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Copper-gold mineral systems in the southeastern Gawler Craton - another Mt Isa Eastern Succession?

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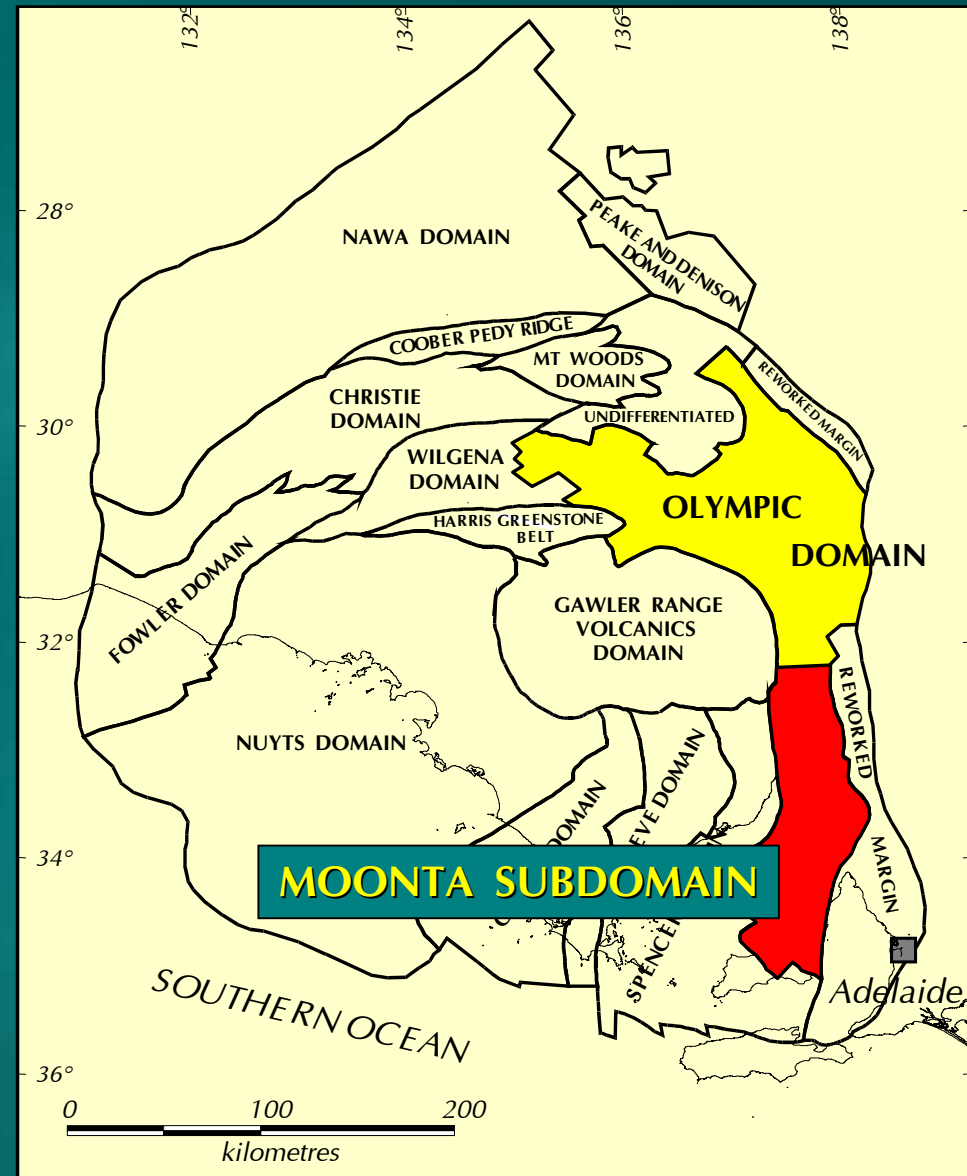
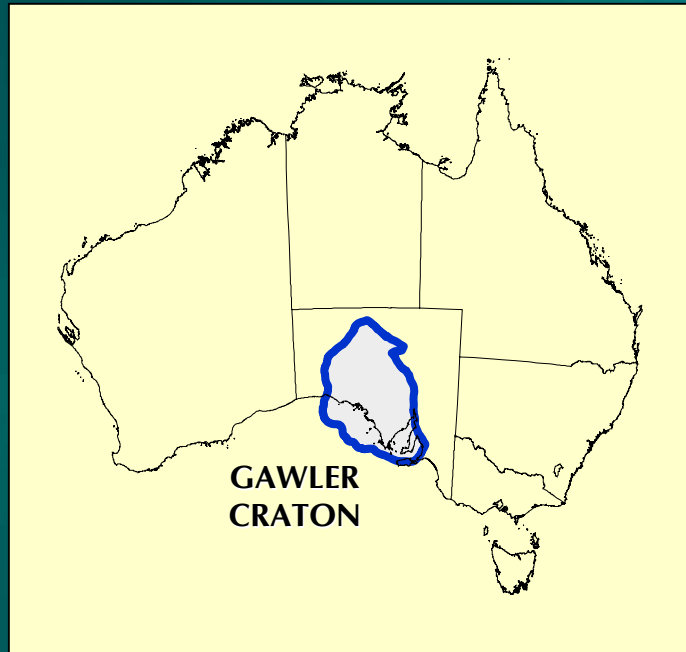
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Tectonic elements of the Gawler Craton

(Ferris et al, 2002)





1400 Ma
1500 Ma
1575 Ma
1600 Ma
1700 Ma
1735 Ma
1765 Ma
1800 Ma

biot. Ar-Ar biot. K-Ar musc. K-Ar

MOONTA SUBDOMAIN

MT ISA EASTERN SUCCESSION

WARTAKAN EVENT

Moonta Wallaroo

MOONTA EVENT (KARARAN, TICKERA, HILTABA)

Hiltaba Suite (SHRIMP U/Pb ages)

Williams Batholith

ISAN OROGENY

Cloncurry Belt Cu-Au

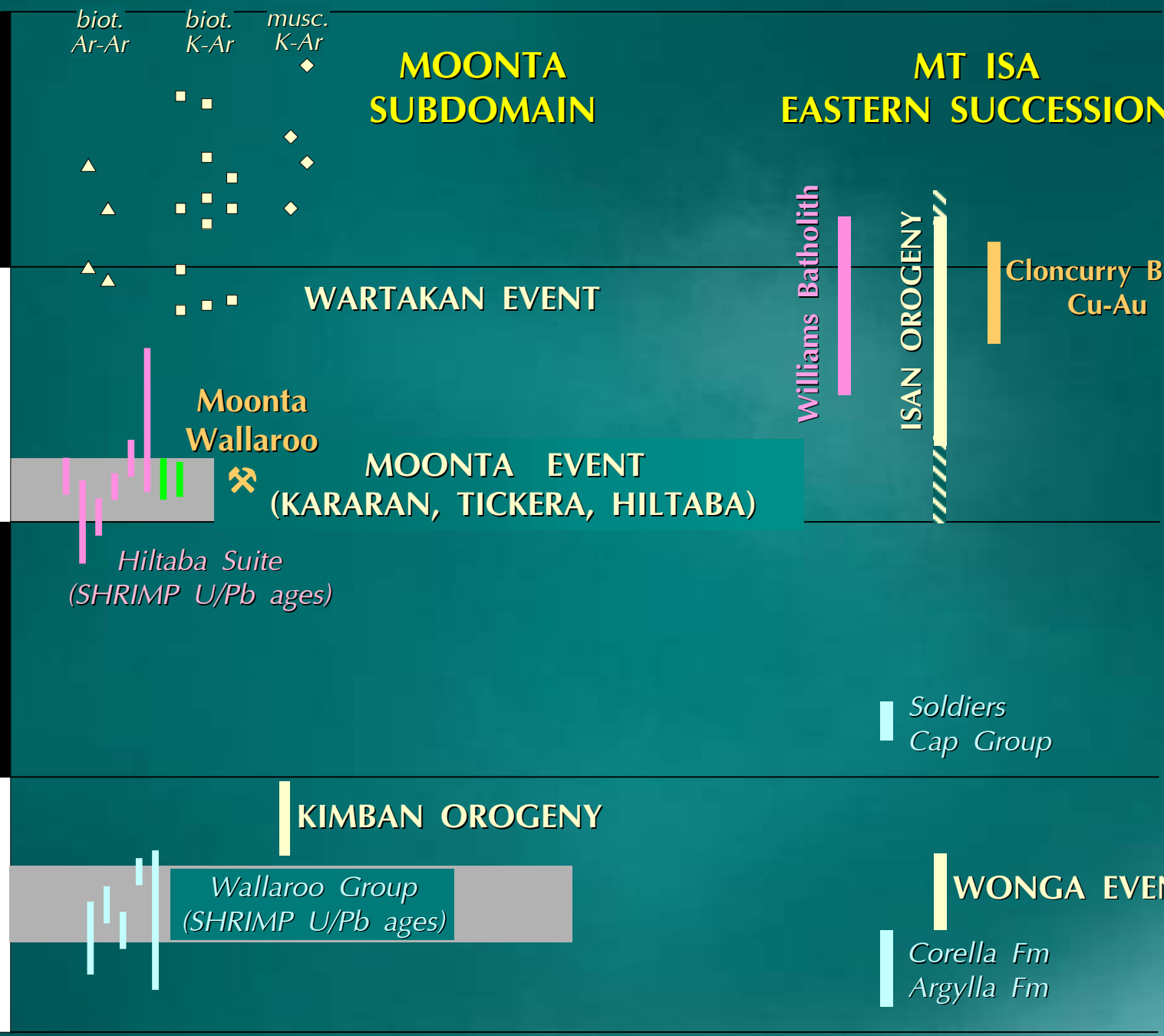
Soldiers Cap Group

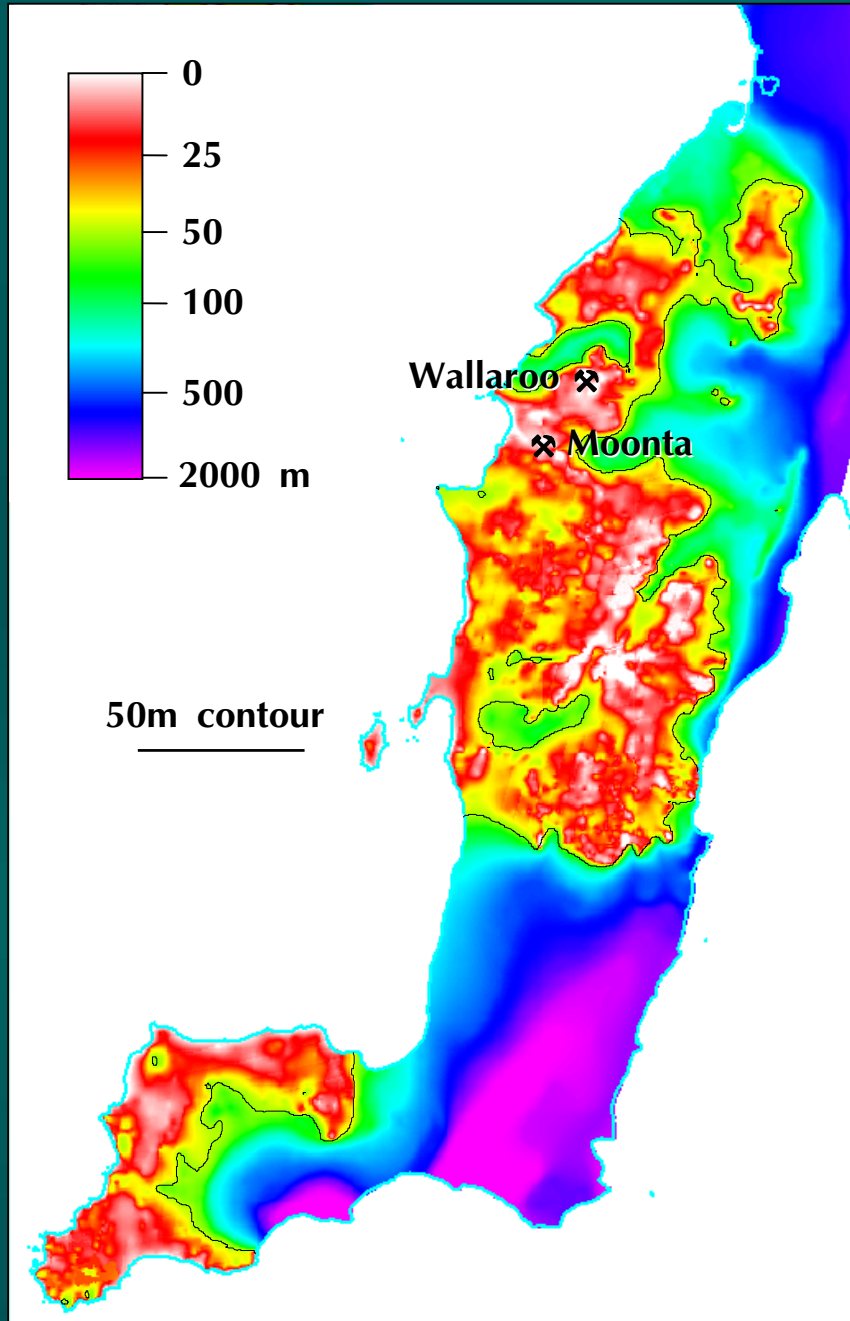
KIMBAN OROGENY

Wallaroo Group (SHRIMP U/Pb ages)

WONGA EVENT

Corella Fm
Argylla Fm

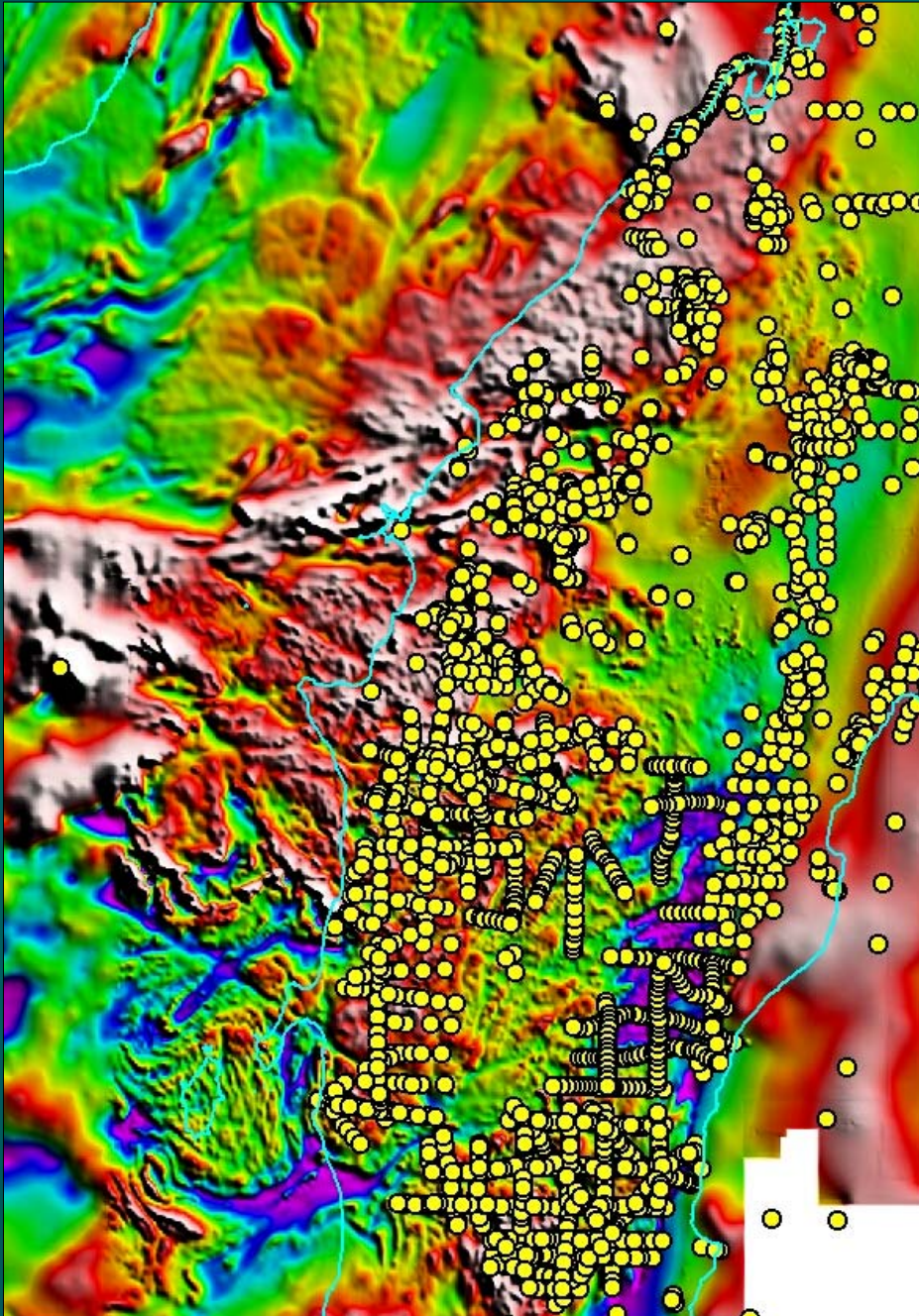




Moonta Subdomain (Yorke Peninsula)

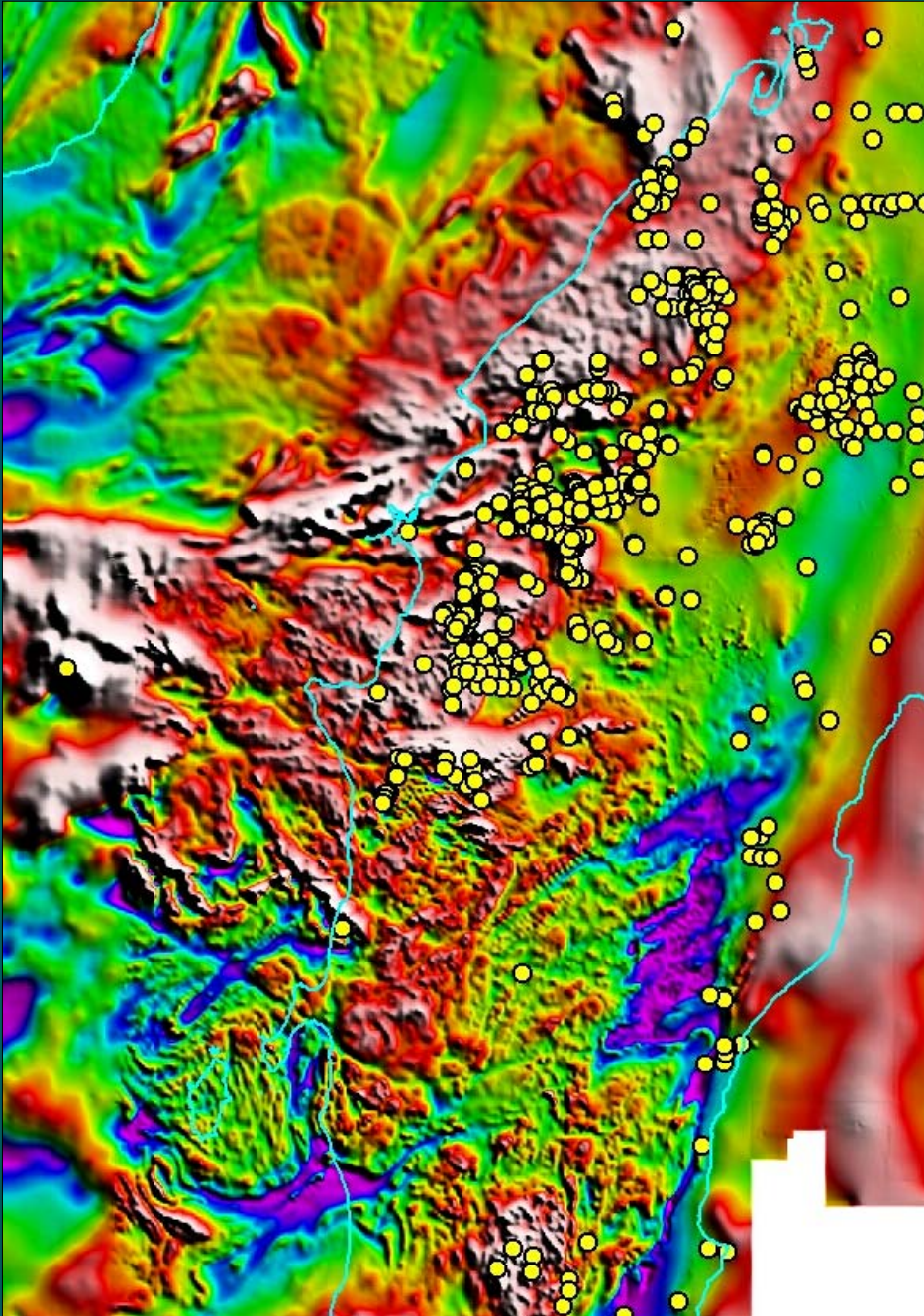
Depth to Palaeo- and Meso-proterozoic basement

- *very little outcrop*
- *basement interpretation through geophysics and drilling*

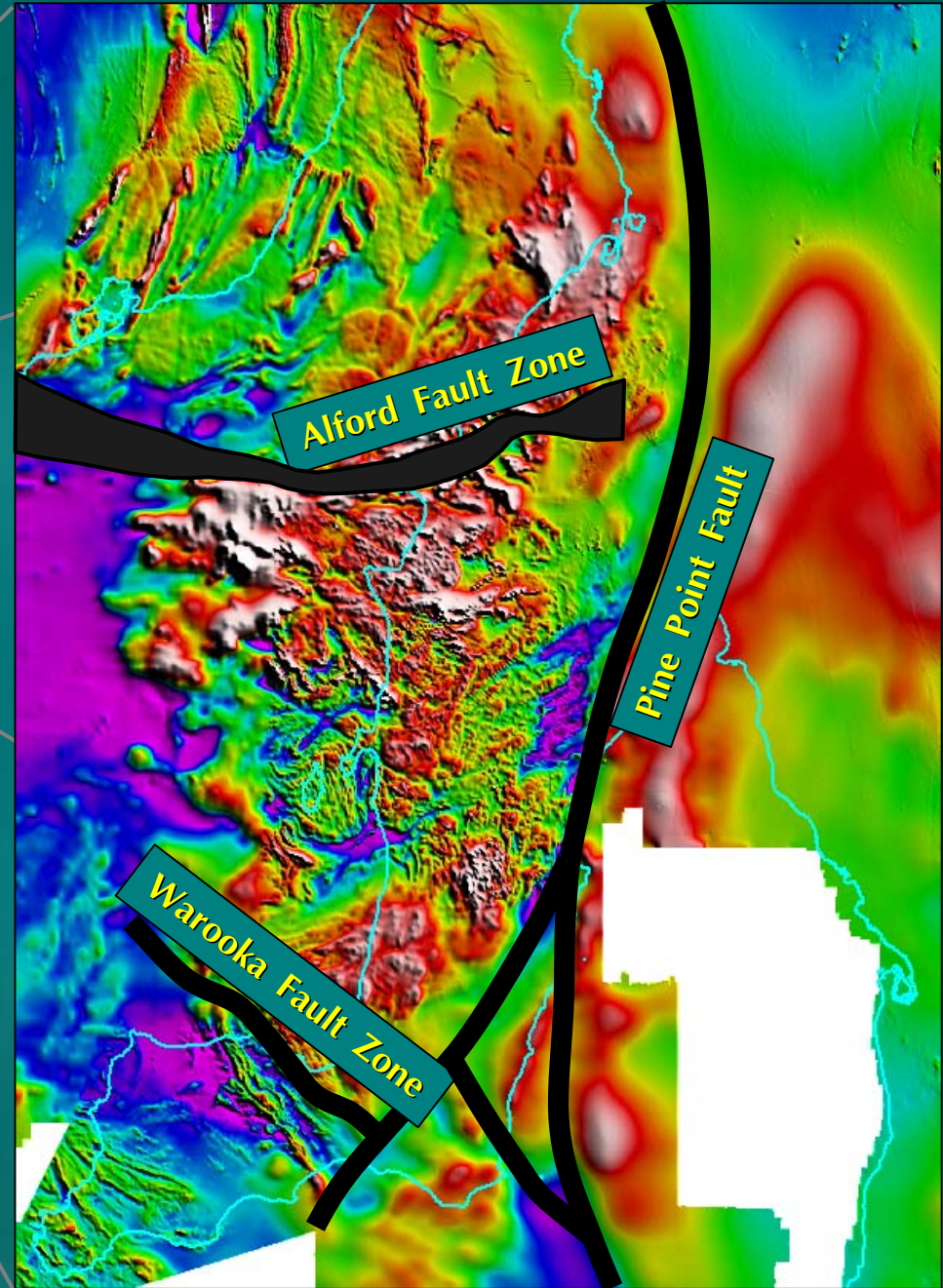


The drillhole coverage initially looks impressive

But remove the drillholes which do not intersect basement and holes with only very short basement tails

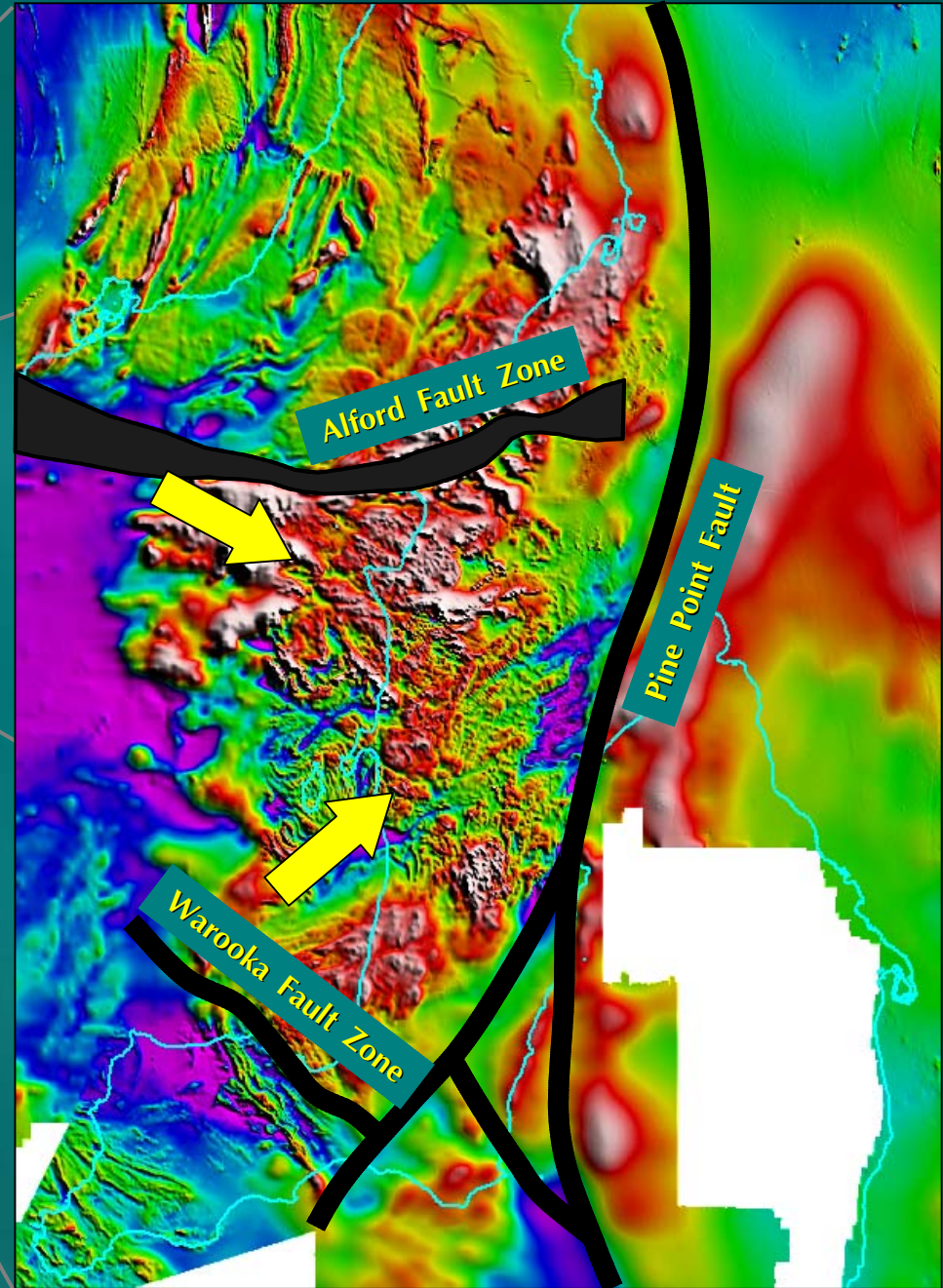


and there is a lot of the Yorke Peninsula basement that has not been adequately tested



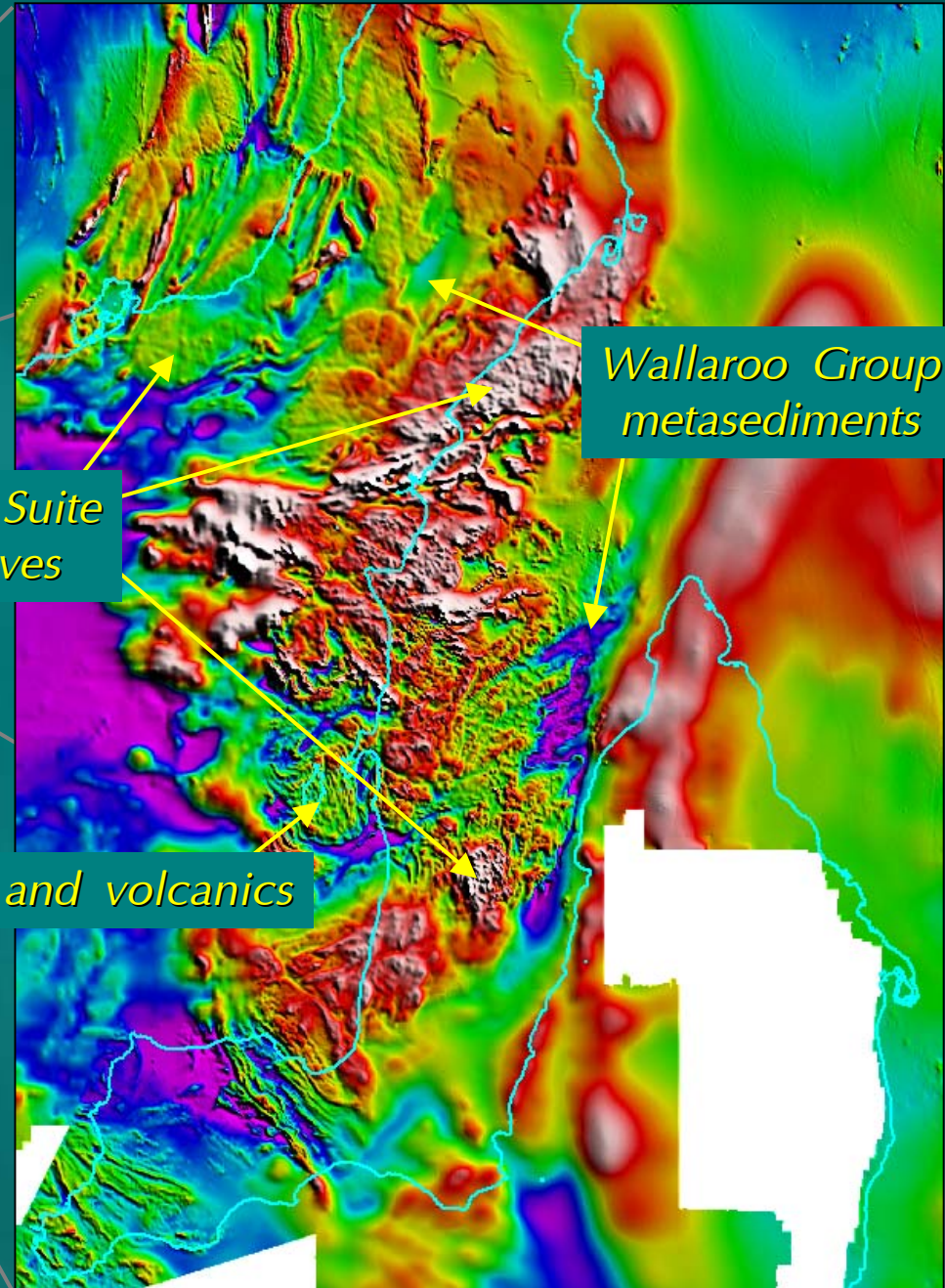
Structure
Total Magnetic Intensity
(NE sunangle)





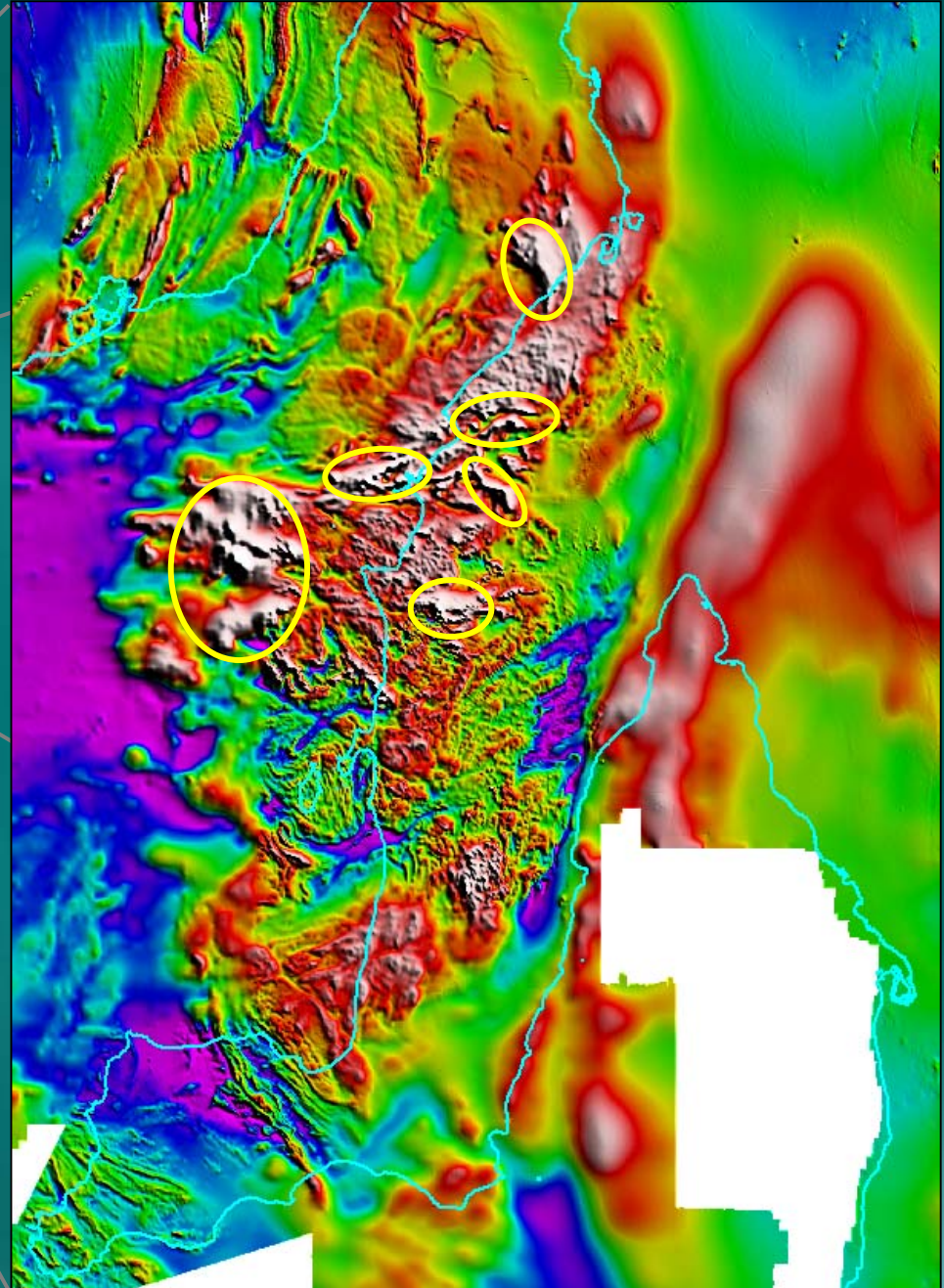
Structure
Total Magnetic Intensity
(NE sunangle)





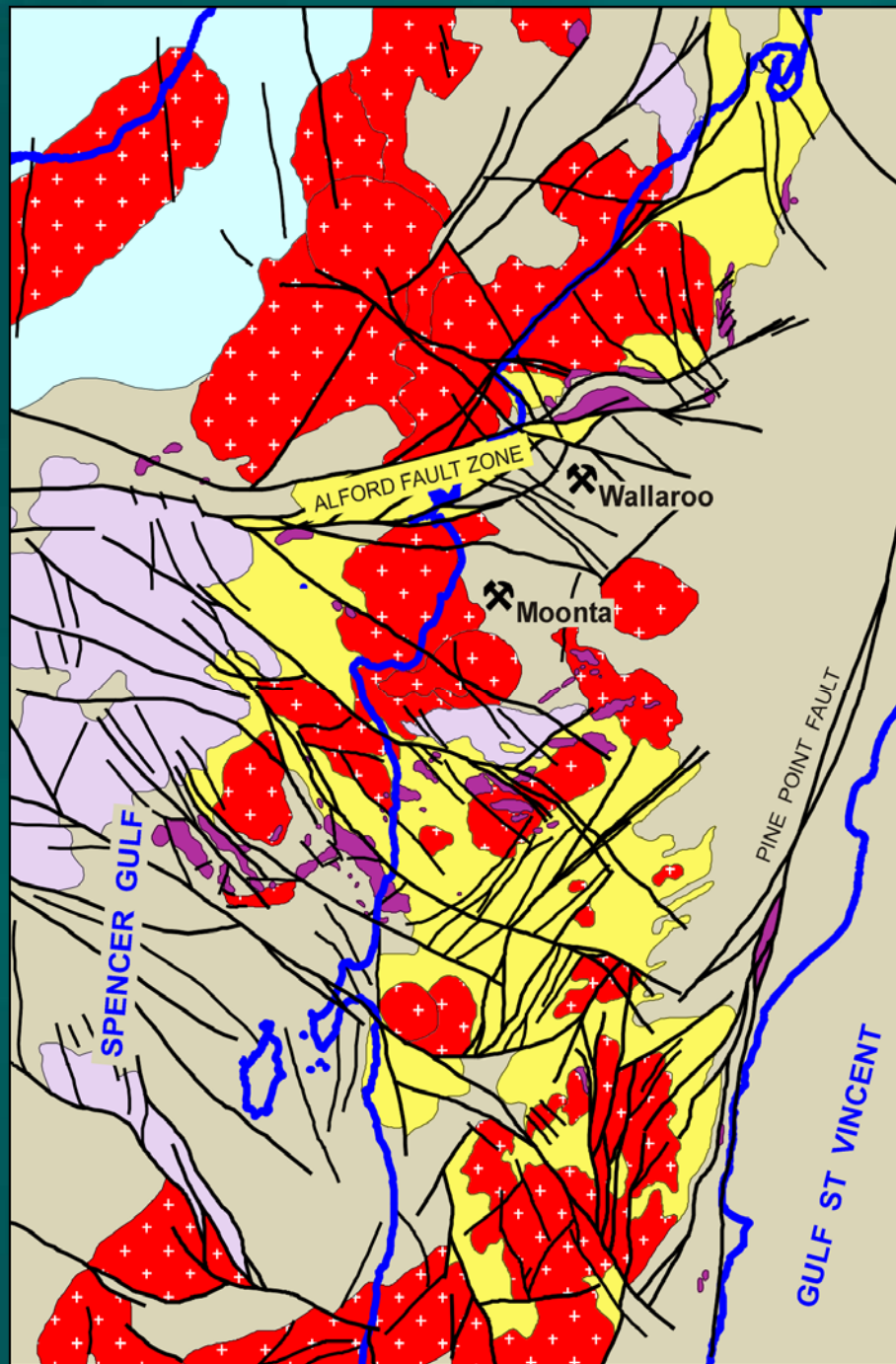
Lithologies
Total Magnetic Intensity
(NE sunangle)






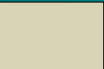



Magnetic alteration
Total Magnetic Intensity
(NE sunangle)





Northern Yorke Peninsula Basement Geology

-  *Regions of magnetic alteration*
-  *Hiltaba Suite*
-  *Mixed Hiltaba Suite and Wallaroo Group*
-  *Wallaroo Group*
-  *Pre-Wallaroo Group basement*

0 20 40 km





Moonta Subdomain

Wallaroo Group

Mt Isa Eastern Succession Corella Fm, Soldiers Cap Group

- mixed siliclastic, feldspathic, carbonate and ?evaporitic metasediments
- felsic and mafic metavolcanics
- greenschist to amphibolite grade
- metamorphic and metasomatic scapolite





Hiltaba Suite

Williams Suite

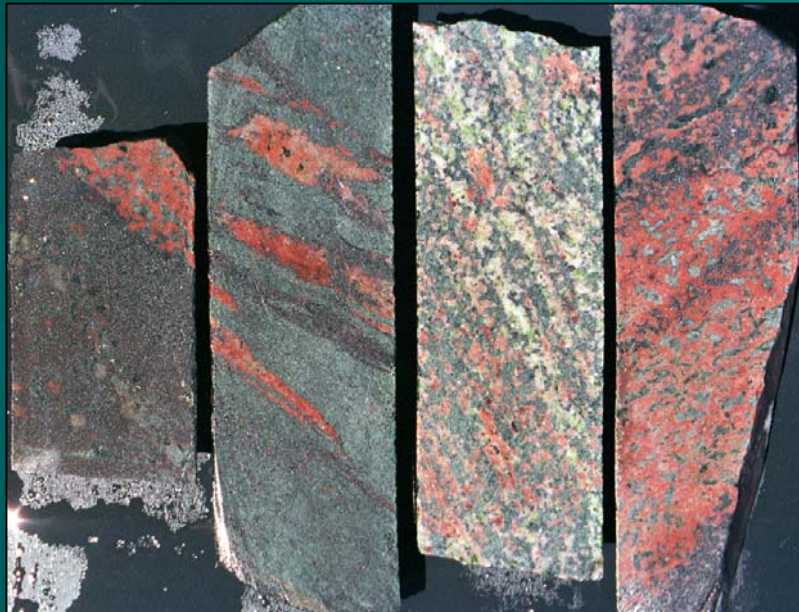
- *Mesoproterozoic, oxidised, I-type magmatism*
- *variably fractionated, felsic and mafic plutons*
- *close spatial and temporal relationships with alteration*





Regional alteration assemblages in the Moonta Subdomain

Albite - calcsilicate - magnetite



Biotite - magnetite - albite



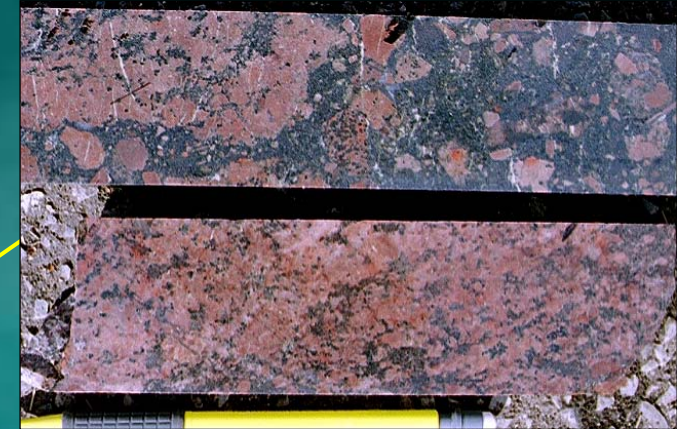
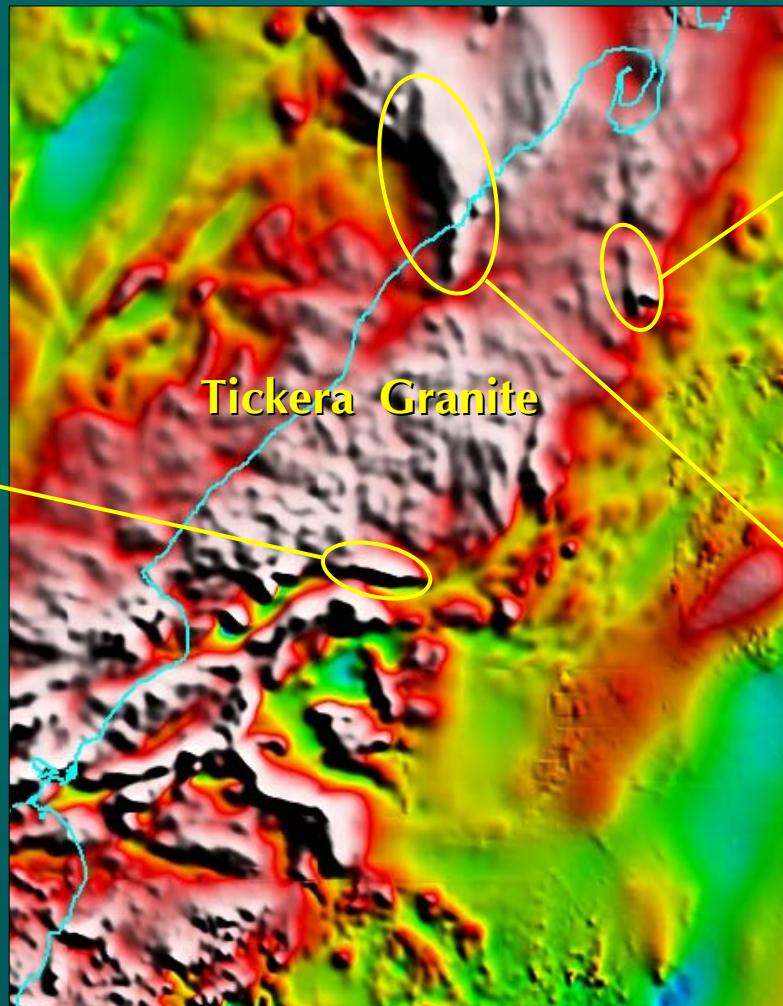


Regional albite - calcsilicate - magnetite alteration

- *calcsilicates typically actinolite and/or clinopyroxene*
- *albite-, magnetite-, and actinolite-dominant variants*
- *± accessory epidote, calcite, titanite, allanite (REE epidote), tourmaline*
- *veins and massive replacement*
- *unfoliated to strongly foliated*
- *breccias and pseudobreccias*
- *typically proximal to granites*

Albite - calcsilicate - magnetite alteration

- *geophysical signature*





Mt Isa Eastern Succession



*Broad association of
Na-Ca-Fe metasomatism
with Cu-Au mineralisation*


*Which outcrop is in the regional
alteration zone around Ernest Henry ?*



*North Beach, near Wallaroo,
Moonta Subdomain*



*Mt Fort Constantine,
Cloncurry Belt*



Biotite - magnetite - albite alteration

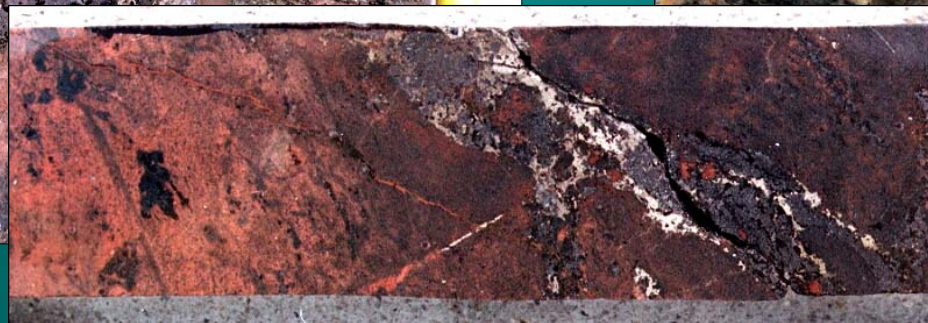
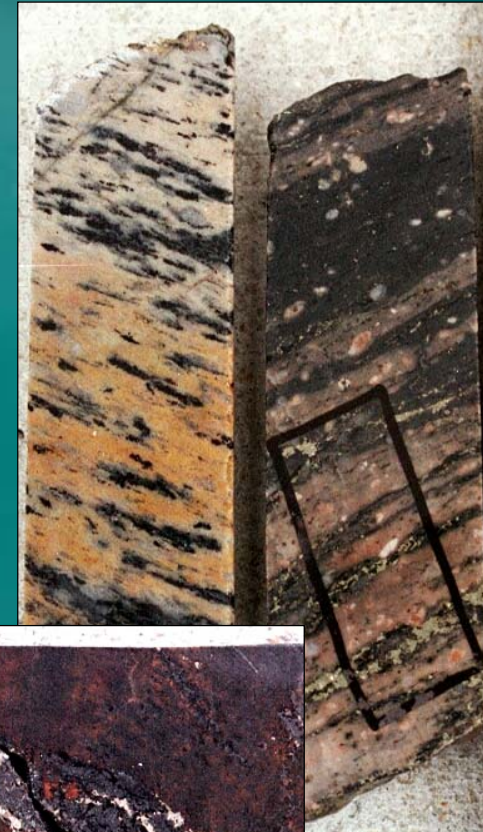
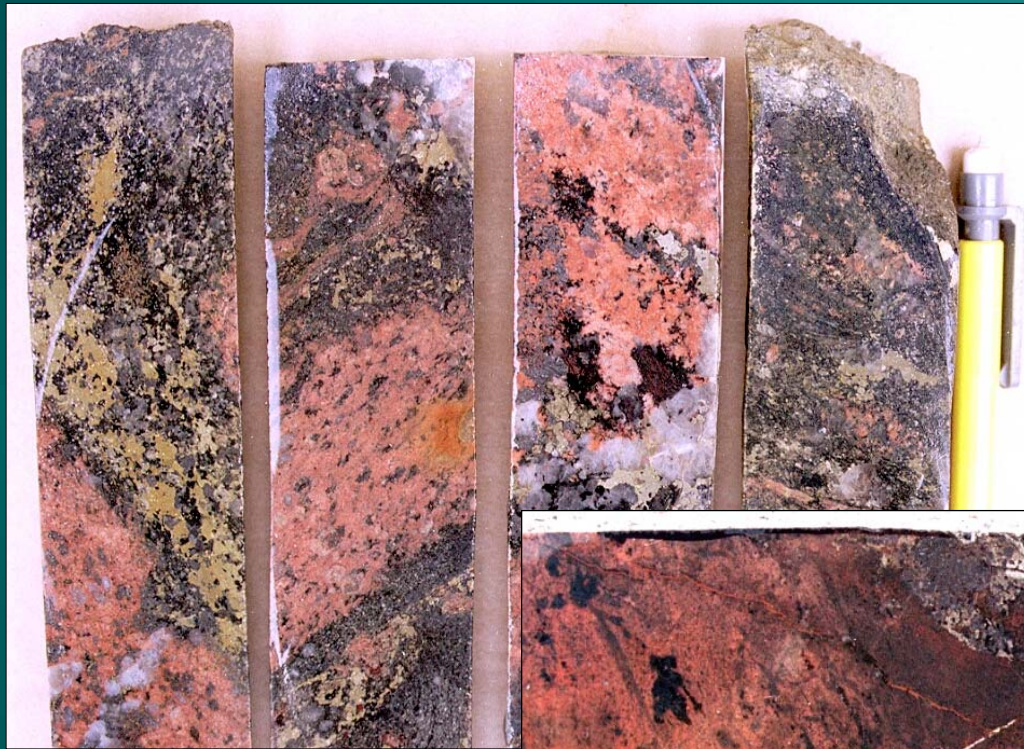
± quartz, apatite, monazite, tourmaline, amphibole, pyrite, chalcopyrite

- commonly foliation-controlled biotite-magnetite alteration domains*
- distal albitic haloes*
- strongly foliated biotite-magnetite schists*
- vein stockworks in weakly foliated rocks*
- massive biotite-magnetite ironstones at contacts of granites*



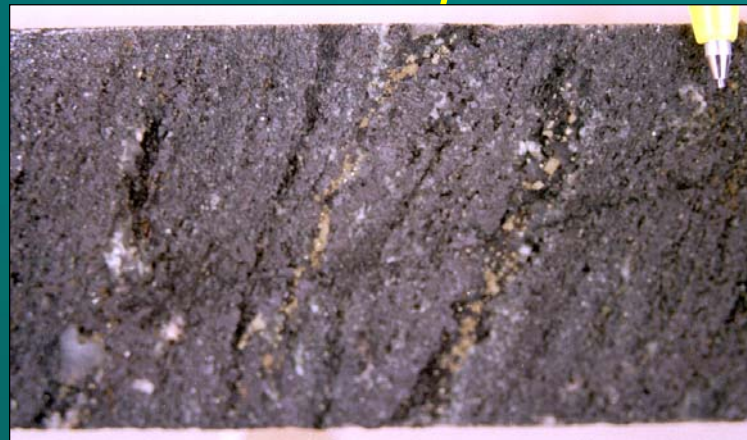
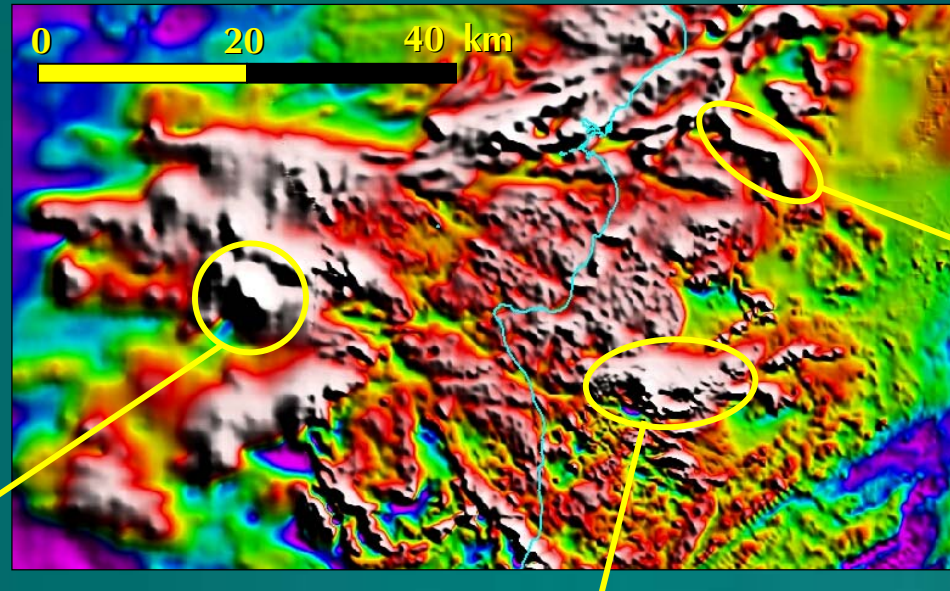
Biotite - magnetite - albite alteration

- *veins and narrow foliation-parallel domains*
- *low grade copper mineralisation*



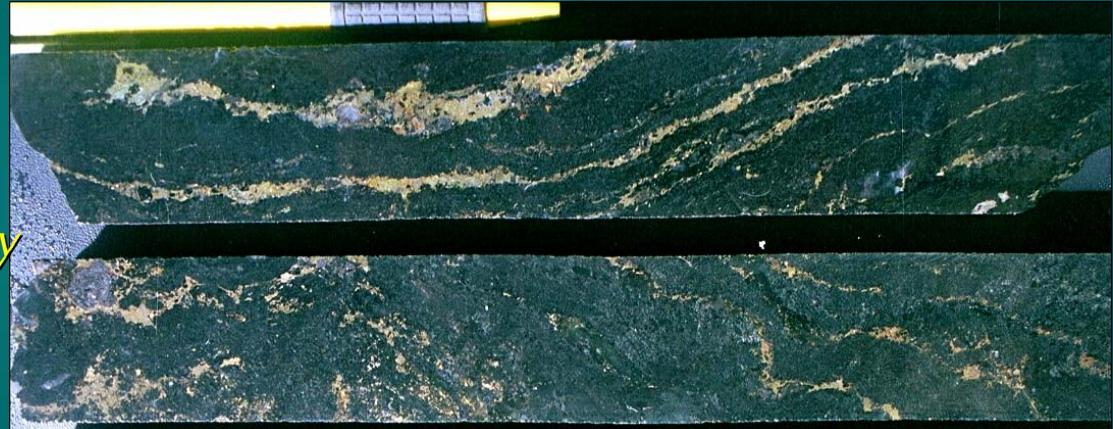
Biotite - magnetite - albite alteration

- *geophysical signature*



Cu mineralisation associated with biotite-magnetite in the Wallaroo district

- *low grade chalcopyrite-pyrite in a sheared host*
- *analogy to some Cloncurry Belt Fe-Cu-Au deposits*



Biotite alteration in the Mt Isa Eastern Succession

- *magnetite-biotite ironstones*
- *potassic alteration commonly proximal to Fe oxide-Cu-Au deposits*

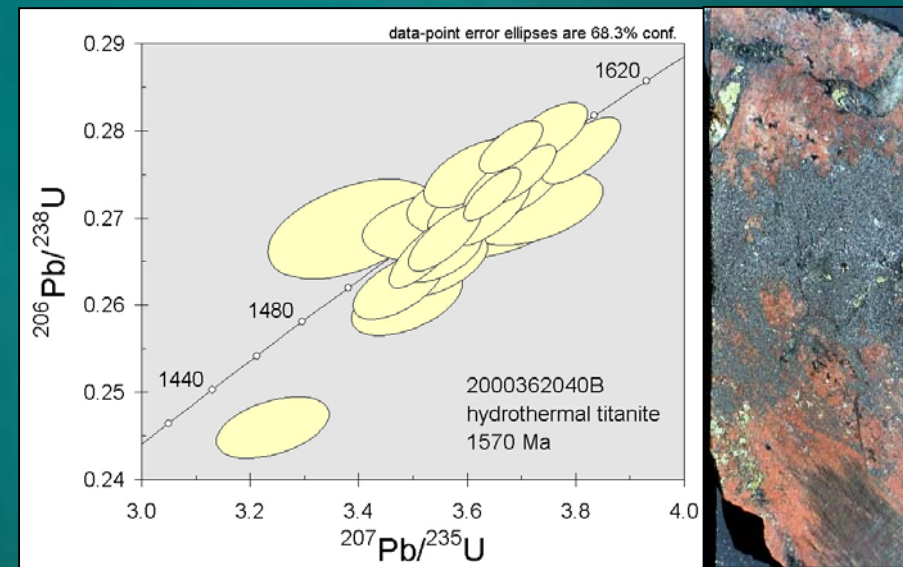
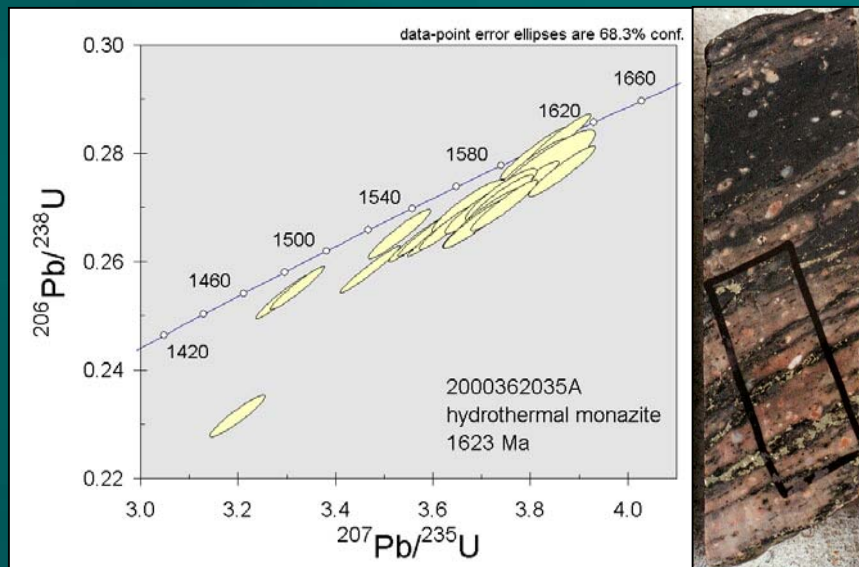
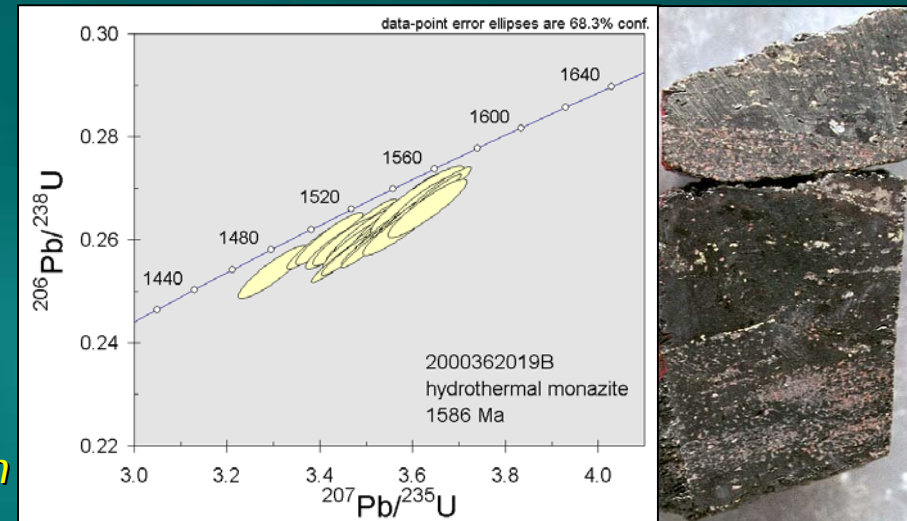
e.g. Ernest Henry

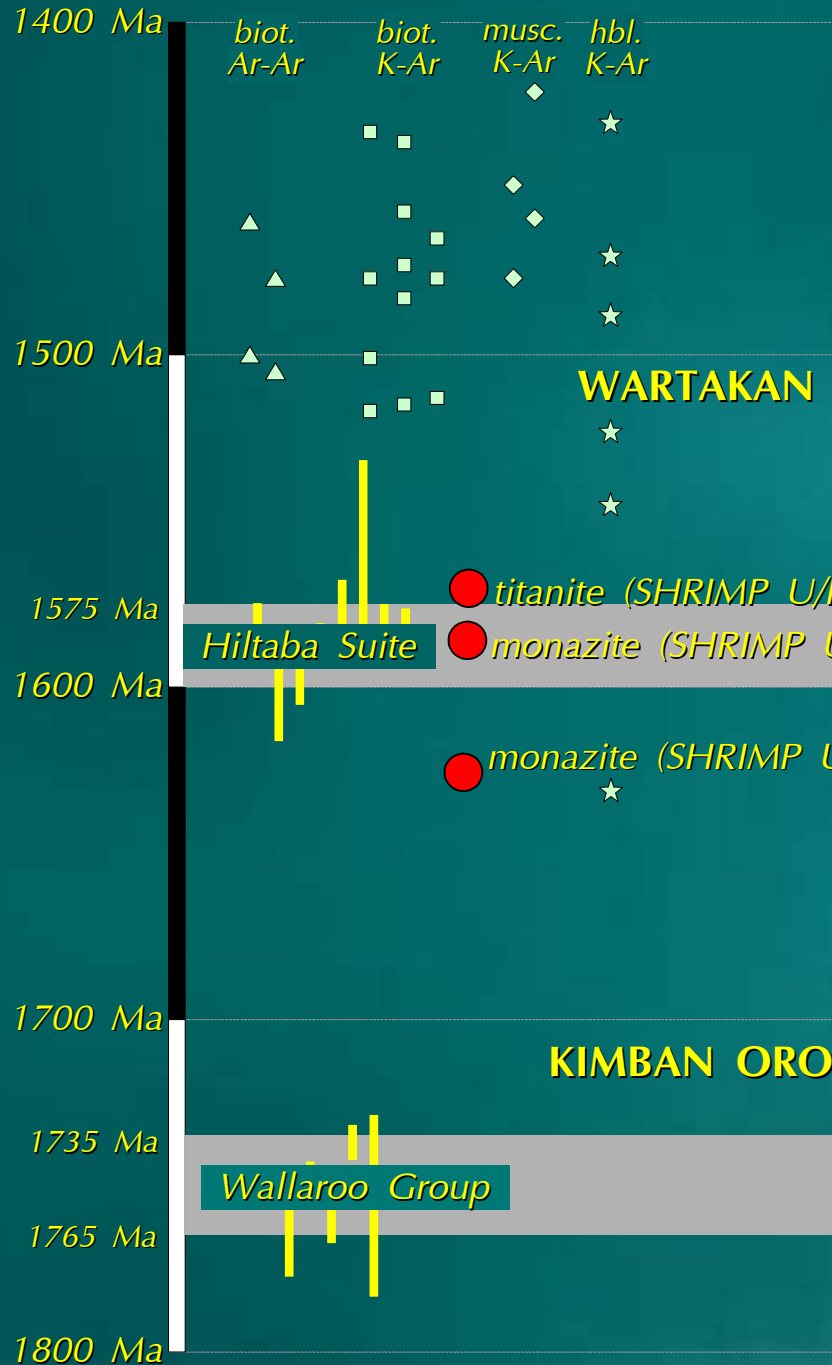


Regional alteration geochronology

(SHRIMP U/Pb preliminary results)

- monazite from biotite-rich alteration
- titanite from albite-magnetite alteration





Regional alteration geochronology

(preliminary results)

evidence of a broader hydrothermal system?





Non-magnetic alteration overprints

- *Chlorite - quartz - hematite - kfeldspar - pyrite - chalcopyrite*
- *Epithermal style kaolinite, quartz and carbonate*
- *Relatively minor regional alteration styles in the Moonta Subdomain*
 - *but locally host significant Cu mineralisation (eg: some Moonta veins)*
 - *under-represented in drilling due to targeting of magnetic highs ?*
- *Paragenetic link to other higher crustal level, oxidised mineral systems in the Olympic Domain*
 - *Olympic Dam*
 - *Prominent Hill*





*Chlorite - quartz \pm hematite \pm kfeldspar
 \pm pyrite \pm chalcopyrite*



- *biotite, actinolite \rightarrow chlorite*
- *albite \rightarrow chlorite, kfeldspar*
- *magnetite \rightarrow hematite*

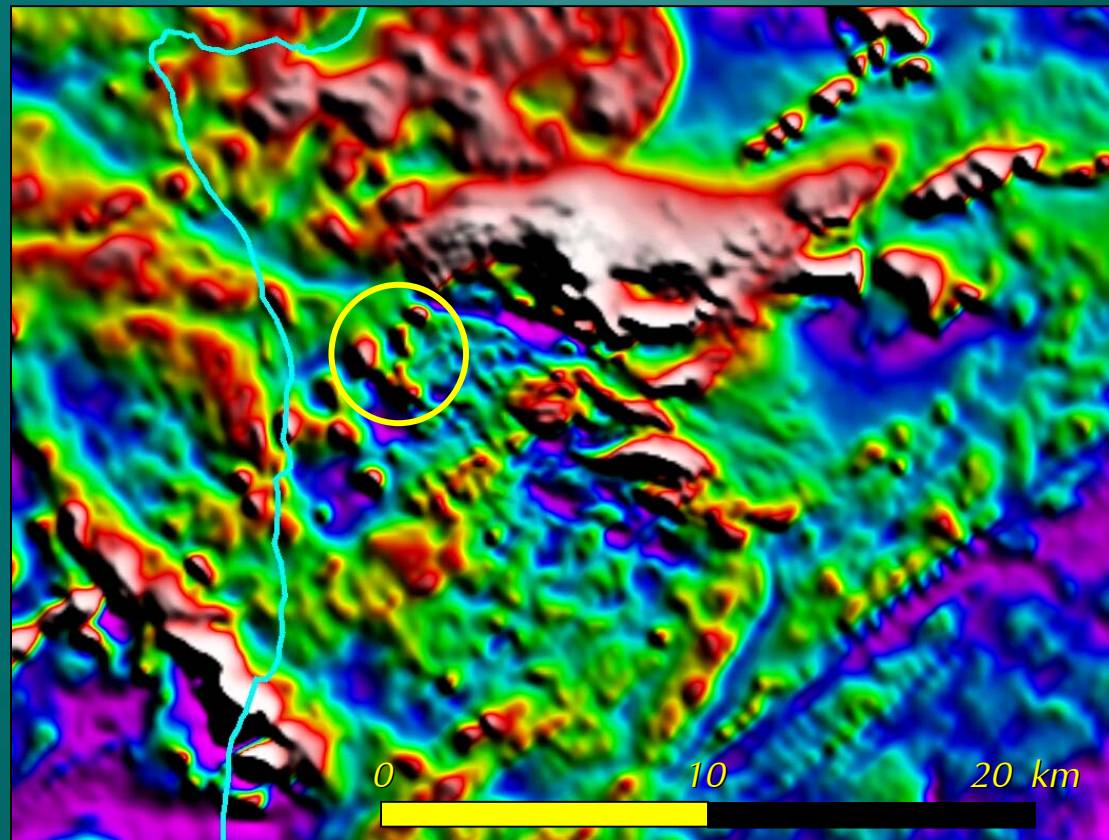


Overprint on albite-actinolite-magnetite alteration



Chlorite - quartz - hematite - chalcopyrite

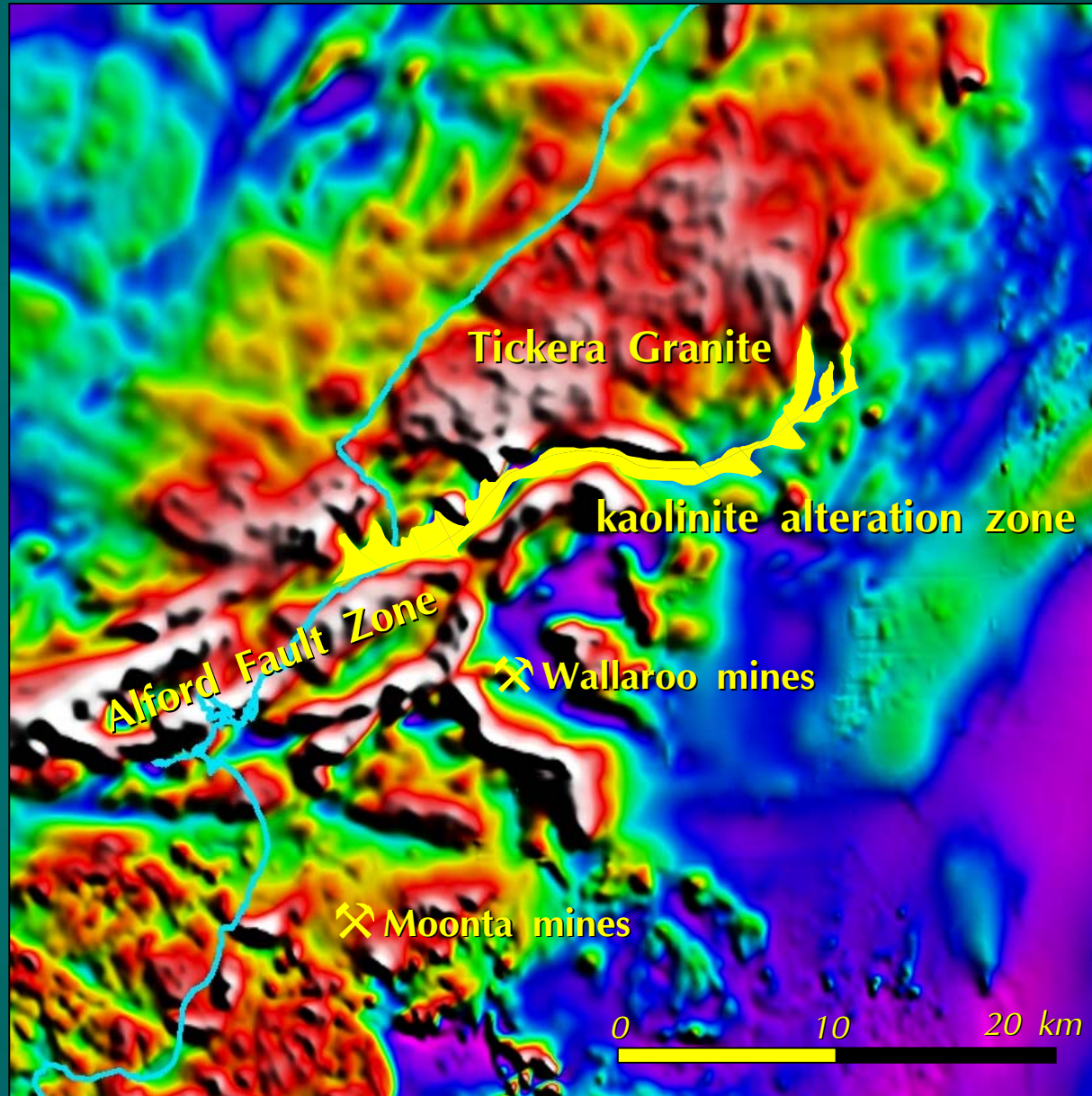
Local demagnetisation along faults of earlier magnetic alteration





'Epithermal' style alteration

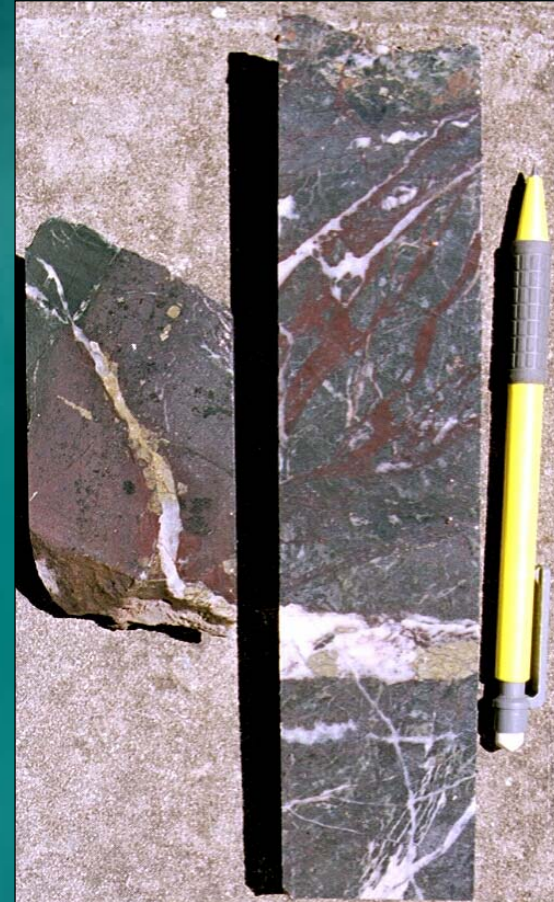
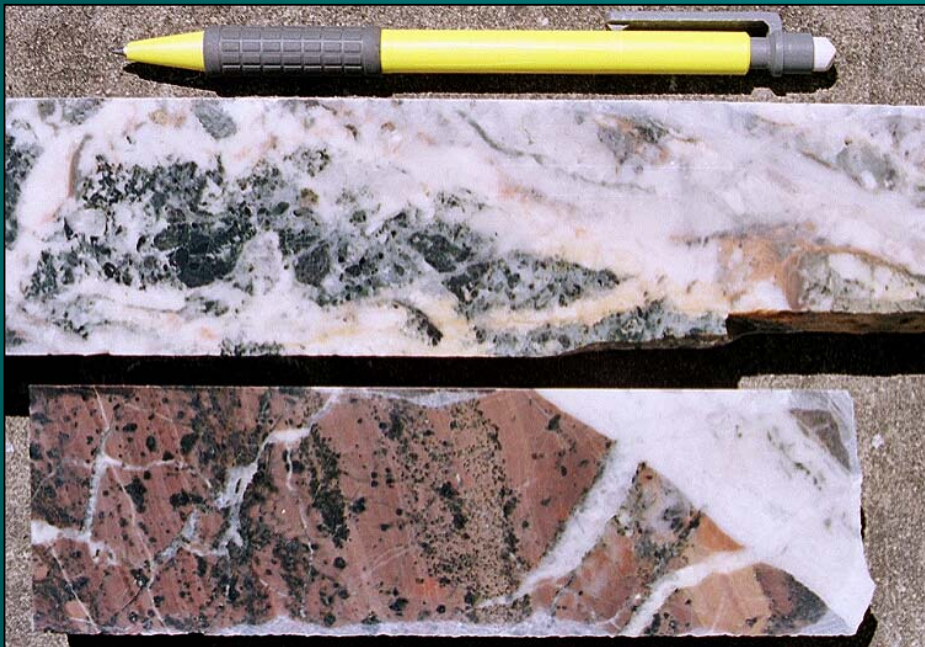
Kaolinite ± quartz, pyrite, alunite, chalcocite





*Quartz - carbonate \pm hematite
 \pm adularia \pm pyrite,
chalcopyrite, bornite*

- local veining and brecciation*





Significance of epithermal alteration styles

The timing of epithermal alteration is poorly constrained

→ important implications for unroofing of the terrane

- Mesoproterozoic → telescoping of the hydrothermal system ?*
- or a much younger system (e.g. Delamarian) ?*





In conclusion .

Moonta Subdomain and Mt Isa Eastern Succession

The Similarities

- *Palaeoproterozoic mixed carbonate / siliciclastic metasedimentary and metavolcanic basement*
- *Mesoproterozoic felsic and mafic intrusive suite*
- *Syn-magmatic deformation and metamorphism; greenschist to amphibolite*
- *Regionally extensive Na-Ca-K-Fe metasomatism associated with magmatism*
- *Regionally extensive fault zones as potential fluid conduits*
- *Fe and K metasomatism associated with Cu mineralisation*
- *Abundant Cu-Au anomalism*



Moonta Subdomain and Mt Isa Eastern Succession

The Differences

- *Palaeoproterozoic phase of metasomatism in the Eastern Succession*
- *Chlorite-quartz-hematite-kfeldspar-chalcopyrite and epithermal styles of alteration in the Moonta Subdomain → the Olympic Dam link ?*
- *Large tonnage Fe oxide-Cu-Au deposits discovered in the Eastern Succession*
- *A lack of Palaeo- and Mesoproterozoic outcrop in the Moonta Subdomain*

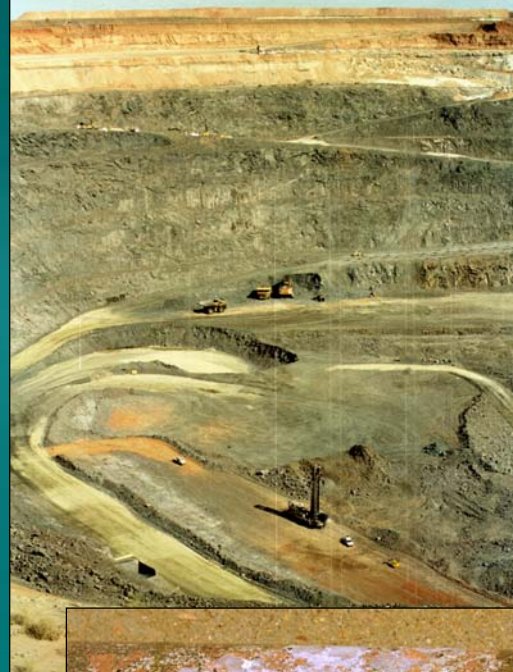




Moonta - Wallaroo



Cloncurry Belt



**Olympic Dam
Prominent Hill**

