Centre for EXPLORATION TARGETING

Understanding the Nova-Bollinger Ni-Cu deposit through the lens of carbonate and garnet systematics

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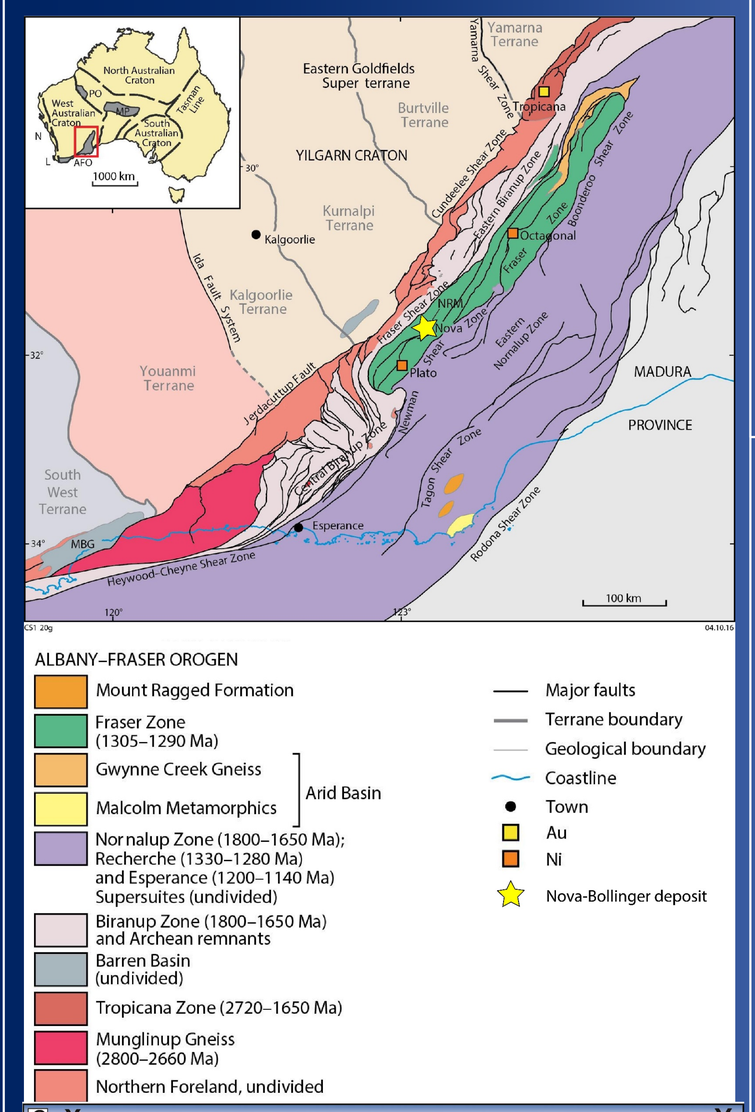
Knowledge Gaps

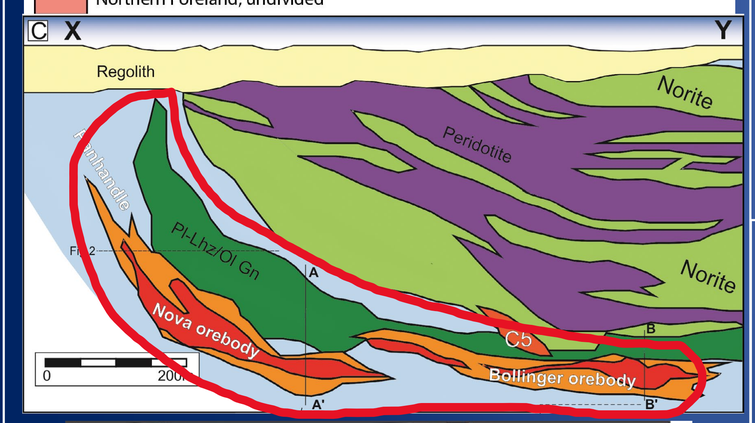
- The high-grade metamorphic lower-crust is typically perceived as unprospective for orthomagmatic sulfide deposits.
- Role of volatiles in facilitating magma and sulfide liquid transport in the lower crust is poorly understood.
- What does garnet record from ore forming processes, could it be used as a mineral indicator of Ni-Cu deposits?

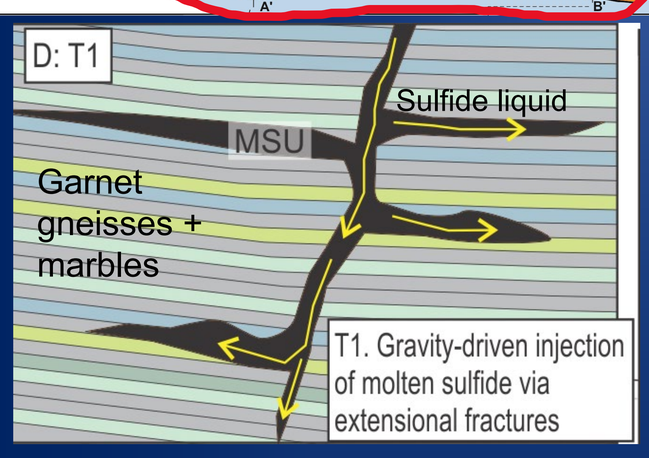
Research project aims

The project focuses on the lower-crustal orthomagmatic Nova-Bollinger Ni-Cu deposit, Fraser Zone, in Western Australia and aims to expand the search-space for metal exploration in lower-crustal, high grade metamorphic terranes through the understanding of the relationship sulfide mineralisation has with carbonate and garnet, alongside fine-resolution quantitative modeling of the P-T conditions at the deposit.

Area of Study







(Top): Geological map of Fraser Zone, WA and Nova-Bollinger deposit. (Mid): Cross-section of the Nova-Bollinger deposit, with Lower intrusion and orebodies in red. (Bottom left): Illustration of sulfide liquid seeping into garnet and carbonate gneisses.
Figures adapted from Barnes et al., (2020, *Econ Geol.*).

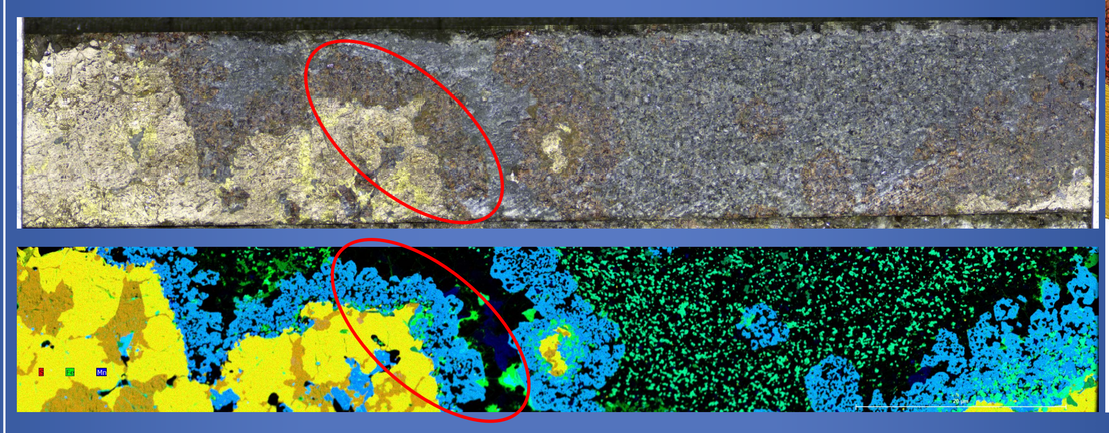
Methodology

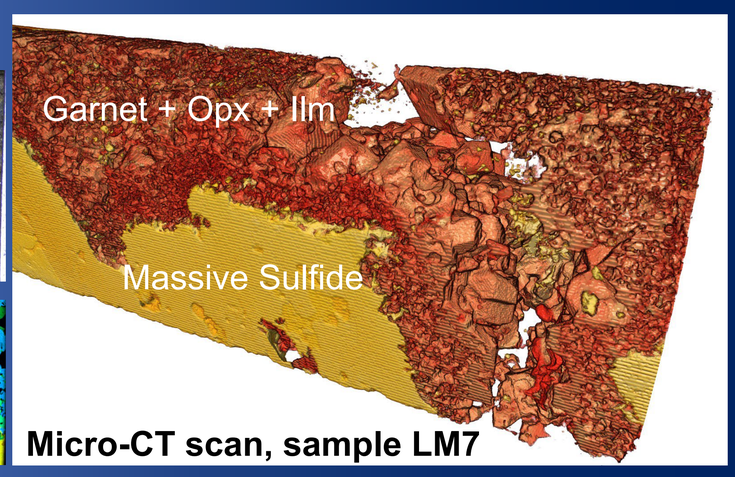
The project will revolve around three segments:

1. Modeling of metamorphic P-T conditions at deposit-scale.
2. Characterisation of garnet associated with sulfide mineralisation
3. Characterisation of carbonate and volatile CO_2 associated with sulfide mineralisation

Project will use optical and 2D and 3D scanning petrography, whole-rock and mineral geochemistry, and stable (C-O) isotope analysis on drill-core and collected samples obtained from the Nova-Bollinger deposit.

Preliminary results

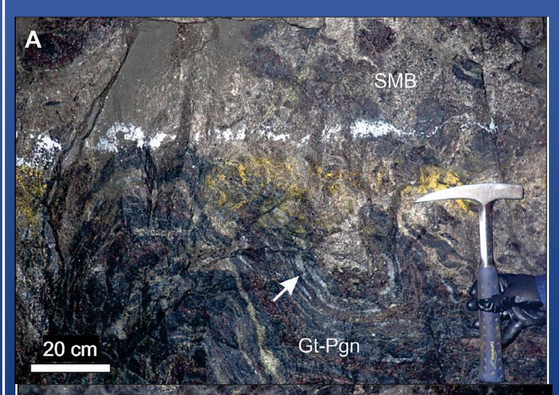




Micro-CT scan, sample LM7

- Top: Drill-core sample LM7 showing sulfide and mafic granulite, with garnet rims around massive sulfide. Maia mapping (directly above) of same sample LM7 highlighting consistent rims of garnet (blue) around sulfide (orange,yellow) in mafic granulite (black, green).
- Top right: Micro-CT scan of LM7 showing clear euhedral garnet growth from sulfide towards silicates. Silicates + garnet in red, sulfide in yellow.

Complex textures



(Left): images adapted from Barnes et al., (2020, *Econ Geol.*) showing complex folded textures between massive sulfide and host and intrusion rocks.
(Top): drill-core sample of granulite – garnet – sulfide transition at Nova-Bollinger.

Projected outcomes

The project will look to

1. Provide quantitative P-T model data for deposit-scale and regional-scale work in the Albany-Fraser Orogen.
2. Identify and provide geochemical and O-isotope markers and reactions for differentiating sulfide-associated garnet from those from ambient country-rock.
3. Identify and provide a deposit-scale model for the role and mechanisms of volatile CO2 relating to sulfide liquid transport and mineralisation.

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