

Evolution and Mineral Potential of the Palaeoproterozoic Warumpi Province

NTGS:

geoscience

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stream sediment survey

John Dunster, Andrew Mugge

GA:

U-Pb SHRIMP geochronology

Andrew Cross, Jon Claoue-Long

geophysical interpretation

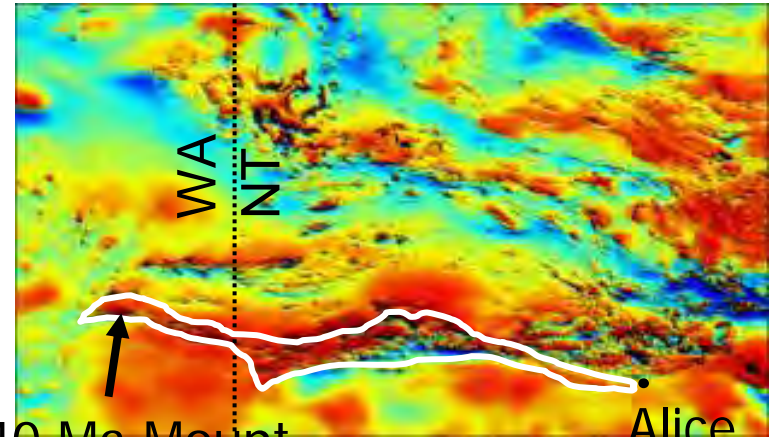
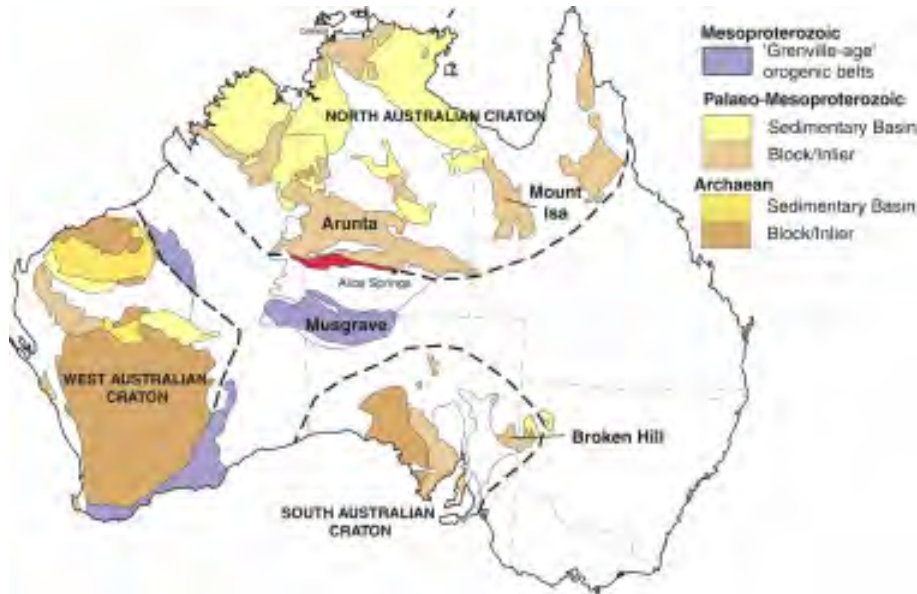
Tony Meixner

Curtin Uni: U-Pb SHRIMP geochronology

Pete Kinny

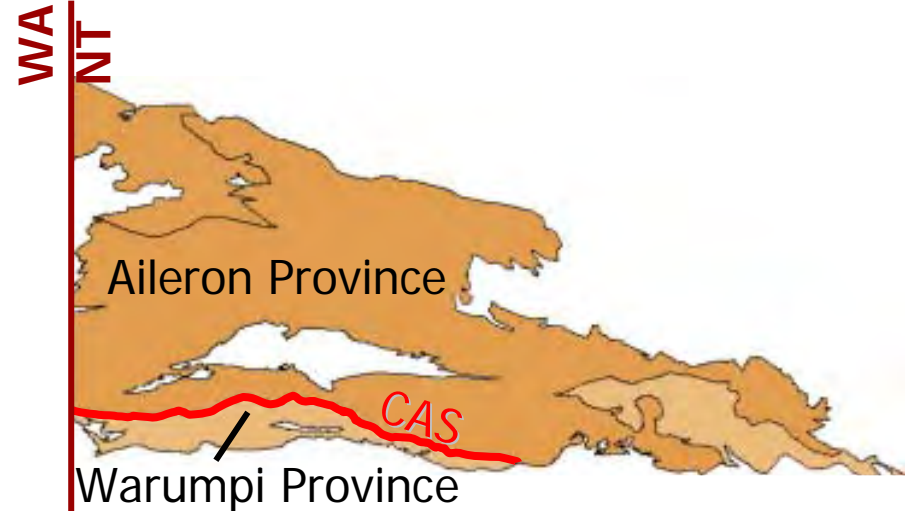
Warumpi Province: Location

- southwestern margin of the North Australian Craton
- late Paleoproter exotic terrane 600km strike length: 1690-1600 Ma; granulite to greenschist metm
- North boundary: the Central Australian Suture



1640 Ma Mount
Webb Granites

Alice
Springs



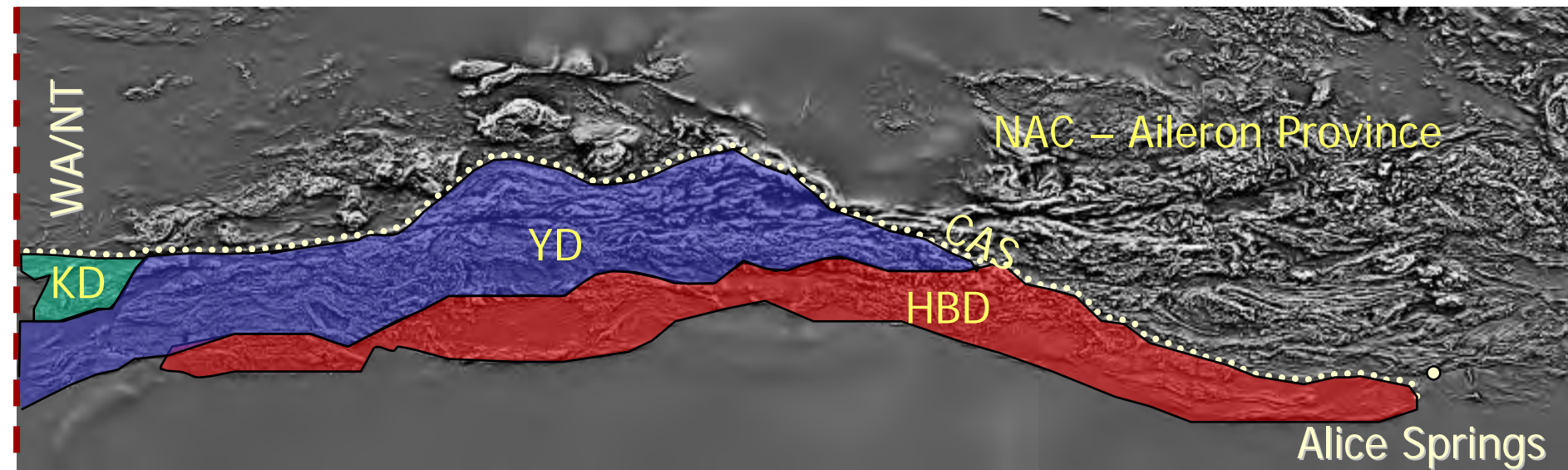
Aileron Province

Warumpi Province

Warumpi Province: Internal architecture

- CAS = Desert Bore SZ, Redbank SZ, Charles River Thrust; fundamentally reworked in the Proterozoic & Palaeozoic
- 3 major domains based on protolith age, metamorphic grade & intensity of the 1640 Ma Liebig Orogeny

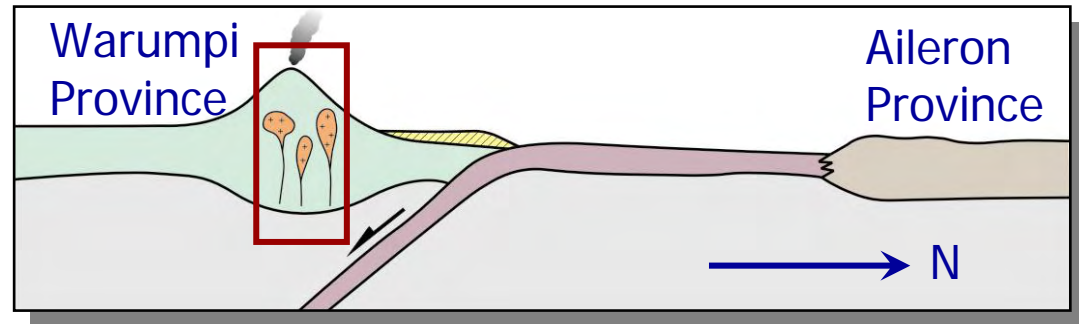
Haast Bluff Domain (HBD) *amphibolite facies* / Yaya Domain (YD) *granulite facies* / Kintore Domain (KD) *greenschist facies*



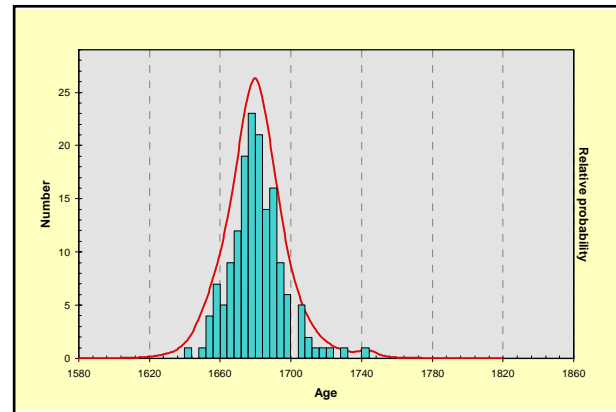
Warumpi Province: Haasts Bluff & Kintore Domains

1690-1670 Ma: Argilke Igneous Event

- Voluminous high K calc-alkaline felsic magmatism: intrusives & extrusives
- Interpreted magmatic arc
- No known magmatism of this age in the NAC
- Absence of NAC signature in zircon population suggests development of arc occurring outboard of NAC



Peculiar Volcanics
1680±4 Ma

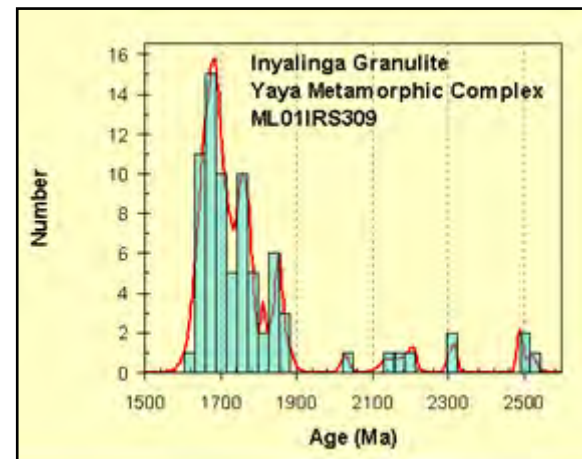
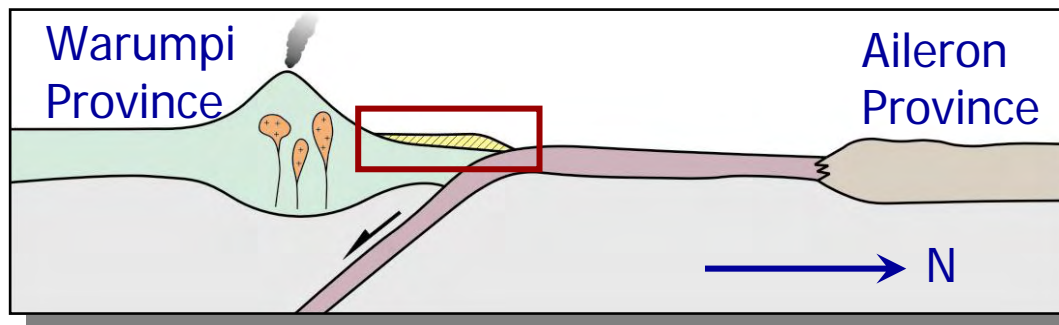


Metallogenic Potential: elevated stream sed geochemistry Au, Bi, Te/
alteration of volcanics suggestive of epithermal Au

Warumpi Province: Yaya Domain

1660-1640 Ma: Yaya Metamorphic Complex

- Submarine deposition of mudstones, sandstones, calc-arenites, mafic extrusives/intrusives in a forearc setting
- Largely sourced from Argilke Igneous Event magmatic rocks
- Maximum deposition age ~1661 Ma

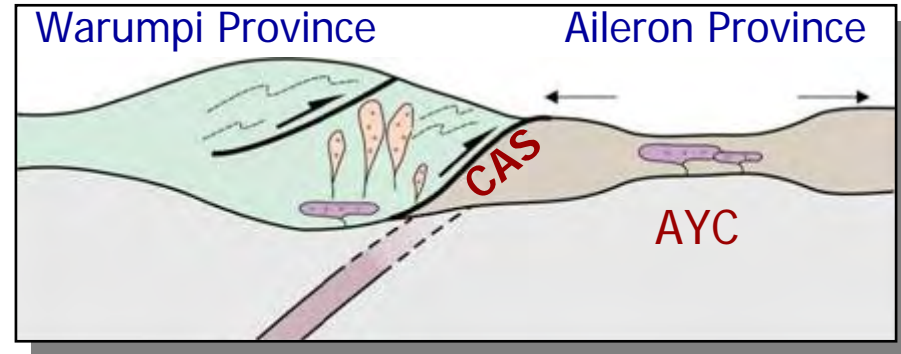


**Metallogenic Potential: elevated Au, Sn, Ni, Cr, Ti stream sed geochemistry/
Silica-poor massive cordierite unit within YMC consistent with metamorphosed
seafloor hydrothermal alteration**

Warumpi Province: Accretion to NAC

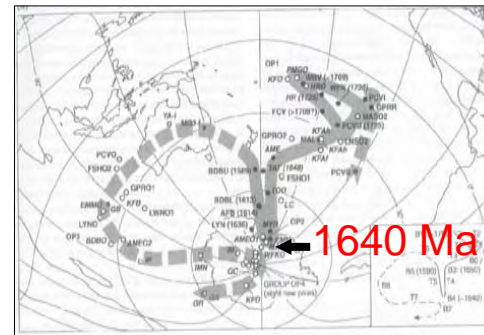
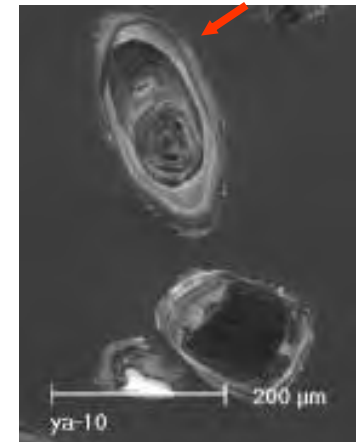
1640-1630 Ma: Liebig Orogeny

- oblique accretion of Warumpi Province to NAC
- deep crustal met^m of Yaya Complex ~ 9-10 kbars & 750-900°C / upper amphibolite facies in HBD - followed by rapid exhumation
- assoc bimodal magmatism: high K, calc alkaline suite at 1640 Ma, AYC & Ilpilli Dolerite at 1633 Ma
- hairpin bend in apparent polar wander path
- assoc zircon rim growth at 1640 Ma



Opx + Sil → Spr + Crd

1640 Ma

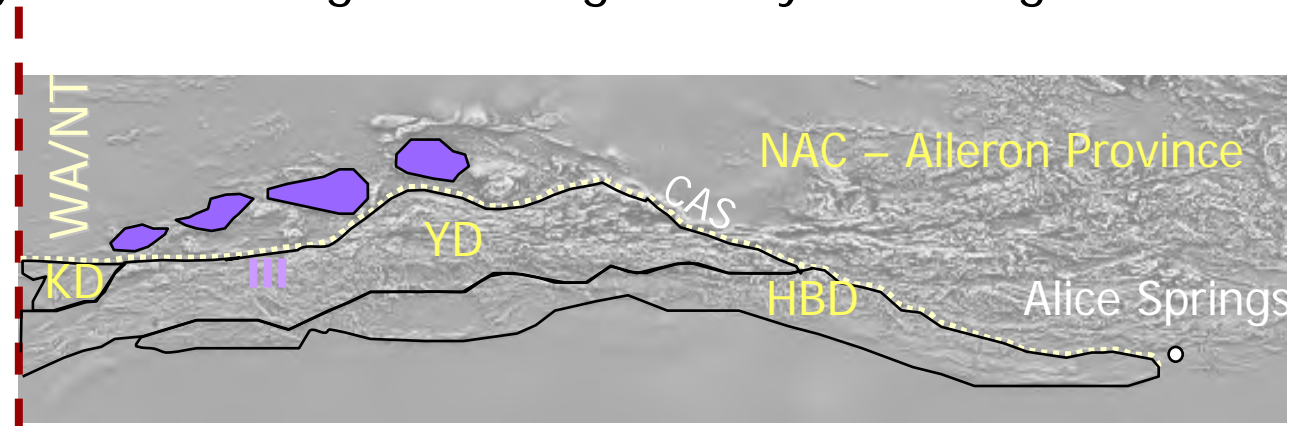


Warumpi Province: Oblique accretion - evidence

1640-1630 Ma: Liebig Orogeny

- High P metm varies across the Yaya Domain - localised burial to 30kms followed by rapid exhumation whilst other parts remained at shallow crustal levels, consistent with a transpressional orogen
- Dolerite sills and layered intrusions occur in the Yaya Domain (Ilpilli Dolerite) & NAC (Andrew Young Complex). Both are dated at 1633 Ma – ie extension synchronous with or immediately postdating Liebig Orogeny
- Partitioning into zones of broadly synchronous compression & extension suggestive of obliquely accreted orogen whilst geometry indicating overall sinistral movement

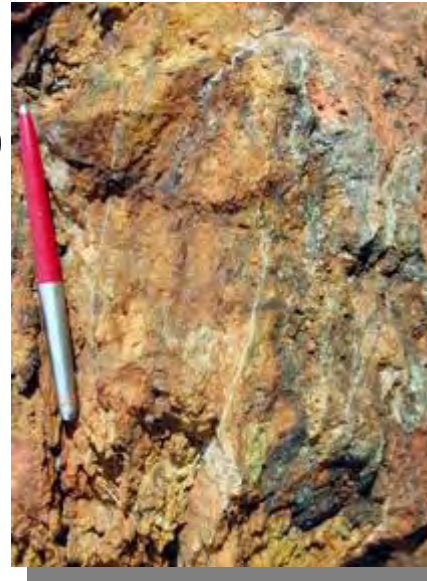
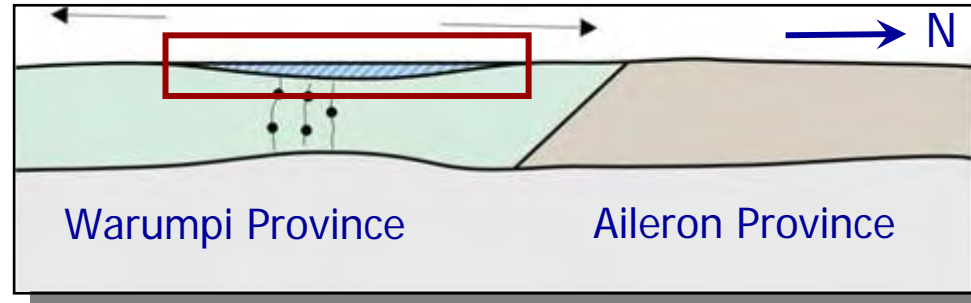
AYC Metallogenic
Potential: Ni, Cu
(Hoatson et al 2005)



Warumpi Province: Haasts Bluff & Kintore Domains

1630-1610 Ma: Iwuputaka Metamorphic Complex

- HBD: feldspathic to quartz musc-bio schist, lesser quartz-musc schist, quartzite, amphibolite, calc-silicate, tremolite/chlorite schist elevated Ni (950ppm), Cr (2050ppm) MgO (28%) ⇒ ultramafic?
- KD: mafic to felsic calc-alkaline/tholeiitic volcanism with tuffaceous sediment interbeds
- Pb isotope data similar to Broken Hill signature (Huston 2006)



Metallogenic Potential: hosts Stokes Yard (Pb-Zn), Ulpuruta (Pb-Zn-Cu) & Haast Bluff (Cu-Au) prospects

Warumpi Province: exotic – isotopic evidence

Sm-Nd isotopic data

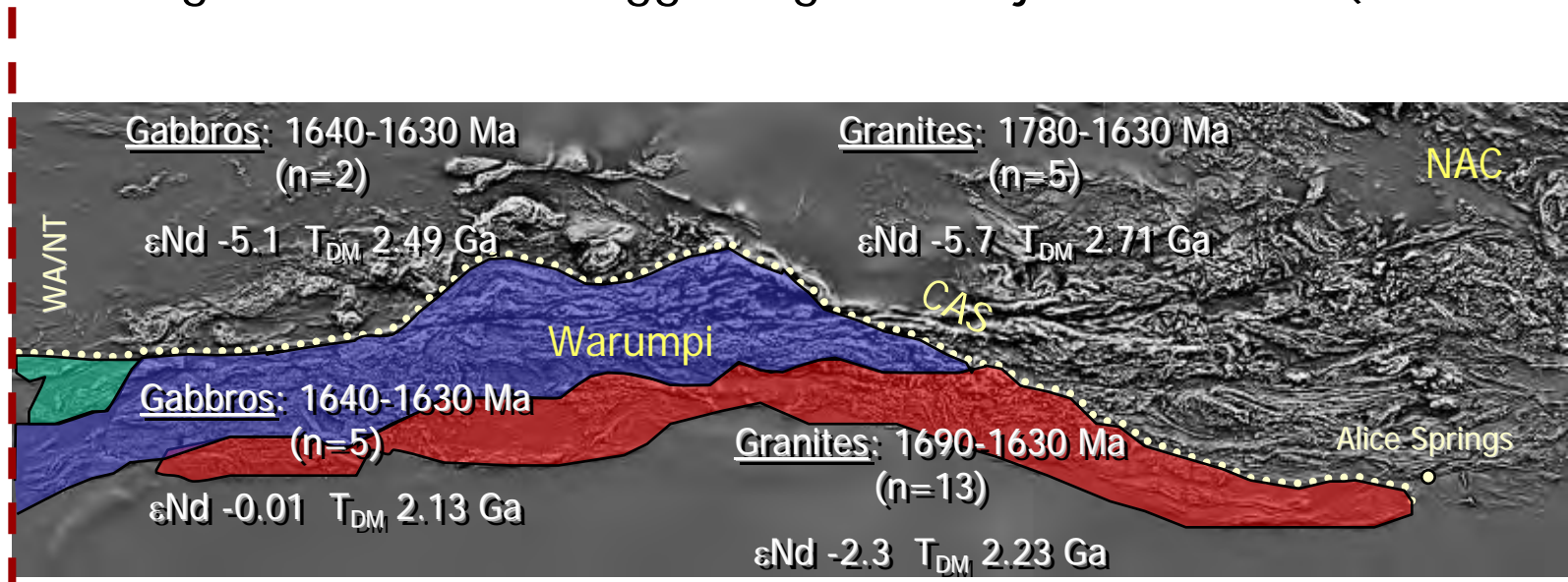
- Warumpi Province comprises younger, less evolved Palaeoproterozoic crust

U-Pb isotopic data

- younger protoliths with no NAC inheritance

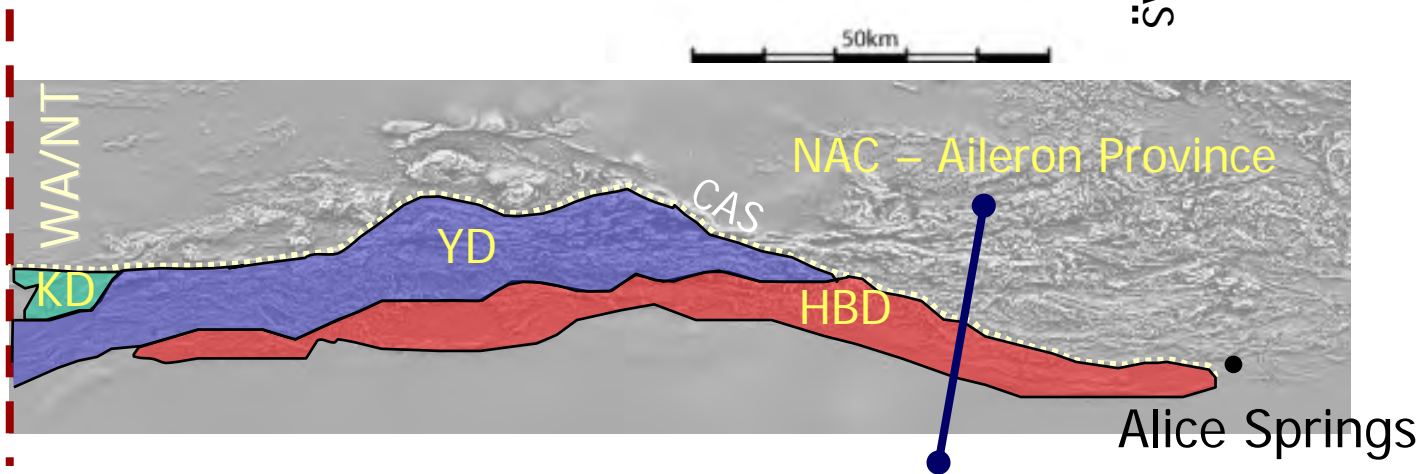
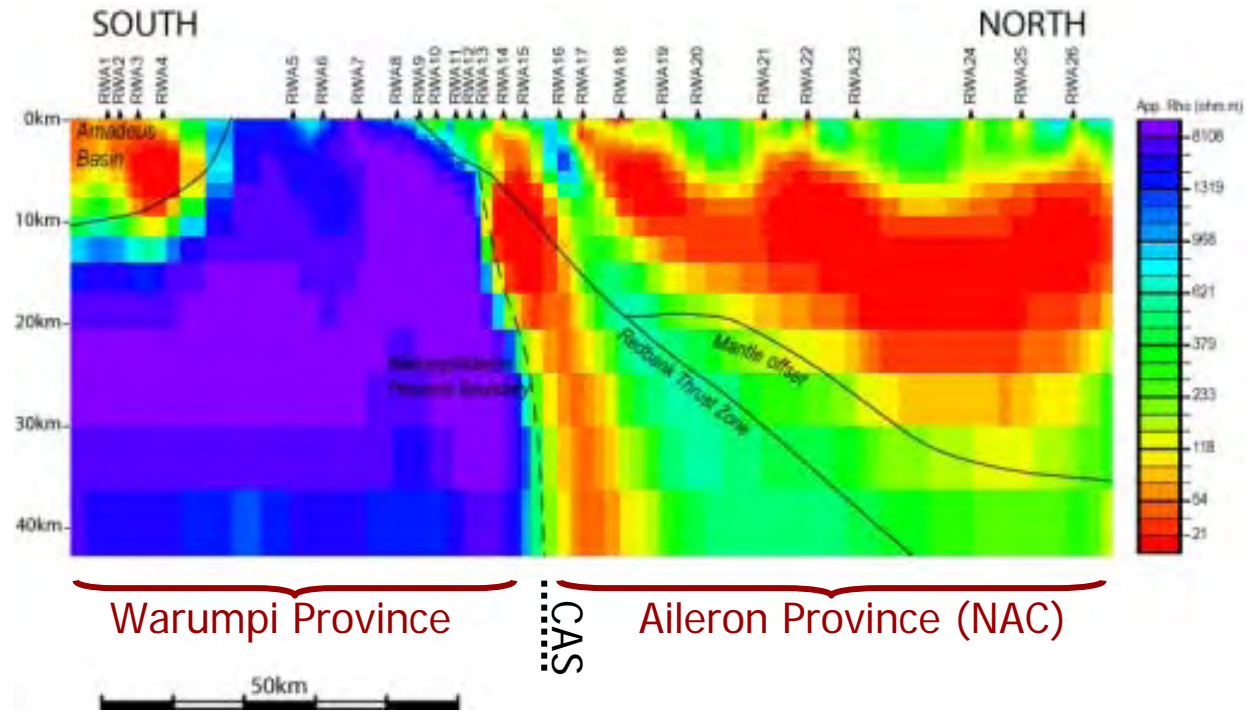
Pb isotopic data

- different signature to NAC: suggesting a more juvenile crust (Huston 2006)



Warumpi Province: exotic – crustal composition

- MT data (Kate Selway, Uni Adelaide) indicates marked conductivity contrast & near vertical boundary (CAS)
- reworked by RSZ



Warumpi Province: HB, Y & K Domains

1590-1570 Ma: Chewings Orogeny

- resulted in the juxtaposition of the Haasts Bluff, Yaya and Kintore Domains into current configuration
- pervasive N-dipping non-coaxial strain fabrics, S-vergent tectonic transport
- upper amphibolite facies in YD, mid to lower amphibolite facies in HBD, greenschist in KD
- no assoc magmatism
- localised post tectonic granites in adjacent NAC (1567-1530 Ma)



Warumpi Province: Teapot TE to ASO

1150 – 350 Ma: Teapot Thermal Event to Alice Springs Orogeny

- Localised effects: isotopic resetting of Ar-Ar, U-Pb zircon rim growth, migmatisation pegmatites & granite intrusion
- undeformed Iherzolite/wehrlite, remnantly magnetised, plug-like features, possible age 1150....300 Ma (*850ppm Ni, 1950ppm Cr, 83ppm Co, 18.1% MgO*)
- effects of ASO: varies from S-vergent structural interleaving of Warumpi with basal Amadeus Basin (east) to gentle open folding (west)
- reactivation of Proterozoic shear zones & localised Ar-Ar isotopic resetting



Warumpi Province: Summary

- Warumpi Province is a terrain exotic to the NAC, comprising pre-existing although more juvenile crust; developed outboard of the NAC until accretion at 1640 Ma
- 'Greenfields' area – no history of exploration
- Protolith ages (1690-1600 Ma) lie within a stratigraphic interval that hosts some of Australia's world class base metal deposits ie Broken Hill (1690 Ma); Mount Isa Group (1654 Ma); McArthur River (1640 Ma) and Century (1610 Ma)
- Evolved in an active plate margin setting with potential for a variety of mineralisation styles including VMS, BHT, IOCG, epithermal & mesothermal Au. May have prospectivity for diamonds

Warumpi Province: Publications & Products

MAPS

- 2nd ed Mount Liebig 1:250k outcrop: hardcopy & attributed GIS 2005
- 2nd ed Mount Rennie 1:250k outcrop: hardcopy & attributed GIS 2005
- 2nd ed Hermannsburg 1:250k outcrop: hardcopy & graphic GIS 1995*
- 1st ed Mount Liebig 1:250k interpreted: hardcopy 2005
- 1st ed Mount Rennie 1:250k interpreted: hardcopy 2005

EXPLANATORY NOTES

- 2nd ed Mount Liebig 1:250k 2005
- 2nd ed Hermannsburg 1:250k 1995
- 2nd ed Mount Rennie 1:250k *in prep*

ABSTRACTS

- AGES 2001-2004 / AGC 2002 & 2004 / TSRC 2005

* GA publication

Warumpi Province: Publications & Products

OTHER NTGS PUBLICATIONS

- Stream Sediment survey of the Western MacDonnell Ranges (Dunster & Mugge 2001)
- **Mineral Potential of the 1690-1600 Ma Warumpi Province (Frater in prep 2006)**
- Summary of results. Joint NTGS-GA geochronology project : southern Arunta region (Cross et al 2005)

PAPERS

- High-*T* granulites and polymetamorphism in the southern Arunta Region, central Australia: Evidence for a 1.64 Ga accretional event (Scrimgeour et al 2006)
Precambrian Research
- Proterozoic mafic–ultramafic intrusions in the Arunta Region, central Australia: Part 1: Geological setting and mineral potential (Hoatson et al 2005) *Precambrian Research*
- Proterozoic mafic–ultramafic intrusions in the Arunta Region, central Australia: Part 2: Event chronology and regional correlations (Claoue-Long et al 2005) *Precambrian Research*