Northern Gawler Craton National Drilling Initiative

Results and regional implications

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GEOLOGICAL SURVEY OF South Australia

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Acknowledgement

We would like to acknowledge the Antakirinja Matu-Yankunytjatjara (AMY) people.

This work is being carried out on the lands of Antakirinja Matu-Yankunytjatjara people with the permission of the AMY Aboriginal Corporation (AMYAC) survey team.

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Background

- GSSA investment of ~$5M for two drilling programs
- Northern Gawler Craton chosen as 2nd National Drilling Initiative area:
  - “Regional greenfields mapping” with the CT rig
  - Depth of cover ~200–450 m
  - Active exploration in the area
- 12 targets chosen, 7 holes drilled, 5 drillholes with basement intersections
- Drilling undertaken from October 2024–February 2025

DIG CT on site for the Northern Gawler NDI

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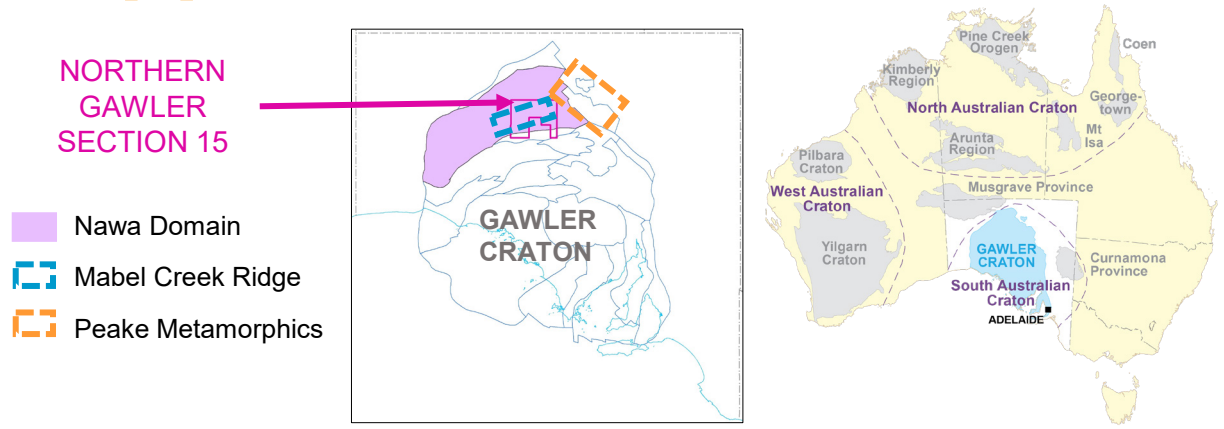
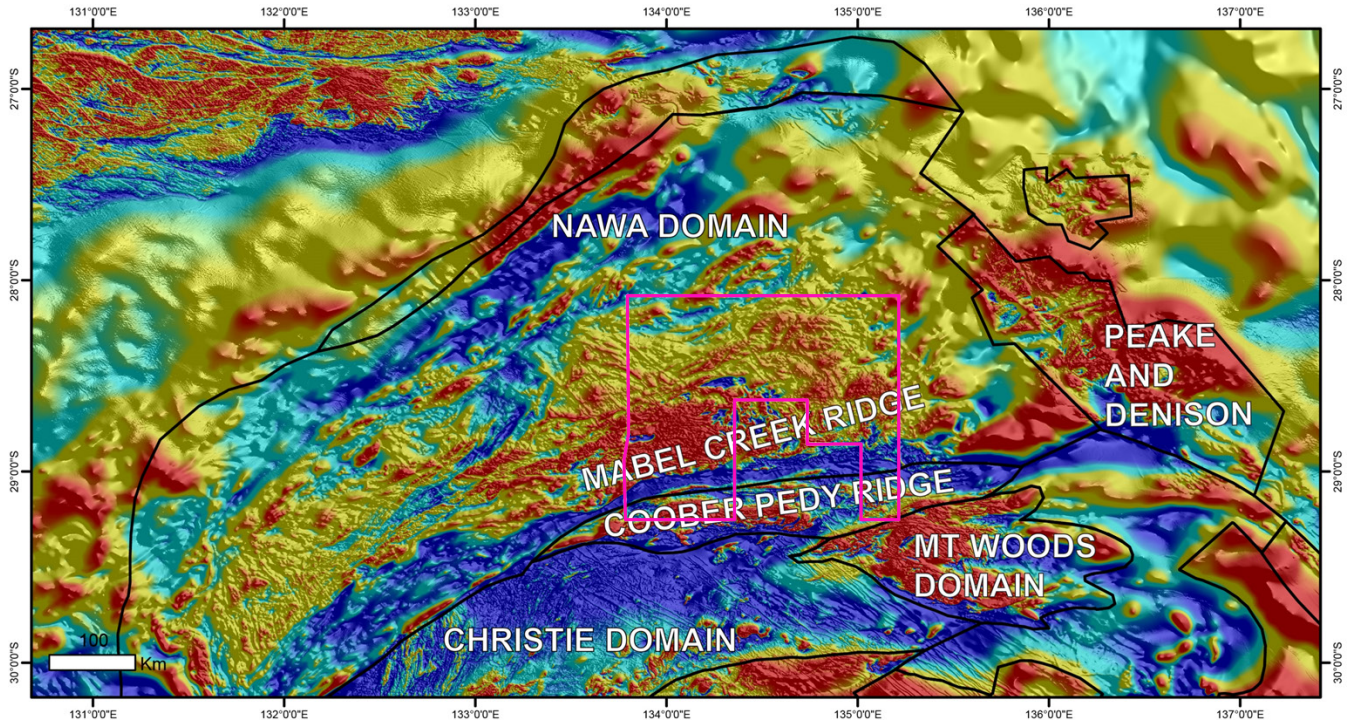
Northern Gawler Craton NDI approach

The Section 15 area encompasses a crucial zone that could aide in understanding the structural architecture of the Northern Gawler Craton

Intersection of three major tectonic domains:

- Nawa Domain
  - Strongly sheared metasedimentary package, with no known Olarian/Kararan (1570–1540 Ma) overprint
- Mabel Creek Ridge
  - Complexly deformed metasedimentary package, with a significant (predominant) Olarian/Kararan overprint
- Peake Metamorphics (Peake and Denison Inliers)
  - Pre-Kimban (pre-1740 Ma) sedimentary package and magmatic intrusives, deformed and metamorphosed during a pre-Kimban event (overprinted during Olarian/Kararan (1570–1540 Ma) and Coorabie (ca. 1450 Ma) events)





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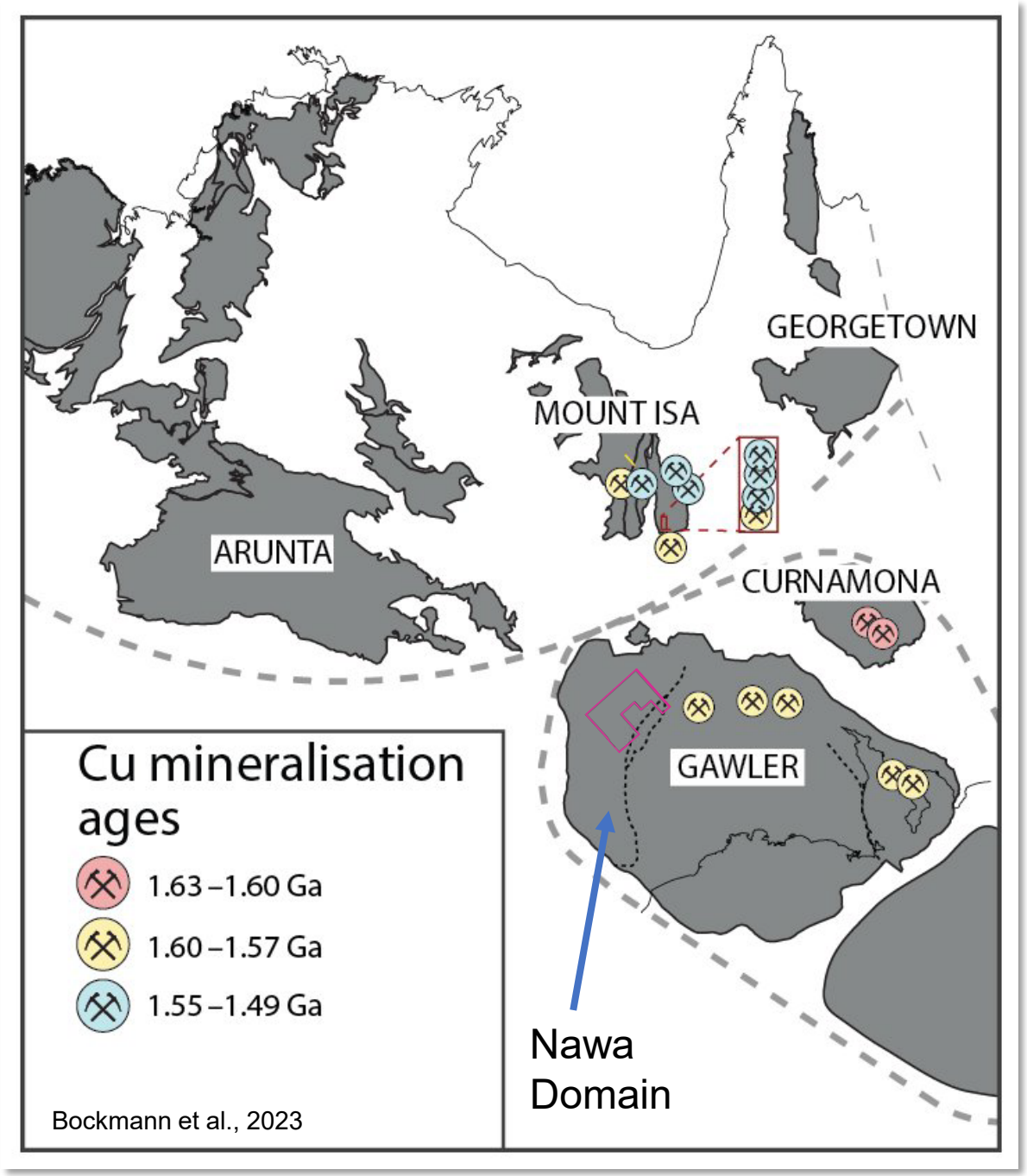
Northern Gawler Craton

The Northern Gawler Craton also encompasses a crucial zone that can contextualise and strengthen links with the North Australian Craton



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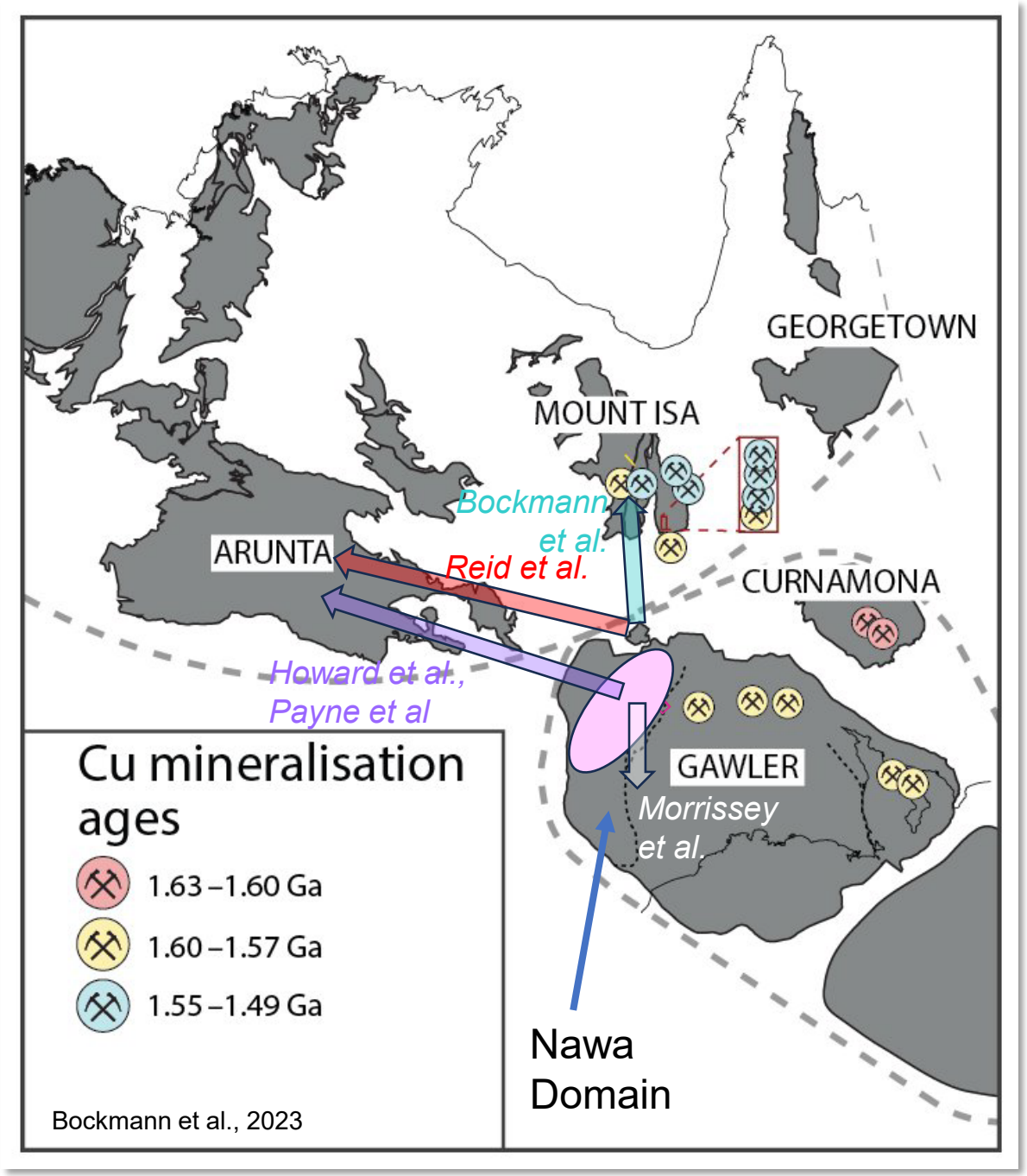
Northern Gawler Craton

The Northern Gawler Craton also encompasses a crucial zone that can contextualise and strengthen links with the North Australian Craton

- Explore terrane correlations
  - *How do the bits of the northern Gawler Craton fit together?*
  - *Correlation with north Australia (Aileron/Arunta, Mt Isa) and other parts of South Australia (Peake and Denison, Gawler Craton, Curnamona Province)*
  - *What are the main rock types, protolith, metamorphic and magmatic ages?*



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Mapping Northern Gawler

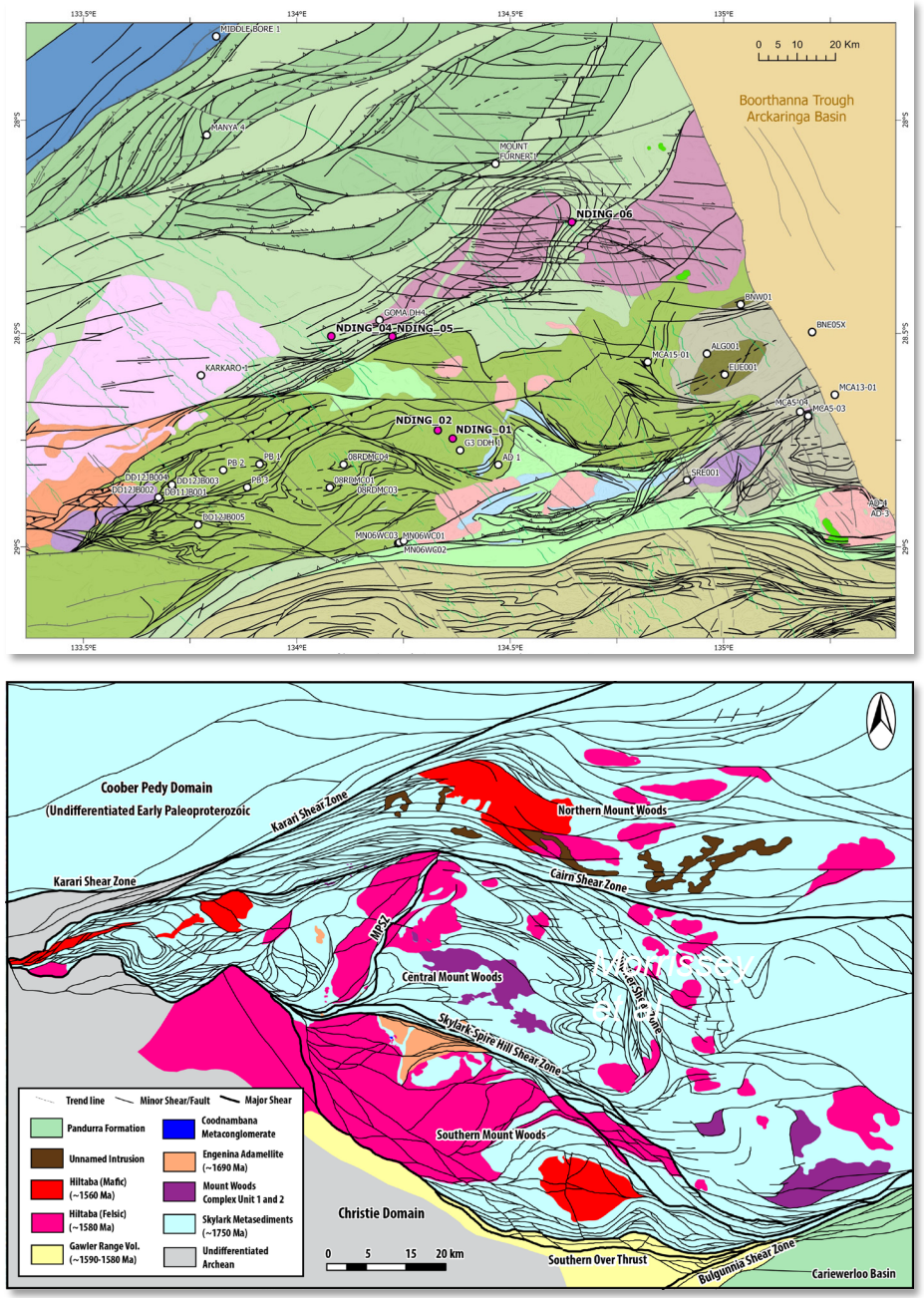
12 drillhole targets* chosen to:

- Characterise different basement rocks and metamorphic history
  - *Filling in the gaps – rock types, protolith ages, metamorphic ages, magmatism*
  - *Context for younger overprinting events*

- Help inform Discovery Mapping project in Northern Gawler Craton (Nawa Domain and Mt Woods Inlier)
  - *Sampling of legacy drillholes in the Northern Gawler Craton – SHRIMP, geochemistry and isotope geochemistry*

- Develop mineral potential in the area (Broken Hill Type (BHT) or sedimentary exhalative (SEDEX) base metals; Cu-Au (IOCG, ISCG), REE)

**Total 5 drillholes completed with basement intersections*



Structural and solid geology interpretation for the Nawa Domain (J. Percival; top) and Mt Woods Inlier, (R. Abdullah; bottom), based on SA 1st Edition Geology.

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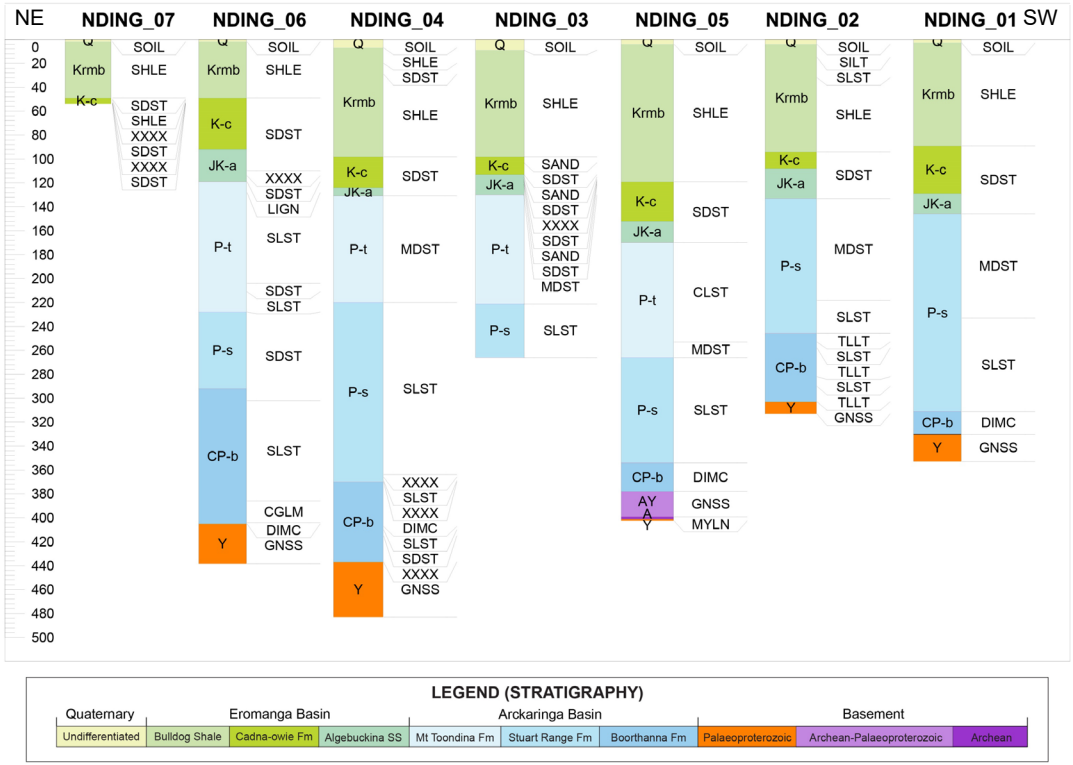
Mapping Cover in the Northern Gawler

- Refine basin cover thickness (depth to basement) and geological characterisation
- Biostratigraphy and depositional environments in Eromanga Basin and Arckaringa Basin

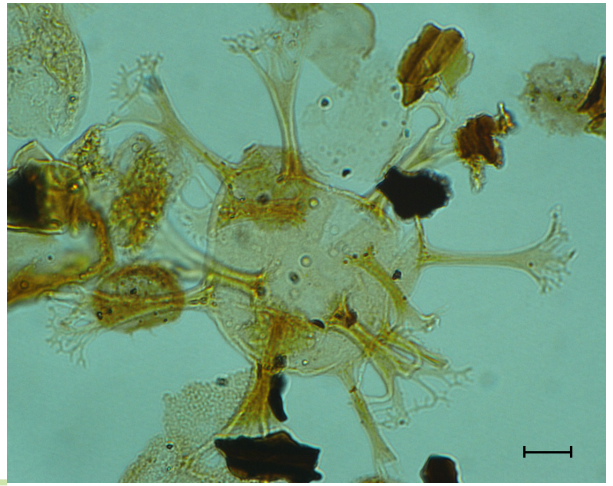


NE-SW projected cross section showing cover unit thickness and depth to basement for NDING drillholes NDING_01 to NDING_07.

EROMANGA BASIN (Cretaceous)

Braided fluvial; non-marine to marginal marine; open marine transgressive.

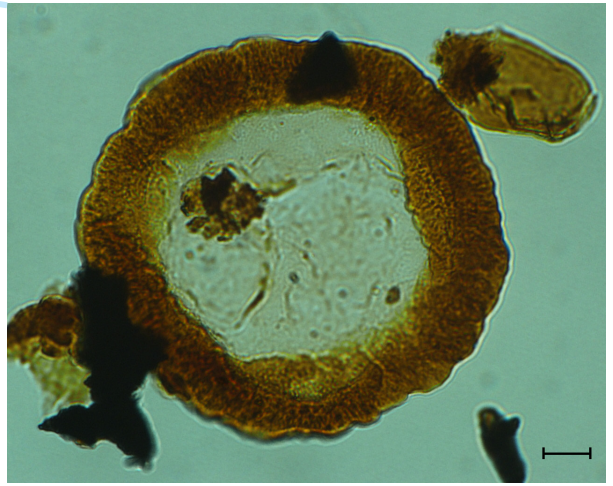
Cretaceous microplankton Oligosphaeridium pulcherrimum, NDING_06, 21–22 m



ARCKARINGA BASIN (Permian)

Shallow marine-fluvial periglacial; marginal marine; lacustrine, meandering fluvial and back swamp.

Permian spore Cannanoropollis perfectus, NDING_06, 246–247 m

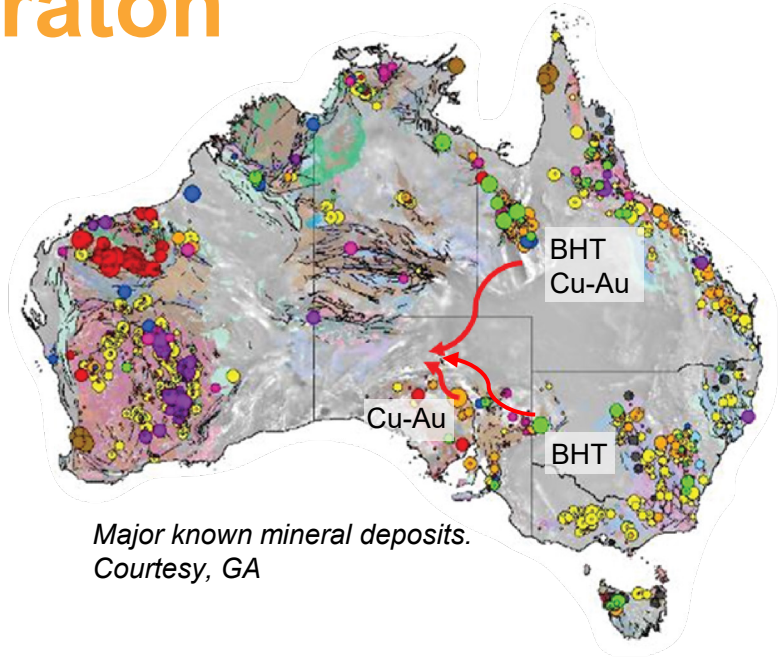


Scale bar 10 µm

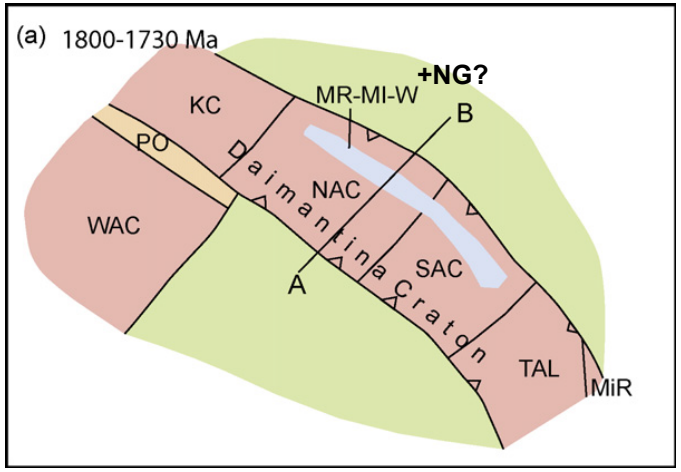
Mineral Potential Northern Gawler Craton

- Build on younger (<1500 Ma) Cu systems (e.g. Yu et al., 2023)
- High-temperature metamorphism and deformation is recognised along major shear zones – mechanism for Cu transport and deposition
- What is driving the younger metamorphism, magmatism and mineralisation?

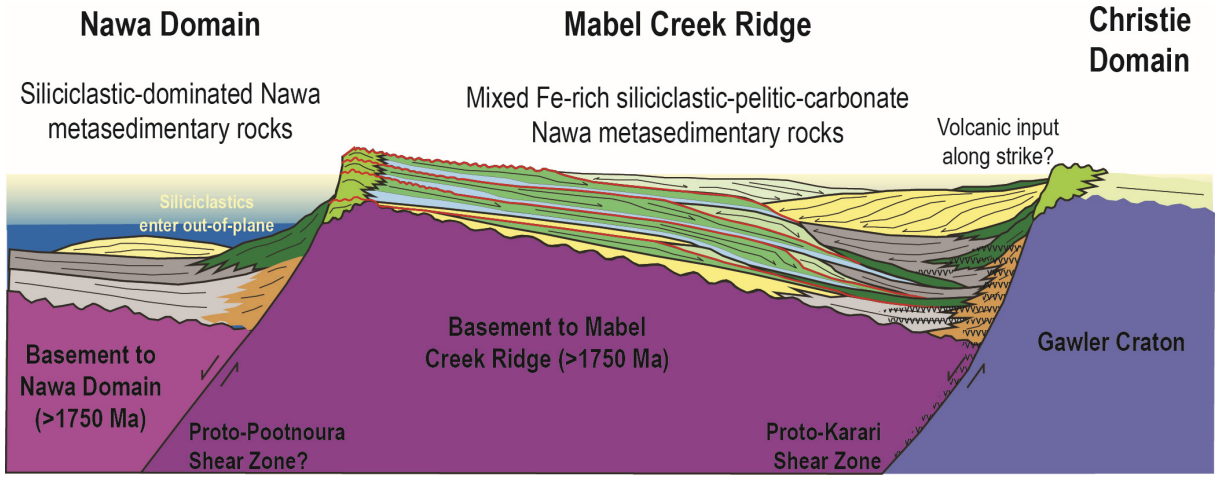
- Investigate potential for BHT or SEDEX base metal systems
  - Evidence for Palaeoproterozoic (rift) basin development and deformation with a long and high-gradient thermal history
  - Bimodal magmatism, clastic metasedimentary rocks



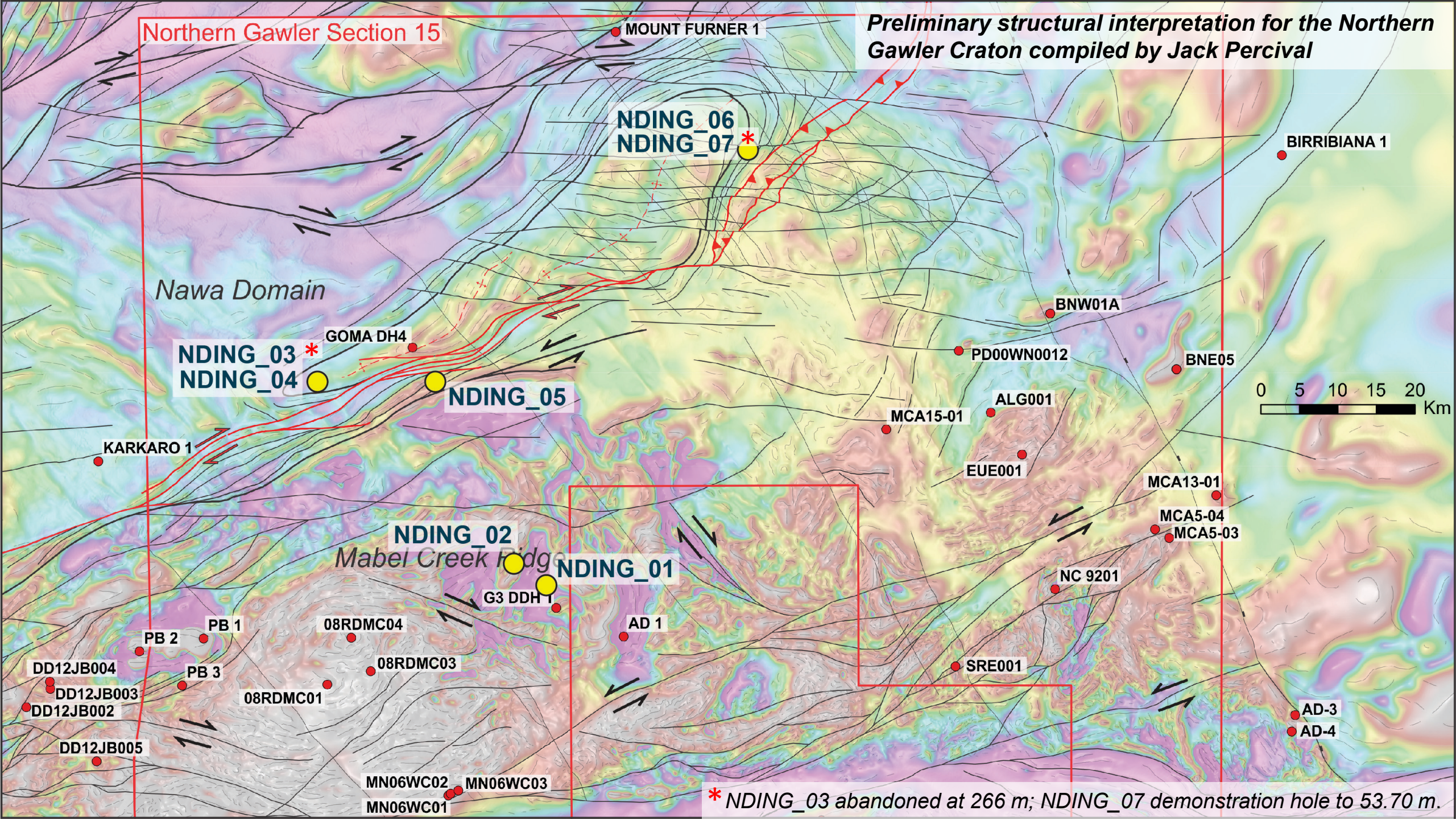
Major known mineral deposits. Courtesy, GA



Schematic plan view of Palaeoroterozoic Australia, highlighting long-lived subduction zones along its NE and SW margins resulting in a largely back-arc environment. MR-MI-W: McArthur River-Mount Isa-Willyama, NG: Northern Gawler; Cawood and Korsch 2008: https://doi.org/10.1016/j.precamres.2008.08.006



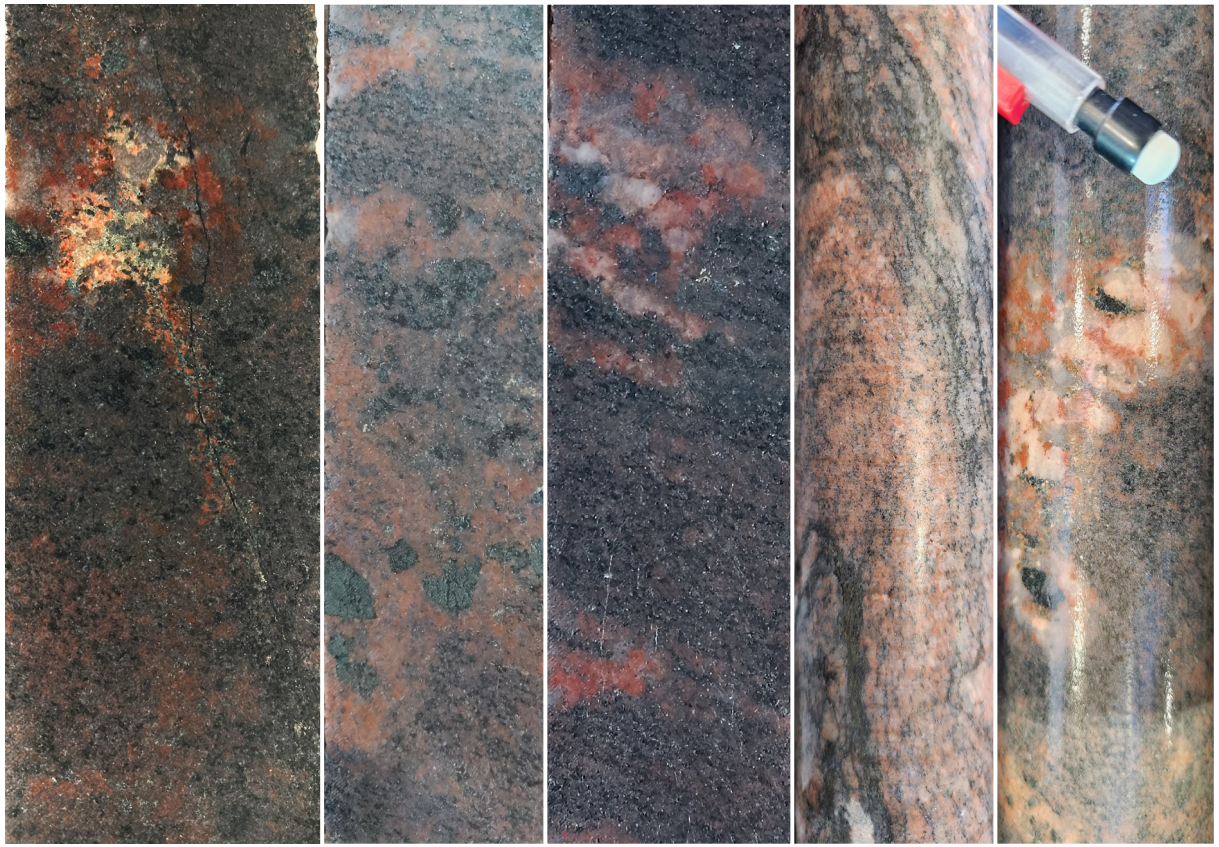
Cartoon cross section of the Nawa Domain and Mabel Creek Ridge ca. 1750–1740 Ma showing the potential basin and structural architecture of the Northern Gawler Craton, modified from Dorobek (2008): https://doi.org/10.2110/pec.08.89.0057

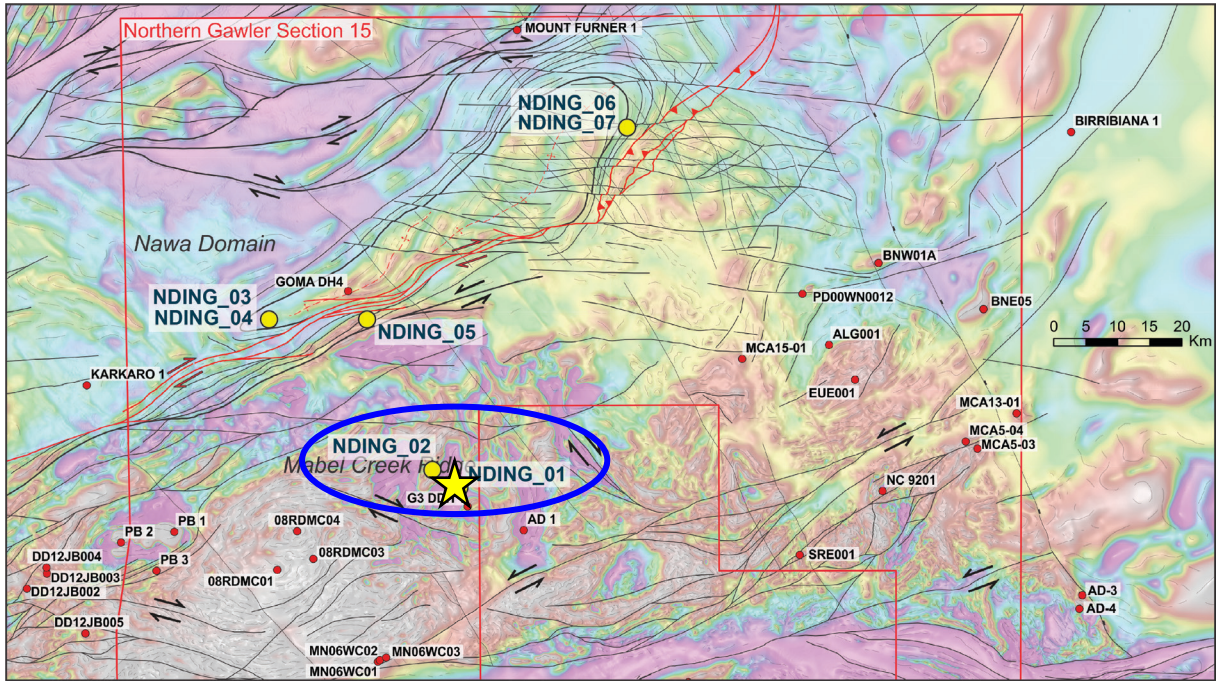

Northern Gawler Section 15
Preliminary structural interpretation for the Northern Gawler Craton compiled by Jack Percival
MOUNT FURNER 1
NDING_06
NDING_07 *
BIRRIBIANA 1
Nawa Domain
BNW01A
GOMA DH4
NDING_03 *
NDING_04
NDING_05
PD00WN0012
BNE05
0 5 10 15 20 Km
ALG001
MCA15-01
KARKARO 1
EUE001
MCA13-01
MCA5-04
MCA5-03
NDING_02
Mabel Creek Ridge
NDING_01
NC 9201
G3 DDH 1
AD 1
PB 1
PB 2
08RDMC04
08RDMC03
PB 3
DD12JB004
DD12JB003
DD12JB002
08RDMC01
SRE001
AD-3
AD-4
DD12JB005
MN06WC02
MN06WC03
MN06WC01
* NDING_03 abandoned at 266 m; NDING_07 demonstration hole to 53.70 m.

MABEL CREEK RIDGE

NDING_01 and NDING_02 drilled to investigate inversely magnetised and strongly magnetised basement rocks, respectively.

NDING_01:
Basement intersection 330 m; EOH: 352.95 m
Bi-K-feld-Qtz-Mag orthogneiss (OTGN)
Magmatic crystallisation age: 1720.2 ± 5.3 Ma

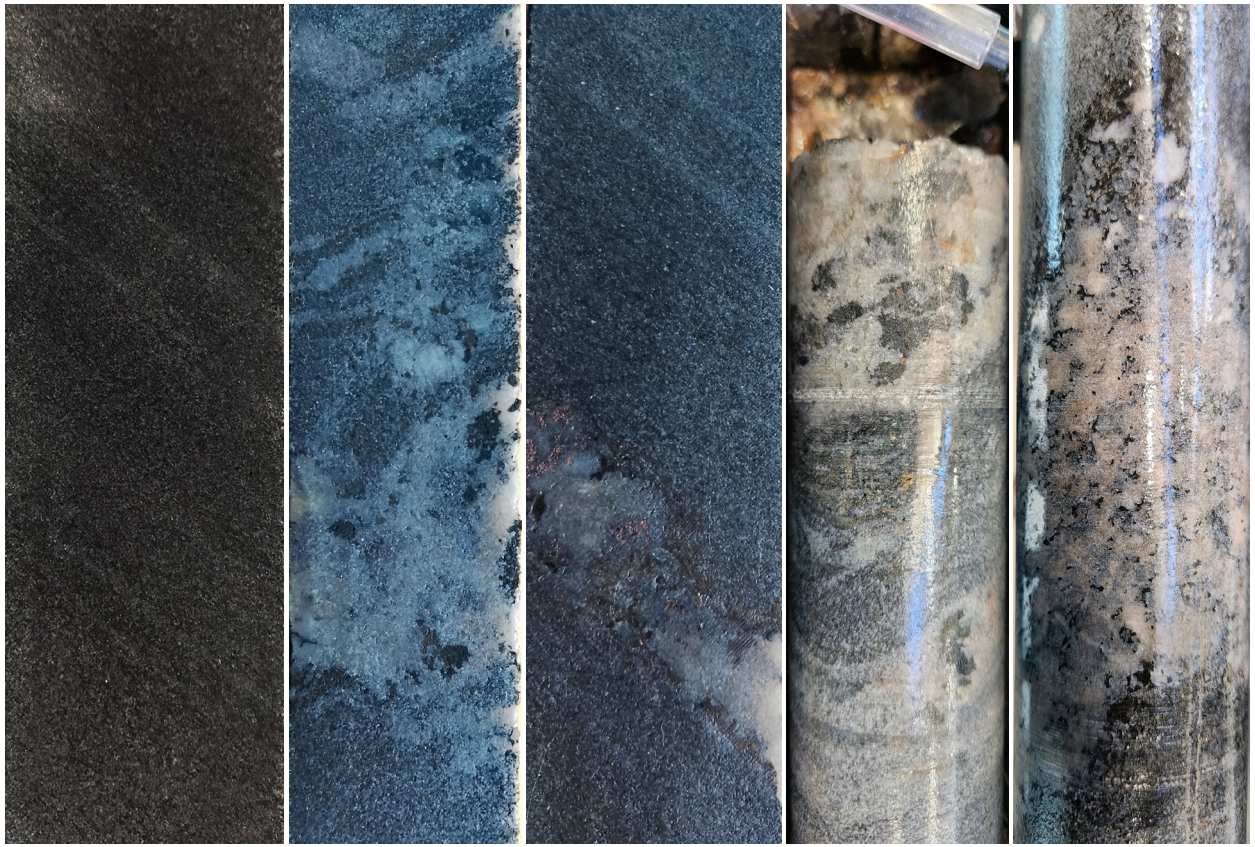


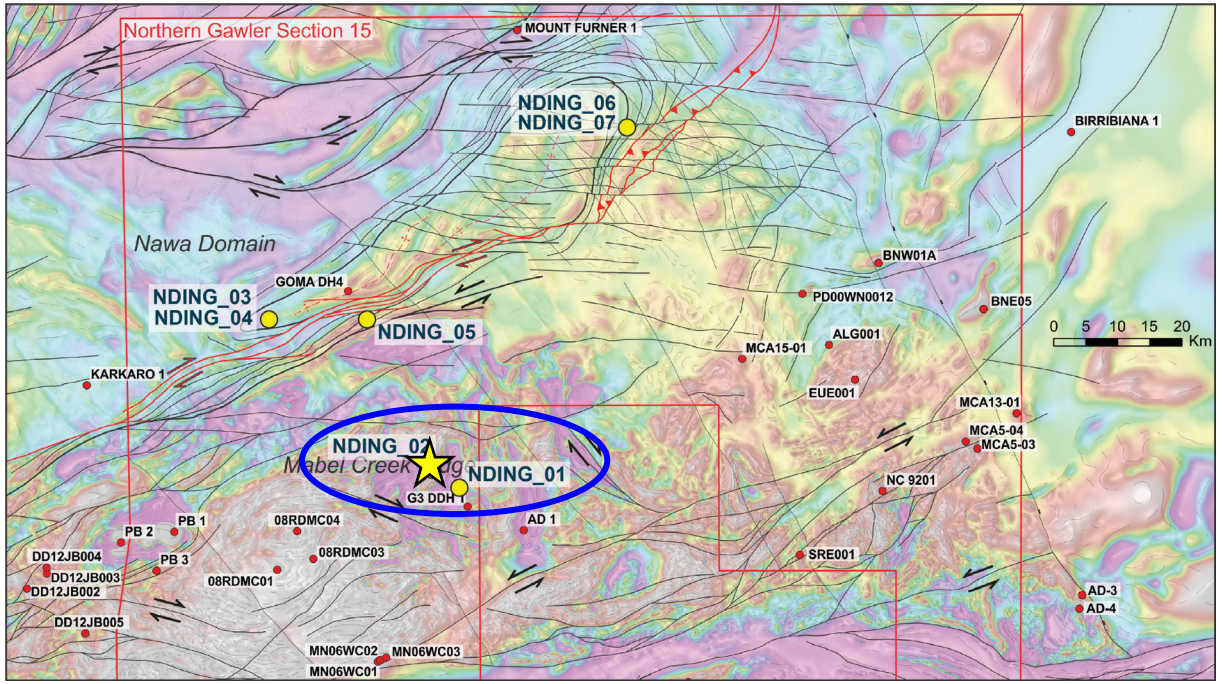


MABEL CREEK RIDGE

NDING_01 and NDING_02 drilled to investigate inversely magnetised and strongly magnetised basement rocks, respectively.

NDING_02:
Basement intersection 303 m; EOH: 313.10 m
Migmatitic Gnt-Mag-bearing Qtz-K-feld-Amph-Bi OTGN
Magmatic crystallisation age: 1723.6 ± 4.2 Ma

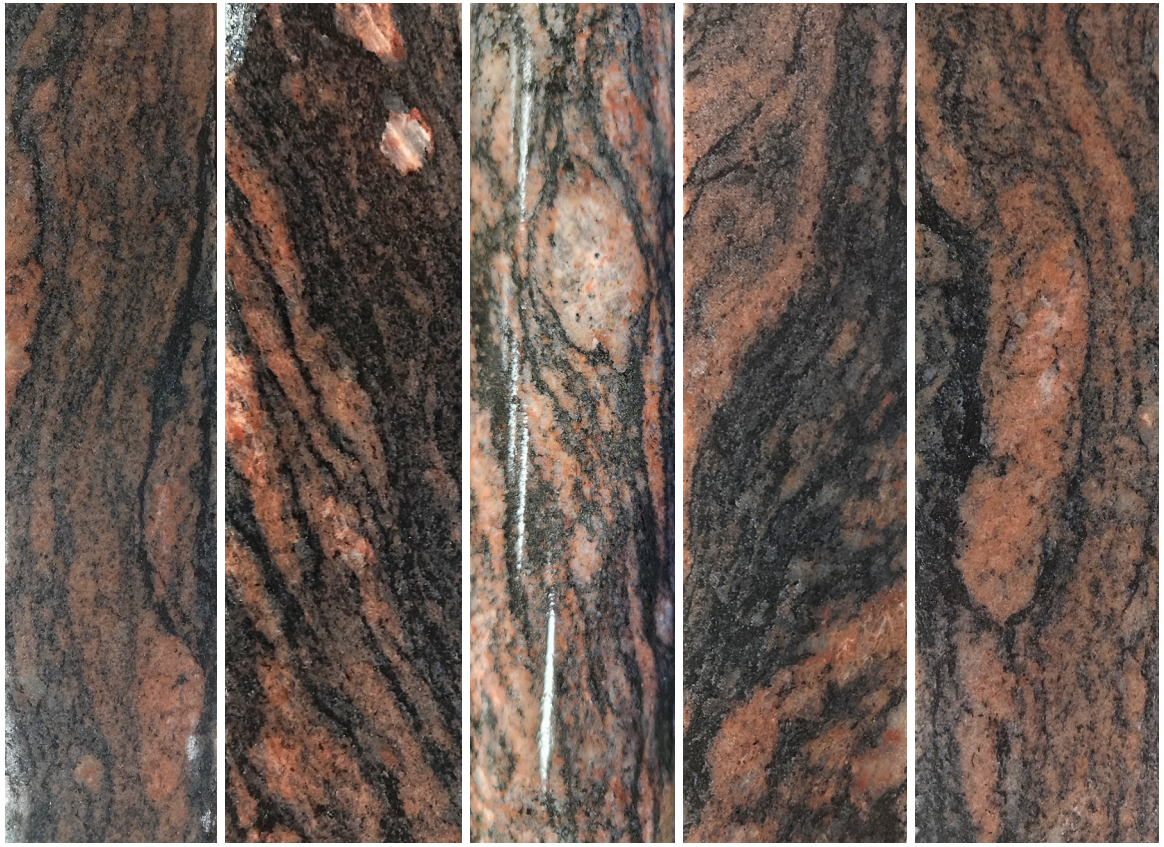


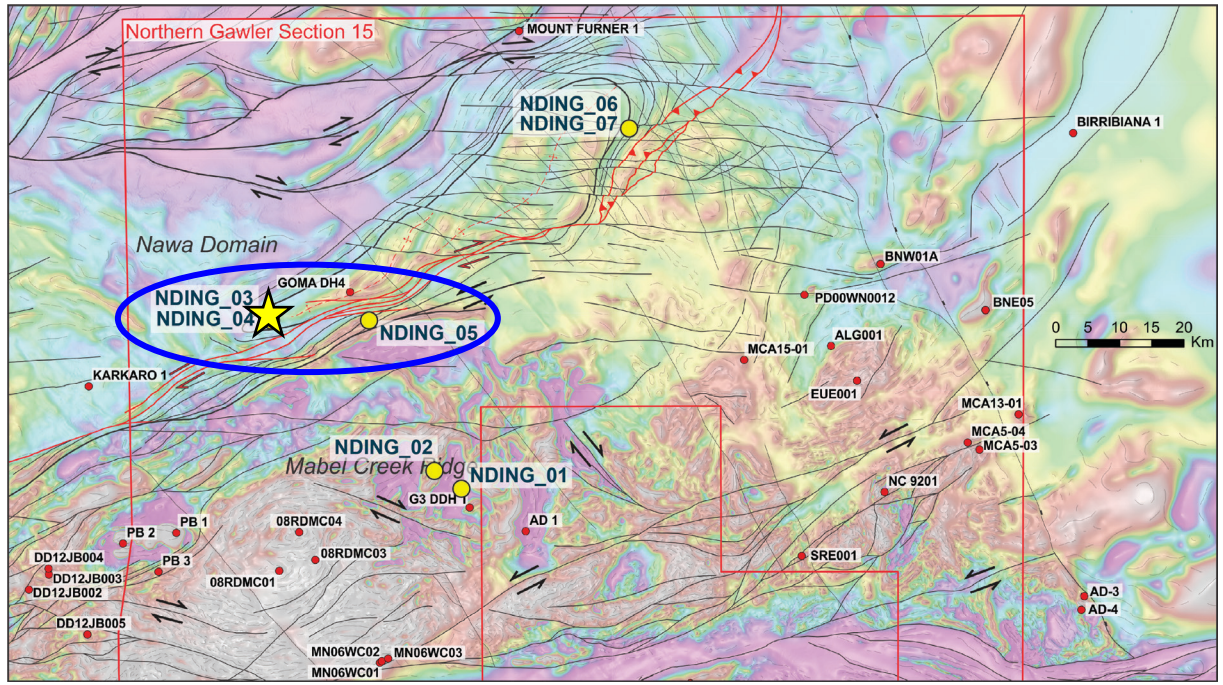


NAWA DOMAIN (SOUTHWEST)

NDING_04 and NDING_05 drilled to help constrain extent of Archean basement and timing of deformation and metamorphism (e.g. 1570 Ma and/or 1520 Ma)

NDING_04:
Basement intersection 437 m; EOH: 482.95 m
Migmatitic Gnt-Mag-bearing Qtz-K-feld-Bi OTGN
Magmatic crystallisation age: 1730.8 ± 5.5 Ma





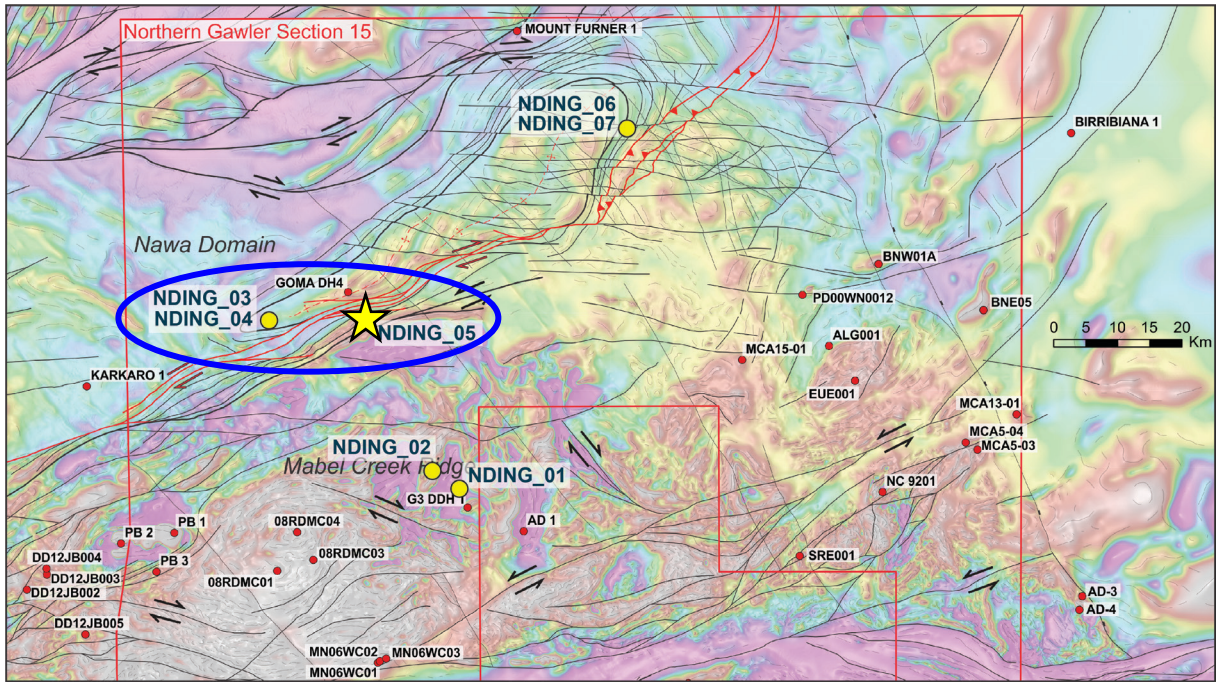
Permian diamictite core, Arckaringa Basin at 406-409 m with basement clasts

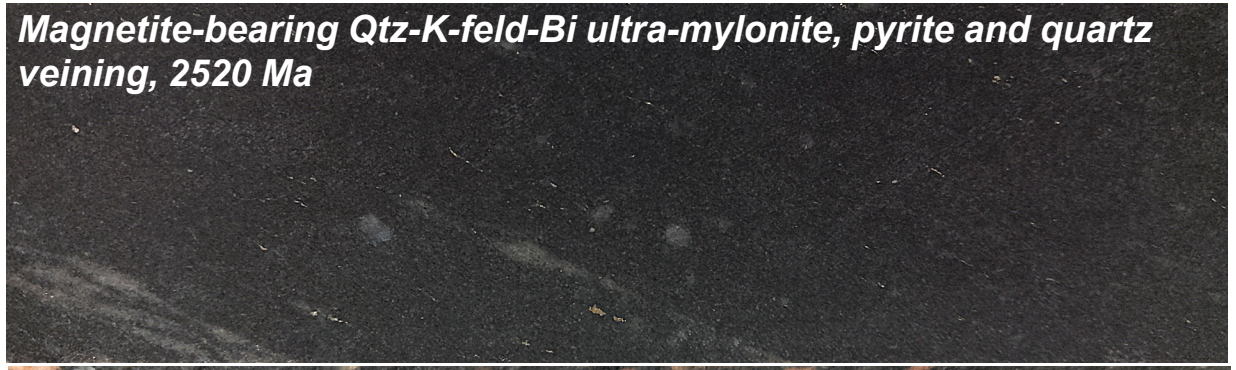
NAWA DOMAIN (SOUTHWEST)

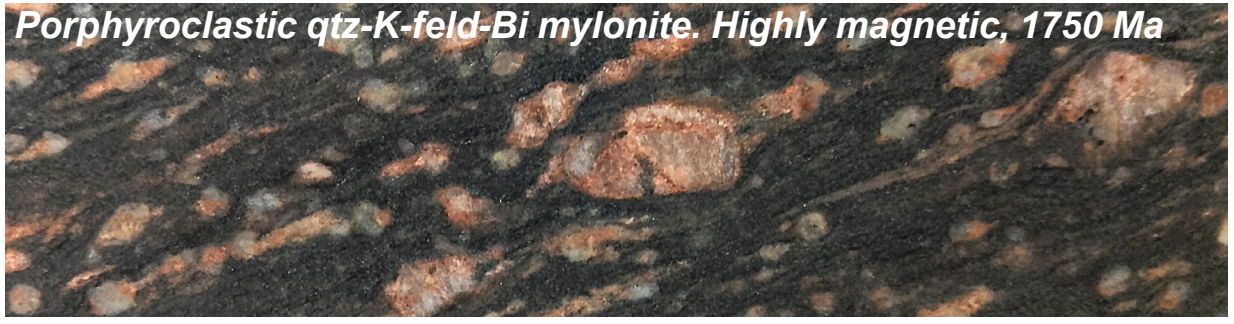
NDING_04 and NDING_05 drilled to help constrain extent of Archean basement and timing of deformation and metamorphism (e.g. 1570 Ma and/or 1520 Ma)

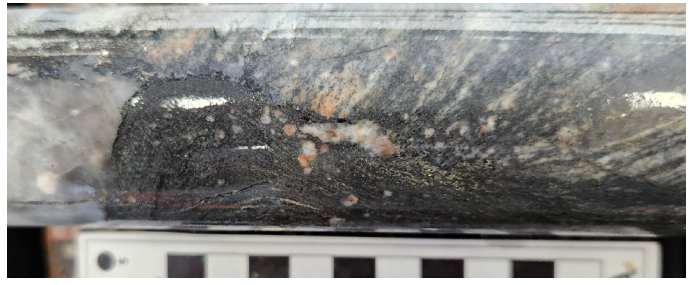
NDING_05:
Basement intersection 378 m; EOH: 402.05 m
Magnetite-bearing Qtz-K-feld-Bi ultra-mylonite,
Maximum depositional age: ca. 2520 Ma

Highly magnetic, porphyroclastic qtz-K-feld-Bi mylonite.
Magmatic crystallisation age: 1751.4 ± 3.6 Ma





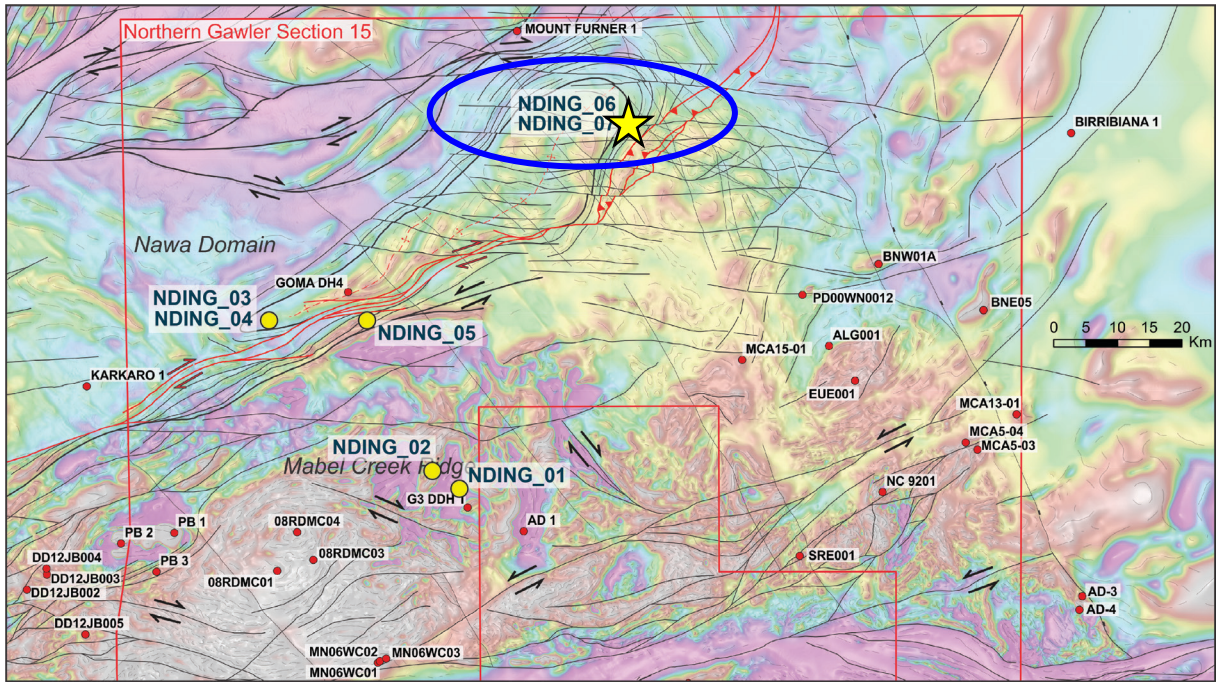


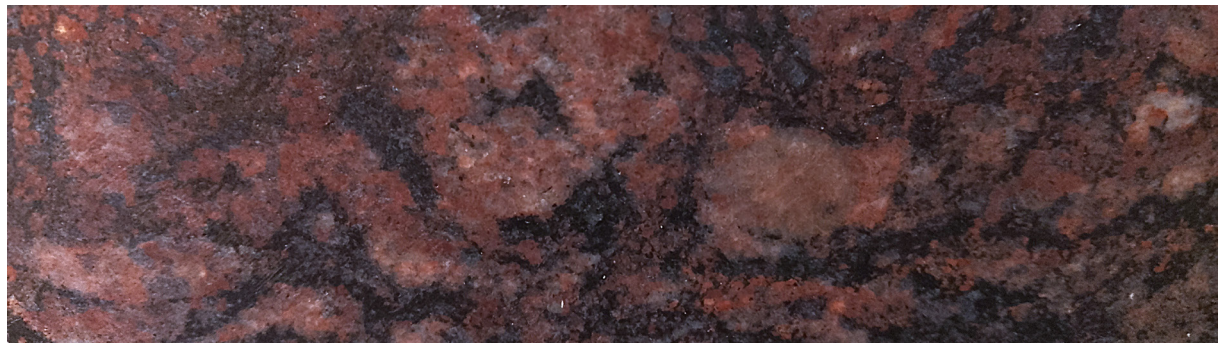


MABEL CREEK RIDGE

NDING_06 drilled to investigate linear magnetic feature between two ovoid regions (granites?)

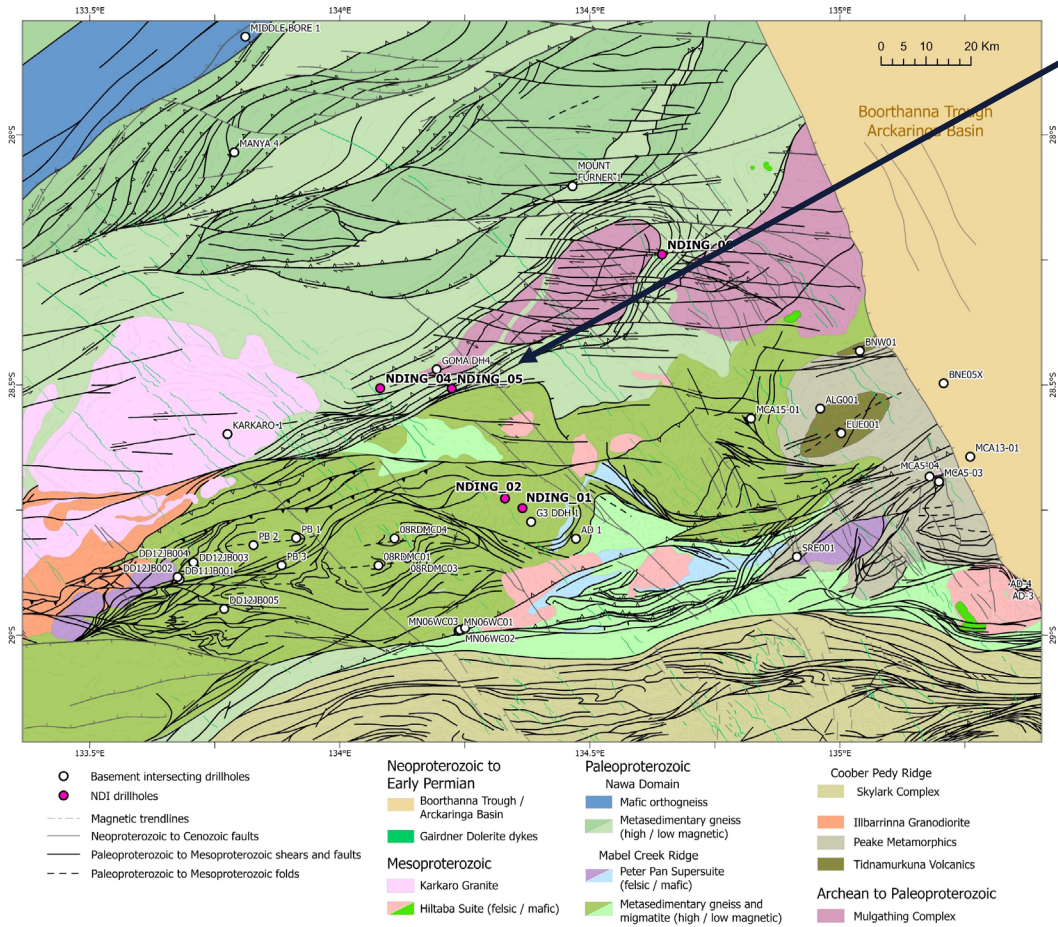
NDING_06:
Basement intersection 405 m, EOH: 438.4 m
Migmatitic Qtz-K-feld-Bi gneiss, with pervasive secondary chlorite, hematite, and sulphides
Magmatic crystallisation age : 1730.1 ± 4.4 Ma

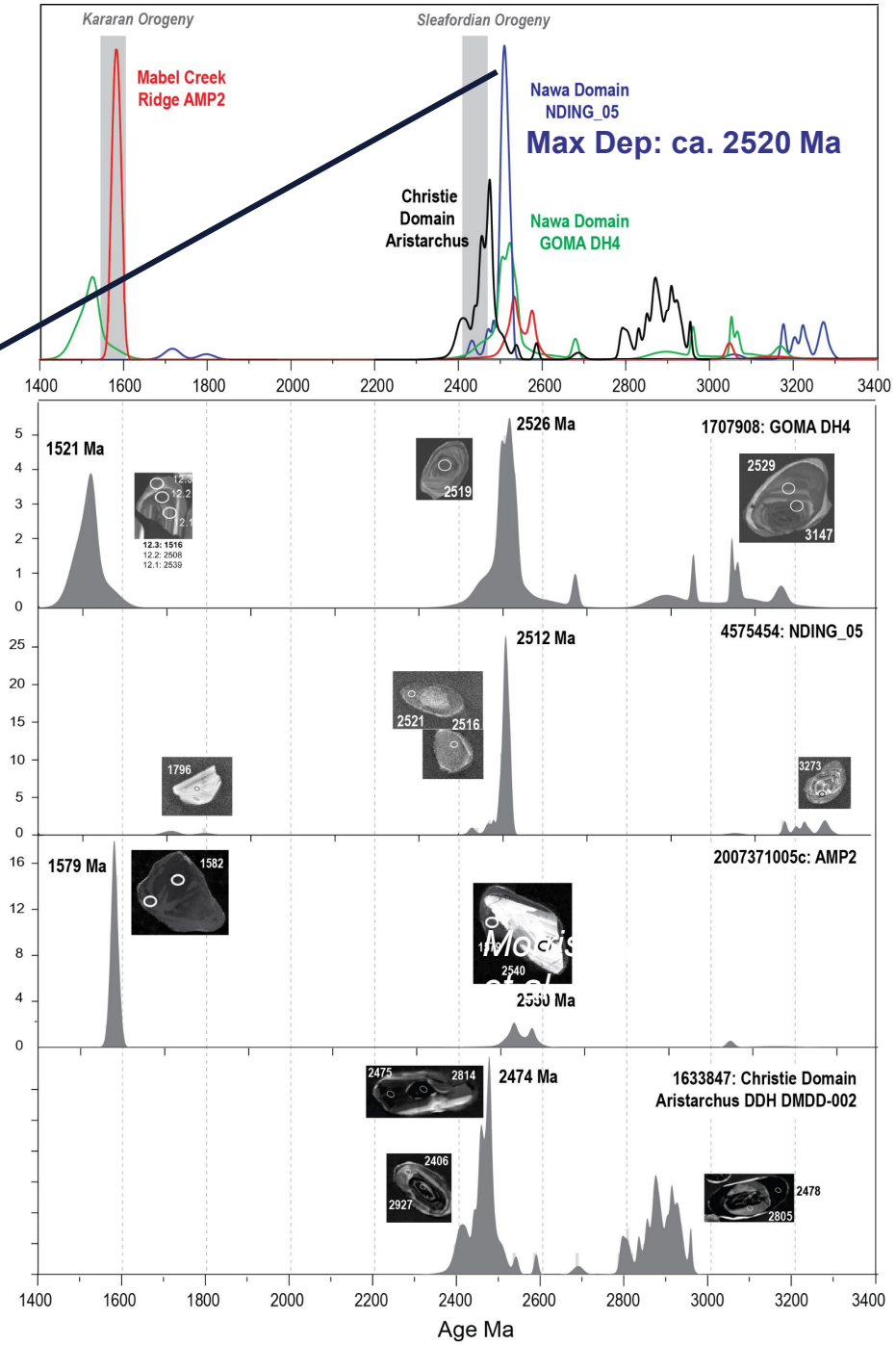




Terrane Correlations - deposition

Ca. 2520 Ma depositional age from NDING_05 confirms “Archean Gawler Craton basement” in Northern Gawler Craton. Implications for depositional history, provenance and crustal architecture.



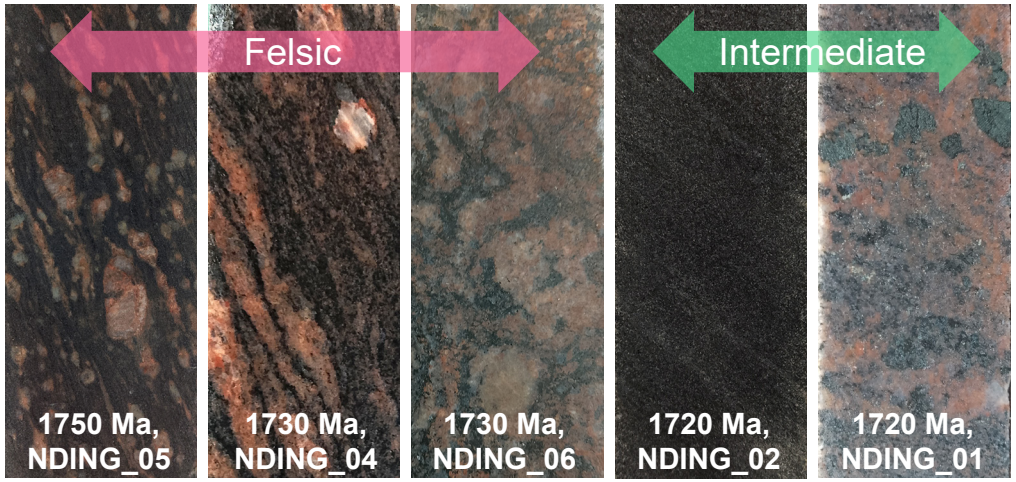


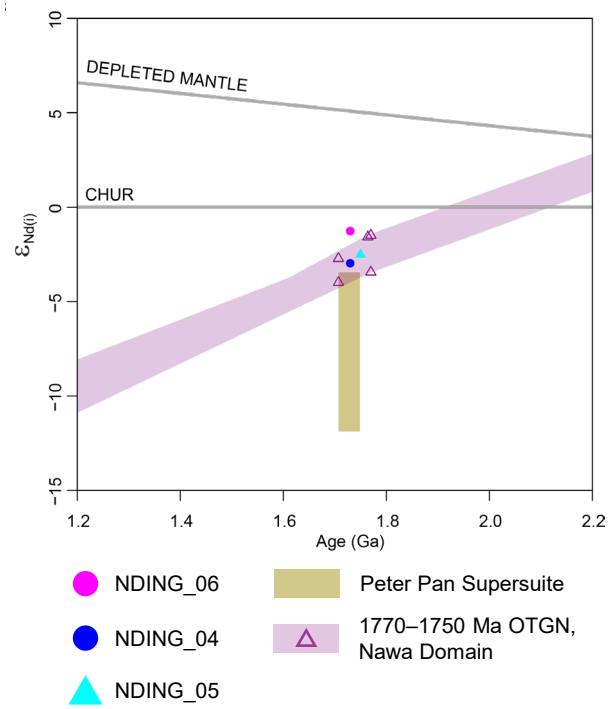
Terrane correlations - magmatism

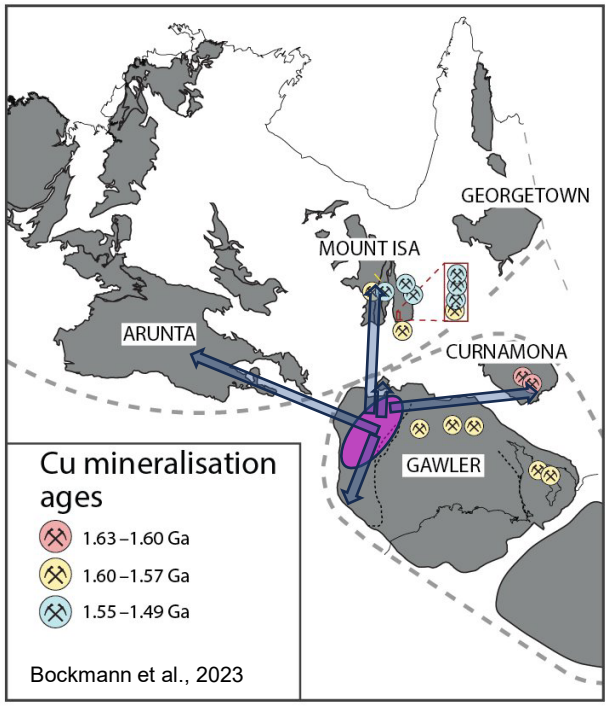
1750 Ma magmatism identified to have geochemical and isotopic affinity to 1770–1750 Ma magmatism in SW Nawa Domain (Howard et al., 2011).

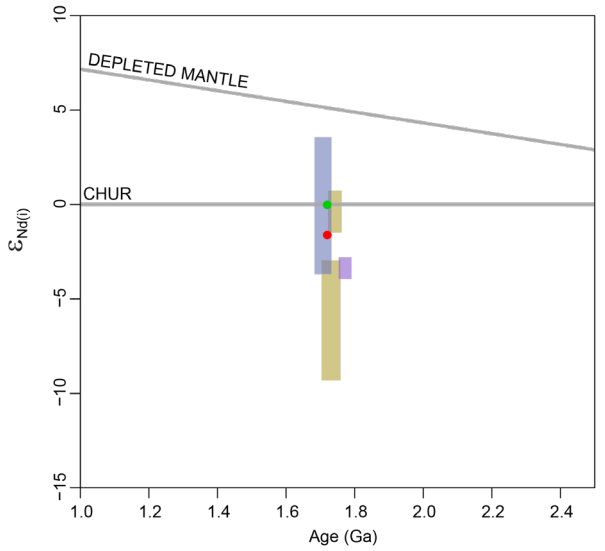
Bimodal 1730–1720 Ma magmatism has juvenile crust and mantle sources, affinity with Willyama Supergroup/Mt Isa Eastern Succession?

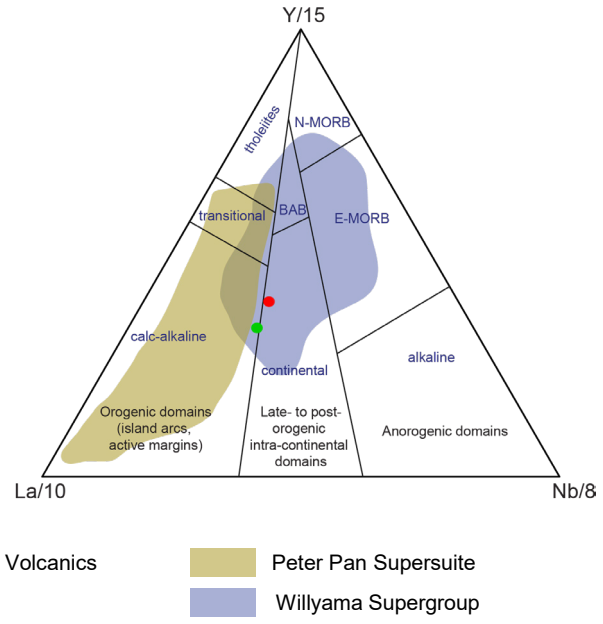
Implications for the tectonic setting, mineral potential and internal architecture of the Nawa Domain.









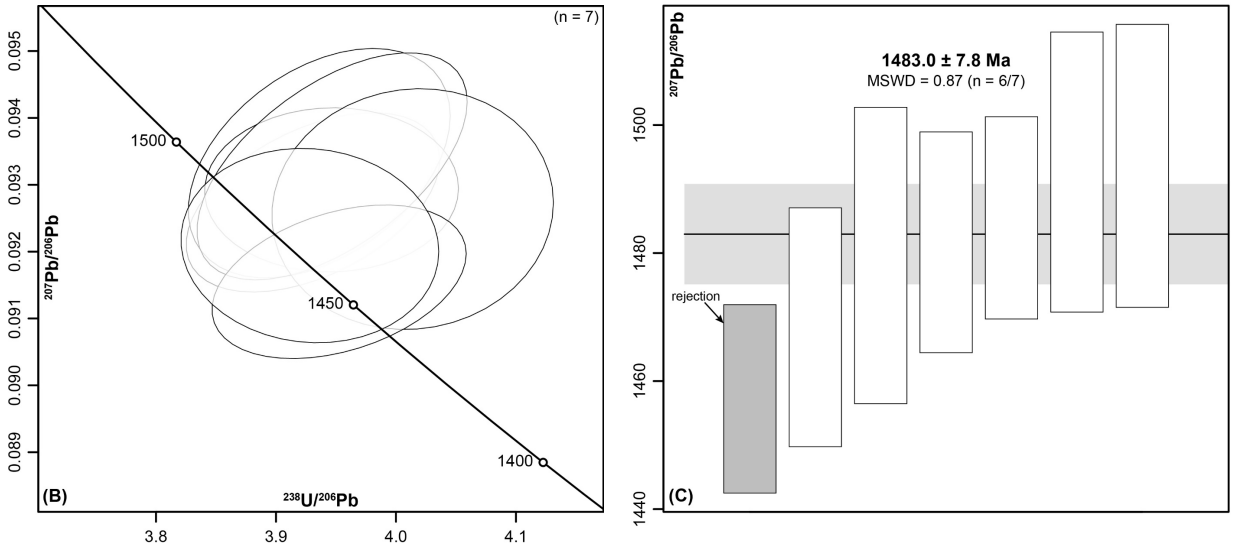


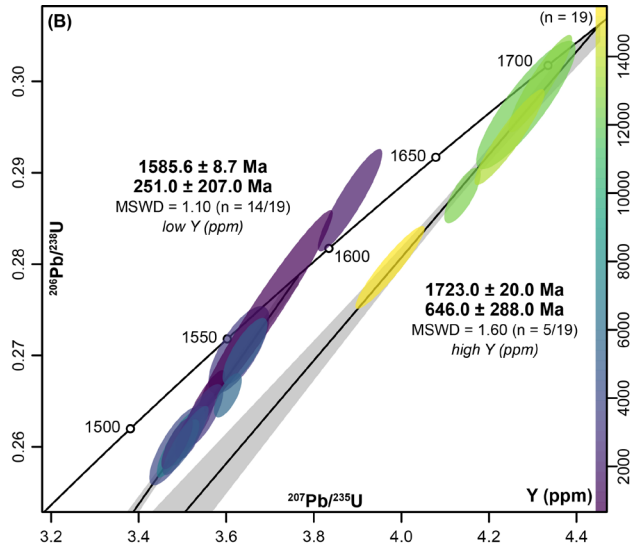
Terrane correlations - metamorphism

NDI samples will help unravel Palaeoproterozoic to Mesoproterozoic metamorphism, with implications for the structural architecture and structure reactivation of the Northern Gawler Craton.

Mylonite, NDING_05, Nawa Domain

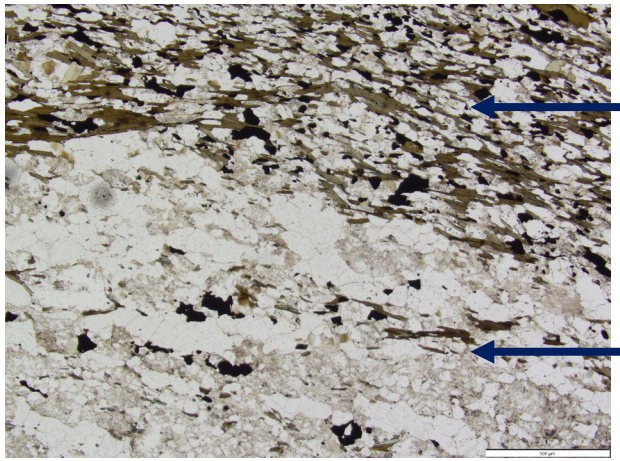
Shear zone reactivation at ca. 1480 Ma

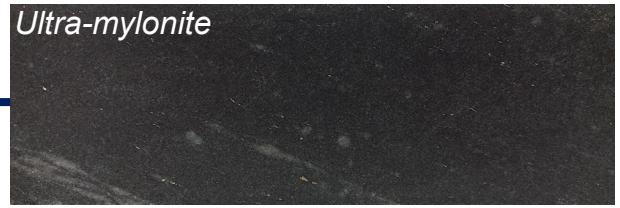


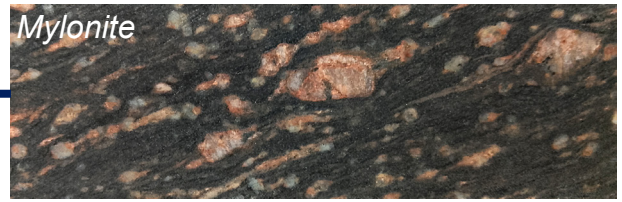


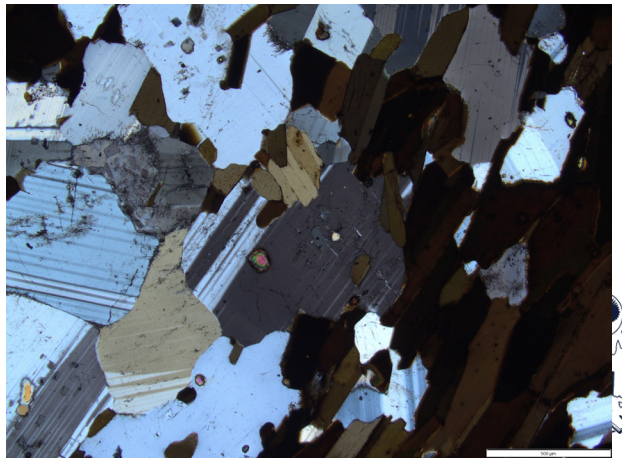
Amphibole-biotite gneiss, NDING_02, Mabel Creek Ridge

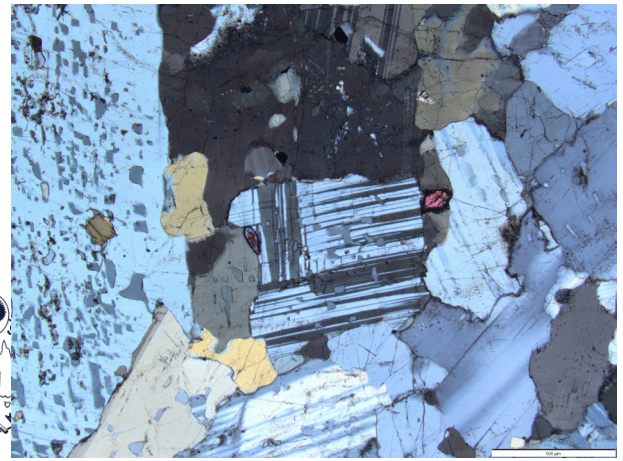
Partial melting during Kimban? Recrystallisation during Olarian/Kararan?











Wrapping up the Northern Gawler

- Completed data collection for NDI samples – currently undergoing interpretation and synthesis
- Exploring tectonic implications:
  - *Boundary between Peake and Denison Inliers and Nawa Domain/ Mable Creek Ridge*
  - *Evidence for Palaeoproterozoic (back arc) basin across SA and North Australian Craton → implications for base metal and Cu-Au prospectivity*
  - *Provide context for younger histories, particularly post-1590 Ma events with Peake and Denison Inliers and Mt Isa → implications for Cu-Au prospectivity*
- Data and report released end of 2025 to early 2026
- Northern Gawler NDI Workshop 9th December

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Acknowledgement of Country

As guests here on Kaurna land, the Department for Energy and Mining (DEM) acknowledges everything this department does impacts on Aboriginal country, the sea, the sky, its people, and the spiritual and cultural connections which have existed since the first sunrise. Our responsibility is to share our collective knowledge, recognise a difficult history, respect the relationships made over time, and create a stronger future. We are ready to walk, learn and work together.