Technical Report

High-Resolution Heliborne Magnetic Survey

New Ross Mn Project,
New Ross Area, Lunenburg County, Nova Scotia
2018

21Alpha Resources Inc.

Prospectair Geosurveys

Dynamic Discovery Geoscience

Prepared by:
Joël Dubé, P.Eng.

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Dynamic Discovery Geoscience
7977 Décarie Drive
Ottawa, ON, K1C 3K3
jdube@ddgeoscience.ca
819.598.8486

Survey flown by :

CP 1832 Succ. Hull
Gatineau, Québec J8X 3Y8
(819)661-2029
Fax: 1.866.605.3653
contact@prospectair.ca

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I. INTRODUCTION

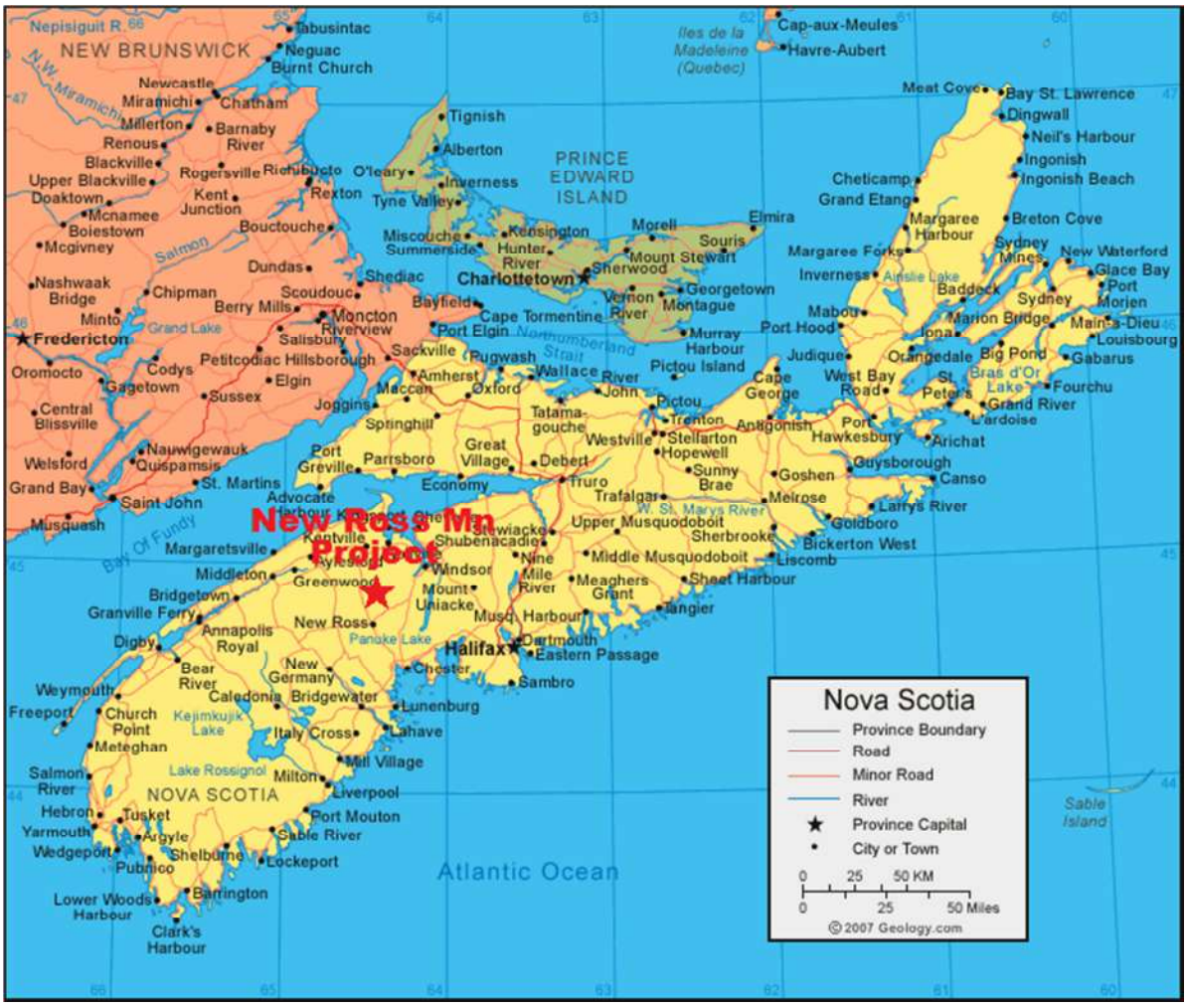
Prospectair conducted a heliborne high-resolution magnetic (MAG) survey for the mineral exploration company 21Alpha Resources Inc. on its New Ross Mn Property located in the New Ross area, Lunenburg County, Province of Nova Scotia (Figure 1). The survey was flown on June 21st 2018.

One survey block was flown for a total of 283 l-km. A total of 2 production flights were performed using Prospectair's Eurocopter EC120B, registration C-GEDI. The helicopter and survey crew operated out of the Stanley Airport, located about 50 km to the northeast of the block.

Table 1: **Survey block particulars**

Block	NTS Mapsheet	Line-km flown	Flight numbers	Date Flown
New Ross Mn	021A16	283 l-km	Flt 1 and 2	June 21st

Figure 1: **General Survey Location**



The New Ross Mn block was flown with traverse lines at 50 m spacing and control lines spaced every 500 m. The survey lines were oriented N122. The control lines were oriented perpendicular to traverse lines. The average height above ground of the helicopter was 48 m and the magnetic sensor was at 27 m. The average survey flying speed (calculated equivalent ground speed) was 41.2 m/s. The survey area is roughly located between the Porcupine, Dean Chapter and Wallaback Lakes, about 13 km north of the village of New Ross. It is covered by forest and wetlands, and the topography is gently undulating, with a few dispersed small hills. The elevation is ranging from 182 to 233 m above mean sea level (MSL). The Property can be easily accessed via secondary forestry roads connecting to Highway 12. Coordinates outlining the survey block are given in Appendix A, with respect to NAD-83 datum, UTM projection zone 20N. The mineral tenure worked by 21Alpha Resources Inc. is shown in red on Figure 3, together with survey lines, and is listed in Table 2.

Figure 2: **Survey Location and base of operation**

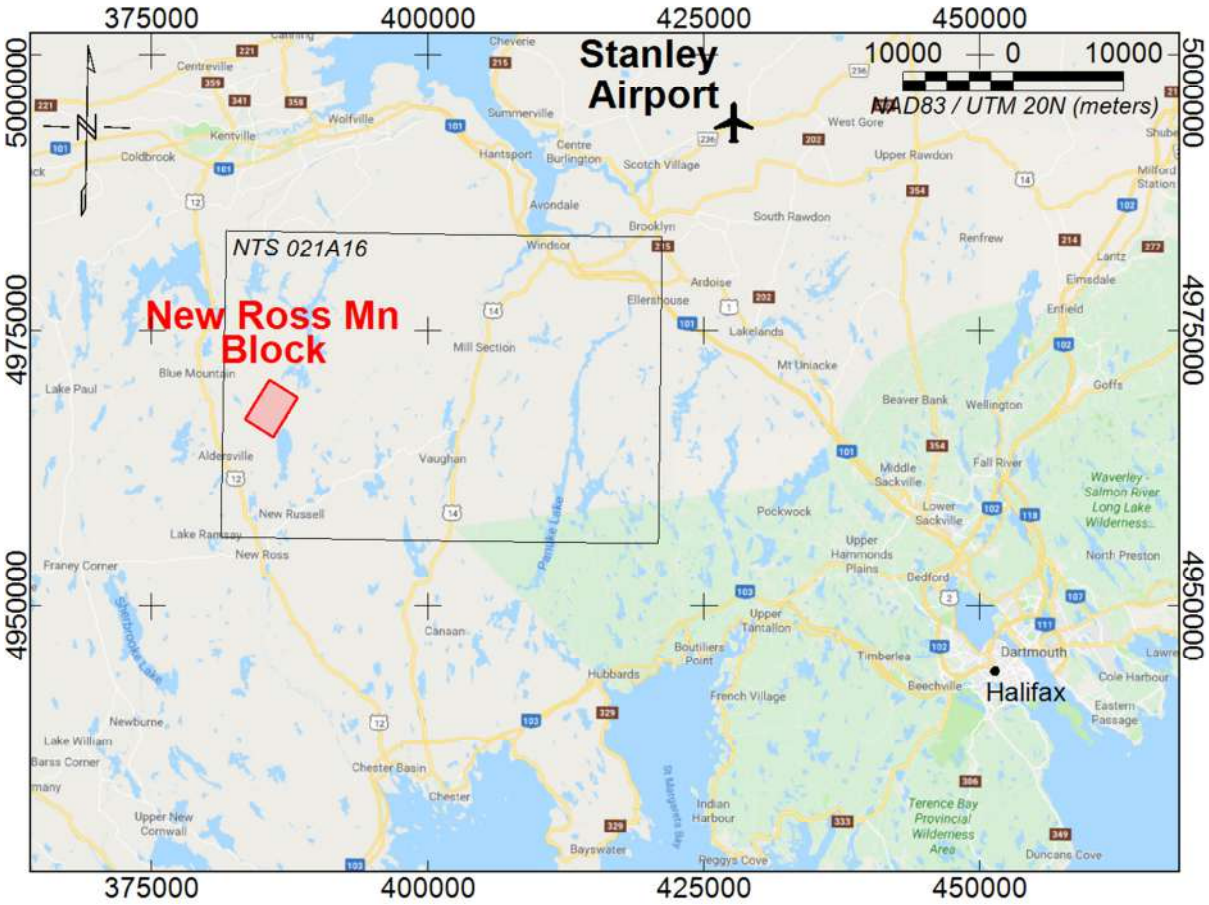
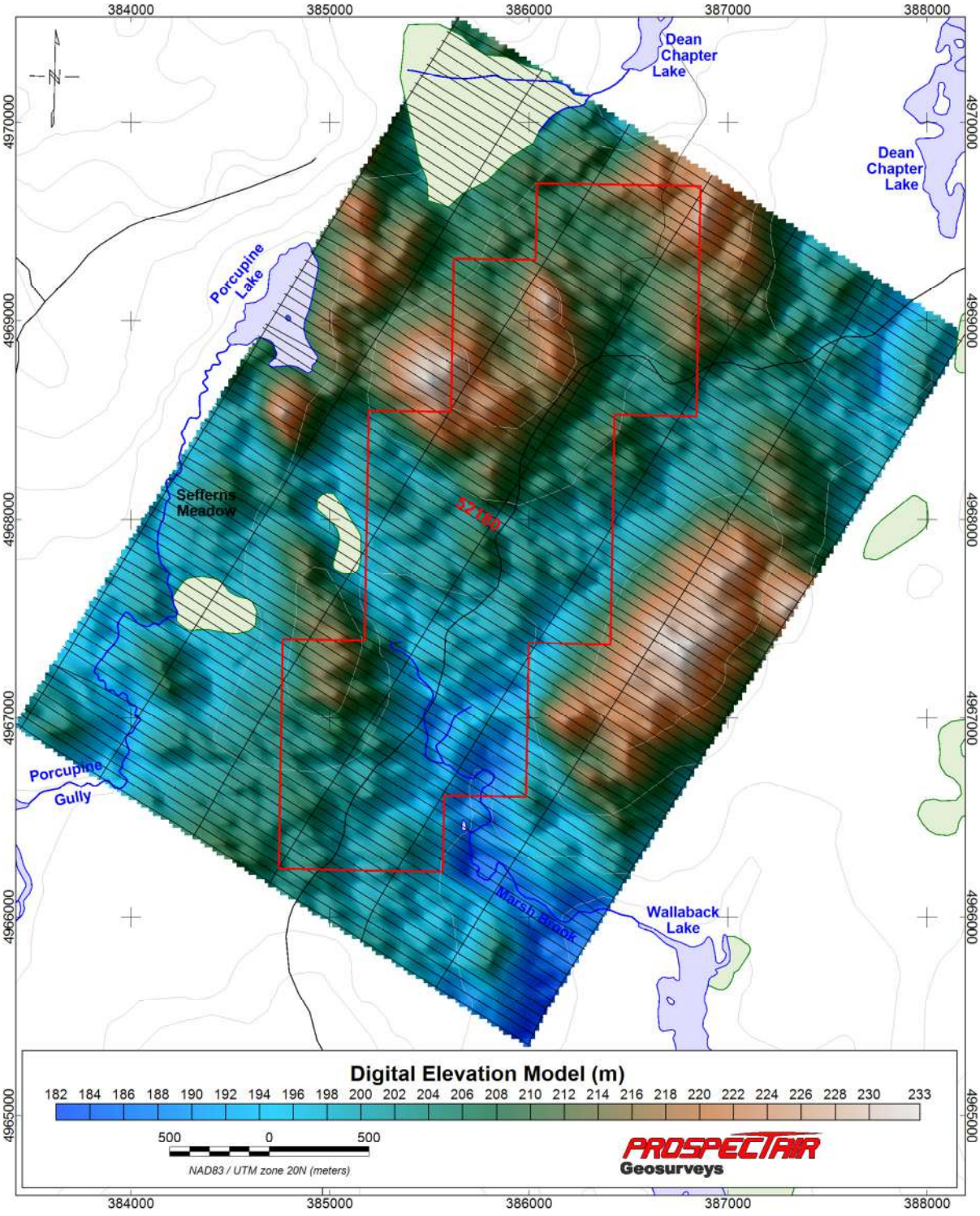


Table 2: **Mineral tenure covered by the survey**

Mineral tenure number	Mineral tenure holder
52180	John Shurko

Figure 3: **Survey lines and New Ross Mn Property claim**



II. SURVEY EQUIPMENT

Prospectair provided the following instrumentation for this survey:

Airborne Magnetometer
Geometrics G-822A
The heliborne system used a non-oriented (strap-down) optically-pumped Cesium split-beam sensor. These magnetometers have a sensitivity of 0.005 nT and a range of 15,000 to 100,000 nT with a sensor noise of less than 0.02 nT. The heliborne sensor was mounted in a bird made of non-magnetic material located 21 m below the helicopter when flying. Total magnetic field measurements were recorded at 10 Hz in the aircraft.

Real-Time Differential GPS
Omnistar DGPS
Prospectair uses an OmniStar differential GPS navigation system to provide real-time guidance for the pilot and to position data to an absolute accuracy of better than 5 m. The *Omnistar* receiver provides real-time differential GPS for the Agis on-board navigation system. The differential data set was relayed to the helicopter via the Omnistar network appropriate geosynchronous satellite for the survey location. The receiver optimizes the corrections for the current location.

Airborne Navigation and Data Acquisition System
Pico-Envirotec AGIS-XP system
The Airborne Geophysical Information System (AGIS-XP) is advanced, software driven instrument specifically designed for mobile aerial or ground geophysical survey work. The AGIS instrumentation package includes an advanced navigation system, real-time flight path information that is displayed over a map image of the area, and reliable data acquisition software. Thanks to simple interfacing, the radar and barometric altimeters and the Geometrics magnetometer are easily integrated into the system and digitally recorded. Automatic synchronization to the GPS position and time provides very close correlation between data and geographical position. The AGIS is equipped with a software suite allowing easy maintenance, upgrades, data QC, and project and survey area layout planning.

Magnetic Base Station
GEM GSM-19
A GEM GSM-19 Overhauser magnetometer, a computer workstation and a complement of spare parts and equipment serve as the base station. Prospectair establish the base station in a secure location with low magnetic noise. The GSM-19 magnetometer has resolution of 0.01 nT, and 0.2 nT accuracy over its operating range of 20,000- to 100,000 nT. The ground system was recording magnetic data at 1 Hz.

Altimeters

Free Flight Radar Altimeter

The Free Flight radar altimeter measures height above ground to a resolution of 0.5 m and an accuracy of 5% over a range up to 2,500 ft. The radar altimeter data is recorded and sampled at 10 Hz.

Digital Barometric Pressure Sensor

The barometric pressure sensor measures static pressure to an accuracy of ± 4 m and resolution of 2 m over a range up to 30,000 ft above sea level. The barometric altimeter data are sampled at 10 Hz.

Survey helicopter

Eurocopter EC120B (registration C-GEDI)

The survey was flown using Prospectair's EC120B helicopter that handles efficiently the equipment load and the required survey range. Table 3 presents the EC120B technical specifications and capacity, and the aircraft is shown in Figure 4.

Table 3: **Technical specifications of the EC120B Eurocopter helicopter**

Item	Specification
Powerplant	One 376kW (504hp) Turbomeca Arrius 2F
Rate of climb	1,150 ft/min
Cruise speed	223 km/h – 120 kts
Service ceiling	17,000 ft
Range with no reserve	710 km
Empty weight	991 kg
Maximum takeoff weight	1,715 kg

Figure 4: **Eurocopter EC120B**

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III. SURVEY SPECIFICATIONS

Data Recording

The following parameters were recorded during the course of the survey:

In the helicopter:

- GPS positional data: (time, latitude, longitude, altitude, heading and accuracy (PDOP)) recorded at intervals of 0.1 s;
- Total magnetic field: recorded at intervals of 0.1 s;
- Pressure as measured by the barometric altimeter at intervals of 0.1 s;
- Terrain clearance as measured by the radar altimeter at intervals of 0.1 s;

At the base and remote magnetic ground stations:

- Total magnetic field: recorded at intervals of 1 s;
- GPS time recorded every 1s to synchronize with airborne data.

Technical Specifications

The data quality control was performed on a daily basis. The following technical specifications were adhered to:

- *Height* – 50m mean terrain clearance for the helicopter except in areas where Transport Canada regulations prevent flying at this height, or as deemed by the pilot to ensure safety. Traverse lines and control lines must be flown at the same altitude at points of intersection; the altitude tolerances are limited to no more than 30 m difference between traverse lines and control lines.
- *Airborne Magnetometer Data* – A 0.5 nT noise envelope not to be exceeded for more than 500 m line-length without a reflight.
- *Diurnal Specifications* – A maximum tolerance of 5.0 nT (peak to peak) deviation from a long chord of one minute at the base station.
- *Flying Speed* – The average ground speed for the survey aircraft should be 120 kph. The acceptable high limit is 180 kph over flat topography.
- *Radar Altimeter* – minimal accuracy of 5%, minimum range of 0-2500 m.
- *Barometer* – Absolute air pressure to 0.1 kPa.
- *Flight Path Following* – The line spacing not to vary by more than 30% from the ideal spacing over a distance of more than 300 m, except as required for aviation safety.

  For New Ross Mn Block:

  Traverse lines: Azimuth N122, 50 m spacing.

  Control Lines: Azimuth N032, 500 m spacing.

IV. SYSTEM TESTS

Magnetometer System Calibration

The survey configuration using a bird towed 21 m below any magnetic piece of the helicopter allows the simplification of the magnetic calibration requirement. Consequently, heading error and aircraft movement noise was considered negligible and no correction was applied to the data.

Instrumentation Lag

The magnetometer lag is a combination of two factors: 1) the time difference between when a reading is sensed, and when that value is recorded by the acquisition system, and 2) the time taken for the sensor to arrive at the location of the GPS antenna. The second factor is defined by the physical distance between the GPS antenna and any given sensor, and the speed of the aircraft. The average total magnetic lag value for the AGIS acquisition system has been calculated to 0.07 s for this survey.

V. FIELD OPERATIONS

The survey operations were conducted out of the Stanley Airport on June 21st, 2018. The data acquisition required 2 flights. At the end of the production day, the data were sent to the Dynamic Discovery Geoscience office via internet. The data were then checked for Quality Control to ensure they fulfilled contractual specifications. The full dataset was inspected prior to provide authorization for the field crew to demobilize. The GSM-19 magnetic base station was set up in the center of the survey block, in a magnetically quiet area, at latitude 44.8595648°N, longitude 64.4470579°W. The survey pilot was Alain Tremblay and the survey system technician was Jonathan Drolet.

Figure 5: **Example of a magnetic base station setup**

VI. DIGITAL DATA COMPILATION

Data compilation including editing and filtering, quality control, and final data processing was performed by Joël Dubé, P.Eng. Processing was performed on high performance desktop computers optimized for quick daily QC and processing tasks. Geosoft software Oasis Montaj version 9.3.3 was used.

Magnetometer Data

General

The airborne magnetometer data, recorded at 10 Hz, were plotted and checked for spikes and noise on a flight basis. An average of 0.07 second lag correction was applied to all data to correct for the time delay between detection and recording of the airborne data.

Ground magnetometer data were recorded at 1 sample per second and interpolated by a spline function to 10 Hz to match airborne data. Data were inspected for cultural interference and edited where necessary. Low-pass filtering was deemed necessary on the ground station magnetometer data to remove minor high frequency noise. The diurnal variations were removed by subtracting the ground magnetometer data to the airborne data and by adding back the average of the ground magnetometer value.

Levelling corrections were performed using intersection statistics from traverse and tie lines. After statistical levelling was considered satisfactory, decorrugation was applied on the data to completely remove any subtle non-geological features oriented in the direction of the traverse lines.

Once the Total Magnetic Intensity (TMI) was gridded, its First Vertical Derivative (FVD) and Second Vertical Derivative (SVD) were calculated to enhance narrow and shallow geological features. Finally, the component of the normal Earth's magnetic field, described by the International Geomagnetic Reference Field (IGRF), has been removed from the TMI to yield the residual TMI.

Tilt Angle Derivative

In order to enhance the subtle magnetic features some more, the Tilt Angle Derivative (TILT) was also computed for this project.

It has been shown that it is possible to use the Tilt Angle Derivative to estimate both the location and depth of magnetic sources (Salem et al., 2007).

When two body of different magnetic susceptibility are in contact, the vertical and horizontal gradients along a horizontal line perpendicular to the vertical contact are governed by the following equations:

$\delta M/\delta h = 2KFc(z_c/(h^2+z_c^2))$

$\delta M/\delta z = 2KFc(h/(h^2+z_c^2))$

where
K = susceptibility contrast
F = magnetic field's strength
c = 1-$\cos^2$(field Inclination)$\sin^2$(field Declination)
h = location along an horizontal axis perpendicular to the contact
z_c = contact depth
$\delta M/\delta h = \text{sqrt}((\delta M/\delta x)^2+(\delta M/\delta y)^2)$

The Tilt Angle (θ) is defined as
$\theta = \tan^{-1}[(\delta M/\delta z)/(\delta M/\delta h]$

By substitution of the gradients we get
$\theta = \tan^{-1} [h/z_c]$

This has two main implications for any given anomaly:

1- The 0° angle line is located directly above the contact between a magnetic source and the surrounding rock. This allow for accurate estimation of source location.
2- The distance between the 0° and the +45° contour lines as well as the distance between the -45° and the 0° contour lines are equal to the depth of the source at the contact. This allow for a direct estimation of the depth of the source of the anomaly. The depth estimated with this method is actually the distance between the magnetic sensor and the top of the source. Knowing that the sensor was 27m above the ground in average enables direct depth estimates.

In practice, the signal originating from multiple sources at different depth within a same area will cause juxtaposition of the Tilt Angle values, and complicate location and depth estimation. Nevertheless, the method remains an excellent tool for rapid assessment of sources characteristics, without the need for complex assumptions to be made or heavy computer requirements, as is the case with 3D Euler deconvolution or 3D data inversions.

Gridding
The magnetic data were interpolated onto a regular grid using a bi-directional gridding algorithm to create a two-dimensional grid equally incremented in x and y directions. The final grids of the magnetic data were created with 10 m grid cell size, appropriate for the survey lines spaced at 50 m. Traverse lines were used in the gridding process.

Radar Altimeter Data
The terrain clearance measured by the radar altimeter in metres was recorded at 10 Hz. The data were filtered to remove high frequency noise using a 1 sec low pass filter. The final data were plotted and inspected for quality.

Positional Data
Real time DGPS correction provided by Omnistar was applied to the recorded GPS positional data.

Positional data were originally recorded at 10 Hz sampling rate in geographic longitude and latitude with respect to the WGS-84 datum. The delivered data locations are provided in X and Y using the UTM projection zone 20 North, with respect to the NAD-83 datum. Altitude data were initially recorded relative to the GRS-80 ellipsoid, but are delivered as orthometric heights (MSL elevation).

VII. RESULTS AND DISCUSSION

General

The residual Total Magnetic Intensity (TMI) of the New Ross Mn block, presented in Figure 6, is extremely settled and varies only over a very limited range of 21 nT, with an average of -53 nT and a standard deviation of 2 nT. The area is affected by a weak regional gradient, with magnetic background values gradually increasing towards the north. The very settled magnetic variations found throughout the survey block are characteristic of non-magnetic sedimentary or felsic intrusive rocks. With respect to the local background, the strongest magnetic anomalies, although very weak in absolute terms, occur as isolated discrete anomalies in the southern part of the Property. Other smaller amplitude discrete anomalies are found elsewhere in the surveyed area. As well, several magnetic lineaments are found. Most magnetic lineaments found within the Property are generally trending NE-SW, except for one larger anomaly oriented N-S in the northeastern part of the Property. Some N-S to NNW-SSE lineaments are also found in the western part of the block. In general terms, magnetic lineaments are related to rock formations that are enriched in magnetic minerals (mostly iron minerals, with magnetite and/or pyrrhotite being the dominant magnetic minerals).

Throughout the block, it is possible to detect structural features offsetting observed magnetic lineaments and causing abrupt interruption or changes of the magnetic response. These features are typically caused by faults, fractures and shear zones. If they are thought to be favorable structures in the exploration context of the New Ross Mn project, they should be paid particular attention and should be the object of a comprehensive structural interpretation, which is beyond the scope of this report.

Shorter wavelength anomalies are greatly enhanced on the FVD (Figure 7) and on the TILT (Figure 8) products. Since the FVD attenuates longer wavelength anomalies, and the TILT enhances very weak amplitude anomalies, they are the preferred products for structural interpretation.

Figure 6: **Residual Total Magnetic Intensity**

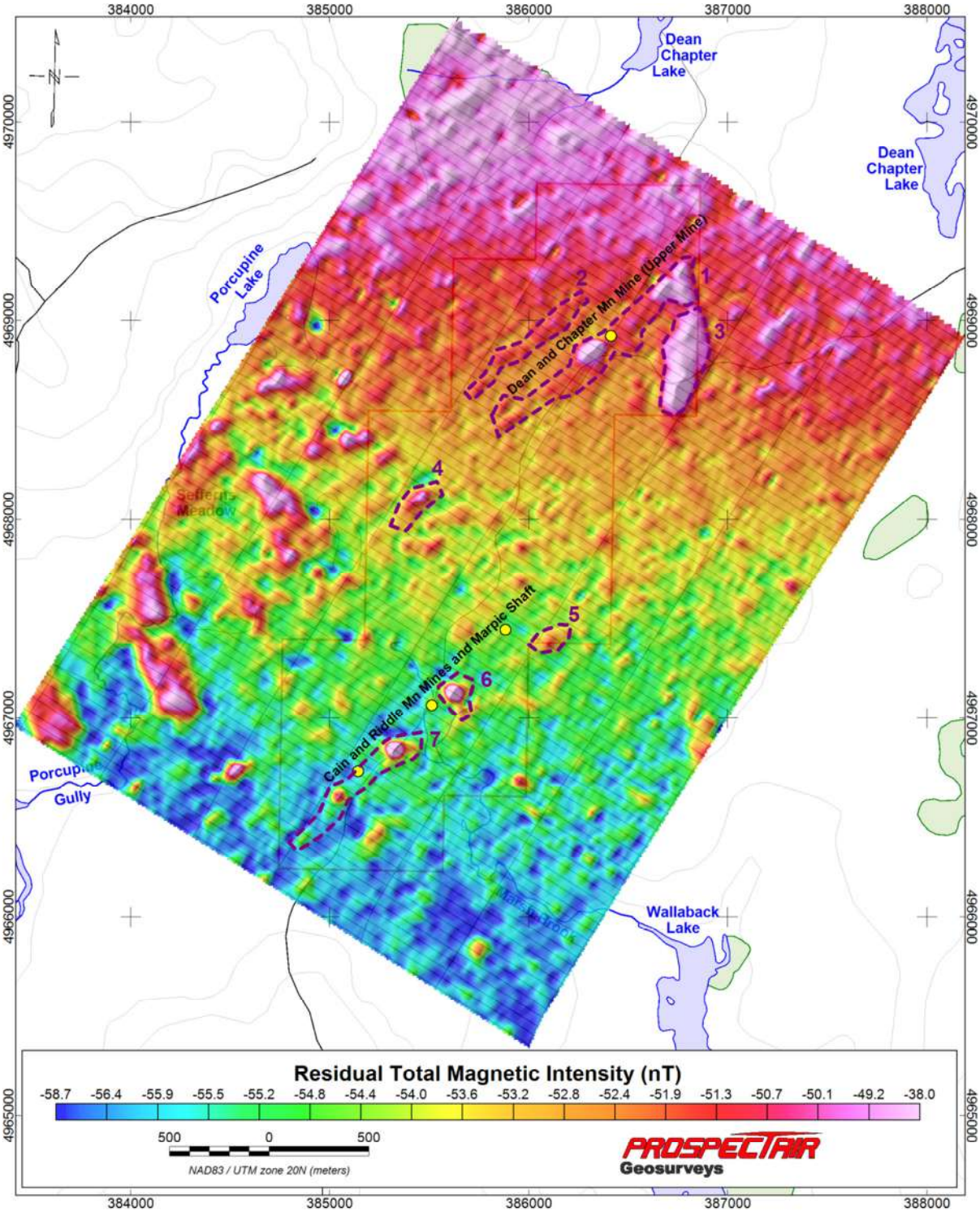


Figure 7: **First Vertical Derivative of TMI**

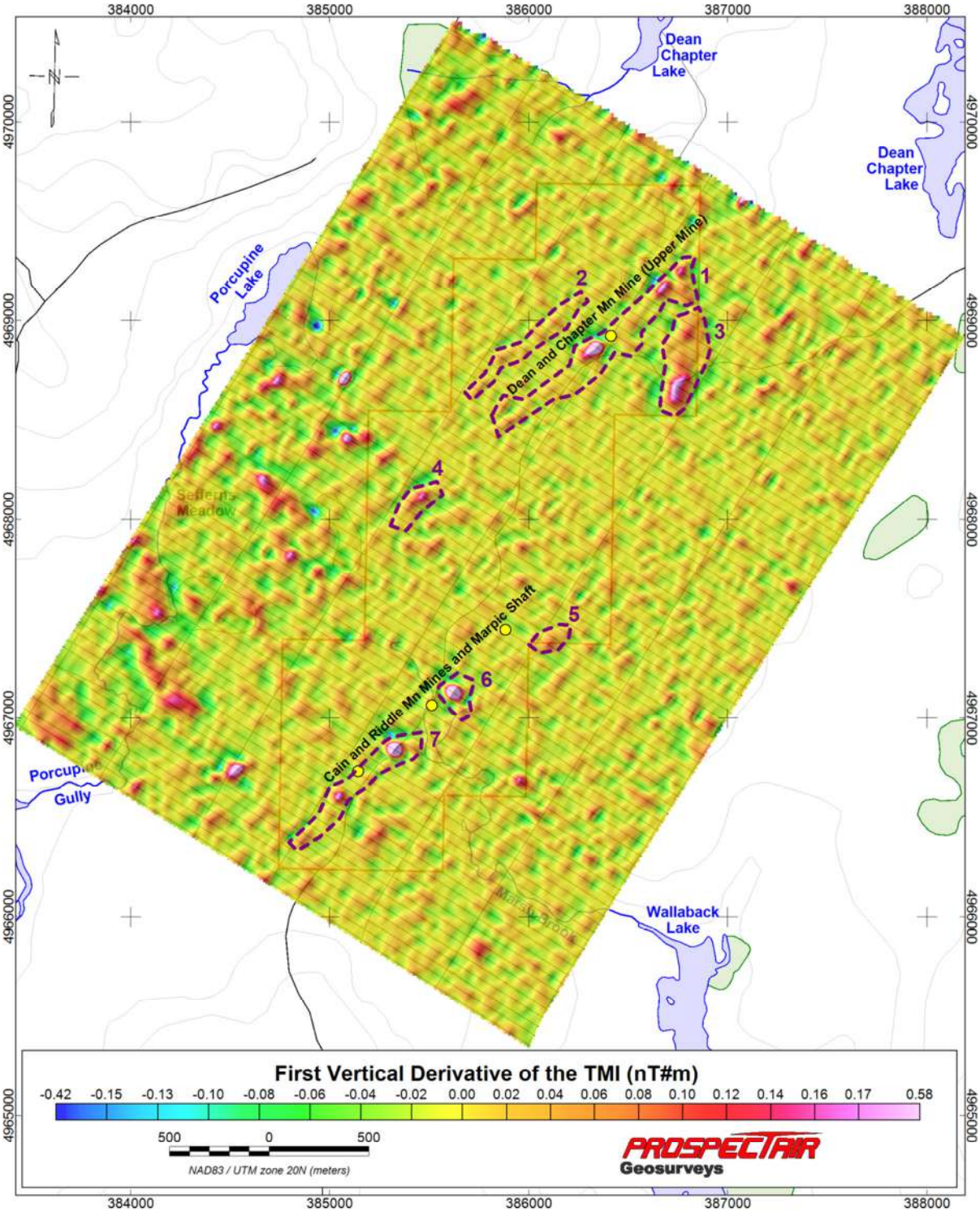
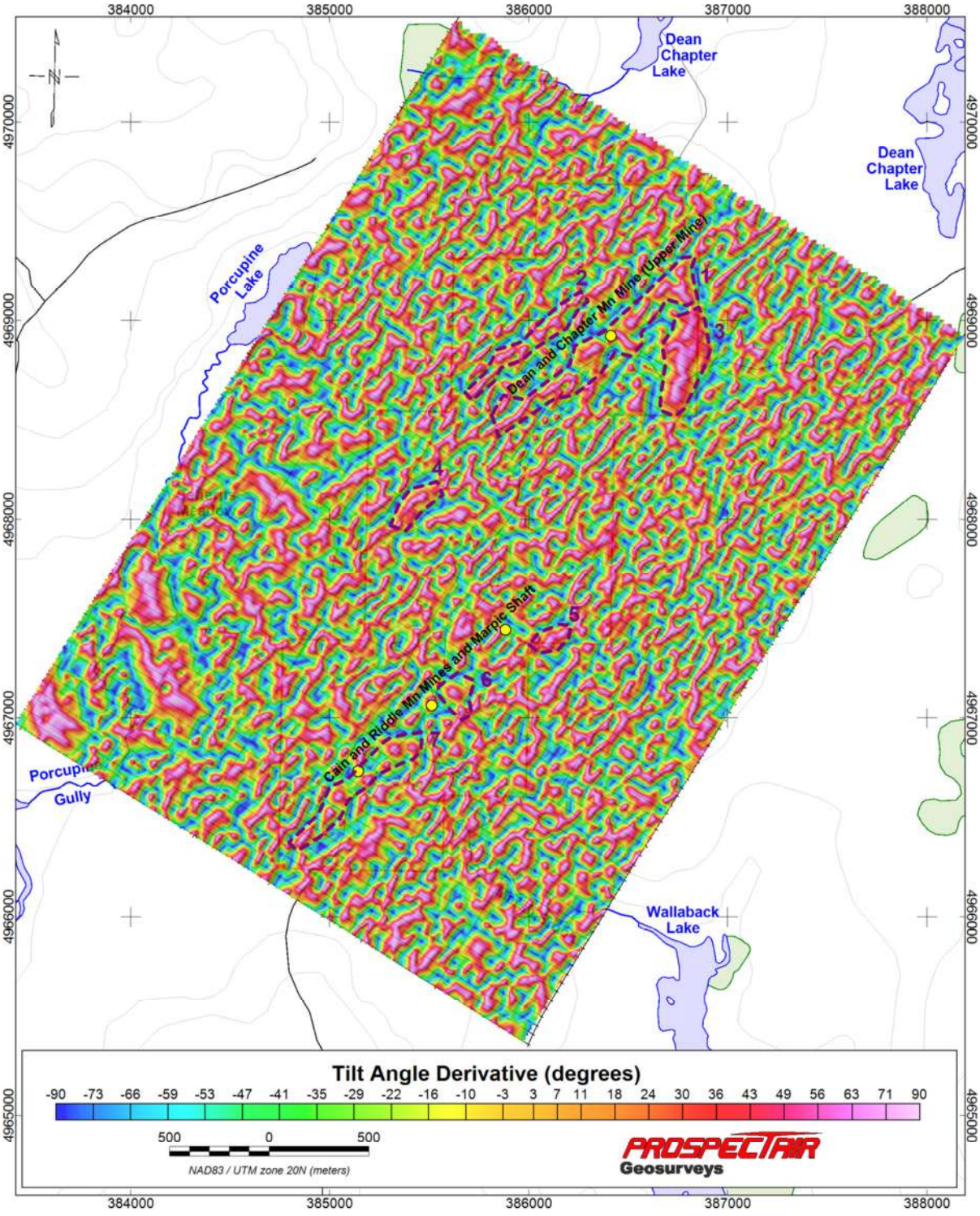


Figure 8: **Tilt Angle Derivative**



Interpretation and prospective areas

Further to the results presented above, the data was analysed to identify areas considered most prospective for mineralized occurrences. Mineral occurrences reported by the Geoscience & Mines Branch of Nova Scotia's Department of Energy and Mines (NSDEM) databases are shown on all the figures of this section to help with the interpretation process.

In the geological setting of the New Ross Mn project, Manganese is the main commodity of interest. This is supported by two mineral occurrences found within the Property: the Dean and Chapter Mn Mine (Upper Mine), and the Cain and Riddle Mn Mines and Marpic Shaft (consisting of several occurrences), both of which are past Mn producing mines, intermittently active until about 1940 and 1958, respectively. Manganese bearing minerals are often found in association with iron oxide minerals, and this is confirmed for both mineral occurrences mentioned above. In the assemblage of iron minerals it is possible to find trace amounts magnetite, and this is likely why Manganese deposits are often associated to magnetic anomalies. As a matter of fact, the Dean and Chapter Mn Mine (Upper Mine) occurrence is directly associated to a NE-SW striking magnetic lineament, locally fluctuating in intensity along its strike length. Magnetic correlation is less clear in the case of the Cain and Riddle Mn Mines and Marpic Shaft occurrences, but a string of discrete magnetic anomalies is still found to be generally trending NE-SW, parallel to the three locations given in the NSDEM database. It is important to note that some inaccuracies are possible for the location of the old mine works, given that the last field check reported was done prior to the GPS era. These magnetic anomalies could therefore relate to Mn-Fe mineralization found in this area. In this type of environment, magnetic anomalies are thus seen as a prime direct targeting vector in the search for Manganese mineralization.

In this context, a number of areas of interest have been selected and are proposed as prospective areas for further investigation. The selection has been focussed to magnetic anomalies with similarities to those found in association with the past producing Mn mines. Prospective areas are shown as thick dashed burgundy polygons on the figures of this section. Each of these exploration targets was assigned an ID number. In total, 7 prospective areas have been identified. They are briefly described here.

Target 1 pertains to the 1.2 km long NE-SW magnetic lineament associated with the Dean and Chapter Mn Mine (Upper Mine) occurrence and is highly prioritized.

Targets 2 to 4 are focusing on other magnetic anomalies found in the vicinity of the Dean and Chapter Mn Mine (Upper Mine) occurrence. Target 2 relates to a weaker and shorter magnetic lineament with a similar strike to the Target 1 anomaly, but offset towards the northwest. Target 4 is also trending similarly, but is found further to the southwest, along the strike of Target 1. While targets 2 and 4 show a similar orientation to the Target 1 anomaly, the anomaly selected for Target 3 is wider and is rather striking N-S, with an amplitude equivalent to the strongest parts of Target 1. It could relate to a new mineralized vein aligned along a different fault system. It could also relate to a folded limb of the past mine's main vein

Targets 5 to 7 outline series of discrete magnetic anomalies globally trending parallel to the three reported locations for the Cain and Riddle Mn Mines and Marpic Shaft occurrence, and parallel to the Target 1 anomaly found further to the north. The strongest magnetic anomaly (with respect to its surrounding background) of the entire survey block is found within Target 7 limits and reaches 16 nT, which is actually very weak in absolute terms.

Note that a few anomalies found further outside of the Property could also bear some potential. It is also worth noting that some of the discrete magnetic anomalies detected by the survey could in fact originate from old mine related infrastructures.

VIII. WORK RECOMMENDATION

The prospective areas defined in this report should be investigated in priority near the old historic deposits, with basic ground prospective methods at first. If the magnetic results are confirmed to be a reliable guide for the exploration of Manganese in the area, other magnetic anomalies found further away should be investigated. If it is not the case, it is recommended to test a few ground geophysics methods, such as the resistivity/IP and/or the gravity ones, and possibly some geochemical techniques, directly above known occurrences to select the best exploration approach for the area.

IX. FINAL PRODUCTS

Digital Line Data

The Geosoft database is provided with the channels detailed in Table 4.

Table 4: **MAG line data channels**

No.	Name	Description	Units
1	UTM_X	UTM Easting, NAD-83, Zone 20 N	m
2	UTM_Y	UTM Northing, NAD-83, Zone 20 N	m
3	Lat_deg	Latitude in decimal degrees	Deg
4	Long_deg	Longitude in decimal degrees	Deg
5	Gtm_sec	Second since midnight GMT	Sec
6	Radar	Ground clearance given by the radar altimeter	m
7	CDED_DEM	CDED Digital Elevation Model (w.r.t. MSL)	m
8	Terrain	Calculated Digital Elevation Model (w.r.t. MSL)	m
9	GPS_Z	Helicopter altitude (w.r.t. MSL)	m
10	Mag_Raw	Raw magnetic data	nT
11	Mag_Lag	Lagged magnetic data	nT
12	Gnd_mag	Base station magnetic data	nT
13	Mag_Cor	Magnetic data corrected for diurnal variation	nT
14	TMI	Fully levelled Total Magnetic Intensity	nT
15	TMIres	Residual TMI (IGRF removed)	nT

Maps

All maps are referred to NAD-83 datum in the UTM projection Zone 20 North, with coordinates in metres. Maps are at a 1:10,000 scale and are provided in PDF, PNG, Geotiff and Geosoft MAP formats for the products detailed in Table 5.

Table 5: **Maps delivered**

No.	Name	Description
1	DEM+FlightPath+Claims	Digital Elevation Model with flight path and property claims
2	TMI	Residual Total Magnetic Intensity
3	FVD	First Vertical Derivative of the TMI
4	TILT	Tilt Angle Derivative

Grids

All grids are referred to NAD-83 in the UTM projection Zone 20 North, with coordinates in metres. Grids are provided in Geosoft GRD format, with a 10m grid cell size, for the products listed in Table 6.

Table 6: **Grids delivered**

No.	Name	Description	Units
1	DEM	CDED Digital Elevation Model	m
2	Terrain	Calculated Digital Elevation Model	m
3	TMI	Total Magnetic Intensity	nT
4	FVD	First Vertical Derivative of TMI	nT/m
5	SVD	Second Vertical Derivative of TMI	nT/m^2
6	TMIres	Residual TMI (IGRF removed)	nT
7	TILT	Tilt Angle Derivative	Degree

Project Report

The report is submitted in PDF format.

Respectfully submitted,

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Joël Dubé, P.Eng.
August 31st, 2018

X. STATEMENT OF QUALIFICATIONS

Joël Dubé
7977 Décarie Drive
Ottawa, ON, Canada, K1C 3K3

Telephone: 819.598.8486
E-mail: jdube@ddgeoscience.ca

I, Joël Dubé, P.Eng., do hereby certify that:

1. I am a consultant in geophysics, President of Dynamic Discovery Geoscience Ltd., registered in Canada.

2. I earned a Bachelor of Engineering in Geological Engineering in 1999 from the École Polytechnique de Montréal.

3. I am an Engineer registered with the Ordre des Ingénieurs du Québec, No. 122937, and a Professional Engineer with Professional Engineers Ontario, No. 100194954 (CofA No. 100219617) and with the Association of Professional Engineers and Geoscientists of New Brunswick, No. L5202 (CofA No. F1853), and with the Association of Professional Engineers of Nova Scotia, No. 11915 (CofC No. 51099).

4. I have practised my profession for 19 years in exploration geophysics.

5. I have not received and do not expect to receive a direct or indirect interest in the properties covered by this report.

Dated this 31st of August, 2018

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Joël Dubé, P.Eng. #122937

XI. Appendix A – Survey block outline

New Ross Mn Block

Easting	Northing
386001	4965344
383412	4966962
385060	4969603
385406	4970164
385638	4970537
388200	4968935
387877	4968403
387360	4967580
386487	4966178
386249	4965792
386148	4965622
386078	4965510
386035	4965423