HELIBORNE HIGH RESOLUTION AEROMAGNETIC SURVEY

Western Lake St.Joseph Iron and Root Lake survey blocks
Pickle Lake Area, Ontario

For:

PIERRE GAGNE CONTRACTING LTD
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Thunder Bay, Ontario
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By:

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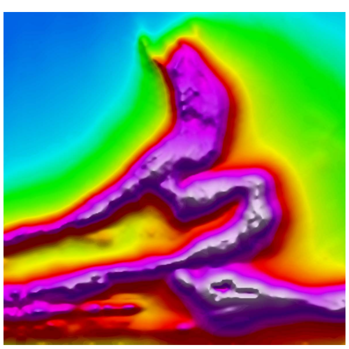
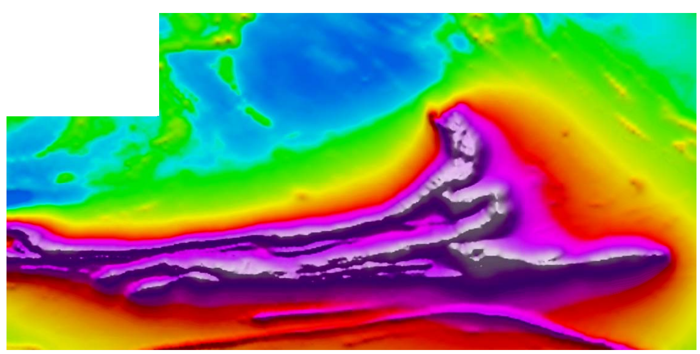
Project Ref.: P11-021 **Final Technical Report**

June 2011





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FINAL TECHNICAL REPORT

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1.0 INTRODUCTION

On May 19th, 2011, **GEO DATA SOLUTIONS GDS INC. (GDS)** was awarded contract P11-021 by **PIERRE GAGNE CONTRACTING LTD (PGCL).** The contract required **GDS** to carry out a high-resolution helicopter borne aeromagnetic survey on two blocks, Western Lake St.Joseph Iron and Root Lake, located in the Pickel Lake area, Ontario.

The field base of operation was set up at Pickel Lake, which is located 85 km North-East of the Western Lake St.Joseph Iron block and 114 km North-East of the Root Lake block.

In terms of altitude, topography in the survey area is classed as moderate. The survey was executed from June 11th to 16th, 2011. Excluding calibration and test flights, 8 production flights were needed to cover the requested blocks. Stable summer weather conditions were observed during the field work period.

Table 1 presents survey specifications, tables 2, 3 and 4 present block co-ordinates and figures 1 and 2 show the planned survey flight-paths. Minimum length of any traverse or tie-line has been adjusted to a minimum of 3 km.

The helicopter nominal ground clearance was 50 metres (figure 5) while the sensor magnetometer was mounted in a bird towed 15 metres beneath the helicopter.

This report describes survey procedures and data verification, which were carried out in the field, and data processing, which followed at the office.

Table 1: Survey Specifications

Block	Traverse Line			Tie Line			Total Line-km
	Azimuths	Line-km	Spacing (m)	Azimuths	Line-km	Spacing (m)	
Main area St.Joseph	N-S	794	100	E-W	83	1 000	877
Infill St.Joseph	E-W	263	50	N-S	-	-	263
Root Lake	N-S	365	100	E-W	40	1 000	405
						Total	**1 545 km**

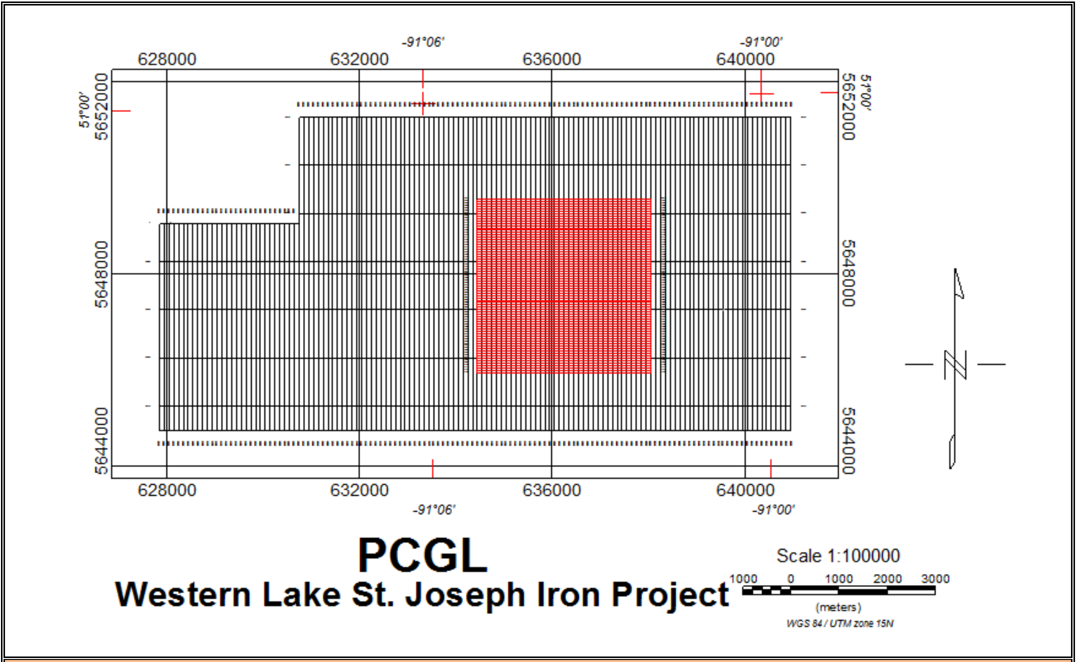


Figure 1: Western Lake St.Joseph Iron and Infill blocks – Theoretical Flight Path

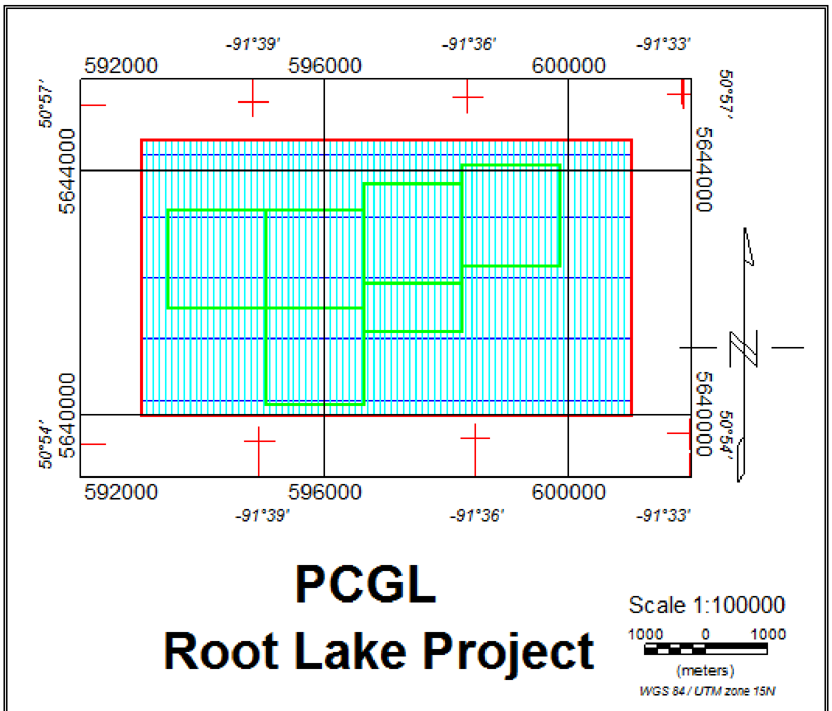


Figure 2: Root Lake – Theoretical Flight Path

Table 2: Western Lake St.Joseph Iron Co-ordinates; Main area (N-S)				
Vertex	**Latitude WGS 84**	**Longitude WGS 84**	**X (UTM) Zone 15**	**Y (UTM) Zone 15**
1	50° 58’ 43.80”	-91° 10’ 43.50”	627 850	5 649 050
2	50° 58’ 41.46”	-91° 08’ 14.87”	630 750	5 649 050
3	50° 59’ 52.64”	-91° 08’ 12.02”	630 750	5 651 250
4	50° 59’ 43.97”	-90° 59’ 29.05”	640 950	5 651 250
5	50° 56’ 13.67”	-90° 59’ 38.12”	640 950	5 644 750
6	50° 56’ 24.67”	-91° 10’ 48.94”	627 850	5 644 750

Table 3: Western Lake St.Joseph Iron Co-ordinates; Infill (E-W)				
Vertex	**Latitude WGS 84**	**Longitude WGS 84**	**X (UTM) Zone 15**	**Y (UTM) Zone 15**
1	50° 58’ 51.50”	-91° 02’ 00.05”	638 050	5 649 550
2	50° 56’ 55.02”	-91° 02’ 04.97”	638 050	5 645 950
3	50° 56’ 58.09”	-91° 05’ 09.36”	634 450	5 645 950
4	50° 58’ 54.57”	-91° 05’ 04.57”	634 450	5 649 550

Table 4: Root Lake Co-ordinates; Main area (N-S)				
Vertex	**Latitude WGS 84**	**Longitude WGS 84**	**X (UTM) Zone 15**	**Y (UTM) Zone 15**
1	50° 54’ 10.13”	-91° 33’ 48.95”	601 000	5 640 000
2	50° 54’ 14.96”	-91° 40’ 38.42”	593 000	5 640 000
3	50° 56’ 40.61”	-91° 40’ 34.29”	593 000	5 644 500
4	50° 56’ 35.76”	-91° 33’ 44.47”	601 000	5 644 500

2.0 SURVEY SPECIFICATIONS

Airborne survey and noise specifications were as follows:

a) traverse spacing and direction
- Table 1 presents traverse/tie-line spacings and directions requested.

b) Total number of line-km flown: 1 545 km

c) Nominal terrain clearances
- helicopter nominal terrain clearances: 50 metres
- magnetometer nominal terrain clearances: 35 metres

d) magnetic diurnal variation
- A maximum tolerance of 3.0 nT (peak to peak) deviation from a long chord equivalent to a period of 30 seconds at the magnetometer base station was respected during all the survey period.

e) magnetometer noise envelope
- in-flight noise envelope did not exceed 0.5 nT, for straight and level flight.
- base station noise envelope did not exceed 0.2 nT.

f) Re-flights and turns
- line-spacing did not vary by more than 25 % from the nominal spacing over a distance of more than 1 km. The minimum length of any survey line was 3 km.
- all reflights of line segments intersected at least two control lines.

3.0 HELICOPTER, EQUIPMENT AND PERSONNEL

3.1 Helicopter

Helicopter:	Robinson 44 (figure 3 and table 5)	
	Mean Survey Speed):	34.6 m/sec
	Typical distance between data:	3.5 metres
	Nominal Ground Clearance:	50 metres

Table 5: The Robinson R44 Helicopter Characteristics

Power plant	One 195kW (260hp) Textron Lycoming O-540 flat six piston engine
Rate of climb 1000 ft/min	1000 ft/min
Number of main rotor blades	2
Cruising speed at 75% power	209 MPH
Service ceiling	14,000 ft
Range with no reserve	645 km
Empty weight	635 kg
Maximum takeoff	1,090 kg

Figure 3: The Robinson R44 Helicopter

3.2 Equipment

Magnetometer:	Geometrics Cesium split-beam total field magnetic sensor installed in a towed bird with a sensitivity of 0.01 nT, a sampling rate of 10 Hz and a resolution better than 0.025 nT per measurement. The sensor tolerates gradients up to 10 000 nT/m, and operates in a range from 20 000 nT to 100 000 nT. A 0.5 nT noise envelope was not exceeded over 500 metres line-length without a reflight.
Magnetometer Base Station:	A GEM GSM-19 Overhauser magnetometer base station (figure 4) was mounted in a magnetically quiet area. The base station measures the total intensity of the earth's magnetic field in units of 0.01 nT at intervals of 1 second, within a noise envelope of 0.10 nT. The Magnetic Field Mean Value obtained at the base station was 57 235 nT

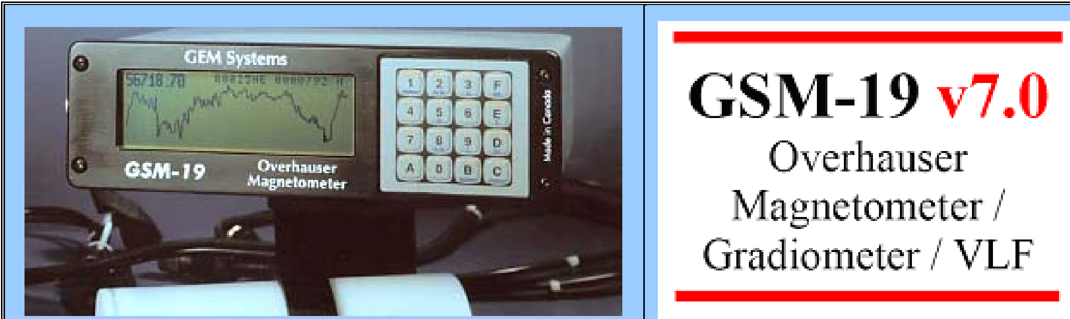


Figure 4: The GSM-19 Base Station Magnetometer

Digital Acquisition System:	PicoEnvirotec, AGIS System
Radar Altimeter:	TRA-3000, accuracy 5%, sensitivity one foot, range 0 to 2,500 feet, 1 sec. recording interval
Electronic Navigation:	Real-Time Differentially Corrected Omnistar System, 1.0 sec. recording interval, accuracy of ±5 metres.
Ancillary Equipment:	Computer workstation, complement of spare parts and test equipment

3.3 Personnel

The general management of the project was monitored offsite by Mr. Mouhamed Moussaoui, **GDS**'s President. Mr. Jose Martinez was responsible for the field data quality control to ensure that the work was carried out according to contractual specifications. Final data evaluation and processing were performed at the Laval **GDS** office by Mr. Jose Martinez. Survey crew and office personnel are listed in table 6.

Table 6: Field and Office Crew

Position	Name
Project Manager	Mr. Mouhamed Moussaoui, P.Eng.
Data quality control	Mr. Jose Martinez
Field Operator	Mr. Alain Tremblay
Pilot	Mr. Alain Tremblay
Final Processing	Mr. Jose Martinez
Survey Report	Mr. Camille St-Hilaire, P.Geo

4.0 SURVEY SCHEDULE

The survey was flown over two blocks, one block including an infill, with flight line bearing selected to run perpendicular to the average trend of the local geological structures.

Survey steps were:

Mobilization:	June 10th, 2011
Survey:	June 11th to 16th, 2011
Demobilization:	June 17th, 2011
Number of Flights:	8 production flights

Preliminary results were available to **PGCL** during field works while final maps and data were sent late in June 2011.

5.0 DATA ACQUISITION

The following test and quality control were performed before and during survey production.

Altimeter Tests:

The radar altimeter pre-survey calibration was performed on June 3rd, 2011 by flying a range of altitudes representative of survey area conditions, above and below the designated survey altitude. These altitudes cover the minimum and maximum range at 5 altitudes of equal increments. Typically, these levels were determined by the real time GPS-Z and barometric altimeter. Appendix A presents the radar altimeter calibration results.

The barometric altimeter pressure readings were noted daily pre- and post flight on flight logs in order to determine any barometric drift. Drift corrections were applied in the processing stage. The corrected barometric altimeter data were verified against the differentially corrected GPS altitude data, which were corrected to the orthometric height.

Quality Control

After each day, profiles were examined as a preliminary assessment of the noise level on the recorded data. Altimeter deviations from the prescribed flying altitudes were also closely examined as well as the magnetic diurnal activity, as recorded on the base station.

All digital data were verified for validity and continuity. Data from helicopter and base station were transferred to a PC's hard disk. Basic statistics were generated for each parameter recorded. These included the minimum, maximum and mean values, the standard deviation and any null values located. Editing of all recorded parameters for spikes or datum shifts was done, followed by final data verification via an interactive graphic screen with on-screen editing and interpolation routines.

Quality of GPS navigation was controlled on a daily basis by recovering the helicopter flight path.

Checking all data for adherence to specifications was carried out before crew and aircraft demobilization.

6.0 DATA COMPILATION AND PROCESSING

6.1 Base maps

Base maps of the survey area were plotted from topographic maps of the Department of Natural Resources Canada at a scale of 1:20 000.

Projection description

Datum:	WGS84
Projection:	UTM Zone 15N
False Easting:	500 000
False Northing:	0
Scale Factor:	0.9996

6.2 Processing of Base Station data

Recorded magnetic diurnal data from the magnetometer base station were reformatted and loaded into the OASIS database. After initial verification of the integrity of the data from statistical analysis, the appropriate portion of the data was selected to correspond to the exact start and end time of the flight. Data were then checked and corrected for spikes using a fourth difference editing routine. Following this, interactive editing of the data was done, via a graphic editing tool, to remove events caused by man-made disturbances. A small low pass noise filter (30 seconds) was then applied. The final processing step consisted of subtracting result from the airborne magnetic data as a pre-levelling step. The average of the Total Field Magnetic Intensity measured at the Base Station was 57 509 nT.

6.3 Processing of the Positioning Data (GPS)

The raw GPS data were recovered and corrected from spikes. The resulting corrected latitudes and longitudes were then converted to the local map projection and datum (WGS84). A point-to-point speed calculation was then done from the final X, Y coordinates and reviewed as part of the quality control. The flight data were then cut back to the proper survey line limits and a preliminary plot of the flight path was done and compared to the planned flight path to verify the navigation. The positioning data were then exported to the other processing files.

6.4 Processing of the Altimeter data

The altimeter data, which includes radar altimeter and the GPS elevation values were checked and corrected for spikes using a fourth difference editing routine. A small low pass filter of 2 seconds was then applied to the data. Following this, a digital terrain trace was computed by subtracting the radar altimeter values from the corrected GPS elevation values. All resulting parameters were then checked, in profile form, for integrity and consistency, using a graphic viewing editor.

6.5 Processing of Magnetic data

The airborne magnetic data were reformatted and loaded into the OASIS database. After initial verification of the data by statistical analysis, the values were adjusted for system lag. The data were then checked and corrected for any spikes using a fourth difference editing routine and inspected on the screen using a graphic profile display. Interactive editing, if necessary, was done at this stage. Following this, the long wavelength component of the diurnal was subtracted from the data as a pre-levelling step.

A preliminary grid of the values was then created and verified for obvious problems, such as errors in positioning or bad diurnal. Appropriate corrections were then applied to the data, as required.

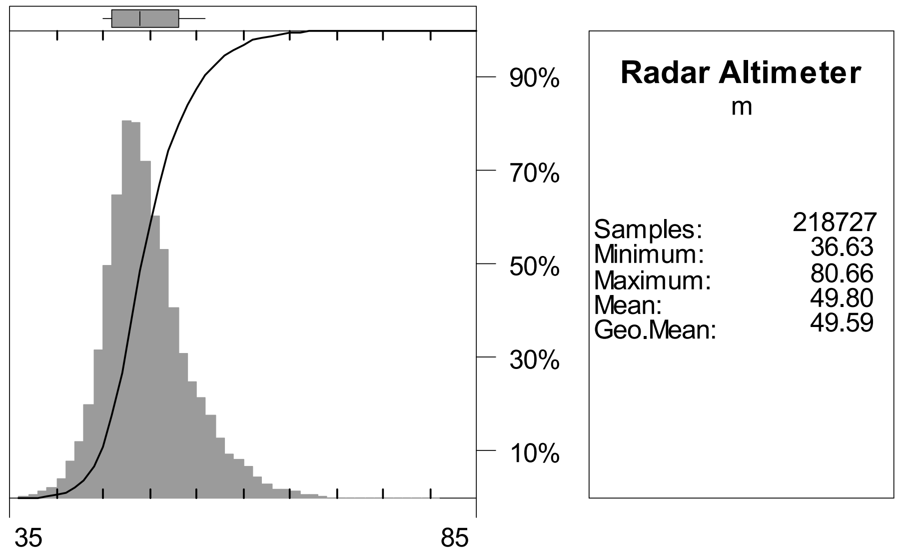
Following this, on the Western Lake St.Joseph Iron infill block, the levelling process was undertaken. This consisted of calculating the positions of the control points (intersections of lines and tie lines), calculating the elevation and magnetic differences at the control points and applying a series of levelling corrections to reduce the misclosures to zero. A new grid of the values was then created and checked for residual errors. Any gross errors detected were corrected in the profile database and the levelling process repeated. Finally, a micro levelling routine was applied to the magnetic data.

6.6 Micro-Levelling

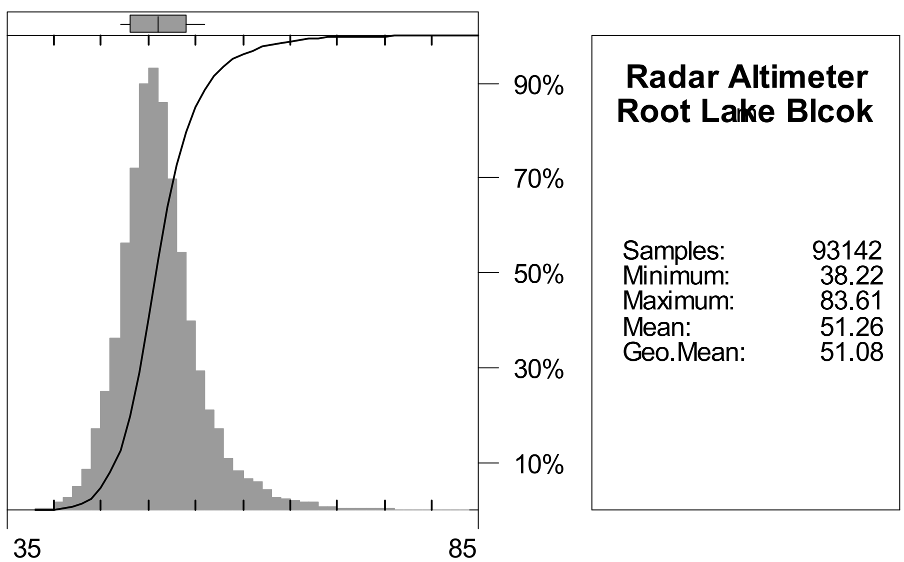
Complex airborne datasets acquired on parallel lines often exhibit subtle artefacts in the line direction.

Micro-levelling is used to filter the primary gridded data in order to reduce or remove long-wavelength noise along survey lines, caused by non-geological effects. For this survey, GDS used a proprietary micro-levelling technique. It uses modified median filters that are designed to match the statistical nature of geophysical data. Along-line and cross-line directional filters plus clean-up filters are used to isolate and remove this sort of noise from the gridded images. Naudy-type thresholds are used to limit the amplitude of change at any data point.

Once the micro-levelling process is applied on each block, colour-shaded images are studied to verify that the residual line noise has been minimized, and that new line noise has not been introduced. The micro-level correction grid is reviewed to confirm that no significant geological signal had been lost. The final stage is to sample the correction grid and apply these corrections to the geophysical data profile.



Histogram of the Ground Clearance, Western Lake St.Joseph Iron block



Histogram of the Ground Clearance, Root Lake block

Figure 5: Histograms of the Ground Clearances

6.7 Total Magnetic field and First Vertical Derivative Grids

The reprocessed total field magnetic grid was calculated from the final reprocessed profiles by a minimum curvature algorithm. The accuracy standard for gridding was that the grid values fit the profile data to within 0.01 nT for 99.99% of the profile data points. According to traverse line spacings, grids have a grid cell size of 25 metres and 12.5 metres.

Minimum curvature gridding provides the smoothest possible grid surface that also honours the profile line data. However, sometimes this can cause narrow linear anomalies cutting across flight lines to appear as a series of isolated spots.

The first vertical derivative of the total magnetic field was computed to enhance small and weak near-surface anomalies and as an aid to delineate the geologic contacts having contrasting susceptibilities. The calculation was done in the frequency domain, using Win-Trans FFT algorithms.

7.0 FINAL PRODUCTS

7.1 Maps:

GDS made base maps from information present on published topographic maps. Each map was produce at a scale of 1:20 000 displaying base-map features, flight path and UTM co-ordinates. Three paper copies of the following final maps were delivered to **PGCL**:

(a) Shaded Total Magnetic Field (colour interval)
(b) Shaded Magnetic First Vertical Derivative (colour interval)

7.2 Final digital archive of line data:

GDS produced copies of a CD-ROM containing digital archives and maps (PDF and Map format). Digital archives, described in Appendix B, contain Geosoft databases of all survey data. Databases are referenced to the standard UTM co-ordinates for the area.

GDS store a copy of the digital archive for one year after production of final products. On request by **PGCL**, **GDS** will supply raw data from the survey with survey products. Otherwise, **GDS** will store raw data with copy of the digital archive.

7.3 Miscellaneous

Three paper copies of this technical report, with the corresponding digital PDF file, have been produced and delivered to **PGCL**.

8.0 CONCLUSION

Flown from June 11th to 16th, 2011, the helicopter borne aeromagnetic survey was completed inside the estimated time frame.

All airborne and ground-based records were of excellent quality. Magnetic data acquisition was done in good diurnal conditions.

Noise levels observed on the Total Magnetic Field were well within accepted limits, determined from the fourth difference of the lagged, edited airborne magnetic data.

GPS results proved to be of high quality. The flight path was surveyed accurately and speed checks showed no abnormal jumps in data.

It is hoped that information presented in this report, and on the accompanying products, will be useful both in planning subsequent exploration efforts and in the interpretation of related exploration data.

Respectfully Submitted,

Camille St-Hilaire, M.Sc.A.
P.Geo. no. 339

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APPENDIX A

TESTING AND CALIBRATION

Geo Data Solutions GDS Inc.

ALTIMETER CALIBRATION

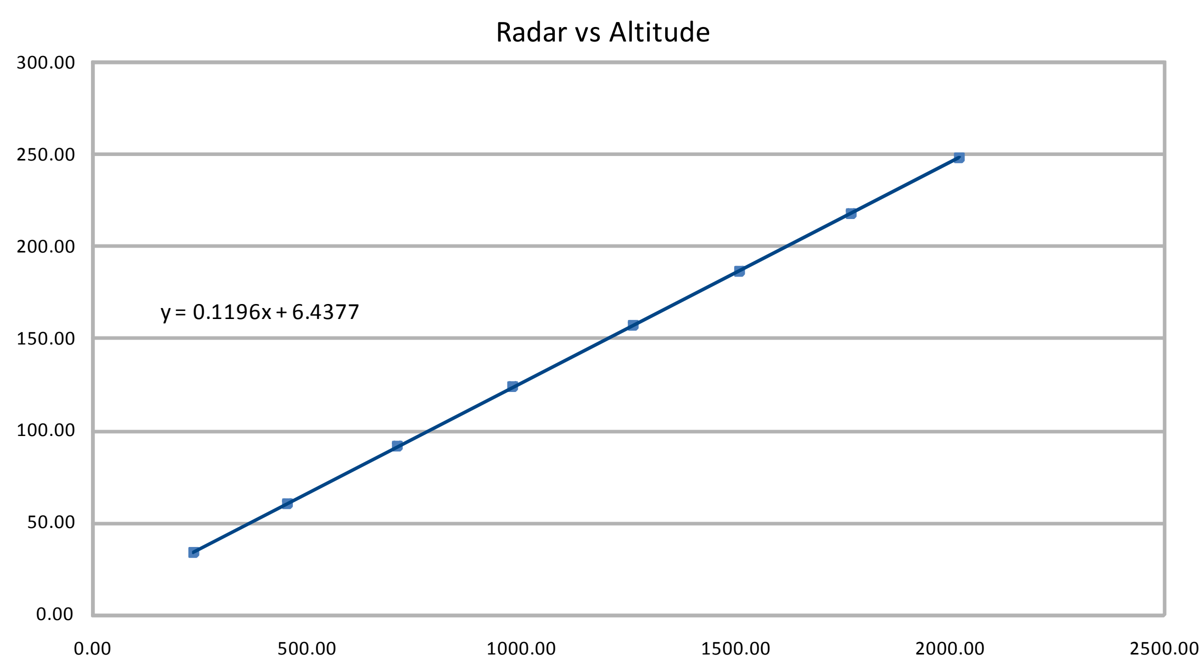
Location: Breckenridge, ON
Pilot: Alain
Operator: Alain

Date: 3-Jun-11
Aircraft: Heli Alain
Compiled by: Carlos Cortada

Antenna Height (m): 2.0

Terrain clearance (ft)	Radar raw (mvolt)	Zgps (m)	Topo (m)	Altitude (m)
100	233.68	99.55	63.66	33.89
200	453.09	126.48	63.65	60.83
300	711.20	157.66	63.68	91.98
400	978.87	189.36	63.65	123.71
500	1259.61	222.69	63.65	157.04
600	1508.63	251.91	63.64	186.27
700	1767.45	283.48	63.65	217.83
800	2020.64	313.89	63.65	248.24

radar(m)= **0.1196** x (mvolt) **+ 6.44**



APPENDIX B

PROFILE DATABASE ARCHIVE AND CHANNEL DEFINITIONS

Channels List

Mag Database

Channel	Description	Sampling	Unit	Format
UTC	UTC Time (seconds after midnight) corrected	10Hz	sec	d8.1
date	Date flown	10Hz	yyyy/mm/dd	f11.0
line	Line number	10Hz		I6.0
FLT	Flight number	10Hz		I6.0
lat	Post Processed Latitude	10Hz	dd.mm.ss.s	d13.2
lon	Post Processed Longitude	10Hz	dd.mm.ss.s	d14.2
x	Post Processed X	10Hz	m	d9.2
y	Post Processed Y	10Hz	m	d10.2
z	Post Processed Z (MSL)	10Hz	m	d7.2
raltlc	Radar Corrected (final)	10Hz	m	d8.2
DTMc	Digital Terrain Model (final)	10Hz	m	d7.2
basea	Edited and filtered base mag	10Hz	nT	d10.3
MBc	Raw compensated mag	10Hz	nT	d10.3
MBclc	Mag Lagged and despiked	10Hz	nT	d10.3
drift_LF	Low-Frequency diurnal correction	10Hz	nT	d10.3
magbc	Mag Diurnal corrected (TMI)	10Hz	nT	d10.3
corlvl	Cumulative leveling correction	10Hz	nT	d10.3
maglvl	Mag leveled	10Hz	nT	d10.3
cormicro	Microleveling correction	10Hz	nT	d10.3
magMicro	Mag microleveled	10Hz	nT	d10.3

Data base and Grid Names:

*** Mag Final.GRD
*** _FVD Final.GRD
***_DB.GDB

Where*** has to be replaced by the property name (**Block Western Lake St Joseph Iron, Block Western Lake St Joseph Iron Infill** and **Block Root Lake**)