NSW GOVERNMENT Resources & Energy

Current mineral system studies at the Geological Survey of NSW

Phil Blevin

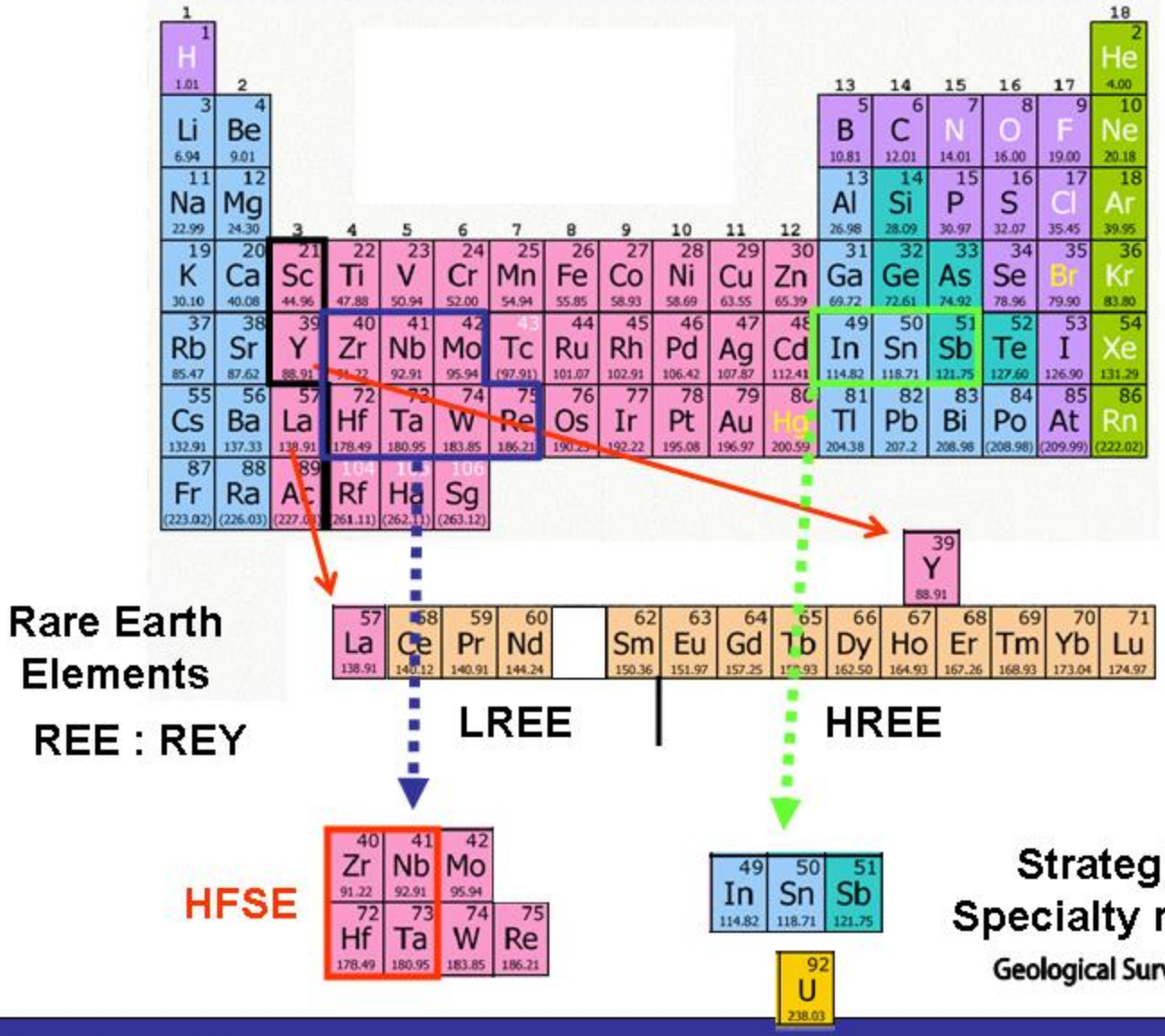
NSW GOVERNMENT Resources & Energy

MinSysNSW

- Phil Blevin, Peter Downes, David Forster, Gary Burton
- Collaborative links with ANU, JCUNQ, UniMelb, Boise, UoWA, GEMOC.

- Statewide Metallogenic Map released
- Strategic/new technology elements.
- Sn systems.
- Ordovician Magmas Project.
- New England SHRIMP & ID-TIMS Dating.
- Nymagee Synthesis.
- Other activities of interest within the Survey.

NSW Periodic Smorgasbord of Exploration Opportunities



Geological Survey of New South Wales

REE deposit types NSW

- Alkaline basalt association
  - Phonolite, commendites
- Felsic granites
  - Highly fractionated I-, A-types;
  - Peralkaline
  - Rare metal granites/pegmatites
- Ion Adsorption

Tend to be Y-HREE Dominant.

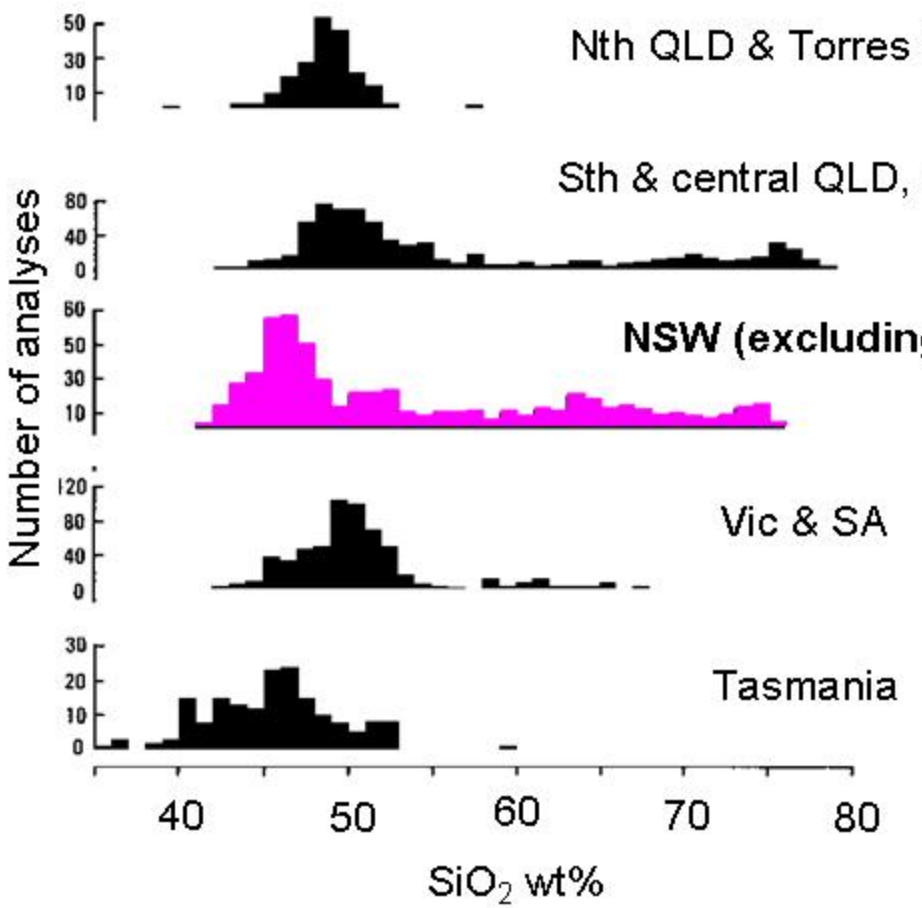
Carbonatites (e.g. Bayan Obo, Mountain Pass, Mount Weld) are not developed in the Tasmanides of eastern Australia.

Nb, Ta, Zr, Hf

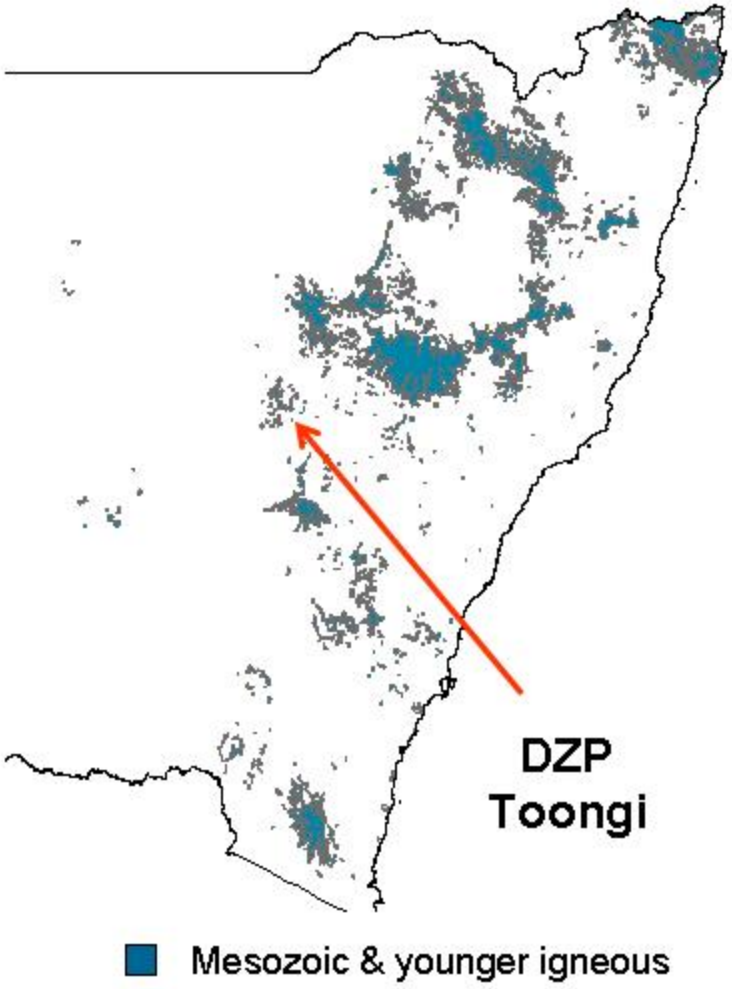
- (Per)alkaline association
  - Basalt trends – commendites, nepheline syenite, phonolites etc
  - Peralkaline granites
  - Rare metal granites (Nb-Ta)

Heavy mineral deposits – substantial zircon (+Ti) resources

Abundance of Cainozoic volcanic rocks in eastern Australia by silica content



Modified after Johnson, 1989



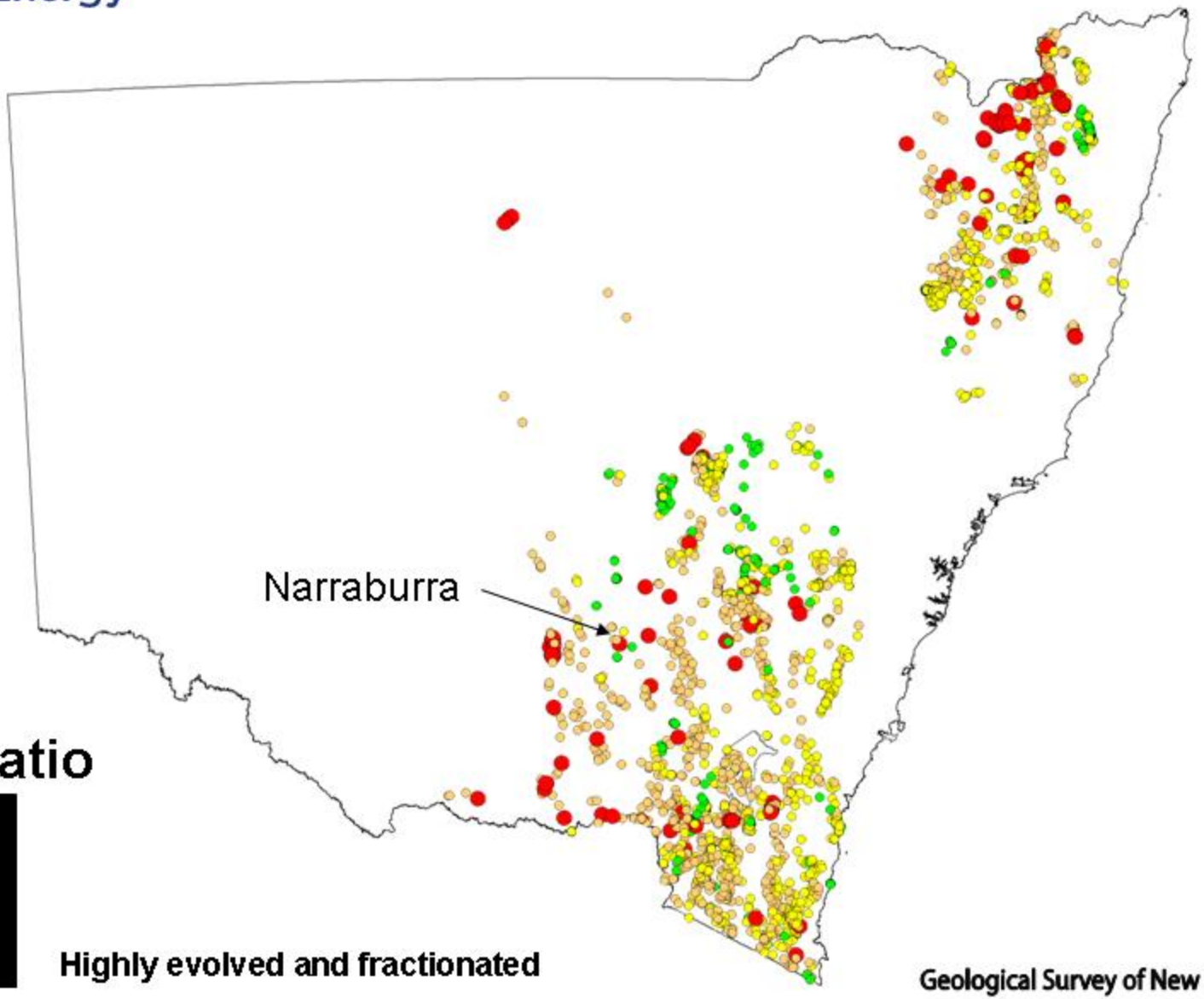
NSW GOVERNMENT Resources & Energy

Pegmatites: REE, industrials and strategic metal potential.

- Previous work of Steve Lishmund.
- Carp. Ex. undertaking current exploration for Sn and W.
- Look at assessment for industrials and REE.

NSW GOVERNMENT Resources & Energy

Location of highly fractionated granites in NSW



Rb/Sr ratio

<0.1
1
10
>100

Highly evolved and fractionated

Geological Survey of New South Wales

Ion adsorption deposits

Soil

Kaolinite rich in REE

Semi – weathered granite

Four major requirements

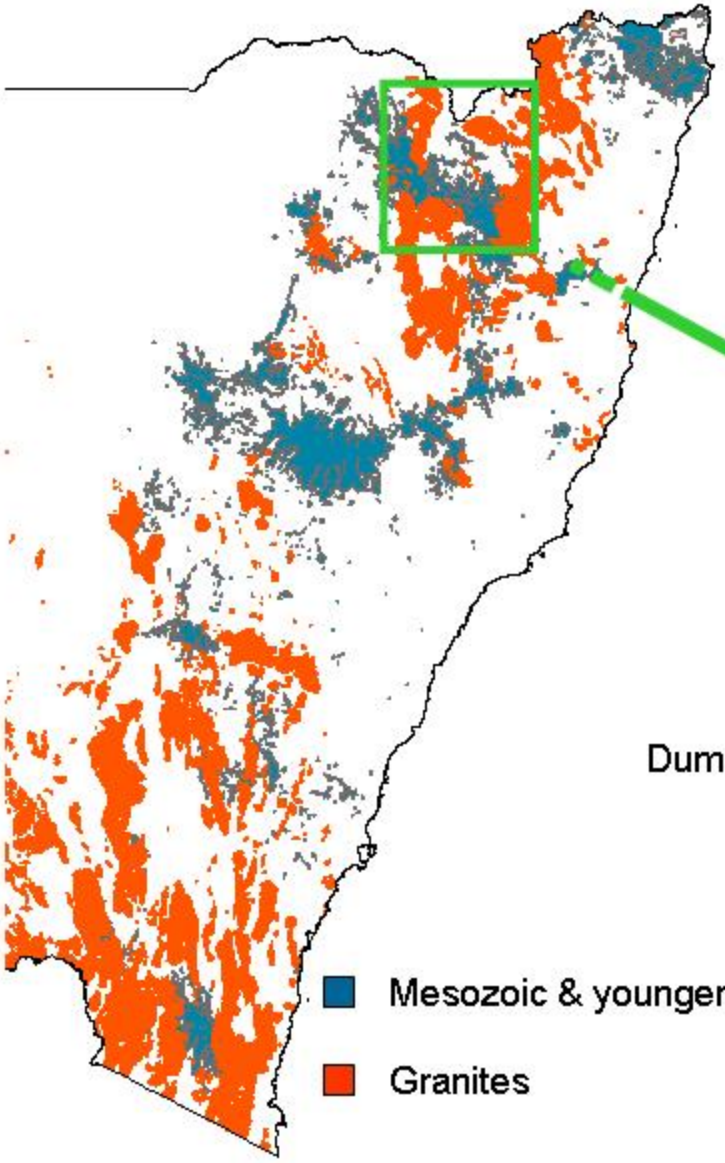
a. Original granite high in REE.
b. REE phases break down. Metamict?
c. Tropical lateritic weathering.
d. Lateritic process preserved and not transported.

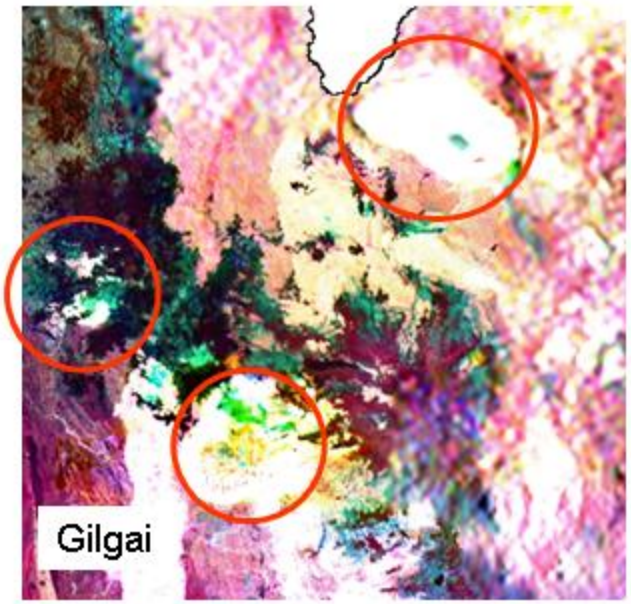
- LREE or HREE enriched deposits form depending on weathering.
- Weathering with REE ions in solution adsorbed on to kaolinite
- Enrichment of REE 3-4+ x unweathered granite.

Coppin et al (2002), Chem. Geol, 182, 57-68
Takahashi et al. (2005), Chem. Geol. 219, 53-67.
Slide content c/- Dr Richard Wormald, pers. commun. 2011

Ion-adsorption REY deposits in NSW?

- Require conditions conducive to laterite/bauxite formation.
- Not present today, but were present in the Tertiary.
- Not all REY rich source rocks are granites!

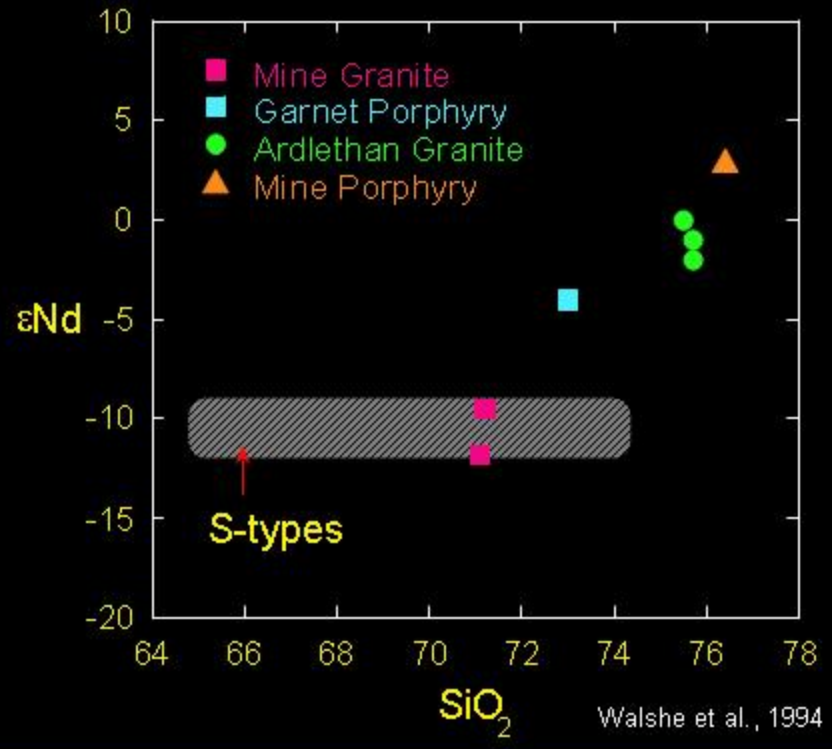




Geological Survey of New South Wales

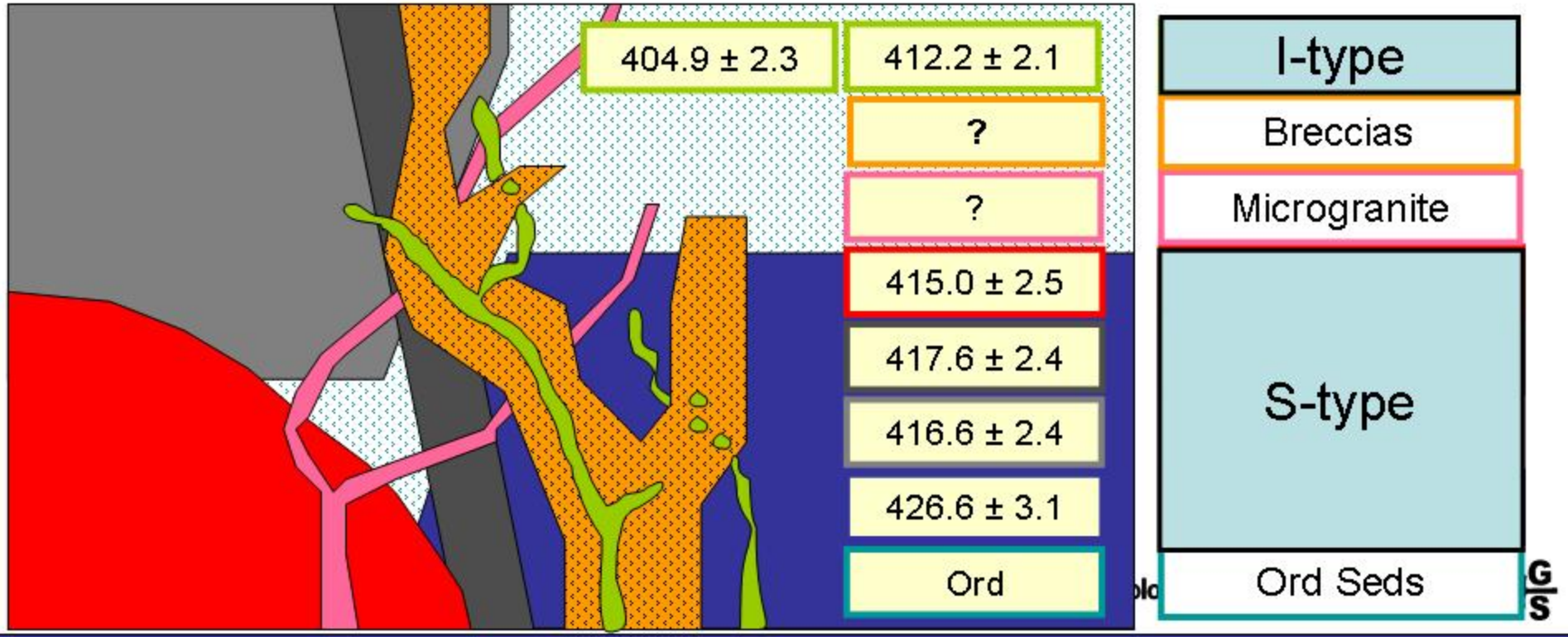
Example of new insights: Ardlethan

- Complex igneous and hydrothermal history
- SHRIMP dating shows a spread of ages



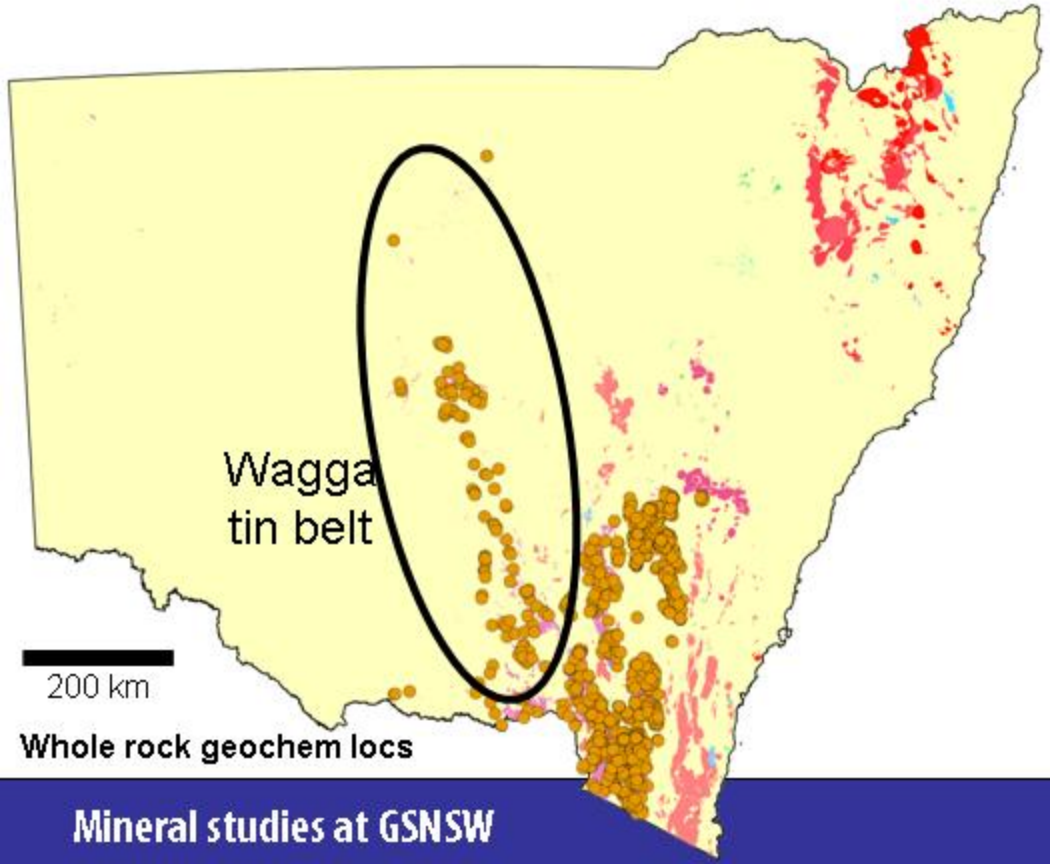
Example of new insights: Ardlethan

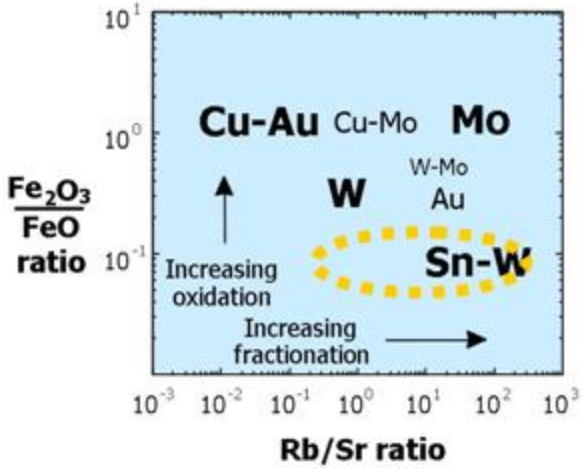
- Complex igneous and hydrothermal history
- SHRIMP dating shows a spread of ages



Nd isotope basement mapping

- Look for variation in the Wagga tin belt granites.
- Look for E-W variation in granites and volcs, including Nymagee.
- Assist with national Nd basement map.





Geological Survey of New South Wales

NSW GOVERNMENT Resources & Energy

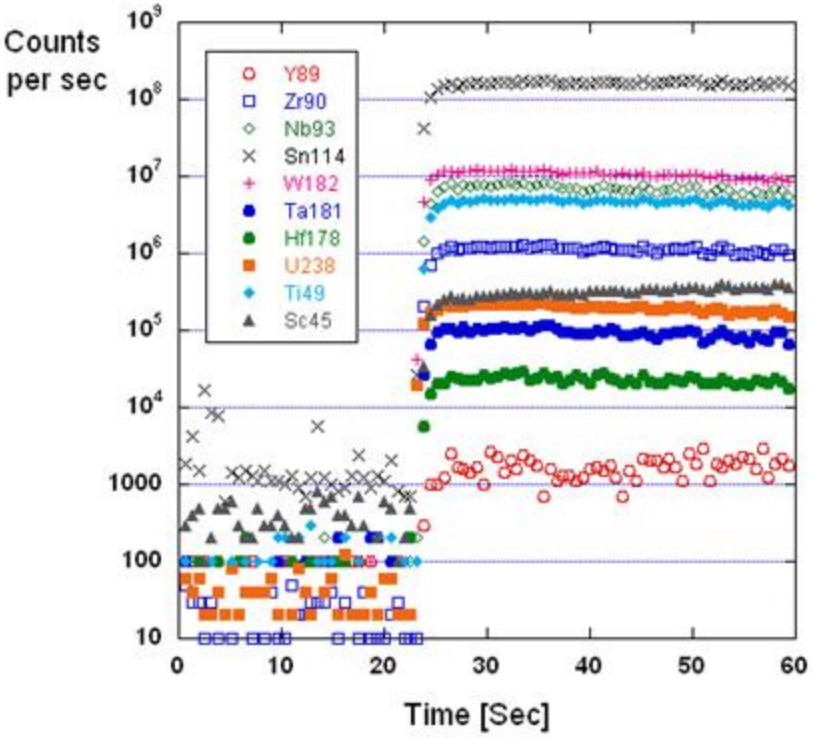
New Gen Tin ARC Proposal

- Age dating, O and Hf isotopes and trace element geochemical fingerprinting.
- ARC resubmitted.
- Qld, NSW and Tas Surveys, RSES-ANU and UoWA (Tony Kemp).
- Tullebung, Murray Basin Mineral Sand Systems, Broken Hill.
- Honours projects at UNE and Macquarie.

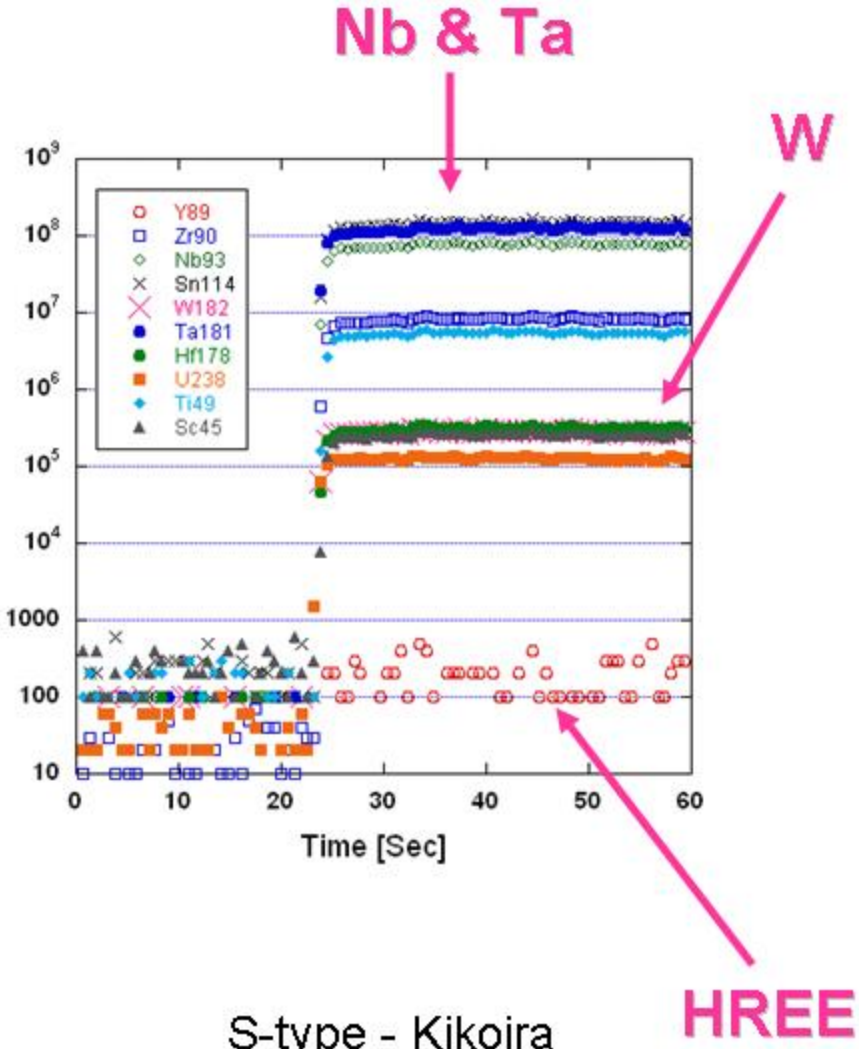
Update 07/2012: knocked back again. Will not be resubmitted.

NSW GOVERNMENT Resources & Energy

Sn



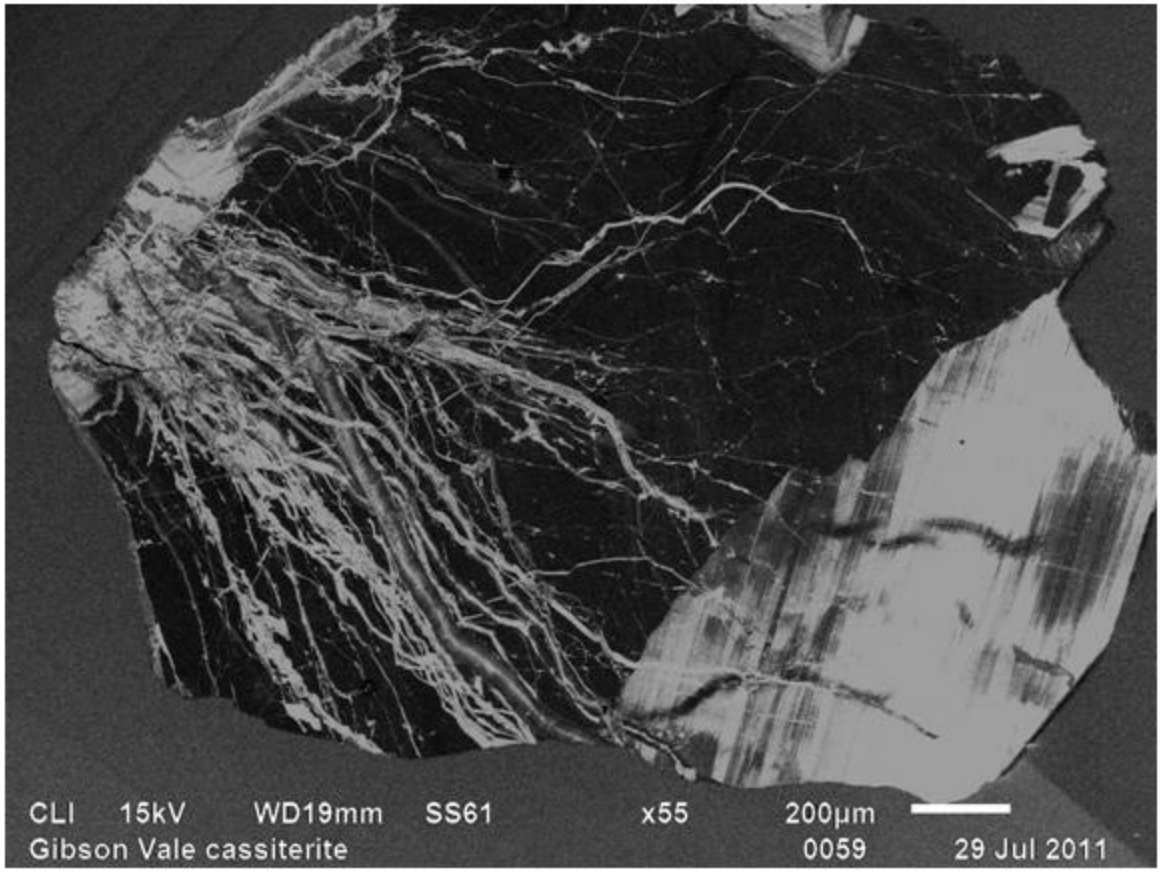
I-type - Emmaville



S-type - Kikoira

Geological Survey of New South Wales

Sn



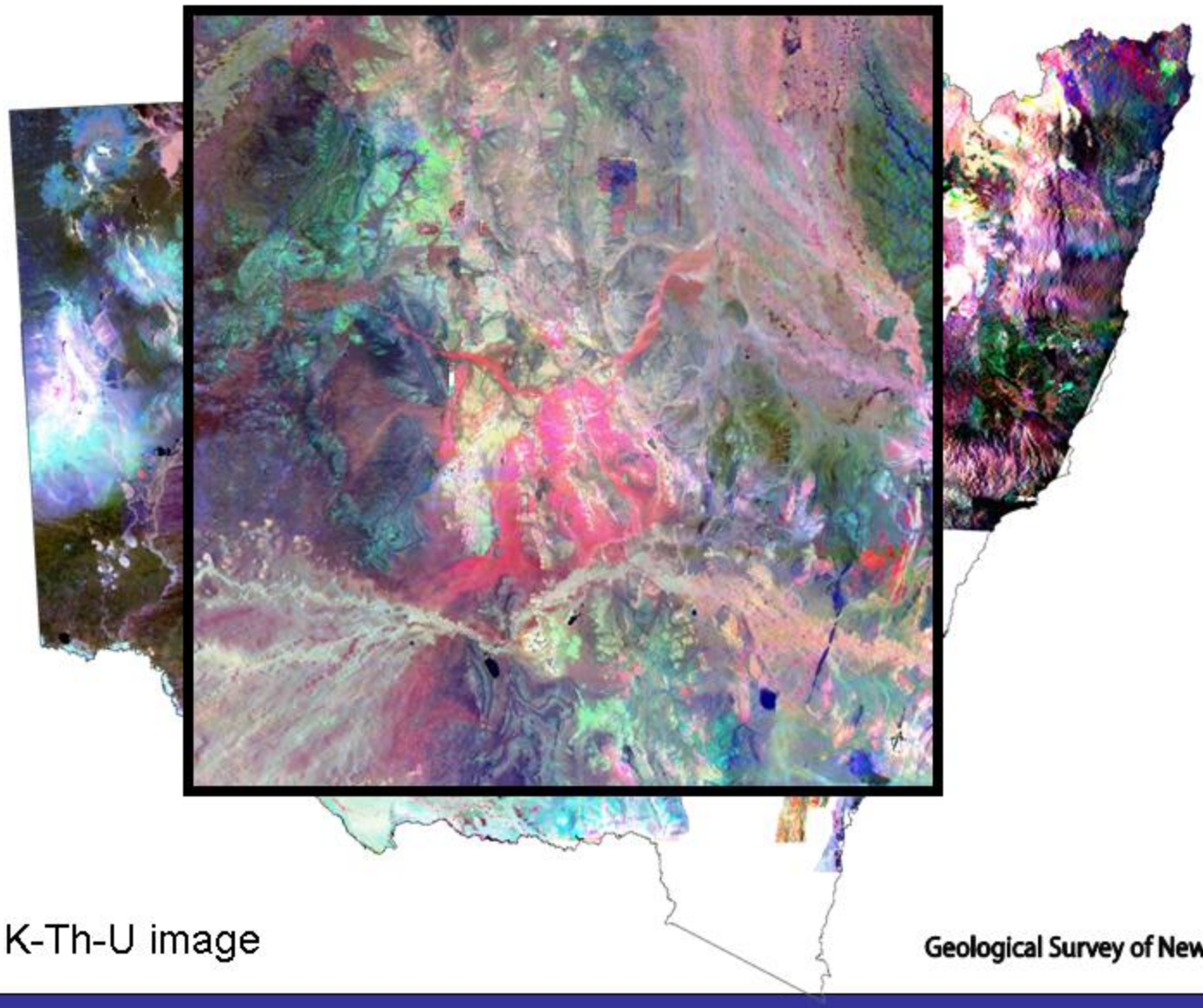
C.I. image of cassiterite showing zoning and veinlets of recrystallised cassiterite.

NSW GOVERNMENT Resources & Energy

Uranium

- Exploration to be allowed.
- Some obvious targets – Broken Hill region.
- Small known occurrences elsewhere.
- Survey will investigate possibility of some models – Silurian Lachlan Orogen granites for example.
- Geoscience Australia Uranium publications are a good guide, although some did not include NSW.

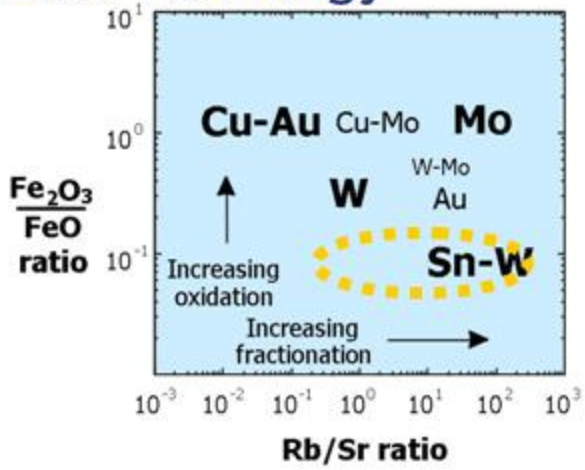
Uranium opportunities



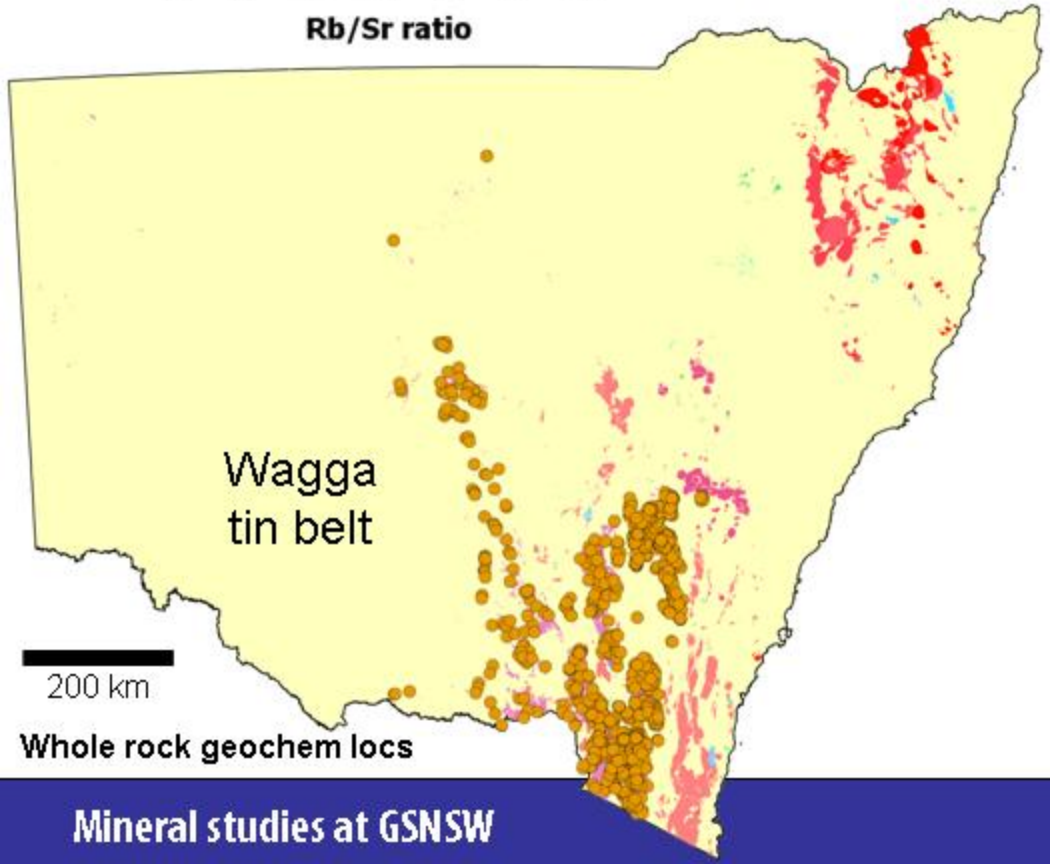
Combined K-Th-U image

Geological Survey of New South Wales

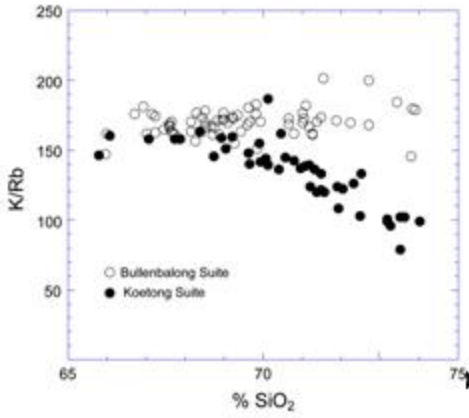
Silurian System



- S-types > I-types
- Distinct Supersuites
- Overwhelmingly crustal
- Fertile for Sn-W, Nb-Ta



- Wagga tin belt associated with distinct Koetong Supersuite.
- Ardlethan deposit clearly younger.

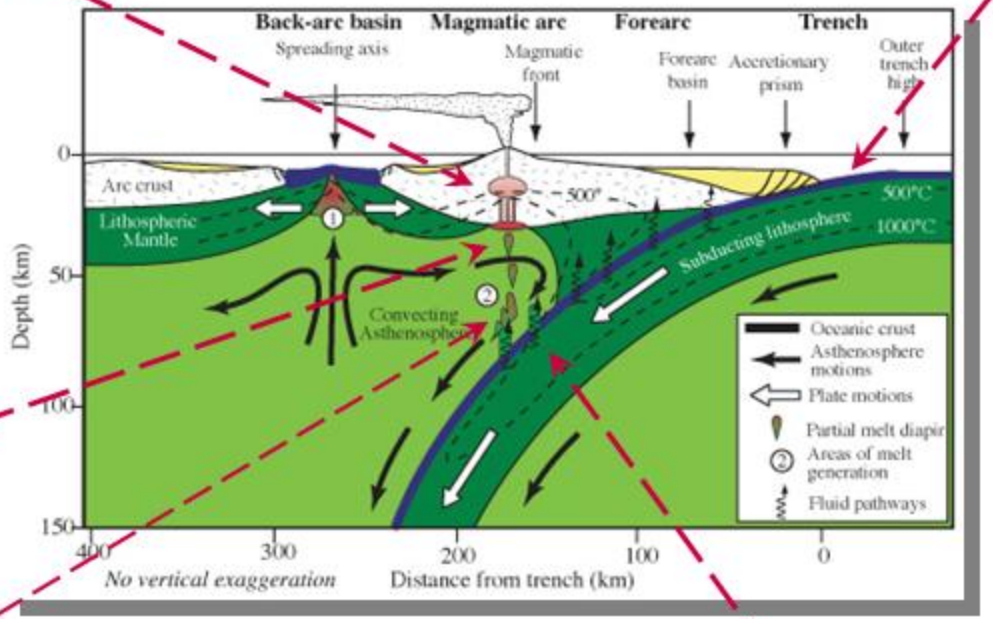


Ordovician O-Hf Study – Tony Kemp

Continental crust
low ε_{Hf}, high $\delta^{18}O$

Sediment (^{18}O-enriched)
terrigenous: low ε_{Hf}
pelagic: high ε_{Hf}

Nd & Hf uncoupling useful too!



Mantle wedge
high ε_{Hf}, low $\delta^{18}O$

Basaltic slab
(upper) high ε_{Hf}, ^{18}O-enriched
(lower) high ε_{Hf}, ^{18}O-depleted

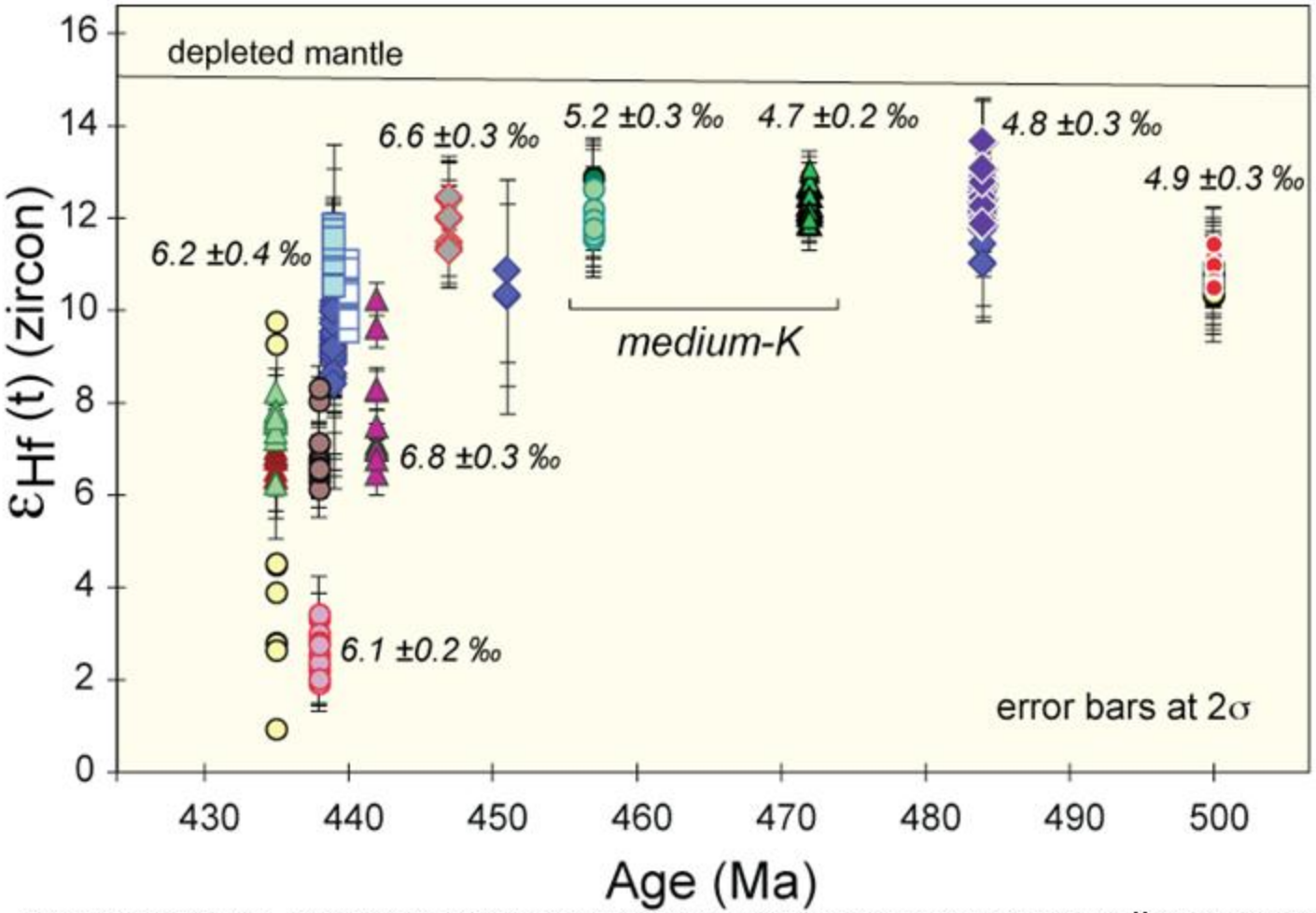


Figure 2. Plot of zircon ε_{Hf} versus emplacement age for the Macquarie Arc intrusives, also indicating the average zircon $\delta^{18}O$ (VSMOW) for some samples.

Source: Kemp et al., 2011; see next for abstract

NSW GOVERNMENT Resources & Energy

Forensic zirconology: tracing the magmatic and metallogenic evolution of intrusive porphyries of the Macquarie Arc, NSW, Australia

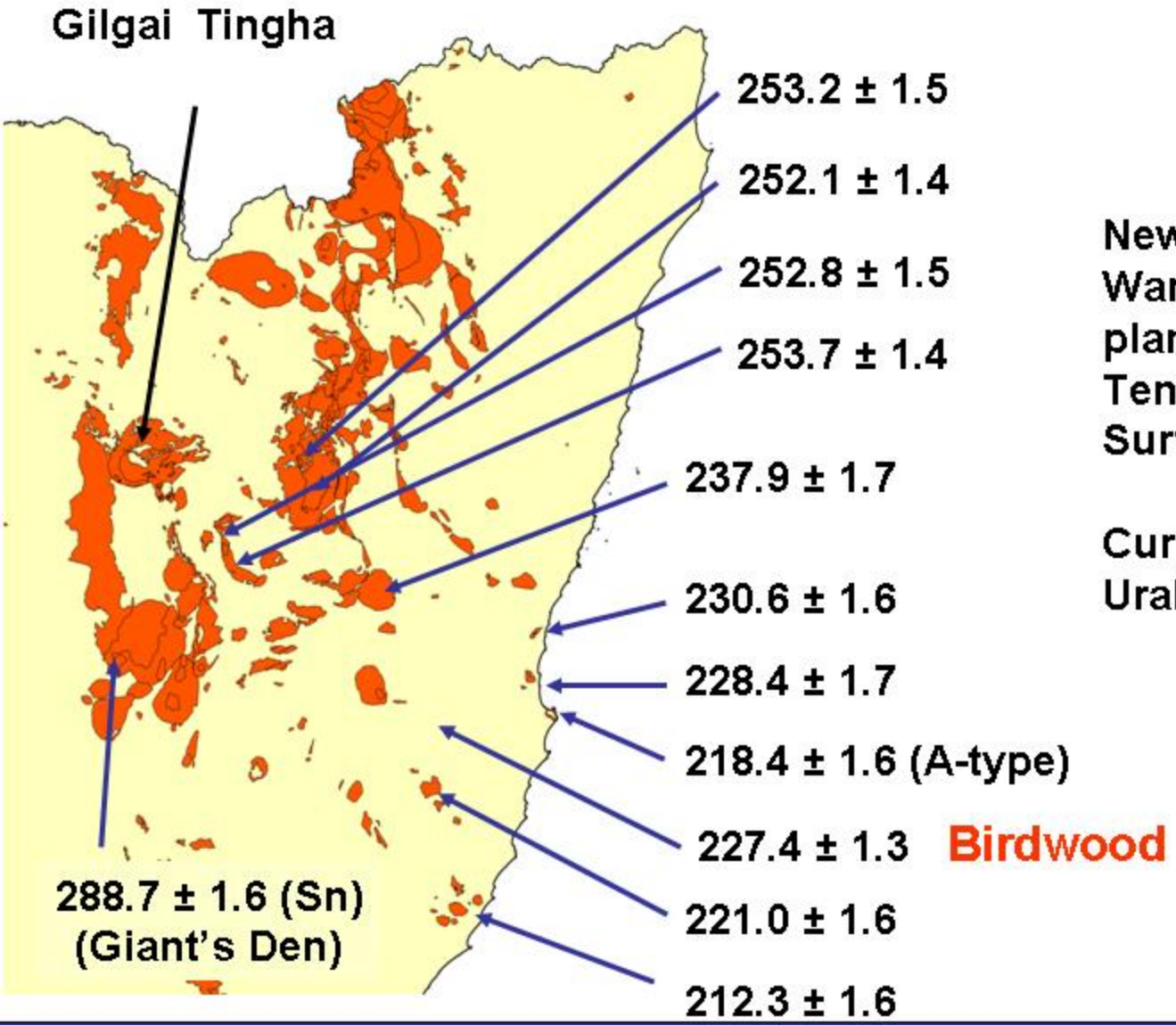
Tony Kemp, School of Earth and Environmental Sciences, James Cook University, Townsville, QLD 4811 Australia
Phillip Blevin, Geological Survey of New South Wales, Industry & Investment NSW, NSW 2310 Australia
Martin Whitehouse, Nordic Centre for Earth Evolution, Swedish Museum of Natural History, Stockholm, Sweden
EIMF, Edinburgh Ion Microprobe Facility, School of Geosciences, University of Edinburgh, Edinburgh, UK

Abstract. We report the results of a 'forensic zirconology' investigation into intrusives of the Ordovician-Silurian Macquarie Arc, southeastern Australia. This involves the sequential microanalysis of U-Pb, oxygen and hafnium isotopes, and trace element contents, to fingerprint the magmatic source inputs and to deduce the crystallisation pathways and intensive parameters (T, oxygen fugacity) of the magmas. We aim to constrain the origin of the porphyry magmas and to explore the link between the nature and proportions of crustal and mantle sources and metal endowment. New geochronological data refines the magmatic history of the arc, particularly regarding the timing of medium-K magmatism and in the identification of a Cambro-Ordovician component. Diversity in rare earth patterns implies a range of magmatic $fO2$, and that the medium-K porphyries were intrinsically more oxidised than high-K to shoshonitic rocks. Temporal Hf-O isotope trends reveal that the oldest intrusives had depleted mantle-like 176Hf/177Hf but sub-mantle δ18O, indicating a distinctive source component, whereas younger porphyries show a decrease in εHf accompanied by a rise in δ 18O, consistent with the progressive addition of supracrustal material. We interpret this trend to reflect evolution in tectonic setting, and suggest that the metallogenic fertility of the Macquarie Arc magmas is influenced by a supracrustal contribution.

11th SGA Biennial Ore Deposits Conference, Antofagasta, Chile, September, 2011.

NEO - New dating

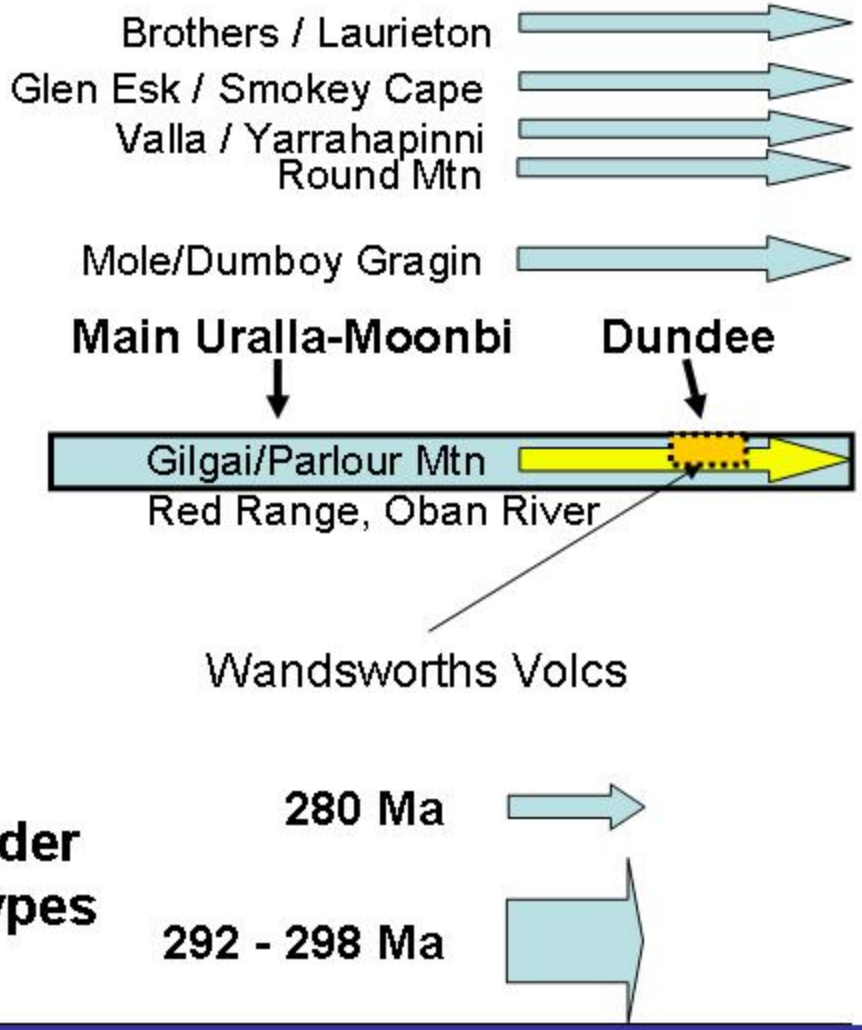
Dating: Andrew Cross, Emma Chisolm GA

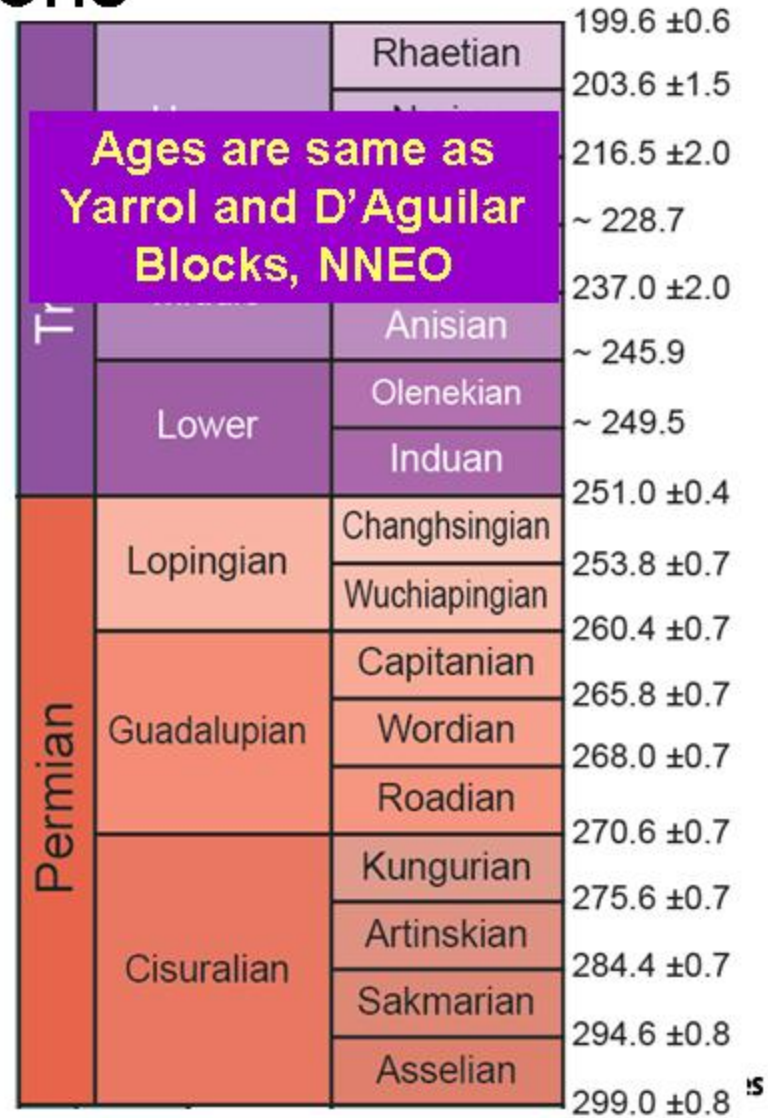


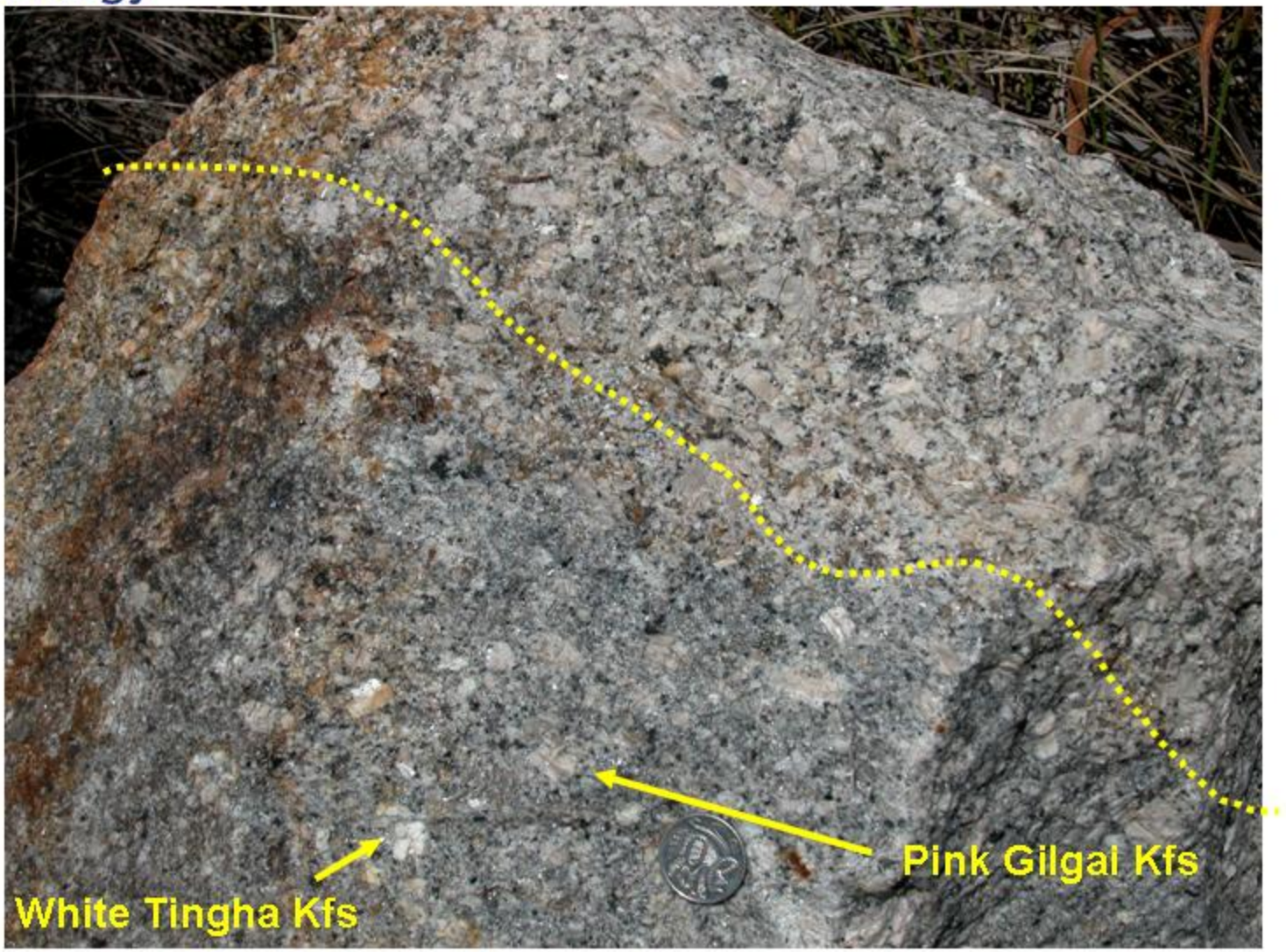
New age results for Wandsworth Volcanics, planned follow up for Tenterfield geophysics Survey 2012.

Current dating around Uralla.

Volcano-plutonic associations





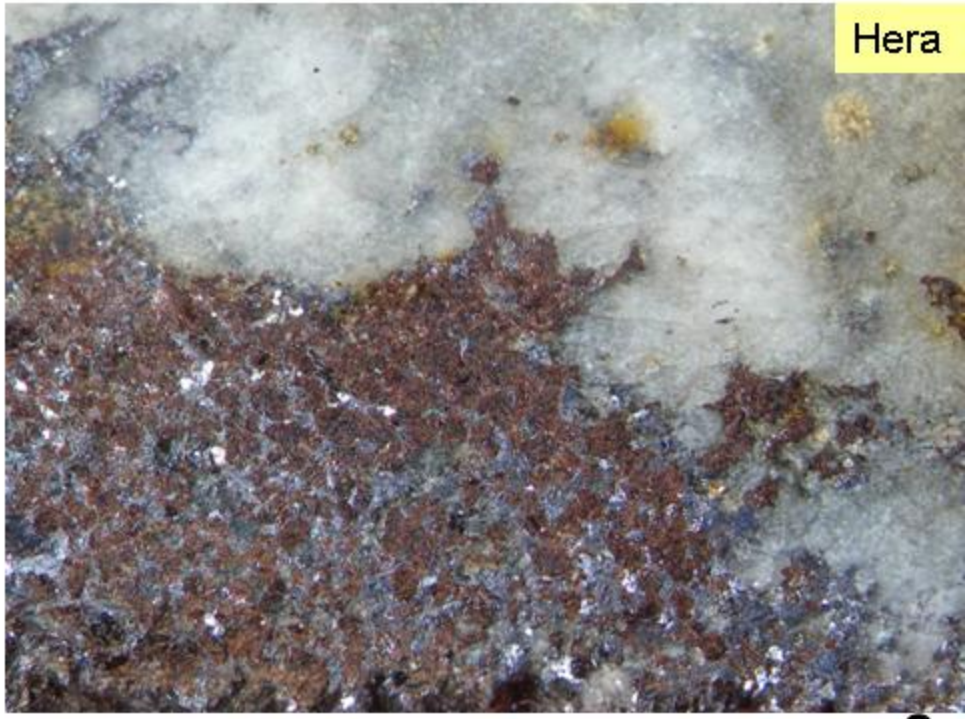


Contact between Gilgai (top) and transitional Tingha facies. There is a vague alignment of K-felds phenos in the Gilgai with the contact.

Nymagee Synthesis

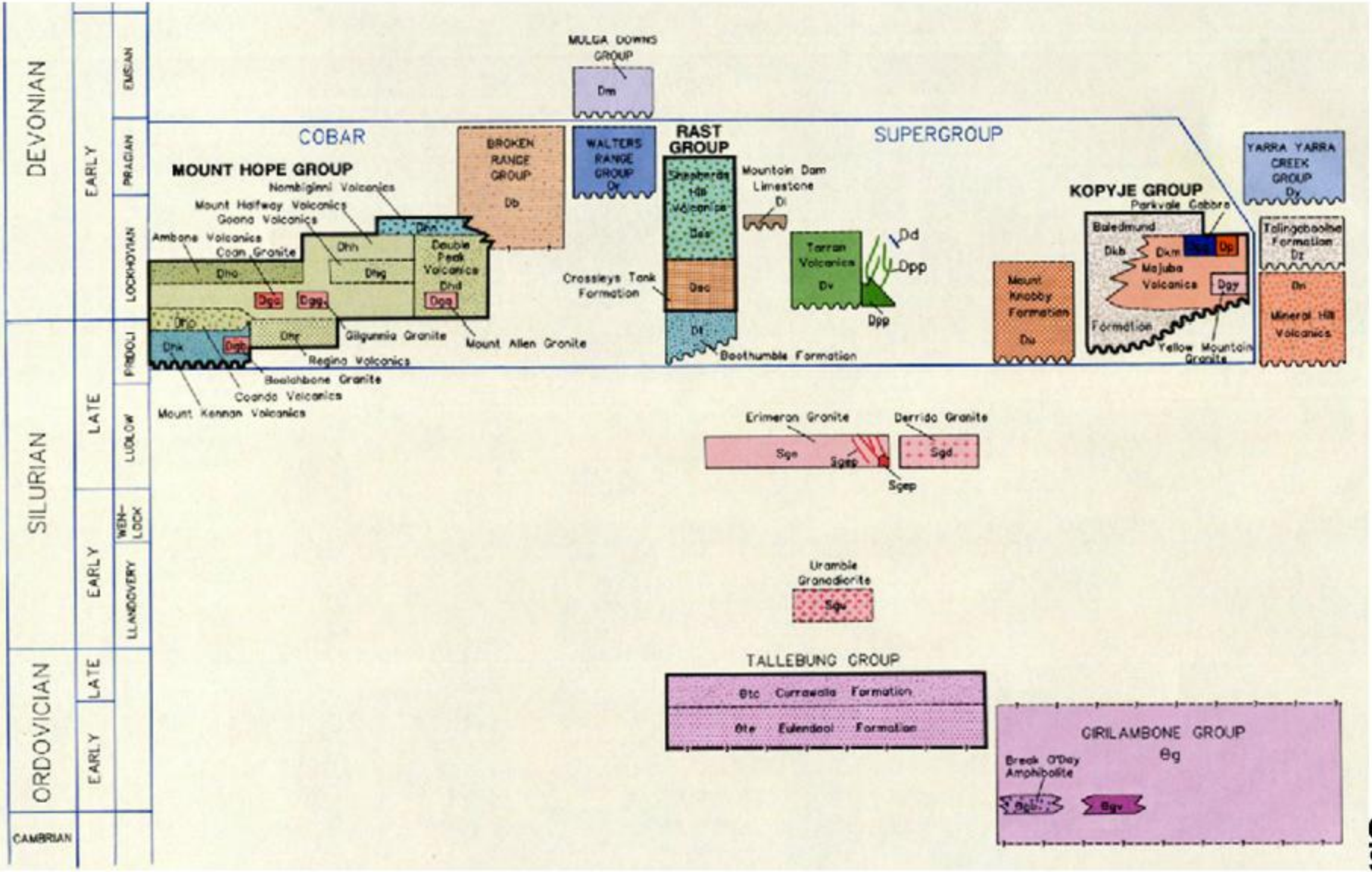
Upgrade the geological, geochronological, geochemical and mineral occurrence data on the Nymagee 250k sheet area and environs.

- New basement geology and geophysical interpretation.
- New dating of igneous rocks and mineralisation.
- New Pb, S, Nd isotope data.
- Data harvesting of DIGS reports
- Updated mineral occurrence data.
- Regional Metallogenic Map
- NVCL digital atlas



Geological Survey of New South Wales

Nymagee Dating



GS

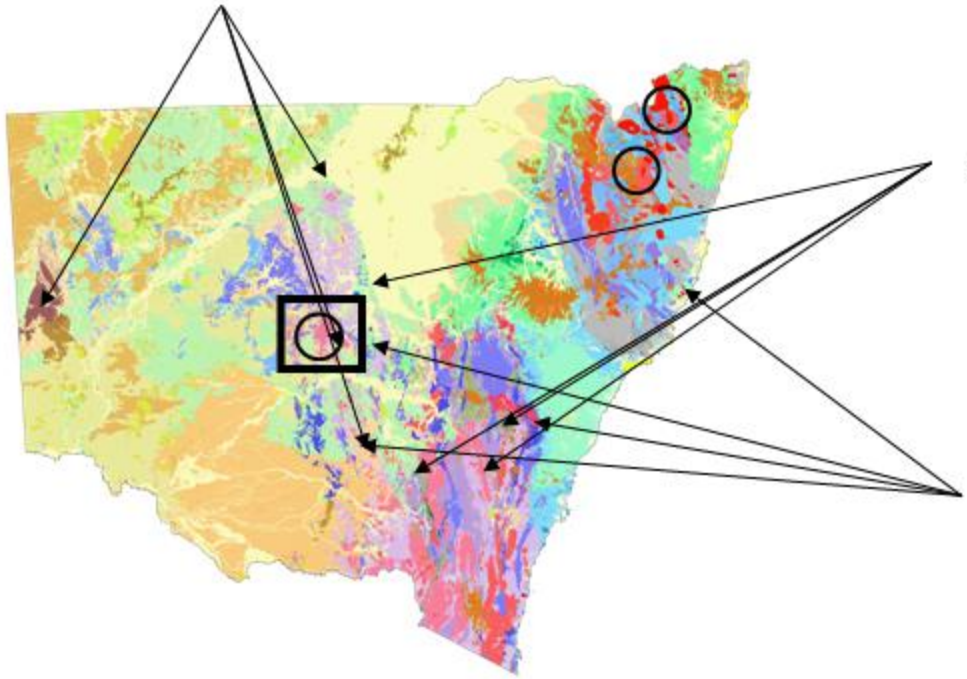
NSW GOVERNMENT Resources & Energy

Metals in Time

Placing mineralisation events in NSW in their regional and tectonic context.

Cassiterite U-Pb dating
- Tullebung
- Ardlethan
- Euriowie – Broken Hill
- Warraweena

Ar–Ar dating
- Uralla
- Blackfellows Dam
- Seven Hills

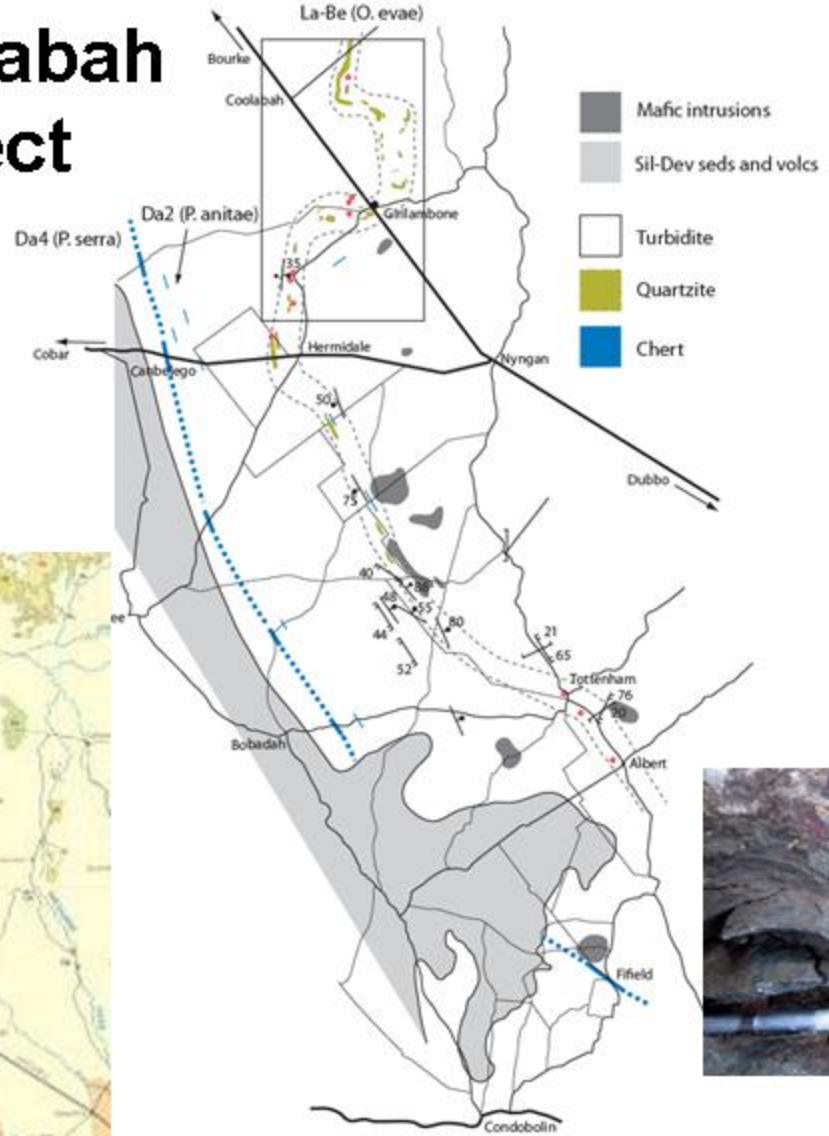


Re–Os dating
- Trundle, Lake Cowal, Copper Hill

SHRIMP U-Pb dating
- Nymagee region volcanics and intrusions
- Birdwood
- Lake Cowal Igneous Complex

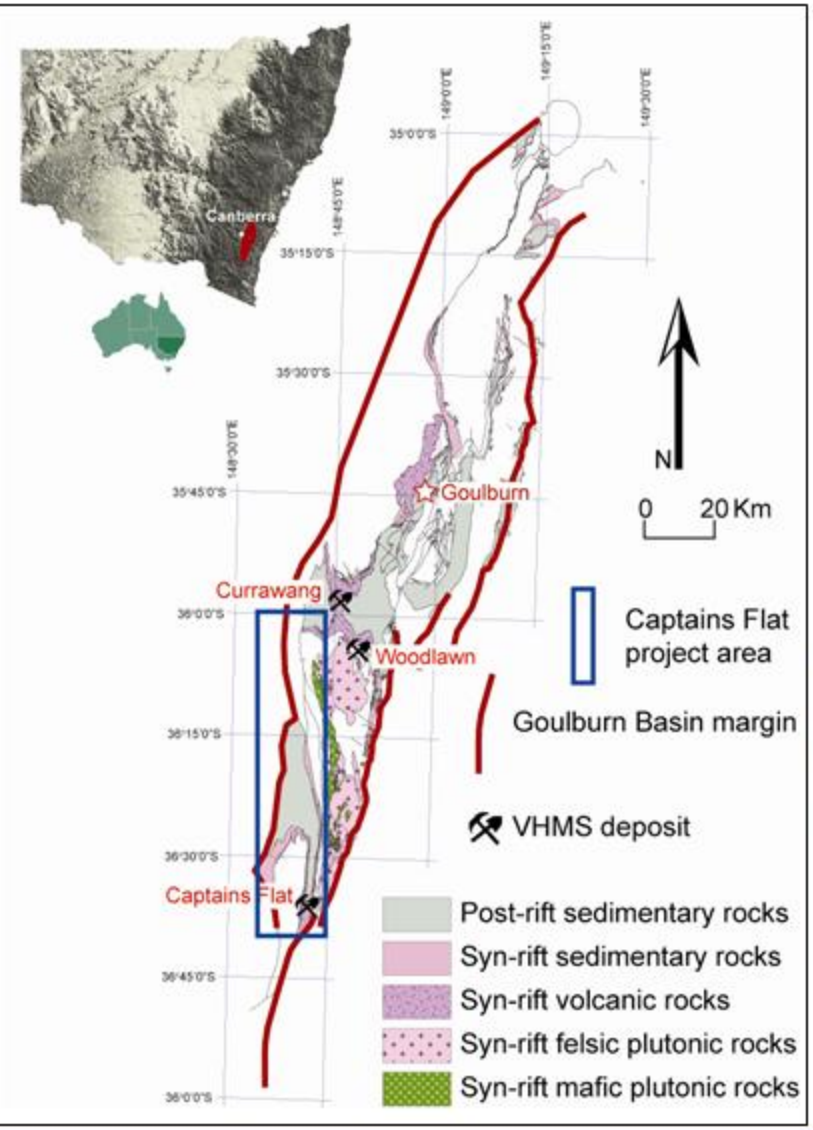
Geological Survey of New South Wales

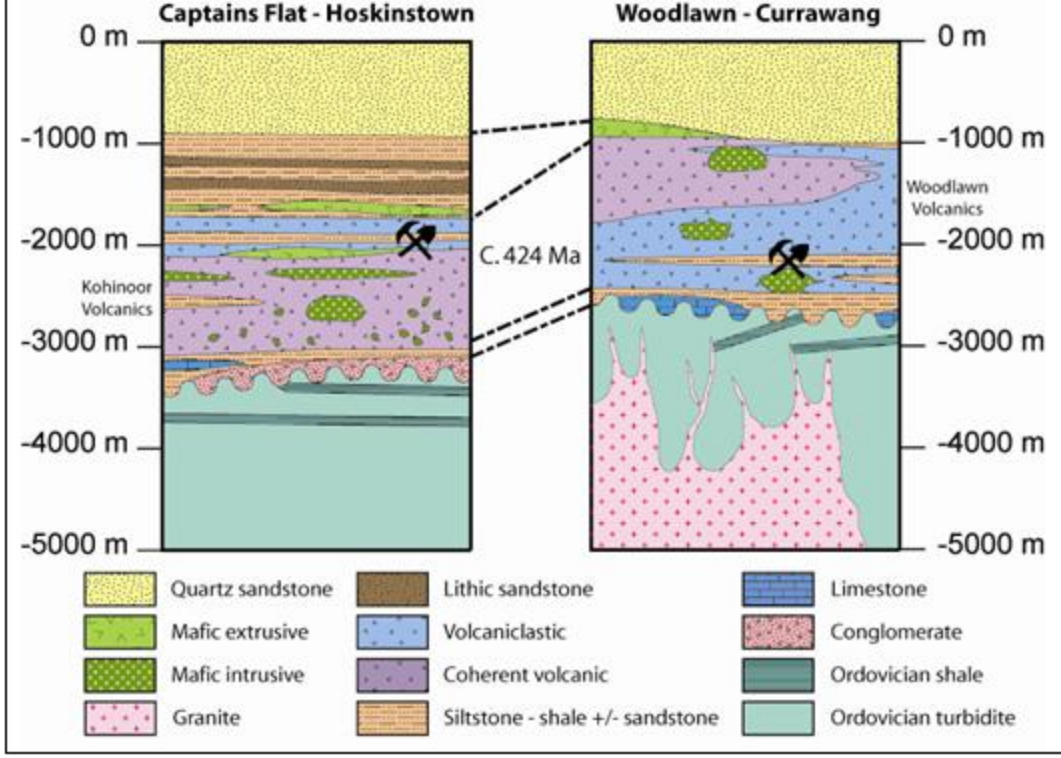
Mt Oxley-Coolabah Mapping Project

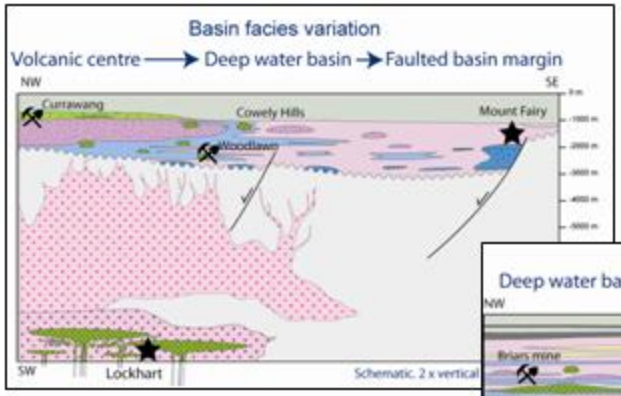


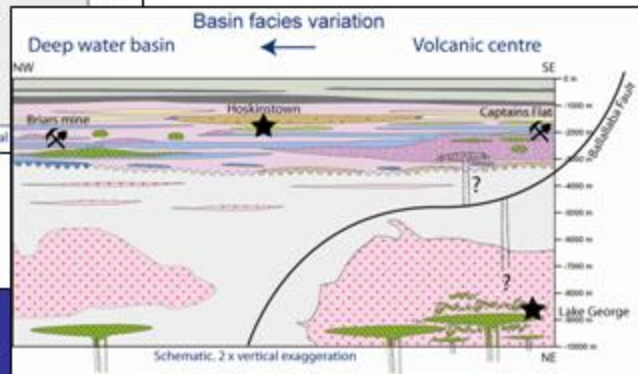
Geological S

Captains Flat Mapping Project









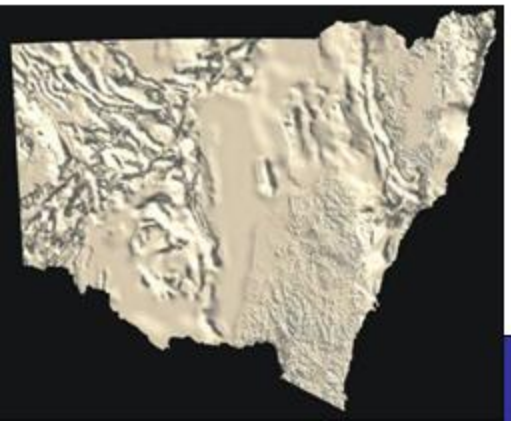
NSW GOVERNMENT Resources & Energy

NSW - New Geophysical Data 2011

Clarence Moreton – NE New England Geophysical Survey released Feb 2012

South East Lachlan Geophysical Survey Processed Data released 2011

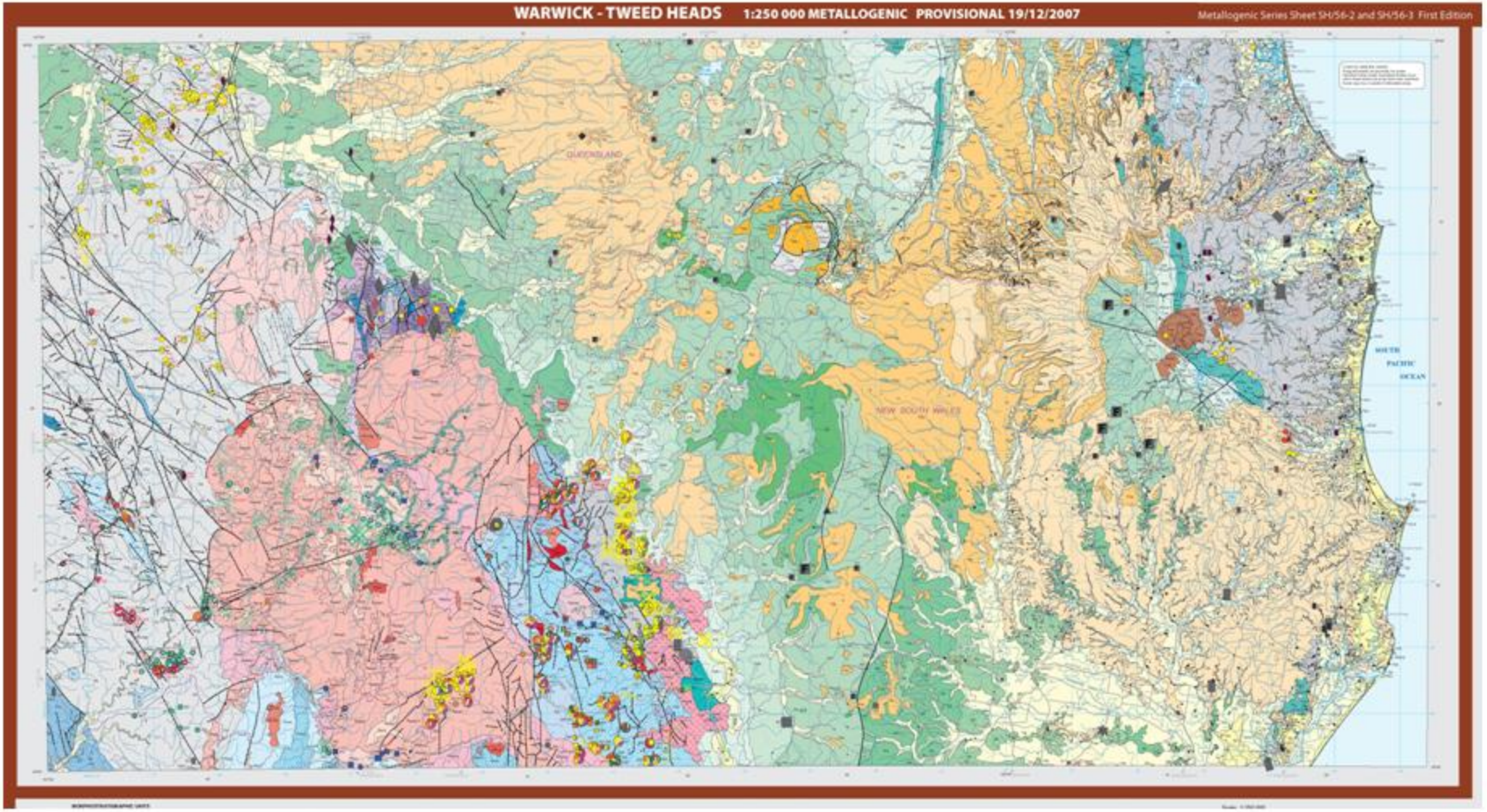
3D DTB



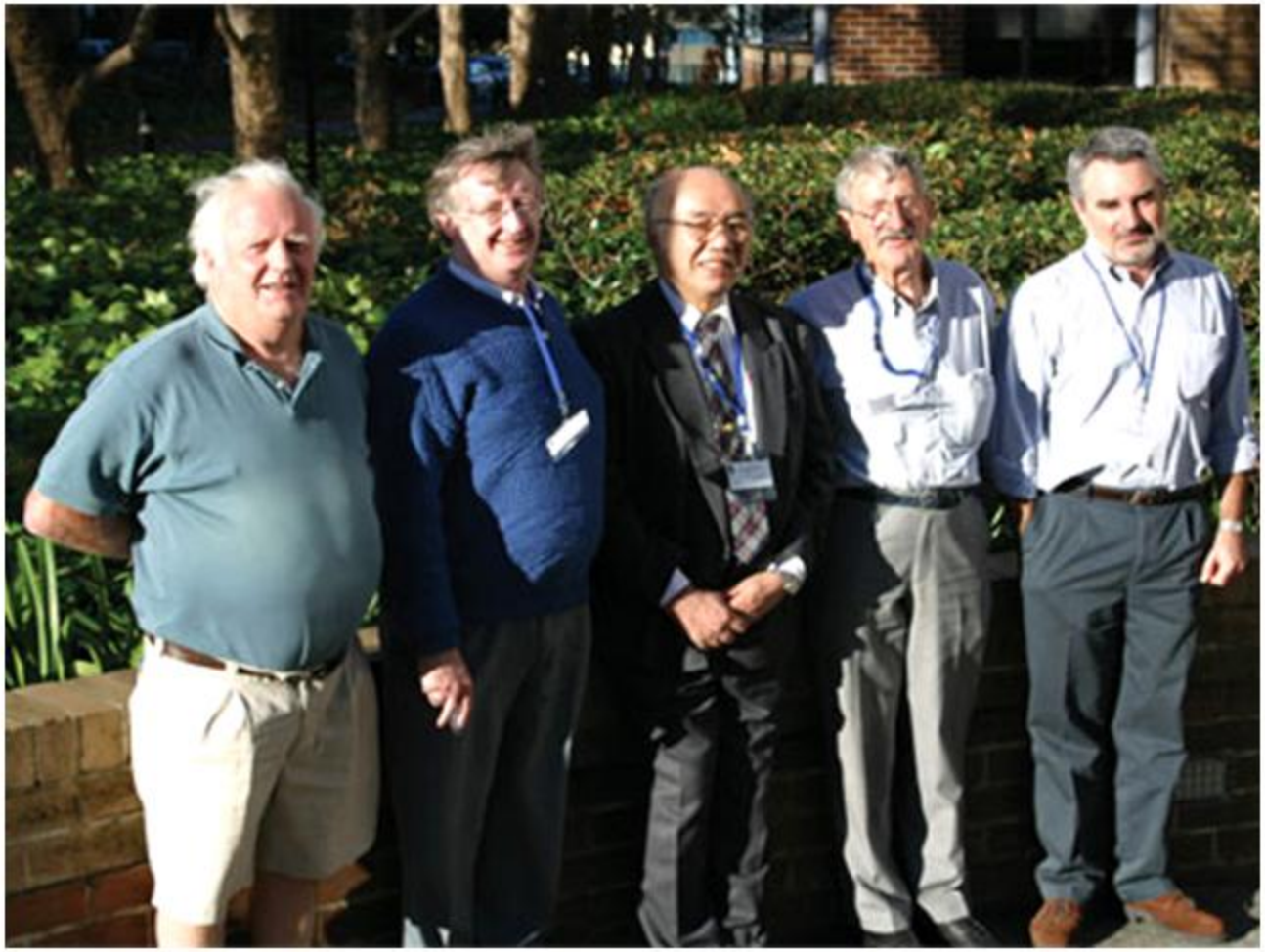
Geological Survey of New South Wales

NSW GOVERNMENT Resources & Energy

Warwick – Tweed Heads



Geological Survey of New South Wales



Bruce Chappell, Neil Williams, Shunso Ishihara, Allan White, Phil Blevin

Bruce Chappell

1936 - 2012