New and improved geophysical and remotely-sensed data in the Northern Territory: 2024

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Introduction

In 2024 acquisition commenced on the NTGS Pine Creek Ground Gravity Survey. This survey and the adjacent NTGS West Arnhem Ground Gravity Survey, will be completed over the next 1–2 years. Together the surveys will provide the northern half of the Northern Territory with complete modern ground gravity data coverage, at a spatial resolution of 4 km or less. These surveys will be followed by the NTGS South Georgina Basin Ground Gravity Survey to complete the coverage of modern ground gravity data at 4 km spacing or less over the entire Northern Territory.

NTGS regional-scale gravity acquisition

As at early 2025, the NTGS Pine Creek Ground Gravity Survey is approximately 80% complete with data acquired at more than 9700 of the 12 000 planned stations. The survey extends from Katherine in the southeast to the coast in the northwest and covers an area of ~40 870 km^2 (**Figure 1**). Most of the data in the survey will be acquired with 2 km station spacing or better. Around 4000 of the planned stations are being funded through collaboration with industry partners.

Preliminary data from the survey is being periodically released and can be downloaded from the *Resourcing the Territory* website (https://resourcingtheterritory.nt.gov.au). **Figure 2** shows data collected in the area around the Burnside. This new, modern data clearly resolves the granites and provides increased structural detail across the area.

Acquisition of the NTGS West Arnhem Ground Gravity Survey will commence as soon as the NTGS Pine Creek Ground Gravity Survey has been completed. The NTGS West Arnhem Ground Gravity Survey will extend east of the NTGS Pine Creek Ground Gravity Survey to near Ramingining (**Figure 1**) and will cover an area of >62 000 km^2 with 4 km station spacing.

In 2026 acquisition will commence on the NTGS South Georgina Basin Ground Gravity survey that will cover an area of approximately 58 500 km^2. This survey will extend from the Stuart Highway, approximately 100 km south of Tennant Creek, east to the Queensland border (**Figure 1**). It is anticipated that data will be collected with 4 km station spacing across the entire survey area resulting in approximately 3630 new gravity data points. This survey will complete the dataset of high-resolution (less than or equal to 4 km spacing) modern ground gravity data over the entire Northern Territory.

NT-wide geophysical compilation

New NT-wide ground gravity grids and associated products will be released in 2025. These products will include the preliminary data from the NTGS Pine Creek Ground Gravity Survey and a number of newly released industry-submitted ground gravity surveys. The products will contain over 275 000 ground gravity readings and will be gridded with a 250 m cell size. Where new data is available older ground gravity readings, acquired using less accurate elevation and navigation systems, will be removed. Products include: (1) the Bouguer anomaly (BA) grid; (2) residual BA with the first-order polynomial trend removed; (3) upward continued BA and first vertical derivative of the BA grids. The input dataset, consisting of longitude, latitude and the BA value for each station included in the grid, will also be available.

Airborne magnetic and radiometric dataset uplift

In 2023 a program to uplift NTGS collection of regional-scale airborne magnetic and radiometric datasets commenced (Dhu 2024). To date 28 survey projects consisting of multiple individual surveys have been uplifted to address: (1) poor navigation data (such as resolving datum and projection, and recombining existing datasets to understand differences);(2) issues with located data (such as the assignment of consistent column headers and reconciling fiducial numbers between surveys); (3), the absence of metadata; and (4) erroneous gridded products (for example where line trimming was incorrect or where grids required microlevelling, decorrugation or other smoothing). The release of the uplifted products via GEMIS has commenced, beginning with the Rum Jungle survey project. Further releases of these uplifted datasets will be ongoing.

Northern Territory Geophysics and Drilling Collaborations program: Round 16 geophysical projects

Eleven geophysical surveys were co-funded during Round 16 of the NTGS Geophysics and Drilling Collaborations program. Surveys included active and passive seismic acquisition projects, airborne gravity gradiometry (AGG) and seismic reprocessing. Over 3000-line km of airborne electromagnetic (AEM) data and over 715 ground gravity stations were also acquired through the program (**Figure 1**).

In the Pine Creek Orogen Mangusta Minerals Pty Ltd acquired an AEM survey and PNX Metals Ltd completed a ground gravity survey. Mangusta Minerals Pty Ltd flew their AEM survey over an area of approximately 150 km^2 containing the Fenton Shear Zone. The Fenton Shear Zone has been interpreted from gravity and magnetic data under 50–200 m of Daly Basin cover sequences (CR2024-0015; Manzi and Murphy 2024). Depth-to-basement estimates were derived from the new survey and ranged from ~500 m in the southwest to ~50 m in the northeast. A number of conductors were also identified within the basement response and have been noted for further follow-up.

PNX Metals Ltd acquired ground gravity over their Moline Project, ~80 km north of Katherine. The Moline

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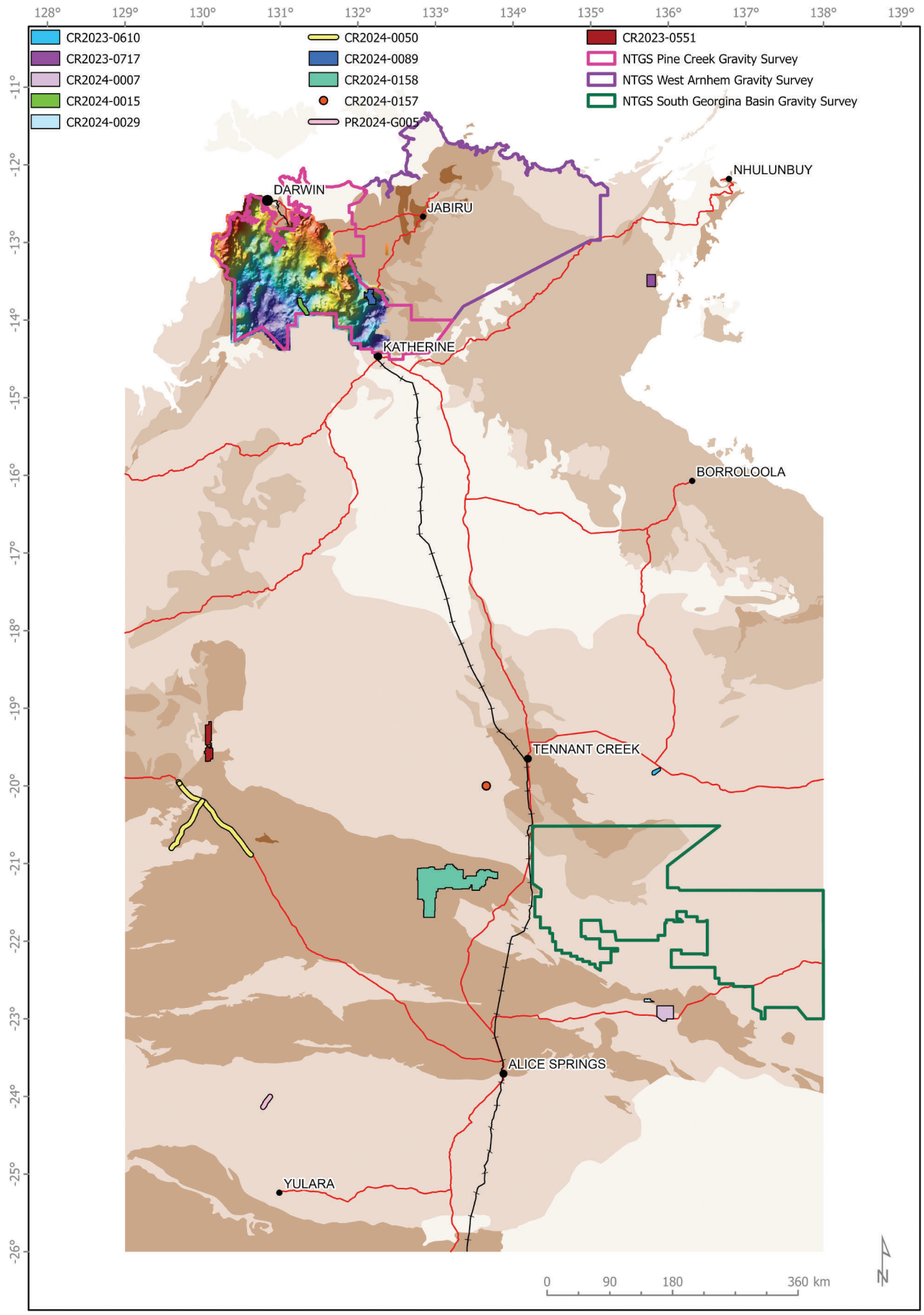

Figure 1. 1:25 M scale geological regions map of the Northern Territory showing locations of: (1) the NTGS West Arnhem Ground Gravity Survey and NTGS South Georgina Basin Ground Gravity Survey planned as part of the NTGS regional-scale ground gravity acquisition program; and (2) Round 16 NTGS Geophysics and Drilling Collaboration geophysical surveys, indicated in colour by project; details of these surveys are available from GEMIS: Collections. NTGS-defined geological regions are shown in brown shades.

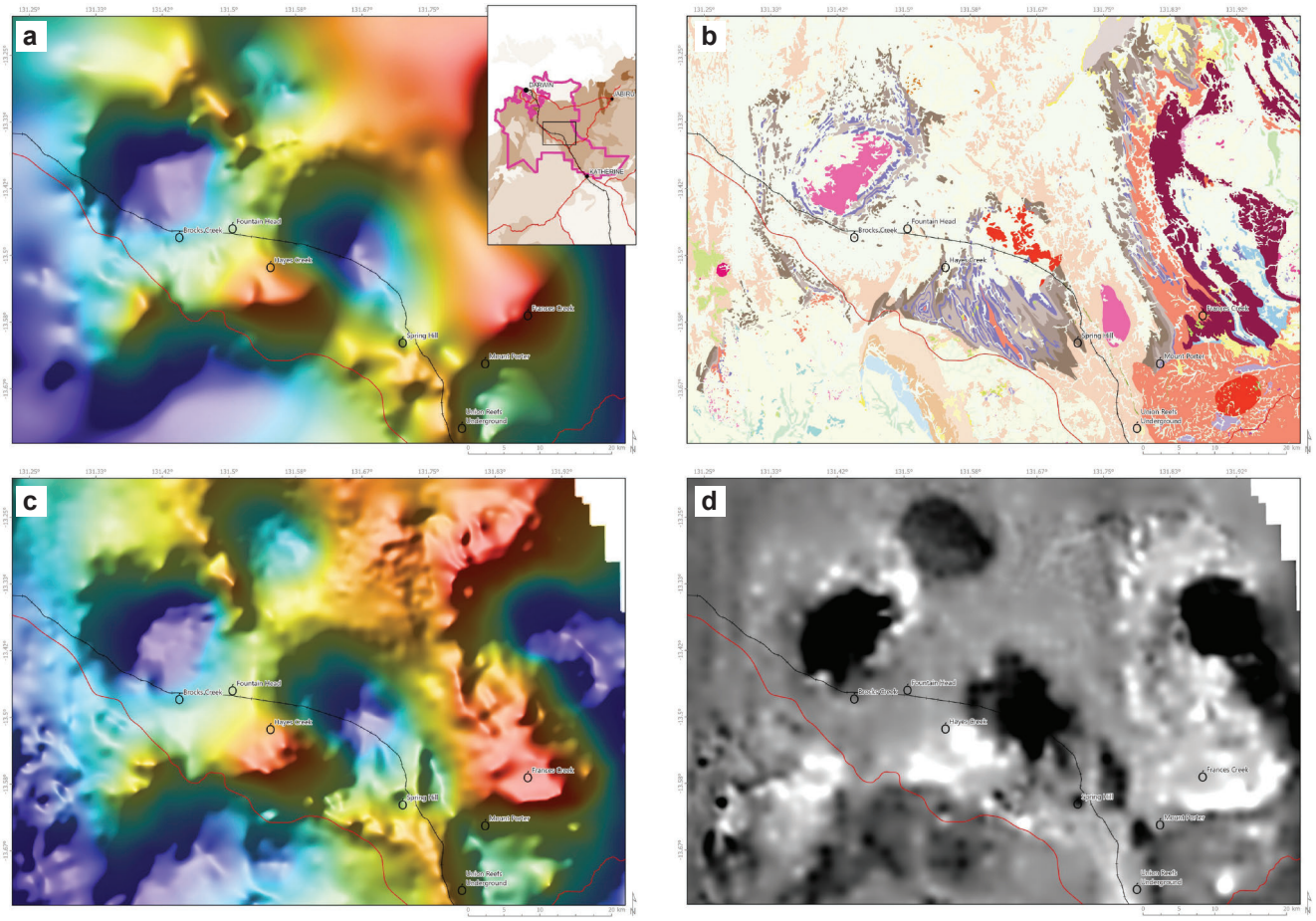

Figure 2. Comparison of Bouguer anomaly grids pre and post the new survey in the region of the Burnside Granite. (**a**) NT-wide Bouguer anomaly prior to the NTGS Pine Creek Ground Gravity survey. (**b**) PINE CREEK 1:250 000 map (Hollis and Glass 2011). (**c**) Bouguer anomaly data from the new NTGS Pine Creek Ground Gravity Survey. (**d**) First vertical derivative Bouguer anomaly data from the new NTGS Pine Creek Ground Gravity Survey.

Project contains gold and base metal occurrences, and the gravity survey was designed to better define intrusions at depth (CR2024-0089; PNX Metals Ltd 2024). The survey acquired 940 ground gravity readings at a grid spacing of 500 m. At the time of reporting the data was being processed and had not yet been interpreted.

DPG Resources Australia flew one AGG survey over the Walker Fault Zone in the McArthur Basin in their sediment-hosted Zn-Pb-Ag exploration tenement. The survey was flown with a line-spacing of 250 m over 190 km^2 with a terrain clearance of 80 m in an east–west direction; the survey aimed to detect potential gravity responses associated with either mineralisation or associated pyritic sediments (CR2023-0717; Aravanis 2023). Interpretation of the new data identified zones of higher density that appear to be controlled by north-northeast trending faults that will form the target for future exploration.

Two projects were completed in the Tanami region: (1) a ground gravity survey by Prodigy Gold NL; and (2) reprocessing of legacy crustal-scale seismic data by Newmont Exploration Pty Ltd. Prodigy Gold NL acquired ~1230 ground gravity stations over an area of 450 km^2 at a spacing of either 400 m or 800 m. The survey was acquired over the Tanami North project within the Suplejack Shear Zone and targeted gold mineralisation. The survey aimed to improve understand the lithology and structural architecture of the region undercover and to aid drill targeting (CR2023-0551; Ferris 2023). At the time of reporting geological modelling and interpretation of the data was in progress.

Newmont Exploration Pty Ltd reprocessed deep-crustal seismic data that had been acquired in 2005 by Geoscience Australia (GA) in collaboration with the NTGS, the Geological Survey of Western Australia, Newmont Exploration Pty Ltd and Tanami Gold NL under the auspices of the Tanami Seismic Research Project. Approximately 225-line km of 2D seismic data was reprocessed from lines 171-05GA-T1 and 171-05GA-T4. The reprocessing aimed to help identify the regional broad-scale crustal architecture, the geometry of deep-seated structures, and potential fluid pathways (CR2024-0050; Haines 2024). The reprocessed data revealed large-scale thrust faults on both seismic lines including beneath known gold deposits. This observation supports an orogenic gold mineralisation model and has been used to define 8 areas of exploration interest. Several areas of 'washed-out' seismic response were also identified, some of which align with known granites and others which may represent previously unidentified granites.

Three surveys were acquired in the Aileron and Irindina provinces, two AEM surveys were completed by IGO Ltd and one ground gravity survey was completed by Investigator Resources Ltd. Investigator Resources Ltd acquired ground gravity data at ~3500 stations with variable spacing in the range 20–200 m over the Molyhil area ~330 km northeast of

Alice Springs in the Aileron Province. Their project targets skarn mineralisation associated with large-scale granitic intrusions and the gravity survey was designed to identify positive gravity anomalies that could be associated with Molyhil-type mineralisation (CR2024-0029; Fabreschi and Crespan 2024). Several gravity anomalies were identified in the new survey data, including a possible offset of the Molyhil deposit.

IGO Ltd flew an AEM survey over the boundary of the Aileron and Irindina provinces ~230 km east-northeast of Alice Springs. This survey acquired ~1400-line km of HeliTEM® data at 300 m line spacing over an area of 420 km^2; it aimed to directly identify conductors potentially associated with magmatic nickel sulphide mineralisation (CR2024-0007; McGloin *et al* 2024a). At the time of reporting two anomalies had been identified for follow-up and the data was being used to develop a detailed cover regolith map.

IGO Ltd also acquired a large AEM dataset over the Willowra Gravity Ridge in the Aileron Province, ~270 km north of Alice Springs. The TEMPEST® system was used to fly 1430-line km at 2000 m spacing over an area of 2490 km^2. The IGO Ltd exploration project targets both magmatic nickel-copper-cobalt mineralisation within mafic intrusions and pegmatite-hosted lithium mineralisation. The AEM survey was flown primarily to map areas with shallow- to moderately-deep cover (CR2024-0158; McGloin *et al* 2024b). At the time of reporting a conductive cover regolith map was being generated to help identify areas where the cover sequences are either: (1) sufficiently shallow to enable soil sampling programs; or (2) too deep to explore with ground electromagnetic techniques. To support further work the data will also be assessed for the presence of discrete conductors.

Within the Warramunga Province and east Tennant area two surveys were completed, both using passive seismic techniques. Knox Resources Pty Ltd completed an Ambient Noise Tomography (ANT) passive seismic survey over their project area ~170 km east of Tennant Creek. This project is focused on exploring under the cover sequences of Georgina Basin and Kalkarindji Basalt in the east Tennant area (CR2023-0610; Abbott 2023). Interpretation of the ANT data has identified velocity variations characterising the boundaries between the Georgina Basin, Alroy Formation and basement, and has also identified possible South Nicholson Basin sediments in the northeast of the survey area.

Castile Resources Ltd partially completed a passive seismic survey over the Rover 1 IOCG deposit, ~100 km west-southwest of Tennant Creek. That survey was designed as a proof-of-concept to test both the ANT and horizontal-to-vertical spectral ratio (HSVR) techniques in differentiating massive ironstone bodies and depth-to-basement (CR2024-0157; Savage 2024). Due to technical issues only 3 sensors were installed, two of which were damaged, so only the HSVR processing could be completed. Nonetheless, results from station 1003 appear to clearly identify a basement paleo-surface and a deeper interface at a depth of ~2 km.

Within the Amadeus Basin an active seismic survey targeting the Zevon lead was acquired ~300 km west of Alice Springs by Central Petroleum Ltd. The Zevon lead is a large sub-salt structure with potential for hosting hydrocarbons, helium and hydrogen (PR2024-G008; Central Petroleum Ltd 2024). The survey was designed to assess optimum acquisition parameters at this prospect, determine whether a weight-drop source could be used successfully and whether the reservoir-target Heavitree Formation could be imaged successfully. Interpretation of the new data has successfully imaged the Heavitree Formation and identified the weight-drop method as being suitable for use in this area.

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