AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

Driving exploration with government geoscience

Marina Costelloe
Branch Head, Minerals Systems
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AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

Government geoscience accelerating resource discovery and development

Karol Czarnota
Principal Science Advisor
Minerals, Energy and Groundwater

Australian Government
Geoscience Australia

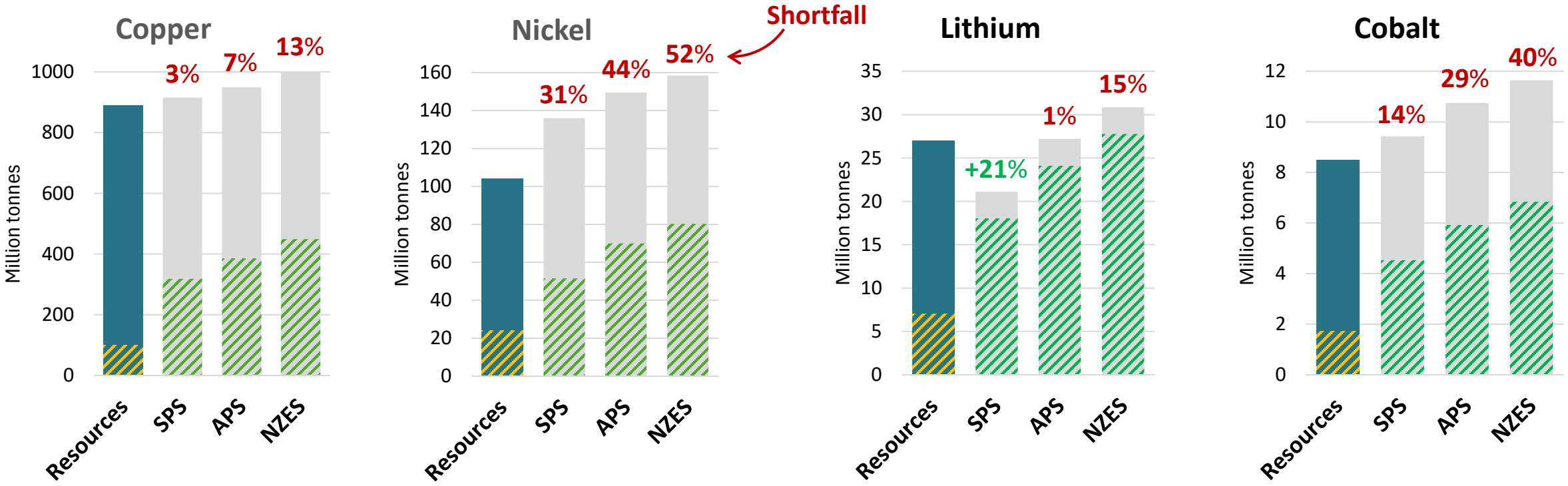
We need to find more – global minerals demand to 2050 vs. resources

IEA Forecast Scenario

SPS – Stated Policies
APS – Announced Pledges
NZES – Net Zero Emissions

- World Economic Resources 2022
- Australian Economic Resources 2022
- Forecast total demand 2050
- Forecast clean energy demand 2050

Even accounting for all reported economic resources in the world, new mineral discoveries are required to meet Net Zero by 2050

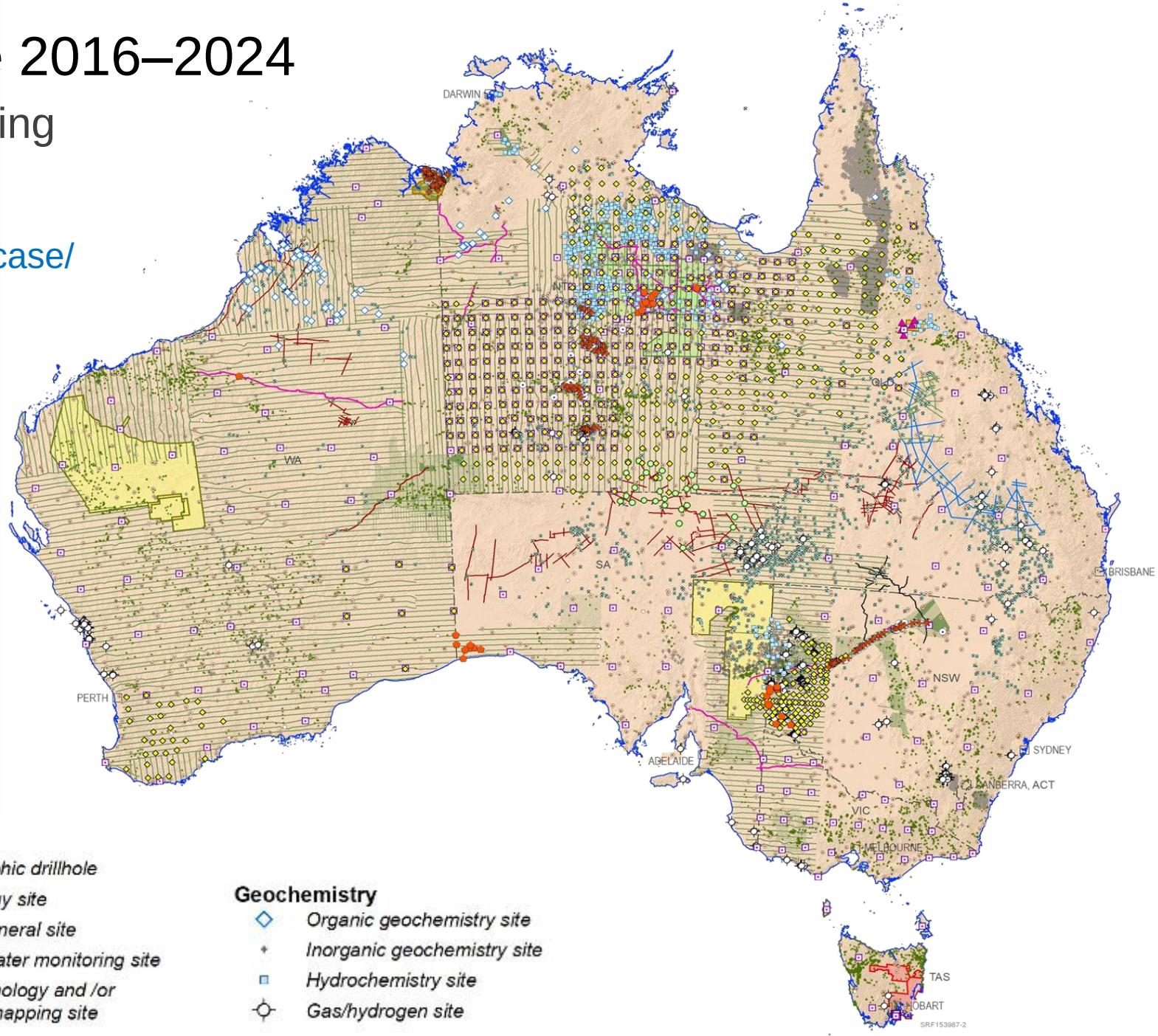


Britt & Czarnota (2024; https://doi.org/10.1080/08120099.2024.2430279)

Exploring for the Future 2016–2024

Data collection and reprocessing

Showcase 2024:
https://www.eftf.ga.gov.au/2024-showcase/
Exploring for the Future Summary:
https://dx.doi.org/10.26186/149743



Geophysics

- *Airborne Electromagnetic survey (reprocessed)*
- *Gravity survey*
- *LiDAR survey*
- *Magnetotelluric survey*
- *Magnetics and radiometrics survey*
- *Airborne Electromagnetic survey*
- *Airborne Electromagnetic survey (reprocessed)*
- *Seismic reflection survey*
- *Seismic reflection survey (reprocessed)*
- *Gravity survey*
- *Borehole Geophysics*
- *Magnetotelluric site*
- *Petrophysics site*
- *Passive seismic station site*
- *Surface Magnetic Resonance site*

Geology

- *Stratigraphic drillhole*
- *Palynology site*
- *Heavy mineral site*
- *Groundwater monitoring site*
- *Geochronology and /or isotopic mapping site*

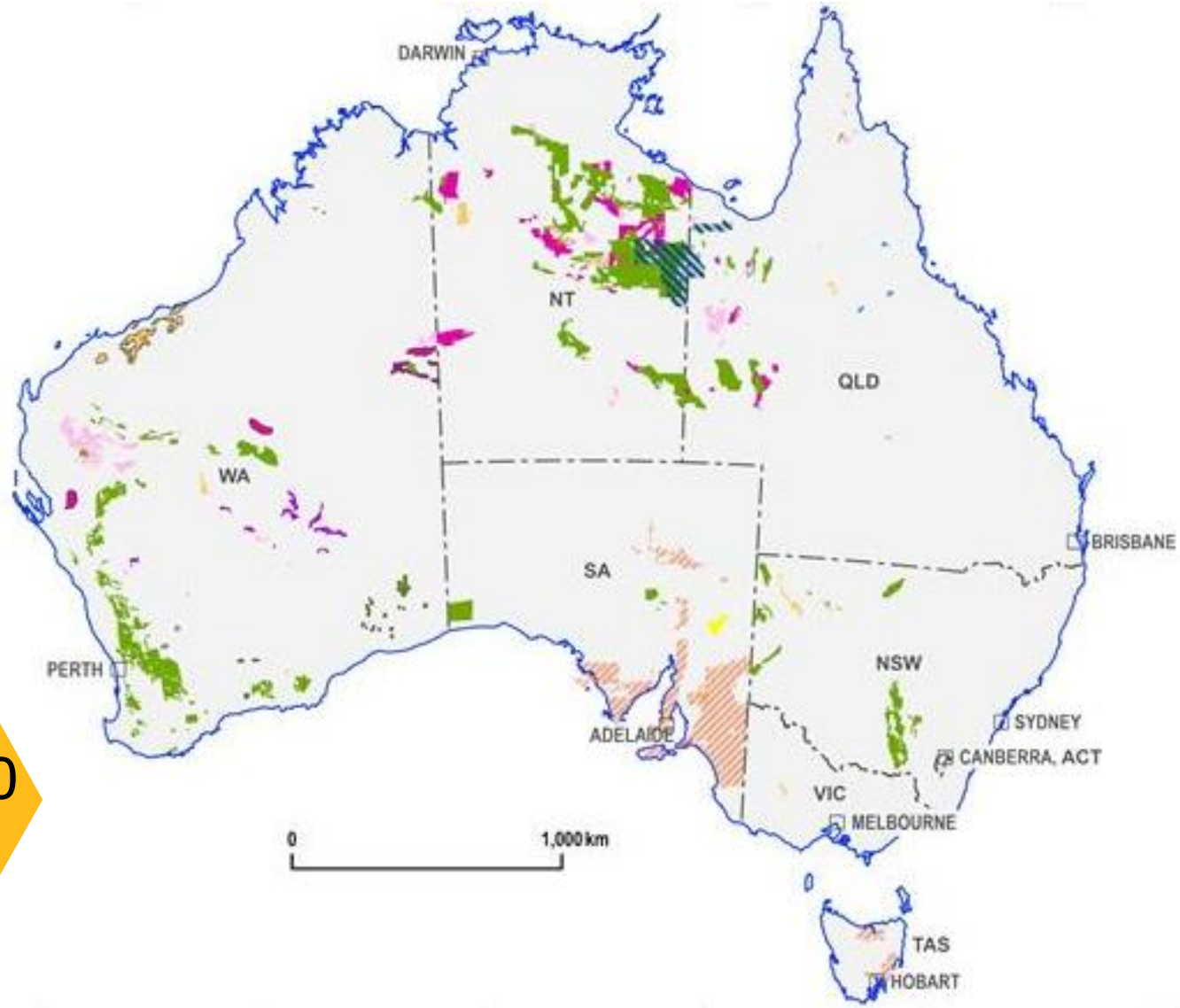
Geochemistry

- *Organic geochemistry site*
- *Inorganic geochemistry site*
- *Hydrochemistry site*
- *Gas/hydrogen site*

The impact of government geoscience on exploration since 2016

Tenements taken up or reinvigorated (as at January 2024)

- Critical Minerals
- Rare Earth Elements
- Hydrogen
- Other minerals
- Petroleum
- Gold
- Potash
- Carbon Capture & Storage
- Uranium



174 companies

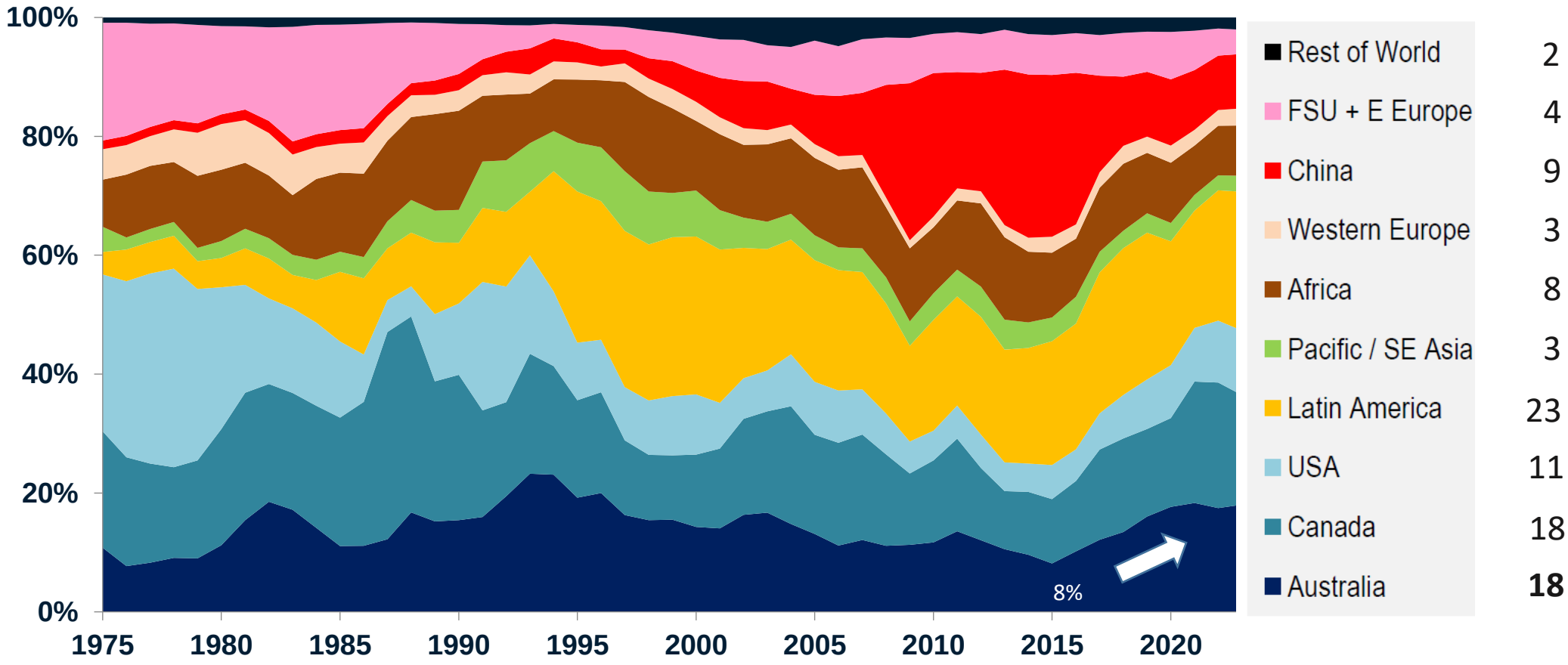
1,327 tenements

590,000 km^2

AUSTRALIA MINERALS

The impact of government geoscience on global exploration share

Since 2015 Australia's share has risen from **8%** to **18%**.



AUSTRALIA MINERALS

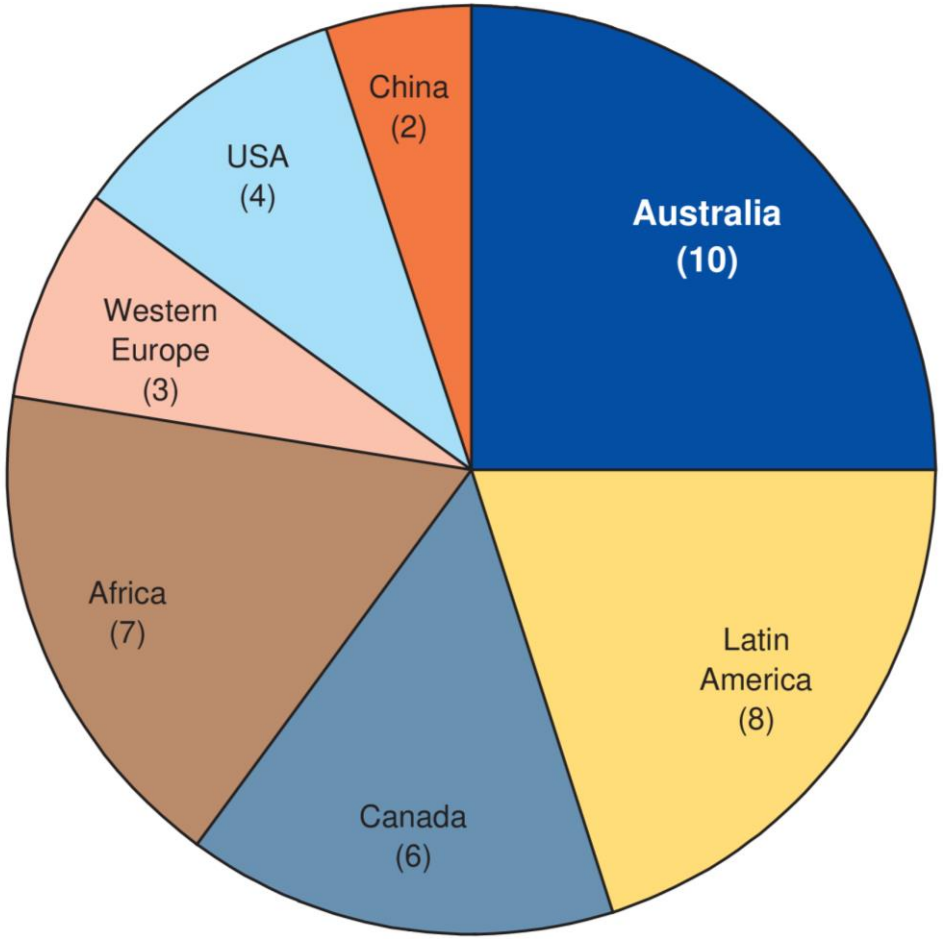
Note: includes expenditures on precious metals, diamonds, base metals, critical minerals and bulk minerals

Sources: MinEx Consulting estimates June 2024, based on data from ABS, NRCan, MNR (China) and S&P Global

Global world-class discoveries (2017–2024)

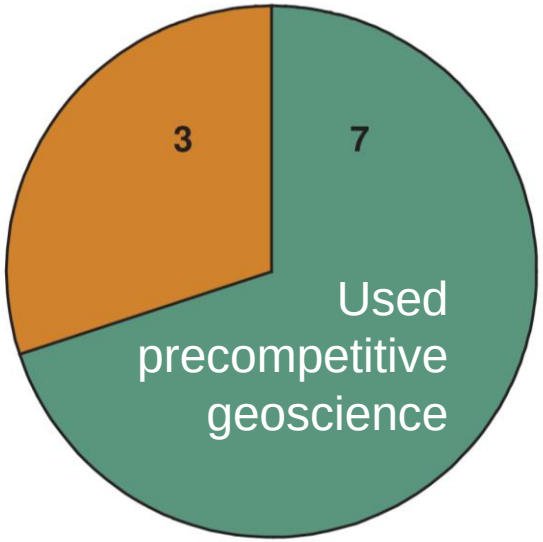
World

Number = 41



Australia

Number = 10



Australian precompetitive geoscience supported **70%** of discoveries

Caution: Number of discovered world class deposits (NPV >$200M) will grow as deposits are drilled out and reported
Source: MinEx Consulting @July 2024

World-class discoveries underpinned by precompetitive geoscience: 2017–2021

Precompetitive geoscience supported discovery **of six undercover** Australia world class discoveries, all with gold

Country	Deposit Name	Commodity	Tier	Mineral System	Depth (m)	Precompetitive			
						Geophysics	Geology/ Geochem.	Genetic model	Legacy exploration
Australia	Andover	Li	2	Pegmatite	0	✓			✓
Australia	Boda	**Au**, Cu, Ag	2	Porphyry	211	✓			
Australia	Gonneville	PGE, Ni, Cu, Co, **Au**	1	Mafic intrusion	30	✓		✓	✓
Australia	Havieron	**Au**, Cu	2	Orogenic	400				✓
Australia	Hemi	**Au**	1	Sanukitoid	25		✓	✓	
Australia	Oak Dam	Cu, **Au**, U_3O_8	2	IOCG	800	✓		✓	
Australia	Winu	Cu, **Au**, Ag	2	Orogenic	40	✓	✓		✓
Brazil	Jaca	Cu, **Au**	2	Porphyry	0			✓	
Canada	Dixie Lake (New)	**Au**	1	Orogenic	10	✓			✓
Canada	Queensway	**Au**	2	Orogenic	5			✓	✓
China	Dahongliutan	Li, Be	2	Pegmatite	0	✓	✓		
Finland	Ikkari	**Au**	2	Orogenic	10	✓	✓		
Guinea	Bankan	**Au**	2	Orogenic	0	✓		✓	

Economic value to the nation

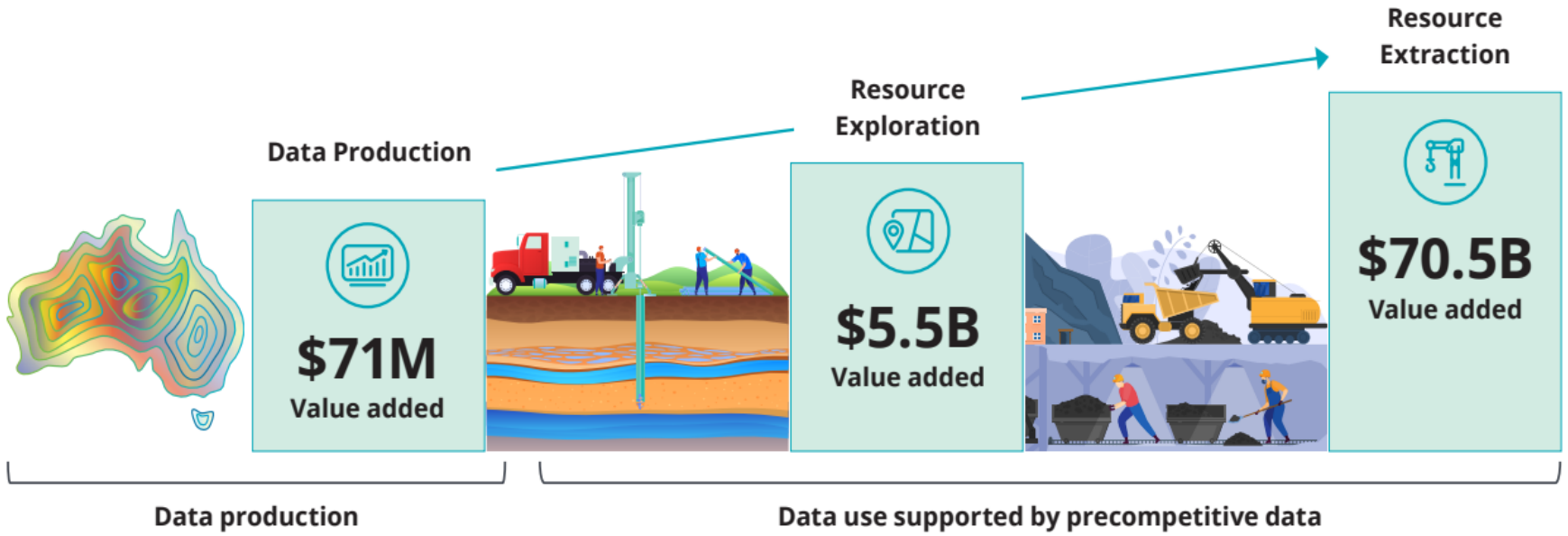
Australia's Mining Industry 2023

13.4% GDP

300k direct employment, 1.1m indirect

A$436B exports (65%)

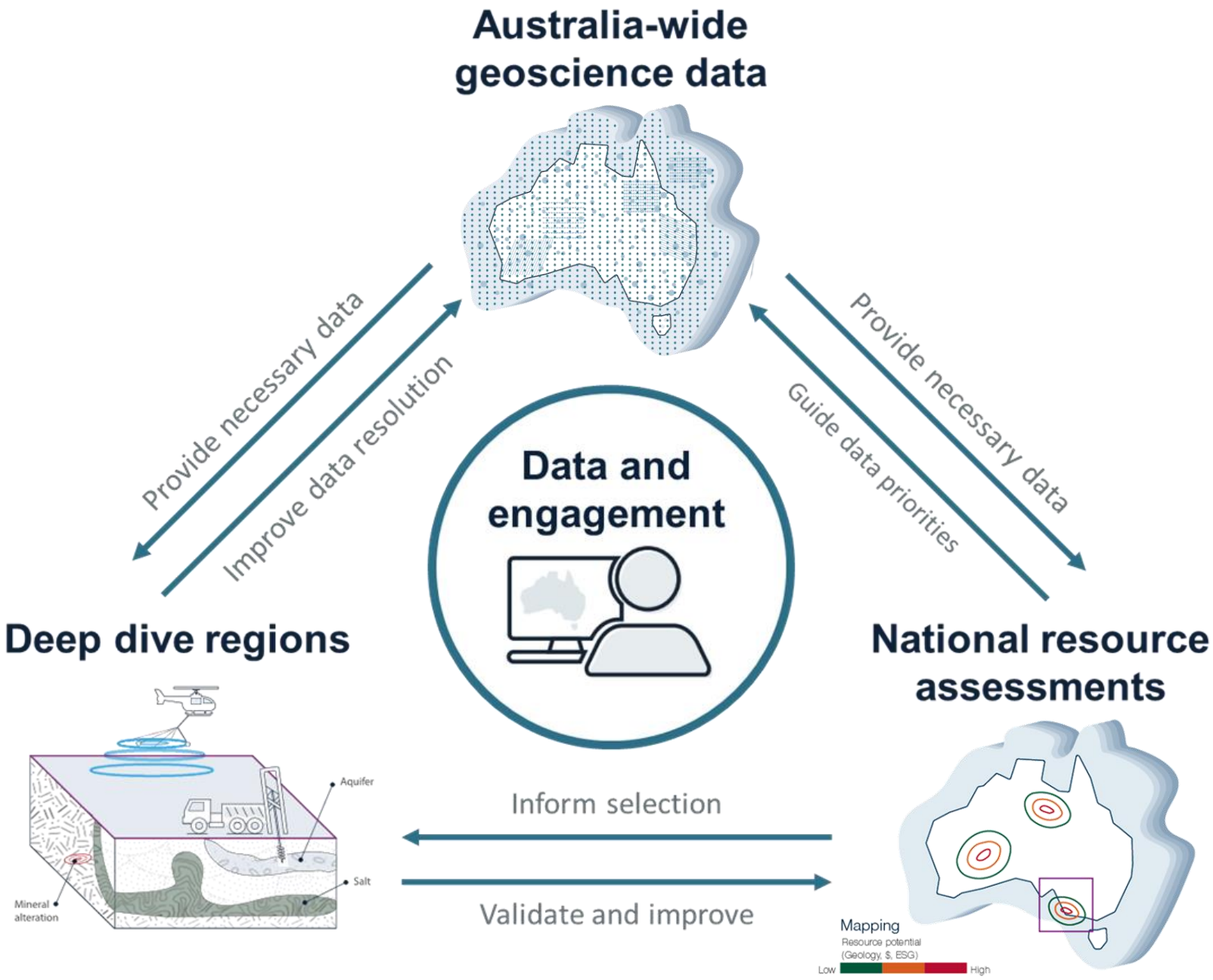
Government geoscience provides the foundation for economic activity in downstream mineral exploration and extraction industries **worth over 1,000 times** initial expenditure



Deloitte Access Economics - The economic value of government precompetitive geoscience data and analysis for Australia's resources industry. https://dx.doi.org/10.26186/148640

Resourcing Australia's Prosperity initiative

- $3.4B over 35 years for precompetitive geoscience
- Focused on:
  - Minerals
  - Energy
  - Groundwater
- Three interrelated geoscience components

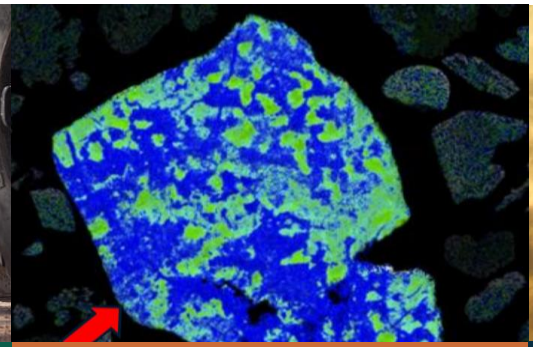


Some examples of the things we are doing

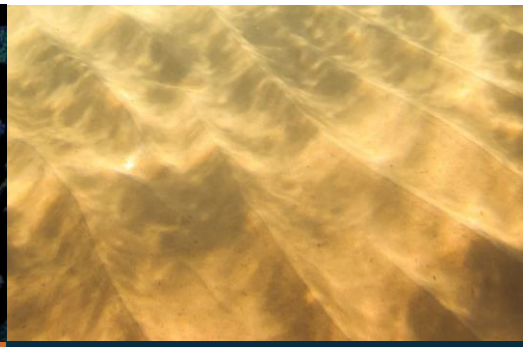
Airborne electromagnetics

Seismometer installation

Reflection seismic trucks



Geochemical characterization

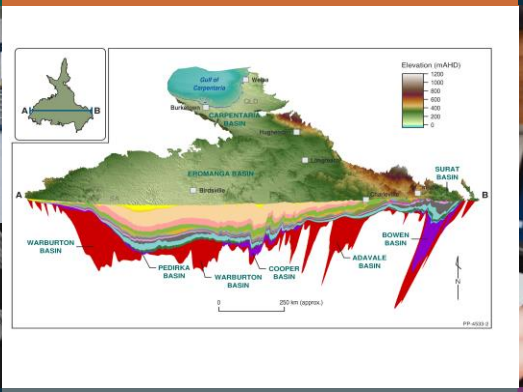


Seabed mapping

High performance computing

Coil tube drilling rig

Mineral dating



3D Geological mapping

Techno-economic modelling

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Thank you

Karol Czarnota
Principal Science Advisor
Minerals, Energy and Groundwater

Australian Government
Geoscience Australia

AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

Stimulating exploration and discovery in South Australia

Innovation, future facing and high-quality geoscience information

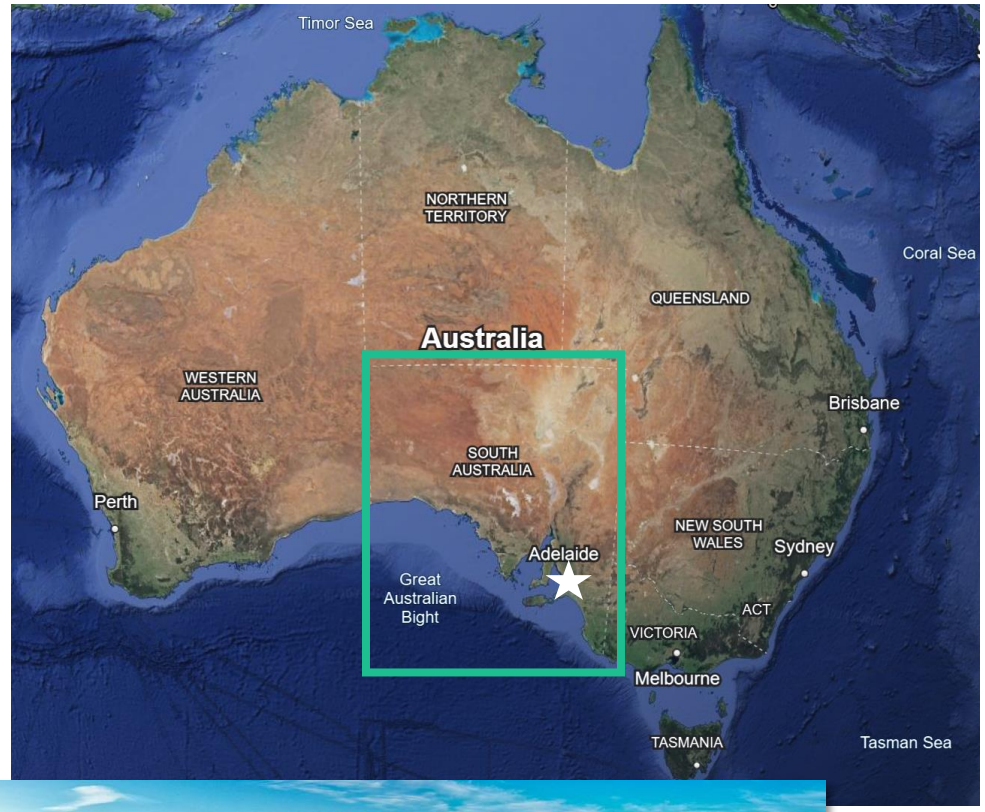
Christie Gerrard
Manager, Geoscience Information and Delivery
Geological Survey of South Australia, Department for Energy and Mining

SOUTH AUSTRALIA

Government of South Australia
Department for Energy and Mining

South Australia – a snapshot

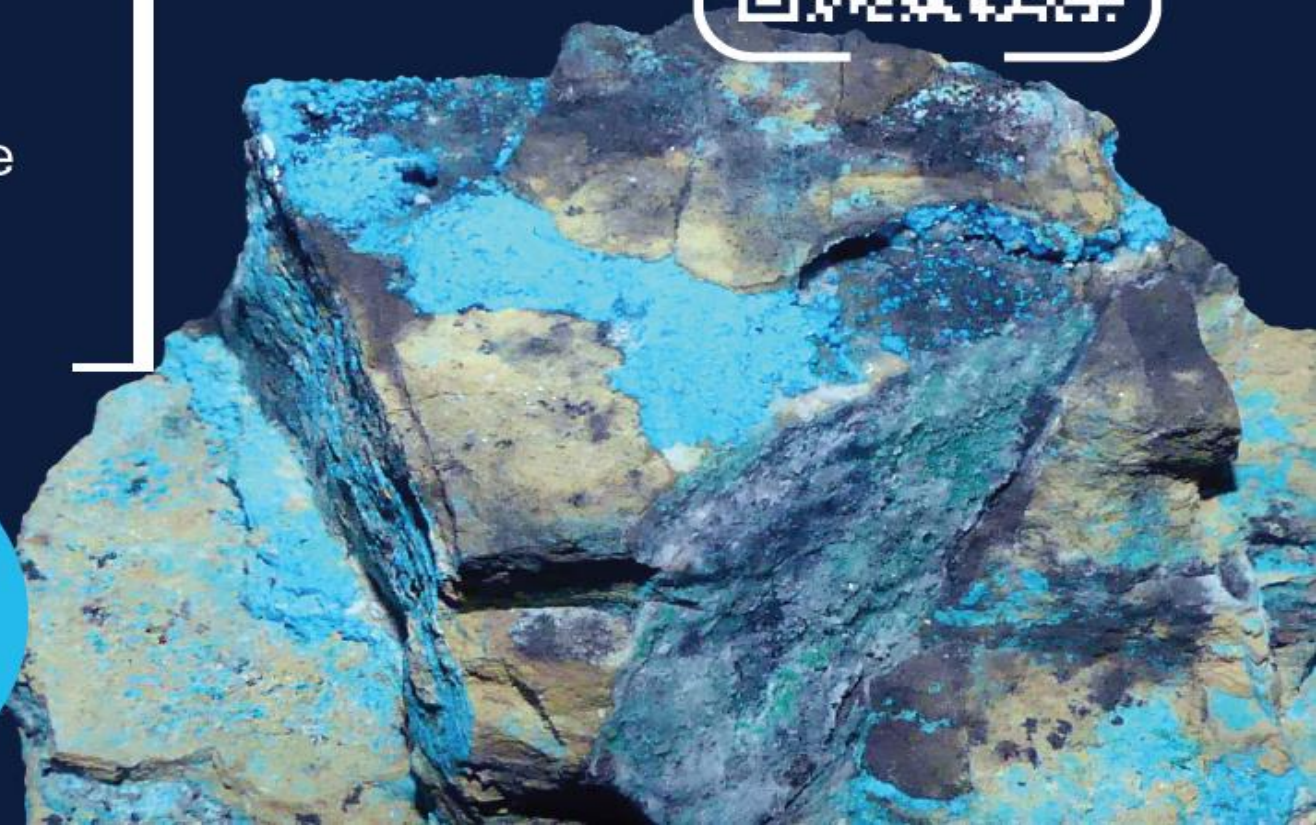
- South Australia has a population 1.8Mil, 77% living in Adelaide
- Climate arid (87%) to the north, mediterranean (coast) to the south
- World-famous wine regions - Barossa and Clare Valley
- World-class mineral resources, hosting 69% of Australia's copper resources, 82% of Australia's uranium resources, 26% of Australia's gold resources, and 76% of Australia's graphite resources.
- South Australia hosts the world's largest uranium resource, ranking 4th globally in production.
- The state is rich in critical minerals, including graphite, titanium, rare earth elements, and magnesium.
- A modern energy system of 75% renewable energy, on track for 100% by 2030.



South Australia
CRITICAL MINERALS

CMSA focuses on advancing knowledge to support critical minerals discovery and exploration in South Australia.

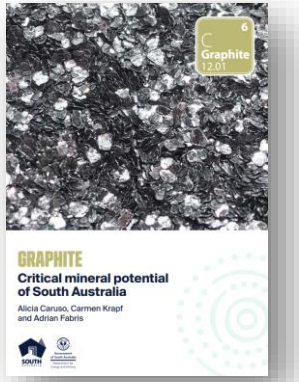
Government of South Australia
Department for Energy and Mining



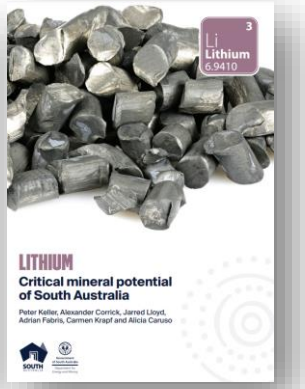
The project seeks to

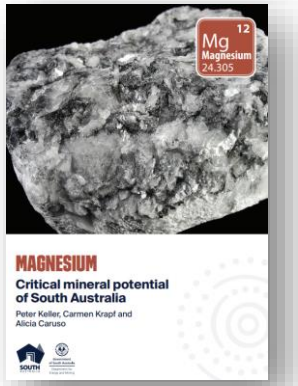
- Expand understanding of South Australia's critical mineral potential
- Identify critical mineral strategy based on an analysis of the economic risk and supply chain, and sovereign risks associated with critical mineral industry

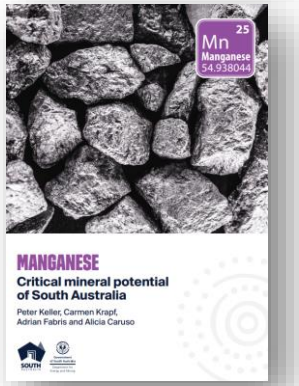

27
Co
Cobalt
58.933
COBALT
Critical mineral potential
of South Australia
Peter Keller, Alexander Corrick and
Alicia Caruso

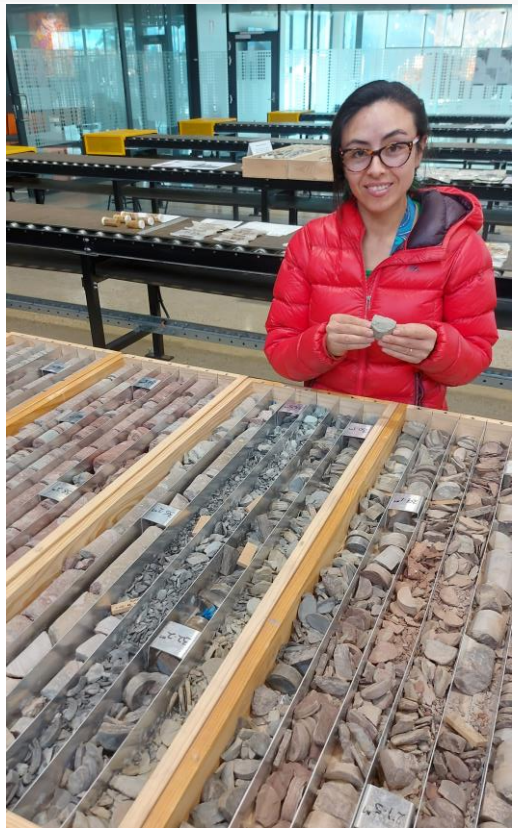

6
C
Graphite
12.01
GRAPHITE
Critical mineral potential
of South Australia
Alicia Caruso, Carmen Krapf
and Adrian Fabris

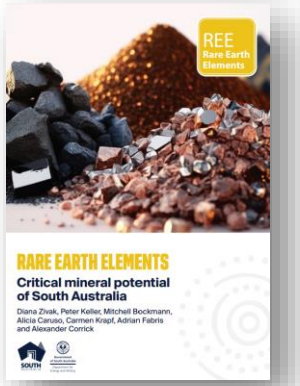

High
purity
alumina
Al_2O_3
HIGH PURITY ALUMINA
Critical mineral potential
of South Australia
Peter Keller, Alexander Corrick,
Mitchell Bockmann, Carmen Krapf and
Alicia Caruso

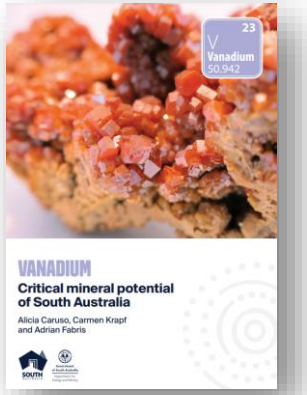

3
Li
Lithium
6.9410
LITHIUM
Critical mineral potential
of South Australia
Peter Keller, Alexander Corrick, Jarred Lloyd,
Adrian Fabris, Carmen Krapf and Alicia Caruso

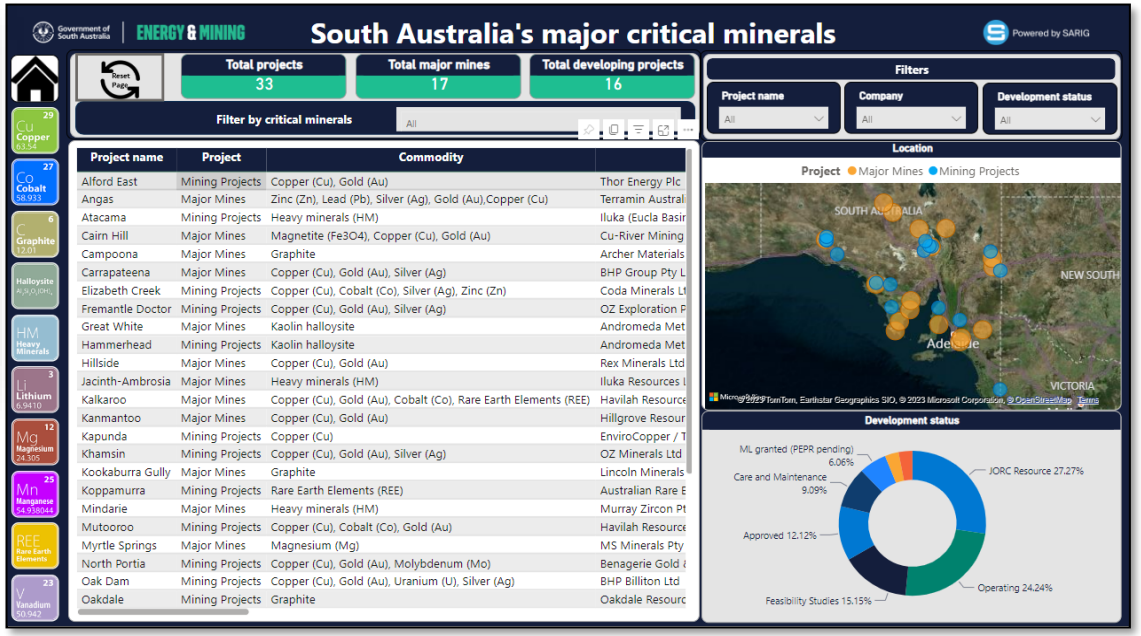

12
Mg
Magnesium
24.305
MAGNESIUM
Critical mineral potential
of South Australia
Peter Keller, Carmen Krapf and
Alicia Caruso


25
Mn
Manganese
54.938044
MANGANESE
Critical mineral potential
of South Australia
Peter Keller, Carmen Krapf,
Adrian Fabris and Alicia Caruso



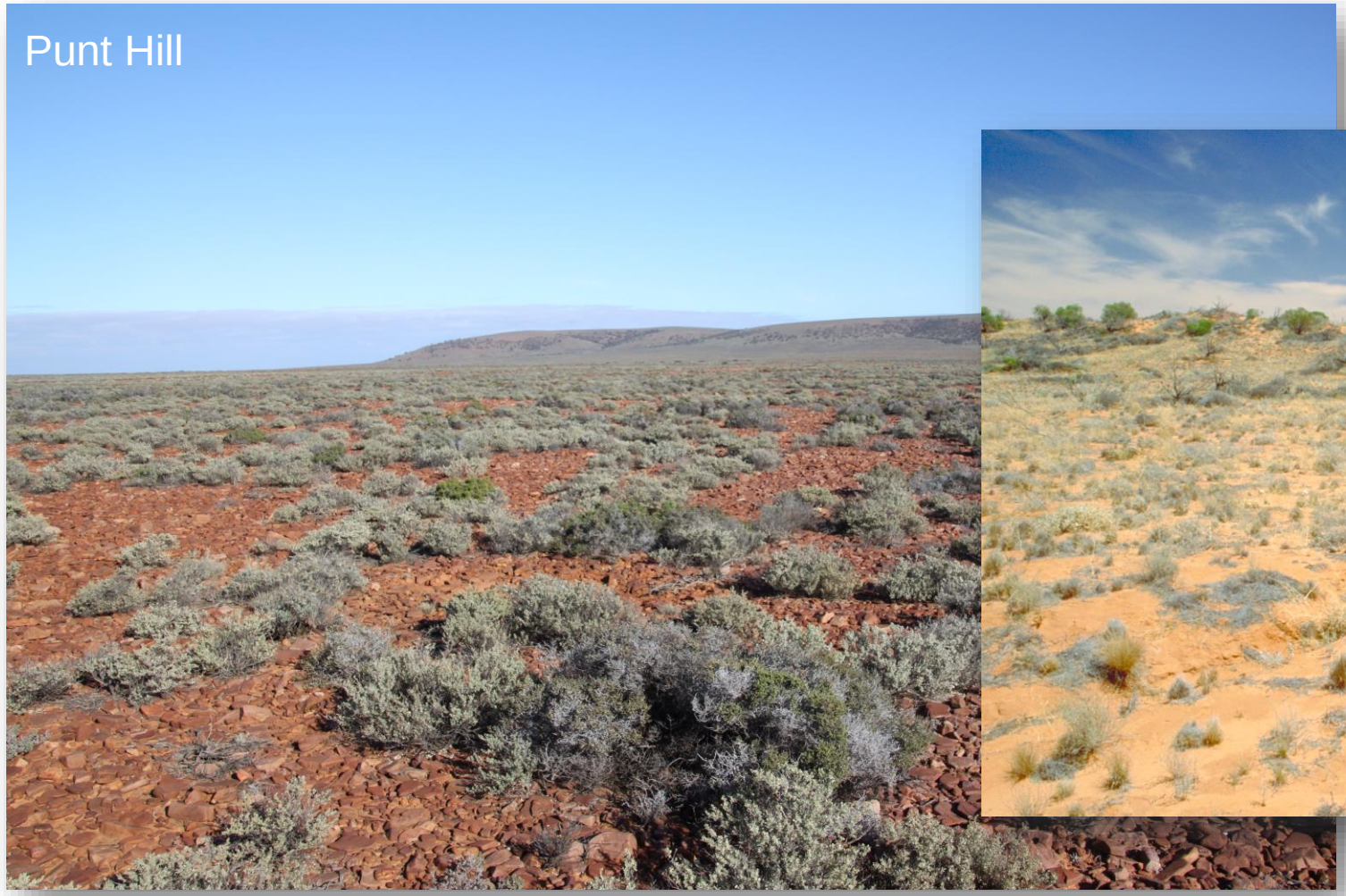

REE
Rare Earth
Elements
RARE EARTH ELEMENTS
Critical mineral potential
of South Australia
Diana Zivak, Peter Keller, Mitchell Bockmann,
Alicia Caruso, Carmen Krapf, Adrian Fabris
and Alexander Corrick


23
V
Vanadium
50.942
VANADIUM
Critical mineral potential
of South Australia
Alicia Caruso, Carmen Krapf
and Adrian Fabris


Government of South Australia
ENERGY & MINING
South Australia's major critical minerals
Powered by SARIG
Reset Page
Total projects
33
Total major mines
17
Total developing projects
16
Filter by critical minerals
Filters
Project name
Company
Development status
Project Name
Project
Commodity
Alford East Mining Projects Copper (Cu), Gold (Au) Thor Energy Plc
Angas Major Mines Zinc (Zn), Lead (Pb), Silver (Ag), Gold (Au),Copper (Cu) Terramin Australi
Atacama Mining Projects Heavy minerals (HM) Iluka (Eucla Basi
Cairn Hill Major Mines Magnetite (Fe3O4), Copper (Cu), Gold (Au) Cu-River Mining
Campoona Major Mines Graphite Archer Materials
Carrapateena Major Mines Copper (Cu), Gold (Au), Silver (Ag) BHP Group Pty L
Elizabeth Creek Mining Projects Copper (Cu), Cobalt (Co), Silver (Ag), Zinc (Zn) Coda Minerals L
Fremantle Doctor Mining Projects Copper (Cu), Gold (Au), Silver (Ag) OZ Exploration P
Great White Major Mines Kaolin halloysite Andromeda Met
Hammerhead Mining Projects Kaolin halloysite Andromeda Met
Hillside Major Mines Copper (Cu), Gold (Au) Rex Minerals Ltd
Jacinth-Ambrosia Major Mines Heavy minerals (HM) Iluka Resources
Kalkaroo Major Mines Copper (Cu), Gold (Au), Cobalt (Co), Rare Earth Elements (REE) Havilah Resource
Kanmantoo Major Mines Copper (Cu), Gold (Au) Hillgrove Resour
Kapunda Mining Projects Copper (Cu) EnviroCopper / T
Khamsin Mining Projects Copper (Cu), Gold (Au), Silver (Ag) OZ Minerals Ltd
Kookaburra Gully Major Mines Graphite Lincoln Minerals
Koppamurra Mining Projects Rare Earth Elements (REE) Australian Rare E
Mindarie Major Mines Heavy minerals (HM) Murray Zircon Pt
Mutooroo Mining Projects Copper (Cu), Cobalt (Co), Gold (Au) Havilah Resource
Myrtle Springs Major Mines Magnesium (Mg) MS Minerals Pty
North Portia Mining Projects Copper (Cu), Gold (Au), Molybdenum (Mo) Benagerie Gold
Oak Dam Mining Projects Copper (Cu), Gold (Au), Uranium (U), Silver (Ag) BHP Billiton Ltd
Oakdale Mining Projects Graphite Oakdale Resourc
Location
Project Major Mines Mining Projects
SOUTH AUSTRALIA
NEW SOUTH
Adelaide
VICTORIA
Development status
ML granted (PEPR pending) 6.06%
Care and Maintenance 9.09%
Approved 12.12%
Feasibility Studies 15.15%
JORC Resource 27.27%
Operating 24.24%


Government of South Australia
ENERGY & MINING
South Australia's mine waste ranking
Powered by SARIG
Reset Page
Feature
Deposit status
Discover year range
Major commodity
Geochemical associations
Name
Mineral deposit link
Mine waste ranking
Commodities
Major commodity
Geochemic
West Lagoon 47 Copper, Silver, Cobalt Cu Cu-Co-Ag-Bi-Au
Iron Magnet 43 Iron Fe N/A
Burra 42 Copper, Dolomite Cu Cu-(Co-Ni-Zn-A
Iron Duchess South 42 Iron Fe N/A
Port Pirie Ree 42 Rare Earths, Rutile REE N/A
Wheal Barton 41 Copper, Silver, Gold, Kaolin Cu Cu-Ag-Au-(Ni-C
Paratoo 41 Copper, Rare Earths Cu Cu-(Au-REE)
Mount Grainger 41 Gold Au Au-(Bi-Fe-Mn-C
Ranking contributions - top values
West Lagoon - 3137
Sahara - 11817
Iron Magnet - 8279
Burra - 3807
Iron Duchess South - 71...
Port Pirie Ree - 8908
Iron Chieftain - 7197
0
10
20
30
40
Associated Commod Ra...
Discovery Year Ranking
Feature Ranking
Known Commod Ranki...
Mine Status Ranking
Other Ranking ...
Location
Deposit
N/A
Prospect
Treatment Site
AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH
Great Australian Bight
VICTORIA
Melbourne

South Australia—exploration challenge 80% of basement is undercover

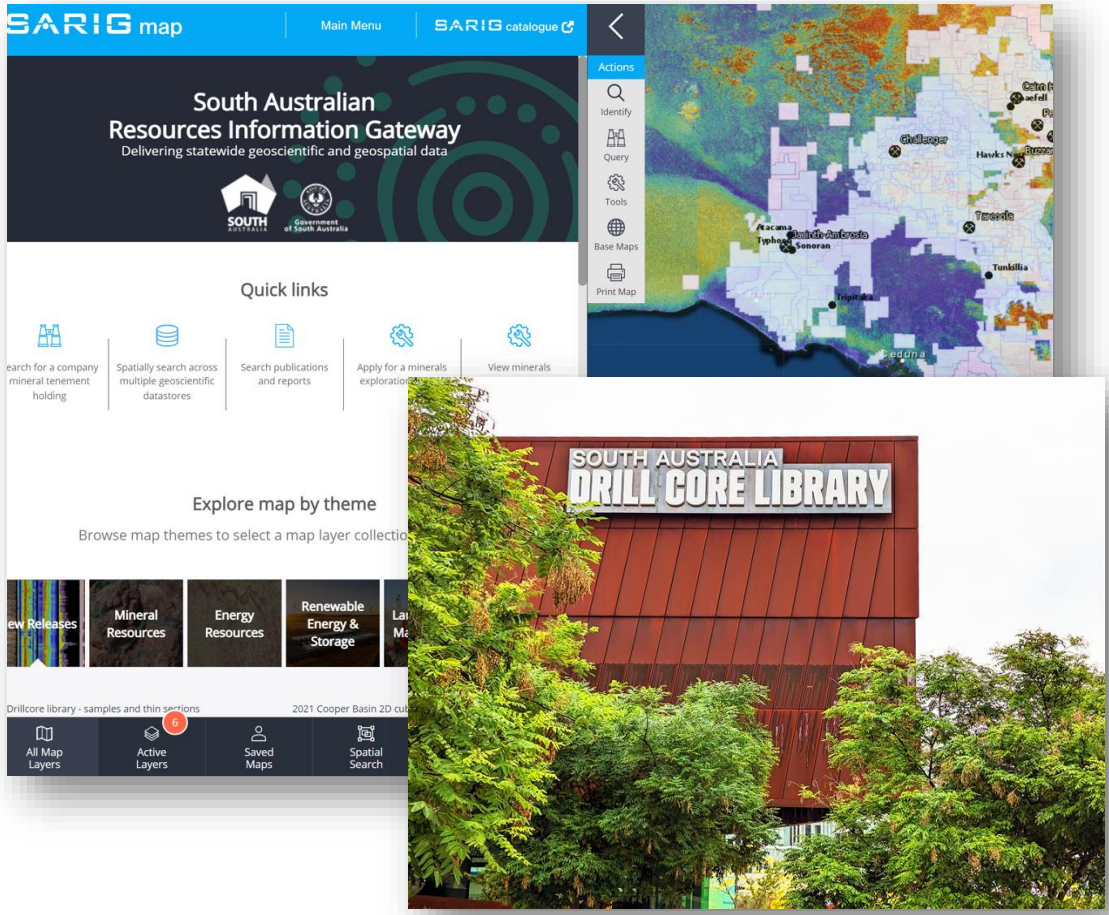


Does precompetitive data make a difference?

Impact of Pre-competitive Geoscience Information for South Australia, 2024 ACIL Allen

Industry stakeholders indicated that access to SARIG (South Australia Resources Information Gateway) and Core Library data were essential to attracting their interest and enabled the State to compete in securing a fair share of highly sought after mobile exploration budgets.

- Public data replacement value more than $7.5 billion.
- By 2050 potential to increase economic output by between $31.2 billion to $33.4 billion and increase employment by around 79,000 jobs.
- Every dollar invested precompetitive data geoscience delivers at least $6.30 back to the economy and as much as $13 return for every dollar invested.
- Provided significant returns, playing a key role in major discoveries including Olympic Dam, Carrapeteena resource and contributing to the recent discovery of Oak Dam by BHP.



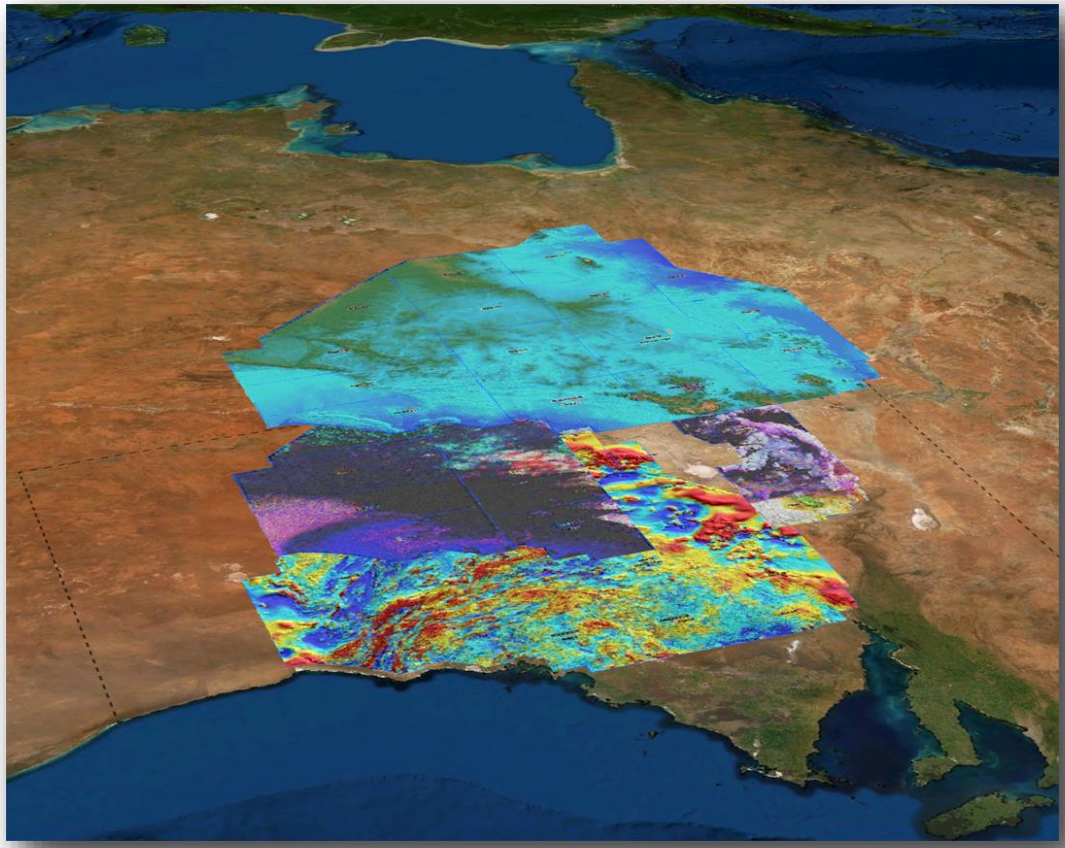
How the GSSA has developed innovated projects and programs delivering new high-quality data and geoscience information …

since1882

Gawler Craton Airborne Survey (GCAS) & Explore SA Challenge

- The **GCAS** survey was the largest ever high-resolution aeromagnetic survey ever in Australia covering over 300,000 km^2 of the Gawler Craton.
- A A$20M investment that has pathed the way for exploration and new GSSA projects.
- The **Explore SA challenge** was a Global data challenge held in 2020 in collaboration with Unearthed to identify and predict area of potential mineralisation within the Gawler Craton in South Australia…
- The competition attracted over 2,200 participants from 90 countries, and we ended up with 59 quality submissions from 23 countries.

What did we learn?



GCAS - magnetics, radiometric and elevation data

GP2 (Gawler Phase 2)

5527 new gravity observations
→ Four-fold increase in resolution in many areas

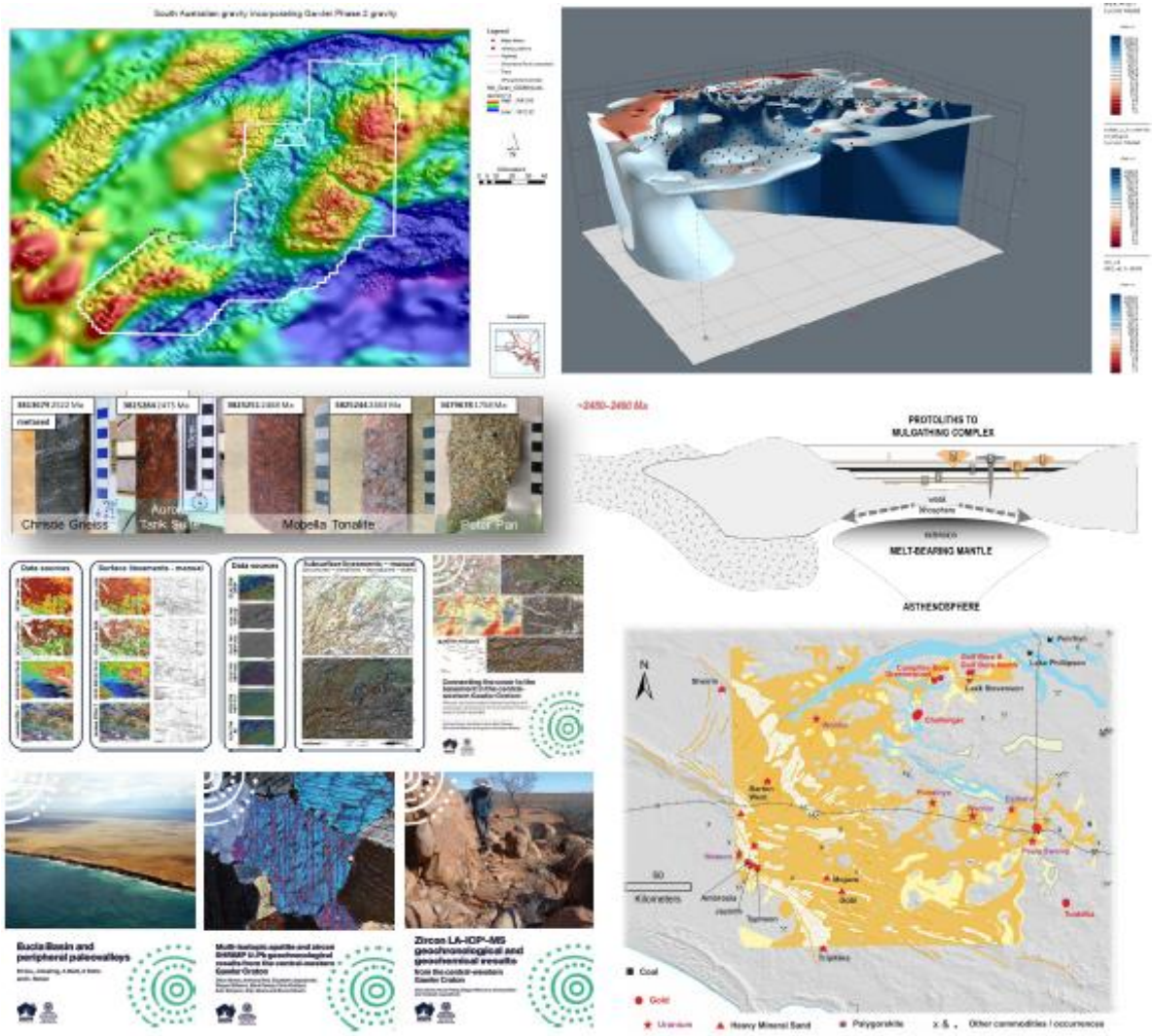
307 new site observations
→ 3D models of the crust

over 300 new samples
→ to constrain basement geology mapping and inform on geological evolution

thousands of new surface and subsurface lineaments mapped
→ to connect basement to cover

two new palaeochannel layers
→ new search space for mineralisation and groundwater

> thousands new legacy data



Exploration driven by GSSA pre-competitive data

Petratherm Limited

Exceptional High-Grade Titanium Rich Heavy Mineral Sands Discovered Over Large Area At Muckanippie

Key points

Mapping, surface sampling, and re-assaying of historic drilling has discovered high-grade Titanium rich heavy mineral sands (HMS) over several kilometres at the Muckanippie Project.

Following the recognition of mineralisation from mapping and surface sampling, legacy drill core acquired as part of a 1991 government funded drilling program was accessed from the SA Drill Core Reference Library. The palaeochannel is interpreted to be up to ~5km in width over MEU tenements, as defined by the GSSA GP2 project.

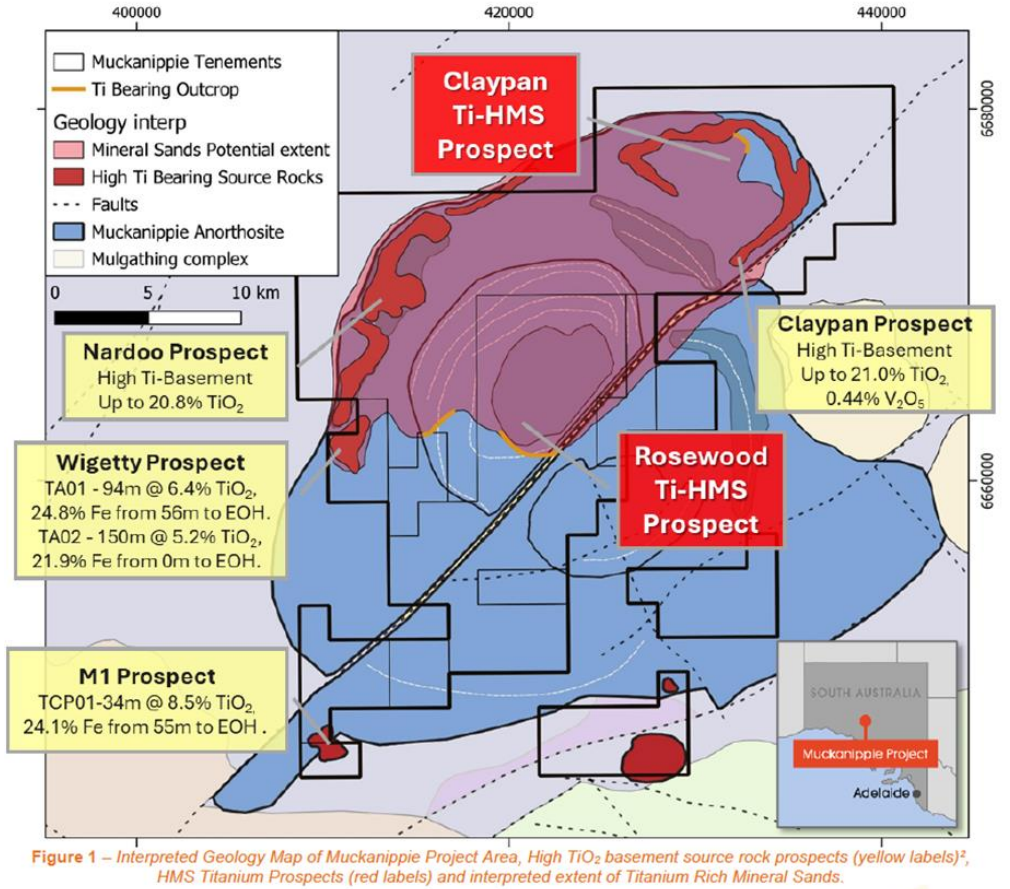


Figure 1 – *Interpreted Geology Map of Muckanippie Project Area, High TiO_2 basement source rock prospects (yellow labels)², HMS Titanium Prospects (red labels) and interpreted extent of Titanium Rich Mineral Sands.*

Petratherm AXS Announcement September 2024

https://api.investi.com.au/api/announcements/ptr/d2dd4269-5ac.pdf

PTR Critical Mineral Explorers

Exploration driven by GSSA pre-competitive data

Marmota Limited

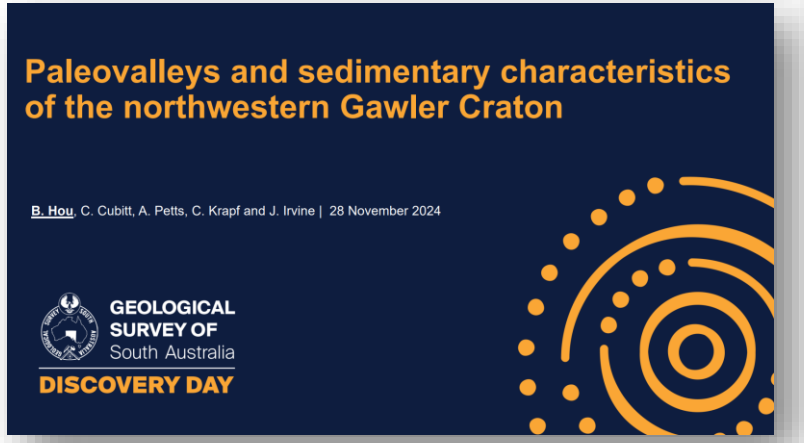
Palaeochannel hosted Titanium Model

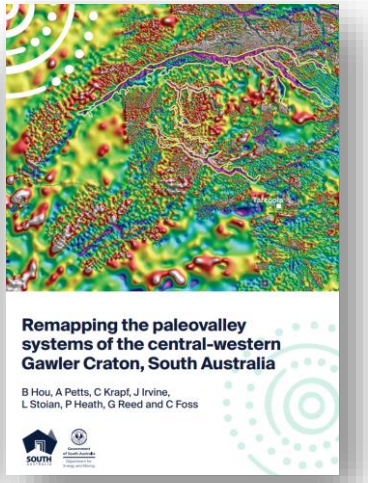
Key points

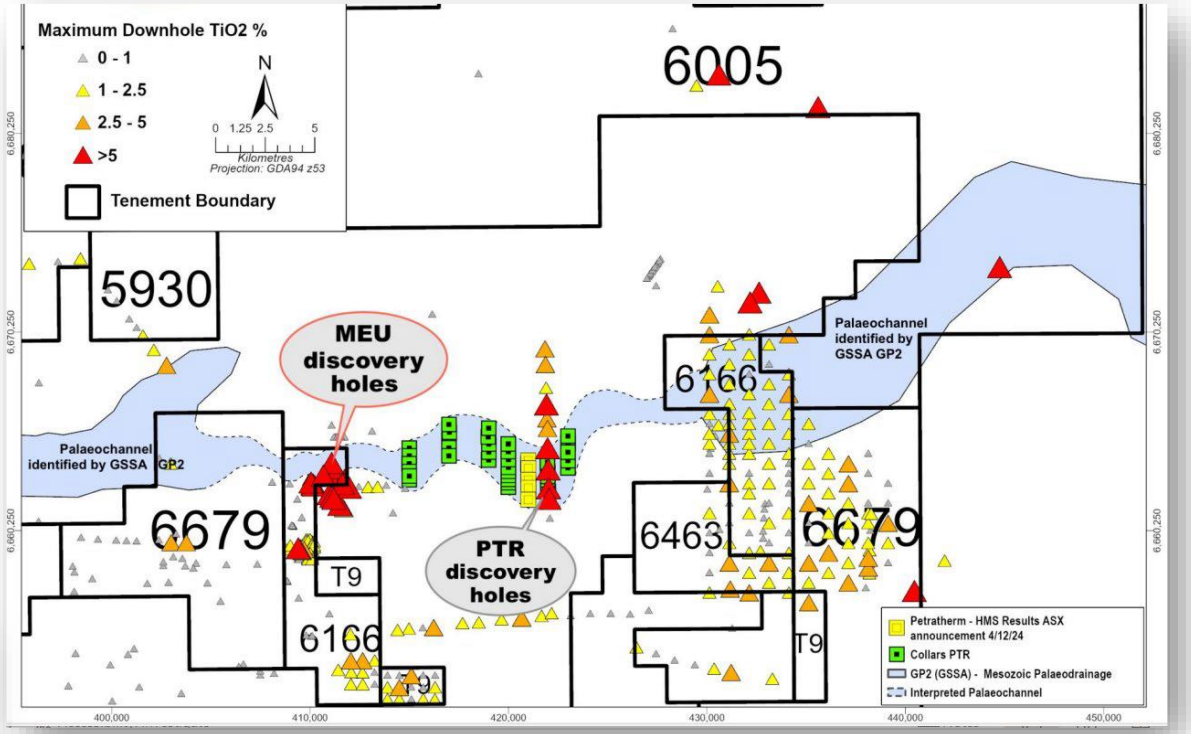
The new interpretation of the Mesozoic palaeochannel has been aided by work published as recently as November 2024 by the Geological Survey of South Australia ('GSSA') GP2 project, state geophysical imagery, topographical features and open-source data.

The Marmota tenements hosting the palaeochannel identified by the Geological Survey of South Australia GP2 project bookends both sides of Petratherm's (PTR) recent titanium discovery [ASX:PTR 11 Sept 2024] and Marmota's titanium discovery[ASX:MEU13 Nov 2024], both at Muckanippie.

The palaeochannel is interpreted to be up to ~5km in width over MEU tenements, as defined by the GSSA GP2 project.







Marmota AXS Announcement January 2025

https://www.listcorp.com/asx/meu/marmota-limited/news/new-palaeochannel-identified-as-host-to-titanium-discoveries-3137934.html

MARMOTA

GSSA continues to drive drilling Initiatives

- Open up new covered frontiers
- New wave of drilling and sensing technologies
- New predictive power
- New knowledge, ideas, toolkits and exploration workflows for exploring through cover

DIG CT on site for the Northern Gawler NDI, photo courtesy OMNI GeoEx

Future projects and programs delivering innovated high-quality data and geoscience information …

since1882

South Australia DISCOVERY MAPPING (SADM)

To improve understanding of South Australia's geology and advance the delivery of geological information, the Geological Survey of South Australia is undertaking the SADM project.

This is generation more detailed, seamless, and intensely attributed geological mapping and information, that will be a significant improvement on previous state-scale datasets.

Government of South Australia
Department for Energy and Mining

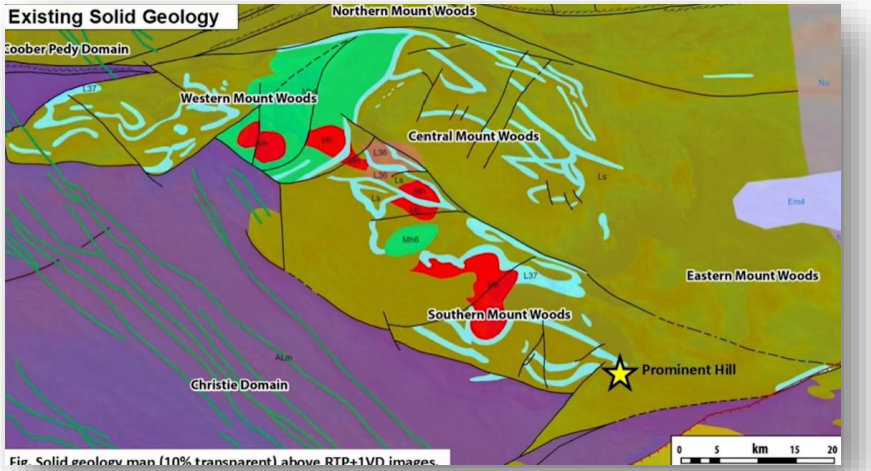


Fig. Solid geology map (10% transparent) above RTP+1VD images

New Geology

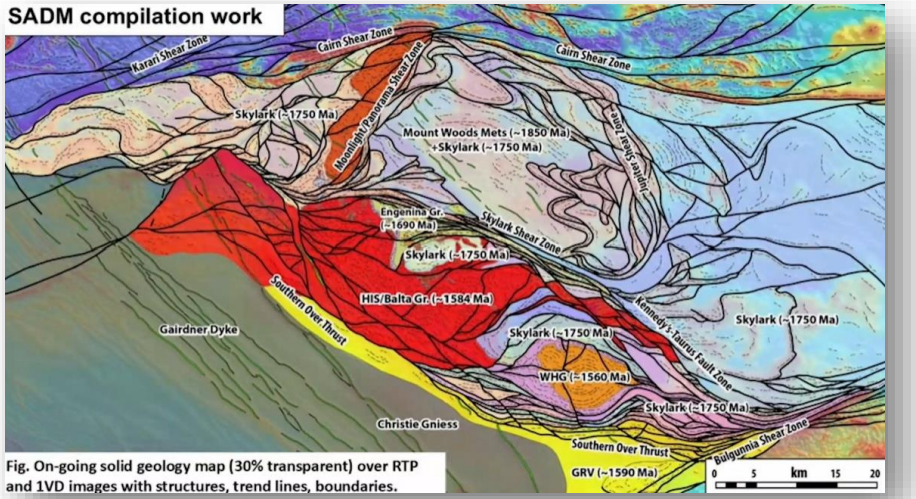
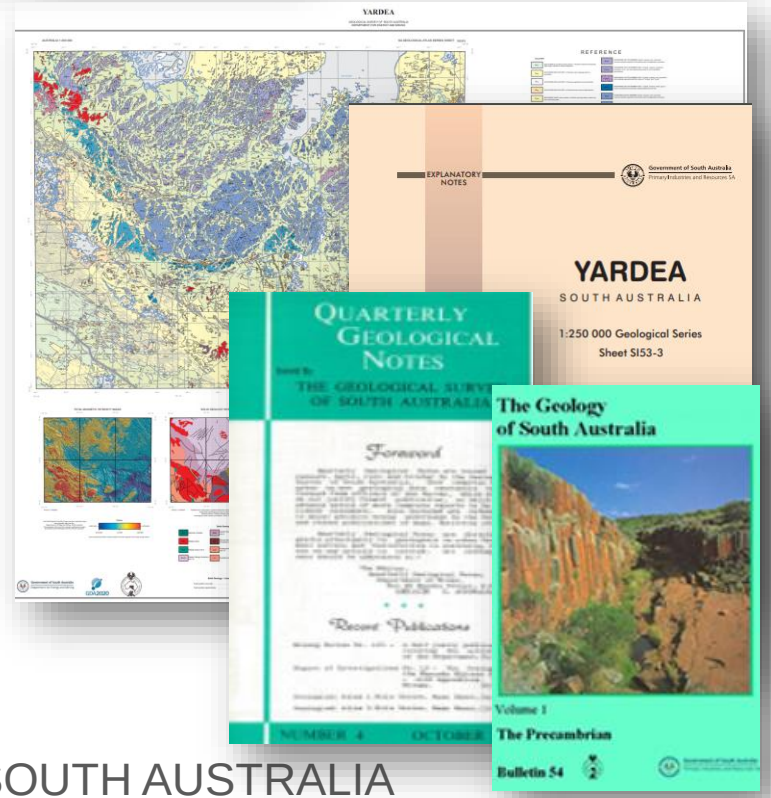
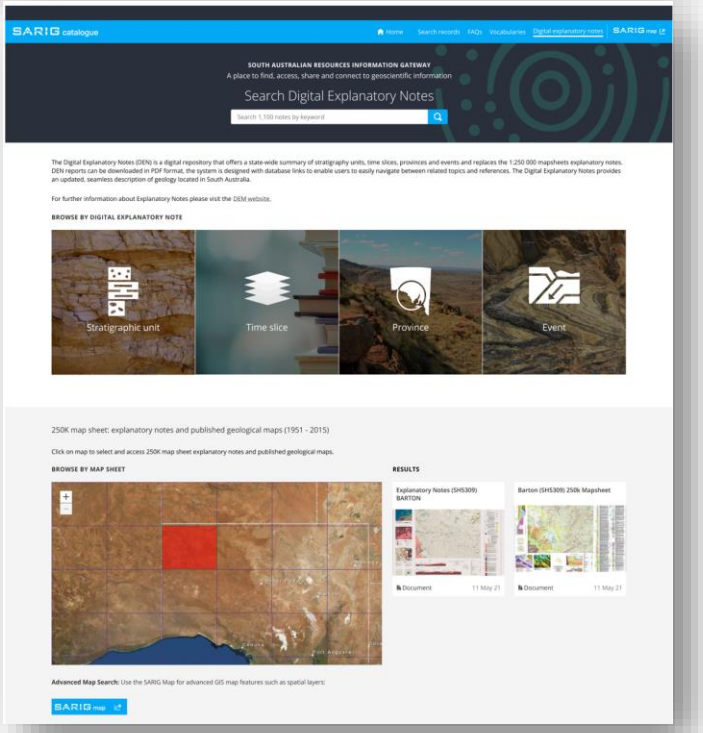


Fig. On-going solid geology map (30% transparent) over RTP and 1VD images with structures, trend lines, boundaries.

- Focus on Gawler Craton Province, creating digital maps and explanatory notes. Quick release of new information.
- 14 Time slices, seamless across 250K mapsheets.
  56 new geology layers (geological unit, faults and attribution).
- Data rich attribution and standard vocabulary.
  Harmonise with other GSSA data sources.
- GeoSciML – complex geoscience web service, international standard compatible with AI/ML programs.



Digital Explanatory Notes



SARIG CI will leverage the geoscience wealth of South Australia's Drill Core Library's past, present and future, to enable modern data-driven exploration and resource discovery.

It will expand South Australia's global geoscience information leadership by 'exploring' and transforming the physical resources into a digital intelligence library.

This will allow its drill core and associated data sets to be accessible anytime and from anywhere in the world.

SARIG Core Intelligence

SARIG Core RFI is open

Government of South Australia
Department for Energy and Mining

AUSTRALIA MINERALS
REALISE THE OPPORTUNITY

Thank you

Christie Gerrard
Manager, Geoscience Information and Delivery
Geological Survey of South Australia, Department for Energy and Mining

SOUTH AUSTRALIA

Government of South Australia
Department for Energy and Mining

AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

Unlocking Western Australia's mineral potential

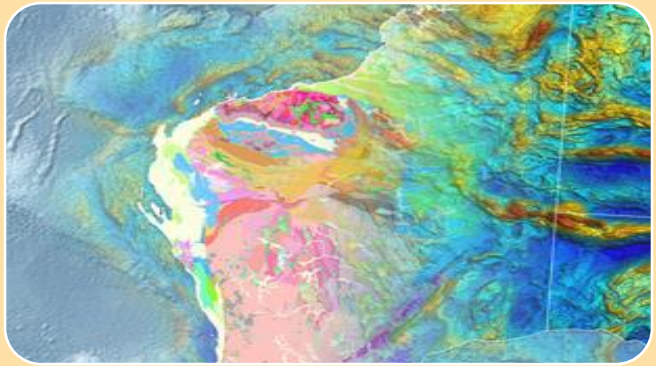
Geological Survey of Western Australia's pre-competitive geoscience

Richard Chopping
Strategic Science Advisor
Geological Survey of Western Australia

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Energy, Mines, Industry Regulation and Safety**
Geological Survey of Western Australia

WA Government: Resource and Environmental Regulation Group



Geological Survey of Western Australia

✓ Collection and interpretation of precompetitive geoscience data

✓ Promoting investment

✓ Education & outreach

✓ Manage the Abandoned Mines Program

Resource Tenure

✓ Manage mineral titles

✓ Provides guidance on policy, codes of practice, royalties

✓ Wardens Court

Resource and Environmental compliance

✓ Compliance monitoring and enforcement – *Mining Act 1978*

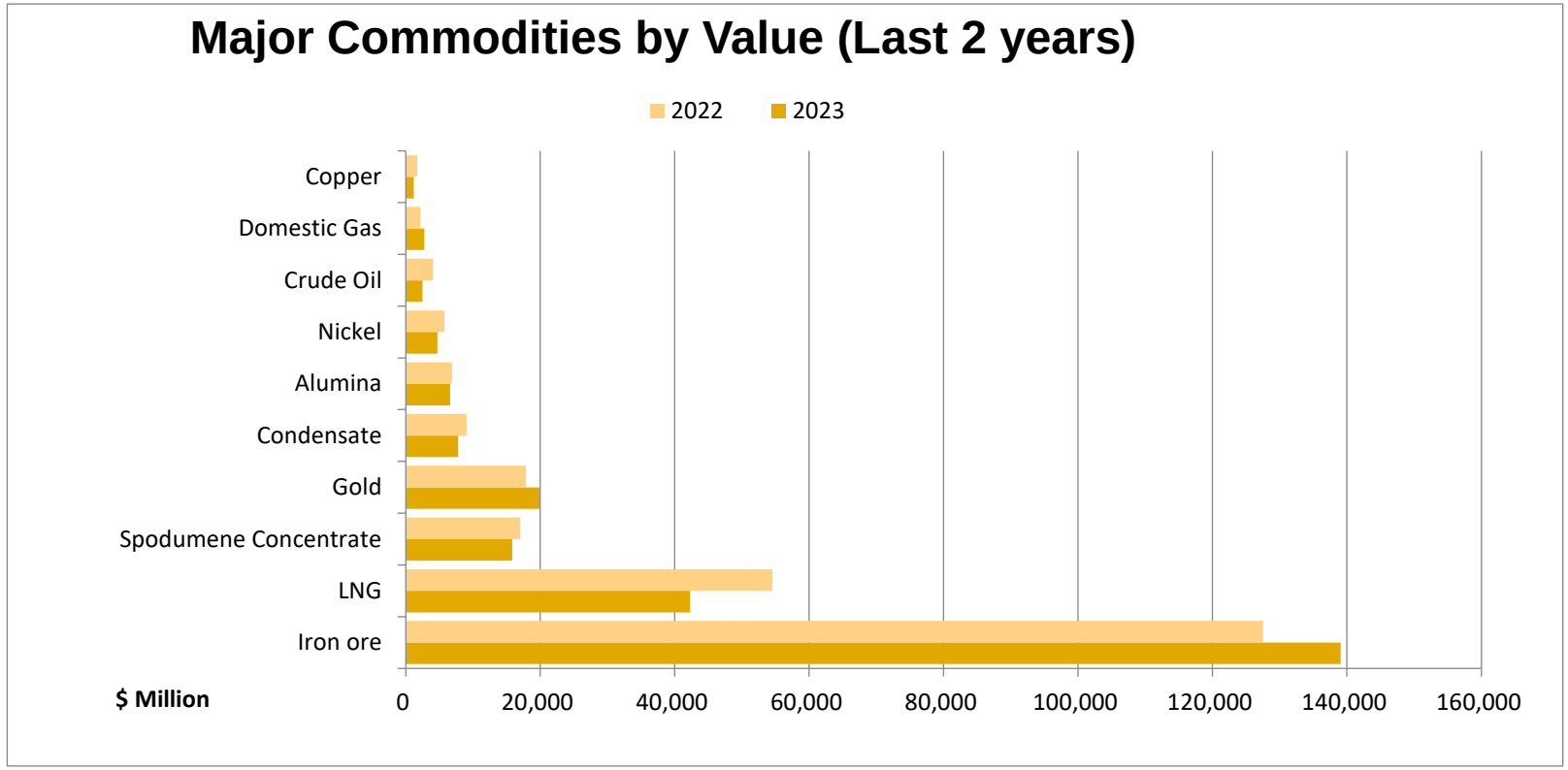
✓ Lifecycle compliance: exploration, mining, decommissioning

✓ Rehabilitation and closure outcomes

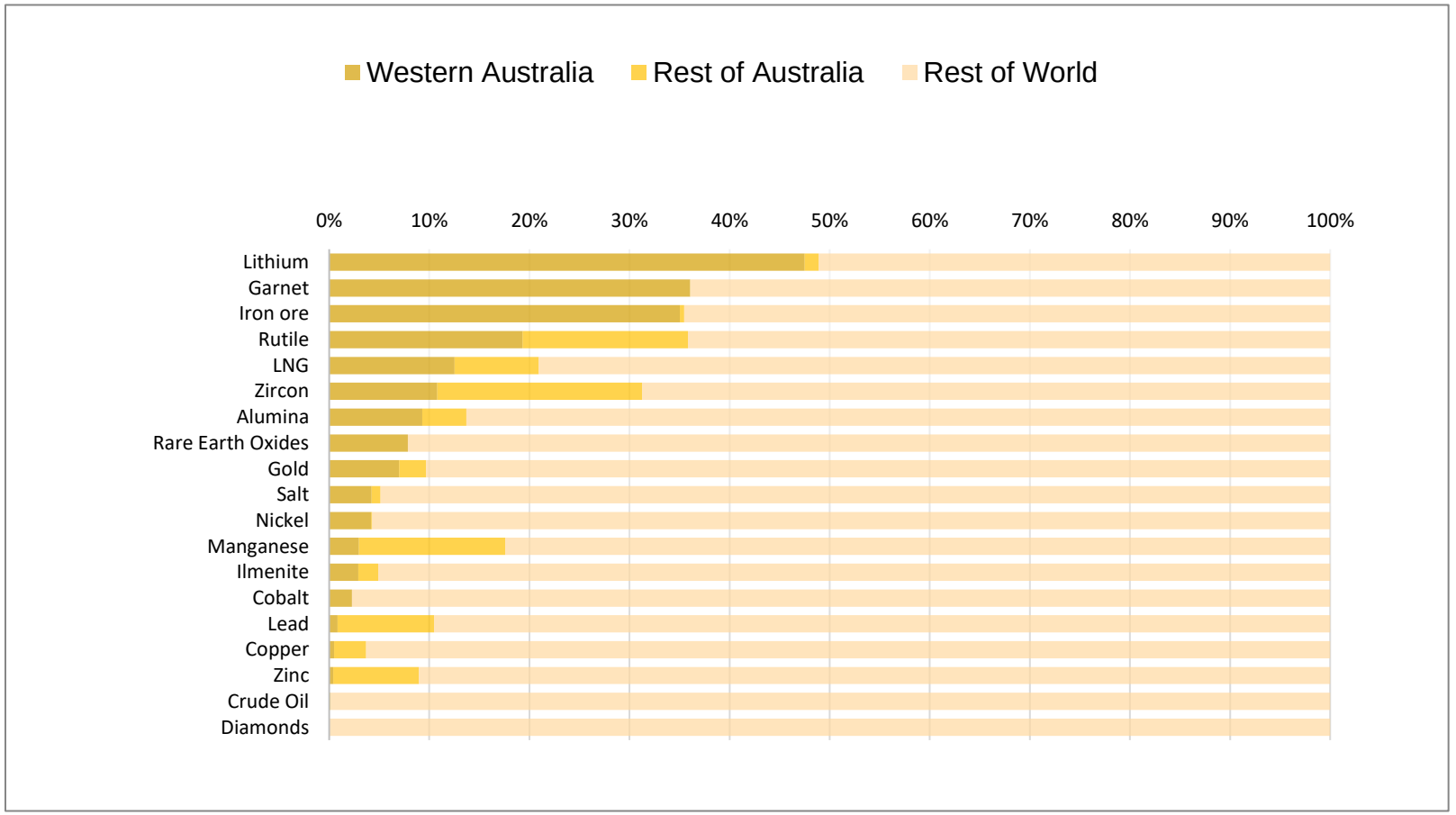
Western Australia's mineral production

2023 highlights

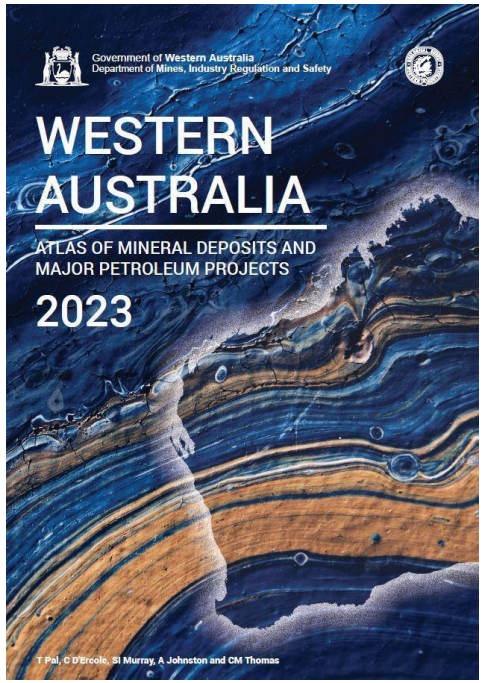
- ✓A$192B in sales
- ✓Iron ore: 860M Mt
  2nd highest year
- ✓Spodumene con: 3.3M Mt
  Record year
- ✓Gold: 6.8M oz

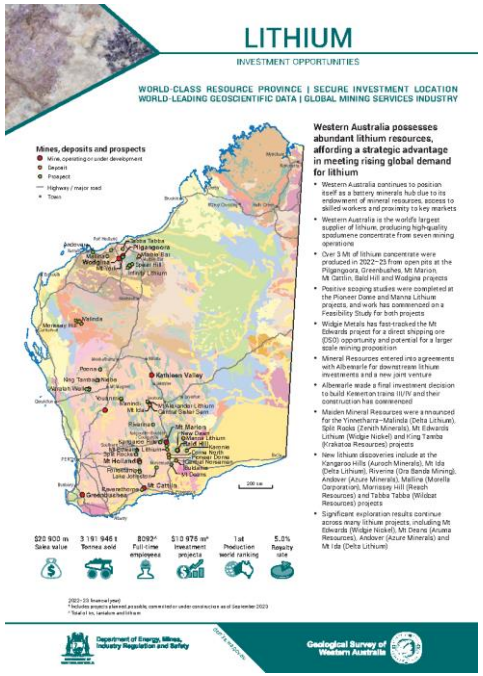


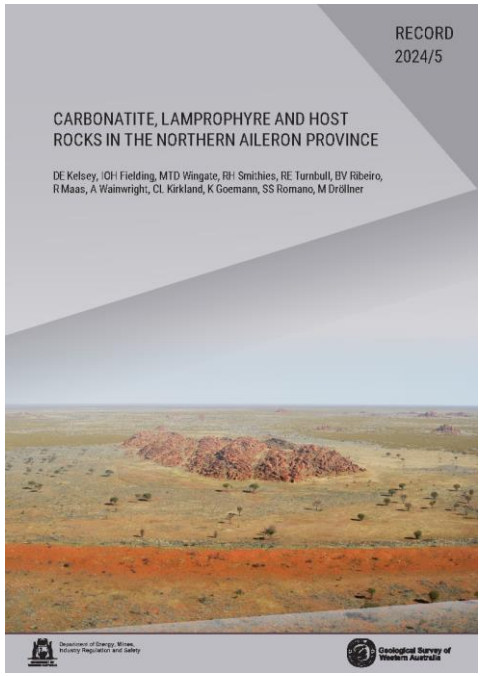
Global production share 2023



Trusted geoscience knowledge products





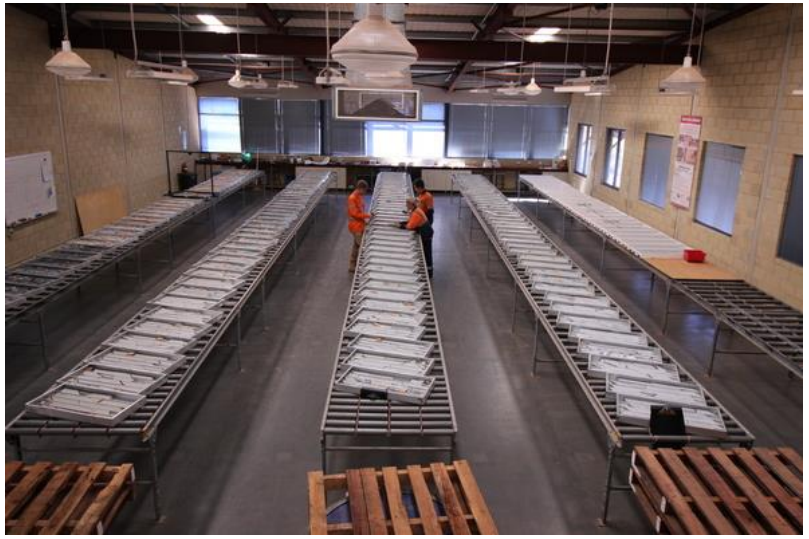


Core libraries

Drillcore acquired during exploration is important to develop geological understanding

DEMIRS has two core libraries
Core can be viewed and sampled by arrangement

Available core via GeoVIEW.WA (demirs.wa.gov.au/geoview)



Exploration Incentive Scheme

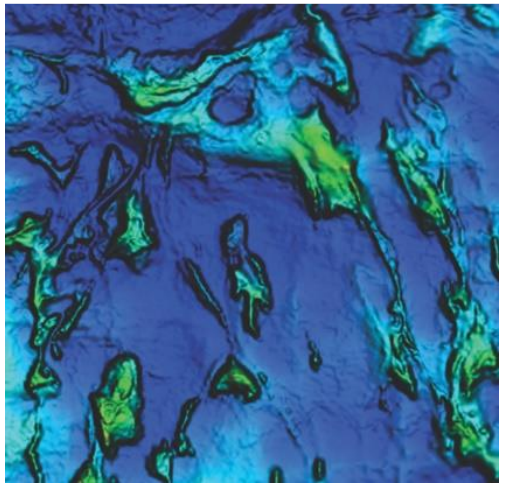
2009 to present

- Stimulate greenfield exploration
- Increase knowledge
- New discoveries

Co-funding scheme
50 per cent refund
(capped values)
3 programs
Competitive process

Exploration drilling

Geophysics



Energy Analysis

AusAEM – WA

Completed 2023 with Geoscience Australia

Data used to identify targets:

Buxton Resources

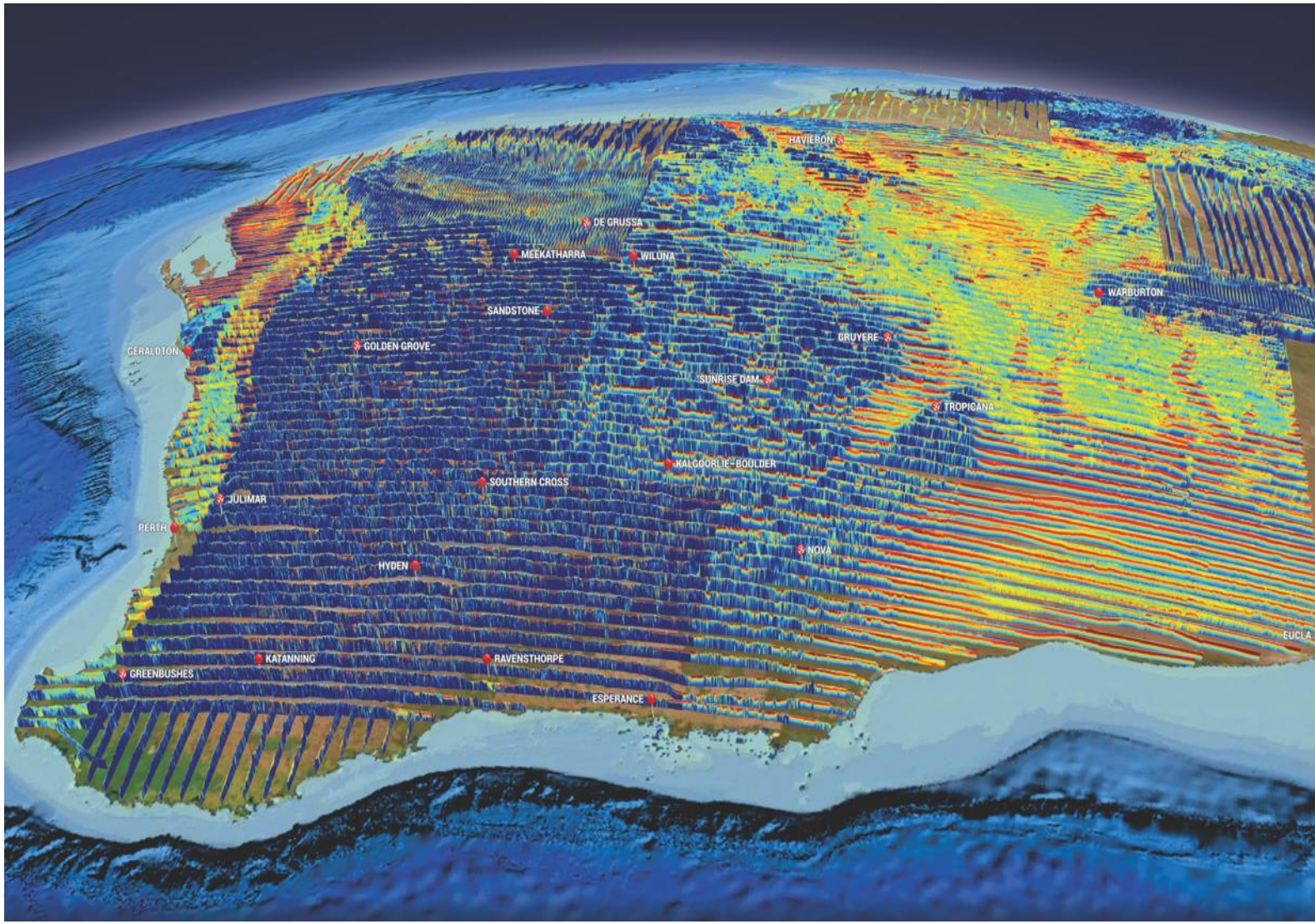
Ni, Cu, PGE (Narryer)

Mamba Exploration

Cu (Copper Flats project)

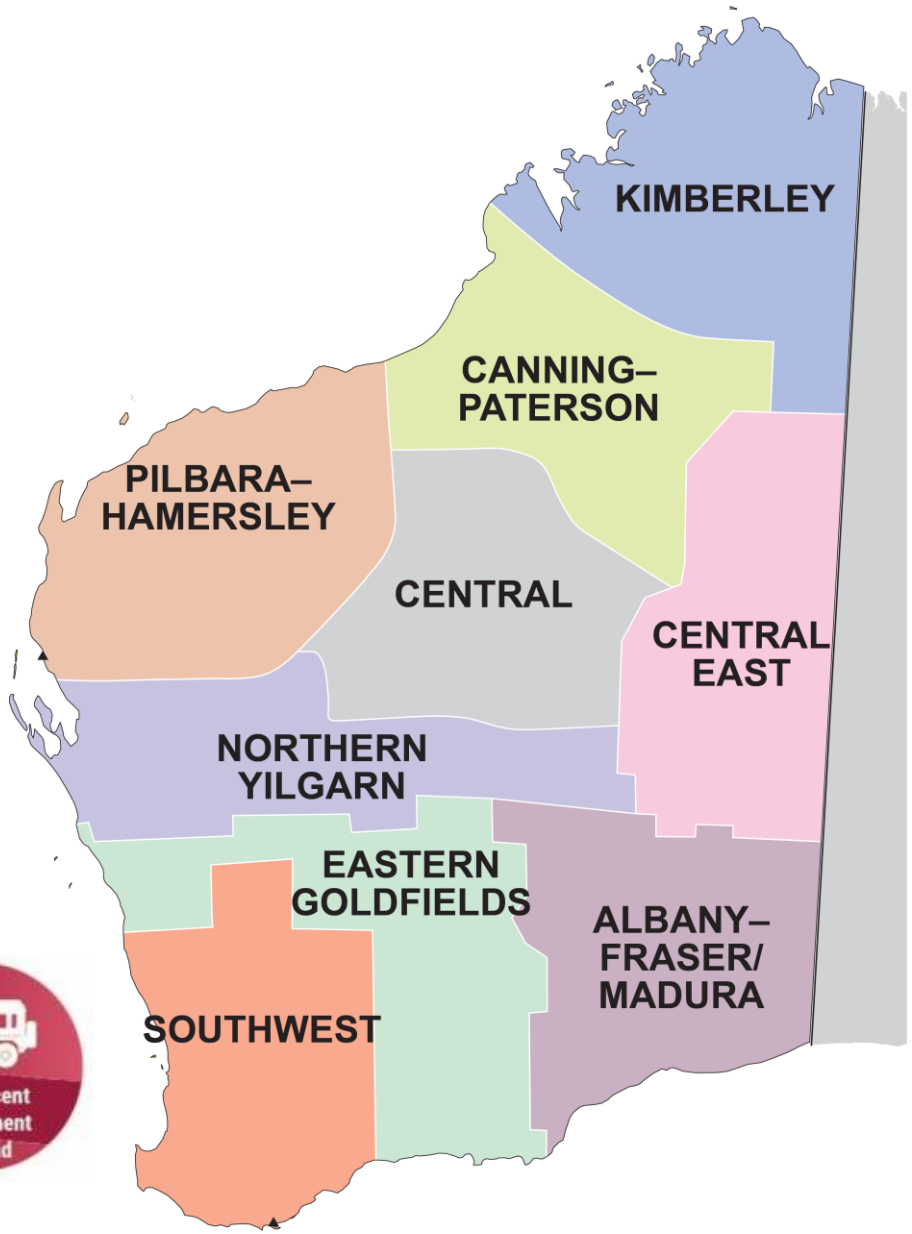
Torque Metals

Ni (Paris nickel project)



WA Array

- Largest passive seismic project in the world
- 10-year project 2022–2032
- 40 km spacing
- 1,500 locations across the State
- A$40 million funding
- Highly collaborative project



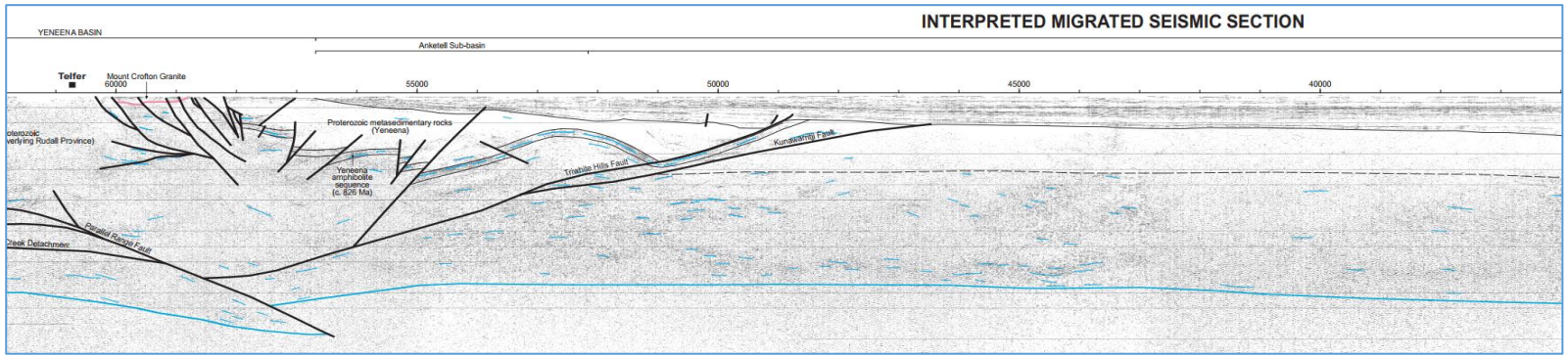
Deep crustal seismic reflection survey

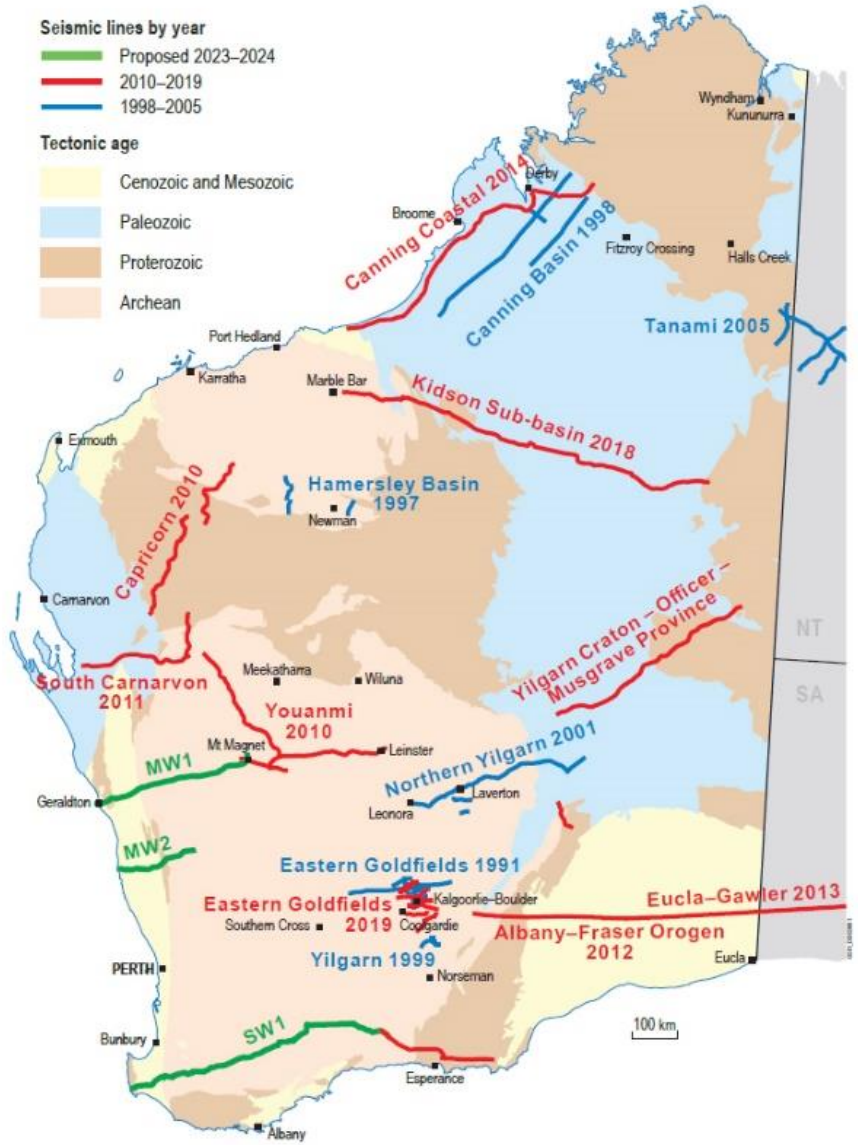
Current: 3 active 2D deep seismic lines ~1,100 km

Historic: 7,000 km of deep crustal seismic surveys

Up to 60 km in depth can be explored

Potential to map deep geological features, groundwater, geothermal, and mineral exploration targets.





Online systems

GeoVIEW.WA	An interactive (GIS-based) mapping system.
Mineral Titles Online	Details of mineral exploration and mining tenements.
Mineral exploration reports (WAMEX)	Open file mineral exploration reports and data (older than 5 years).
Mines and mineral deposits (MINEDEX)	Database of mines, mineral deposits, projects, project owners and more.
Western Australian Petroleum and Geothermal Information Management System (WAPIMS)	Public information generated from energy resource exploration and production; CO_2 Storage Atlas of Western Australia.
TENGRAPH Web	Search for mining tenements and petroleum titles.
MAGIX	A register and repository of geophysical survey datasets.
Data and Software Centre (DASC)	Spatial datasets relating to geology, mining and petroleum titles, geochemistry, and other geoscience information, spatial applications and training material.
DEMIRS eBookshop	Repository of GSWA maps, publications, datasets, and other sources of trusted geoscience information.

How to engage with us

Annual and biennial conferences in Perth and Kalgoorlie.

Technical workshops and discussion hubs.

Webinars and educational videos.

Social media: LinkedIn, Facebook, Instagram.

demirs.wa.gov.au/gswa

Western Australia’s advantages

We are a resource-rich state. Our success is because we:

Provide world-class pre-competitive geoscience data.

Manage a robust regulatory and tenure system.

Maintain low sovereign risk.

Retain a highly skilled workforce.

demirs.wa.gov.au/gswa

AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

Thank you

Richard Chopping
Strategic Science Advisor
Geological Survey of Western Australia

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Energy, Mines, Industry Regulation and Safety**
Geological Survey of Western Australia

AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

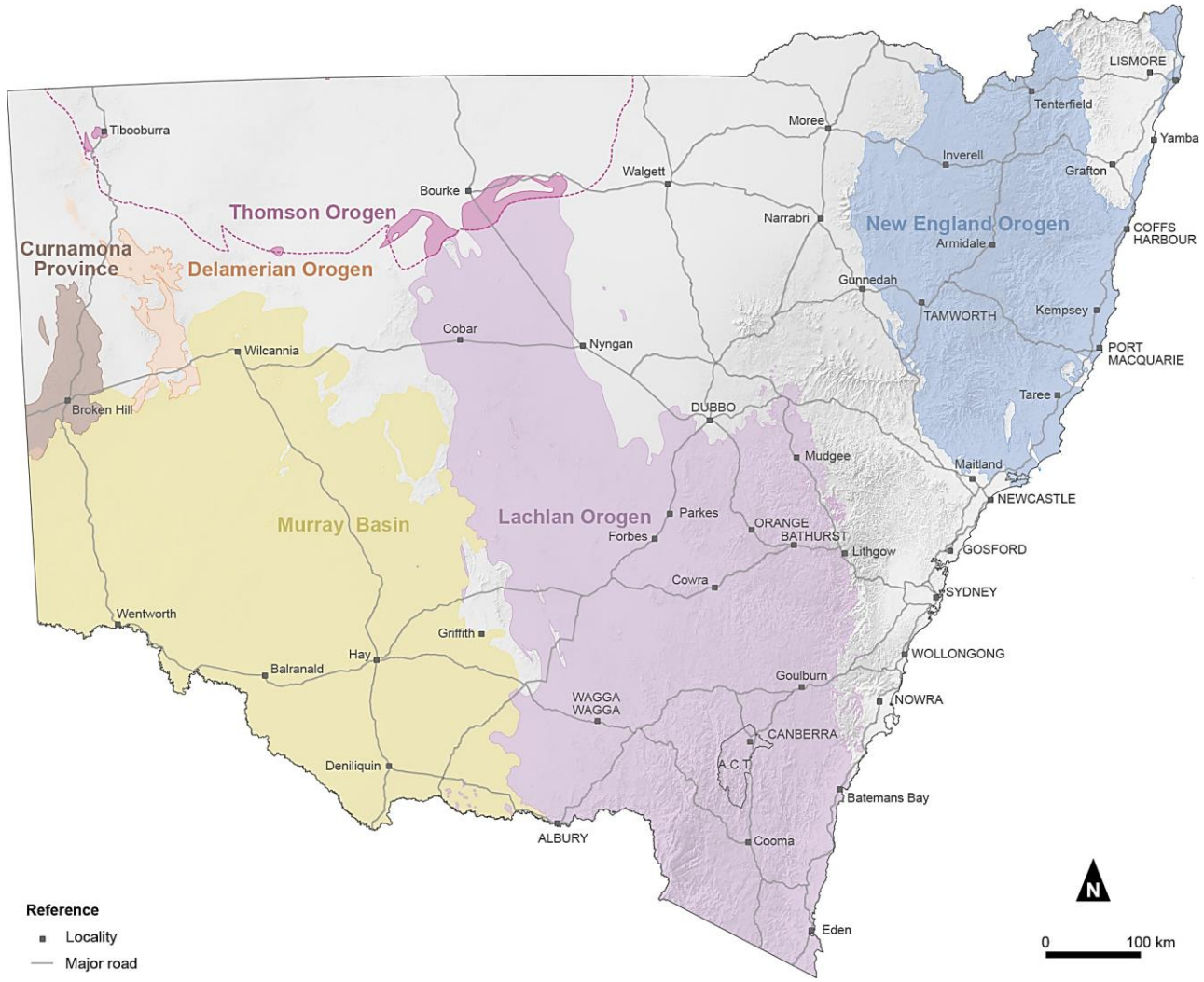
New geoscience to drive exploration success in New South Wales

Dr Phillip Blevin
Chief Geoscientist & Head
Geological Survey of New South Wales

NSW GOVERNMENT

NSW critical minerals

21 of the 31 critical minerals on the Australian Government's critical minerals list



Broken Hill	Murray Basin	Lachlan Orogen	New England
Chromium Cobalt PGE Tungsten Vanadium	REE Titanium Zirconium	Bismuth Chromium Cobalt Hafnium High-purity alumina Indium Lithium Magnesium Molybdenum Nickel Niobium PGE REE Scandium Silicon Tantalum Tungsten Vanadium Zirconium	Antimony Chromium Cobalt High-purity alumina Indium PGE Scandium Tungsten

Known/potential NSW occurrence

Priority metals

REE Rare earth elements

Sc 21 Scandium

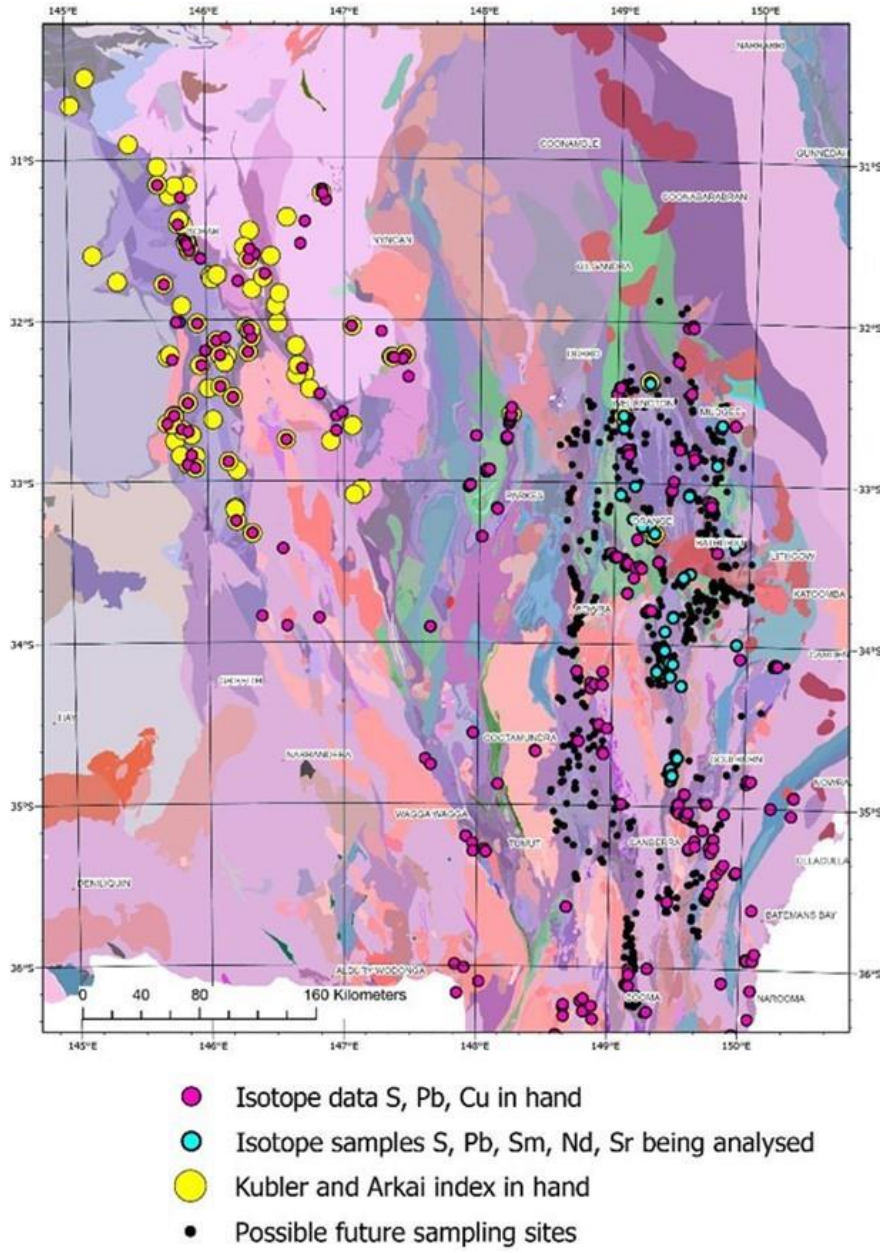
Cu 29 Copper

Ag 47 Silver

Co 27 Cobalt

Major Mineral Projects

- Understanding metallogenesis through heat and isotope mapping of NSW
- Copper: Scientific Drilling in Cobar Basin
- Silver: Re-characterising the Rylstone Volcanics – NCRIS/CSIRO part funded study.
- REE and HFSE critical metal resources related to alkaline igneous rocks in NSW



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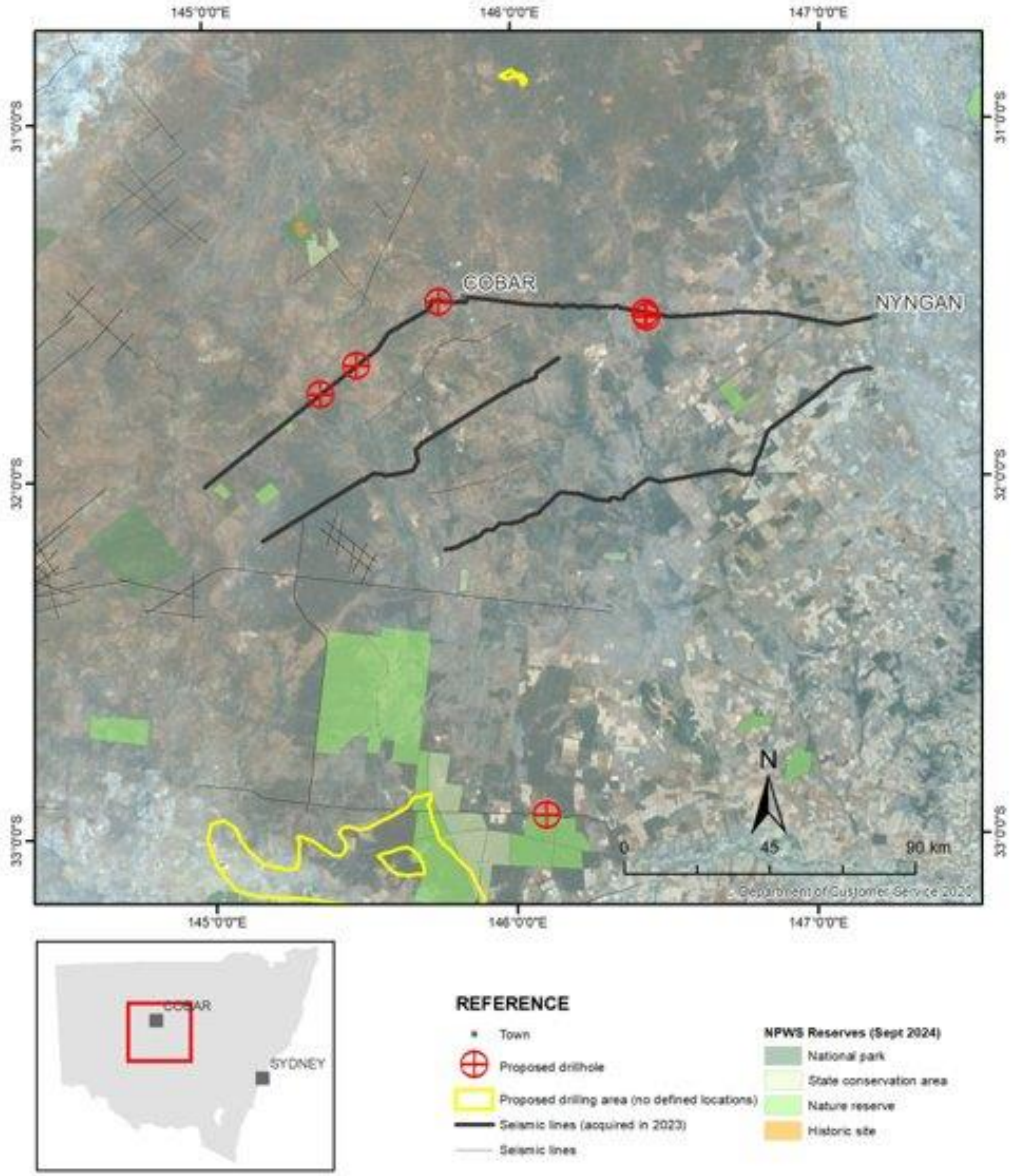

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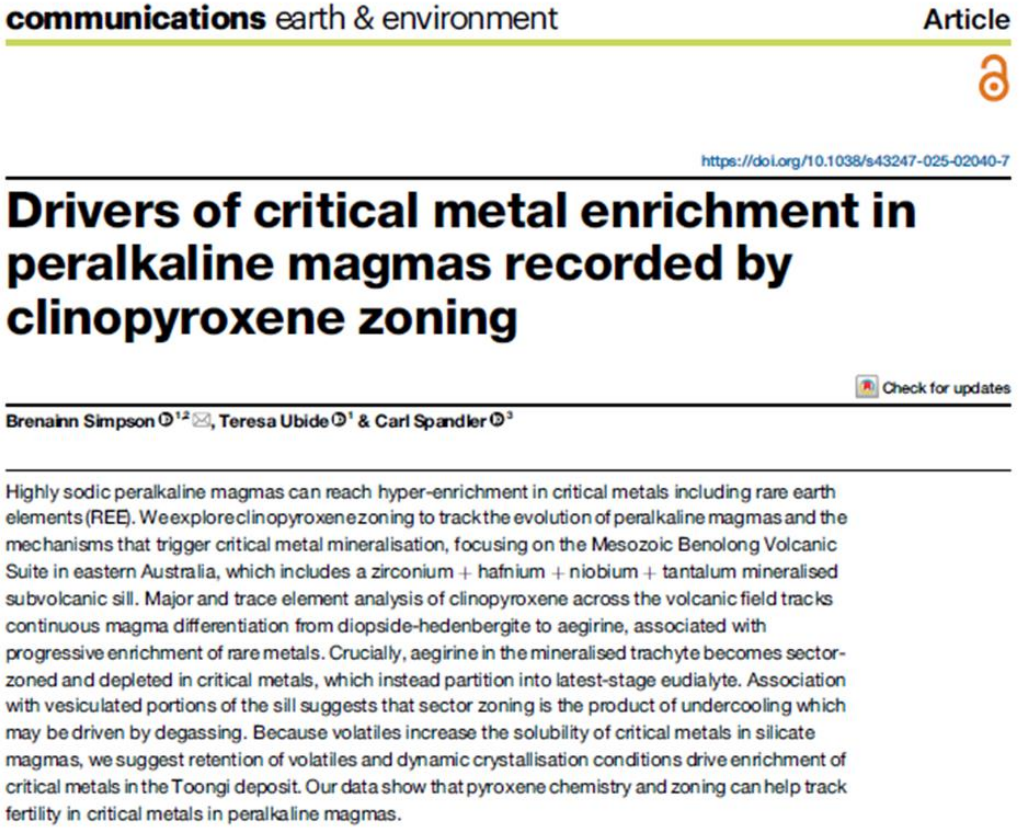


communications earth & environment Article

https://doi.org/10.1038/s43247-025-02040-7

Drivers of critical metal enrichment in peralkaline magmas recorded by clinopyroxene zoning

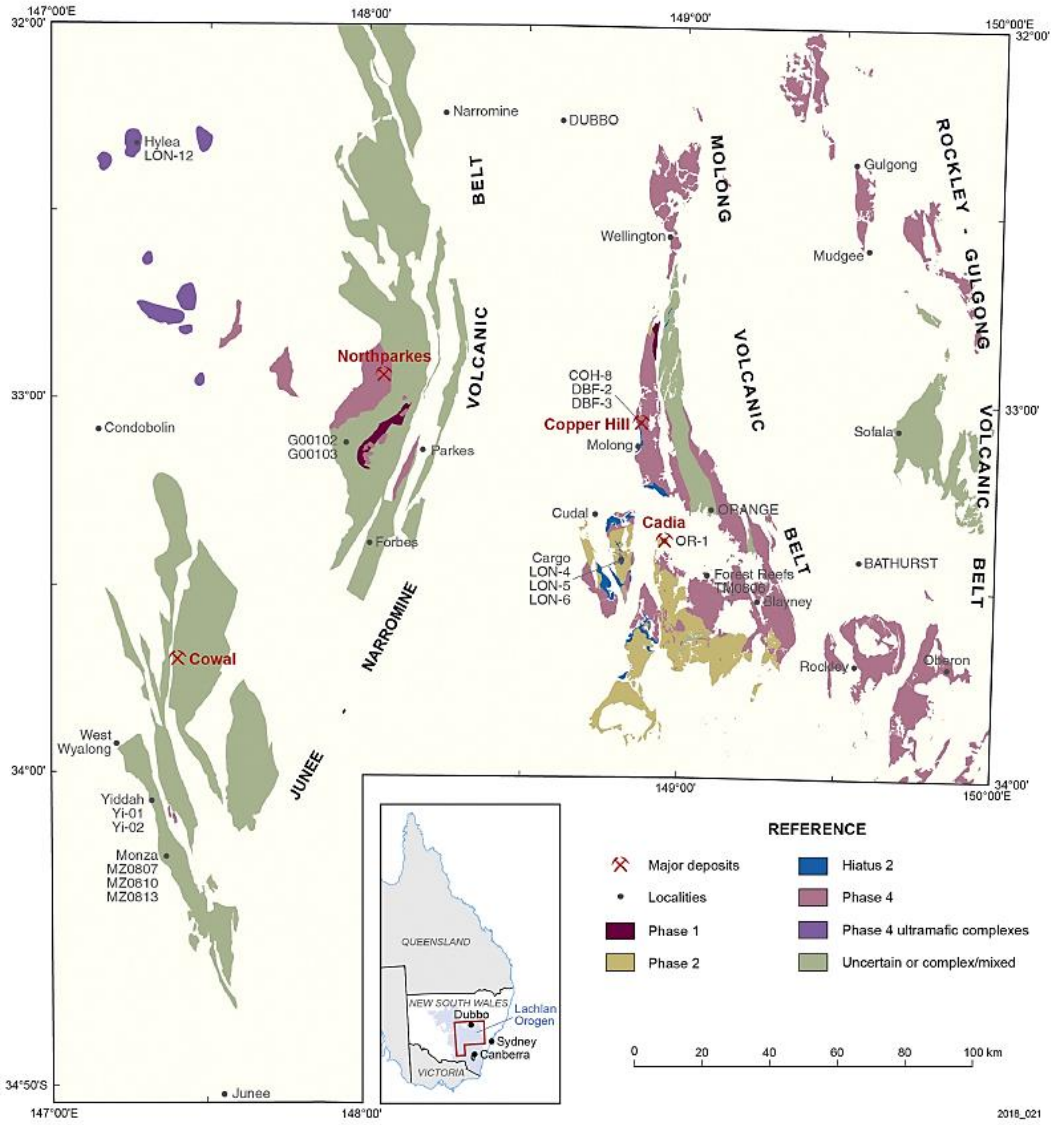
Check for updates

Brenainn Simpson[1,2], Teresa Ubide[1] & Carl Spandler[3]

Highly sodic peralkaline magmas can reach hyper-enrichment in critical metals including rare earth elements (REE). We explore clinopyroxene zoning to track the evolution of peralkaline magmas and the mechanisms that trigger critical metal mineralisation, focusing on the Mesozoic Benolong Volcanic Suite in eastern Australia, which includes a zirconium + hafnium + niobium + tantalum mineralised subvolcanic sill. Major and trace element analysis of clinopyroxene across the volcanic field tracks continuous magma differentiation from diopside-hedenbergite to aegirine, associated with progressive enrichment of rare metals. Crucially, aegirine in the mineralised trachyte becomes sector-zoned and depleted in critical metals, which instead partition into latest-stage eudialyte. Association with vesiculated portions of the sill suggests that sector zoning is the product of undercooling which may be driven by degassing. Because volatiles increase the solubility of critical metals in silicate magmas, we suggest retention of volatiles and dynamic crystallisation conditions drive enrichment of critical metals in the Toongi deposit. Our data show that pyroxene chemistry and zoning can help track fertility in critical metals in peralkaline magmas.

Macquarie Arc

- Develop a temporal framework, 4D model of the tectonic and thermal history of the Macquarie Arc and successor basins
- U-Pb dating, palaeontology & geochemistry
- Reinterpretation of Blayney and Oberon 100k
- Timing and nature of magmatism along the Parkes Thrust
- Extension of thermal and tectonic evolution studies in the Mac Arc (fission track, Arkai/Kubler)
- Industry collaboration and substantial core donations



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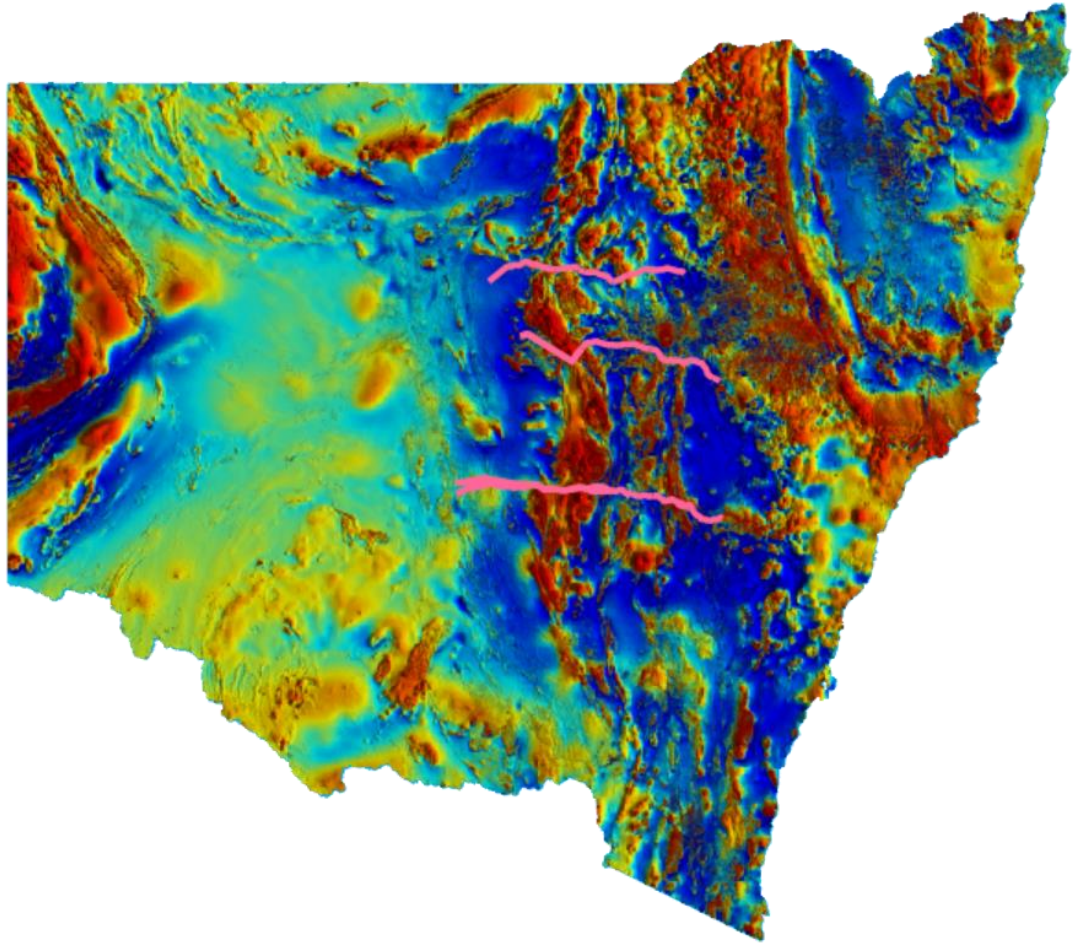
- And……. two new seismic lines!



Reanalysis of whole rock samples, mine dumps and ores

Critical Mineral Analysis Project

R00076228 (GS2024/0026)

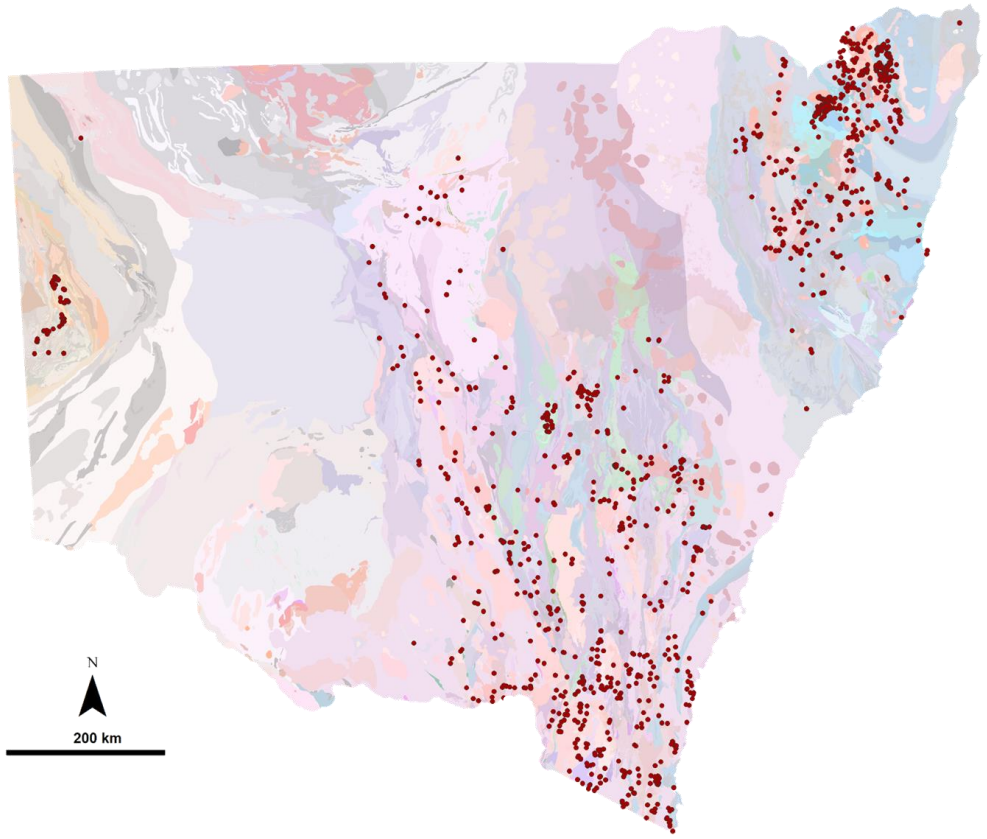
NSW

Phillip Blevin, Kevin Capnerhurst, Ryan Dwyer, Melanie Ricketts

2024

NSW GOVERNMENT

1841 samples by four-acid digest & Li-B fusion ICPMS techniques



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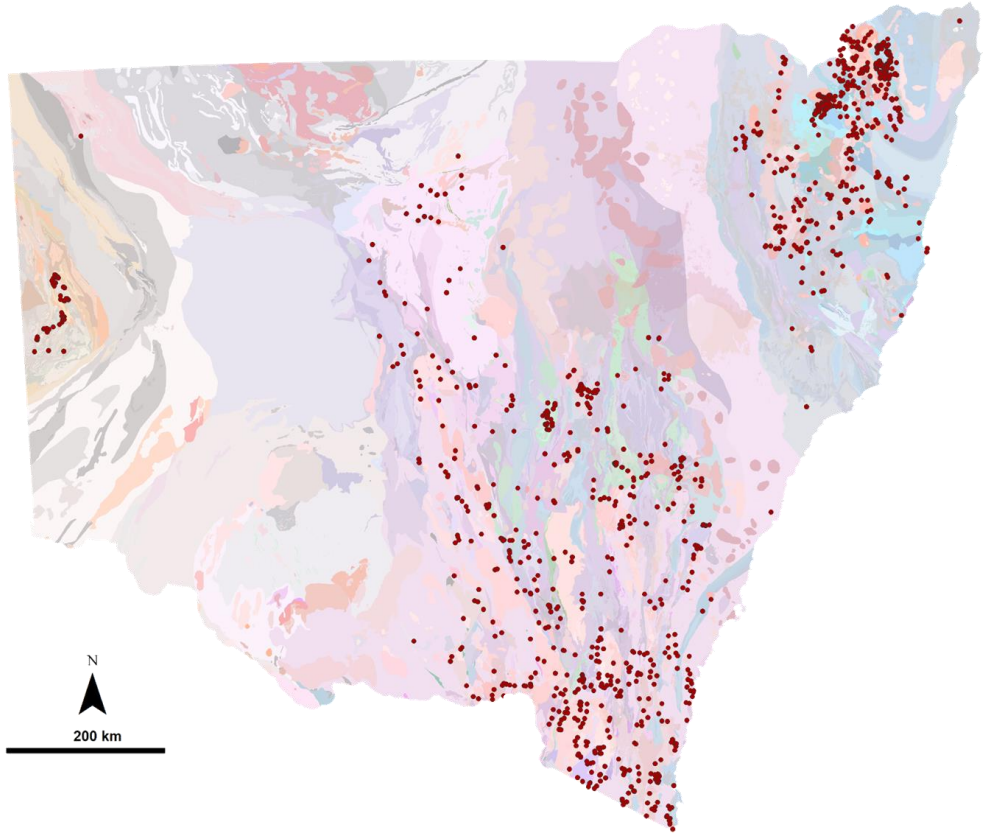

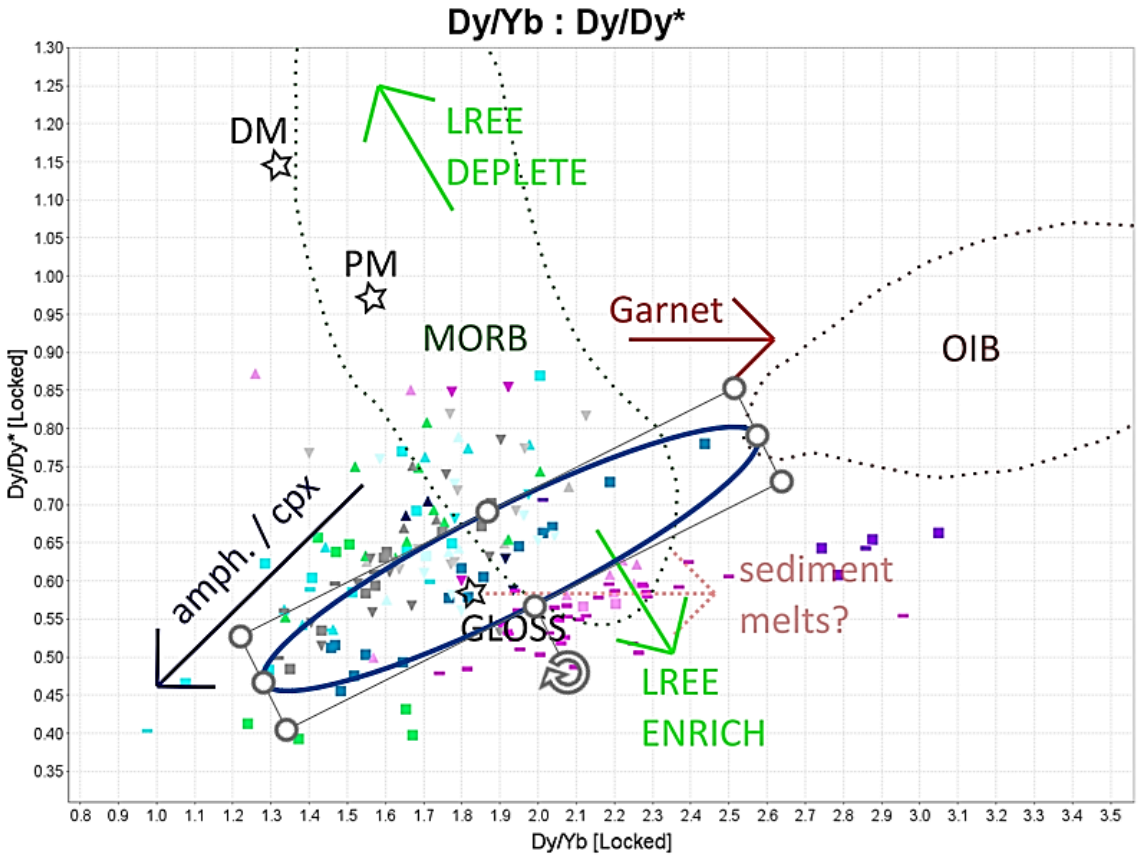

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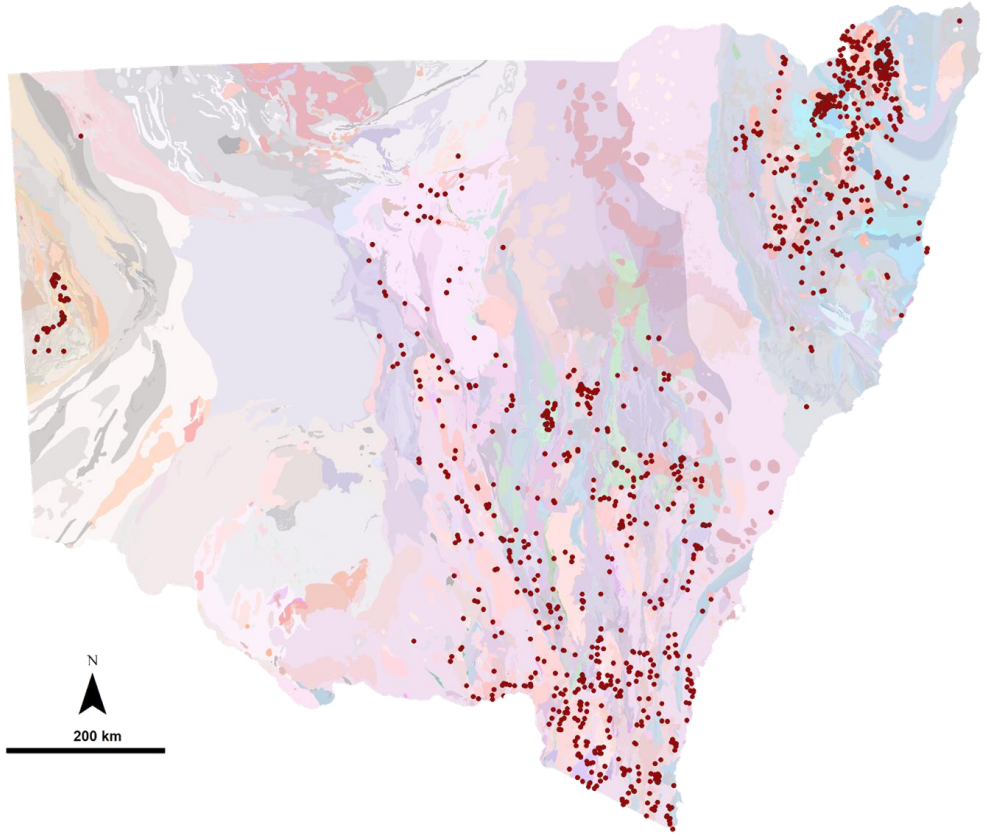

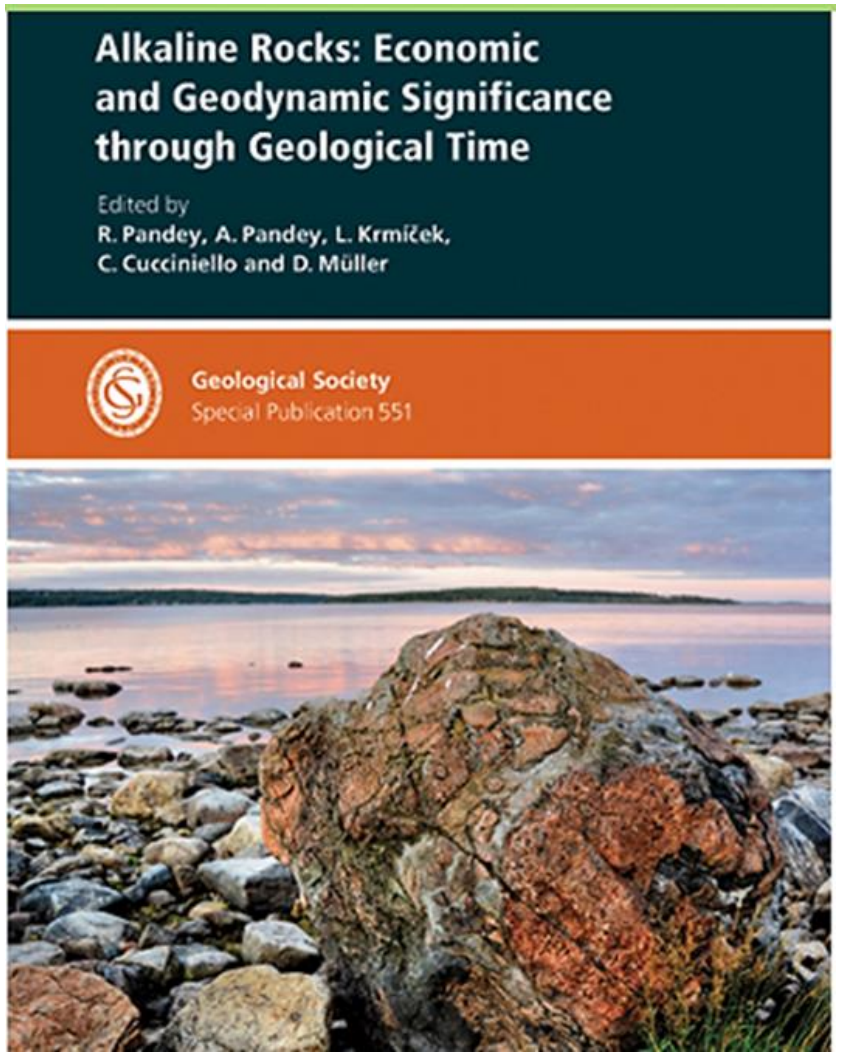

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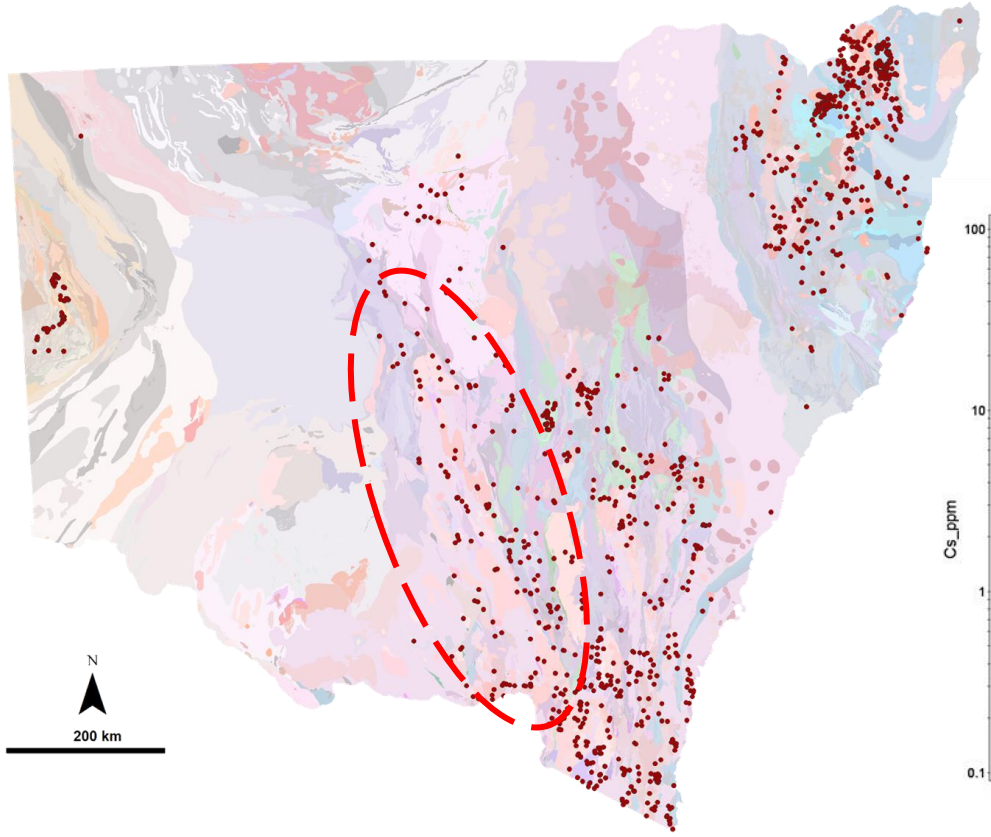
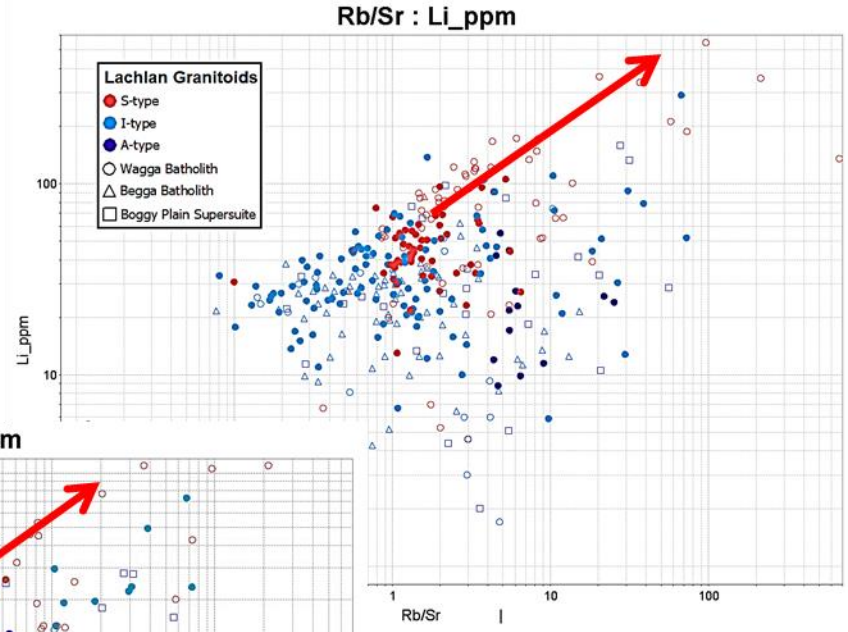
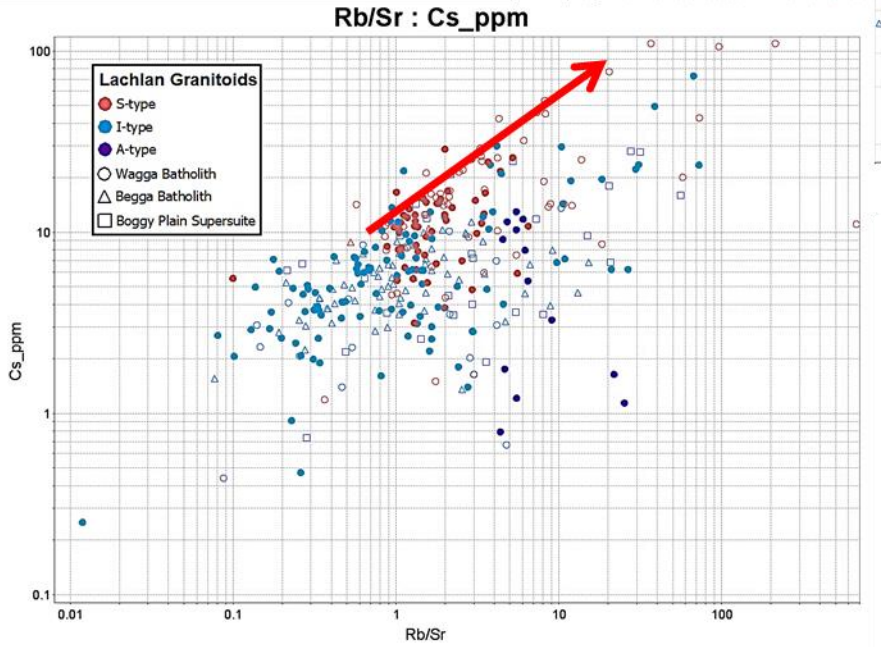
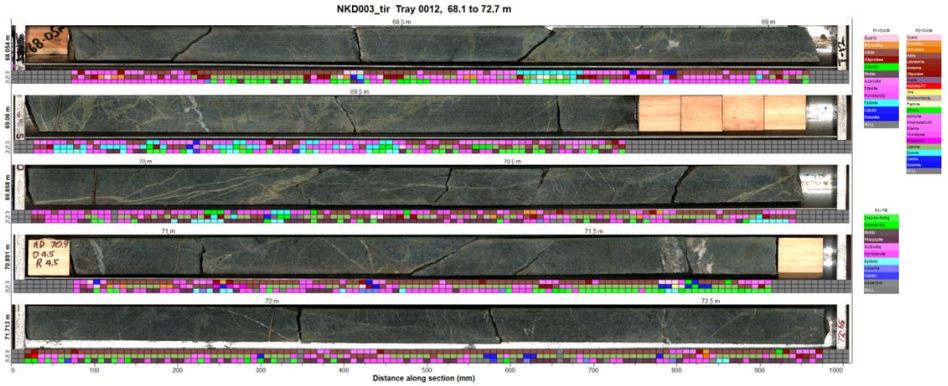




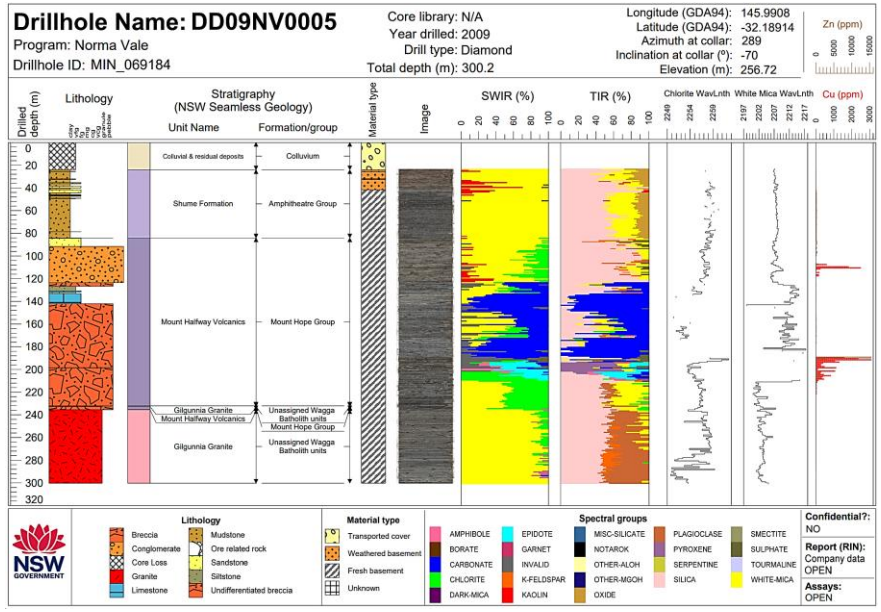


Drillhole Atlas and Hyperspectral

- 1020 holes in the NVCL
- New HyLogger 4
- VNIR-SWIR-MWIR-LWIR
- Optical and 3D profilometer

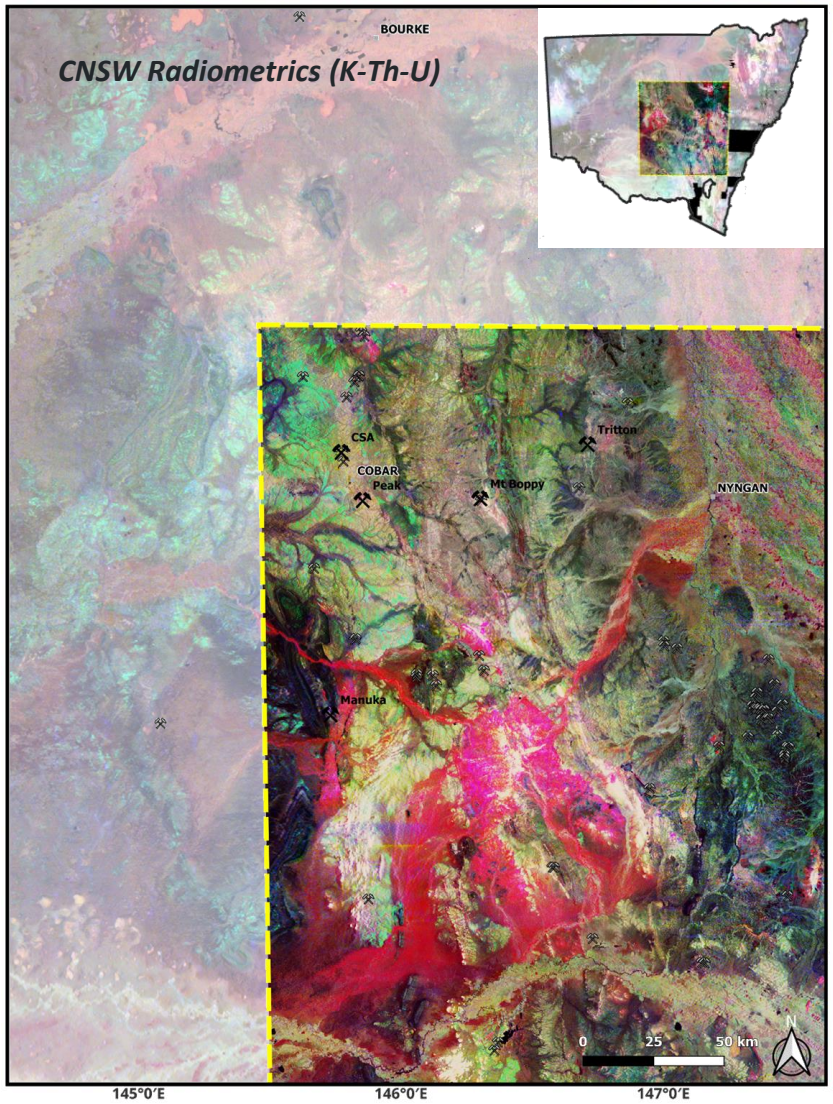


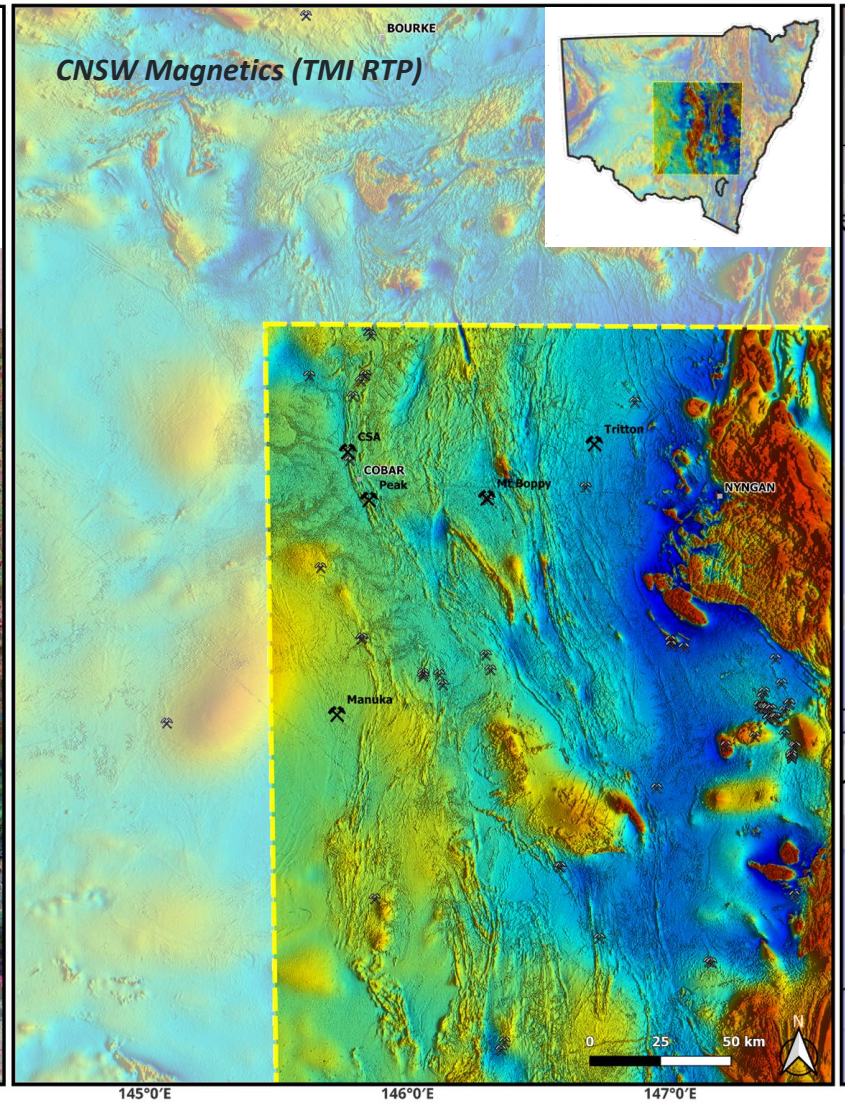
- Open file drillhole dataset and new downhole data visualisation template (n=539)
- Priority for deep drillholes and drillholes stored in GSNSW core library
- Collar information + survey data + downhole lithology/stratigraphy (QC'd data spreadsheets provide simple loading into 3D software)

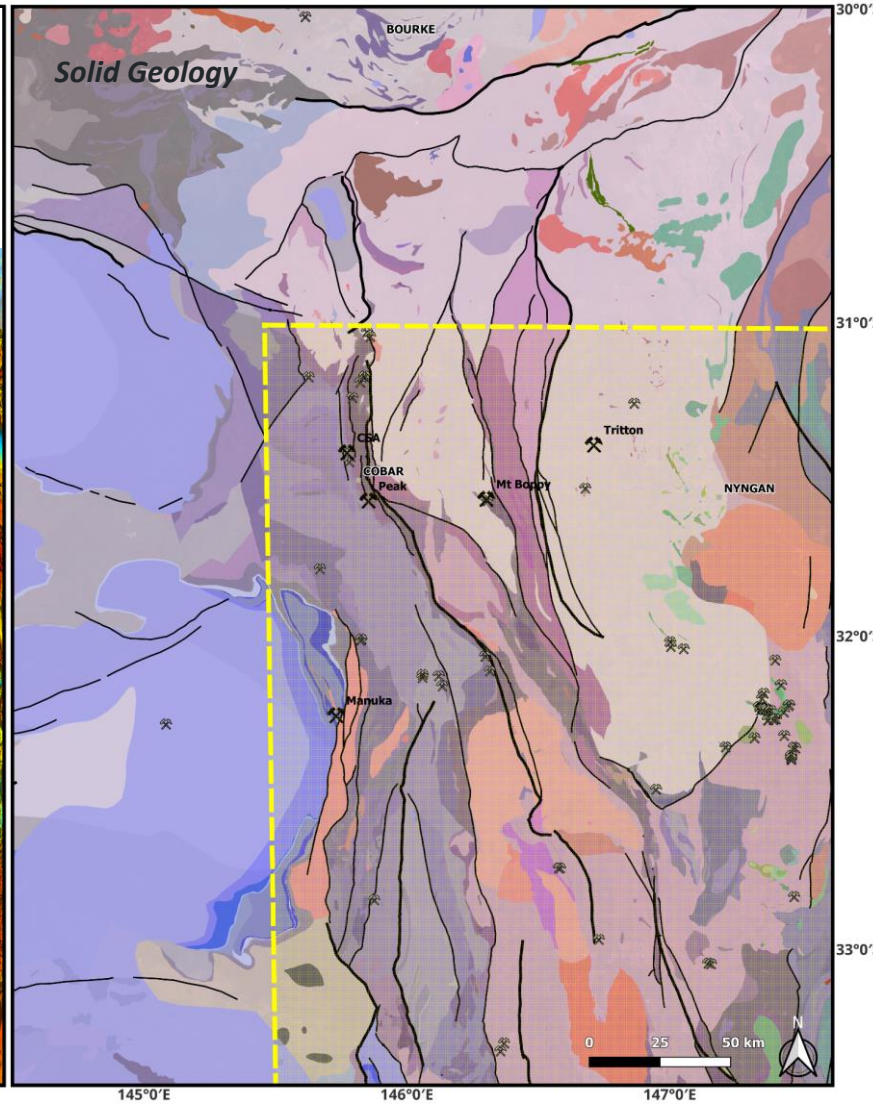


Central NSW Geophysical Merges (10 m) – ultra high resolution

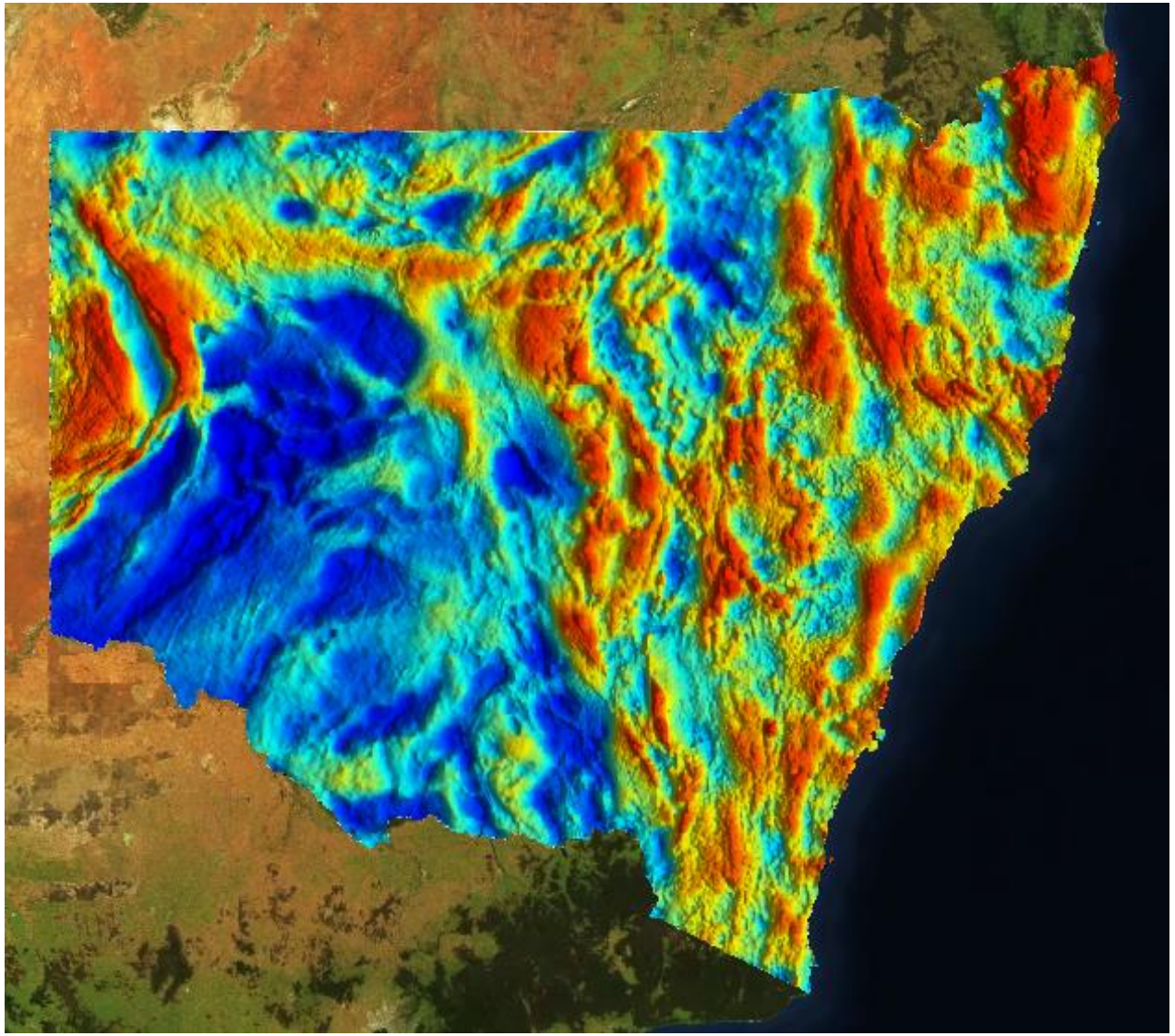
Data available now @ MinView





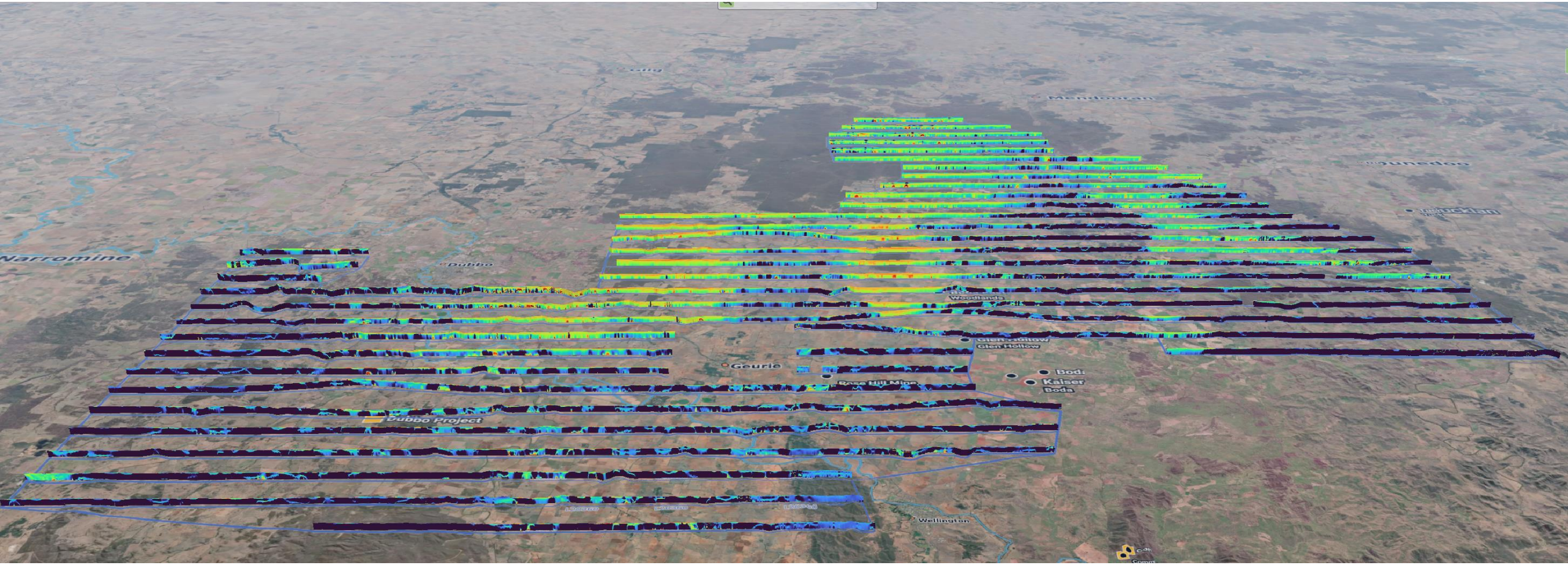


New Statewide Airborne Gravity



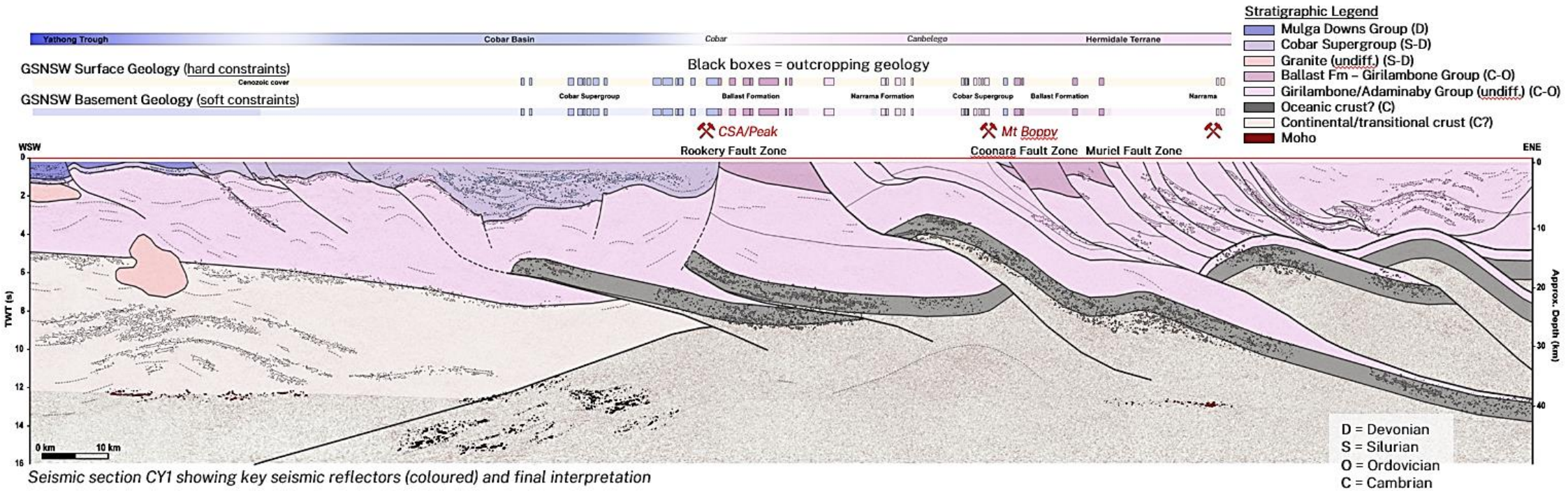
New AEM

Dubbo AEM Survey – 2.5 km spaced lines



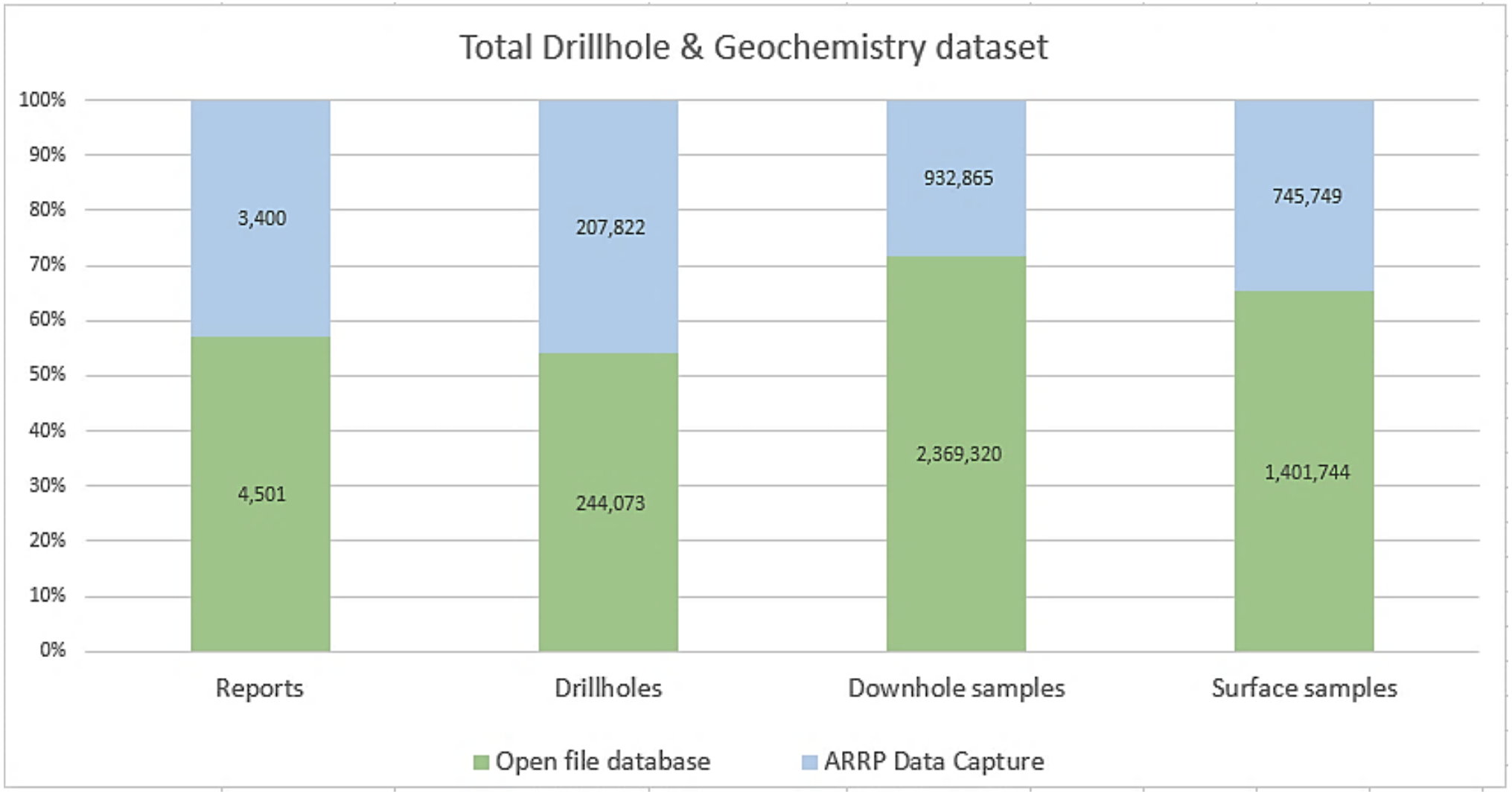
New seismic crustal-based interpretations

- Hugely successful seismic campaign
- Significant new interpretations
- Connecting source regions with accessible mineral systems
- A new paradigm for copper and gold in the Lachlan Orogen

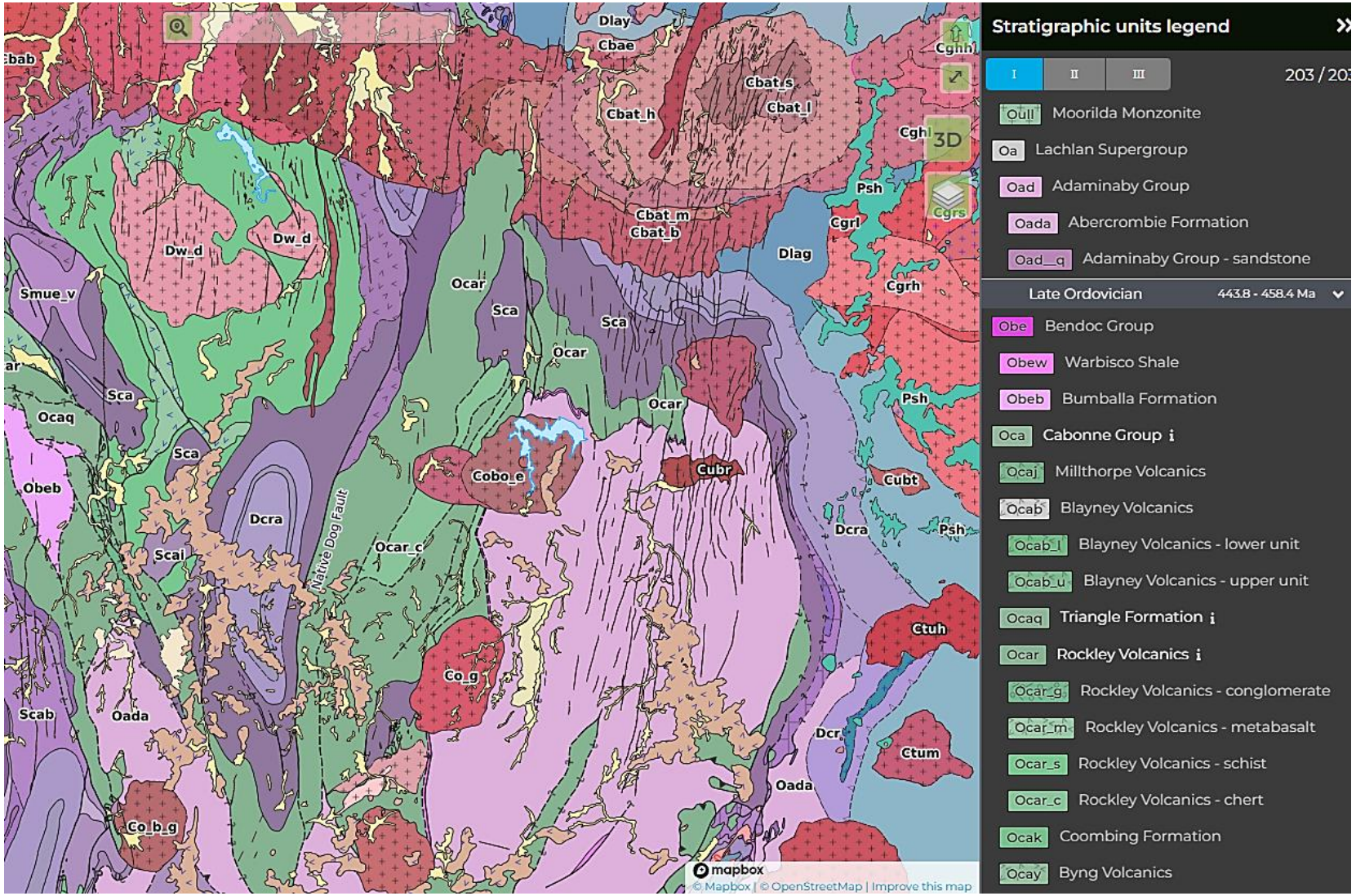


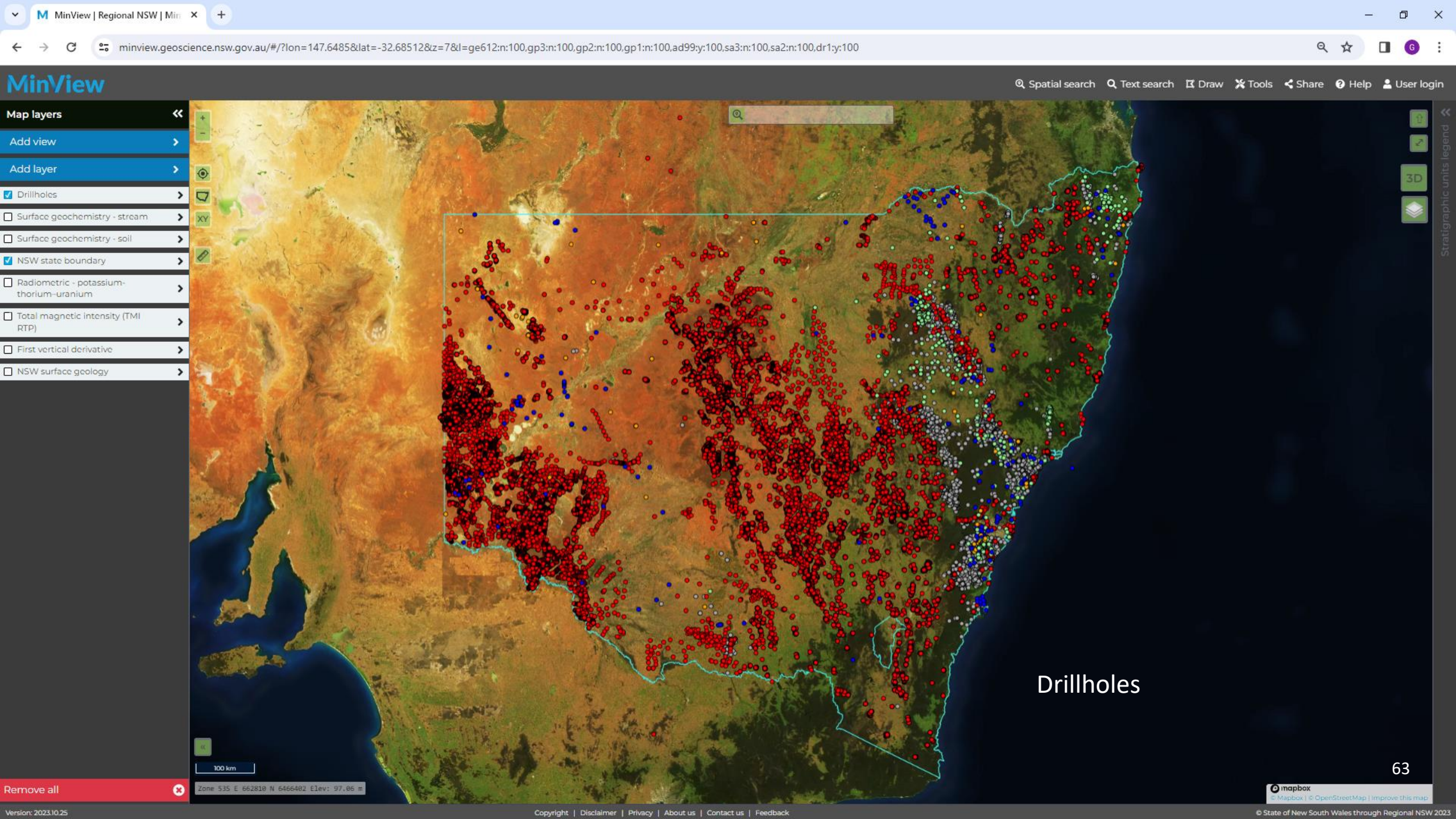
Seismic section CY1 showing key seismic reflectors (coloured) and final interpretation

Annual Report Data Release Project



Continuous updates to MinView

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Add view
Add layer
Drillholes
Surface geochemistry - stream
Surface geochemistry - soil
NSW state boundary
Radiometric - potassium-thorium-uranium
Total magnetic intensity (TMI RTP)
First vertical derivative
NSW surface geology
Remove all
3D
Stratigraphic units legend
100 km
Zone 535 E 662810 N 6466402 Elev: 97.06 m
Drillholes
63
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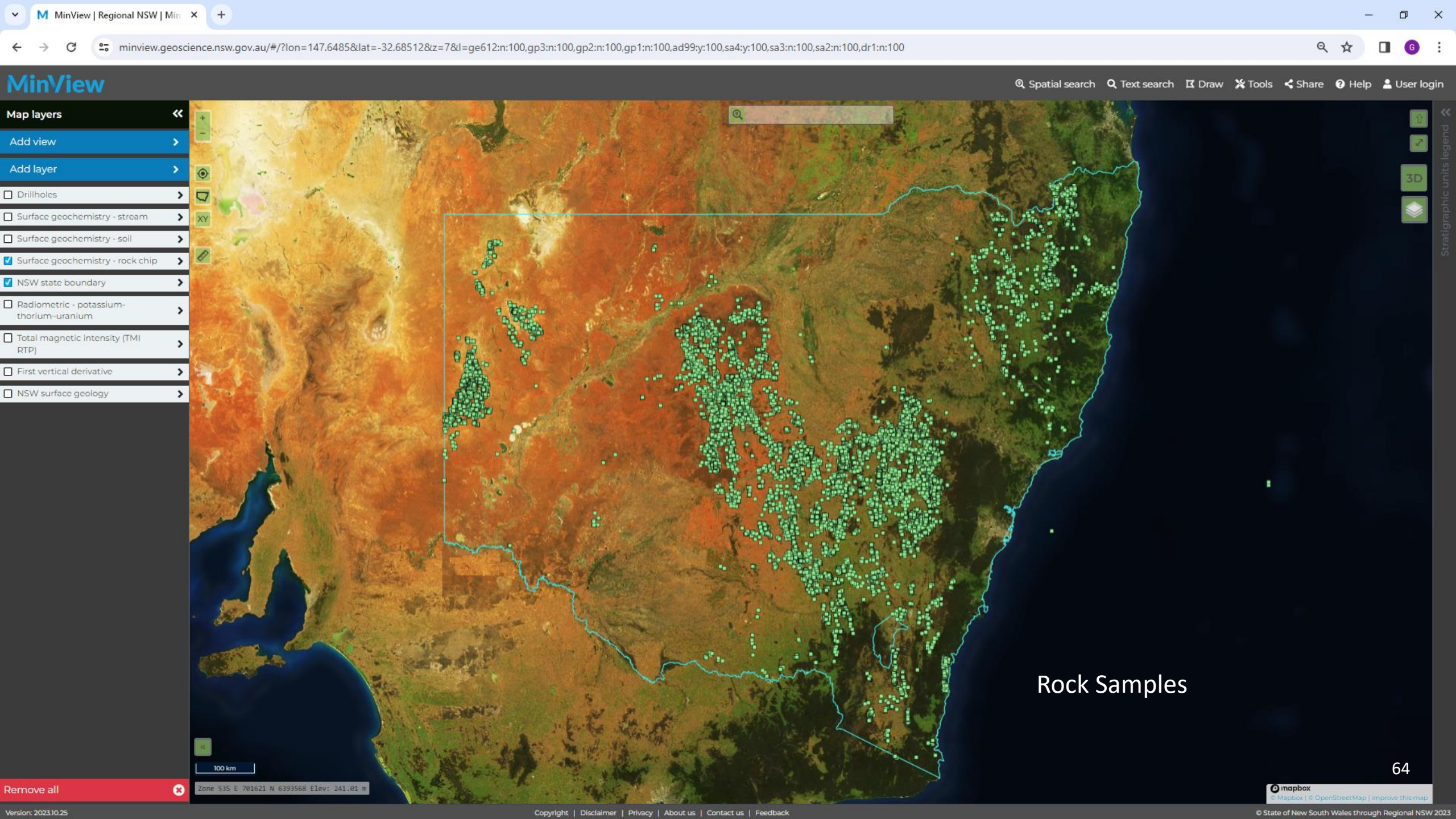
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Surface geochemistry - stream
Surface geochemistry - soil
Surface geochemistry - rock chip
NSW state boundary
Radiometric - potassium-thorium-uranium
Total magnetic intensity (TMI RTP)
First vertical derivative
NSW surface geology
Remove all
3D
Stratigraphic units legend
100 km
Rock Samples
64
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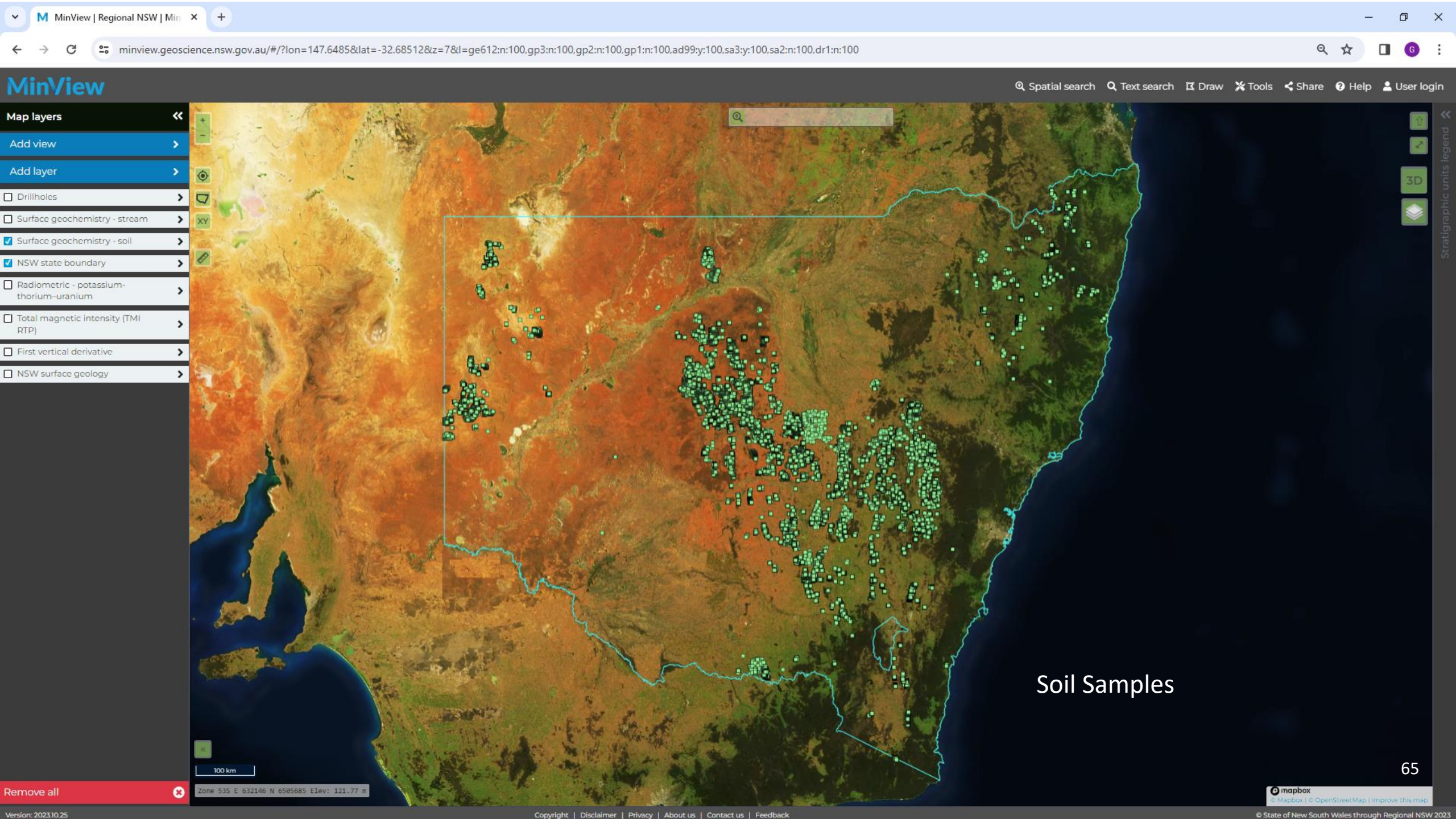
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Surface geochemistry - stream
Surface geochemistry - soil
NSW state boundary
Radiometric - potassium-thorium-uranium
Total magnetic intensity (TMI RTP)
First vertical derivative
NSW surface geology
Remove all
3D
Stratigraphic units legend
100 km
Zone 53S E 632146 N 6505685 Elev: 121.77 m
Soil Samples
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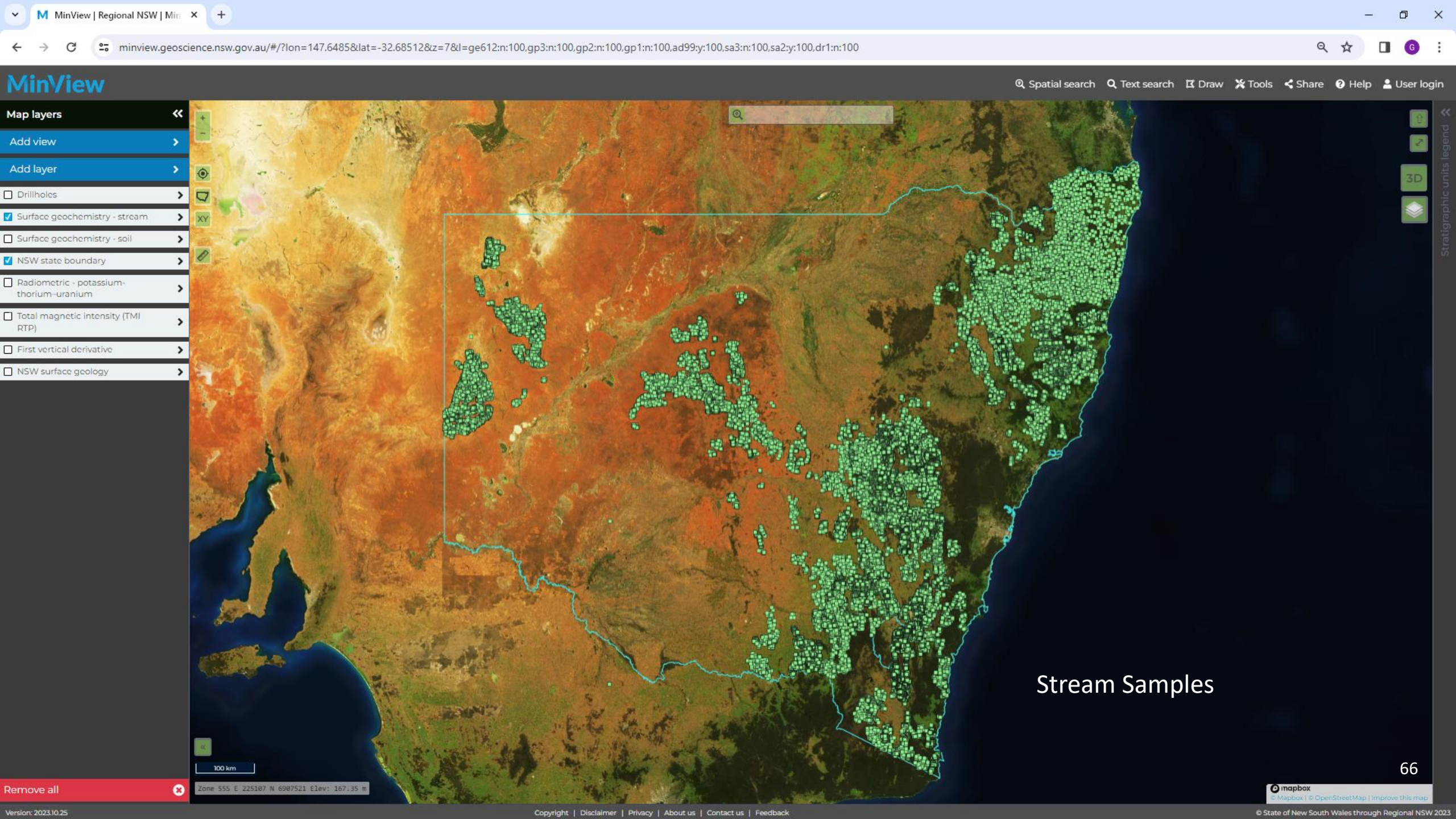
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Zone 555 E 225107 N 6907521 Elev: 167.35 m
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Stream Samples
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REALISE THE OPPORTUNITY

Thank You

Dr Phillip Blevin
Chief Geoscientist & Head
Geological Survey of New South Wales

NSW GOVERNMENT