

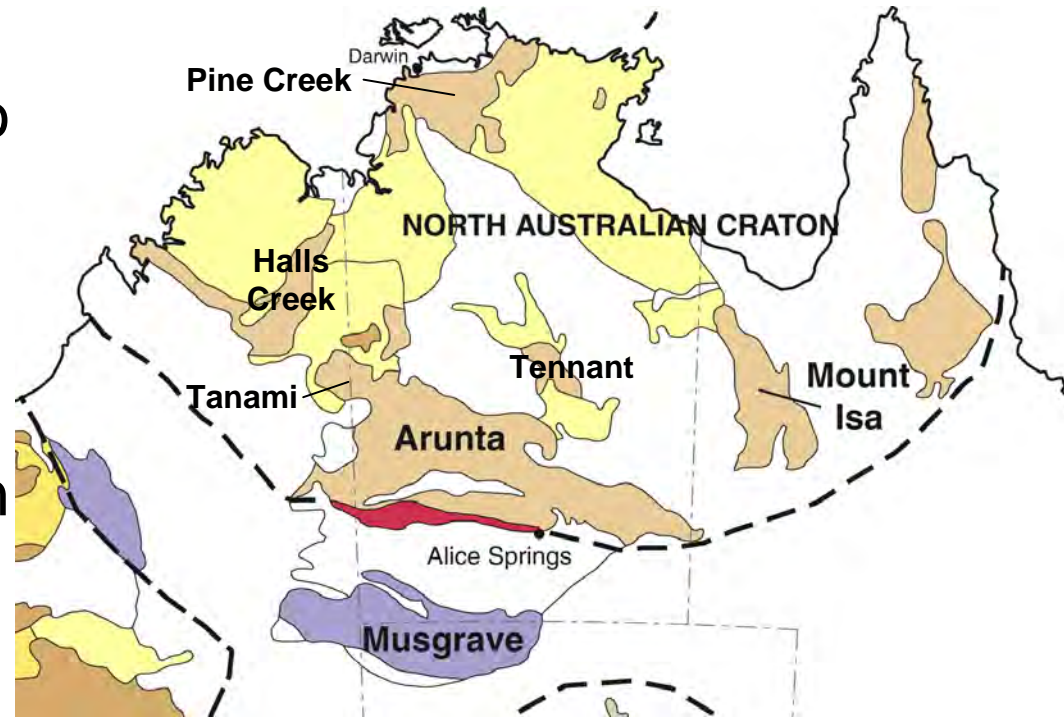
An overview of the North Australian Craton (with an NT bias...)

IAN
SCRIMGEOUR

North Australian Craton

Archean basement in Pine Creek and Tanami, likely to be more widespread

Multiple tectonothermal events and basins between 1870-1570 Ma – highly prospective interval



Contrasting styles of metamorphism, magmatism, deformation and sedimentation reflecting varying tectonics

Can we link the timing and setting of mineralisation in the NAC with the tectonic evolution?

Contrasting tectonic models

Intraplate model (eg Etheridge et al 1987)

Plate tectonic model (Myers et al 1996)

The plate tectonic paradigm is widely accepted – but much of the tectonics of the NAC occurred in an intraplate setting!

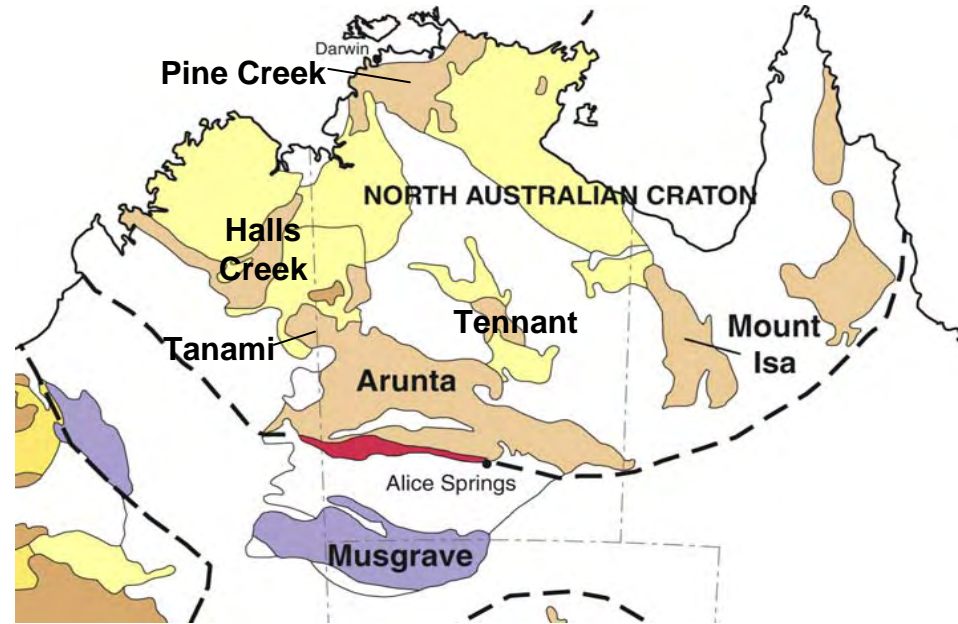
NAC underwent numerous extensional and compressional intraplate events as a response to events occurring at the craton margins

Evidence for plate margin events is preserved in the Arunta (southern margin of the craton)

Early evolution of the NAC

Widespread packages of greywacke-siltstone, felsic volcanics, tuffs, (BIFs)

Hosts to most significant Au mineralisation



Prior to 2000

2006

Mount Partridge Gp >1880 Ma

2025 Ma

Sth Alligator Group 1880 Ma

1863 Ma

Finniss River Group 1880-1870Ma

1862 Ma

Warramunga Fm ~1860 Ma

~1860 Ma

Lander Rock beds >1880 Ma

1840-1830 Ma

Tanami Group 1880-1820 Ma?

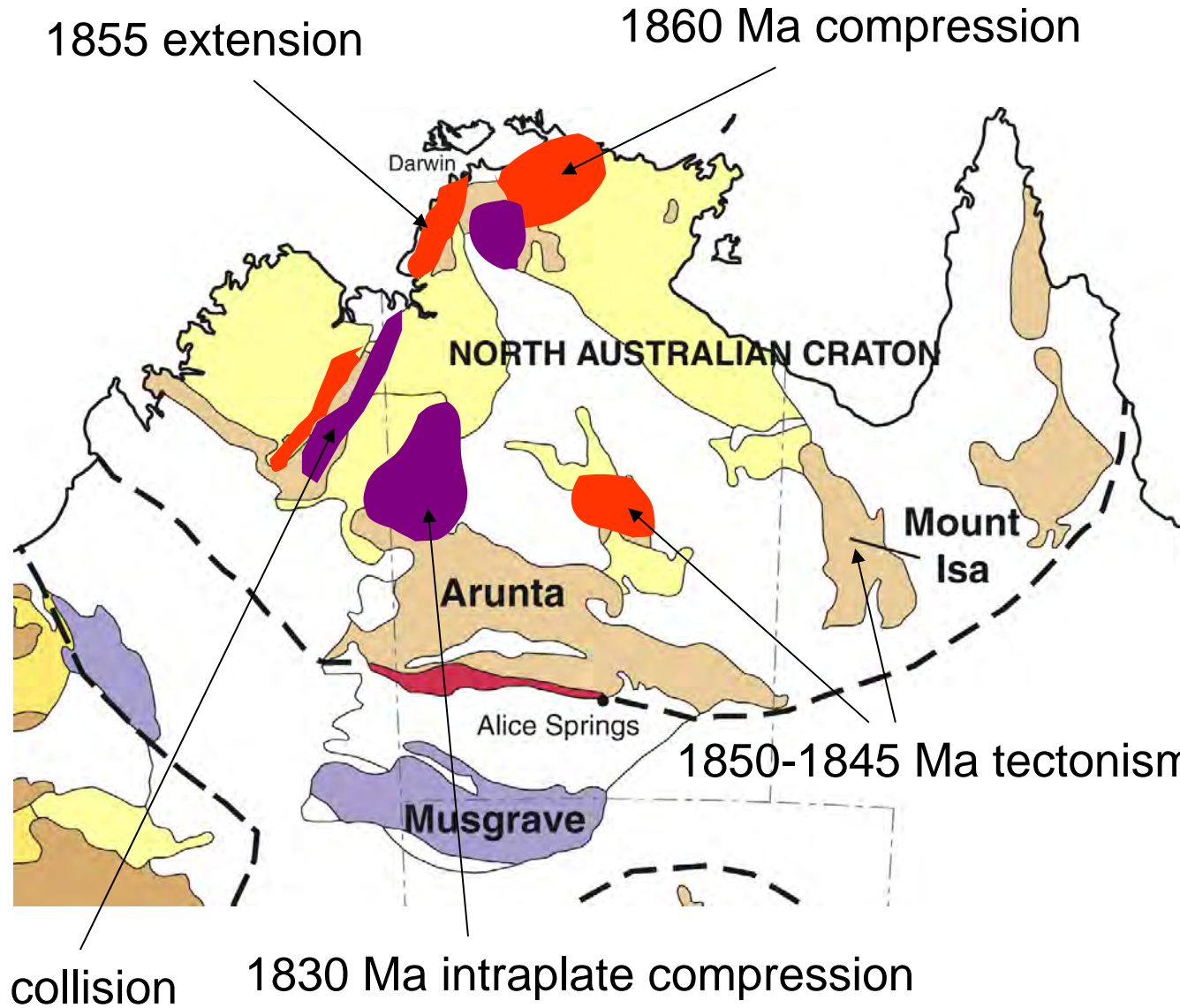
1840-1830 Ma

1860-1820 Ma tectonism

**Nimbuwah
Hooper
Tennant
(1860-1845)**

**Halls Creek
Tanami
(1835-1825)**

**Au-Cu Tennant Ck
Au, Pine Ck
Au, Ni-Cu, Halls Ck**



Summary of early evolution

- Concept of single orogenic event (Barramundi) oversimplified
- Potential correlations between Warramunga and upper PCO succession at c.1860 Ma
- Metamorphism in Litchfield occurred at 1855 Ma
- Tennant Event occurred around 1850-1845 Ma
- Tanami Group is 1840-1830, equivalent to Lander Rock Fm and Ooradidgee Group
- Halls Creek Orogeny and Tanami Event at 1830 Ma
- Younger succession at 1820-1810 Ma including Ware Group, lower Hatches Creek Group, lower Strangways MC.

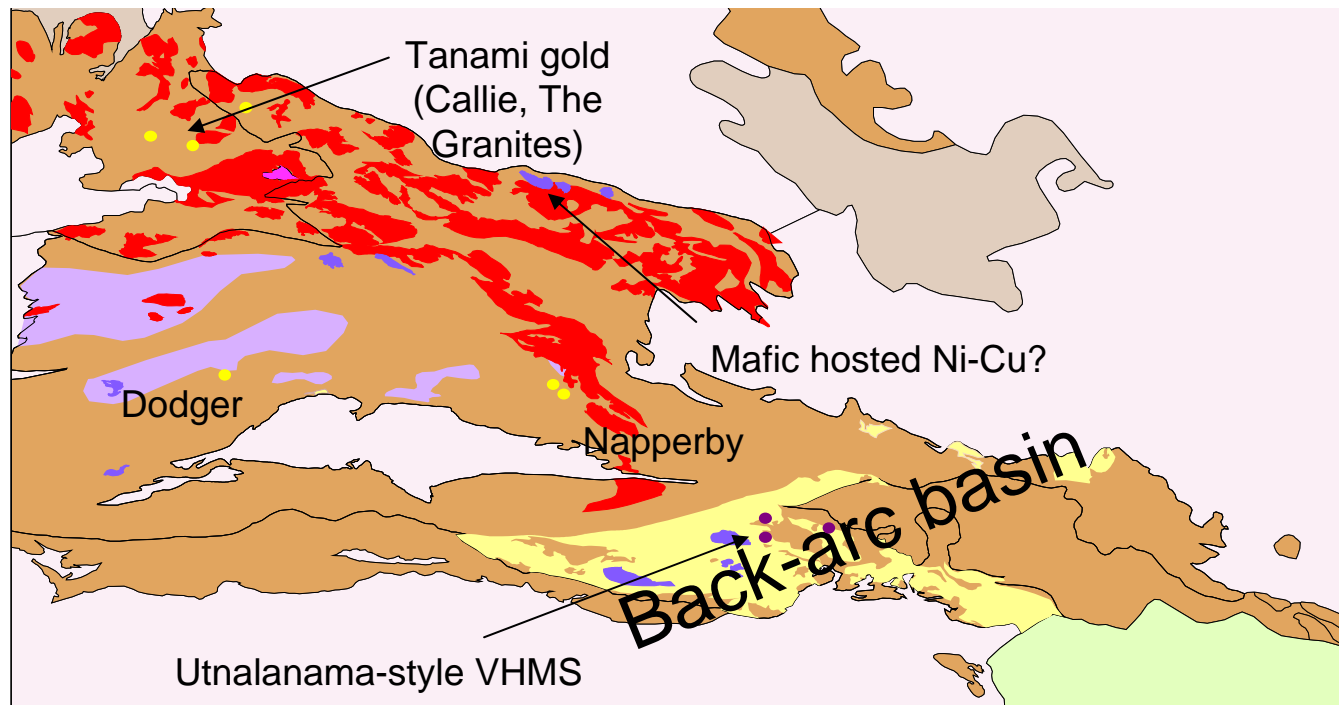
Stafford Event - 1810-1790 Ma

Initiation of north-dipping subduction system

Eastern Arunta – volcanoclastic sediments, bimodal magmatism, VHMS base metal mineralisation (Utnalanama, Edwards Creek)

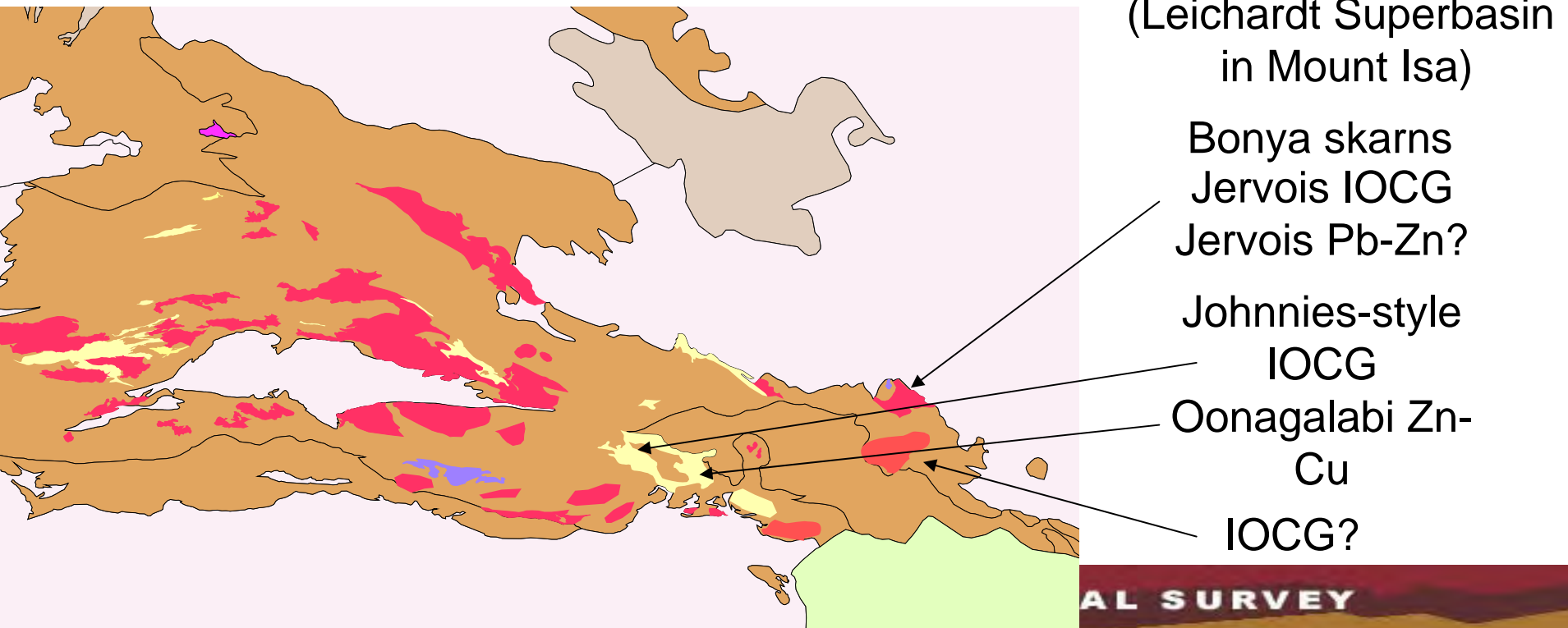
northern Arunta-Tanami – magmatism, deformation, high-T, low-P metamorphism, orogenic Au (eg Callie)

Back-arc in south-east, grading to intraplate def^m in north



Yambah / Inkamulla Events 1780-1745 Ma

- Progression of magmatism to south, then further southeast
- **1780-1770 Ma** Voluminous arc-related magmatism across southern Arunta, upright deformation, local high-grade metamorphism
- Closure of back-arc, and formation of a continental arc?
- **1770-1750 Ma** Renewed volcanoclastic sedimentation (eg Oonagalabi), magmatism in SE, localised high-T, low-P metamorphism
- Extension – renewed back-arc? Slab rollback?



Strangways Event - 1730-1700 Ma

Major event in eastern Arunta

Pervasive high-grade metamorphism, W?-directed thrusting

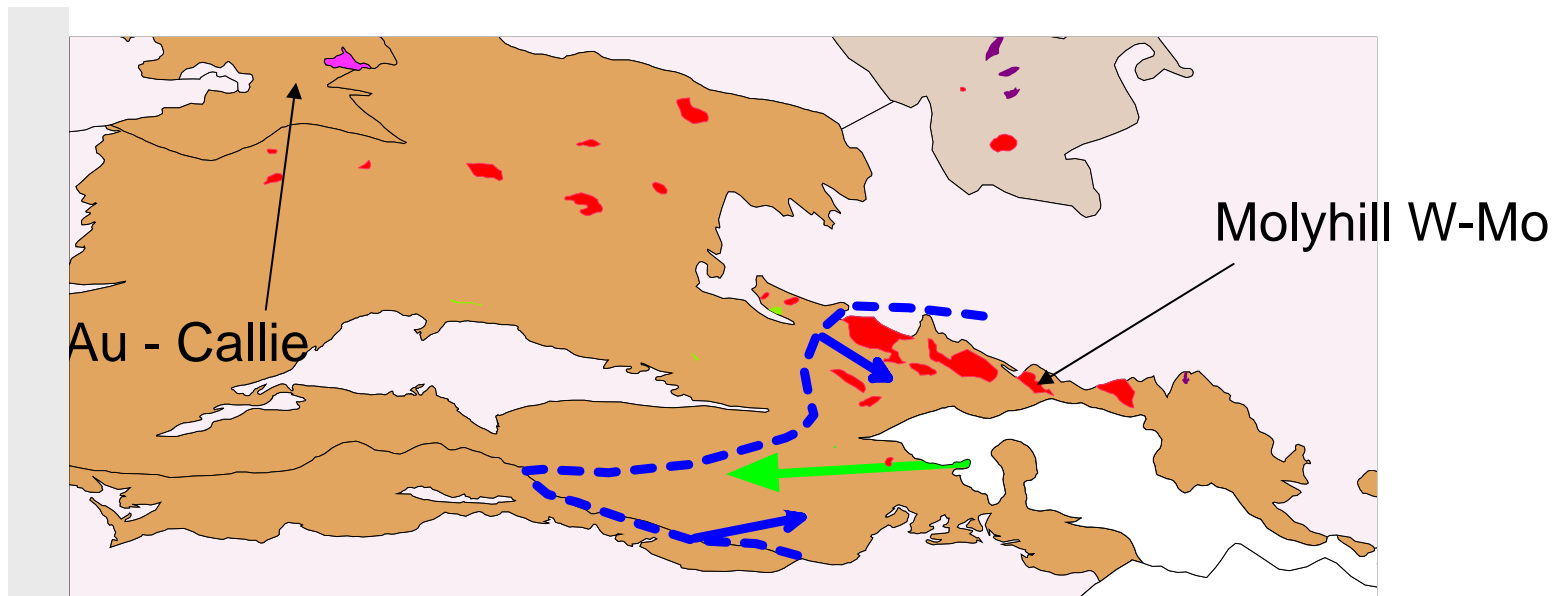
Collision or accretion?

Termination of N-dipping subduction

W-Mo-Sn, Skarn? mineralisation

Au mobilisation

(Calvert Superbasin in Mount Isa)



Warumpi Province 1690-1600 Ma

South-dipping subduction and terrane accretion

1690-1660 Ma Argilke Igneous Event

Magmatic arc off NAC – epithermal/mesothermal Au?

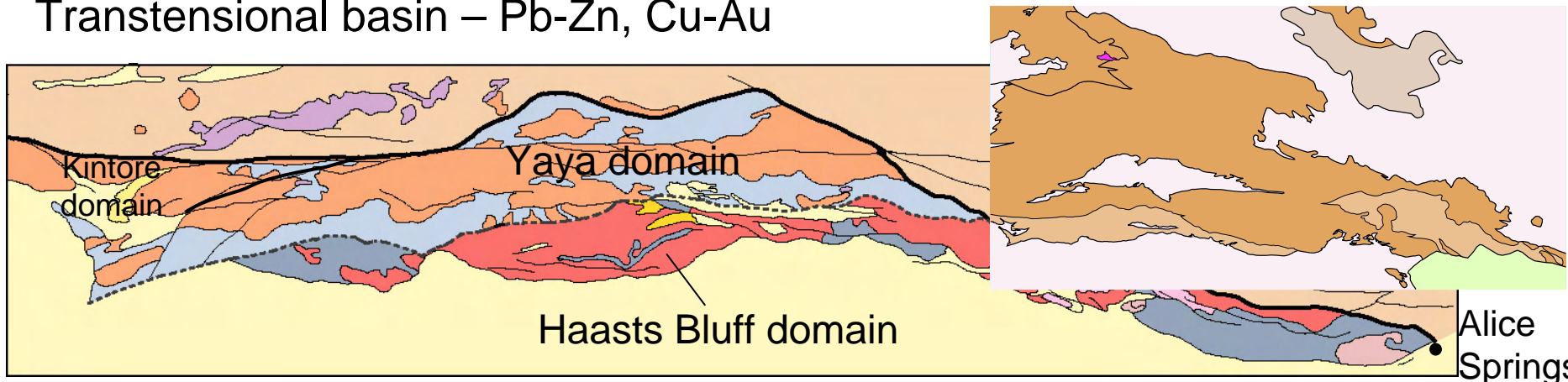
1660-1650 Ma Formation of Yaya domain

Extensional arc environment – BHT, VHMS?

1640-1635 Ma **Liebig Orogeny** Accretion of Warumpi onto NAC – calc-alkaline felsic to mafic magmatism. Mafic-hosted Ni-Cu, Mount Webb Cu-Au

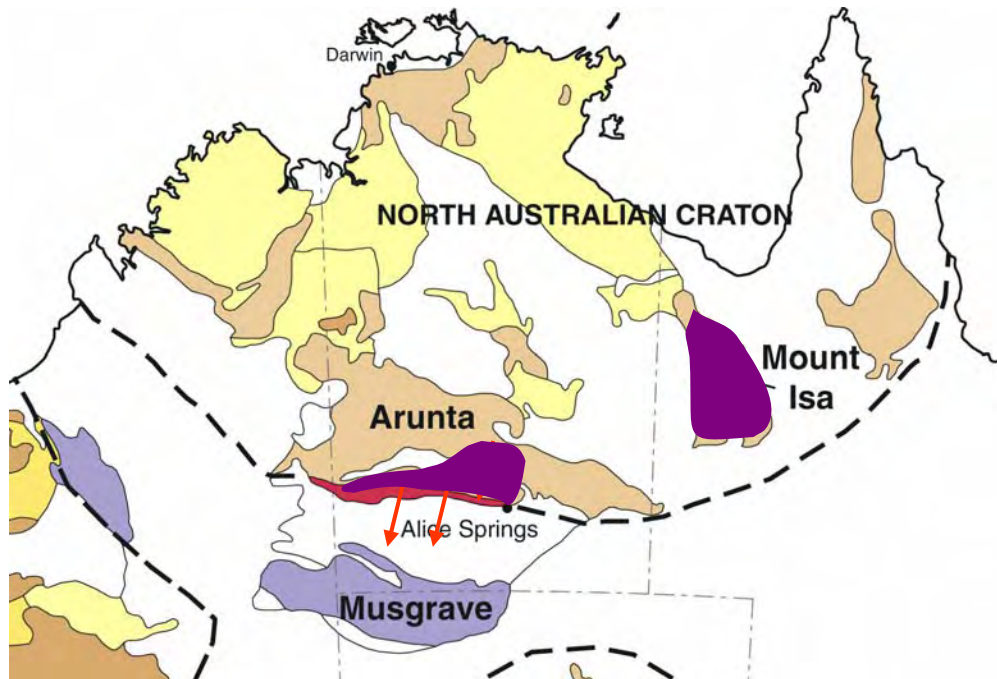
1635-1610 Ma Extension, deposition of Iwupataka Complex

Transtensional basin – Pb-Zn, Cu-Au



Chewings and Isan Events - 1590-1560 Ma

- S-directing thrusting in southern, central Arunta
- Mylonitic deformation, no magmatism
- Arc magmatism in Musgrave
- **Amalgamation of NAC and SAC?**
- No mineralisation in southern NAC
- Mineralisation to north in basins (eg Century)



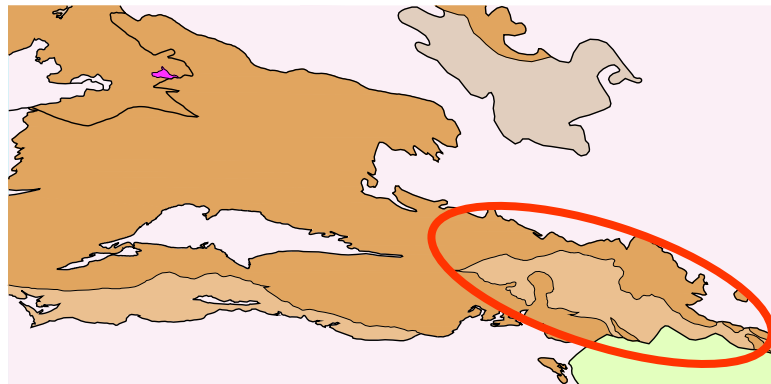
Palaeozoic intraplate reworking

520-460 Ma Extension in eastern Arunta

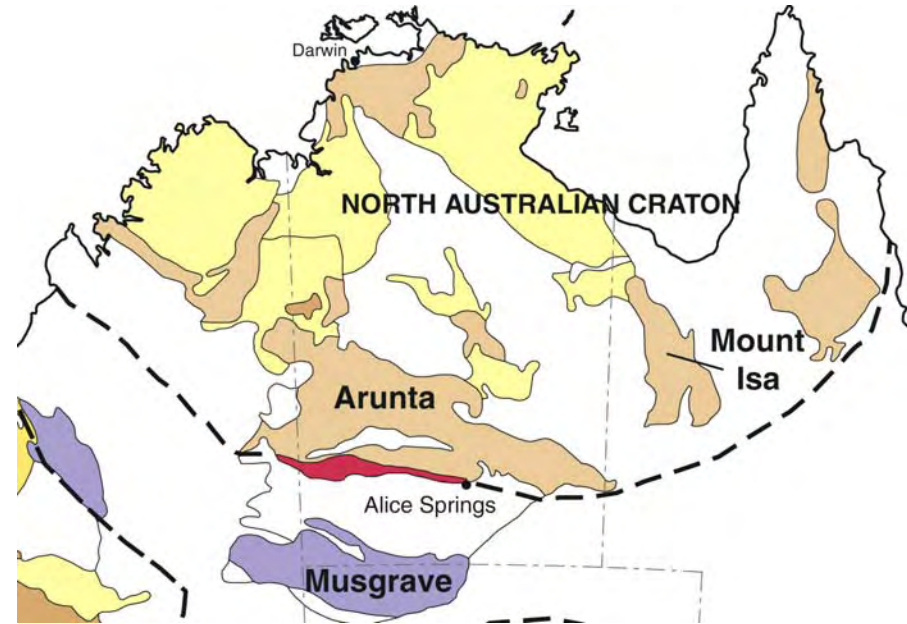
- Deep transtensional fault-controlled basin in eastern Arunta (potential for sediment-hosted base-metal mineralisation),
- Abundant Cambro-Ordovician mafic intrusion and extrusion
- High-grade metamorphism of basin in extensional setting

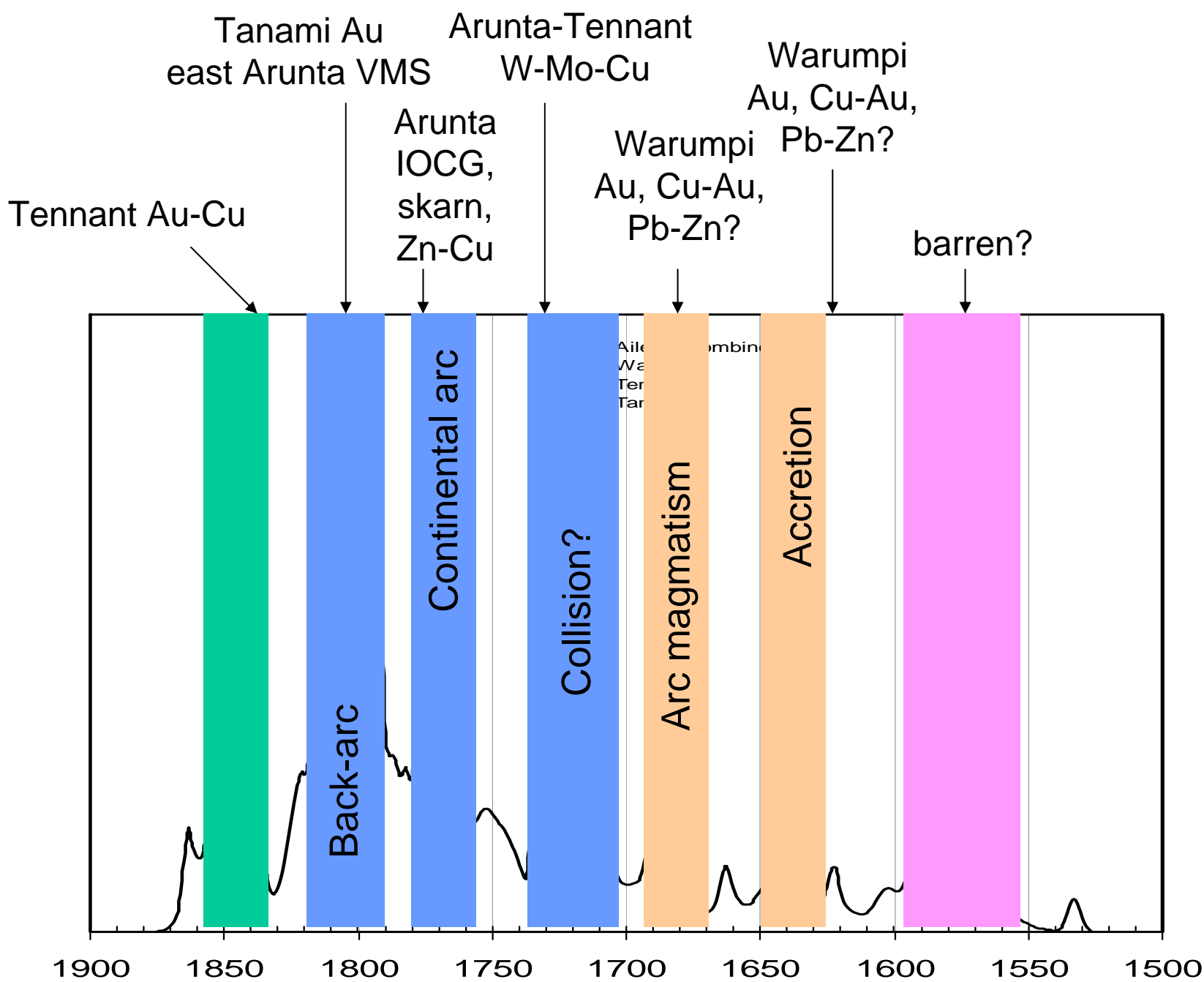
450-300 Ma Alice Springs Orogeny

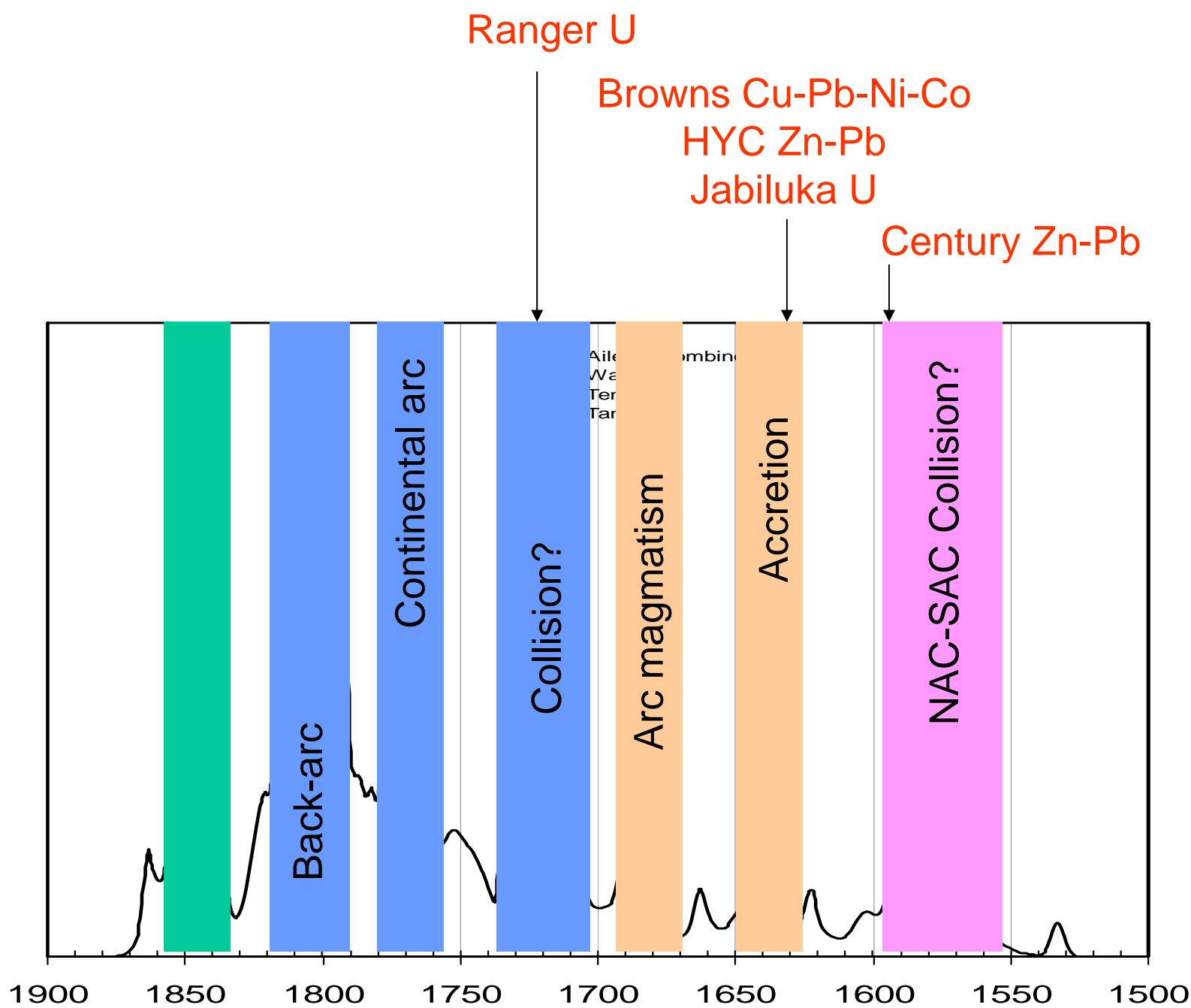
- Long lived punctuated intraplate tectonism
- Widespread fault reactivation across much of NAC
- High fluid flux, pegmatites, REE- and Au mobilisation – Arltunga + Winnecke Au, Nolans Bore REE?, Bruces Cu-Au



- NAC is fundamentally affected by multiple plate margin events
- **Active (plate margin?) tectonics in northern Australia at 1865-1830 Ma**
- **SE Arunta was an active margin (N-dipping subduction) at 1810-1700 Ma,**
- **SW Arunta was an active margin (S-dipping subduction) at 1700-1600 Ma**
- Diachronous events and shifting loci of deformation/magmatism
- Numerous extensional events related to convergent plate margins
- Activity terminated by amalgamation of NAC and SAC
- Intraplate reworking in Palaeozoic







Mineralising events in the NAC (NT)

1850-1820 Ma – Tennant Creek Au-Cu, Pine Creek intrusion-related mineralisation

1810-1700 Ma – long-lived N-dipping subduction – evolving back-arcs and continental arcs along southeastern margin

- VHMS, IOCG, skarn, mafic-hosted mineralisation, diverse lithologies in southeast proximal to plate margin
- Orogenic Au (eg Tanami) and granite-related W-Sn-Mo-(Cu) mineralisation further north and northwest.

1700-1600 Ma – evolving plate margin in southwest – high potential for mineralisation in Warumpi Province for BHT, VMS, skarn, mafic-hosted Ni-Cu. Liebig Orogeny associated with fault-reactivation and mineralisation in craton (eg HYC, Browns Cu-Pb-Ni-Co, Jabiluka U at 1.64 Ga).

520-460 Ma – intraplate rift basin – base metal, Ni-Cu-Cr-PGE potential

450-300 Ma – intraplate orogeny – large scale fluid flux – Au, REE, U