Australian Government
Geoscience Australia

Resourcing Australia's Prosperity

GEOLOGICAL SURVEY OF South Australia
DISCOVERY DAY

Delamerian mineral systems and mineral potential

Yanbo Cheng

Senior Mineral System Geoscientist
Geoscience Australia

Acknowledgement of Country

Geoscience Australia values the lands, water and sky as we work to deepen a shared understanding of Country and Earth.

We respect First Nations peoples and their enduring connection, contribution and obligations to Country. Reflecting on our shared history, we are committed to listen and learn.

Geoscience Australia: A Journey of Connection
Artwork by Lani Balzan

Major Geoscience Initiatives in Support of Resources for the Future

Australian Government
Geoscience Australia
Resourcing Australia's Prosperity

Australian Government
Geoscience Australia
Exploring for the Future

MinEx CRC

GEOLOGICAL SURVEY OF South Australia

University of South Australia

THE UNIVERSITY of ADELAIDE

UNIVERSITY of TASMANIA

Australian National University

NSW GOVERNMENT

GEOLOGICAL SURVEY OF VICTORIA

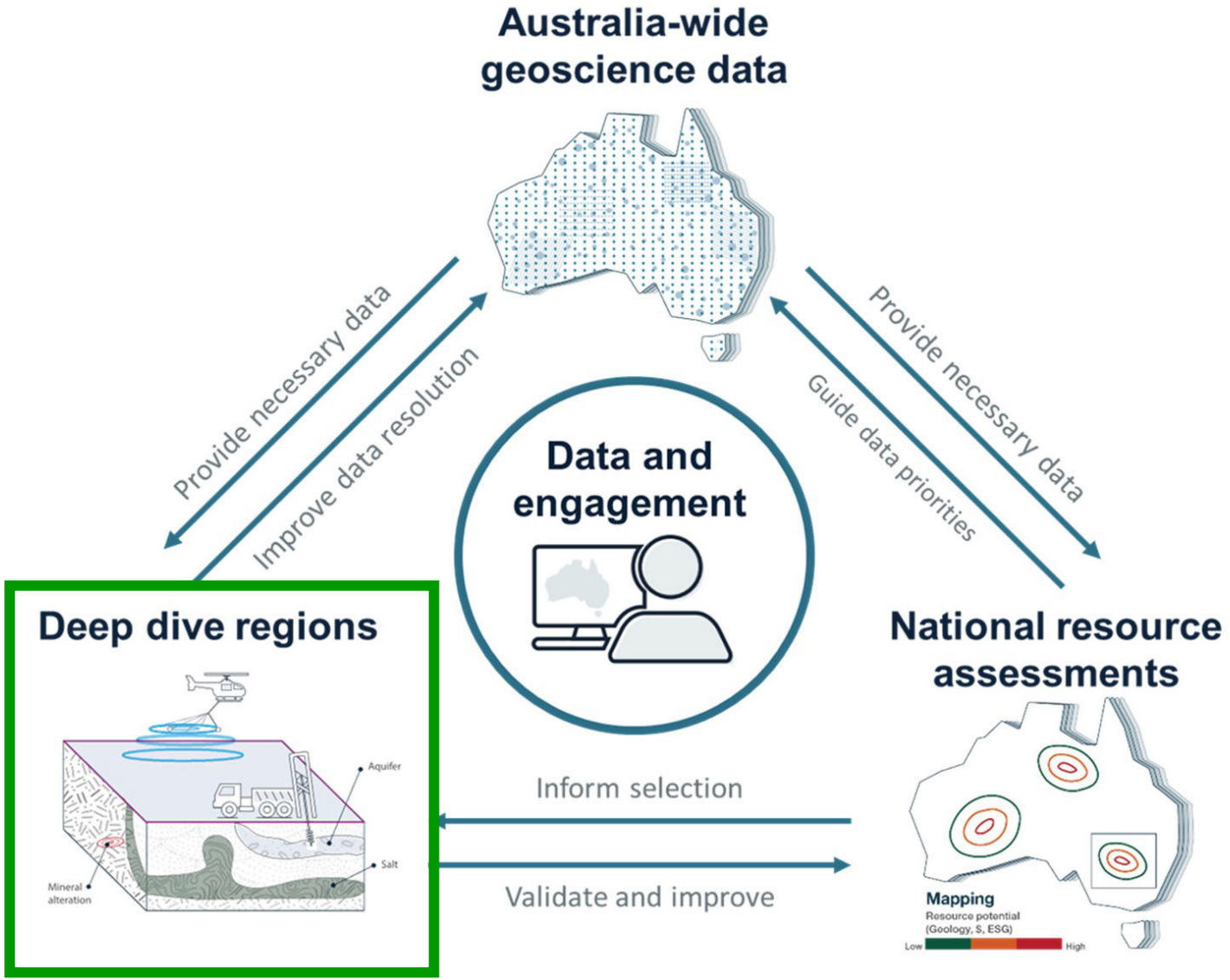
THE UNIVERSITY OF MELBOURNE

Resourcing Australia’s Prosperity initiative (RAPi)

Resourcing Australia's Prosperity

Mapping Australia’s resources for a sustainable future

- $3.4 billion over 35 years
- Led by Geoscience Australia
- Critical minerals and other resources
- Support Australia’s net zero transition
- Enable responsible management of resources

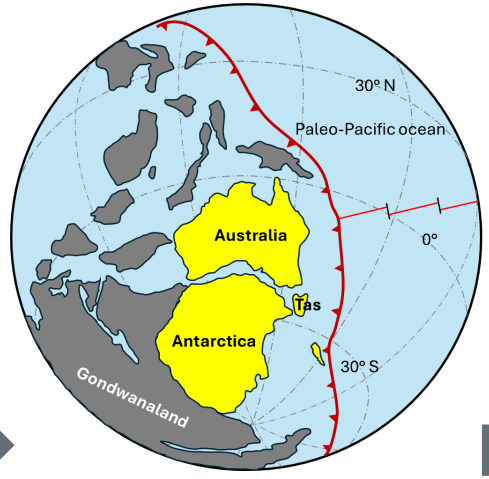


Metallogeny records 200 million years of supercontinent cycles and accretionary orogens

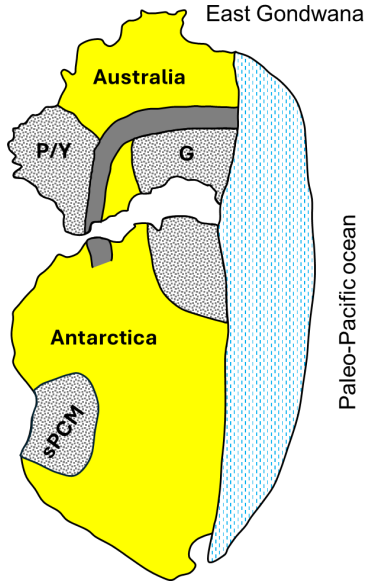
Late Neoproterozoic (~600 Ma)

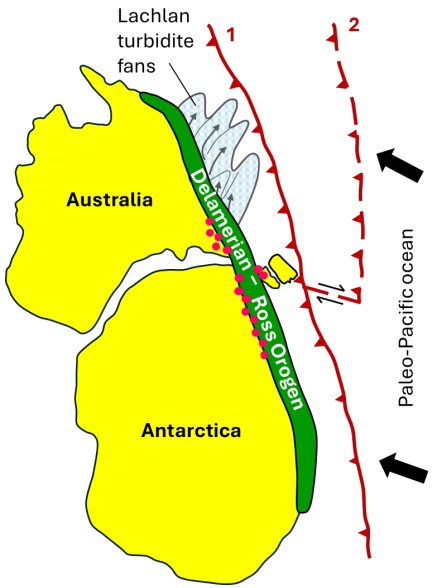
Mid-late Cambrian (~505 Ma)

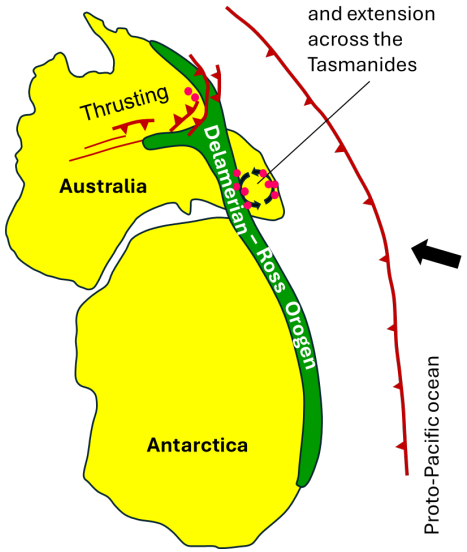
Early Devonian (~410 Ma)

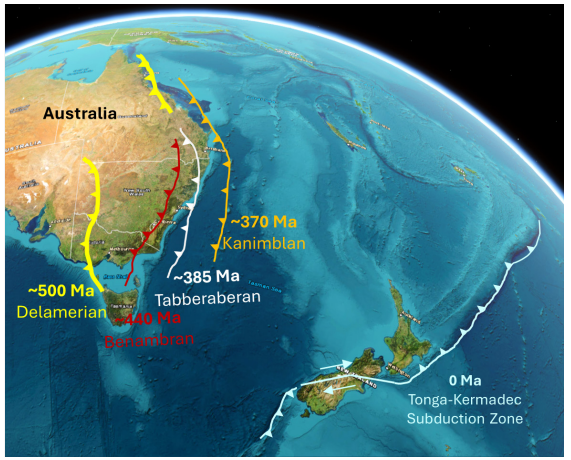


Earth today (0 Ma)

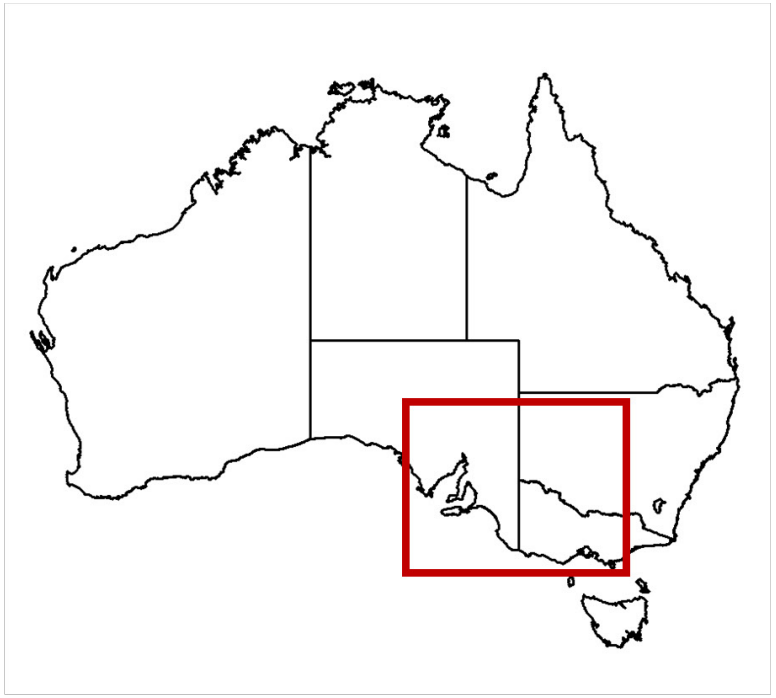




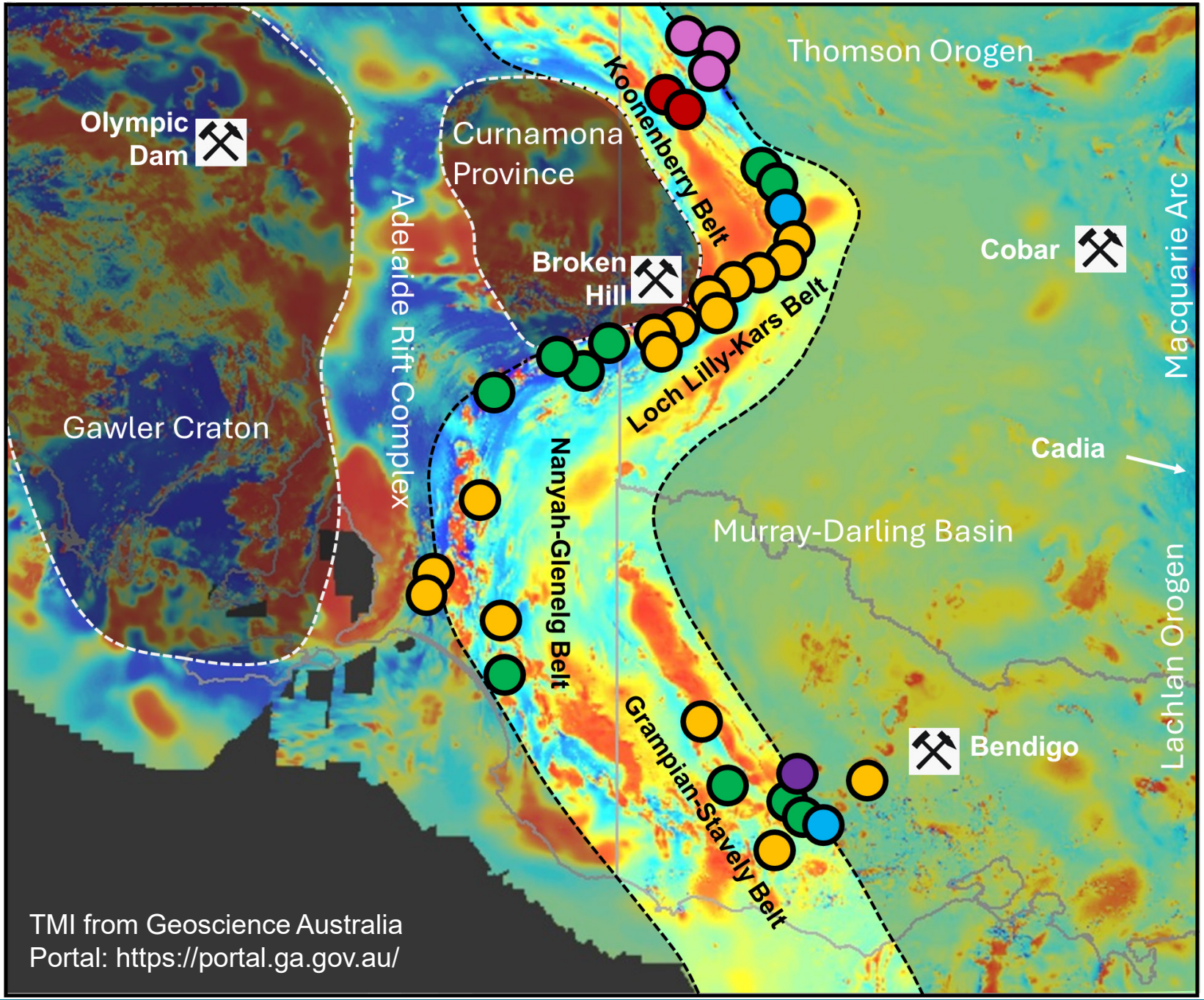




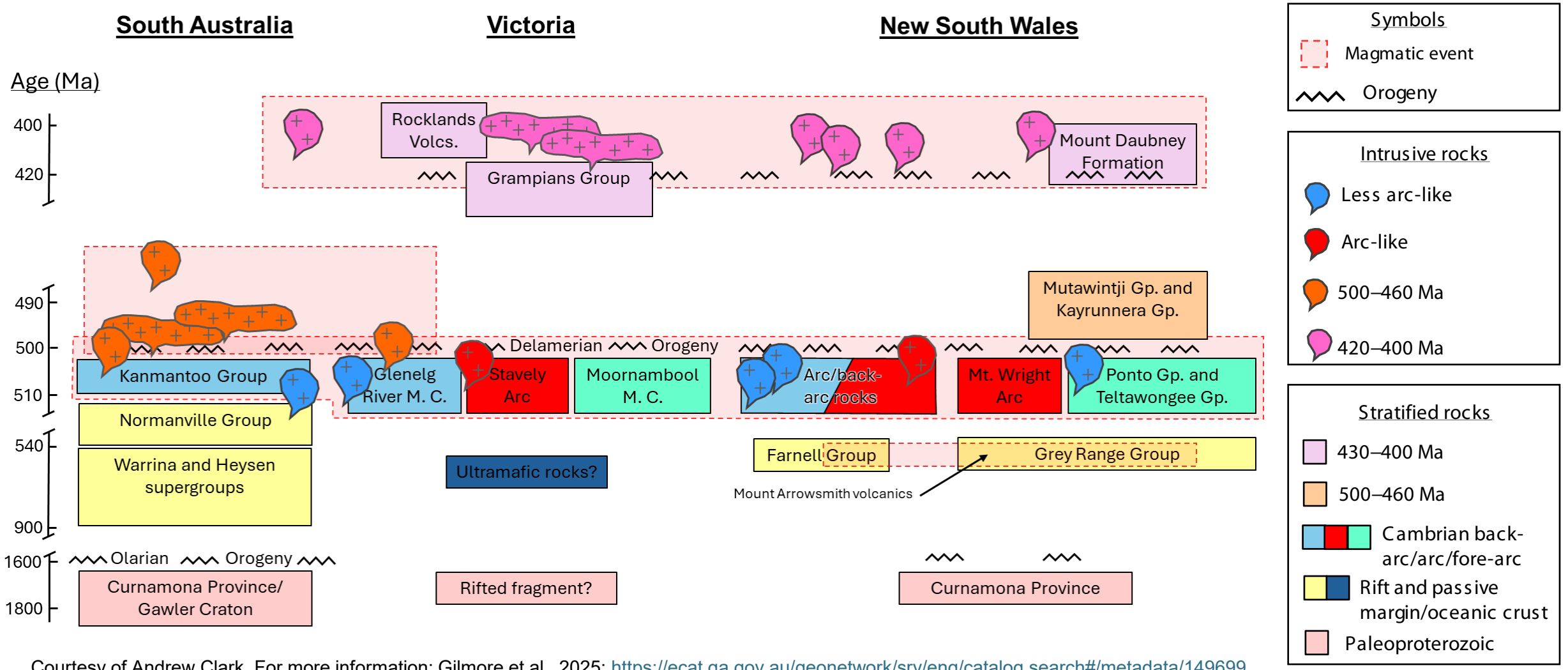
Data source: Li and Powell (2001); Blewett (2012); Foster and Goscombe (2013); Champion et al. (2016); Glen and Cooper (2021); Lewis C (pers comm); Google Earth



- Porphyry-epithermal Cu-Au system
- VHMS Cu-Zn system
- Orogenic Au system
- Orthomagmatic Ni-Cu system
- Intrusion related Au system
- Unclassified mineral system
- World class mineral deposit

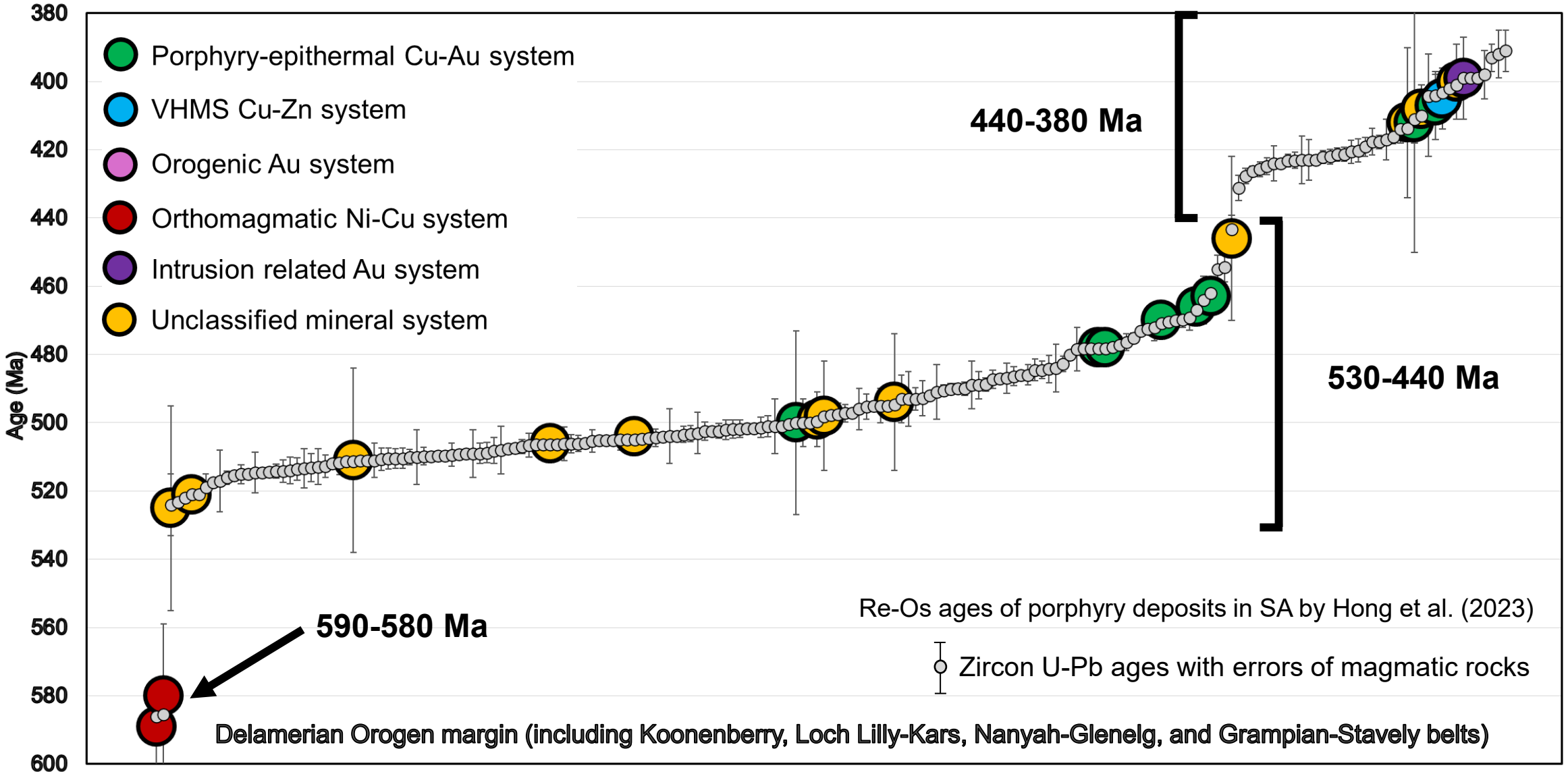


The Delamerian in time and space: a high-level summary

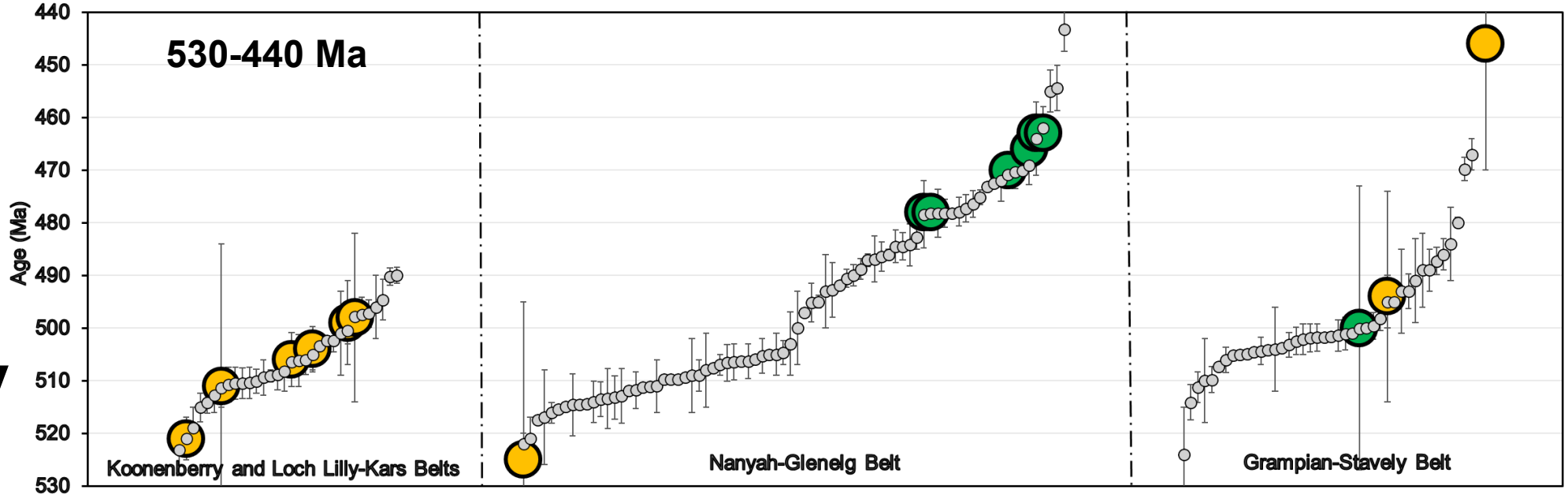


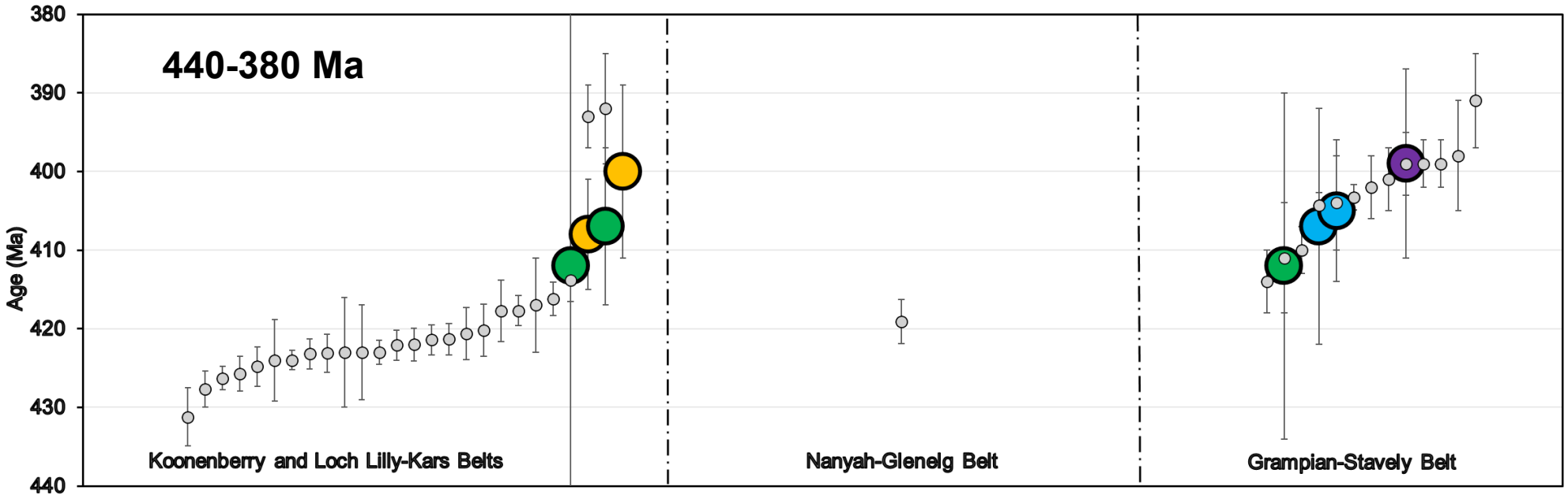
Courtesy of Andrew Clark. For more information: Gilmore et al., 2025; https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/metadata/149699

The 200 Ma metallogenic history along the Delamerian margin



Regional heterogeneity





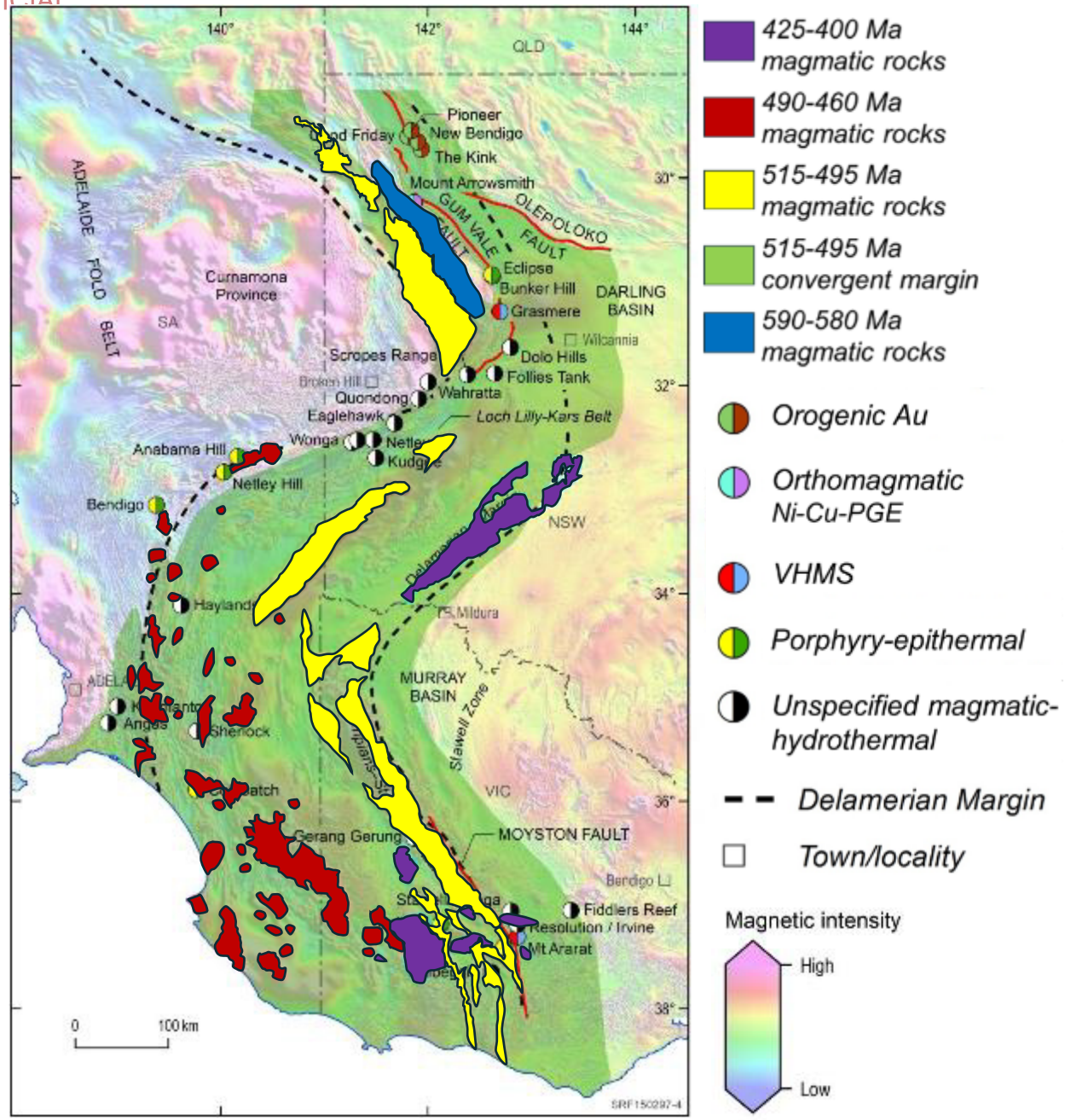
- Porphyry-epithermal Cu-Au system
- VHMS Cu-Zn system
- Orogenic Au system
- Orthomagmatic Ni-Cu system
- Intrusion related Au system
- Unclassified mineral system
- Zircon U-Pb ages with errors of magmatic rocks

Re-Os ages of porphyry deposits in SA by Hong et al. (2023)

Delamerian mineral systems and mineral potential

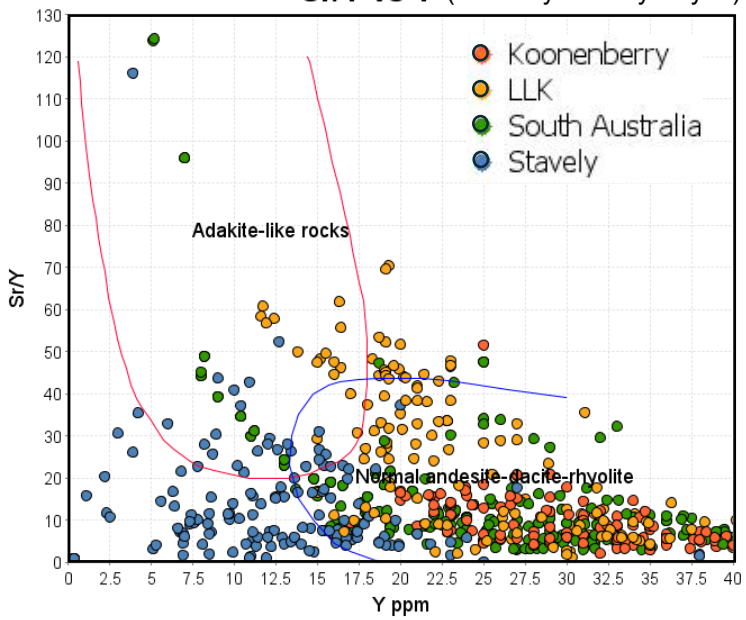
	600-580 Ma	515-495 Ma	480-460 Ma	450-430 Ma	420-400 Ma
Porphyry-epithermal system		✓	✓		✓
VHMS system		✓			
Magmatic Ni-Cu-PGE system	✓				
Orogenic Au system				✓	
Unspecified magmatic-hydrothermal systems		✓			✓

Commodities: **Cu, Au, Zn, Ni, Mo, Ag, Pb**

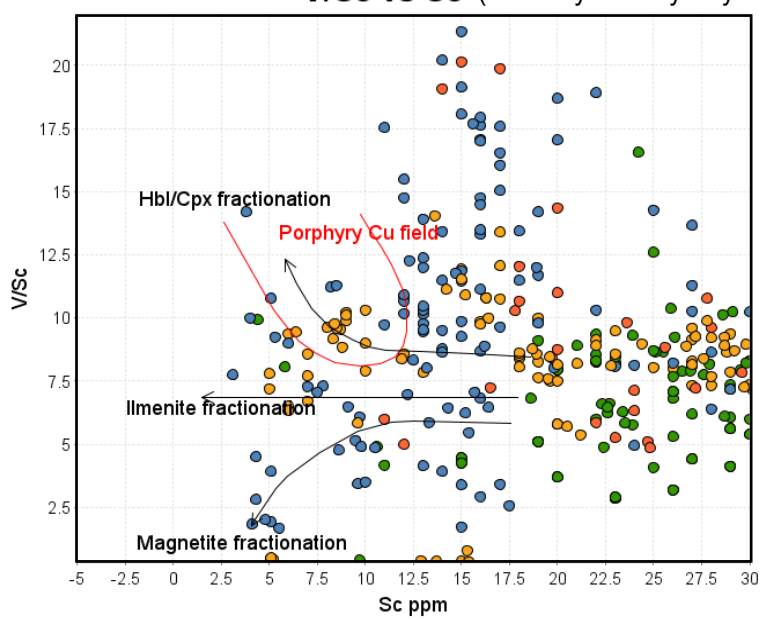


Magma fertility parameters vary significantly across Delamerian regions

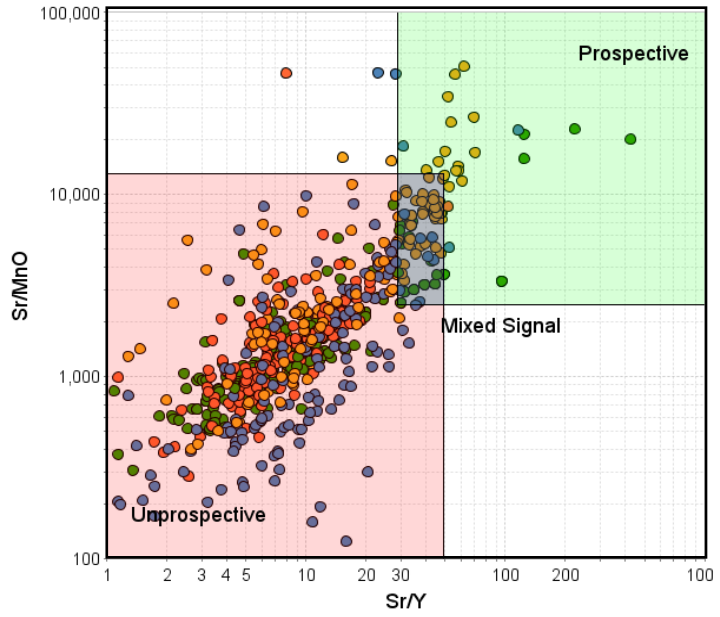
Sr/Y vs Y (courtesy of Holly Taylor)

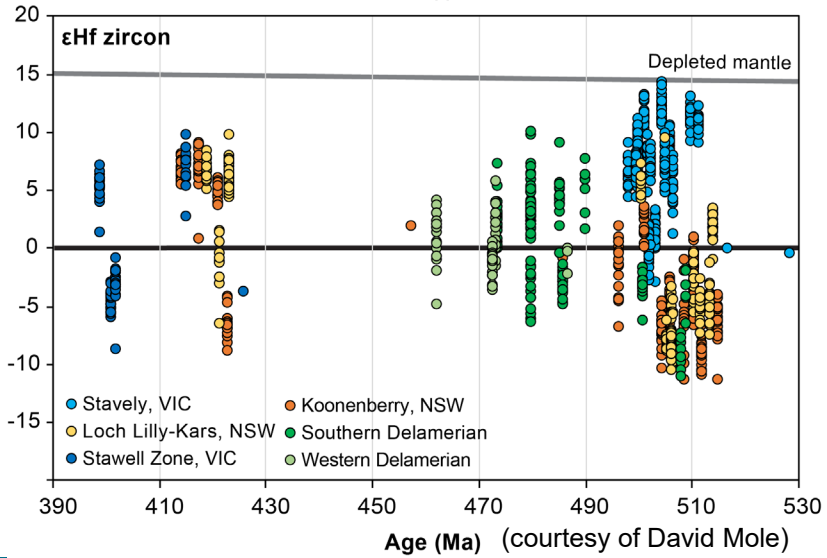


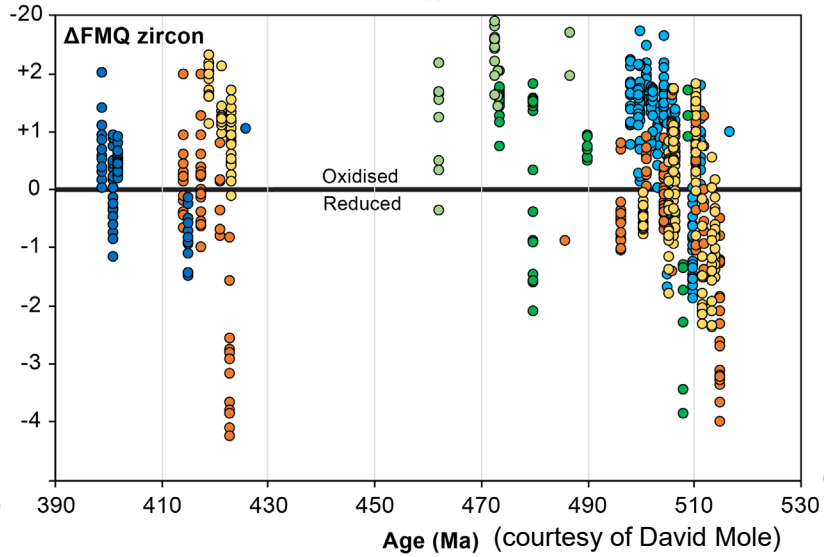
V/Sc vs Sc (courtesy of Holly Taylor)

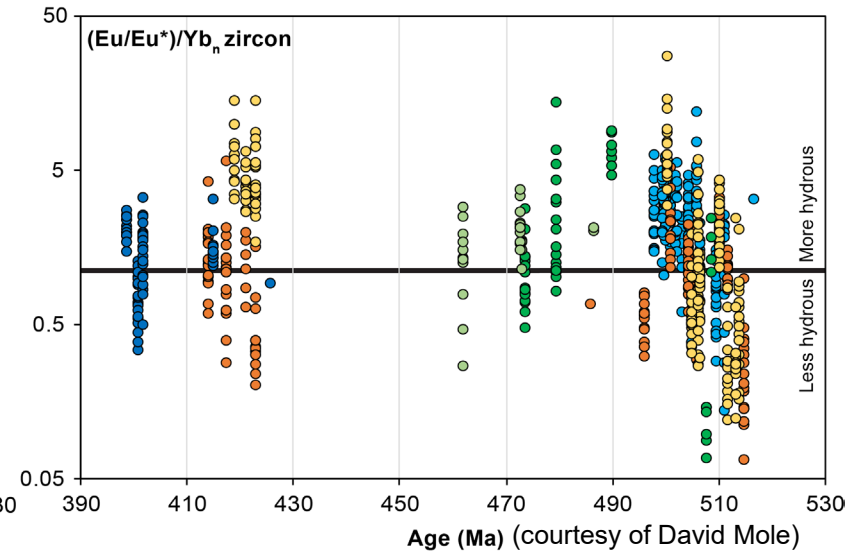


Sr/MnO vs Sr/Y (courtesy of Holly Taylor)

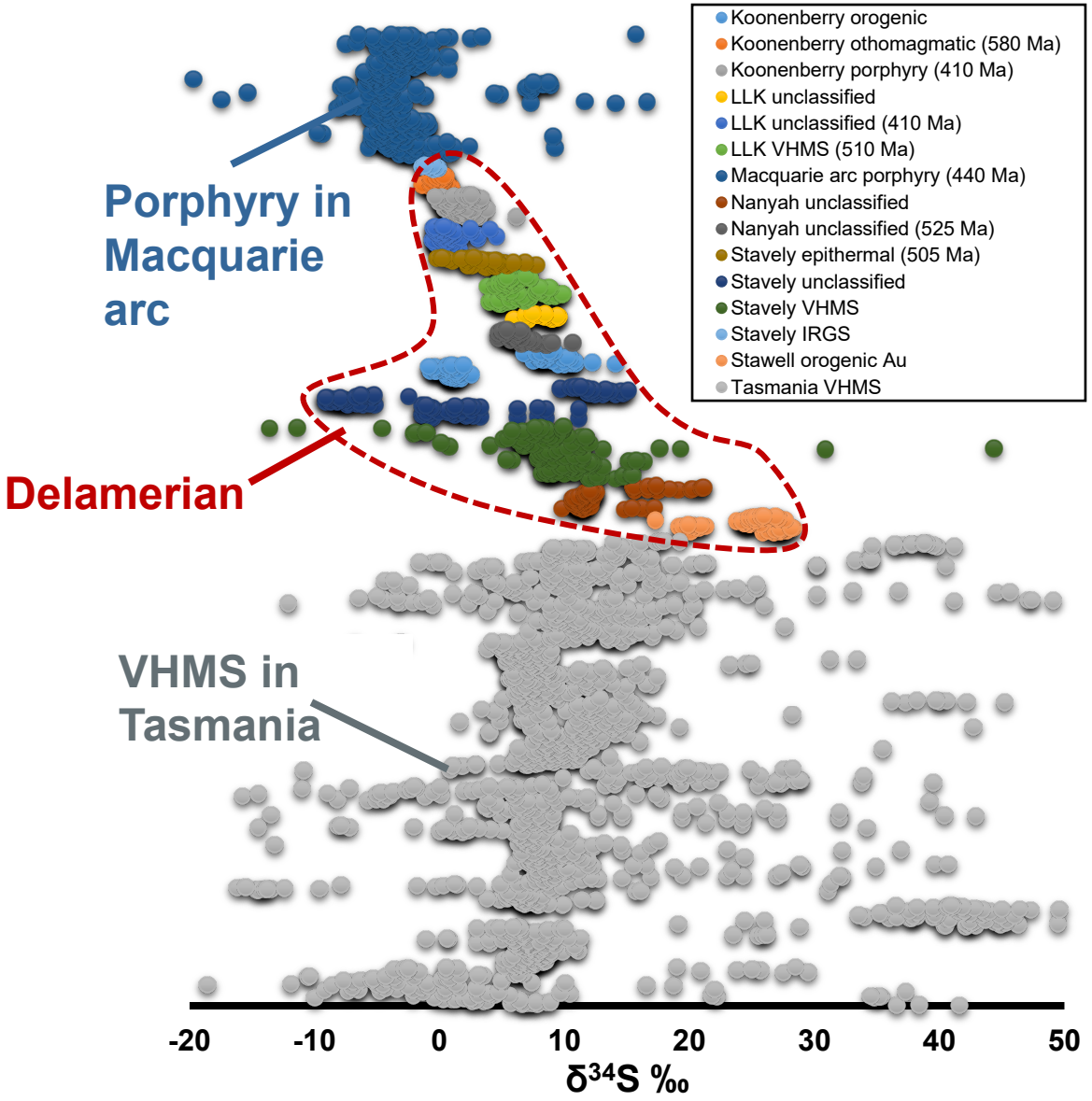


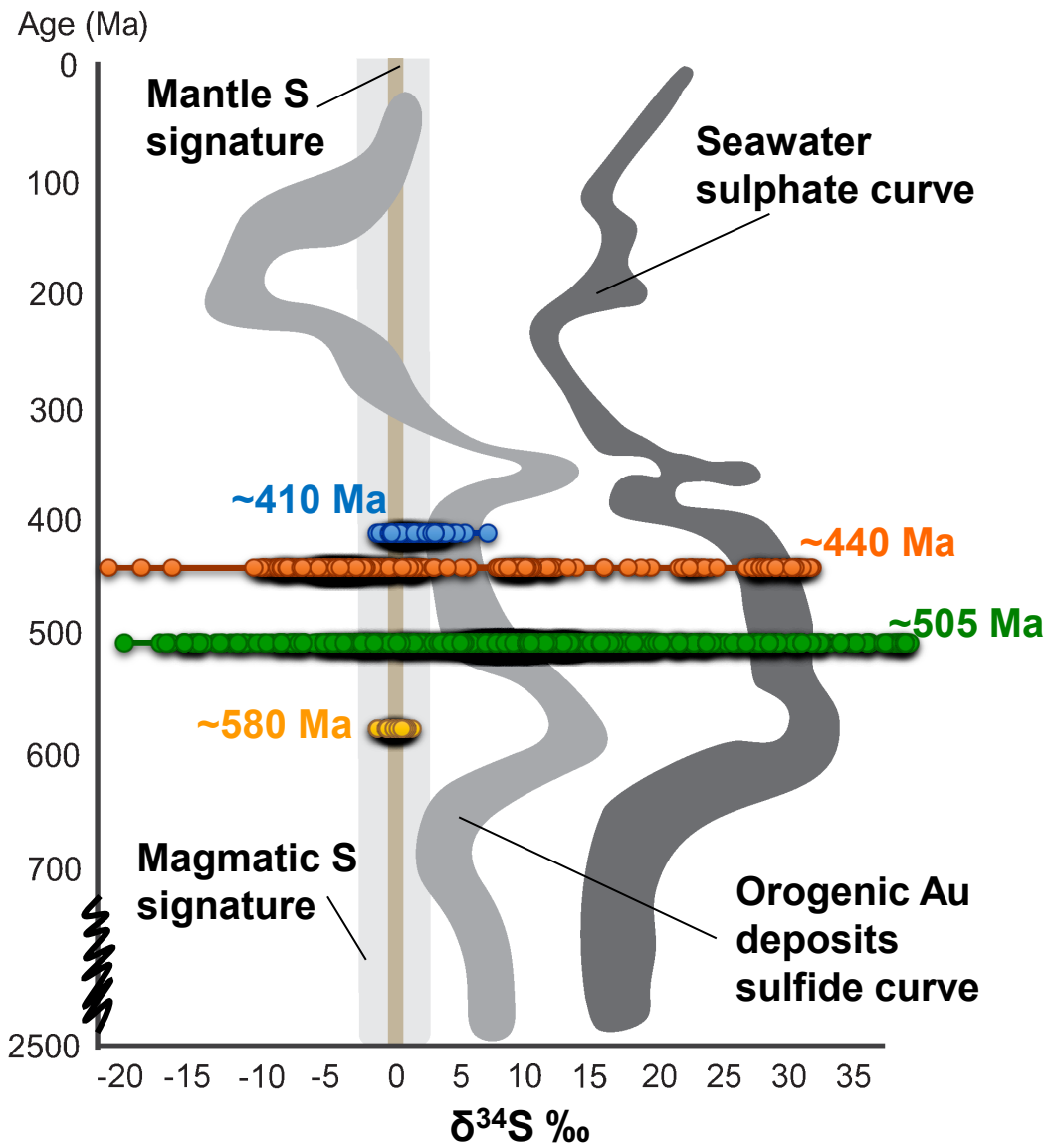






2600+ S isotopes data fingerprint the formation of mineral systems in SE Australia





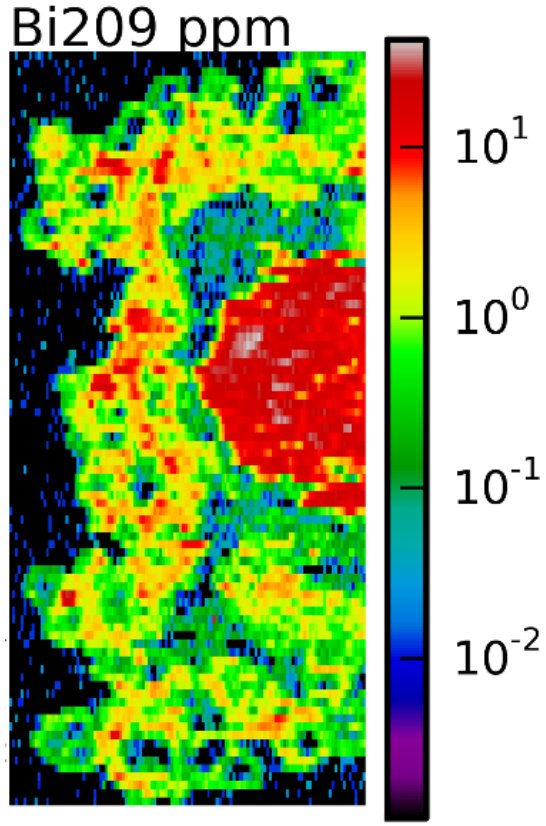
Critical minerals in Delamerian: what do we have?

Strategic materials	Cu	Zn									
Critical minerals	Ti	Mn	Co	Ni	As	Mo	Sb	Te	Gd	Ta	Bi

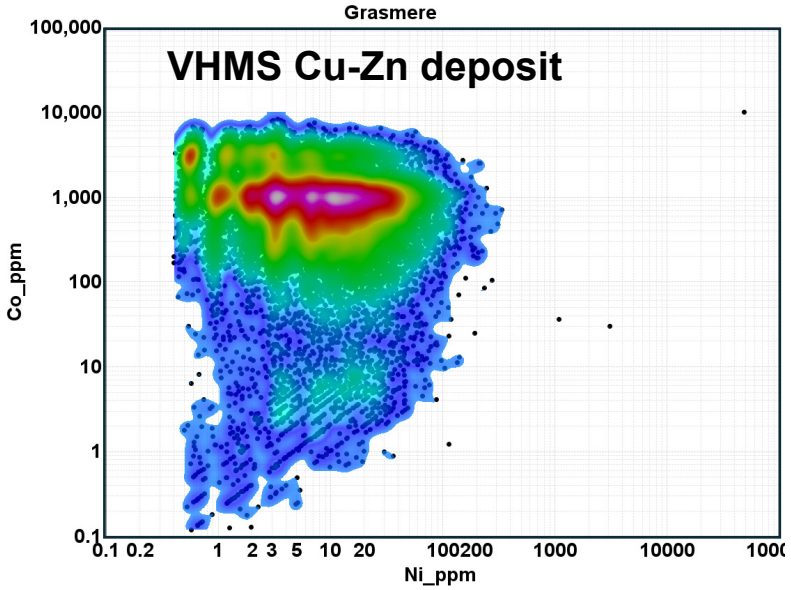
Australia's Critical Minerals List and Strategic Materials List | Department of Industry Science and Resources

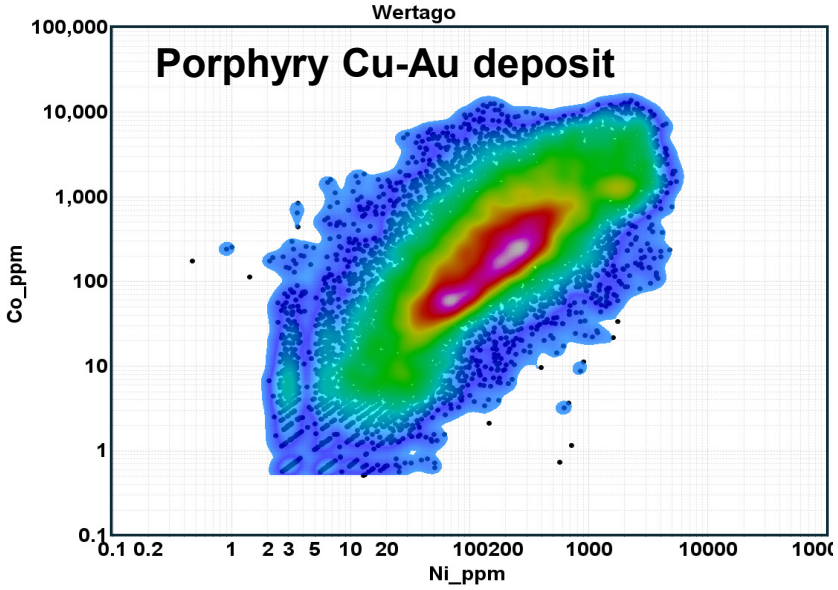
1000 ppm threshold (**6,570,650** data points, **20+** deposits):

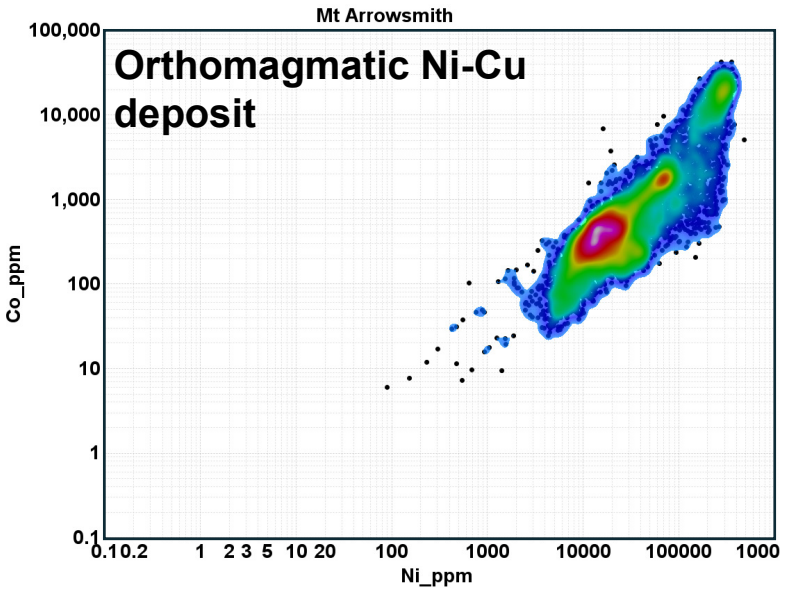
- **Sphalerite:** Ti, Mn, Co, Cu, Cd, Ta, Bi
- **Pyrite:** Ti, Mn, Co, Ni, Cu, Zn, As, Mo, Te, Gd, Au, Bi
- **Galena:** Mn, Zn, Ag, Bi
- **Pyrrhotite:** Ti, Mn, Co, Ni, Cu, Zn, As, Cd, Ta, Bi
- **Chalcopyrite:** Ti, Mn, Co, Ni, Zn, As, Ag, Cd, Sb, Te, Ta, Bi

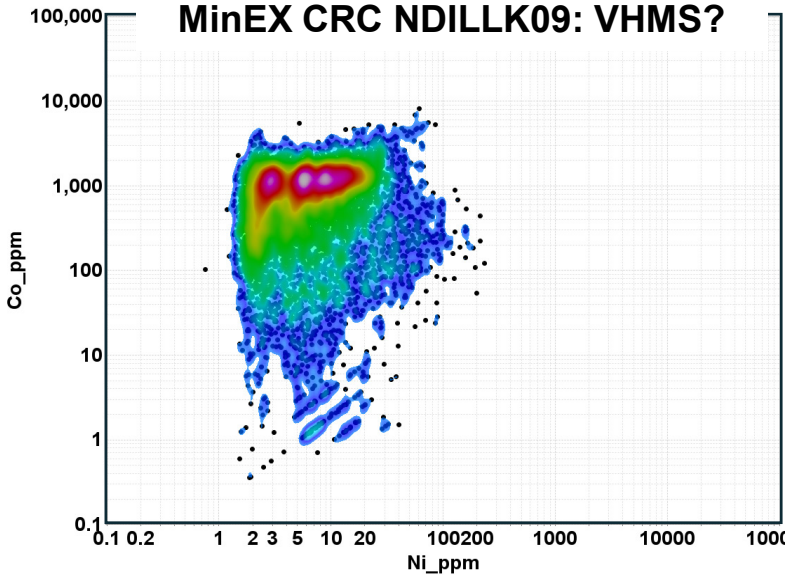


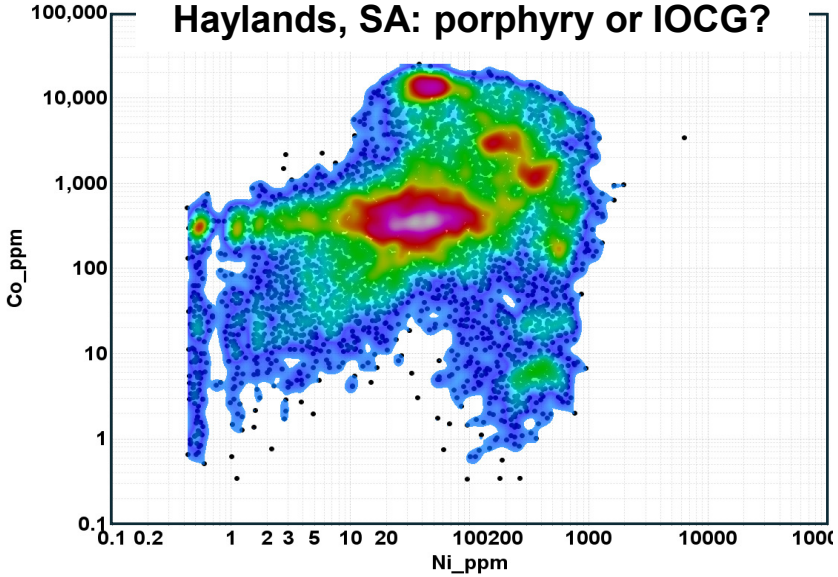
Pyrite chemistry: a deposit-type indicator in Delamerian

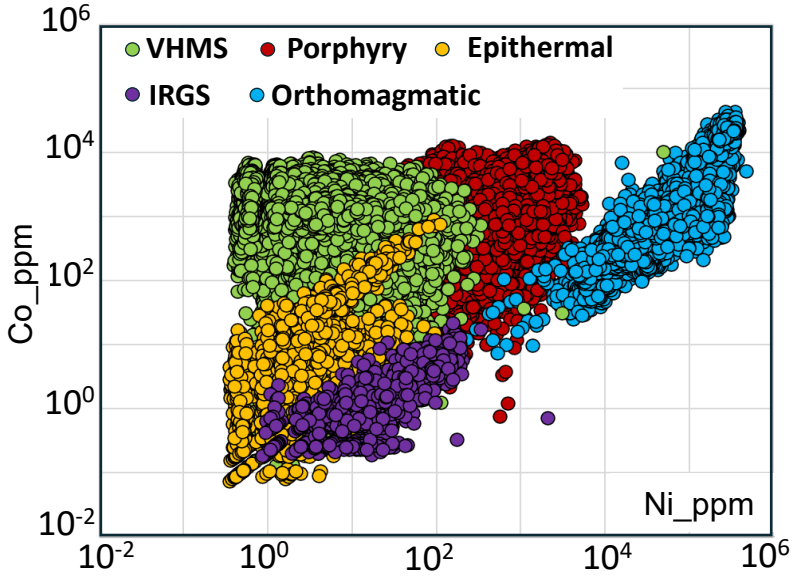




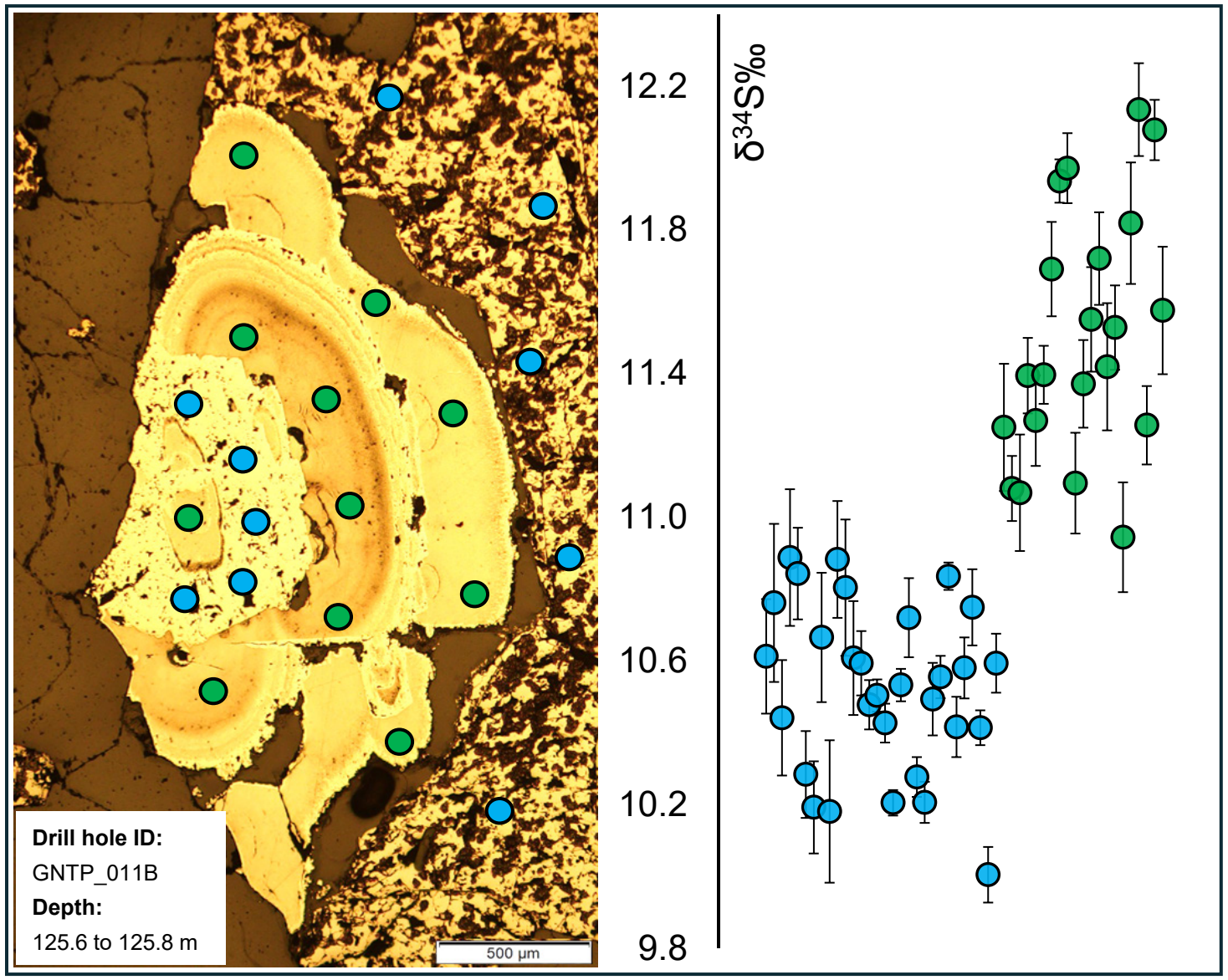


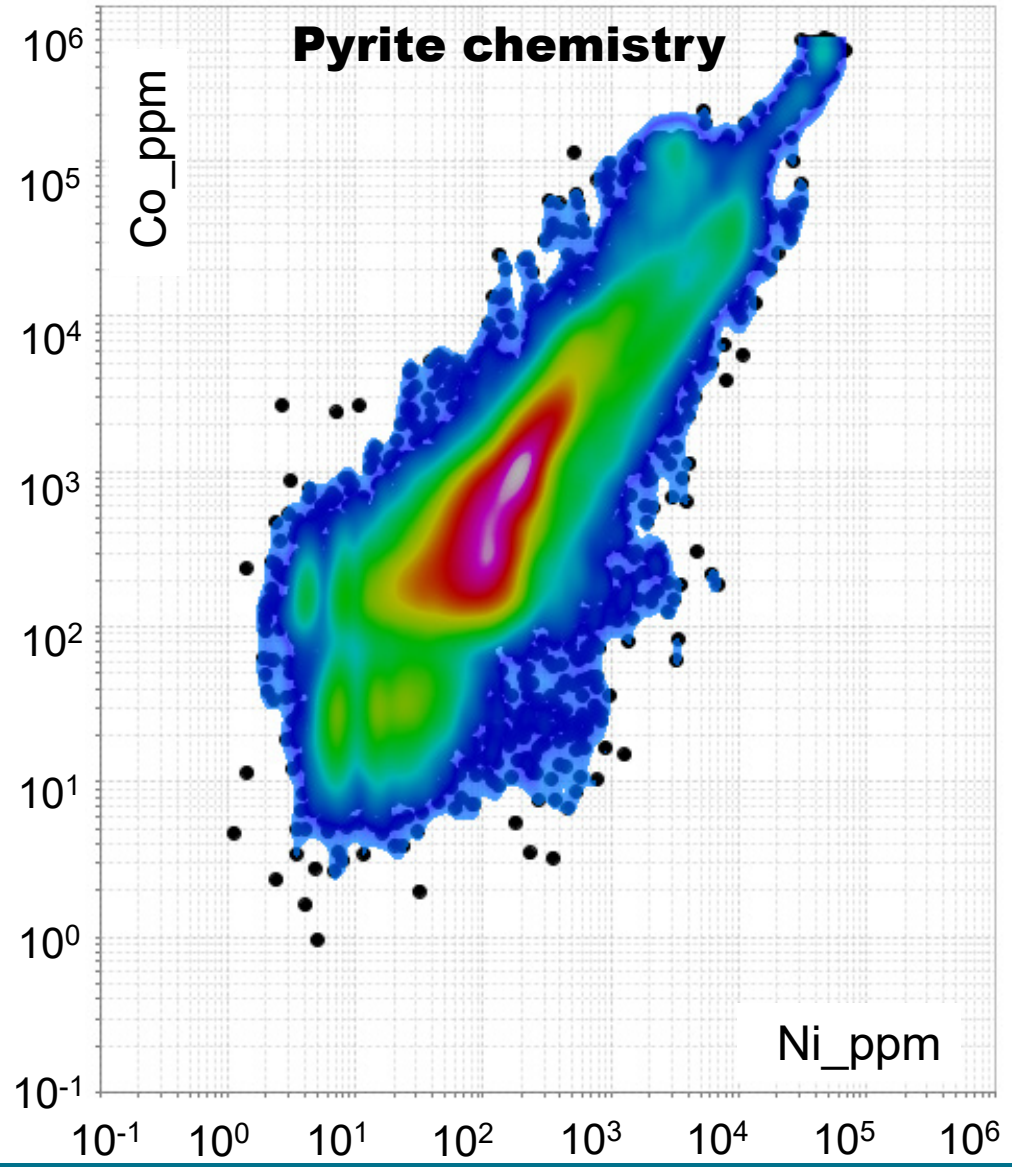




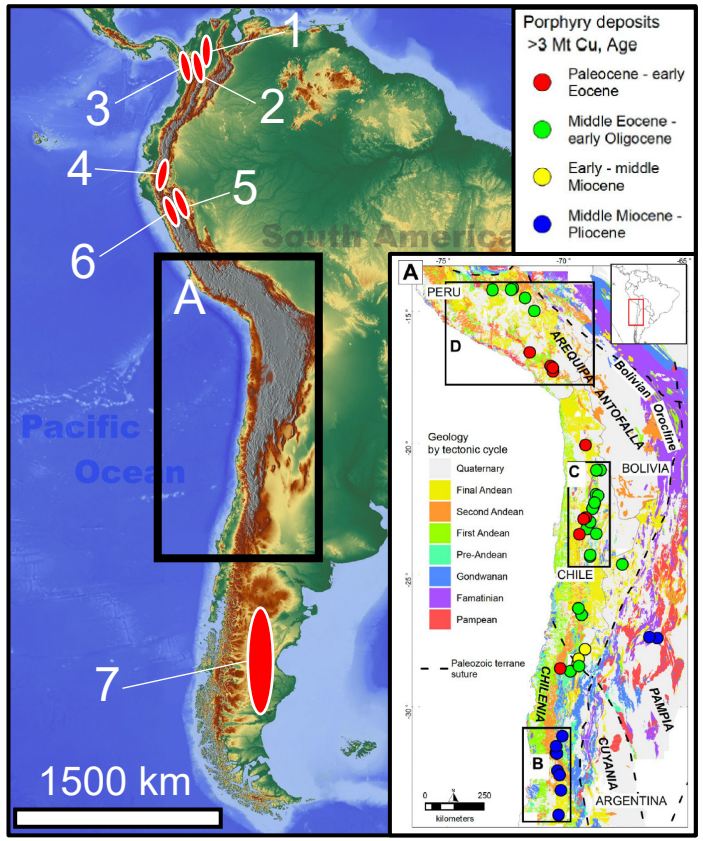


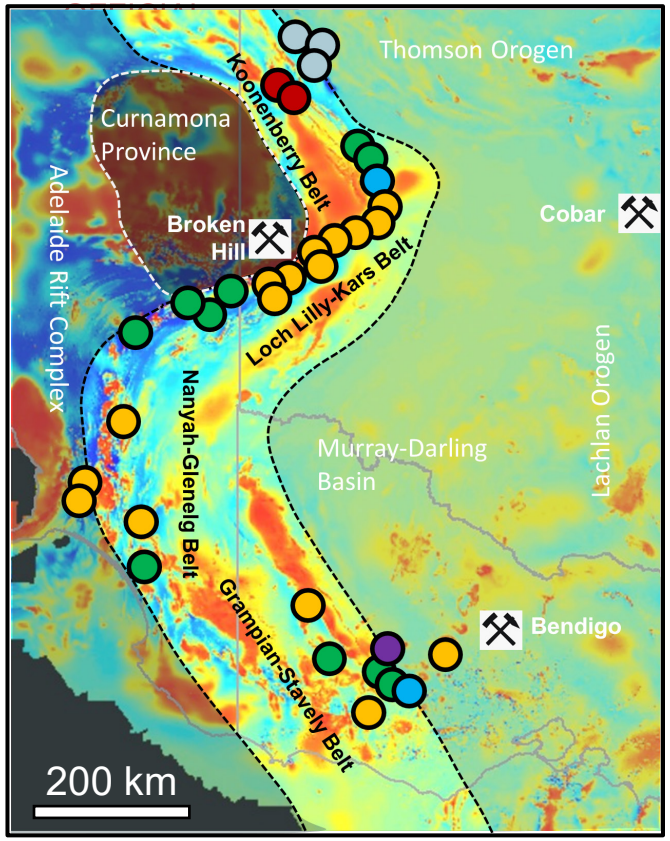
Kanmantoo: a major Cu-Au deposit in SA Delamerian margin

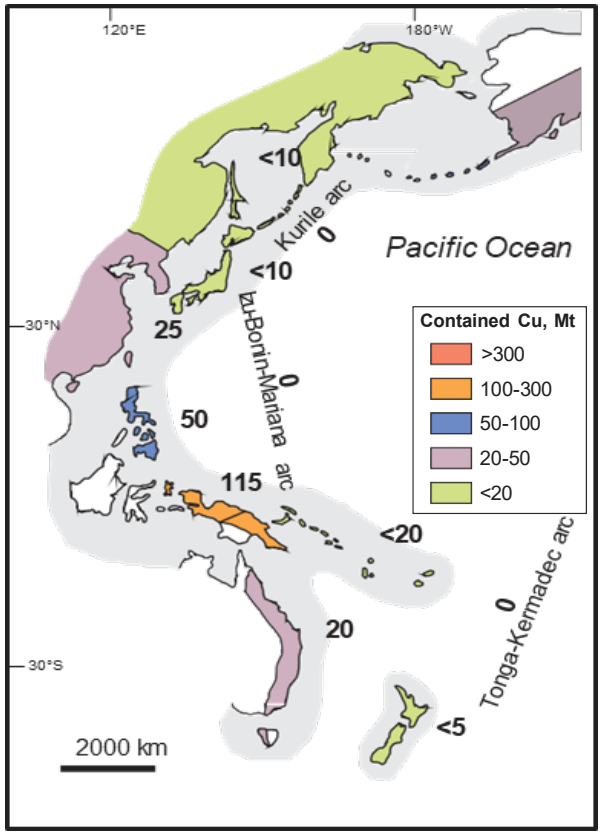




Data source:
Sillitoe and Perello (2005);
Sillitoe, 2008;
Sillitoe, 2018;
Farrar et al., 2023







	Andes	Delamerian	Japan
Tectonics	Continental margin, contraction, crustal thickening, and arc migration	Convergent margin overall, differentiate locally	Island arc, weak inter-plate coupling, trench retreat, and extension
Magmatism	Plutonic, volcanic, calc-alkaline widespread	Plutonic, volcanic, calc-alkaline widespread	Ash-flow caldera, and bimodal magmatism
Fertility	High Sr/Y, High H_2O content, oxidised	A variety of mixed characteristics	Low Sr/Y, reduced and highly fractionated
Metallogeny	Porphyry, skarn, HS epithermal, VHMS, IOCG	Porphyry, VHMS, epithermal, IRGS, orogenic Au	LS epithermal, VHMS
Preservation	High surface uplift rates and rapid exhumation	Basin sediments widespread	Shallow erosion, cannot reveal deposits

Delamerian revealed: new insights, future directions

- ✓**Geodynamic Record:** The Delamerian Orogen captures tectonic evolution from the Neoproterozoic to Devonian, providing a robust geological framework for resource assessment.
- ✓**Mineral Endowment:** Hosting porphyry, epithermal, VHMS, magmatic Ni-Cu, and orogenic Au systems, the region delivers a rich suite of commodities including Cu, Au, Zn, Ni, Mo, Ag, and Pb.
- ✓**Critical Minerals Potential:** Sulfide assemblages carry strategic elements, including Ti, Mn, Co, Ni, As, Mo, Sb, Te, Gd, Ta, Bi, directly supporting Australia's critical minerals agenda.
- ✓**Exploration Insights:** our holistic studies sharpen the understanding of mineral system formation and metallogenic pathways, lowering exploration risk.
- ✓**Legacy:** Cutting-edge analytical techniques and integrated precompetitive geoscience datasets will drive more precise targeting, unlocking new opportunities across the Delamerian Orogen margin.

Australian Government
Geoscience Australia

Resourcing Australia's Prosperity

Thank you

Delamerian mineral systems and mineral potential

Further information

Dr. Yanbo Cheng
Email: Yanbo.Cheng@ga.gov.au
Telephone: +61 2 6126 8747
Address: Cnr Jerrabomberra Avenue and Hindmarsh Drive, Symonston ACT 2609
Postal Address: GPO Box 378, Canberra ACT 2601