Copper to the World

South Australia:
Copper Capital Powering the Decarbonisation Agenda

Dr Paul Heithersay | Tuesday 18 June 2024

energymining.sa.gov.au

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Government of South Australia
Department for Energy and Mining

Acknowledgement of Country

As guests here on Kaurna land, we acknowledge everything this department does impacts on Aboriginal country, the sea, the sky, its people and their spiritual and cultural connection 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.

Ngaityalngadlu taikunthitya yalaka

Yantupinarna Kaurna yartangka, ngadlu tampinthi tupa yaintya pirku wapinthi, wiwunthi yaitya yarta, yarlu, ngayirda, miyurnakuma parnaku tuwila tapa purruna tarraitpayinthi. Muna tirntu parrka-parrka wanti.

Ngadluku taingi ngutu yungkurrinthi, tampinthi yurni ngantanthi pukingka, niipurna pintyathi mankurrititya, taingintya tarrkarri pintyanthi.

Nata ngadlu padnitha, tirkatha Kuma kumangka warpulayi-utha.

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% Annual Variable Wind and Solar Renewable Energy

2 Denmark

3 Ireland

4 Germany

5 Spain

6 United Kingdom

7 Chile

8 Australia

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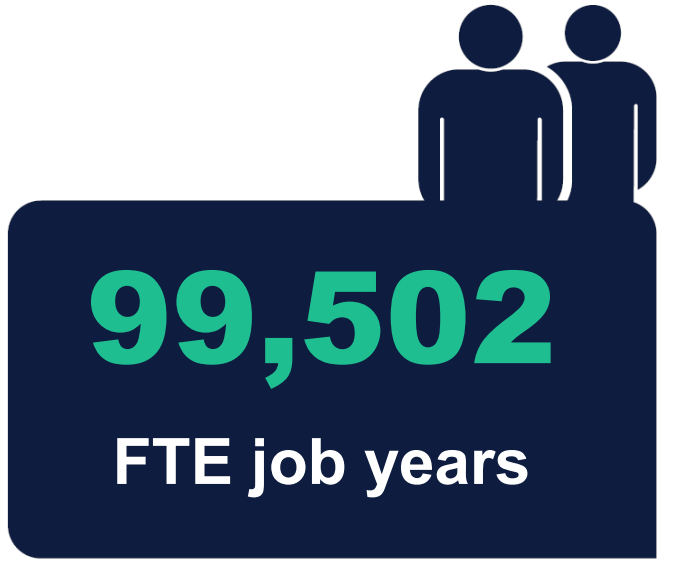
OFFICIAL

GEOSCIENCE
DISCOVERIES
INVESTMENT
MINING

By 2050 minerals for the global green transition can add



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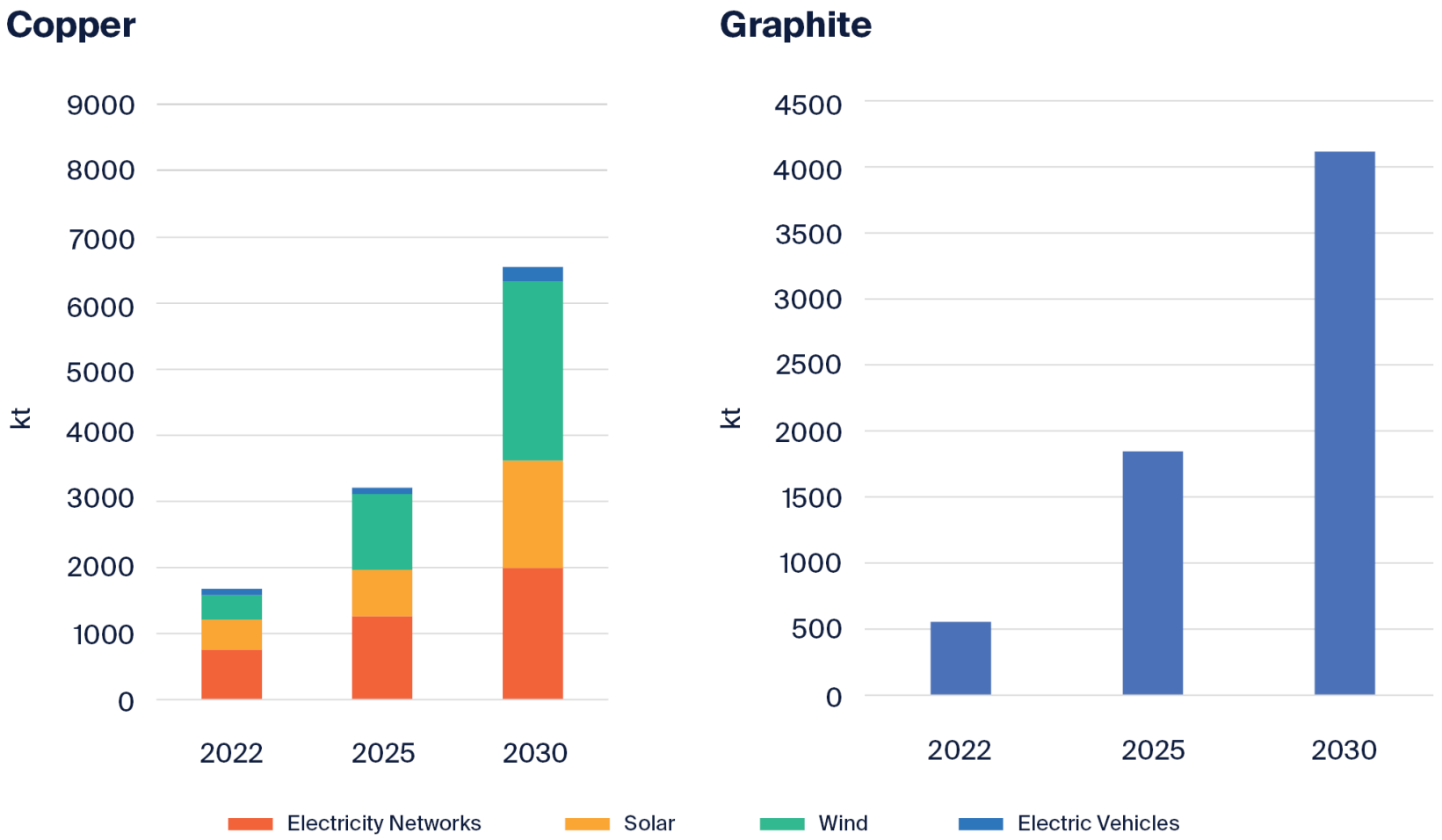
ACIL Allen 2023

Close to tripling in demand for copper energy minerals by 2030



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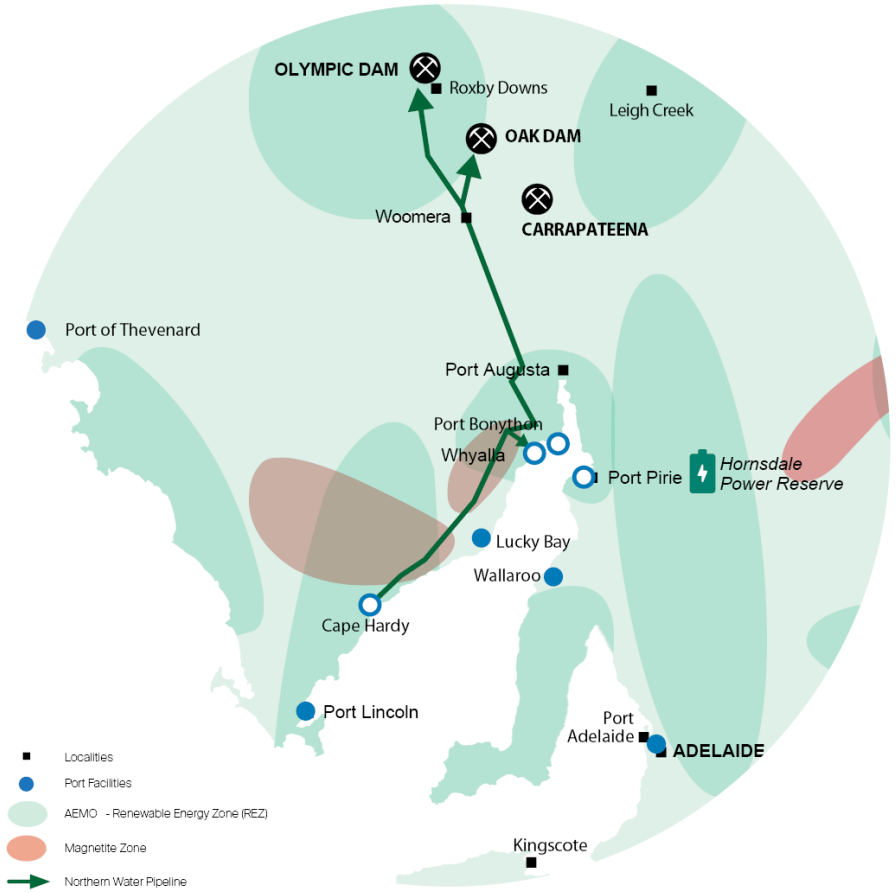
IEA 2023

Capitalise on the global green transition

Leveraging South Australia's sustainability credentials and natural endowment to provide green energy, products and services to the world, contributing to both our smart and sustainable economy ambitions.



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South Australia's Copper Growth Strategy

Accelerate exploration, **discovery** and information

Develop **innovative** infrastructure, services and research

Engage to build **industry** and **community** capacity

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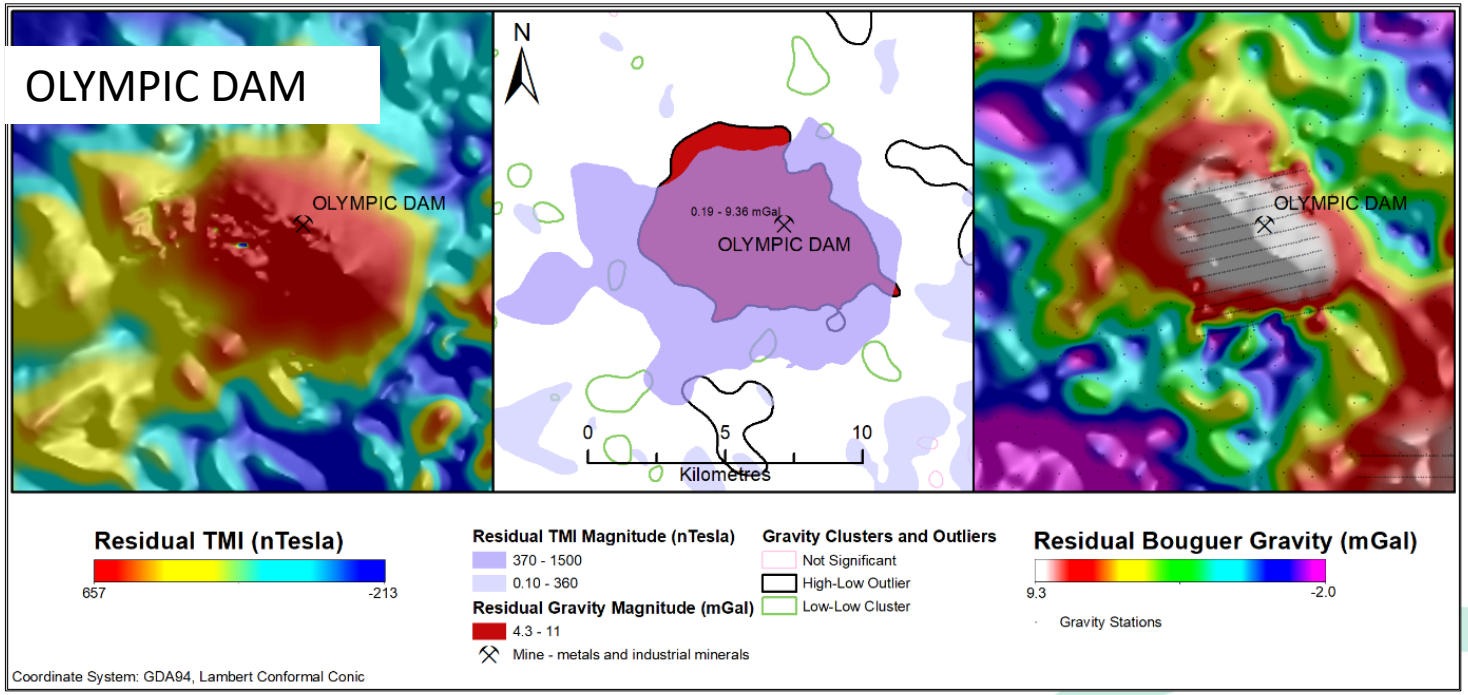
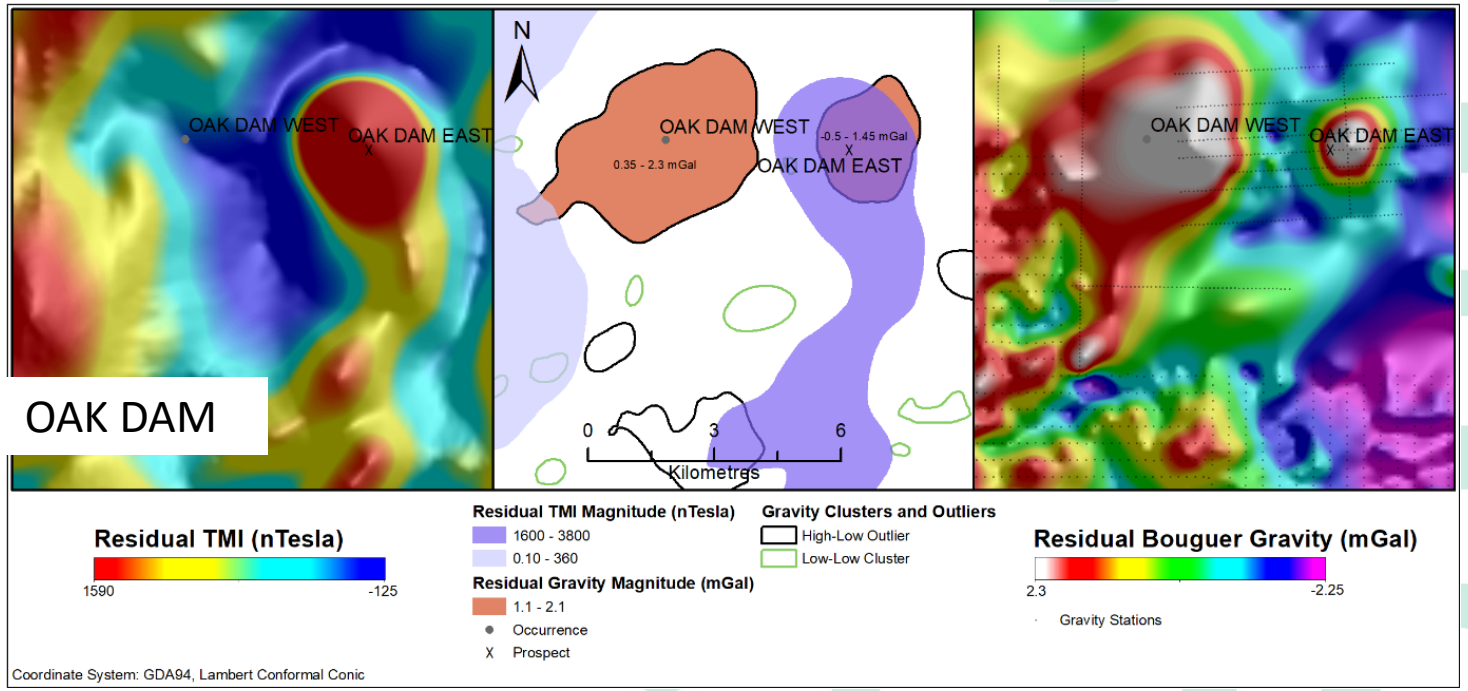
Deposit Footprints

- Spatial statistics to quantify correlations between magnetic and gravity responses
- Gravity and magnetic polygons over selected IOCG deposits/prospects
- Oak Dam West gravity high





Katona and Fabris, in press. GAC-MAC 2019, Quebec, SC Volume "Exploring for IOCG Deposits"

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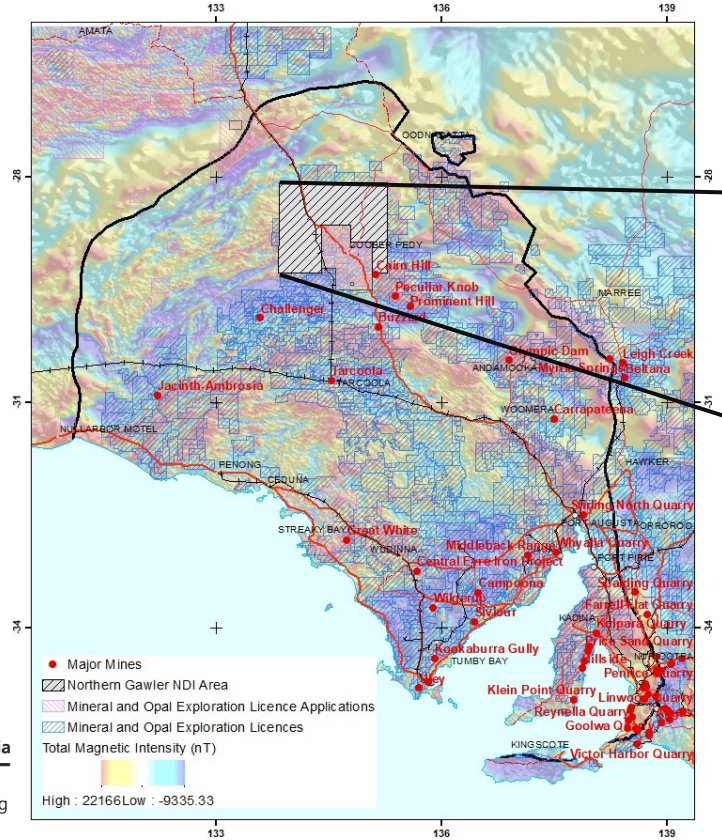
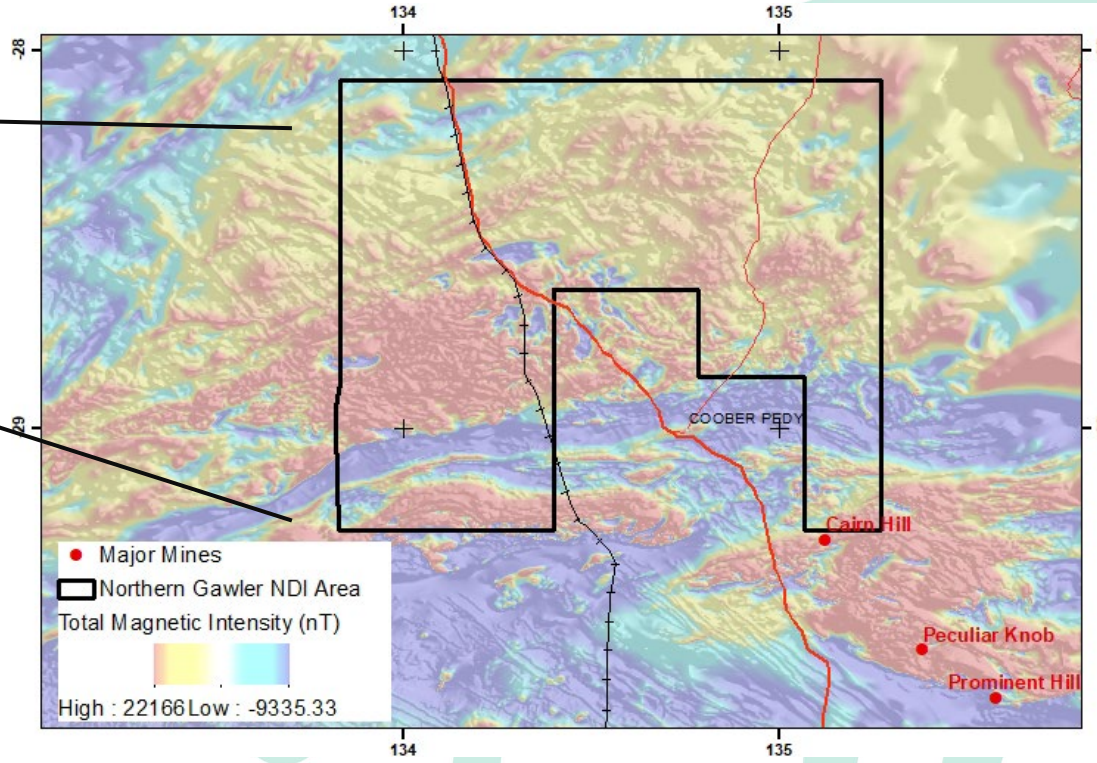
Department Energy and M

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





MinEx CRC

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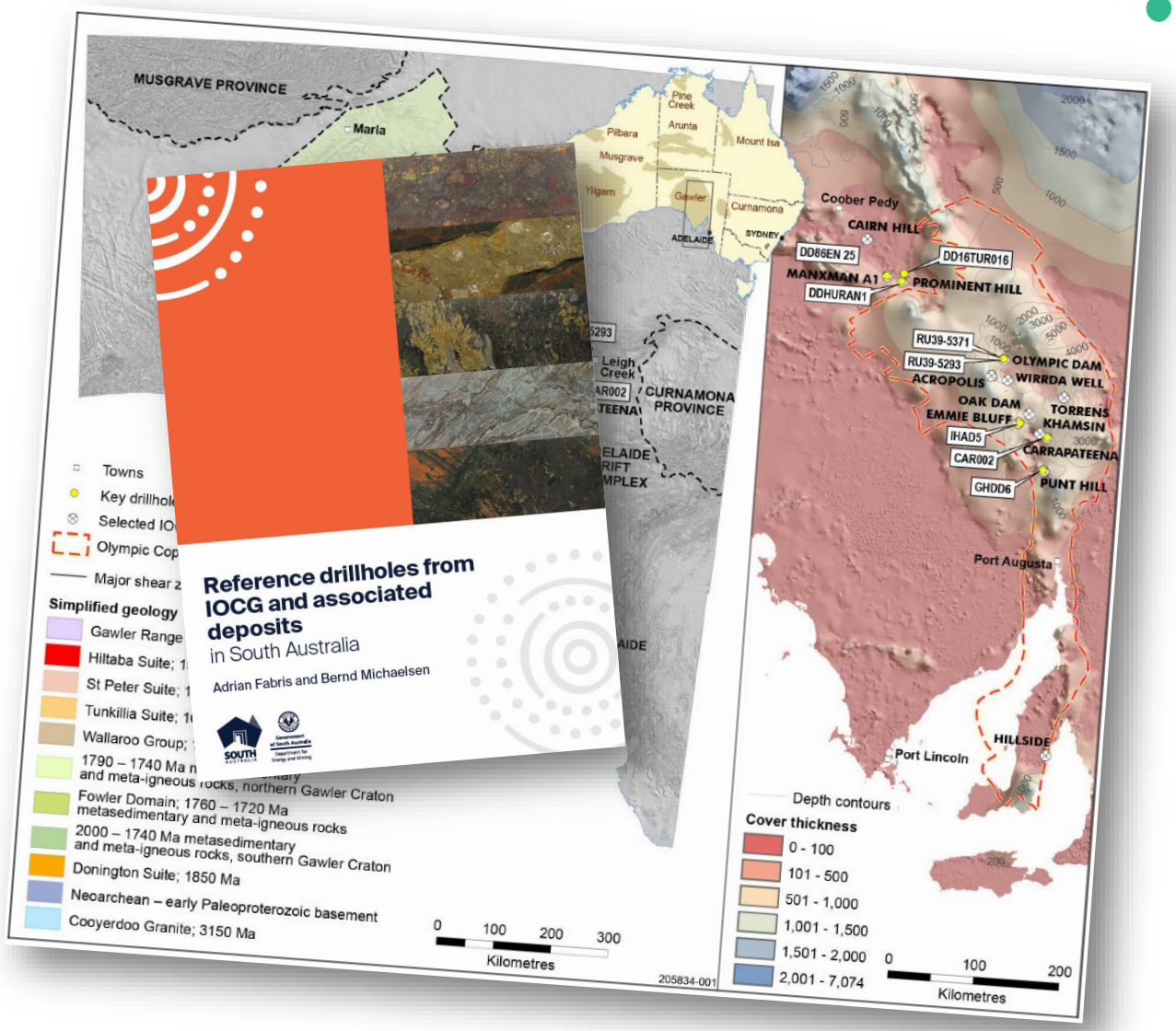
New Release - Reference Drillhole Report from selected IOCGs

- Report describes drillholes from 7 selected SA's iron oxide copper-gold (IOCG) deposits and prospects
- Highlights diversity in alteration and mineralisation styles, **aiding exploration** and understanding of **mineral potential**
- Reference tool: useful for studying IOCG deposits in SA, including looking at examples of IOCG deposits in drill core.
- Access: Drillholes are available at the SA Drill Core Reference Library, Tonsley, for viewing on request.



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GP2 Value added data

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

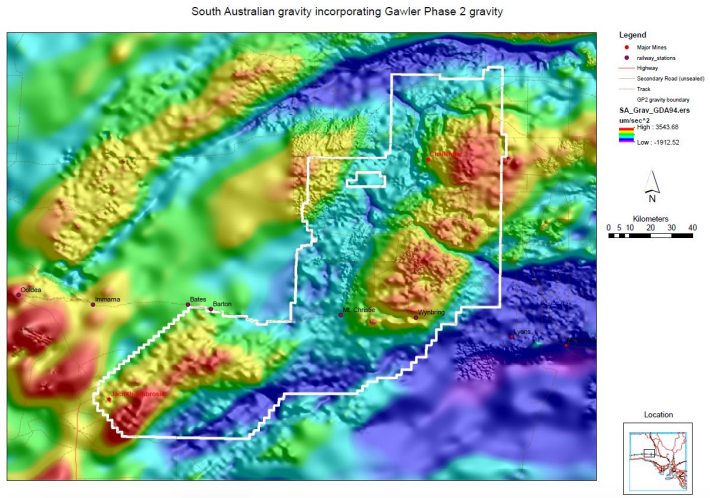
307 new site observations
→ 3D models of the crust

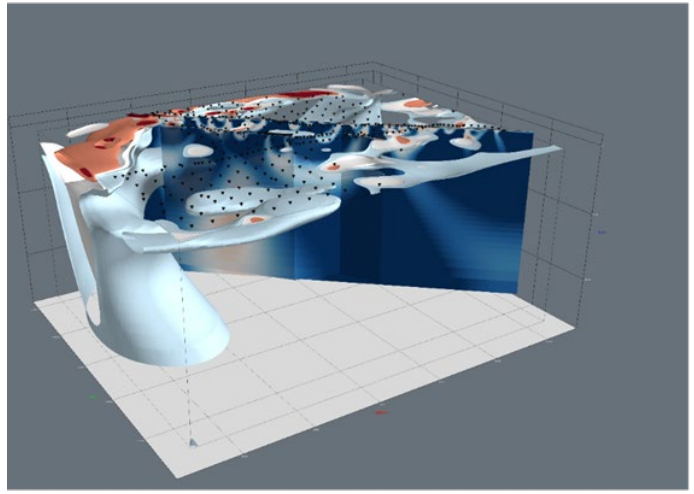
over 300 new samples
→ to constrain basement geology mapping and inform on geological evolution

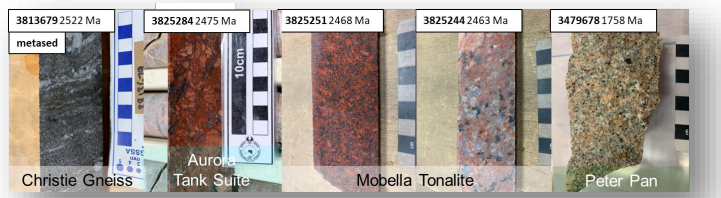
thousands of new surface and subsurface lineaments mapped
→ to connect basement to cover

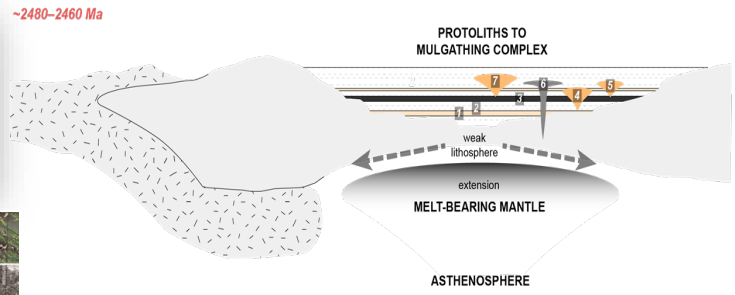
two new palaeochannel layers
→ new search space for mineralisation and groundwater

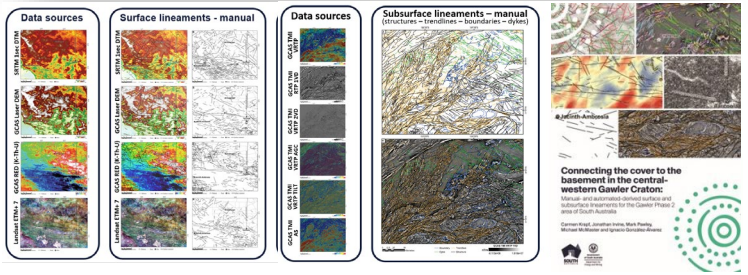
> thousands new legacy data

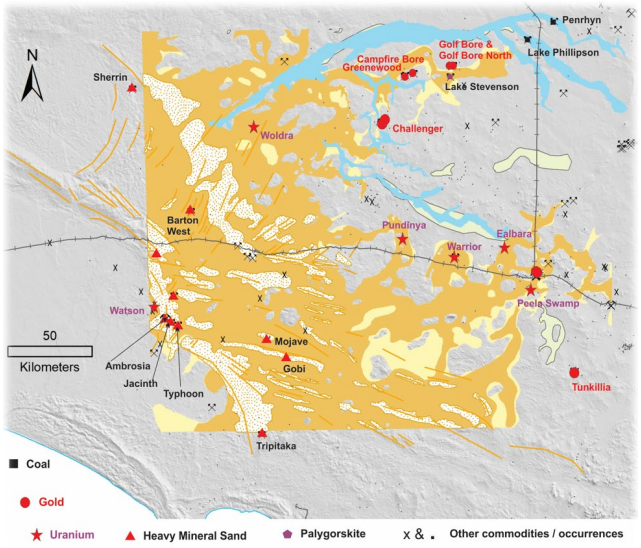


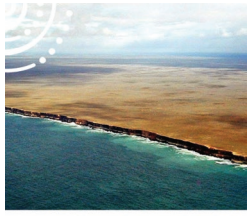




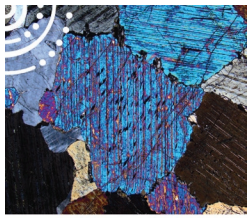








Eucla Basin and peripheral paleovalleys
B Hou, J Keeling, A Reid, A Petts and L Stolan

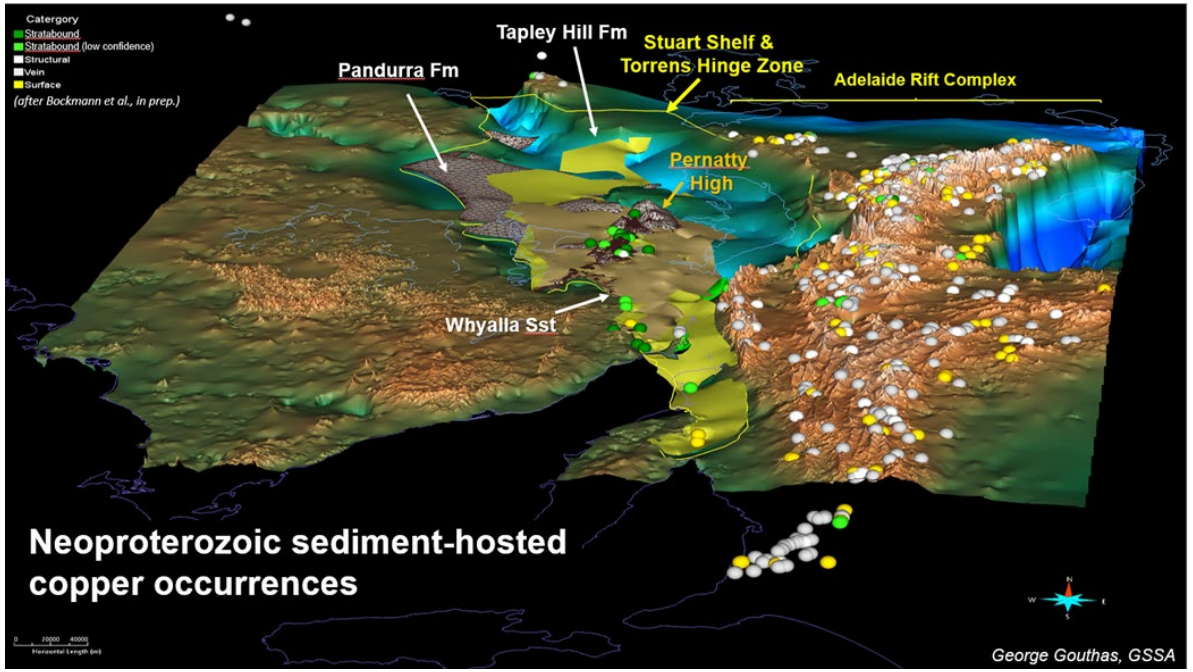


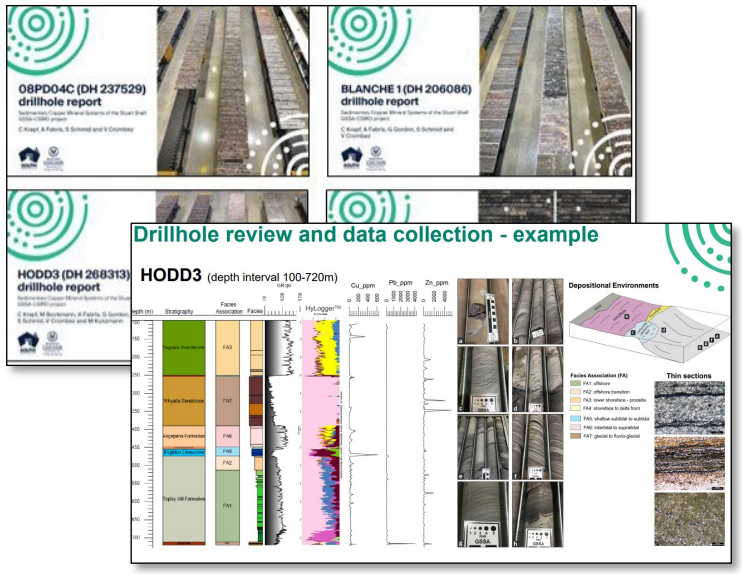
Multi-isotopic apatite and zircon SHRIMP U–Pb geochronological results from the central-western Gawler Craton
Dillon Brown, Anthony Reid, Elizabeth Jagodzinski, Megan Williams, Mark Pawley, Chris Kirkland, Alex Simpson, Stijn Glorie and Bruno Ribeiro

Zircon LA–ICP–MS geochronological and geochemical results from the central-western Gawler Craton
Dillon Brown, Mark Pawley, Megan Williams, Anthony Reid and Elizabeth Jagodzinski

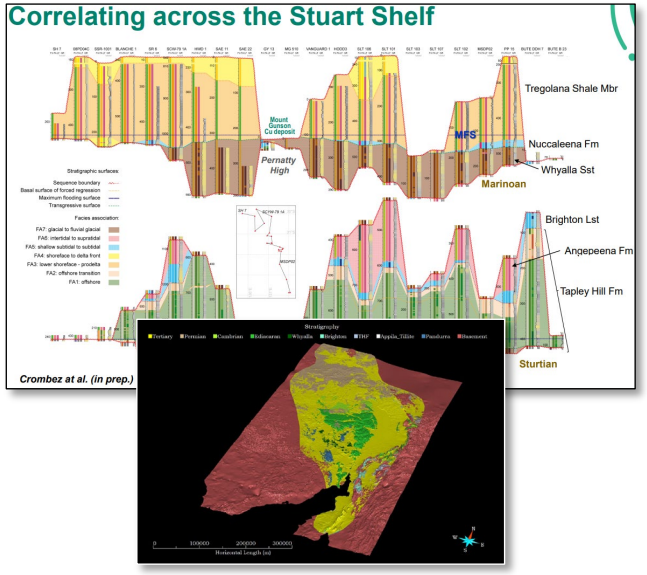
Sedimentary Copper Mineral Systems of the Stuart Shelf

Joint project with CSIRO focused on sedimentary copper potential of the Stuart Shelf

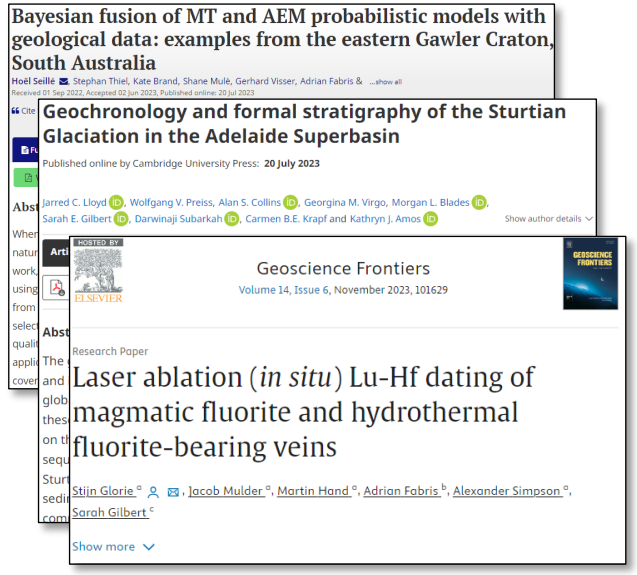




Drillhole summary reports



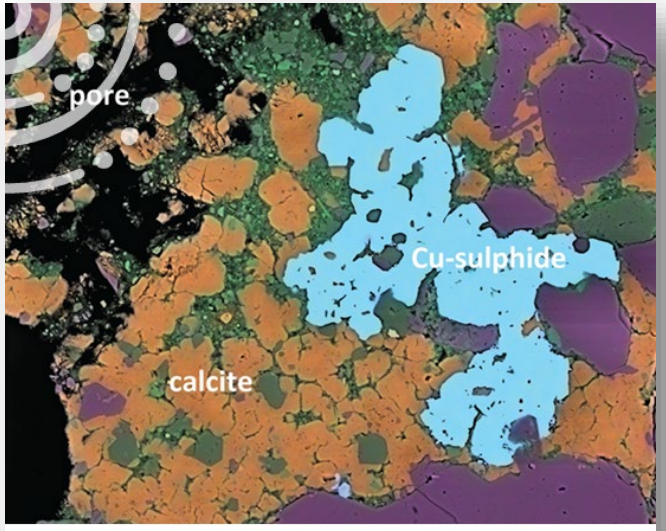
Cross-sections and models



Scientific papers

Sedimentary Copper Mineral Systems of the Stuart Shelf

Joint GSSA-CSIRO project to develop a robust model and understanding of the basin architecture of the Stuart Shelf to guide exploration for sedimentary copper in this area.

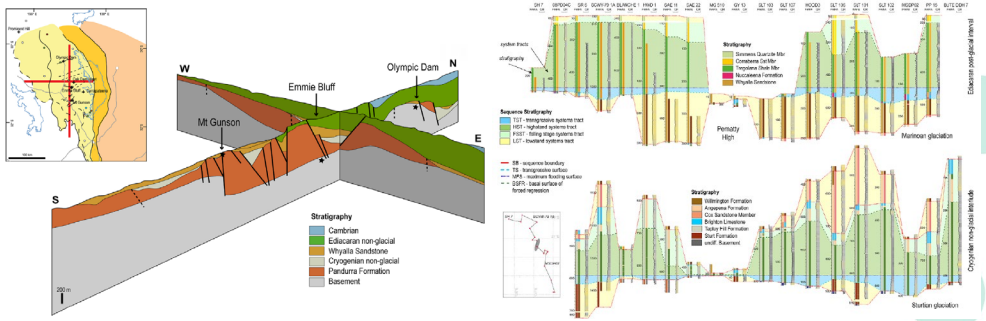


Sedimentary Cu mineral systems, Stuart Shelf, South Australia

Metadata report

Susanne Schmid, Carmen Krapf, Clive Foss, Andrew King, Giovanni Spampinato, Vincent Crombez, Aaron Davis, Tobias Schlegel, Adrian Fabris, Mitchell Bockmann, George Gouthas and Georgina Gordon

- New report with associated data package has been released summarising the methodologies and new datasets created by the CSIRO-GSSA project team. Includes drillhole characterisation and basin evolution, assessment of AEM to map basin architecture and an updated 3D model of the Stuart Shelf.
- New paper providing new insights on the Cryogenian and Ediacaran stratigraphy of the Stuart Shelf, marking a significant leap forward in our geological understanding.



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Taylor & Francis
OPEN ACCESS

Stratigraphy and sequence stratigraphy of the Neoproterozoic (Cryogenian–Ediacaran) Stuart Shelf, South Australia

S. Schmid[a], C. B. E. Krapf[b], V. Crombez[a], G. Spampinato[a], A. J. Fabris[b], A. King[a] and M. J. Bockmann[b]

[a]CSIRO Mineral Resources Australian Resources Research Centre, Kensington, WA, Australia; [b]Department for Energy and Mining, Geological Survey of South Australia, Adelaide, SA, Australia

ABSTRACT

The Stuart Shelf is part of the Adelaide Superbasin overlying the Gawler Craton and Curiewerloo Basin in South Australia. The basin is of interest for sediment-hosted copper mineralisation known to be hosted in numerous stratigraphic intervals across the region. Therefore, facies analysis and understanding of spatial distribution of host units are essential for exploration targeting and mineral systems research. Our study presents improved and new definitions of Cryogenian and Ediacaran Stuart Shelf stratigraphy, and a detailed, regional-scale sequence stratigraphic analysis. The Cryogenian non-glacial interlude was of particular interest, as it includes the Tapley Hill Formation, a known host for copper mineralisation. The succession of Tapley Hill Formation (including Sturtian cap carbonates), Brighton Limestone and Angepena Formation represents a third-order depositional cycle, an equivalent to the lowermost cycle of the Cryogenian non-glacial interlude in the adjacent Adelaide Rift Complex. The Ediacaran post-glacial succession includes the Nuccaleena Formation and Tent Hill Formation and is interpreted as a second-order depositional cycle. The Sturtian and Marinoan cap carbonates form regional stratigraphic marker horizons and were deposited in a transgressive systems tract. Variations in facies and thickness can be linked to development of localised depocentres and topographic highs, such as the Pernatty High. Modelling of 3D surfaces reveals a shift in the basin orientation between the Cryogenian and Ediacaran sedimentation from an NNW–SSE axis towards a N–S axis. The Stuart Shelf sequence stratigraphic framework provides new insights in the basin sedimentology and evolution, which aids sediment-hosted mineral systems analysis and improves the understanding of Cryogenian and Ediacaran basin evolution in Australia.

ARTICLE HISTORY
Received 4 December 2023
Accepted 5 April 2024

KEYWORDS
Sequence stratigraphy; Neoproterozoic; copper; mineral systems; Cryogenian; Ediacaran

KEY POINTS

1. The Cryogenian non-glacial interlude on the Stuart Shelf represents a third-order depositional cycle.
2. The Pernatty High develops during deposition of the Cryogenian successions.
3. The Stuart Shelf basin orientation shifts from NNW–SSE during the Cryogenian towards N–S in the Ediacaran.
4. 3D stratigraphic surfaces aids copper exploration targeting in sediment-hosted mineral systems.

Introduction

Sedimentary basins host economically valuable metals, such as copper, lead, zinc, uranium, and critical minerals like cobalt, REE and lithium. The understanding of basin stratigraphy, architecture and evolution is fundamental in mineral exploration targeting using a sediment-hosted mineral systems approach. Facies analysis is one of the first steps in evaluation of prospectivity and comprises descriptions of depositional environments based on sedimentary structures and lithology.

The stratigraphic framework and understanding of depositional environments allow prediction of the spatial extent of favourable host units. Thus, establishing such a framework is of essence for any further research in understanding and locating copper mineralisation within the basin using a mineral systems approach. Here we present a description of stratigraphy, lithology, depositional environments and show their distribution across the Stuart Shelf.

The Neoproterozoic Stuart Shelf in South Australia hosts several copper deposits with most notable mineralisation at Mount Gunson, Myall Creek, Emmie Bluff and Sweet Nell (Bockmann *et al.*, 2022; Tonkin & Creelman, 1990). Together with the Adelaide Rift Complex, its eastern neighbour, it represents one the of the most prospective sediment-hosted copper provinces in Australia. There are 662 known copper occurrences hosted within the Neoproterozoic strata within the Adelaide Superbasin (including Stuart Shelf, Torrens Hinge Zone, Adelaide Rift Complex; Bockmann *et al.*, 2022). Noticeable

CONTACT S. Schmid Susanne.Schmid@csiro.au CSIRO Mineral Resources Australian Resources Research Centre, Kensington, WA, Australia
Editorial handling: Anita Andrew
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South Australia's strategic critical minerals

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29 Cu Copper 63.54

27 Co Cobalt 58.933

6 C Graphite 12.01

Kaolin-Halloysite $Al_2Si_2O_5(OH)_4$

HM Heavy Minerals

3 Li Lithium 6.9410

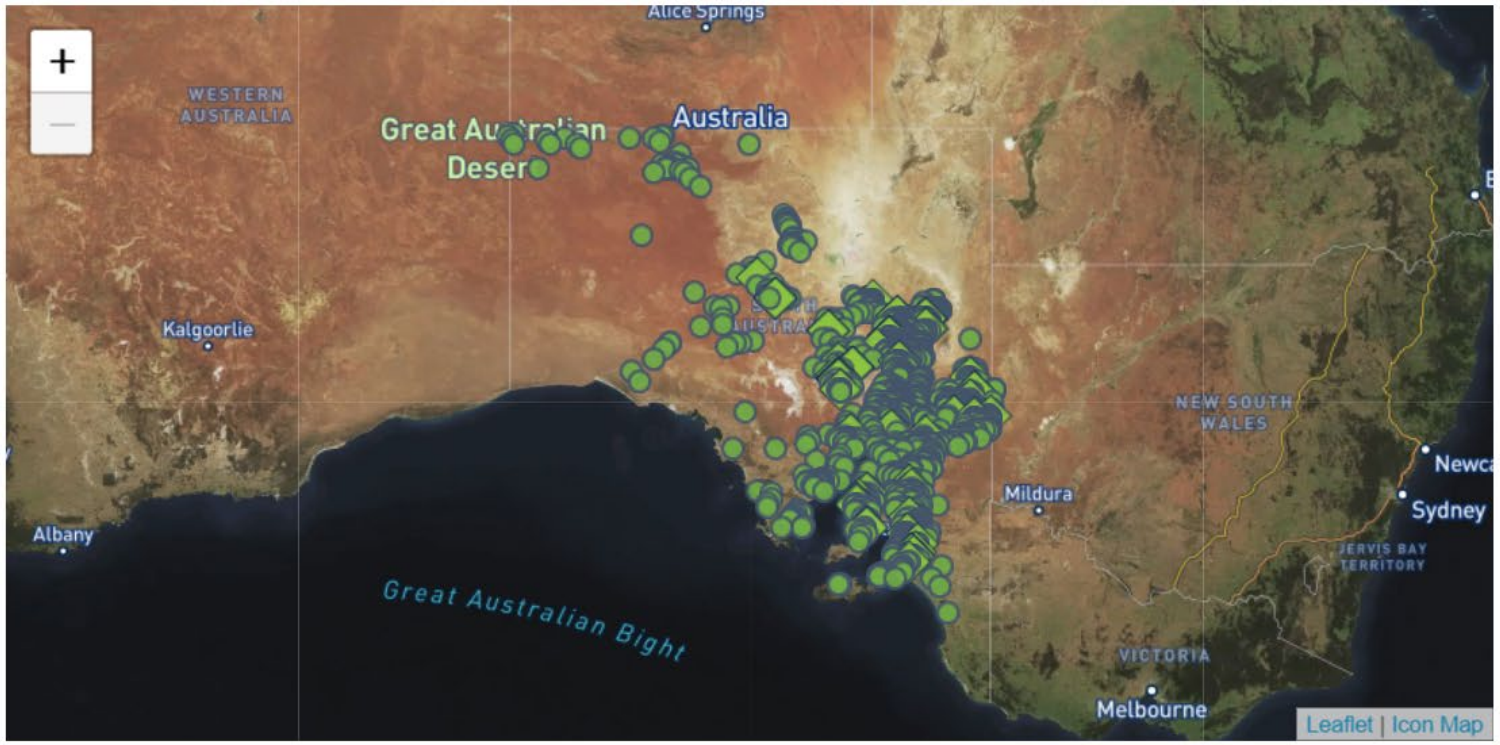
12 Mg Magnesium 24.305

25 Mn Manganese 54.938044

REE Rare Earth Elements

23 V Vanadium 50.942

Copper



Commodity layer: All

Infrastructure layer: No Infrastructure layer

RESET

Name	Mineral deposit links	Resource type	Resource class	Ore Resource	Ore Resource Unit	Resource grade average
Carrapateena		JORC mineral resource	Measured	140000000	Tonne	1.10
Hillside		JORC mineral resource	Total mineral resource	337000000	Tonne	0.56
Kalkaroo		JORC mineral resource	Total mineral resource	245480000	Tonne	0.49
Kanmantoo		JORC mineral resource	Total mineral resource	6400000	Tonne	1.09
Olympic Dam		JORC mineral resource	Total mineral resource	11320000000	Tonne	0.71

Reserve and resources

15M — Reserve contained product by tonnes

91M — Resource contained product by tonnes

1603 — Number of mineral occurrences

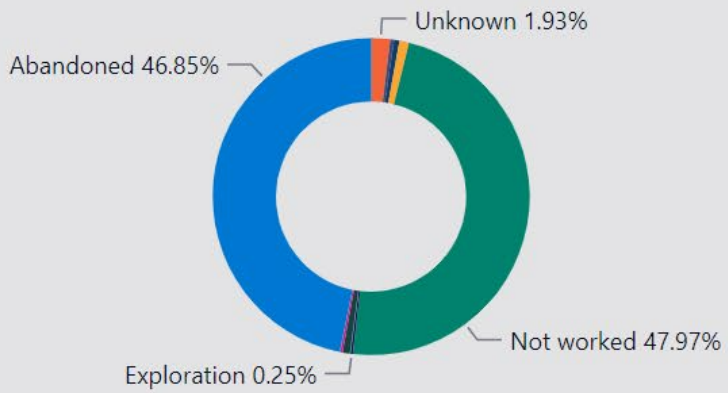
Mineral occurrence filters

Deposit name: All

Deposit type: All

Deposit status: All

Mineral occurrence deposit status



South Australia Drill Core Reference Library

Hosts geological drill core and samples recovered from over **130 years** of exploration for minerals and energy resources.

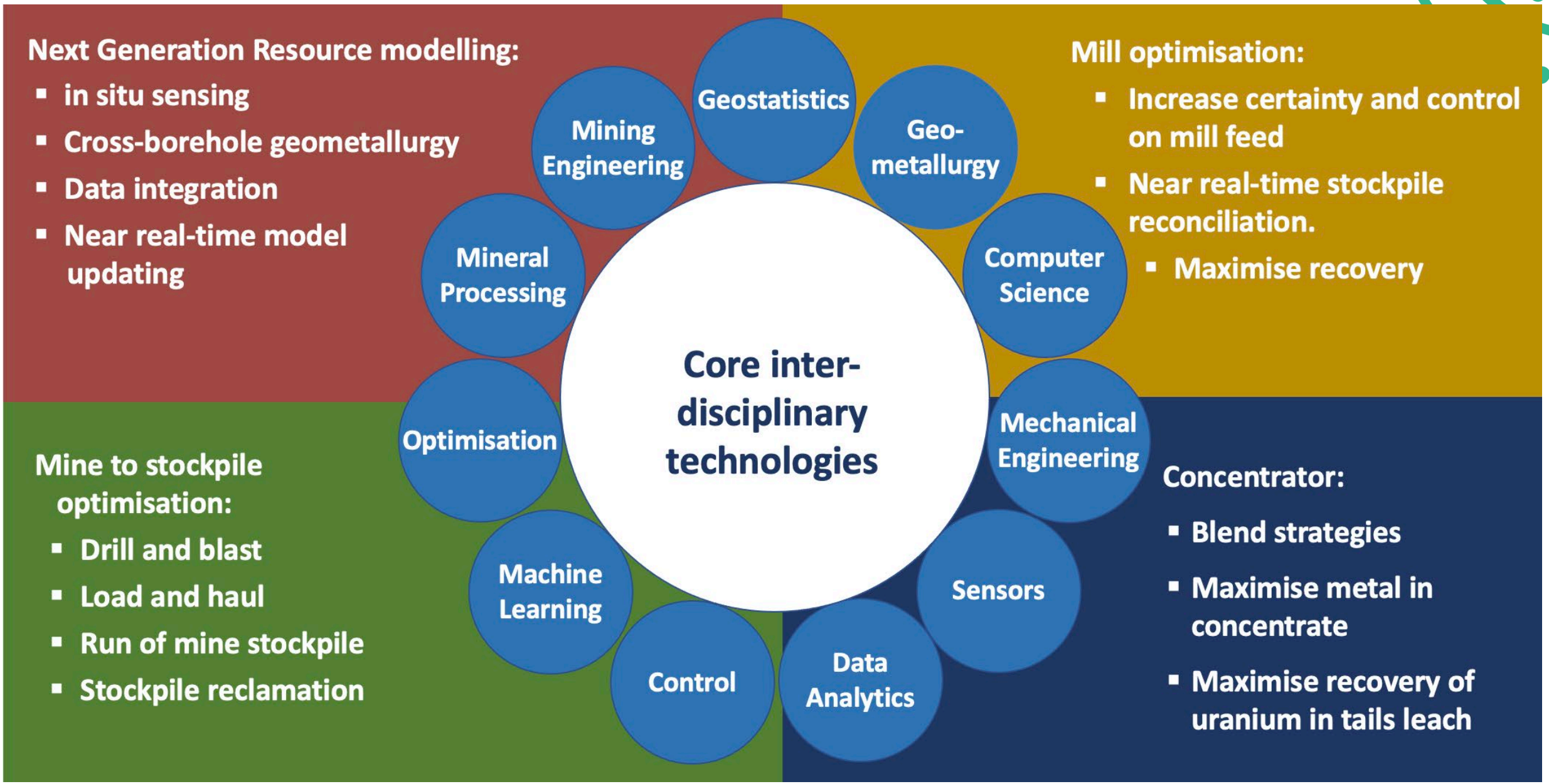
→ **Opportunities to uncover future copper and critical minerals resources**








PRIF Integrated Mining Consortium



PRIF Integrated Mining Consortium

Research and industry partners

BHP

Think & Act Differently
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DASSAULT SYSTEMES

MAPTEK

eka

ORICA

VERACIO

MZ Minerals

MAGOTTEAUX

PETRA

CRC ORE

SCANTECH

METS IGNITED

Rockwell Automation

MANTA CONTROLS

RoqSense

THE UNIVERSITY of ADELAIDE

University of South Australia

Government of South Australia

BUREAU VERITAS

RESA Capability Solutions

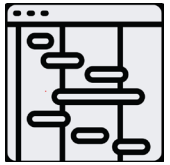
amira

Curtin University

Digital transformation
How will mining and exploration regulation system benefit industry?

MERS will:

- provide industry with the ability to monitor application progress and assessment timeframes
- allow industry to track critical regulatory dates and manage reporting requirements
- reduce assessment and approval timeframes
- provide tenement holders with account management functionality
- enable community to more easily access publicly available information.




Olympic Dam
Roxby Downs
Oak Dam
Carrapateena
Ceduna
Port Augusta
Whyalla
Port Pirie
Port Lincoln
ADELAIDE
Solar & Wind
Copper
Magnetite Iron Ore
Port Facilities
Smelters & Steelworks
Northern Water

Company Activity

Olympic Dam – BHP investigating two-stage smelter to expand production

Kanmantoo – Hillgrove Resources successfully commissioned processing facility, producing copper concentrate in 2024

Selected developing projects

- Hillside – Rex Minerals
- Kalkaroo – Havilah Resources, approved
- Oak Dam – BHP, resource definition
- Elizabeth Creek – Coda Minerals
- Kapunda – Enviro Copper

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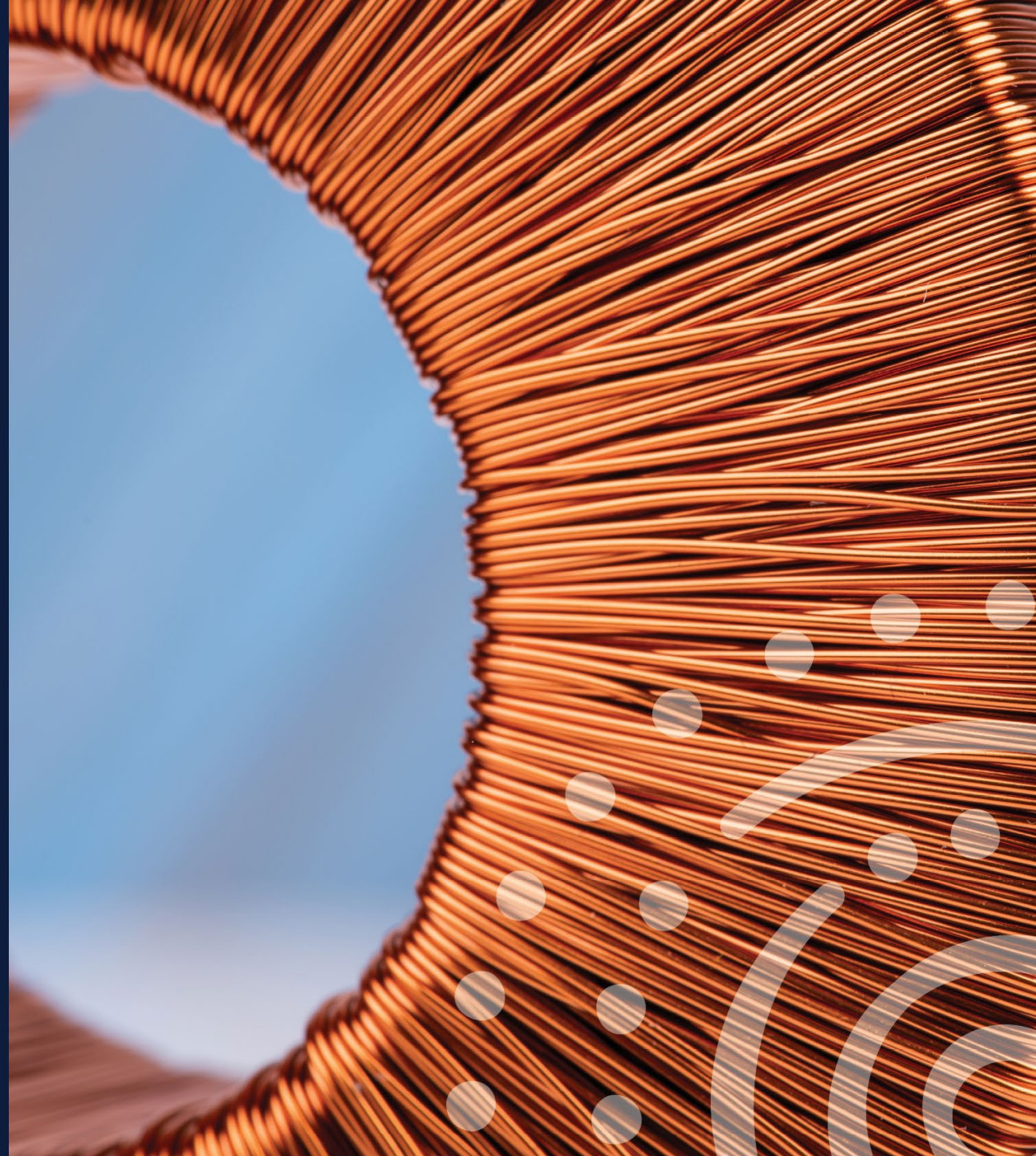
SOUTH AUSTRALIA'S COPPER STRATEGY

Creating more value from copper while powering the world's clean energy and technology transformation



Contacts

Dr Paul Heithersay, CE

Department for Energy and Mining

11 Waymouth Street,
Adelaide, South Australia 5000
GPO Box 320
Adelaide, South Australia 5001
E: demreception@sa.gov.au

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