



SMEDG NOVEMBER 2016 SYDNEY

# **The countdown to drilling in the Southern Thomson Orogen**

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**Director Geoscience Acquisition & Synthesis**  
**Geological Survey of New South Wales**







Aim:

Unlock a new mineral province through improved geological knowledge

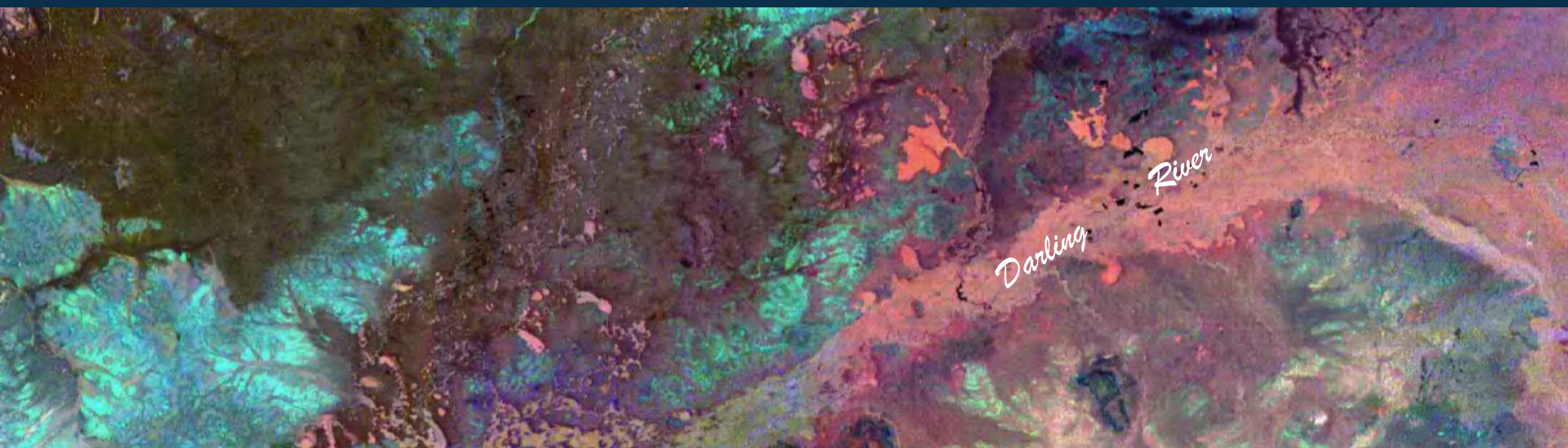
Collaborative inputs on two fronts:

1. **NCF** - GSNSW, Geoscience Australia, & Geological Survey of Queensland
2. **ARC LINKAGE** - GSNSW, GSQ, University of Newcastle, QUT and UQ.

New work discussed here will include:

- phase 2 AEM results
- gravity modelling
- surface geochemistry
- progression of tectonics ideas
- drilling program & plans





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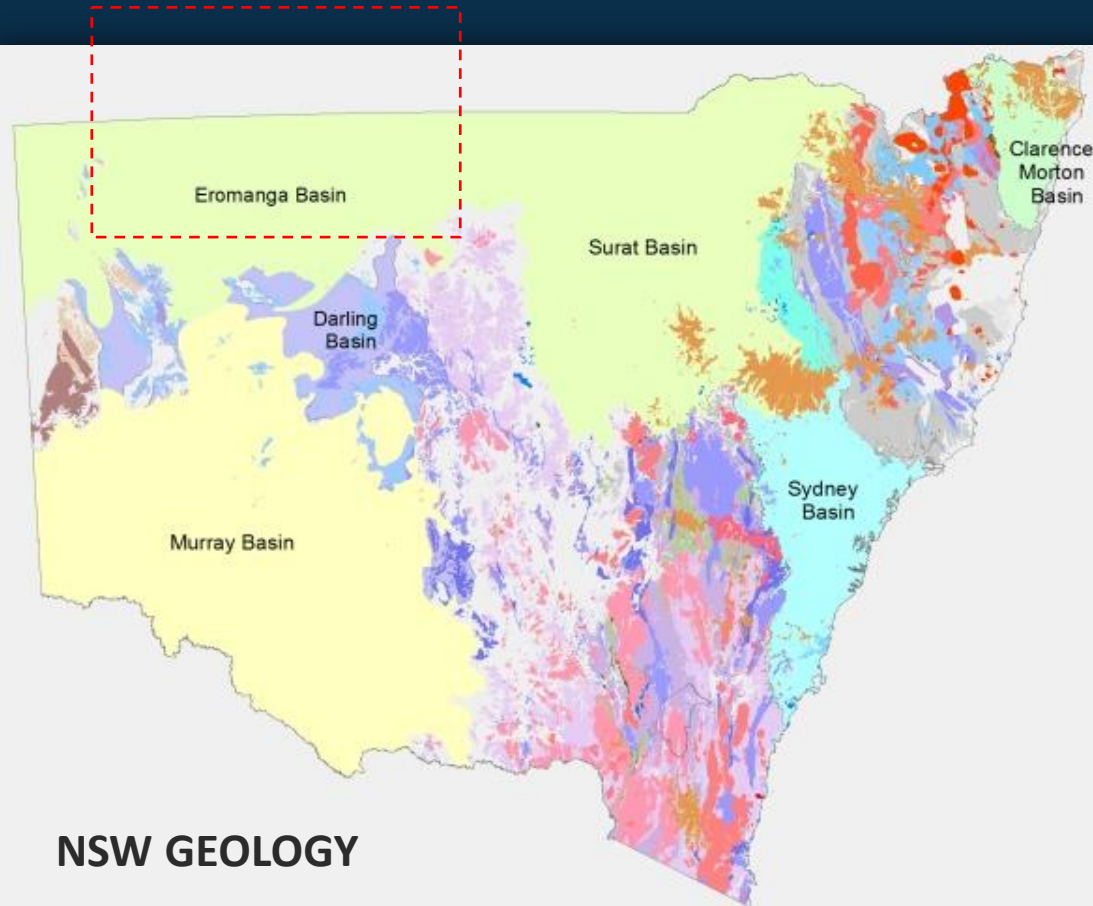
Australian Government  
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## UNCOVER terrane - thickness & nature of cover

**Depth to bedrock** (defined as pre-Permian rocks)

- Eromanga Basin, Lake Eyre Basin and regolith
- irregular DTB surface
- GAB



**CRETACEOUS  
OUTCROP**

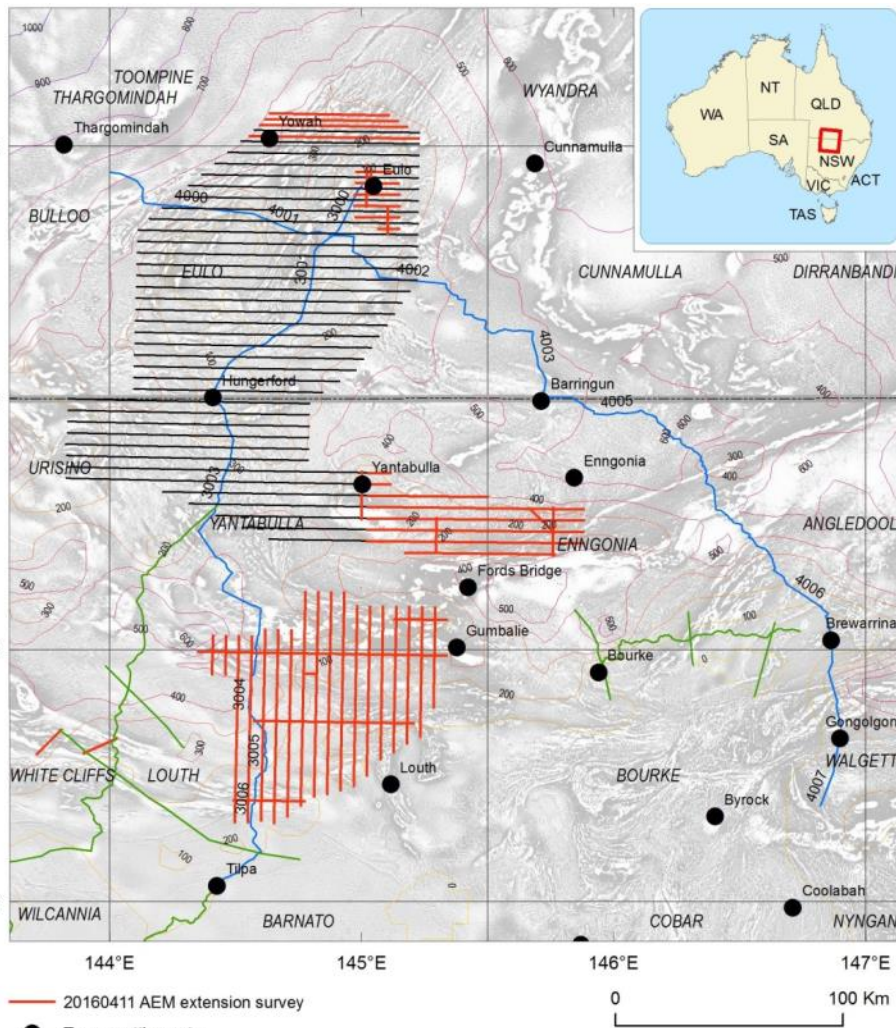


**BASAL  
UNCONFORMITY**

**ARTESIAN BASIN**



## Additional AEM surveying completed



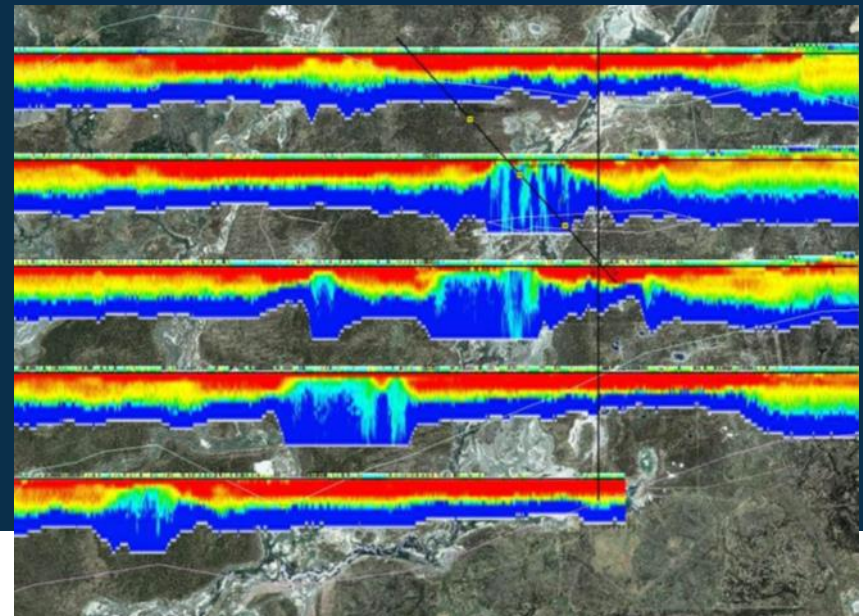
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Regional VTEM Plus® 2052.5 line km in NSW acquired at 5km spacing in June 2016 (GA) - shown in red

Astounding “reveals” of resistive basement topography beneath cover

Laterally-constrained “all-in-one” inversion algorithm developed by GA

Induction tool results will constrain AEM conductivity sections



Data to be released first-half 2017

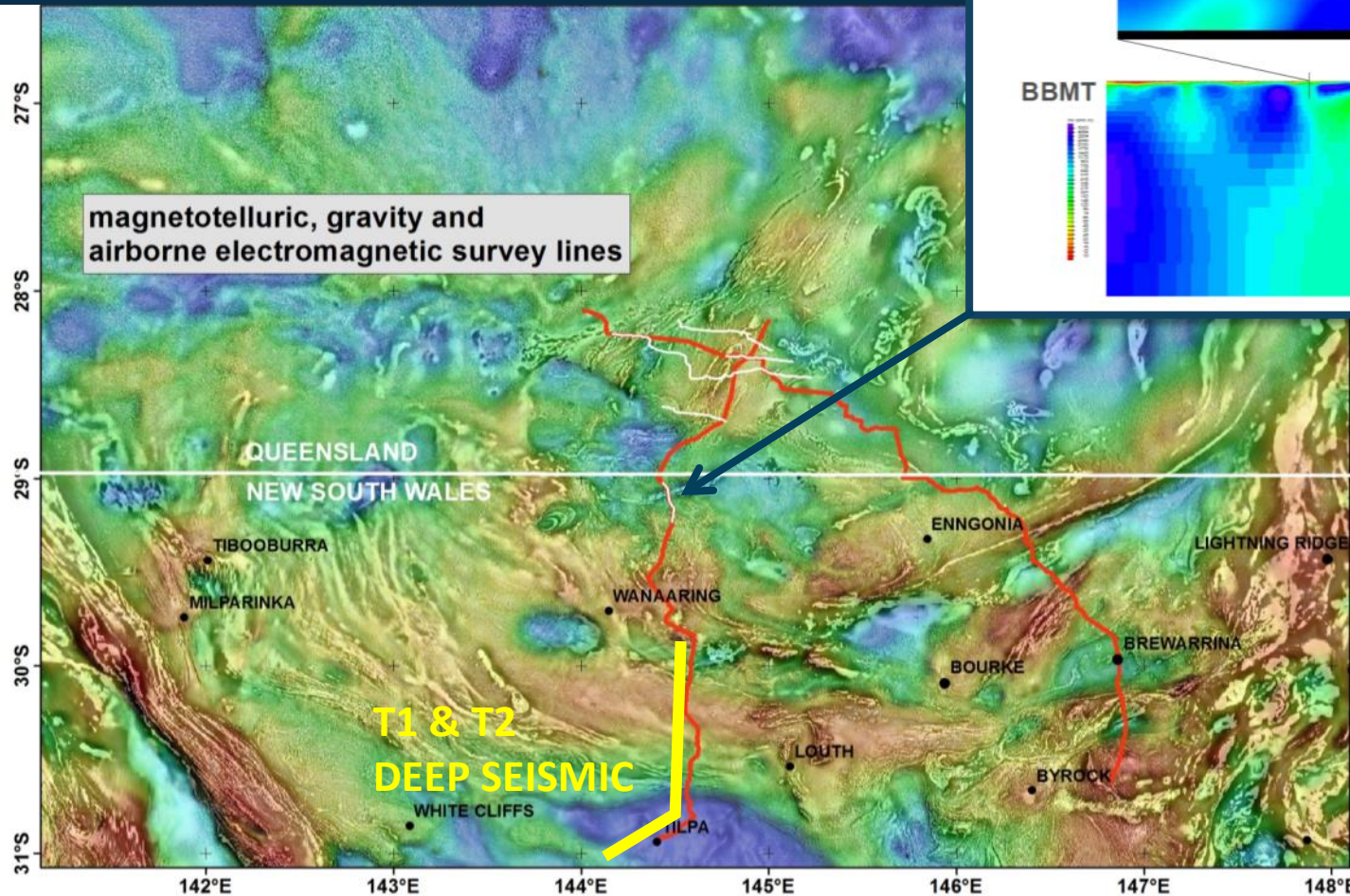
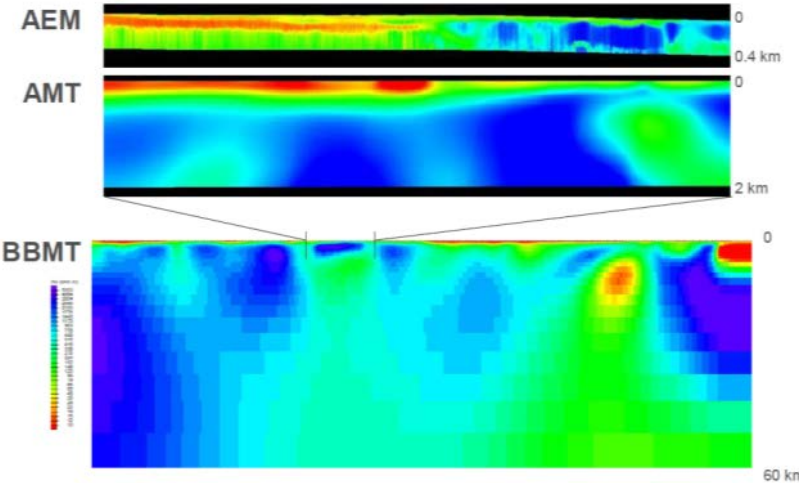


# Acquiring electromagnetic signals at increasing depths of penetration

Project collected and modelled conductivity data along a series of “cross-trend” traverses

- airborne electromagnetic (AEM) single lines
- some audio frequency (AMT) tests @ 1km
- broadband magnetotelluric (BBMT) @ 5 km
- (also ground gravity @ 333 m)

## MT to augment AEM



Combination helps at different scales to improve:

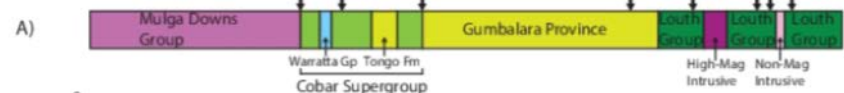
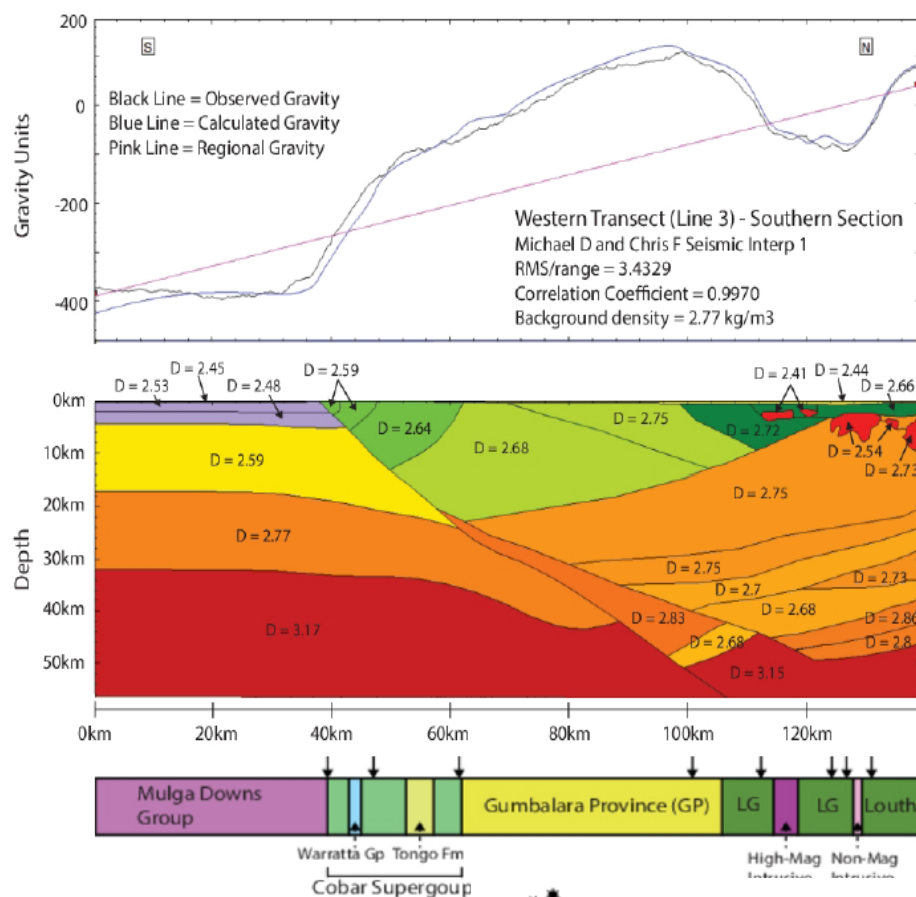
- estimations of basement depths
- understanding of crustal architecture

# Integrating gravity, seismic, AEM and MT data to investigate crustal architecture and cover thickness: modelling new geophysical data from Southern Thomson region.

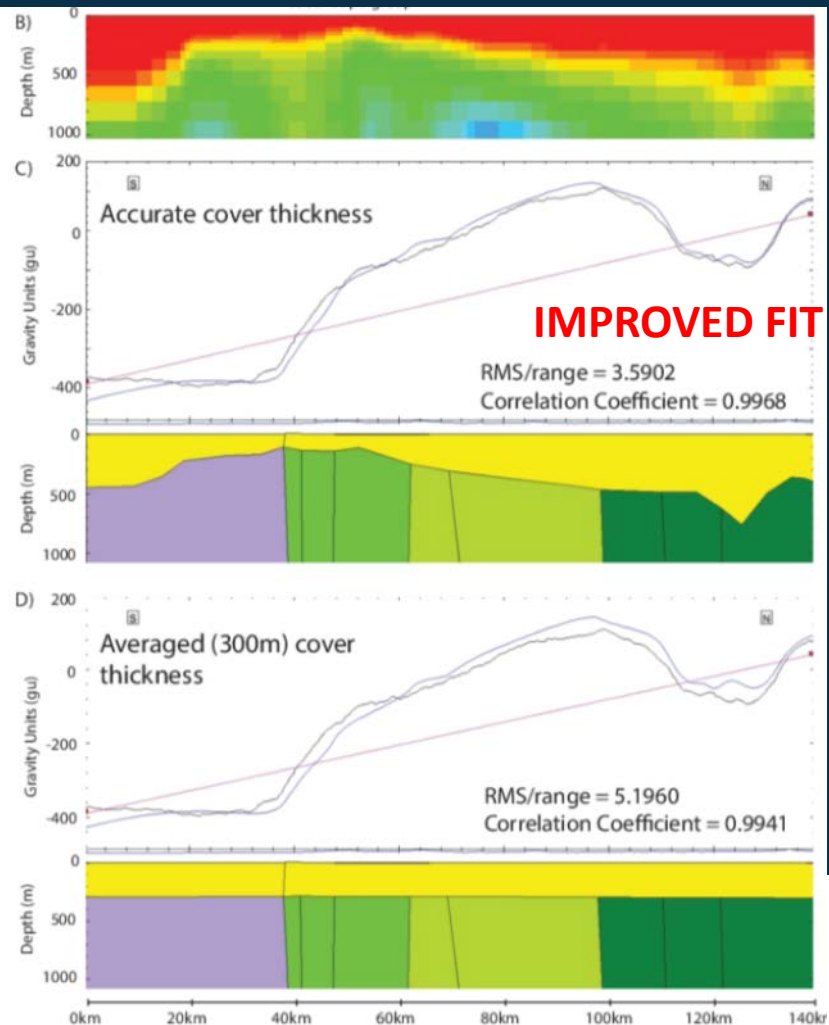
ASEG Presentation 2016: Chris Folkes (GA)

...then comparing agreement between calculated and observed gravity data using different cover thickness models...

## Gravity forward modelling across Olepoloko Fault based on deep seismic profile interpretation



## cover thickness interpreted from BBMT conductivity

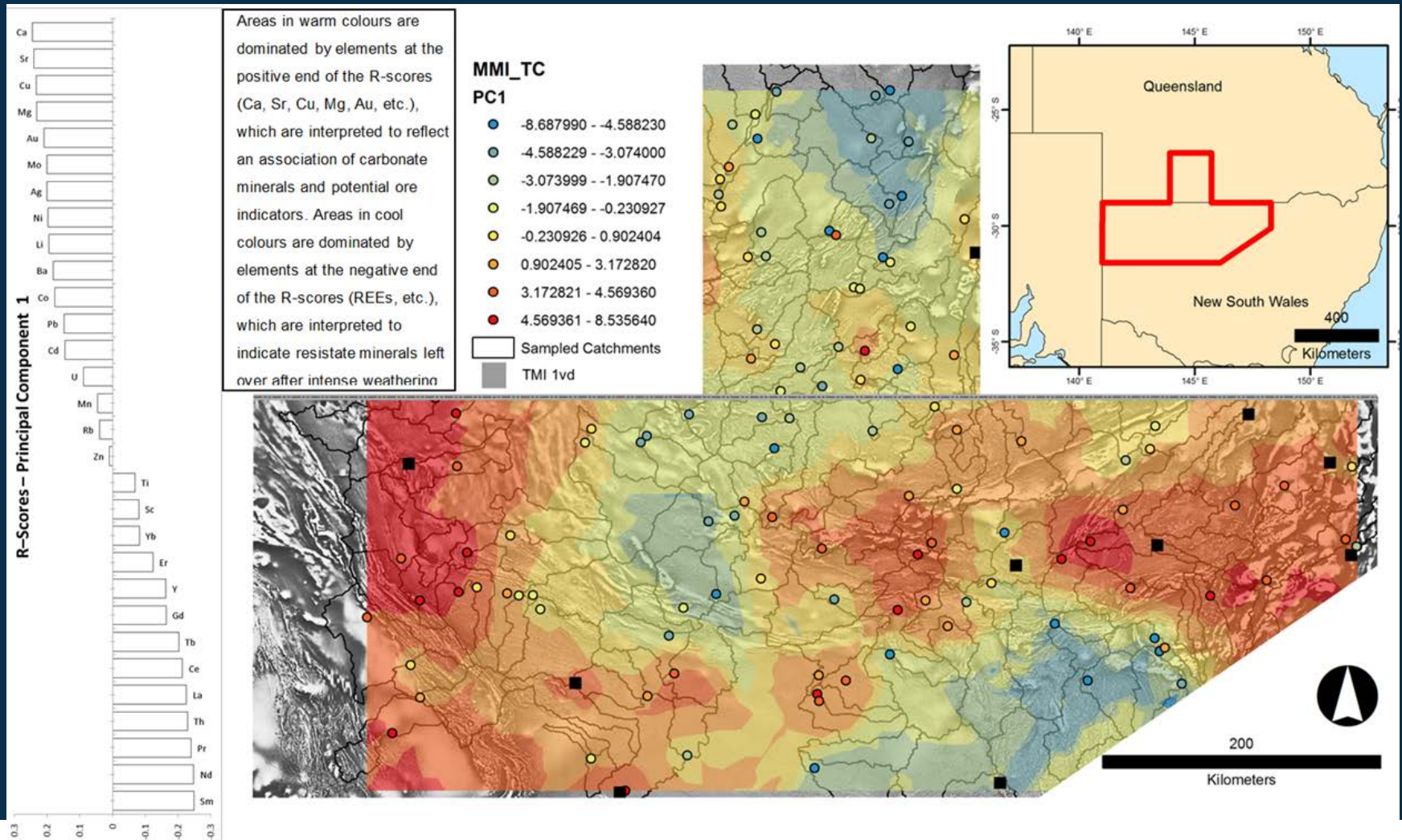


Geoscience Australia Record in prep



# Geochemical survey of the southern Thomson Orogen, SW Qld & NW NSW – the chemical composition of surface and near-surface catchment outlet sediments

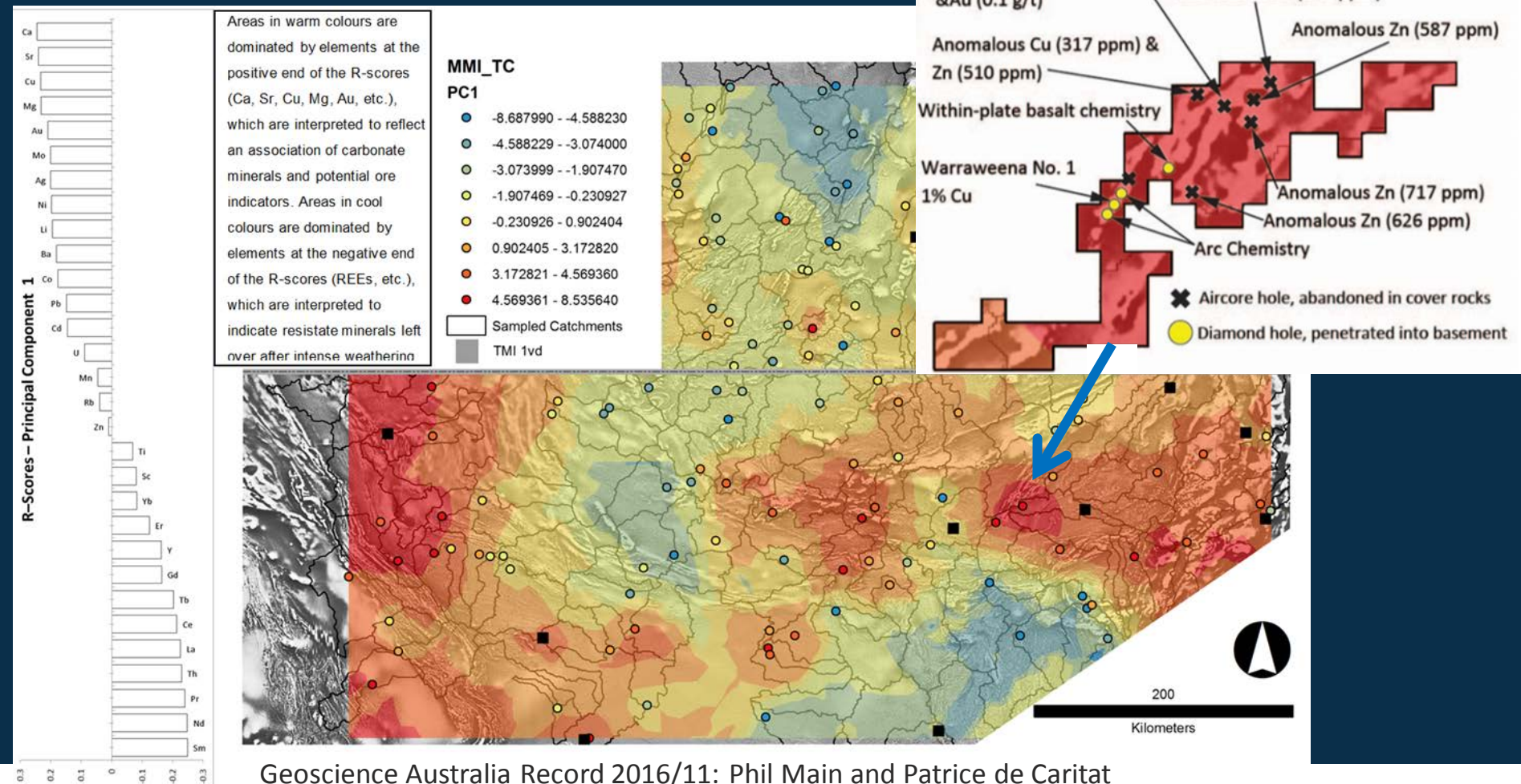
Geoscience Australia Record 2016/11: Phil Main and Patrice de Caritat



Kriged colour map of Principal Component 1 for the Mobile Metal Ion<sup>®</sup> analysis of coarse fraction Top Outlet Sediments (Tc)

MMI analysis suggests potential as vector to mineralisation, highlighting three areas, including the Warraweena area, east of Bourke

- Elevated zinc recorded from cover sequences (exploration aircore)
- Basalt to basaltic andesite (Warraweena volcanics)

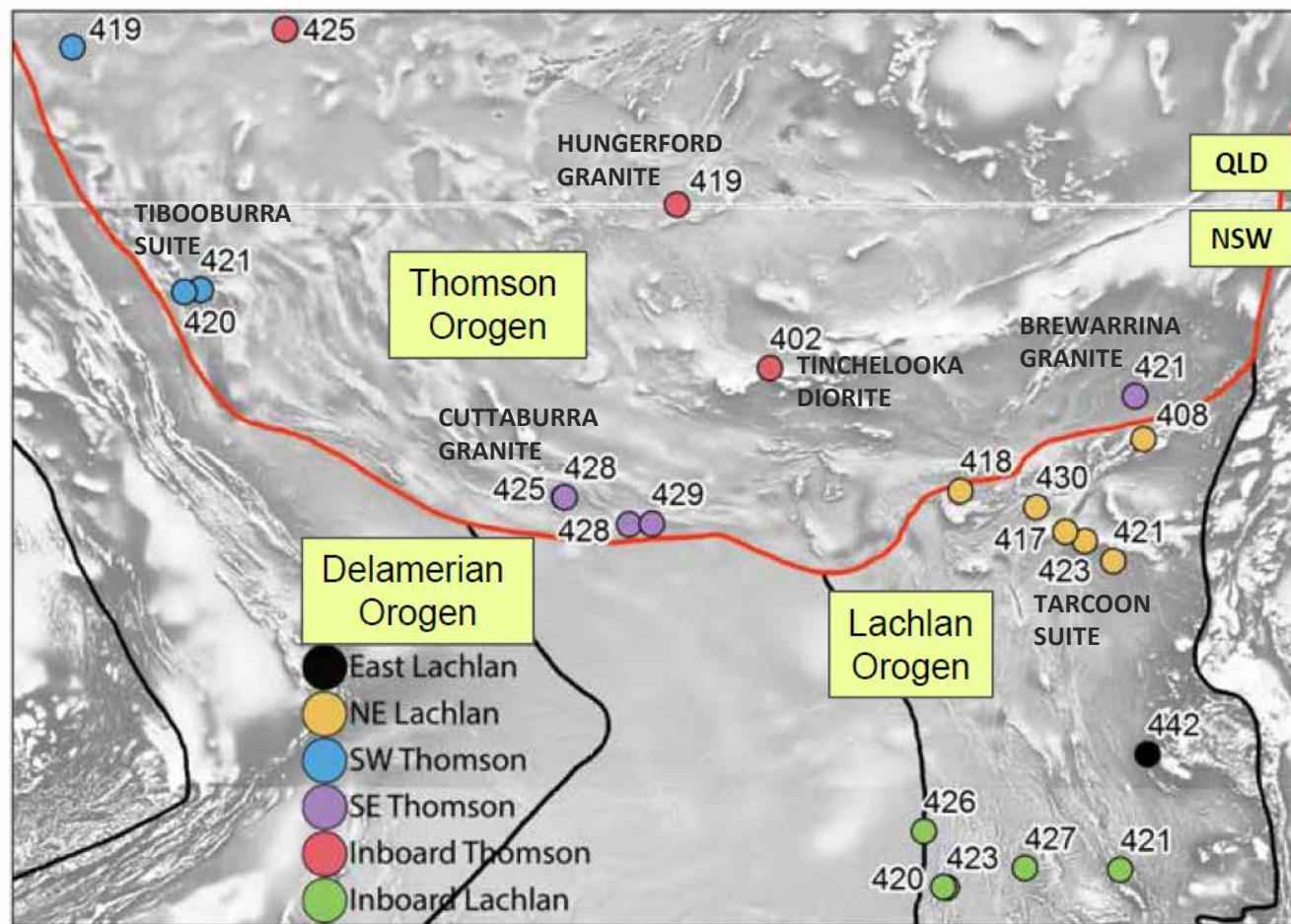




# Exploring the nature of the Thomson–Lachlan boundary through zircon Lu-Hf and O isotopes

AESC Presentation 2016

Kathryn Waltenberg & Simon Bodorkos (GA), Richard Armstrong & Bin Fu (PRISE)



## STUDY OVERVIEW

- Using Hf + O isotopes to map source regions
- 11 Thomson samples & 12 Lachlan samples
- 8 S-type and 15 I-type samples
- Compare the Lachlan and Thomson orogens

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Exploring the nature of the Thomson - Lachlan boundary through zircon Lu-Hf and O isotopes



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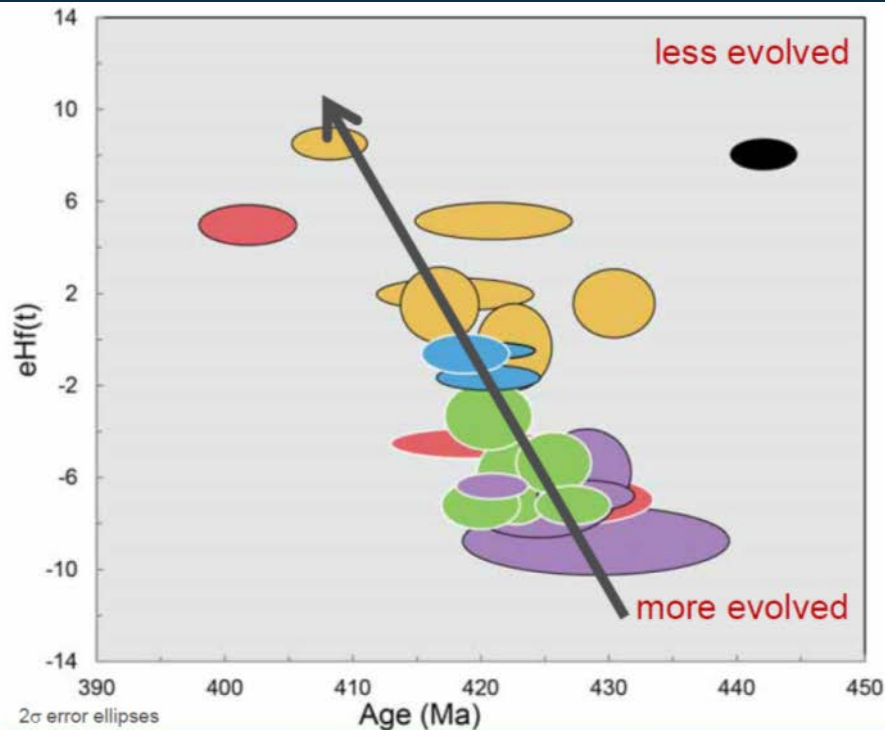
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## STUDY CONCLUSIONS

- Overall similarity between Lachlan and Thomson orogen samples



### Time trends in Hf

Possible time trend?

Exceptions:

northeast Lachlan,  
younger Thomson sample

Tarcoon Suite  
~ 416 - 408 Ma

Tinchelooka Diorite  
~ 400 Ma



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Exploring the nature of the Thomson - Lachlan boundary through zircon Lu-Hf and O isotopes

## SOURCES

- Most juvenile NE Lachlan => Macquarie Arc Source
- Others mixed with more evolved crust (no new mantle input required)

AESC presentation, 2016

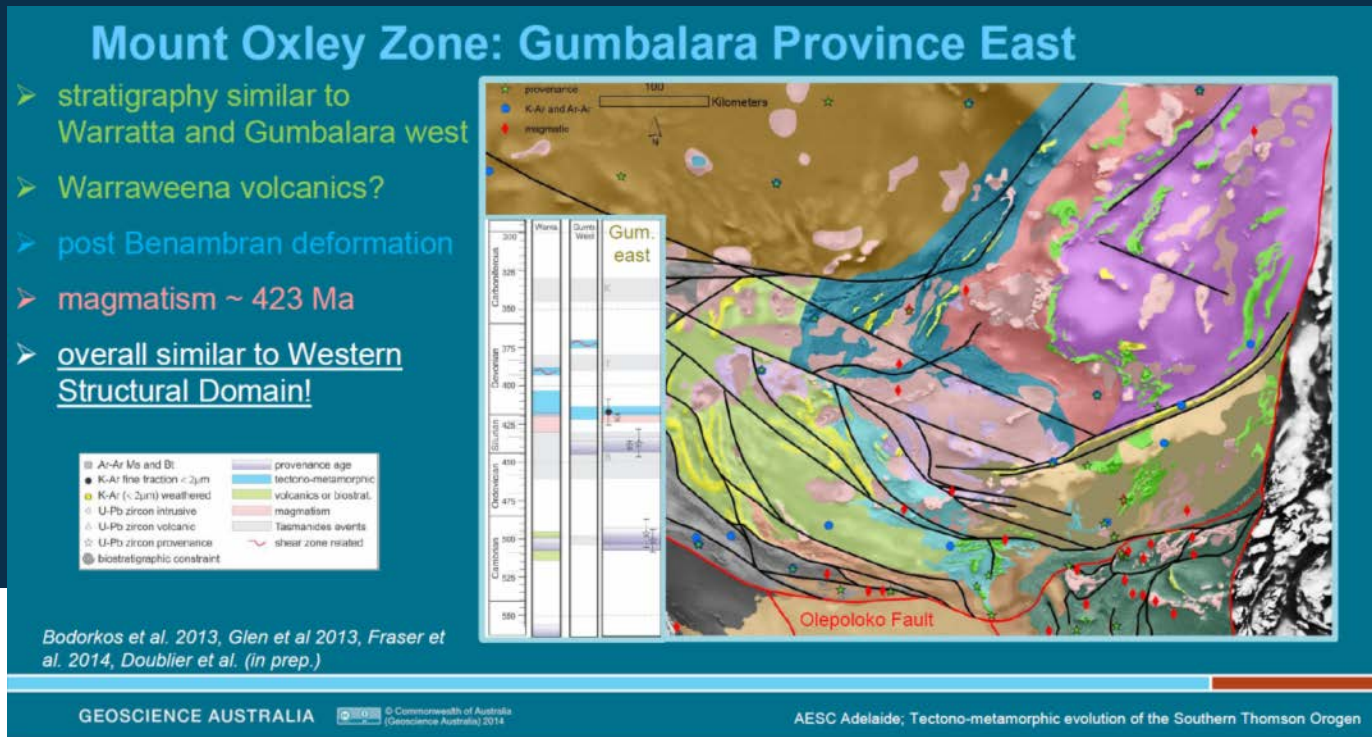
Kathryn Waltenberg & Simon Bodorkos (GA), Richard Armstrong & Bin Fu (PRISE)



Doublier, Zwingmann, Hegarty, Purdy, Fraser, Thorne, Cross & Champion

Integration of structural interpretation, geochronology data and metamorphic petrology data:

- K-Ar geochronology to date the main cleavage-forming event in lower grade rocks
- Dominant fabric is centred on 415 Ma through most of project area within NSW
- Incorporating new deformation/metamorphic data to develop time–space plots using age constraints of provenance, emplacement, biostrat, volcanism & regional events

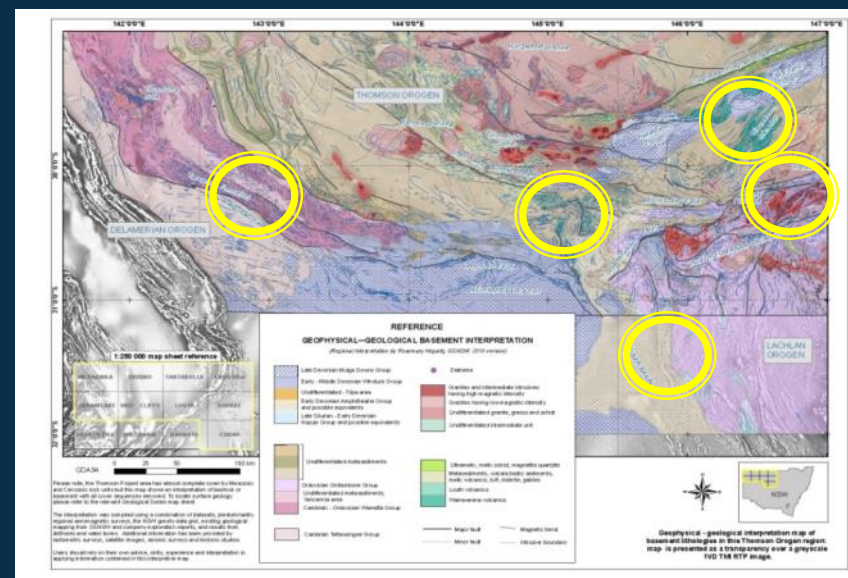


# ARC LINKAGE Project “The southern Thomson Orogen – a missing link in the Tasmanides”

Chief Investigator - University of Newcastle  
(Prof Bill Collins)

Also – University of Queensland, Queensland  
University of Technology  
Partner Investigators – GSQ, GSNSW

- Systematic age determination of key lithostratigraphic units across the STO - sedimentary, igneous and metamorphic
- Detrital zircon age spectra of major sedimentary units for provenance analysis



*Testing tectonic models*  
*Providing increased understanding of key geological sites*  
*Supporting Students at Hons and PhD*



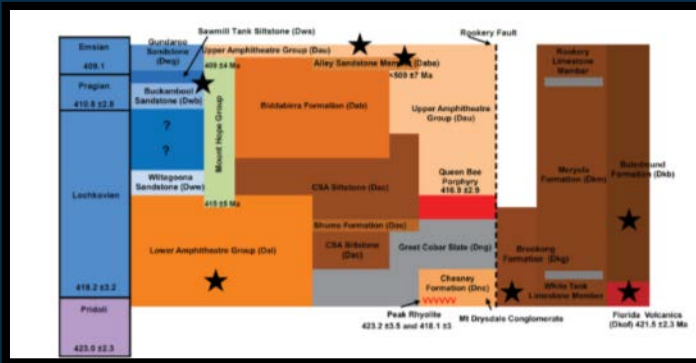
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# ARC LINKAGE Completed Project Highlights

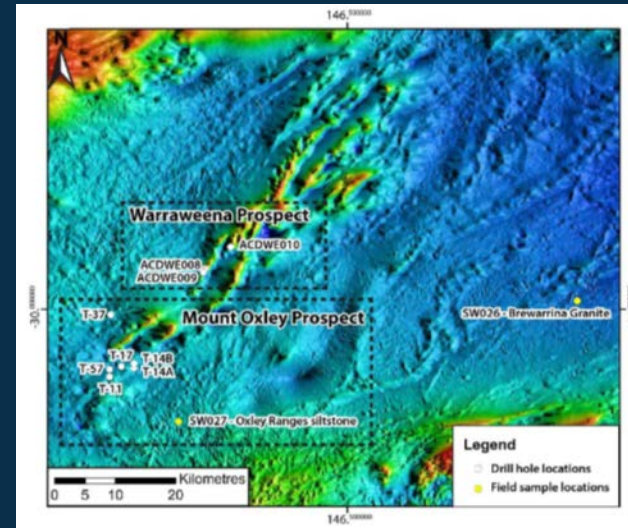
***“Age and provenance of the Cobar Supergroup”*** (results in prep for publication)

Honours thesis completed by Matthew Parrish, 2014, at University of Newcastle

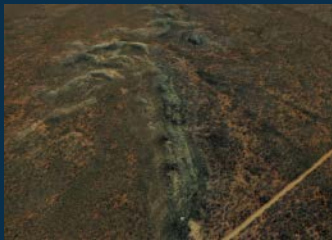


Focus: define detrital provenance for Cobar Super Supergroup so that Southern Thomson investigations can compare with confidence.

***“Uncovering the Southern Thomson Orogen, NSW: Geodynamic Significance of Warraweena Volcanics and Related Rocks”*** (results in prep for publication) Hons thesis completed by Sarah Whalan, 2014, at University of Newcastle



***“Structure and kinematics of the Louth-Eumarra Shear Zone (north-central New South Wales, Australia) and implications for the geodynamics of the Thomson-Lachlan boundary”*** (Sam Dunstan 2015. University of Queensland)



## ARC LINKAGE 2016 Project Highlights –

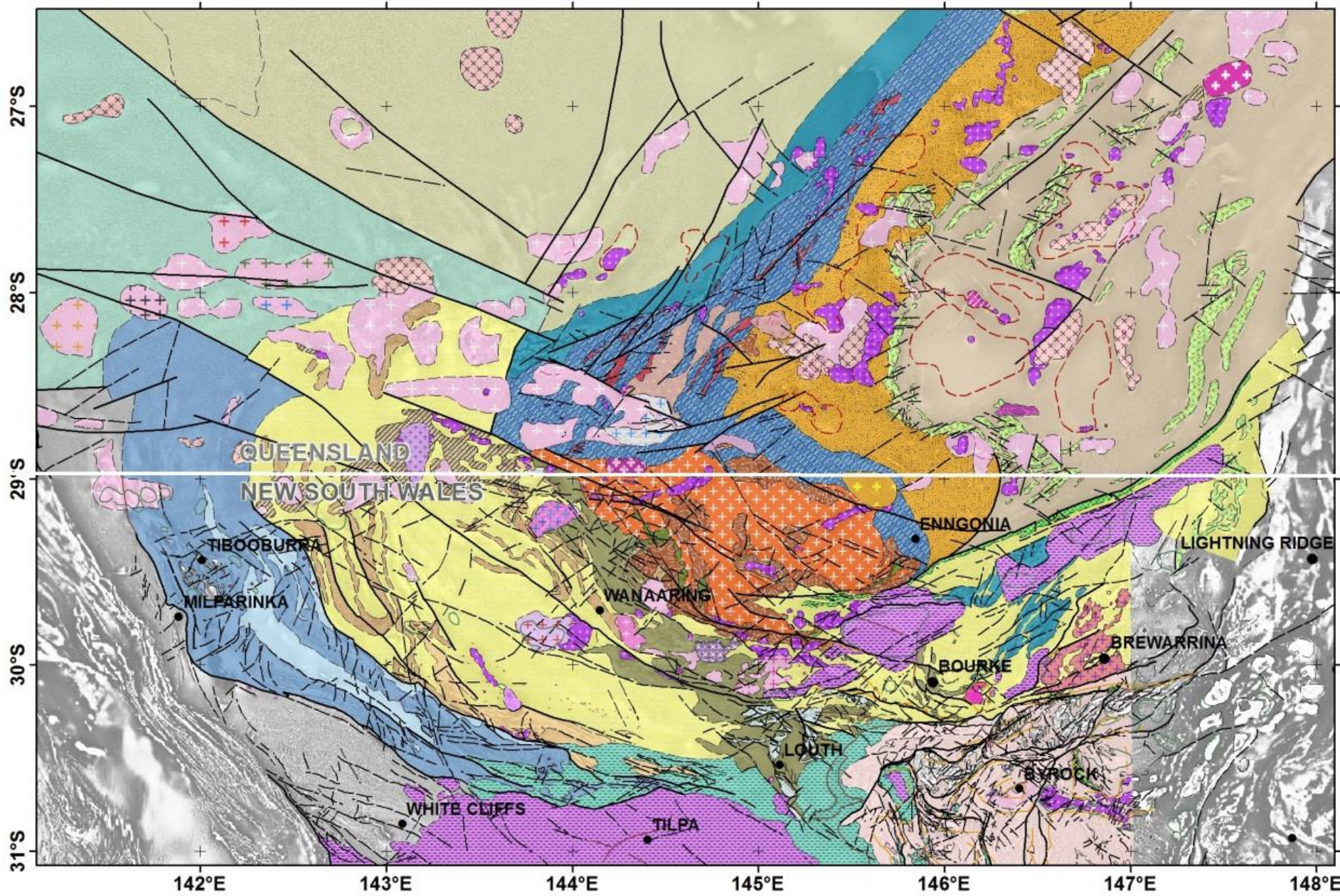
- ❑ **Sebastian Wong**, an Honours student from University of Newcastle has submitted his thesis on **lithology, structure and age in the YANCANNIA area (between White Cliffs and Cobham Lake)**, with three weeks of field mapping completed in the Yancannia Ranges.
- ❑ **Ryan Dwyer**, an Honours student from University of Newcastle has submitted his thesis on **U-Pb isotopic dating of provenance and magmatic crystallisation for the rocks in the LOUTH area**.
- ❑ **Rashed Abdullah**, a PhD student from University of Queensland is progressing with a study to **interpret existing seismic survey data for STRUCTURAL & TECTONIC inferences in Qld and NSW**.
- ❑ **Pascal Asmussen**, a new student at the Queensland University of Technology is developing a project to compare/contrast the **stratigraphy and provenance of DEVONIAN BASINS across the southern Thomson Orogen in Qld and NSW**.

*Valuable and successful studies that add detail in key areas*



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## Stratigraphic drilling program and plans:

### QUEENSLAND

- Two stratigraphic holes were successfully completed in Qld near Eulo during September/October 2016 and basement cores obtained.
- DTB estimates from geophysics were very close to the actual unconformity depths drilled
- Core sampling by collaborative partners to take place in Brisbane during late November



A new drilling contract will be let in early 2017



# SUMMARY

- GSNSW is investing in southern Thomson projects to develop UNCOVER potential for this remote and under-explored region
- NCF Collaborative Project with GA and GSQ is providing new data and ideas, with new stratigraphic cores planned
- ARC LINKAGE project research is developing detailed understanding of key geological aspects and sites

Benefits are many...

Determining lithology and age constraints for basement rocks

Improve tectonic understanding.

Defining cover thickness and character

Testing techniques for accurate depth to basement mapping

Recognising structures and mineral system potential

Reducing exploration risk