

## Folds, gold and critical metals: An Industry–Government–Academia reassessment of the Pine Creek Orogen in 3D

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Here we launch a new project to generate two-dimensional (2D) and three-dimensional (3D) geological re-interpretations of the main mineralised area in the Central Domain of the Pine Creek Orogen (PCO) for pre-competitive release. Our vision is to deliver a suite of high-quality products that will assist exploration and government decision-making and encourage investment in the region.

The Central Domain has a long history as a gold and uranium province, but it is also rich in polymetallic natural resources, including the rare critical metals of cobalt, lithium, tantalum, tungsten, and platinum group elements; and the more abundant critical metals of copper and nickel (Ahmad and Hollis 2013). Mineralisation occurs in deformed and metamorphosed Palaeoproterozoic clastic, carbonate, carbonaceous and volcanic rocks, which have been intruded by mafic sills and dykes and voluminous post-tectonic granites; all are unconformable above Neoproterozoic (ca 2670–2500 Ma) granitic and gneissic basement rocks (eg Hollis *et al* 2011).

The resources in the PCO are vital for a low emissions future and the manufacture of electric vehicles, rechargeable batteries, medical applications, computers, smartphones and wind turbines, amongst other things. Due to these considerations, the Northern Territory Geological Survey (NTGS) under the NT Government's *Resourcing the Territory* (RTT) initiative has begun a program to review the region and update the stratigraphic and structural framework (Close 2023). The large spectrum of metals, range of rock types of different ages, varied chemistry of magmatic rocks, presence of Archean basement, and complex structural and metamorphic patterns, together suggest that, according to the Mineral Systems concept (Wyborn *et al* 1994; McCuaig *et al* 2010), the PCO is likely to present a variety of opportunities for exploration and critical metals discovery. As such, the NTGS under RTT have commissioned the Sustainable Minerals Institute (SMI) at the University of Queensland to undertake the project discussed herein.

This project will focus on the main mineralised area of the Central Domain. Working closely with NTGS and industry, SMI will bring together public domain and unpublished industry data in order to generate a new 2D interpretation of this mineralised area and a high-quality 3D model of the area. The project builds on a prototype 3D model of the region. We seek to lay the foundations for a mineral systems analysis of the different commodities, identify potential inconsistencies in existing interpretations, and determine the next generation of geophysical, geological, or geochemical surveys required to advance exploration in the region. Specific objectives are to:

- Review and check the quality control/quality assurance (QA/QC) of the existing data and literature.

- Review and update the 3D geological (structural and stratigraphic) framework of the areas of interest, incorporating unpublished, exclusive industry data.
- Review the potential mineral systems models of the region.
- Deliver high quality map and 3D products that visualise the geological framework in formats easily consumed by the minerals exploration industry and members of the public.
- Summarise issues in existing interpretations, especially with stratigraphy.
- Provide a gap analysis to identify and recommend geophysical, remote sensing and regional geochemical surveys that would both better constrain regional geology and help stimulate exploration.

Finally, in this presentation, we will demonstrate the potential to develop 4D interpretations and continually updating digital twins of minerals geoscience data, which could be applied in the PCO as a Data Discovery tool.

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