The Chewings Event: Intracratonic Orogeny in Mesoproterozoic Australia

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University of Adelaide

Martin Hand, Ben Wade, Karin Barovich

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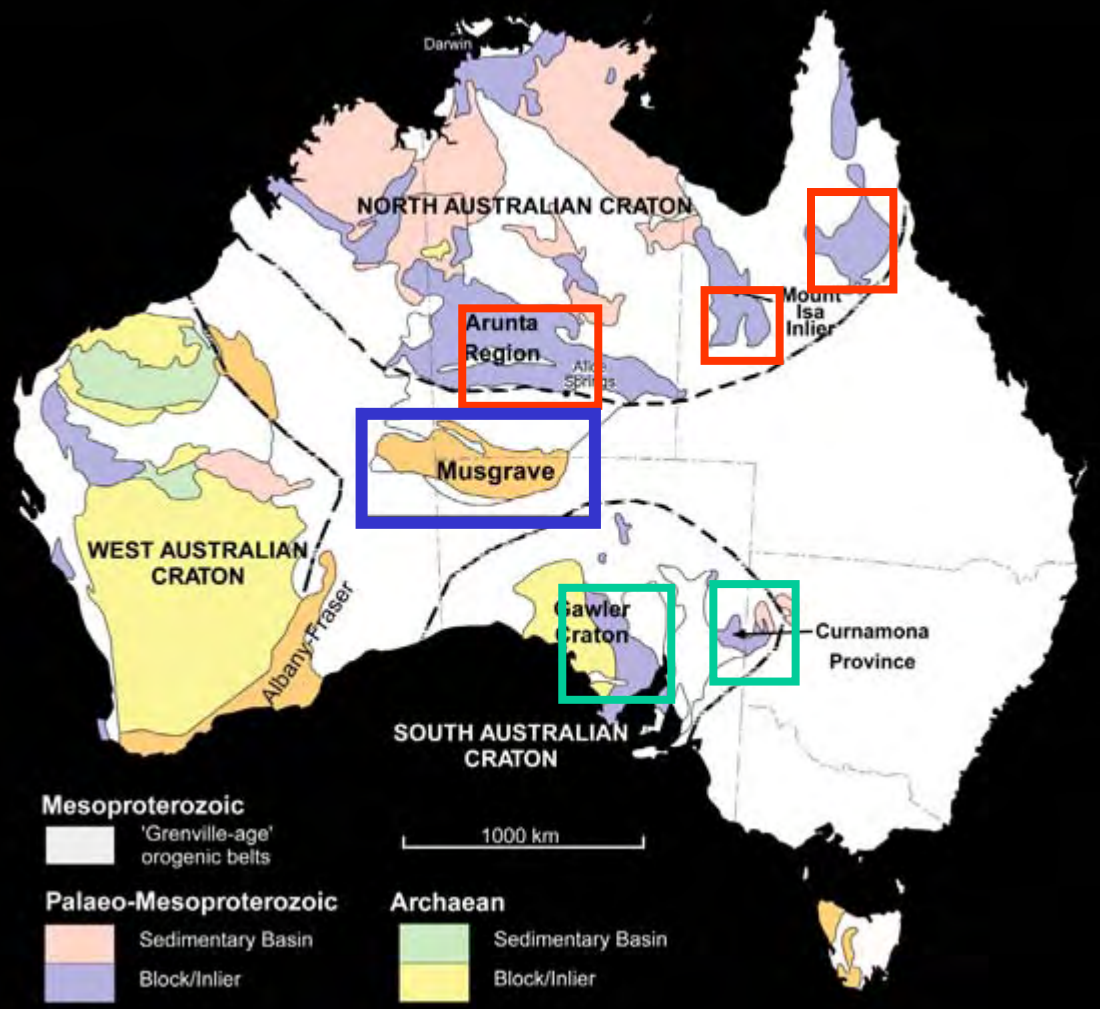
c. 1600-1570 Ma tectonism in Proterozoic Australia



Event timing

Chewings: 1595-1570 Ma

Early Isan:1600-1580 Ma

NE NAC:1585-1560 Ma

Olarian: 1610-1590 Ma

Hiltaba: 1595-1575 Ma

Common elements

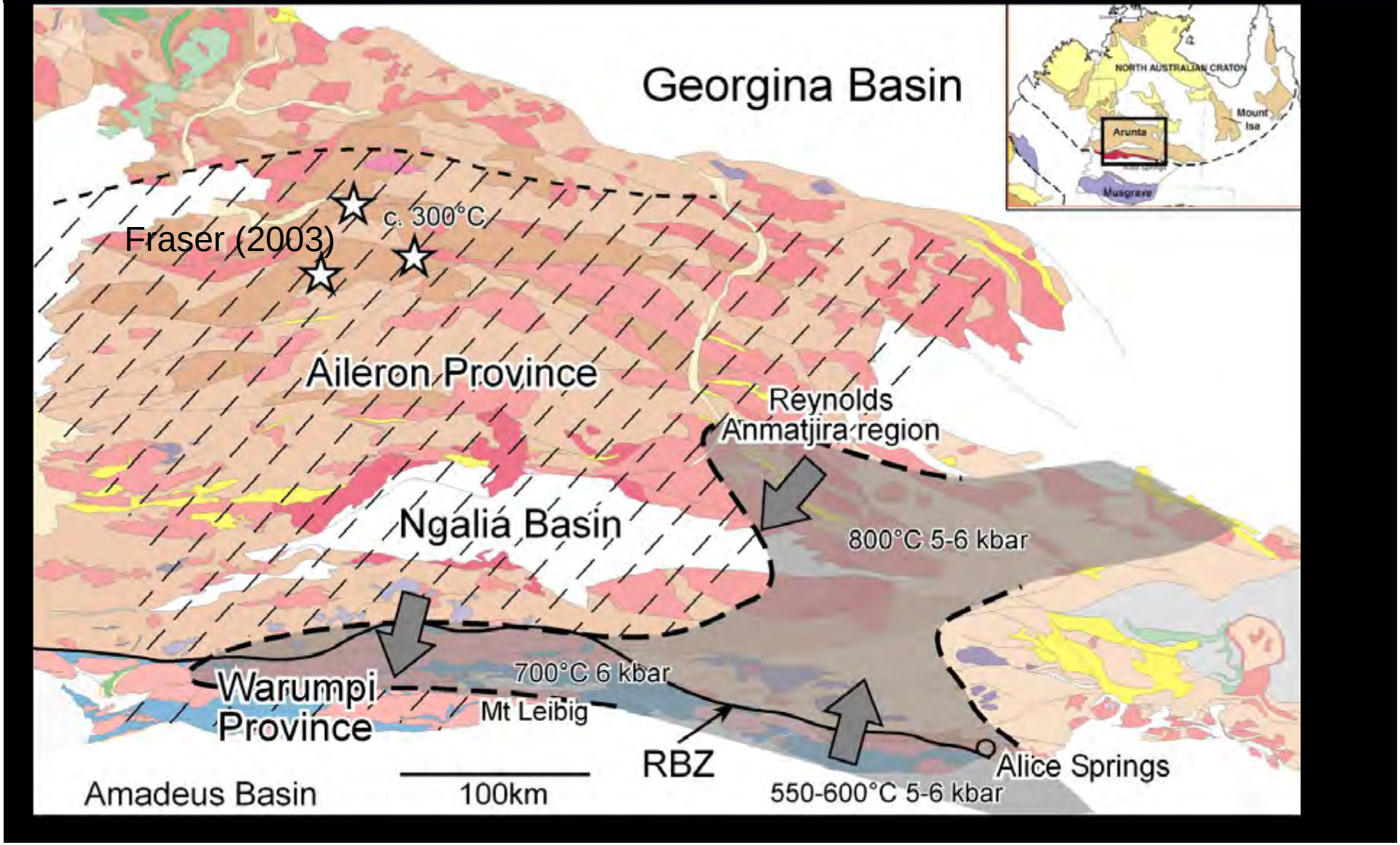
Reworked existing crust

High heat flow: low(ish)-P

Contractional deformation

20-30 Ma duration

Chewings Orogeny: Reworking in the Arunta: 1600-1570 Ma



Chewings Orogeny: Reworking in the Arunta: 1600-1570 Ma

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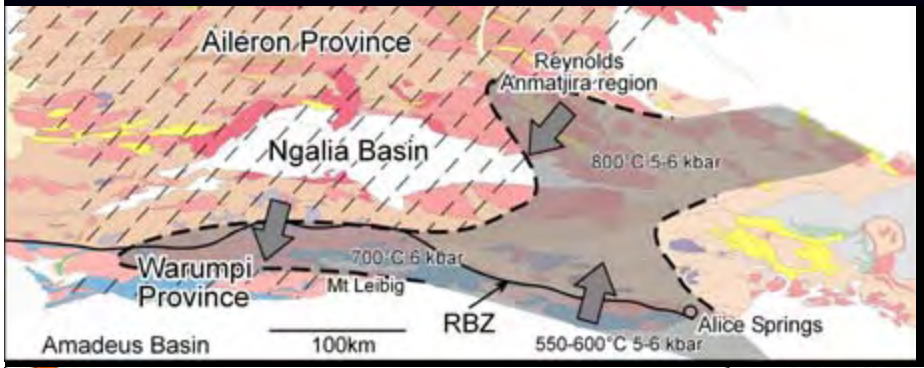
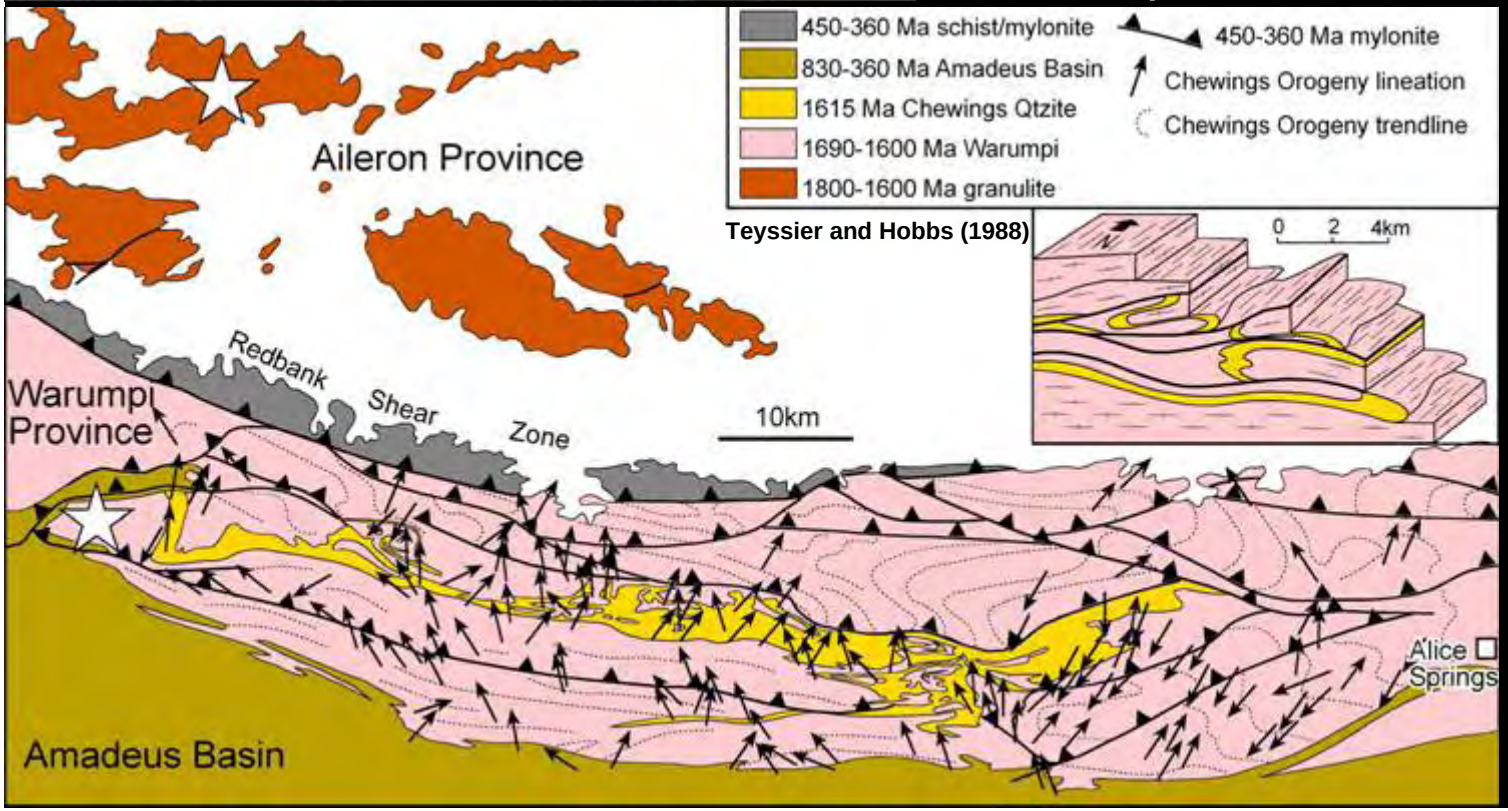


Chewings Range region:

- High-strain large-scale top plate N transport
- Barrovian (600°C, 5-6 kbar) metamorphism.



SW Arunta:

- Top plate south
- Upper amphibolite-grade (700°C, 5-6 kbar) metamorphism.

Chewings Orogeny: Reworking in the Arunta: 1600-1570 Ma

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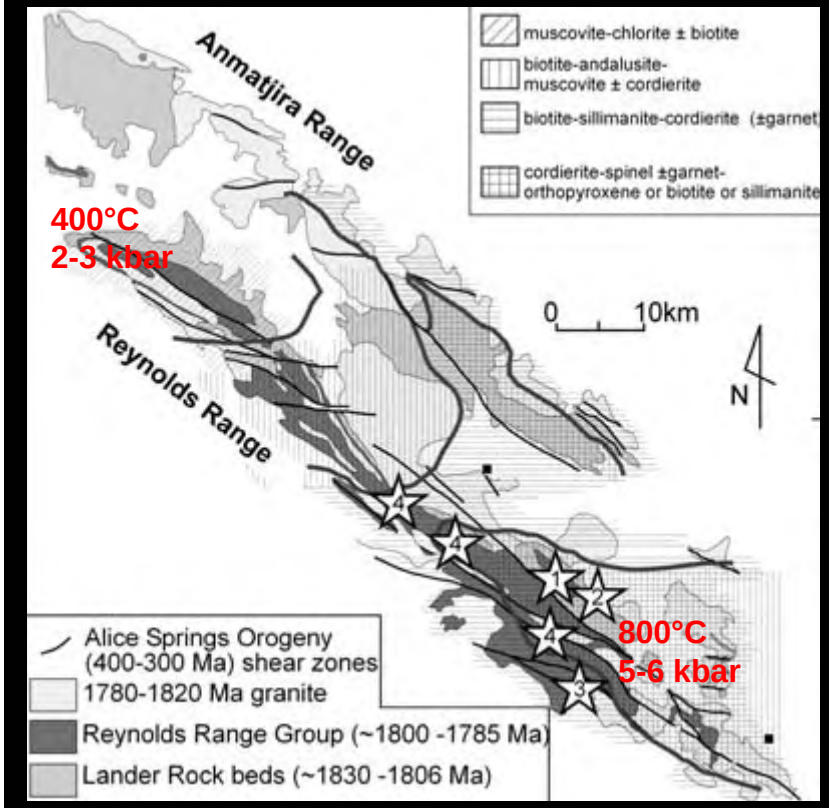

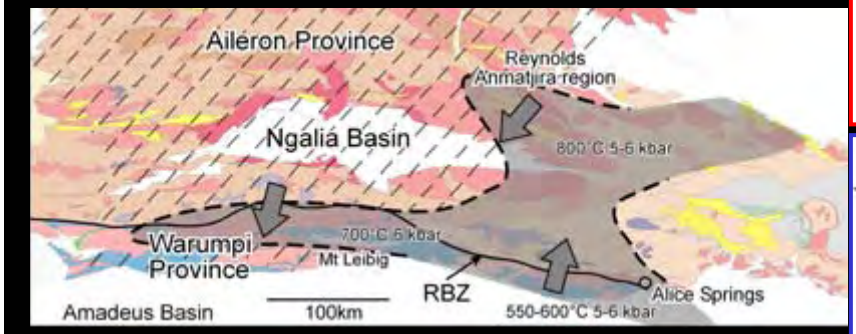

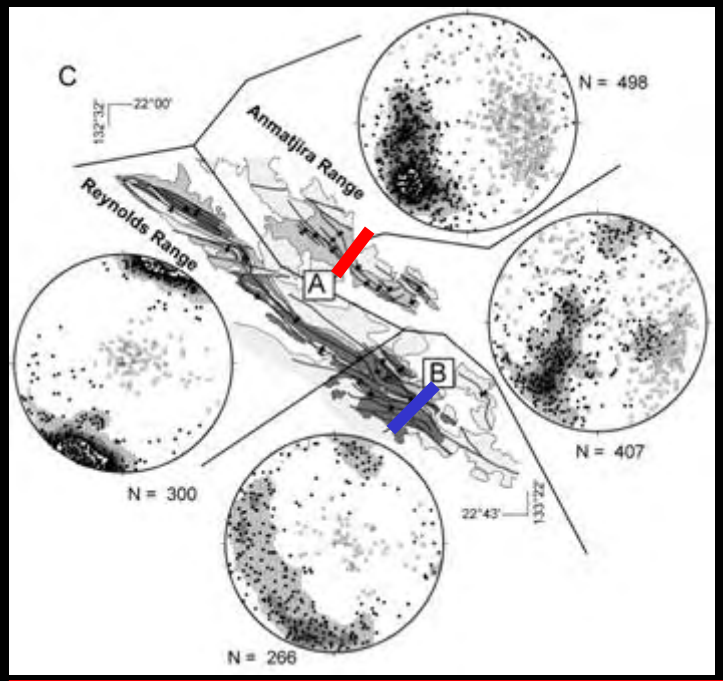

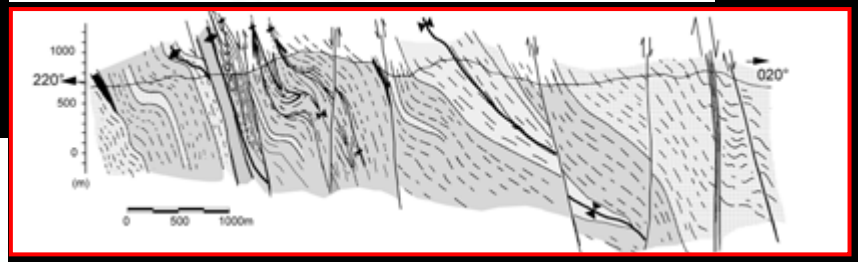

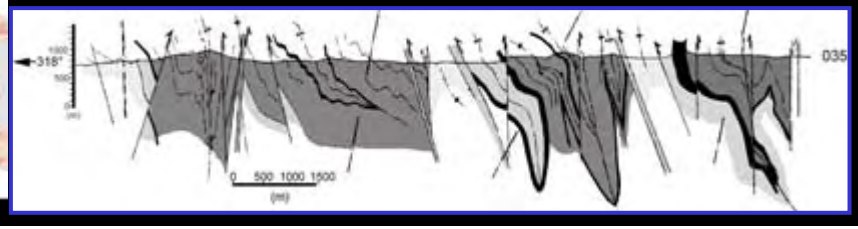

Central Arunta Region: Greenschist to granulite grade HGG metamorphism

N-S shortening (~50%), top SW transport

Chewings Orogeny: Reworking in the Arunta: 1600-1570 Ma

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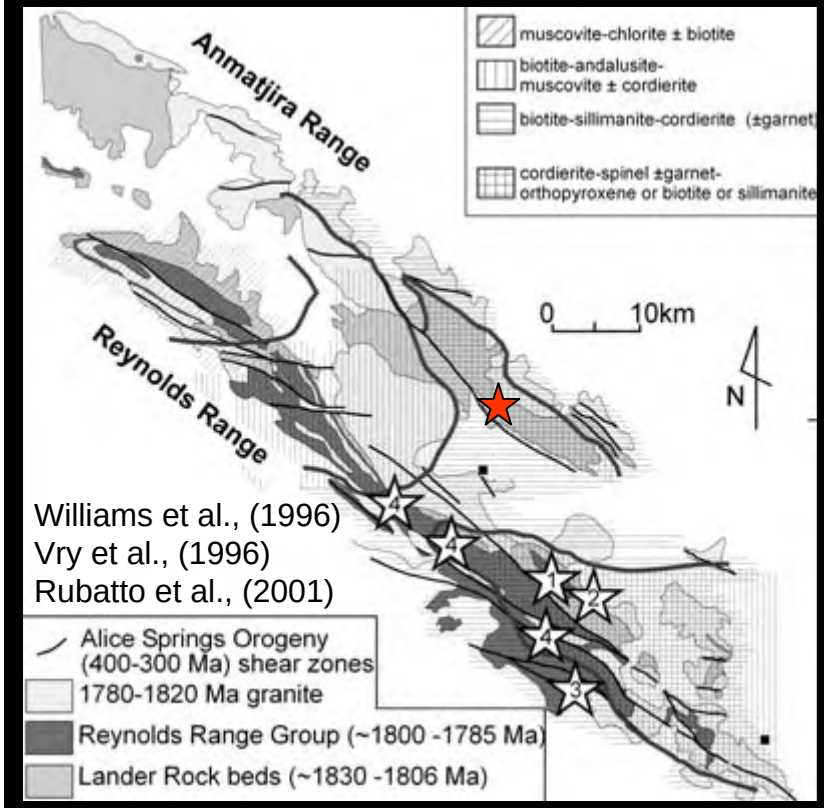
Central Arunta Region:

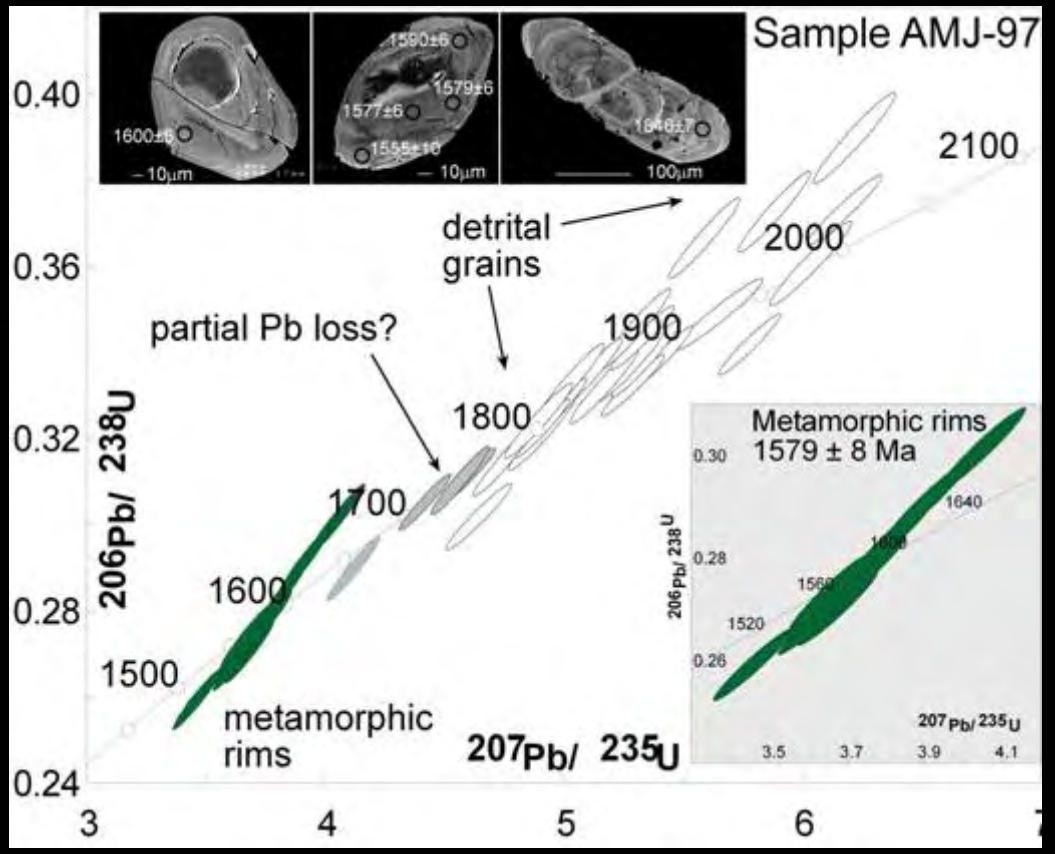
N-S shortening, top SW transport

Greenschist to granulite grade HHG metamorphism



Timing of peak metamorphism in the Anmatjira Range

Garnet-cordierite-spinel-sillimanite-biotite-metapelite



Early Isan Orogeny: 1600-1570 Ma

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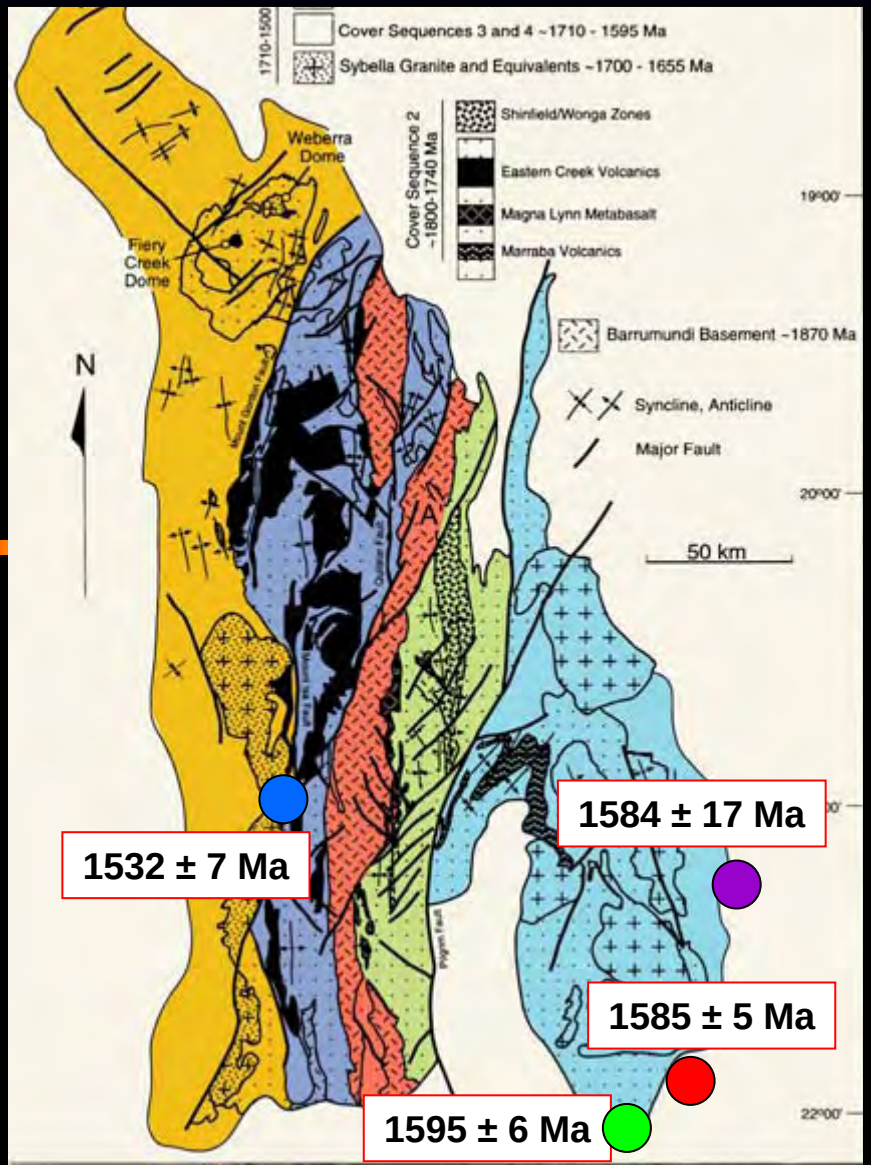
Inverted multi-stage rift complex

3 phases of basin development between c. 1760-1595 Ma



Isan Orogeny (c. 1600-1500)

- Conner & Page, (1995)
- Page & Sun, (1998)
- Rubenach et al., (2001)
- Giles & Nutman, (2002)

Early Isan Orogeny: 1600-1570 Ma

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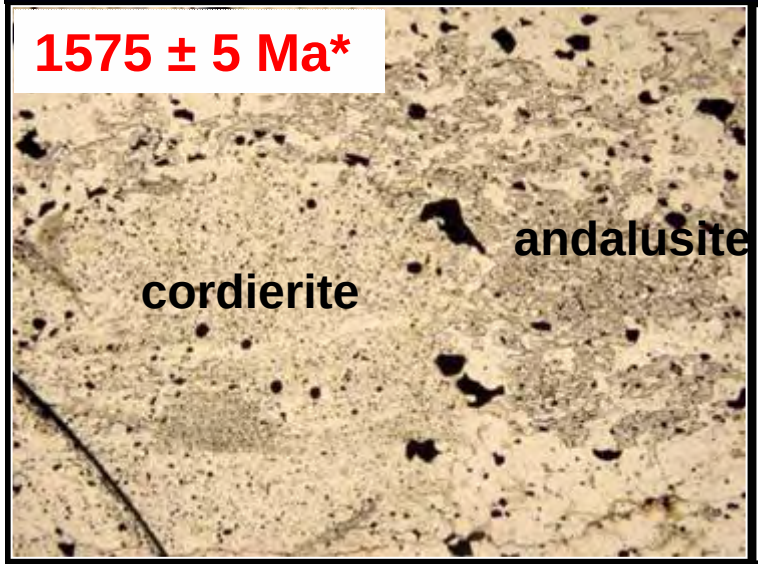
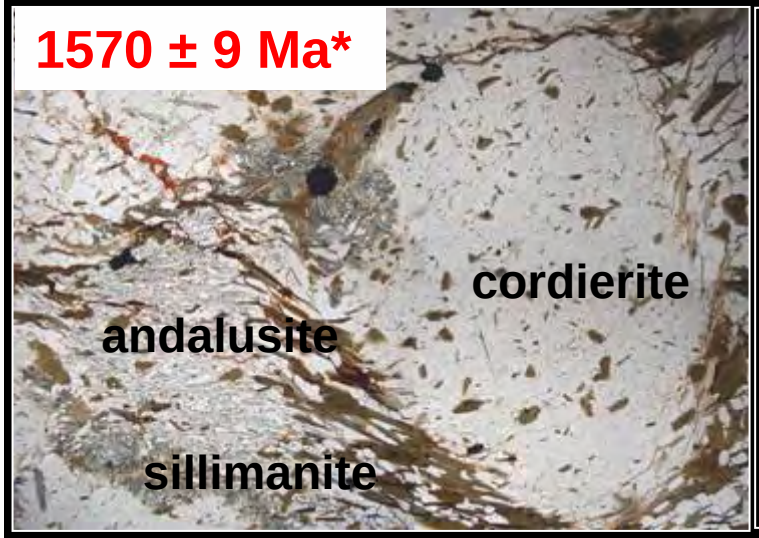
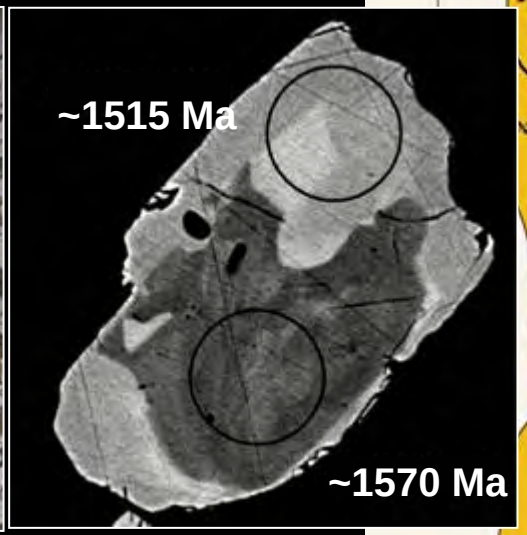
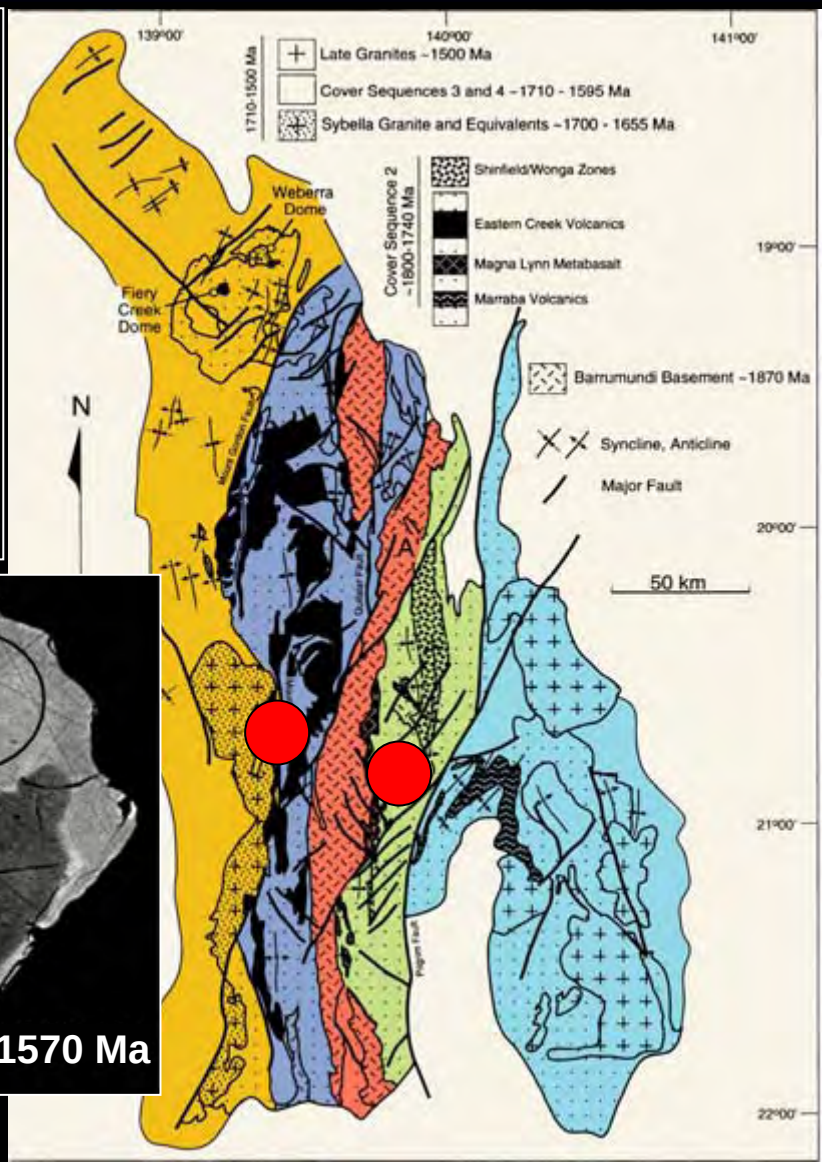


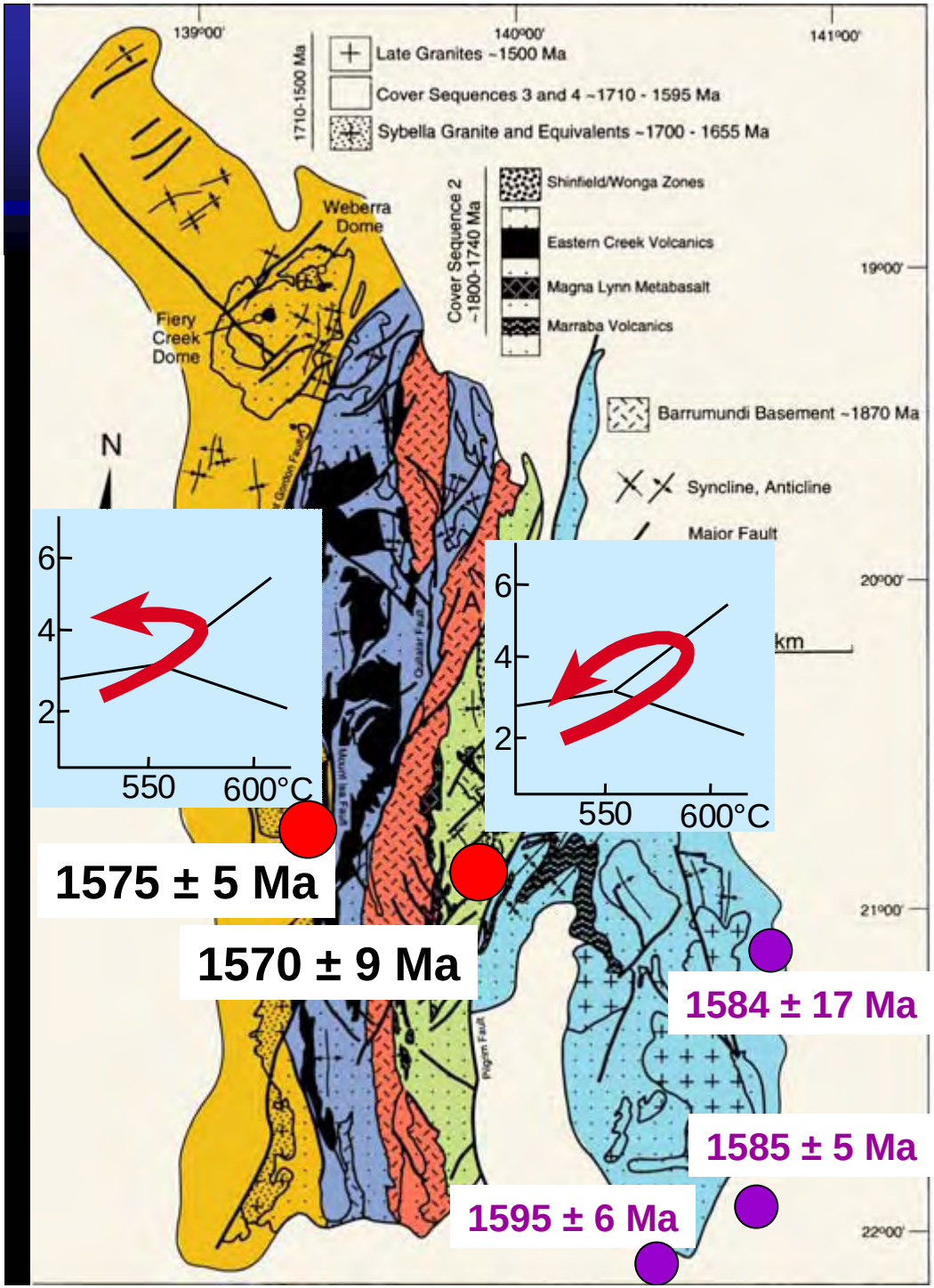


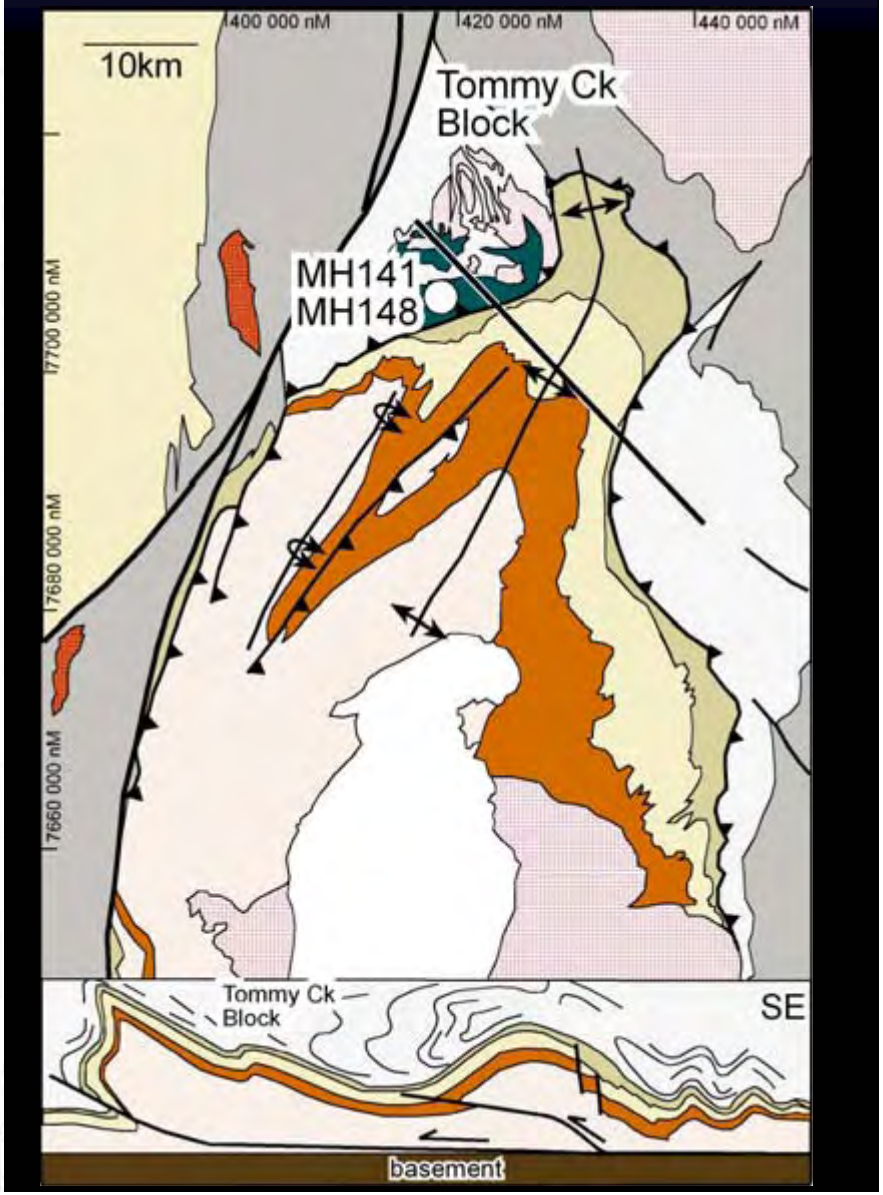




*Hand & Rubatto, (2002)

Early Isan Orogeny: 1600-1570 Ma





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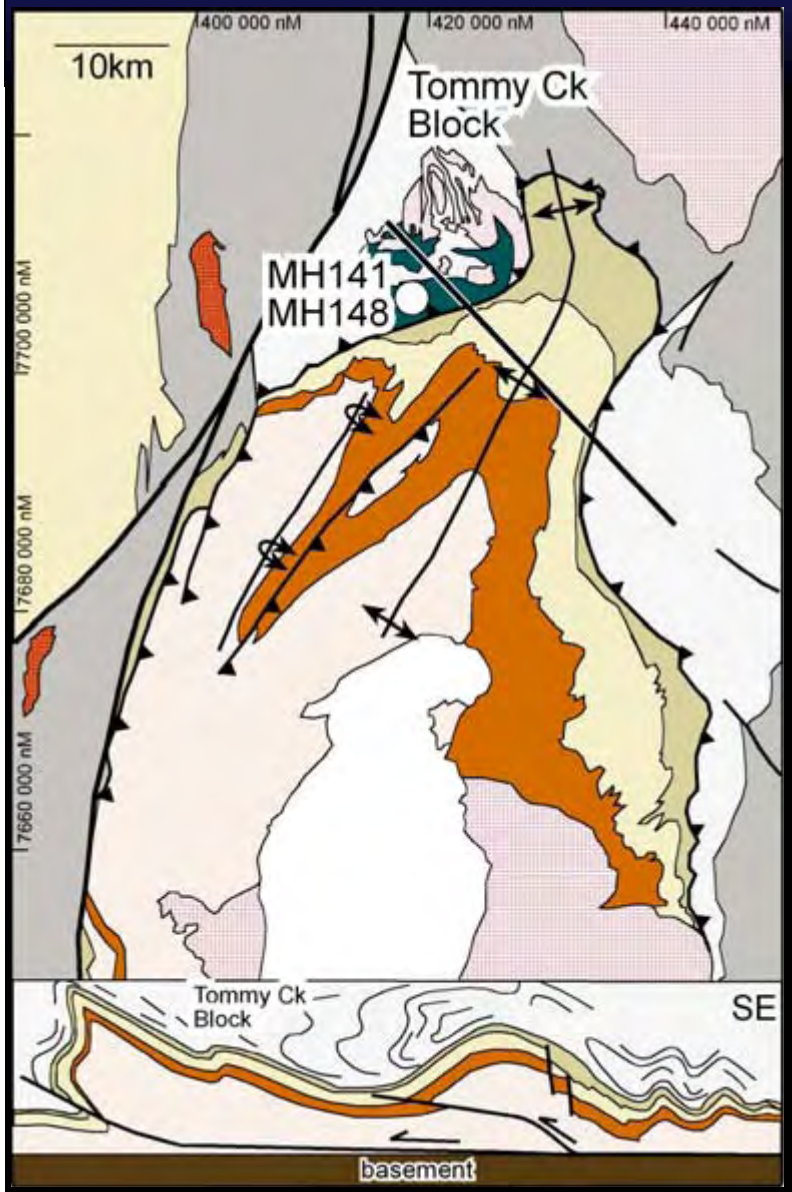
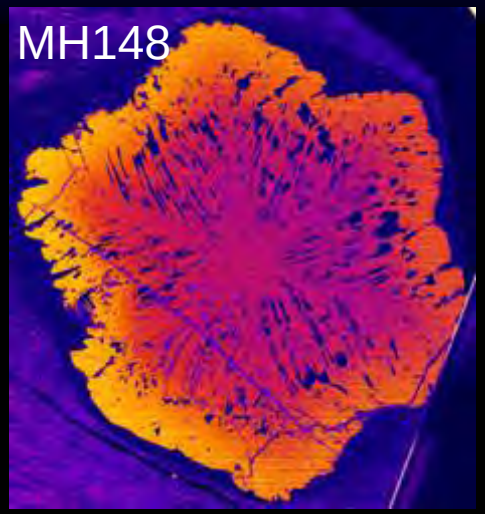
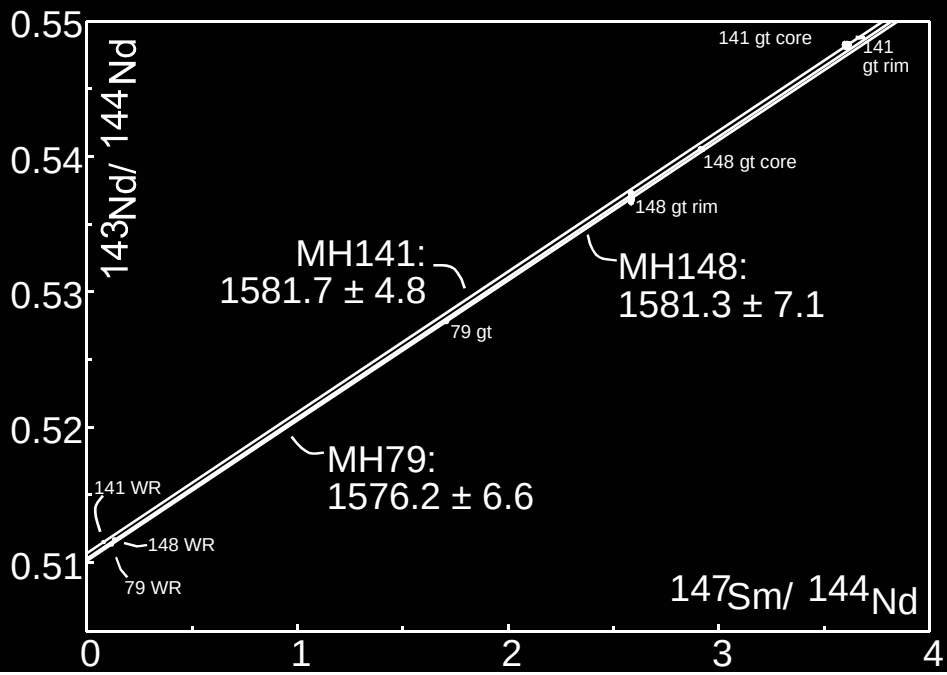


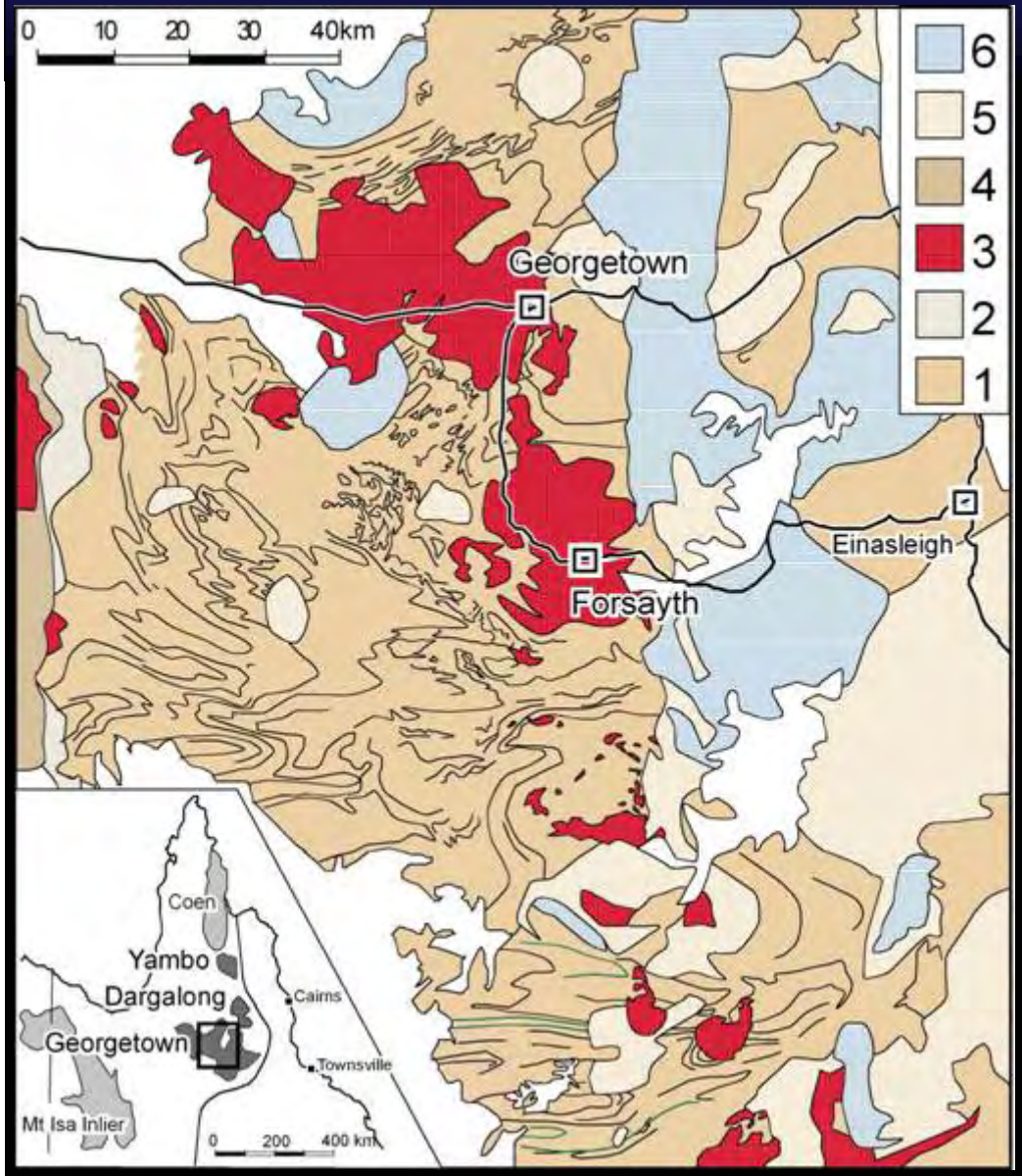
O'Dea et al., (2006)

Tommy Creek Block: prograde zoned up-P garnets





Georgetown Inlier et al



Georgetown Inlier

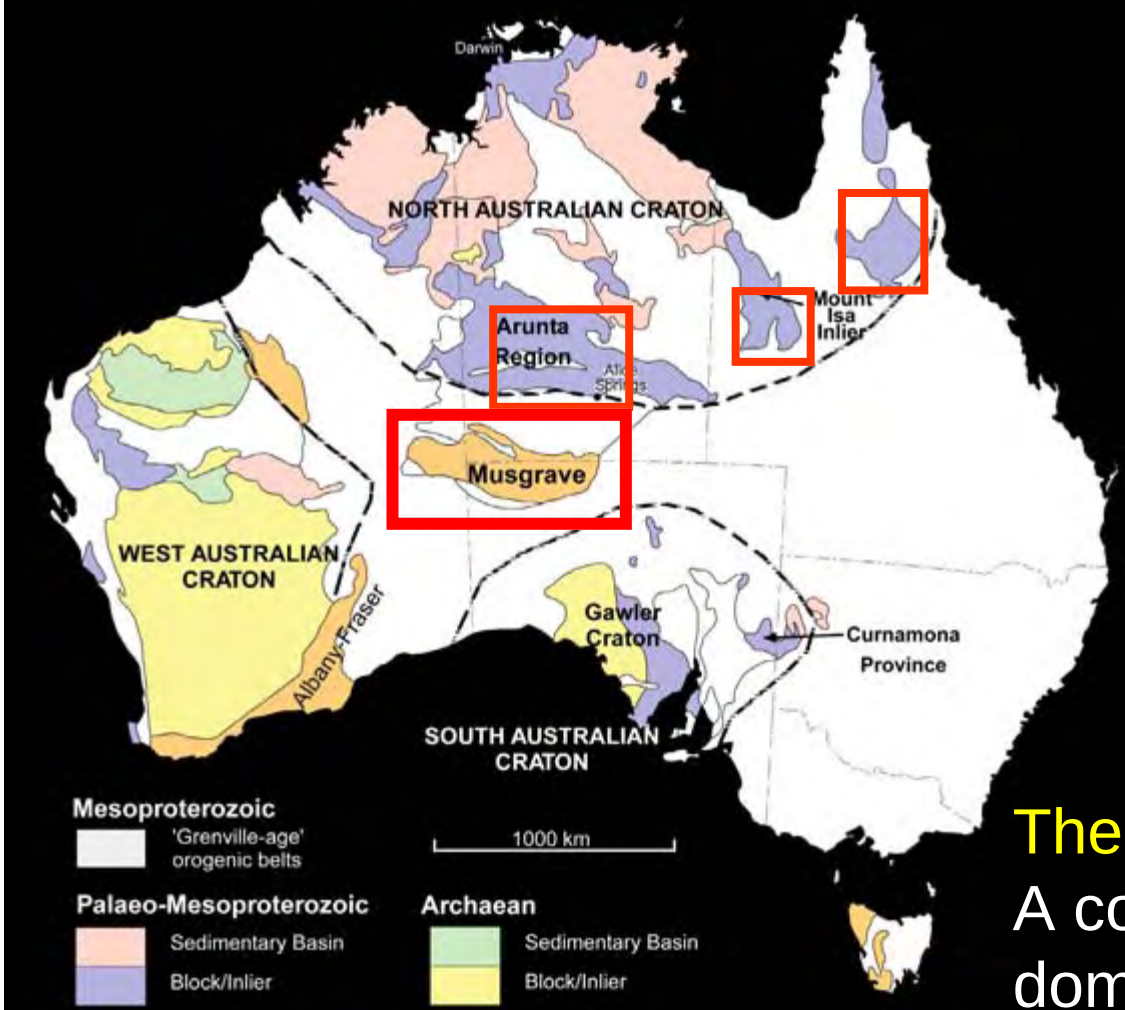
Etheridge Group (~ 1700-1600): equivalents to Isan SS 2 & 3?

Early N-S shortening & Up-P Barrovian amphibolite-grade metamorphism at and prior to 1562 ± 4 Ma (Boger & Hansen, 2004; Black et al , 2005).

Dargalong and Yambo Inliers

Granulite-grade metamorphism 1585 ± 5 Ma - 1576 ± 5 Ma. (Blewett et al., 1998).

Intracratonic Orogeny in Mesoproterozoic Australia



Summary of NAC ICO's

- t = 1600-1570(ish) Ma
- High geothermal gradient's
- Contractional deformation

What else was happening in early Mesoproterozoic Australia?

The Musgrave Block

A comparatively juvenile felsic-dominated volume separating the Gawler (SAP) from the NAC.

The Musgrave margin? A driver for c. 1600-1570 Ma NAC ICO's?

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- ca. 1.59-1.55 Ga felsic rocks of the Musgrave Block appear to have formed in a subduction related environment…..

The Musgrave margin? A driver for c. 1600-1570 Ma NAC ICO's?

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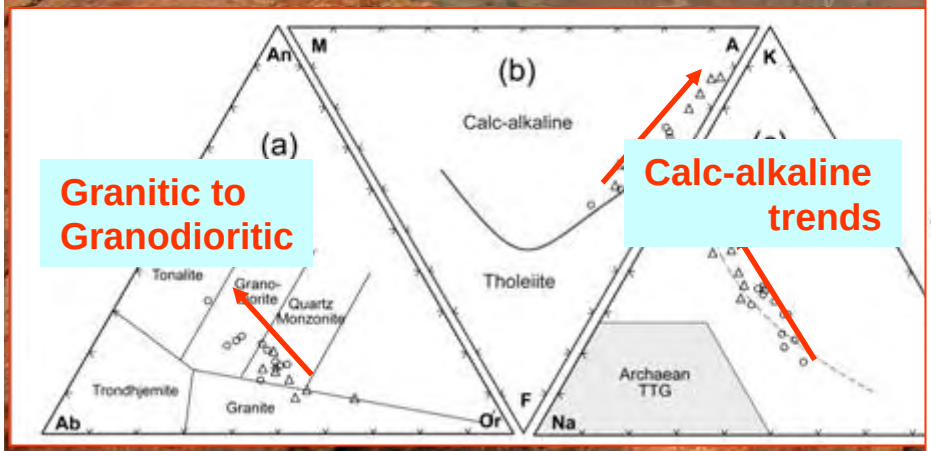
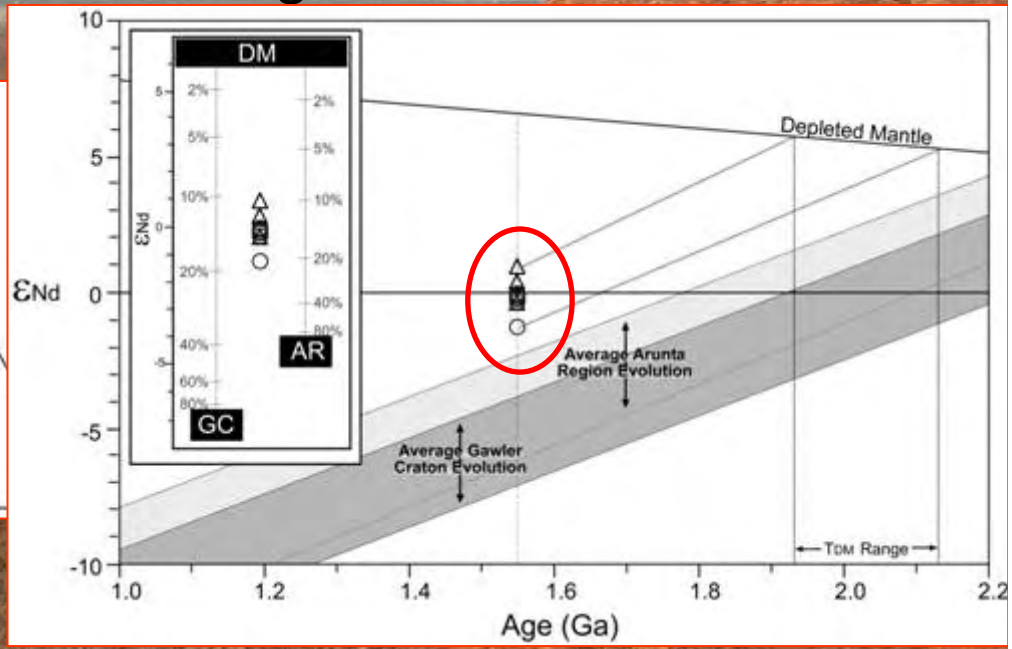
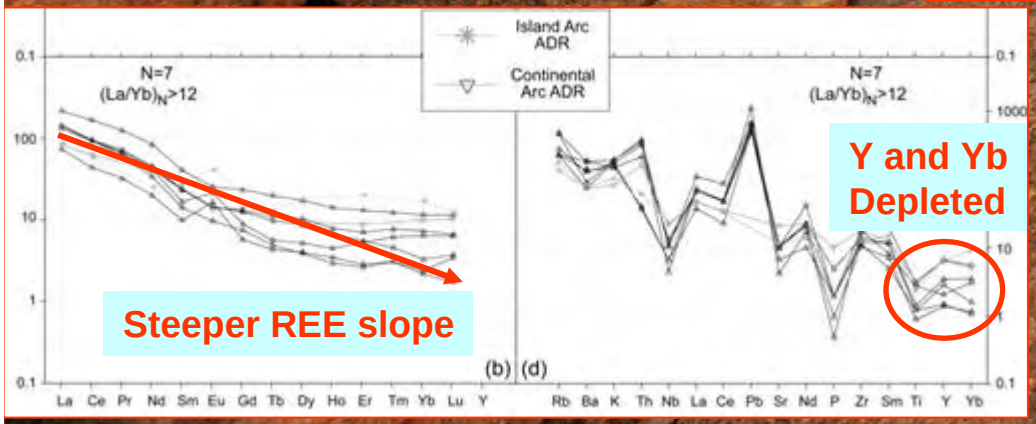
- ca. 1.59-1.55 Ga felsic rocks in the Musgrave Block



Granitic to Granodioritic

Calc-alkaline trends





Steeper REE slope

Y and Yb Depleted

- Felsic rocks are dominantly juvenile with respect to surrounding older crustal domains, have calc alkaline trends and HEE depletion.

Wade et al., (2006)

The Musgrave margin? A driver for c. 1600-1570 Ma NAC ICO's?

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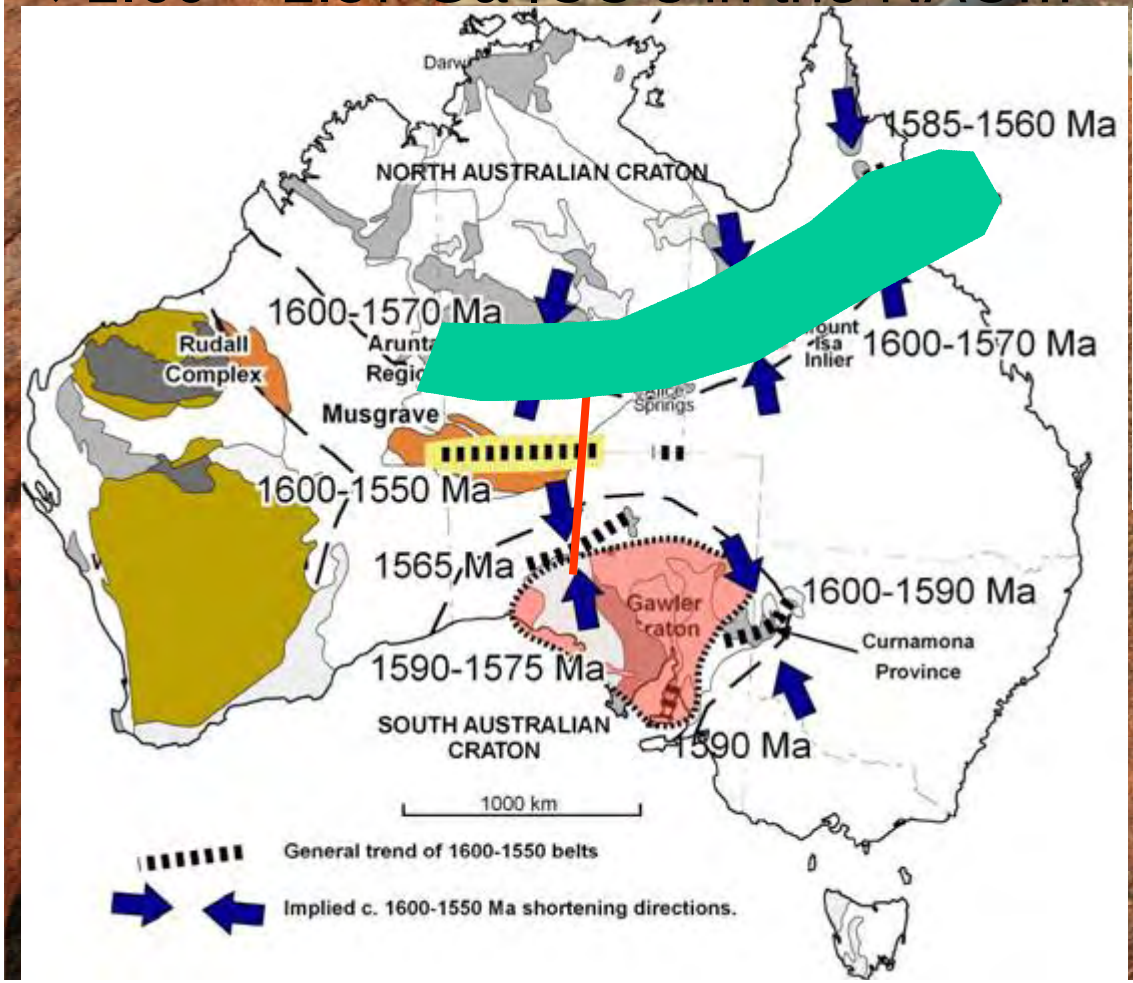
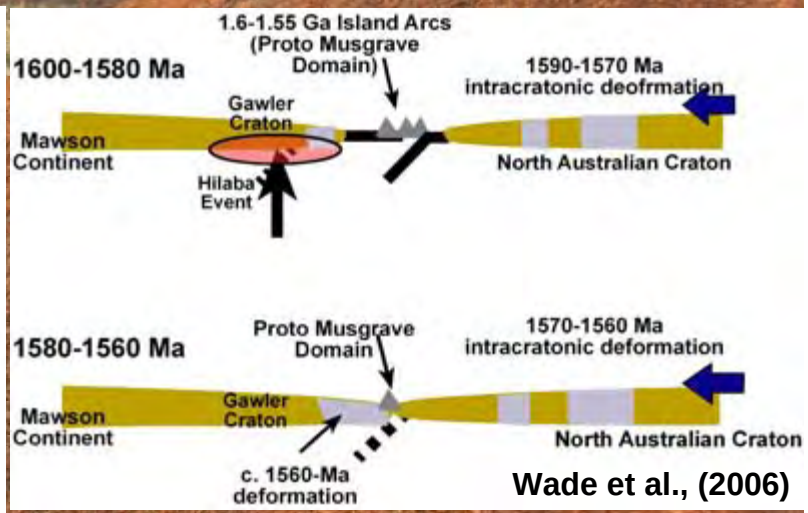
- ca. 1.59-1.55 Ga arc-related felsic rocks in the Musgrave Block?
- 1.60 – 1.57 Ga ICO's in the NAC…





Wade et al., (2006)

- Is there an early Mesoproterozoic IC orogenic belt in the NAC that mirrors the Musgrave margin?

The Musgrave margin? A driver for c. 1600-1570 Ma NAC ICO's?

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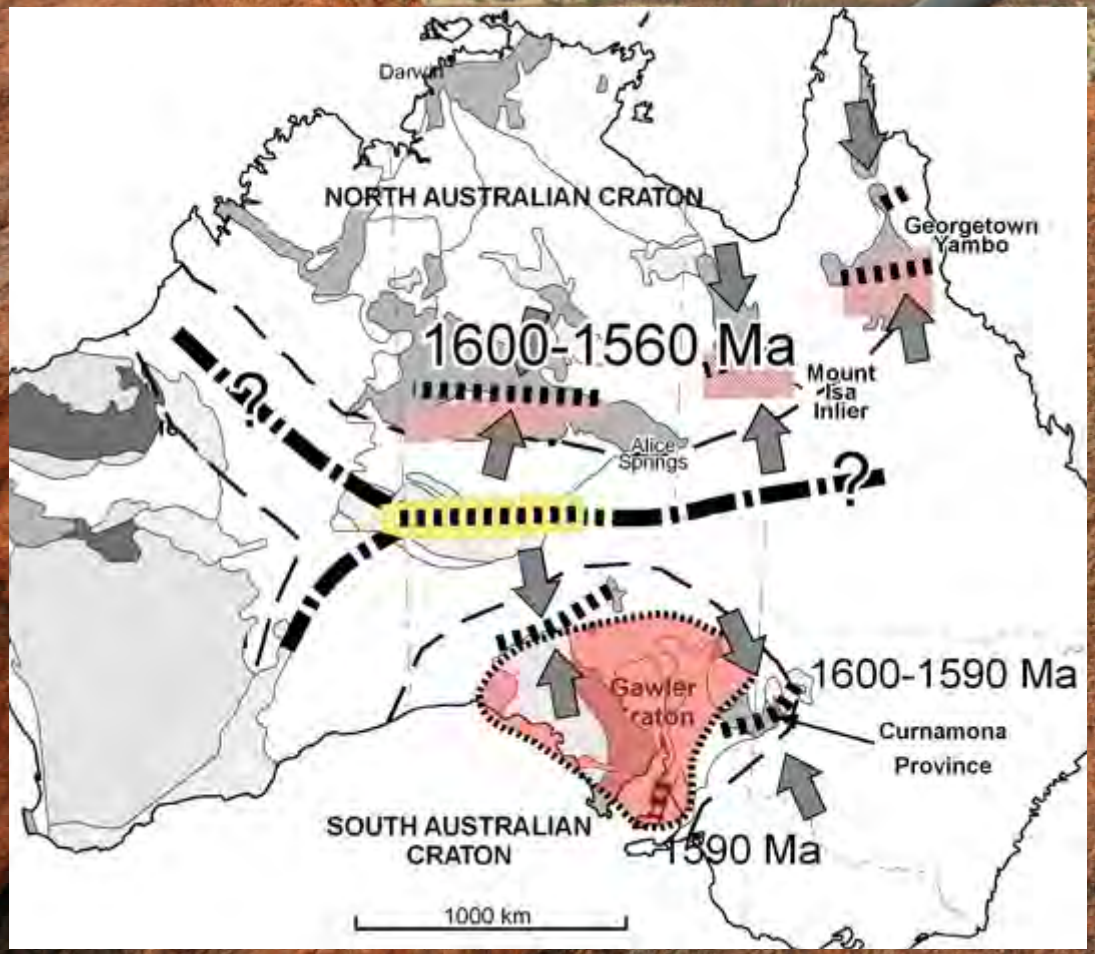
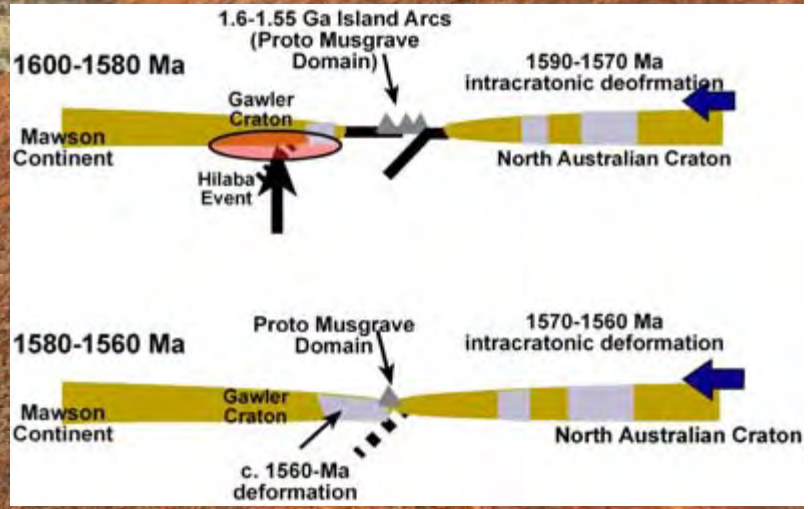
If there was a margin – where might it go?





Is there an early Mesoproterozoic suture beneath the Canning Basin that forms part of the Musgrave magin?

What controlled the IC responsiveness of the NAC?

Chewings, Early Isan and Georgetown-Yambo systems had GTG ~40-60C km^{-1}.

Early Isan Orogeny overlapped with basin development.

Were these IC orogens localised by hot pre-orogenic basins?

What controlled the IC responsiveness of the NAC?

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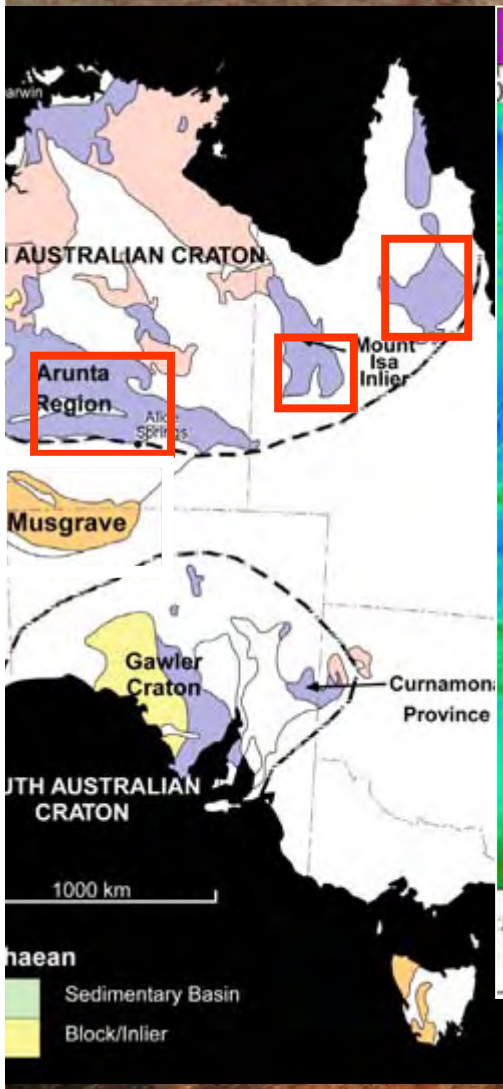
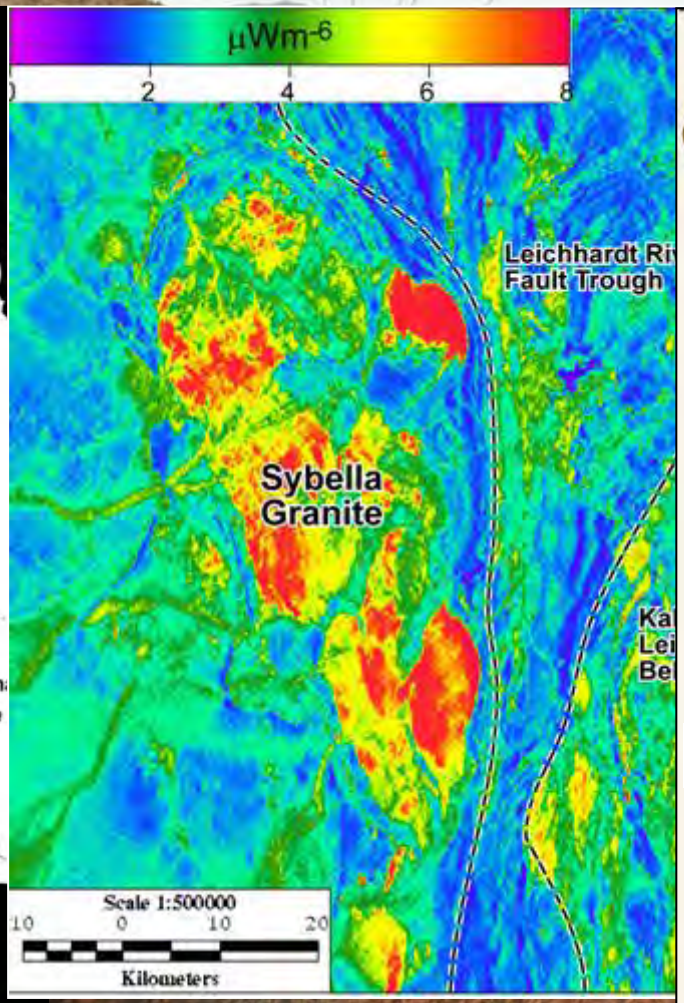
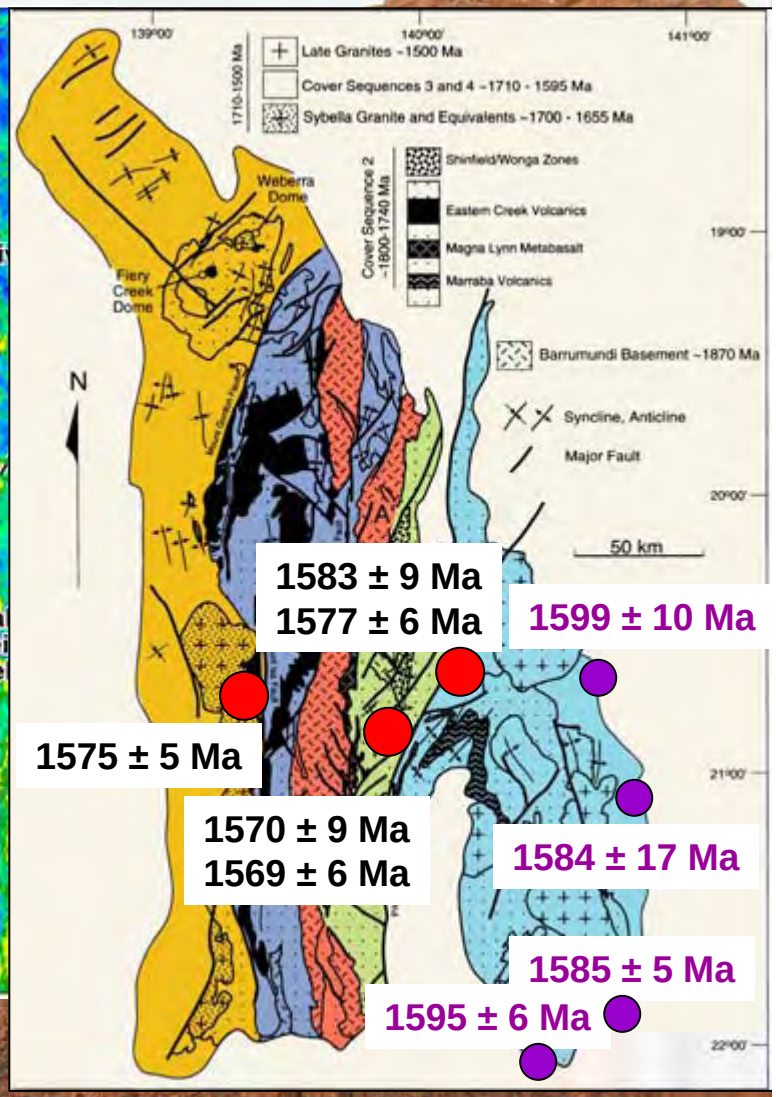




e.g. McLaren et al., (1999)



What controlled the IC responsiveness of the NAC?

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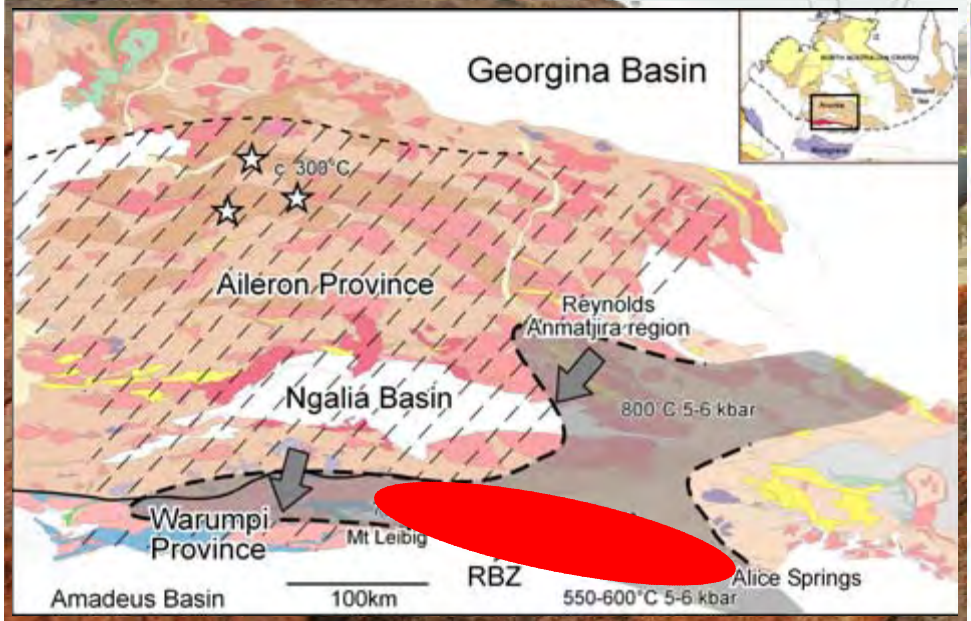
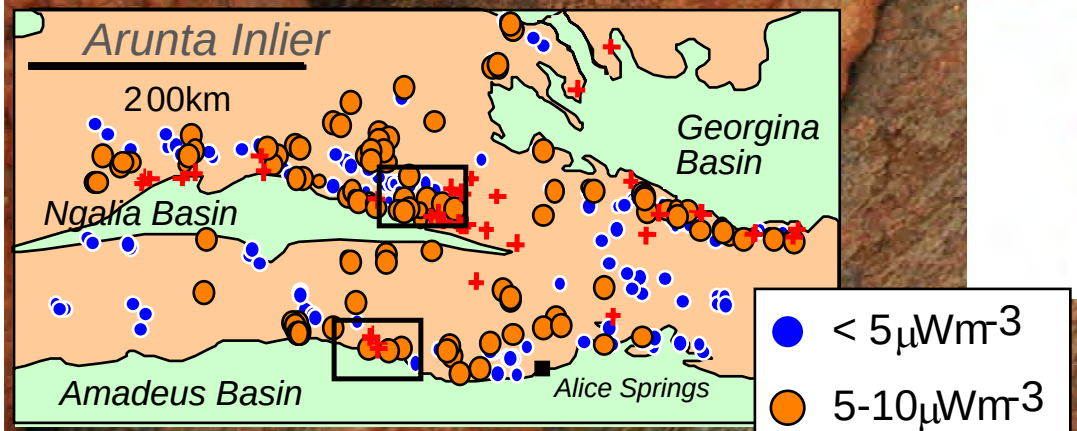
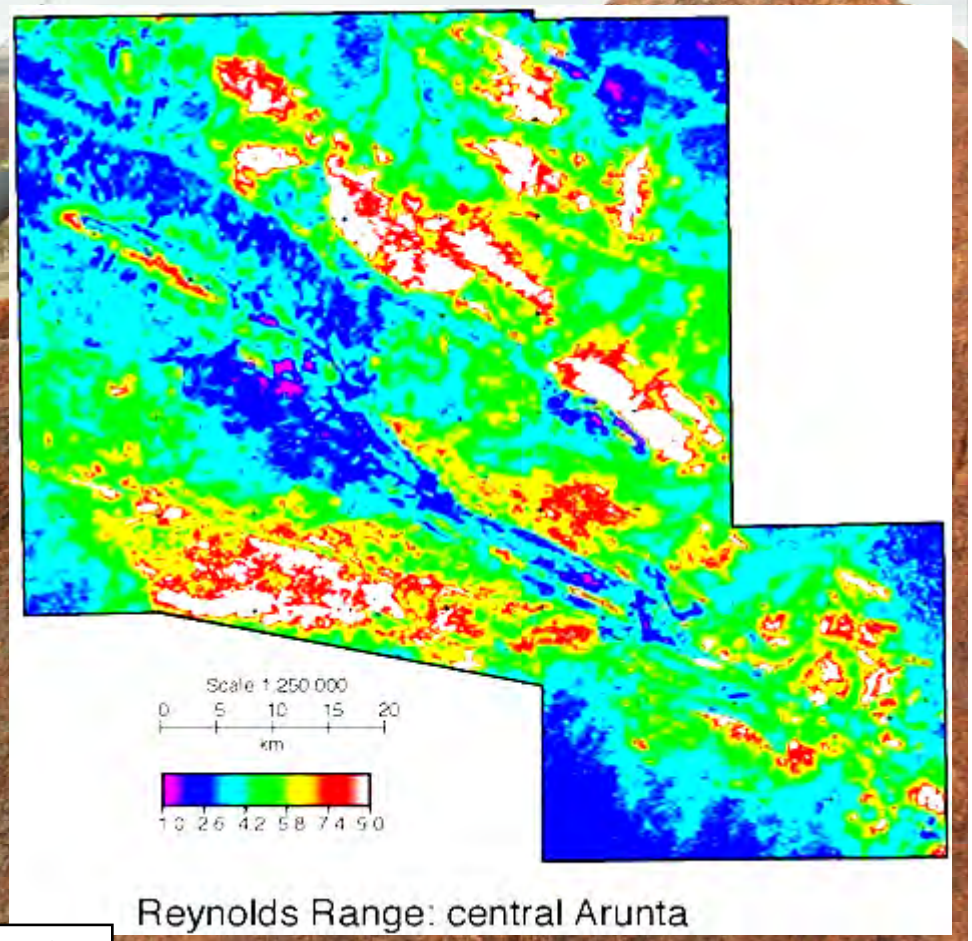




< 5μWm-3

5-10μWm-3

> 10μWm-3



Reynolds Range: central Arunta

Hot basin development in the southern Arunta @ c. 1620 Ma

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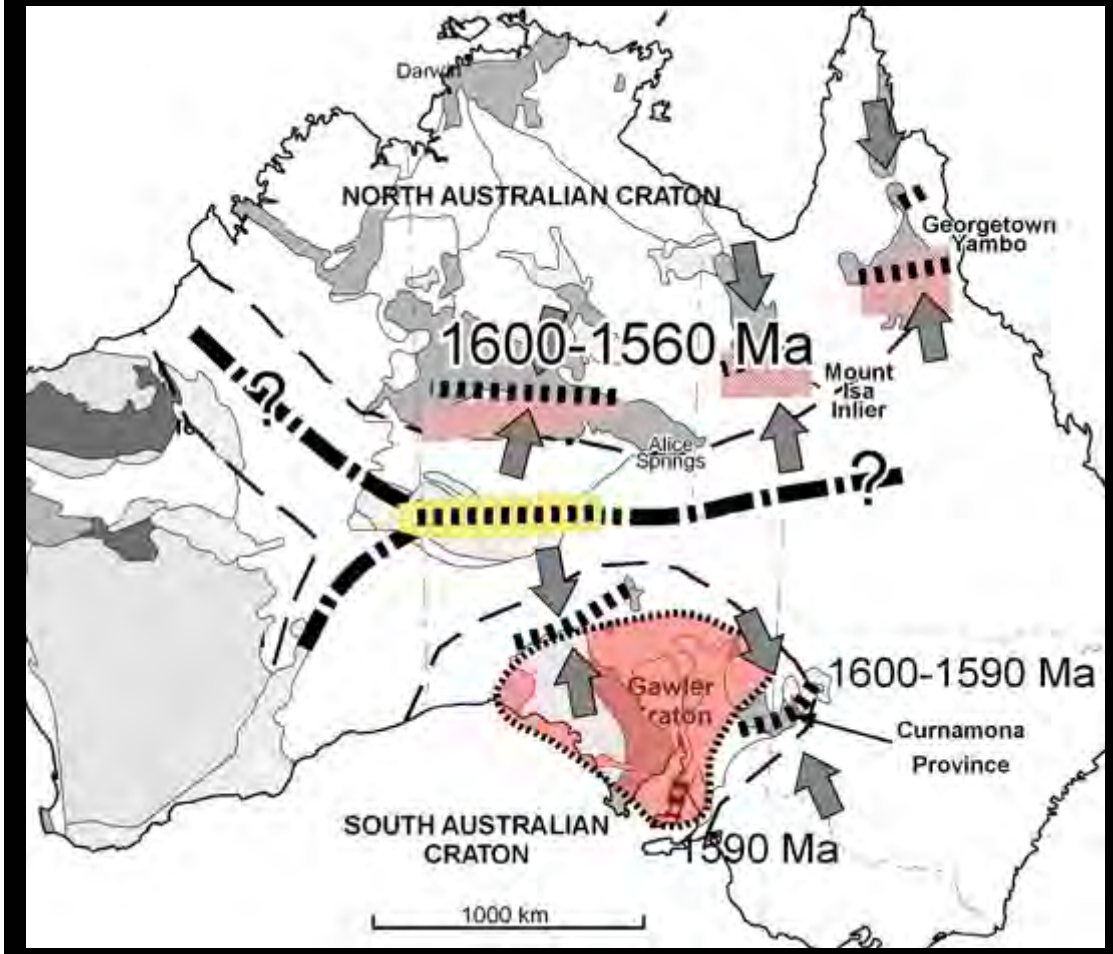

ca. 1600-1570 Ma high-T reworking of the NAC was synchronous with the development of a juvenile arc system (Musgrave Province).

N-S IC shorting in the NAC reflects convergence on the margin.

IC responsiveness of NAC inherited from pre-orogenic basins and localized hhp crust.

Is there an early Mesoproterozoic suture beneath the Canning Basin?

Southern Australian Proterozoic

Curnamona Province

Inversion of 1715-1640……..Ma Willyama Superbasin

HGG metamorphism @ 1610-1590 Ma