

Geoscientific work in NSW for the National Drilling Initiative, MinEx CRC

Chris Folkes

13th May 2022



Acknowledgements

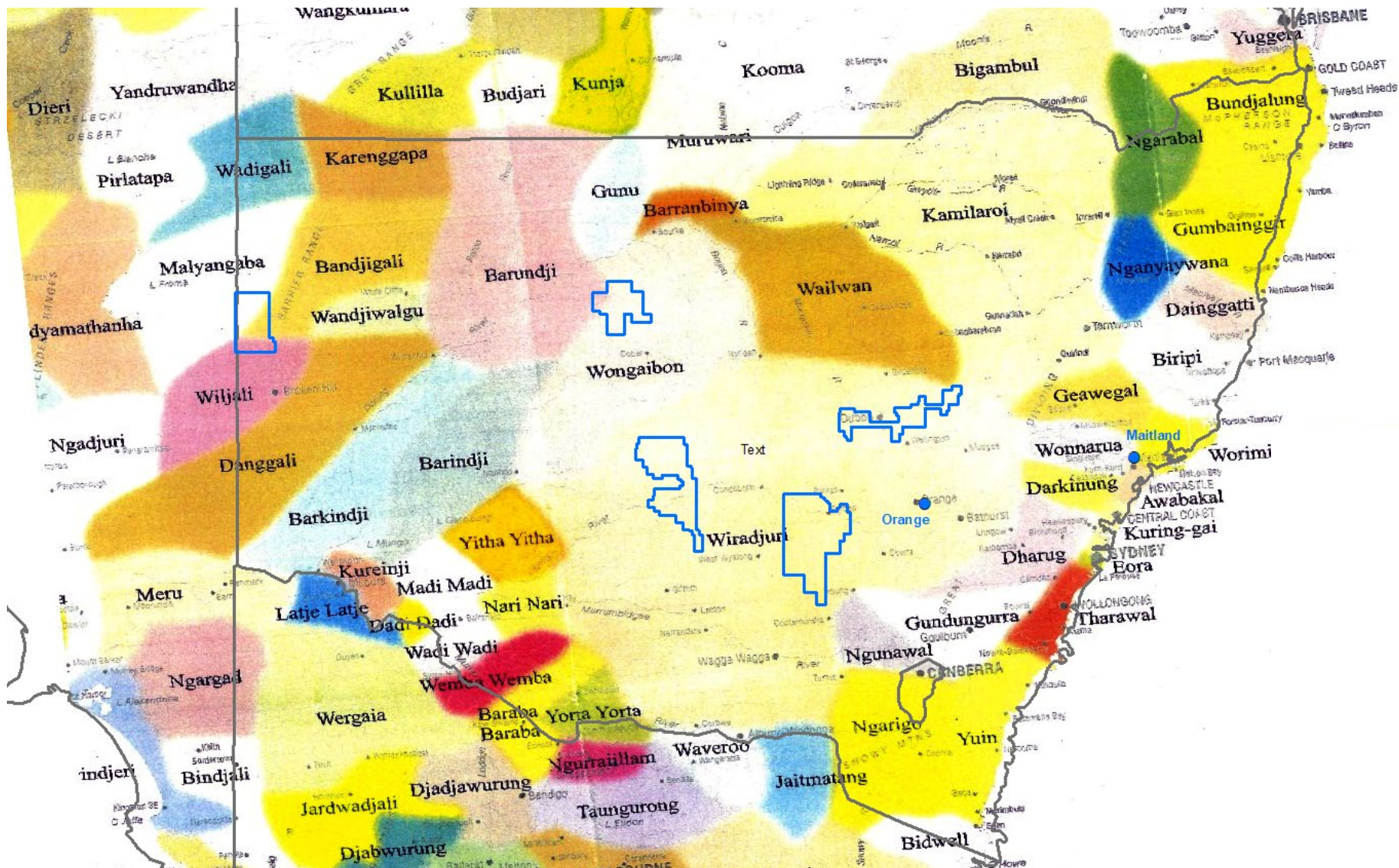
- The work has been supported by the Mineral Exploration Cooperative Research Centre (MinEx CRC) whose activities are funded by the Australian Government's Cooperative Research Centre Program. This is MinEx CRC Document 2021/44.
- This presentation includes work with these MinEx CRC research and industry participants:



- & Kenex Pty Ltd.

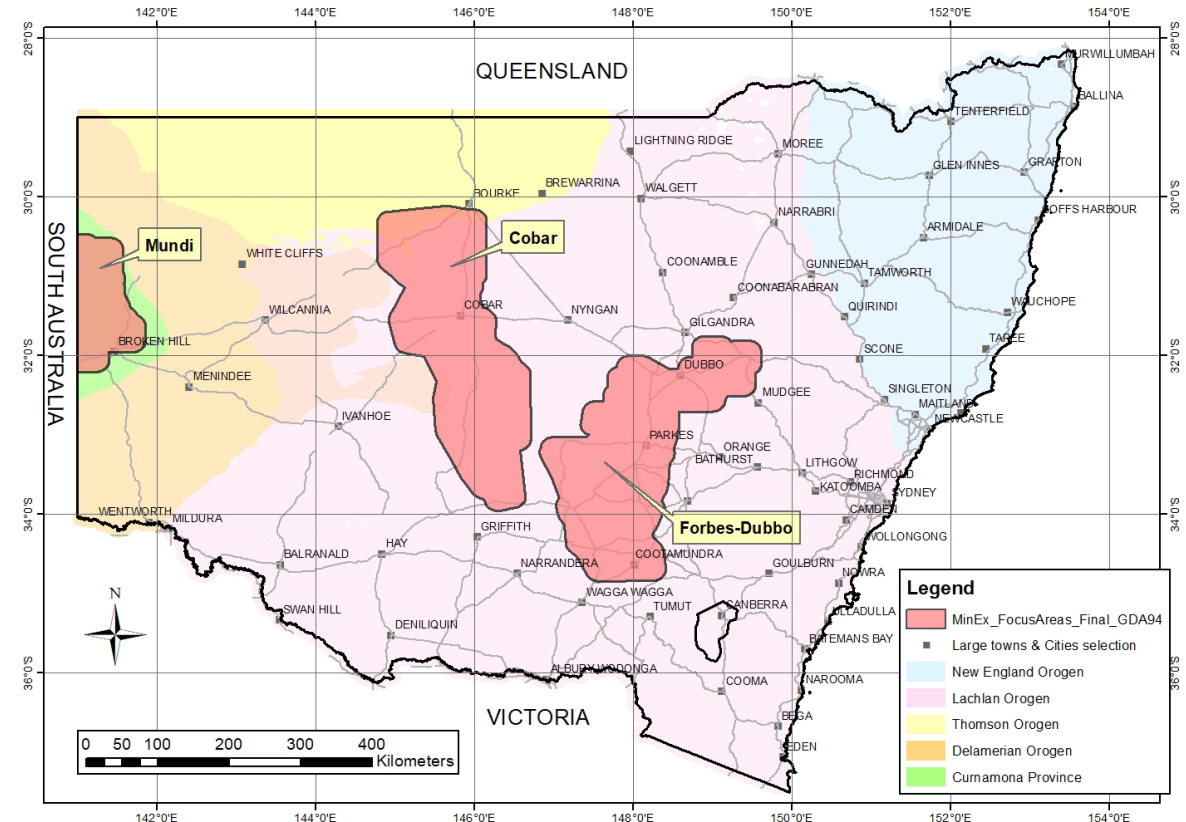


NSW MinEx focus areas & Traditional custodians



MinEx CRC in NSW – focus areas

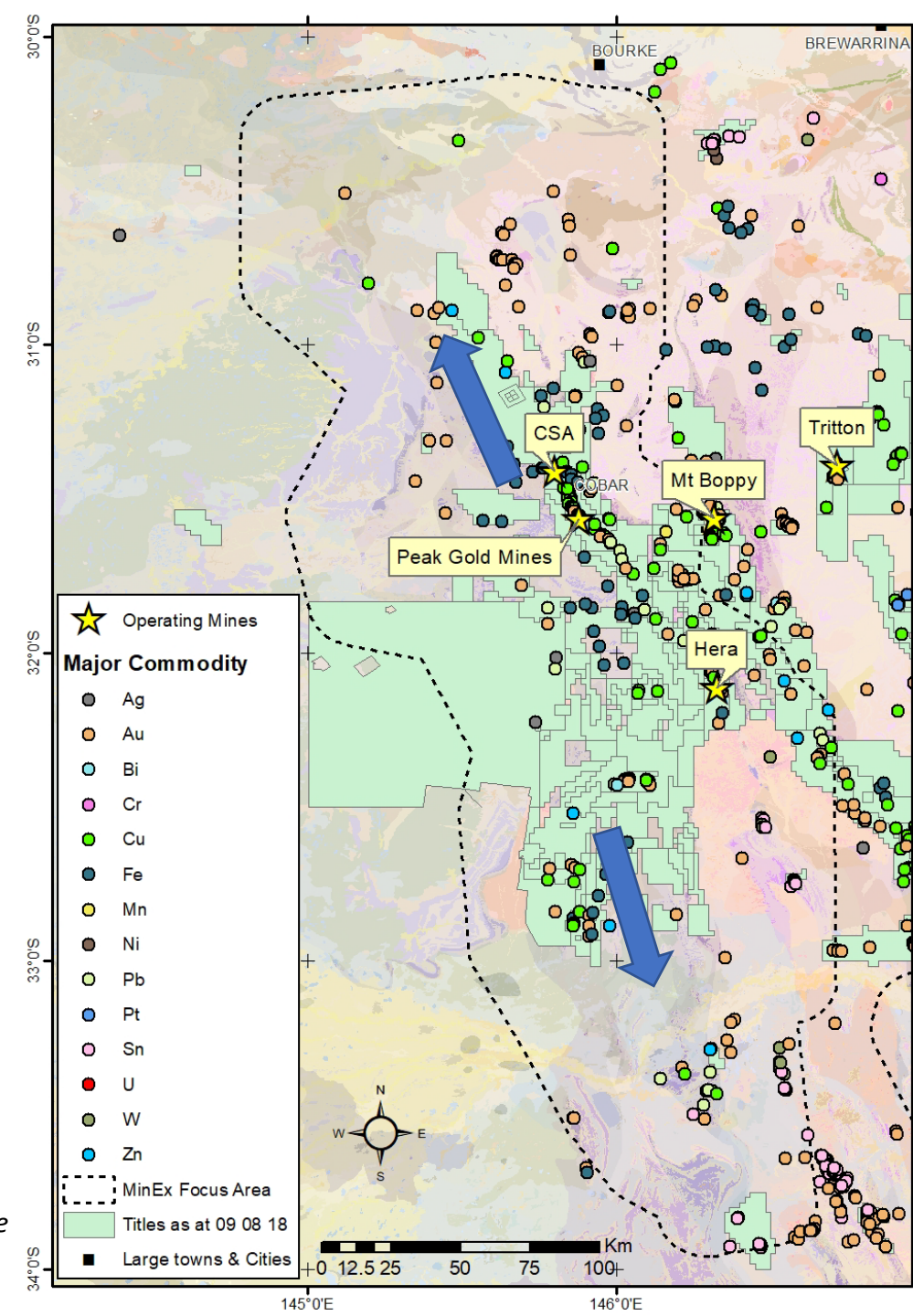
- Undercover extensions of known mineralised terranes
- Depth to basement (i.e. cover thickness) is under 500 m over the majority of the area (and often far less)
- Away from sensitive land (e.g. national parks, and regions with known and important groundwater aquifers)
- Integrated program of data compilation, mapping, geochemistry, geophysics and drilling over 10 years
 - Regional drilling program
- Currently at the start of phase 2 (2022–2024)
- Work to date – pre-drilling phase



→ Goal is to help drive a new generation of discoveries

Why Cobar?

- World class precious and base metal mineral province
 - Continuous mining for 150 years since discovery of the Great Cobar deposit in 1870
- But mining requires new discoveries to extend mine life
- Current exploration boom in the basin with significant discoveries in the last 10 years
- Some companies are looking for a 'hub and spoke' mining model
- GSNSW program is focused away from the main line of lode to where the basin goes undercover to the north and south (MinEx CRC areas)



Cobar Basin mineral systems

- Cobar mineral systems are classified into two groups.

1) Magmatic

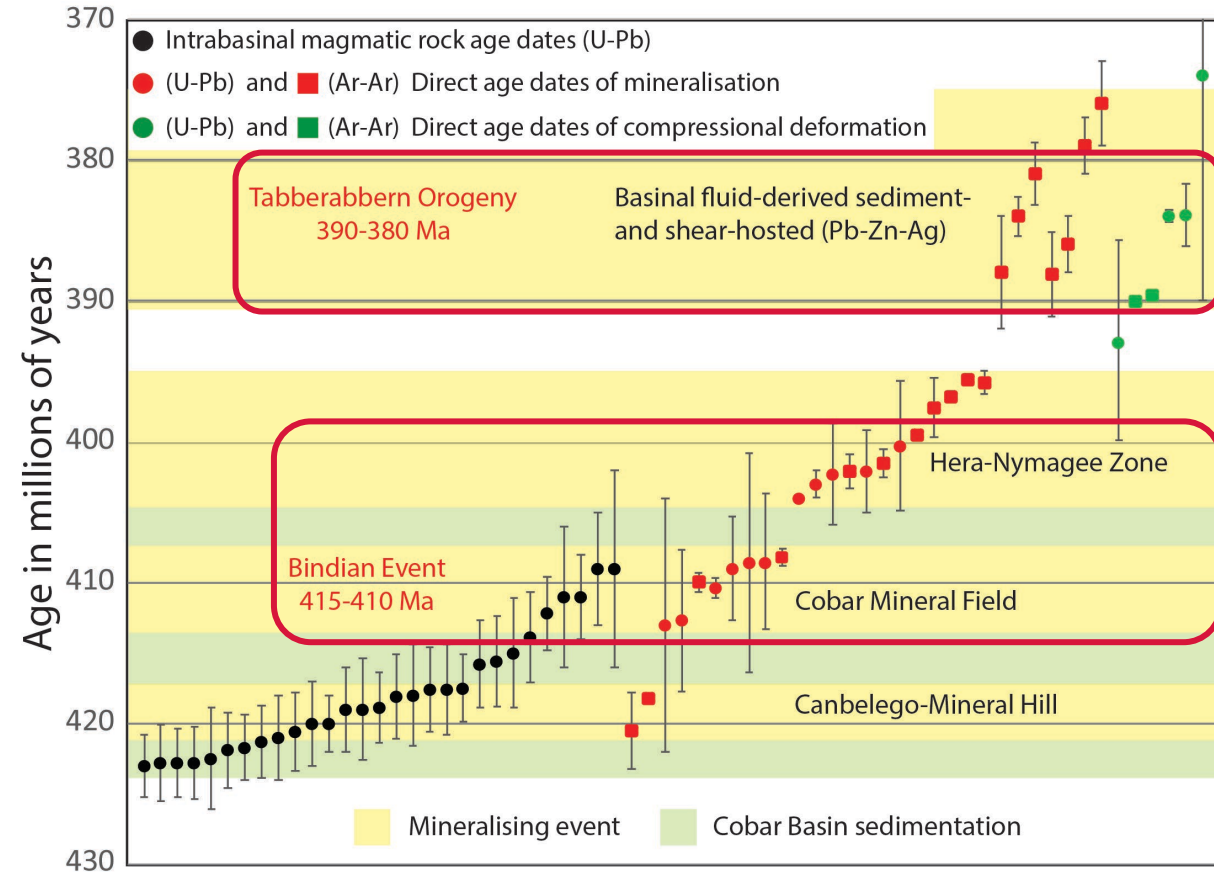
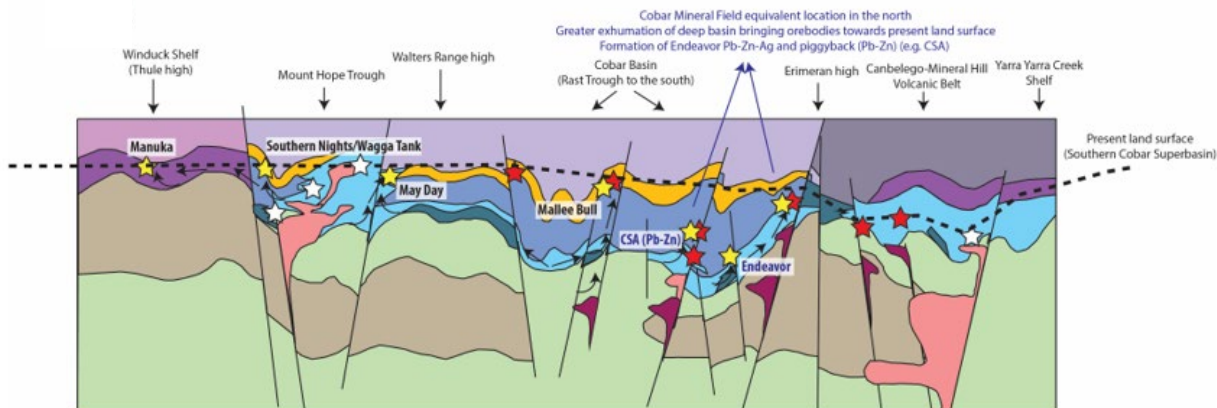
~415–400 Ma: transitional rift to sag phase magmatic-related systems (Cu–Au±Zn; high-T). Bindian Event.

2) Non-magmatic

~390–380 Ma: syn-inversion non-magmatic mineralisation (Pb–Zn–Ag; low-T). Tabberabberan Orogeny (figure below)

- See presentation by Joel Fitzherbert (GSNSW)

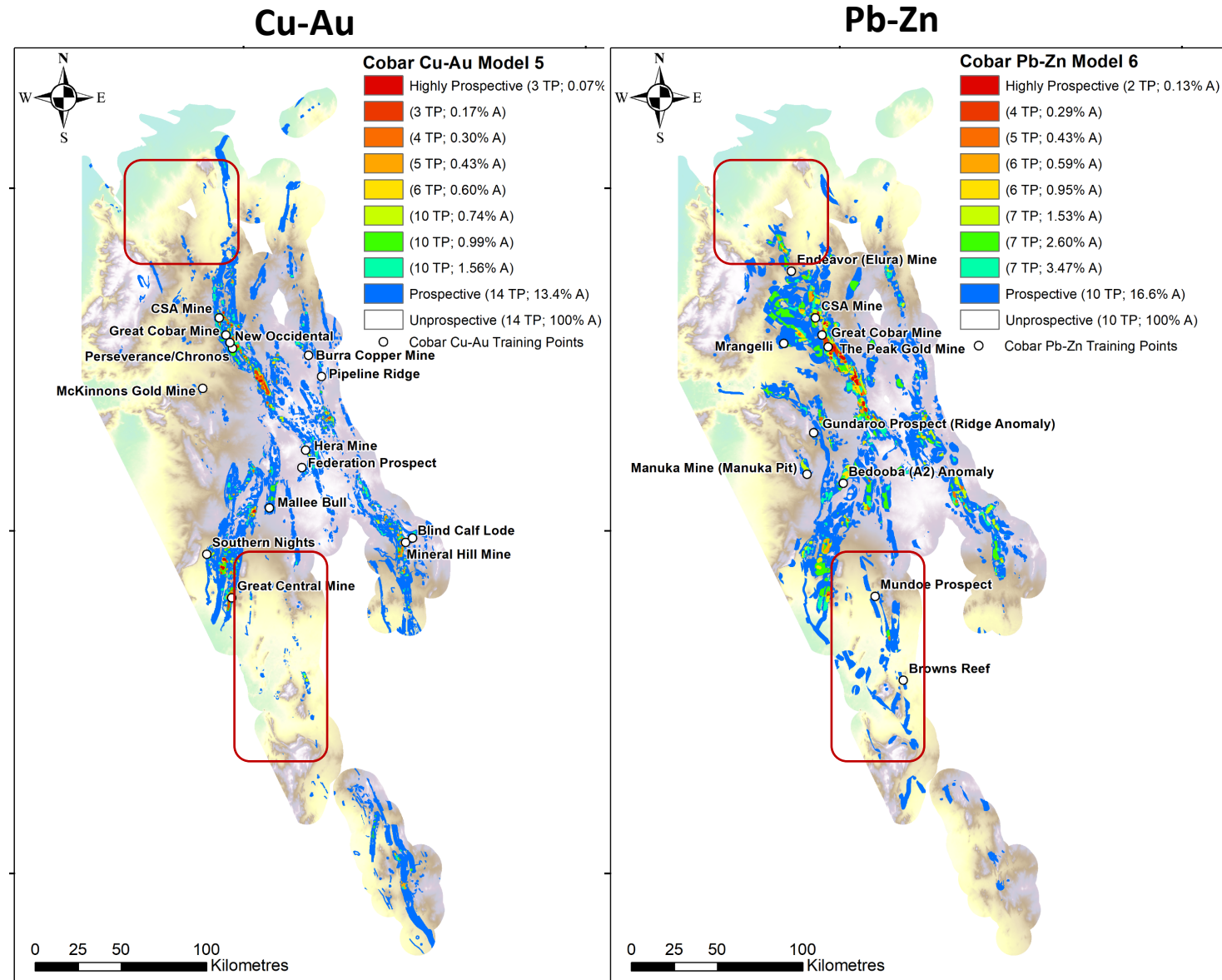
Southern Cobar Superbasin ca. 390–380 Ma
(Inversion phase)



Compilation of direct dating of mineralisation and zircon U-Pb dating for intra-basin magmatic rocks (Fitzherbert and Downes 2021 and references therein; GS2021/0042)

Central Lachlan Orogen Mineral Potential Mapping

- Existing data synthesised and Mineral Potential Mapping completed in 2020
- In conjunction with Kenex Pty Ltd (granite Sn–W, Cobar Cu–Au, Cobar Pb–Zn systems)
- Predicted location of known deposits and highlighted new areas of potential mineralisation, but data skewed towards outcrop
- Available data:
 - Report (DIGS): GS2020/0741.
 - Data package i.e. GIS layers (DIGS): <https://search.geoscience.nsw.gov.au/product/9261>
 - MinView (<https://minview.geoscience.nsw.gov.au/>)

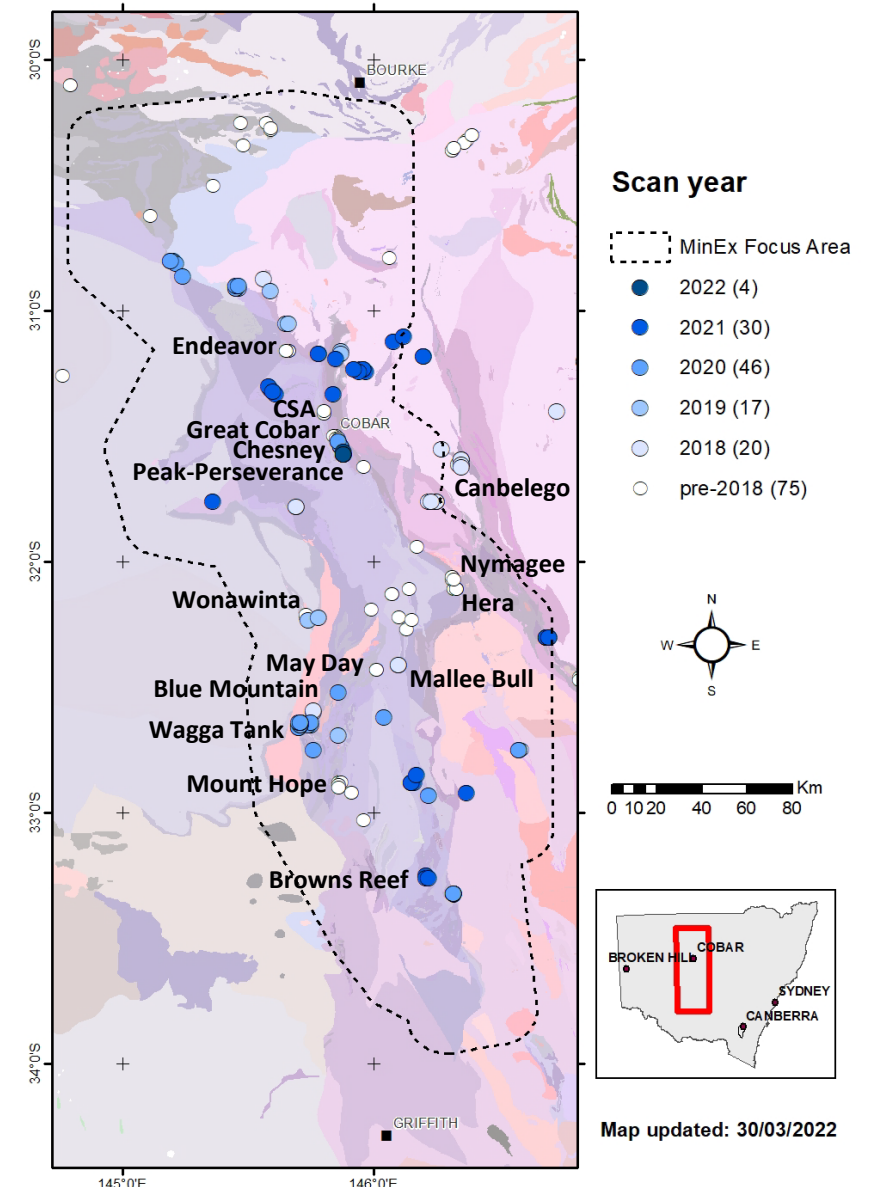


HyLogger™ – ‘the stats’

Cobar HyLogger™ snapshot since MinEx CRC (2018 to present)

- Drillholes scanned = 117
- Metres scanned > 26 km
- Key scanning campaigns
 - MinEx CRC NDI drillholes (regional)
 - Endeavor; CSA; Great Cobar, Chesney, Peak-Perseverance, New Occidental, Hera, Blue Mountain, Wagga Tank–Southern Nights, Canbelego, Mineral Hill; Browns Reef
- Available in MinView
(<https://minview.geoscience.nsw.gov.au/>)
- Available on AuScope NVCL portal
(<http://portal.auscope.org.au/>)

Cobar HyLogger™ Drillholes



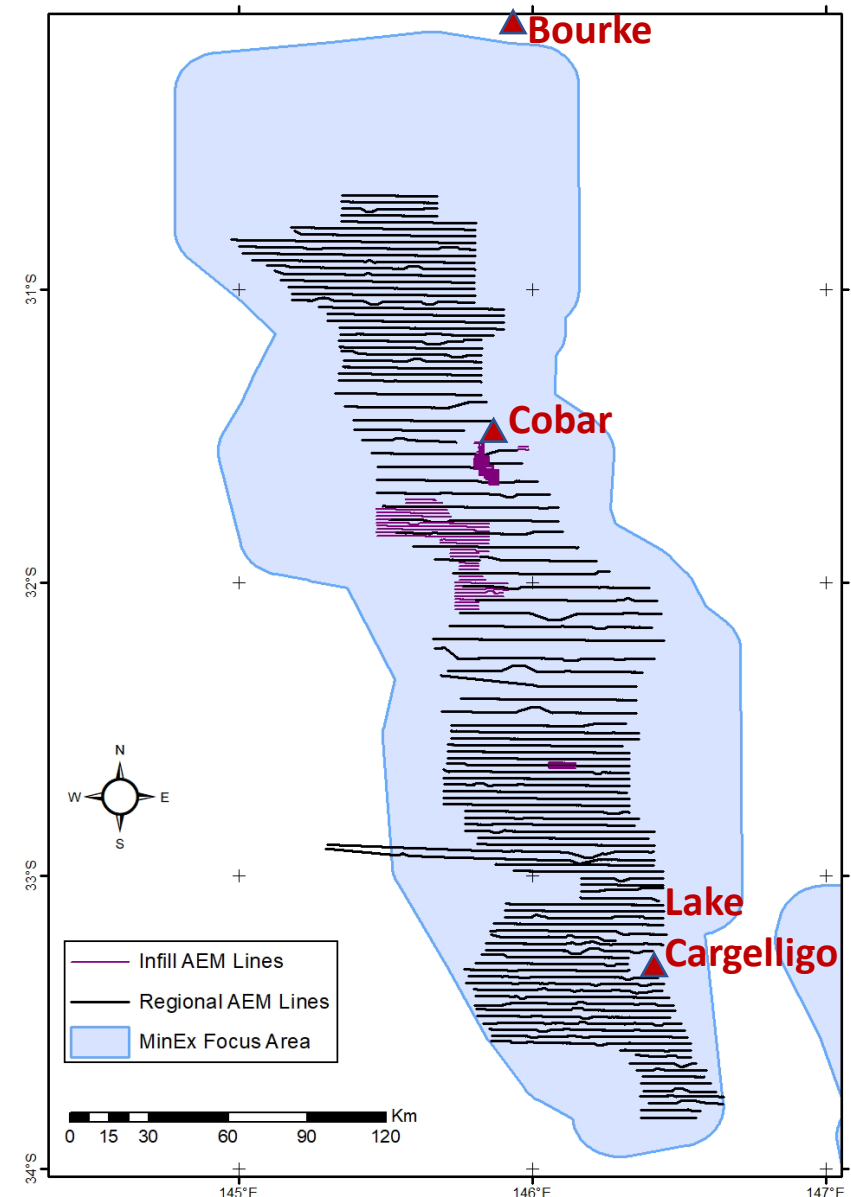
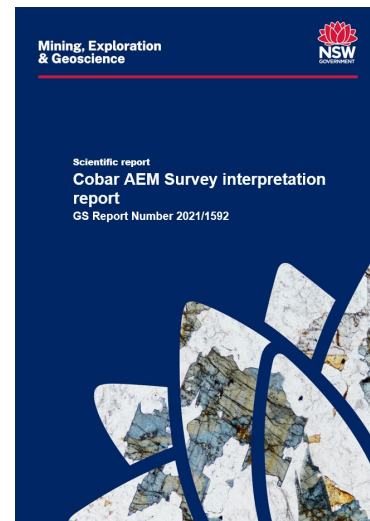
Cobar airborne electromagnetic (AEM) Survey



Australian Government
Geoscience Australia

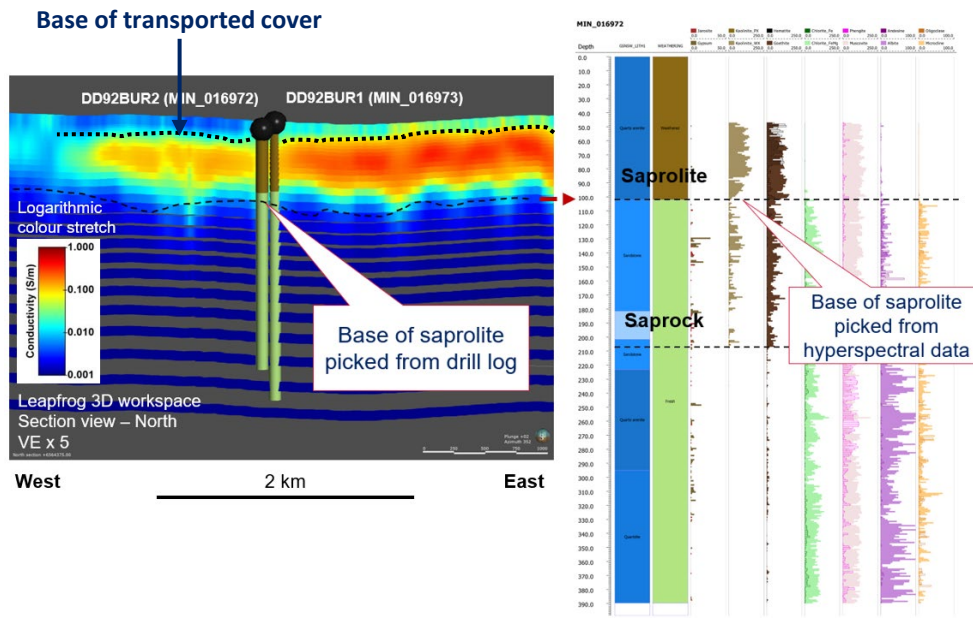
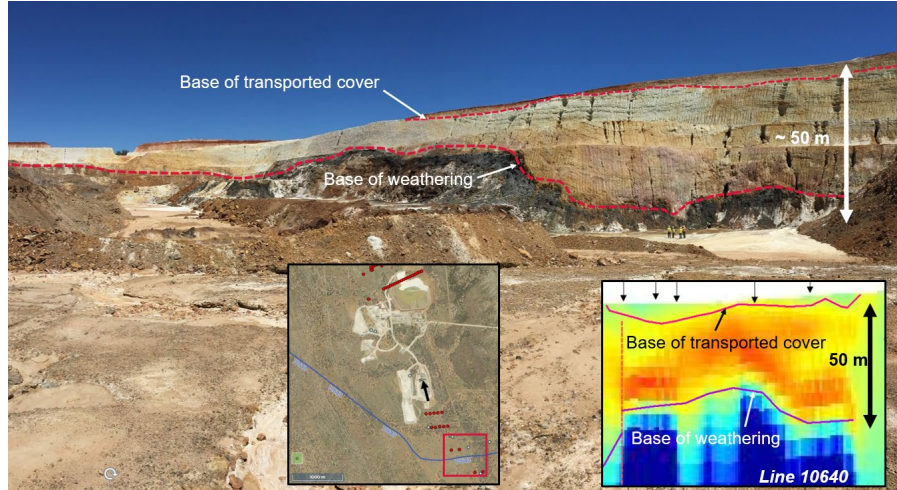
- Collaborative project between Geoscience Australia (GA) and GSNSW – largest AEM survey in NSW (Sept 2019)
- Heli-borne time-domain system (Xcite™) – flight height of 60 m, sensor suspended 30 m below, depth of investigation (DOI) up to ~400 m
- 116 east–west (**black**) lines; 2.5 km and 5 km apart; 5,908 line km; 19150 km²
- Four infill areas funded by industry (**pink lines**); all are now publicly available
- Processed data publicly available from MinView and GA's portal and e-catalogue

Interpretation
report and data
package released
(March 2022)!

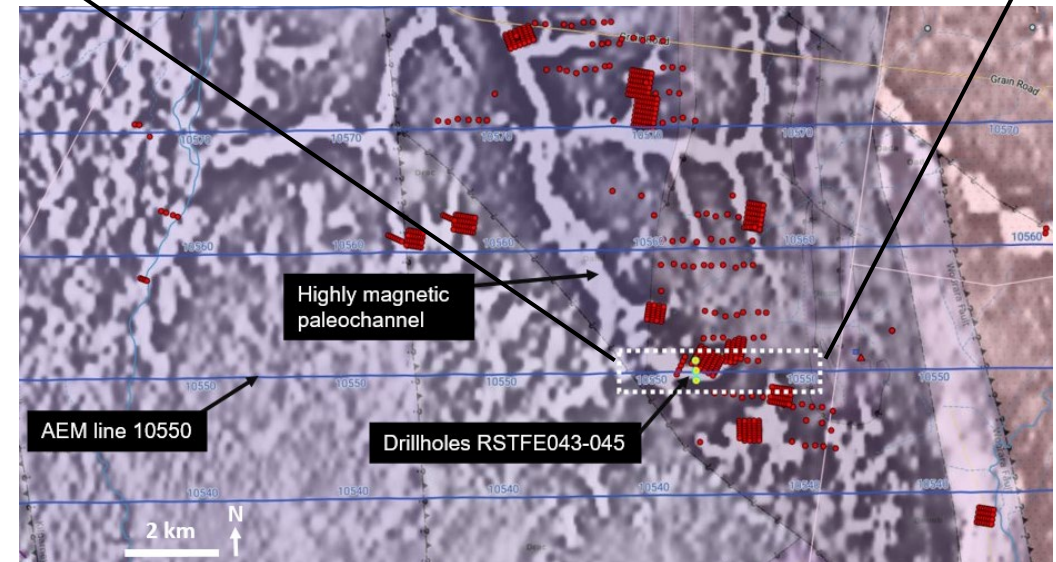
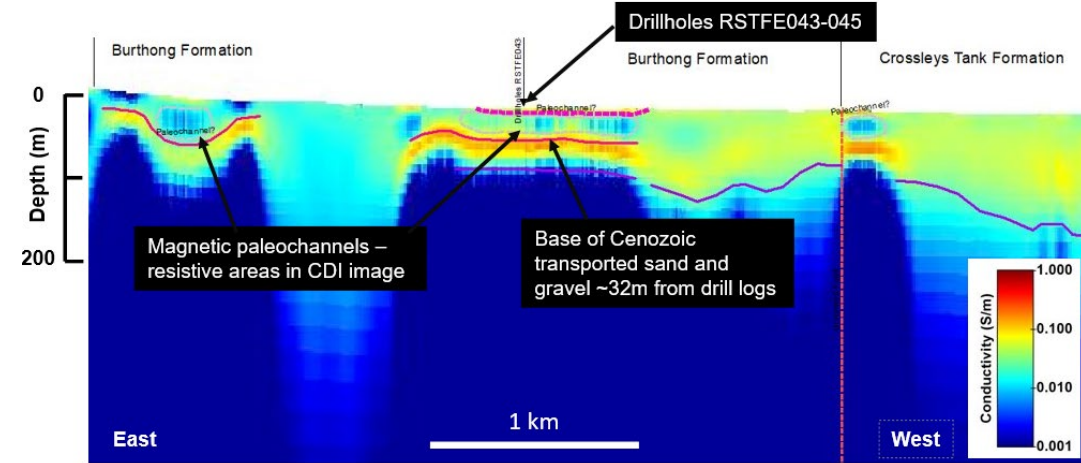


Cobar AEM Survey – interpretations

1) Mapping key interfaces

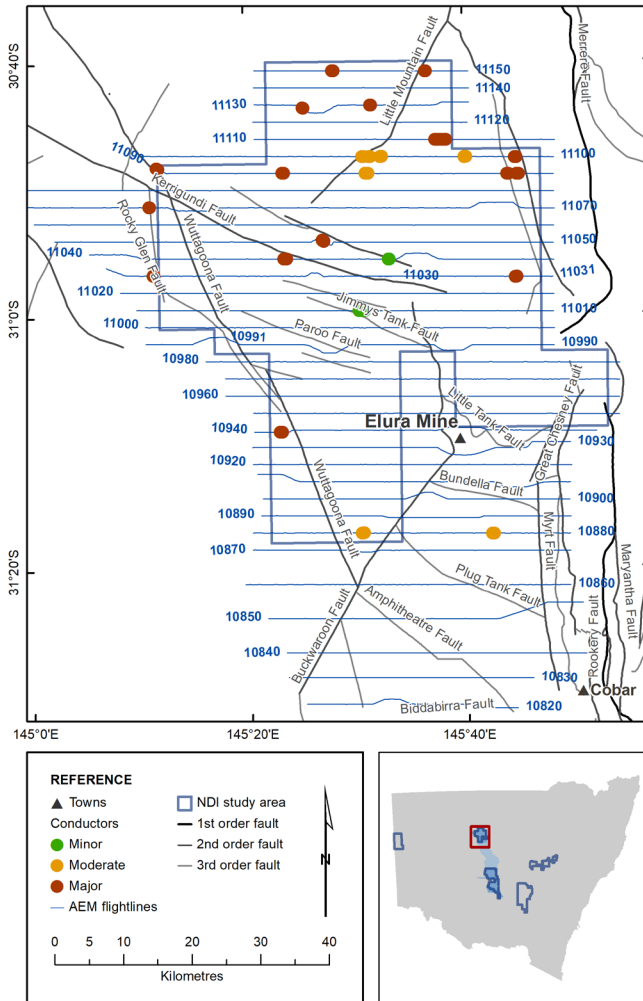


2) Groundwater & paleochannels



Cobar AEM Survey – interpretations

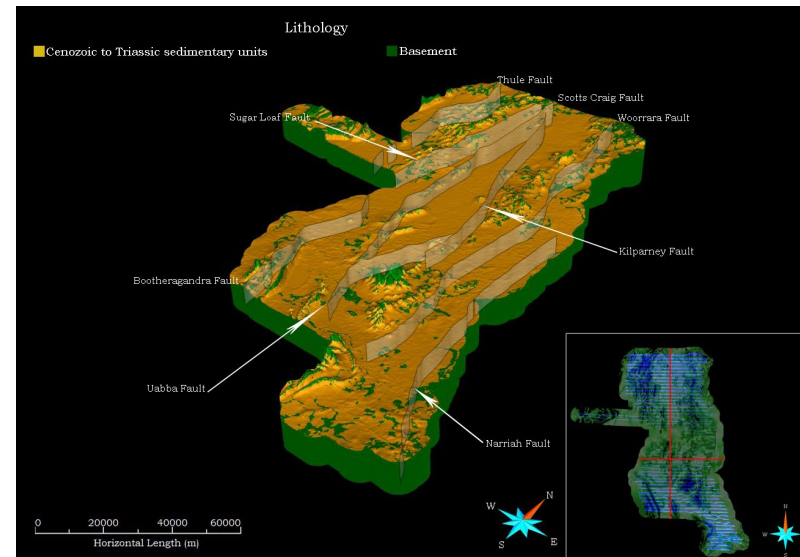
3) Conductive anomalies



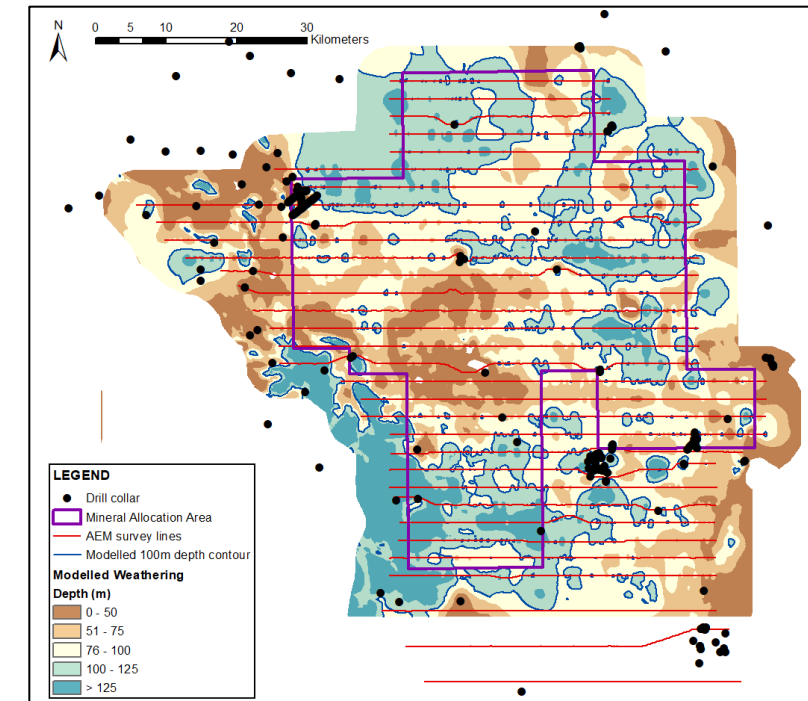
Depth to (geological) conductive anomalies
in North Cobar focus area (Astrid Carlton)

4) 3D models and depth to key interfaces

Data available for download in MinView ('3D models layer')



3D basement elevation model in South Cobar
focus area (Giovanni Spampinato;
GS2021/1646)

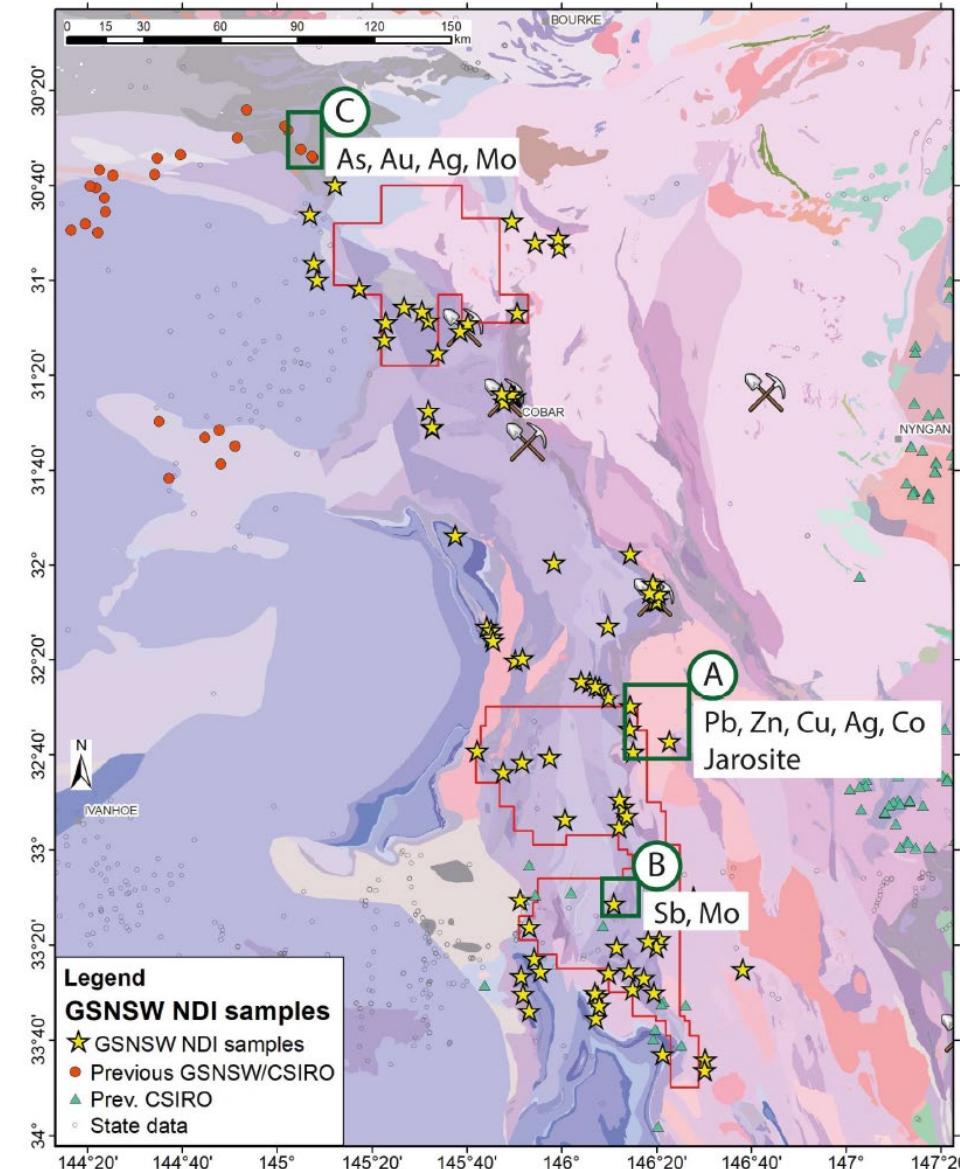
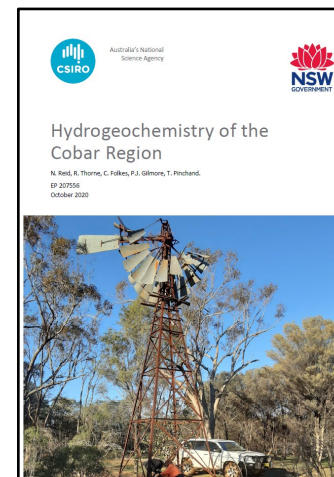


Depth of weathering (saprolite) in North
Cobar focus area (Karen Montgomery;
GS2021/1645)

Cobar hydrogeochemistry

- In collaboration with CSIRO
- 86 waterbores sampled (+ previous data)
- Analyses
 - Full suite of trace elements
 - O, H, D, S isotopes
 - (Hydro)-chronology (mostly 'older' – 10 to 18 ka but some as young as 100 ya)
- Hydrogeochemistry data available in MinView
- Comprehensive report: GS2021/0054
<https://search.geoscience.nsw.gov.au/report/R00034704>)

AuMinC index = $2*[Au+As+Ag+Sb]$ –
most successful for finding Au-related
Cobar-type deposits?

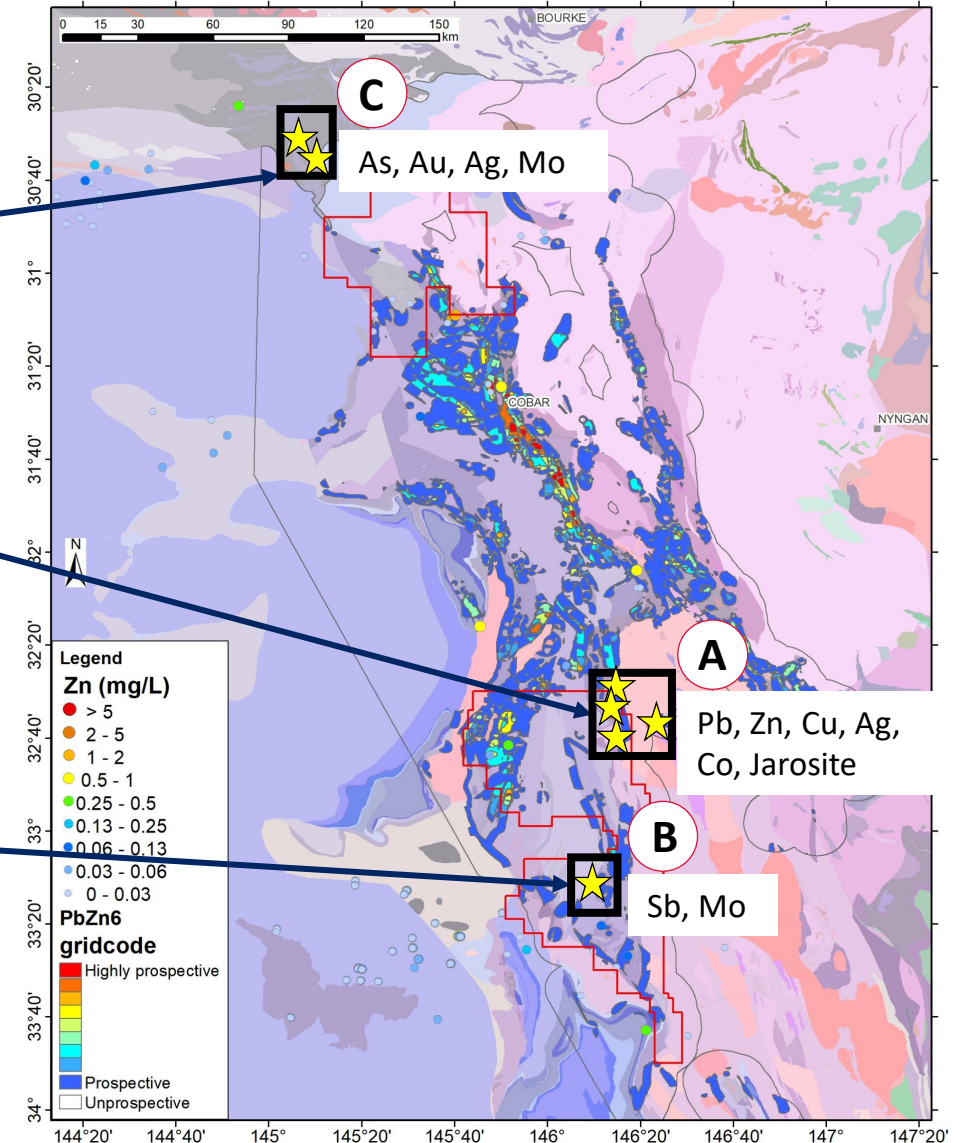


Hydrogeochemistry and mineral potential

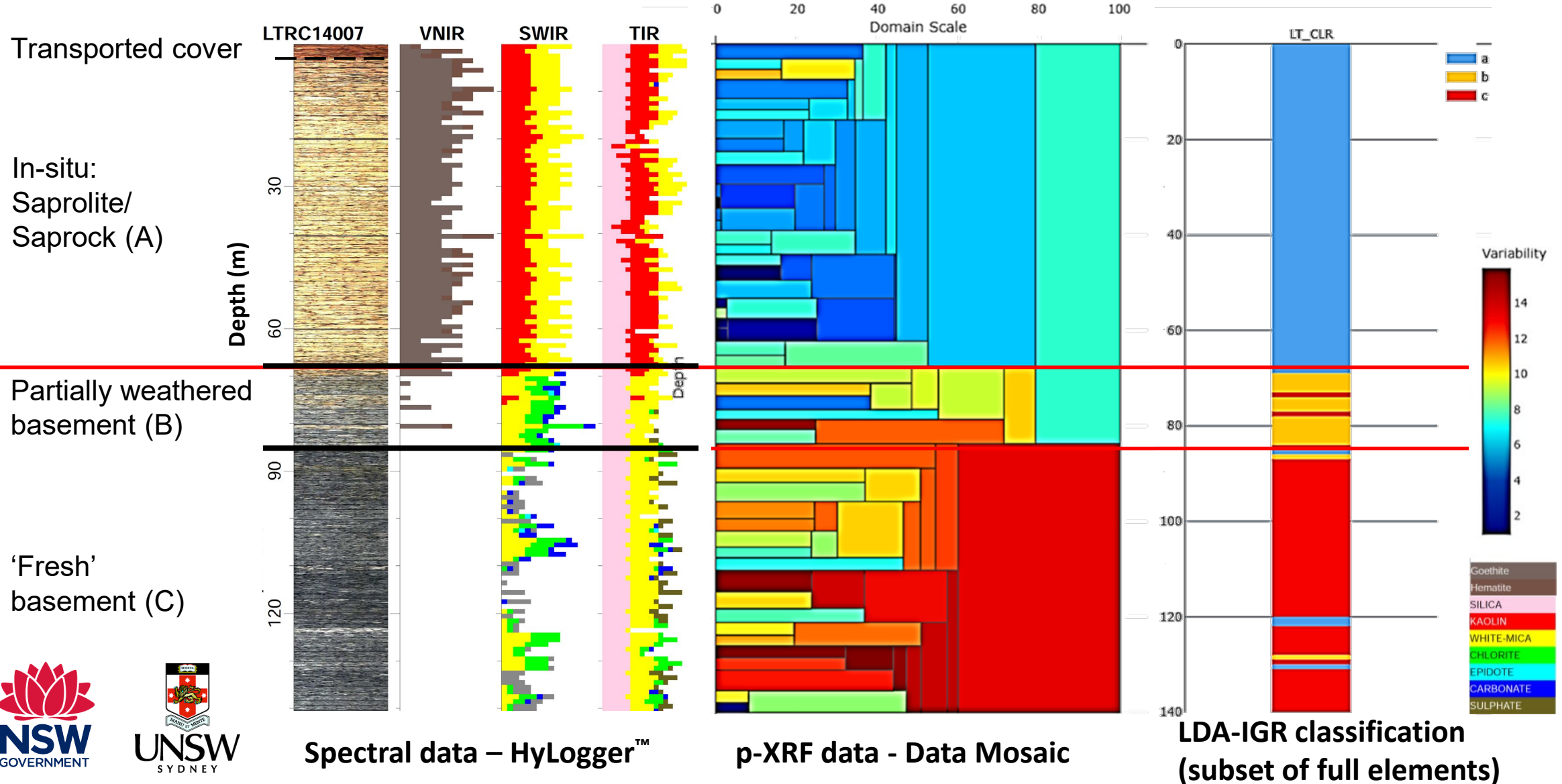
Area C: elevated concentrations of As, Au, Ag, Mo

Area A: up to 400 ppt Ag, Cu 880 ppb, Pb 114 ppb, Se 13 ppb, Zn 2800 ppb. Oversaturated with respect to Jarosite, suggesting free SO_4 in the region

Area B: multi-point, multi element anomaly with elevated concentrations of Mo 50 ppb and Sb 10 ppb

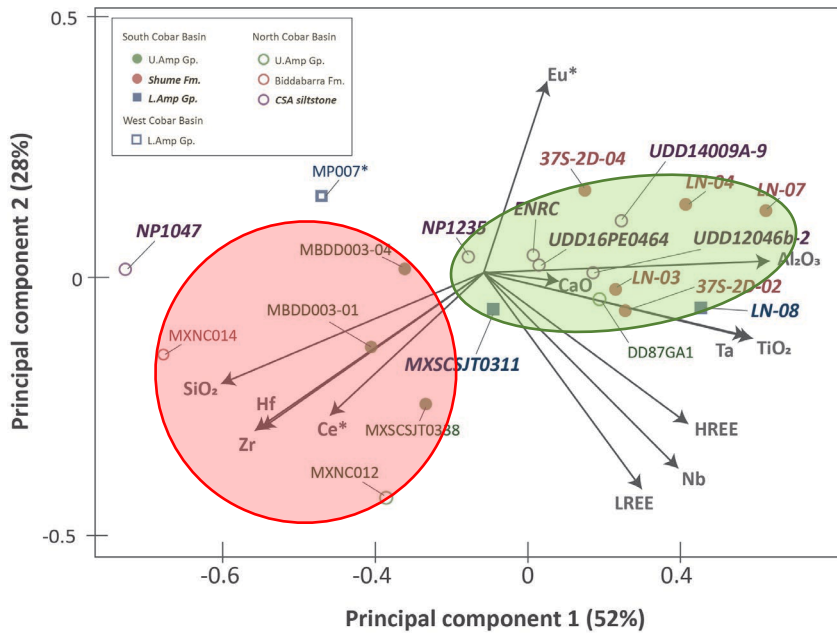


Interface detection – p-XRF & Hylogger™



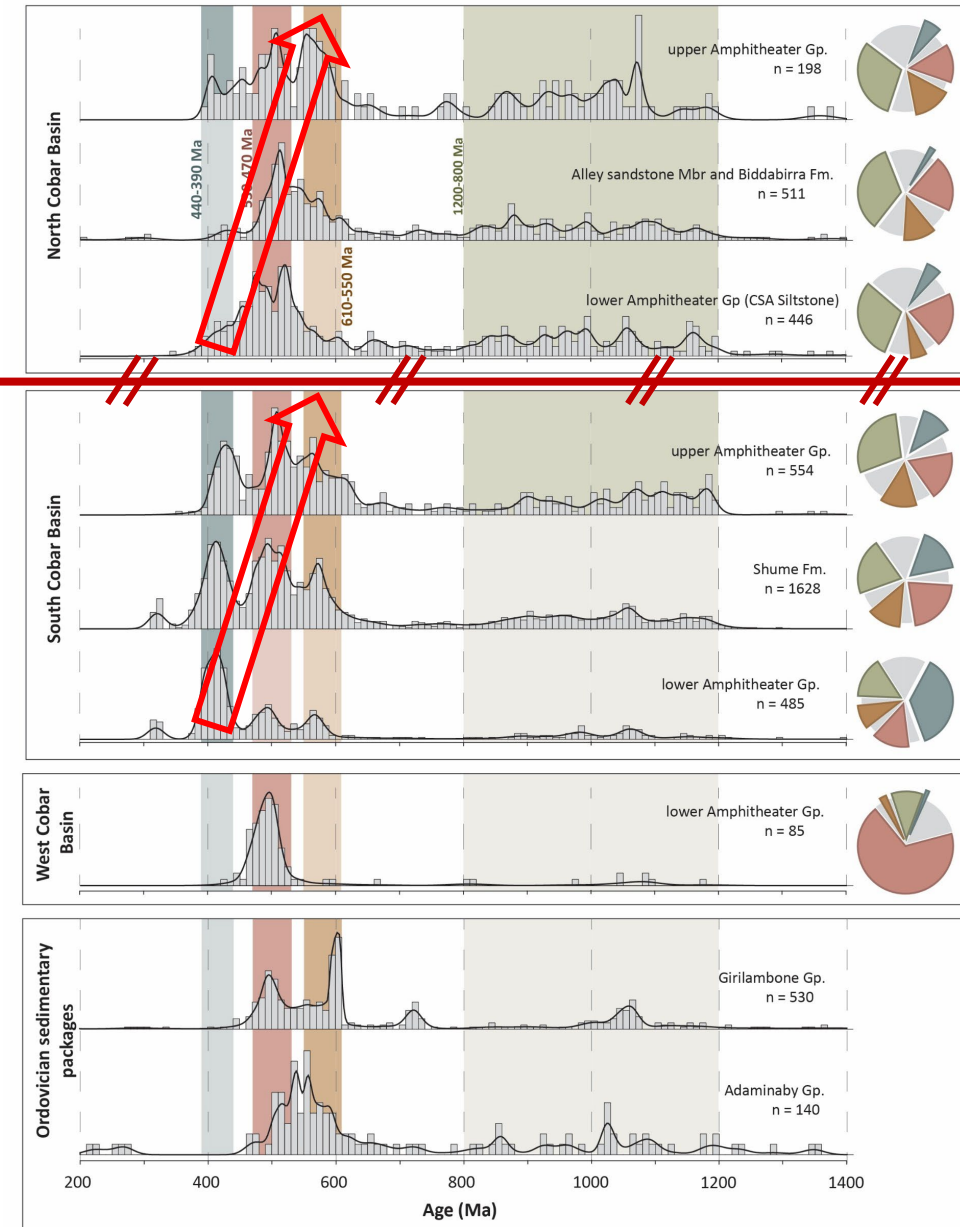
Sedimentary provenance study

- **Detrital zircon geochronology** – provenance of Cobar Basin sediments. Two major sources:
 - ~435–400 Ma magmatic rocks (south and south-east)
 - Cambro-Ordovician basement sediments (north and east)
- Basin received more detritus from older Cambro-Ordovician sources as it filled (i.e. Lower vs Upper Amphitheatre groups)
- Also structural controls limiting mixing of sediments between the northern and southern parts of the Basin



• Sedimentary geochemistry (principal component analysis)

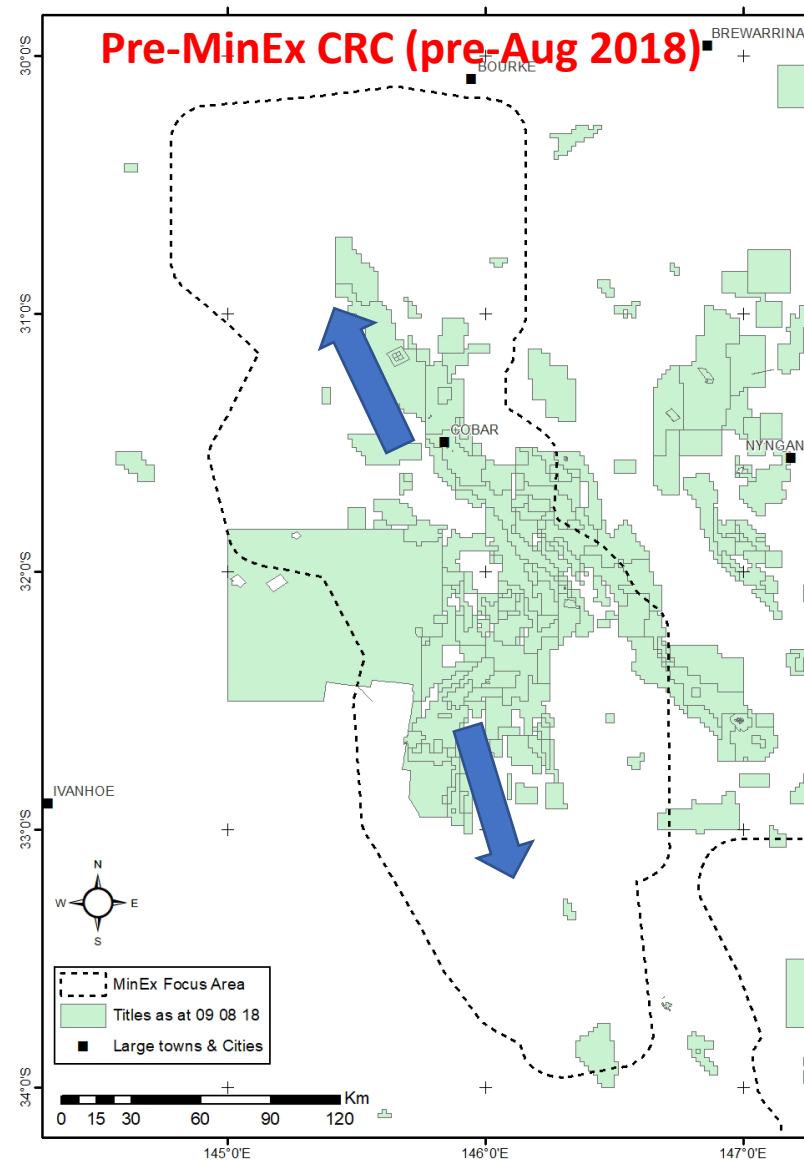
- Differences between:
 - Mineral hosting formations (e.g. Lower Amphitheatre Gp)
 - Mineral barren formations (e.g. Upper Amphitheatre Gp)



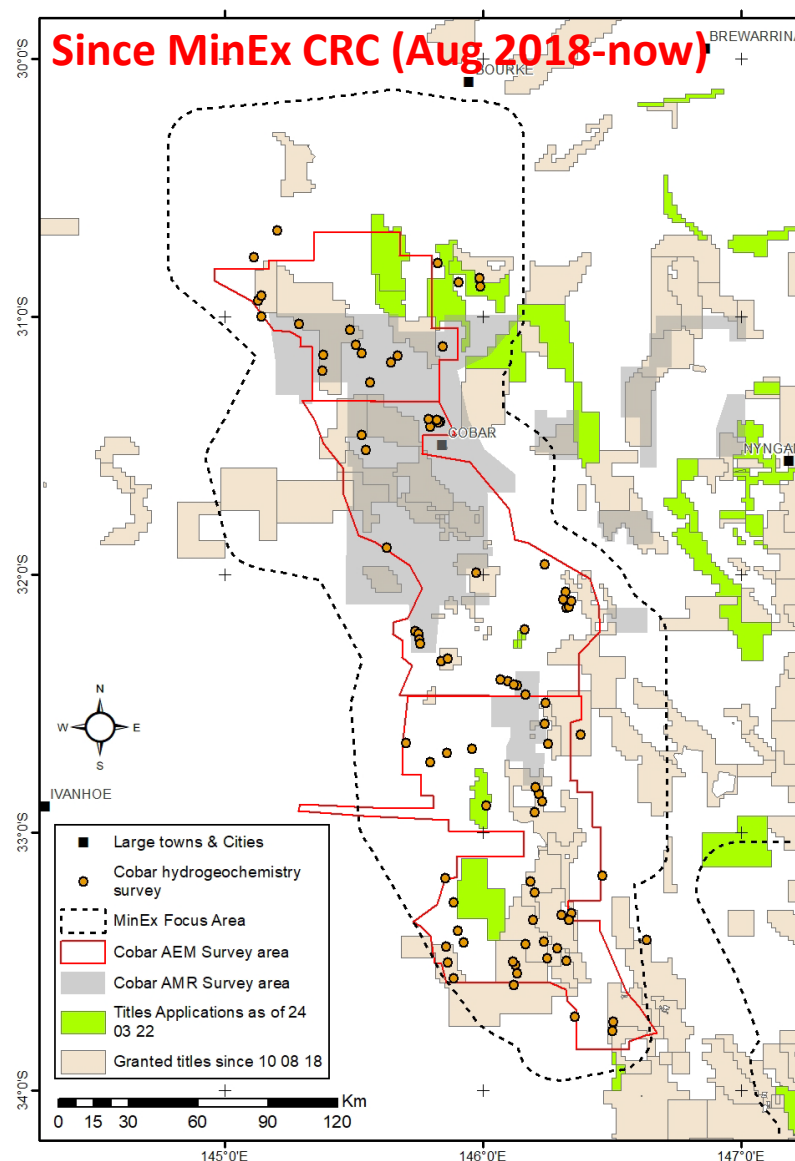
Exploration application – Cobar Basin

Data current as per
24 March 2022

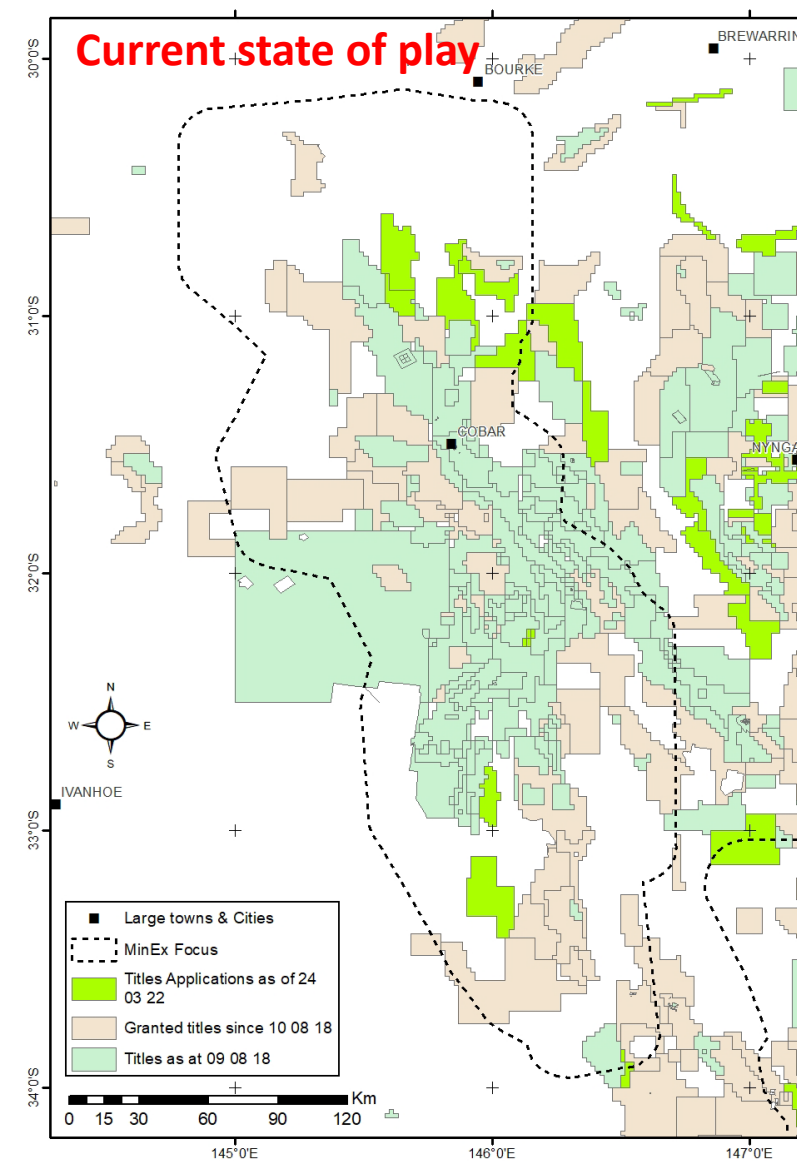
Pre-MinEx CRC (pre-Aug 2018)



Since MinEx CRC (Aug 2018-now)



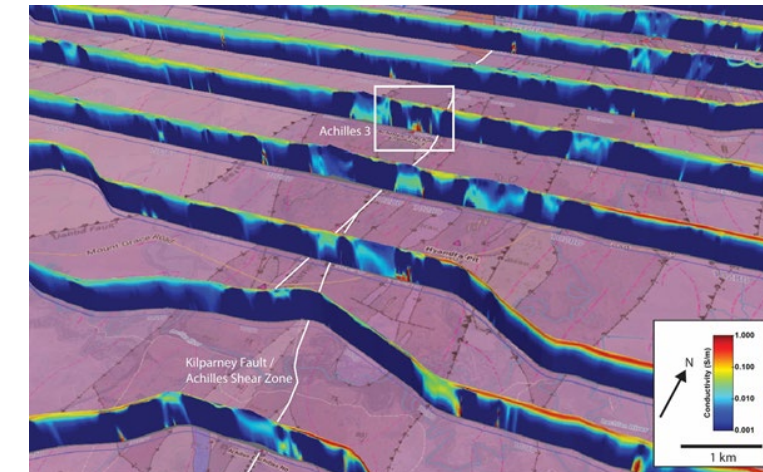
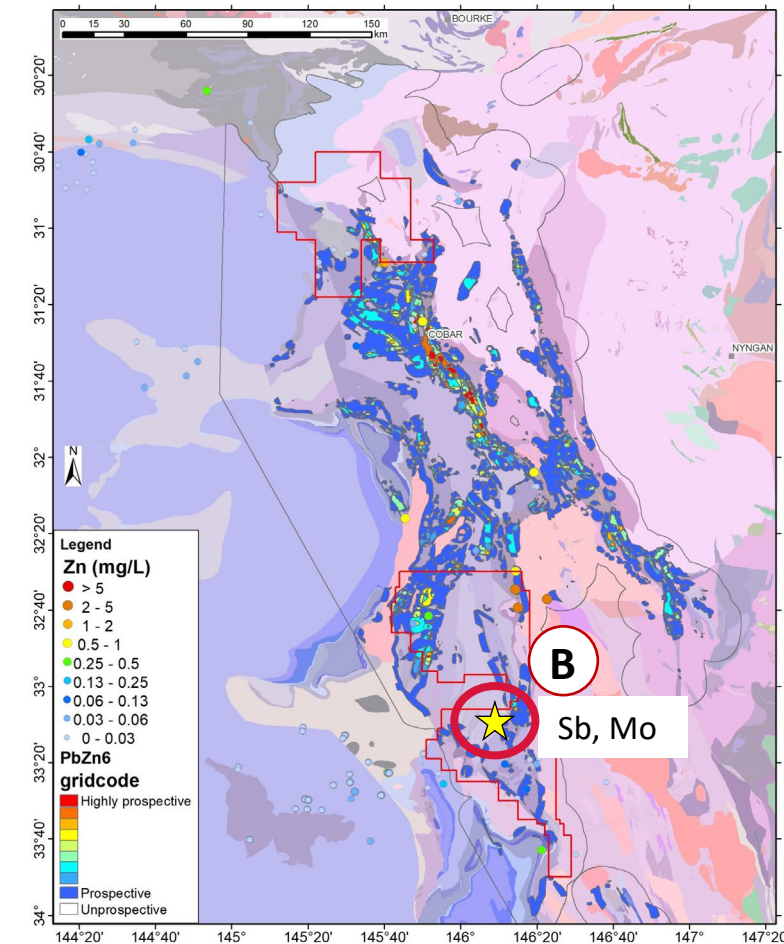
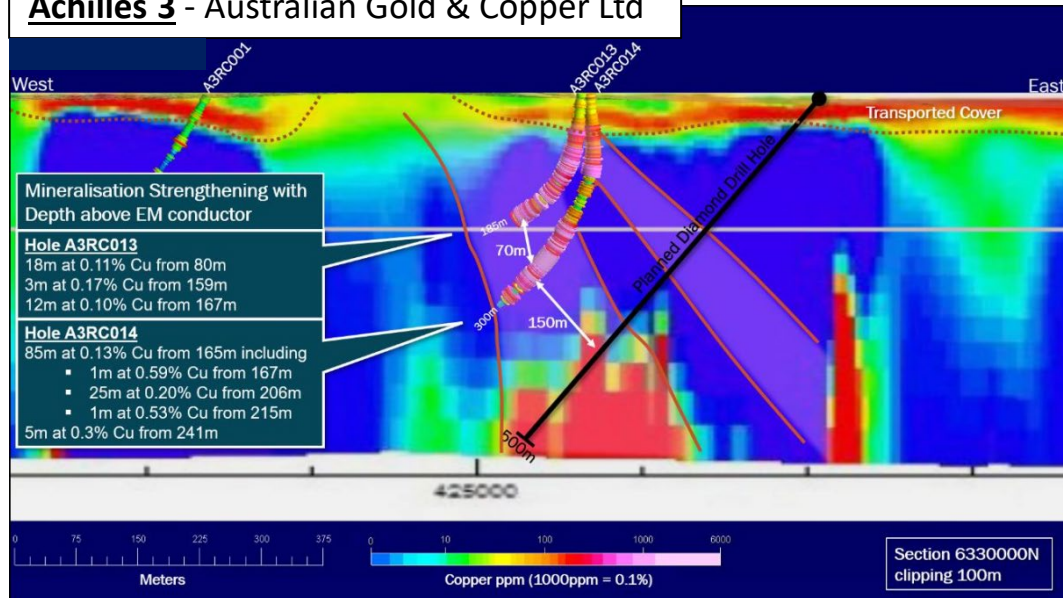
Current state of play



Exploration results - minerals

- Hydrogeochemistry ~2 km south of the Achilles 3 prospect showed anomalous Molybdenum (Mo) and Antimony (Sb) (area B)
- Also coincident lead (Pb) soil anomaly with electromagnetic (EM) and airborne EM anomalies at depth
- >2800 m, 12-hole reverse circulation (RC) drilling; 546 m diamond drilling – intersected 500 m-wide base-metal sulfide (copper ± lead and zinc) target zone above conductor

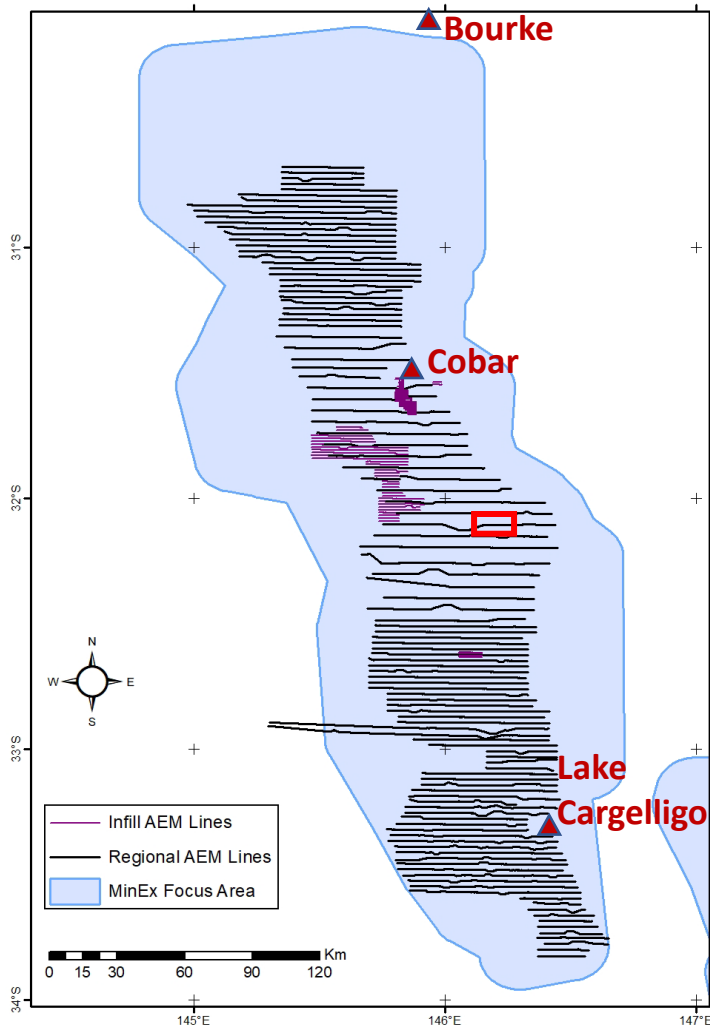
Achilles 3 - Australian Gold & Copper Ltd



Source: ASX announcements – 03/05/21, 28/10/21

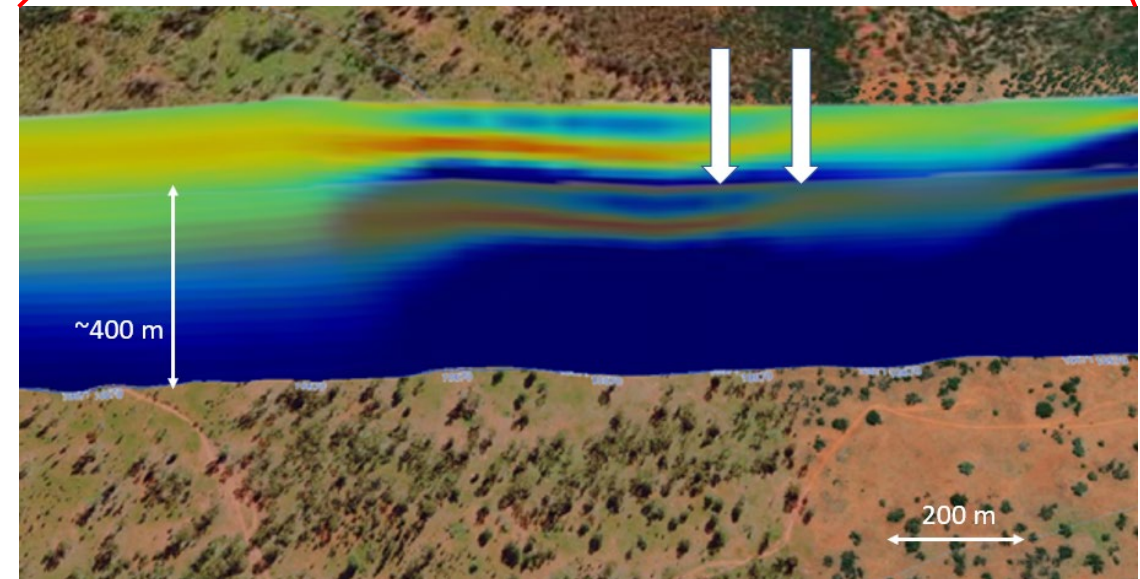
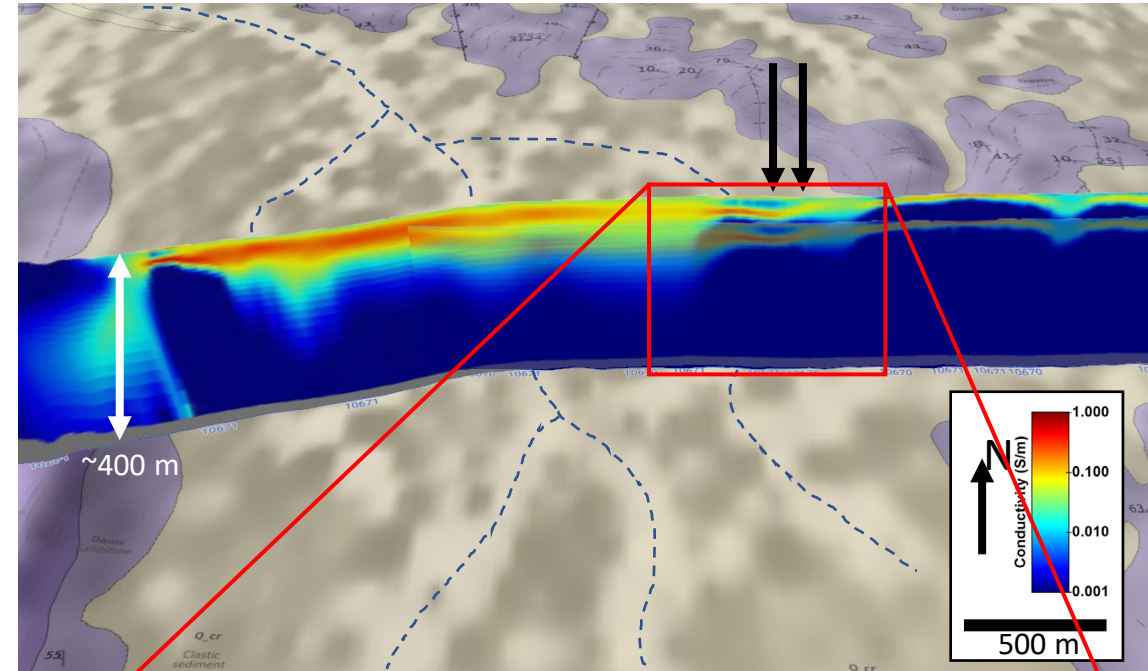
Exploration results - groundwater

Wirlong – Peel Mining

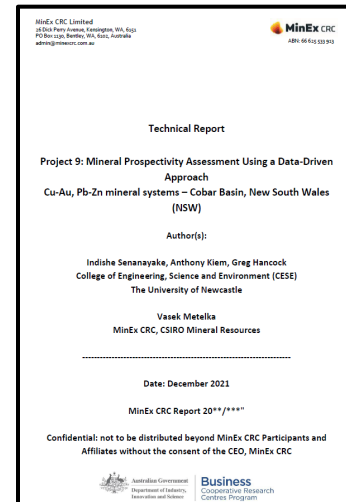
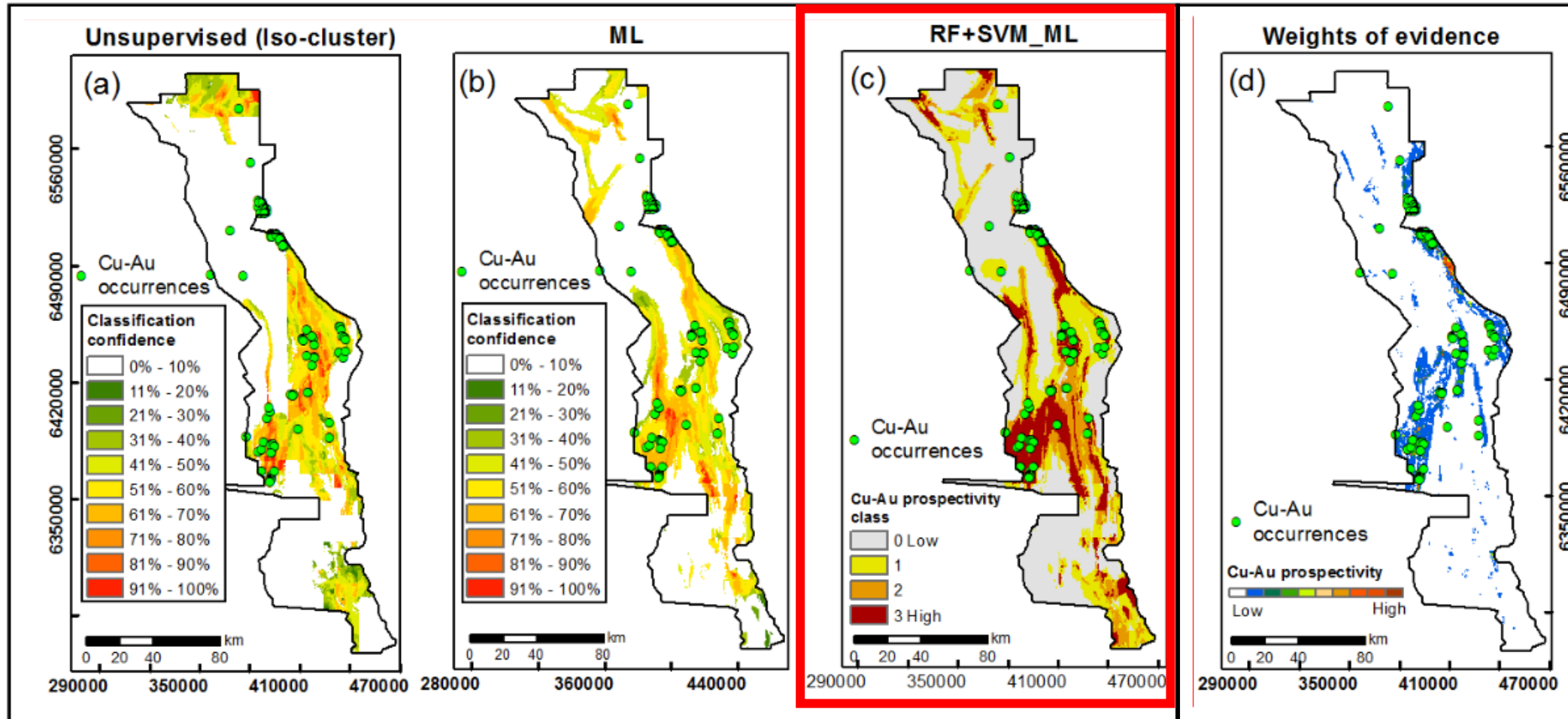


- 1) SWL: 68.7 m;
flow rate 7–8
L/sec
- 2) SWL: 71.1 m;
flow rate 2 L/sec

*Used with permission
of Peel Mining*



New mineral potential mapping

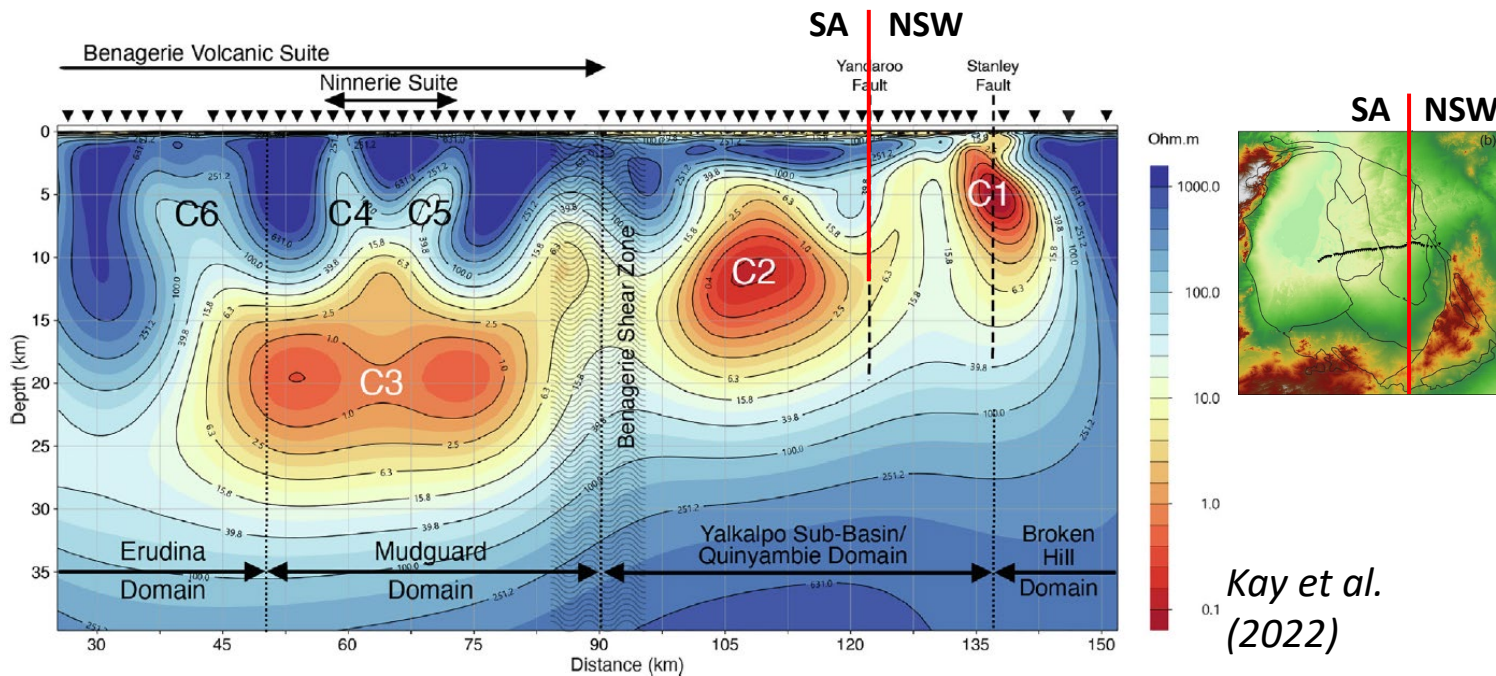


Report & data
coming soon!

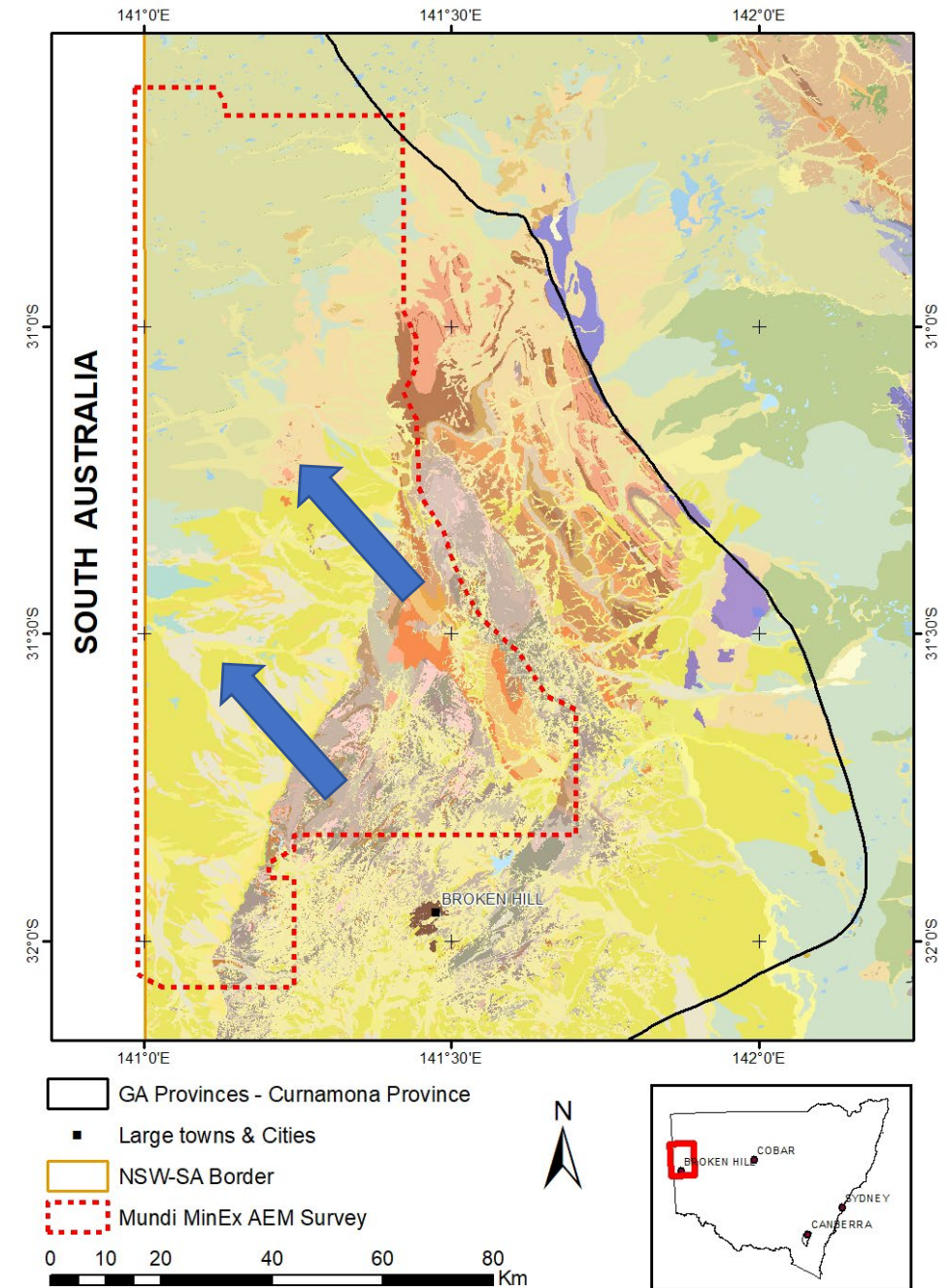
- **Input data layers:** magnetic-VRTP, magnetic-1VD, gravity anomalies, weighted distance to faults, AusLAMP Magnetotelluric, AEM data
- **Classification algorithms** – iso-cluster **unsupervised** classification, **supervised** (Random Forest, Support Vector Machine, Maximum Likelihood classification)

Mundi focus area

- Mineralised Paleo- to Neoproterozoic basement rocks under Mundi Mundi Plain (Mesozoic-Cenozoic)
- Mineral systems
 - Broken Hill-type (BHT)
 - Other mineral systems – IOCG, MVT (Pb-Zn-Ag)
- Curnamona 'conductor'

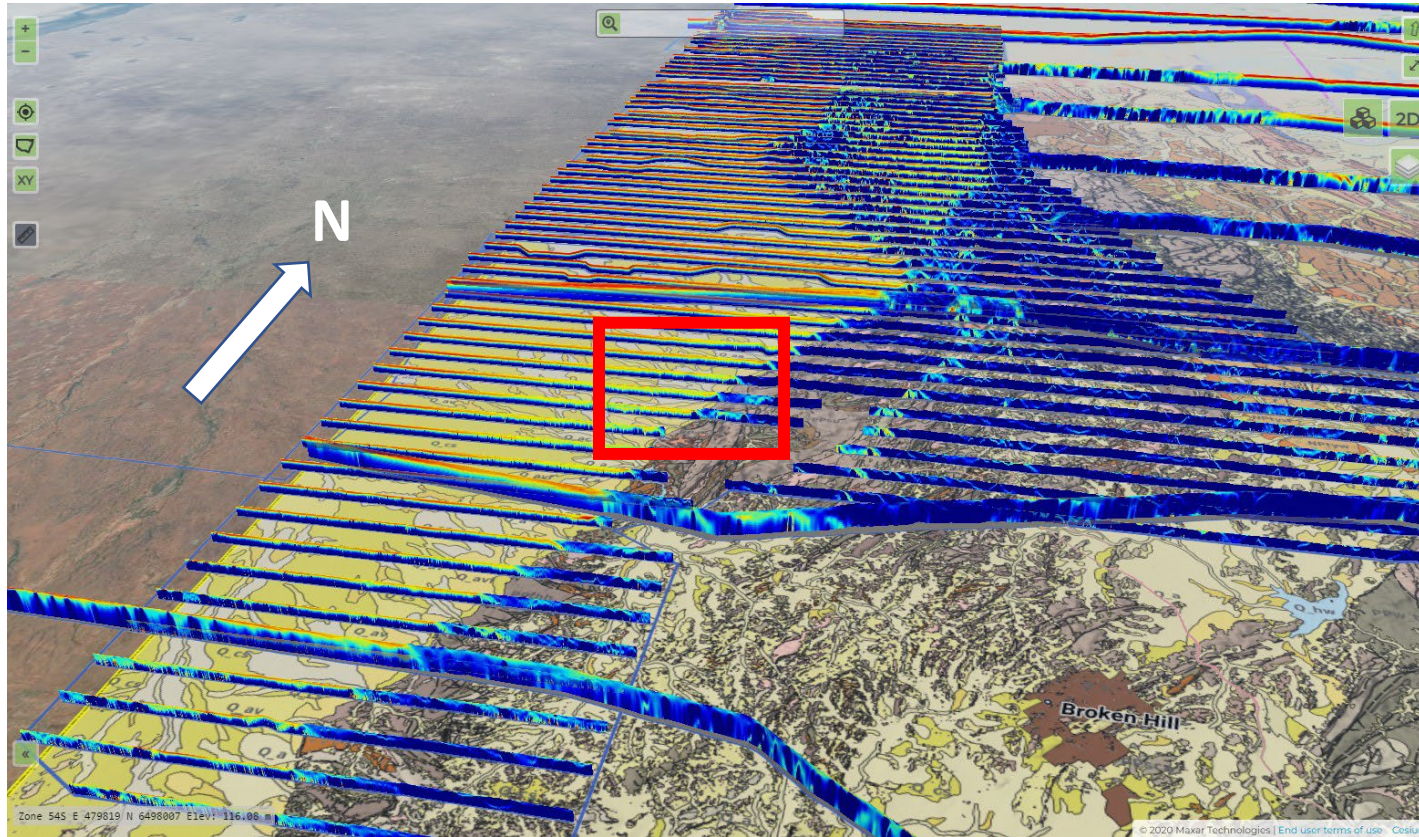


Kay et al.
(2022)

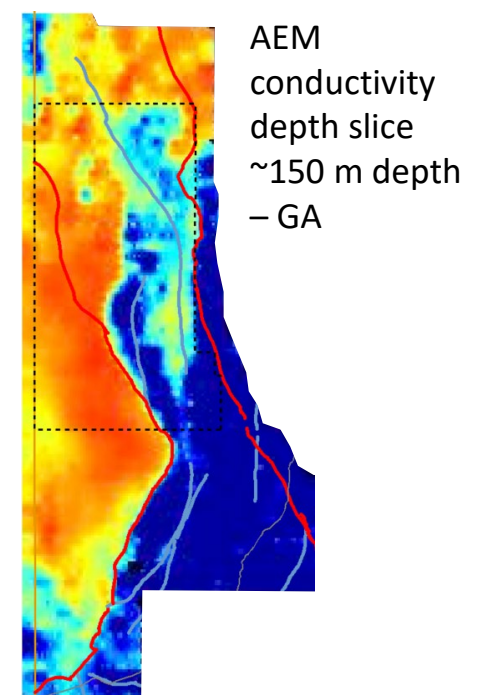
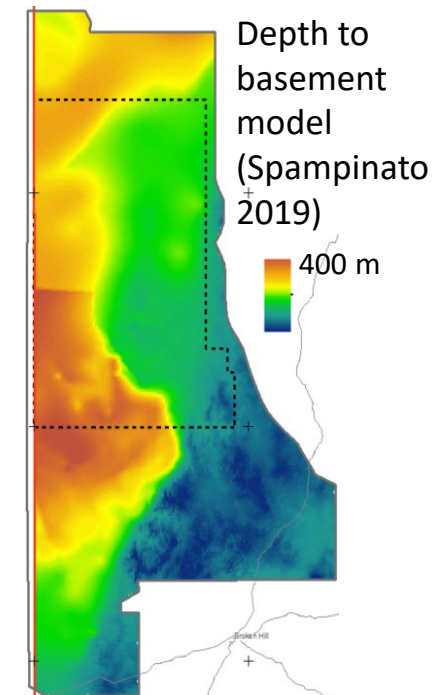
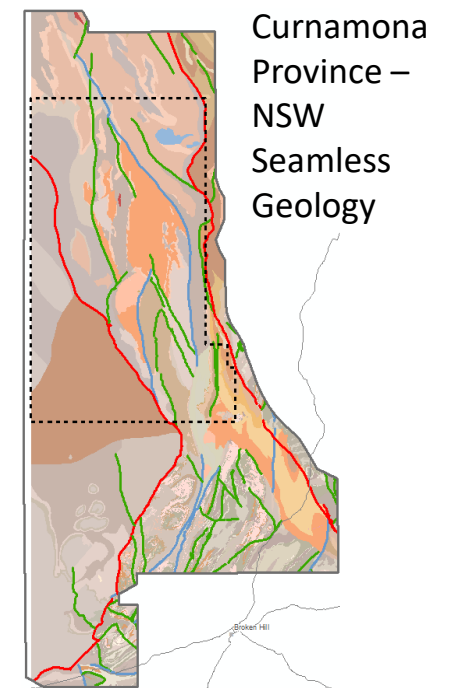
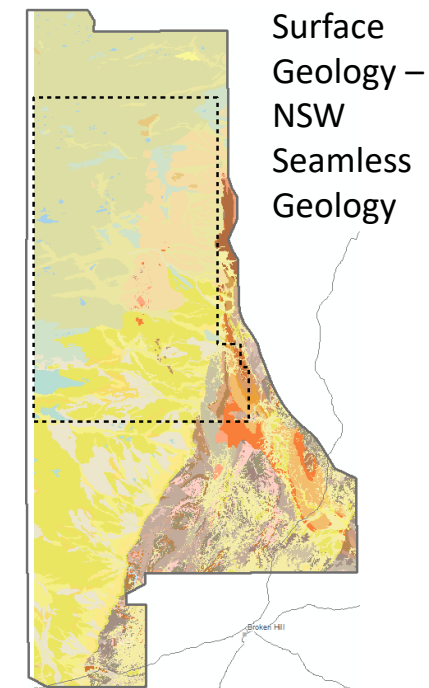


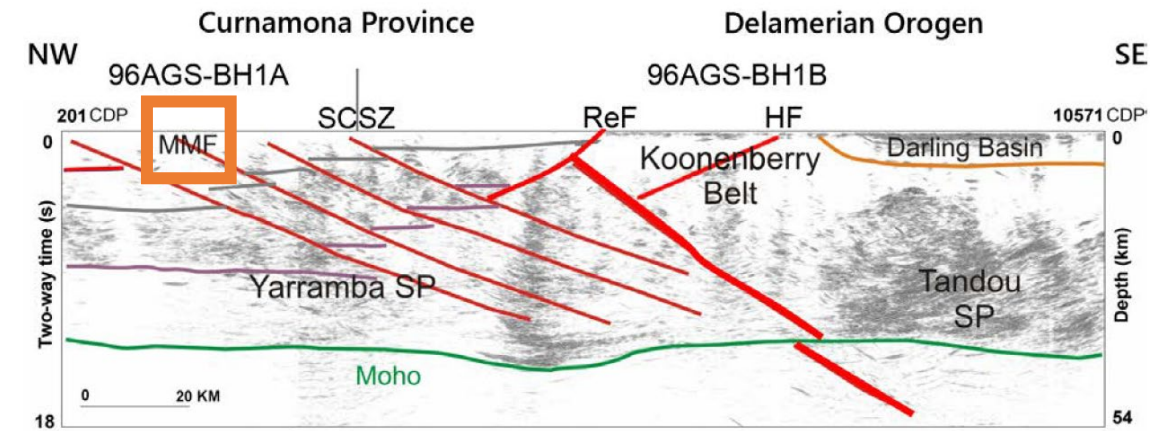
Base image – surface geology (NSW Seamless Geology)

Mundi AEM Survey

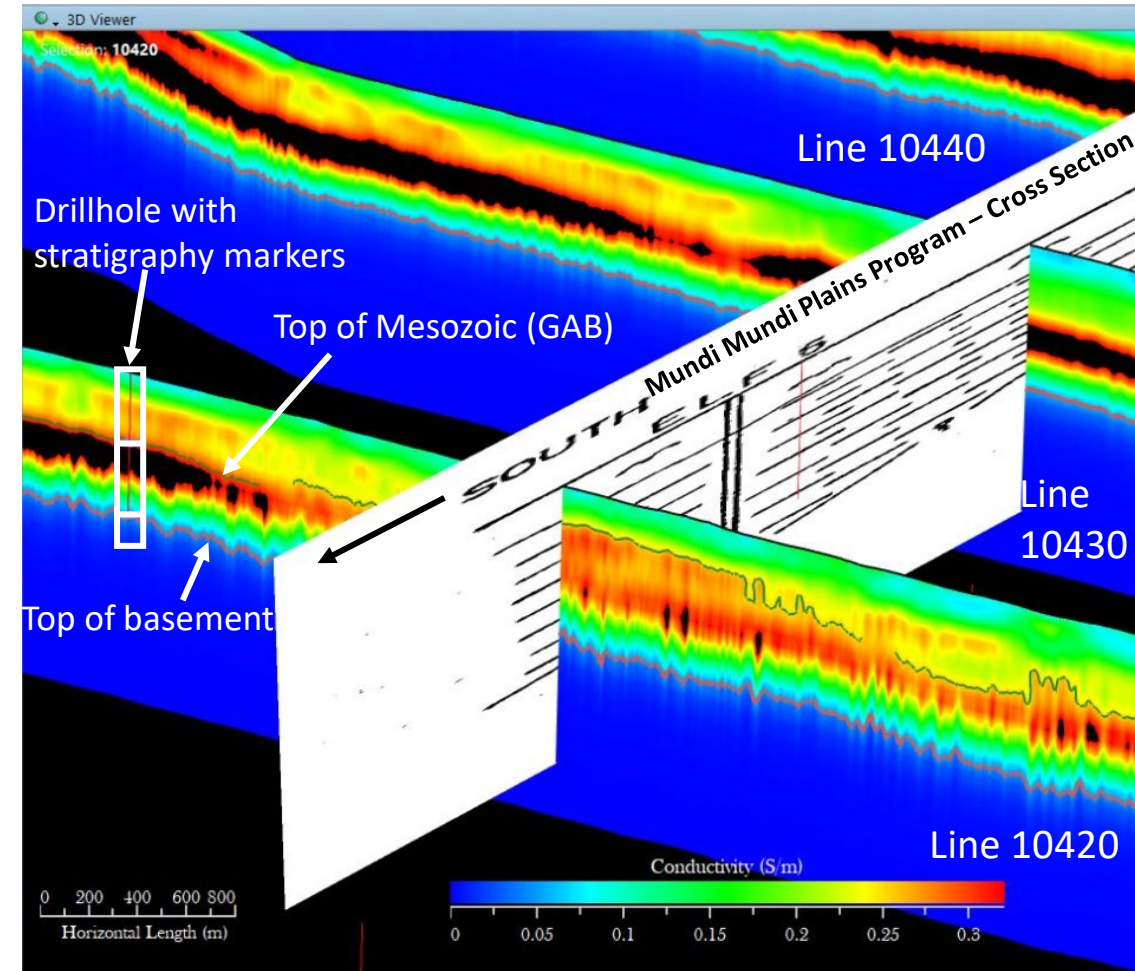
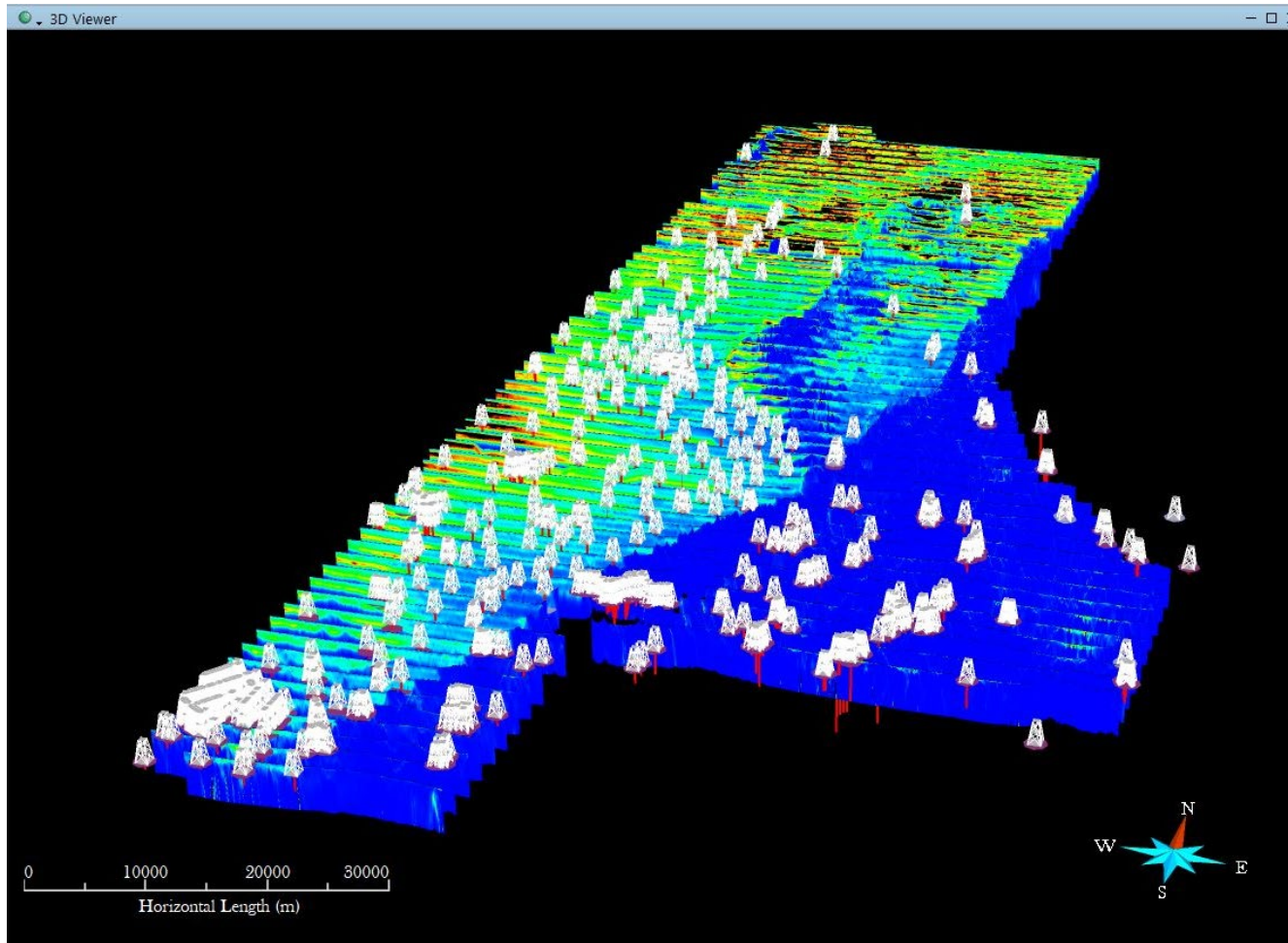


→ 3D AEM conductivity 'curtains' and data download now in MinView!





Mundi AEM Survey

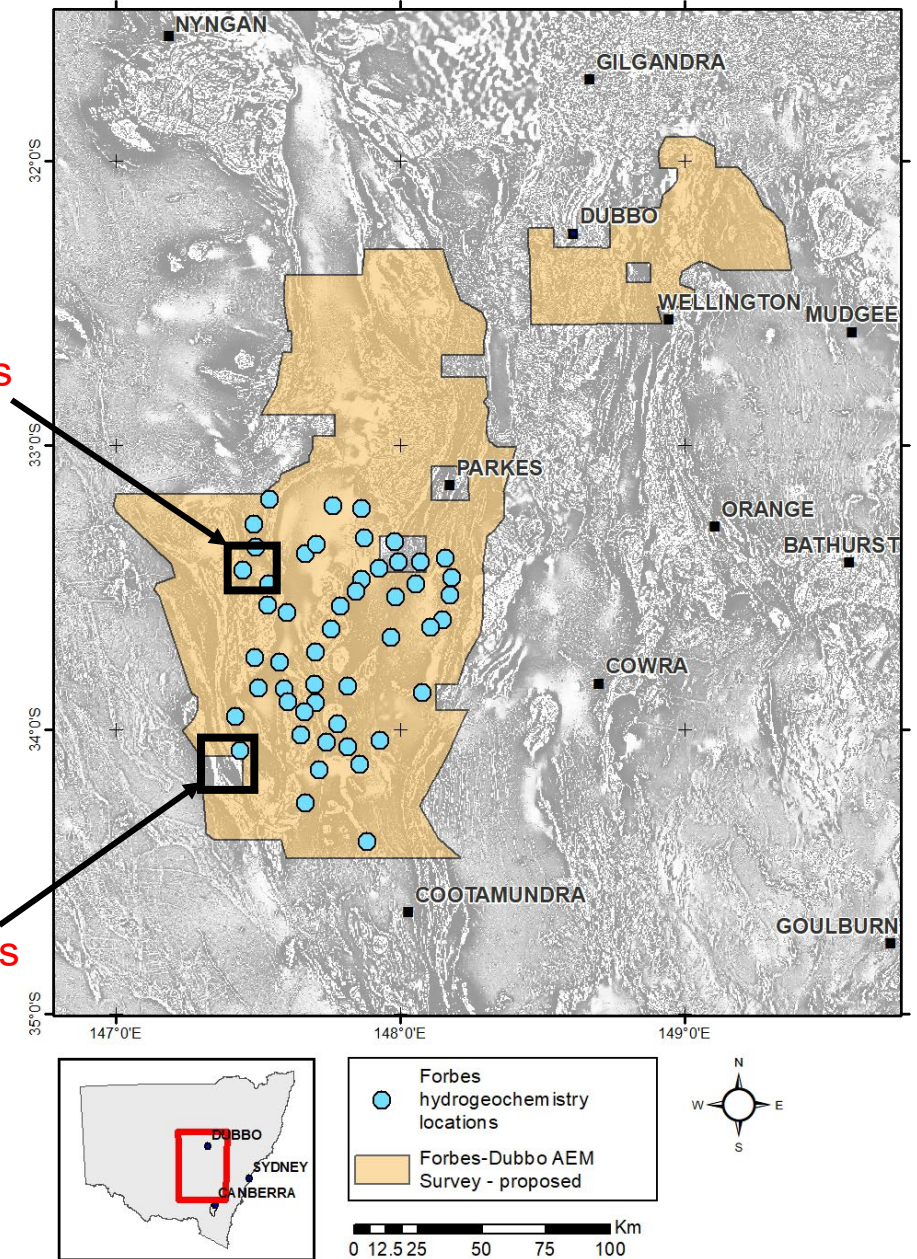


Forbes-Dubbo focus area

- Hydrogeochemistry
 - 60 waterbores sampled (July-October 2020)
 - Full analyses as per Cobar dataset
 - Data available via MinView
 - Interpretive report coming soon!
- Forbes-Dubbo AEM Survey
 - Acquisition planned for second half of 2022
 - 2.5 km line-spacing

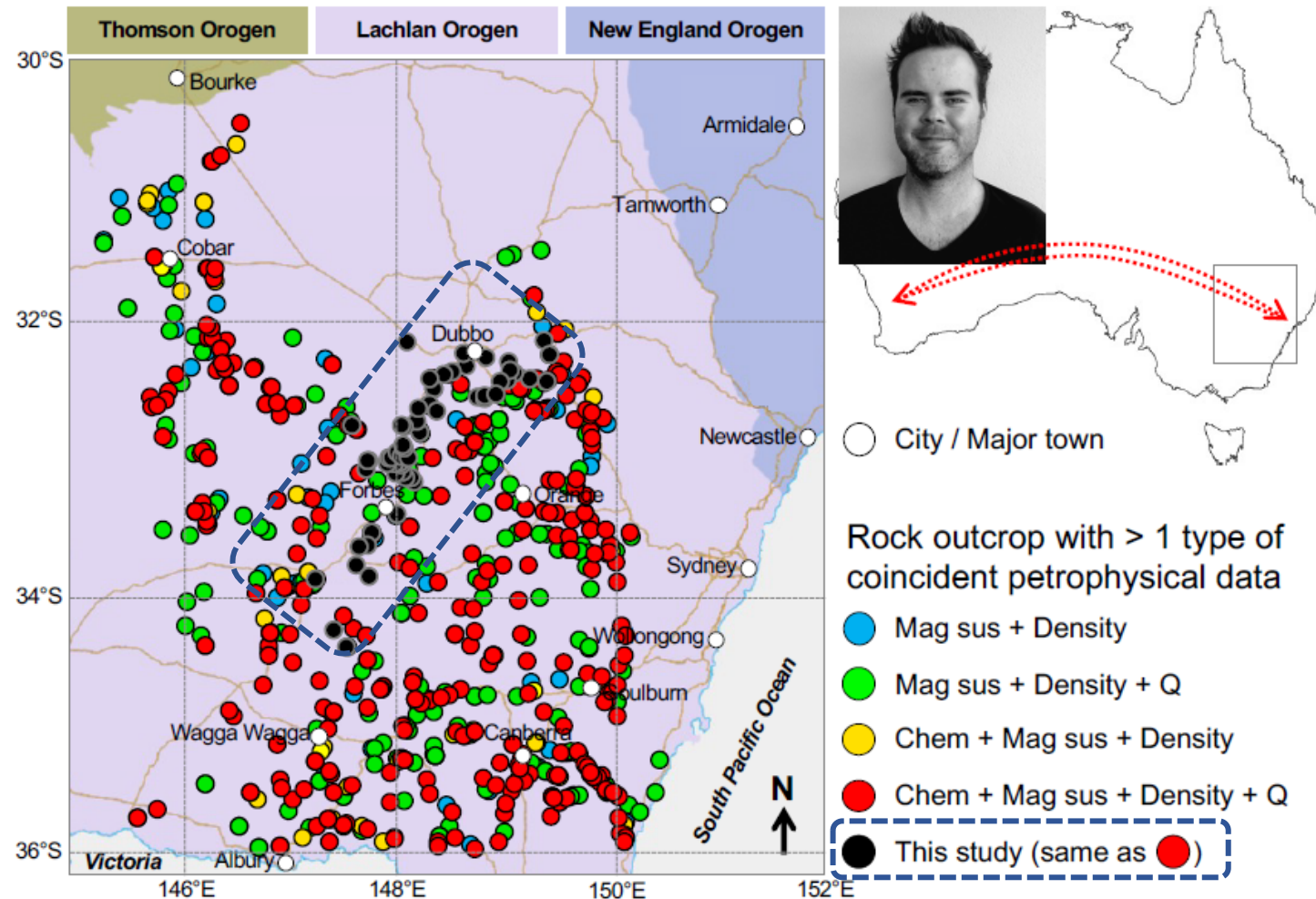
Elevated Au and Pt concentrations

Elevated Au concentrations



Forbes-Dubbo focus area - rock properties of the Macquarie Arc

Historical data were manually inputted and integrated with new data



NRM mini-cores (dry)



NRM mini-cores (wet)



Results, data and
interpretation
coming soon!

Other MinEx research projects in NSW

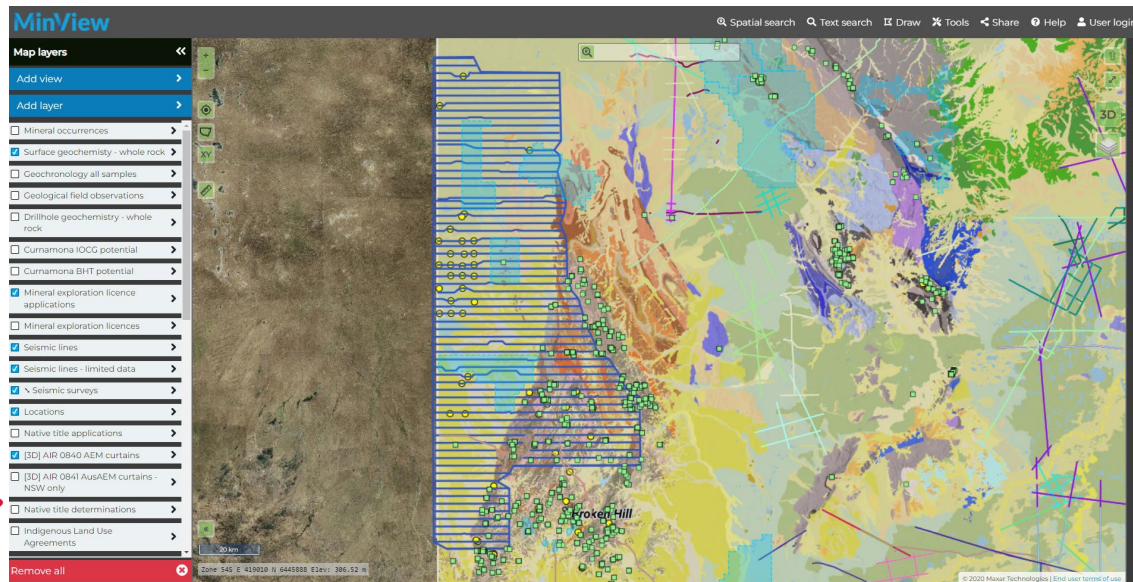
- Biogeochemistry (Cypress Pines) in the Cobar Basin – **Joe Schifano** (PhD, UNSW)
- (Micro-)biogeochemistry (groundwater) in the Cobar Basin – **Bianca Polombi** (PhD, UoN)
- Groundwater and AEM in the Cobar Basin – **Millicent Crowe** (PhD, UNSW)
- Integrated petrophysics and geophysics in the Cobar Basin – mineral systems characterisation – **Jim Austin** (CSIRO)
- Cu- and S-isotopic study of Cobar Basin mineral systems – **Zara Woolston** (iPhD, UoA)
- Ultrafine+ soil geochemistry in the Cobar Basin – **Ryan Noble** (CSIRO)

How to access data and products

- MinView

- <https://minview.geoscience.nsw.gov.au>

MinView



- DIGS



- <https://search.geoscience.nsw.gov.au/>
 - Reports (and associated data packages)

- GSNSW MinEx webpage

- <https://www.regional.nsw.gov.au/meg/geoscience/minexcrc>
 - MinEx CRC project in NSW and focus area updates and links

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<https://www.regional.nsw.gov.au/meg/geoscience/minexcrc>