AusLAMP Southeast Australia: Imaging the Tasmanides

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Plus many others at GA, GSNSW & GSVic
Imaging mineral systems with MT

Heinson et al 2006

Heinson et al 2018
Detailed study to better understand the nature of cover and mineral prospectivity in the Cloncurry region.

- 3D grid layout
- 2km station spacing

Jingming Duan – preliminary model

- Ernest Henry
- Mt Margaret

Wang et al., 2018
**Magnetotellurics to map architecture**

- MT one of the few techniques that can image the very upper crust to the base of the lithosphere
- Different ‘flavours’ of MT essentially differ in recording time and sampling rate
- Image crustal architecture => mineral deposit locations
- One of the highest priorities of UNCOVER

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**Cover-thickness – Audio MT (pre-drilling)**

**Crustal architecture: Broadband MT (regional survey)**

**Lithospheric architecture: Long-period MT (AusLAMP)**

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Alison Kirkby, Discovery in the Tasmanides, 2019
AusLAMP

- Australian Lithospheric Architecture Magnetotelluric Program
- Commenced late 2013; collaborative project with universities/State surveys
- Completed ~1300 of ~3000 sites every 0.5°
- Most advanced continental scale MT survey in the world

GA contribution:
- **Northern Australia**
- **New South Wales** (GA + GSNSW) fieldwork ongoing since 2016
National conductivity map

Wang et al., 2014

- “AusLAMP v0.0”: from magnetic observatory stations (Wang et al. 2014)
- 57 stations Australia-wide
- Magnetic field only
Magnetotelluric method
What is MT?

>1 Hz signal generated by world-wide thunderstorms

<1 Hz signal from interactions of Earth’s magnetic field variations with solar wind

Lightning

Derive Earth’s electrical conductivity structure (or resistivity)

Measure time variations of Earth’s electric and magnetic fields

Solar wind
MT data acquisition

Schematic MT field layout, modified from Schmoldt (2011)
New South Wales geology
Geology of SE Australia

GA tectonic provinces (2013)

GA 1:2500k Surface geology portal.ga.gov.au

Legend

- **material formed in surficial environment**
- **sedimentary rock**
- **phaneritic igneous rock**
- **granitoid**

- **myiolitic**
- **basalt**
- **compound material**
- **metamorphic rock**

- gold/silver deposits
Tectonic development

Meffre & others:
(Schaan et al 2019)

Concurrent subduction zones

Cayley & others:
(Cayley 2011; Moresi et al., 2014; Cayley 2015 & in prep)

Rotation during microcontinent accretion

Schaan et al 2019

Moresi et al, 2014
AusLAMP NSW/Vic magnetotelluric data
AusLAMP NSW

- Funding & land access from GSNSW / GSVic
- Ongoing acquisition (~10 instruments during northern field season, more in wet season)
- 203 sites completed in NSW out of 320 (+ 95 in Victoria)
- Recording time ~30 days + (at most sites)
- Period range 6.4 to (up to) 40000 s

Victoria data from Duan & Kyi, 2018
Uni Adl data from Robertson et al., 2016
Signal penetration depth (estimate)

Minimum depth

Maximum depth

Penetration depth in km for minimum period

Penetration depth in km for maximum period

Depth, km

Depth, km
AusLAMP NSW model
AusLAMP NSW - Model

- Stations collected to July 2019
- 193 new sites + 10 sites (UofA) + 95 (Victoria) = \textbf{298 sites} in model
- (excludes 18 further sites awaiting processing/modelling)
- Grid cell size 7.5 x 7.5 km
- Compute time ~ 16 days
- RMS misfit 1.8

Victoria data from \textit{Duan & Kyi, 2018}; Uni Adelaide data from \textit{Robertson et al., 2016}
Depth Slice 10 km

- Masked > 0.5° from stations
- Mostly resistive, except:
  - Mesozoic – Cenozoic basins
  - Curnamona conductor (Robertson et al 2016)
  - Conductor in Melbourne Zone
Depth Slice 40km (base of the crust)

Moresi et al., 2014; Cayley 2011
Depth Slice 60km (mantle lithosphere)

Moresi et al., 2014; Cayley 2011
Depth Slice 140km (mantle)

- Central Victoria conductor
- New South Wales – northeasterly alignment
- Similar to Australian plate motion
Depth Slice 140km (mantle)

Leucitite volcanoes along Cosgrove hotspot track (Davies et al 2015)

Lithosphere-Asthenosphere Boundary (Davies et al 2015)
Implications for prospectivity
Imaging mineral systems with MT

Heinson et al 2006

Heinson et al 2018
Depth Slice 30km and gold

All Gold

Occurrences from Australian Mines Atlas

Orogenic Gold

NSW production + contained resource from GSNSW;
Vic production from GSVic; + contained resource from GA (AIMR, 2018)
Statistical Analysis

Orogenic Gold

90% of deposits within ~20km of the 100 ohm-m contour

Percentage of deposits > 0.3t

- True deposit locations
- Random locations (excluding Murray Basin)

Distance (m) to 100 Ωm contour

Depth, m

Moho

LAB

Mean N value
Max N value
Mean N value (-1std)
Max N value (-1std)
National conductivity map (with detail in SE Australia)

- New AusLAMP model provides increased detail in SE Australia
- In NSW/Vic, we have taken the first step from “AusLAMP light” => AusLAMP
- Demonstrating power to resolve lithospheric architecture and regions of interest
- Next step: infill

Wang et al., 2018

Ernest Henry
Mt Margaret
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