Gold-Antimony systems in Victoria

Discoveries in the Tasmanides



11 September 2026

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We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it.

We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

Resources Victoria is committed to genuinely partnering with Victorian Traditional Owners and Victoria's Aboriginal community to progress their aspirations.

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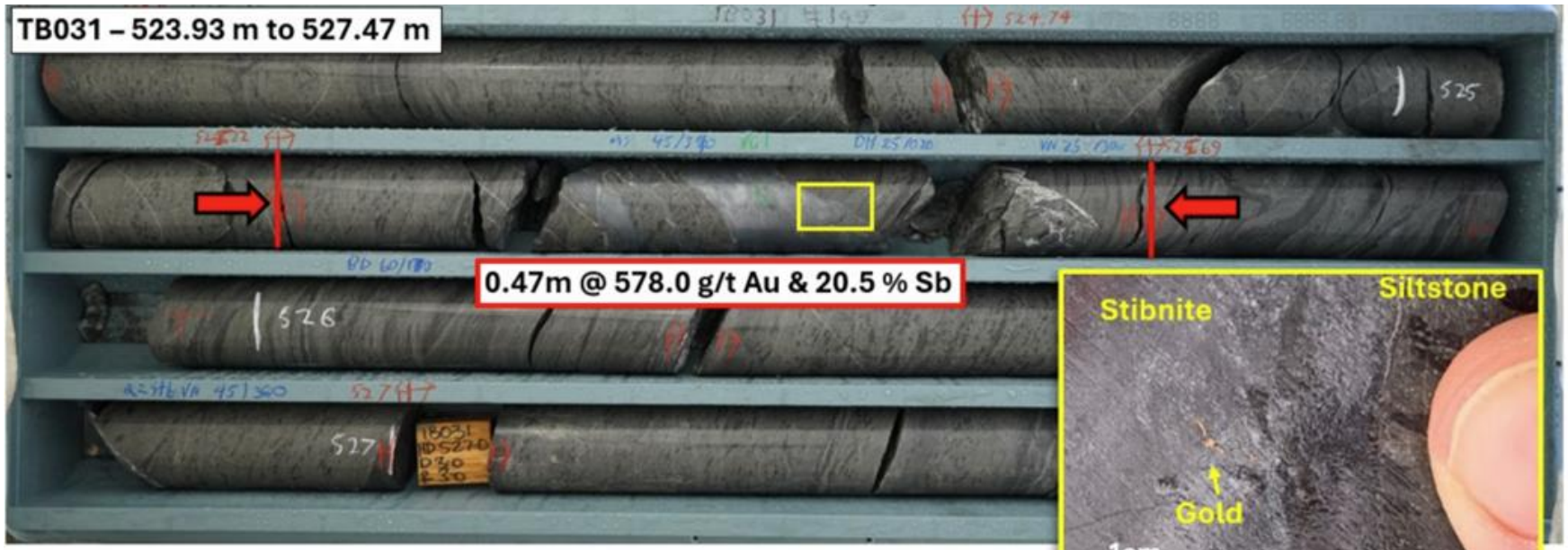
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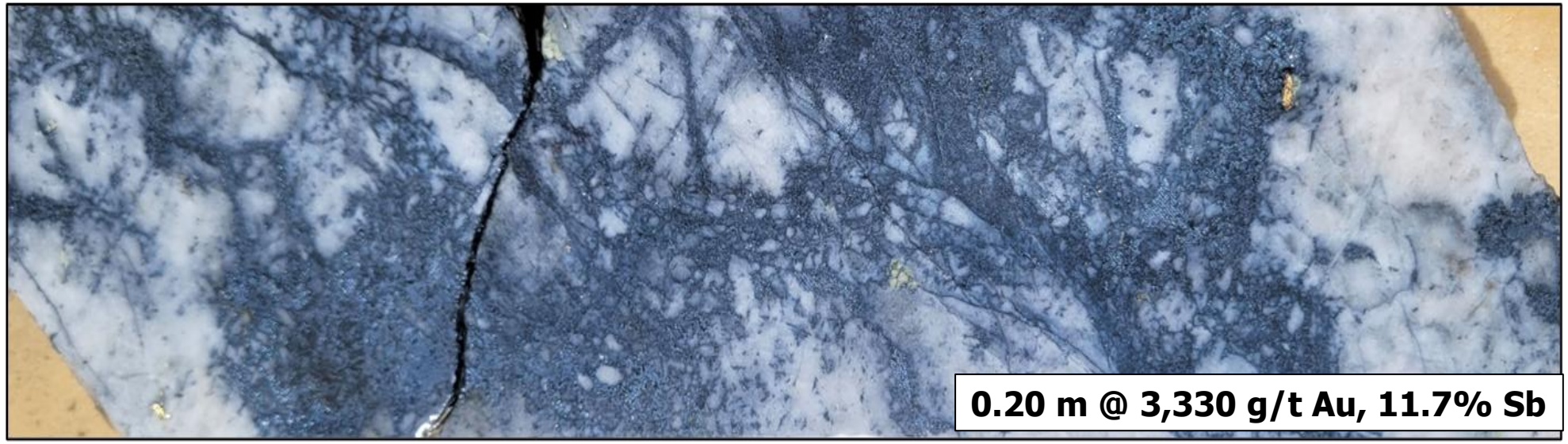
Reference

Andrews, T.A. Cairns C.P., Boger S.D., Waugh S.A.F., Pintér Z., Travers S.J., Farmer N., Cayley R.A. & Creaser R.A. 2026, Gold-Antimony systems in Victoria, Discoveries in the Tasmanides, Orange.

Why gold-antimony?



Costerfield, True Blue, TB031, 525.5m

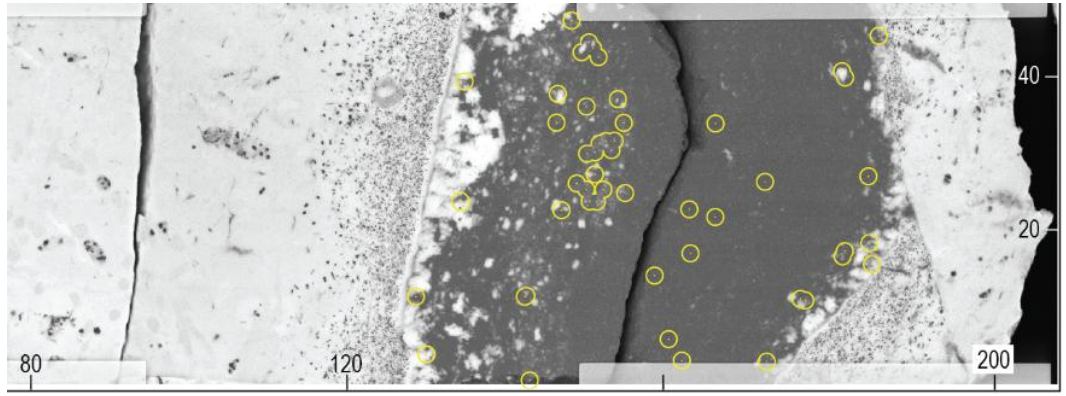


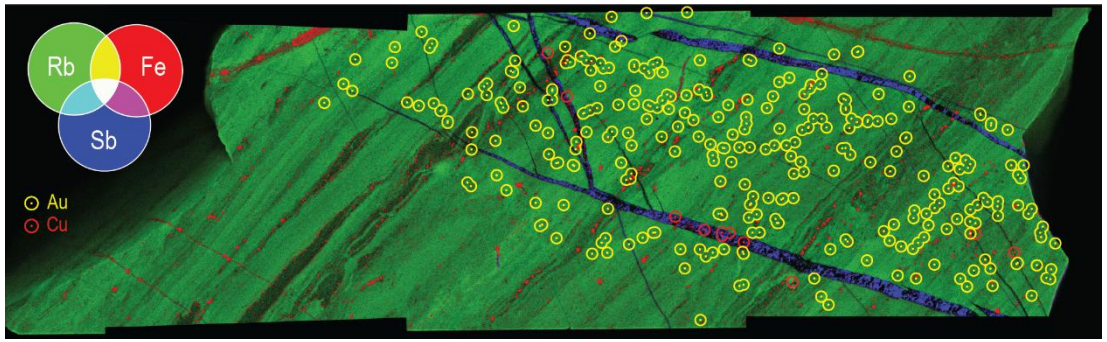
Sunday Creek, Rising Sun, SDDSC144, 776.6m

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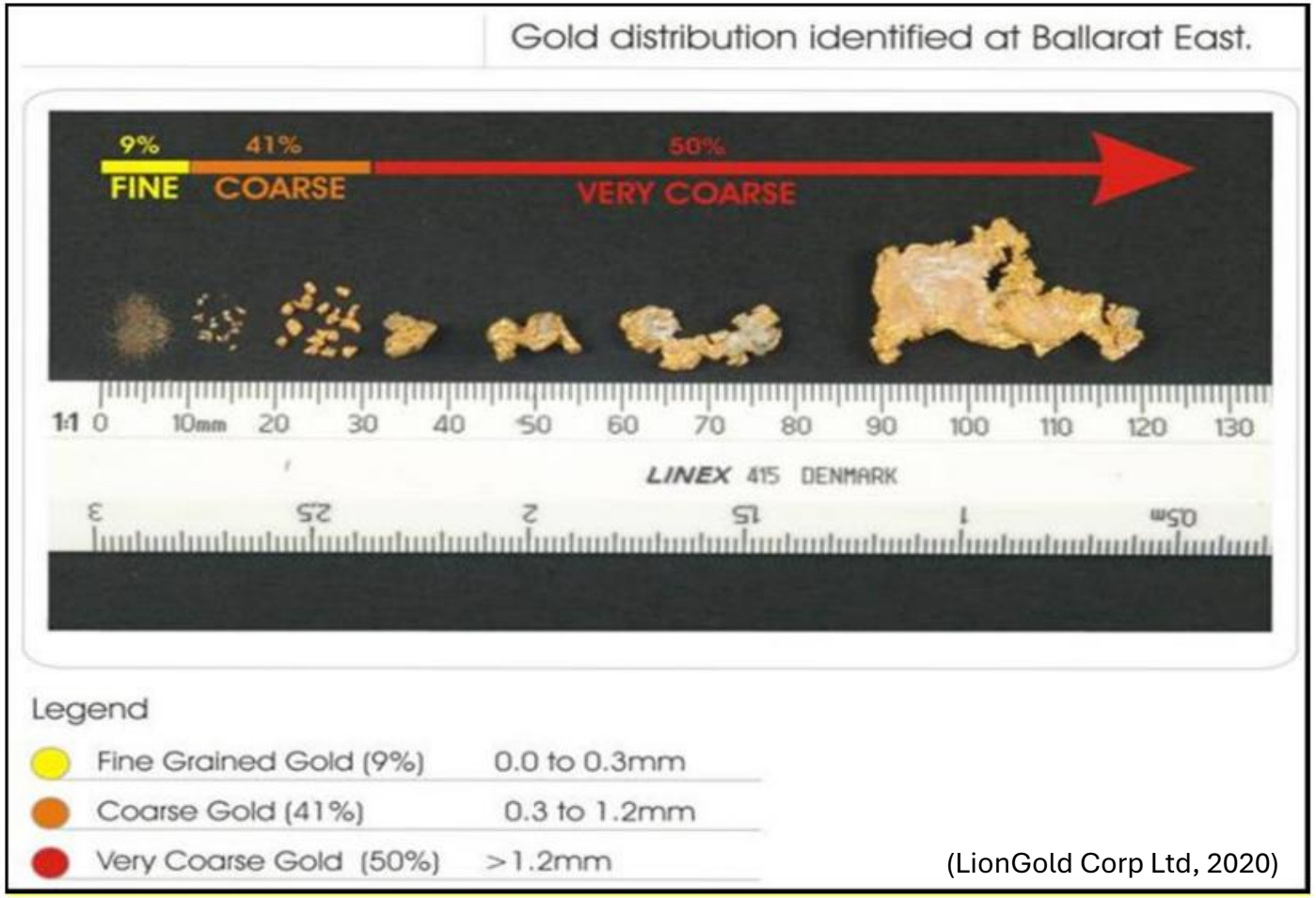
Gold grain size and distribution

Tabberabberan gold – antimony: Costerfield, Sunday Creek, Fosterville





Benambran gold: Ballarat, Bendigo

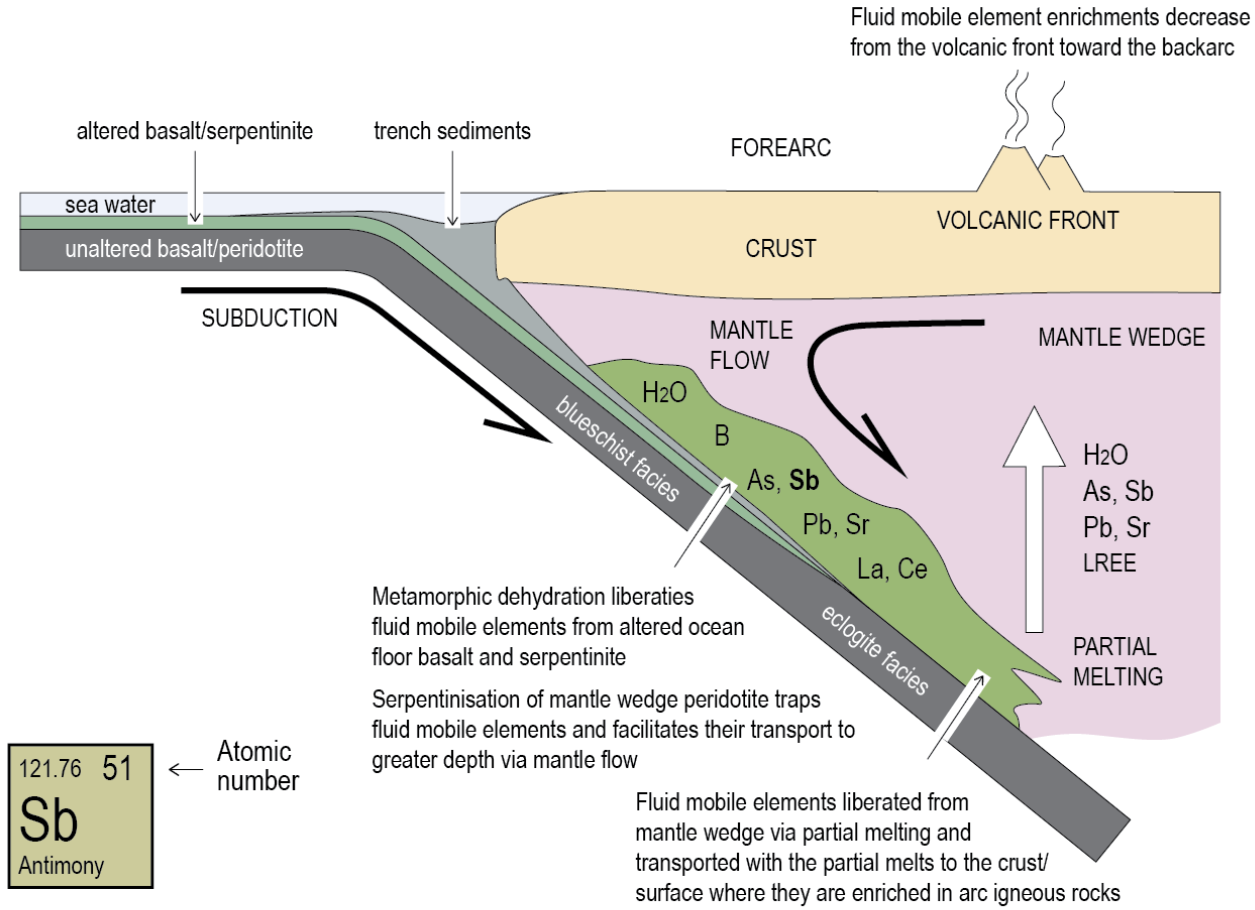


(LionGold Corp Ltd, 2020)

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Crustal antimony cycle

- Antimony metasomatically added to MORB and peridotite during serpentinisation
- Introduced to mantle wedge via subduction
- Mobilised into the crust via partial melting of enriched mantle
- Antimony becomes enriched in arc igneous rocks
- Forms an enriched crustal reservoir available for remobilisation

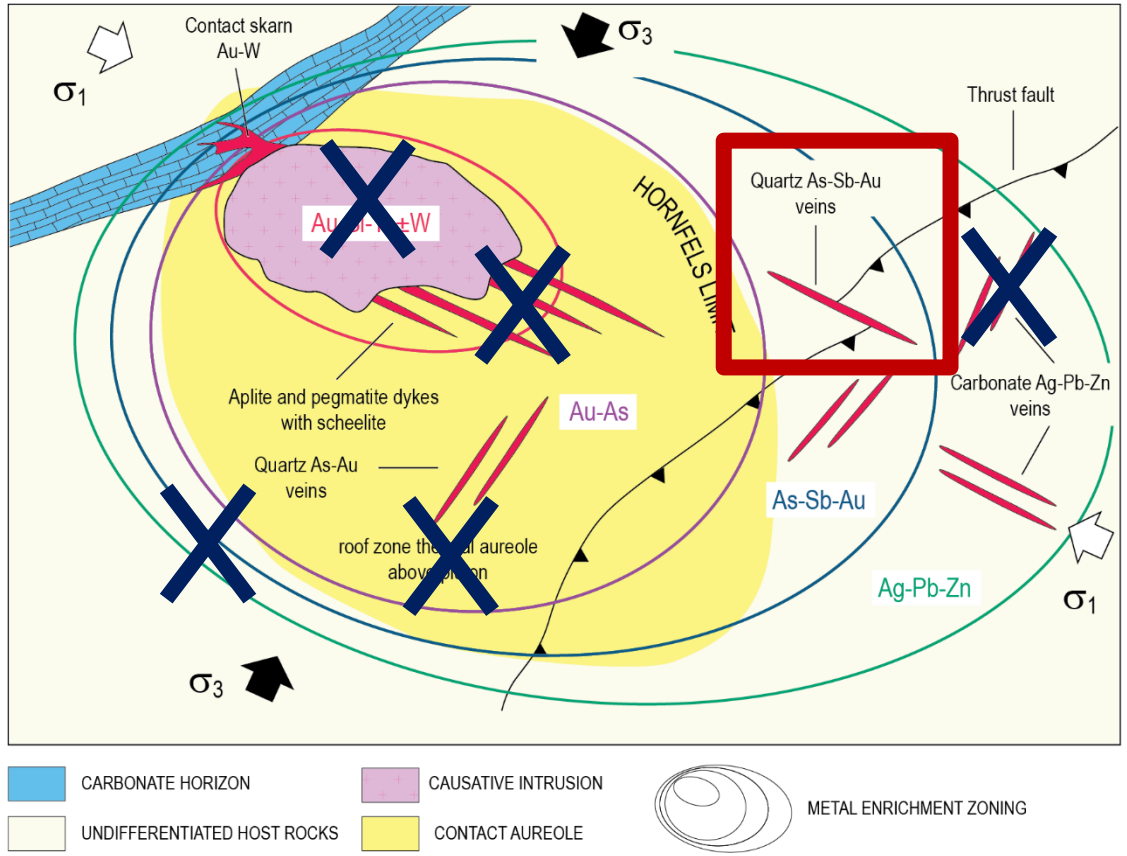


(Cairns et al., 2026)

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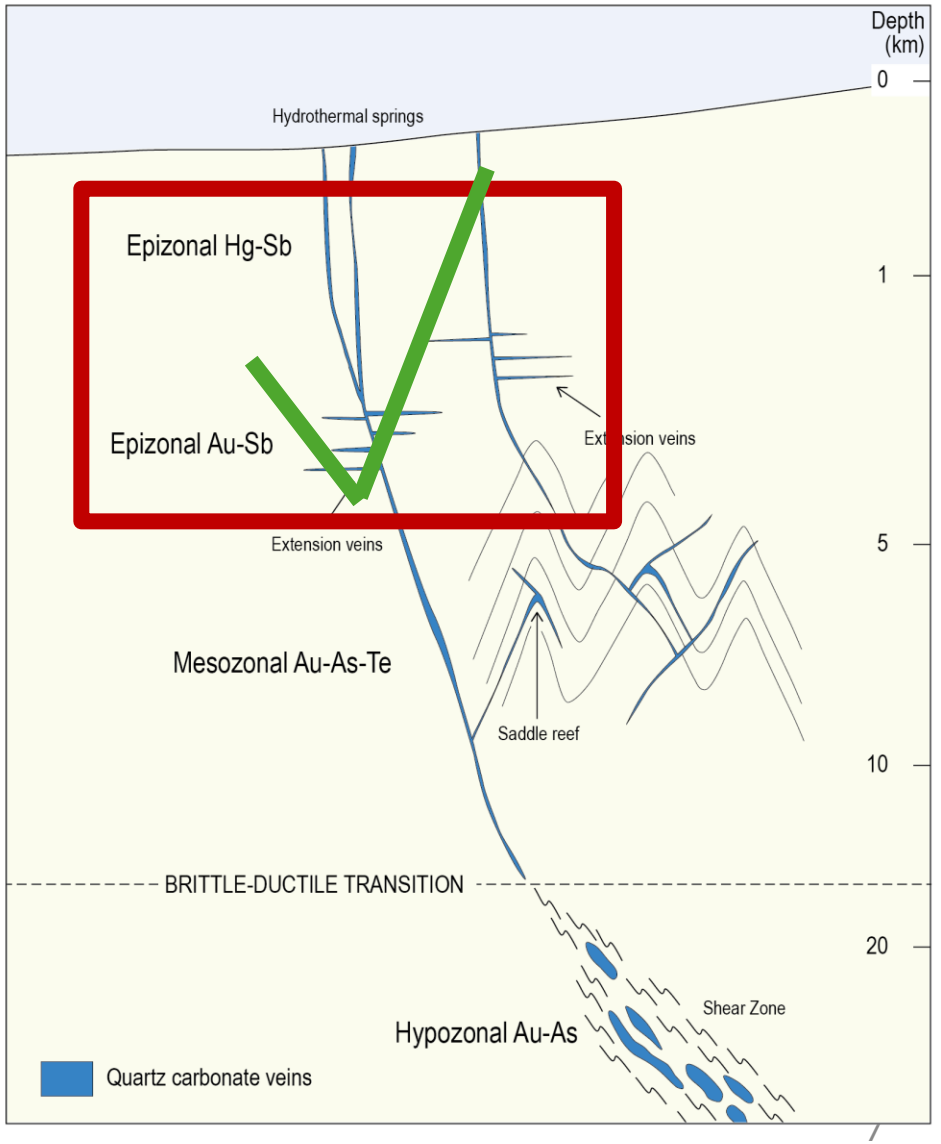
Mineral system candidates

Reduced intrusion related distal gold-antimony

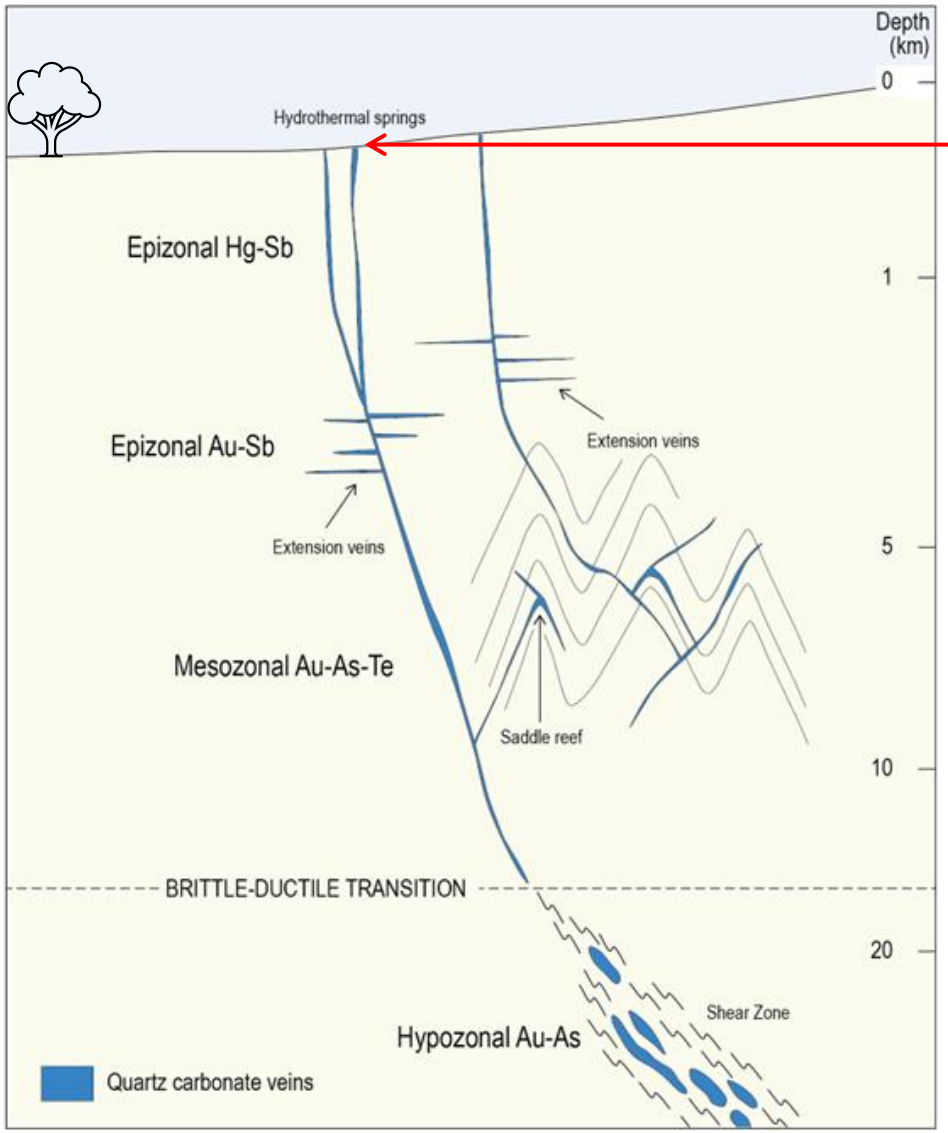


X - Fluid inclusion chemistry – not saline enough

Epizonal orogenic gold-antimony



Temperature



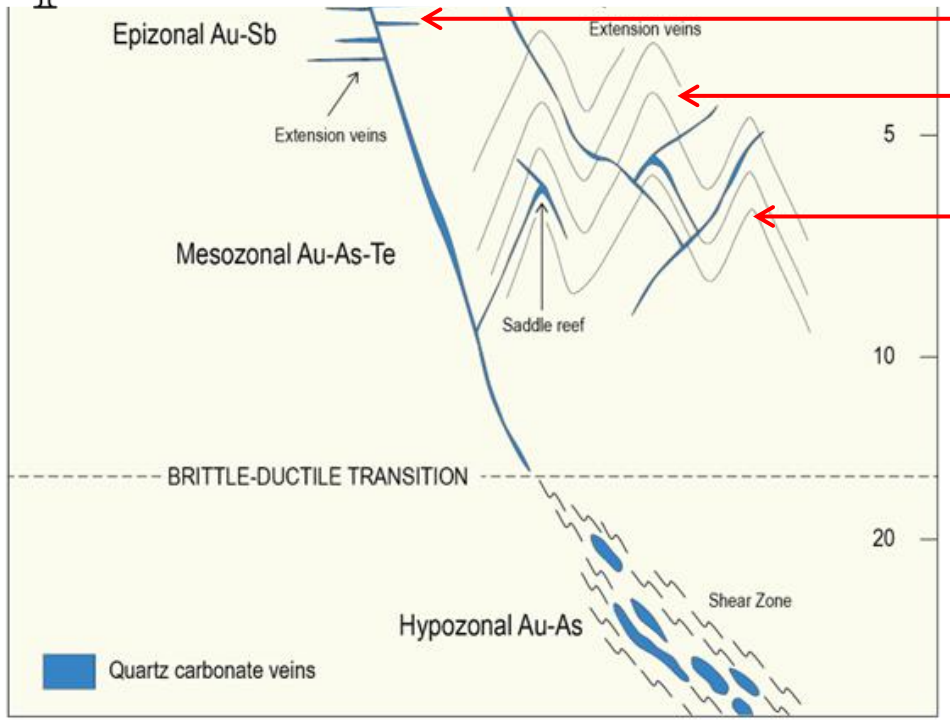
Schematic representation of crustal depth and structural style of orogenic Au-As-Te-Sb-Hg deposits (after Cox et al., 1991; Groves et al., 1998).



Champagne Pool,
Waiotapu geothermal field,
Taupo Volcanic Zone,
New Zealand



Depth and temperature



Costerfield

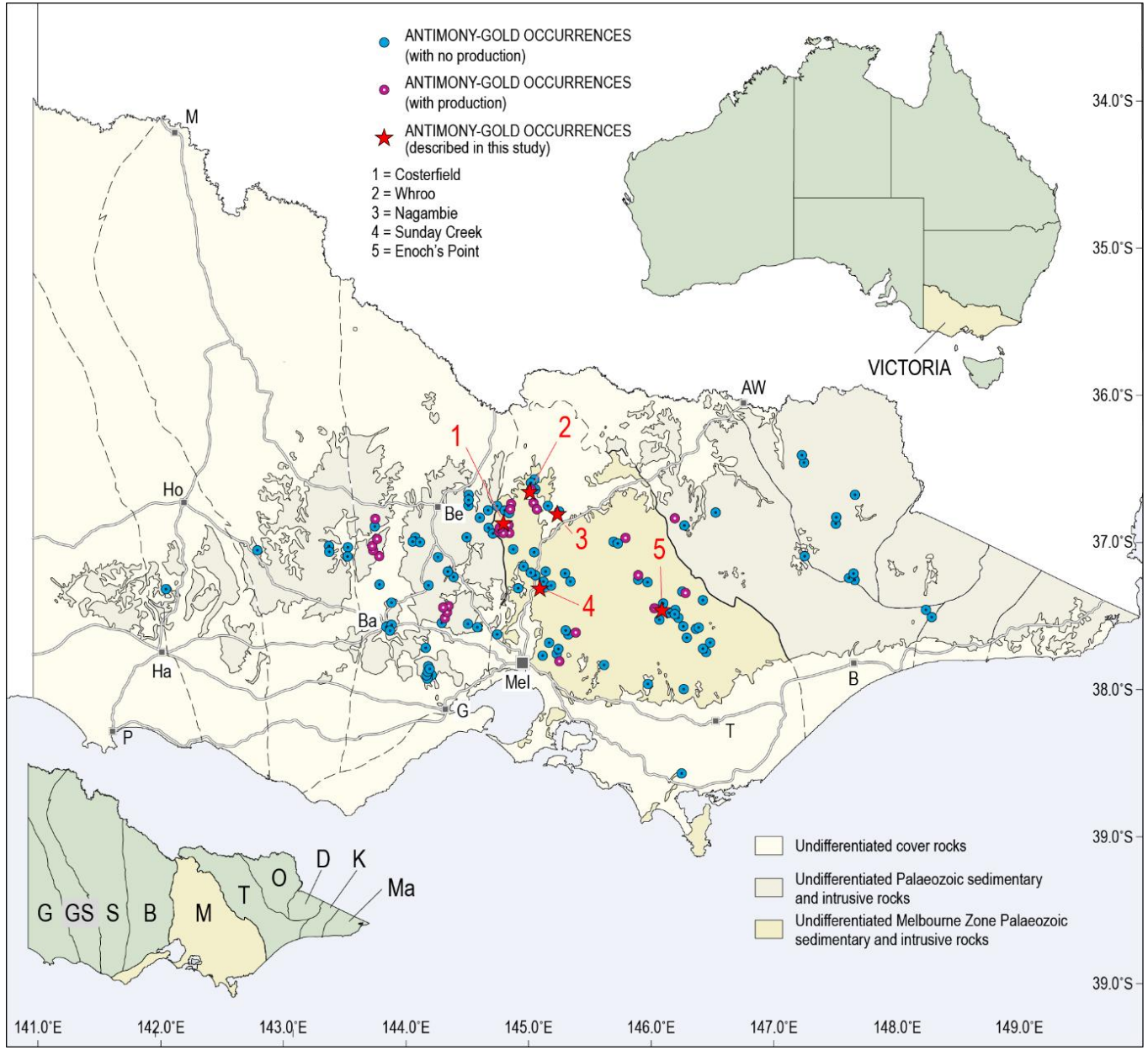
Fosterville?

Bendigo

Schematic representation of crustal depth and structural style of orogenic Au-As-Te-Sb-Hg deposits (after Cox et al., 1991; Groves et al., 1998).

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Victoria's gold-antimony occurrences



Discovery: 1853

Occurrences: 255

First ore: 1854

Production centres: 126

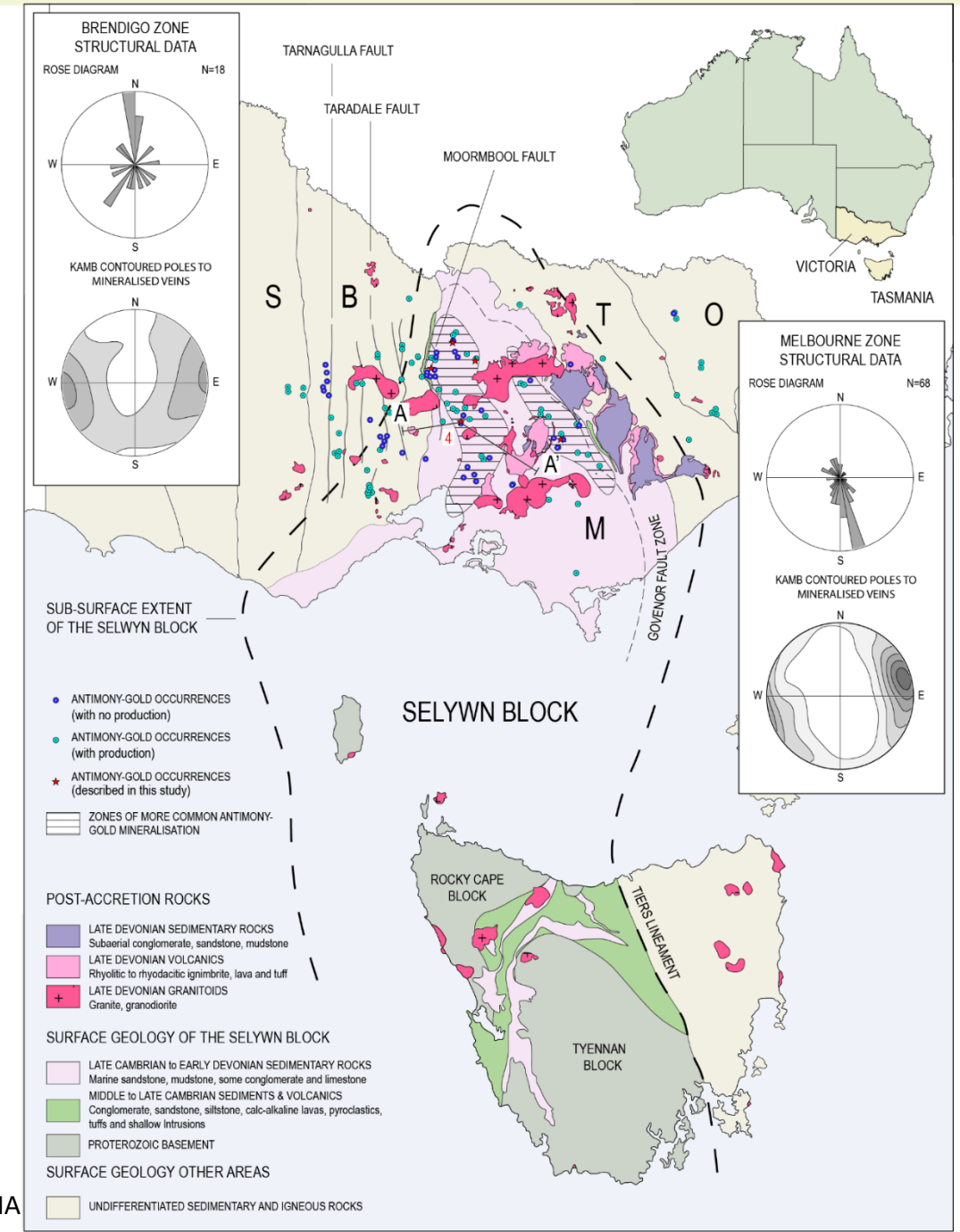
Total production (end 2025):
>2.15Mt antimony ore
~113,000t antimony concentrate

Largest deposit:
Costerfield (ca. 2Moz AuEq)
1,093,000Moz Au
111,000t Sb
95% of ore tonnes since 2006

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The Selwyn Block

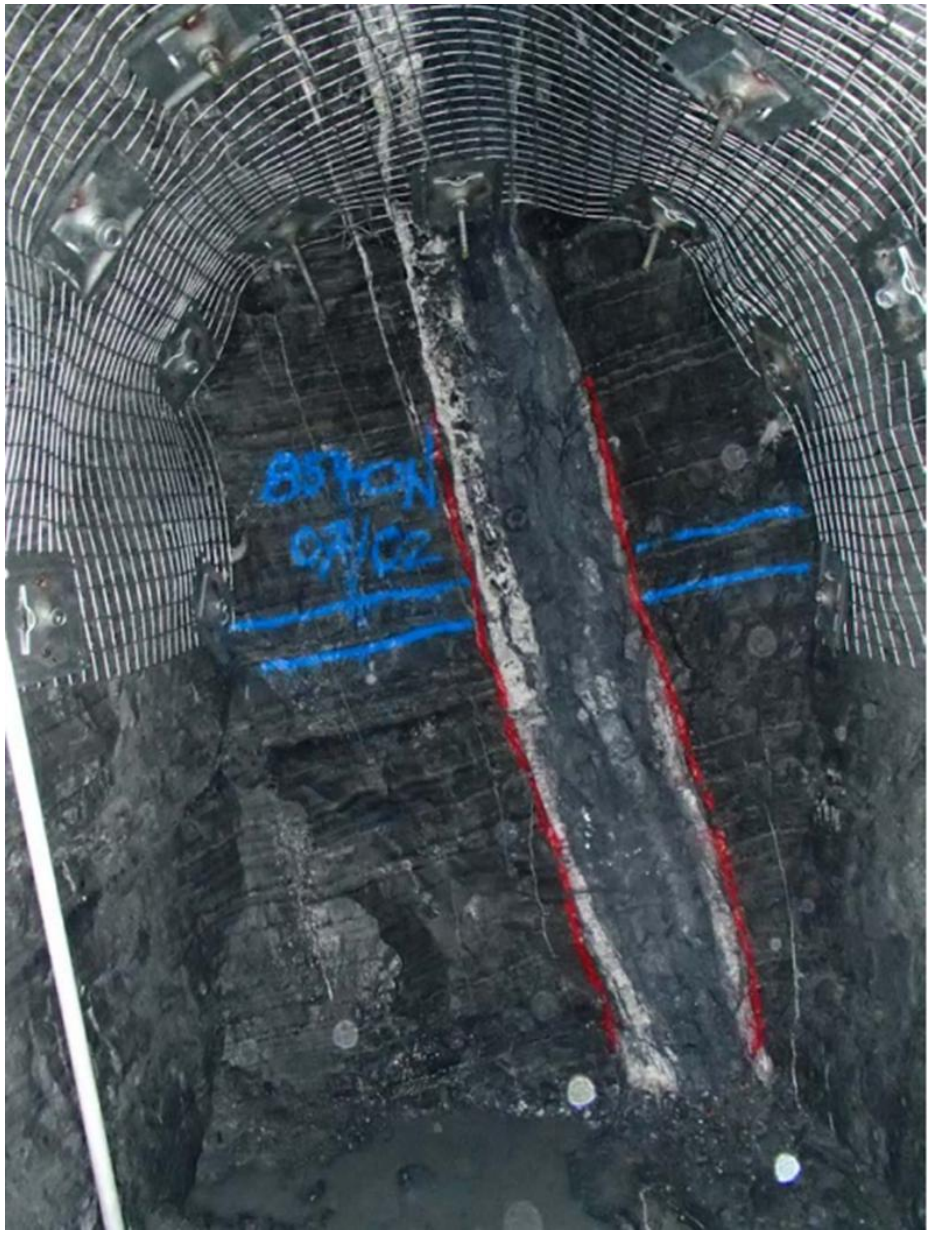
- Antimony mines focussed above the Selwyn Block
- Proterozoic – Cambrian microcontinent
- Basement to the Melbourne Zone
- Exposed in fault bounded windows in the Governor Fault Zone, Waratah Bay and Barrabool Hills
- Spatially coincident with high Ba granites (Rossiter & Gray, 2008)



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Host geology and mineralisation

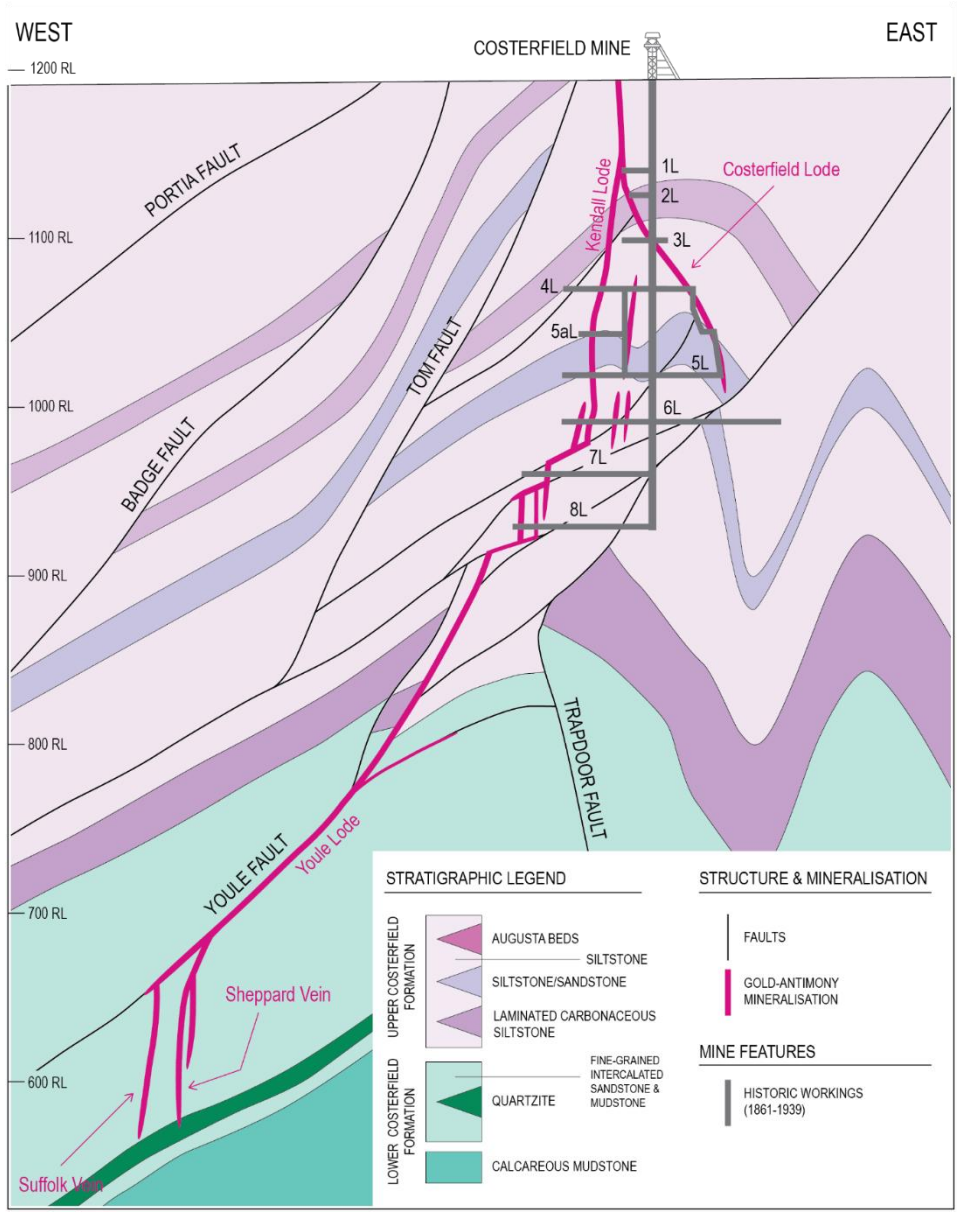
- Marine mudstone, shale, sandstone
  - Siluro-Devonian Murrindindi Supergroup (Melbourne Zone)
  - Ordovician Castlemaine Group (Bendigo Zone)
- Mafic – felsic dykes
- Massive to semi-massive quartz-stibnite-carbonate veins
  - cm's to up to 1m wide
  - 10's m to +100m, strike and down dip
  - Predominantly north-south, steep
  - ~1km vertical extent: zonation
- Primary ore minerals: Native gold, gold rich arsenopyrite, stibnite
  - **Sulphosalts**: boulangerite, jamesonite, tetrahedrite, chalcostibite, famatinite, zinkenite
  - Aurostibite (Costerfield, Coimadai, Fosterville)
  - Accessories: pyrite, lesser chalcopyrite, galena, sphalerite,
- Cryptic hydrothermal alteration
  - Pyrite, sericite, carbonate, chlorite



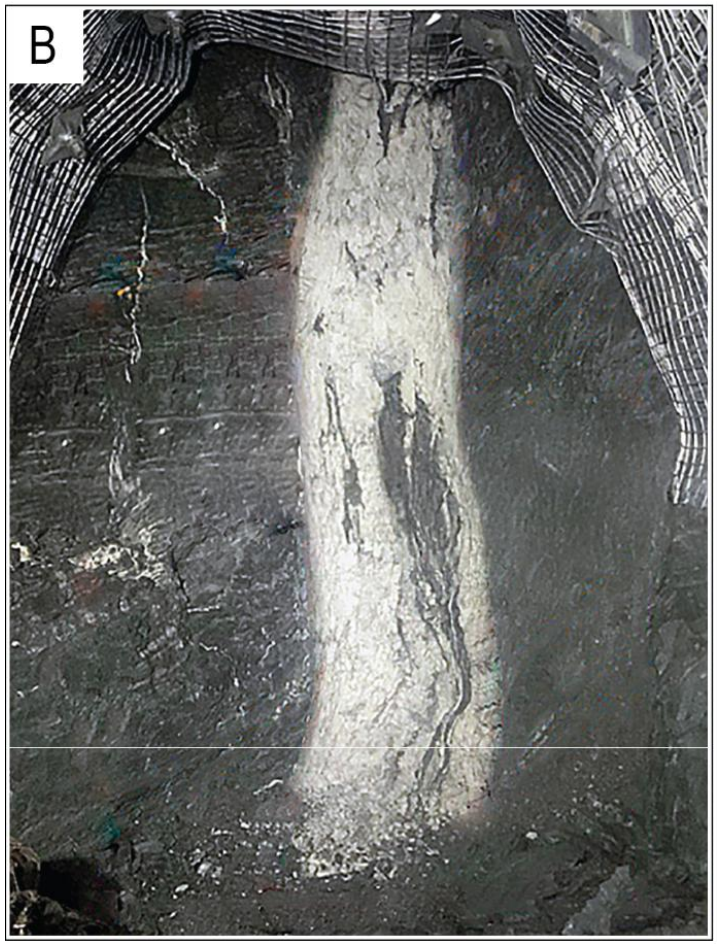
Steep dipping massive stibnite-quartz vein cross cutting bedding, Cuffley Lode, Costerfield (Fenwick, 2019).

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Costerfield



Cross section though the original Costerfield Mine and the underlying Youle and Shepherd gold-antimony lodes within the greater Costerfield deposit. Modified after Figure 7.6 of Gneil et al., (2024).



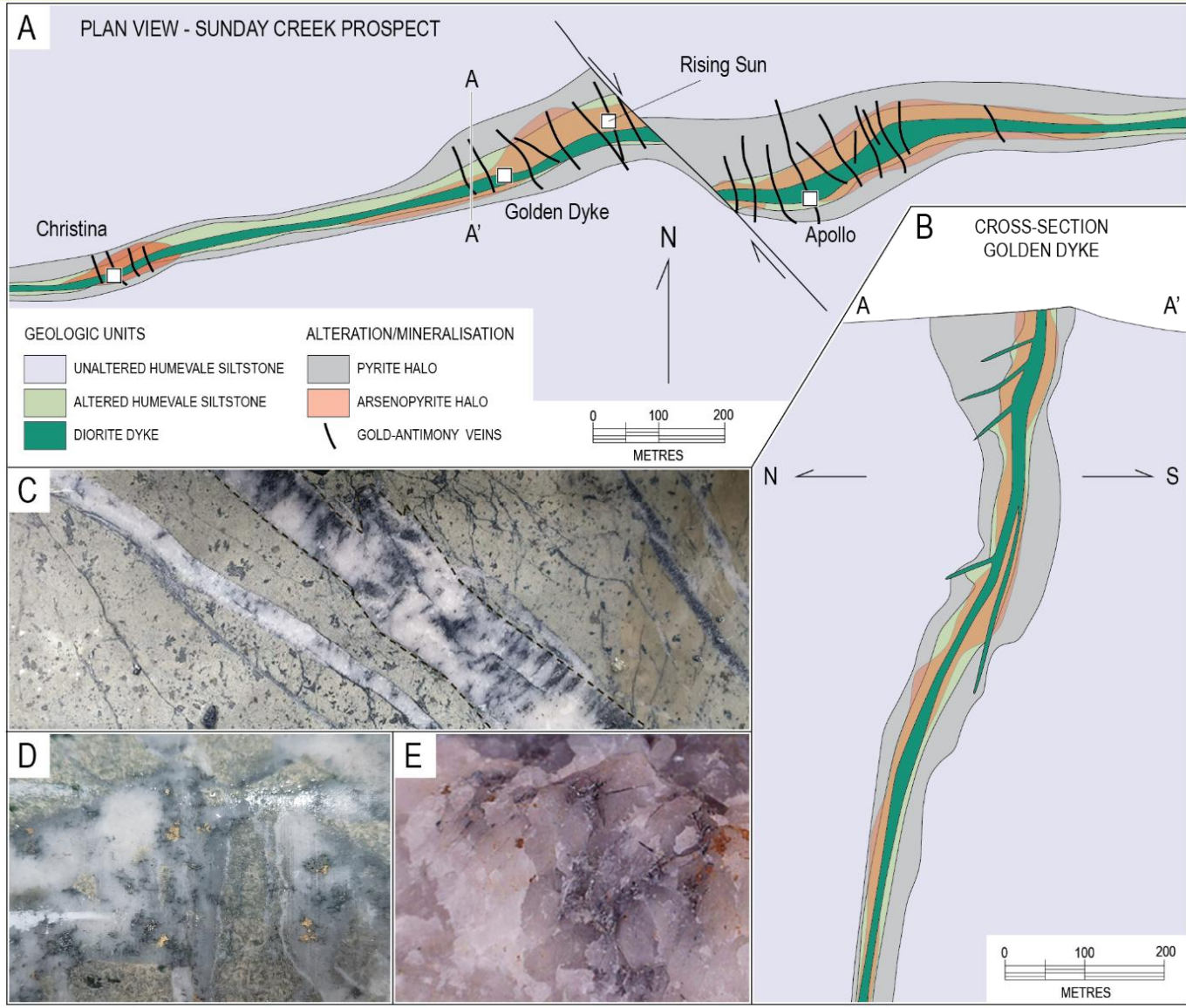
Mineralisation styles at Costerfield. Quartz-rich gold-only vein. Youle Lode, 617 Level (Bush et al., 2024).

- Mineralisation in northwest striking, steeply east and west dipping veins linked by mineralised segments of early west dipping faults
- Continuously mined since 2006 for approx. 2 million Oz gold equivalent
- Has been a top 10 highest grade gold mine globally

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Sunday Creek

- Northwest striking steeply east and west dipping gold antimony veins
- Hosted in east-west striking, steeply north dipping diorite dyke
- Historical production:
  - 41kOz Au
  - 27t ore for 3t Sb metal over 4 discontinuous years (1876-1883)
- Exploration target:
  - 10.4 – 11.9 million tonnes grading from 8.9 g/t gold equivalent (“AuEq”) to 12.1 g/t AuEq for: **3.0 Moz** AuEq to **4.6 Moz** AuEq – 4 August 2026 (Southern Cross Gold, 2026).

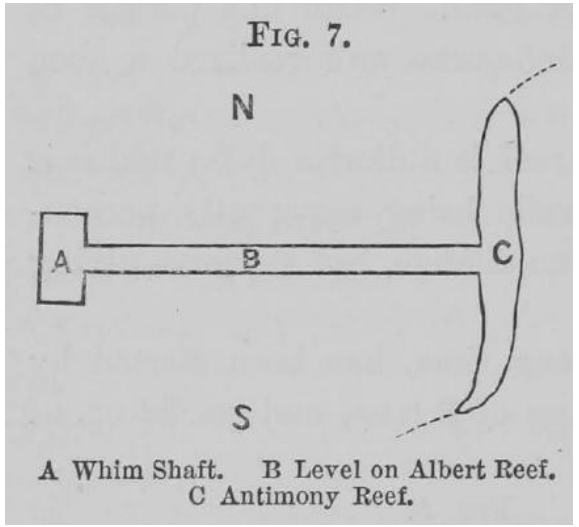


Geology and mineralisation at Sunday Creek (after Bush et at., 2024 and Southern Cross Gold (2023).

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Nagambie and Whroo

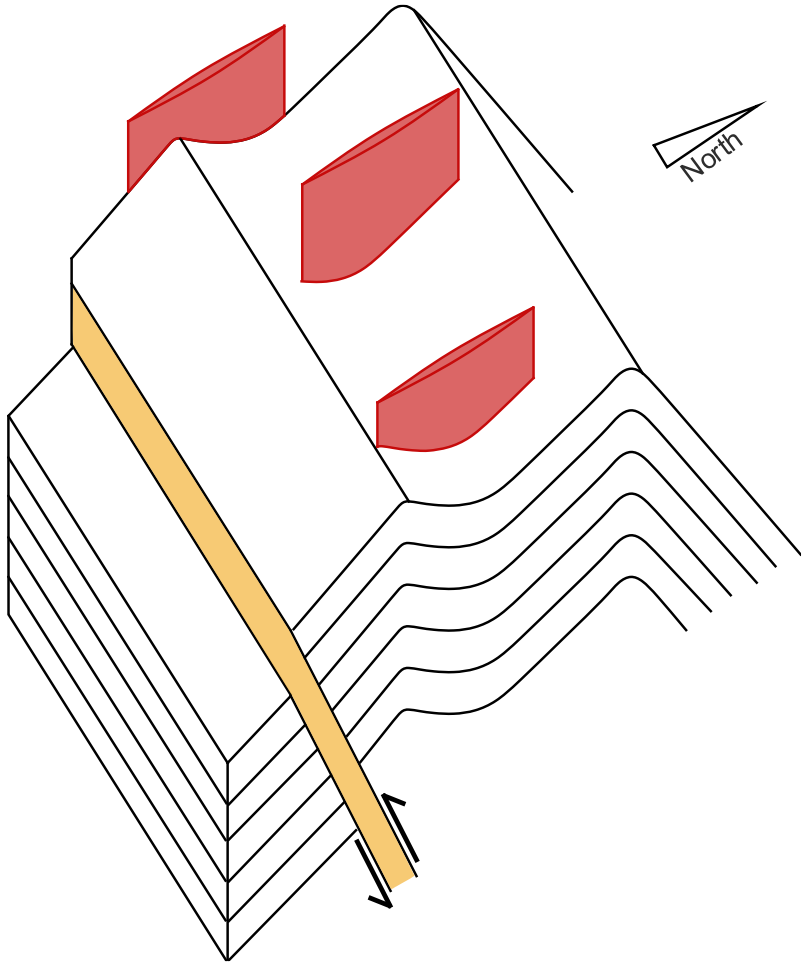
- Hosted in east-west striking anticlines
- Gold in north dipping thrust faults
- Gold-antimony in late north-south striking, sub-vertical veins, some with dextral offsets



GSV Reference ID 8860



Stibnite cemented breccia, C veins, Nagambie.



Schematic representation of fold, fault and vein architecture at Nagambie and Whroo. Gold only mineralisation hosted in north dipping thrust faults (orange). Antimony-gold hosted in sub-vertical north striking veins (red veins).

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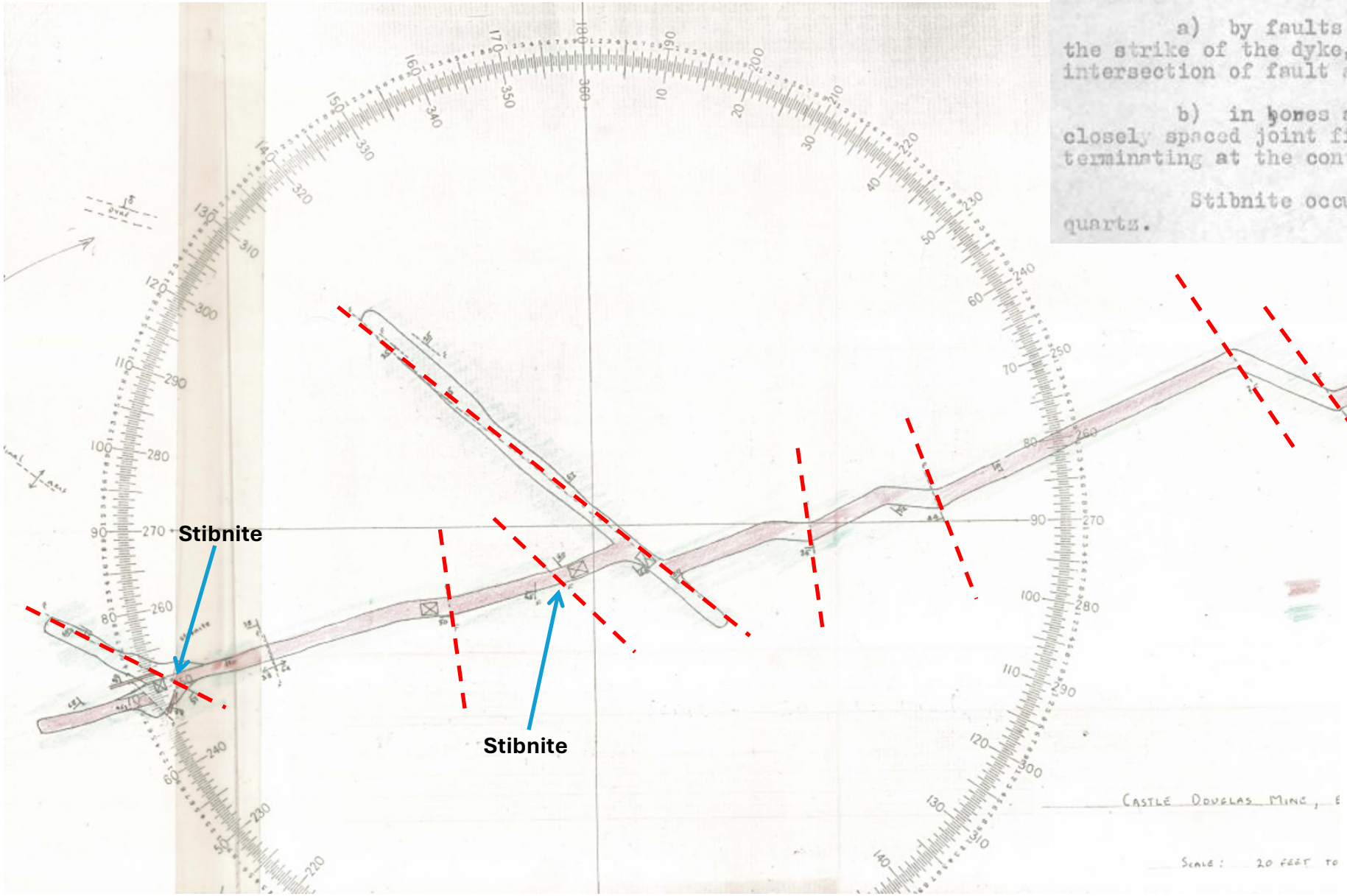
Snobs Creek / Castle Douglas

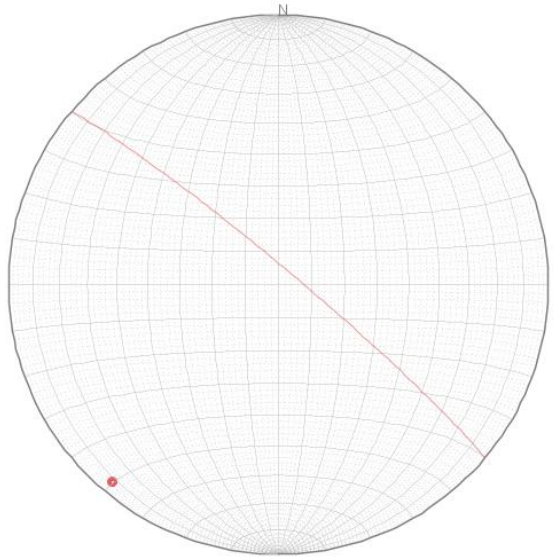
Mineralisation is structurally controlled in two ways:

a) by faults striking roughly perpendicular to the strike of the dyke, where stibnite is localised at the intersection of fault and dyke.

b) in bones along the dyke which are present as closely spaced joint fillings running, across the dyke and terminating at the contact with the country rock.

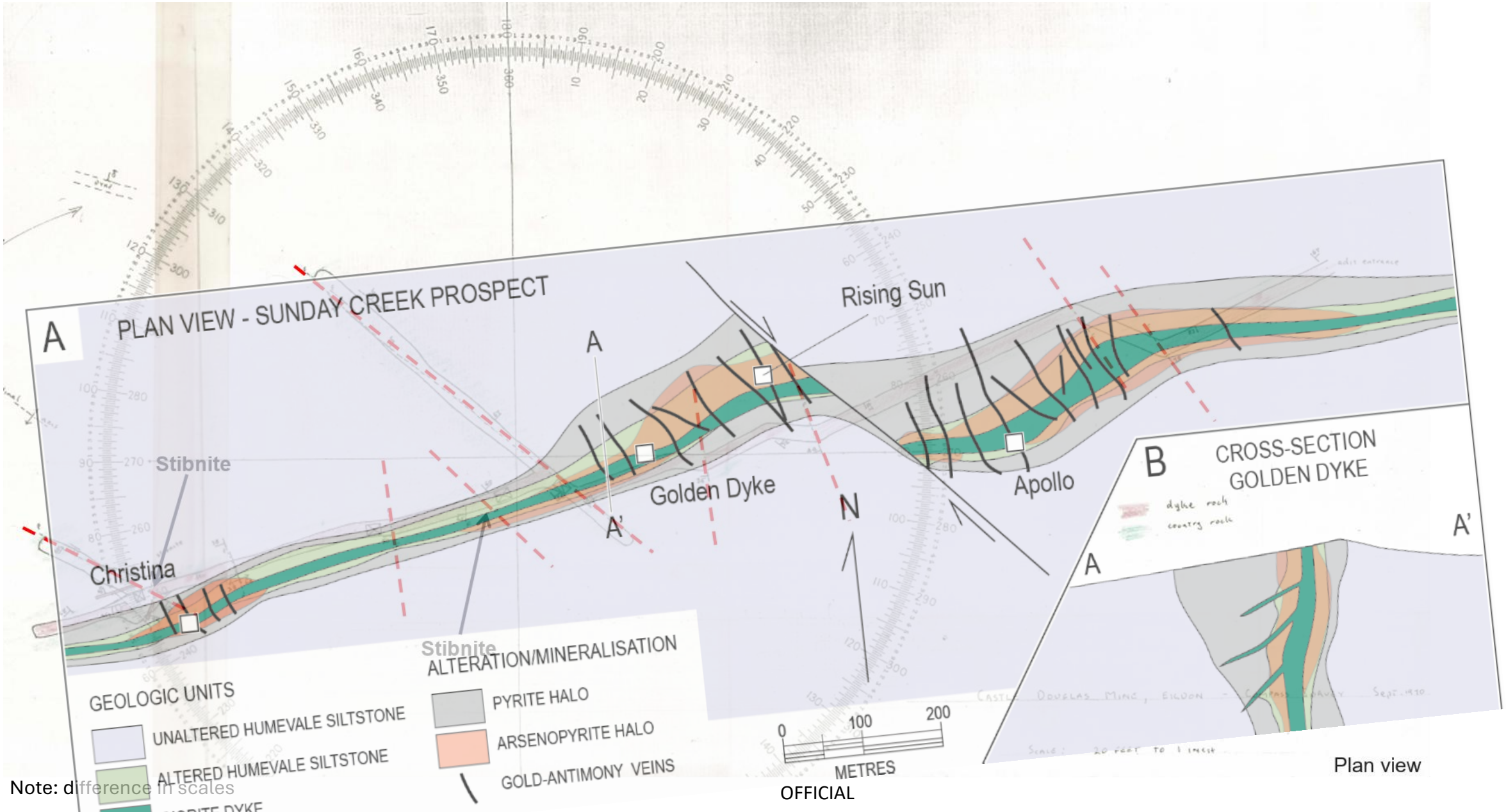
Stibnite occurs in irregular masses with or without quartz.





GSV Reference ID 1665

Sound familiar?

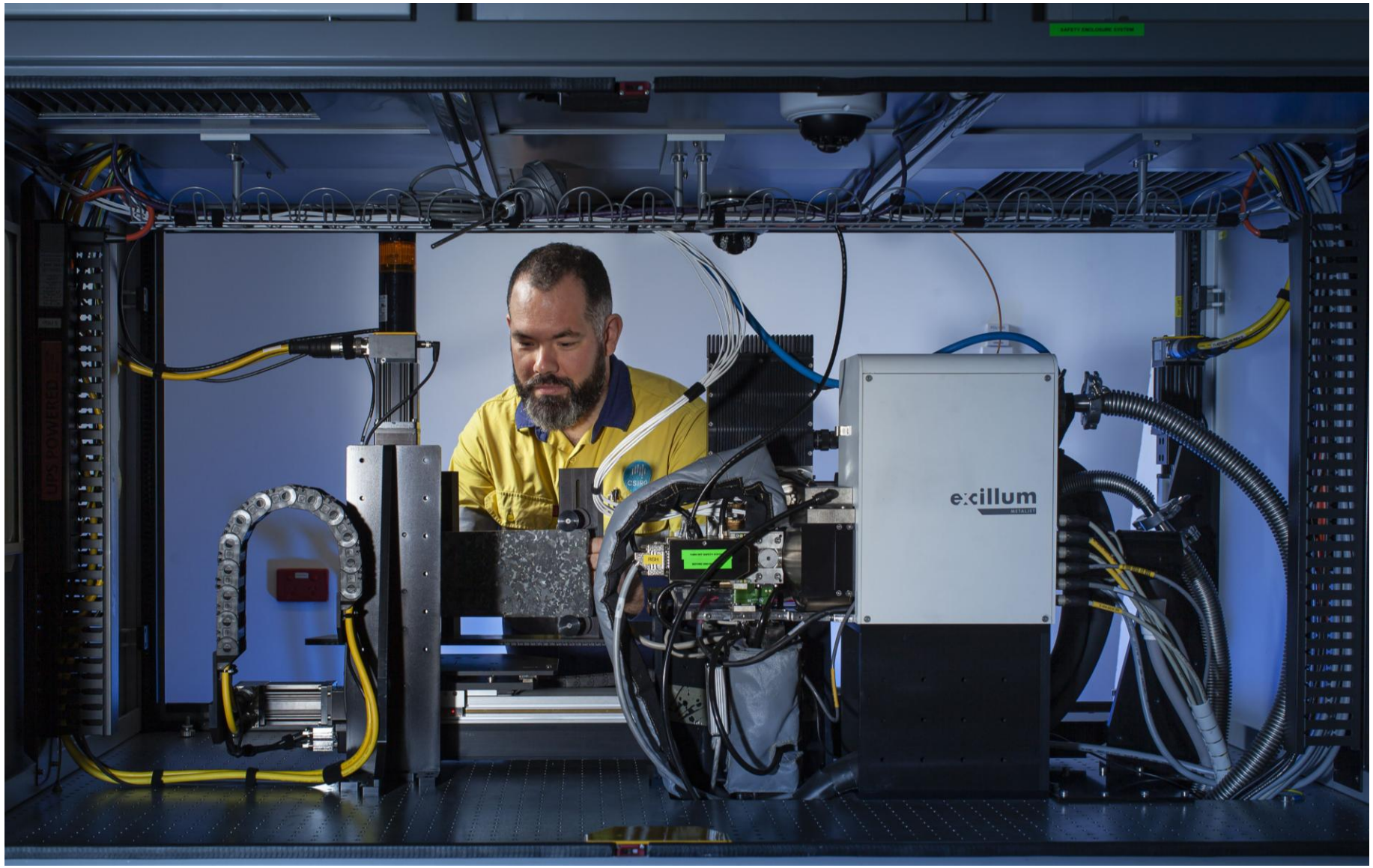


Plan view

Note: difference in scales

Maia Mapper

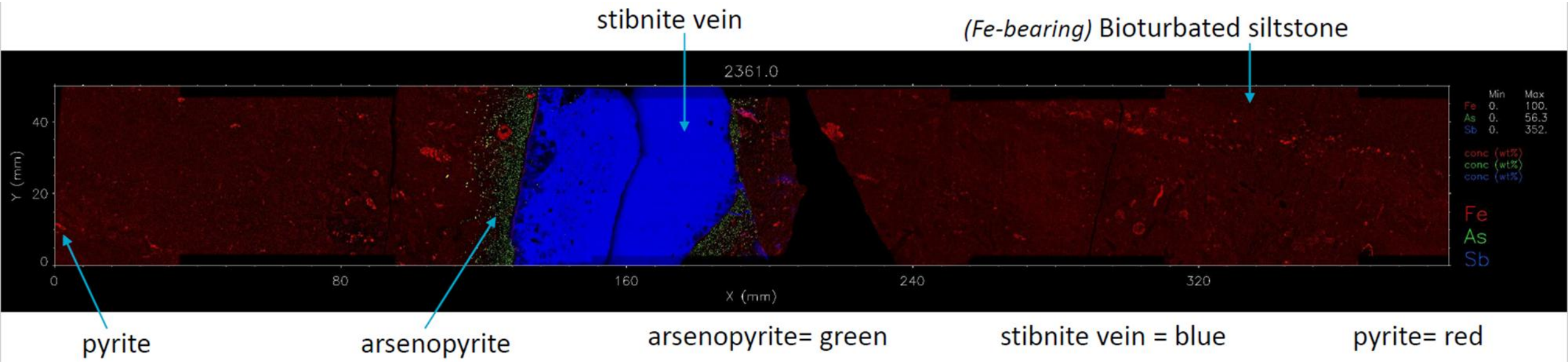
A laboratory μXRF mapping system for efficient elemental imaging of drill core.

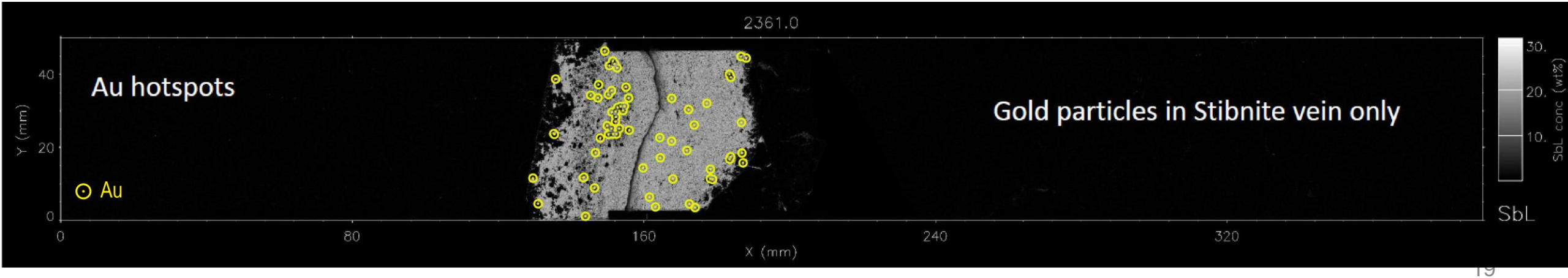


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Costerfield (Youle)

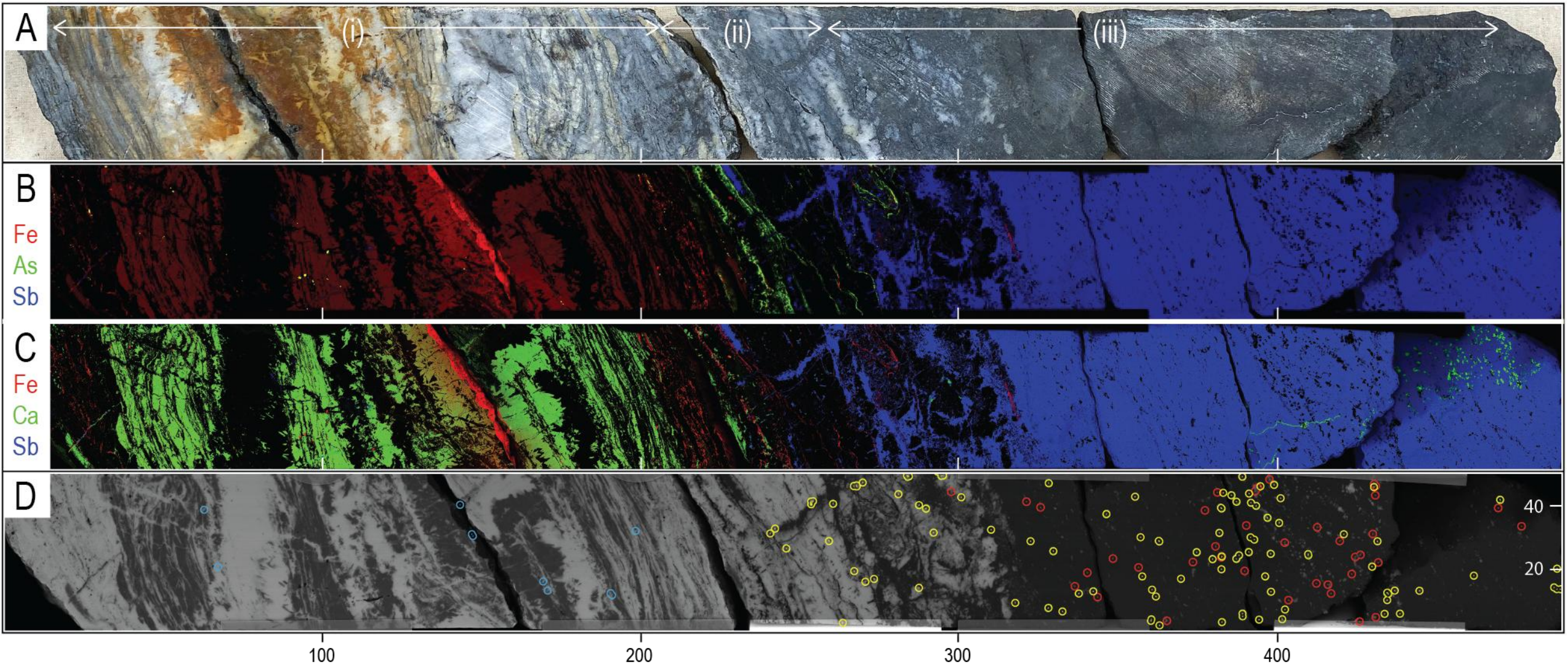
GSV sample 310415, drill hole BC120, 131.50-132.00m. The Maia map is within sample interval 131.76-131.98 43.9g/t Au and 21.0% Sb (Mandalay Resources, 2020).





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Costerfield (Youle)

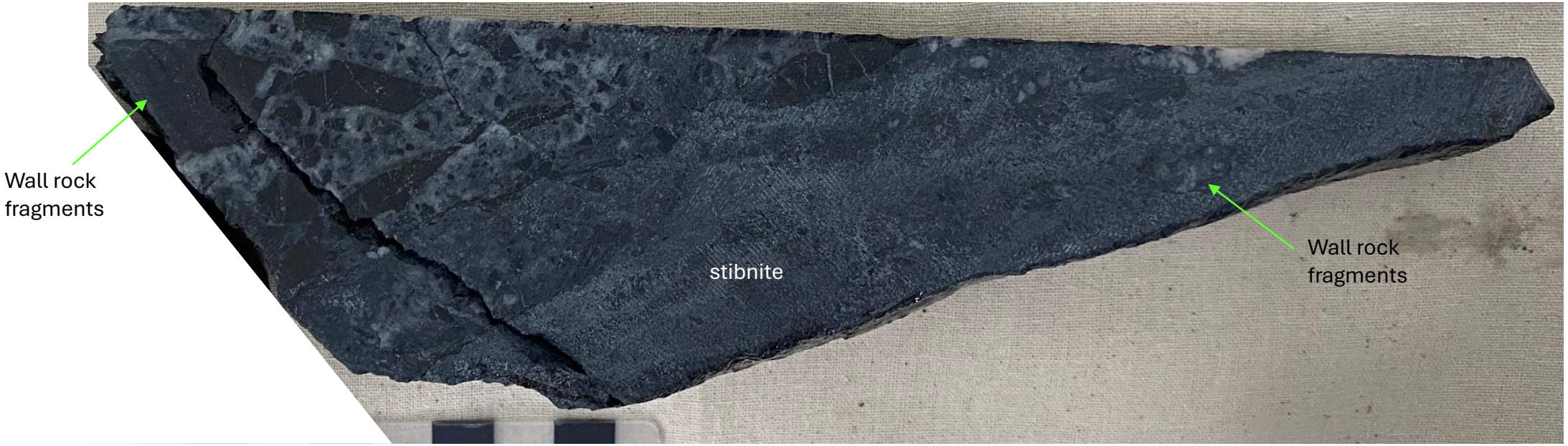


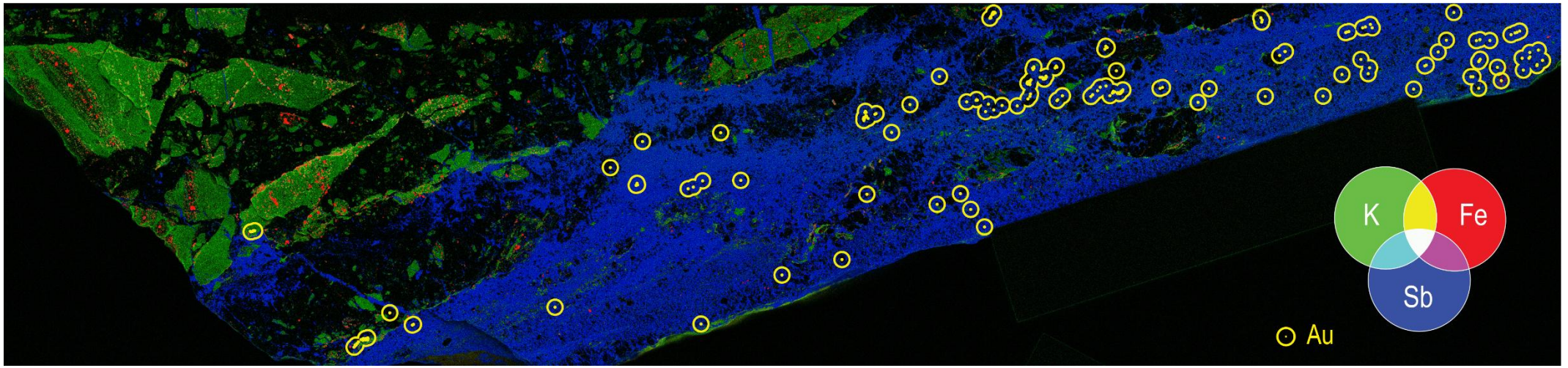
GSV sample 310406, Youle, Costerfield, drill hole BC047W1, 372.44-372.93m. Maia map.

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Sunday Creek (Apollo)

GSV sample 322114, drill hole SDDSC033, 194.20-194.45m. The Maia map occurs within sample interval 194.3 – 195.1m, 38.35g/t Au and 7.12% Sb (Mawson Gold Limited, 2022).

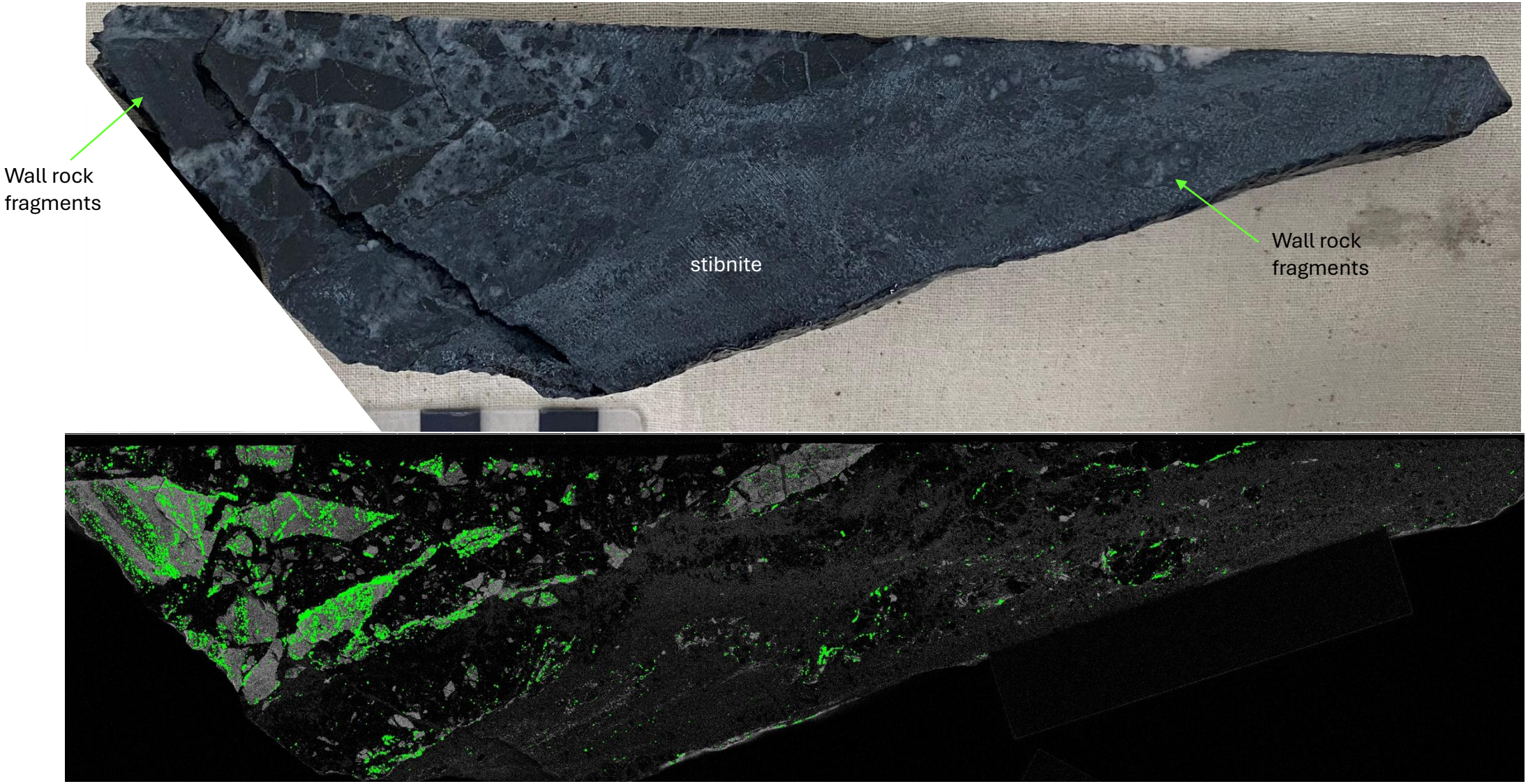




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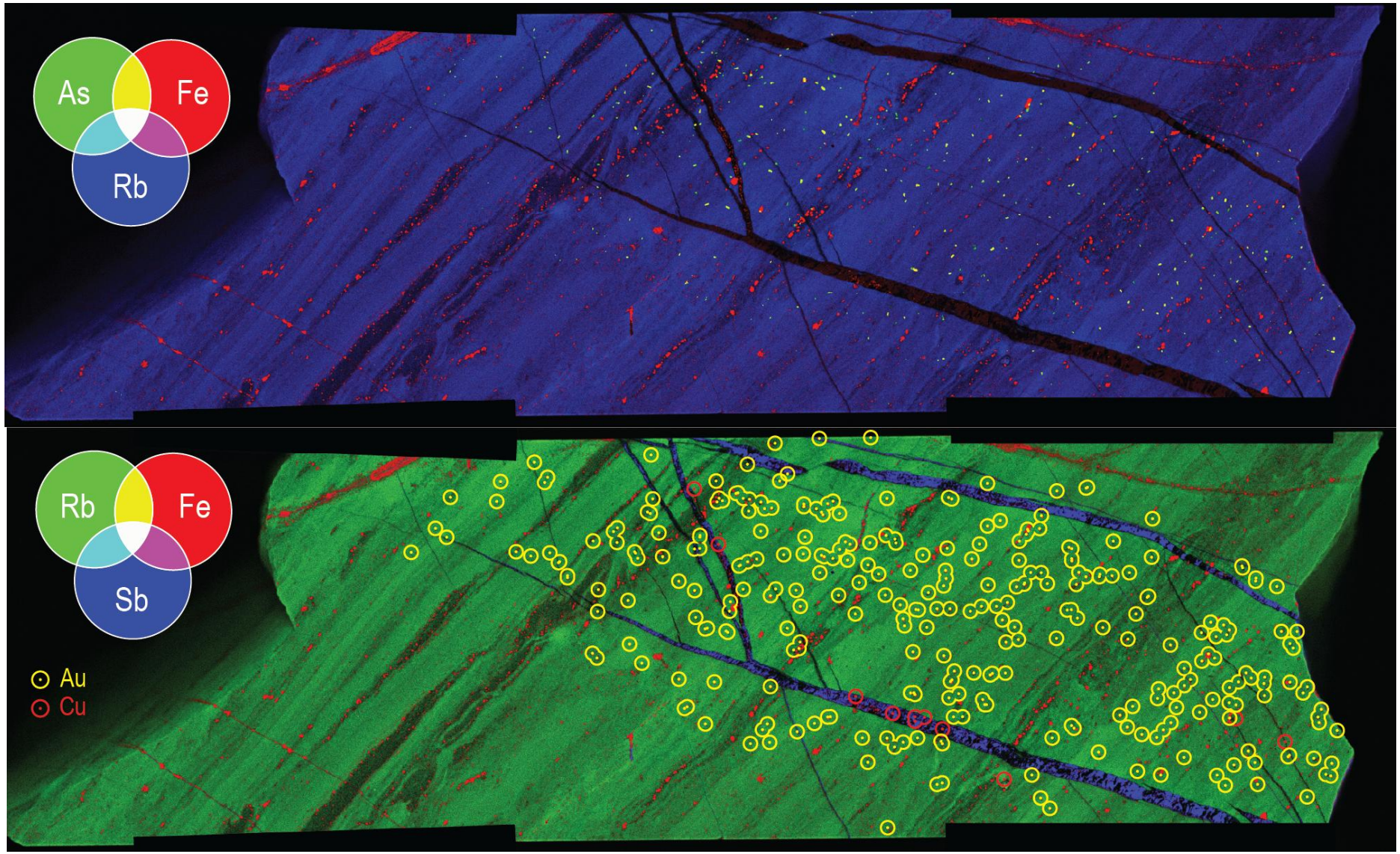
Sunday Creek (Apollo)

GSV sample 322114, drill hole SDDSC033, 194.20-194.45m. The Maia map occurs within sample interval 194.3 – 195.1m, 38.35g/t Au and 7.12% Sb (Mawson Gold Limited, 2022).



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Sunday Creek (Apollo)

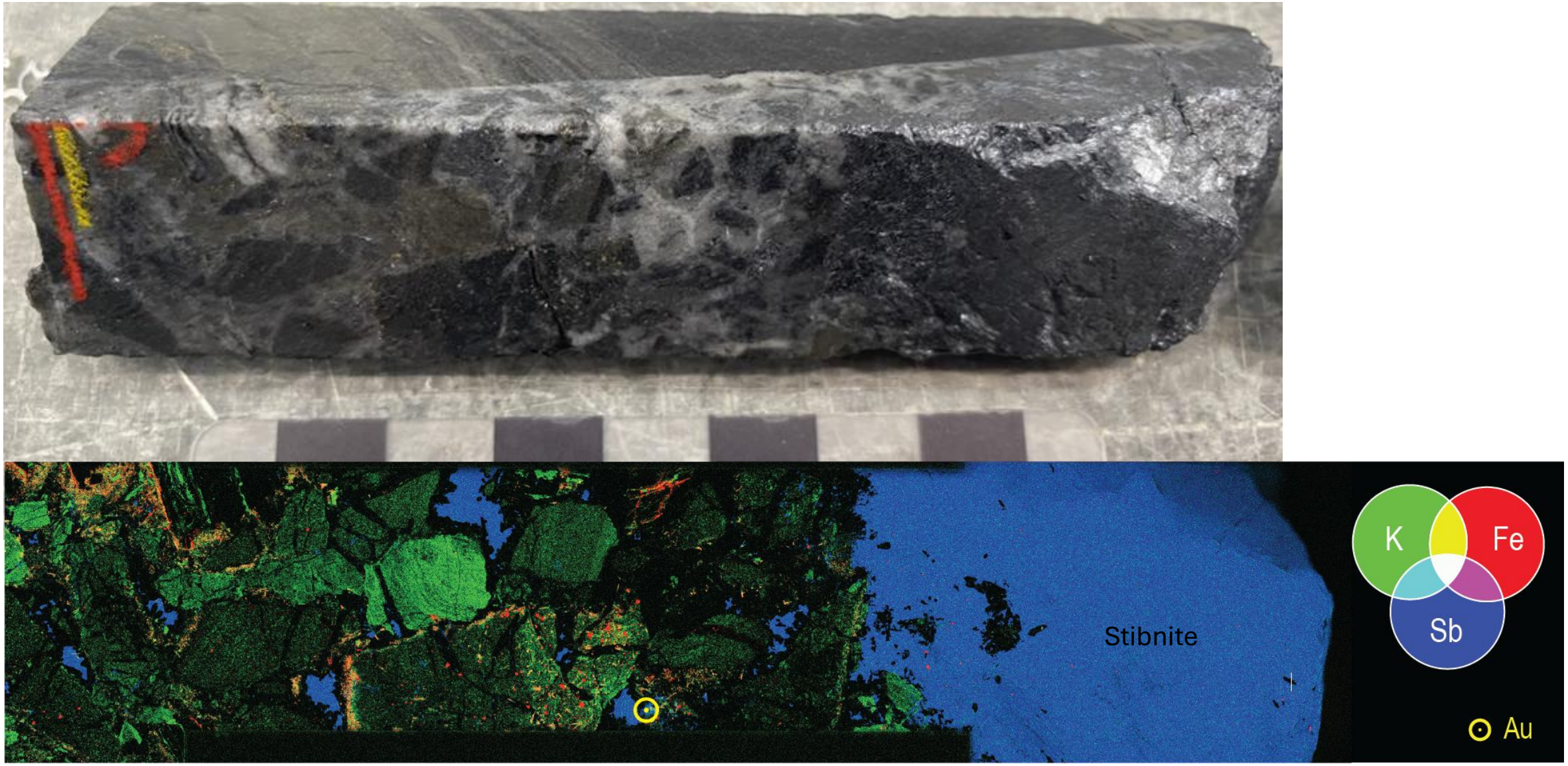


GSV sample 323029, Apollo, Sunday Creek, drill hole SDDSC066, 307.65-307.87m. The Maia map occurs within interval 307.61-307.96m, 0.9g/t Au and 0.1% Sb (Mawson Gold Limited, 2023)

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Nagambie (C1 vein east)

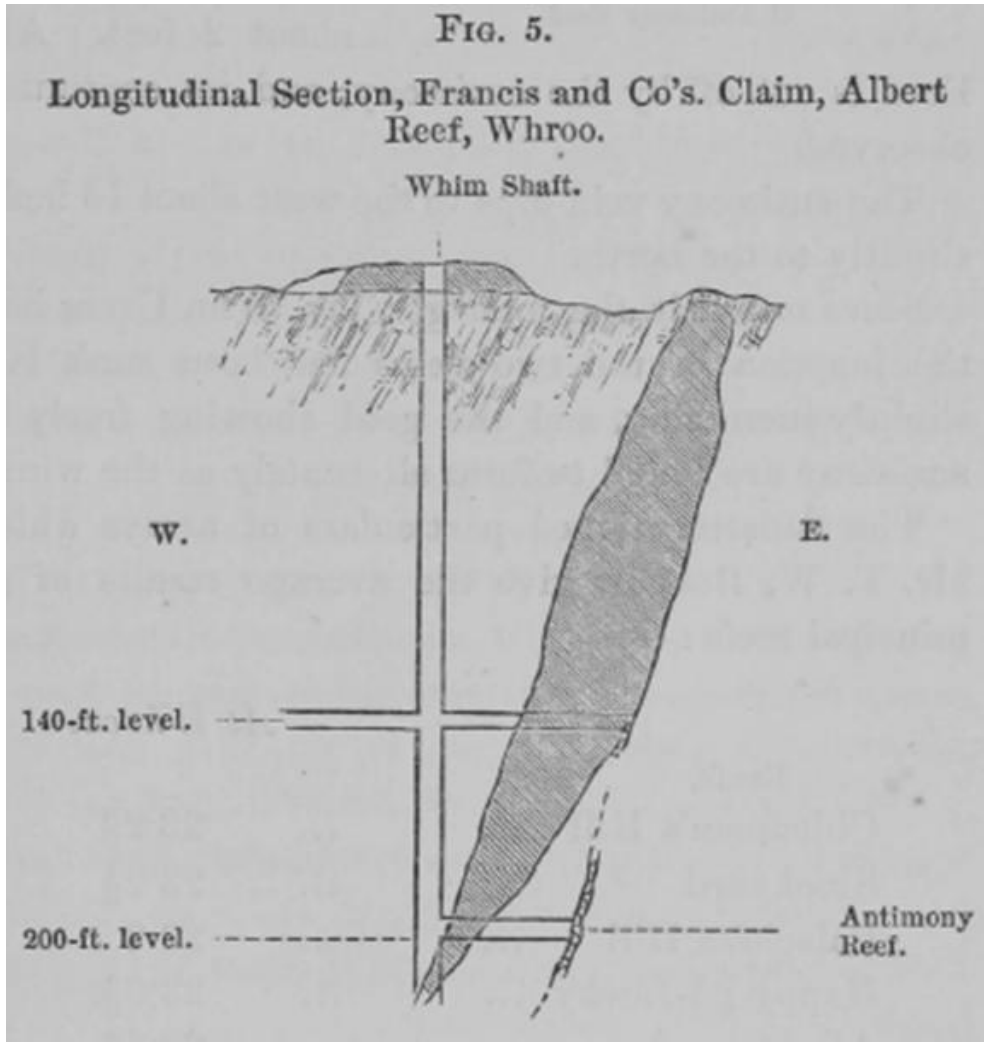
GSV sample 322247, N1 vein, drill hole NAD036, 311.45-311.72m. The Maia map occurs within interval 310.00-314.16m, 3.32g/t Au and 1.24% Sb (Nagambie Resources, 2024



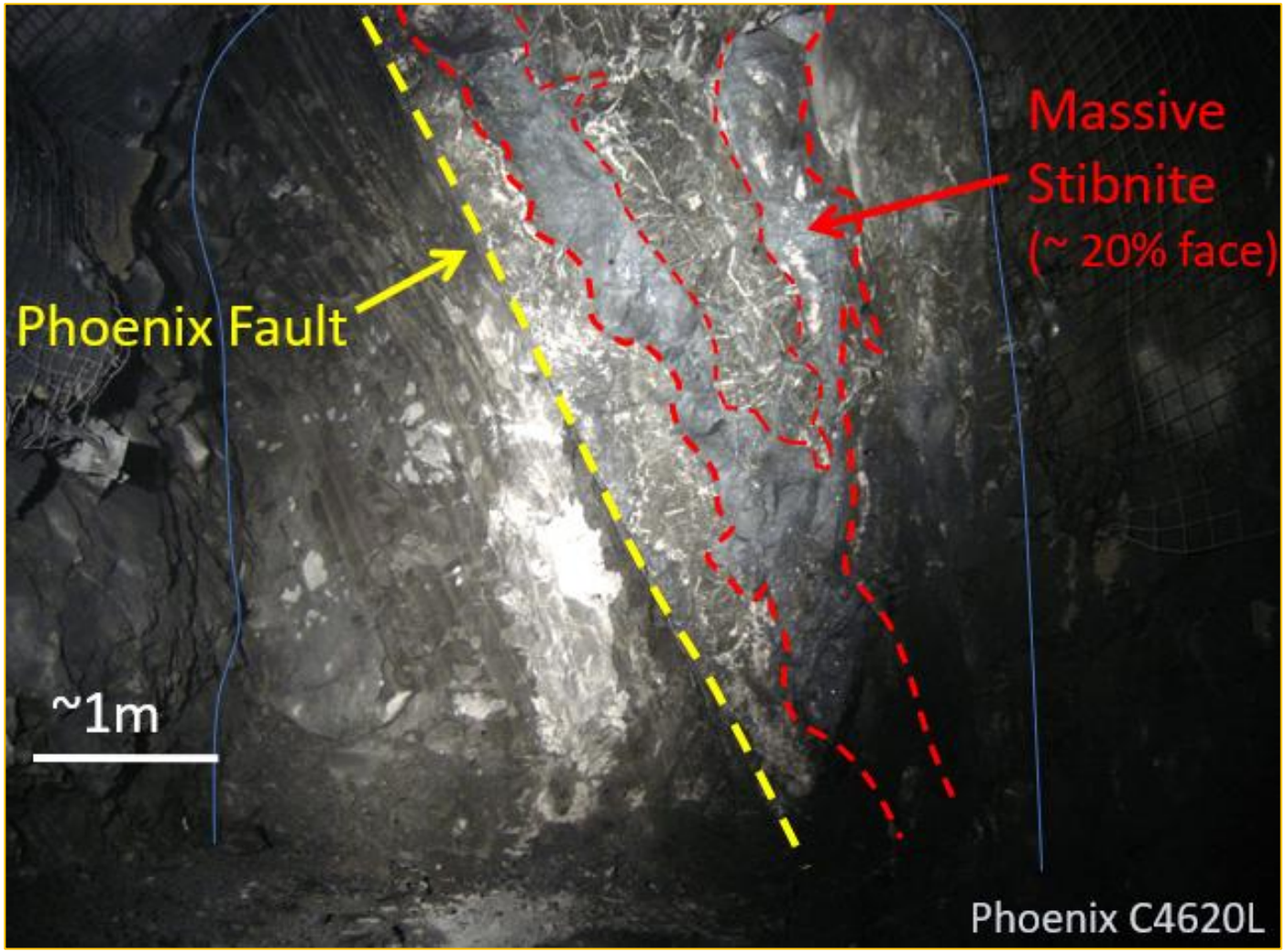
Brecciated wall rock

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Timing



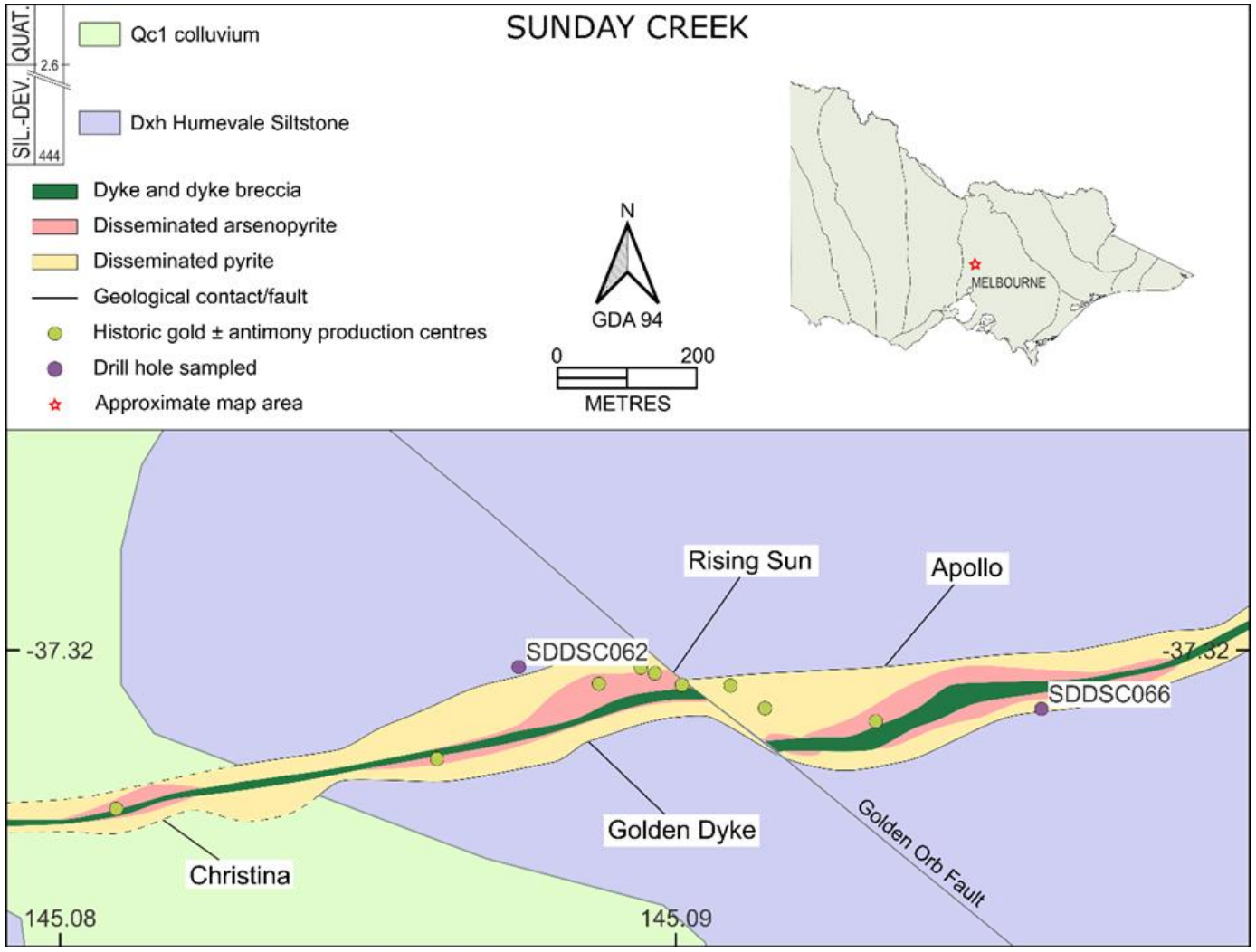
Couchman (1877)



Quartz-filled faults with variable gold associated with the Phoenix Fault overprinted by massive stibnite, Fosterville (Bush et al. 2024).

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Re-Os geochronology

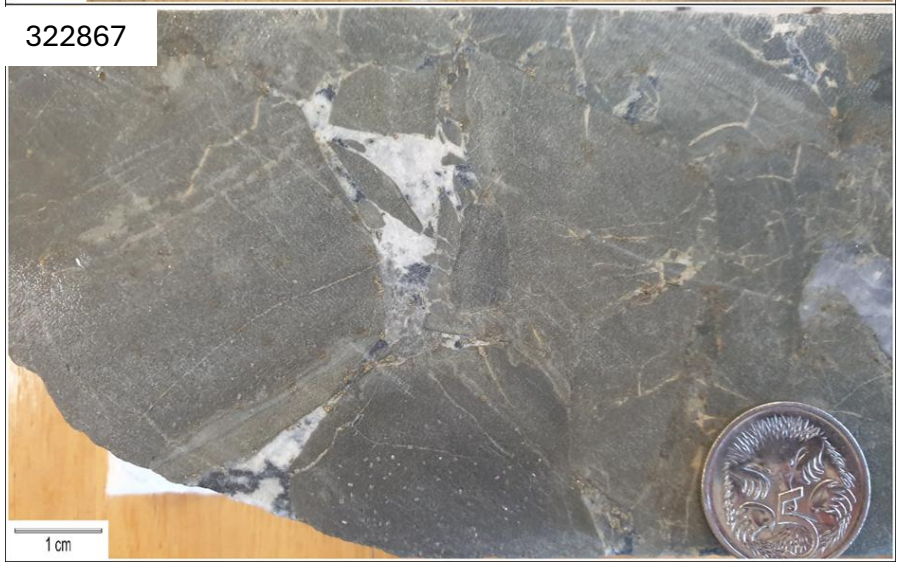


GSV Sample	Occurrence	Mineral	Model age (Ma)	± 2σ
322119	Golden Dyke	Pyrite	378.8	1.6
322866	Apollo	Arsenopyrite	379.1	1.6
322867	Apollo	Arsenopyrite	380.0	1.6

Waugh et al. (2024)







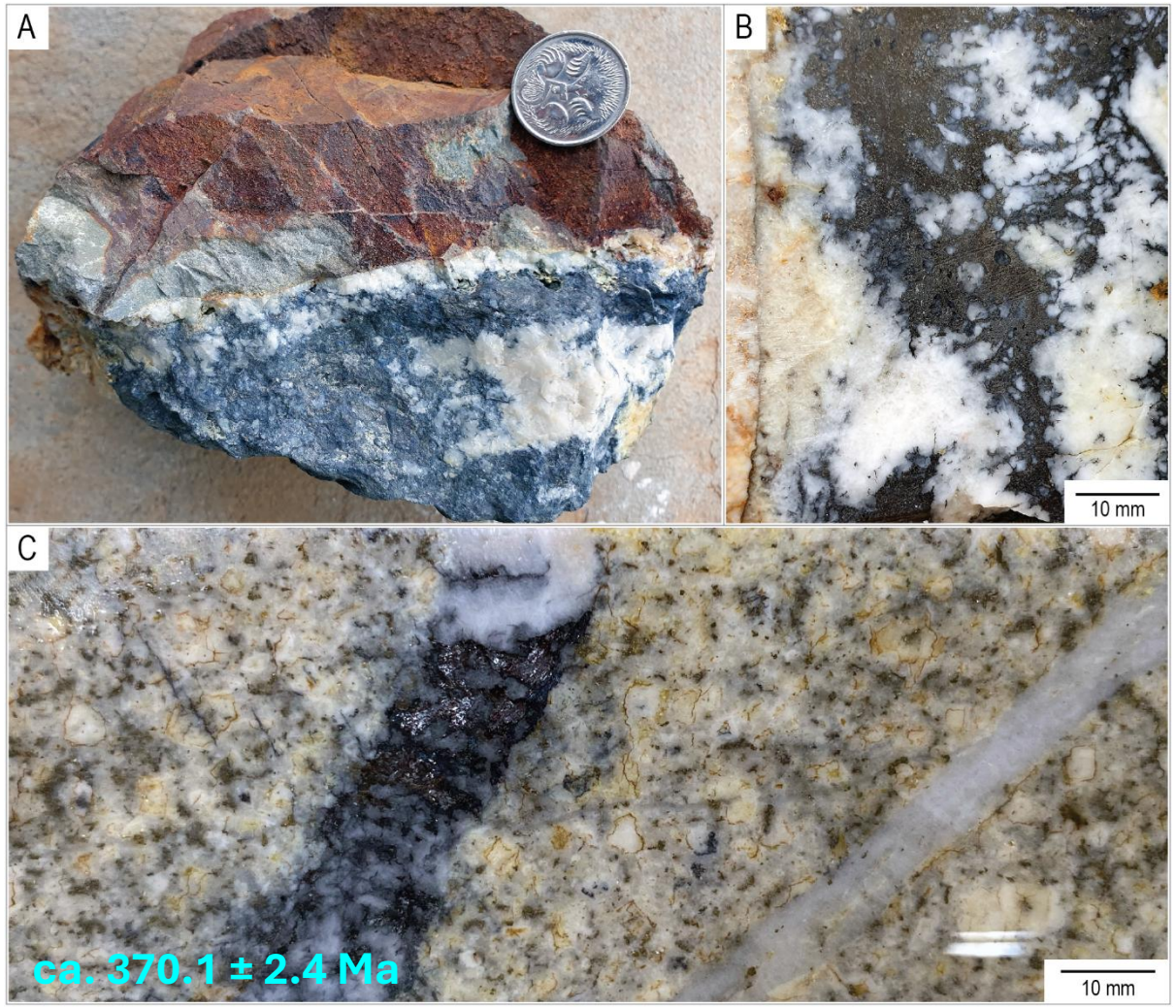
Relative timing – U-Pb geochronology



Steels Creek, drill hole BQ3 237ft (228-237’ 0.28ppm Au, 172ppm Sb, 195ppm As, Krummei, 1989), quartz-stibnite veinlet in quartz-feldspar porphyry.



Steels Creek, drill hole BQ1 219ft (217’6’’-227.5’ 0.02ppm Au, 88ppm Sb, 20ppm As, Krummei, 1989.

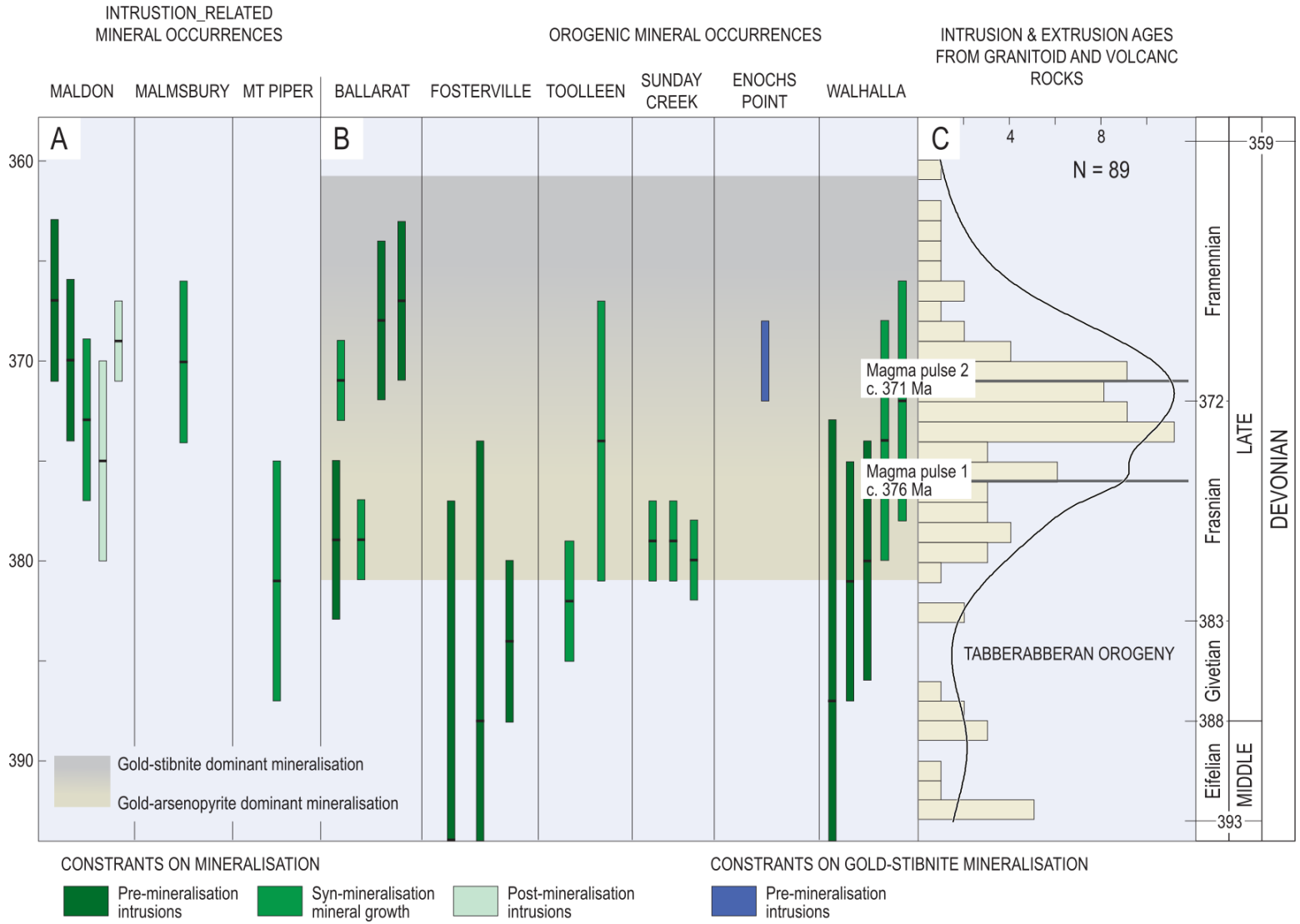


Stibnite bearing veins overprinting granite dyke from Big River Mine - Enochs Point.

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Mineralisation and magmatism

- Mineralisation overlaps with late Devonian magmatism
- Magmatism emplaced during period of crustal extension, rifting and continental sedimentation



Modified from (Cairns et al., 2026)

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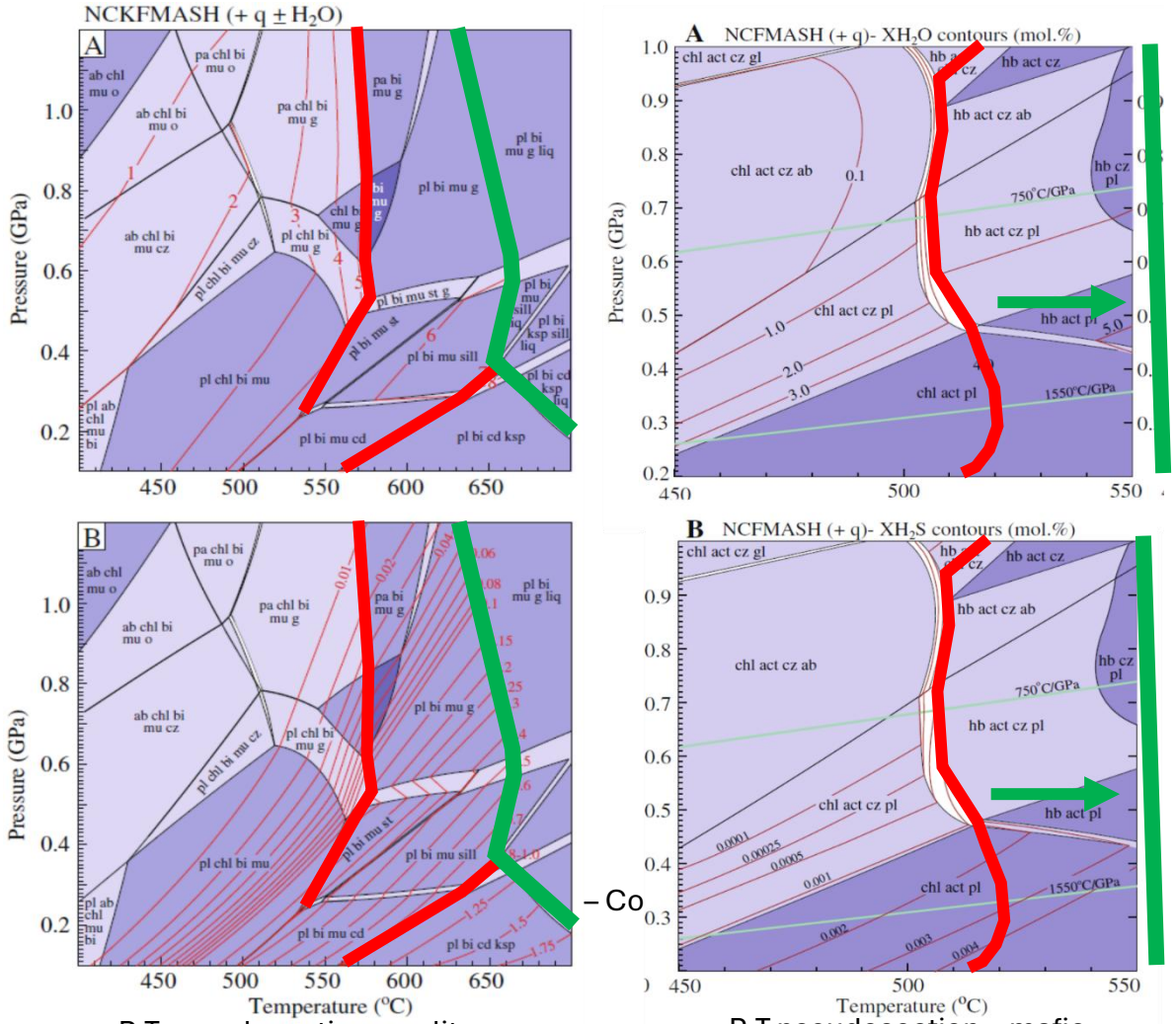
Recap

- Orogenic (metamorphic) gold-antimony deposits emplaced at shallow crust levels
- Hosted in varied structural settings, but dominant sub-vertical and north-northwest striking vein orientations
- Consistent general paragenesis of early gold-arsenopyrite and late gold-antimony – some overlap
- Arsenopyrite and pyrite dated at ~380 Ma
- Stibnite overprints felsic dykes sometime after ~371 Ma
- Mineralisation overlaps with felsic magmatism
- Mineralisation overlaps with period of extension – continental rifting, sedimentation

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Prograde metamorphism and gold deposits in intraplate settings

- For rocks to melt in intraplate settings, they must first cross the greenschist – amphibolite transition
- Most H_2O and H_2S are liberated during chlorite and/or muscovite breakdown - (Tomkins, 2010)
- Simultaneously, 93% of **Au** and ~75% of As; and ≥90% of Mo, Cd, Pb, **Sb**, W, Cu, Bi, Te, and Tl are released from pyrite - (Latheef Thathrampally et al., 2025)
- This generates metamorphic fluids capable of forming orogenic gold deposits
- We know the Melbourne Zone basement took this prograde path, because we have the result: late Devonian magmatism
- Decompression anataxis insufficient to explain magma volume
- The posited driver of the additional advective heat input is magmatic underplating



P-T pseudosection – pelite

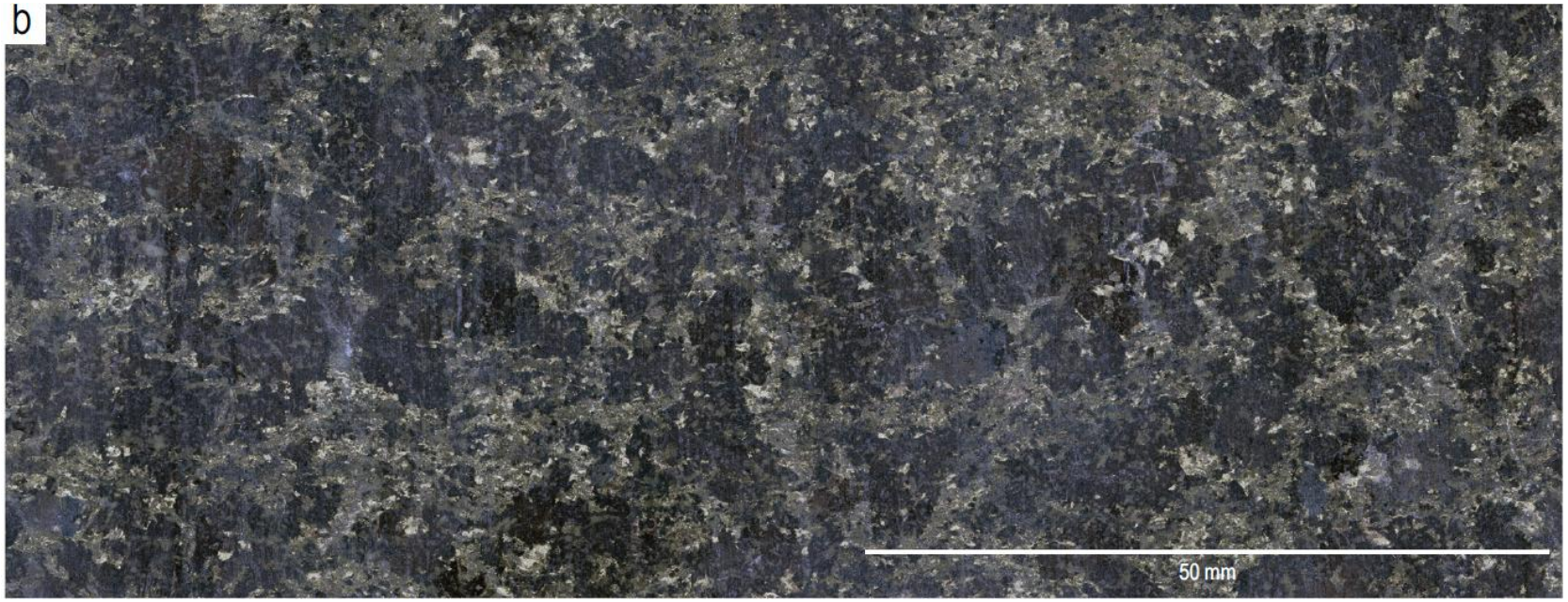
P-T pseudosection – mafic

(Tomkins, 2010)

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Evidence for magmatic underplating – high degree mantle meting

- PGEs are strongly chalcophile
- Can only be extracted from the mantle once high degree melting causes complete sulphur depletion
- PGEs at Coopers Creek confirm this occurred – causing magmatic underplating and massive advective heat input into the crust

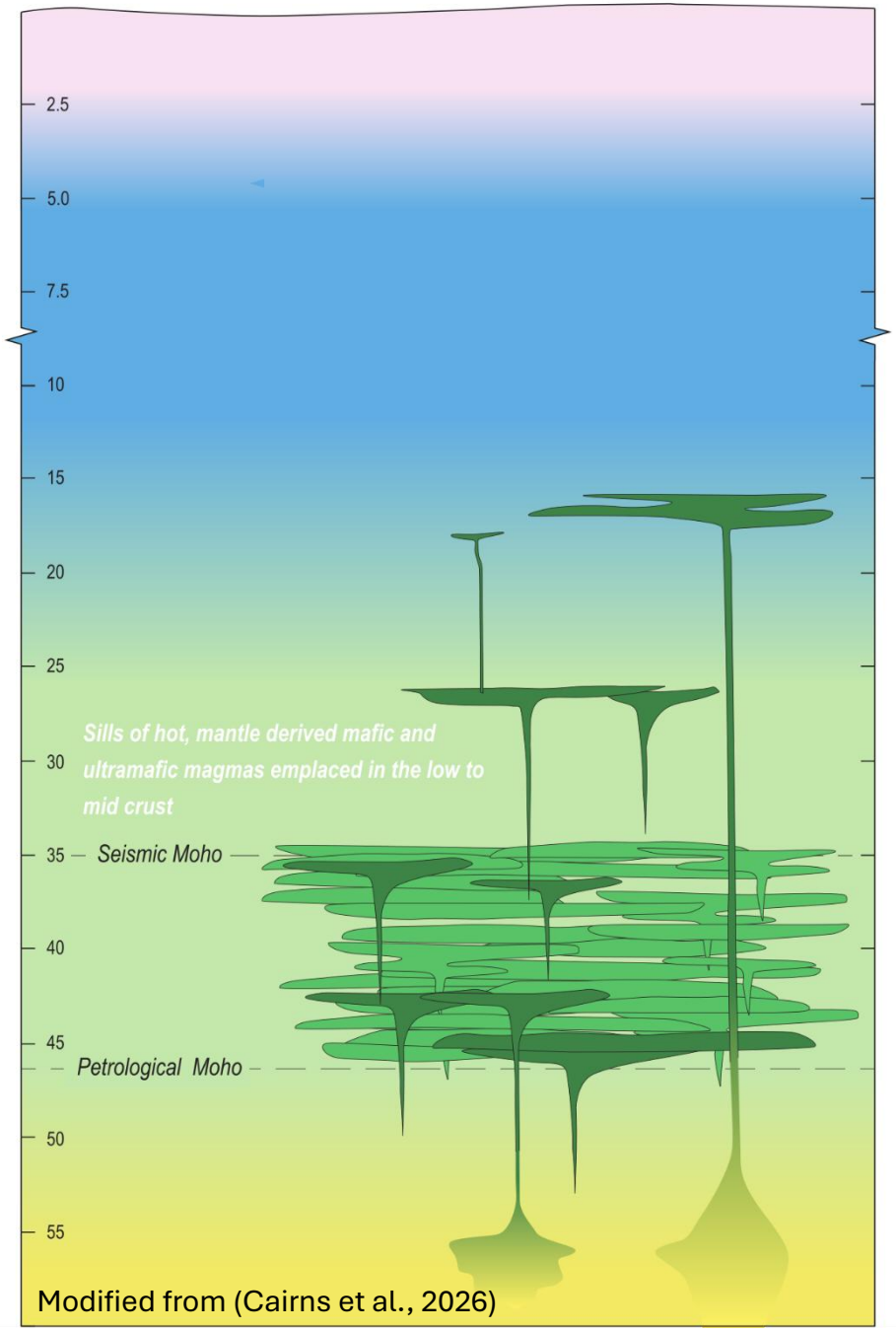


Net textured Ni-Cu-PGE sulphides, Coopers Creek, Victoria (Boger et al. 2025)

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Systematic thermal progression

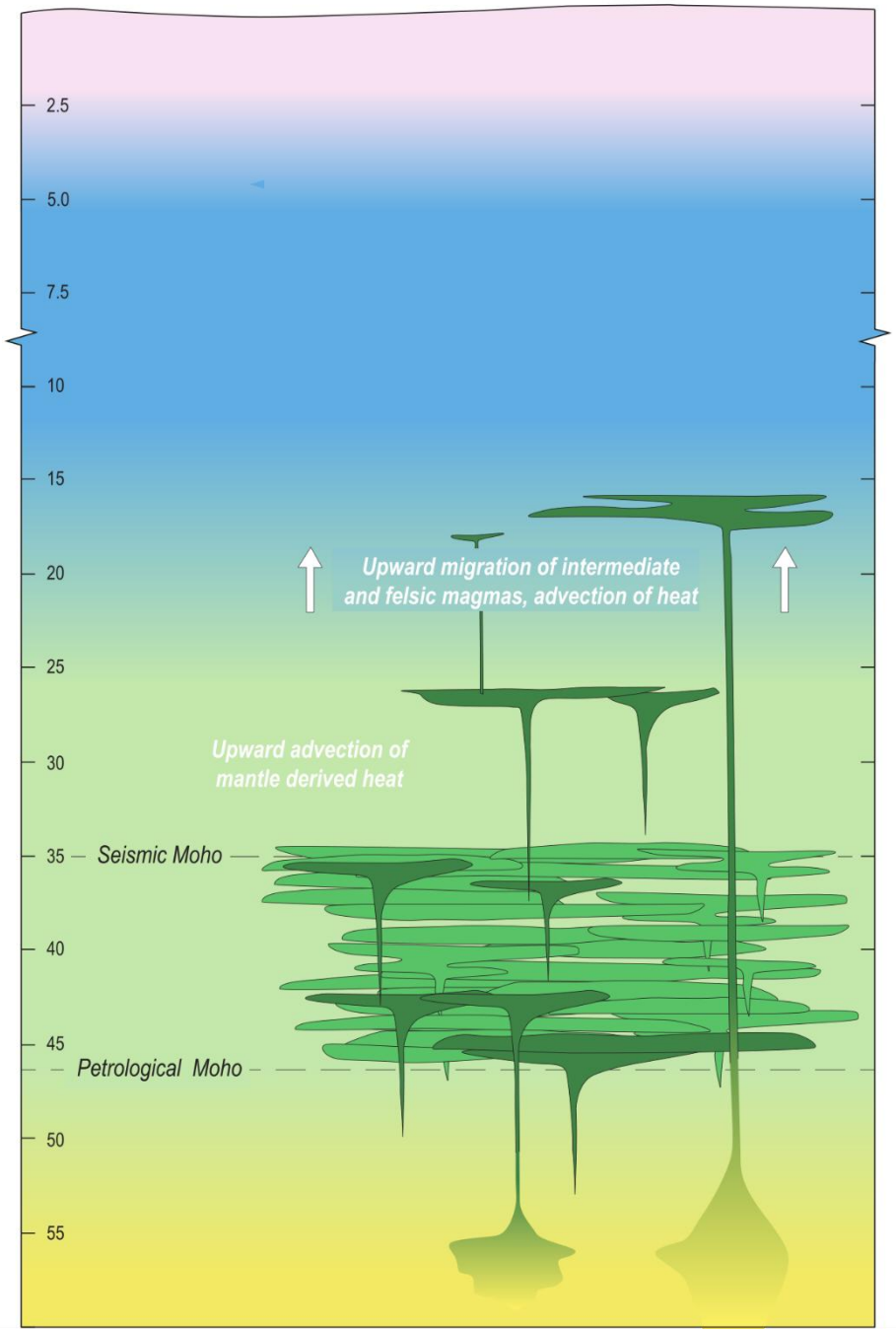
- Rapid ascent and decompression melting of hot asthenospheric mantle (c. 1500 °C) causes widespread and voluminous mantle partial melting
- Sills of mantle derived basaltic magma (c. 1100 - 1250 °C) intrude into the lower crust and upper lithospheric mantle to provide heat, mass and volatiles



Modified from (Cairns et al., 2026)

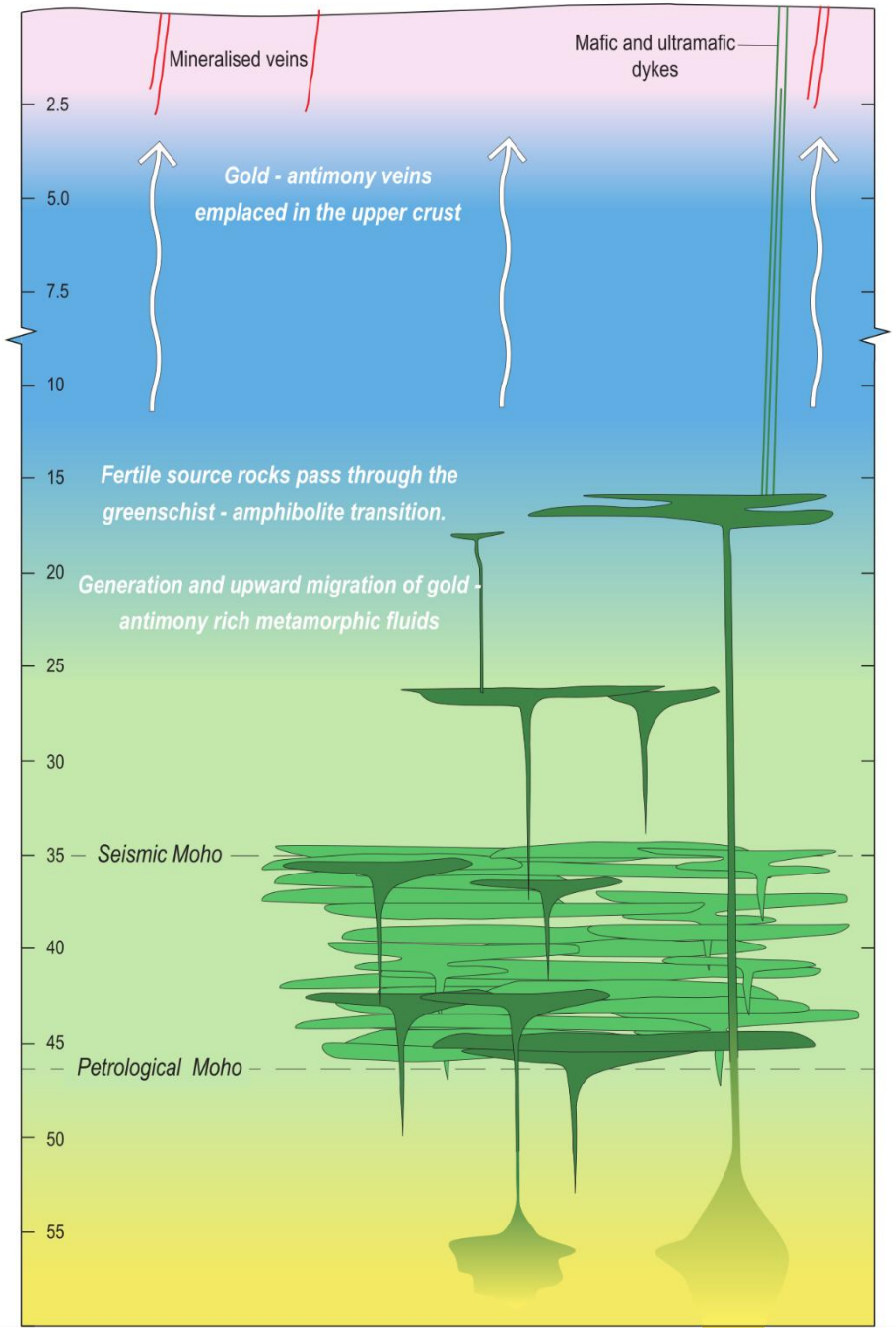
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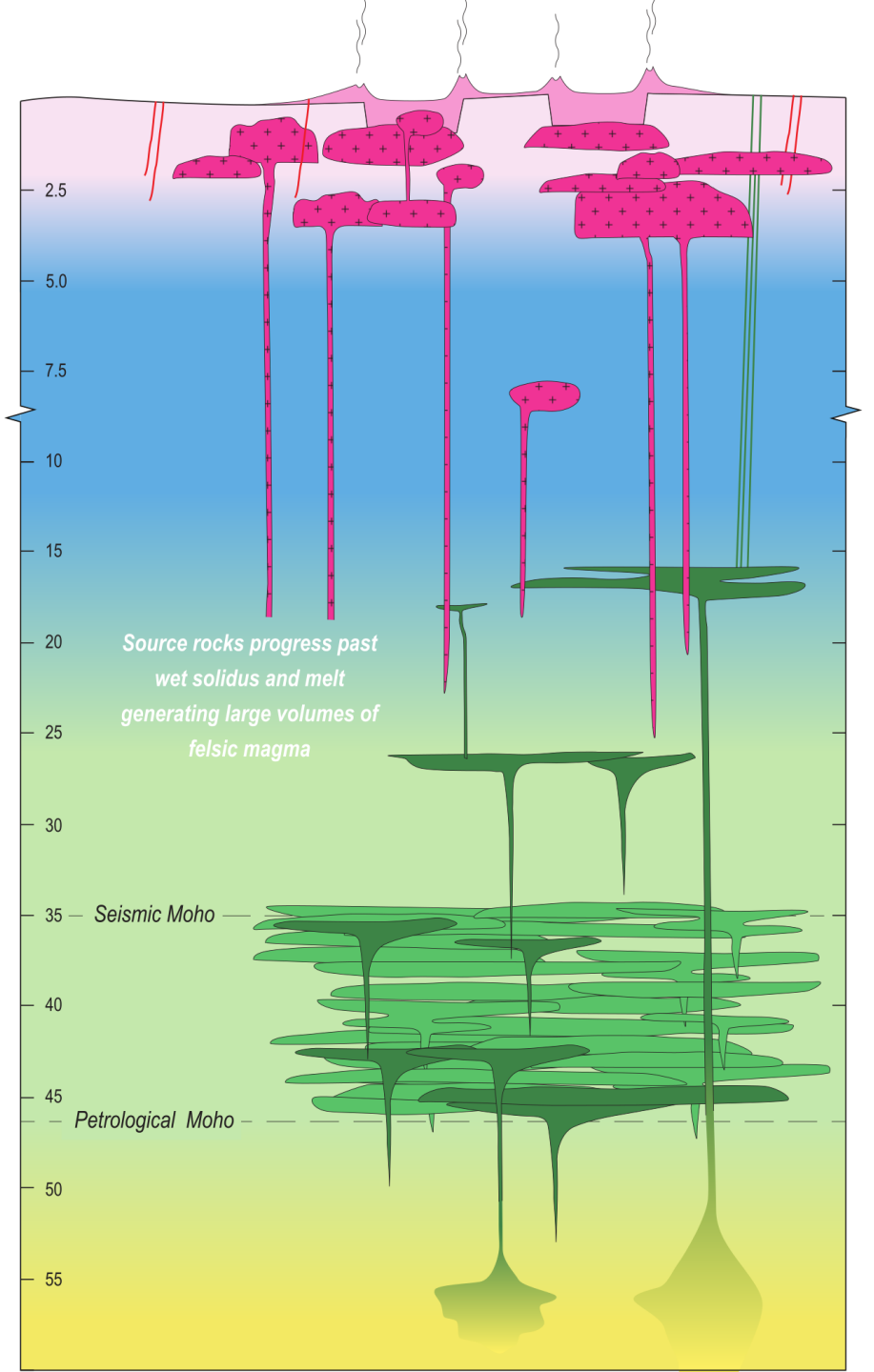
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- Fluids cool (c. <~250 °C) on reaching near surface and precipitate gold-stibnite-arsenopyrite mineralization in and adjacent to structurally controlled veins



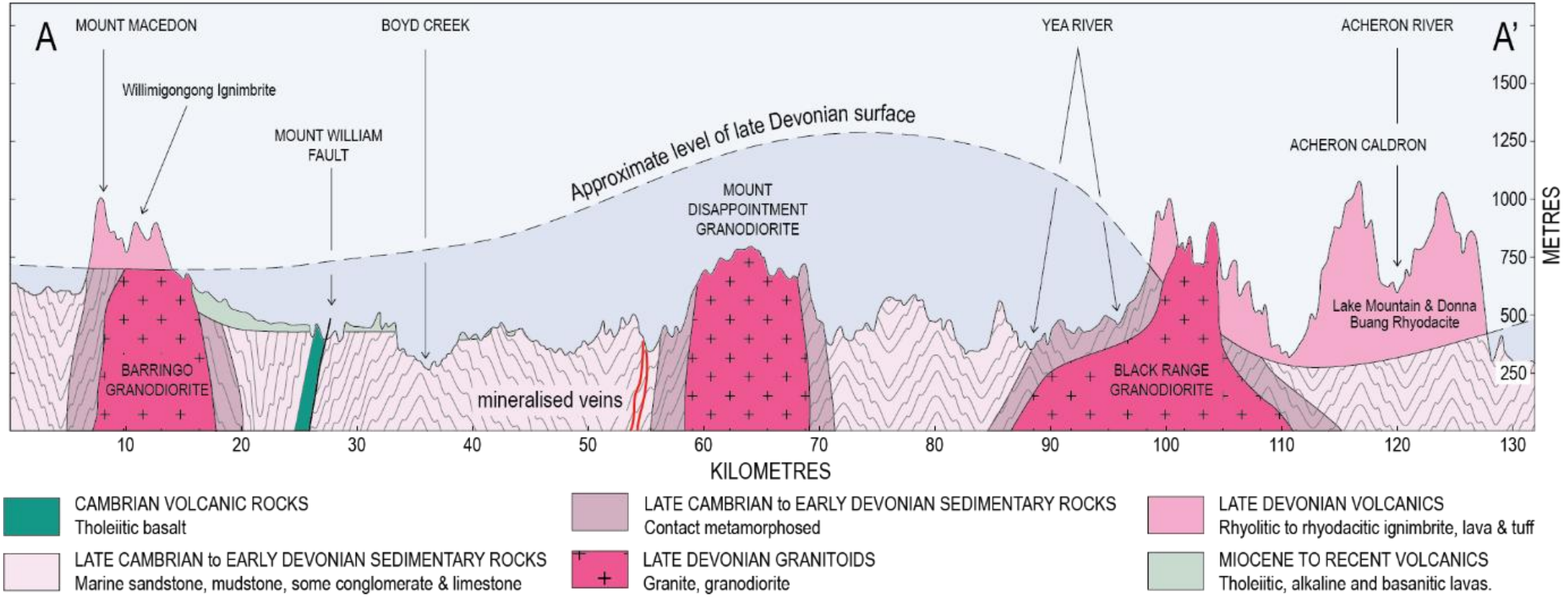
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- Rocks progress past the wet solidus (c. 670 °C) for hydrous sedimentary and volcanic rocks. Anatexis forms silicic magmas.
- Large volumes of silicic magmas emplaced in the upper crust and erupted on the surface



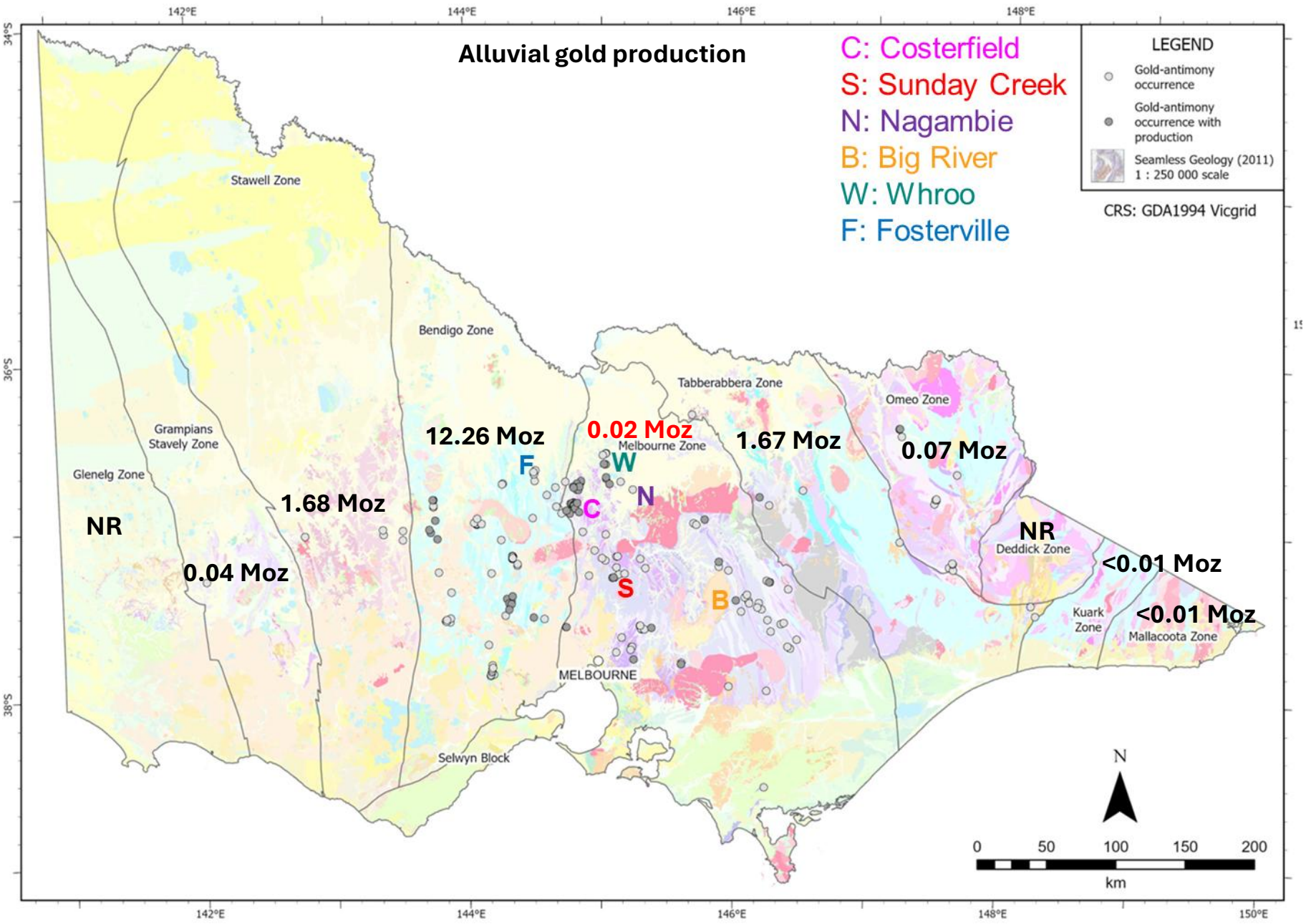
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Preservation



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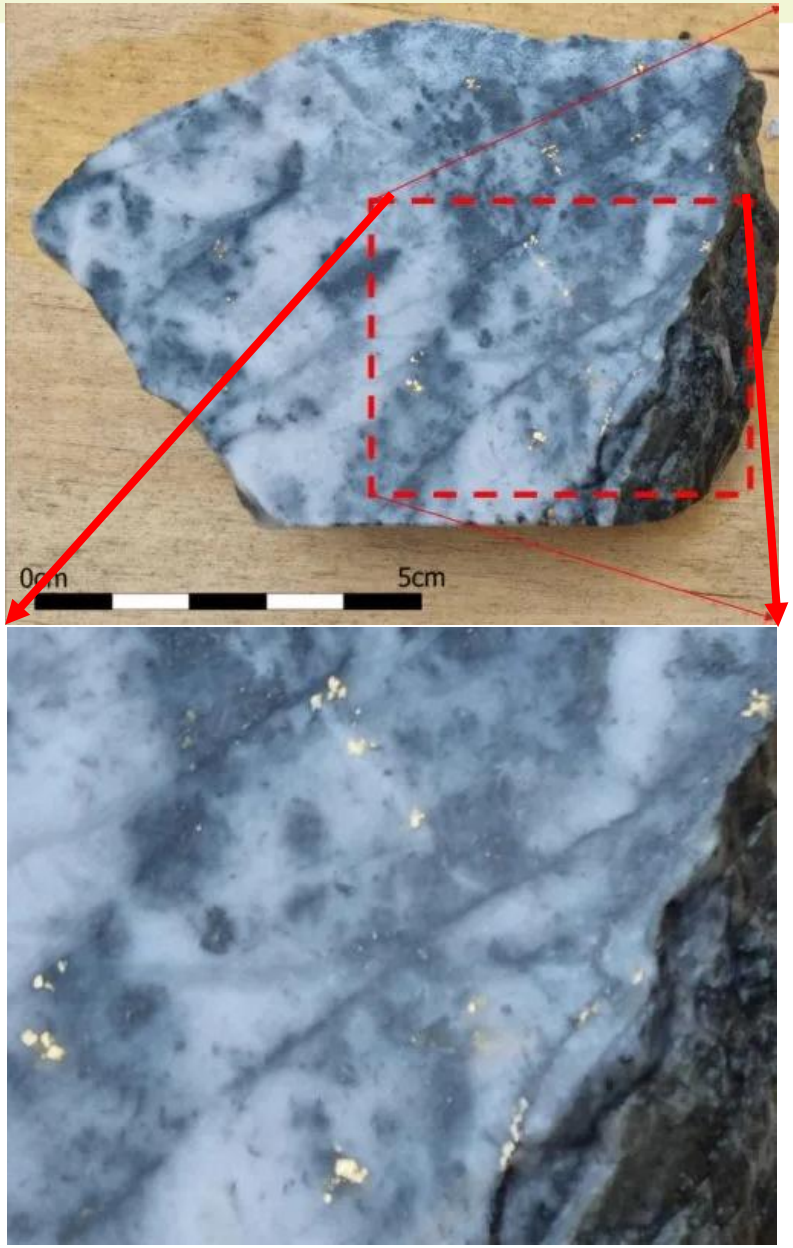
Alluvial gold production: a proxy for preservation?



- The lack of post mineral erosion limits the formation of alluvial deposits
- The uppermost gold rich portions are at the current land surface
- The entire vertical extent of these systems (>1km) are preserved

Summary

- High-grade orogenic gold-antimony deposits with good grade continuity
- Consistent vein orientations and kinematics hosted in varied litho-structural settings
- General paragenesis of early arsenopyrite-gold and late gold-stibnite mineralisation
- Mineralisation spans ~380 – 365 Ma
- Coeval with extension, magmatism, rifting and sedimentation
- Prograde metamorphism related to magmatic underplating, not crustal thickening
- Well preserved, little post mineral erosion
- The uppermost portions of vertically extensive systems



SXG hole SDDSC107. 0.3 m @ **7,330** g/t Au within 1.0 m @ **2,318** g/t Au (estimated true width ("ETW") 0.7 m)(Mawson, 2024)

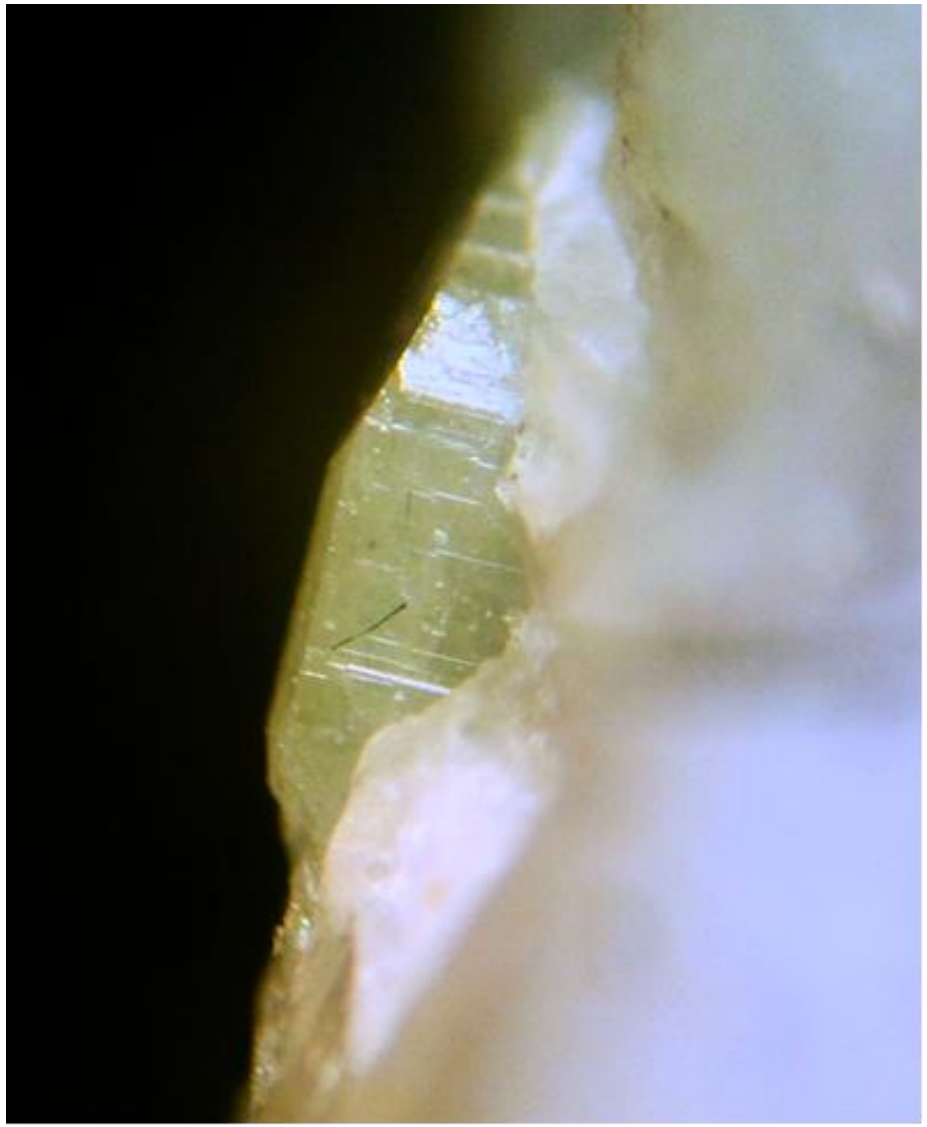
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What's next?

- Report
  - **Mineralisation and textures of select gold-antimony occurrences from the Melbourne Zone, central Victoria**

- Geochronology
  - U-Pb Apatite
  - Rb-Sr Mica
  - SHRIMP U-Pb zircon

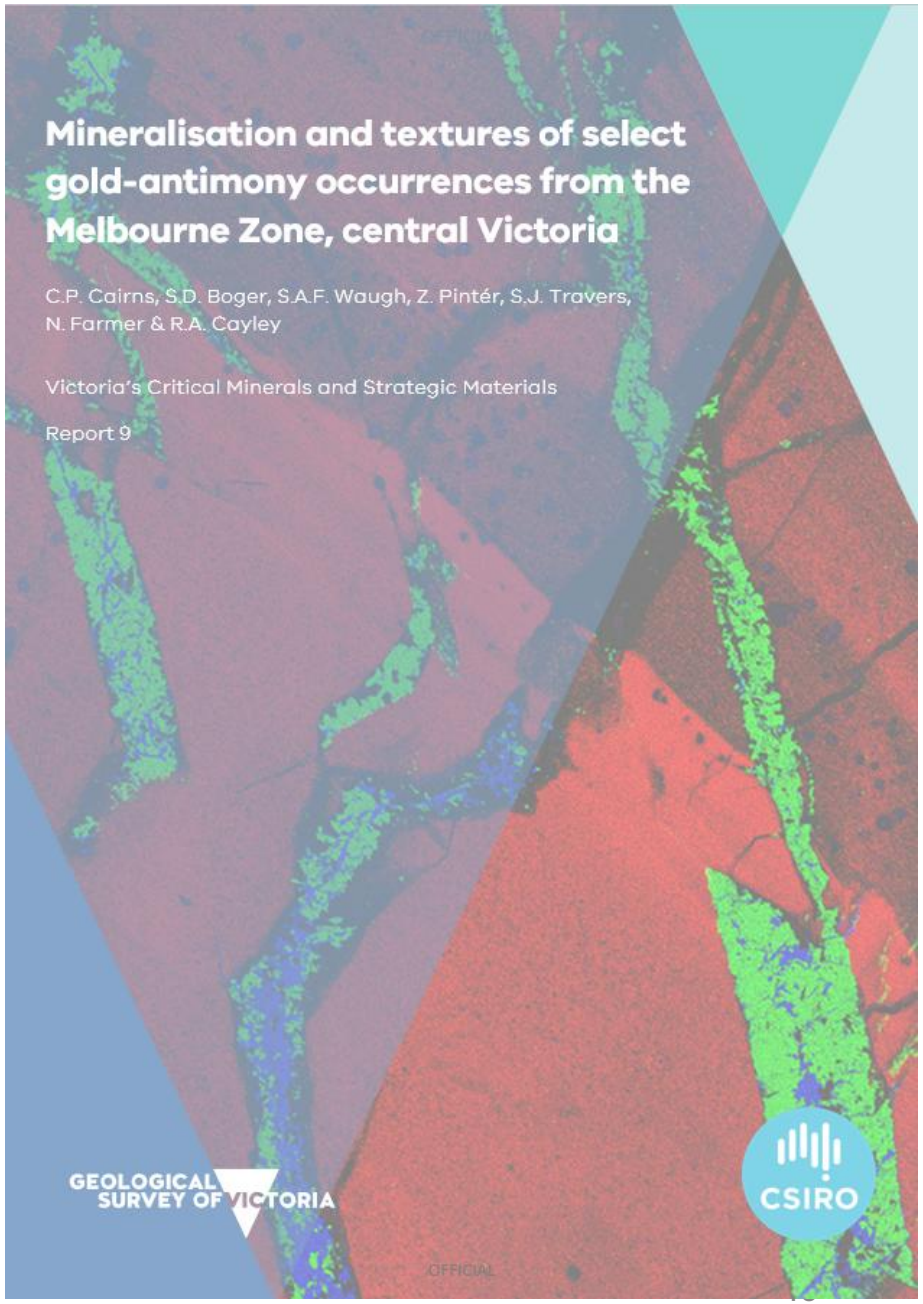
- Mineral systems analysis
  - Sourcing a source
  - The age-old debate: orogenic vs intrusion-related? An emerging interplay?



Stibnite(?) needle within apatite, Costerfield. Courtesy R. Eagle

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Thank you

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