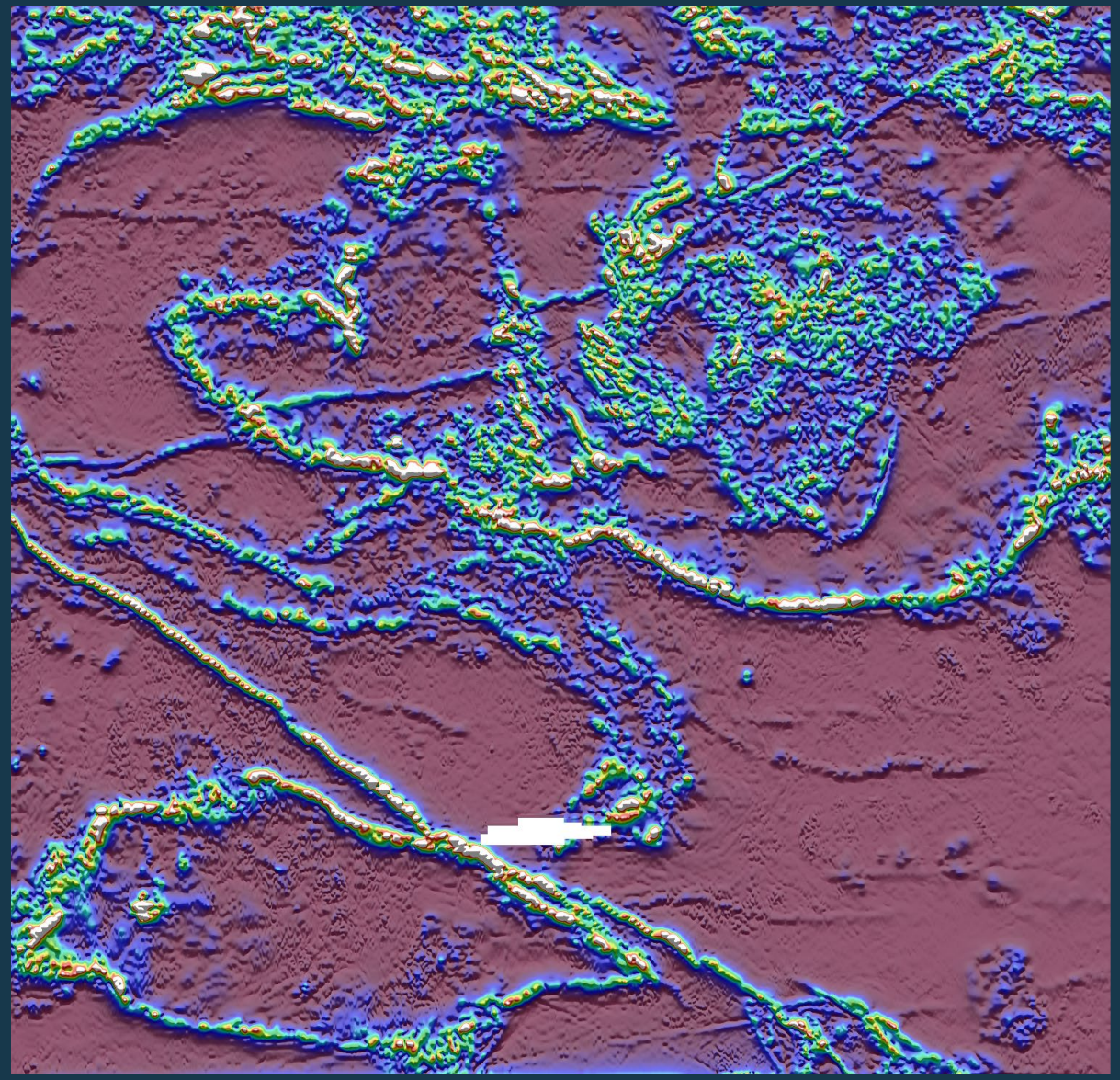


STRUCTURAL MAPPING AND URANIUM TARGETING FROM AIRBORNE GEOPHYSICAL DATA

NABARLEK REGION, PINE CREEK OROGEN

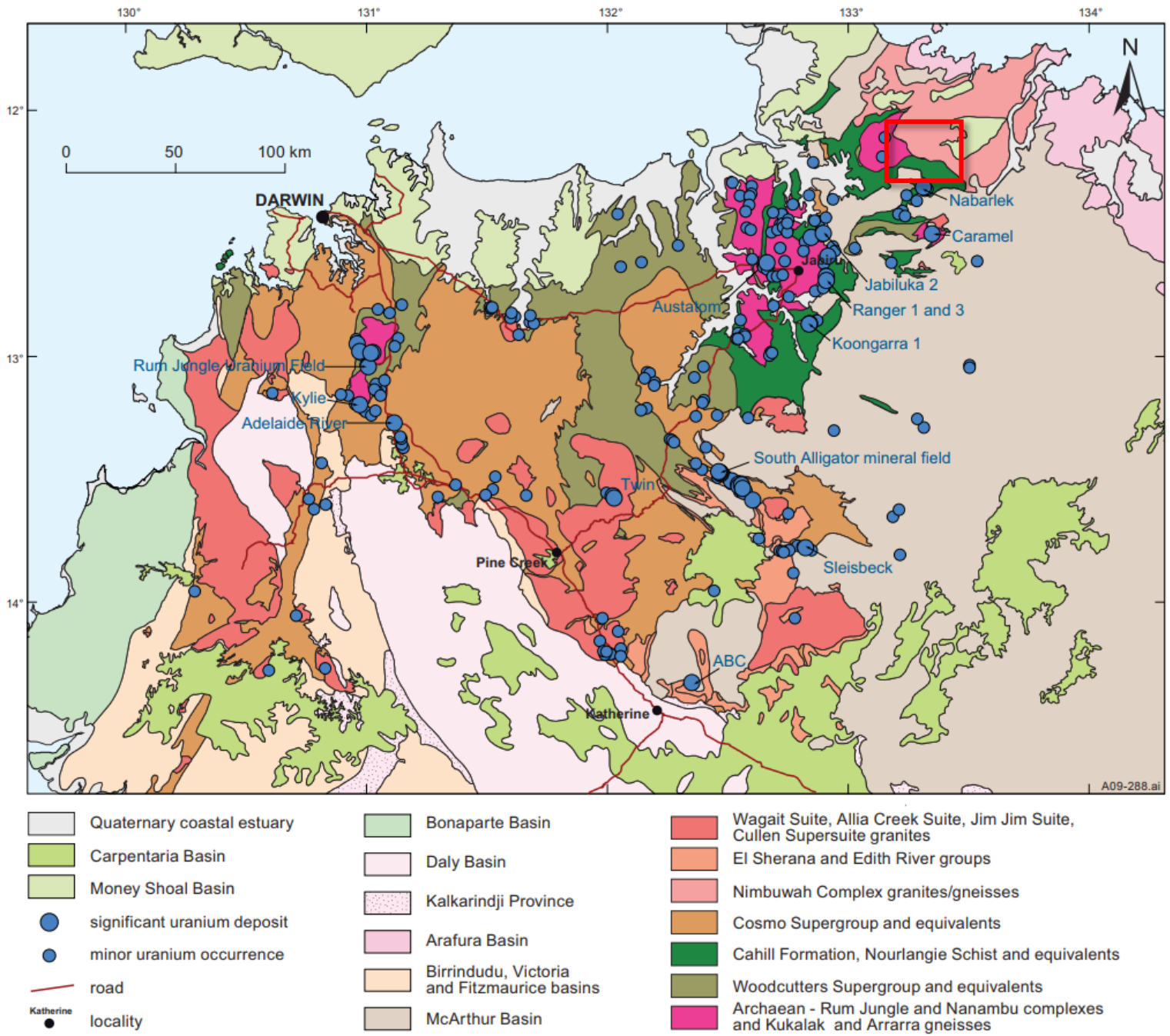
Dr Teagan Blaikie, SGC

Acknowledgements Rob Lightfoot & Alligator Energy

SOUTHERN GEOSCIENCE

Nabarlek North Project, Alligator River

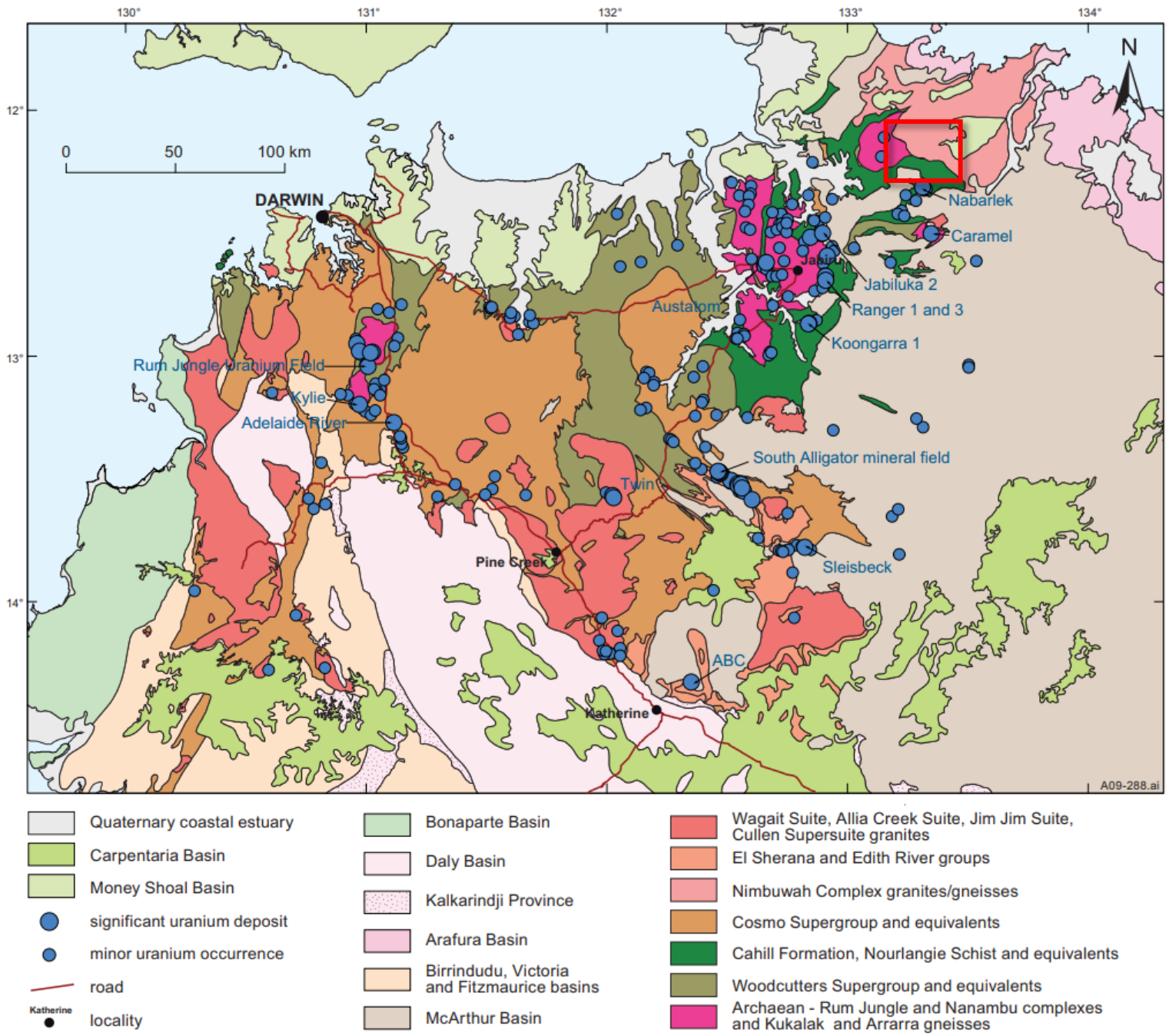
- Located in the highly prospective and under-explored Alligator River Uranium Province (ARUP).
- Features an exhumed Proterozoic unconformity prospective for mineralization, however cover sediments have obscured radiometric signatures, limiting past exploration efforts.
- Historical geological data has been inconclusive regarding bedrock composition - it has commonly been assumed to be Nimbuwah Complex granites and gneisses with low potential for mineralisation.
- In 2024 Alligator Energy commissioned a 100 m line spaced MAG/RAD survey across the project
- A 1:50,000 scale structural interpretation and targeting project was completed based on the new data
- Work was co-funded by the NTGS Geophysics and Drilling Collaborations (GDC) program



Pine Creek Orogen. Geology of the NT Ch 5, NTGS

Regional Geology

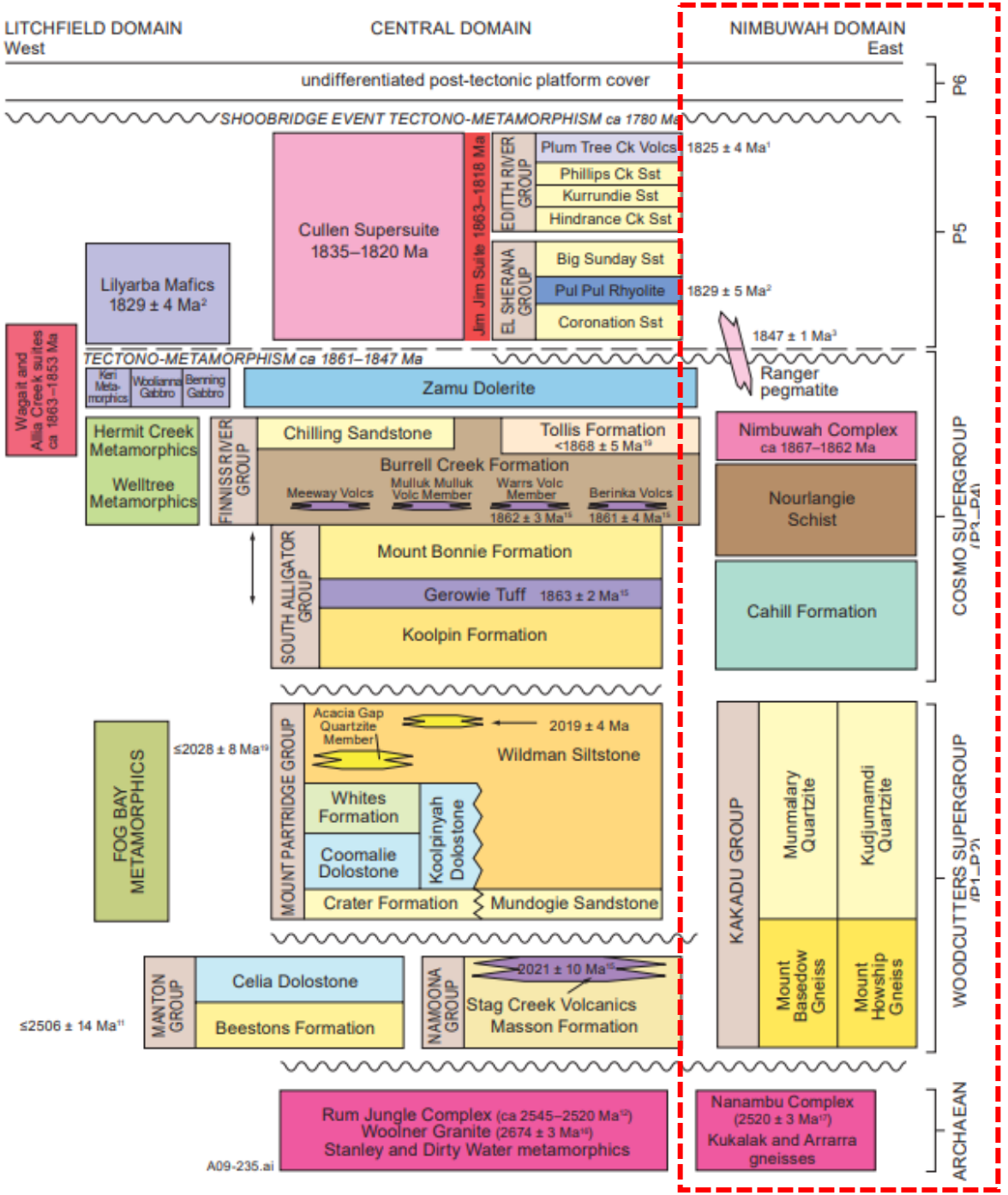
- The Nabarlek North project area is located near the eastern margin of the Neoarchean and Paleoproterozoic Pine Creek Orogen
- The oldest rocks are the Archean gneisses of the Nanambu Complex.
- These are unconformably overlain by rocks of the Pine Creek Geosyncline, which are in turn overlain by the sedimentary and volcanic rocks of the Cahill Formation and Nourlangie Schist.
- The area experienced moderate to high-grade metamorphism and deformation and emplacement of I-type monzogranitic plutons of the Nimbuwah complex
- This was followed by a significant period of uplift and erosion and was then unconformably overlain by the sediments of the Kombolgie subgroup.
- The entire sequence was then intruded by the Oenpelli Dolerite, which often forms strongly magnetic and highly remanent dykes, sills, laccoliths and lopoliths.



Pine Creek Orogen. Geology of the NT Ch 5, NTGS

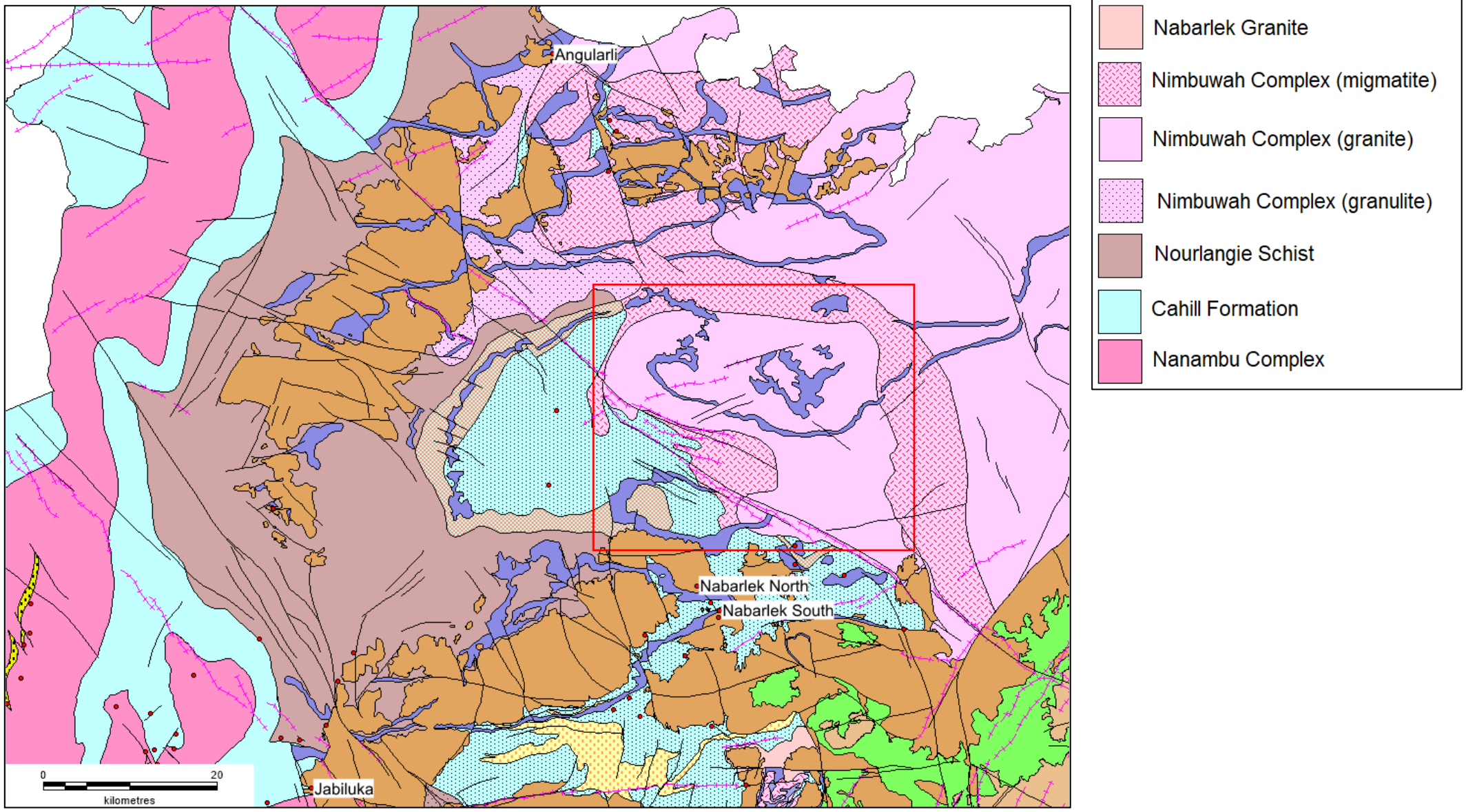
Nabarlek North Project

- The geology of the Nabarlek North project area is comprised of:
  - Archean gneisses of the Nanambu Complex
  - I-type monzogranitic plutons of the Nimbuwah complex.
- These are unconformably overlain by the fluvial sediments of the Kombolgie Subgroup
- The entire sequence was then intruded by the Oenpelli Dolerite, which often forms strongly magnetic and highly remanent dykes, sills, laccoliths and lopoliths.
- **Question** – is the Cahill Formation present in the project area?



Pine Creek Orogen. Geology of the NT Ch 5, NTGS

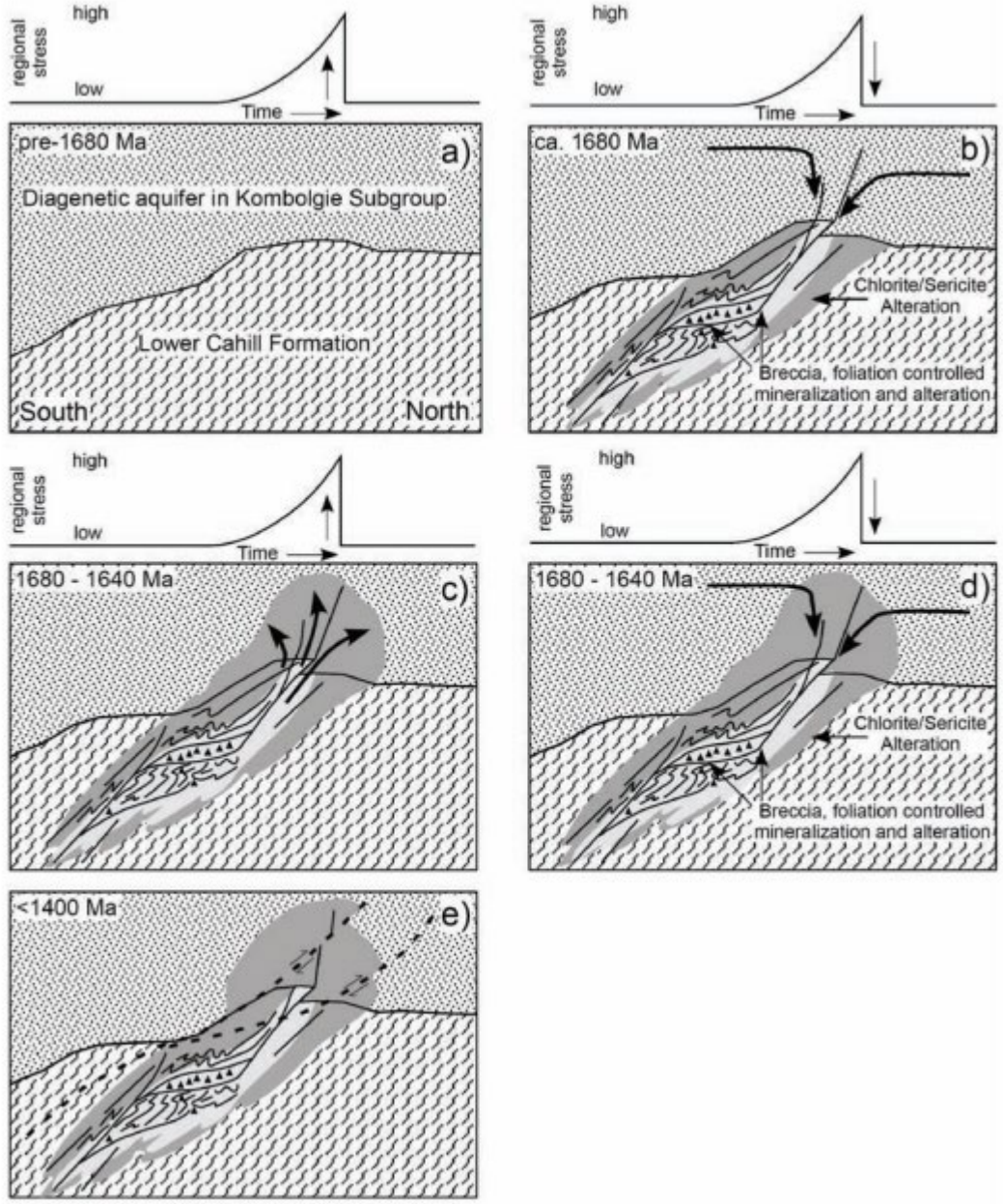
Nabarlek North Project



NTGS – Pine Ck 1:500 K interpreted geology

Uranium Mineralisation

- Uranium mineralisation is typically associated with the unconformably contacts between
  - Archean basement-Cahill Formation
  - Cahill Formation-Kombolgie Subgroup.
- Mineralising fluids are derived from the overlying sedimentary basin and descended from the Kombolgie Subgroup into the basement along faults and fractures
- Fluids interacted with reducing lithologies in the basement, resulting in the precipitation of uranium-bearing minerals.
- Mineralisation is generally structurally controlled
  - Thrust, steep reverse or oblique strike-slip faults make prime exploration targets.

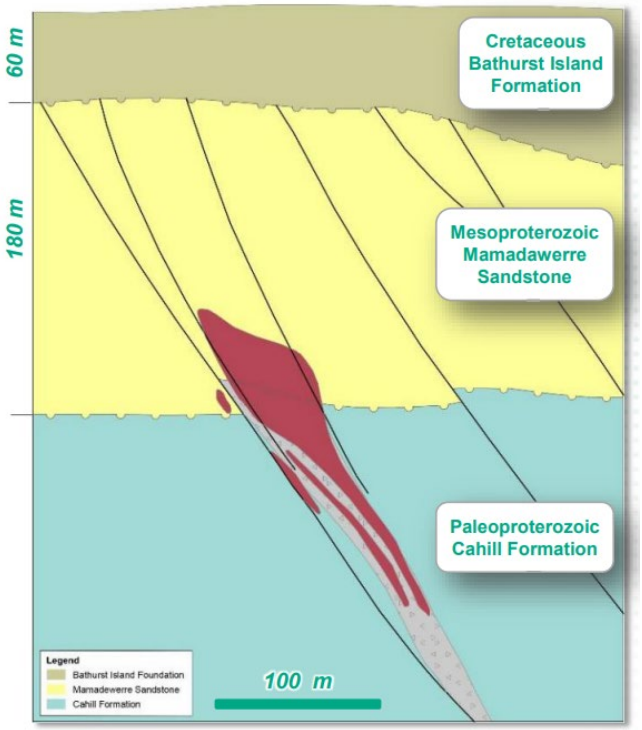


Hollis and Wygralak (2012), after Polito et al., (2005)

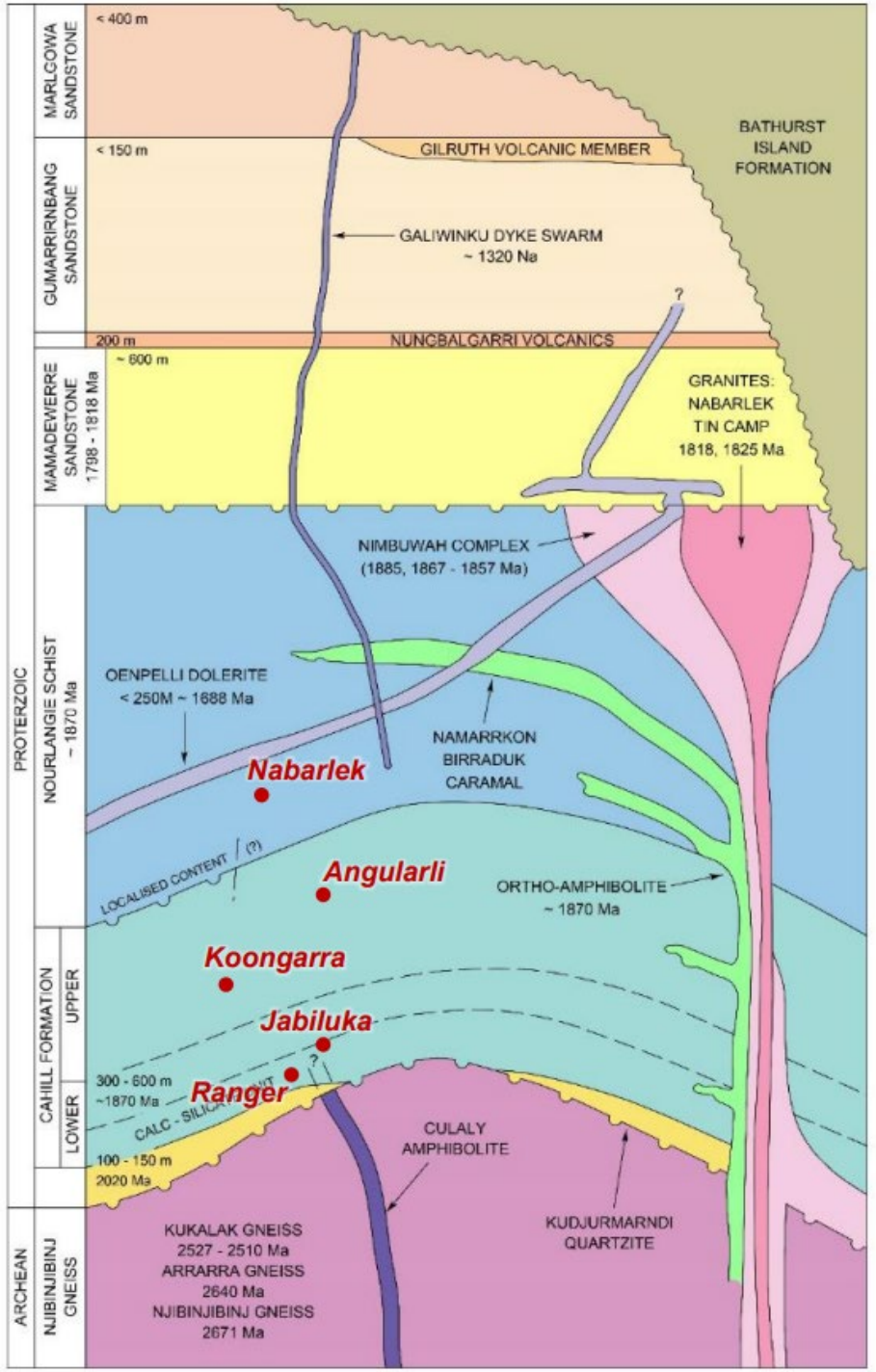
Uranium Mineralisation

Known deposits in the area:

- **Ranger** – broadly stratabound, hosted in the Cahill Formation close to the contact with the Nanambu Complex
- **Angularli** - unconformity related deposit, Cahill Formation unconformably overlain by the Mamadawerre Sandstone. Mineralisation hosted within the Angulari Fault Zone
- **Nabarlek** –hosted within altered metapelitic rocks, possible equivalent of the Nourlangie Schist. The deposit occurred close to the unconformity with the (now eroded) Kombologie Subgroup.
- **Jabiluka** - hosted within the Cahill Formation unconformably overlain by the Mamadewerre Sandstone. Possibly controlled by fracture and breccia zones related to graphitic shears.



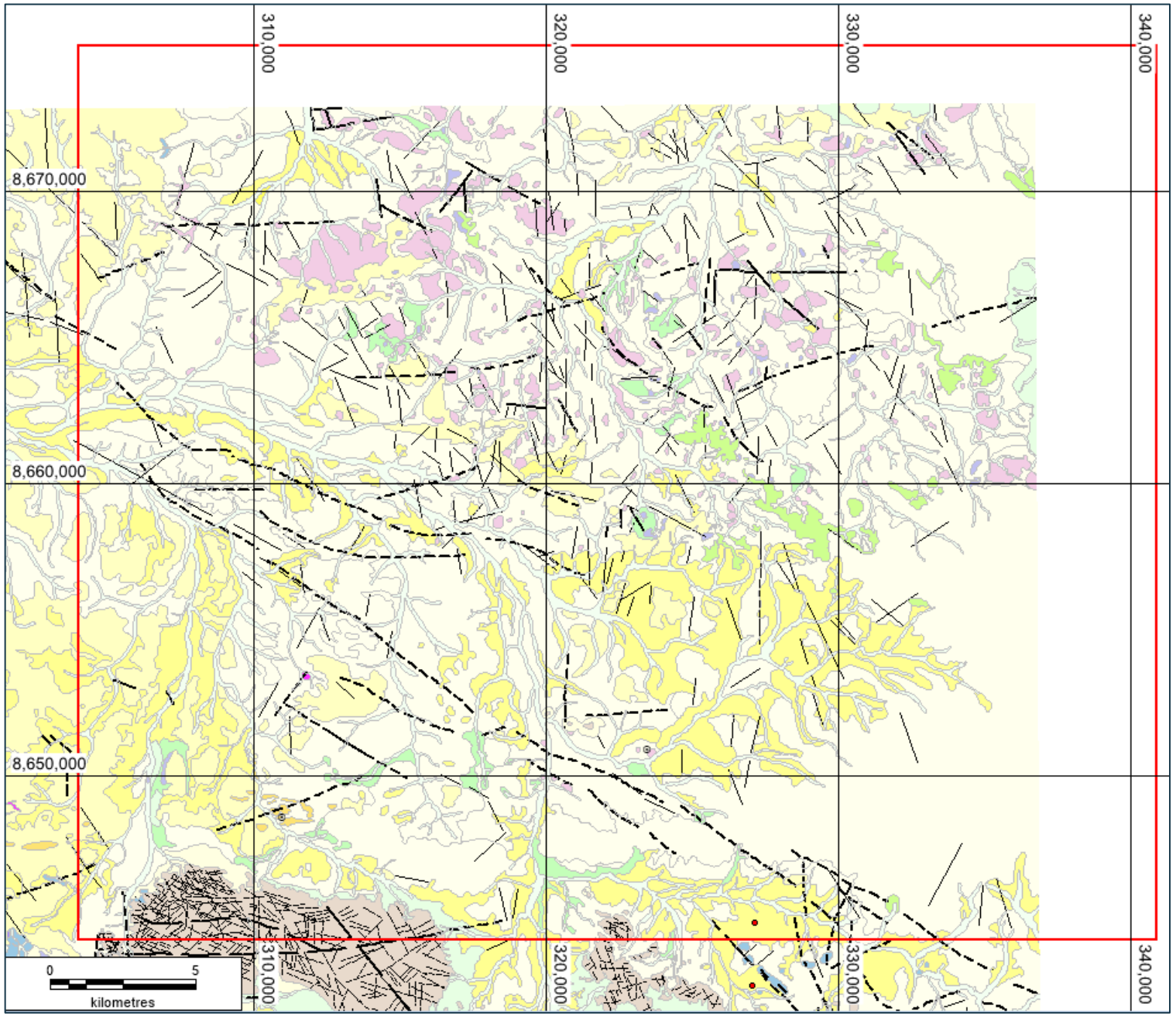
From Sinclair (2019)



Nabarlek North

- Limited outcrop mapped, all mapped as Nimbuwah Formation
- High-quality aeromagnetic data was used to improve resolution of structures within the basement obscured by cover

NTGS – Oenpelli 1:100 K geological map



Mamadawerre Sandstone
sandstone

Oenpelli Dolerite
dolerite

Nimbuwah Complex
monzodiorite

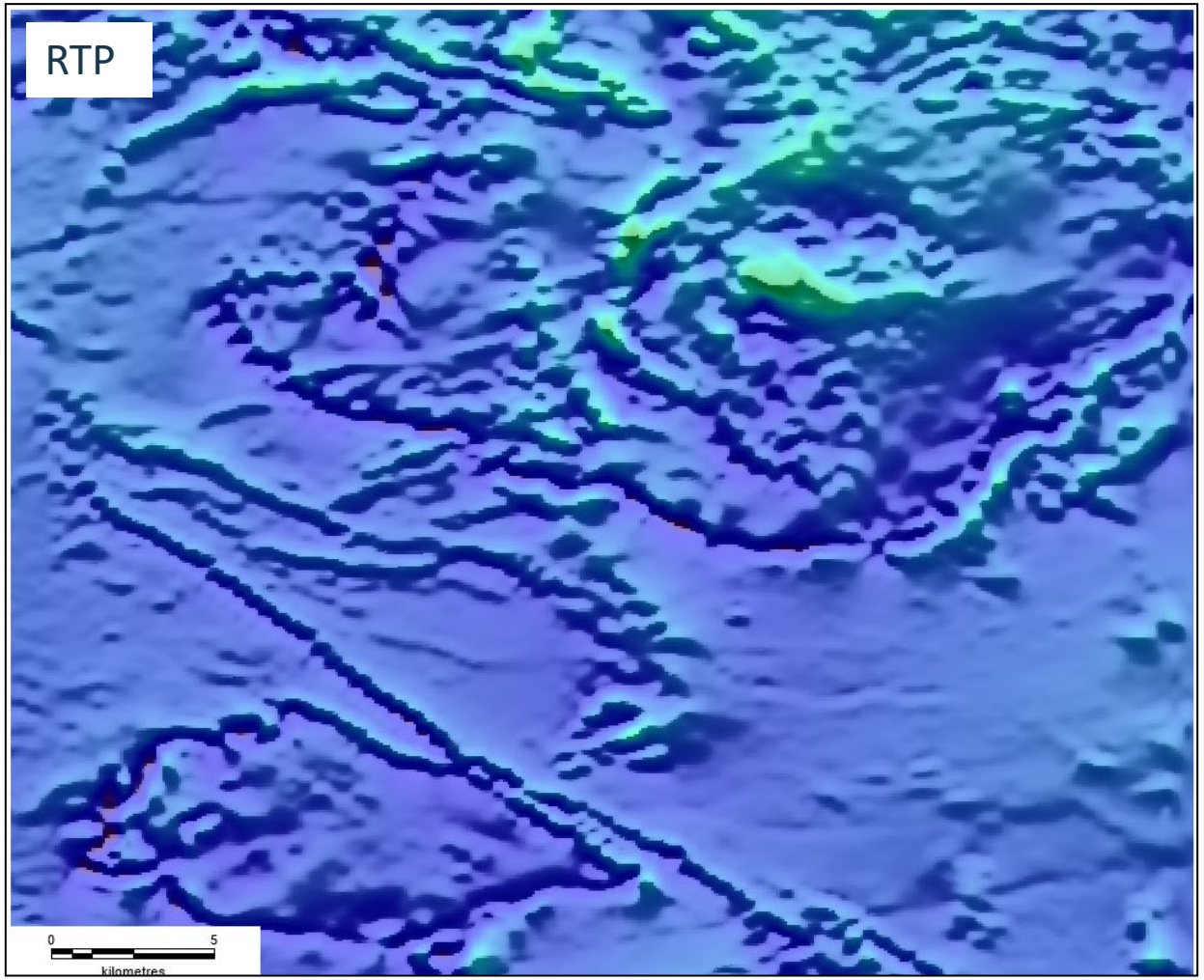
Marligur Member
sandstone

Namarrkor Amphibolite
amphibolite

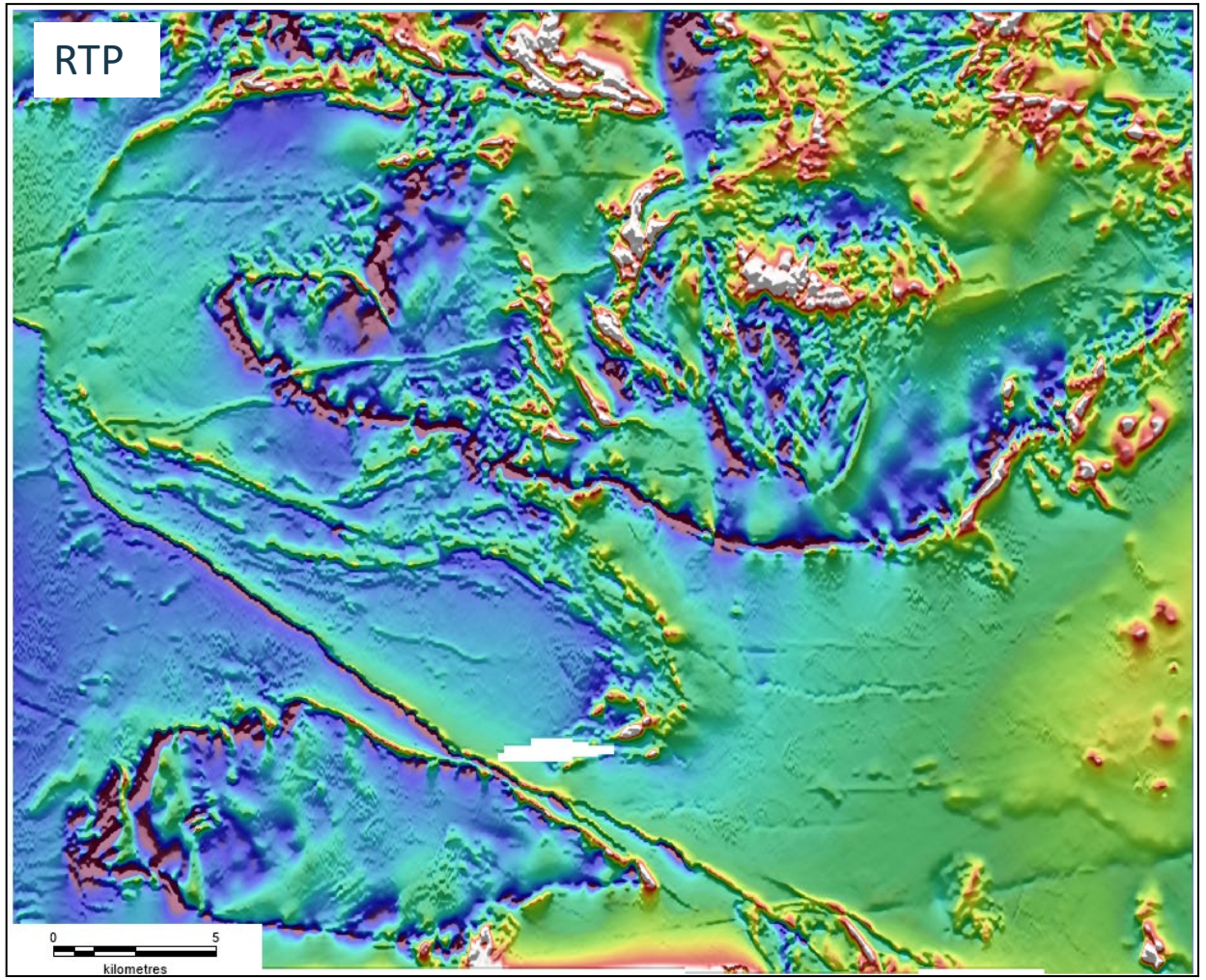
Nourlangie Schist
psammopelite

Kudjumarndi Quartzite
quartzite

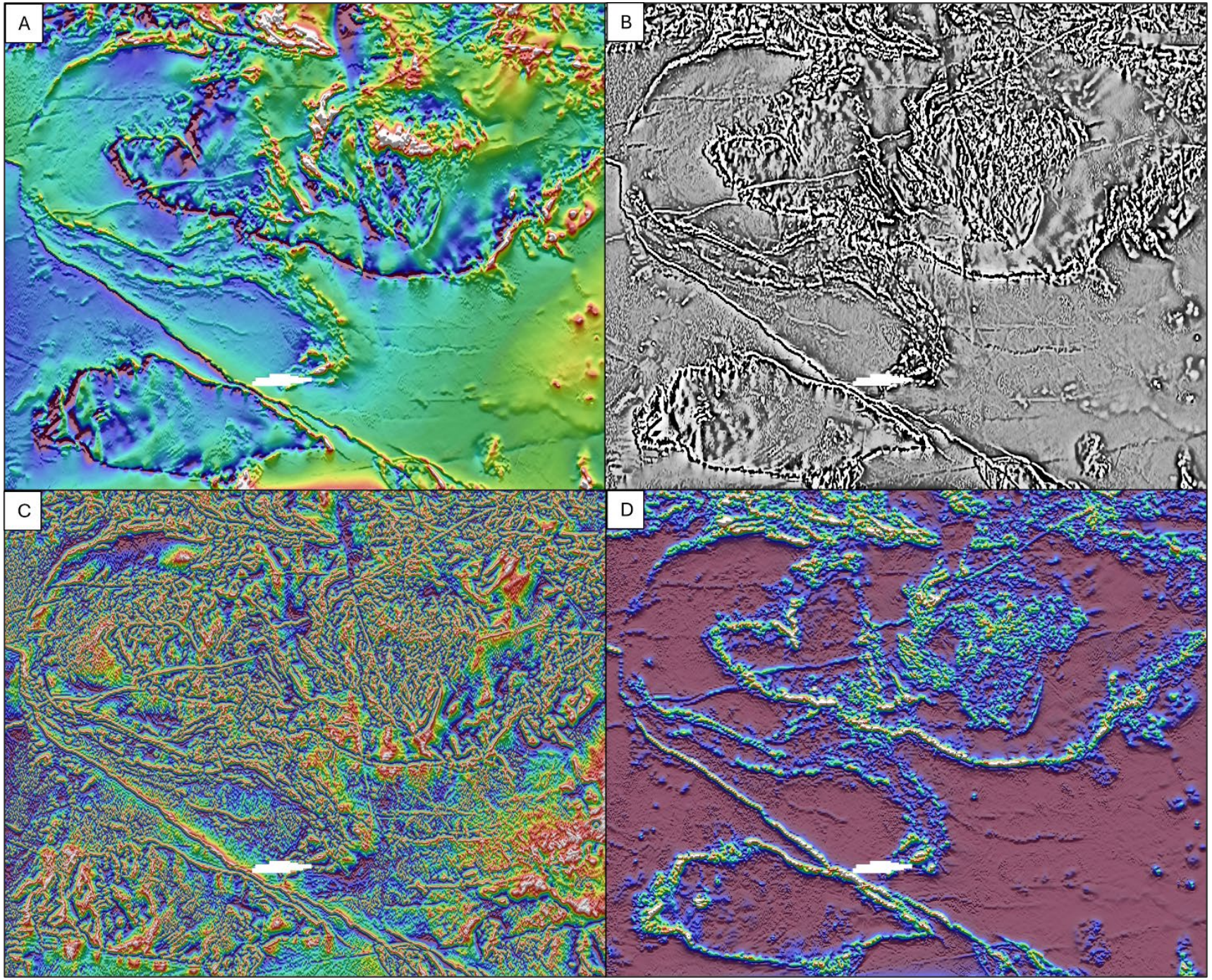
Nabarlek Aeromagnetic survey



NT-wide stitch, 400 m data. Not optimised to area.



Alligator Energy, 100 m LS survey flown 2014



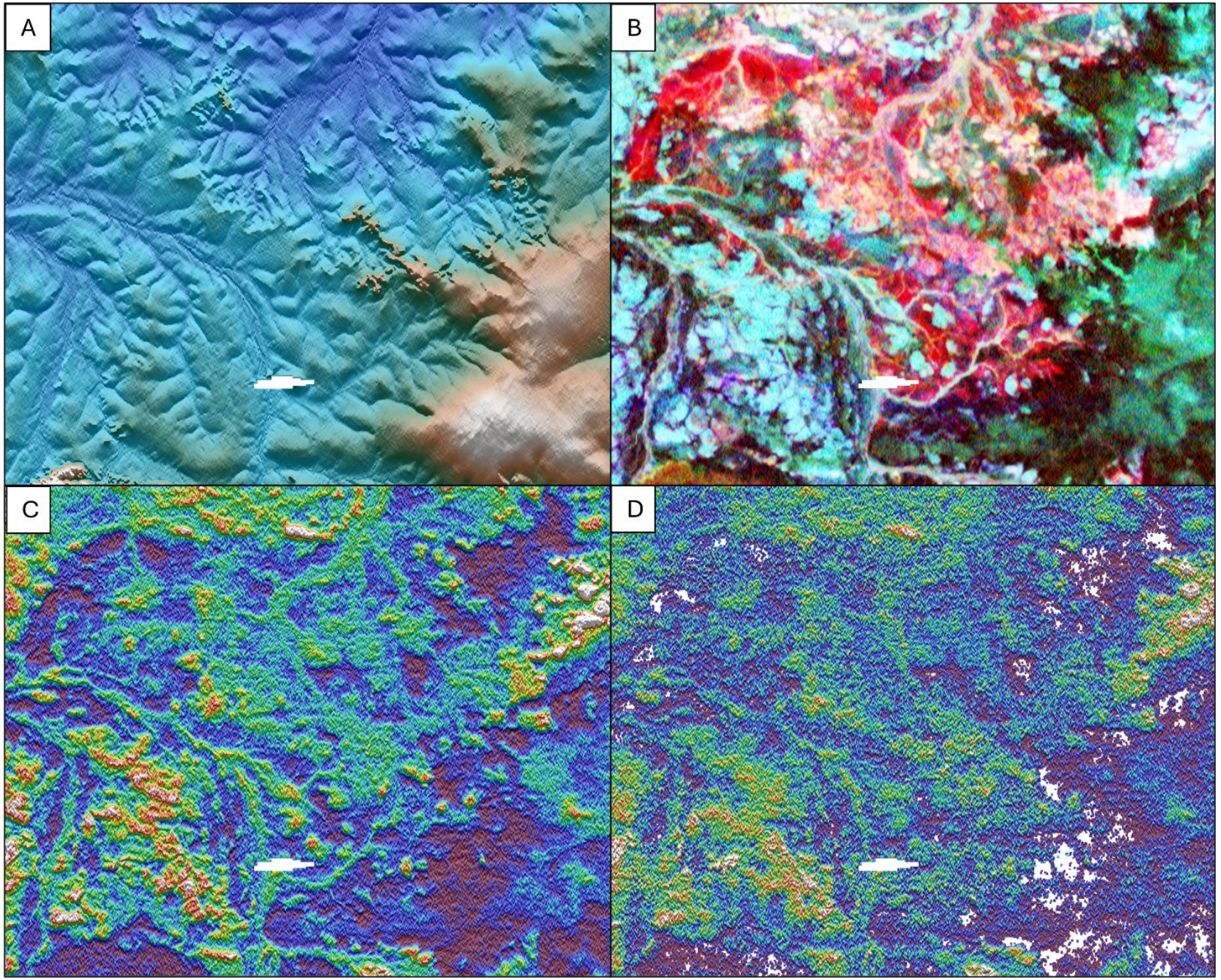
Enhanced imaging MAG

A) RTP magnetics (Linear stretch, 1-99% data clip, shaded from the north),

B) B) RTP 2VD, upward continued 25 m,

C) C) Tilt derivative,

D) D) Analytical Signal (Linear stretch, 1-99% data clip, shaded from the north).



Enhanced imaging RAD & DEM

A) Digital elevation model,

B) Ternary image of radiometrics,

C) Uranium image (Linear stretch, 1-99% data clip)

D) U^2/Th image which highlights uranium anomalies in the absence of a response in the thorium channel

Lithomagnetic domains

Oenpelli Dolerite

Strongly magnetic with variable and complex magnetic character. Strong remnant response with both normally and reversely magnetised anomalies observed.

Kombolgie Sandstone

Broad domain with flat magnetic response.

Nanambu Complex

Broad domain with flat magnetic response. Occasional weak linear fabric can be observed.

Nimbuwah Complex

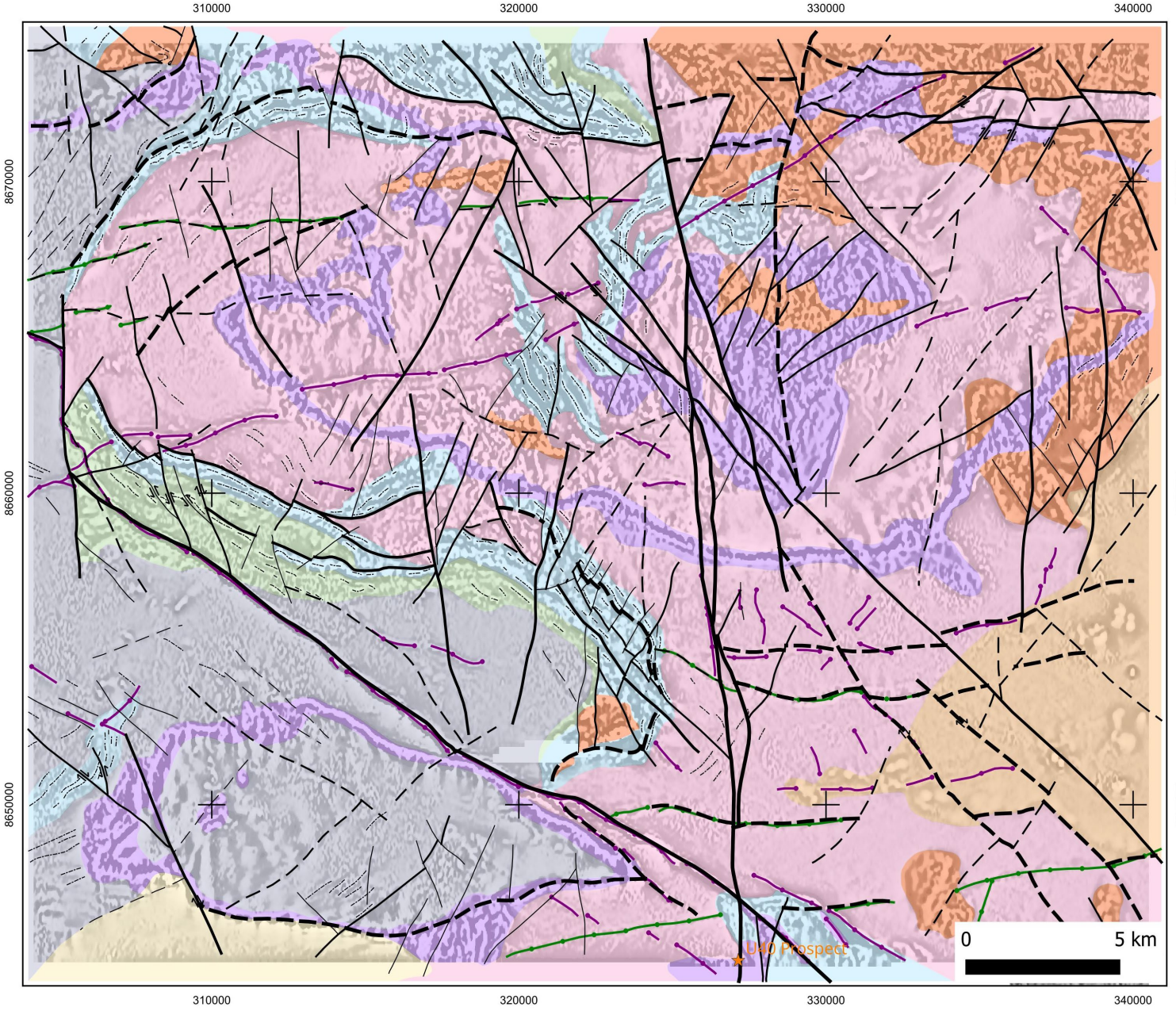
Broad domain with flat magnetic response. Often intruded by dykes of variable orientation. (Granite or gneiss?)

Moderately, and a weakly magnetic domain with curvilinear magnetic fabrics, often appearing to be tightly folded. Possible domains of gneissic rocks within the Nimbuwah Complex (gneiss?)

Isolated domains of strong magnetic intensity, often with diffuse margins. Typically observed coincident to the Oenpelli Dolerite, but is generally positively magnetised compared to the largely negative anomalies of the dolerite. Possible intrusive. (Mafic or felsic intrusives?)

Could this be Cahill Formation?

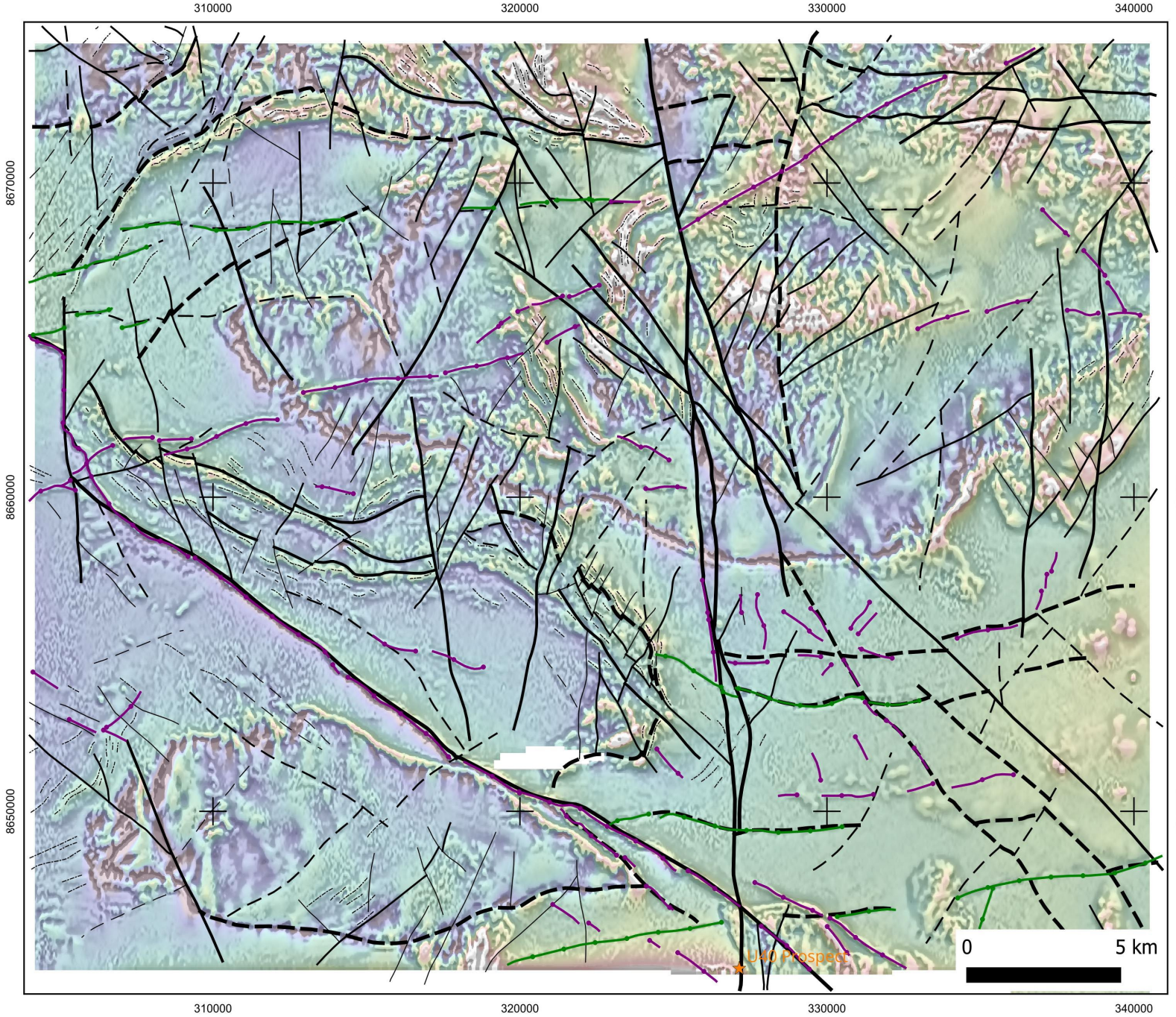
Further work needed to understand what these domains are – area is a lot more heterogenous than the mapping would suggest – Is it all Nimbuwah Complex?



SGC4463 (2024)

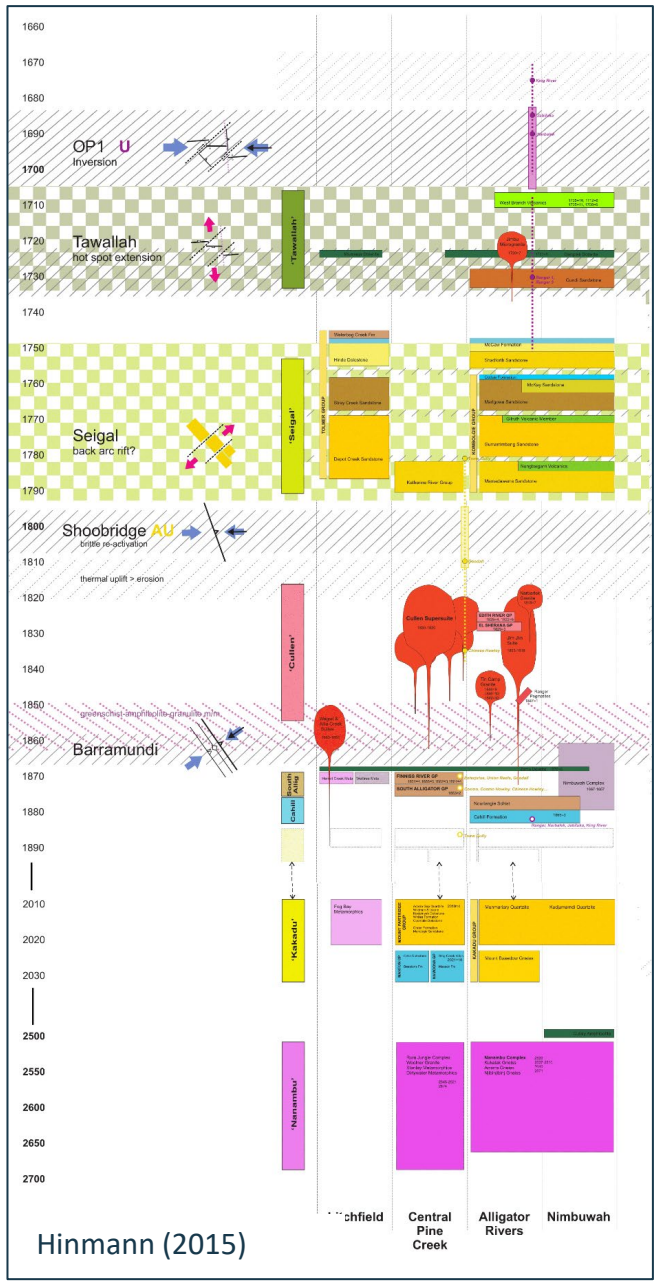
Structural Interpretation

- Limited outcrop has previously limited detailed structural interpretations
- Faults and fractures interpreted from
  - Breaks, truncations or offset of magnetic anomalies
- Linear cross-cutting magnetic features represent dykes or sills, potentially also intruding fault or fracture.
- Low magnetic contrast or noise from surficial/volcanic features limited the ability to accurately resolve the location of faults and fractures in some places

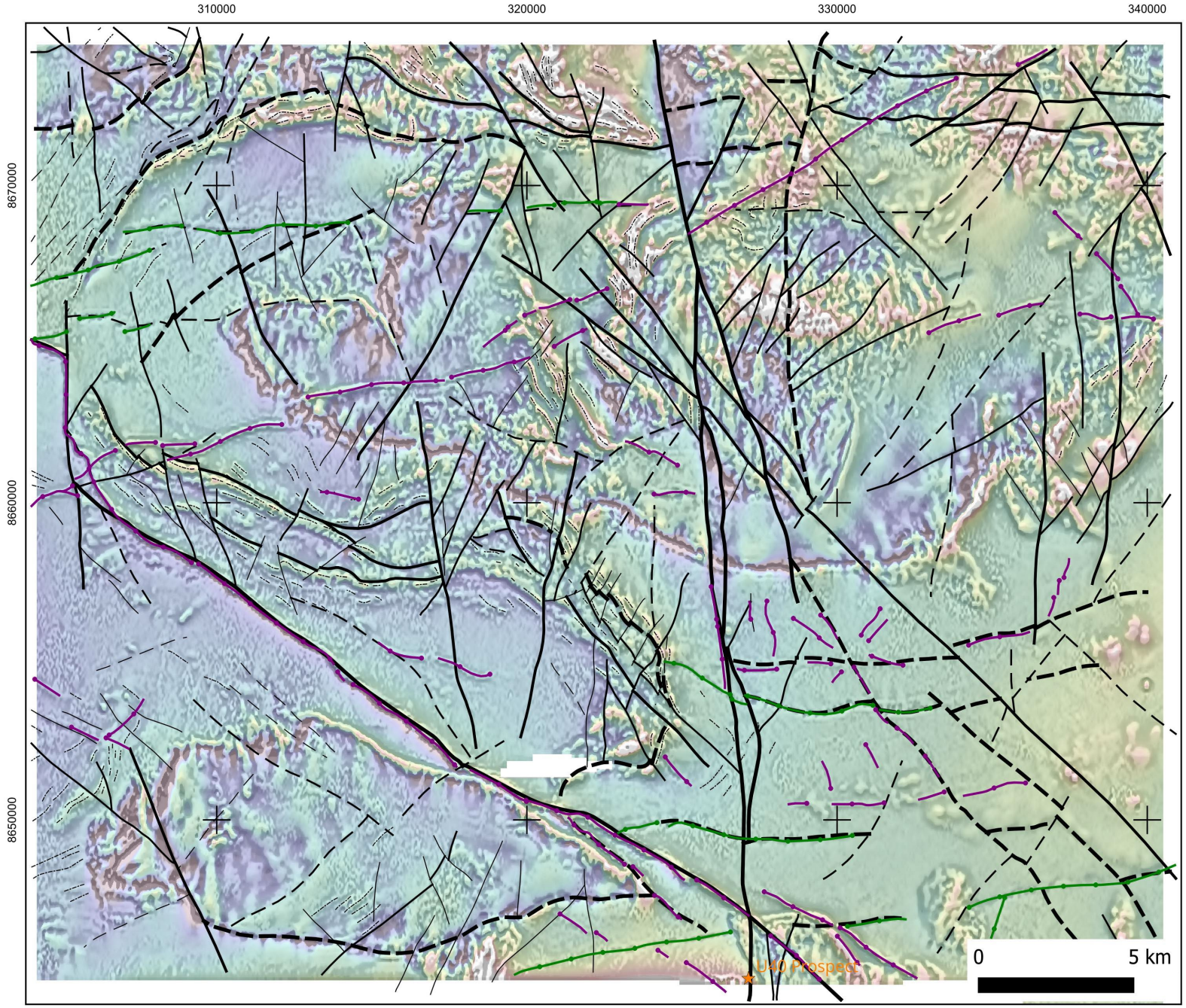


SGC4463 (2024)

Structural Interpretation



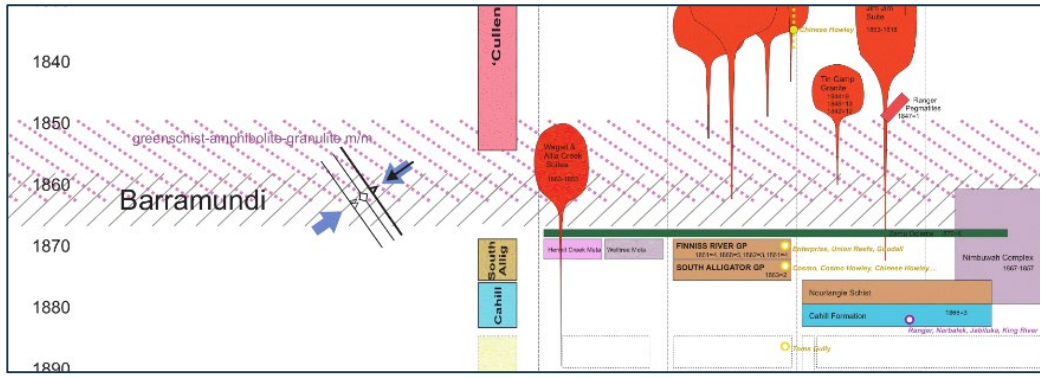
Hinmann (2015)

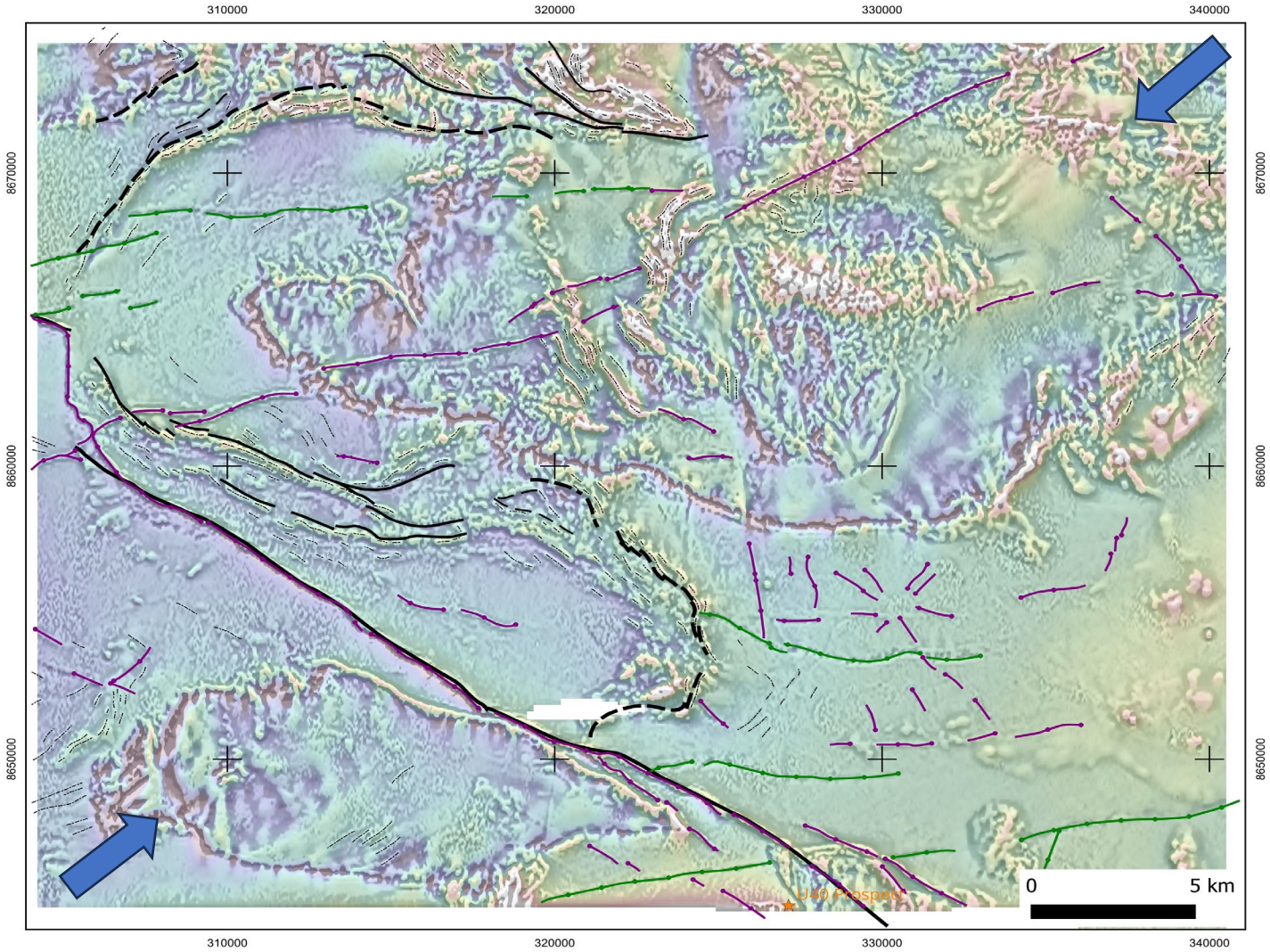


SGC4463 (2024)

Fault timing

- **Barramundi Orogeny (ca. 1860 Ma, NE-SW directed shortening)**
  - Curvilinear thrust faults largely resolved as presently east-west trending structures rotating to either a southwest or southeast orientation.

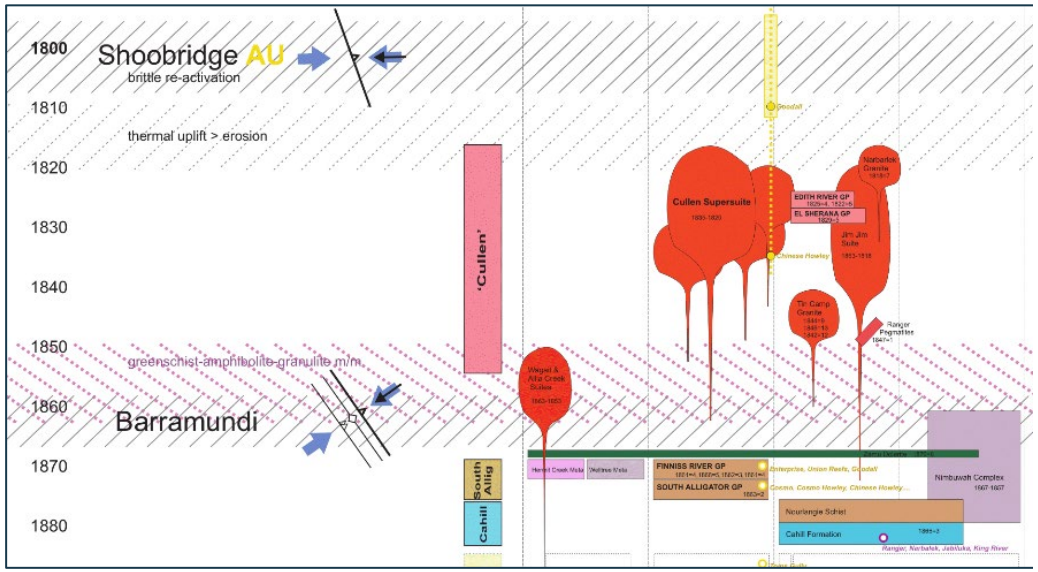


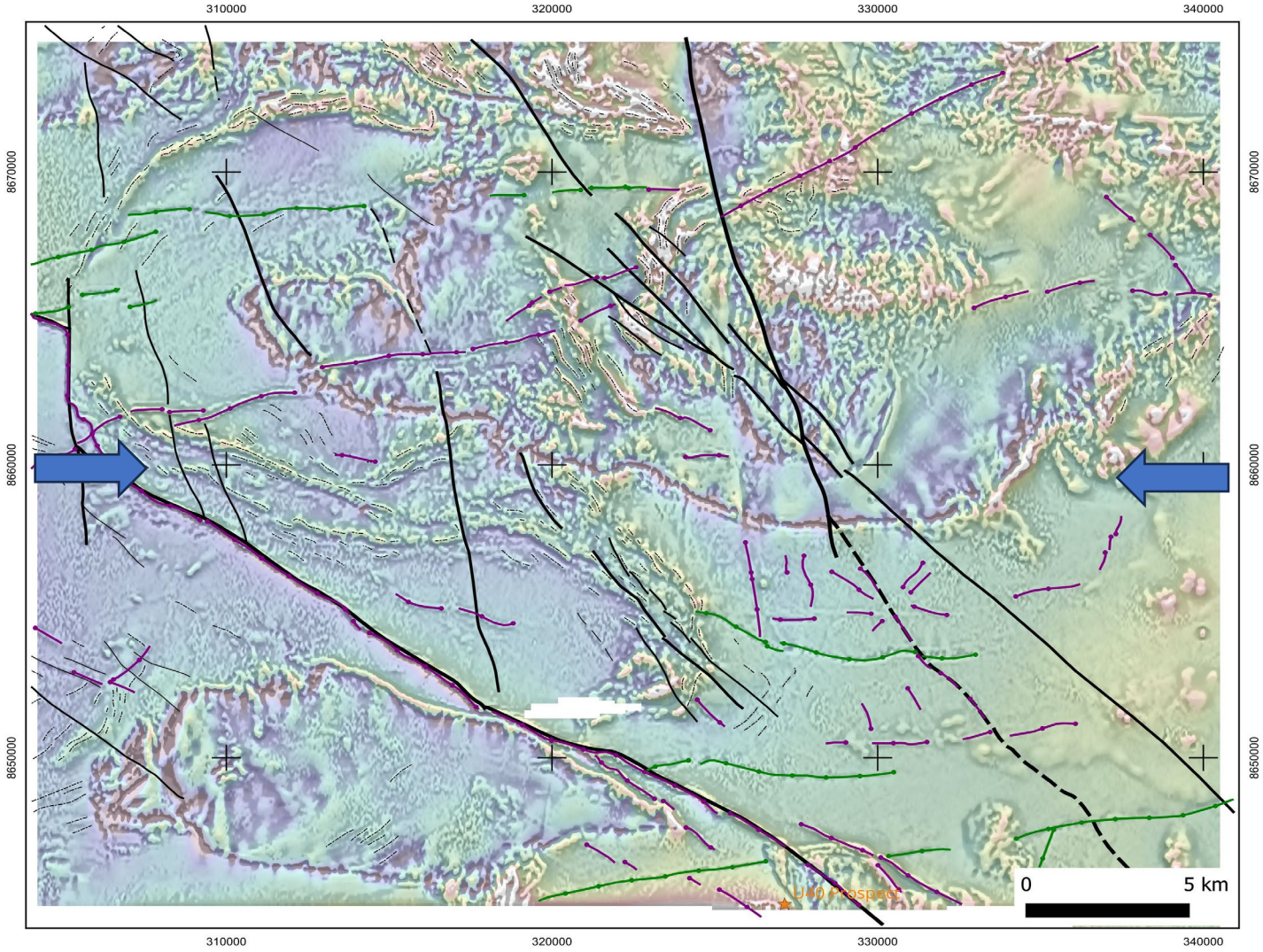


Hinmann (2015)

Fault timing

- **Shoobridge Event (ca. 1800 Ma, E-W directed shortening)**
  - Northwest to North-northwest trending thrust and/or reverse faults

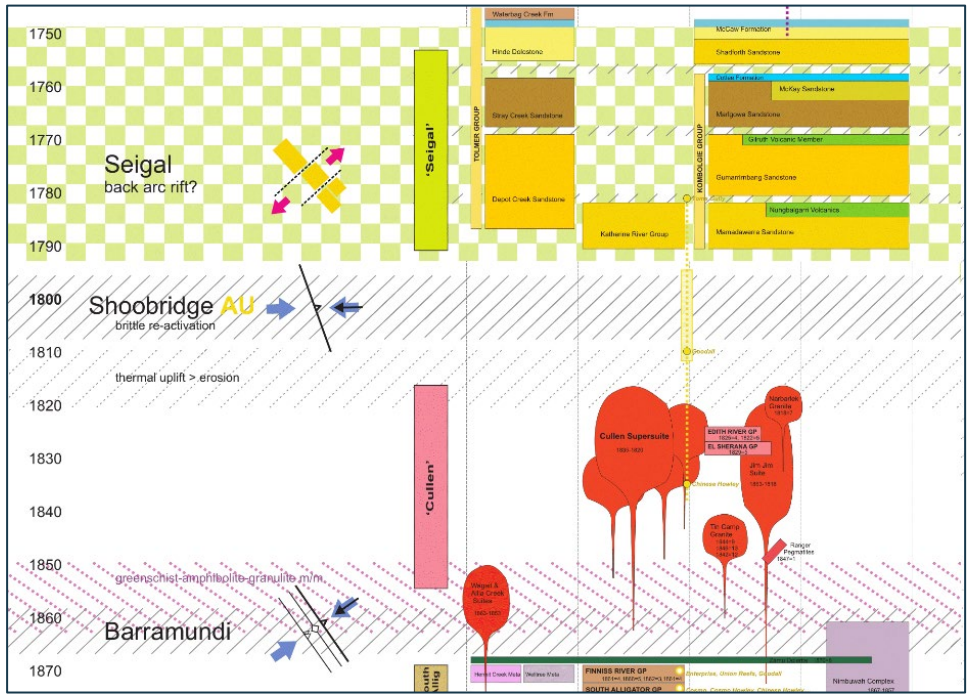


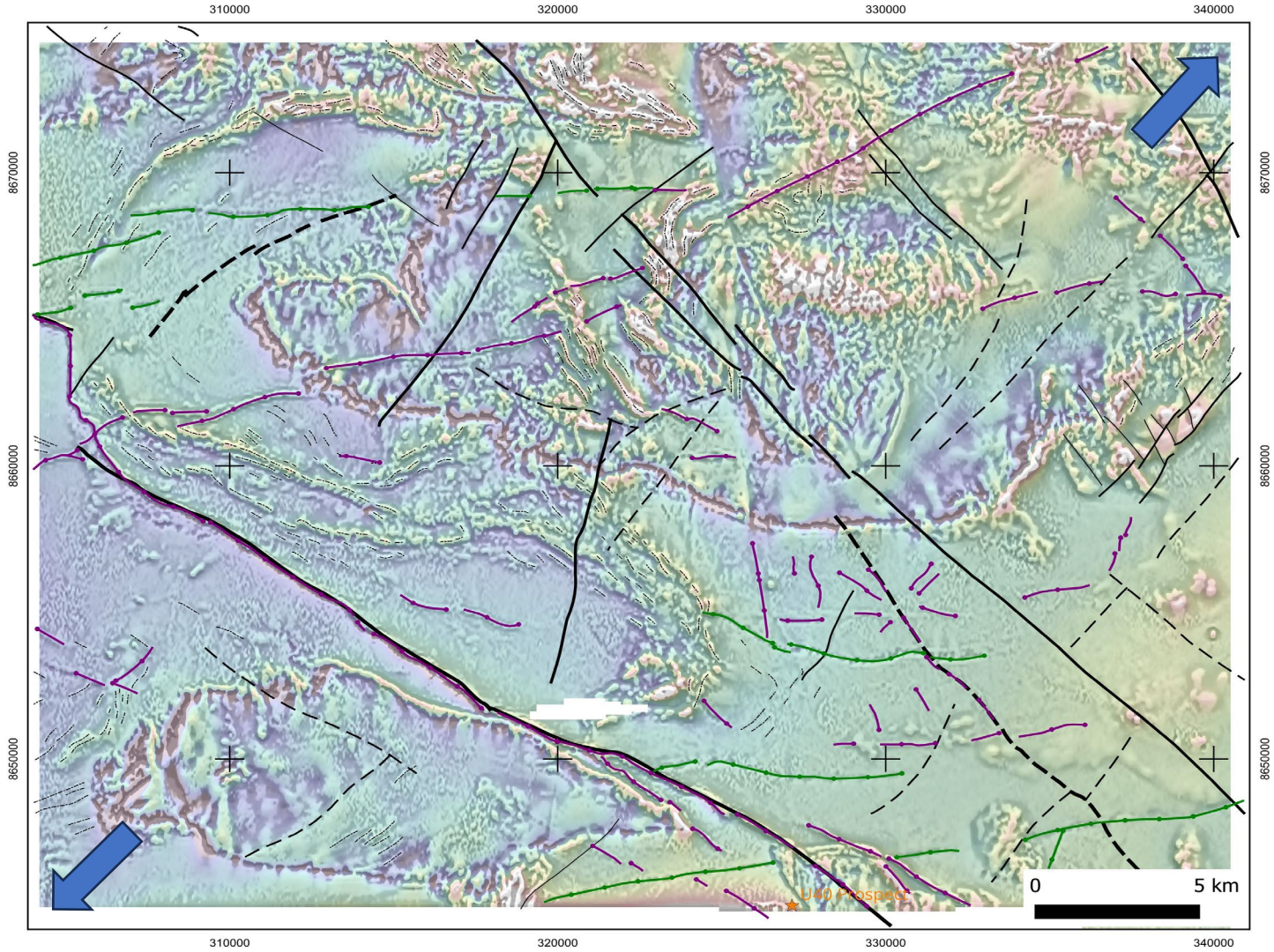


Hinmann (2015)

Fault timing

- **Seigal Event (ca. 1790-1750 Ma, NE-SW directed extension)**
  - Northwest trending normal and northeast trending strike-slip faults

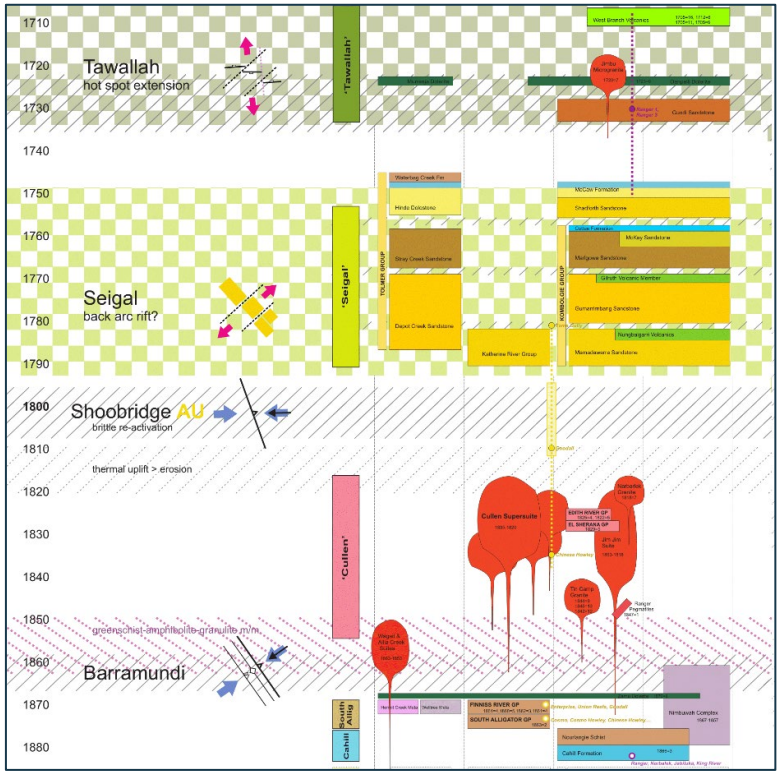


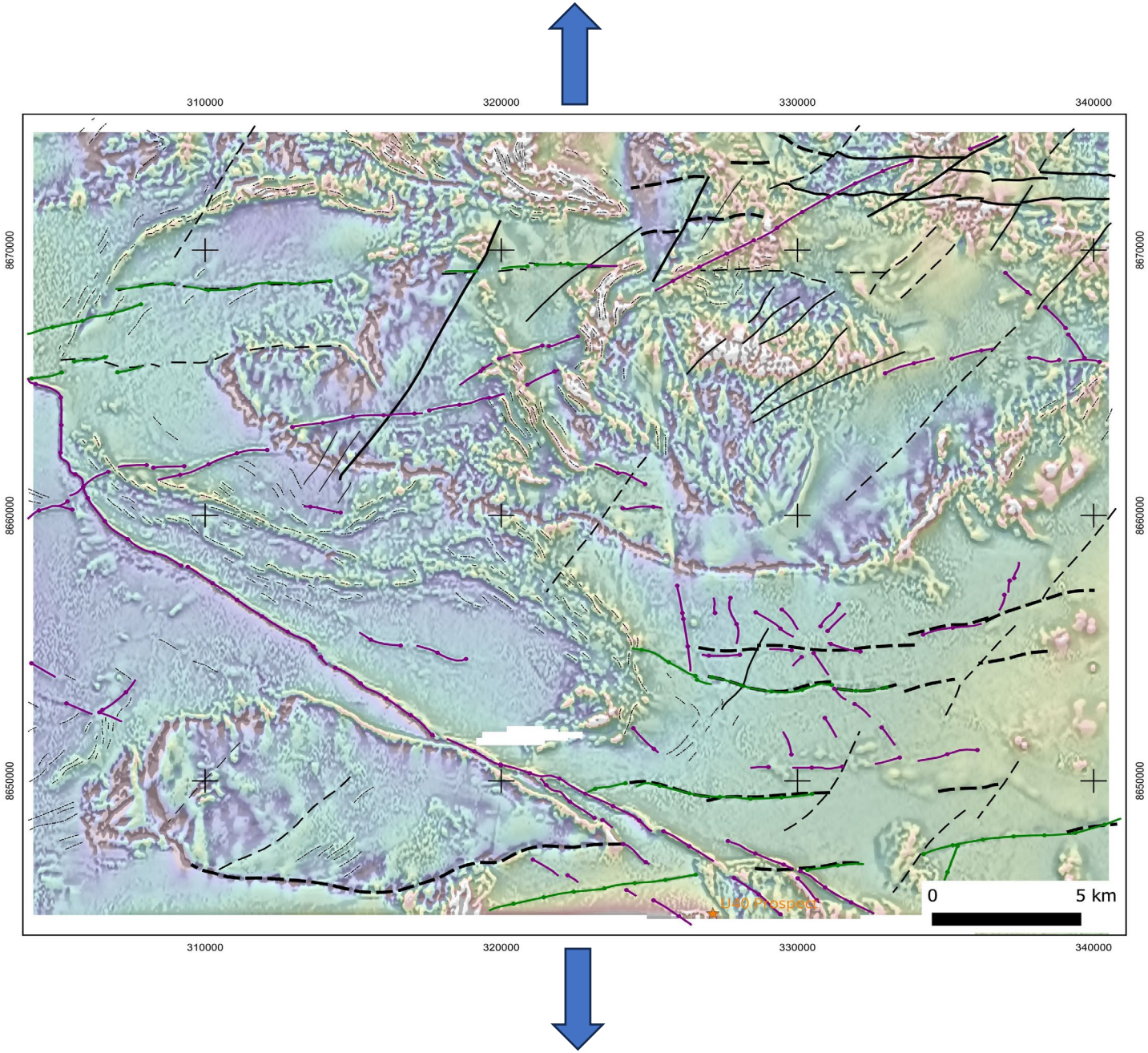


Hinmann (2015)

Fault timing

- **Tawallah Extension Event (ca. 1740-1700 Ma, N-S directed extension)**
  - East-west trending normal and northeast trending strike-slip faults

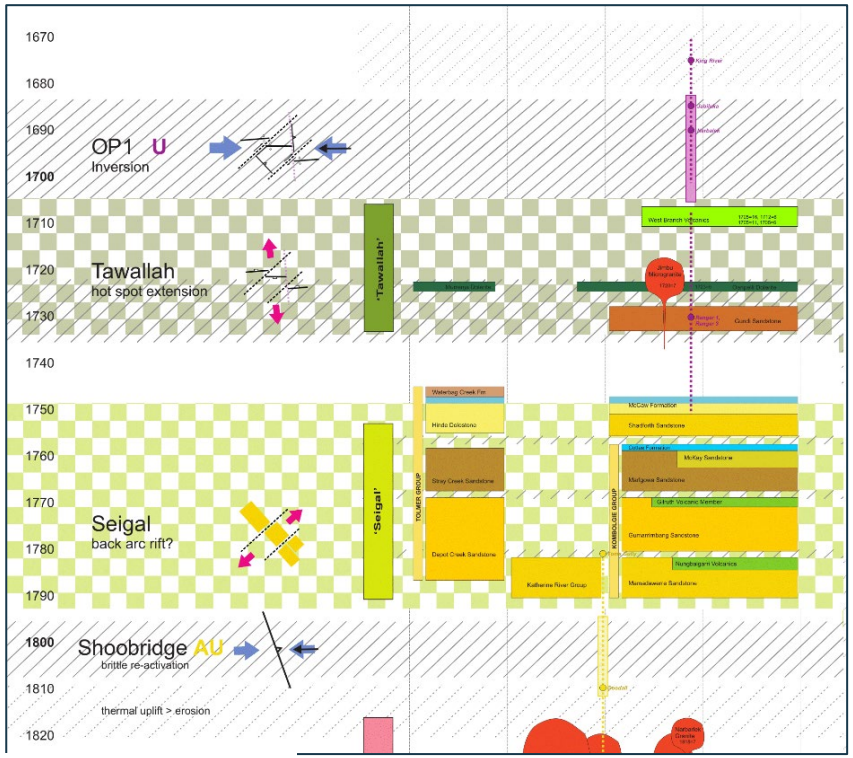


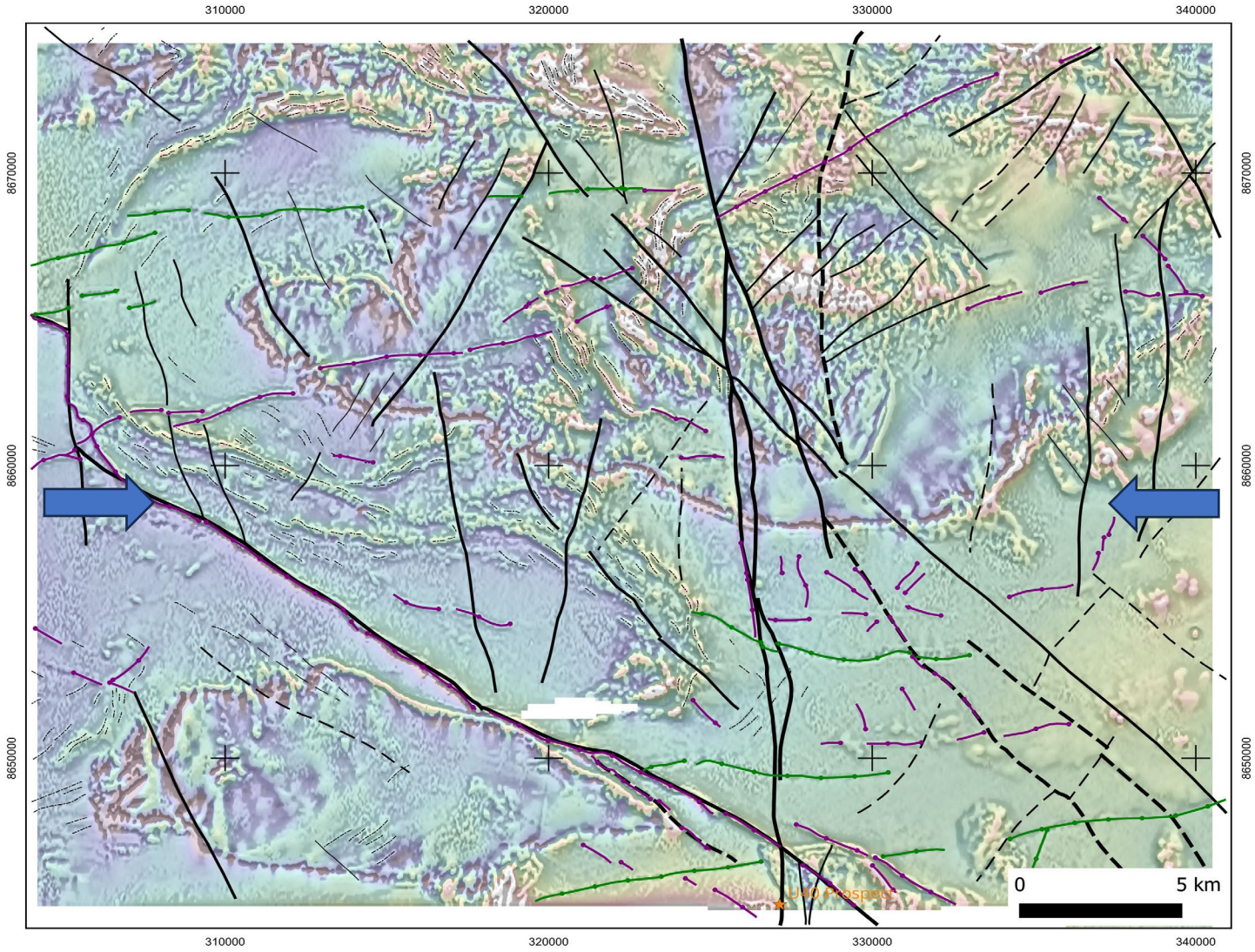


Hinmann (2015)

Fault timing

- **Post-Tawallah Inversion Event (ca. 1700-1680 Ma, E-W directed shortening)**
  - Reactivation of multiple fault orientations, including northeast trending strike-slip, east-west normal, and northwest and north-south trending thrust/reverse faults.

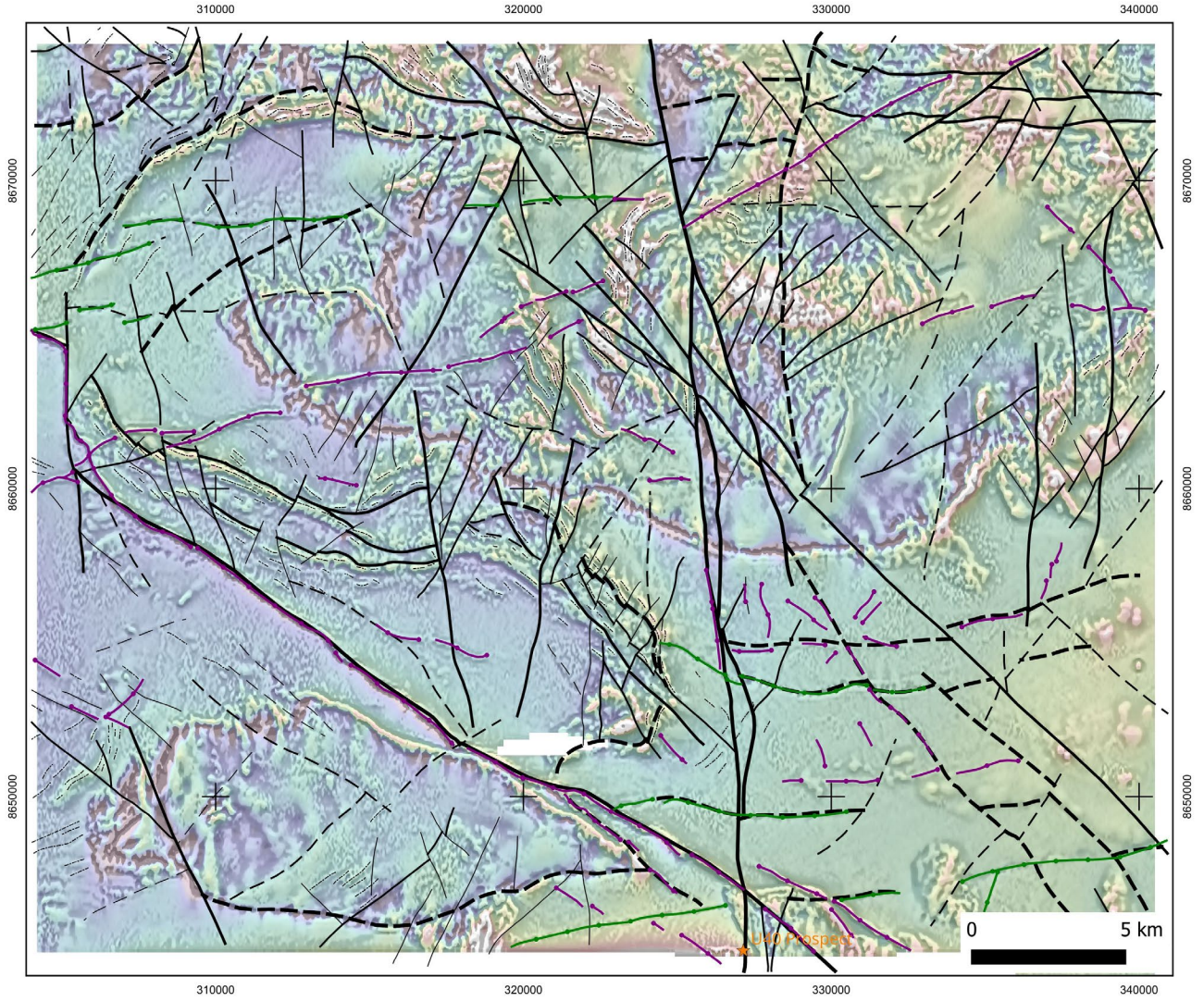




Hinmann (2015)

Fault timing

- **Barramundi Orogeny**
  - Curvilinear thrust faults largely resolved as presently east-west trending structures rotating to either a southwest or southeast orientation.
- **Shoobridge Event**
  - Northwest to North-northwest trending thrust and/or reverse faults
- **Seigal Event**
  - Northwest trending normal and northeast trending strike-slip faults
- **Tawallah Extension Event**
  - East-west trending normal and northeast trending strike-slip faults
- **OP1 Inversion Event**
  - Reactivation of multiple fault orientations, including northeast trending strike-slip, east-west normal, and northwest and north-south trending thrust/reverse faults.

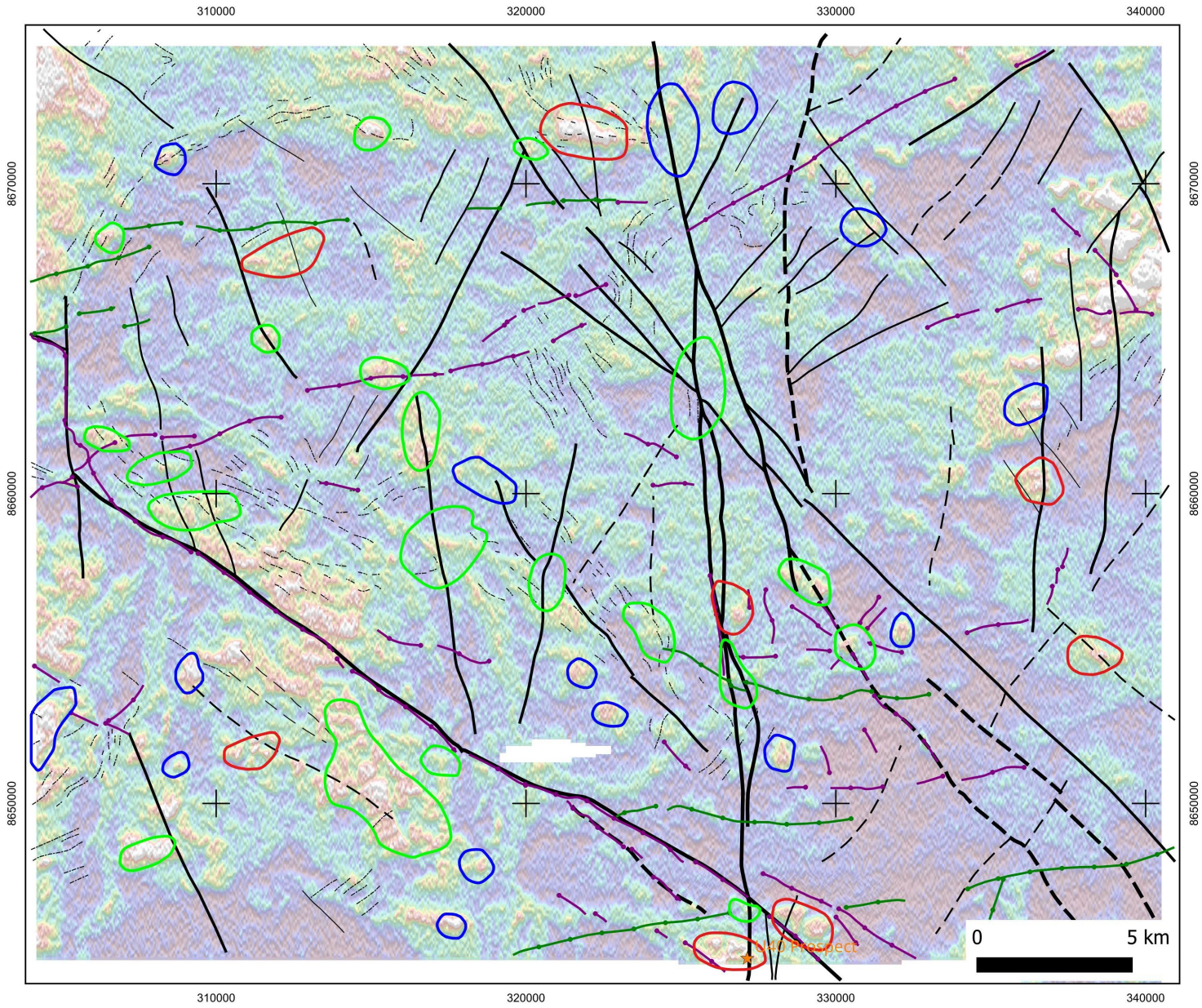


SGC4463 (2024)

Suggested targets

Suggested target set for further work. Targeting criteria includes:

- Uranium anomaly in radiometric data, particularly when anomalies observed in U/Th or U2/Th ratio images.
- Flexure in major shear zone which may have been a possible dilation site for increased fluid flow.
- Zones of structural complexity (e.g., intersection of several faults).
- Extension along strike of structure known to host mineralisation.
- Units exhibiting either increased or decreased magnetic intensity (suggesting alteration) in conjunction with intersecting or cross-cutting shear-zones, faults, fractures and/or dykes.

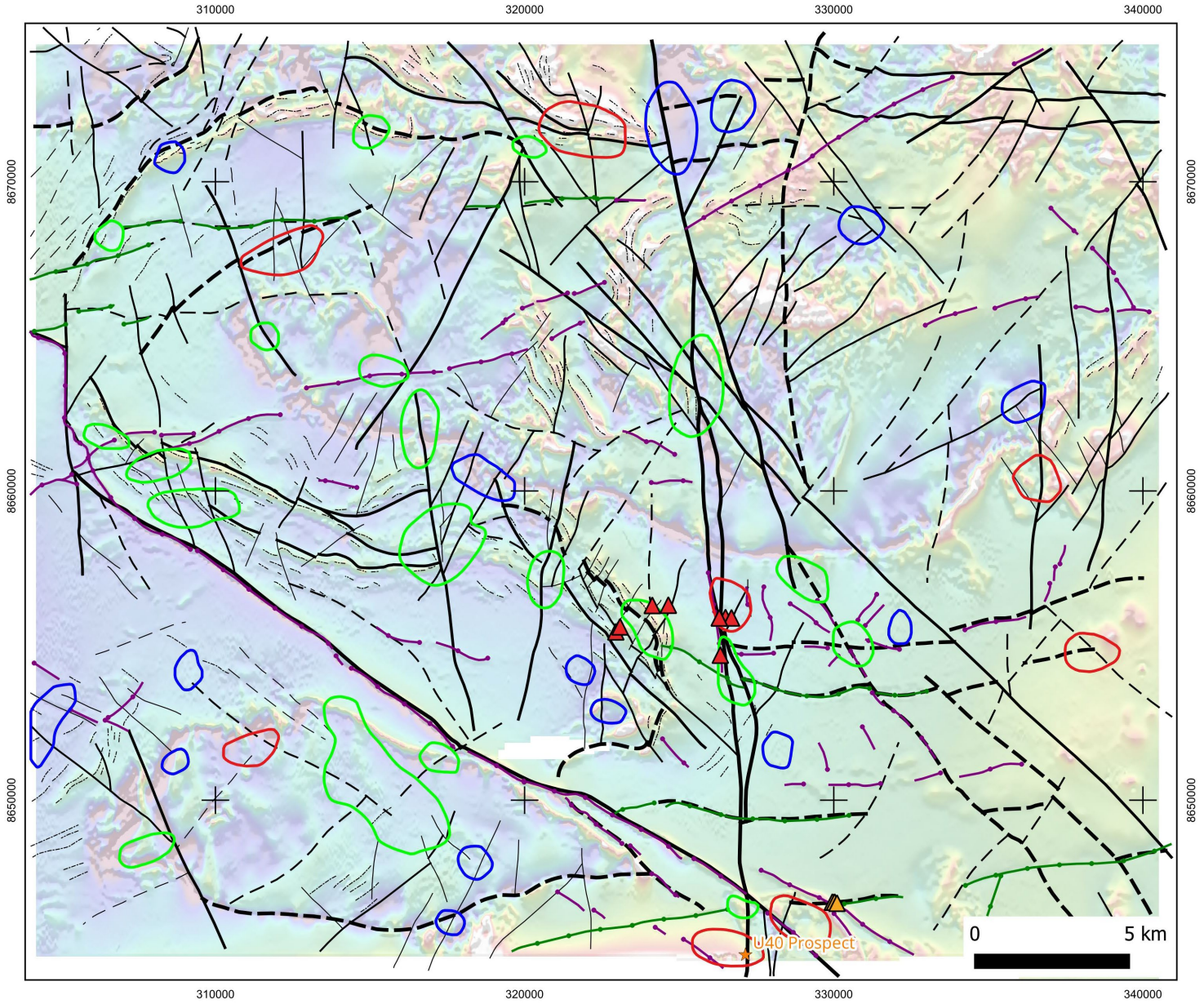


Hall and Lightfoot (2025)
AGES2025 presentation

Suggested targets

Follow up co-funded drilling completed by Alligator Energy in 2024. Results from Howard and Lightfoot (2024):

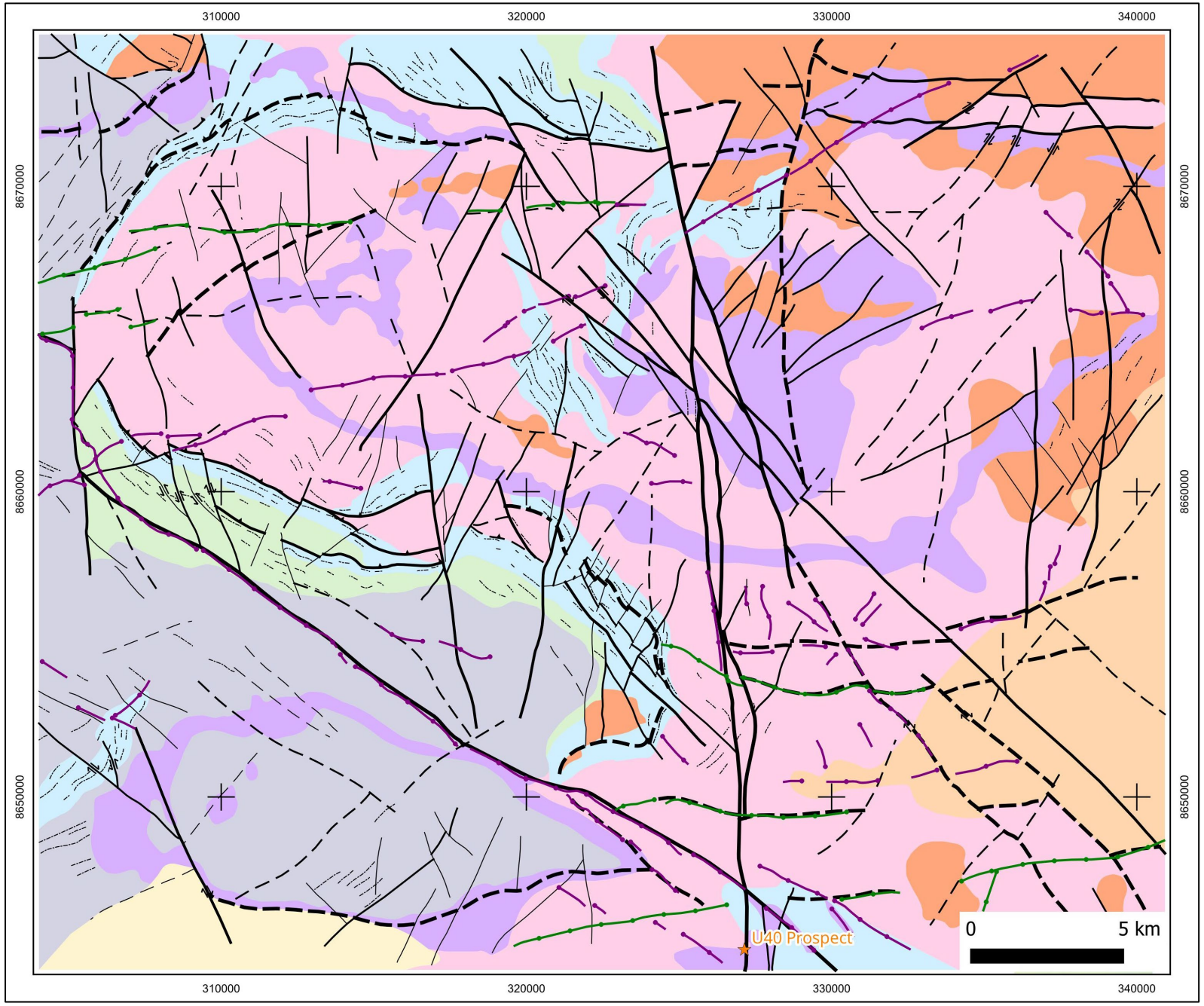
- Northern drill holes intersected predominantly Archean gneiss and granite
  - Confirmed interpretation of granite/gneiss in this area
  - Questions still remain if Cahill Fm equivalents preserved at depth
- Southern drill holes targeted a structural setting comparable to the U40 prospect
  - Intersected fine-grained ductile schist units with sericite alteration - characteristic of the Cahill Formation.
  - Assays returned a peak of 108 ppm U_3O_8 at 83–84 m depth, with additional shallower anomalism around 30 m



Hall and Lightfoot (2025) & SGC4463 (2024)

Conclusion

- The interpretation added a significant level of structural detail to existing geological maps
  - Interpretation of fault timing was completed based on previous structural framework
- Identified heterogeneity in the magnetic response in areas mapped as Nimbuwah Complex
  - *Different lithological domains are evident, but further work needed to understand what these are.*
- Generated preliminary set of targets for follow up work. Several were tested and some mineralisation close to the U40 prospect



References & Acknowledgements

Thanks to Alligator Energy for permission to share this work.

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Alligator Energy

SOUTHERN GEOSCIENCE