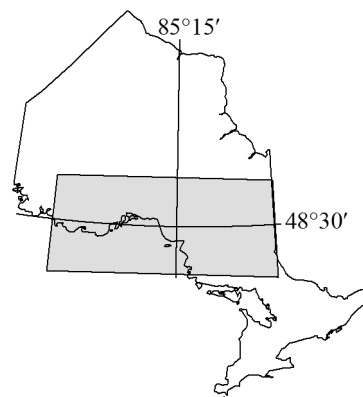


## 46. Potential Field Data Acquisition and Compilation Across Metal Earth's Areas of Interest



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### INTRODUCTION

Ground geophysical potential field data (i.e., gravity and magnetic data) are being acquired as part of the geophysical component of the Metal Earth project. Collected and collated data will be processed and used to assist geologists in the geological interpretation of their study areas. The processed geophysical data will also be used to create two-dimensional (2-D) and three-dimensional (3-D) models of subsurface features. This work is part of the multi-year Metal Earth project carried out by MERC (Mineral Exploration Research Centre, Laurentian University, Sudbury).

The initial models—constrained by surface geology, seismic sections, magnetotelluric and petrophysical data—will be improved using gravity and magnetic data inversion, to assist in identification of density and magnetic susceptibility contrasts associated with different lithologies or boundaries (e.g., faults, shear zones, etc.). These contrasts in geophysical properties can potentially identify features that correlate with mineralization.

### GRAVITY DATA

Thus far, gravity data have been collected by 2 geophysical field crews over 2 field seasons: during the summer of 2017 (along 3 transects: Chibougamau, Amos–Malartic and Rouyn–Noranda); and during the summer of 2018 (along 7 transects: Sudbury, Cobalt, Larder Lake, Swayze, Matheson, Geraldton and Dryden) (e.g., Figure 46.1). Gravity data acquisition included data collection, quality assurance and quality control, and initial field processing. All gravity readings were taken using 2 Scintrex CG-6 Autograv<sup>TM</sup> gravity meters (herein referred to as a CG-6), and during the 2018 field season a Trimble<sup>®</sup> R2 GNSS receiver with FieldPoint RTX<sup>TM</sup> correction was used to precisely measure the location and elevation of each station (Photos 46.1A, 46.1B and 46.1C). (GNSS refers to global navigation satellite systems, which include the GPS and GLONASS systems.) The elevation measurements are critical to correct the gravity data and remove signal that is unrelated to the subsurface geology (Yushkin 2011; Scintrex 2016).

During the first day of data collection for each transect, new gravity base stations were established at spatially convenient locations by tying them to existing Canadian Gravity Station Network base stations. During acquisition of data along the transect, readings were taken at these new base stations at the start and end of each day (Kearey, Brooks and Hill 2012). In order to compare the two CG-6 instruments, some gravity measurements were collected by both machines, at different times, for quality assurance and quality control and to assess the precision of readings. At survey stations where bedrock was exposed, a sample of the rock was collected for subsequent density measurements, to assist in modelling.

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*Summary of Field Work and Other Activities, 2018,  
Ontario Geological Survey, Open File Report 6350, p.46-1 to 46-5.*

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Survey stations were primarily chosen alongside roads or within walking distance from roads, with an average spacing between stations of 300 m. However, where the acquired data values appeared to increase or decrease sharply on plotted profiles, infill data with 150 m spacing from adjacent stations were acquired. To add the possibility for future 3-D investigations, measurements along sideroads within 1 km of the transect were acquired, where road access permitted (Olaniyan, Smith and Lafrance 2014).

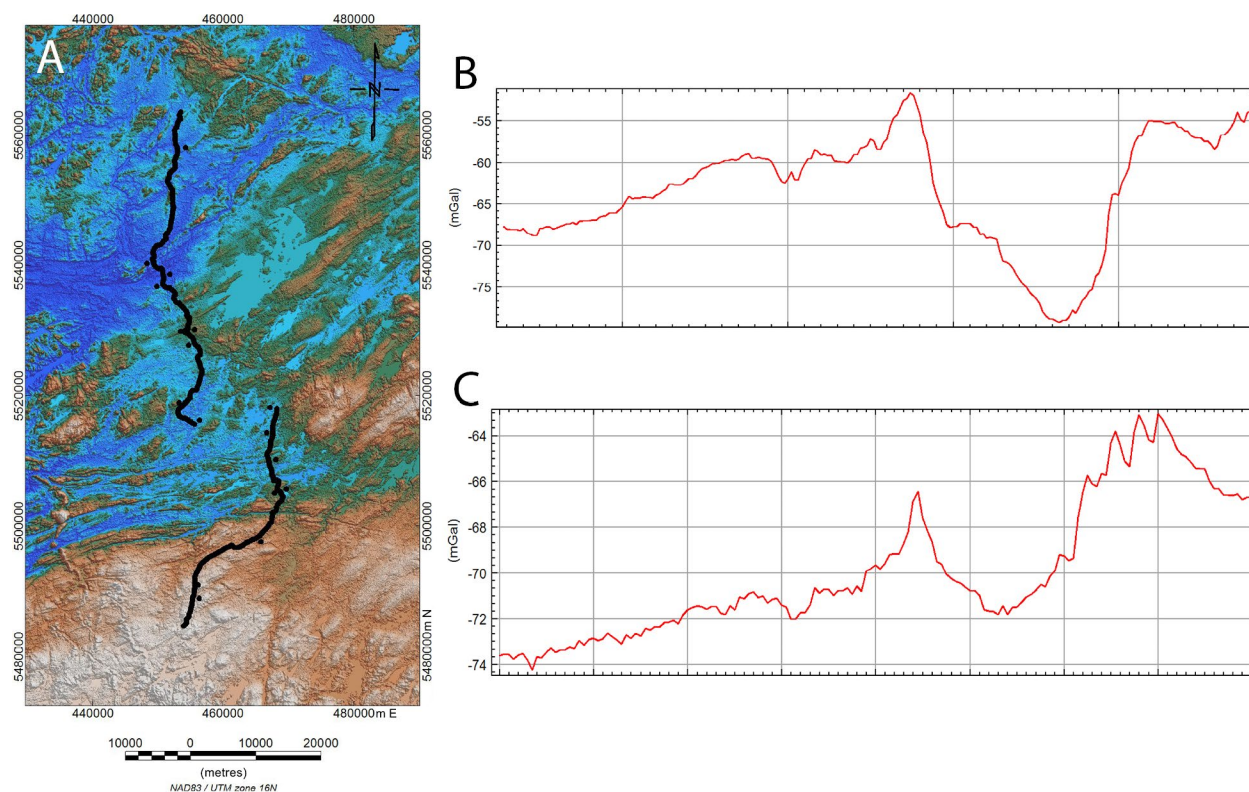
Collected gravity measurements were processed and corrections were applied (i.e., instrumental drift correction, latitude correction, free air correction, Bouguer correction and terrain correction) to calculate the final “Complete Bouguer Anomaly” (Nowell 1999).

Since the commencement of the Metal Earth project, we have acquired a total of 2974 gravity readings along approximately 822 line-kilometres (1066 gravity readings along approximately 309 line-kilometres in 2017, and 1908 gravity readings along approximately 523 line-kilometres in 2018).

## MAGNETIC DATA

Existing magnetic grids and surveys were collated from different organizations and companies (e.g., Geological Survey of Canada, Ontario Geological Survey, Ministère de l'Énergie et Ressources naturelles du Québec, and other private companies or partners). In addition, Metal Earth acquired aeromagnetic data for a few specific areas, to deliver high-resolution data and improve the understanding of those regions.

The surveys compiled were carried out using different resolutions and survey specifications (e.g., line spacing and terrain clearance). For this study, grids overlying areas of interest around each Metal Earth transect were selected and cropped to the area of interest. Surveys containing the highest resolution data were preferred. For areas not covered by high-resolution surveys, other, lower resolution surveys



**Figure 46.1.** A) Locations where gravity data were collected (black dots; along the transect and sideroads) across the Geraldton transect, overlain on the topographic data for the area. B) Complete Bouguer anomaly along the northern and C) southern parts of the transect.



were selected. This process required re-levelling of data and removing long-wavelength responses, to ensure a consistent and coherent grid. For example, most of the Swayze study area is covered by the high-resolution survey of Ontario Geological Survey (OGS) Geophysical Data Set (GDS) 1037—Revised (40 m cell size, average flight height of 70 m) (Ontario Geological Survey 2017). Therefore, this survey was selected for use in this study and the data were cropped to the area of interest. However, the southeast and southwest parts of the area of interest were not covered by this grid, so OGS GDS 1035, a master survey with a lower resolution (250 m cell size, 305 m average flight height) (Ontario Geological Survey 2003), was used to fill blank areas of the Swayze transect. As a part of previous OGS processing, GDS 1037—Revised had been levelled to be consistent with GDS 1035, and long-wavelength responses



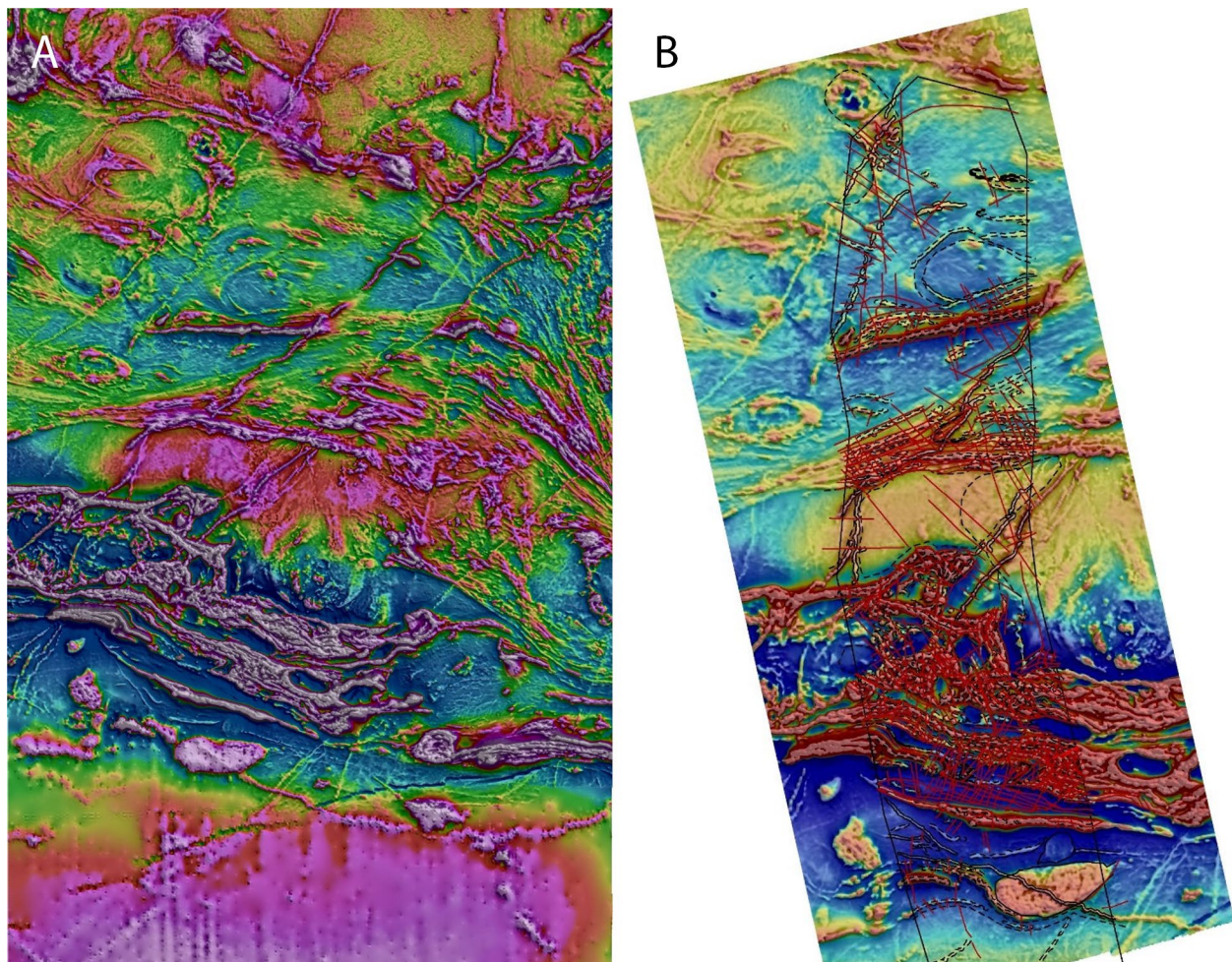
**Photo 46.1.** A, B) Geophysical field crews collecting gravity data and petrophysical samples in summer 2018. C) Scintrex CG-6 Autograv™ gravity meter (right) and a Trimble® R2 GNSS receiver (left) used in the collection of the gravity data.



were removed. In order to ensure that the data merged (or stitched) together seamlessly, the Metal Earth geophysicist applied downward continuation on GDS 1035 to bring it to the same survey height (70 m) as GDS 1037—Revised. Comparable processes were applied for other transects.

Compiled aeromagnetic grids were processed and different processing methods (e.g., reduction to pole, vertical derivatives, tilt angle, analytic signals) were applied to the grids (Reeves 2005). The associated maps and images were integrated into a single database, and delivered to the geological and geophysical teams active on selected transects to aid in the interpretation of the geology of their area. These high-resolution products (e.g., Figure 46.2) can potentially highlight surface geological features and boundaries associated with different magnetic properties, and are useful for delineating lineaments (e.g., faults, folds), identifying intrusions and outlining possible metamorphic zones associated with the creation or destruction of magnetic minerals.

In addition to the collation and acquisition of magnetic grid data, geological mapping crews from each active transect in 2018 (Amos–Malartic, Cobalt, Dryden, Geraldton, Matheson, Rouyn–Noranda and Swayze areas) collected magnetic susceptibility data from the outcrops they visited. The goal of



**Figure 46.2.** Magnetic survey across the Amos–Malartic transect, and geological interpretation of the survey. **A)** Reduction-to-pole data (colour) superimposed on greyscale first vertical derivative (red is high magnetic response, blue is low). The map represents 80 km from east to west, and geographic north is to the top. **B)** Geological interpretation of the magnetic data. Red lines indicate interpreted lineaments and faults. The map represents 41 km in width and geographic north has been rotated to the left so the transect runs from the bottom to the top of the page.

collecting these data is to characterize the statistical variation of the susceptibility of all the rock types encountered on Metal Earth transects. These statistics will be helpful in modelling the magnetic data. On outcrops, the mappers would take 10 magnetic susceptibility readings. If more than one rock type was present, the geological team would collect 10 readings per rock type. This collection method is outlined by Muir (2013). After a quality check, the data will be compiled into a similar format as outlined by Muir (2013).

## SUMMARY

In the gravity data acquisition, a total of 2974 gravity observations were acquired, checked and processed, and the Bouguer anomaly calculated, to generate an initial database. As part of the magnetic data compilation, magnetic grids with different resolutions and survey specifications were processed and compiled. The geological crews also collected magnetic susceptibility readings and samples from outcrops along the transects they mapped. These data will be augmented by magnetic susceptibility and density measurements derived from rock samples collected on each transect. Future work includes 2-D and possibly 3-D modelling of gravity and magnetic data, integrated with seismic and magnetotelluric models.

## ACKNOWLEDGMENTS

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