

# Environmentally sustainable production of critical metals: a new Tasmania-focused research project at CODES/UTAS

Regional Research Collaboration Program: Building capacity in regional Australia to enhance Australia's economy through research, training and environmentally sustainable production of critical metals (RRC)

**Julie Hunt<sup>1</sup>, David Cooke<sup>1</sup>, Sharon Fraser<sup>2</sup>, Lejun Zhang<sup>1</sup>**

# Why critical minerals/elements ?

Scheelite on muscovite (China)



Scheelite on quartz (Europe)



Sources: [www.itia.info](http://www.itia.info); [www.mindat.org](http://www.mindat.org)

Wolframite on quartz (Tasmania)



# Critical minerals/elements

- A 'critical mineral' is a metallic or non-metallic element that has two characteristics:
  - **It is essential for the functioning of modern technologies, economies or national security**
  - **There is a risk that its supply chains could be disrupted**
- Critical minerals are used to manufacture advanced technologies including mobile phones, computers, fibre-optic cables, semi-conductors, banknotes, and defence, aerospace and medical applications. Many are used in low-emission technologies such as electric vehicles, wind turbines, solar panels, and rechargeable batteries. Some are also crucial for common products such as stainless steel and electronics.
- Risks to critical mineral supply chains can come about when mineral production or processing is dominated by individual countries or companies that could limit availability. Other risks include market immaturity, political decisions, social unrest, natural disasters, mine accidents, geological scarcity, pandemics, and war.
- Individual countries develop their own lists of critical minerals based on the relative importance of particular minerals to their industrial needs and strategic assessment of supply risks. In addition, assessments of mineral criticality reflect market and political conditions at a particular point in time and are subject to change.

<https://www.ga.gov.au/scientific-topics/minerals/critical-minerals>

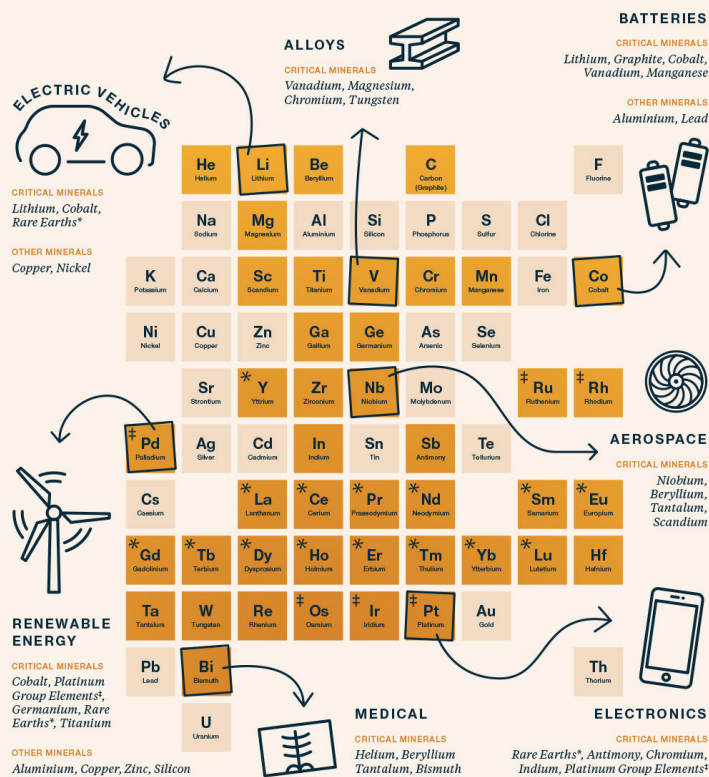
# Australian Critical Minerals resource wealth

CRITICAL MINERALS  
OTHER MINERAL RESOURCES

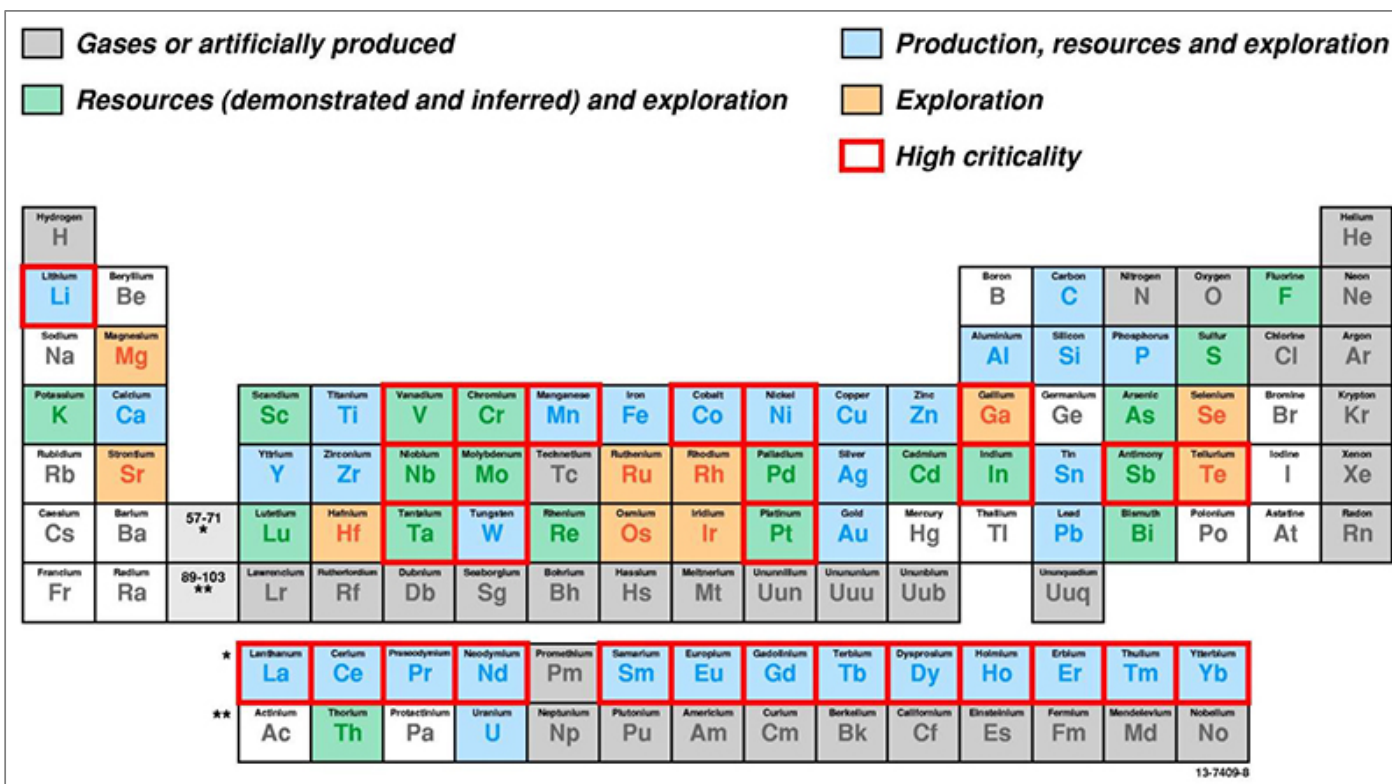


## OUR MINERALS SUPPLY THE WORLD

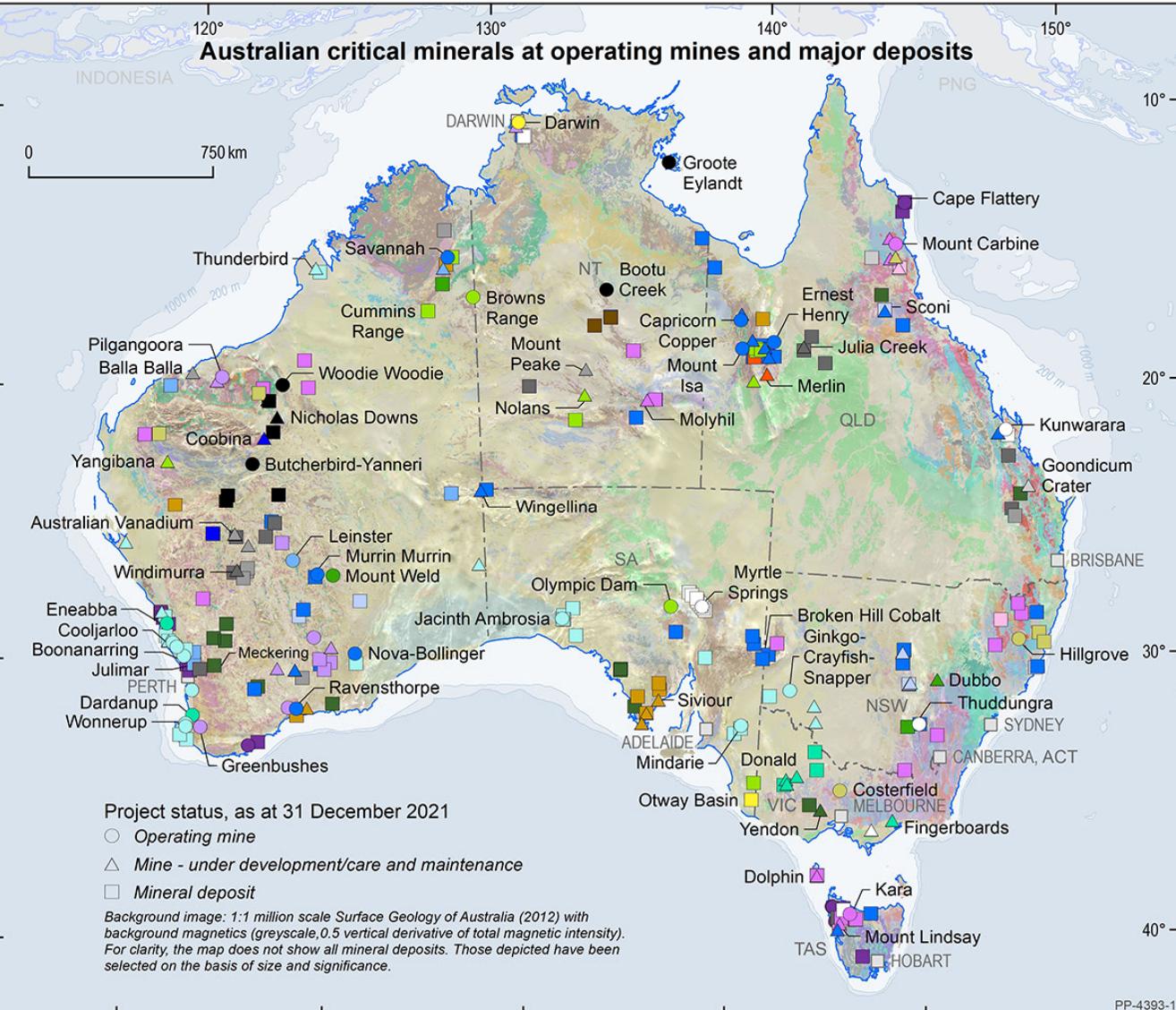
CRITICAL MINERALS  
Antimony, Cobalt, Graphite, Lithium, Magnesium, Manganese, Platinum Group Elements, Rare Earths, Tantalum, Titanium, Tungsten, Vanadium, Zirconium



- The Australian Government considers 26 resource commodities to be critical minerals: Al, Sb, Be, Bi, Cr, Co, Ga, Ge, C, Hf, He, In, Mg, Mn, Nb, PGE, REE, Rh, Sc, Si, Ta, Ti, W, V, Zr



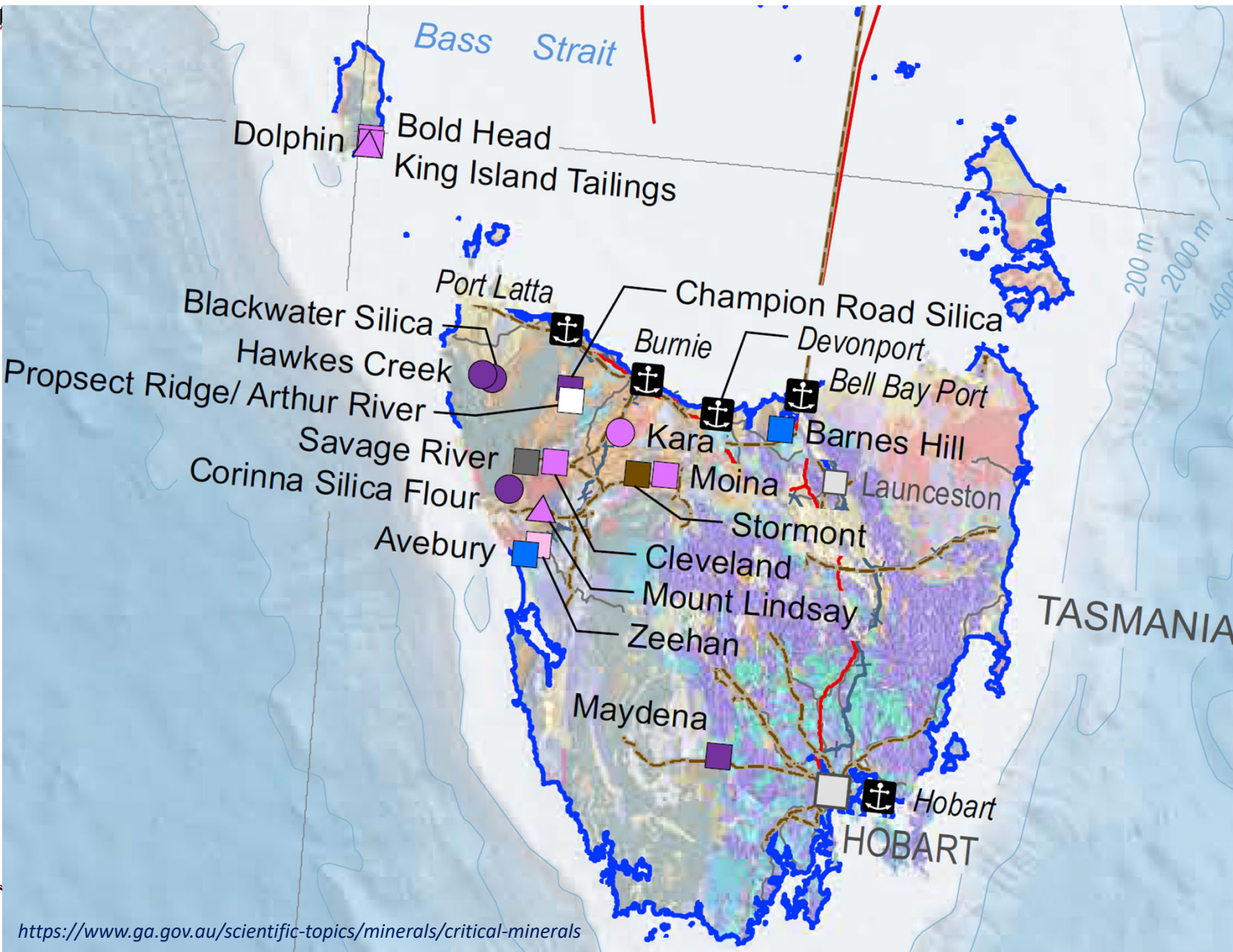
# Australian critical minerals at operating mines and major deposits



## Commodity type

- Aluminium (HPA)
- Antimony
- Bismuth, +/- Cobalt, +/- Indium
- Chromium, +/- Cobalt, +/- PGE
- Cobalt
- Platinum Group Elements (PGE), +/- Cobalt
- Scandium, +/- Cobalt, +/- PGE
- Graphite
- Helium
- Indium
- Lithium, +/- Tantalum, +/- Niobium
- Magnesium
- Manganese ore
- Heavy Mineral Sands (HMS) - Titanium, Zirconium
- HMS - Titanium, Zirconium, REE
- Rare Earth Elements (REE)
- REE, Zirconium, Niobium, +/- Hafnium, Lithium, Tantalum, Gallium
- Rhenium
- Silicon
- Tungsten
- Titanium
- Titanium, Vanadium
- Vanadium

[https://www.ga.gov.au/scientific-topics/minerals/critical-minerals/Australian\\_Critical\\_Minerals\\_Prospectus.pdf](https://www.ga.gov.au/scientific-topics/minerals/critical-minerals/Australian_Critical_Minerals_Prospectus.pdf)



- MINERAL DEPOSITS <sup>1</sup>**
- Commodity Type**
- Aluminium (High-purity alumina)
  - Antimony
  - Bismuth, +/- Cobalt, +/- Indium
  - Chromium, +/- Cobalt, +/- PGE
  - Cobalt
  - Platinum Group Elements (PGE), +/- Cobalt
  - Scandium, +/- Cobalt, +/- PGE
  - Graphite
  - Helium
  - Indium
  - Lithium, +/- Tantalum, +/- Niobium
  - Magnesium
  - Manganese ore
  - Heavy Mineral Sands (HMS) - Titanium, Zirconium
  - Heavy mineral sands - Titanium, Zirconium, REE
  - Rare Earth Elements (REE)
  - REE, Zirconium, Niobium, +/- Hafnium, Lithium, Tantalum, Gallium
  - Rhenium
  - Silicon (High-purity silica/quartz)
  - Tungsten
  - Titanium
  - Titanium, Vanadium
  - Vanadium
- Project status, as at 31 December 2021**
- Operating mine
  - △ Mine - under development
  - Mine - care and maintenance
  - Mineral deposit

**Regional Research Collaboration Program: Building capacity in regional Australia to enhance Australia's economy through research, training and environmentally sustainable production of critical metals**

- \$3.5 million in government funding, awarded for three years
- Starting late 2022 to 2025
- 3 new post doctoral researcher positions
- 9 PhD student scholarships
  - 8 CODES
  - 1 Education Faculty

# RRC program: Collaborating organisations

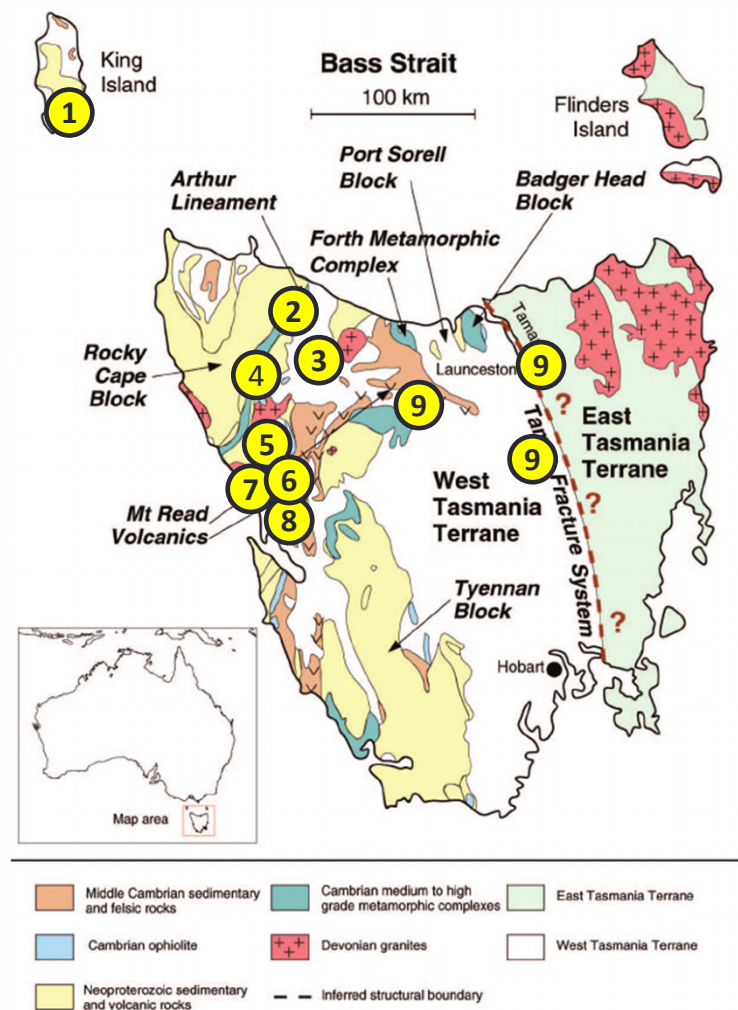
- Academic partners
  - University of Queensland – SMI (Sustainable Minerals Institute)
  - University of Liege – GeMMe (Minerals Engineering, Materials and Environment Research Group)
- Supported by
  - Mineral Resources Tasmania (MRT)
  - Tasmania Minerals, Manufacturing and Energy Council (TMEC)



# RRC program: Collaborating organisations

## Industry partners:

1. Group 6 Metals (Dolphin W mine, King Island)
2. GWR – Tasmanian Magnesium (Prospect Ridge Mg project)
3. Tasmania Mines (Kara Fe-W mine)
4. Grange Resources (Savage River Fe mine - Co, Mg)
5. MMG (Rosebery Zn-Pb-Ag-Au-Cu mine - Co, In)
6. Bluestone Mines Tasmania Joint Venture (Renison Sn mine – potential for CMs ?)
7. Mallee Resources (Avebury Ni mine - Co)
8. Copper Mines of Tasmania (Mt Lyell Cu mine - Co)
9. ABX Group (Deep Leads REE exploration projects)



*Simplified geology map of Tasmania, after Rawlinson et al. (2010)*

# Regional Research Collaboration Program: Building capacity in regional Australia to enhance Australia's economy through research, training and environmentally sustainable production of critical metals

Three themes:

- **Element 1: Unlocking Critical Metal Resources**
  - Characterisation of critical metals for effective resource evaluation and improvements to waste management
- **Element 2: Pathways to Production**
  - Address industry's barriers to cost-effective critical metal production (e.g., crushing and grinding, mineral separation, energy efficiency)

# Regional Research Collaboration Program: Building capacity in regional Australia to enhance Australia's economy through research, training and environmentally sustainable production of critical metals

- **Element 3: Education and Engagement**
  - Devise innovative solutions to community-based barriers that affect engagement in STEM\* and limit growth of the STEM-capable workforce needed by regional industries for critical metals production
  - Innovative education and outreach tools, including immersive 3D visualisations of mining operations, will be created to engage with and educate regional communities

STEM\*: Science, Technology, Engineering, Mathematics

# RRC program: people



RRC project funding was announced May 1<sup>st</sup> at the Kara mine.

Project leader &  
CI: Unlocking CM resources



David Cooke

CI: Education &  
engagement

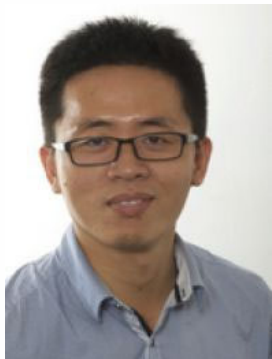


Sharon Fraser

CI: Pathways to  
production



Julie Hunt



Lejun Zhang  
(RRC & P1249)

New Faces



Owen Missen



Mohammad Fathi



Wei Hong  
(RRC & P1249)



Yamila Cajal  
(RRC & P1249)

- Team members CODES/Earth Science/Education faculty

# RRC program: PhD candidates

Avebury Ni:  
characterisation



Jose Barillas Diaz

Renison Sn mine:  
characterisation



Javier Gil Rodriguez

Rosebery Co:  
characterisation



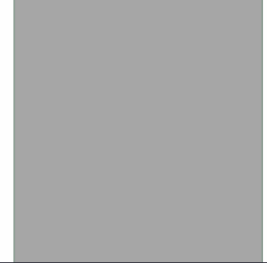
Vinicius Da Cruz

Site TBD



Nelao Naimbale

Education and  
engagement



TBD

Dolphin W mine



Angela Santos Costa

Kara Fe-W mine:  
PTP



Musa Dogara

Savage River Co,  
Ni: Environmental



Pratiche Mondal

Prospect Ridge Mg:  
characterisation, PTP &  
environmental



Alfredtina Appiah

Mount Lyell:  
Western Tharsis  
characterisation



Emrecan Yurdakul

# Regional Research Collaboration Program: Building capacity in regional Australia to enhance Australia's economy through research, training and environmentally sustainable production of critical metals

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## Dolphin Mine

### A World-Class Tungsten Deposit

#### Scheelite Skarn Mineralisation





*Click here for regional geology tours*



**virtual tour area**

*Click in the image above to download the MRT Grassy 1:25,000 geology map.*

Magnetite series, I-type, biotite-hornblende monzogranite of the Sandblow Granite intruded rocks of the Mesoproterozoic Fraser Formation and the Neoproterozoic Grassy Group near Grassy in the early Carboniferous (351 Ma).

The reactive rocks of the lower Grassy Group were contact metamorphosed to hornblende hornfels facies for at least 500m from the contact with the granite. Subsequent fluid exsolution from the crystallising magma exploited permeable pathways to produce tungsten skarn (scheelite) mineralisation in favourable carbonate horizons. Economic orebodies are located within calcic marble horizons that dip towards the granite contact. Scheelite mineralisation was mined at Grassy from 1937 until 1990 and plans to reopen the Dolphin Mine are well advanced.



*Click in the image above for details of King Island Scheelite Resources*



*Click in the image above for direct access to 3D models and samples*



*Click in the image above for details of the Dolphin W deposit*

*This tour is best viewed on a 16:9 aspect ratio screen in full screen mode*

*Navigate between sites using the map and thumbnail options from the menu bar below.*





*Click in the image above to access large-scale UAV 3D models.*



*Click in the image above to access high-resolution orthoimages with links to 3D models and sample data.*

Visualisations by Michael Roach

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[https://www.ausgeol.org/assets/media/uploads/tours/Savage\\_Start2/index.html](https://www.ausgeol.org/assets/media/uploads/tours/Savage_Start2/index.html)

**Savage River Operations – Virtual Tour**

Preliminary

Operational Overview

Exploration Geology Planning Mining Mineral Processing Pelletising Plant Ship Loading

Environment

First Draft

Click on the buttons above to explore aspects of the Savage River operations

UNIVERSITY of TASMANIA

GRANGE RESOURCES

Visualisations by Michael Roach



Thank you for your attention