

The Gawler Craton in its global tectonic setting: Implications for mineral systems

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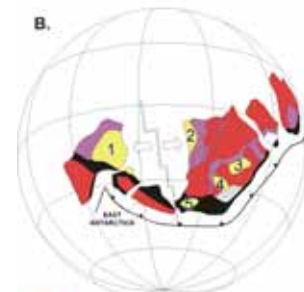
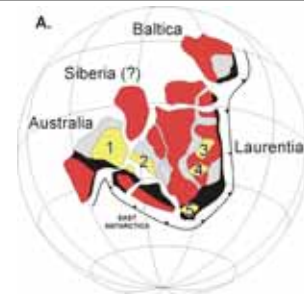
- Palaeoproterozoic evolution of the Australian continent is interesting because of the high density of large tonnage deposits.

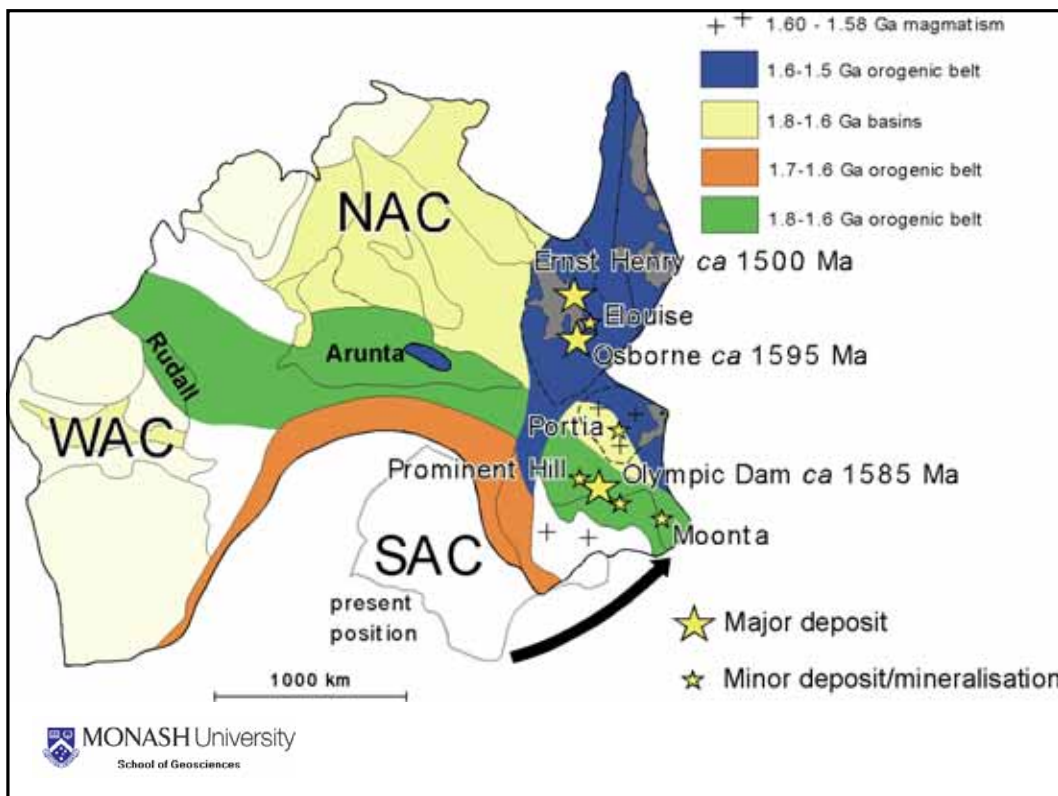
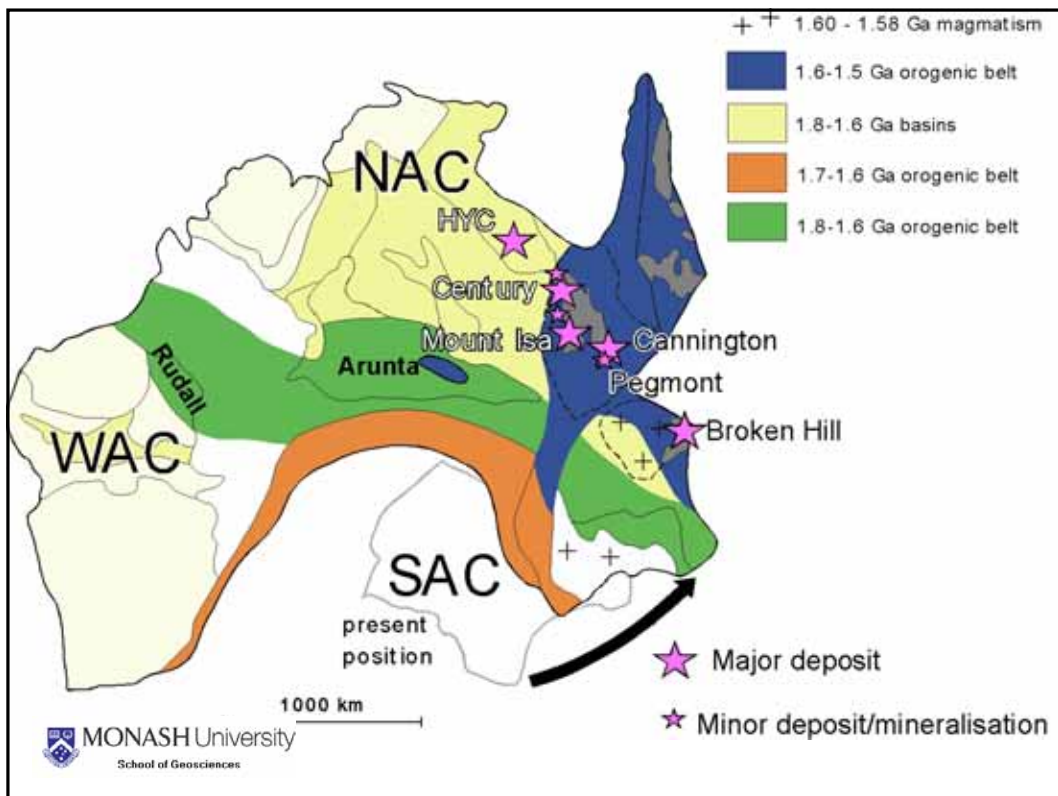
- At least for some of this time Australia appears to have been part of a larger continental mass which included Laurentia, Baltica, and Siberia.

- Any interesting facet of this larger continental mass (which has a configuration that is conjectural) is that Australia appears to have enjoyed many of the *base metal spoils* (over a relatively short interval)

- ca 1.67-1.50 Ga.

- Between two supercontinent cycles (Columbia and Rodinia)

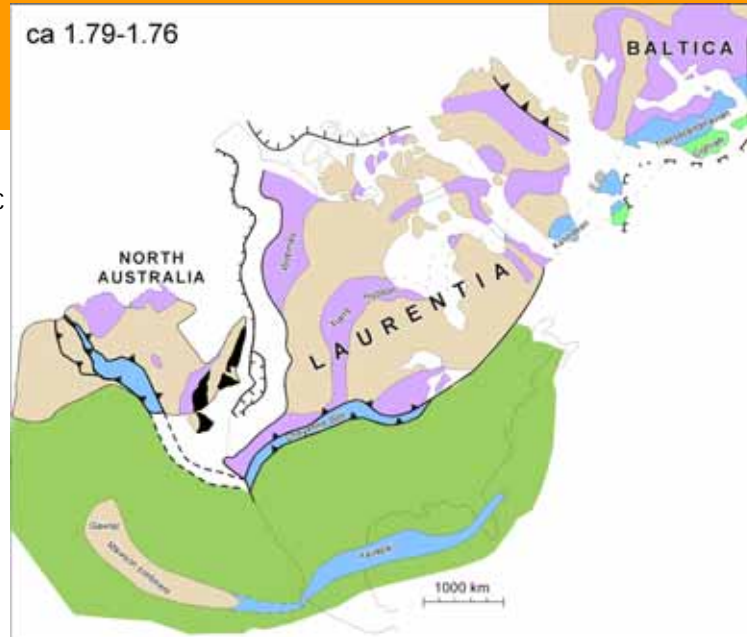




Comparison

Temporal correlation between major orogenic events in Australia and Laurentia.

•1.79-1.76 Ga Yapungku-Yamba-Cheyenne

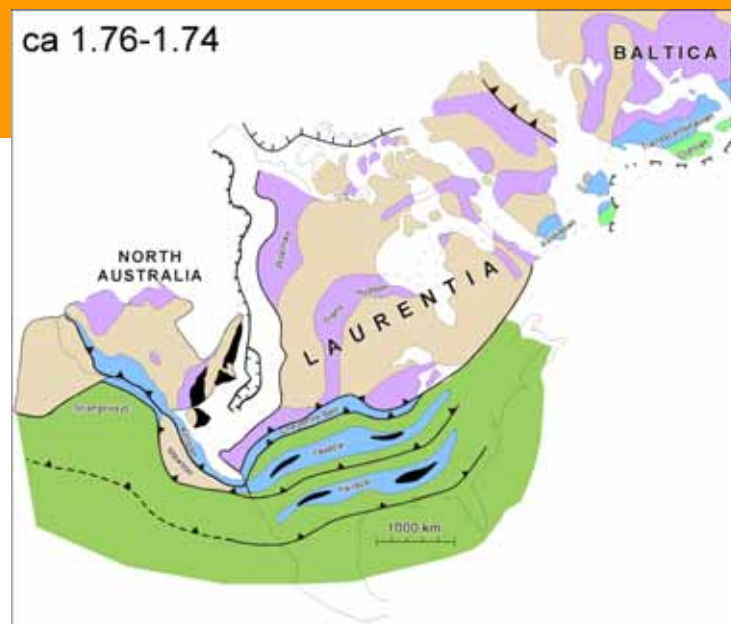


Comparison

•1.74-1.70 Ga Strangways-Kimban-CYavapai

Collision between Mawson and North Australia.

Multiple accretionary events of juvenile arc terranes leading up to final accretion at ca 1.70 Ga.



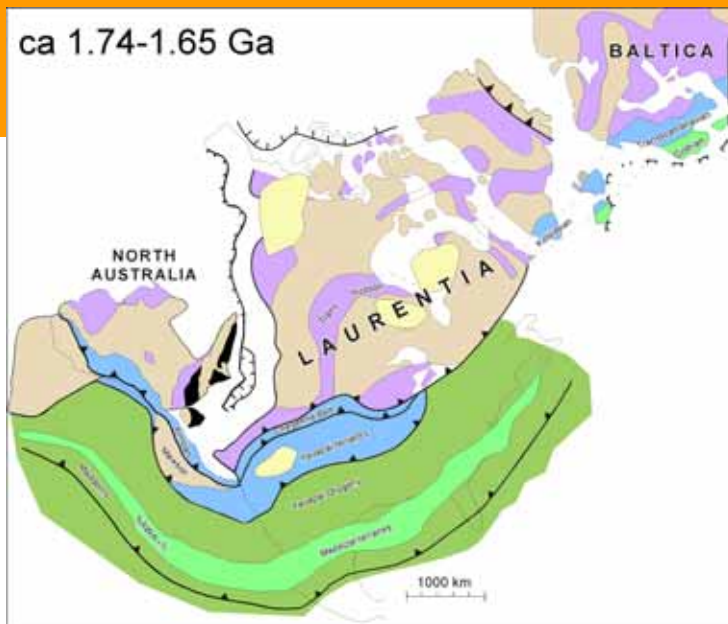
Comparison

1.65-1.64 Ga Early Kararan-Leibig-Mazatzal

The nature of Australian terranes poorly resolved & may represent allochthonous terranes (continental vs arc?)

Mazatzal terranes allochthonous juvenile arc terranes with several sutures.

Magmatic event at ca 1.68-1.67 Ga in all terranes with arc-looking rocks in Gawler (Tunkillia Suite).



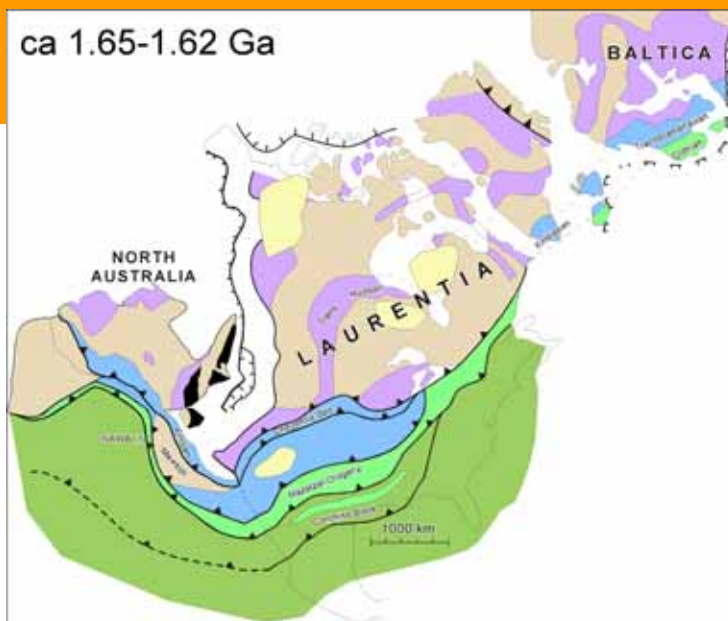
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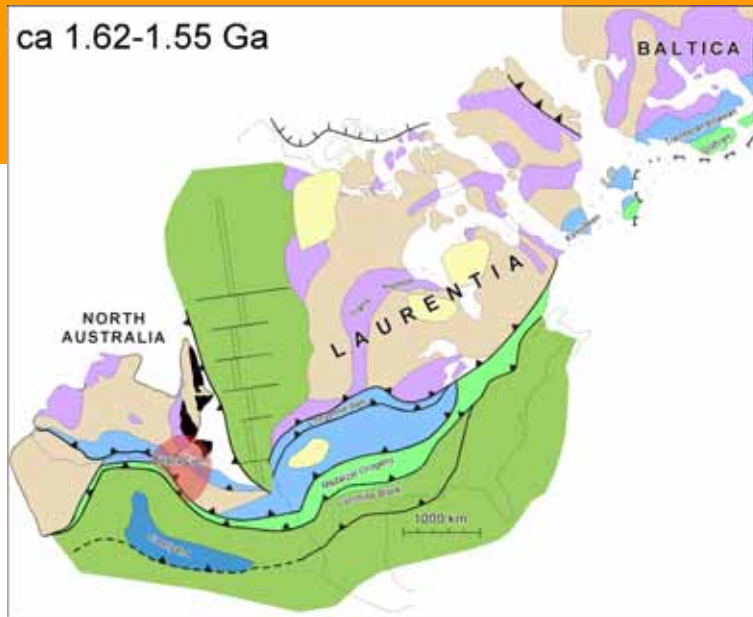
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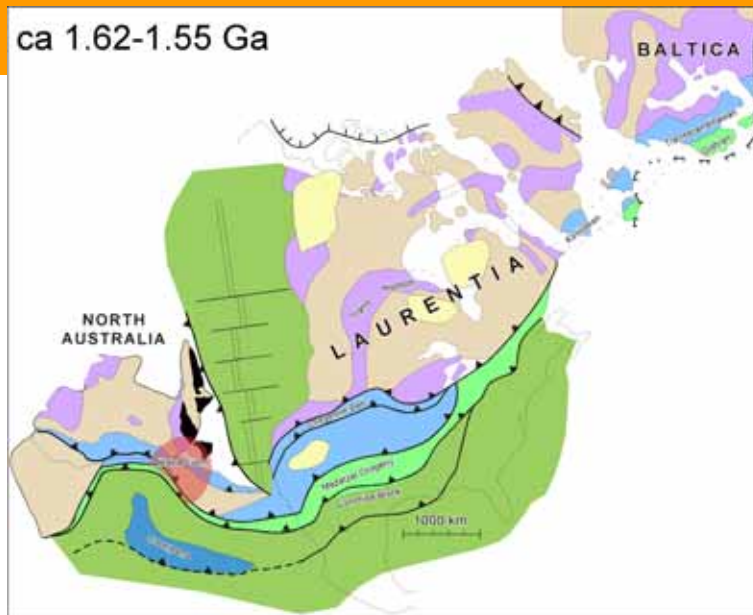
Comparison

- Divergence after 1.65 Ga.
- Both record 1.62 Ga arc magmatism
- Magmatic gap in the Laurentia.
- Australia: 1.60-1.58 Hiltaba Event.
- Widespread magmatism and HT metamorphism.



Comparison

- Separation between the continents.
- Sag-basins at ca 1.65 Ga
- Break-up?
- Complicated orogenic belt along the eastern margin of the Australia
- Arc magmatism in the Georgetown Inlier
- Records closure of the ocean - different configuration?



What happened at 1600 Ma? Catastrophic event?

• Major tectono-thermal event that is manifested as:

• HT metamorphism and crustal shortening (ca 1600 Ma)

- central Australia (Chewings)
- Curnamona (Olarian)
- Mt Isa (Isan)
- Georgetown (Jana)

• bimodal volcanism (Gawler Range Volcanics)

• A-type granites (Gawler Craton, Curnamona)

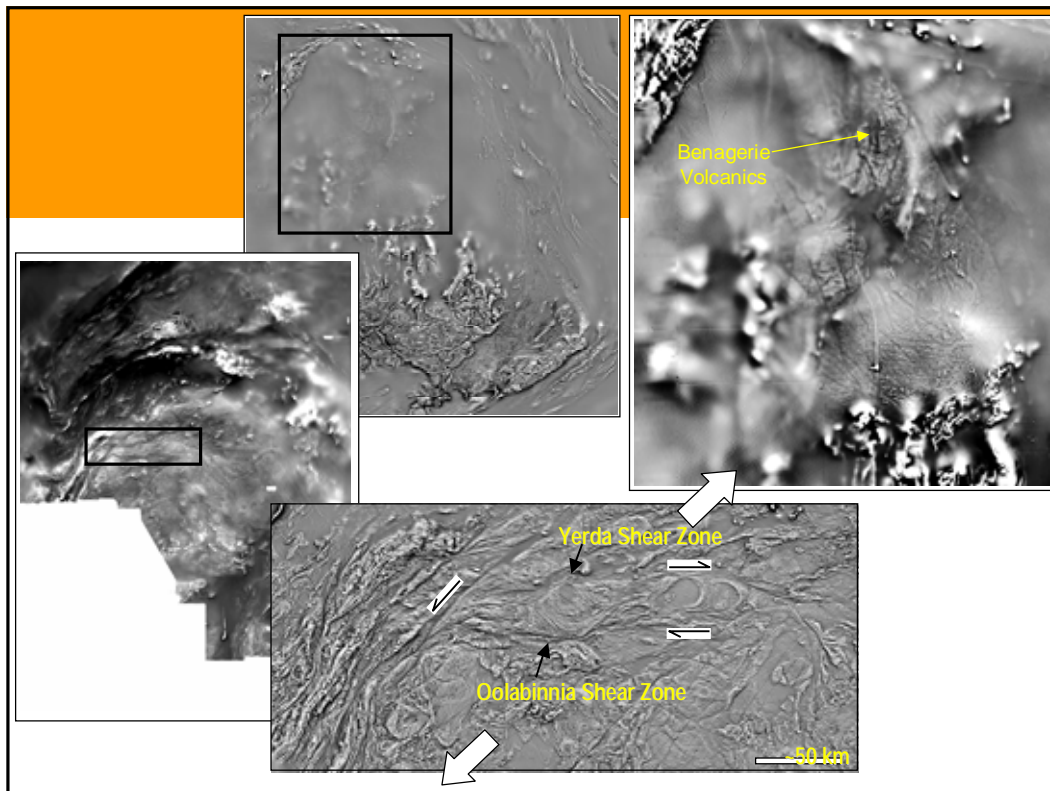
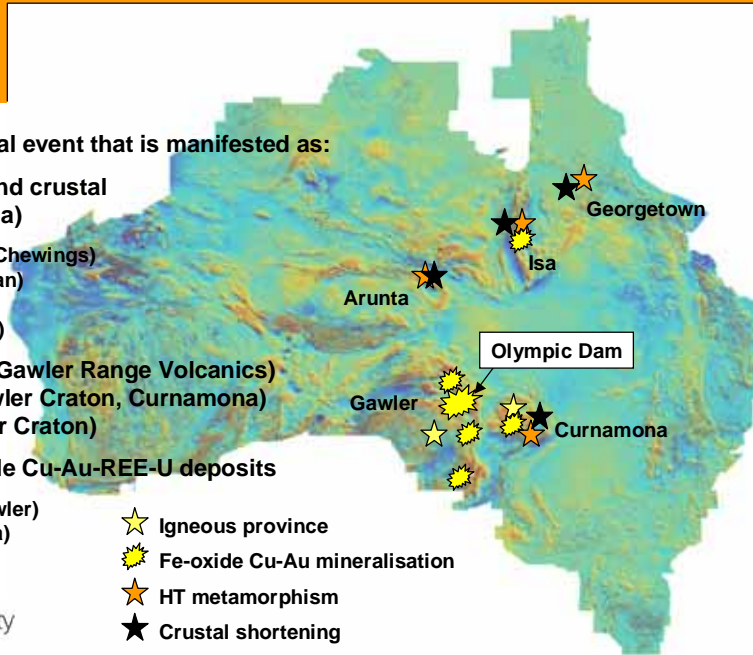
• Picrite dykes (Gawler Craton)

• Formation of Fe-oxide Cu-Au-REE-U deposits

- Olympic Dam (Gawler)
- Portia (Curnamona)
- Osborne (Isa)

- ★ Igneous province
- ★ Fe-oxide Cu-Au mineralisation
- ★ HT metamorphism
- ★ Crustal shortening

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The key observations

1. Superposition of a younger ca 1620 Ma arc on an older arc terrane inboard of the plate margin.
2. Cessation of ca. 1620 Ma arc-related magmatism along the SW margin of the Gawler Craton.
3. The onset crustal shortening ca. 1600-1590 Ma in central & eastern Australia.
4. HT- metamorphism in the orogens.
5. ca. 1590-1580 Ma felsic dominated magmatism and bimodal volcanism in the central Gawler Craton.
6. Plume related signature.
7. Syn-deformational emplacement of Hiltaba Granites.
8. Northward decrease age of granites suites along the eastern margin of the Gawler Craton



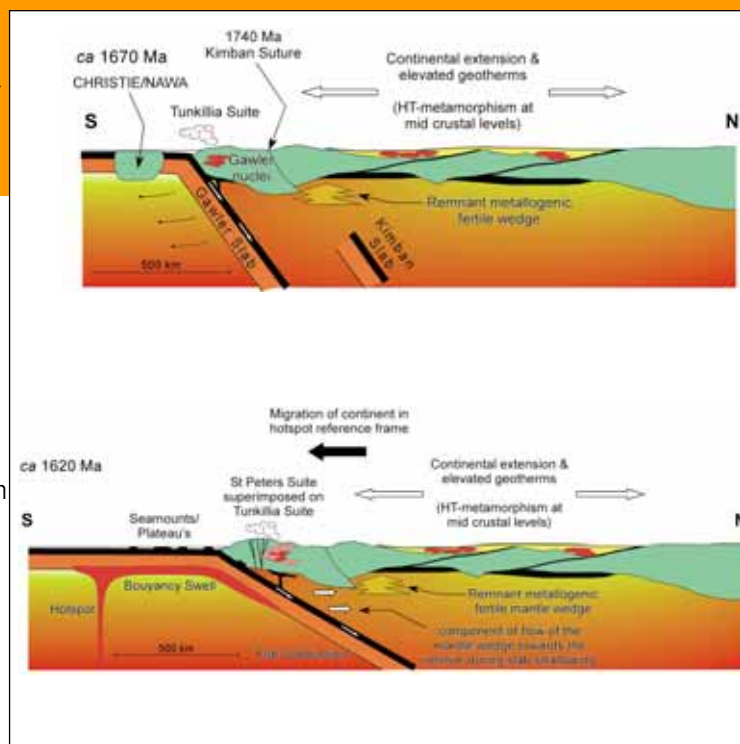
A model

(1) Roll-back of north to NW-dipping subducting slab at ca 1670 Ma results in arc magmatism and extension in the overriding plate.

- Tunkillia Suite
- ca 1650 Ma Accretion - Early Kararan Orogeny
- Superbasin

(2) Hot spot - oceanic plate resulting in buoyancy swell.

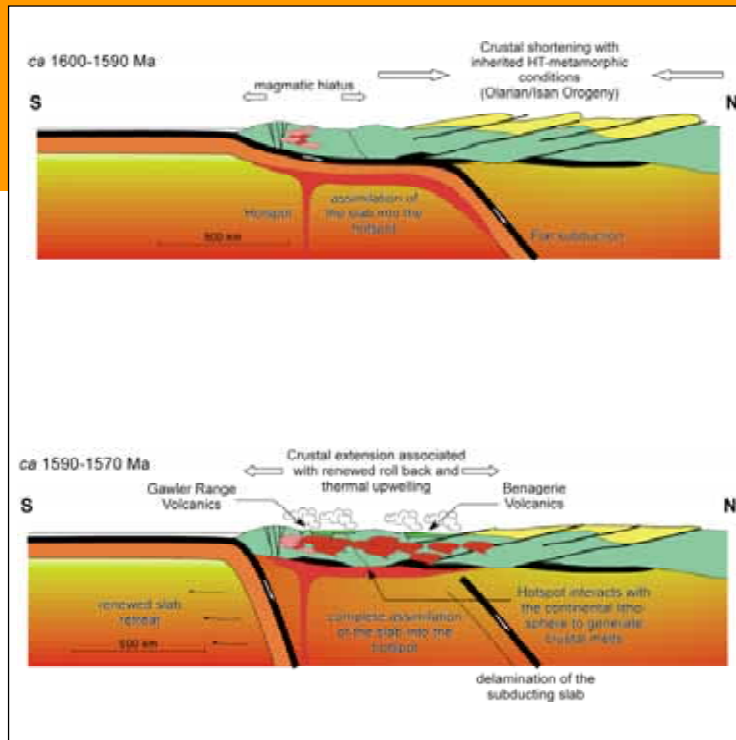
- buoyant subduction results in shallowing of the slab.
- arc magmatism (St Peters Suite) shifts towards the interior of the continent.
- extension in the overriding plate results in lithospheric thinning & HT met.



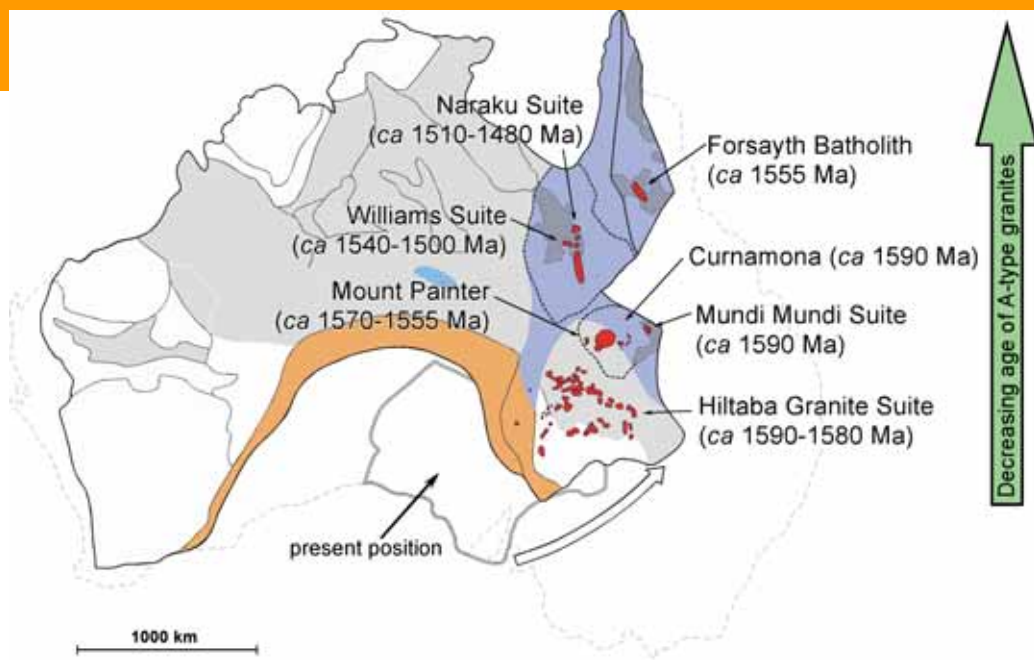
A model

(3) Overriding plate retreats over the subducting plume resulting in flat subduction.

- arc switches off.
 - crustal shortening in the overriding plate where lithosphere is attenuated
- (4) slab assimilates with the hotspot or thermally eroded.
- Roll-back is renewed – tectonic switch.
 - hotspot interacts with the continental lithosphere.
 - mafic underplating
 - bimodal magmas - plume signature.
 - picritic dykes - Olympic Dam.
 - extension in the overriding plate



Hotspot trail (?)



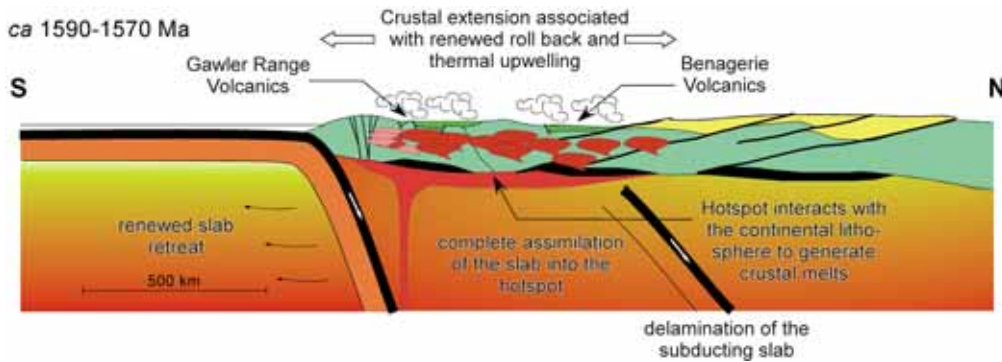
Something to think about

It is difficult to ignore the influence of a mantle plume for providing the heat engine to drive such large hydrothermal system(s) necessary to produce Olympic Dam size deposits.

The plume itself may not have been the source of metal, nor the only significant influence on mineralisation.

Tectonic switch to extension just before mineralisation:

- promote crustal fluid flow
 - decompressive melting
 - reactivation of major structures

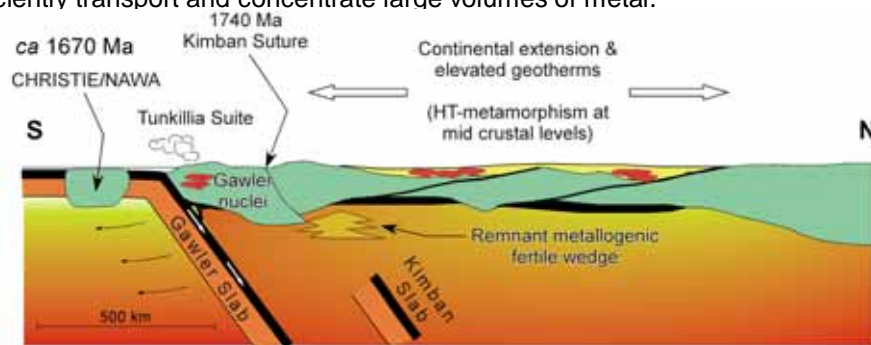


Something to think about

More than the interaction of a plume and the continental margin but the protracted lithospheric pre-history leading up to mineralisation, which may have resulted in pre-conditioning of the mantle lithosphere favourable for mineralisation.

Such pre-conditioning might include:

- the episodes of protracted magmatism (e.g. Donington Suite).
 - multiple episodes mantle wedge metasomatism.
 - long-lived activity of lithospheric-scale structures, including those producing steps in the Moho (i.e., mantle tapping).
- Combined, these factors constitute a terrane that is chemically pregnant and able to efficiently transport and concentrate large volumes of metal.



Monash's Role in the linkage project

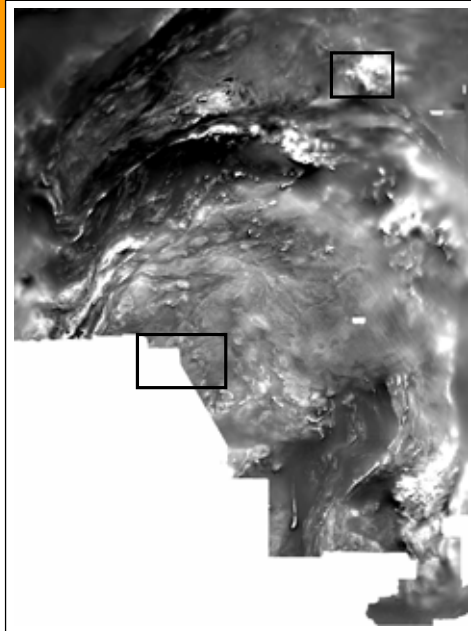
Began by focussing on two critical regions.

1. St. Peters Suite Volcanics

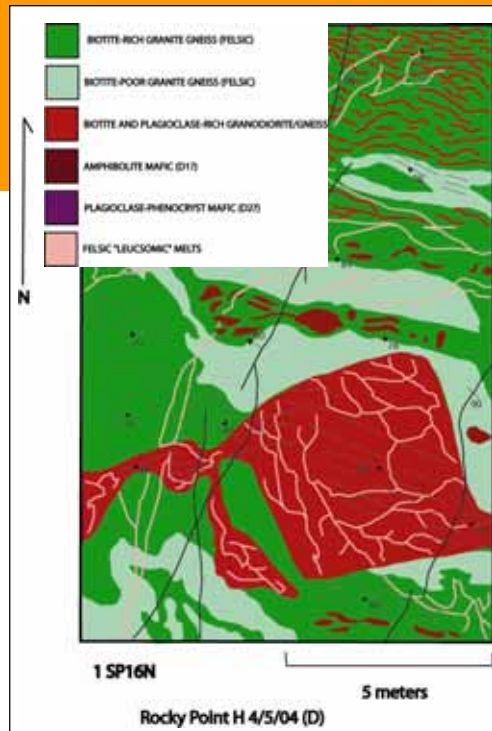
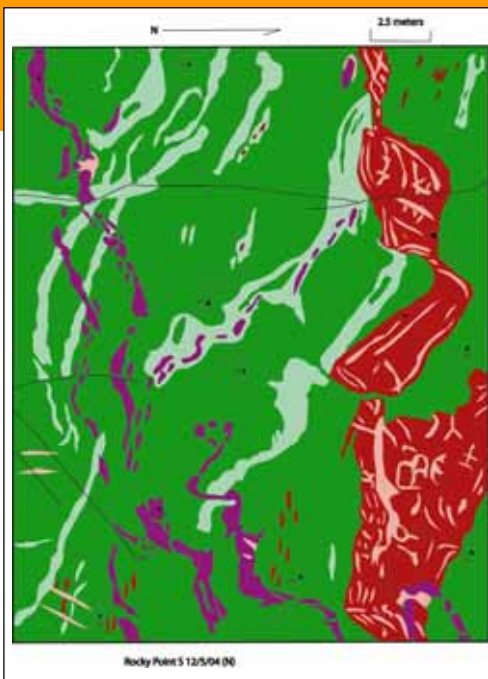
integrated mapping, regional geophysical interpretation and geochemistry projects aimed at pulling apart the evolution of the Gawler Craton leading up to the Hiltaba Event.

2. Peake and Denison Inlier

to assess if there are bits of the Western Fold Belt preserved in the northern Gawler Craton



St Peters Suite Project



St Peters Suite Project

