

South Australia

SA Exploration & Mining Review

Bronwyn Camac

Director, Geological Survey of South Australia

Friday, 1 December 2023

energymining.sa.gov.au



Acknowledgement of Country

As guests here on Kurna land, the Department for Energy and Mining (DEM) acknowledges everything this department does impacts on Aboriginal country, the sea, the sky, its people, and the spiritual and cultural connections which have existed since the first sunrise. Our responsibility is to share our collective knowledge, recognise a difficult history, respect the relationships made over time, and create a stronger future. We are ready to walk, learn and work together.



Exploration Investment in SA



2022-2023
industry
investment on

\$181.7B



\$64.2M

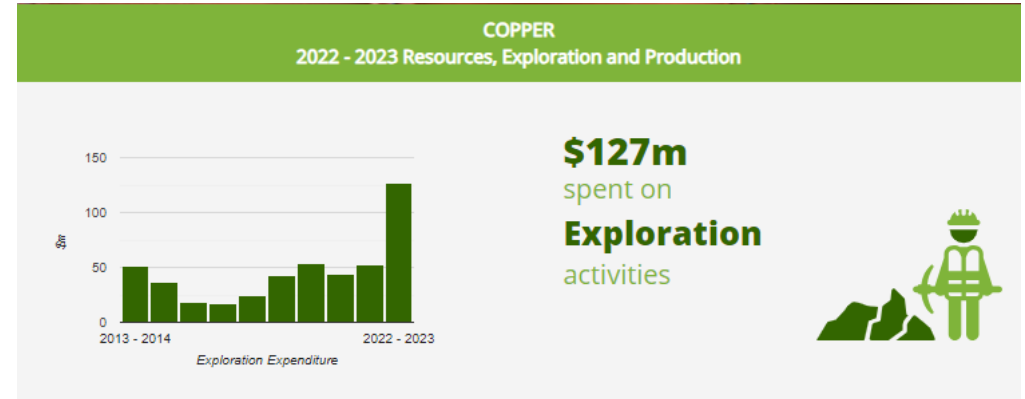
In March quarter
compared to \$61M
previous quarter



**Mining
increased**

13.9%

Exploration Expenditure by Major Commodity

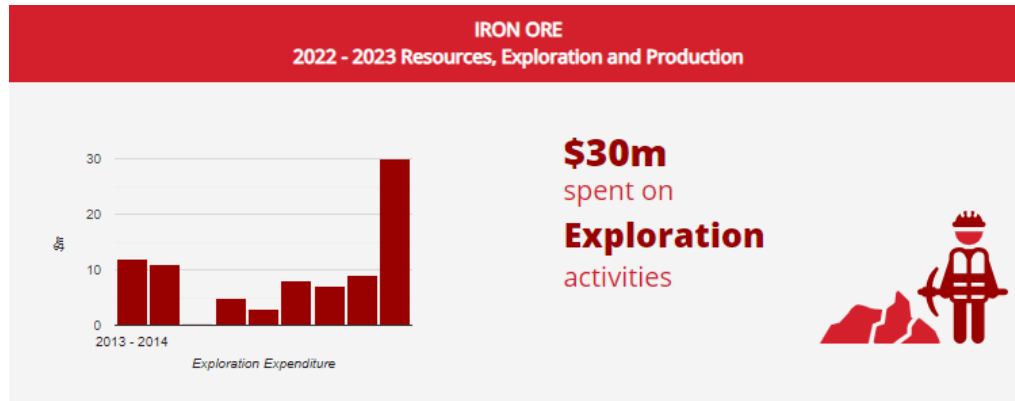


Contained Copper

15Mt
Reserves



94Mt
Resources



Contained Iron

70Mt
Reserves



2,000Mt
Resources



Contained Uranium

354,000t
Reserves



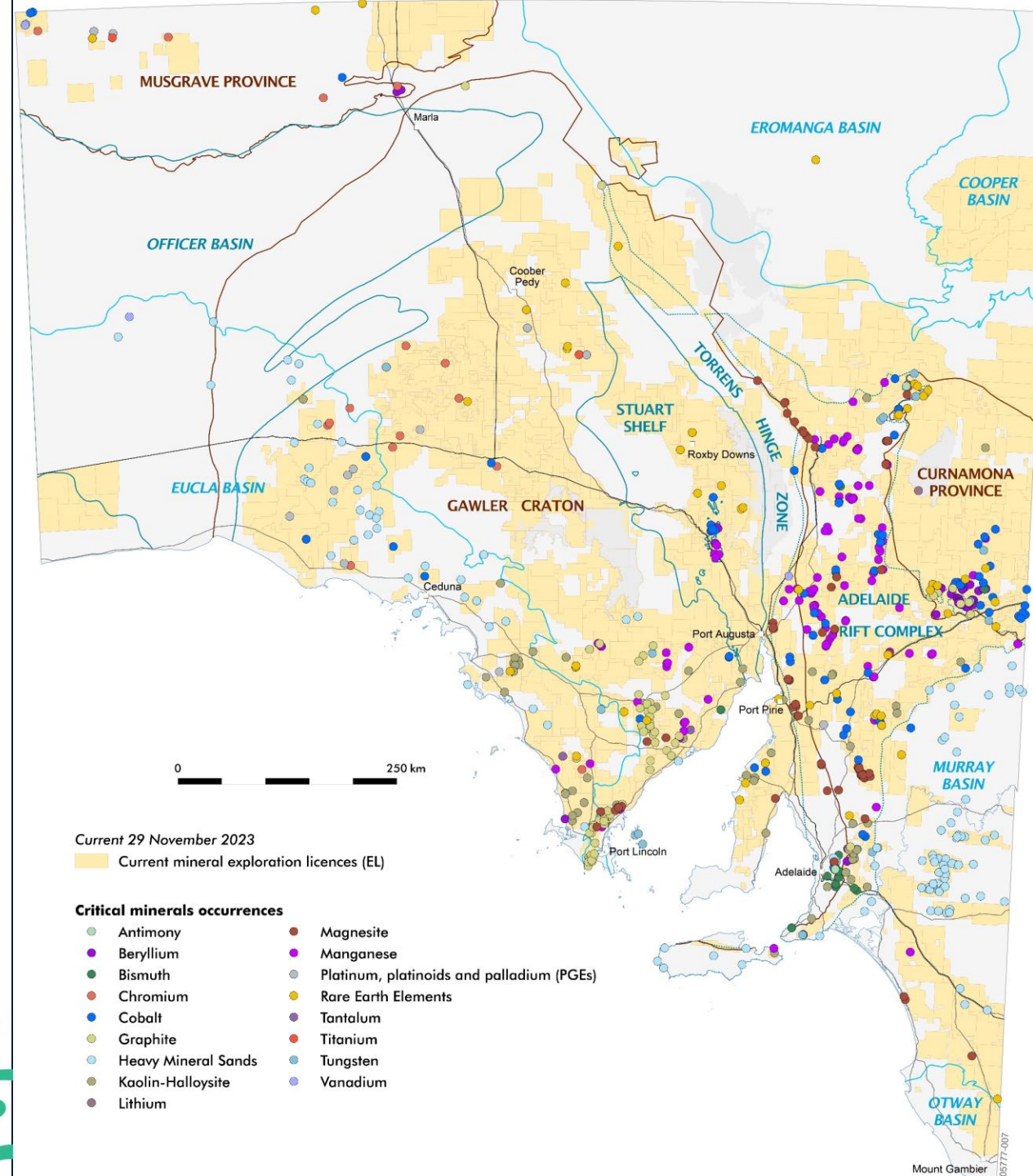
2Mt
Resources

Exploration snapshot

902 active exploration licenses

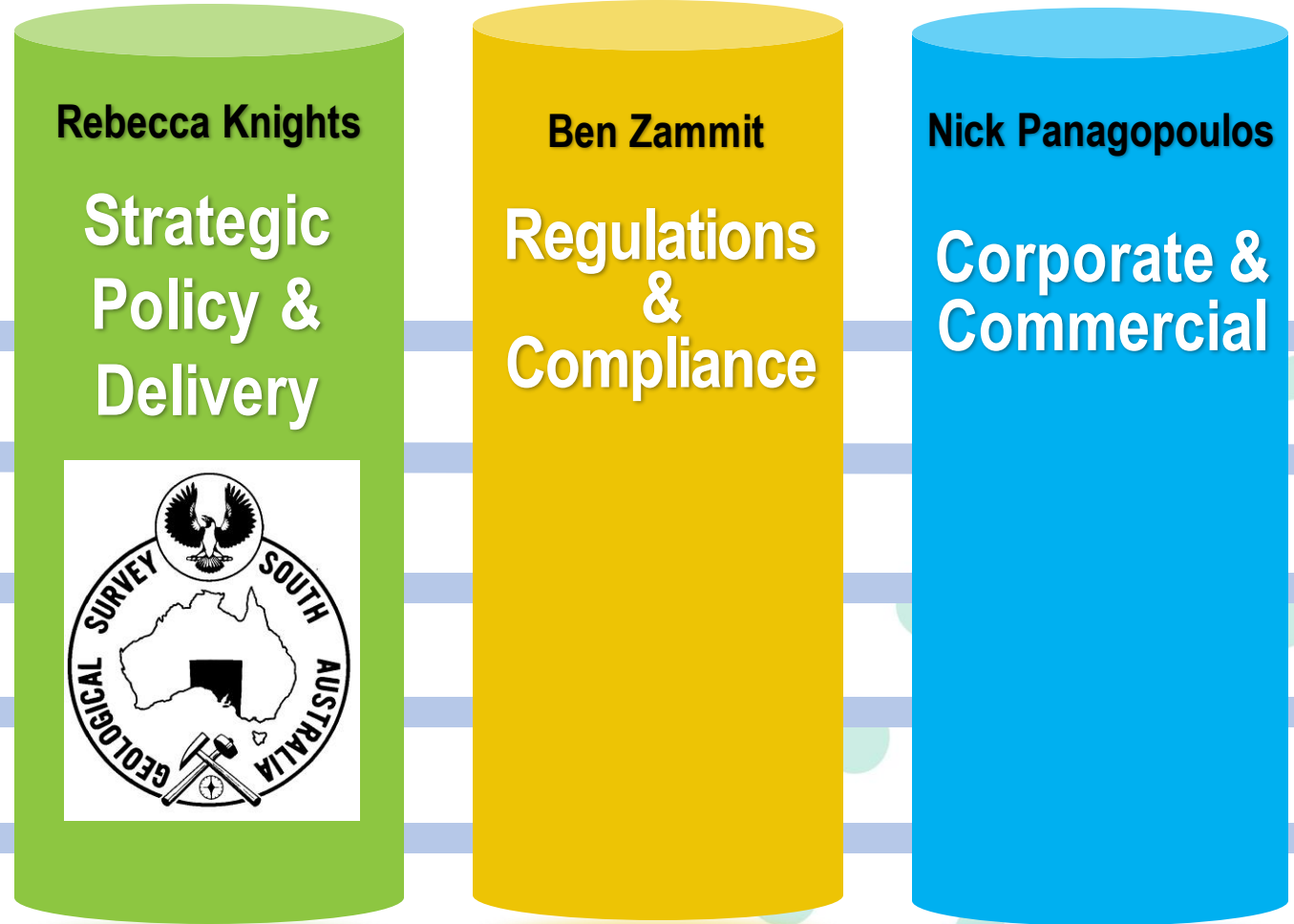
Trends

- Increased exploration activity at Oak Dam
- BHP and Oz Minerals merge driving interest in Copper exploration
- Critical Minerals activity increased on ground activity across the state
- Ongoing interest in Central Gawler Craton
- REE discoveries and resource upgrades on the Eyre peninsula and SE
- Magnetite interest increased
- Renewed interest and activity in mineral sands



New DEM Structure

Chief Executive: **Paul Heithersay**
Deputy Chief Executive: **Vince Duffy**



Rebecca Knights

Strategic
Policy &
Delivery



Ben Zammit

Regulations
&
Compliance

Nick Panagopoulos

Corporate &
Commercial

Industry

Rest of Government

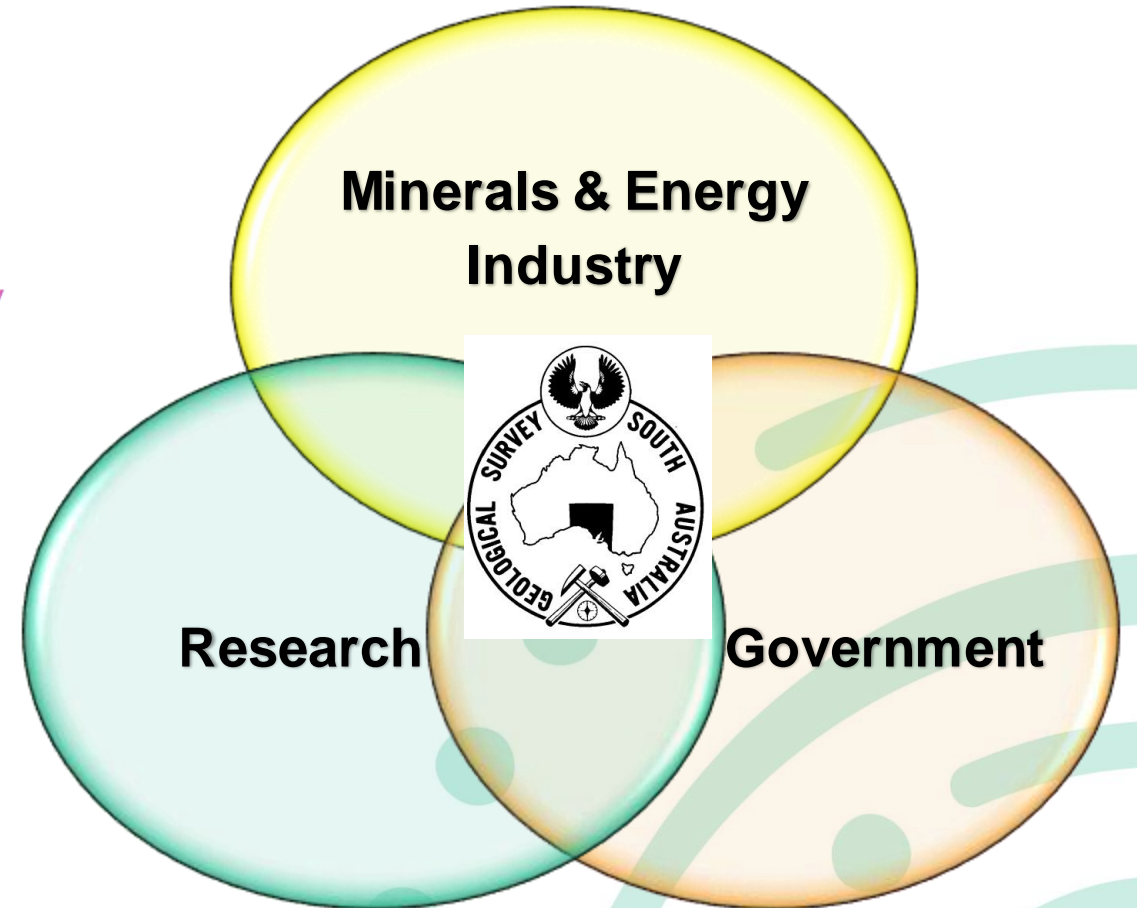
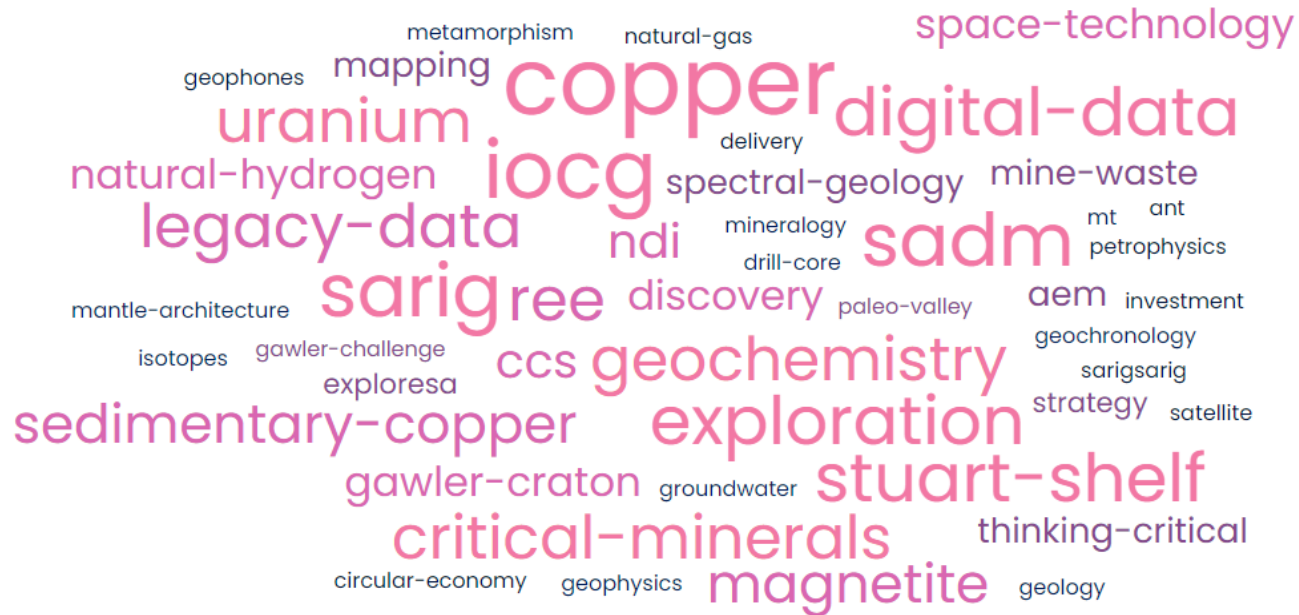
Collaborators

Community

Commonwealth



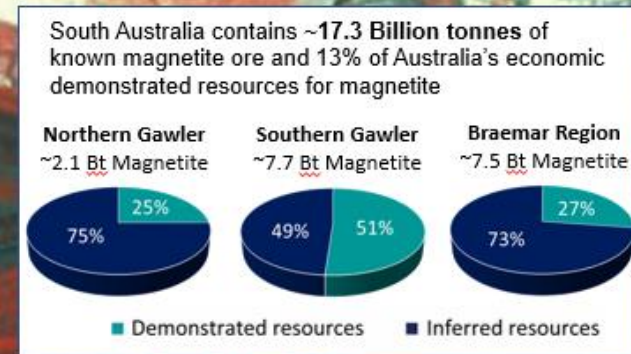
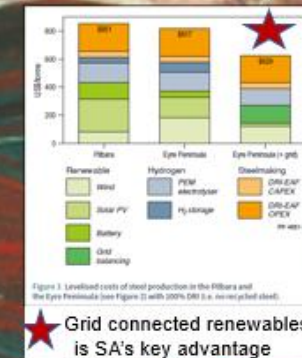
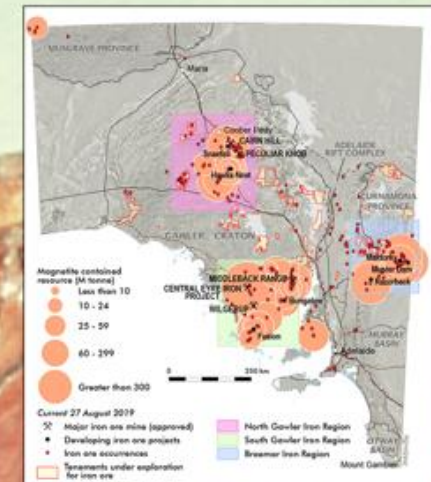
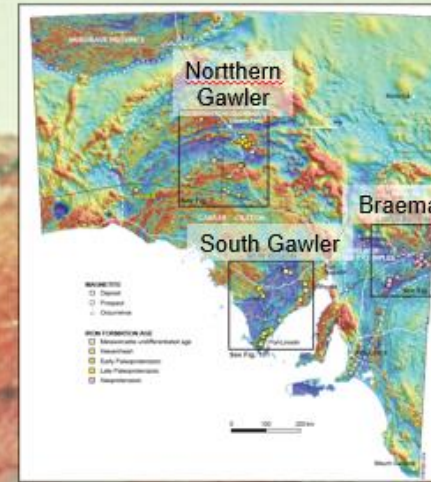
All Resource Geosciences & Digital Delivery Now in One Team!



New SA Strategies: in DRAFT!

South Australia's
CRITICAL MINERALS
STRATEGY
2023-2035
DRAFT

energymining.sa.gov.au



Magnetite in South Australia

by Davies and Twining 2018

Considerations: Geology & Metallurgy
The majority of SA magnetite ores have a rock strength classified as soft to medium. Bond crushing work index (CWI) values typically 10–20 kWh/t Abrasion index (Ai) values 0.2–0.6 (majority <0.5) and Bond ball mill work index (BWI) values 11–19 kWh/t Magnetite ores from Braemar iron region are notable for being comparably softer than magnetite ores from other iron regions, enabling grinding to finer grain size without incurring significant additional power inputs. All magnetite ores from SA produce concentrates with low levels of deleterious elements inclusive of those deposits with relatively coarse grinds in the range 75–125 μm. Main styles of magnetite in SA are:
1) banded iron formations and metasediments;
2) magnetite metasomatite to skarn.
Metamorphism plays an important role in grain coarseness. There are still questions on the age of host rocks and the control this may play in some deposits.

Three Economic Studies for SA

ACIL ALLEN

Impact of Pre-competitive Geoscience Information for South Australia

DRAFT REPORT

Economic study for the sustainable development of critical minerals sector and value chain in South Australia

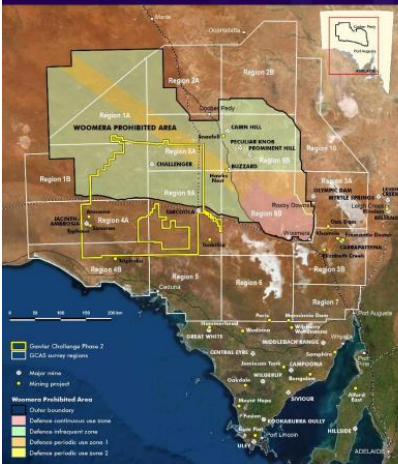
Report commissioned by
The Department for Energy and Mining

Report prepared by
The South Australian Centre for Economic Studies
University of Adelaide

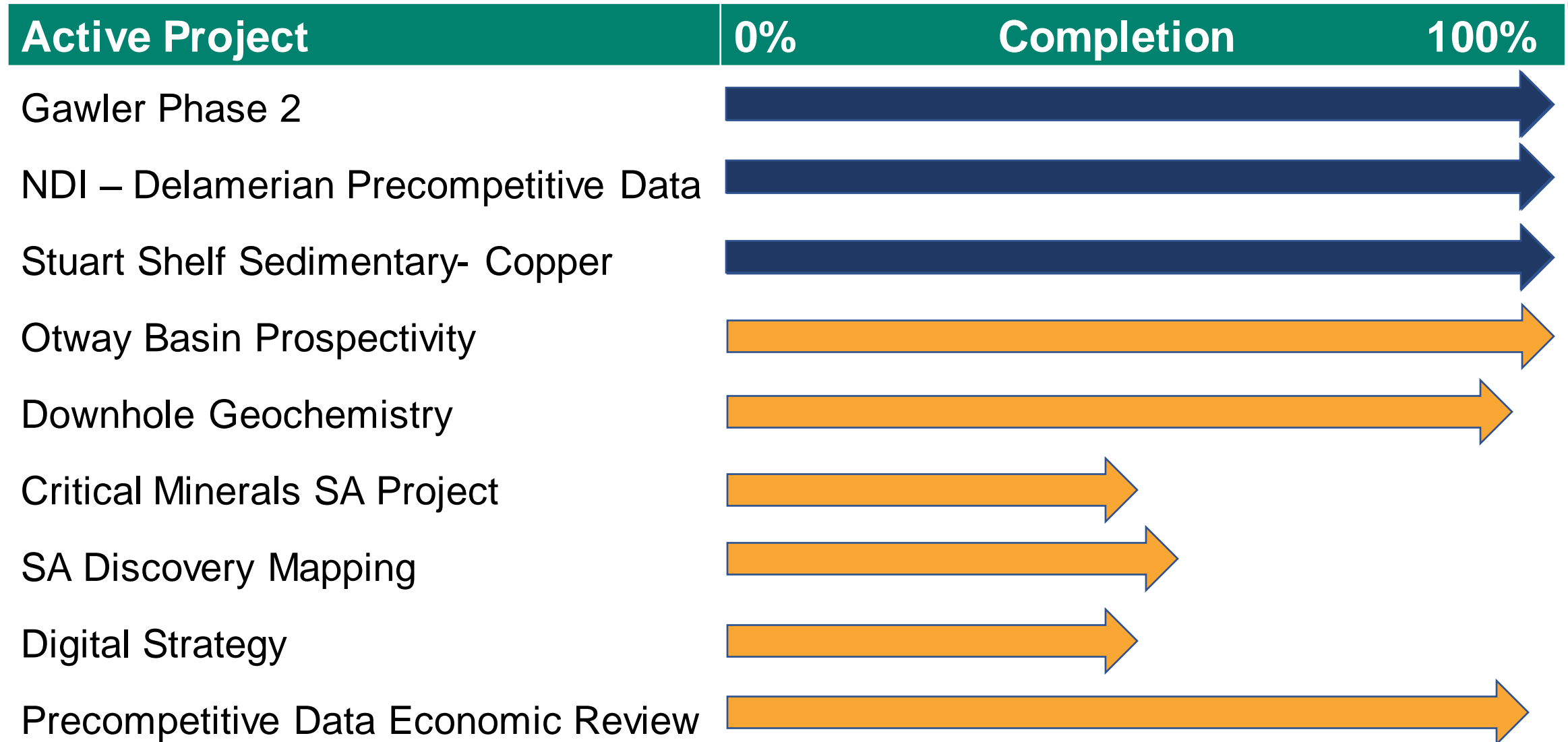
scyne |
ADVISORY

Department for
Energy and Mining
Woomera Prohibited Area
Resource Prospectivity and
Economic Assessment

October 2023



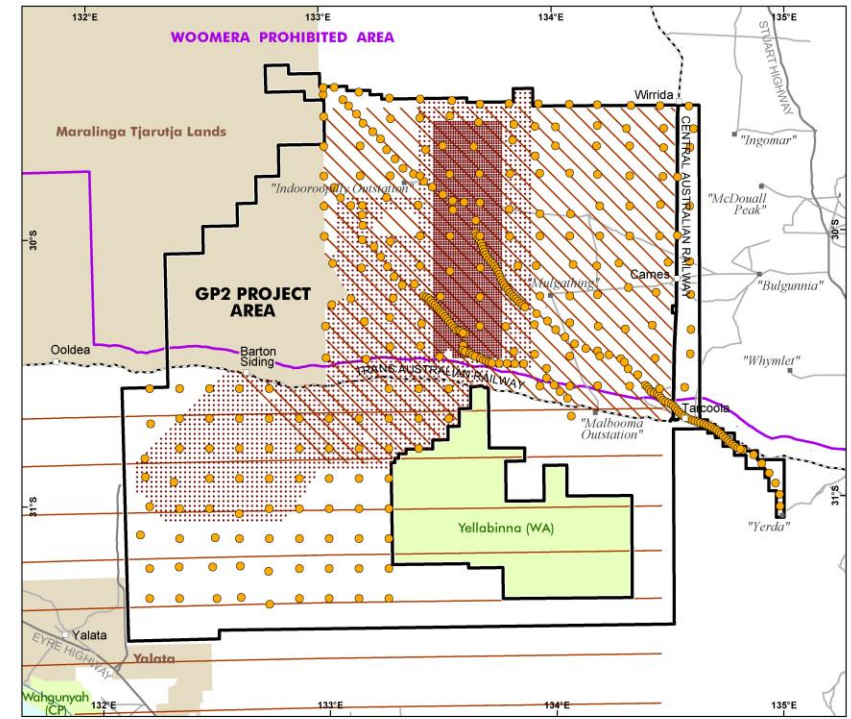
GSSA Project Status YE 2023



Gawler Phase 2

- Largest and most complex project the GSSA has undertaken due to remoteness of the region, harsh climate, no road access, technological limitations, the number of survey sites completed across multiple survey types.
- New Gravity, MT and AEM data collected will help to connect to surface to the sub-surface to deepen our mineral system knowledge and the geological processes leading to the potential for hosting valuable mineral deposits.

Active Project	0%	Completion	100%
Gawler Phase 2			
NDI – Delamerian Precompetitive Data			
Stuart Shelf Sedimentary- Copper			
Otway Basin Prospectivity			
Downhole Geochemistry			
Critical Minerals SA Project			
SA Discovery Mapping			
Digital Strategy			
Precompetitive Data Economic Review			



GP2 project area

Gawler Phase 2 surveys

- Magnetotelluric (MT) sites
- Gravity sites
- Flighlines

Restricted land

- Woomera Prohibited Area
- Park with no exploration access
- Aboriginal lands

Topographic information

- Locality
- Homestead
- Major road
- Secondary road
- Railway

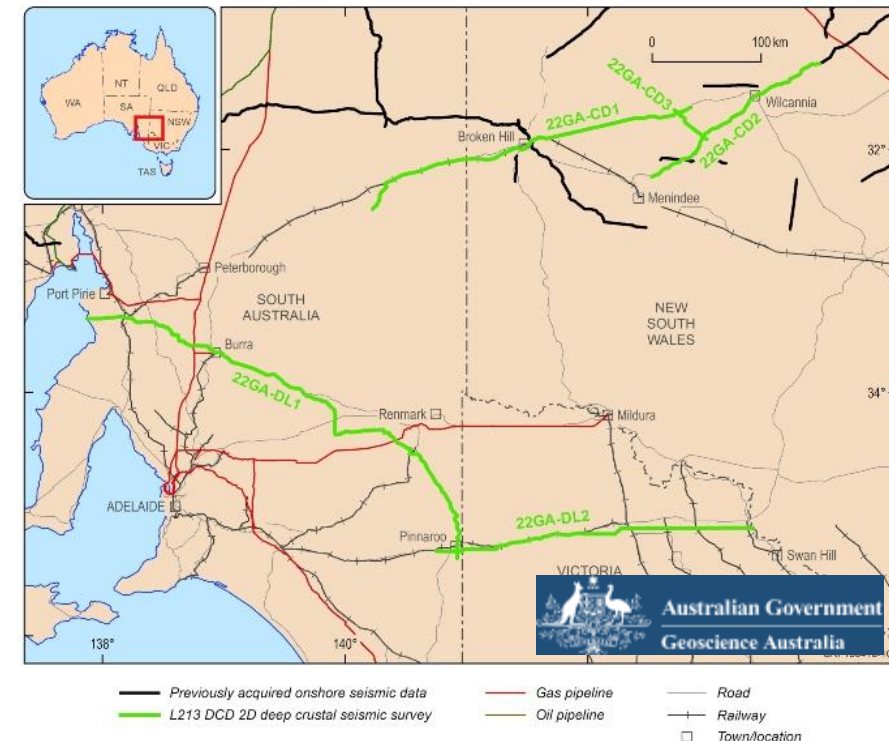


National Drilling Initiative (NDI #1) & EFTF2 Deep Crustal 2D Seismic

Quondong Vale (12 DH) and Alawoona (11 DH) regions of the Murray Basin.

- Provided valuable knowledge on the Delamerian Orogen and its mineral potential
- Drilling completed Aug 2022 – but the data acquisition and geological work continued well into his year
- Almost 7 km of hand-held pXRF and magnetic susceptibility readings, lithological and stratigraphic logging, core and chip tray photography
- GA acquired over the Delamerian Orogen ~1200km of deep crustal seismic data in 2022, with lines crossing the margins of the Gawler Craton and Curnamona Province, the Flinders Ranges and the Murray Basin.
- **Precompetitive geoscience has stimulated exploration**

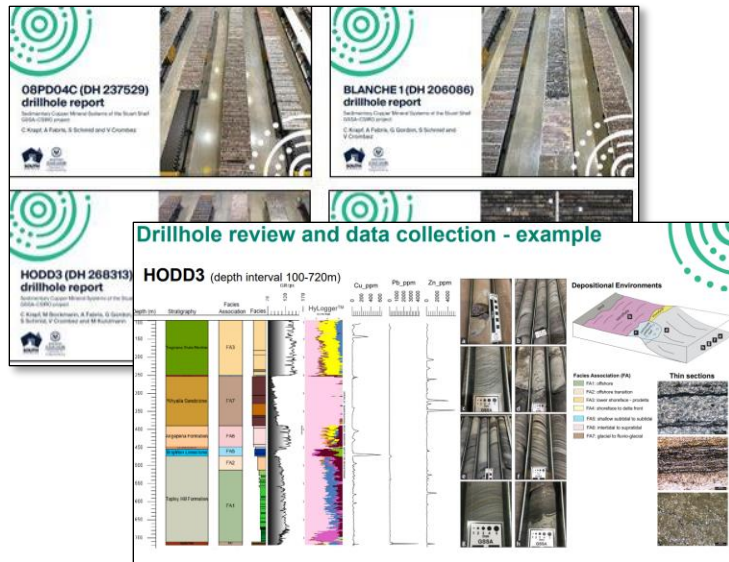
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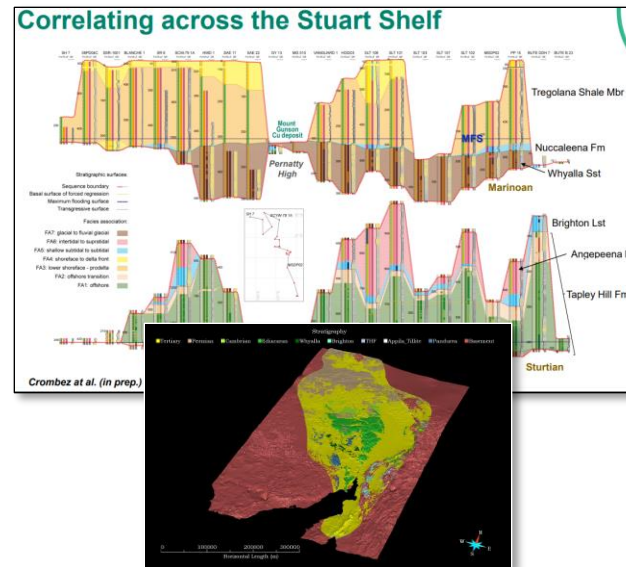
Sedimentary Copper Mineral Systems of the Stuart Shelf

- Joint project with CSIRO focused on sedimentary copper (and Co-Ag) potential of the Stuart Shelf

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Precompetitive Data Economic Review			



Drillhole summary reports



Cross-sections and models

Bayesian fusion of MT and AEM probabilistic models with geological data: examples from the eastern Gawler Craton, South Australia

Hoell Seiffel, Stephan Thiel, Kate Brand, Shane Mule, Gerhard Visser, Adrian Fabris & ...show all

Received 01 Sep 2022; Accepted 02 Jun 2023; Published online: 20 Jul 2023

Geochronology and formal stratigraphy of the Sturtian Glaciation in the Adelaide Superbasin

Published online by Cambridge University Press: 20 July 2023

Jarred C. Lloyd, Wolfgang V. Preiss, Alan S. Collins, Georgina M. Virgo, Morgan L. Blades, Sarah E. Gilbert, Darwinaji Subarkah, Carmen B.E. Krapf and Kathryn J. Amos

Geoscience Frontiers
Volume 14, Issue 6, November 2023, 101629

Laser ablation (*in situ*) Lu-Hf dating of magmatic fluorite and hydrothermal fluorite-bearing veins

Stijn Glorie, Jacob Mulder, Martin Hand, Adrian Fabris, Alexander Simpson, Sarah Gilbert

Show more

Scientific papers

Critical Minerals SA Project

Active Project	0%	Completion	100%
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Government of South Australia
Department for Energy and Mining

New Critical Mineral Dashboards – Released This Week!

South Australia's strategic critical minerals

Government of South Australia | ENERGY & MINING | Powered by SARIG

Total projects
33

Total major mines
17

Total developing projects
16


Clear all filters | Filter by critical minerals: All

Filters

Project name: All | Company: All | Status: All

Location

Major Mines | Mining Projects



Reserve and resources

N/A Reserve contained product by tonnes

146M Resource contained product by tonnes

12 Number of mineral occurrences

Mineral occurrence filters

Deposit name: All | Deposit type: All | Deposit status: All

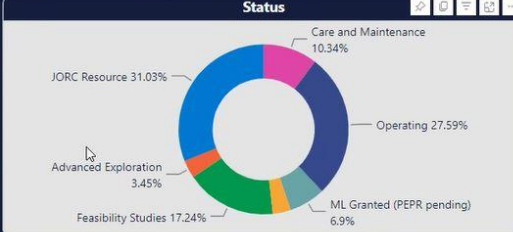
Mineral occurrence deposit status

Ceased 8.33%

Not worked 91.67%

Project name	Project	Commodity	Company	Company link	Status	Mineral deposit link
Alford East	Mining Projects	Copper (Cu), Gold (Au)	Thor Energy Plc		JORC Resource	
Angas	Major Mines	Zinc (Zn), Lead (Pb), Silver (Ag), Gold (Au), Copper (Cu)	Terramin Australia Limited		Care and Maintenance	
Atacama	Mining Projects	Heavy minerals (HM)	Iluka (Eucla Basin) Pty Ltd		Assessment	
Cairn Hill	Major Mines	Magnetite (Fe3O4), Copper (Cu), Gold (Au)	Cu-River Mining Australia Pty Limited		Care and Maintenance	
Campoona	Major Mines	Graphite	Archer Materials Limited		ML granted (PEPR pending)	
Carrapateena	Major Mines	Copper (Cu), Gold (Au), Silver (Ag)	BHP Group Pty Ltd		Operating	
Elizabeth Creek	Mining Projects	Copper (Cu), Cobalt (Co), Silver (Ag), Zinc (Zn)	Coda Minerals Ltd		Feasibility Studies	
Fremantle Doctor	Mining Projects	Copper (Cu), Gold (Au), Silver (Ag)	OZ Exploration Pty Ltd		JORC Resource	
Great White	Major Mines	Kaolin halloysite	Andromeda Metals Limited		Approved	
Hammerhead	Mining Projects	Kaolin halloysite	Andromeda Metals Limited		JORC Resource	
Hillside	Major Mines	Copper (Cu), Gold (Au)	Rex Minerals Ltd		Approved	
Jacinth-	Major Mines	Heavy minerals (HM)	Iluka Resources		Operating	


Status



South Australia's strategic critical minerals

Government of South Australia | ENERGY & MINING | Powered by SARIG

Magnesium



Commodity layer

Name	Mineral deposit links	Resource type	Resource class	Ore Resource	Ore Resource Unit	Resource grade aver.
Sabbage		Non-JORC	Estimated	25000000	Tonne	1
Davenport Creek		Non-JORC	Estimated	50000000	Tonne	1
Limbun Creek		Non-JORC	Estimated	20000000	Tonne	1
No. 1						
Camel Flat						

Reserve and resources

N/A Reserve contained product by tonnes

146M Resource contained product by tonnes

12 Number of mineral occurrences

Mineral occurrence filters

Deposit name: All | Deposit type: All | Deposit status: All

Mineral occurrence deposit status

Ceased 8.33%

Not worked 91.67%

South Australia's mine waste ranking

Government of South Australia | ENERGY & MINING | Powered by SARIG

Feature: All | **Deposit status**: All | **Discovery year range**: All | **Major commodity**: All | **Geochemical associations**: All

Name	Mineral deposit link	Mine waste ranking	Commodities	Major commodity	Geochemical associations	Discovery year	Classification code
West Lagoon		47	Copper, Silver, Cobalt	Cu	Cu-Co-Ag-Bi-Au	1895	Deposit U
Iron Magnet		43	Iron	Fe	N/A	1930	Deposit U
Bunta		42	Copper, Dolomite	Cu	Cu-Co-Ni-Zn-Au-Mo-Fe-U-REE	1845	Deposit U
Iron Duchess South		42	Iron	Fe	N/A	1930	Deposit U
Port Pine Ree		42	Rare Earths, Rutile	REE	N/A	1955	Treatment site O
Iron Chertain		41	Iron, Manganese	Fe	N/A	1933	Deposit U
Iron Knight		41	Iron	Fe	N/A	1930	Deposit U
Kapunda		41	Copper, Rare Earths	Cu	Cu-REE-Sr-Au	1842	Deposit U

Ranking contributions - top values

Location	Ranking
West Lagoon - 2137	47
Iron Magnet - 8279	43
Bunta - 3807	42
Iron Duchess South - 71...	42
Port Pine Ree - 8908	42
Iron Chertain - 7197	41
Iron Knight - 7201	41

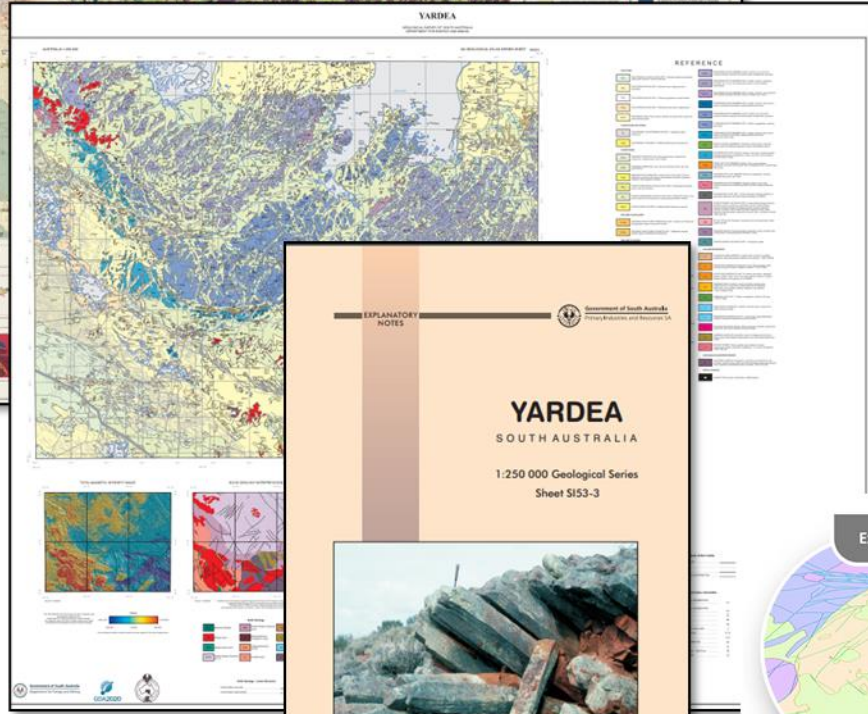
Location



SA Discovery Mapping

Active Project	0%	Completion	100%
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Stuart Shelf Sedimentary- Copper			
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Human Readable



EXPLANATORY NOTES

Government of South Australia
Energy Resources and Development SA

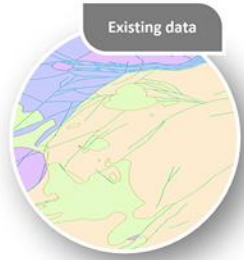
YARDEA

SOUTH AUSTRALIA

1:250 000 Geological Series
Sheet S153-3

Geological Survey of South Australia

MPWA 20180440112



SARIG map

Multi-Media SARIG catalogue

Active Layers

Active Layers displays a list of all map layers that are currently active on the SARIG map. Further options are available for each map layer such as view legend, metadata and map layer downloads. To save and share the current active layers go to the 'Saved Maps' option located on the above toolbar.

Map transparency

Geology - solid geology

Archaean - Early Mesoproterozoic polygons

Archaean - Early Mesoproterozoic faults

SARIG catalogue

Christie Gneiss (ALmc)
Megan Williams, Anthony Reid, Mark Pawley

Description
Predominantly metasedimentary gneiss with migmatitic layers. Felsparitic, iron formation, carbonates, calciculate and quartzite with minor volcanoclastic and mafic lithologies. Max deposition age c. 2485-2480 Ma; metamorphosed c. 2470-2435 Ma. Hosts Challenger gold deposit.

GSSA Status: Described but not defined
Rank: Formation
Parent unit: [Mulgathing Complex \(ALmc\)](#)
Child unit: none
Province: [Christie Domain](#)
Time Mark: [Gardinerian](#)

Summary
The Christie Gneiss occurs in the northern and western Mulgathing Complex, northeast of Tarcoolia, within an area ~25 000 km². Outcrop and drillhole intersections in the area are sparse. The formation consists of compositionally banded metasediments with interbedded felsic and mafic gneissic lithologies. Quartzofeldspathic, migmatitic gneisses with mostly metasedimentary protoliths dominate but are poorly outcropping. Original sedimentary features and more massive lithologies have been identified locally. The most prominent lithology in outcrops is iron formation (magnetite-quartz gneiss) with a banded appearance, associated with thin calciculate and carbonate layers. Minor mafic units also occur, mostly interbedded in drillholes. The formation was deposited in a shortened extensional basin (c. 2530-2480 Ma) and eroded by syn-depositional to syn-tectonic felsic and mafic gneissic units. The Christie Gneiss was metamorphosed to high grade during the Adelaide Orogeny (c. 2470-2435 Ma) with peak conditions of 6-7 kbar and 800-950 °C. Post-Adelaidean re-emergence has resulted in the partial or complete replacement of pyroxene and cordierite with lower grade minerals. The Christie Gneiss hosts gold mineralisation, most significantly at the Challenger lode and Gulf Store. Challenger is interpreted as a metamorphosed deposit, with the host felsic gneisses hydrothermally altered shortly before high-temperature Adelaidean metamorphism. Gold-bearing structures typically have abundant coarse-grained magnetite inclusions. Disseminated sulphides are common in the quartzofeldspathic lithologies, including associated with gold mineralisation. The formation is completely foliated (at least 4 generations of deformation) and intersected by multiple deep north east trending shear zones. Iron formations and mafic units have strong magnetic responses, but the predominant felsic gneisses have low magnetic responses.

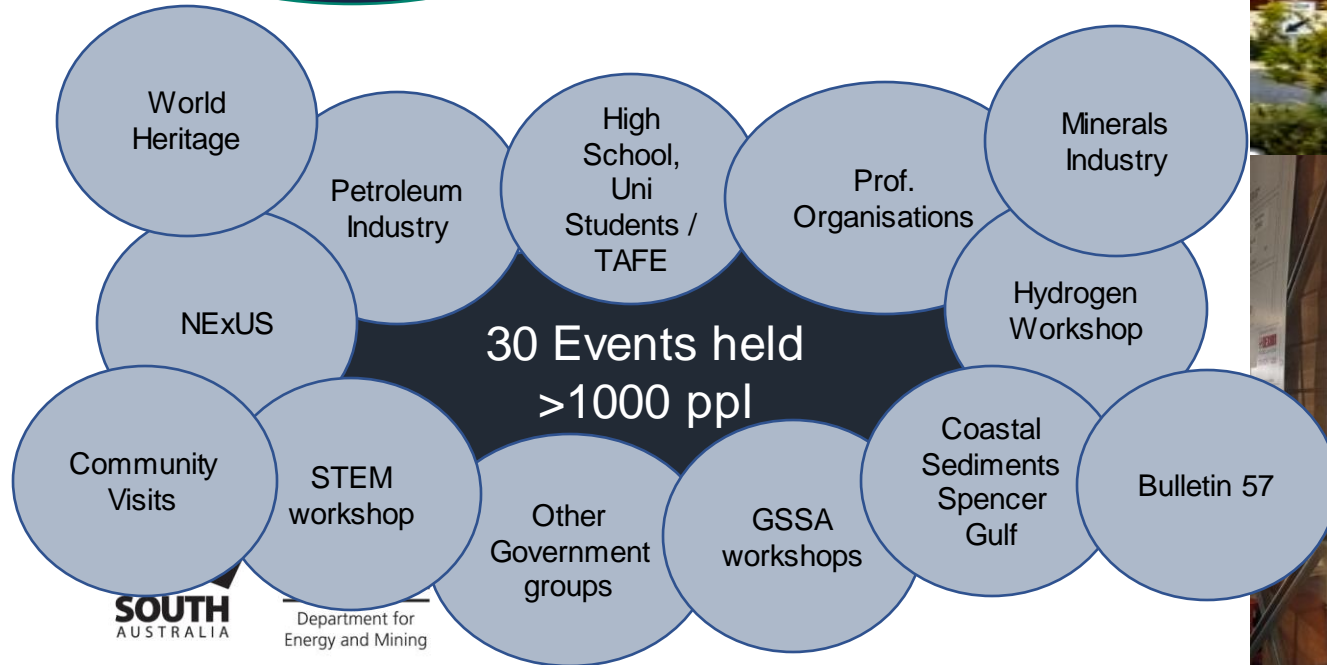


DIGITAL DELIVERY
Innovation, digital science
and insight

Drill Core Library 2023 Tonsley

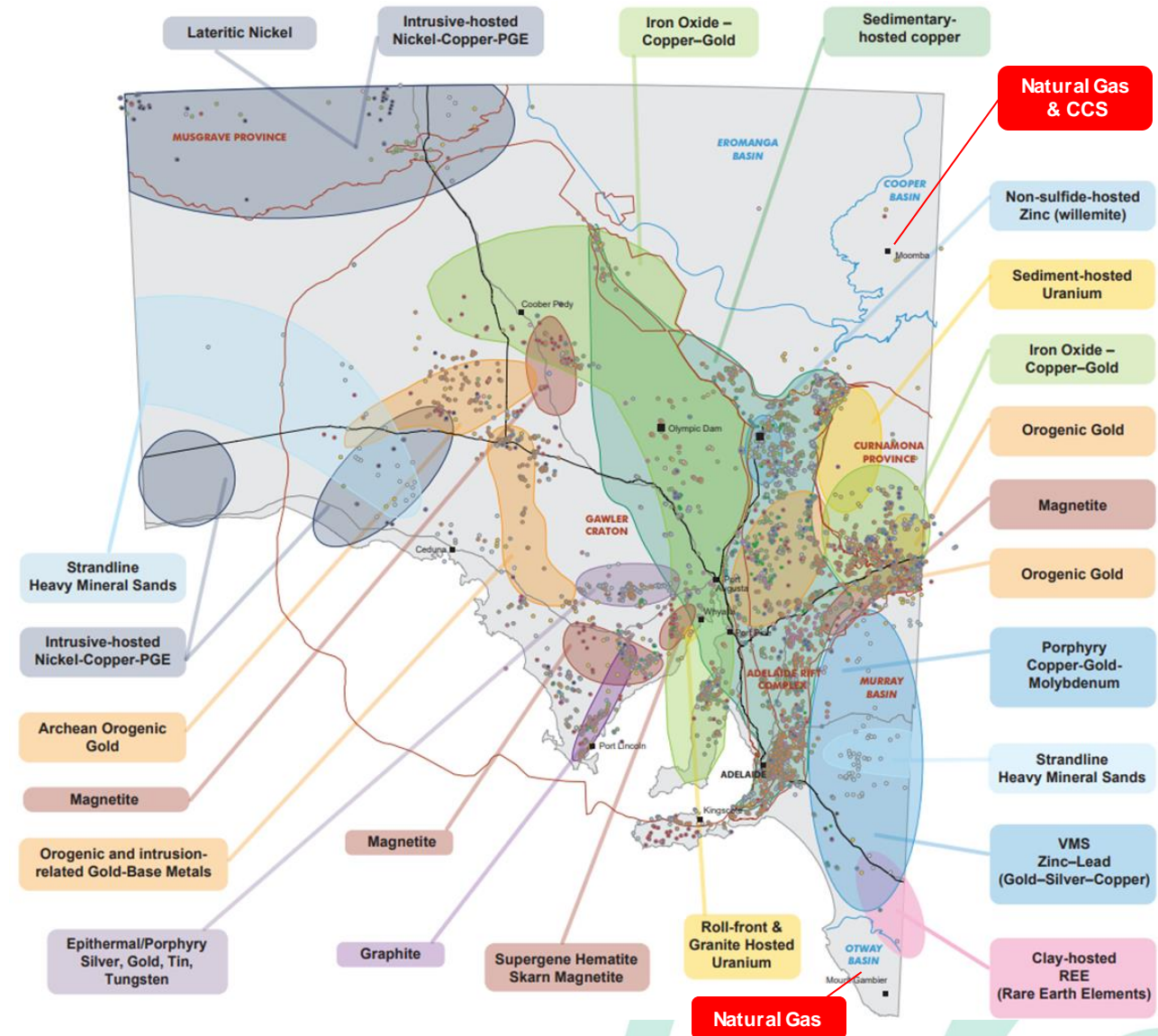
150 Inspections
194,427m core
and cuttings
viewed

17,162 trays laid
out
2209 samples taken
for analytical work



What's Next?

- Precompetitive Data Economic Review for SA
- Critical Minerals SA Project: (YE 2024)
- SA Discovery Mapping (MY 2025)
- Cooper Basin Gas (ongoing)
- Geochronology (YE 2024)
- **NDI Round 2 (late 2024-25)**
- GSSA Digital Strategy: Digital to the Core
- Data Delivery: Explore | Map | Catalogue
- ?Digitising the Core Library?
- ?More geophysics?
- ?More natural gas?

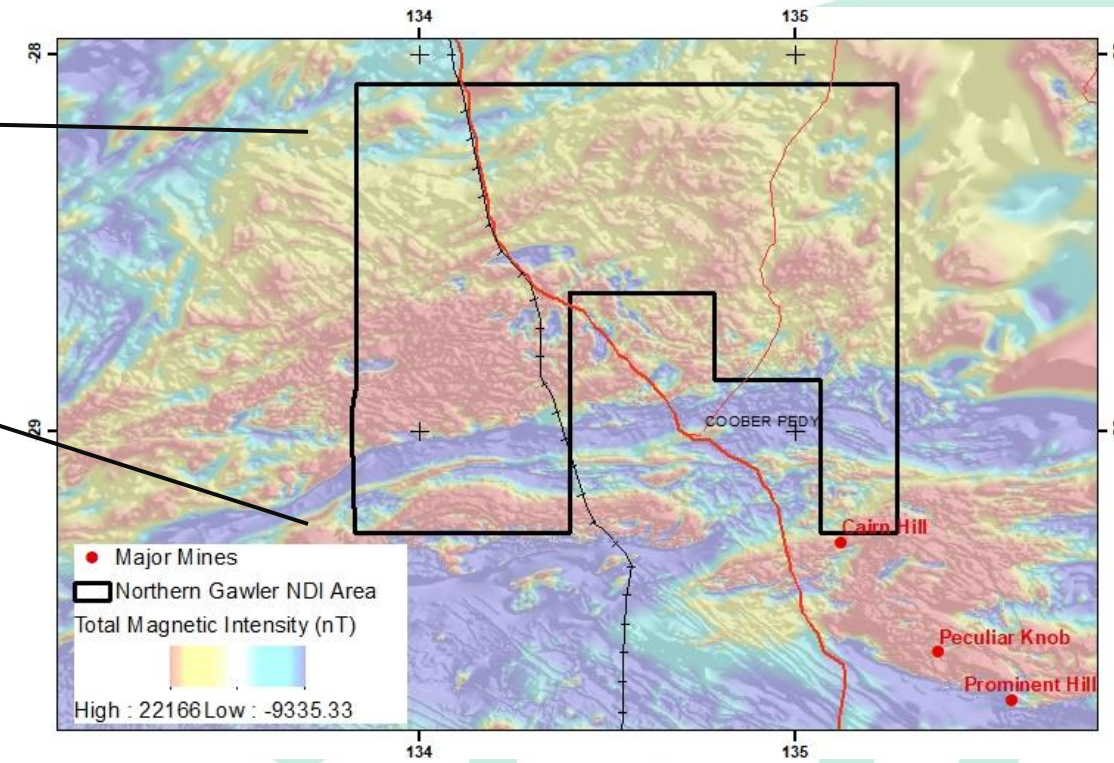
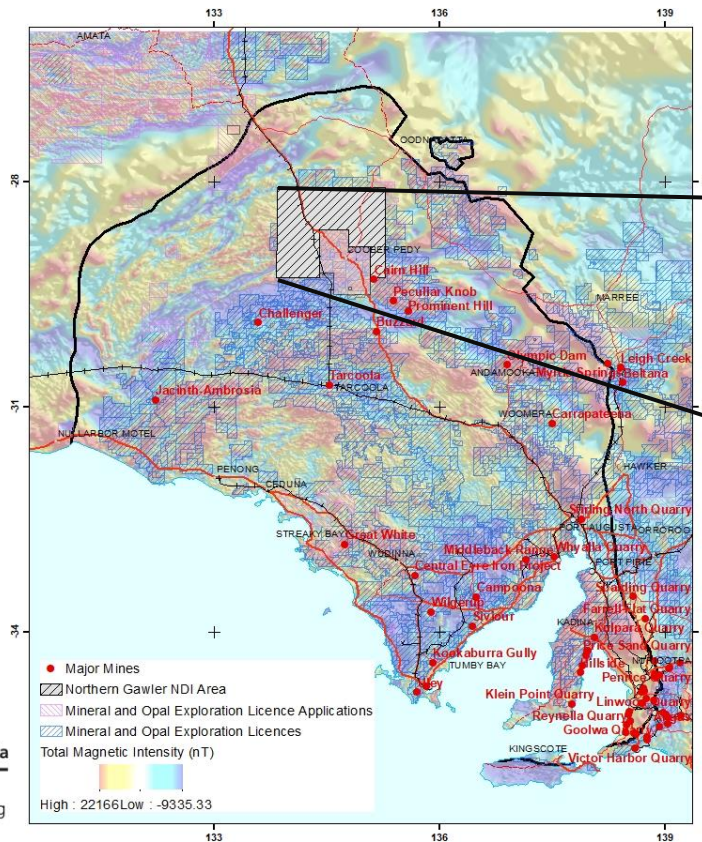


Northern Gawler Craton: NDI #2

- Copper-Gold, Nickel focus
- Stimulate greenfields exploration under deeper cover (200-400 m)



Petratherm eastern Mabel Creek Ridge drilling; Open File Envelope 11316



Government of South Australia
Department for Energy and Mining

Thank you for listening

Bronwyn Camac, Director, Geological Survey of South Australia

Department for Energy and Mining

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