Resourcing the Territory program: delivering new precompetitive geoscience

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Under the $9.5 million per annum ongoing *Resourcing the Territory* program, funded by the Northern Territory Government, the Northern Territory Geological Survey (NTGS) provides pre-competitive geoscience, investment and exploration stimulus projects. The range of projects, data collection and data synthesis are designed to increase exploration activity, drive success rates, and open new areas of the Northern Territory for exploration. A brief update on projects under the *Resourcing the Territory* program themes is provided here.

Providing competitive grants to stimulate exploration success

The Geophysics and Drilling Collaborations (GDC) program aims to support the discovery and development of resources in the Territory and is a significant component of the *Resourcing the Territory* program. Through a competitive grant scheme, the GDC program makes available $3 million of the total program funding annually. The GDC co-funds selected industry projects that address geoscientific knowledge gaps and advance exploration activity, with two thirds of the grant allocation dedicated to projects targeting critical minerals as defined in the Critical Minerals in the Northern Territory 2025[3].

For successful applicants, the program provides co-funding assistance of up to 50% of the direct claimable project costs, inclusive of GST, capped at specific co-funding amounts under each eligibility criteria. Information gained from the successful projects are required to become open file 6 months after the completion of project fieldwork, or on 1 August 2026 (whichever is earlier).

Eligibility criteria for co-funding are:

- Greenfields drilling: To increase the density of geoscientific data, improve geological knowledge, and de-risk exploration in underexplored areas of the Northern Territory. Capped amounts for co-funding contribution are $200 000 for a single deep diamond hole; $150 000 for a multi-hole diamond drilling program; and $100 000 for a non-diamond drilling program (such as RC, aircore, sonic, RAB).
- Brownfields drilling: To help bring forward resource development in areas of known resource endowment. Capped amount for co-funding is $150 000 for diamond drilling programs that test new concepts below or adjacent to a known deposit.
- Regional-scale geophysics: To significantly improve the resolution and quality of geophysical data in underexplored areas. Capped amounts for co-funding are $150 000 for regional-scale geophysical acquisition that results in a significant improvement in the resolution and quality of existing geophysical data; and $150 000 for reflection seismic surveys (prior to Round 18 this criterion was capped at $100 000).
- Innovative targeting: To promote innovation in the testing of methods and techniques for exploration targeting. Capped amounts for co-funding are $100 000 for camp- or prospect-scale acquisition of geophysics and/or geochemistry where technique and/or approach is innovative in the area of interest; and $100 000 for seismic re-processing to assist in visualizing sub-surface geology and/or targeting resources undercover.
- Advancing critical minerals: To support assessment of critical minerals endowment or recoverability using new or existing sample sets. Capped amounts for co-funding are $50 000 for re-analysis of existing sample sets and/or mine waste to include previously untested critical minerals; and $50 000 for early-stage metallurgical test work and/or ore characterisation to assess potential recoverability of critical minerals from mineralised material.

Applications for Round 18 of the GDC program opened on 25 February 2025 and close on 28 April 2025. Information on the program can be found at https://resourcingtheterritory.nt.gov.au/gdc.

Underpinning exploration success through enhanced geophysics

As geophysical data is a primary tool for area/target selection in resources exploration, improvement of the quality, accuracy, resolution, and accessibility of government-acquired and industry-submitted geophysics remains a major focus of the *Resourcing the Territory* program.

Improve the quality and resolution of regional-scale geophysical datasets

Although the majority of the Northern Territory is covered by ground gravity data at a minimum spacing of 4 km (largely acquired under previous Northern Territory Government initiatives), key areas still have only data with 11 km spacing (which was acquired by the Bureau of Mineral Resources in the 1960s). One of these areas is the Pine Creek Orogen, where there is a well-documented spatial association between gold mineralisation, major structures and granite bodies. Through the *Resourcing the Territory* program, the NTGS has prioritised the acquisition of high-resolution ground gravity data to improve understanding of these spatial relationships. The NTGS Pine Creek Gravity Survey commenced in 2024 and acquired 9700 gravity stations at spacings between 500 m and 4 km with

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the more closely-spaced data acquired through industry infill contributions (Dhu 2025). The Pine Creek Gravity Survey will recommence in 2025 with the acquisition of a further 2300 gravity stations to complete the coverage of the Pine Creek Orogen. Ground gravity acquisition at 4 km spacing will then continue directly east from the Pine Creek Gravity Survey with the commencement of the West Arnhem Gravity Survey in 2025. Industry infill will also be invited as part of the West Arnhem Gravity Survey regional acquisition program (Dhu 2025).

Accelerating resource development in known mineral provinces

Pre-competitive geoscience projects in areas of known endowment will improve the quality and consistency of foundational geoscience datasets, including regional-scale geophysics; stratigraphic, igneous and metamorphic frameworks; and mineral/energy systems studies, where appropriate. Targeted collaboration with industry, federal agencies and research institutions, plus data and information acquired through the GDC program, will expand and enhance these projects. Areas of focus under this theme include the Pine Creek Orogen and the Warramunga Province (Tennant Creek area).

Pine Creek Orogen

The Pine Creek Orogen, a polymetallic province with historical gold and iron ore production, is prospective for a wide range of commodities, including critical minerals as listed on the Critical Minerals of the Northern Territory 2025[4]. Much of the regional-scale structure and stratigraphy of the central and western Pine Creek Orogen (ie the main mineralised corridors) have not been reviewed since the 1980s. The NTGS is undertaking a program of systematically characterising and redefining, where required, the stratigraphy of this area of the Pine Creek Orogen. This program will provide consistent and comparable multi-suite geochemical data, isotopic analysis, petrographic descriptions as well as field descriptions and structural data. Through this approach, NTGS will be able to redefine the geological framework and tectonic evolution of the western and central Pine Creek Orogen to modern geoscience standards (Reno *et al* 2025, Burton-Johnson *et al* 2025).

Warramunga Province

The Tennant Creek region is one the Territory's premier gold districts and remains the focus of exploration for iron-stone hosted, high-grade gold deposits and copper systems, plus ancillary cobalt, magnetite and bismuth resources. The prospective geology of the Tennant Creek mineral field extends: (1) west under cover to include the copper–gold and lead–zinc potential of the Rover Field; and (2) east of the Tennant Creek mineral field where recent pre-competitive geoscience data from drilling funded under Geoscience Australia's *Exploring for the Future* program and the Territory's *Resourcing the Territory* initiative (2018–2022) has seen an increase in exploration for IOCG targets concealed beneath the younger Georgina Basin.

Under the *Resourcing the Territory* program the NTGS continues to invest in improving the understanding of the mineral systems in the Tennant Creek regions through a collaboration with the University of Tasmania, Emmerson Resources and Geoscience Australia. A comprehensive study of the age and paragenesis of mineralisation at the Warrego deposit (Braize *et al* 2025), is providing new understanding of the mineralising fluid phases that can potentially provide pathways to the discovery of further deposits of this scale in the Tennant Creek region.

Attracting and supporting resource development in frontier areas

Although a range of projects in the Northern Territory have yielded, and continue to yield, highly significant quantities of a range of commodities, much of the Northern Territory remains underexplored due to the paucity of modern geoscience data. Under the *Resourcing the Territory* program, key underexplored areas have been targeted to generate new datasets and improve data resolution, to improve quality and consistency of surface and subsurface data sets, and to de-risk and attract exploration into these largely greenfields areas.

Birrindudu Basin

Targeted pre-competitive geoscience programs under both the *Resourcing the Territory* program and Geoscience Australia's *Exploring for the Future* and *Resourcing Australia's Prosperity* initiatives (Henson *et al* 2025) are providing a new understanding of the potential of the Birrindudu Basin, the least-explored part of the greater McArthur Basin.

Ongoing analysis of drillholes from the Birrindudu Basin by the NTGS, CSIRO, Geoscience Australia (Henson *et al* 2025) and the University of Adelaide (Khanna *et al* 2025) has provided a consistent suite of data pertaining to the subsurface geology. These new insights assist in interpreting the Northwest Northern Territory Seismic Survey (Henson *et al* 2025) and thus help improve the understanding of the architecture of this basin.

Under the *Resourcing the Territory* program, the NTGS commissioned a study by CSIRO on the sediment-hosted copper mineral potential of the Birrindudu Basin (Schmid and Baumgartner 2024a, Schmid and Baumgartner 2024b) using a mineral systems approach that incorporated characteristics of the known European Kupferschiefer-style sediment-hosted copper mineral system. Using this approach, the study showed that the metamorphosed sedimentary and volcanoclastic basement successions that underlie the Birrindudu Basin may constitute suitable source rocks, while the Limbunya Group may contain favourable host rocks for sediment-hosted copper.

[4] https://geoscience.nt.gov.au/gemis/ntgsjspui/handle/1/93531

Amadeus Basin

The well-exposed eastern Amadeus Basin is being remapped by the NTGS to improve understanding of the stratigraphic and structural framework of the basin. The current focus is an update of the first edition RODINGA 1:250 000 geological map sheet (Hansman and Verdel 2024) that will add to the seamless geology and redefined stratigraphic framework established on the second edition HENBURY 1:250 000 geological map sheet (Donnellan *et al* 2023). Initial field work, analytical results and structural reconstructions have already led to a significantly revised understanding of the Amadeus Basin stratigraphy in this area (Hansman and Verdel 2024).

Applying geoscience to support a low emissions future

Geothermal energy in the Northern Territory

In 2024, NTGS released a commissioned study into the prospectivity for geothermal power generation in the Northern Territory (Beardsmore and Mitjanas 2024) as an update to the 'Geothermal energy potential of the Northern Territory' report (Beardsmore 2007). The updated study focussed on prospectivity for geothermal power generation using current and emerging technologies related to three broad strategies for producing geothermal energy from the subsurface: (1) hot sedimentary aquifers (HSA); (2) engineered geothermal systems (EGS); and (3) advanced geothermal systems (AGS); prospectivity was defined as the likelihood that geological conditions at a given location and depth may support geothermal power generation.

Over 60 primary and derivative datasets were compiled into the companion GIS package, relevant to assessing temperature prospectivity at depths of 3500 m and 5000 m; the potential production of hot water from natural or introduced sources; and the hardness of the overburden as an proxy for ease of drilling. These datasets were then used to identify geological regions within the Northern Territory that may be prospective for the generation of electrical power.

The Beardsmore and Mitjanas (2024) assessment focussed solely on the geological conditions conducive for producing geothermal energy for power generation and did not include economic assessments of different strategies for power generation or any project-scale financial modelling. A key finding is that locations within the McArthur Basin are most prospective for power generation via all three power generation technologies.

Geological storage potential for the Territory's onshore basins

To improve the understanding of the geological storage potential of the Northern Territory's onshore basins the NTGS commissioned CSIRO to undertake a high-level screening of the geological storage potential for CO_2, hydrogen (H_2) and compressed air across five pre-selected onshore sedimentary basins, namely the Amadeus, Bonaparte (onshore), Georgina, McArthur (including the Beetaloo Sub-basin) and Ngalia basins (Talukder *et al* 2024). These basins were chosen due to both their stratigraphic and geographic distribution and the availability of subsurface data. Hydrocarbon reservoirs (both current and depleted), saline aquifers and salt diapirs were the primary focus for assessments of geological storage potential in all basins. Using assessment criteria jointly agreed by NTGS and CSIRO, each basin was ranked based on its prospectivity for successful storage of CO_2, H_2 and compressed air. The ranking criteria included capacity, injectivity, level of knowledge (ie existing data availability), containment and existing resources/infrastructure.

The study identified 31 potential plays for the geological storage of CO_2 across the five selected basins. The most prospective, or highest-ranked, plays occur in the Kiana Group of the basal Georgina Basin, the Moroak Sandstone of the Beetaloo Sub-basin, the Kulshill Group of the onshore Bonaparte Basin, and the Palm Valley and Ooraminna gas fields of the Amadeus Basin. Limiting factors on CCS prospectivity include paucity of existing data pertaining to injectivity and containment, as well as a lack of pre-existing infrastructure. Due to the high containment threshold required, prospective sites for underground hydrogen storage (UHS) and compressed air energy storage (CAES) are currently limited to the evaporitic units of the Amadeus Basin, namely the Chandler Formation and the uppermost Gillen Formation.

Genesis of lithium bearing pegmatites in the Bynoe Pegmatite Field, Pine Creek Orogen

A collaborative research project between the NTGS, the University of Adelaide and Core Lithium is investigating the genesis of lithium-caesium-tantalum-type (LCT) pegmatites in the Bynoe Pegmatite Field. A focus of this work is evaluating the hypotheses of: (1) a parent granite source or (2) formation of pegmatites via anatexis followed by fractional crystallisation. An improved understanding of the genesis of the LCT pegmatites would provide key spatial and temporal constraints on their distribution within the regional geological context (Chalmers *et al* 2025).

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