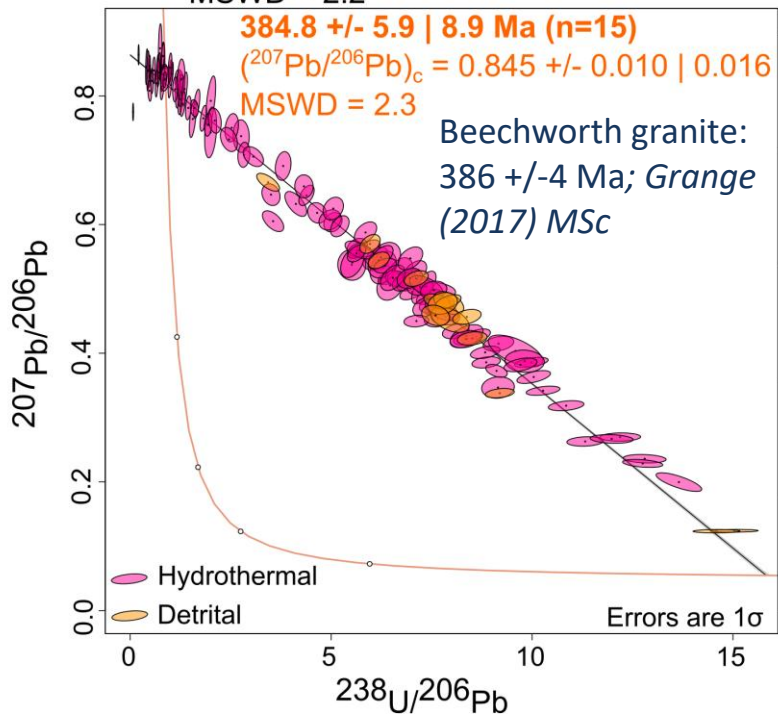
$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.845 \pm 0.010 \mid 0.016$

MSWD = 2.3

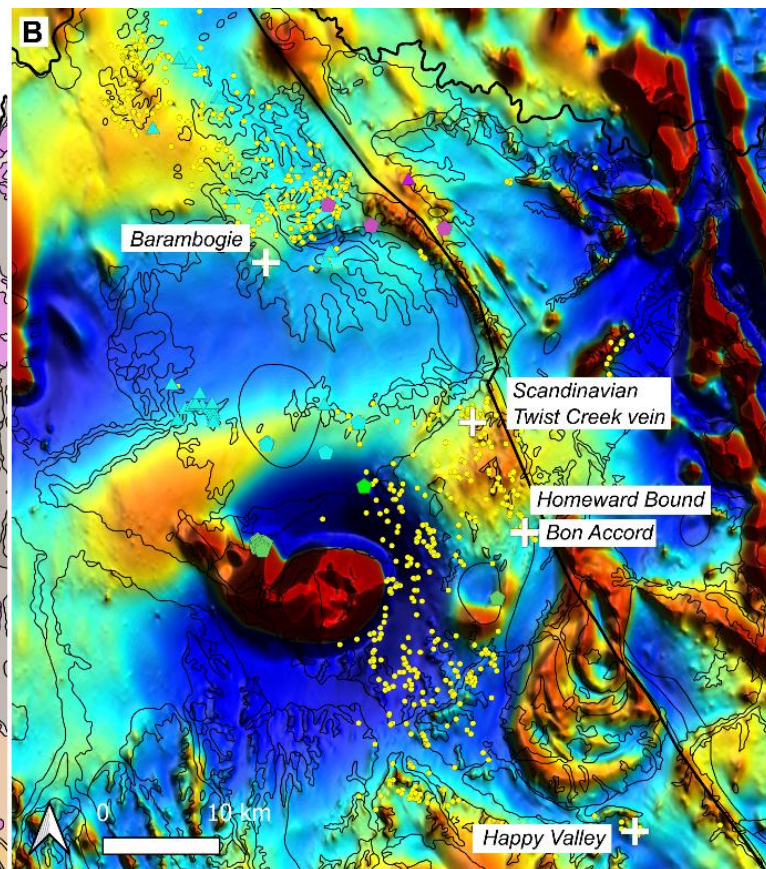
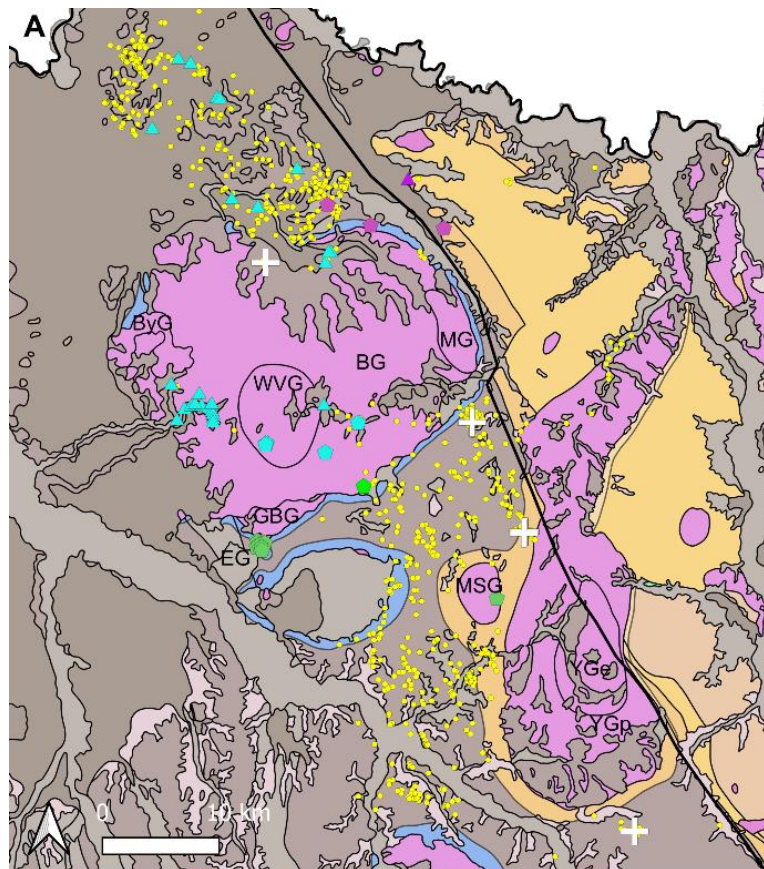
Beechworth granite:

386 +/- 4 Ma; *Grange*

(2017) MSc



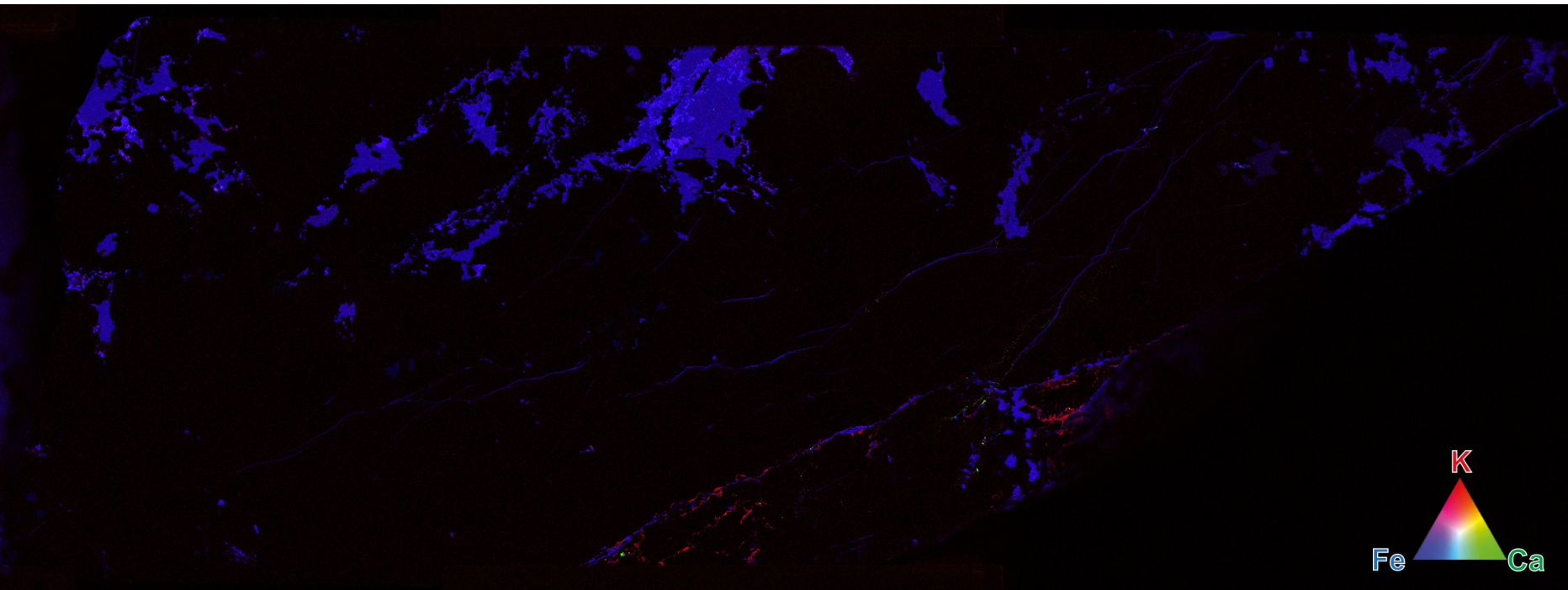
Prospects near Beechworth & Yackanhandah granites

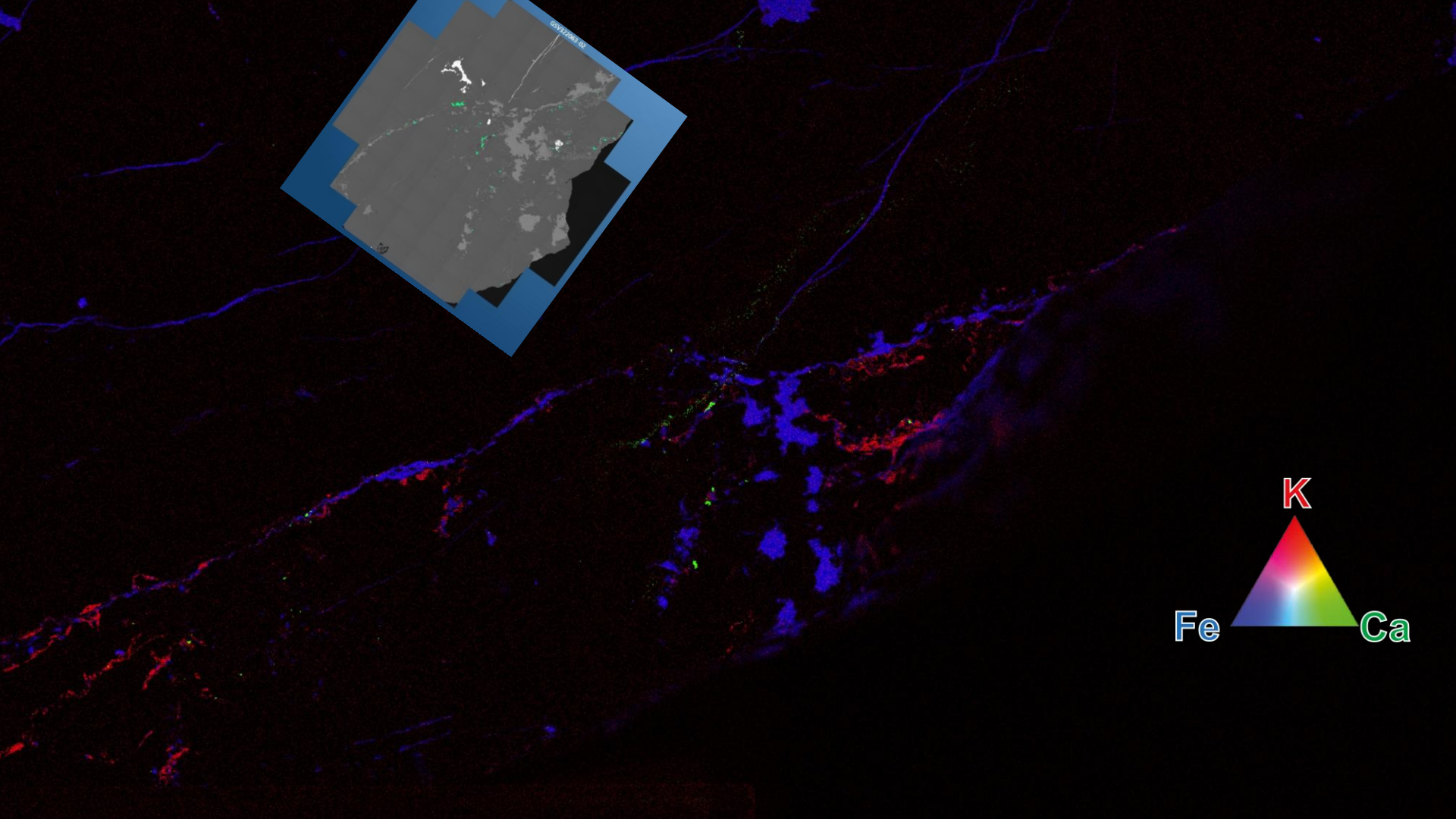


Twist Creek



Twist Creek





U-Pb apatite in quartz veins

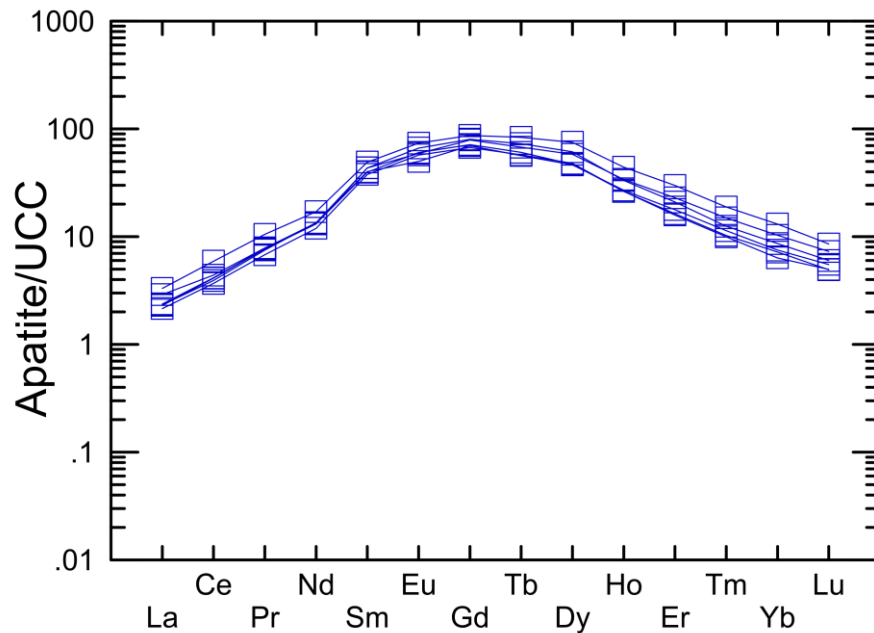
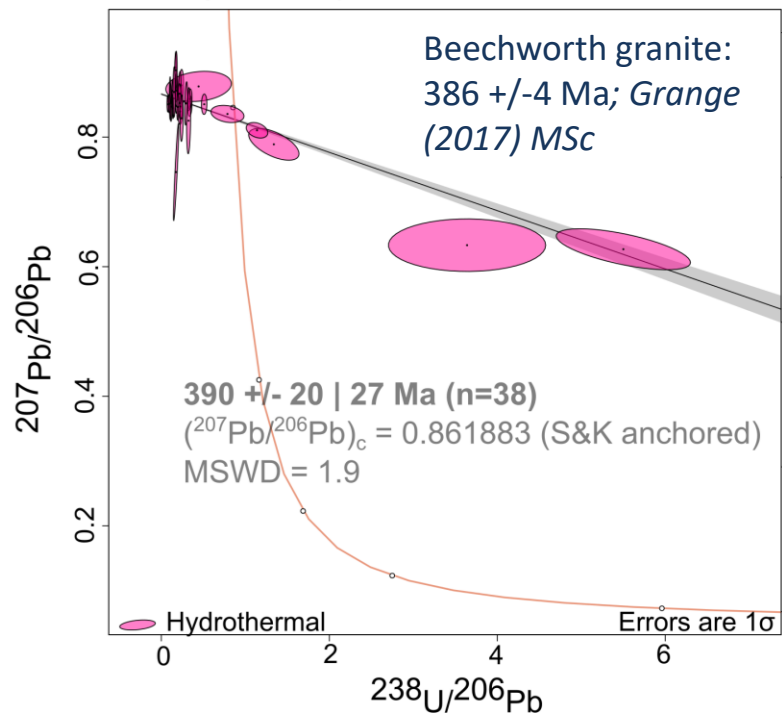
Twist Creek

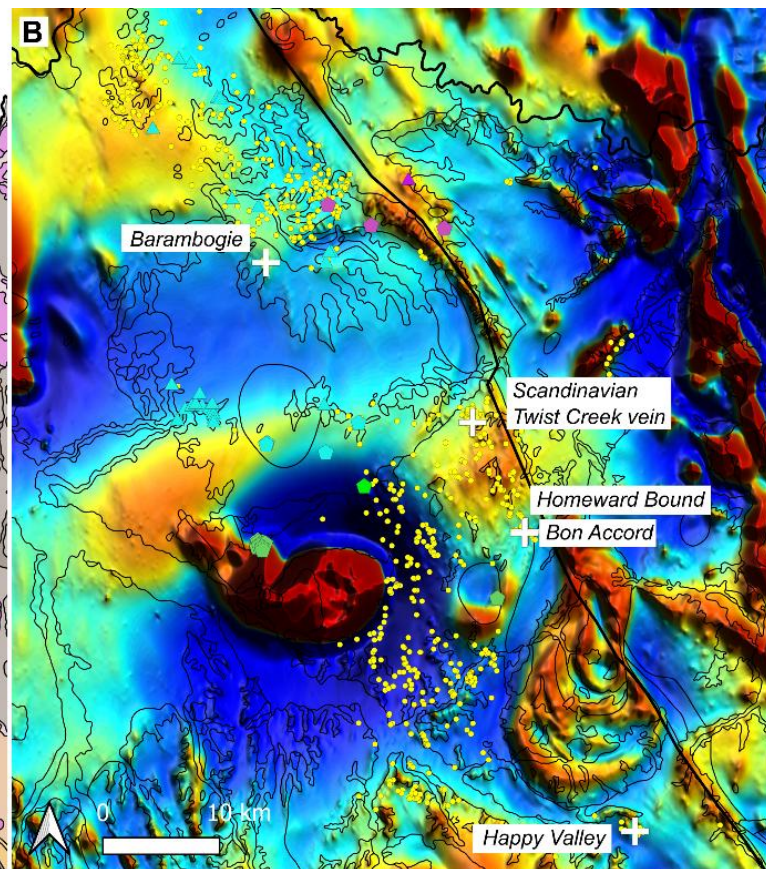
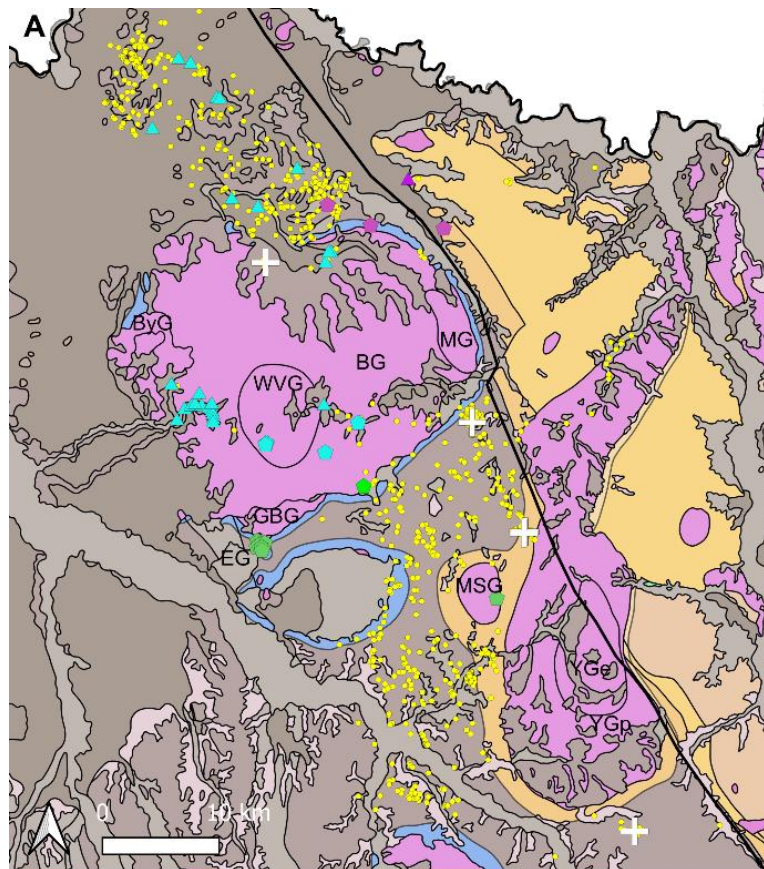
347 +/- 22 | 27 Ma (n=38)

$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.8665 \pm 0.0018 \mid 0.0021$

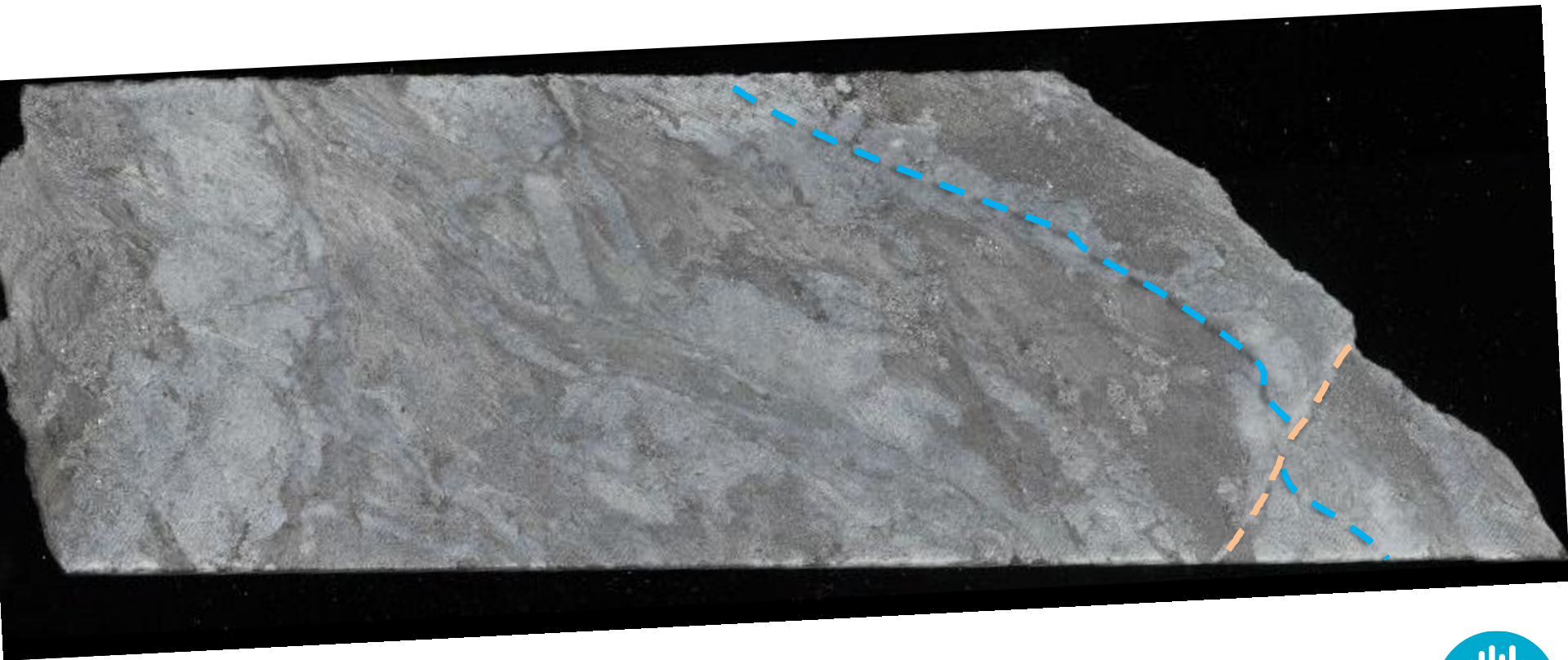
MSWD = 1.5

Beechworth granite:
386 +/- 4 Ma; *Grange*
(2017) *MSc*

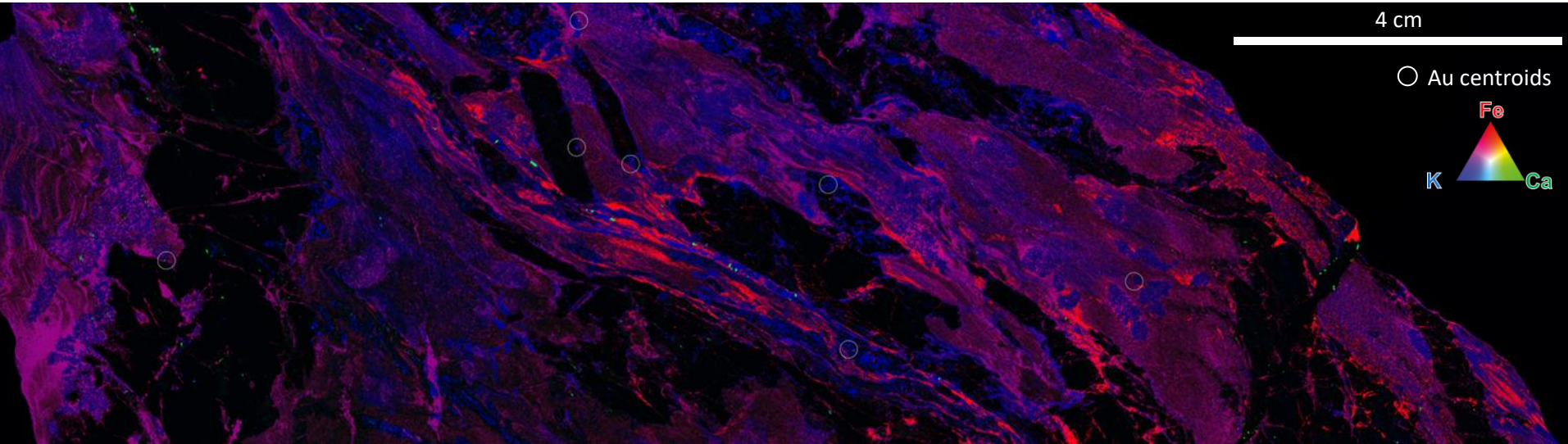




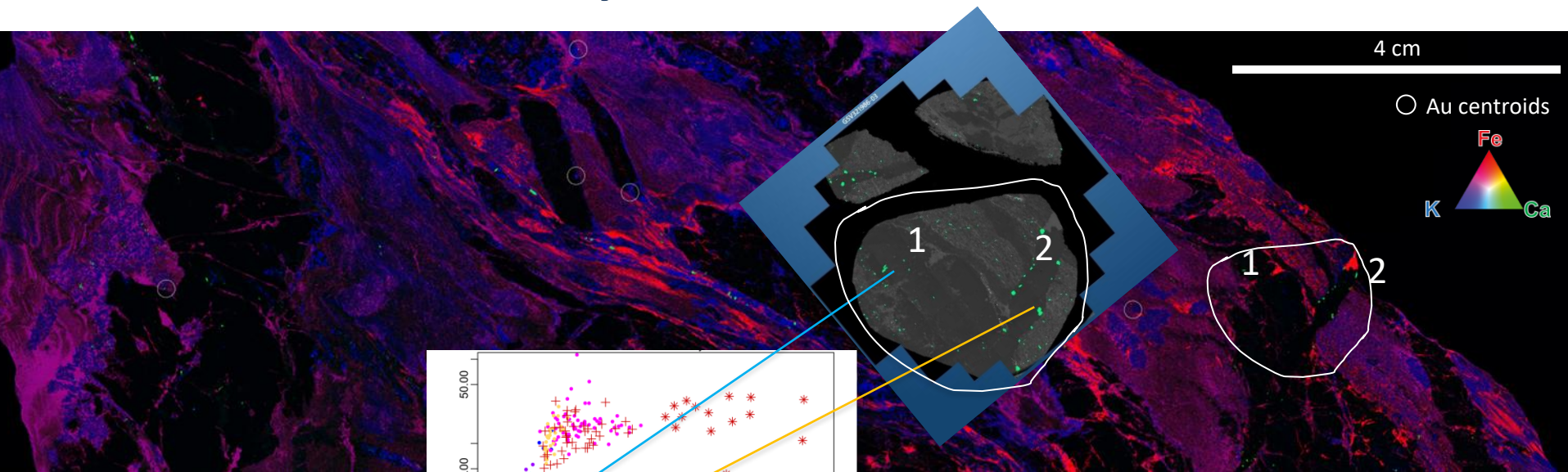
Bon Accord



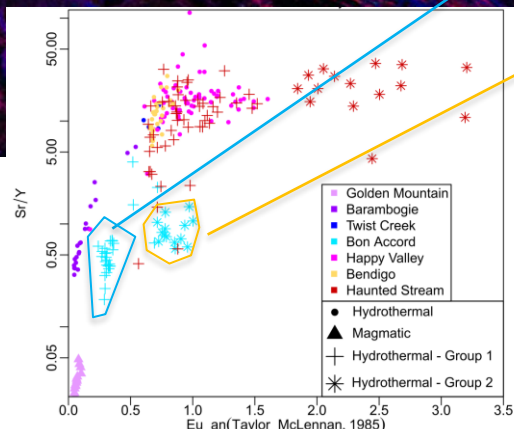
Bon Accord



Apatites record multiple hydrothermal fluids



Bon Accord



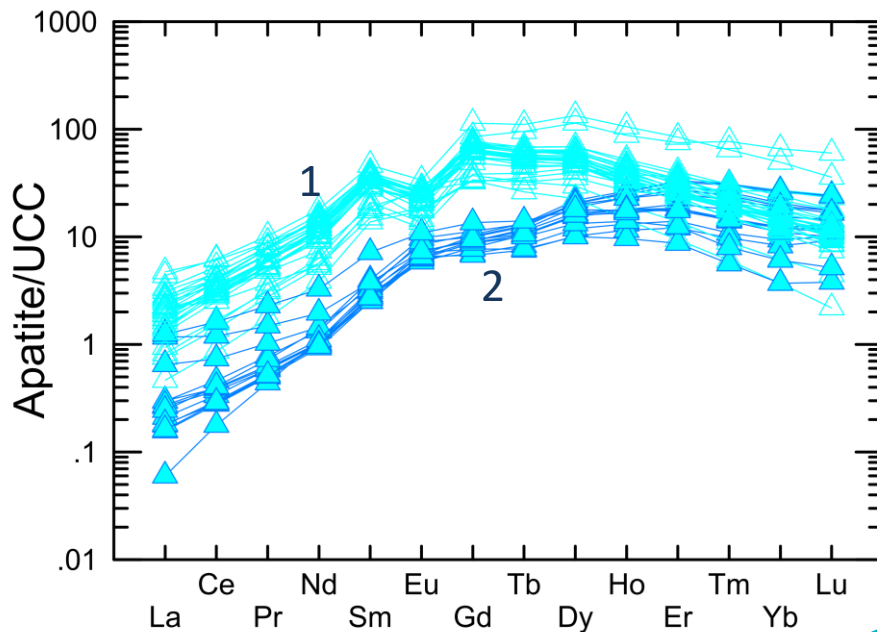
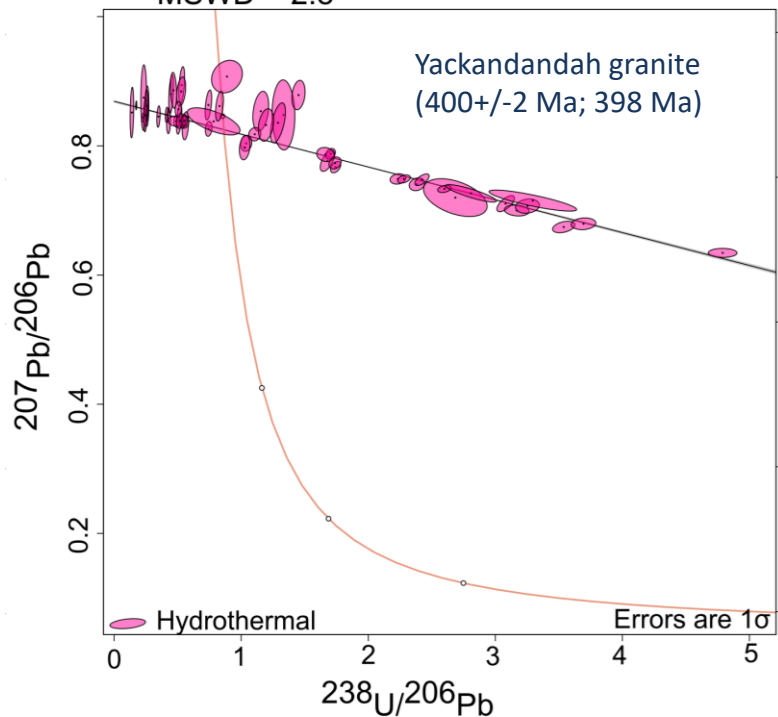
U-Pb apatite in quartz veins

Bon Accord

390.1 +/- 6.0 | 9.9 Ma (n=55)

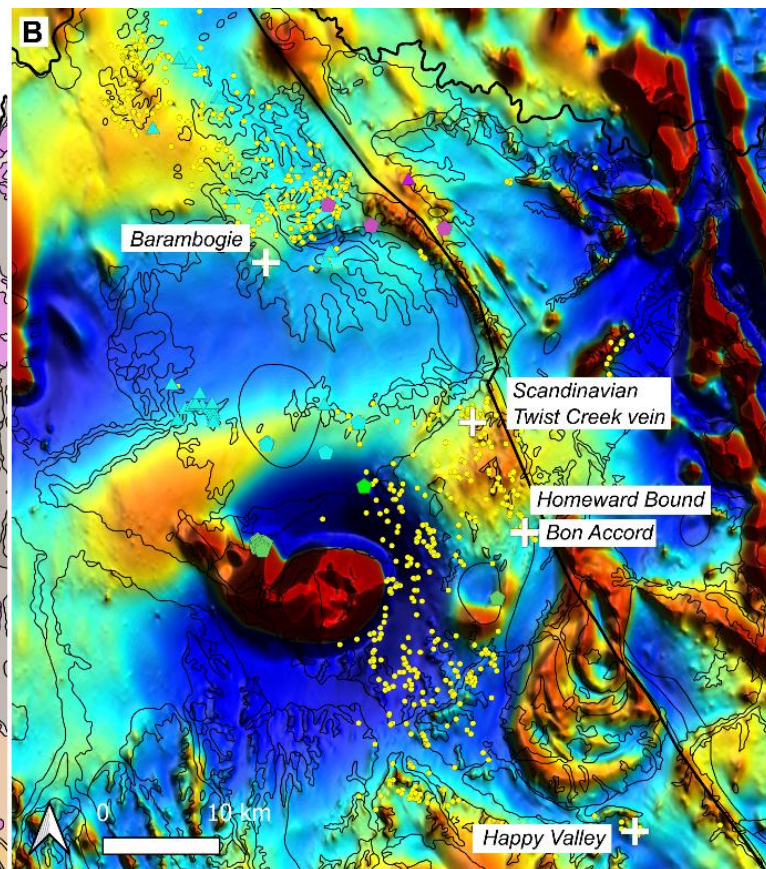
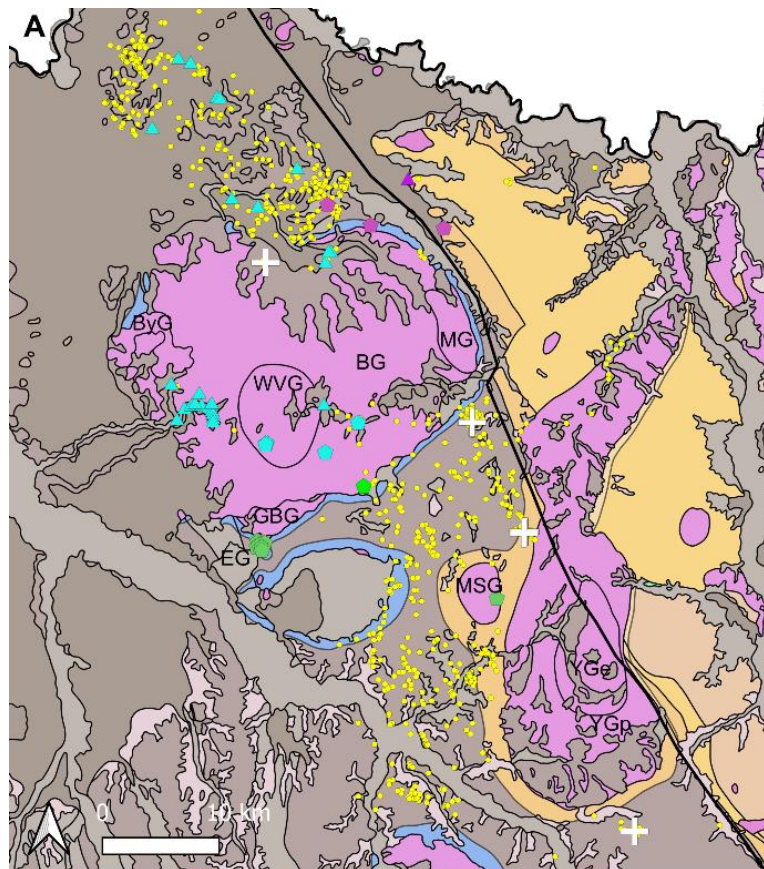
$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.8688 \pm 0.0018 \mid 0.0031$

MSWD = 2.8



Two populations

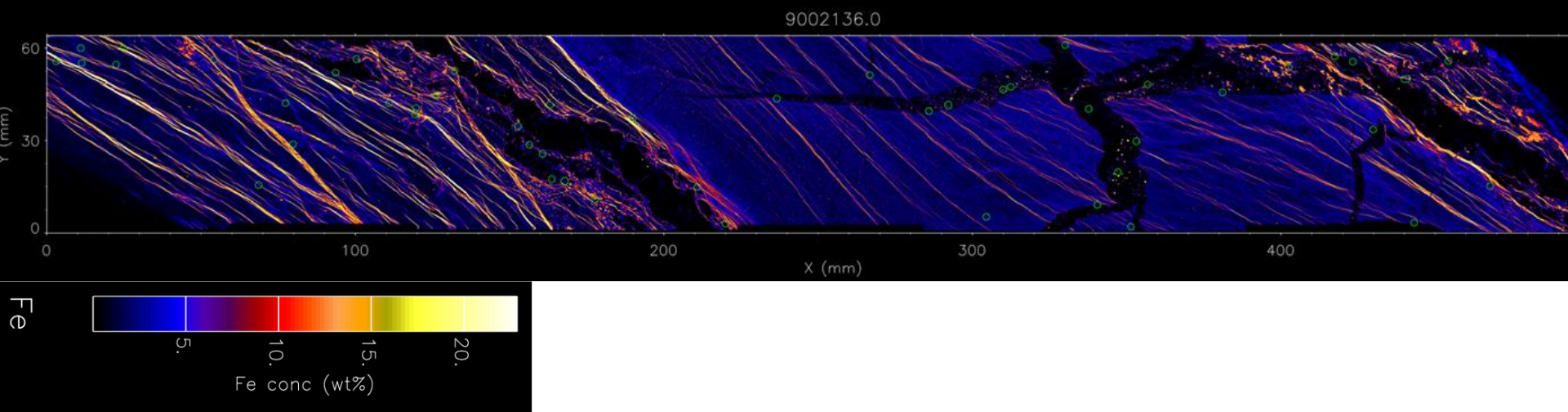
Prospects near Beechworth & Yackanhandah granites



Happy Valley



Happy Valley



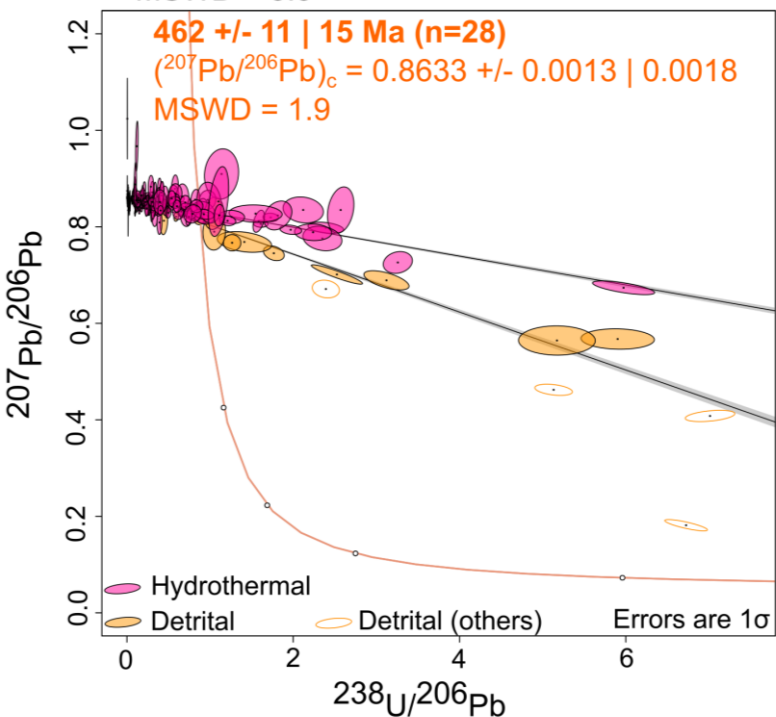
U-Pb apatite in quartz veins

Happy Valley

234.0 +/- 6.6 | 12.0 Ma (n=145)

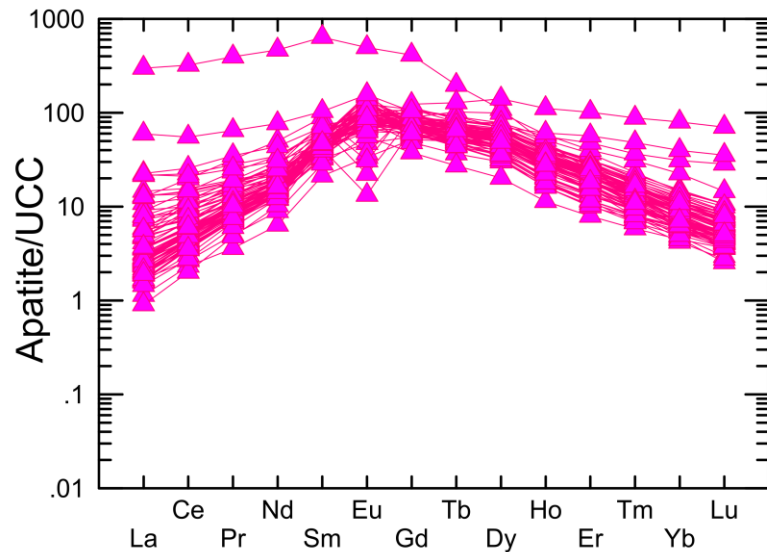
$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.85861 \pm 0.00058 \mid 0.00105$

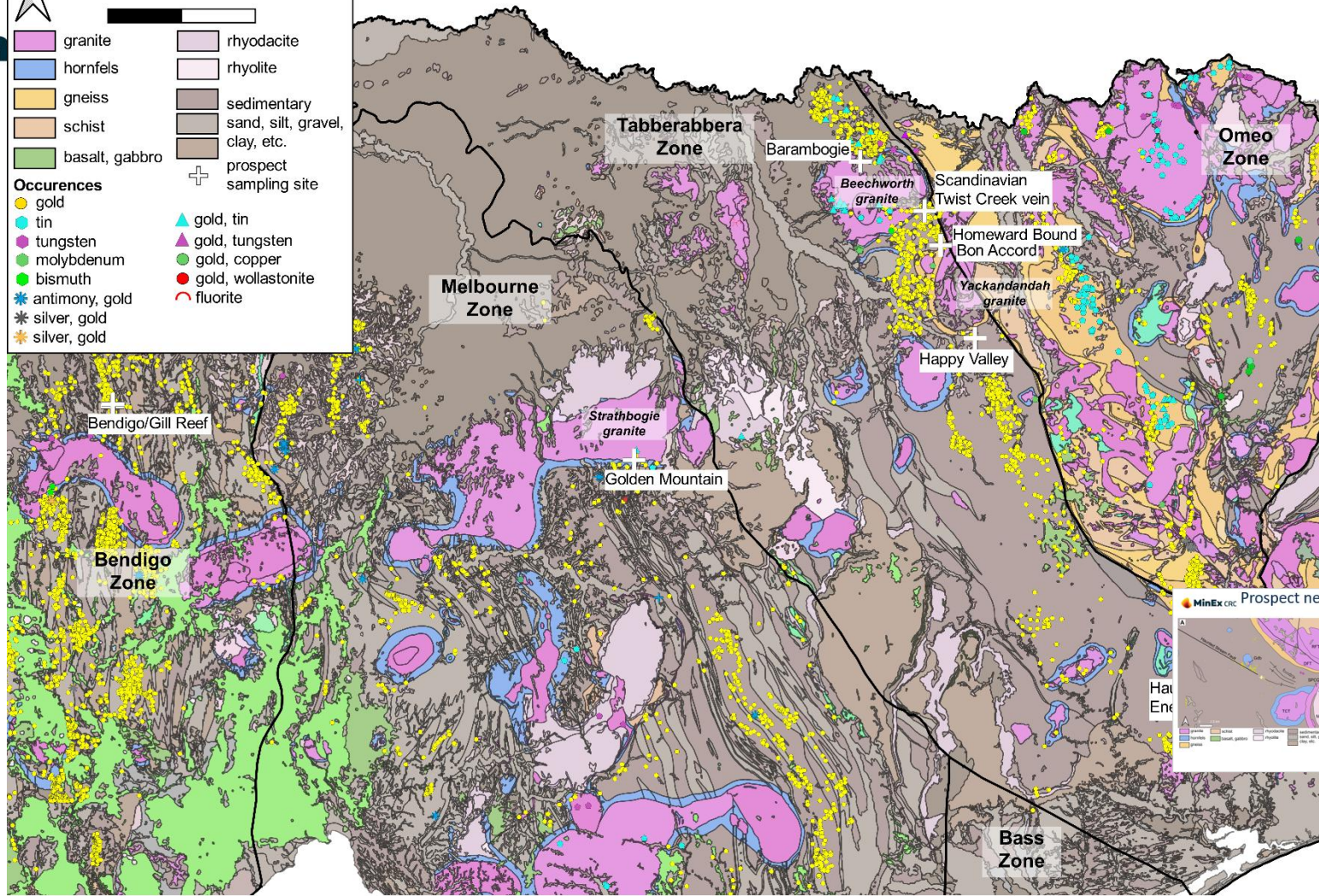
MSWD = 3.3



Brothers Syenite,
 Mount Leinster
 Igneous Complex:
 232±5 Ma (*Bowen*
 1974)

Unnamed trachyte,
 western
 Tabberabbera Zone:
 227±12 Ma
 (*unpublished*)

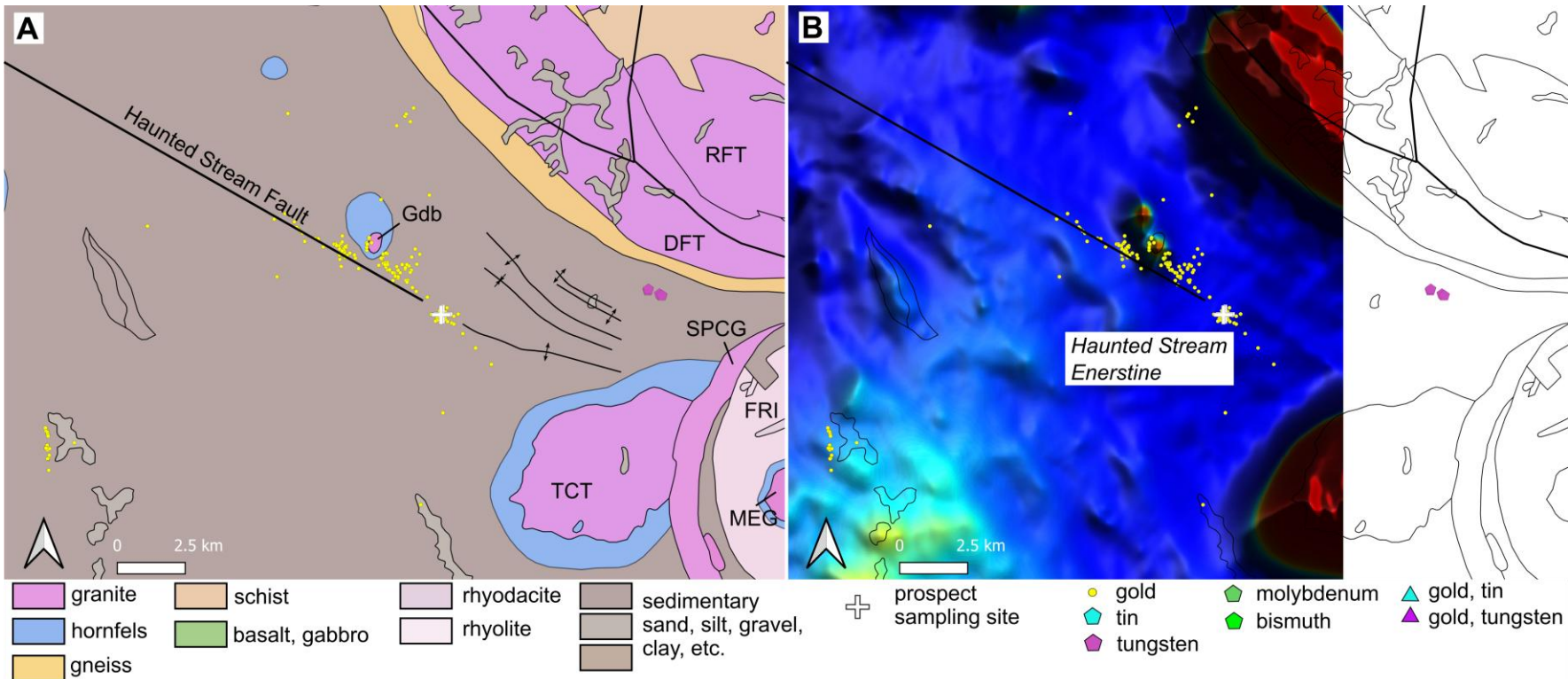




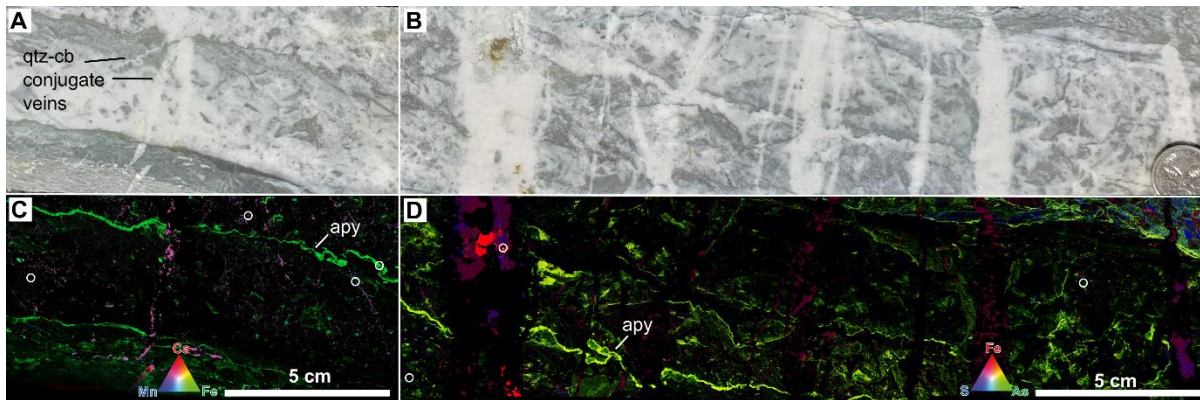


MinEx CRC

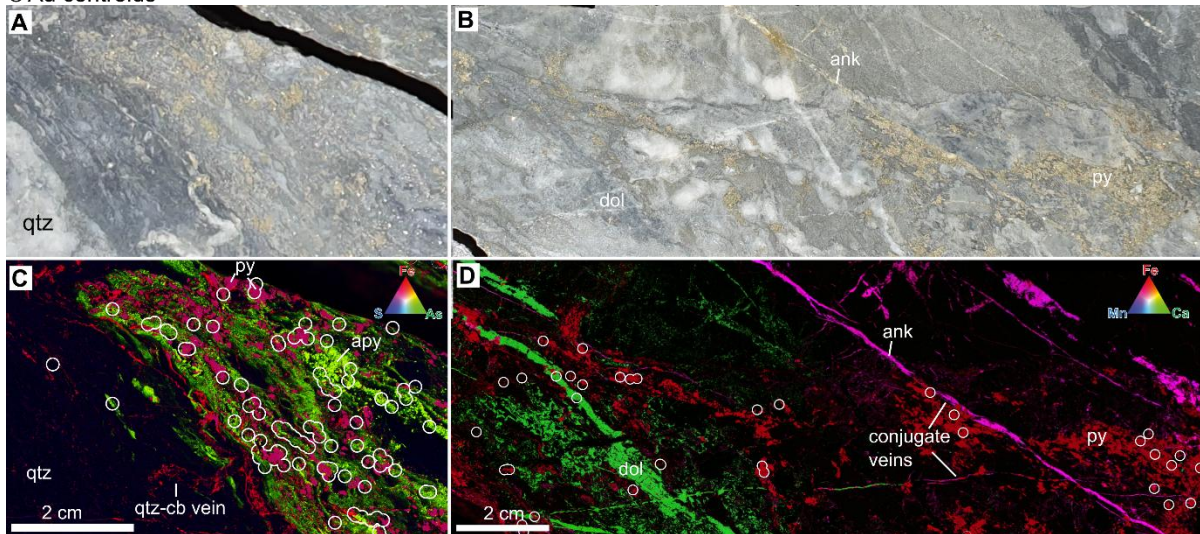
Prospect near the Dead Bird Suite



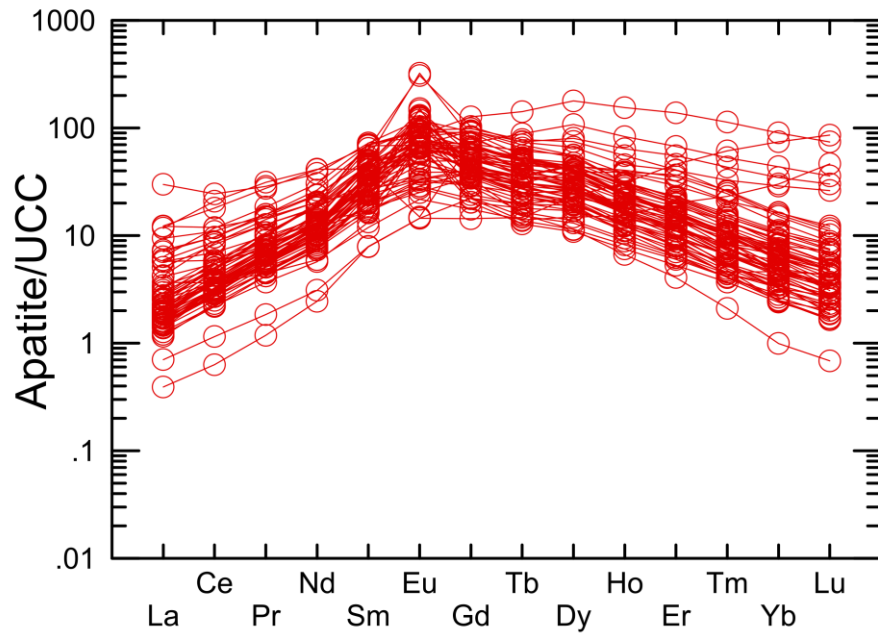
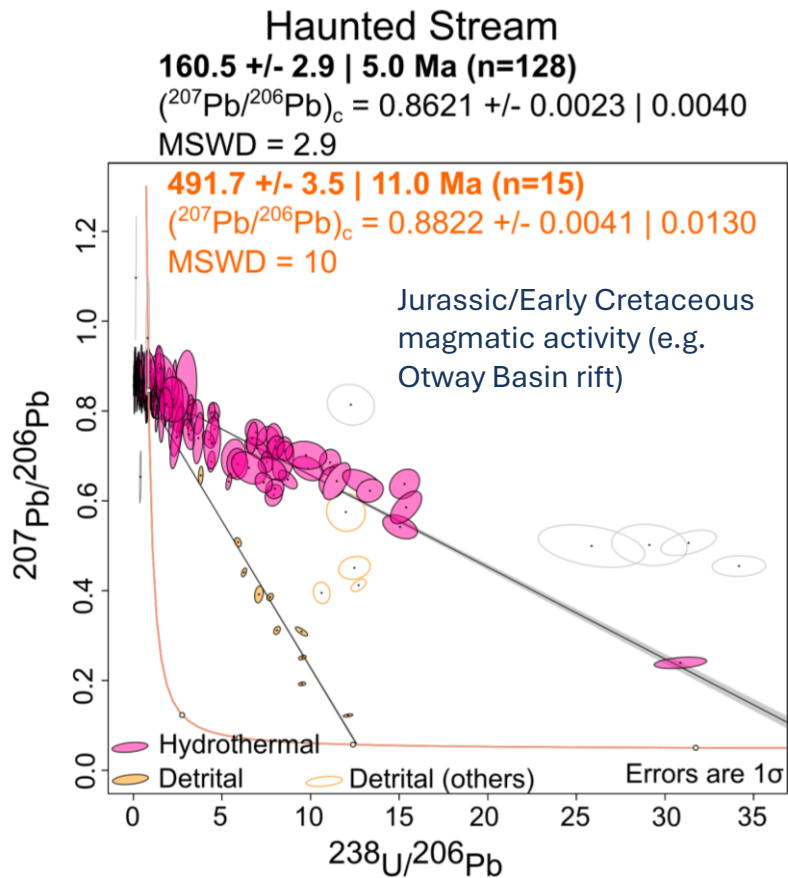
Haunted Stream

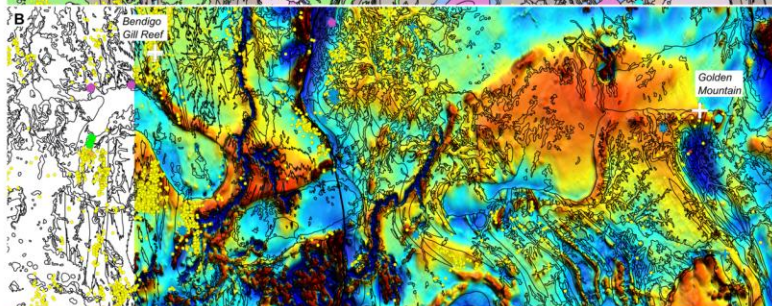
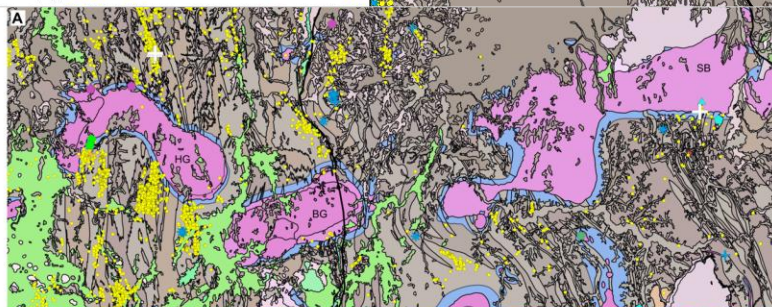
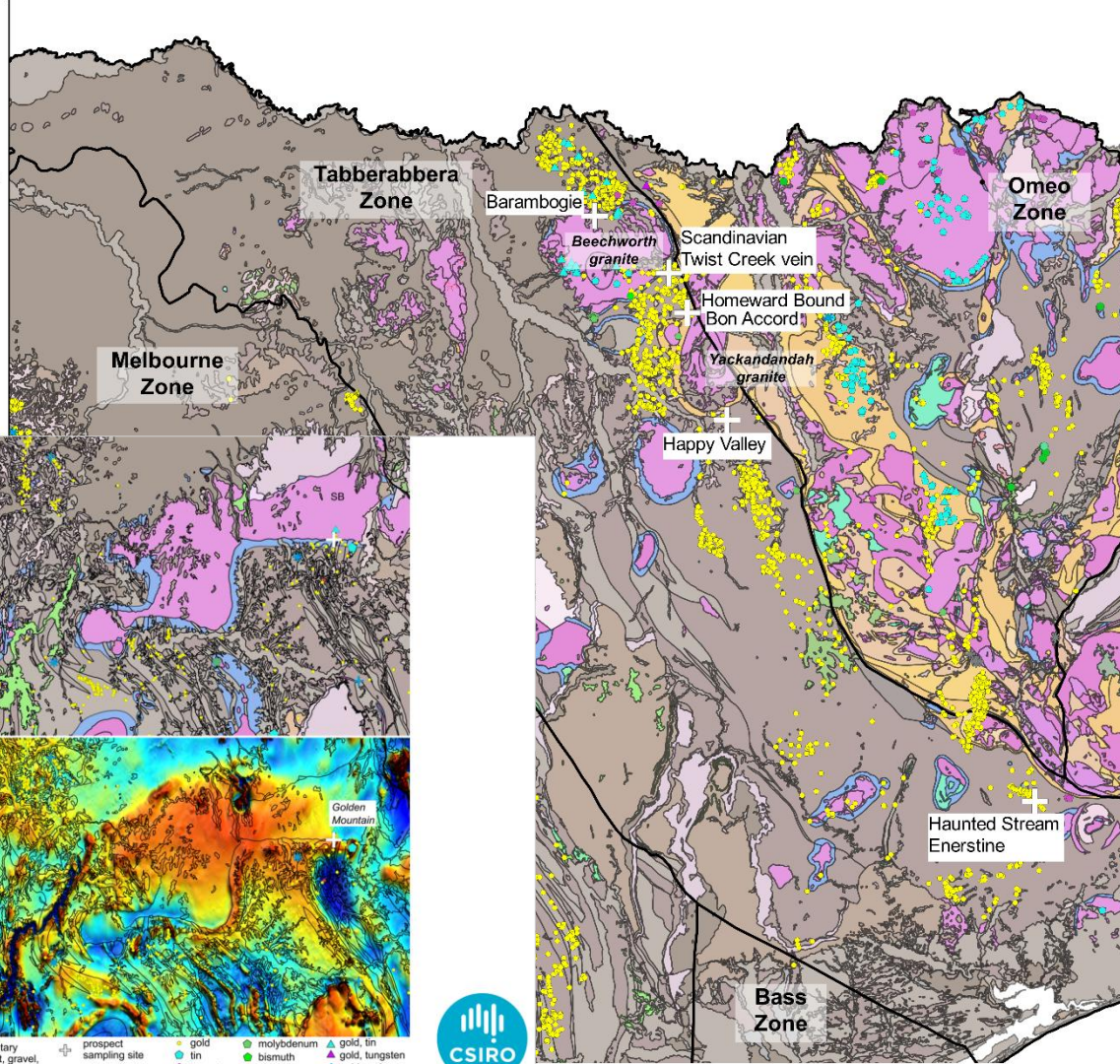
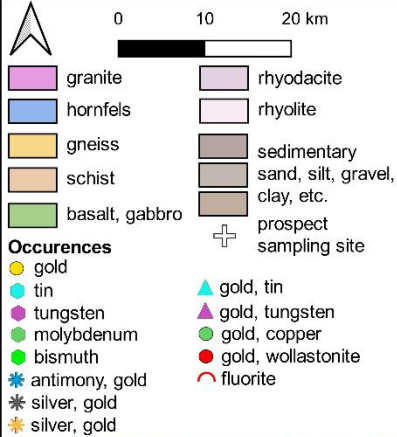


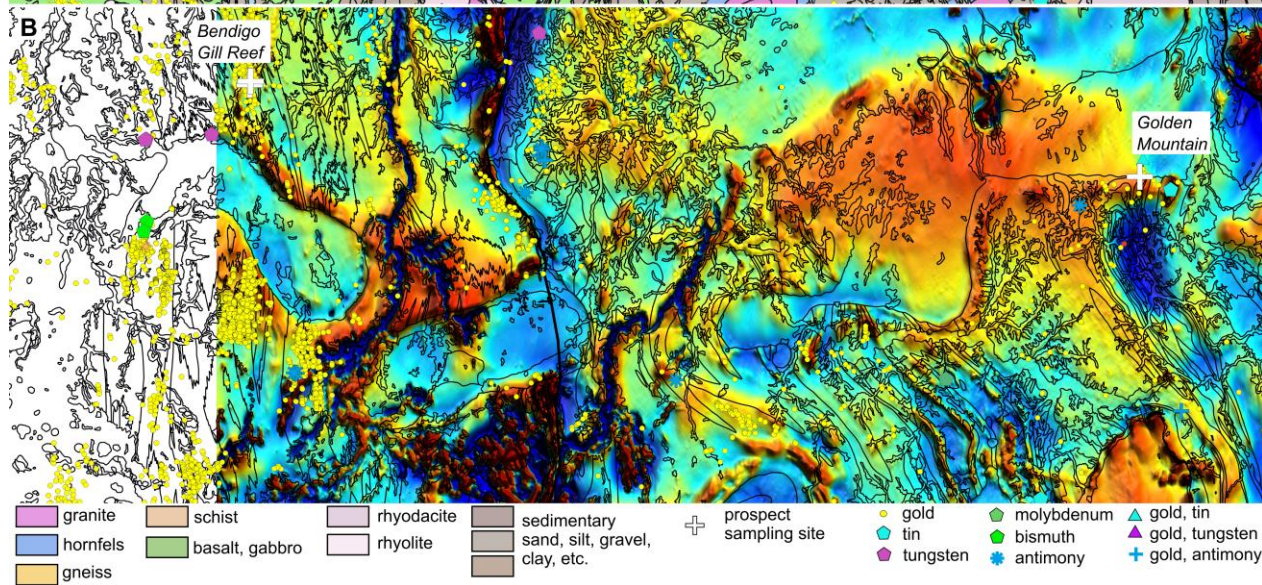
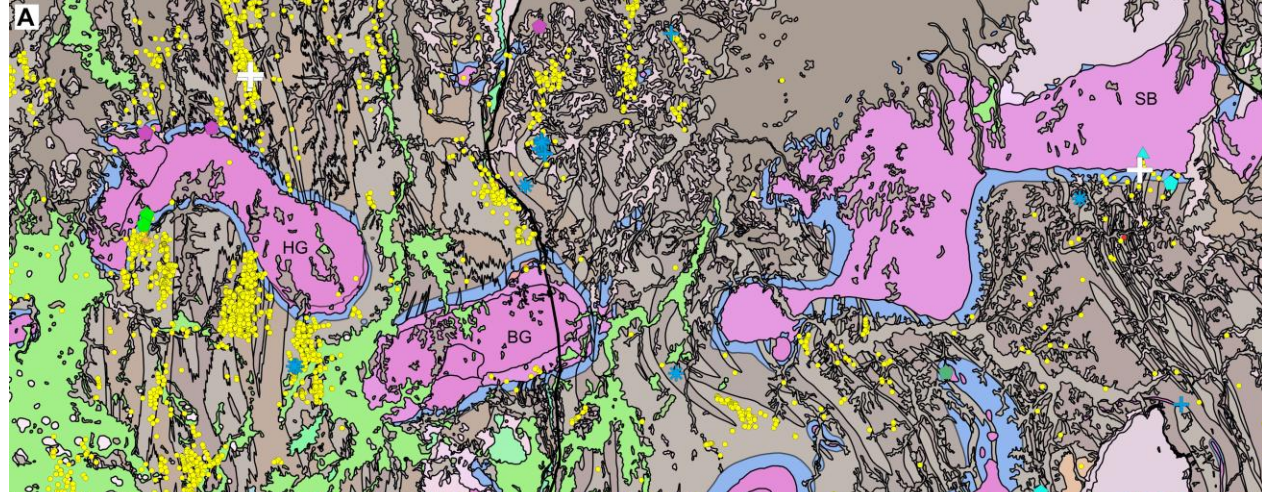
○ Au centroids

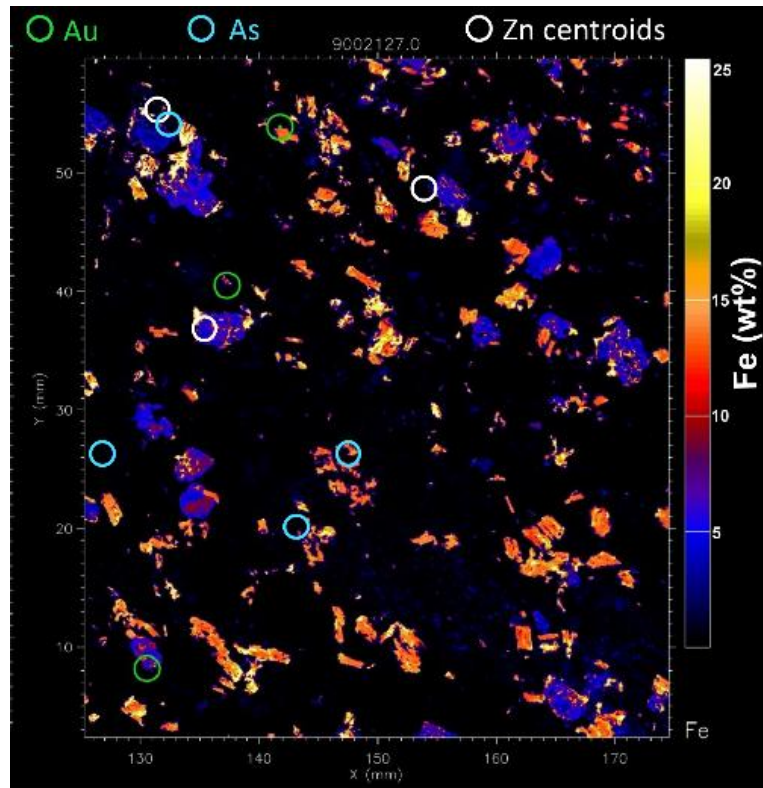
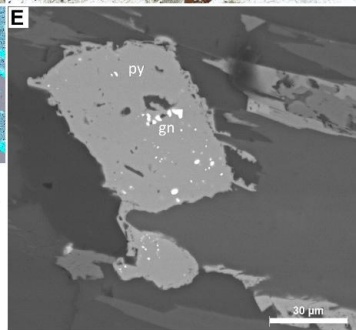
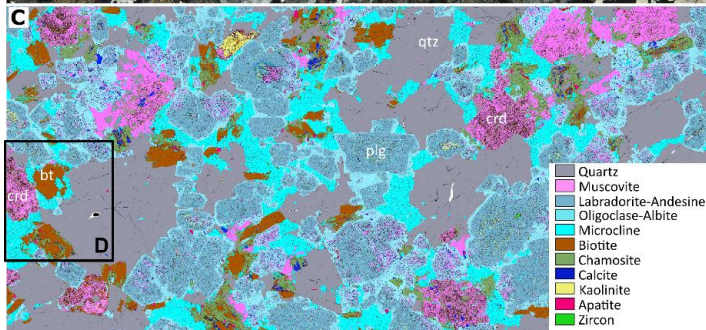
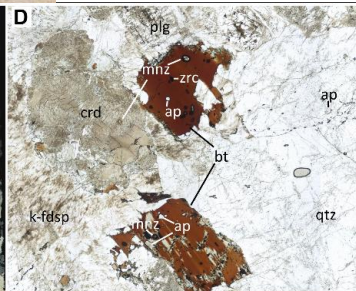
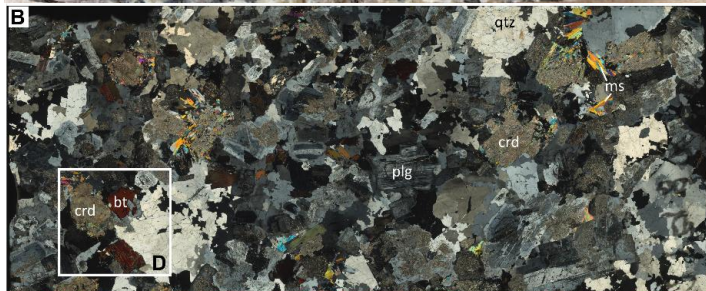


Haunted Stream









Golden Mountain

Golden Mountain

366.0 $\pm$ 2.1 Ma (n=22)

$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.8602125$ (S&K anchored)

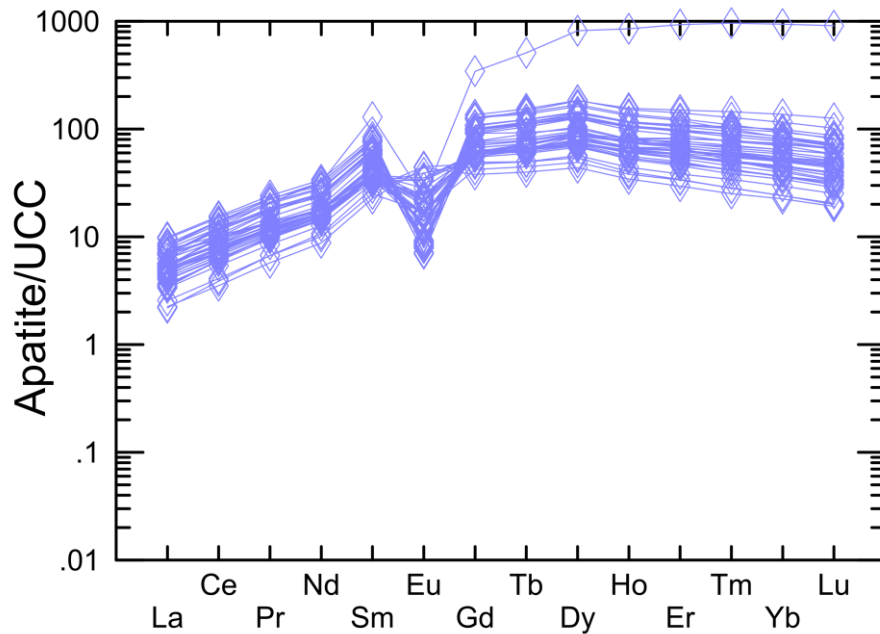
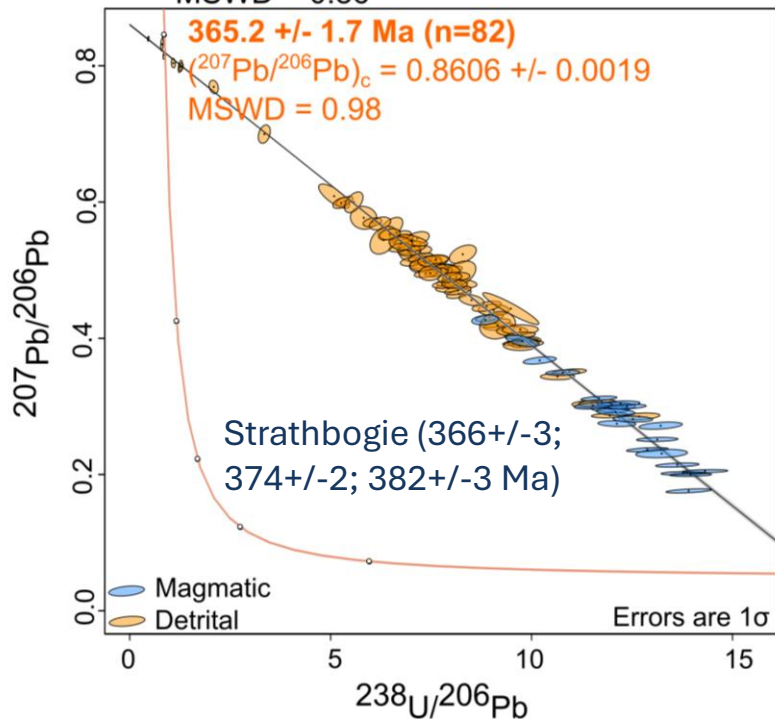
MSWD = 0.86

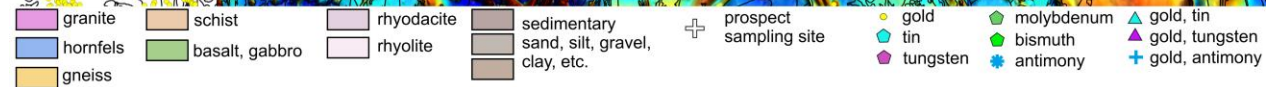
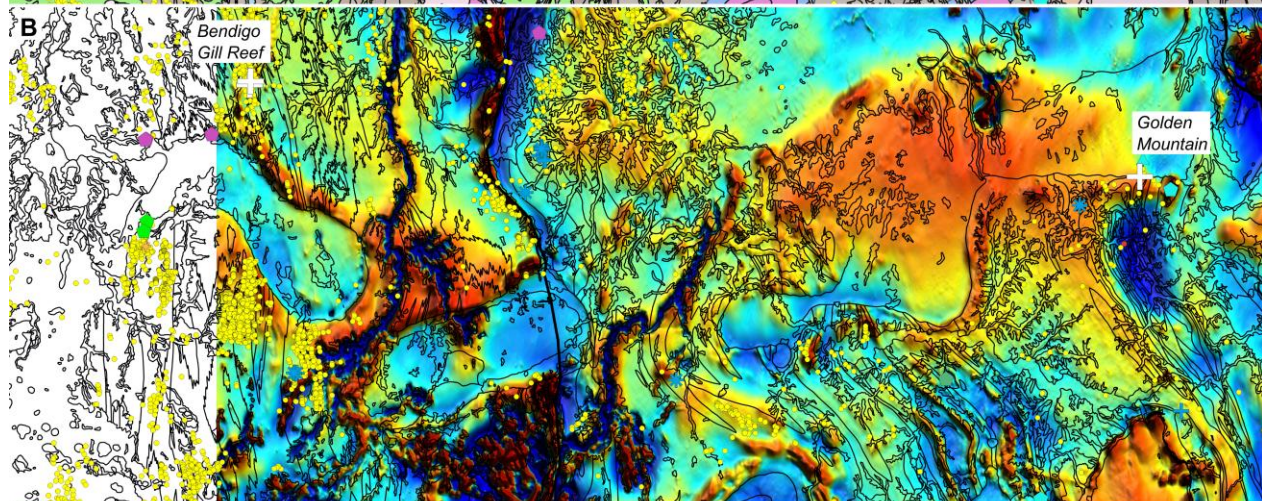
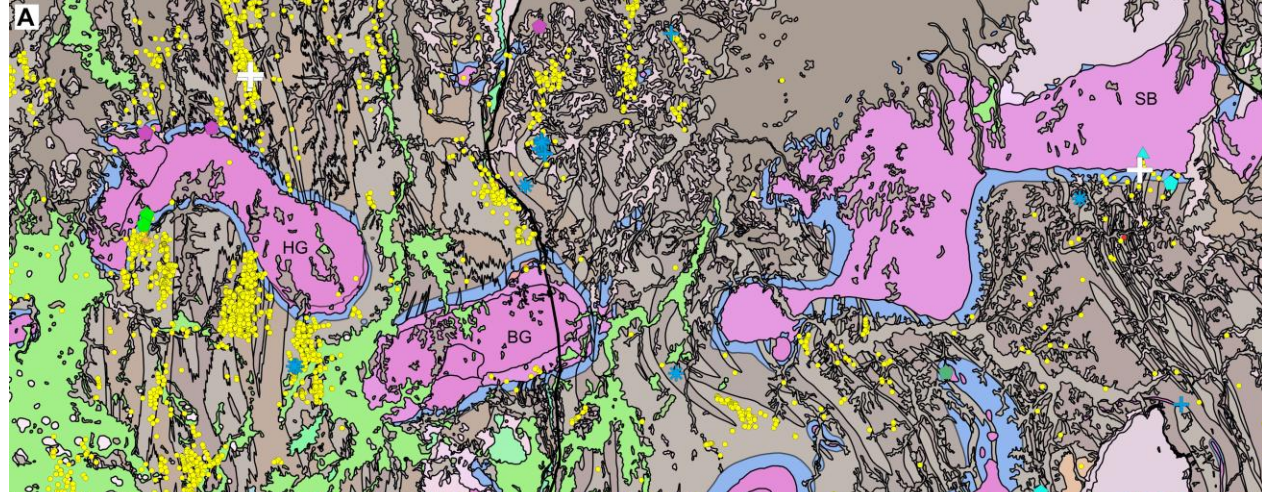
365.2 $\pm$ 1.7 Ma (n=82)

$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.8606 \pm 0.0019$

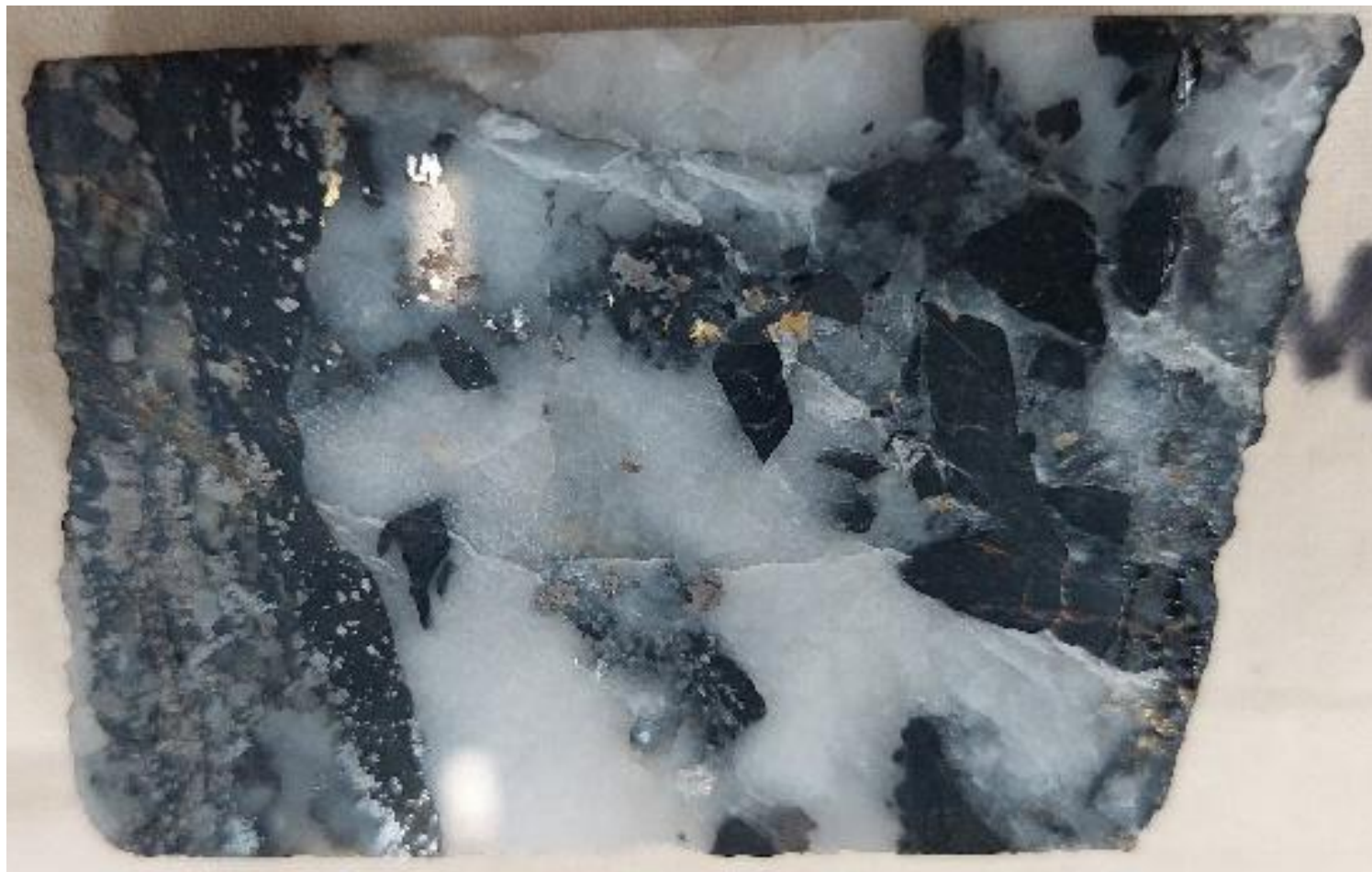
MSWD = 0.98

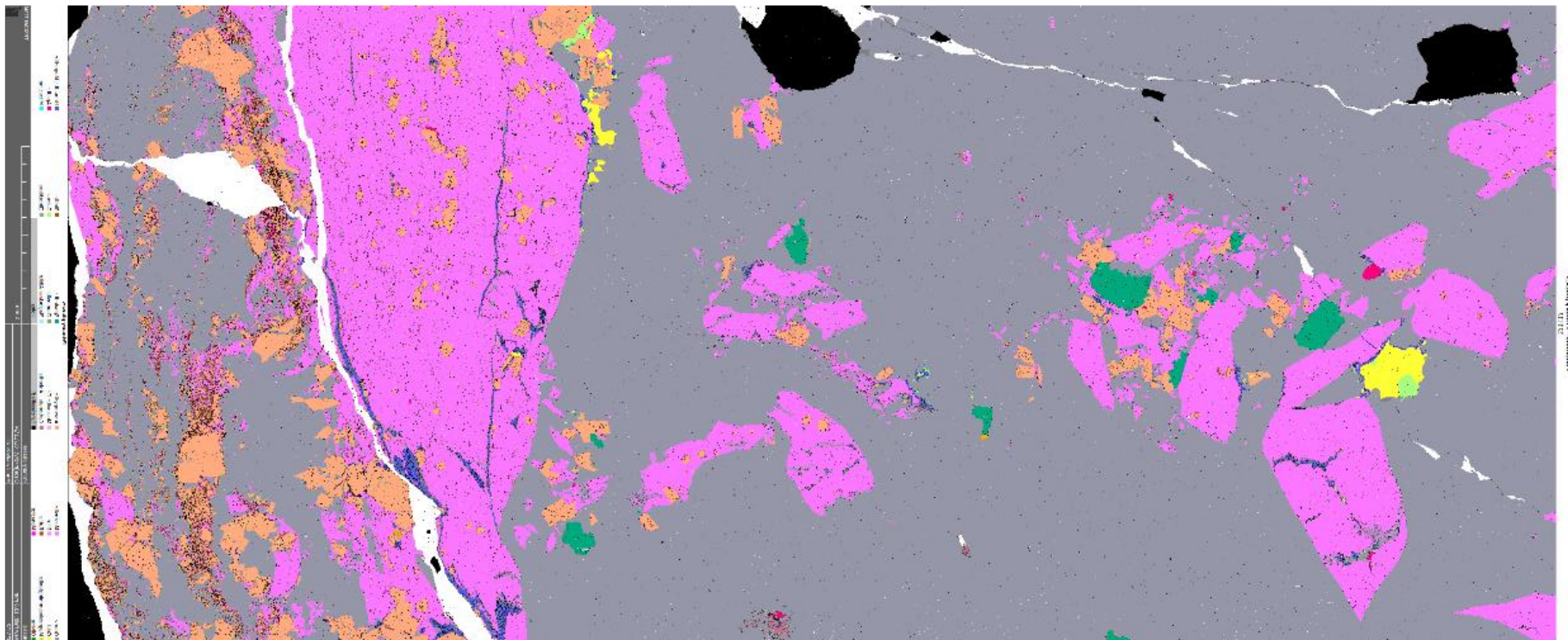
Strathbogie (366 $\pm$ 3;
374 $\pm$ 2; 382 $\pm$ 3 Ma)





Bendigo/Gill Reef





Bendigo/Gill Reef

Bendigo

334.5 +/- 9.1 | 13.3 Ma (n=55)

$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.8705 \pm 0.0023 \mid 0.0034$

MSWD = 2.1

492.7 +/- 3.8 | 6.1 Ma (n=21)

$(^{207}\text{Pb}/^{206}\text{Pb})_c = 0.8685 \pm 0.0029 \mid 0.0047$

MSWD = 2.6

Harcourt Granodiorite:

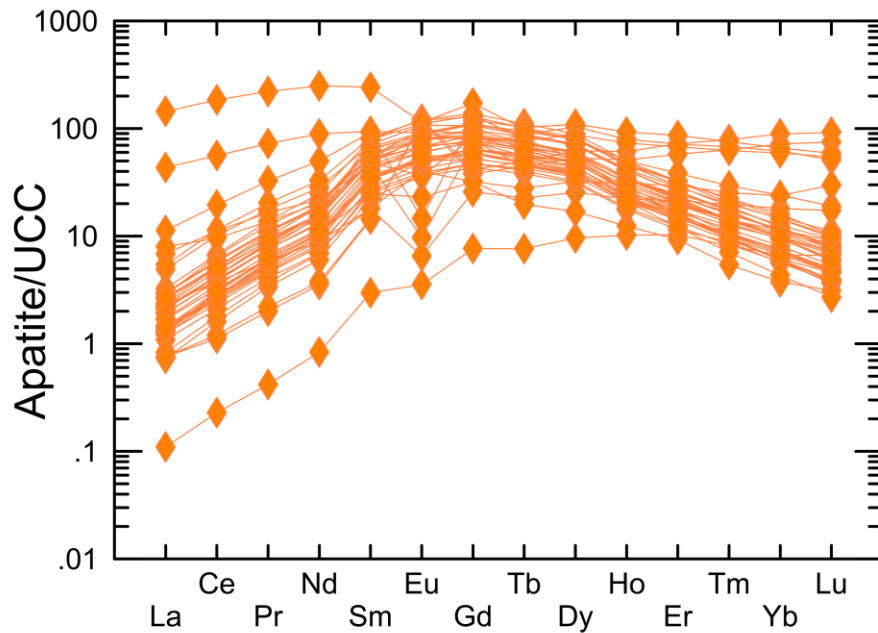
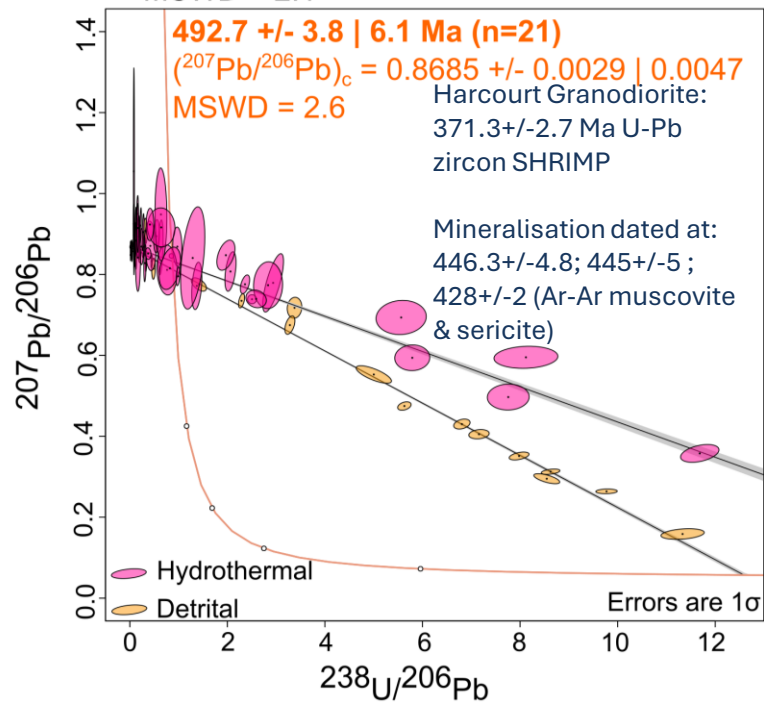
371.3 +/- 2.7 Ma U-Pb

zircon SHRIMP

Mineralisation dated at:

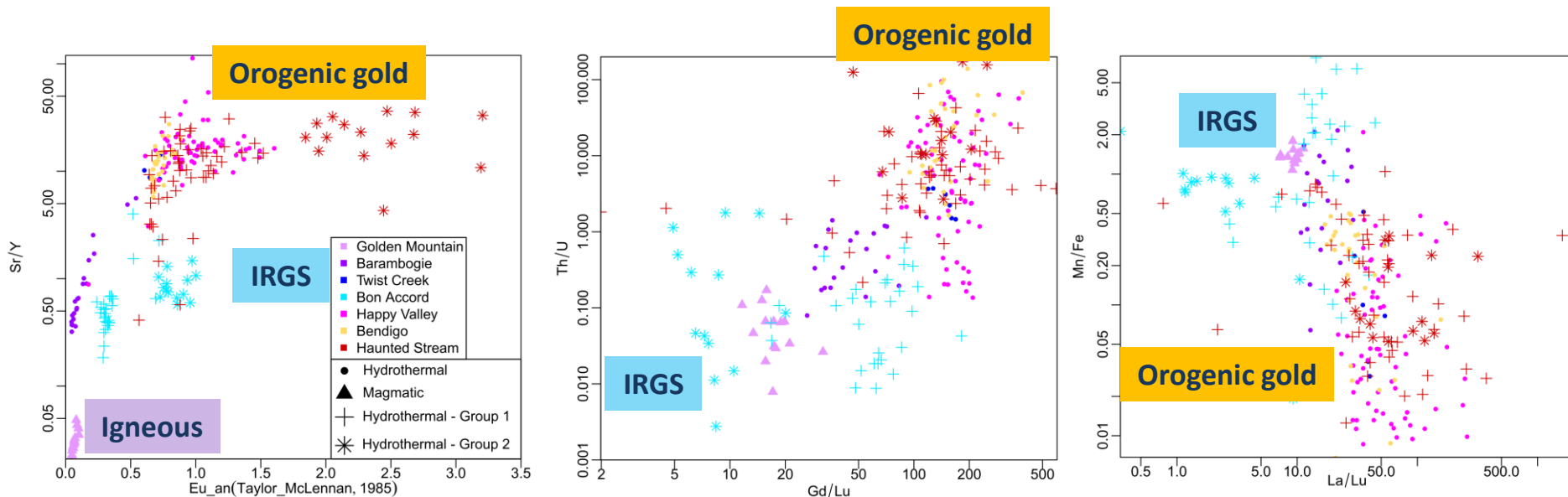
446.3 +/- 4.8; 445 +/- 5 ;

428 +/- 2 (Ar-Ar muscovite
& sericite)



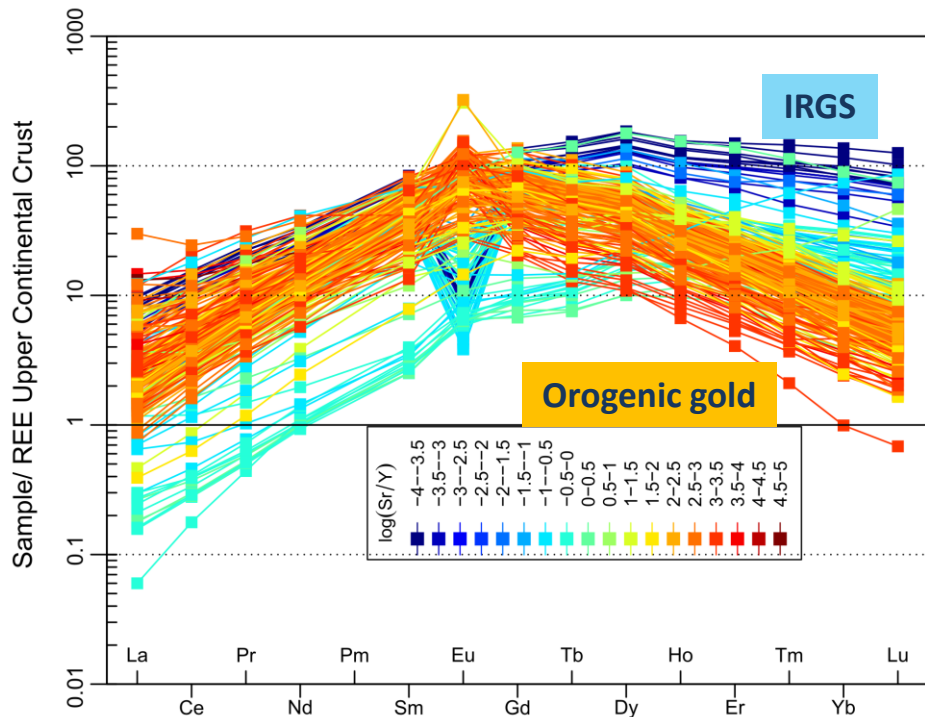
Apatite compositions

Gold prospects



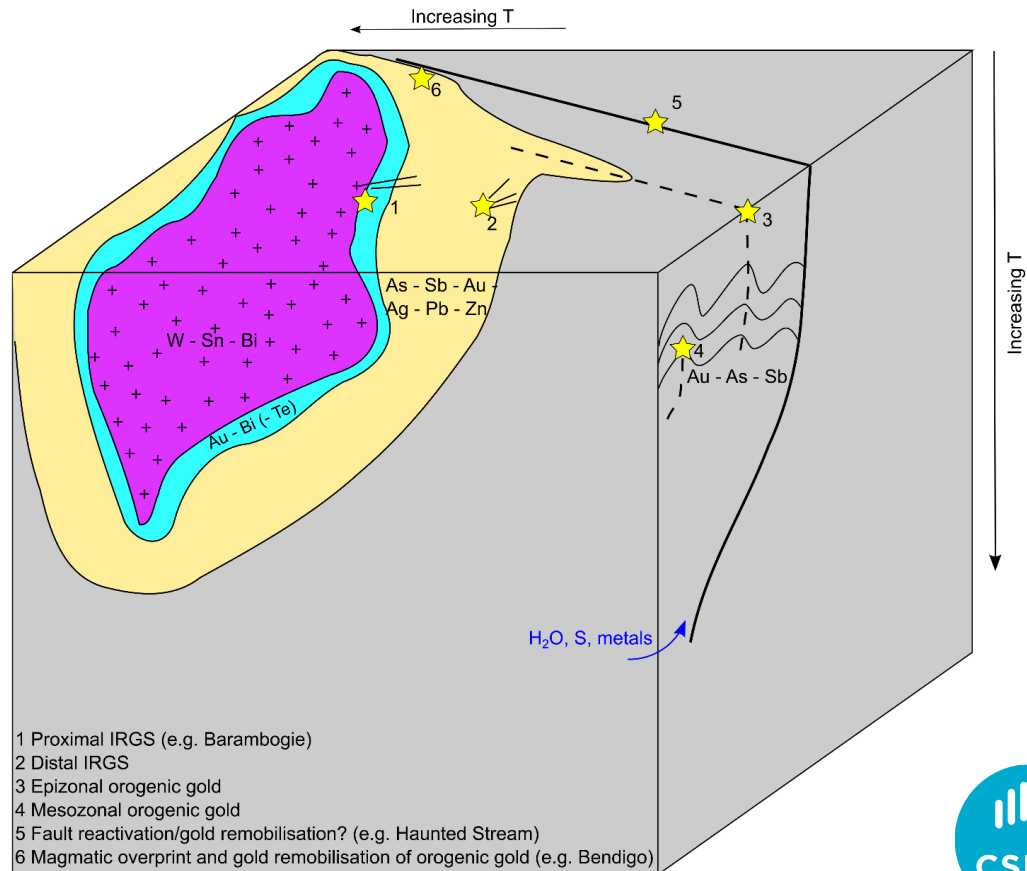
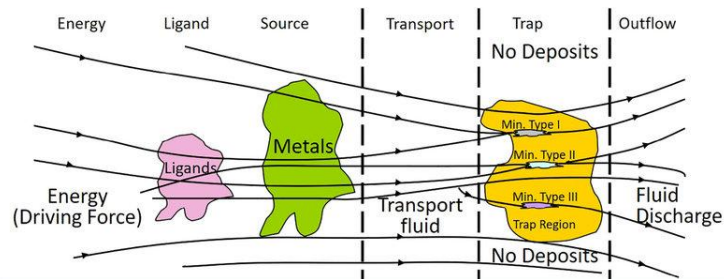
Apatite compositions

A potential indicator to distinguish IRGS and orogenic gold



- Apatite compositions differ between intrusion-related and orogenic-style gold mineralisation
- IRGS:** low Sr/Y, Th/U, negative Eu anomaly, high Mn/Fe (reduced fluids) & HREE/MREE
- Orogenic gold:** high Sr/Y, Th/U, positive Eu anomaly, low Mn/Fe (oxidised fluids) & HREE/MREE
- Mn/Fe > redox
- Sr/Y > fractional crystallisation of plagioclase or early saturation of apatite and delayed plagioclase crystallisation.

Key takeaways





minexcrc.com.au