Queensland Government

FROGTECH Geoscience

Uncovering the basement North West Queensland: a new SEEBASE® model

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September 24, 2018

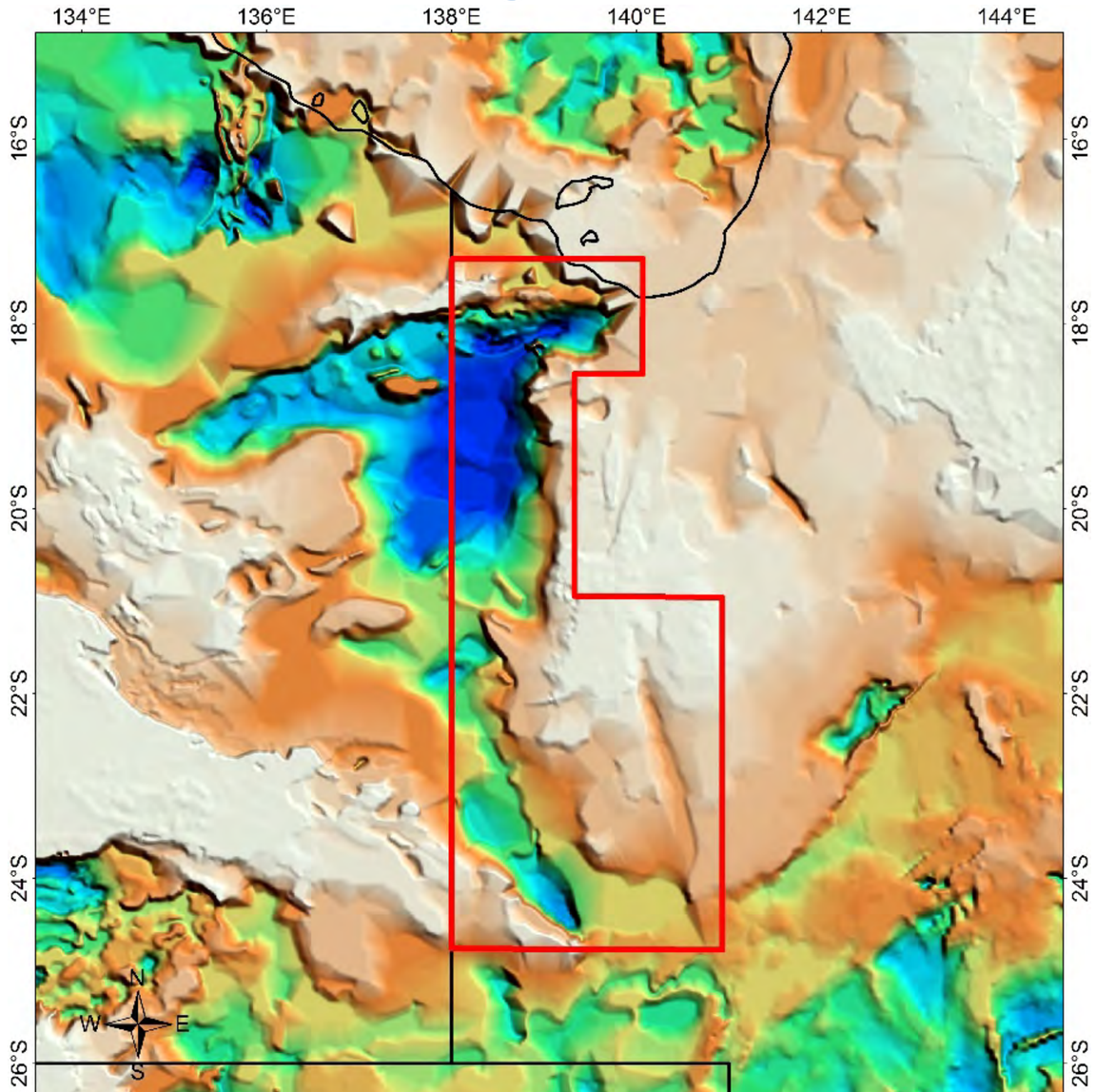
Acknowledgments

- Santos Limited and Central Petroleum Limited

- Project commissioned by Geological Survey of Queensland, Department of Natural Resources, Mines and Energy (DNRME)
- GSQ project team – Laurie Hutton, Matt Greenwood, Alison Troup, Behnam Talebi, and Justin Gorton
- Frogtech project team –Zhiqun Shi, Adam Kroll, Chris Pietrucha, John Vizy, and Grace Westerman

Project Aims

Uncovering NWQ Basement: a new comprehensive SEEBASE® model



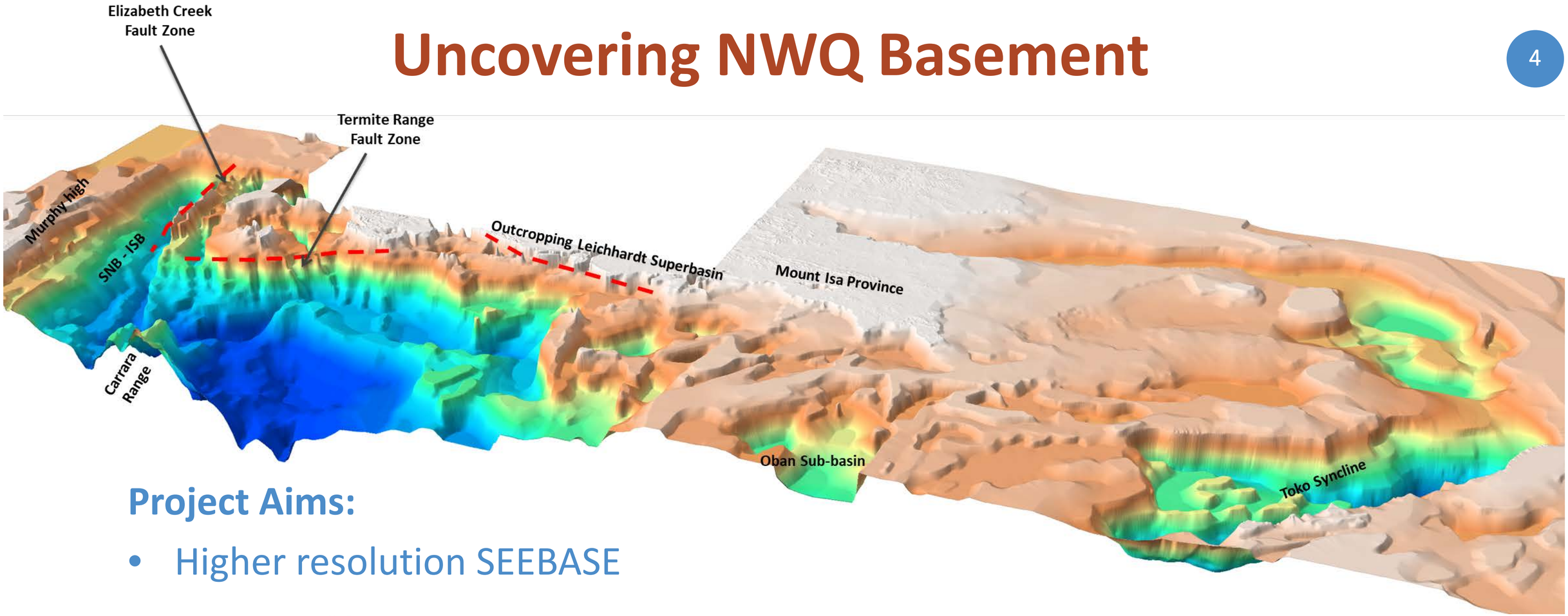
3D Depth-to-basement surface

(SEEBASE = *Structurally Enhanced view of Economic BASEment)*

SEEBASE workflow

- Importance of basement – terranes, composition, fabric, and evolution
- Integrated, iterative interpretation (seismic, wells, potential field, etc.); *hand-contoured*
- *Predictive*

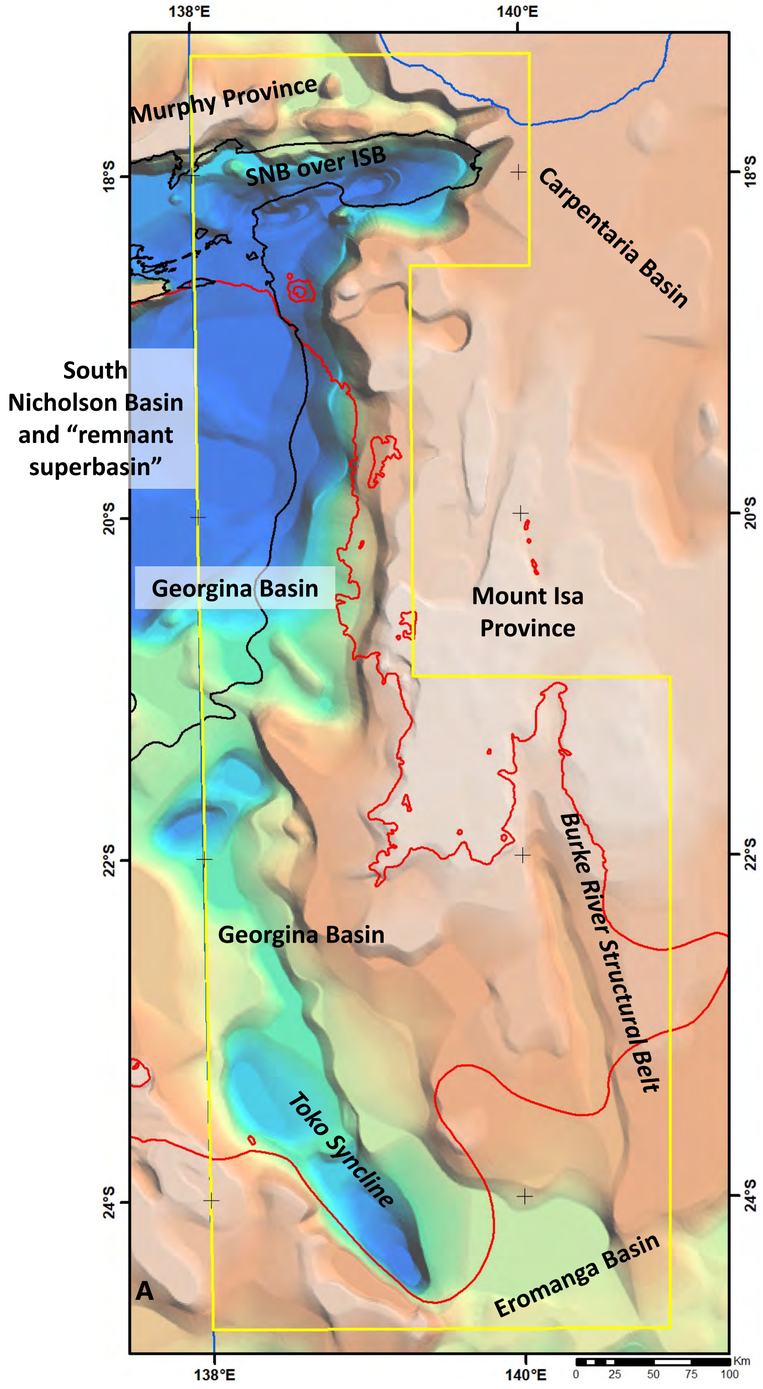
Uncovering NWQ Basement

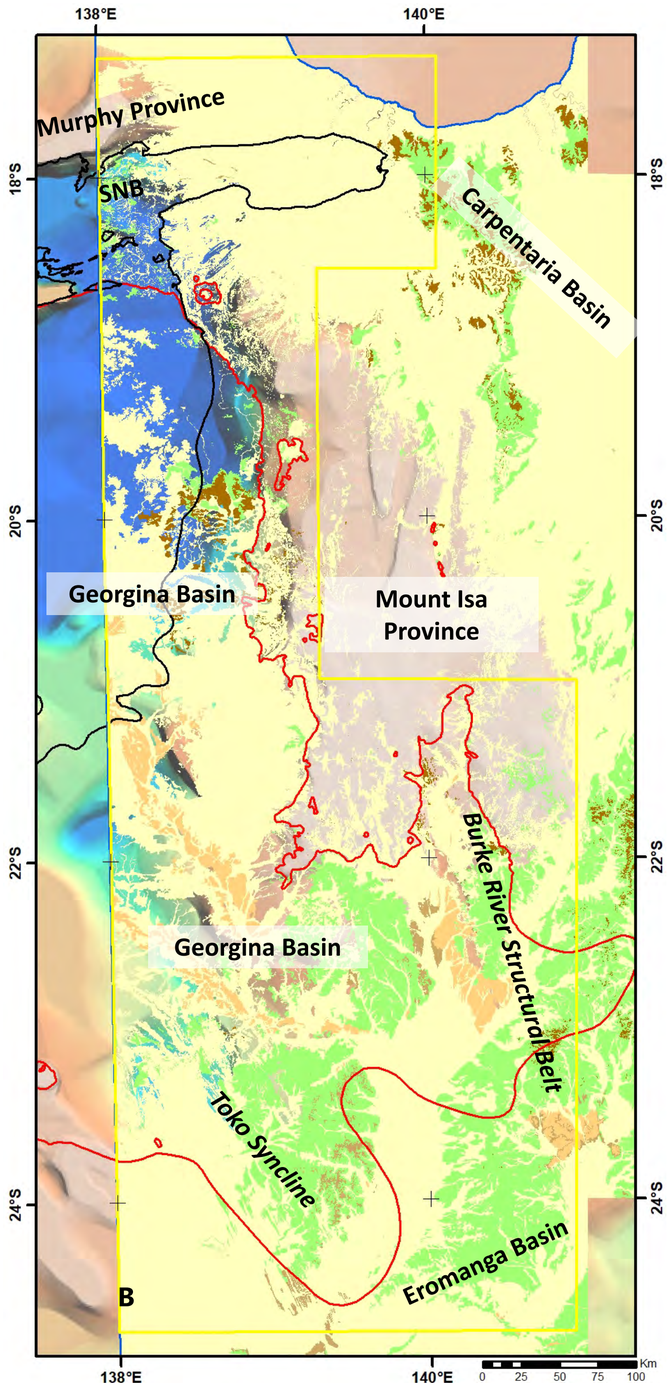


Project Aims:

- Higher resolution SEEBASE
- Nature of basement
- Basement controls on basin evolution
- Crustal architecture
- Basement heat flow

Location and Geology





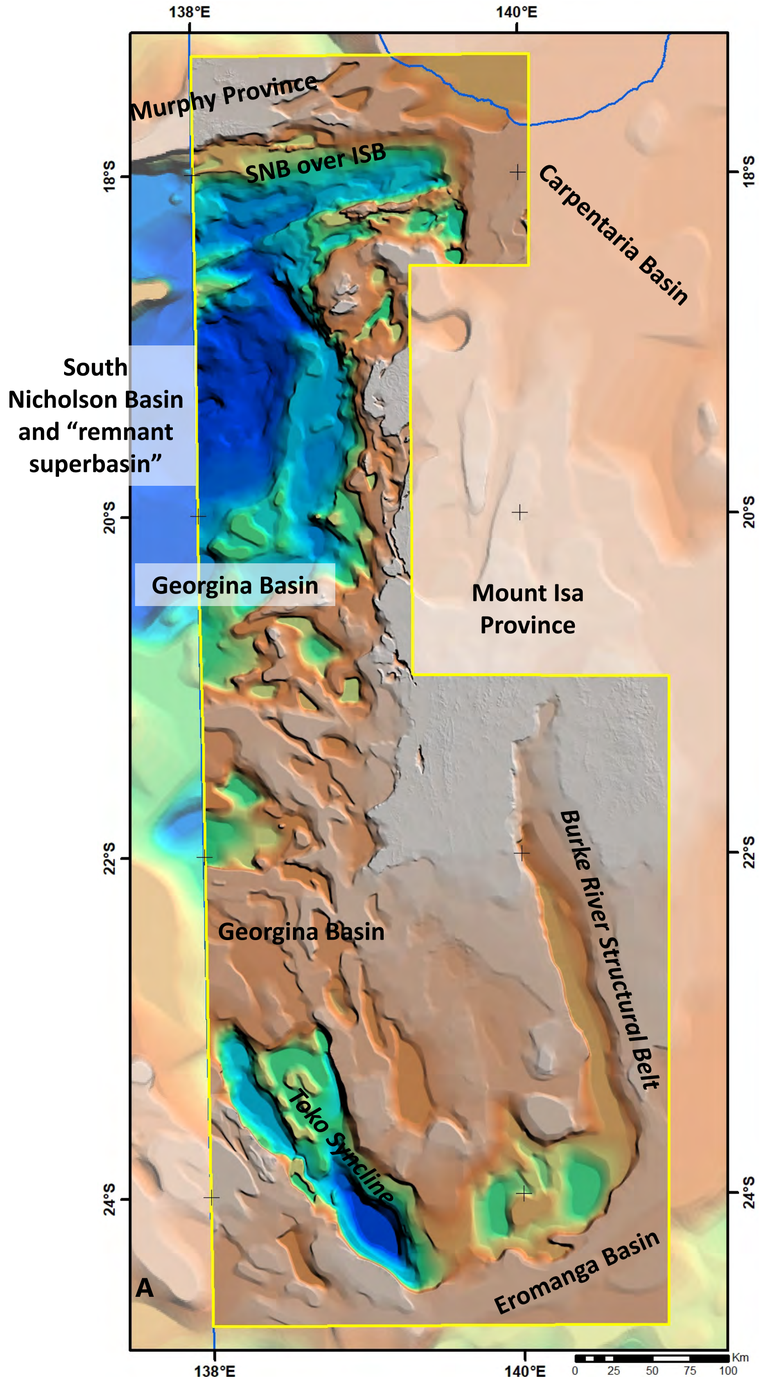
- Extensive cover
- Georgina Basin – red outline
- S Nicholson (SNB) – thin in Qld and absent along E of Georgina Basin
- Isa Superbasin (ISB) outcrop and seismic (6-8km thick)
- SNB + Isa ~5-7km (Paul Henson)
- OZ SEEBASE – deeper depocentre

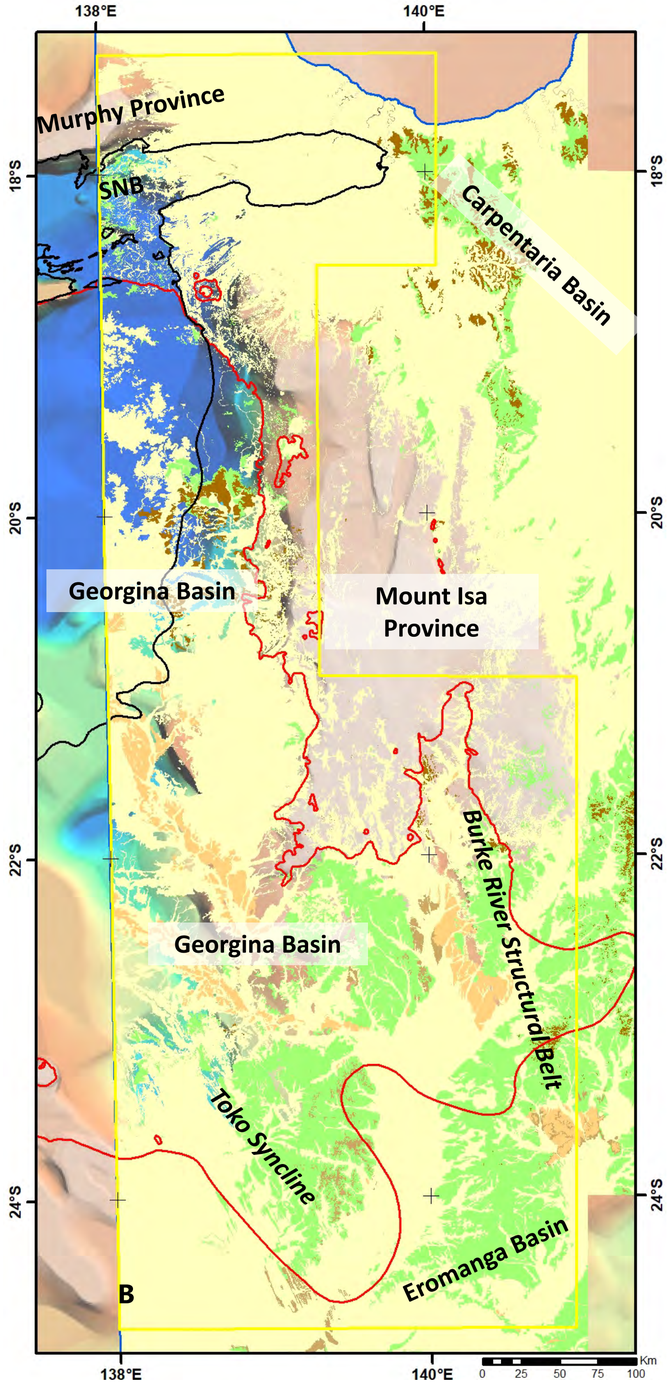
Basin Outlines

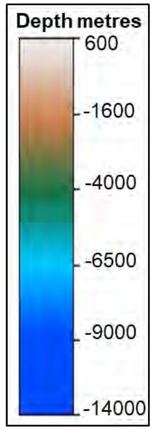
Cover Basins

Location and Geology

- Main depocentres well defined in original
- Significant increase in resolution





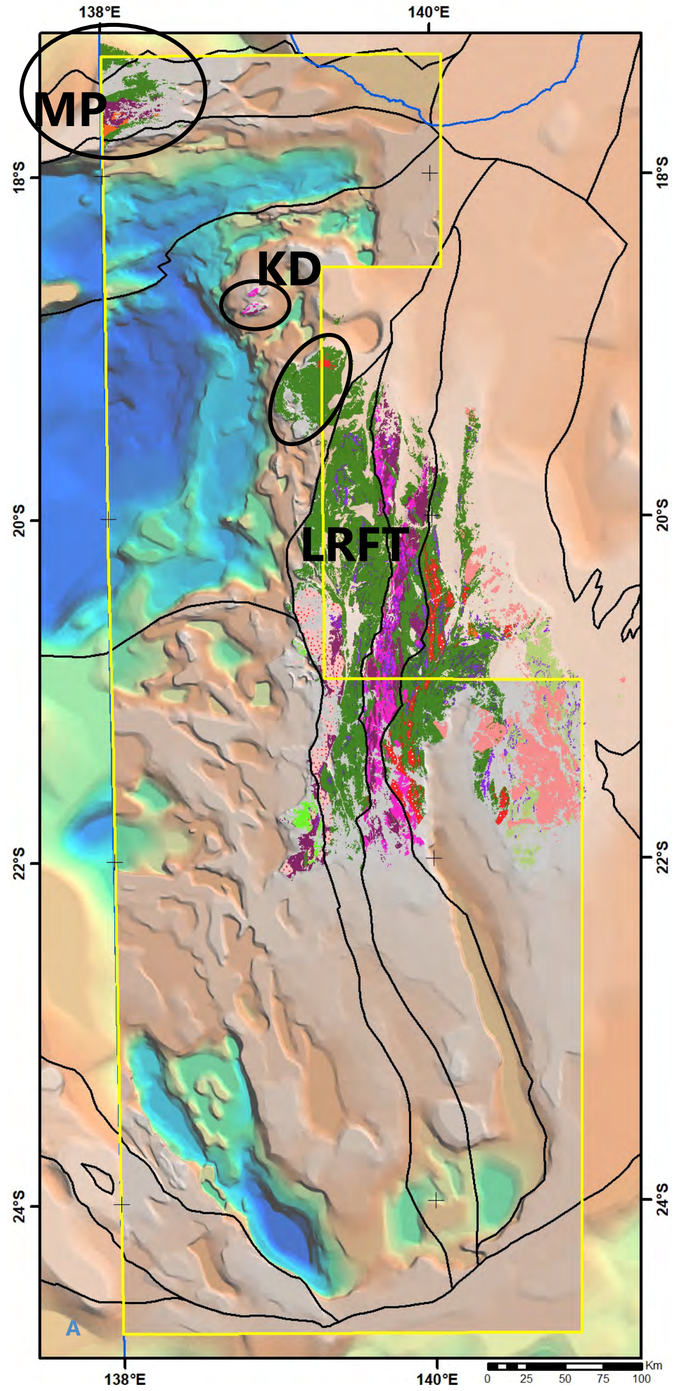


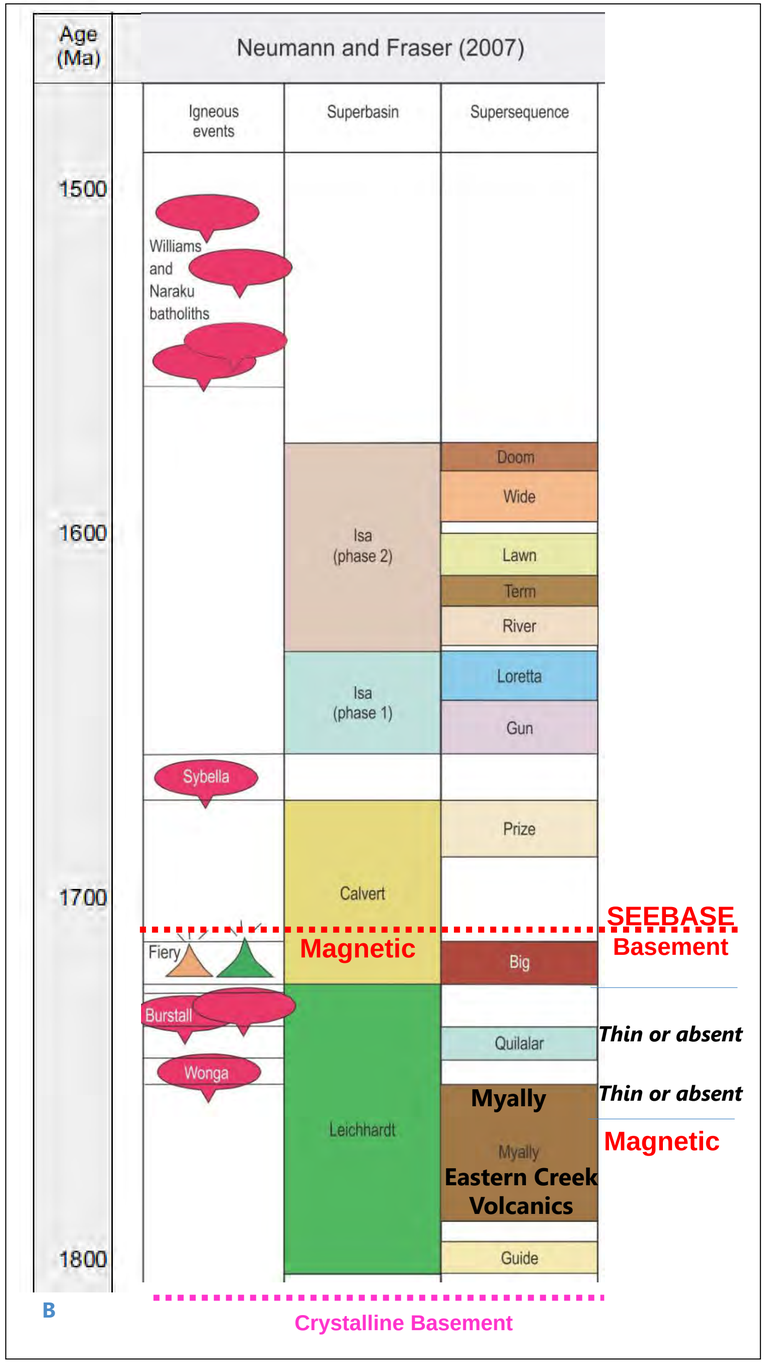
Basin Outlines

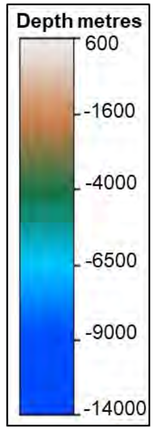
Cover Basins

What is Basement

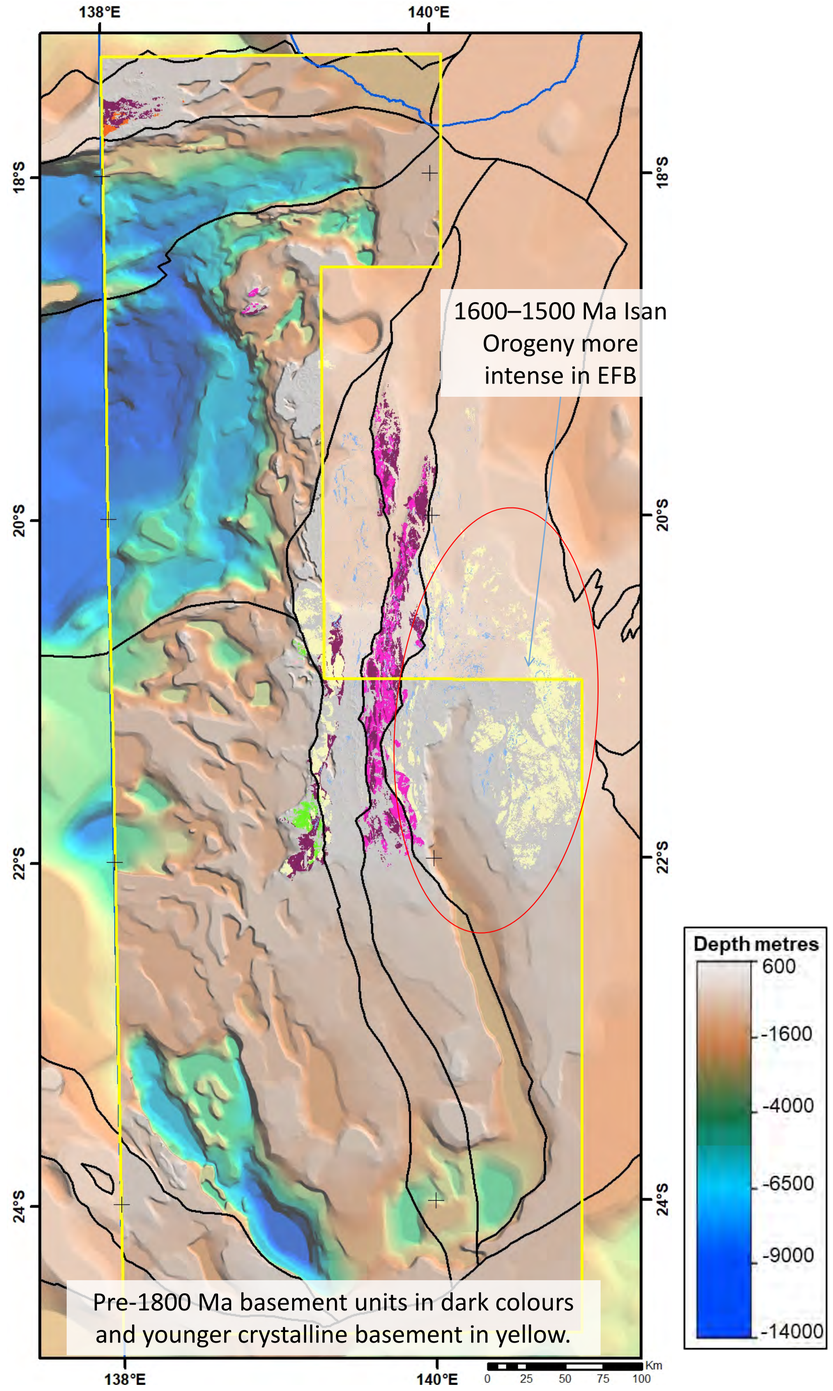
- Not a trivial question
- Crystalline, magnetic, economic?
- Not straightforward in NWQ – ideally look at several surfaces
- Focus in this project – economic basement for hydrocarbons
- Close to magnetic basement

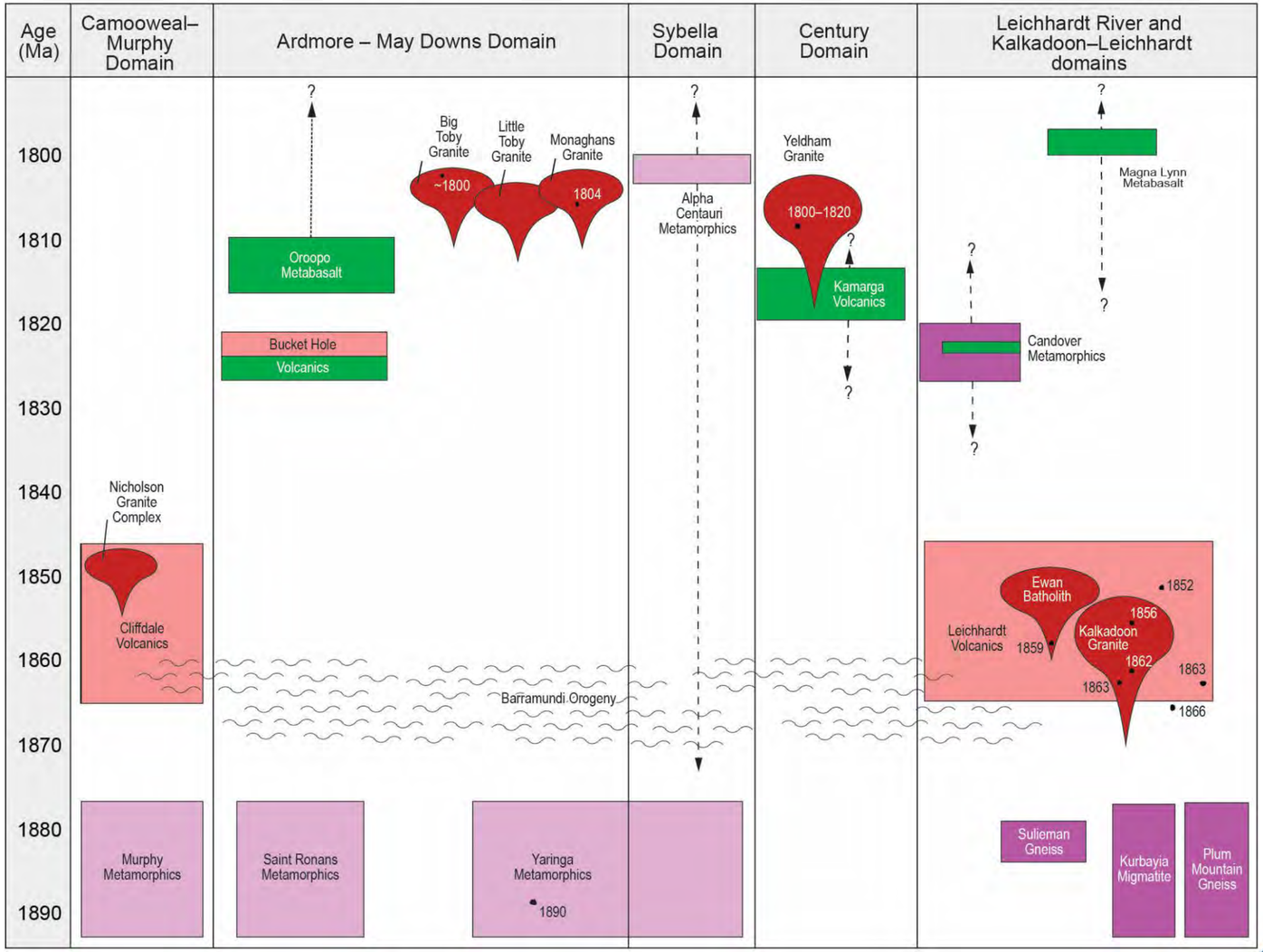






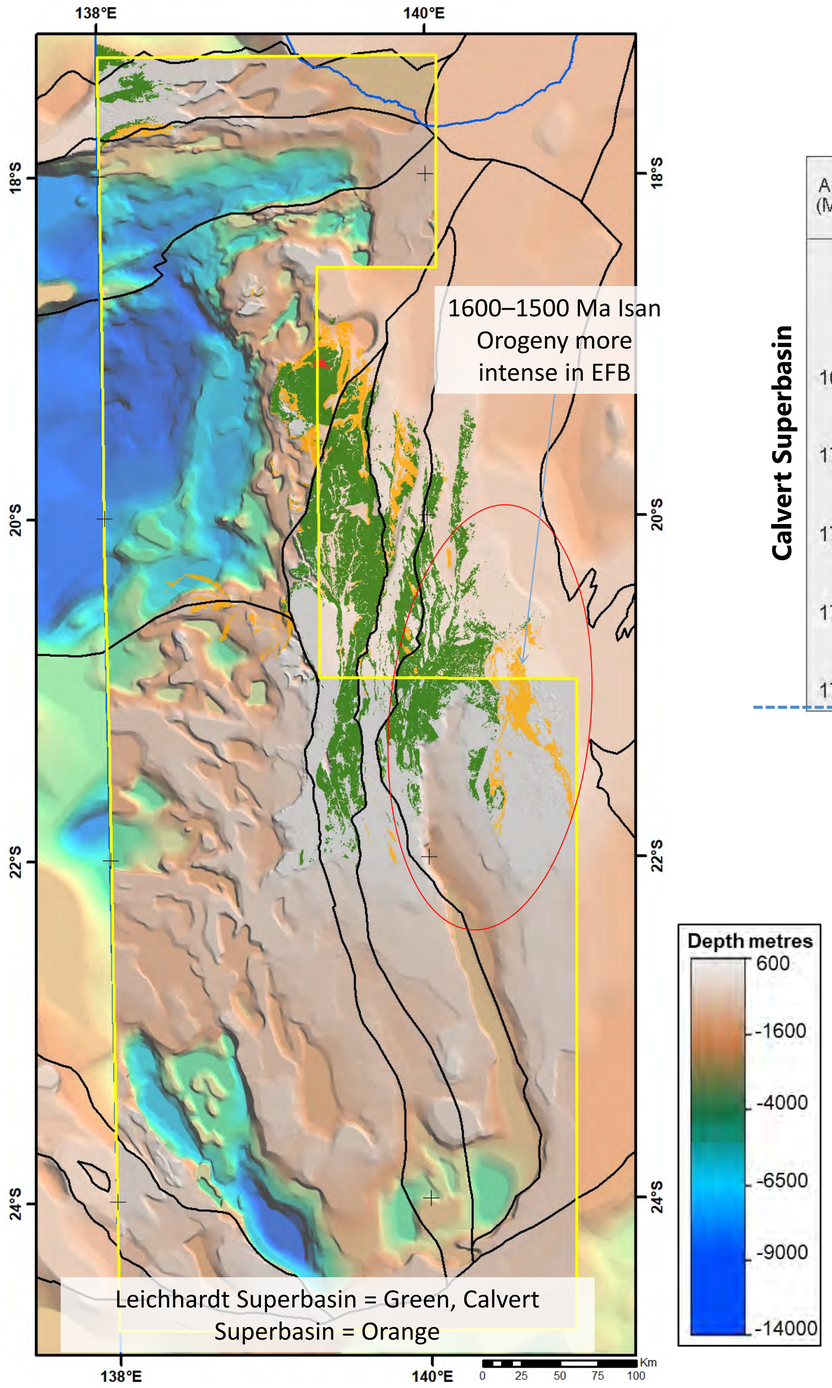
What is Basement

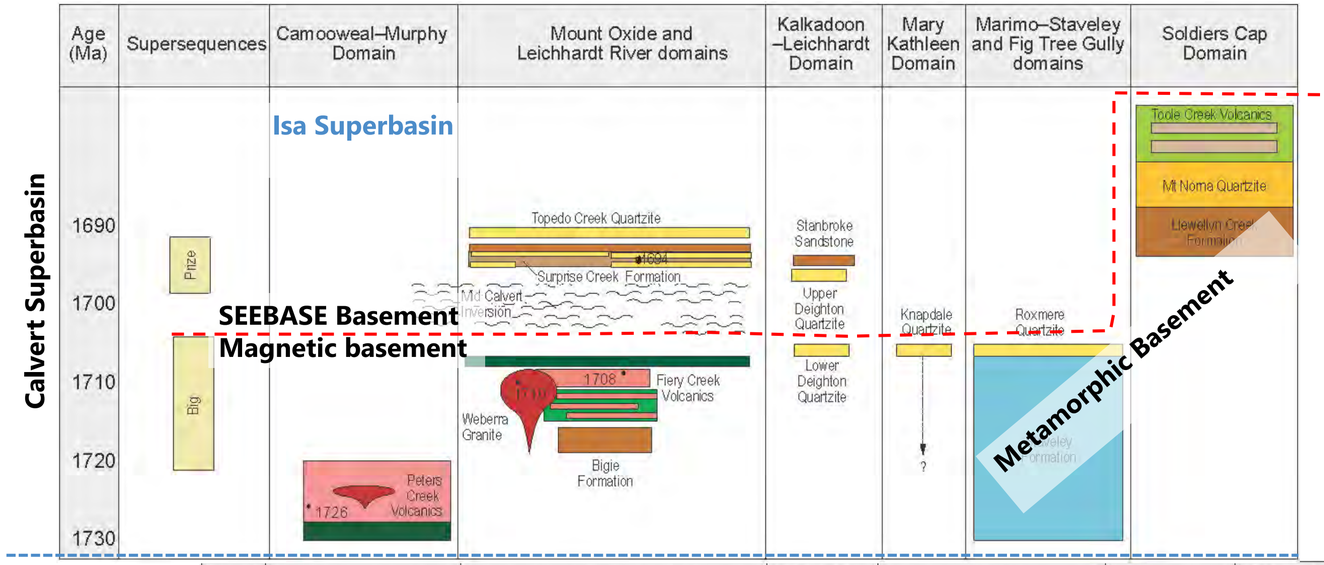


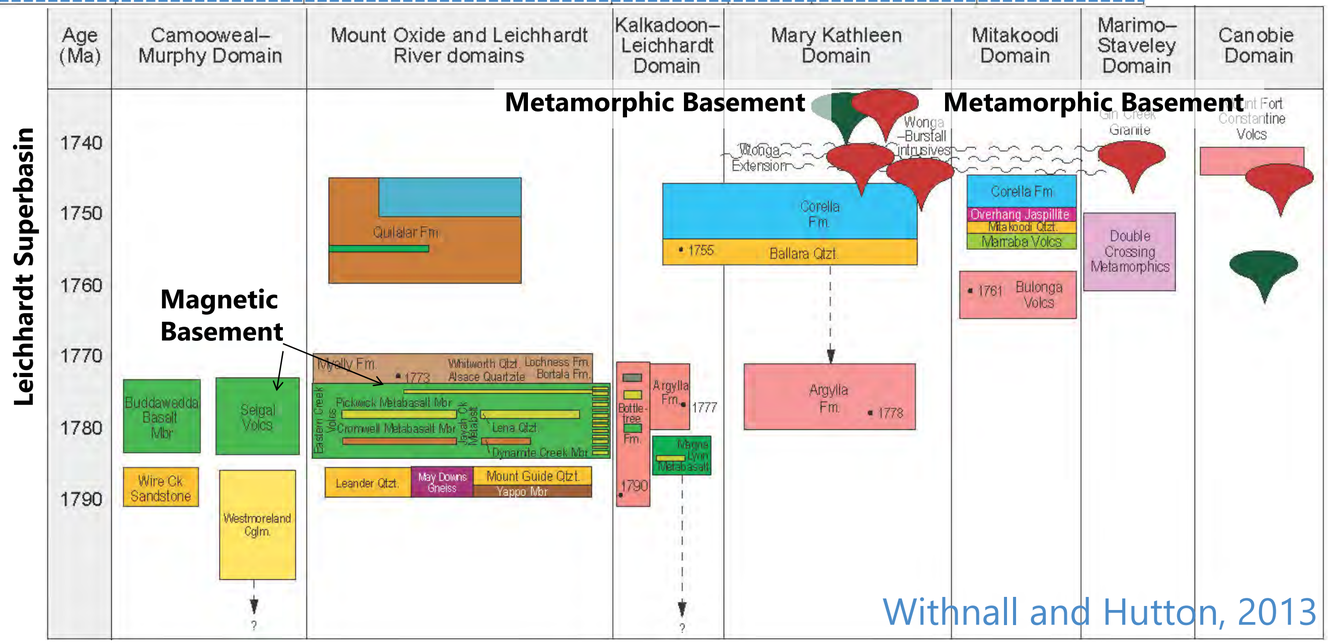


Withnall and Hutton, 2013

What is Basement



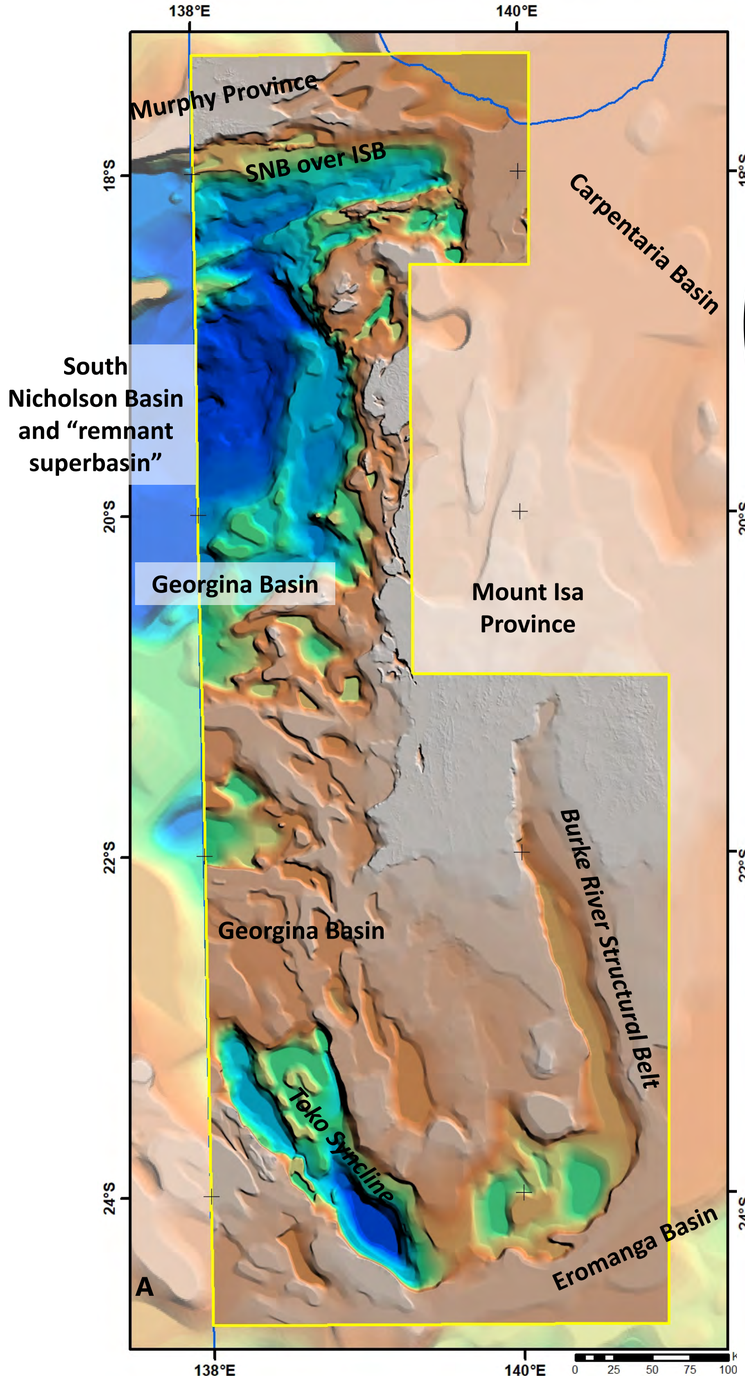


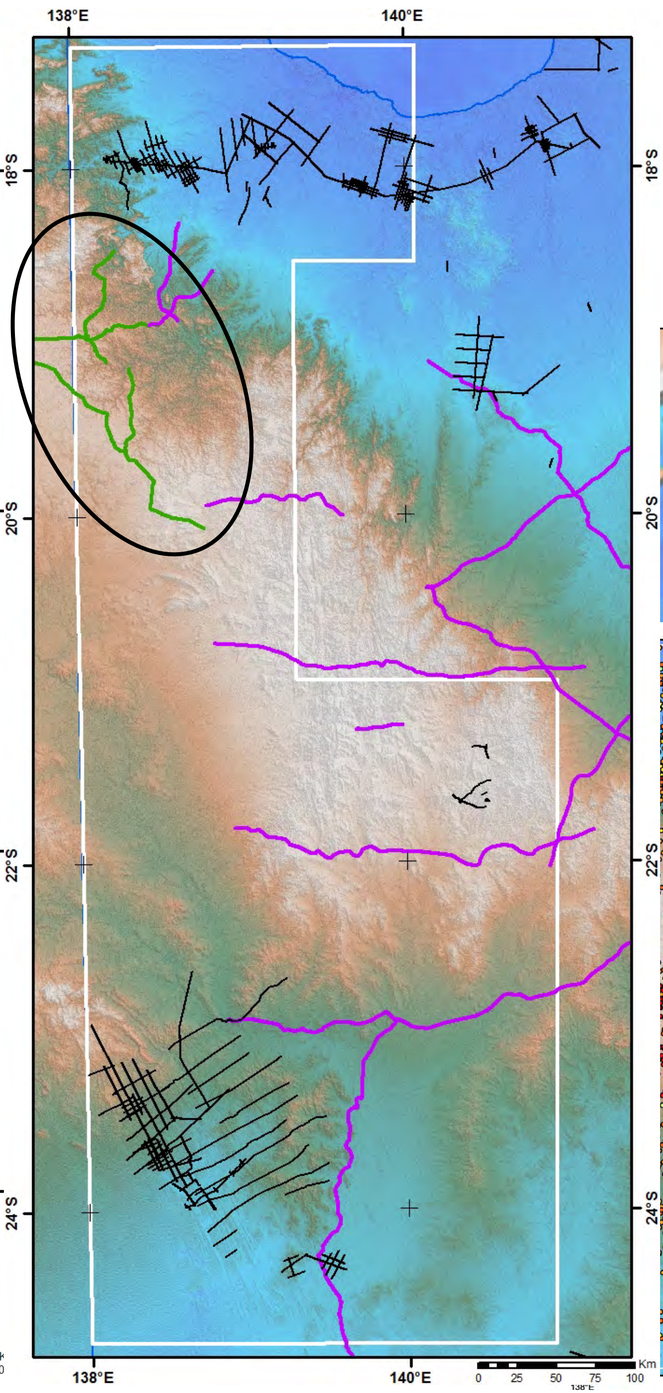


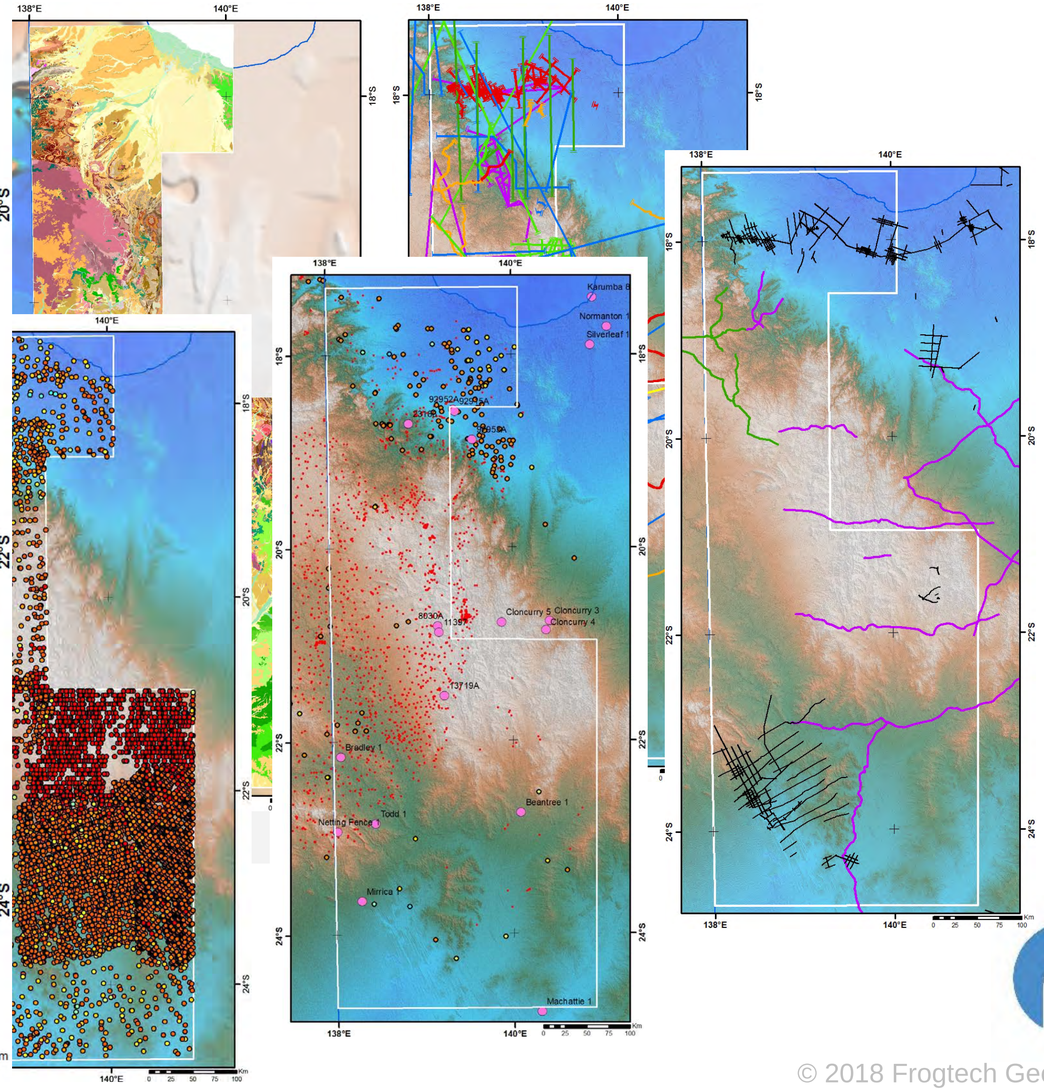
Withnall and Hutton, 2013

2018 SEEBASE

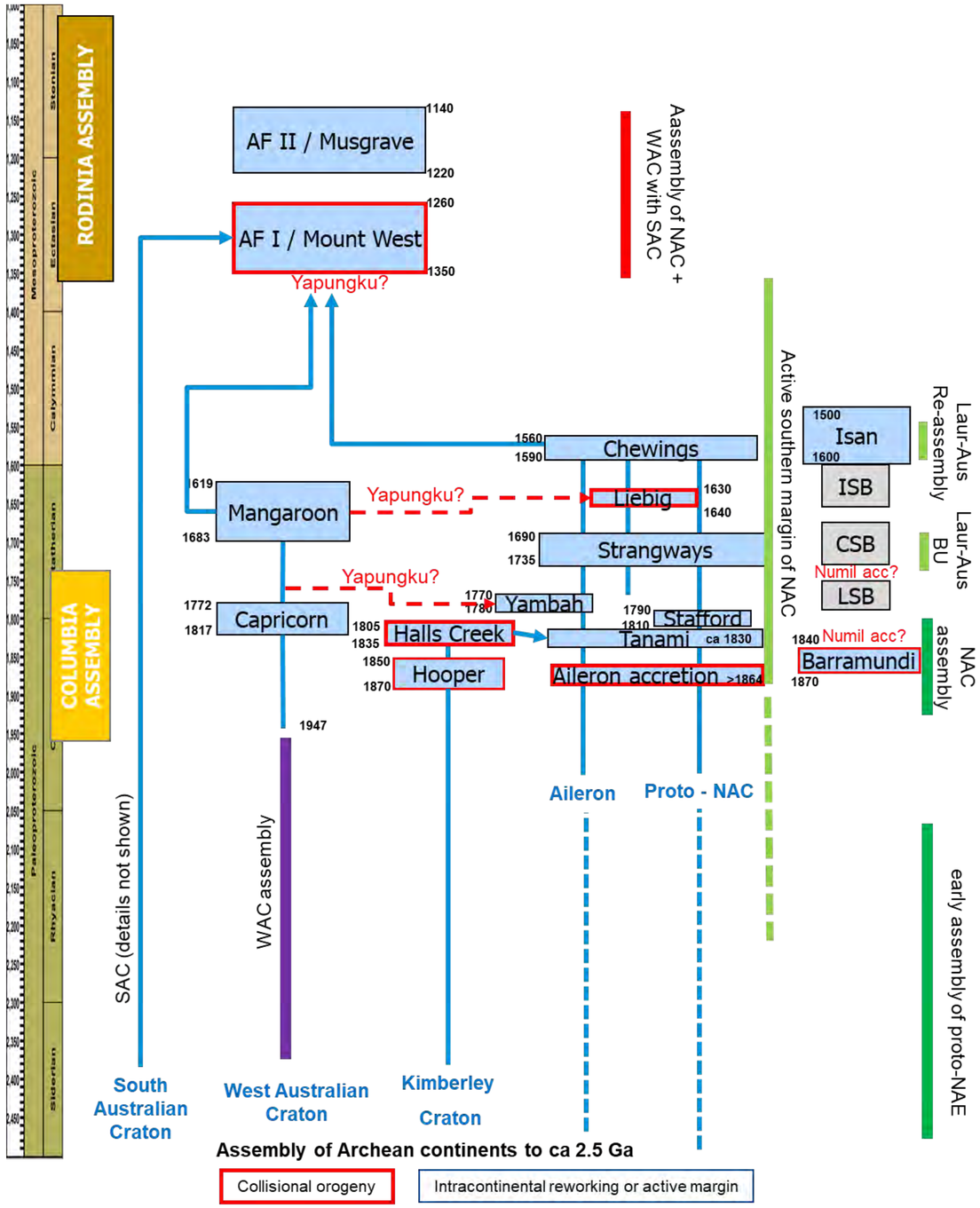
- Order of magnitude higher resolution
- Better data, better databases, and *more time*

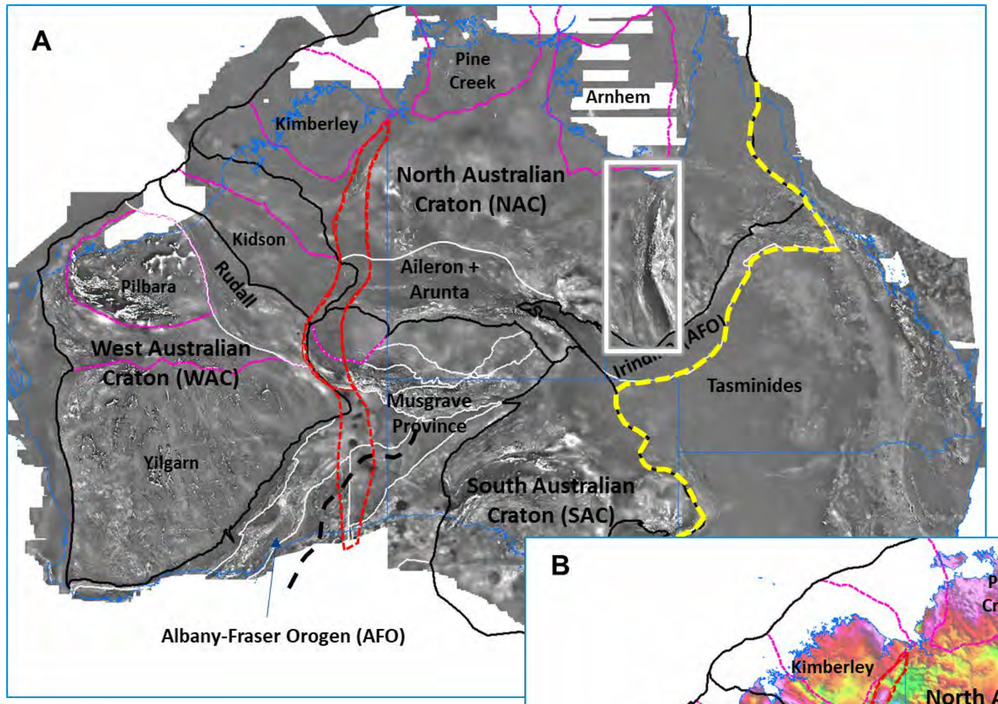


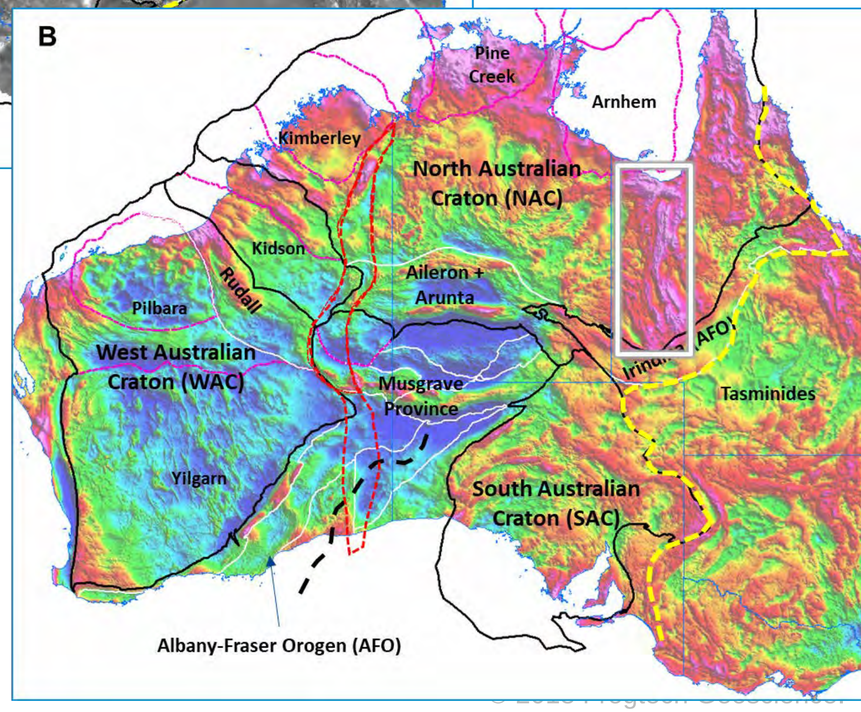




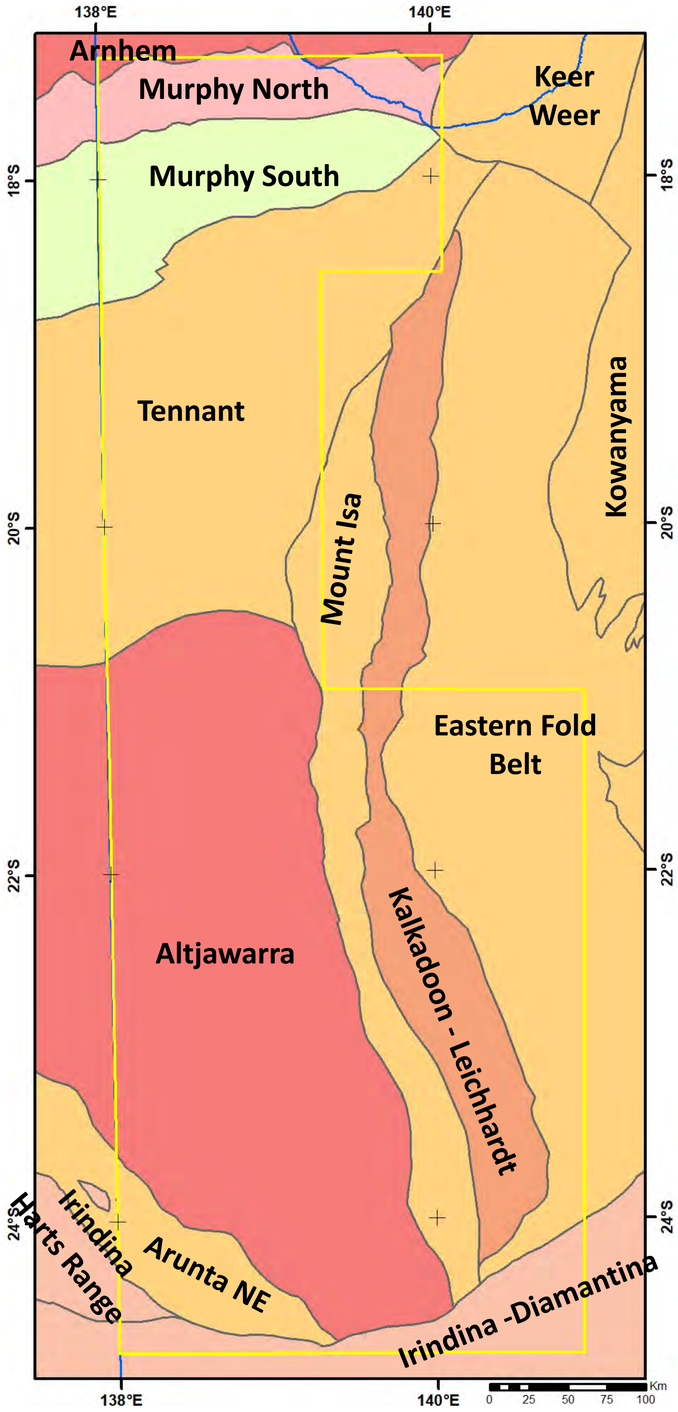
Tectonic Evolution



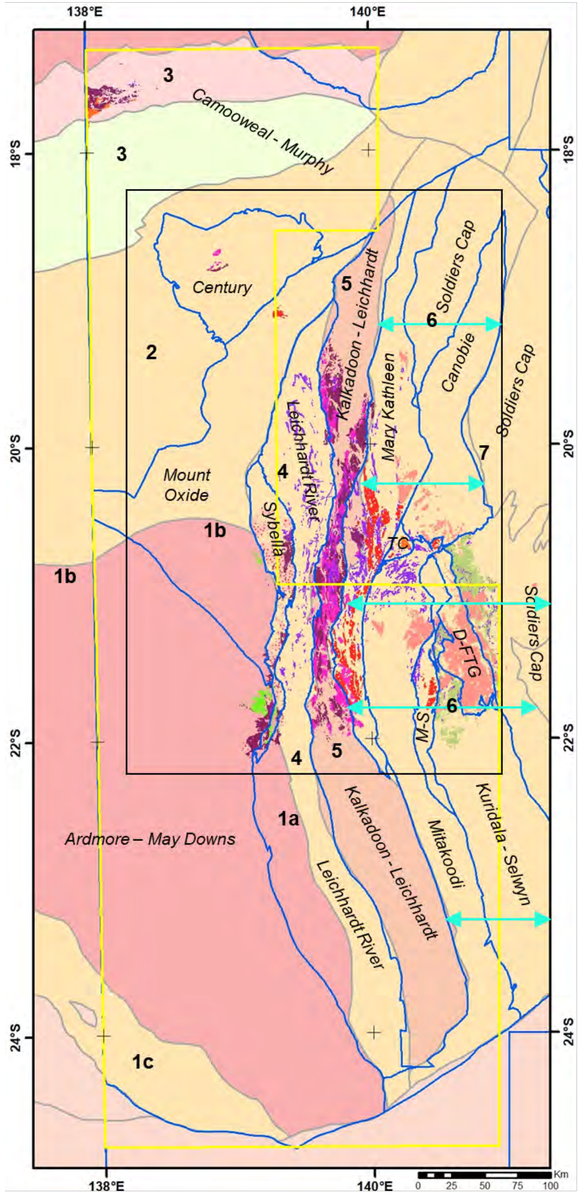


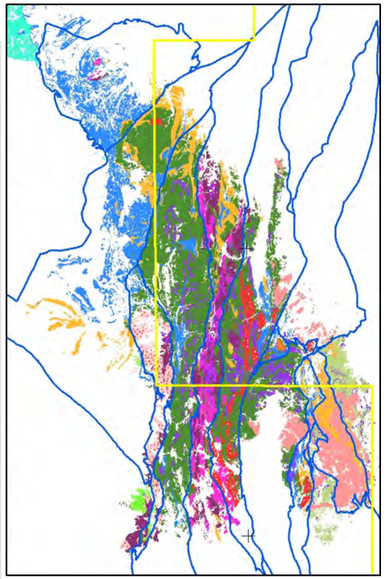


Basement Terranes



Legend

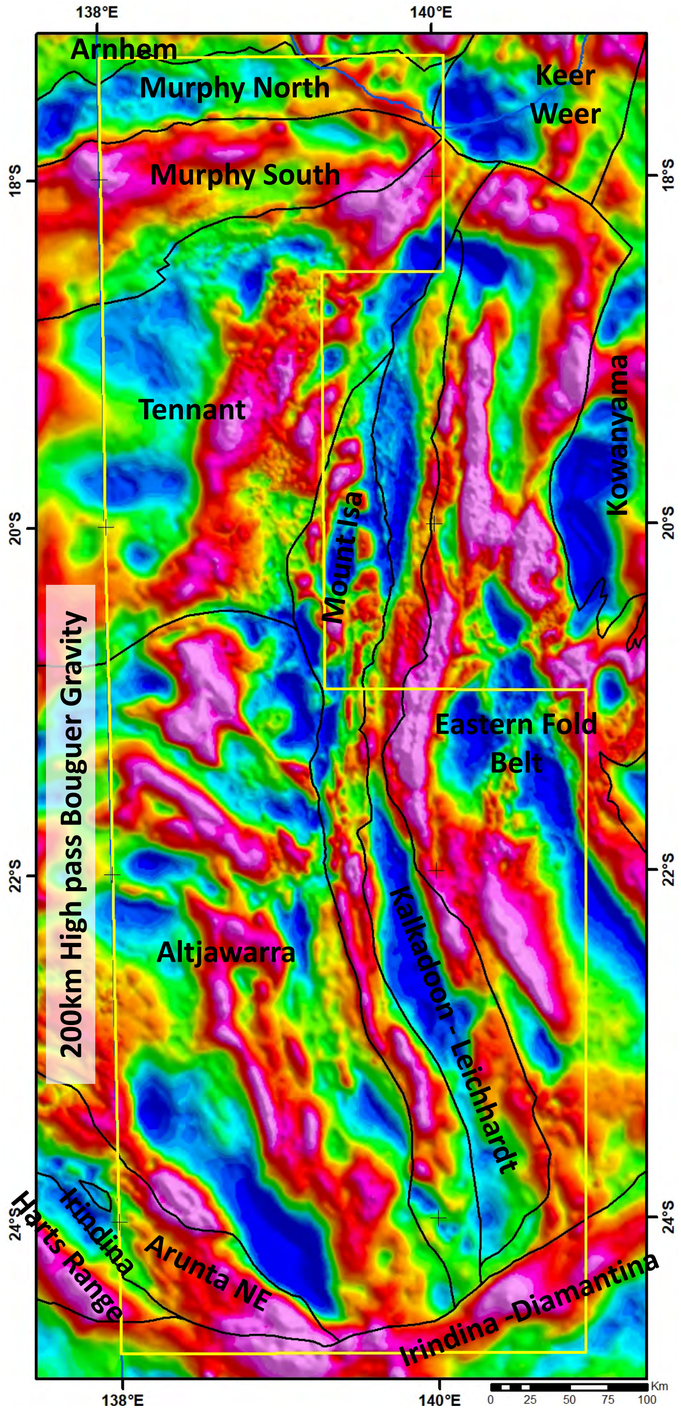


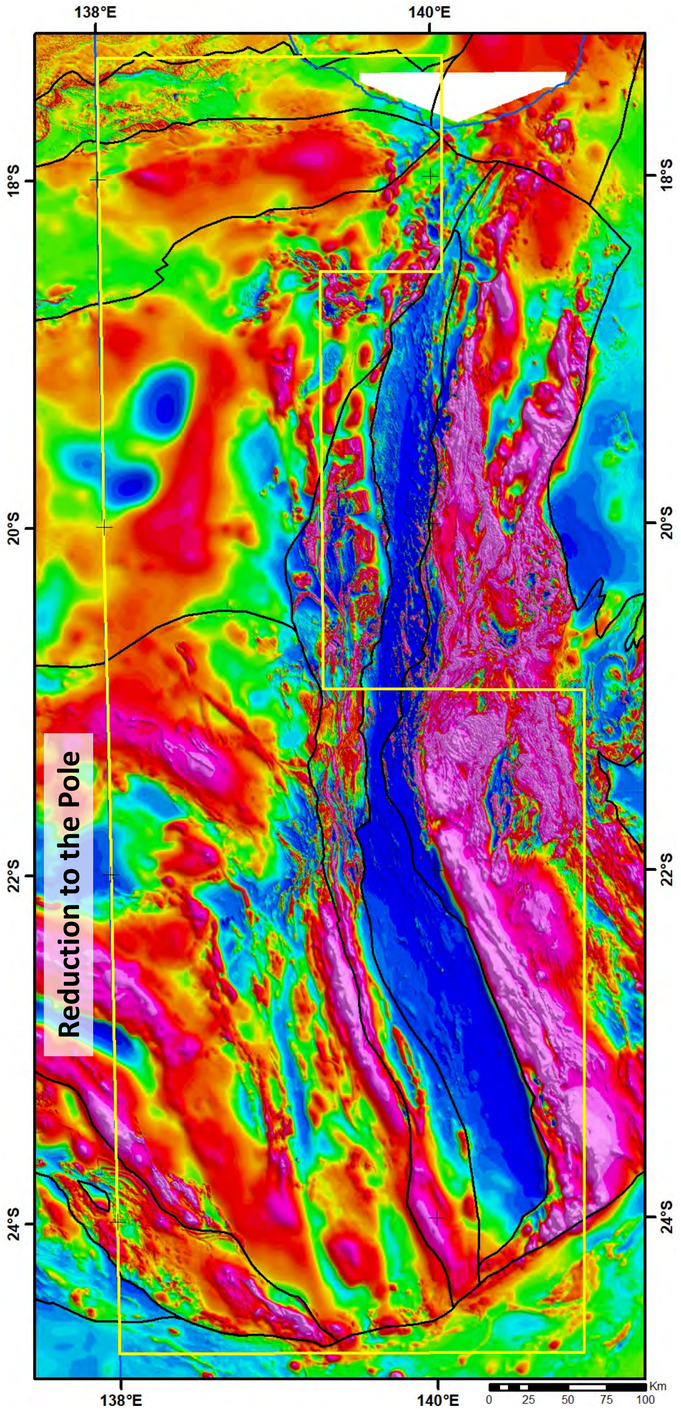


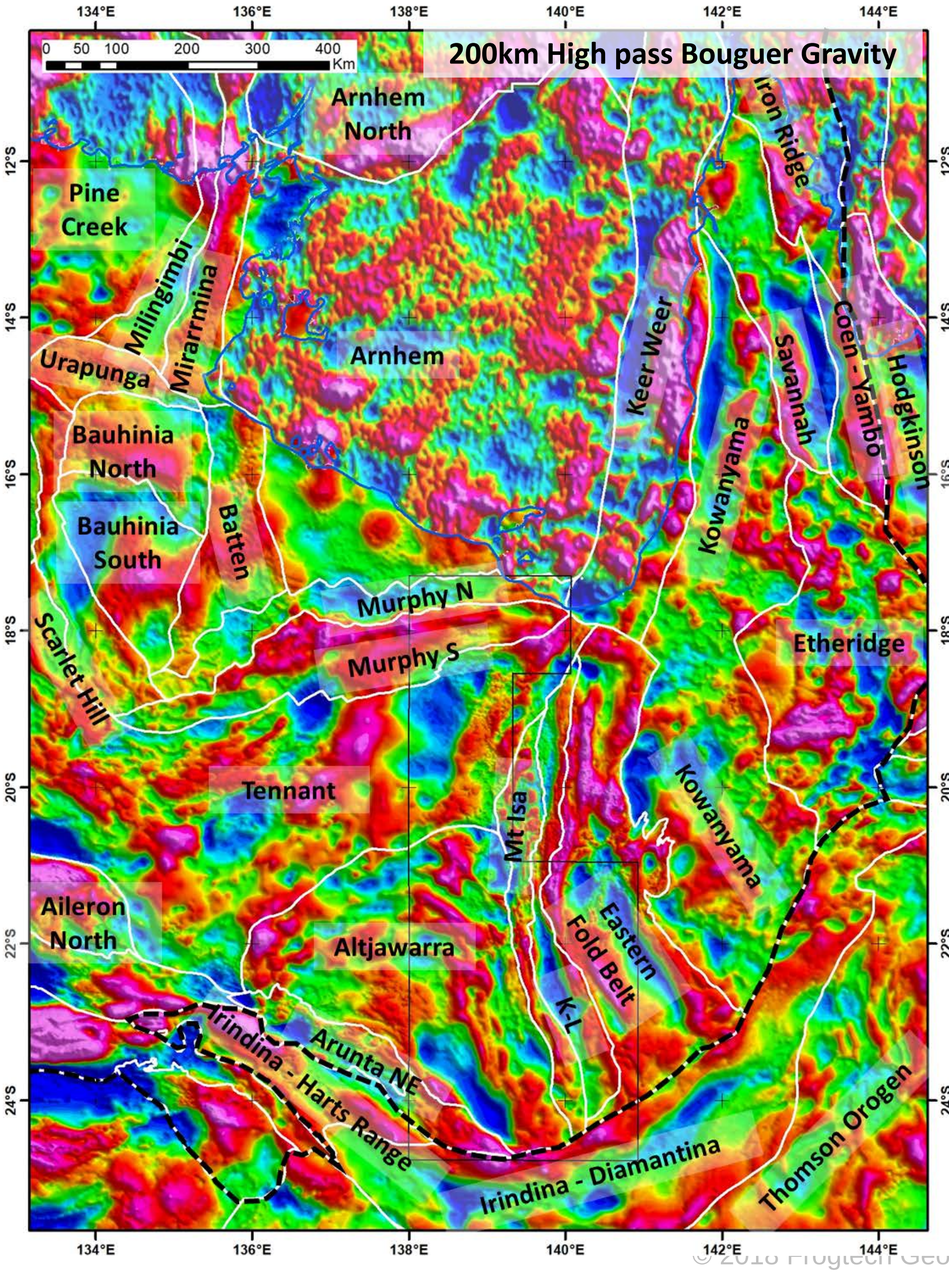
Superbasins – Simplified Geology

- <1500 Ma
- South Nicholson Basin
- Quamby Conglomerate
- Williams Igneous Event
- 1550-1500 Ma
- Esmeralda Igneous Event
- 1790-1600 Ma
- Mafic intrusive Events
- 1670-1590 Ma
- Isa Superbasin
- Tommy Creek Igneous Event
- Soldiers Cap/Kuridala
- Sybella Igneous Event
- 1730-1700 Ma
- Weberra Igneous Event
- Calvert Superbasin
- 1730-1740 Ma
- Wonga/Burstall Igneous Intrusives
- Wonga/Burstall Igneous Extrusives
- Arunta Block granitoids
- 1800-1740 Ma
- Leichhardt Superbasin
- 1870-1800 Ma
- Nicholson Igneous Event
- Big Toby Igneous Event
- Yeldham Igneous Event
- Kalkadoon Igneous Event
- Syn- and post-Barramundi rocks
- >1870 Ma
- Pre-Barramundi basement

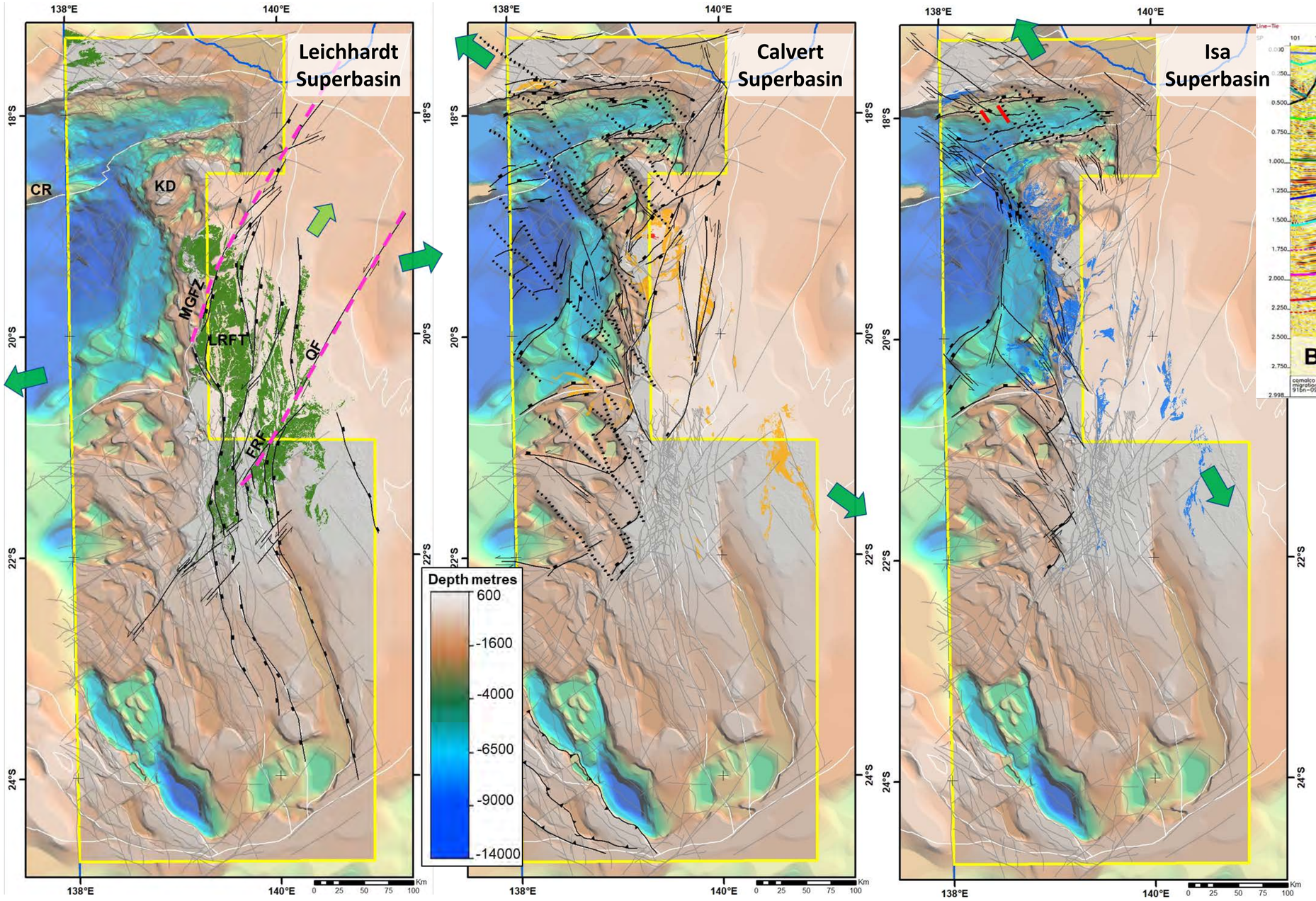
Basement Terranes

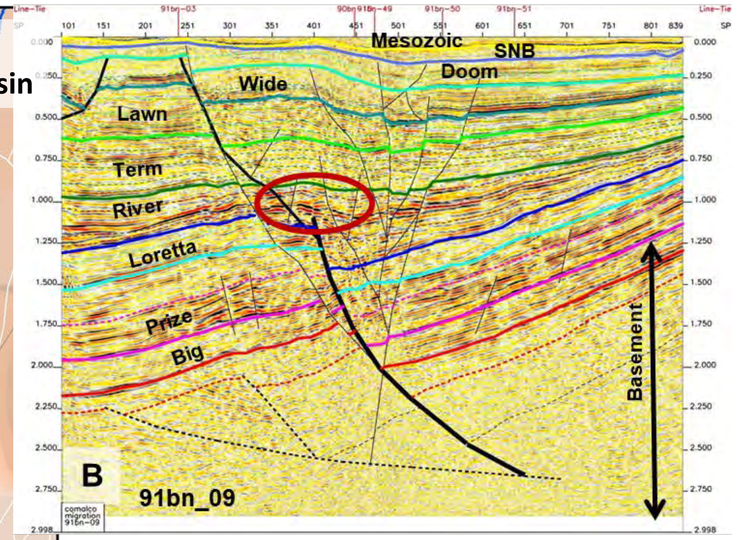


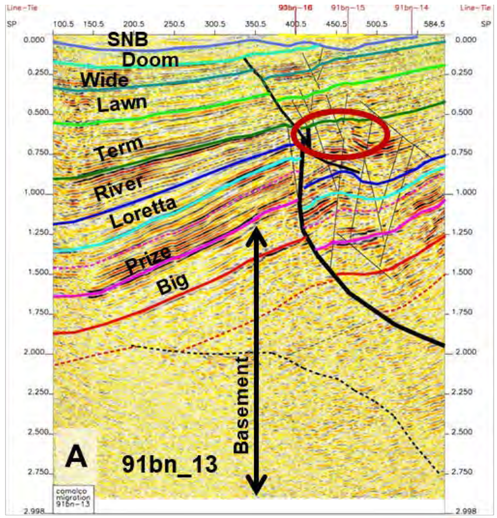




Structural Evolution

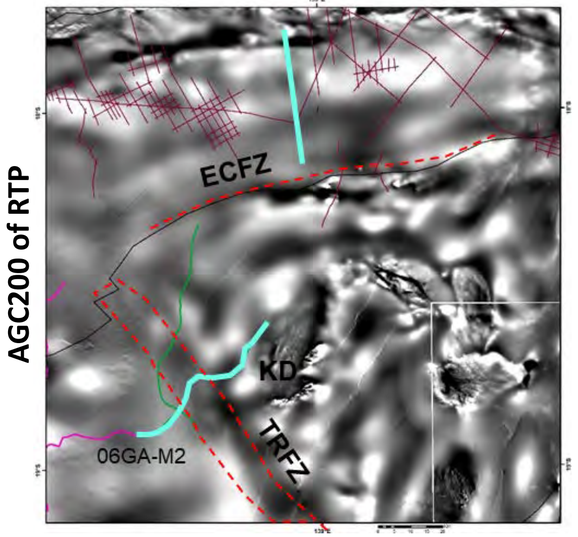




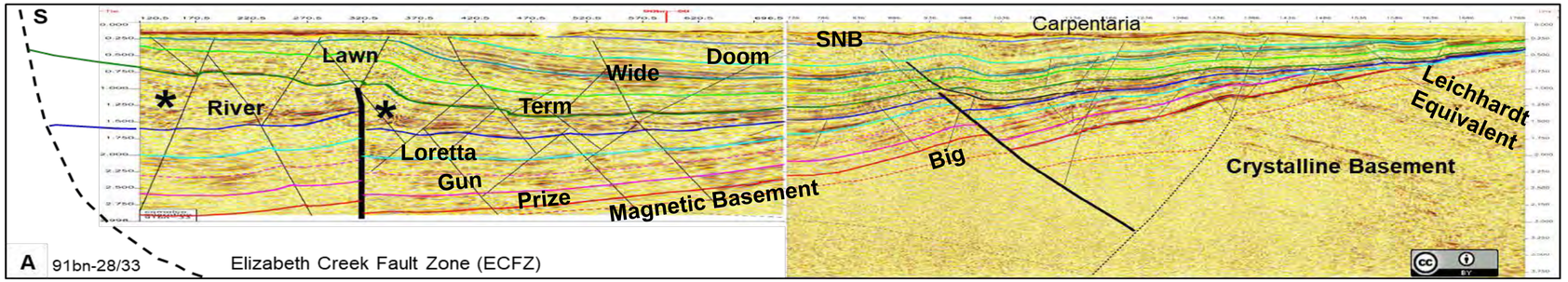


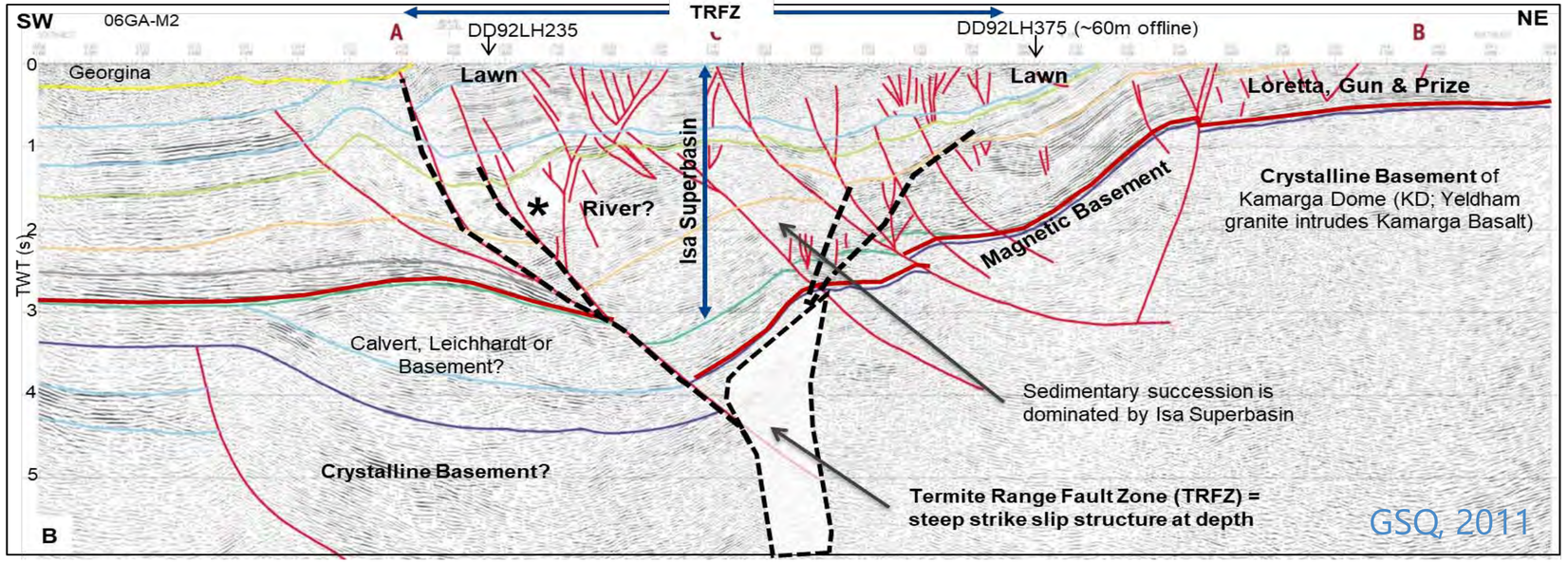
Bradshaw and Scott, 1999

Structural Evolution

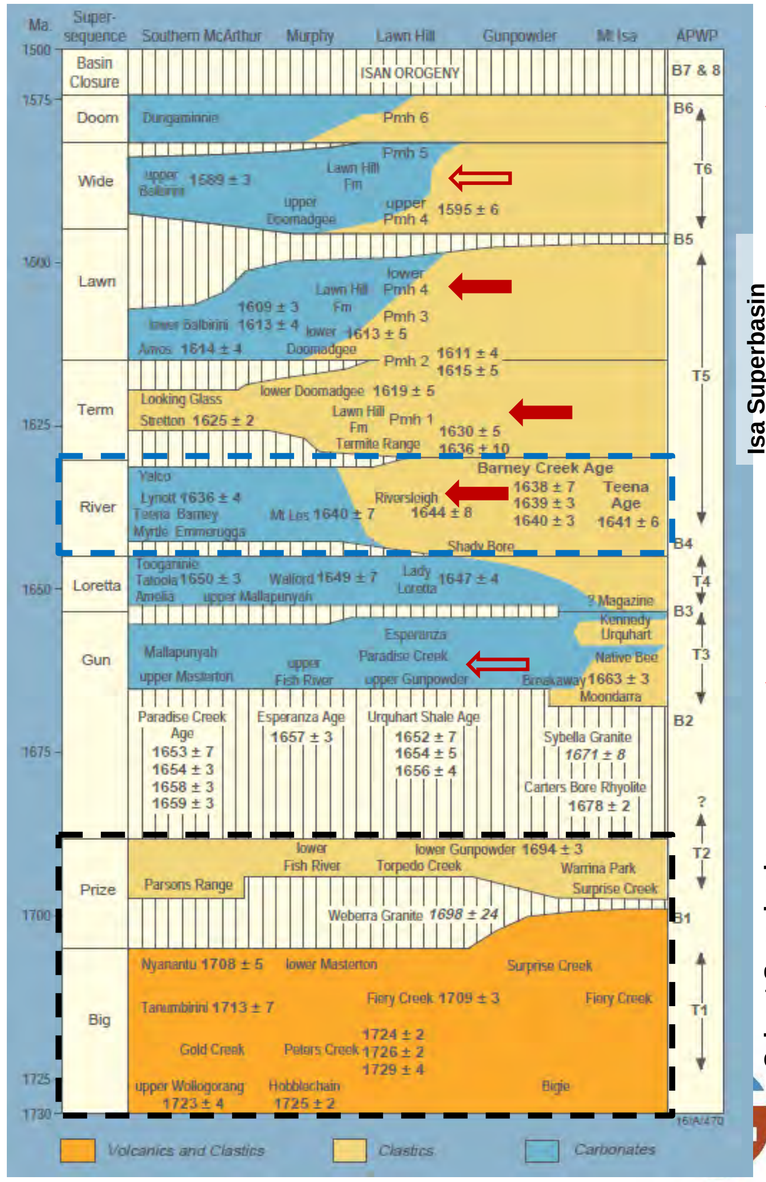


Murphy High





GSQ, 2011



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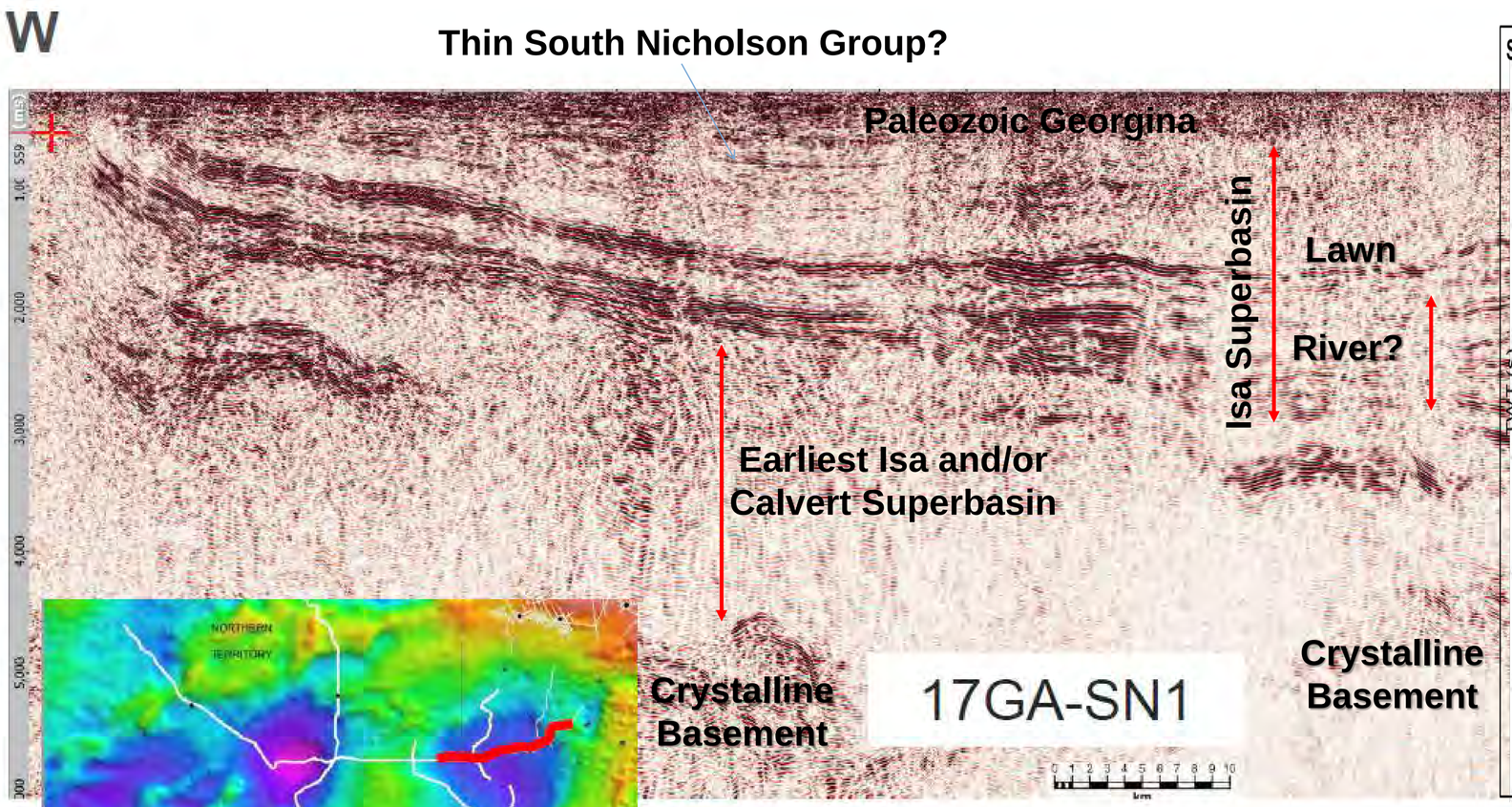
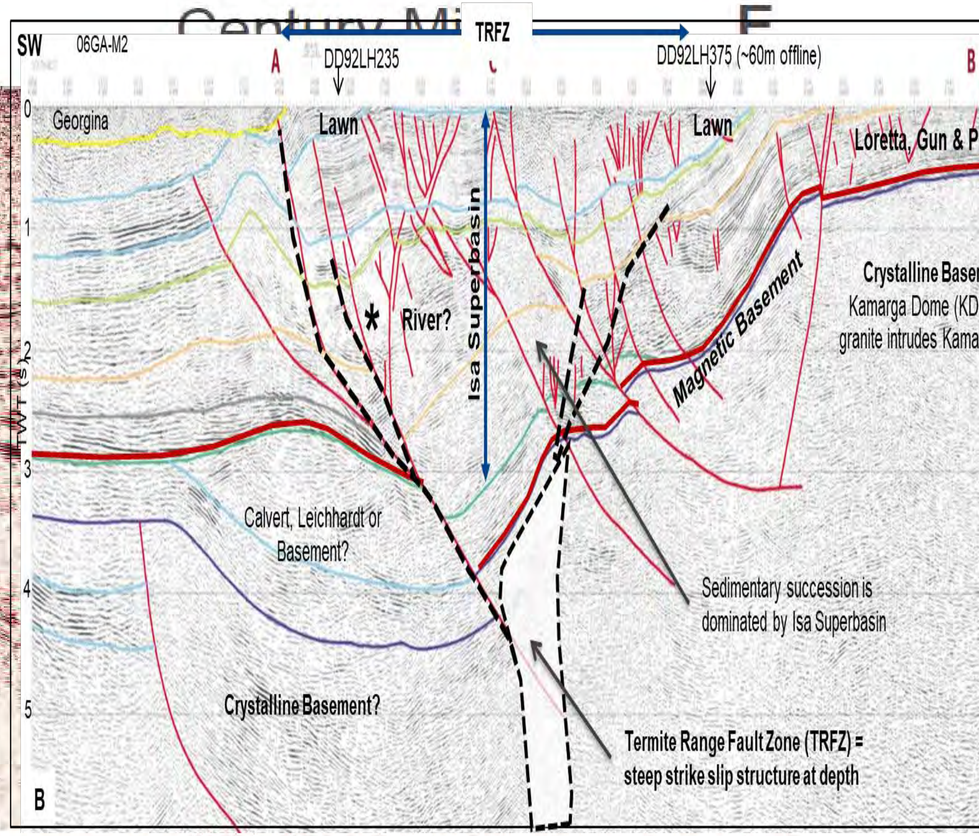
Structural Evolution





Henson et al. 2018 AGES Conference

“Remnant Superbasin” Sediment-fill

Outcrop Lady Loretta and Esperanza

S

N

Paleozoic Georgina

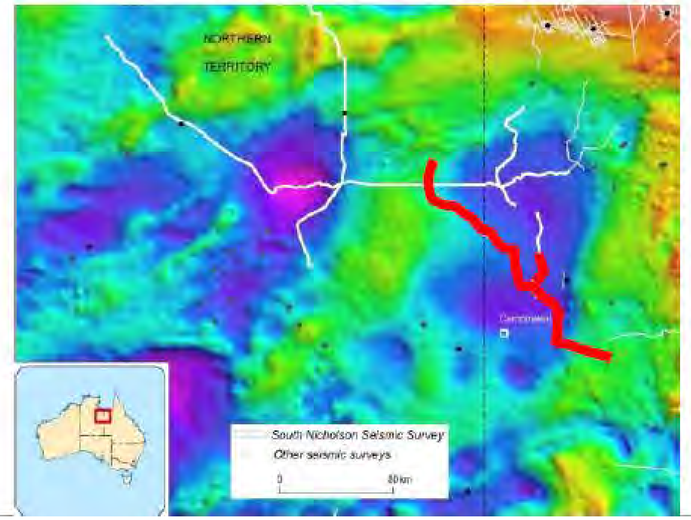
Isa

Carrara Range

Crystalline Basement

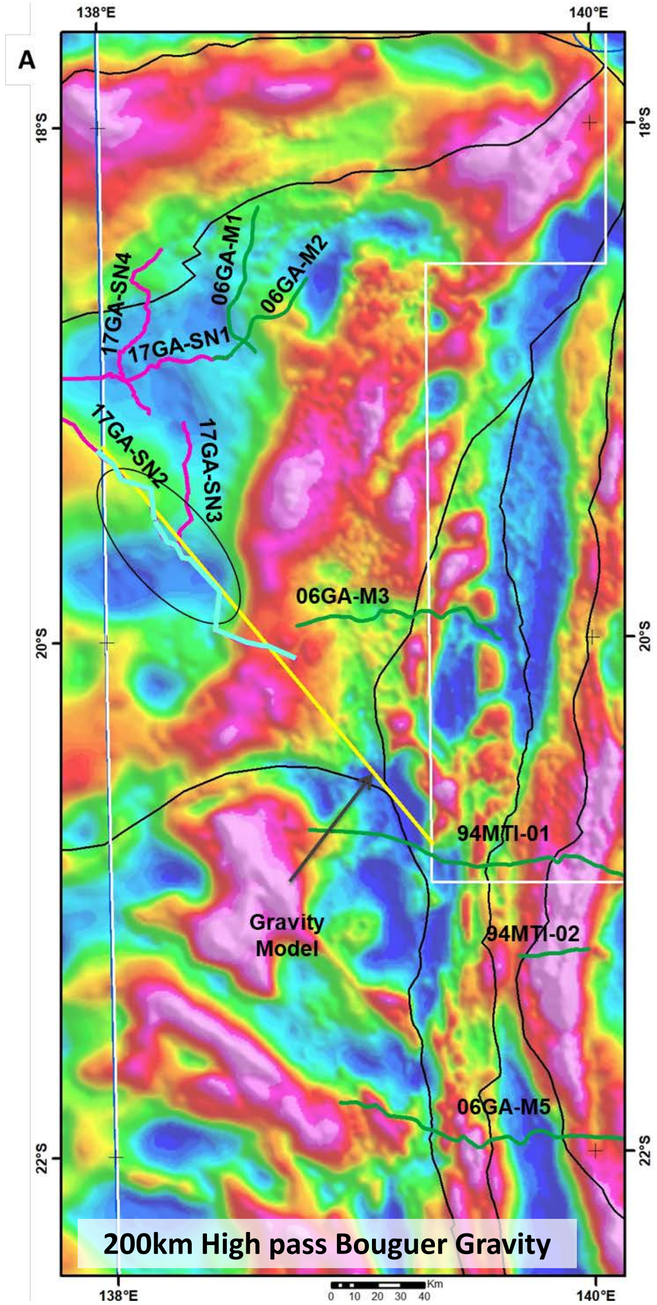
17GA-SN2

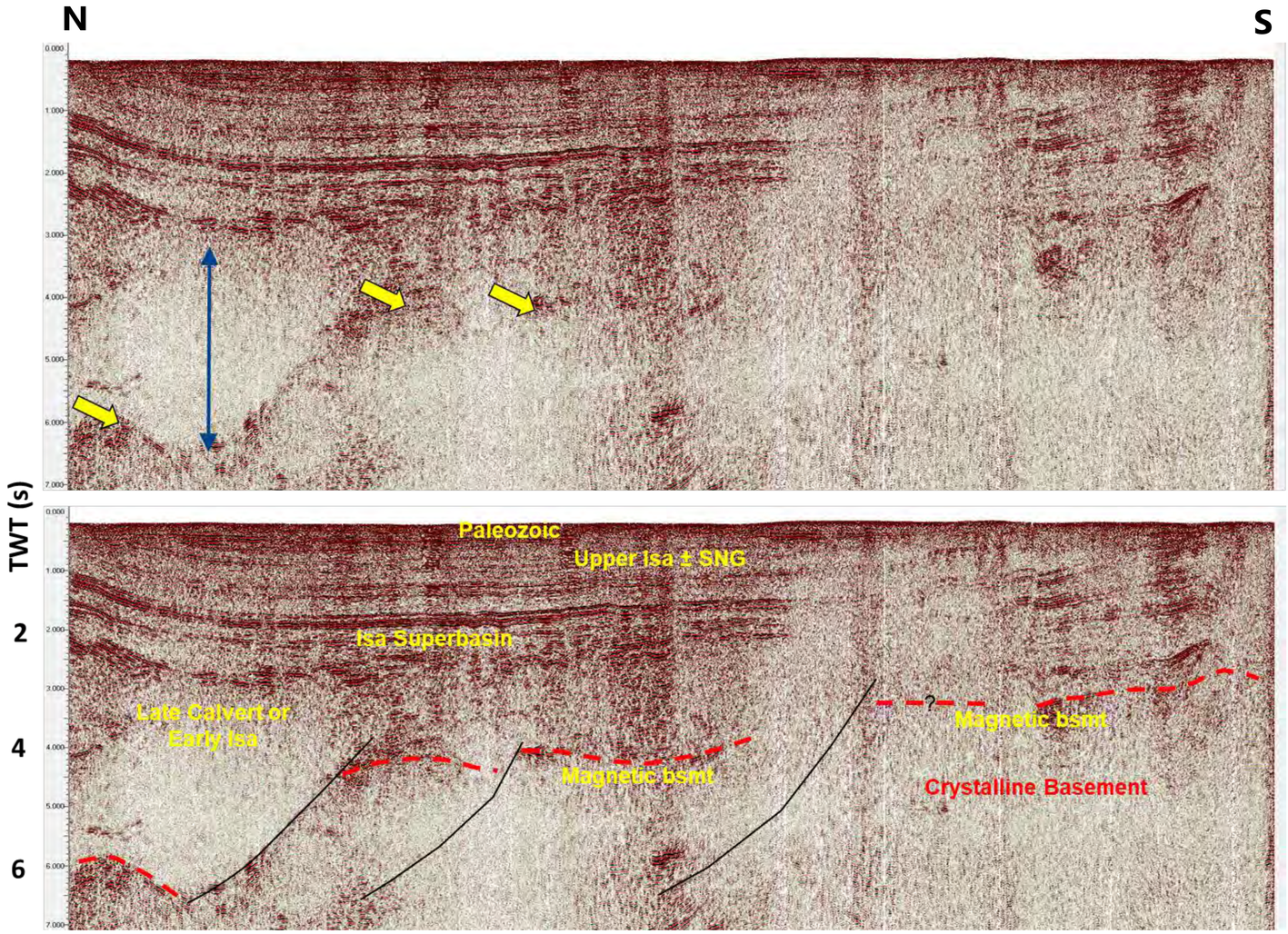
17GA-SN3



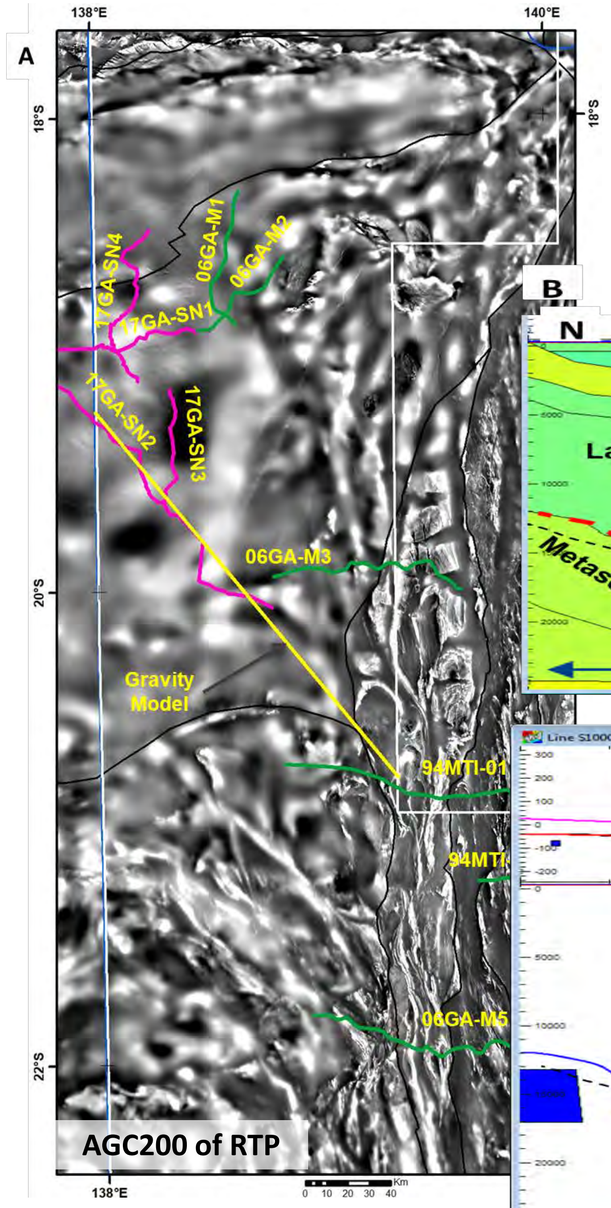
Henson et al. 2018 AGES Conference

“Remnant Superbasin” Sediment-fill

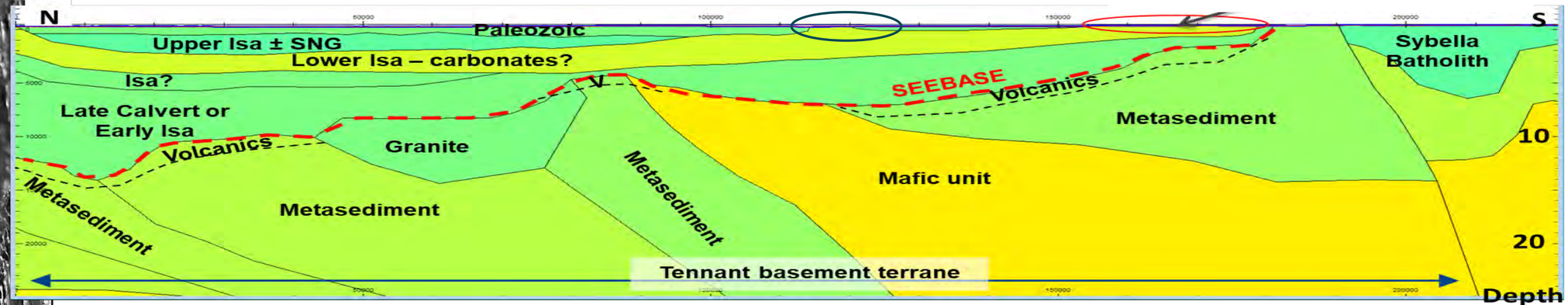


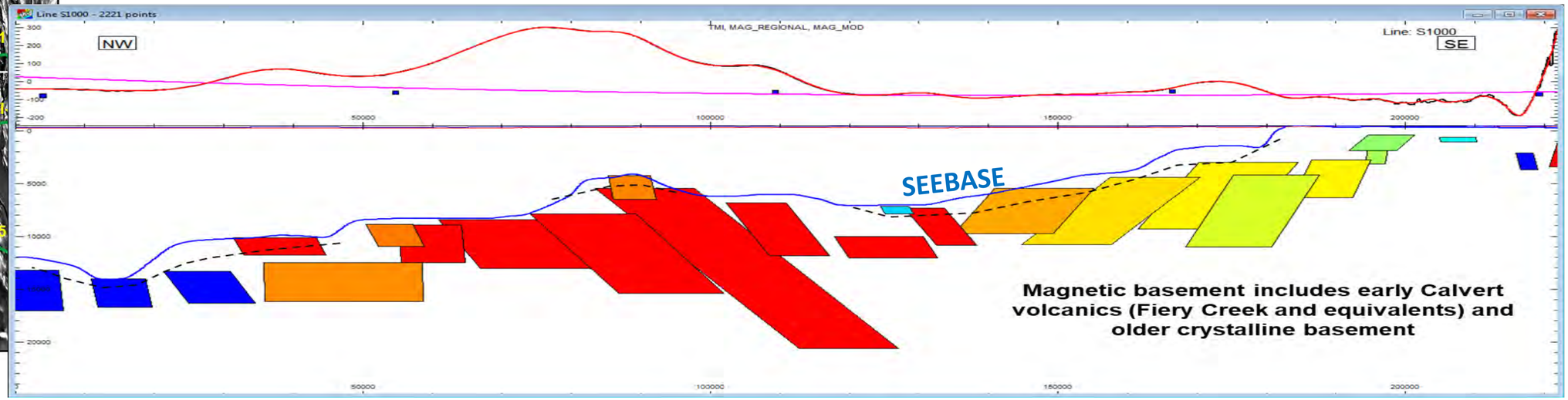


Gravity Modelling

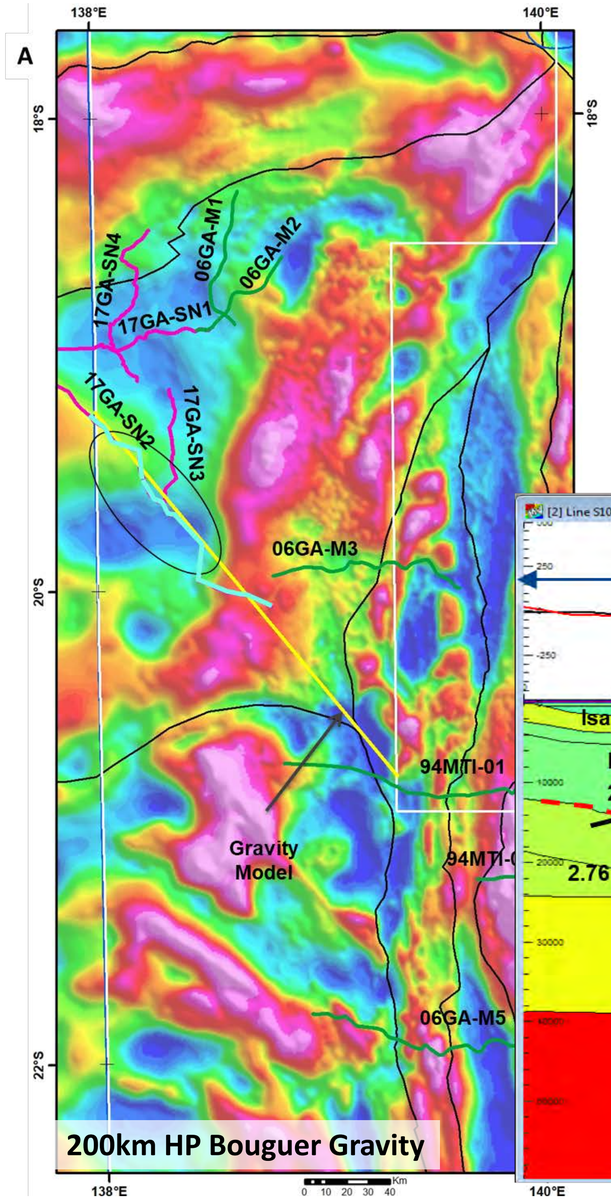


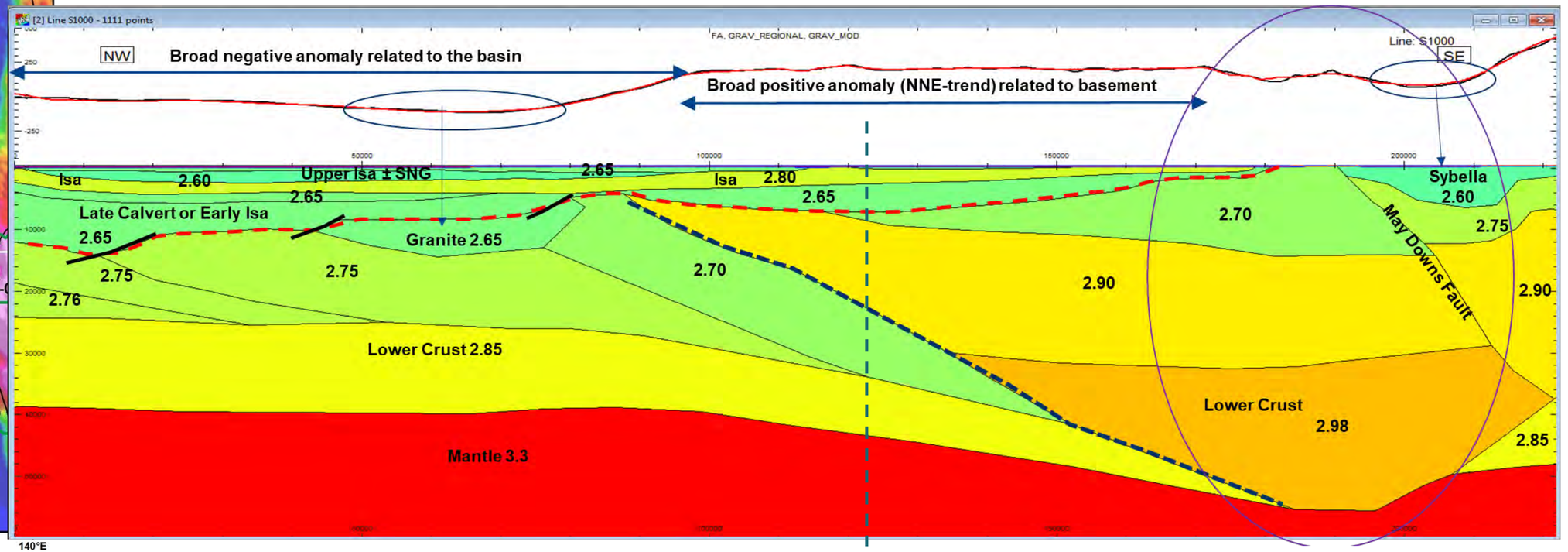
Lady Loretta and Esperanza outcrop





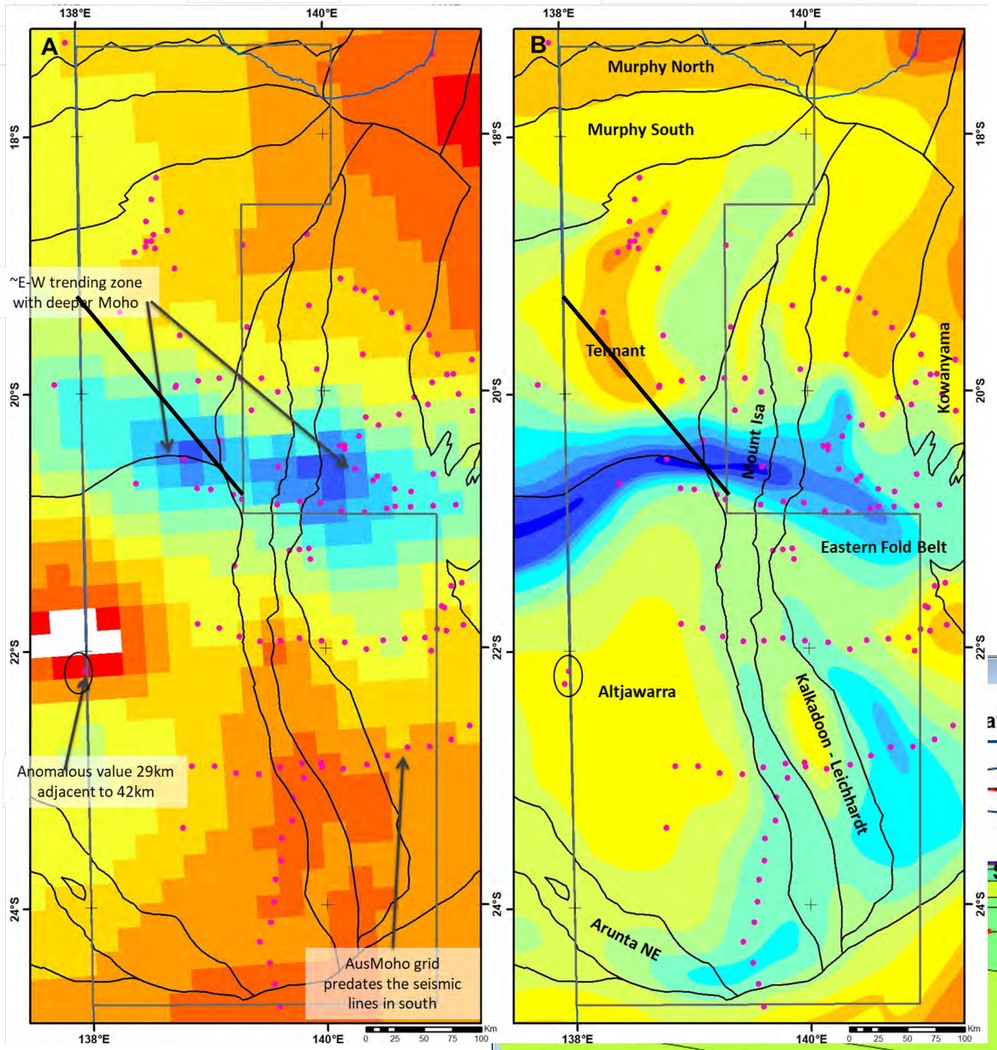
Gravity Modelling

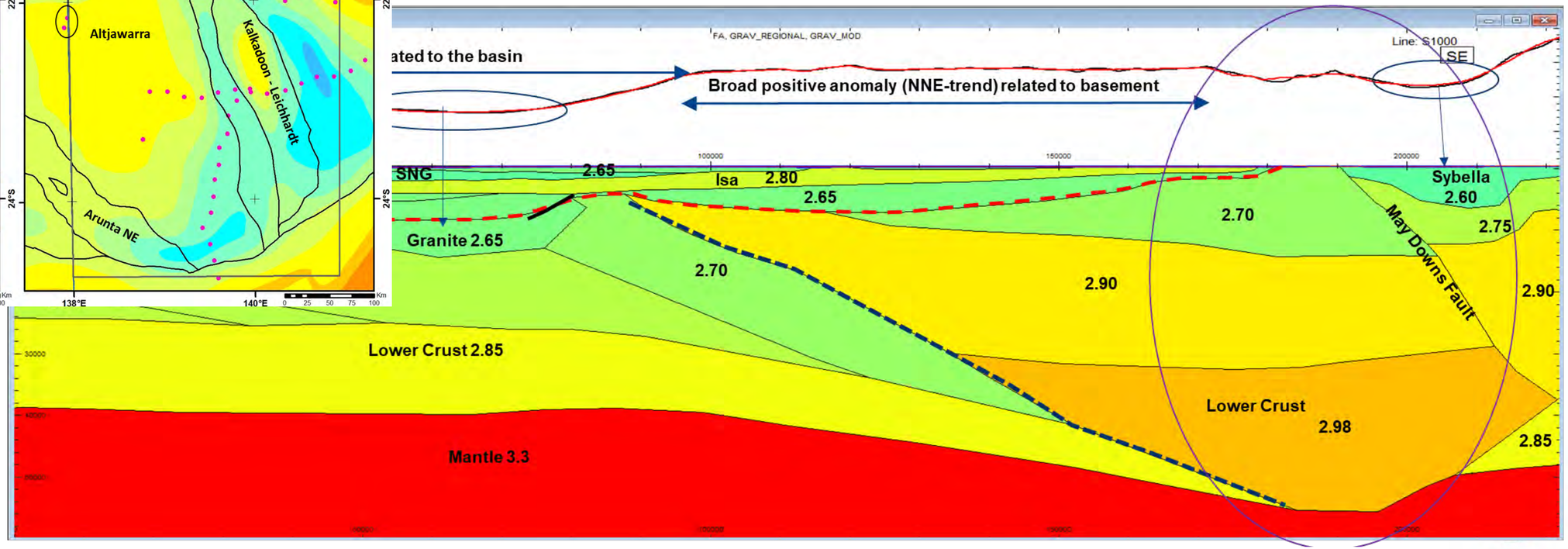




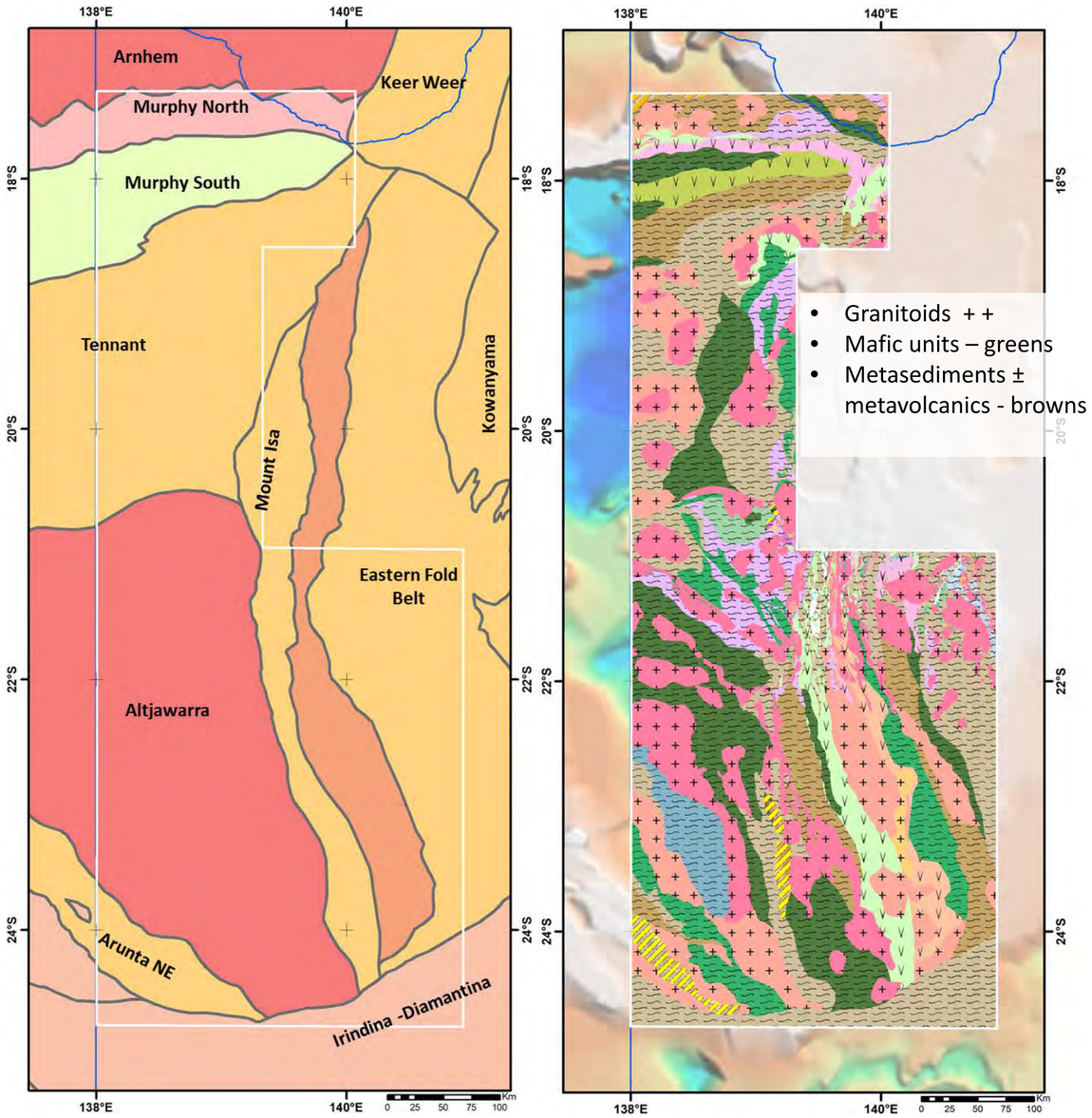
Units coloured by relative density (values g/cc)

Gravity Modelling

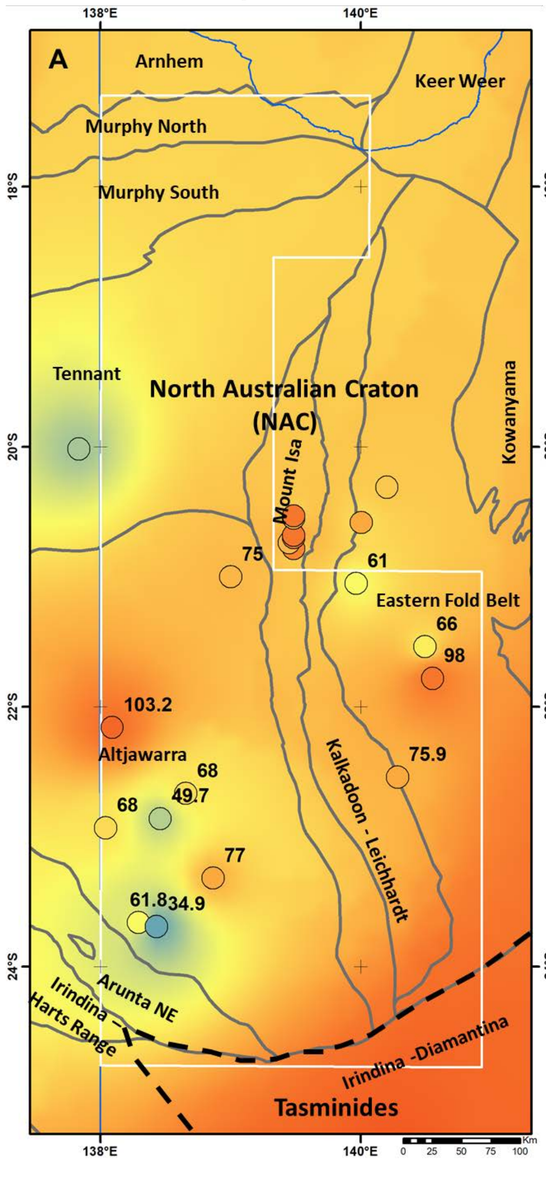




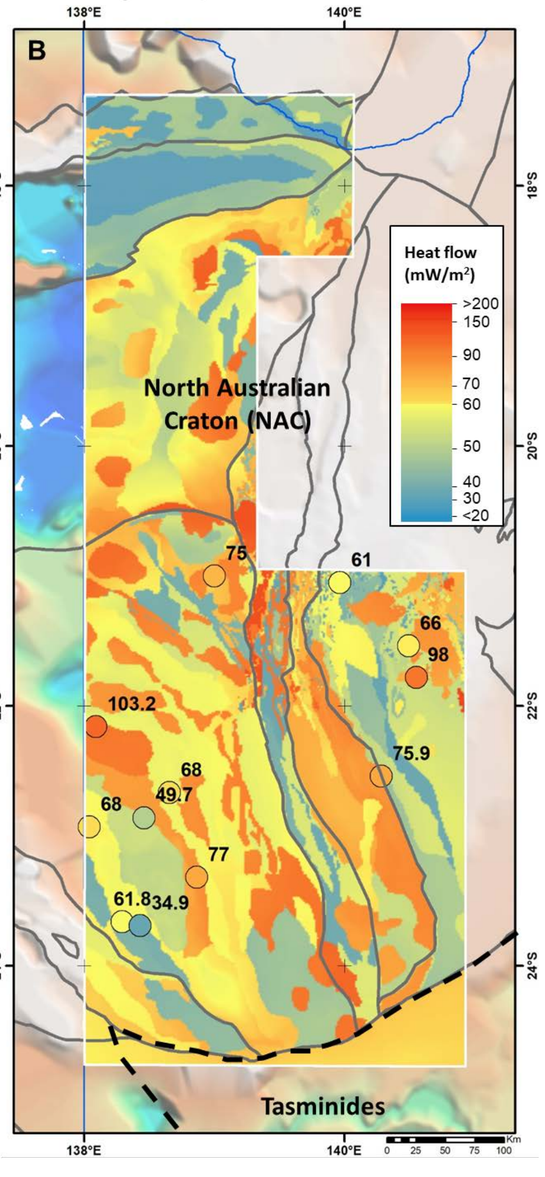
Basement Composition and Heat Flow



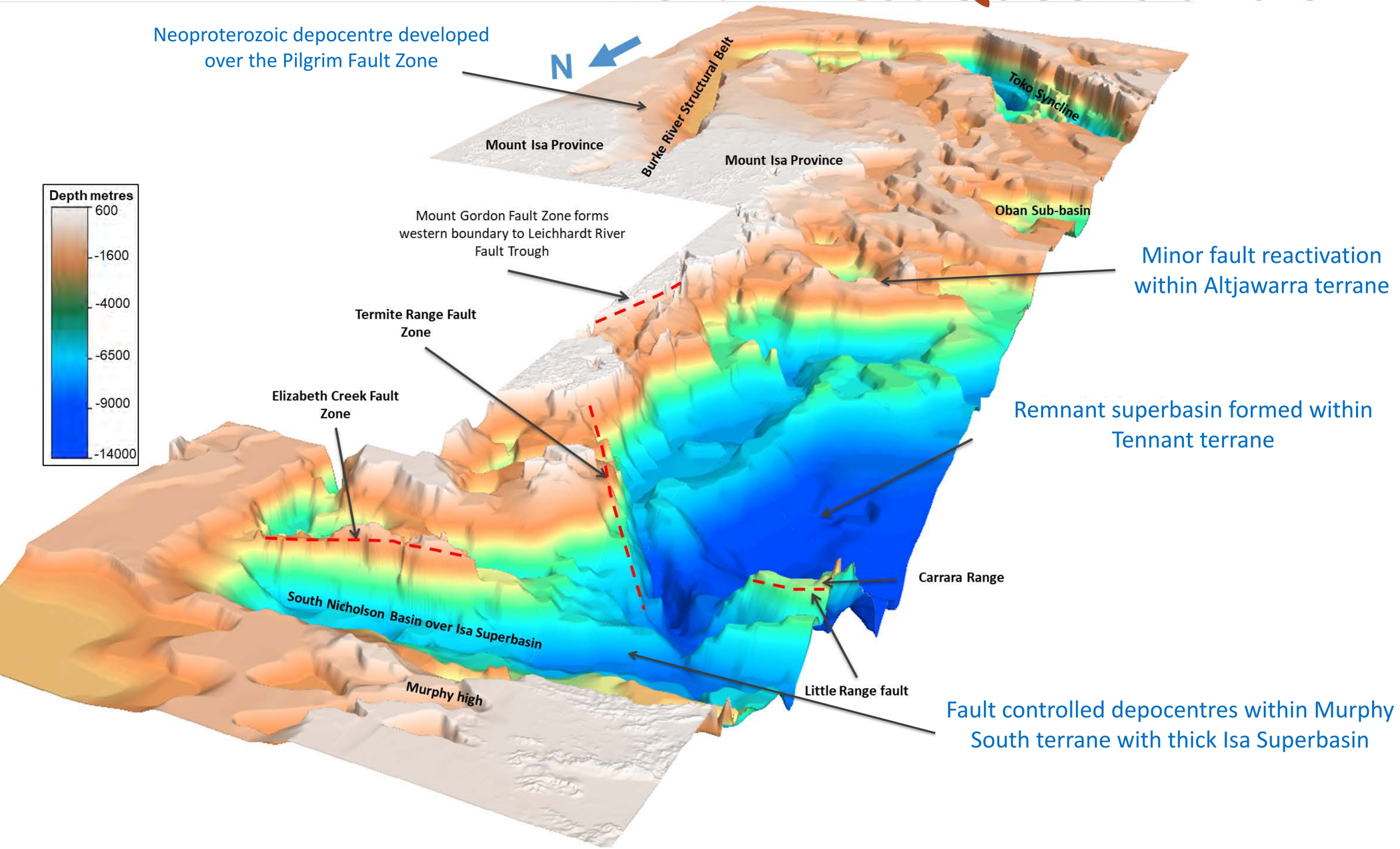
Interpolated Grid



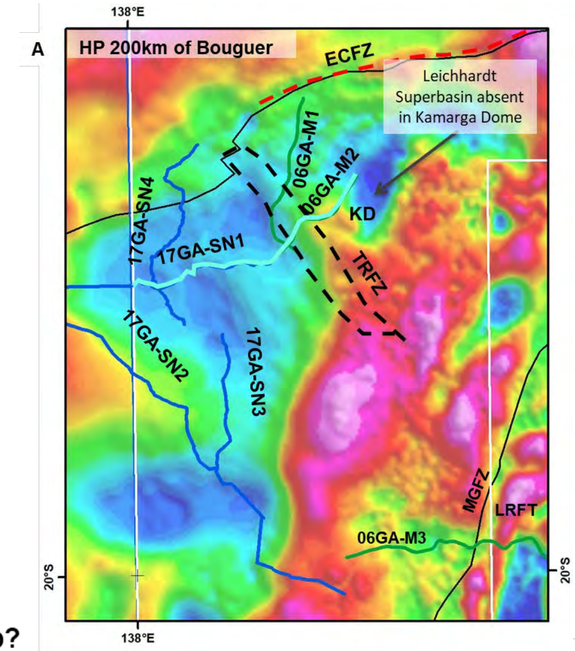
Geologically-constrained Model

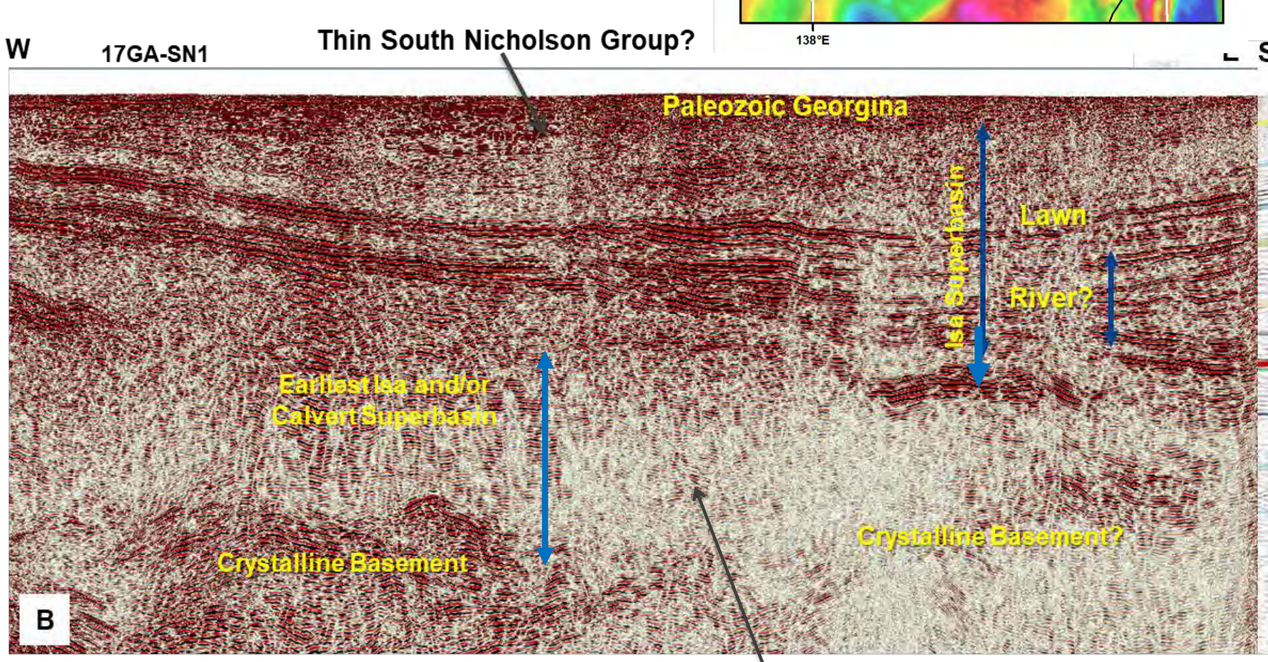


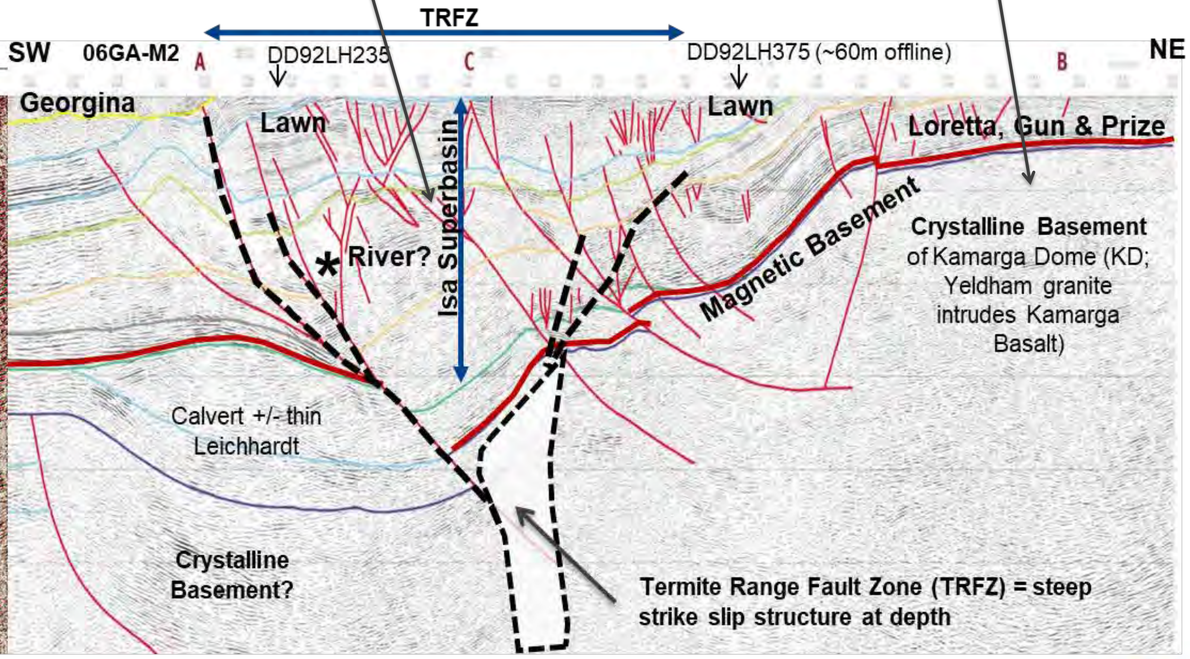
North West Queensland SEEBASE



Sediment fill of the remnant superbasin



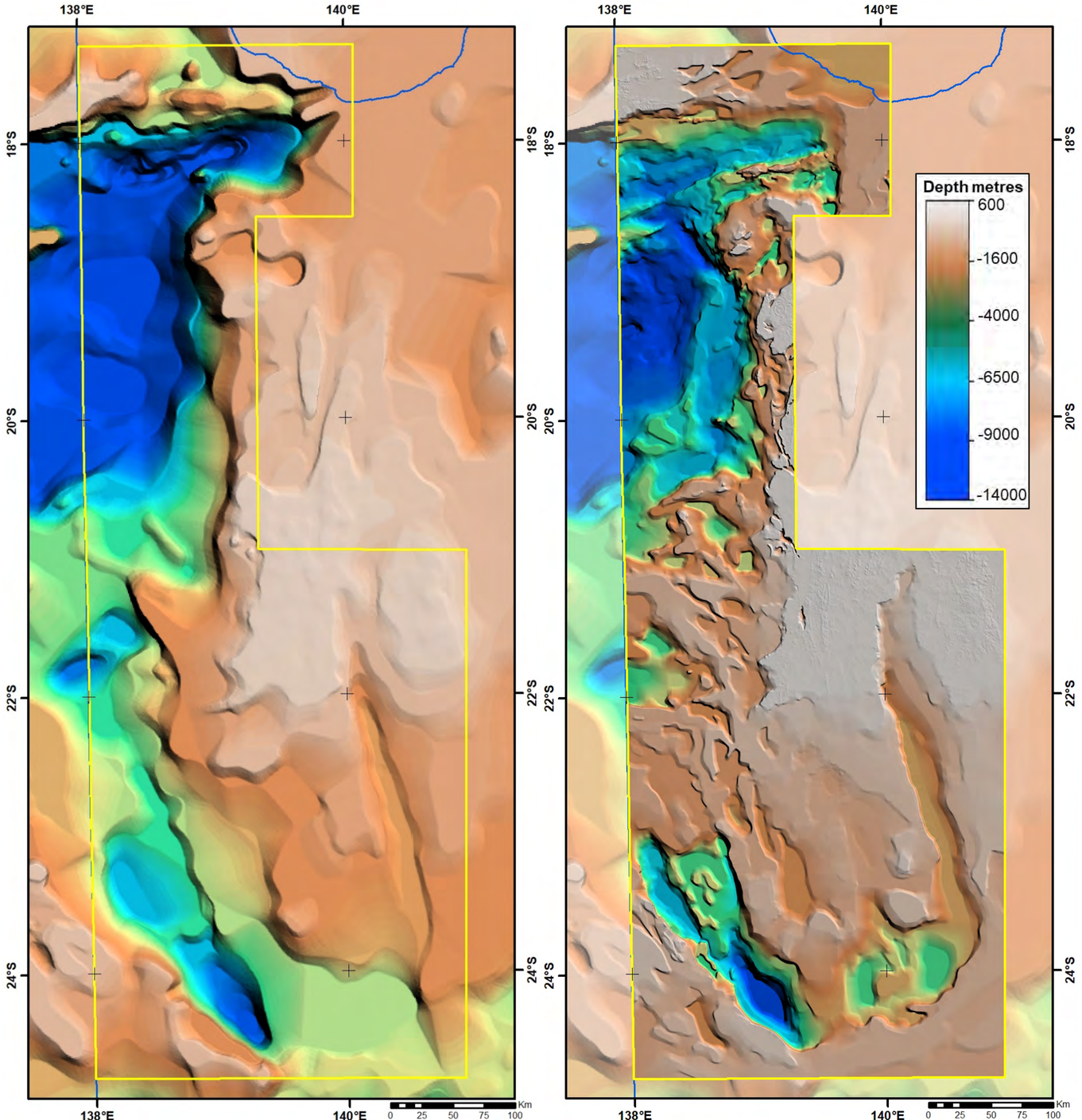




1-4 s TWT Calvert or early Isa superbasins

Myally ??

GSQ, 2011



Conclusions

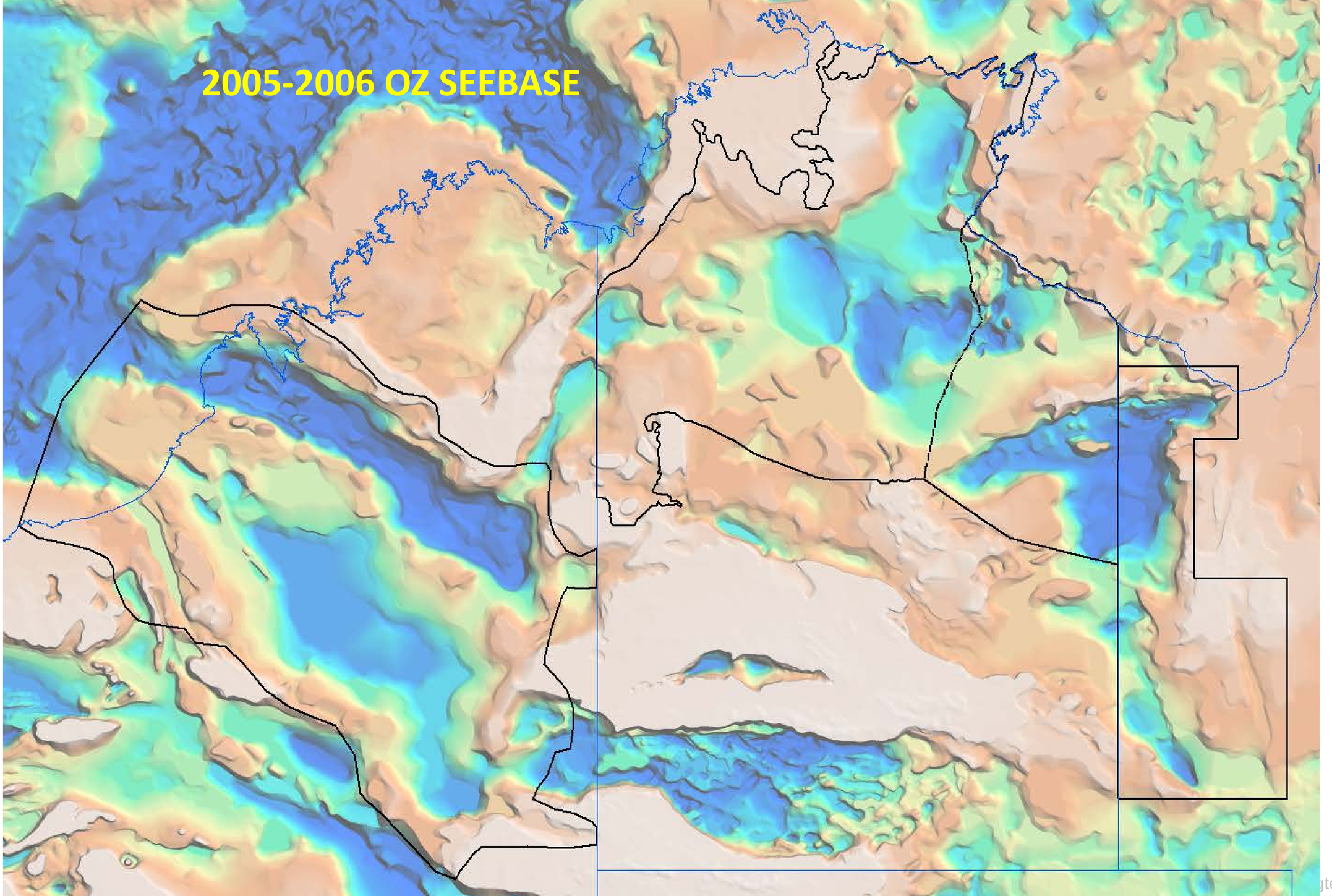
SEEBASE methodology

- More than a 3D basement grid
- powerful tool for understanding basement evolution, *and the response of the overlying basins*

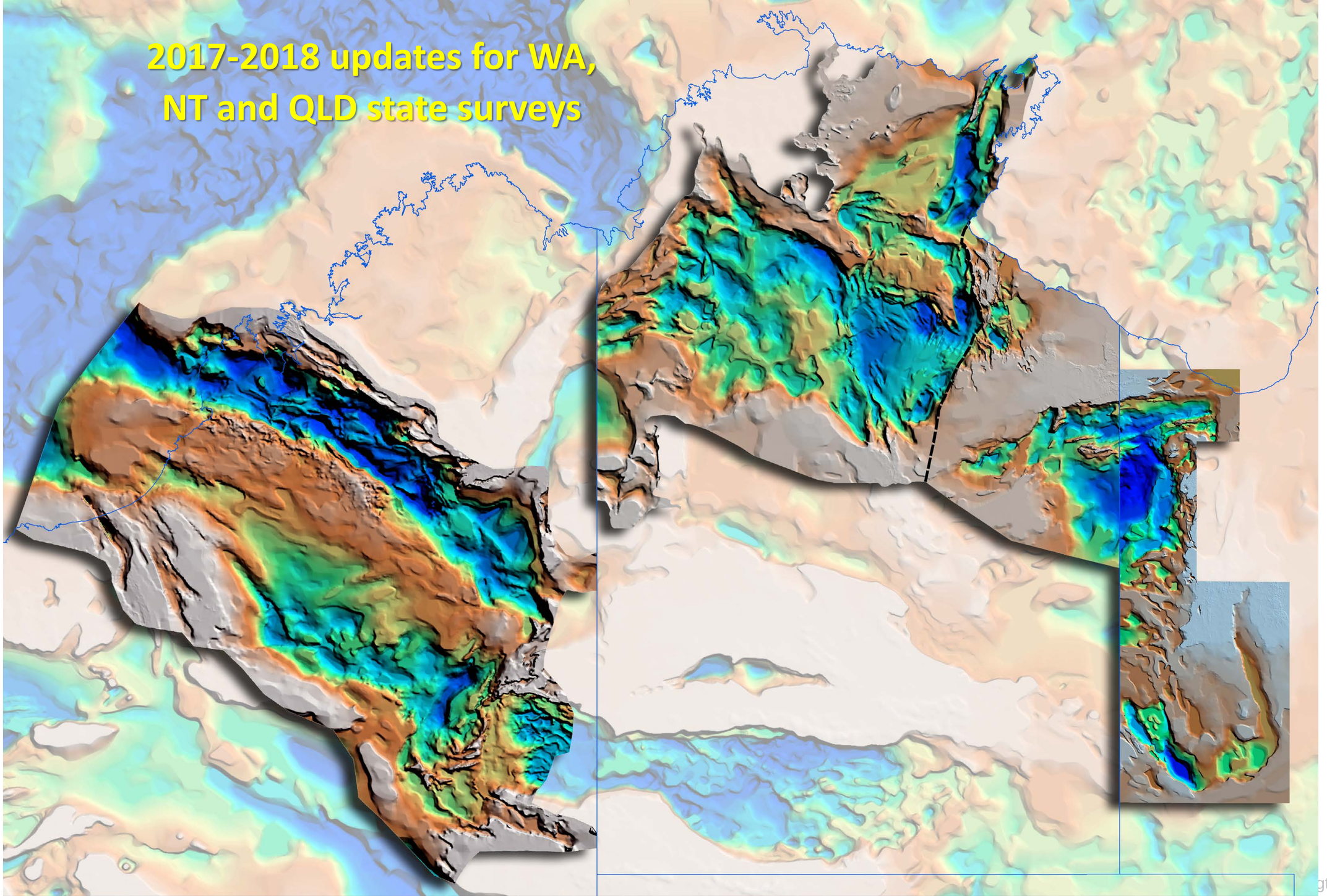
Improved understanding of the basement allows for *prediction*

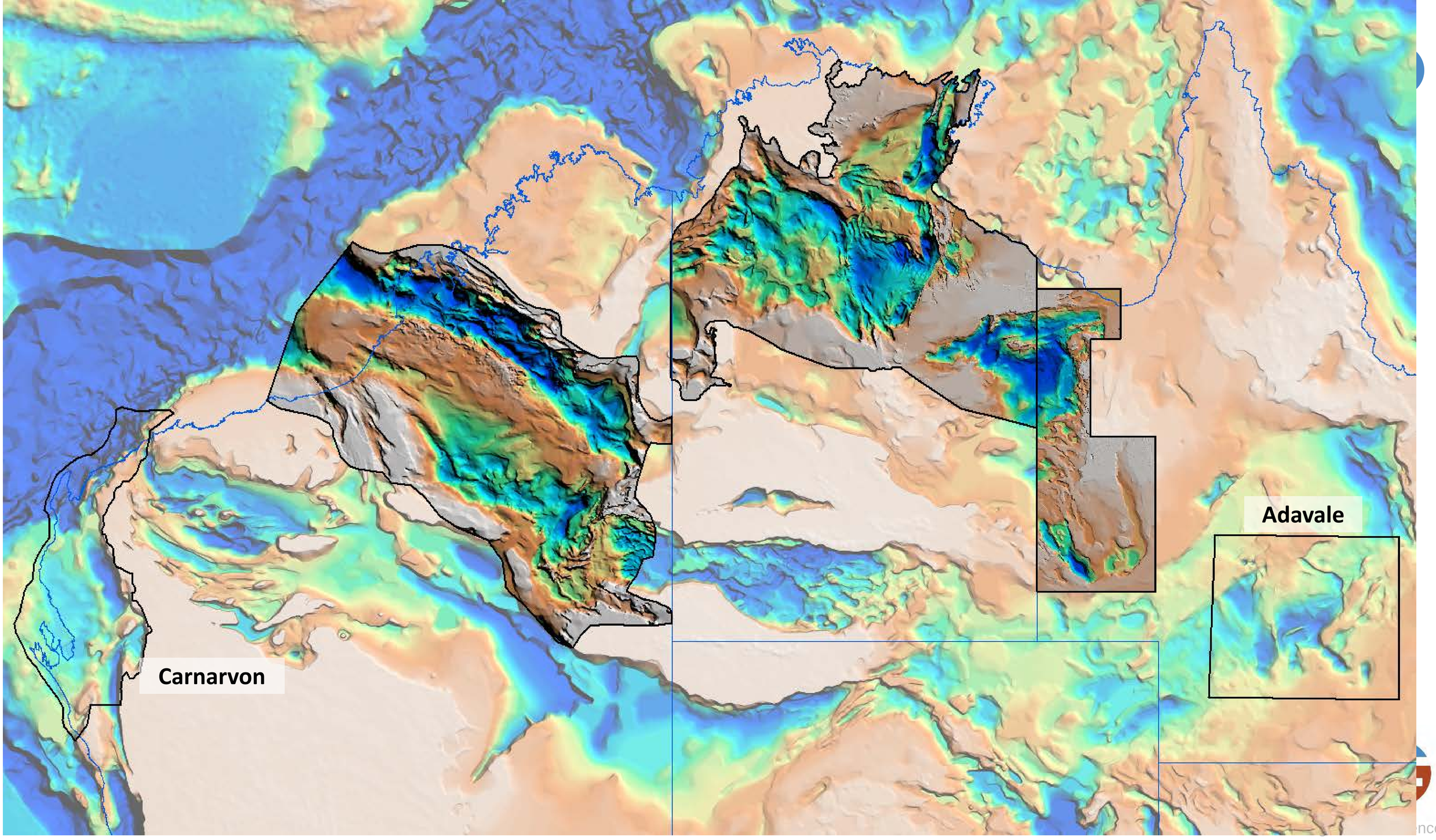
- basin evolution
- basement depth
- basement heat flow

Full report and ArcGIS project



2017-2018 updates for WA, NT and QLD state surveys




Carnarvon
Adavale

Thank you

Report and GIS available from GSQ - DNRME