Collaborating on pre-competitive geophysical projects in the Northern Territory, Australia

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SUMMARY

This paper reviews three different collaborative approaches that have been applied to acquire pre-competitive geophysical data in the Northern Territory. The collaborative structures involve the resource exploration industry, Northern Territory Geological Survey (NTGS) and Geoscience Australia (GA), classified as Industry-led, NTGS-led and GA-led dependent on which group takes the lead role in survey design and project management.

Each collaborative structure has different benefits, trading off between project targeting, impact and scale. All three collaborative approaches have successfully contributed to increasing the coverage, resolution, quality and variety of pre-competitive geophysical data within the NT and will continue to be refined and applied into the future.

Key words: Pre-competitive geophysics, Northern Territory, regional-scale geophysical data, collaborative geoscience.

INTRODUCTION

The acquisition and delivery of pre-competitive geoscientific data by Australian state, territory and federal government agencies is a key approach to increase exploration activity and success rates, particularly in under-explored areas. The Northern Territory Geological Survey (NTGS) has worked with the resource exploration industry and Commonwealth Government geoscience agency Geoscience Australia (GA) using a number of different collaborative structures to improve the range, quality and resolution of geophysical data that is publically available in the Northern Territory (NT), Australia.

The first geophysical surveys in the NT were acquired by the Aerial, Geological and Geophysical Survey of Northern Australia (Stamp, 1940) commencing in 1935. In the 1950s the Bureau of Mineral Resources (BMR), now GA, commenced airborne magnetic surveying (Denham, 1997). BMR also commenced a 15 year program to collect ground gravity data at approximately 11 km station spacing across all of Australia in 1959 (Anfiloff et al., 1976).

In 1970 the NTGS was formed within the Mines Branch of the Northern Territory Administration. Following the granting of Self-Government to the NT in 1978 the NTGS became part of the NT Department of Mines and Energy. The first NTGS-funded airborne geophysical survey at Barrow Creek, flown at 500 m line-spacing, was completed in 1981. From 1981 until 1999 NTGS systematically acquired airborne magnetic and radiometric data, on average flying 1:250,000 map sheet per year (Ahmed and Munson, 2013).

Further regional geophysical acquisition projects have been funded through a number of subsequent NT Government funding initiatives summarised below:

- 1998 *NT Exploration Initiative* (NTEI): $16 million over 4 years
- 2003 *Building the Territory's Resource Base* (BTRB): $15.2 million over 4 years
- 2007 *Bringing Forward Discovery* (BFD): $25.8 million over 7 years
- 2014 *Creating Opportunities for Resource Development* (CORE): $23.8 million over 4 years
- 2018 *Resourcing the Territory* (RTT): $26 million over 4 years

In 2003, under the *BTRB* initiative, NTGS focussed on improving the resolution of ground gravity data to 4 km or better. Many of these surveys included financial contributions from industry to improve resolution of data in areas of interest. This is an example of the first collaborative structure classified as NTGS-led.

NTGS Geophysics and Drilling Collaborations (GDC) program commenced in 2008 under the *BFD* initiative. In addition to co-funding resource exploration industry drilling programs, the GDC program also provides co-funding for geophysical projects. Originally this co-funding targeted regional to semi-regional scale geophysical projects aiming to improve coverage and resolution of NT-wide geophysical datasets. Subsequently this program has been expanded to also provide funding for smaller-scale innovative geophysical programs. This forms the second collaborative structure classified as Industry-led.

The third form of collaborative structure is classified as GA-led and comprises new geophysics acquired by GA primarily under Commonwealth Government initiative funding programs such as the:

- 2006 *Onshore Energy Security Program* (OESP): $59 million over 5 years
- 2016 *Exploring for the Future* (EFTF): $100.5 million over 4 years

NTGS has, and continues to provide both in-kind and funding contributions to these programs to increase the volume or resolution of geophysical data acquired.

INDUSTRY-LED COLLABORATIONS

Industry-led geophysics projects are entirely designed and run by industry. Industry submits applications to the GDC program which are then assessed against set criteria. Originally surveys needed to be regional to semi-regional in nature, covering a minimum of 500 square km with airborne surveys having a line spacing of 100 m or greater and ground gravity surveys having a station spacing of 1 km or greater. For the past few years surveys that are innovative in nature i.e. testing new technology or applying geophysics to a geological problem that may have applications on a regional scale have also been considered. Successful surveys receive 50% of direct survey costs up to a maximum value of $100,000. Data remain confidential for 6 months after completion of fieldwork.

Industry-led programs are advantageous in that data is directly relevant to industry and industry undertakes the bulk of the administrative, quality assurance and reporting tasks. The majority of the surveys including those that are regional or semi-regional target specific geological questions which adds to the impact these data have.

The major drawbacks of this approach are in the areas of survey design, especially in terms of system characteristics and instrument calibration and the inability to target surveys to systematically address NT-wide regional geophysical coverage requirements.

Through Rounds one to ten (2008-2018) of the GDC program, 32 Industry-led programs have been completed. Over 50,000 line km of airborne magnetic and radiometric data and 20,000 ground gravity stations along with almost 20,000 line km of airborne electromagnetic (AEM) data have been acquired and publically released (Figure 1). In addition, audio-magnetotelluric (MT), active seismic, passive seismic and heli-borne sub-audio magnetic surveys have been completed.

NTGS-LED COLLABORATIONS

NTGS-led geophysical programs are designed by NTGS with contract management and quality assurance undertaken by GA under the National Collaboration Framework on NTGS behalf. Industry is invited to infill most ground gravity surveys, and more recently have been invited to infill the NTGS Tanami Region Airborne Magnetic and Radiometric Survey.

Industry contributions to NTGS-led gravity programs under the CORE and RTT initiatives have acquired over 8700 ground gravity stations making up 22% of the total acquisition costs. Benefits to industry from infilling NTGS-led programs include economies of scale, outsourcing of project management including land access and delivery of high-quality products.

Drawbacks include survey design limitations that are imposed by NTGS to make infill projects manageable. These include minimum overall survey infill area and maximum resolution, and often project timelines are very long due to the project size. No confidentiality is offered to infill projects with all data released publically at the same time.

Overall benefits from this structure include increased resolution and guaranteed impact of data, along with high-quality products delivered through GA's extensive experience in the acquisition and processing of regional scale pre-competitive geophysical data. Projects are targeted to systematically improve regional-scale NT-wide geophysical coverages and this structure allows for long-term planning, however there is no guarantee that industry will be willing or able to infill any particular project.

Under the CORE and RTT initiatives, ground gravity data has been acquired at 4 km station spacing or better over 400,000 square km and with the completion of the NTGS Tanami Region Airborne Magnetic and Radiometric Survey almost 500,000 line km of data at 400 m line spacing or better has been acquired (Figure 2).

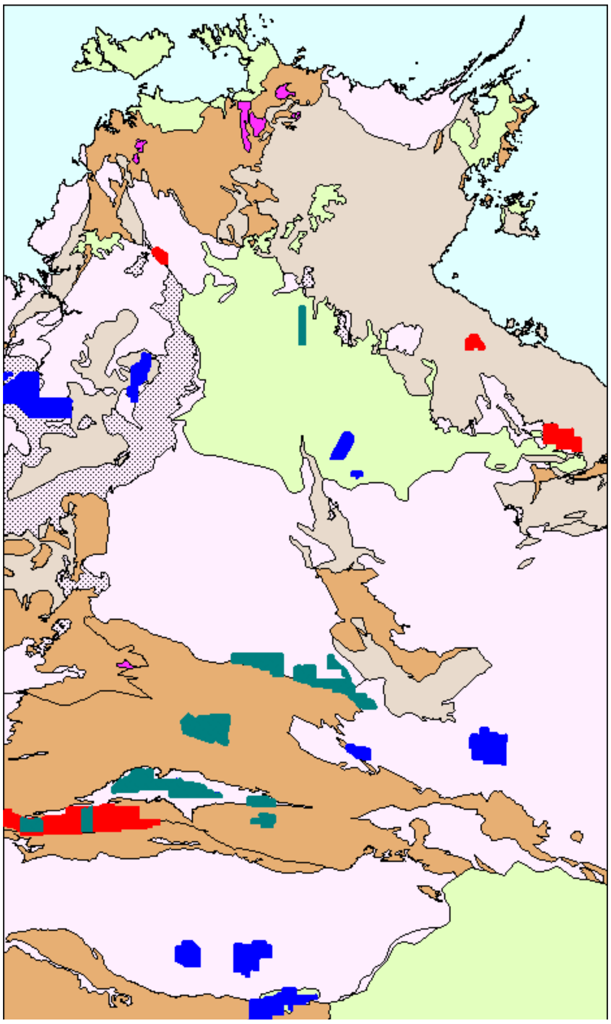

Figure 1. Industry-led airborne magnetic and radiometric surveys (red polygons), ground gravity (blue polygons) and airborne electromagnetic surveys (green polygons) acquired under the GDC program overlain on the regional geology of the Northern Territory.

GA-LED COLLABORATIONS

GA-led geophysical programs are designed and run by GA with input from NTGS. In addition to in-kind contributions, NTGS provides funding into individual projects, often to increase the volume or resolution of geophysical data that is acquired. An example of this are funding contributions made to the OESP and EFTF deep crustal seismic programs that extended the number of line km acquired.

GA-led programs provide geophysical data on an unprecedented scale through programs such as the Australia-Wide Airborne Geophysical Survey (Milligan et al., 2009) and the AusAEM project (Ley-Cooper and Richardson, 2018). Such large scale projects would be difficult, if not impossible, to achieve without Commonwealth resources.

There is generally a collaborative aspect to the survey design; this provides some capacity to target projects to address NT-wide regional geophysical coverages. GA manages the administrative, quality assurance and reporting tasks and ensure high quality data is acquired. Industry is invited to infill some of the projects with the majority of this relationship managed by GA. GA does offer a confidentiality period on infill projects which impacts data release timelines. Timelines for projects can be very long due to the scale of projects and the level of quality assurance and value-added processing applied to the data.

Under the OESP and EFTF programs over 60,000 line km of AEM, almost 3000 ground gravity stations and approximately 1000 line km of deep crustal seismic have been acquired (Figure 3), in addition to the exceptional AWAGS survey. AusLAMP (MT) and AusARRAY (passive seismic) projects are also underway with more AEM, active seismic, gravity and broadband MT projects currently either in planning or in progress.

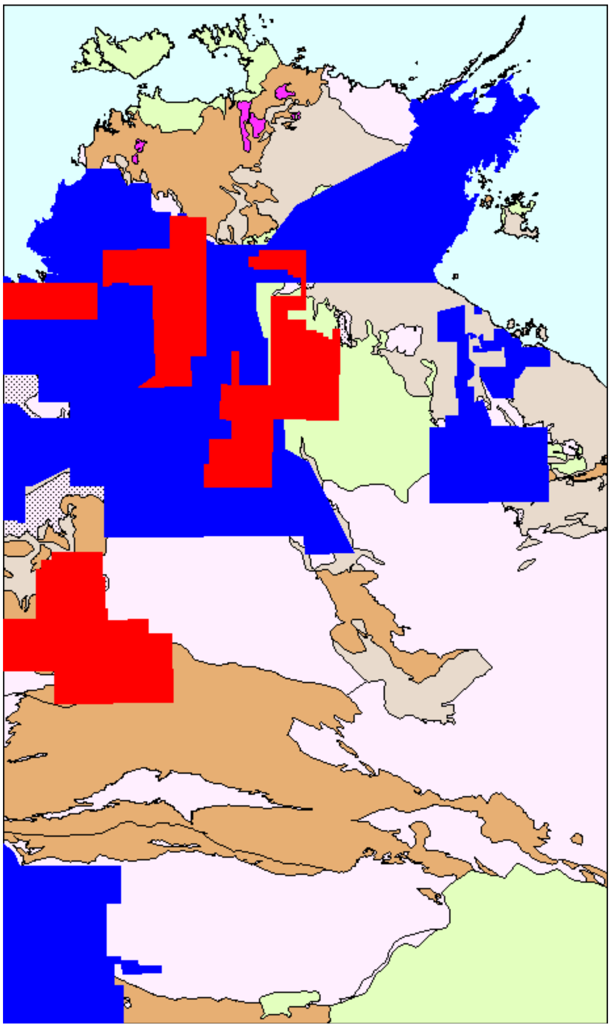

Figure 2. NTGS-led ground gravity (blue polygons) and airborne magnetic and radiometric surveys (red polygons) acquired under the CORE and BFD initiatives overlain on the regional geology of the Northern Territory.

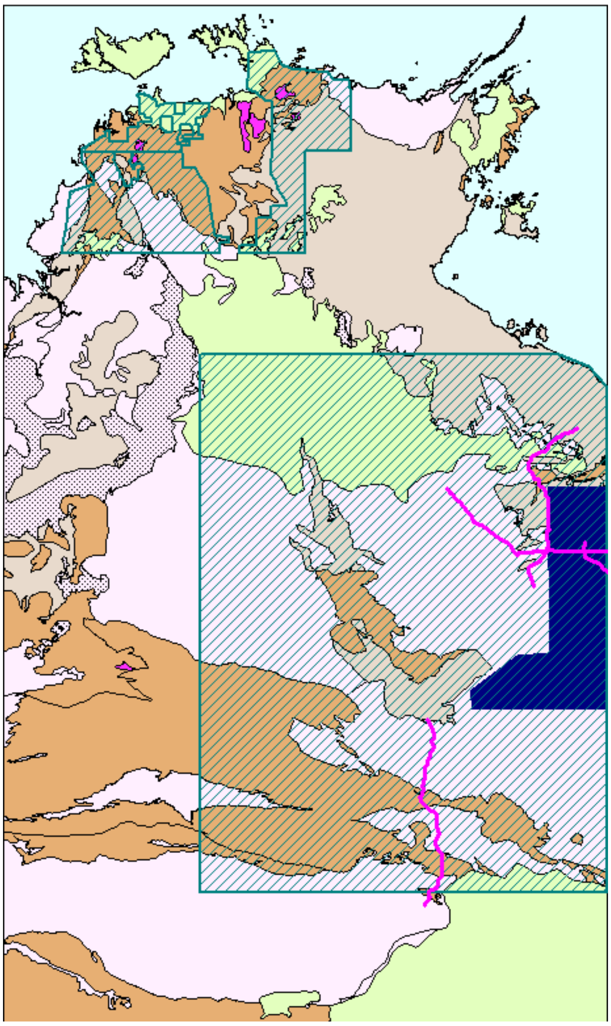

Figure 3. GA-led AEM surveys (green hatching), ground gravity (blue polygons) and deep crustal seismic (pink lines) acquired under the OESP and EFTF programs overlain on the regional geology of the Northern Territory.

FUTURE DIRECTIONS

Since 1981 NTGS has systematically acquired regional scale pre-competitive geophysical data, supported through NT Government funding initiatives. In 2017 an external review of the BFD and CORE initiatives identified that some of the earliest data, often acquired over highly prospective areas, was not modern quality; improvements in instrumentation and survey design rendering this data inadequate for current needs. A key recommendation was to acquire new airborne magnetic and radiometric datasets at 200 m line spacing over basement areas and 400 m line spacing over basins.

A key question to be addressed is whether acquiring similar data such as 400 m line-spaced airborne magnetic and radiometric data over historic 500 m line-spaced data provides enough new information for the investment. The goal of acquiring generational data, data that will be the baseline for 20 or more years to come, must be balanced with the scale of the project and resourcing available. Another consideration is what type of baseline geophysical dataset will be required to underpin the next wave of successful resource exploration; higher resolution magnetic, radiometric and ground gravity data or other systems such as AEM or airborne gravity gradiometry (AGG).

At this stage NTGS has focussed on acquiring 200 m line-spaced airborne magnetic and radiometric data in regions identified to be upgraded but focussing on areas of relatively high-frequency magnetic signal where improved resolution on a regional-scale will have the most impact.

CONCLUSIONS

NTGS adopts three collaborative structures to provide new pre-competitive geophysical data in the Northern Territory. NTGS-led programs allow the systematic acquisition of regional-scale geophysical data that is targeted to build NT-wide coverages. Currently this program is moving from consistent NT-wide datasets to varying resolution data as a trade-off between impact and investment.

Industry-led collaborative projects provide smaller scale geophysical datasets which target specific geological questions while GA-led collaborative projects provide pre-competitive geophysical data on an unprecedented scale. All three collaborative approaches, each with unique strengths and limitations, provide key pathways to improving the coverage, resolution, quality and variety of pre-competitive geophysical data within the NT.

ACKNOWLEDGEMENTS

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