Stimulating exploration through new geoscience under the *Resourcing the Territory* initiative

Dorothy Close[1]

The Northern Territory Government's four-year (2018–2022) $26 million *Resourcing the Territory* initiative (*RTT*) is focused on delivering integrated and contemporary geoscience data and interpretations designed to open up new areas for exploration and underpin private sector exploration success in the Territory. A major component of this initiative is the acquisition of new, targeted pre-competitive geoscience data to improve the understanding of the geological framework, and mineral and petroleum potential in key areas in the Territory. Under *RTT*, the Northern Territory Geological Survey (NTGS) is undertaking a range of projects designed around six key themes. Four of these themes relate to the acquisition of new geoscience information and data, and are described below.

Upgrading the Territory's coverage of geophysical data

The intent of acquiring regional-scale magnetic, radiometric and gravity datasets over the Territory is to provide consistent datasets that not only allow a regional-scale insight to the physical properties of the geology but also provide reliable data that can be infilled to camp- and prospect-scale by industry. Major acquisition programs under previously funded Northern Territory Government initiatives have provided extensive regional-scale coverage of aeromagnetic, radiometric and ground gravity data. However, many of the early programs were acquired at non-optimal spacing and predate the advent of GPS and therefore, do not meet current standards for regional datasets. NTGS aims to achieve a Territory-wide minimum standard of 400 m line-spacing/80 m flight height with differential GPS for airborne magnetics and radiometrics, and 4 km-spaced ground gravity. In areas where it is considered that higher resolution datasets are required to provide insights into the geological framework and better support exploration, closer spaced acquisition is undertaken at 200 m line-spacing/60–80 m flight height for magnetic and radiometric surveys, and 2 km-spaced ground gravity. To provide opportunities for enhanced datasets, industry are given the option to infill areas of interest at higher resolution to be incorporated into the publically released dataset.

NTGS has reviewed the existing regional-scale magnetic, radiometric and ground gravity coverage and has identified areas that do not meet minimum standards and will be targeted for improvement under the *RTT* initiative. The first geophysical acquisition project under this initiative was the NTGS Tanami Region Airborne Magnetic and Radiometric Survey, supplying the largest regional-scale airborne magnetic and radiometric survey ever undertaken at this resolution in the Territory. Final located and gridded data for this survey were released on 1 November 2019. The survey was acquired over an area in the Tanami Region where the current dataset did not meet minimum standards and where magnetic data is an invaluable tool for understanding structure and stratigraphy that hosts major gold deposits such as Callie. The survey was flown at 200 m line spacing, acquiring more than 240 000 line km of data, covering an area of 42 000 km^2 with another 30 000 line km of infill data at 100 m line-spacing funded by contributions from industry (Dhu 2019, 2020: figure 1).

The next stage of geophysical acquisition was the NTGS Mount Peake–Crawford Airborne Magnetic and Radiometric Survey, which is centred 250 km north-northeast of Alice Springs in the northern Aileron Province. This survey involved the acquisition than 120 000 line km of data at 200 m spaced lines at 60 m ground clearance. Industry partners funded a further 18 000 line km of data to infill areas of interest to 100 m line spacing. This data upgrades existing 500 m line-spaced data acquired in 1980–1990. It was released in early March 2020 (Dhu 2020).

As the Tanami Region is currently the focus of renewed gold exploration activity, an upgrade to the existing ground gravity coverage of this area from 4 km-spacing to 2 km resolution will be undertaken in 2020. The survey will cover an area of almost 30 000 km^2, complementing the recent airborne magnetic and radiometric survey. The proposed survey will acquire over 4000 ground gravity stations infilling existing data to 2 km-spacing. Industry will be able to participate in the survey to infill areas; expressions of interest are currently being sought. Acquisition is planned to commence in June 2020 (Dhu 2020).

Unlocking the resource potential of the Barkly and Gulf regions through collaborative geoscience

A key focus of the NT Government's previous (2014–2018) *Creating Opportunities for Resource Exploration* (*CORE*) initiative was improving the understanding of the greater McArthur Basin (Close 2014) and its resource potential. The recently published definition of the Beetaloo Sub-basin represents a key outcome from NTGS' work in the greater McArthur Basin (Williams 2019, 2020). An ARC Linkage Project in collaboration with University of Adelaide (industry partners and academic partners; Collins *et al* 2018, 2019), commenced under *CORE* with a focus on unravelling the tectonic palaeogeography of the greater McArthur Basin (eg Yang *et al* 2019). It has been extended under *RTT* and will conclude in mid-2021.

Collaboration with Geoscience Australia under the federally funded *Exploring for the Future* program (*EFTF*) has provided the opportunity to extend the findings under *CORE* into the Barkly region by investigating the covered crystalline basement and improving the knowledge of underexplored basins with affinities to the greater McArthur Basin. New data acquisition through *EFTF* includes soil

[1] Northern Territory Geological Survey, GPO Box 4550, Darwin NT 0801, Australia
Email: dorothy.close@nt.gov.au

and hydro geochemistry data, improved resolution ground gravity at 4 km spacing or better, long-period and broadband magnetotelluric data, regional-scale passive seismic, and the first ever seismic reflection data collected in this area (eg Hackney *et al* 2020). A stratigraphic drilling program in the Barkly and Gulf regions through the Program 3 National Drilling Initiative under the MinEx CRC has been designed by Geoscience Australia to test new concepts using data derived from the *EFTF* program. Drilling is planned to commence in 2020.

NTGS is undertaking new regional-scale mapping of outcropping geology in the Lawn Hill Platform and South Nicholson Basin, focusing on the MOUNT DRUMMOND 1:250 000 mapsheet. This program is integrating new seismic data acquired from *EFTF* to improve understanding of surface and subsurface geological relationships. This new mapping will investigate the geological relationship of these two basins with the resource-rich McArthur Basin and Beetaloo Sub-basin, as well as the cross-border stratigraphic correlations.

A suite of new programs has been designed to reinvigorate exploration in the Tennant Creek area. Over the lifetime of *RTT*, specific projects will include: integration of open file geoscience data to produce mineral atlases and 3D modelling and visualisation of the Rover field and Tennant Creek mineral field (Valenta *et al* 2020); in collaboration with Geoscience Australia, the acquisition of new data from NTGS and industry-held drill core to improve understanding of the gold and base metal potential of the concealed Rover field (Huston *et al* 2020); and delivery of a physical and virtual repository of representative drill core from the Tennant Creek mineral field and Rover field utilising the HyLogger™ to provide spectral information on key drill core.

Geoscience programs designed to improve the knowledge of the geology and resource potential in central Australia

The NTGS is committed to continuing to open up new greenfields areas for exploration in central Australia. Under *RTT*, this is particularly focusing on the Amadeus Basin and Aileron Province.

Regional-scale geoscience mapping is in progress to produce updated outcrop maps at 1:250 000 and 1:100 000 scales across the central and western Amadeus Basin (eg Verdel *et al* 2020). This will result in consistent basin-wide stratigraphic correlation and improved understanding of stratigraphy, structural evolution and palaeogeography. Basin-wide 1:500 000 scale pre-Mesozoic interpretative geology maps are being developed through the integration of seamless stratigraphy with regional-scale geophysics. Ongoing geoscience outcrop mapping at 1:100 000 scale across the northeastern Aileron and Irindina provinces will provide an updated geological framework to these polymetallic provinces; this includes the newly published Jervois Range Special map and explanatory notes (Reno *et al* 2019, Weisheit 2019, Weisheit *et al* 2019). This updated framework is designed to provide context to a new understanding of the geology and base metals potential of the Aileron Province, including copper-bearing mineral systems in the region.

Precompetitive geoscience through co-funded industry grants program

The Geophysics and Drilling Collaborations (GDC) program has been revised and enhanced to encourage exploration in greenfields areas. The enhanced grants program offers 33% more in funding than the previous scheme and with less restrictive criteria. It is designed to maximise local industry participation in exploration by making service and supply by Territory-based companies eligible for co-funding. This has broadened eligibility for pure greenfields exploration to allow greater participation by the junior exploration sector.

The total funds available for each GDC Round is $1 million per annum. GDC now includes funding for reverse circulation drilling exclusively in greenfields areas with no previous drilling activity. In addition, the total amount of funding available for diamond drilling programs has now increased to a maximum of $125 000 per project. There is also additional funding available under the Territory Supplier Incentive whereby a maximum of a further $10 000 per project is available for projects that engage Territory-based enterprises. All reports and data acquired through the GDC program are made publicly available six months after completion of fieldwork.

The first funding Round under the revised GDC program (2018–2019) saw the highest number of applications in the history of the program. Applications for GDC funding for 2020–2021 opened through the GrantsNT portal (www.grantsnt.nt.gov.au) on Thursday 27 February 2020 and will close on Tuesday May 5 2020. Successful applicants will be announced in May. Further information on the Geophysics and Drilling Collaborations program can be found at www.resourcingtheterritory.nt.gov.au/about/gdc.

References

Close DF, 2014. New regional geoscience in the Northern Territory: in '*Northern Territory Geological Survey, 2014. Annual Geoscience Exploration Seminar (AGES) 2014. Record of abstracts*'. *Northern Territory Geological Survey, Record* 2014-001.

Collins AS, Farkas J, Glorie S, Cox G, Blades ML, Yang B, Nixon A, Bullen M, Foden JD, Dosseto A, Payne JL, Denyszyn S, Edgoose CJ, Close DF, Munson TJ, Menpes S, Spagnuolo S, Gustenhuber J, Sheridan M, Baruch-Jurado E and Close D, 2018. Orogens to oil: government-industry-academia collaboration to better understand the greater McArthur Basin: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings, Alice Springs, Northern Territory 20–21 March 2018*'. Northern Territory Geological Survey, Darwin.

Collins AS, Farkas J, Glorie S, Blades ML, Cox M, Foden JD, Hall T, Payne JL, Yang B, Nixon A, Cassidy E, Subarkah D, Shannon A, Higgie D, Toledo G, Dosseto A, Kirscher U, Edgoose C, Close DF, Munson TJ, Menpes S, Spagnuolo S, Close D, Baruch-Jurado E, Warburton J and Hokin G, 2019. Life and times of the Proterozoic McArthur–Yanliao Gulf: Update on the ARC–Industry–NTGS Linkage Project: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings,*

Alice Springs, Northern Territory 19–20 March 2019'. Northern Territory Geological Survey, Darwin.

Dhu T, 2019. New geophysical and remote sensed data in the Northern Territory: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings, Alice Springs, Northern Territory 19–20 March 2019*'. Northern Territory Geological Survey, Darwin.

Dhu T, 2020. New geophysical and remote sensed data in the Northern Territory: 2019: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings, Alice Springs, Northern Territory 24–25 March 2020*'. Northern Territory Geological Survey, Darwin (this volume).

Hackney R, Schofield A, Clark A, Doublier M, Murr J, Skirrow R, Goodwin J, Cross A, Pitt L, Duan J, Jiang W, Wynne P, O'Rourke A, Roach I and Czarnota K, 2020. *Exploring for the Future*: Integrated geoscience supporting exploration and discovery in the under cover Tennant Creek – Mount Isa region: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings, Alice Springs, Northern Territory 24–25 March 2020*'. Northern Territory Geological Survey, Darwin (this volume).

Huston DL, Cross AS, Skirrow RS, Champion DC, and Whelan JA, 2020. The Tennant Creek mineral field and Rover fields: Many similarities but some important differences: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings, Alice Springs, Northern Territory 24–25 March 2020*'. Northern Territory Geological Survey, Darwin (this volume).

Reno BL, Weisheit A, Beyer EE, Whelan JA and Kraus S, 2019. *Jervois Range Special, Northern Territory (First Edition). 1:100 000 geological map series, 6152 and part 6252.* Northern Territory Geological Survey, Darwin.

Valenta R, Gunter J, Connors K and Gow P, 2020. The Rover Mineral Field Deposit Atlas: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings, Alice Springs, Northern Territory 24–25 March 2020*'. Northern Territory Geological Survey, Darwin (this volume).

Verdel C, Verity J Normington VJ, Donnellan N and Simmons J, 2020. Ediacaran stratigraphic correlations in the western Amadeus Basin, central Australia: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings, Alice Springs, Northern Territory 24–25 March 2020*'. Northern Territory Geological Survey, Darwin (this volume).

Weisheit A, 2019. Structural evolution of basement and basin rocks in the Jervois Range Special 1:100 000 mapsheet. *Northern Territory Geological Survey, Record* 2019-014.

Weisheit A, Reno BL and Beyer EE, 2019. *Jervois Range Special, Northern Territory. 1:100 000 geological map series explanatory notes, 6152 and part 6252*. Northern Territory Geological Survey, Darwin.

Williams B, 2019. Definition of the Beetaloo Sub-basin. *Northern Territory Geological Survey, Record* 2019-015.

Williams B, 2020. Definition of the Beetaloo Sub-basin: in '*Annual Geoscience Exploration Seminar (AGES) Proceedings, Alice Springs, Northern Territory 24–25 March 2020*'. Northern Territory Geological Survey, Darwin (this volume).

Yang B, Collins AS, Blades ML, Capogreco N, Payne JL, Munson TJ, Cox GM and Glorie S, 2019. Middle–late Mesoproterozoic tectonic geography of the North Australia Craton: U–Pb and Hf isotopes of detrital zircon grains in the Beetaloo Sub-basin, Northern Territory, Australia. *Journal of the Geological Society* 176, 771–784.