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# **Craton-scale controls and time-space distribution of IOCG and gold systems in the Gawler Craton**

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**Government of South Australia**  
Primary Industries and Resources SA

**IOCG Workshop**  
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Geoscience Australia



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Gawler Project team at Geoscience Australia  
Primary Industries & Resources South Australia  
Adelaide University  
University of Tasmania

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Res., TeckCominco, WMC Res.



## Three messages

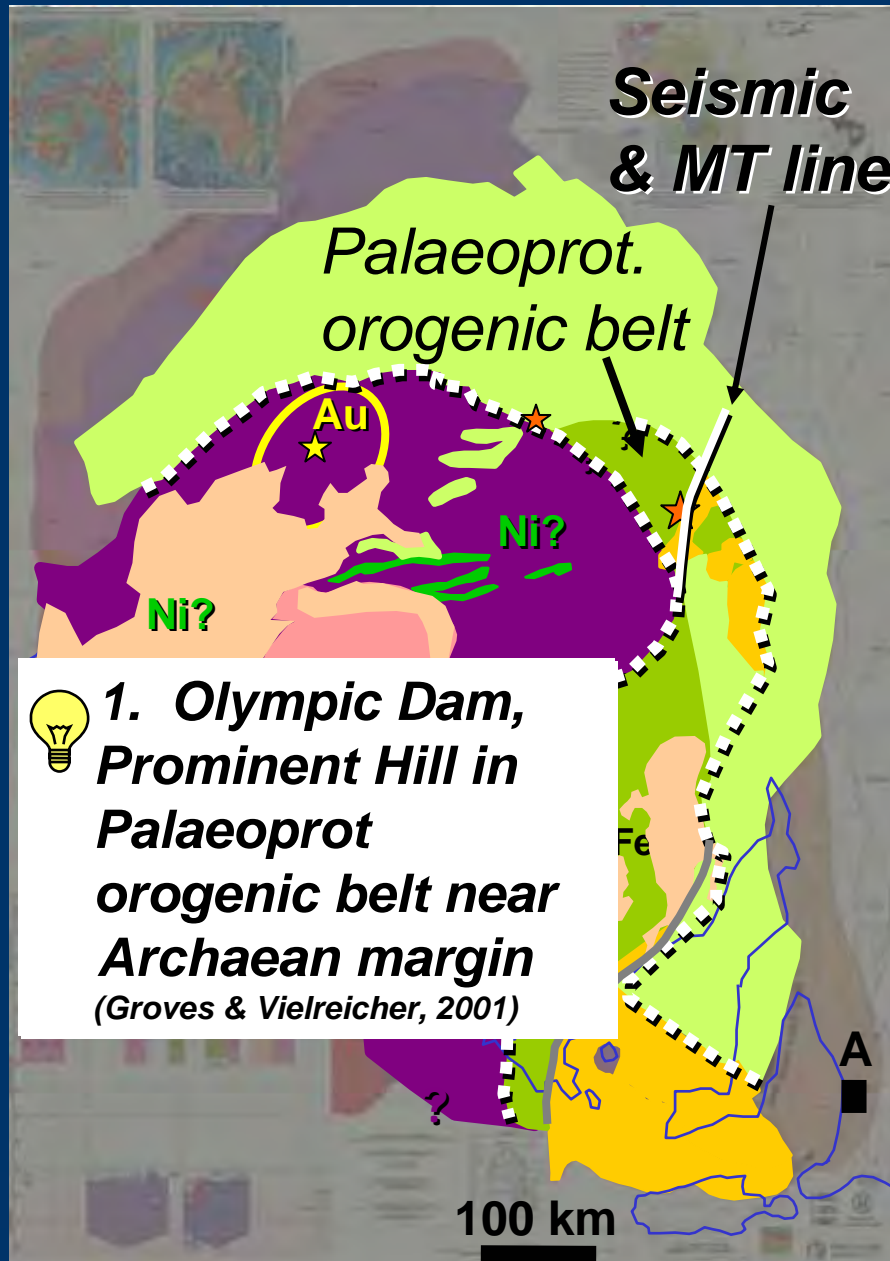
1. **'Plumbing'** - major Mesoproterozoic IOCG systems in Palaeoproterozoic orogenic belts at margins of Archaean 'core'; metased basins favourable for saline fluids.
2. **Timing** - Iron oxide Cu-Au ( $\pm$ U) in eastern Gawler, and Au in central Gawler, all at  $\sim$ 1575 to  $\sim$ 1595 Ma - broadly coeval and spatially associated with *some* Hiltaba-GRV magmatism and deformation (new dating).
3. **Heat** - IOCG districts developed where high heat flow at 1575-1595 Ma (magma compositions and Fe-oxide alteration mark these districts).



# 1. Plumbing systems of IOCG deposits



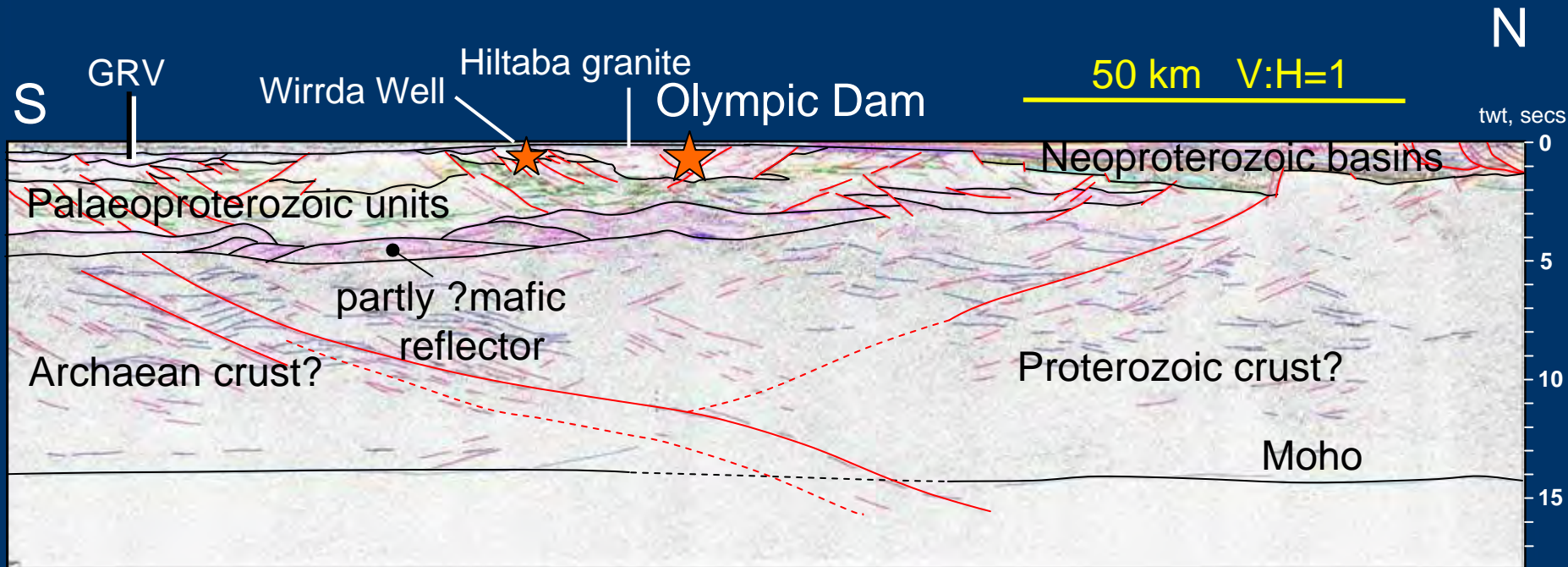
# Gawler Craton evolution



**1. Olympic Dam, Prominent Hill in Palaeoprot orogenic belt near Archaean margin**  
(Groves & Vielreicher, 2001)

- 2900?-2520 Ma: Archaean seds, volcs, incl. komatiites
- Au mineralisation, pre- or syn-2440 Ma metamorphism
- <2000-1850 Ma: BIF, carbonates, siliciclastics
- 1850 Ma: granitoids, syn-orogenic
- <1850-1740 Ma: siliciclastics, felsic volcs, BIF
- ~1720-1670 Ma: granitoid and mafic intrusions, syn-orogenic shear zone – Kimban Orogeny
- ~1620 Ma: I-type granitoids

# Olympic Dam region 'plumbing': Seismic reflection data and interpretation



- 💡 1. Two crustal domains – OD in Prot near margin of Archaean
- 💡 IOCG fluid flow partly controlled by major Palaeoprot(?) faults reactivated in early Mesoproterozoic

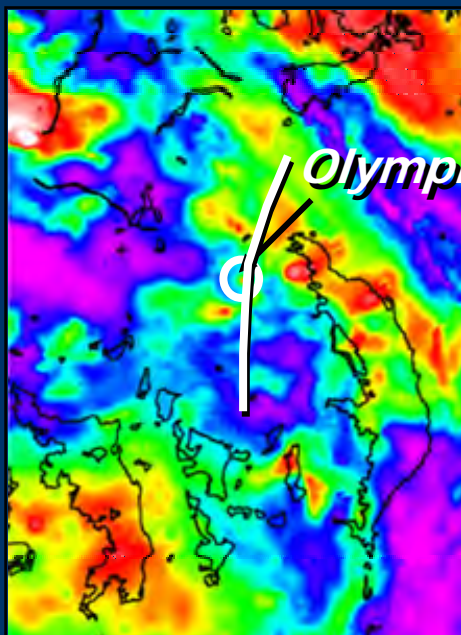
Seismic data processing: Leonie Jones

Interpretive linework: Patrick Lyons, Bruce Goleby, Wolfgang Preiss, Roger Skirrow, Barry Drummond, Jennifer Totterdell, Michael Schwarz, Martin Fairclough, Nick Direen, Andrew Shearer (Lyons et al., 2004, 2005)

IOCG Workshop, Feb06

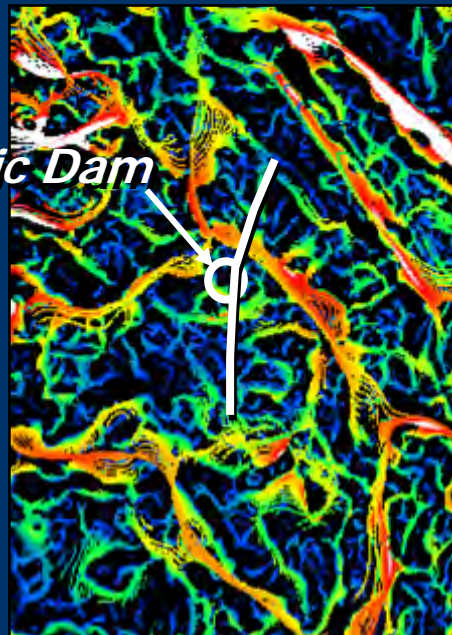
# Eastern Gawler 'plumbing' – major structural orientations

Gravity



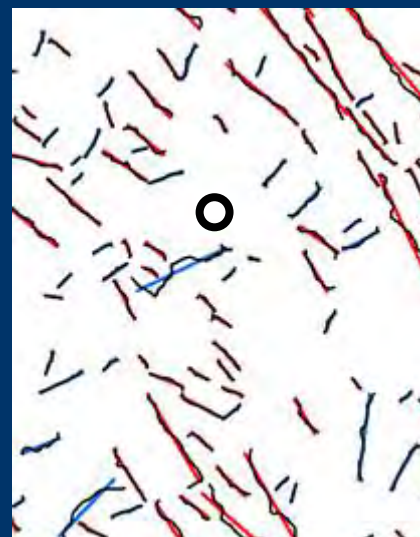
Olympic Dam

Edges or 'worms'



Worms from Fractal Graphics

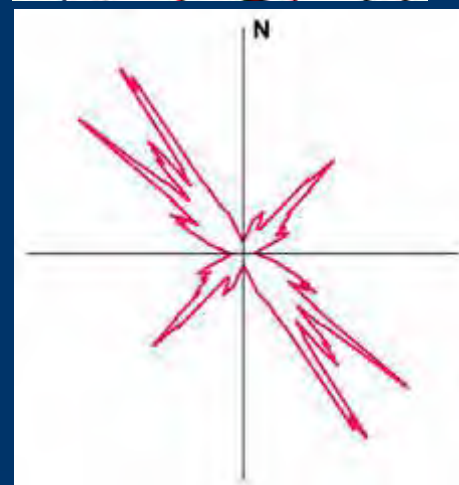
Structure - conjugate NW & NE worm=fault? network



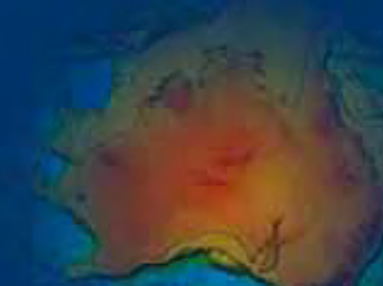
NW edges: red  
NE edges: blue  
(major structures only)



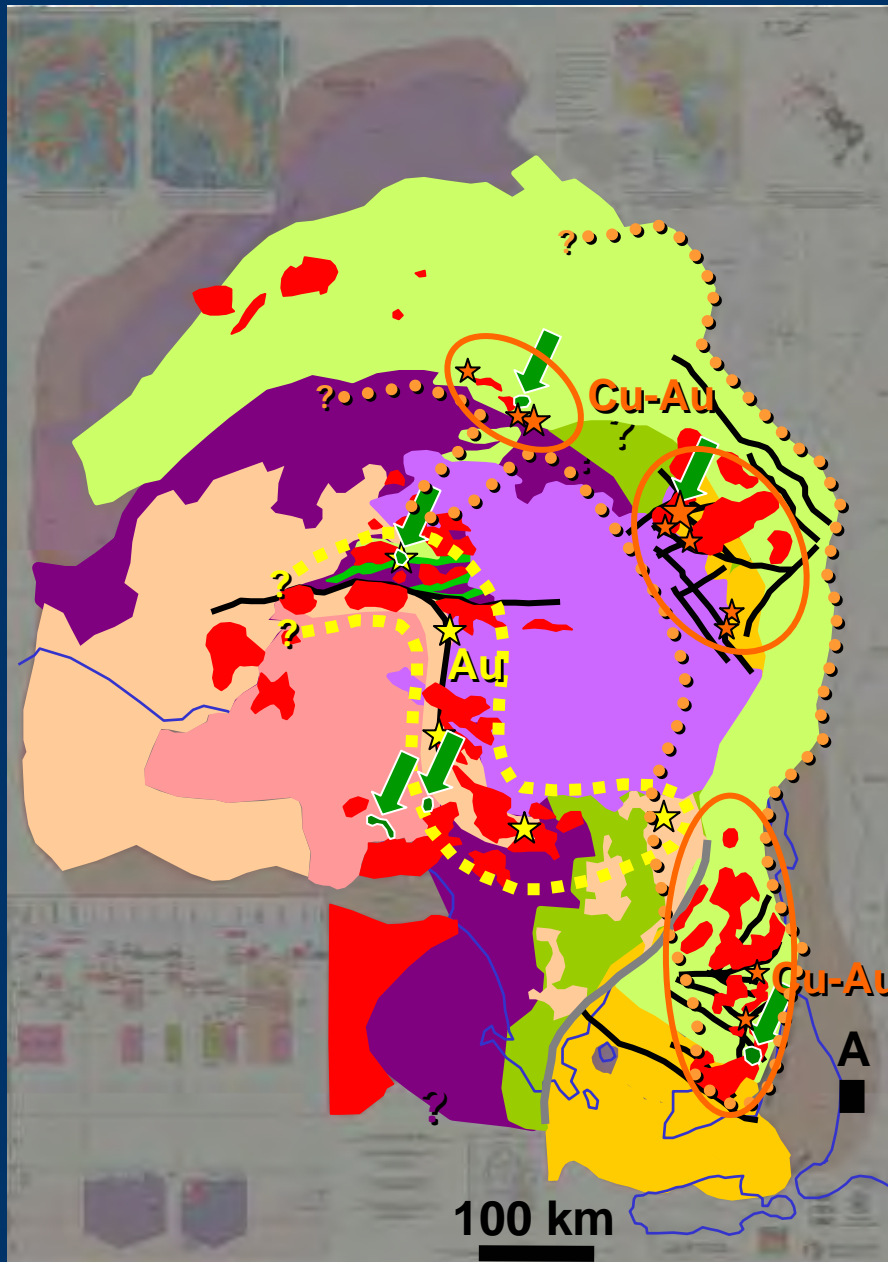
**1. Major structures, OD region: NW, NE**  
(Sugden, 1992; Gow et al., 1993; Direen et al., 2002)



Edge azimuth histogram



# Olympic Cu-Au province



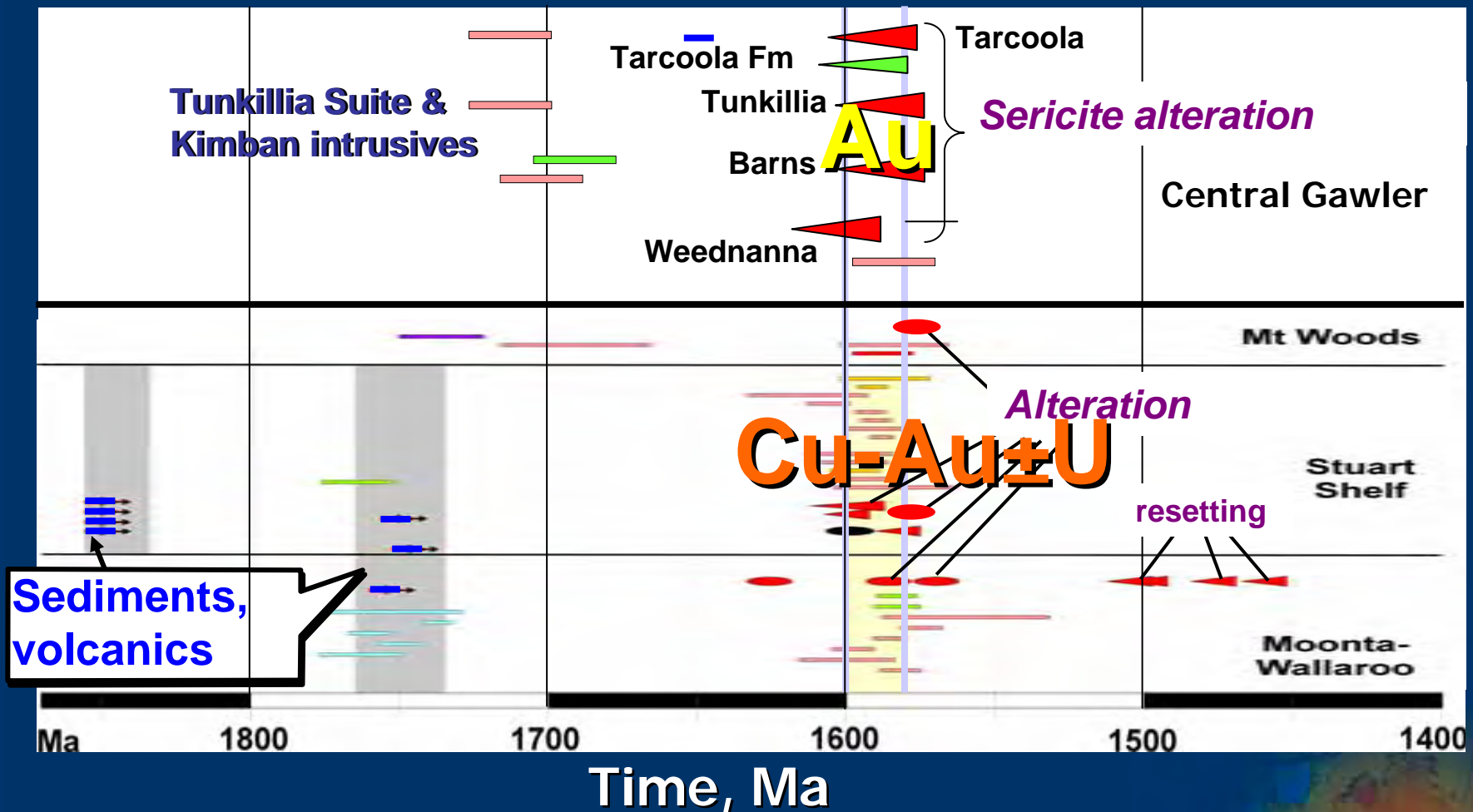
- ~1590 Ma: Gawler Range Volcanics (bimodal, mainly felsic)
- ~1595-1575 Ma: Hiltaba Suite granitoid and mafic intrusions; faults
- ~1590-1575 Ma: Olympic Cu-Au province; 3+ 'footprints'
- ~1580 Ma: Central Gawler Au province



2. *Cu-Au (-U)* spatially assoc'd with some Hiltaba-GRV, and Palaeoproter sed basins (Wallaroo Gp)

## 2. Timing of IOCG hydrothermal systems

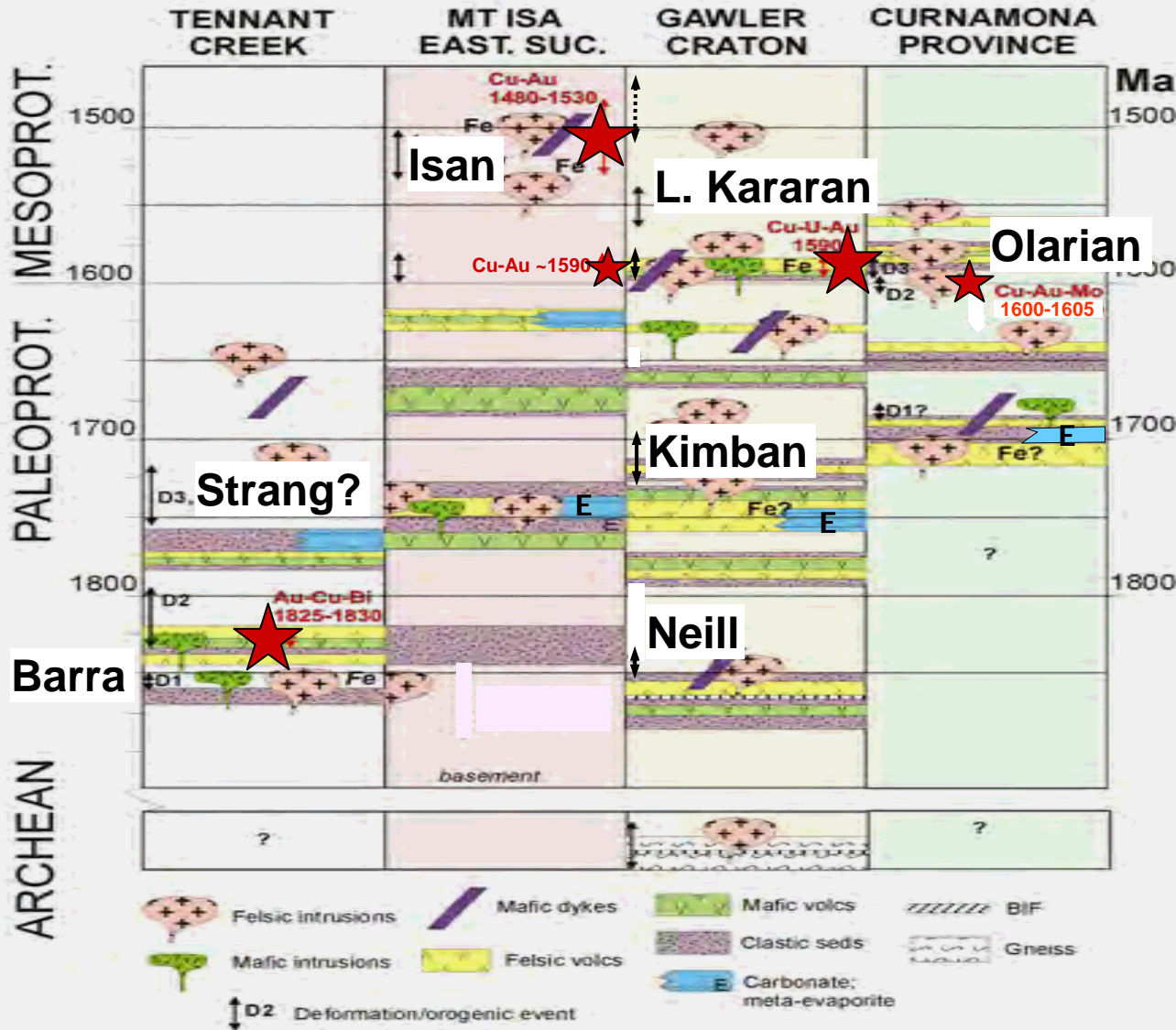
## 2. Timing – eastern Gawler IOCG, central Gawler Au & Hiltaba-GRV magmatism all at 1575-1595 Ma



(new results in red; ◀ = Ar-Ar, other data: U-Pb & Re-Os)

(E. Jagodzinski, G. Fraser, A. Budd, G. Ferris, O. Holm, R. Skirrow)

# FE-CU-AU TIMING AND TECTONO-STRATIGRAPHIC EVOLUTION



## Australian Proterozoic

← 1500-1530 Ma Cu-Au event

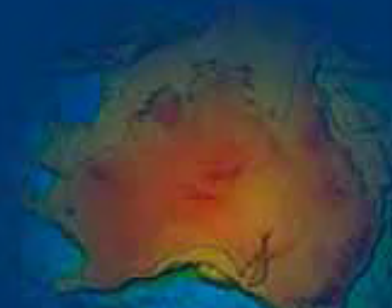
← 1590 ± 15 Ma Cu-Au event(s)

← ~1825 Ma Au-Cu event(s)

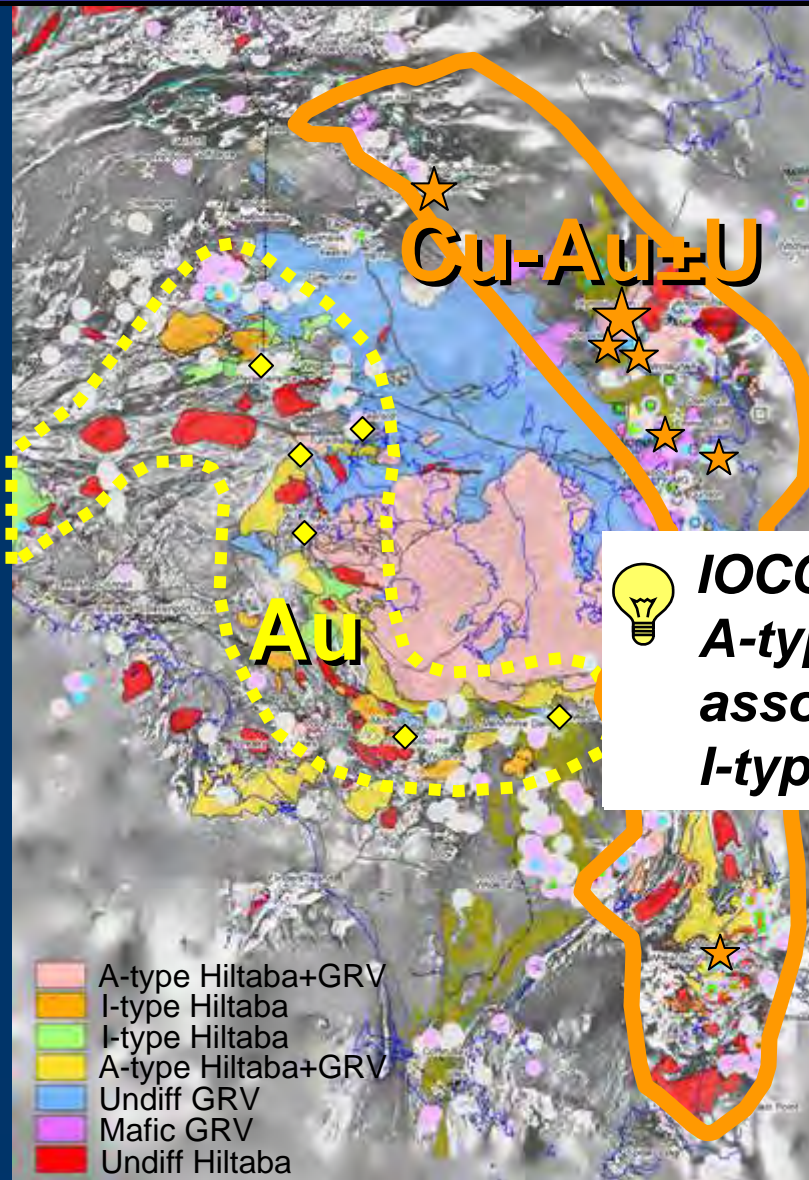
(Skirrow, 1999)



# 3. Heat drivers of IOCG hydrothermal systems

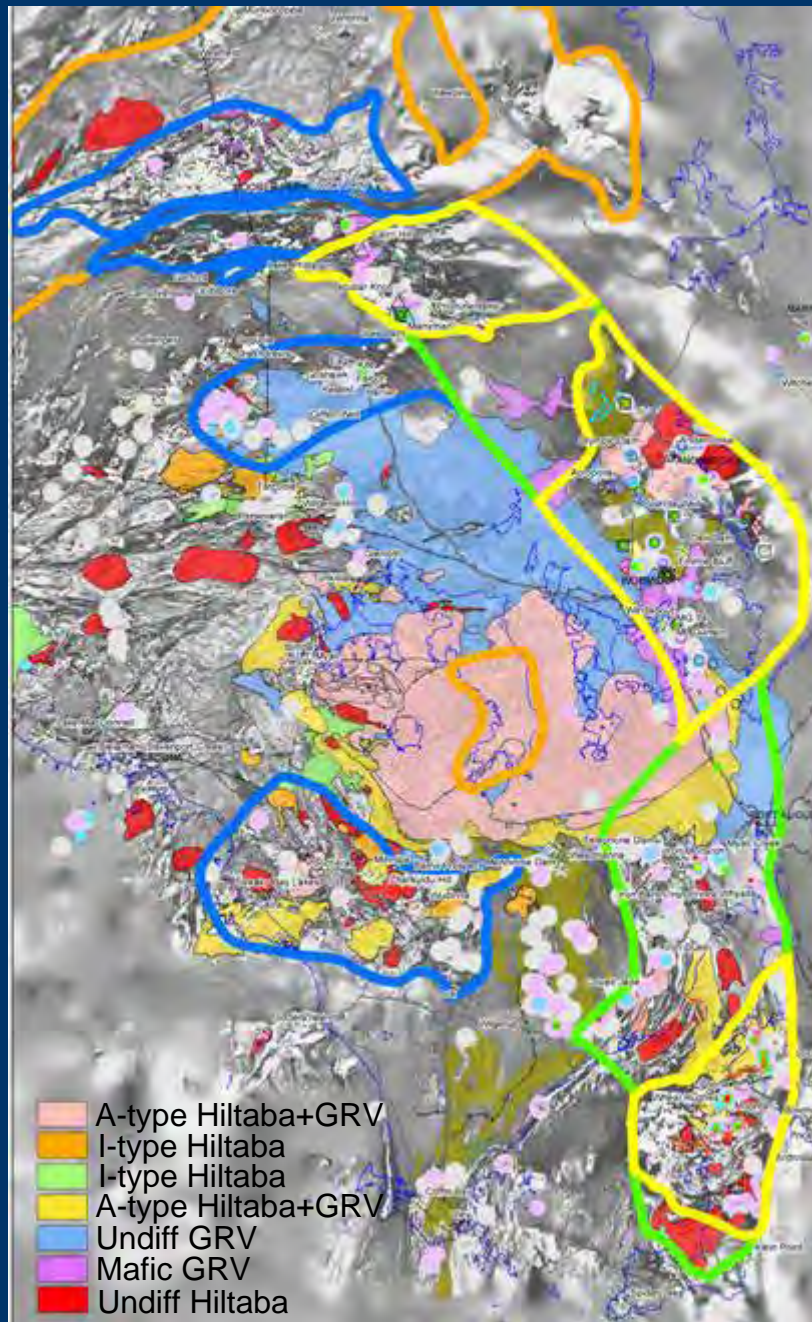


### 3. Heat at 1575-1595 Ma: High-T GRV+Hiltaba granitoids+mafics vs. lower-T Hiltaba

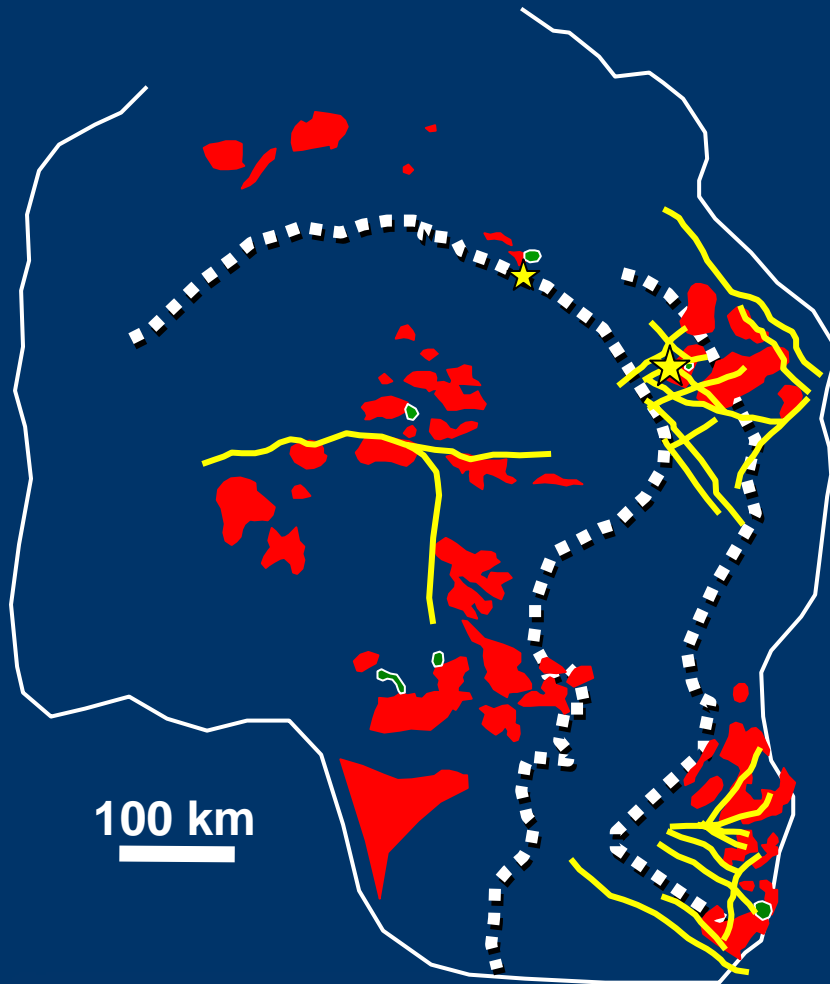


***IOCG assoc'd with A-type granites; Au assoc'd with lower-T I-types***

# IOCG Potential Map



# Summary – craton scale area selection for IOCG deposits, Gawler Craton



- 1. **PLUMBING+SOURCE** - Palaeoproterozoic orogenic belt(s) at margin of Archaean, + metased basins, + **NW/NE faults**
- 2. **TIMING** – broadly coeval with Hiltaba-GRV
- 3. **HEAT** – manifest in 1575-1595 Ma mafic & high-temp granitoid complexes & volcs
- Major IOCGs in overlaps