Geoscience BC Report 2009-7



Final Report for Geoscience BC Project 2008-032

Helicopter-borne Z-Axis Tipper Electromagnetic (ZTEM) and Aeromagnetic Survey, Mt. Milligan Test Block

Geotech Ltd.



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Helicopter-borne Z-Axis Tipper Electromagnetic (ZTEM) and Aeromagnetic Survey, Mt. Milligan Test Block

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Part 1:
Report on a Helicopter-Borne Z-Axis Tipper Electromagnetic (ZTEM) and Aeromagnetic Geophysical Survey, Mt. Milligan Test Block, Mackenzie Region, British Columbia

Part 2:
Summary Report on Helicopter-Borne ZTEM Tipper AFMAG Survey Results over Mt-Milligan Test Block, January 2009

Part 3:
Maps

REPORT ON A HELICOPTER-BORNE Z-AXIS TIPPER ELECTROMAGNETIC (ZTEM) AND AEROMAGNETIC GEOPHYSICAL SURVEY

Mt. Milligan Test Block

Mackenzie Region, British Columbia

For:

GEOSCIENCE BC & TERRANE METALS CORP.



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Survey flown during October, 2008

Project 8242

January, 2009

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REPORT ON A HELICOPTER-BORNE Z-AXIS, TIPPER ELECTROMAGNETIC GEOPHYSICALSURVEY

Mt. Milligan Project
Mackenzie Region, British Columbia

Executive Summary

During October 15th to 22nd, 2008 Geotech Ltd. carried out a helicopter-borne geophysical survey for Geoscience BC in conjunction with Terrane Metals Corp. over the Mt. Milligan Test block situated in the province of British Columbia, Canada.

Principal geophysical sensors included a Z-Axis Tipper electromagnetic (ZTEM) system, and a caesium magnetometer. Ancillary equipment included a GPS navigation system and a radar altimeter. A total of 232 line-kilometres were flown.

The survey operations were based out of the town of Mackenzie located in British Columbia. In-field data quality assurance and preliminary processing were carried out on a daily basis during the acquisition phase. Preliminary and final data processing, including generation of final digital data and map products were undertaken from the office of Geotech Ltd. in Aurora, Ontario.

The processed survey results are presented as profiles of In-Phase and Quadrature of the tippers (Z/X & (Z/Y)in addition to grid contours of the In-Phase and Quadrature Divergences, Phase Rotated grid contours and the Total Magnetic Intensity grid contours. Real and imaginary parts of the Z/X (X-component) and Z/Y (Y-component) were calculated for five extracted frequencies (30, 45, 90, 180 and 360 Hz). Due to the cross-over nature of the Tipper responses, a derived parameter, the Total Divergence or DT (DIV Z/X, Z/Y)), was calculated at each frequency that directly relates to conductive/resistive properties of the subsurface. A similar parameter, the 90 degrees Phase Rotated (PR) grids were generated, four for each frequency (Z/X direction, Z/Y direction, In Phase and Quadrature), that exhibit maxima over conductors and minima over resistors and therefore assist with the interpretability of the results. The two orthogonal grids can be added to obtain a resulting Phase Rotated grid.

Data quality and calculated results were of good quality. They are reliable and allow for, at this stage, to qualitatively contribute to the understanding of the spatial distribution of conductivity, relating to lithological structure and alteration, within the Selwyn Basin region. Digital data include all electromagnetic and magnetic products, plus ancillary data.

The survey report describes the procedures for data acquisition, processing, final image presentation and the specifications for the digital data set. No formal interpretative discussion is included in this report.

1. INTRODUCTION

1.1 General Considerations

These services are the result of the Agreement made between Geotech Ltd. and Terrane Metals Corp. in conjunction with Geoscience BC to perform a helicopter-borne geophysical survey over the Mt. Milligan Test block located in the Mackenzie Region near the town of Mackenzie in British Columbia, Canada (Figure 1).

C.D. Anglin and Peter Kowalcyk, acted on behalf of Geoscience BC and Terrane Metals Corp. during the data acquisition and data processing phases of this project.

The geophysical surveys consisted of helicopter borne AFMAG Z-axis Tipper electromagnetic (ZTEM) system and aermagnetics using a ceasium magnetometer. A total of 232 line-km of geophysical data were acquired during the survey. The survey area is shown in Figure 2.

In a Z-TEM survey, a single vertical–dipole air-core receiver coil is flown over the survey area in a grid pattern, similar to regional airborne EM surveys. Two orthogonal, air-core horizontal axis coils are placed close to the survey site to measure the horizontal EM reference fields. Z/X and Z/Y Tippers (Vozoff, 1972) are the derived components. The ZTEM was used to map geology using resistivity contrasts and magnetometer data were also collected to help map geology using magnetic susceptibility contrasts.



Figure 1 - Property Location

The crew was based at the Alexander Mackenzie Hotel in the town of Mackenzie, British Columbia, for the acquisition phase of the survey. Survey flying started on October 15th and was completed on October 22nd, 2008

Data quality control and quality assurance, and preliminary data processing were carried out on a daily basis during the acquisition phase of the project. Final data processing followed immediately after the end of the survey. Final reporting, data presentation and archiving were completed from the Aurora office of Geotech Ltd. in January, 2009.

1.2 Survey and System Specifications

The Mt. Milligan Test block (55° 7'23.92"N, 124° 2'15.19"W) is located inside the Mackenzie region of British Columbia approximately 64 kilometers west-south-west of the town of Mackenzie as shown in Figure 2.

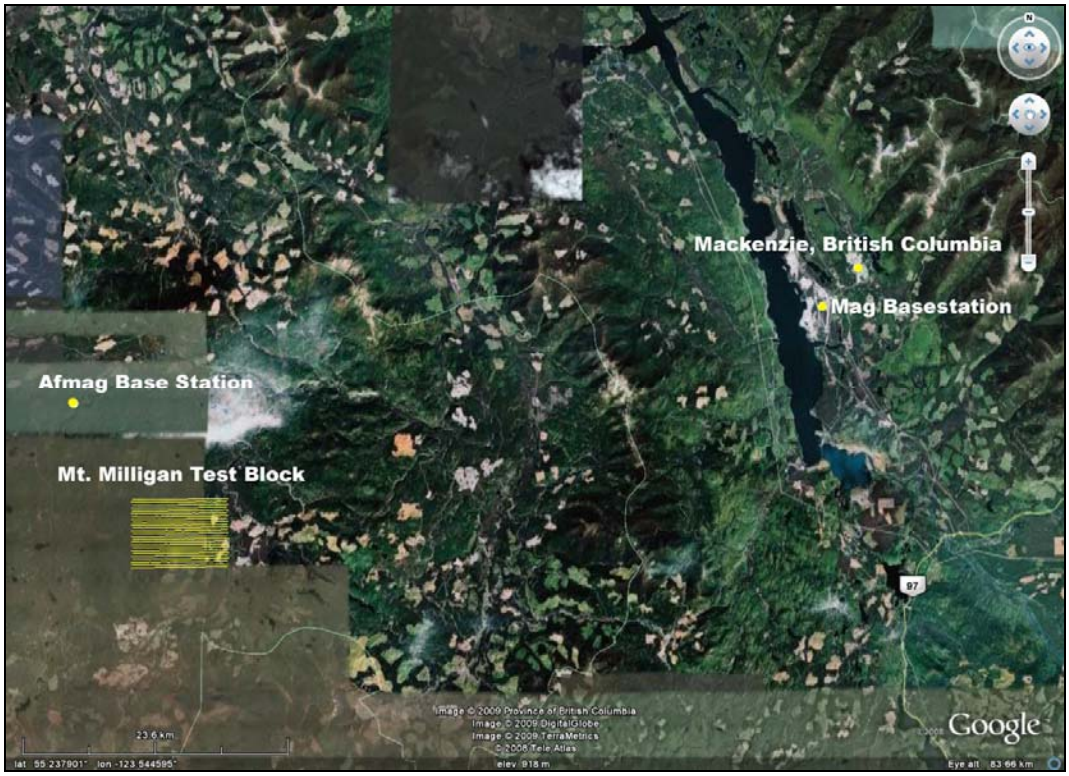


Figure 2 –Mt. Milligan Test Block, with Base Station Locations.

The Mt. Milligan Test block was flown in am east-west (N 90° E / N 270° E) direction with a traverse line spacing of 250 metres, as depicted in Figure 3. Tie lines were neither planned nor flown for this survey. For more detailed information on the flight spacing and direction see Table 1.

1.3 Topographic Relief and Cultural Features

1.3.1 Mt. Milligan Test Block

Topographically, the Mt. Milligan Test block exhibits a high relief, with an elevation ranging from 973 to 1483 metres above sea level (see Figure 3). There are many small rivers running through the survey connecting various small lakes and wetland areas. There are roads and trails found within the survey area. The roads run in an n east-west direction starting from the east side of the block and ending near the middle of the block. The survey block covers 19 British Columbia mining claims, which are shown in Appendix A. The survey block is covered by NTS (National Topographic Survey) of Canada sheets 093N01 and 093O04.

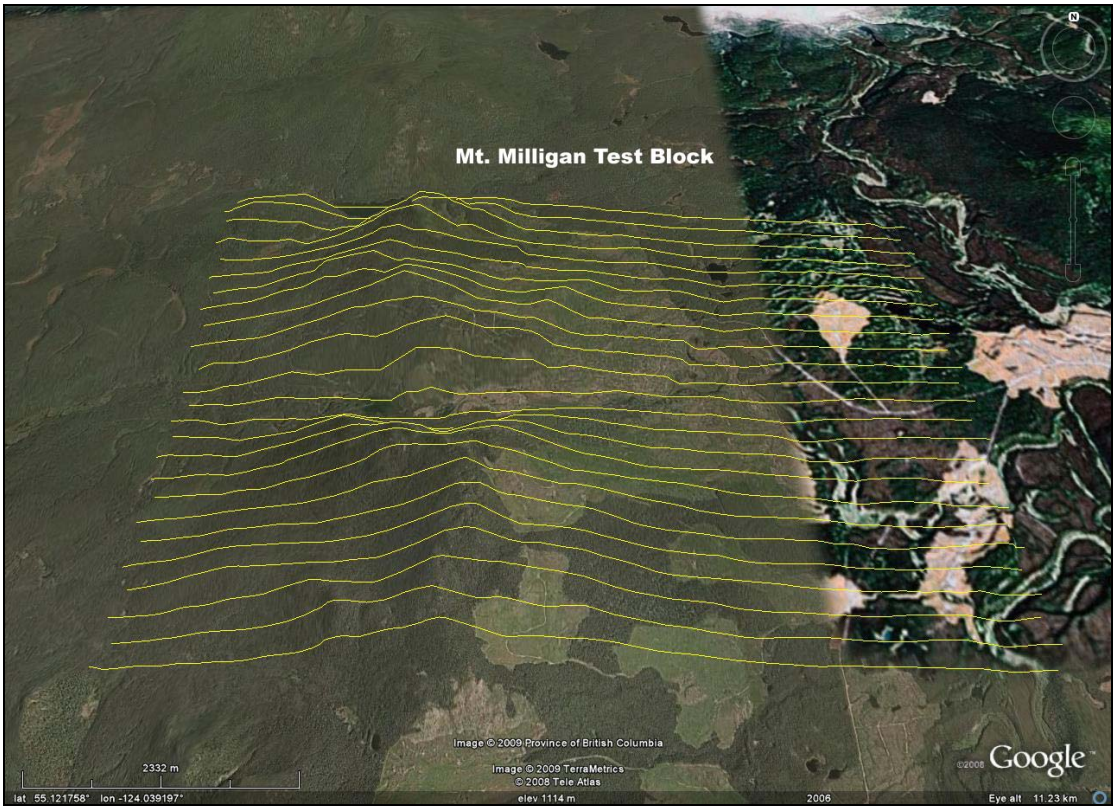


Figure 3 – Mt. Milligan Test Block

2. DATA ACQUISITION

2.1 Survey Area

The survey block (see Location map in Appendix A and Figure 2) and general flight specifications are as follows:

Table 1 - Survey Specifications

Survey block	Traverse Line spacing (m)	Area (km^2)	Planned Line-km	Actual Line-km[1]	Flight direction	Line numbers
Mt. Milligan	Traverse: 250	51.0	232	211.2	N 90 E N / 270 E	L1000-L1240
	Tie: N/A		N/A	N/A	N/A	N/A
TOTAL		51.0	232	211.2		

Survey block boundaries co-ordinates are provided in Appendix B.

2.2 Survey Operations

Survey operations were based out of the Alexander Mackenzie Hotel located in the town of Mackenzie, British Columbia from October 15th to 22nd, 2008. The following table shows the timing of the flying.

Table 2 - Survey schedule

Date	Flight #	Flown km	Block	Crew location	Comments
10-15-2008				Mackenzie, BC	System installation, helicopter installation
10-16-2008				Mackenzie, BC	Completed installation, performed system test.
10-17-2008				Mackenzie, BC	Scouted fuel cache, base station location
10-18-2008				Mackenzie, BC	Mobilization
10-19-2008	1-2	200	Mt. Milligan	Mackenzie, BC	Production
10-20-2008				Mackenzie, BC	Production aborted-low ceiling/visibility
10-21-2008	3-4	200	Mt. Milligan	Mackenzie, BC	Reflights
10-22-2008				Mackenzie, BC	Job complete

[1] Actual line kilometers are less then Planned line kilometers and represent the total line kilometers contained in the final Geosoft database. Actual line kilometers are less then Planned line kilometers as all survey lines were not flown.

2.3 Flight Specifications

During the survey the helicopter was maintained at a mean height of 161 metres above the ground with a nominal survey speed of 80 km/hour. This allowed for a nominal EM sensor terrain clearance of 71 metres and a magnetic sensor clearance of 91 metres.

The data recording rates of the data acquisition was 0.1 second for electromagnetics, magnetometer and 0.2 second for altimeter and GPS. This translates to a geophysical reading about every 2 metres along flight track. Navigation was assisted by a CDGPS receiver and data acquisition system, which reports GPS co-ordinates as latitude/longitude and directs the pilot over a pre-programmed survey flight path.

The operator was responsible for monitoring of the system integrity. He also maintained a detailed flight log during the survey, tracking the times of the flight as well as any unusual geophysical or topographic feature.

On return of the aircrew to the base camp the survey data was transferred from a compact flash card (PCMCIA) to the data processing computer. The data were then uploaded via ftp to the Geotech office in Aurora for daily quality assurance and quality control by qualified personnel, operating remotely.

2.4 Aircraft and Equipment

2.4.1 Survey Aircraft

The survey was flown using a Eurocopter Aerospatiale (Astar) 350 B2 helicopter, registration C-GPTC. The helicopter was operated by Great Slave Helicopters Ltd. Installation of the geophysical and ancillary equipment was carried out by Geotech Ltd.

2.4.2 Airborne Receiver

The loop is a Geotech Z-Axis Tipper (ZTEM) which is isolated from most vibrations by a patented suspension system and is encased in a fibreglass shell. It is towed from the helicopter using a 90 metre long cable. The cable is also used to transmit the measured EM signals back to the data acquisition system.

The coil has a 7.4 metre diameter with an orientation to the Vertical Dipole. The digitizing rate of the receiver is 2000 Hz.

2.4.3 Base Station Receiver

The two Geotech Z-Axis base station receiver coils are set up perpendicular to each other and roughly oriented according to the flight line direction. The orientation of both units is not critical as the horizontal field can be further decomposed into the two orientations of the survey flight. The orientation of the base stations were measured using a compass.

The base station coil has a diameter of 3.5 meters for each coil, with the coil orientation to the horizontal dipole.

The base station receiver coils were installed near a river (55° 13.326'N, 124° 11.117'W) 100 15 kilometers north-west of the survey block

2.4.4 Airborne magnetometer

The magnetic sensor utilized for the survey was a Geometrics optically pumped caesium vapour magnetic field sensor, mounted in a separate bird, and towed 70 metres above the mean terrain clearance. The sensitivity of the magnetic sensor is 0.02 nanoTesla (nT) at a sampling interval of 0.1 seconds The magnetometer will perform continuously in areas of high magnetic gradient with the ambient range of the sensor approximately 20k-100k nT. The Aerodynamic magnetometer noise is specified to be less than 0.5 nT. The magnetometer sends the measured magnetic field strength as nanoTesla to the data acquisition system via the RS-232 port.

2.4.5 Radar Altimeter

A Terra TRA 3000/TRI 40 radar altimeter was used to record terrain clearance. The antenna was mounted beneath the bubble of the helicopter cockpit.

2.4.6 GPS Navigation System

The navigation system used was a Geotech PC104 based navigation system utilizing a NovAtel CDGPS (Canada-Wide Differential Global Positioning System Correction Service) enabled OEM4-G2-3151W GPS receiver. Geotech's Navigate software, using a full screen display with controls in front of the pilot, allows him to direct the flight. A NovAtel GPS antenna is mounted on the helicopter tail (Figure 15). As many as 11 GPS and two CDGPS satellites may be monitored at any one time. The positional accuracy or circular error probability (CEP) is 1.8 m, with CDGPS active, it is 1.0 m. The co-ordinates of the block were set-up prior to the survey and the information was fed into the airborne navigation system.

2.4.7 Digital Acquisition System

The power supply and the data acquisition system are mounted on an equipment rack which is installed into the helicopter. Signal and power wires are run through the helicopter to connect on to the tow cable outside. The tow cable supports the Z-TEM and magnetometer birds during flight via a safety shear pin connected to the helicopter hook. The major power and data cables have a quick disconnect safety feature as well. The installation was undertaken by the Geotech Ltd. crew and was certified before surveying.

A Geotech data acquisition system recorded the digital survey data on an internal compact flash card. Data is displayed on an LCD screen as traces to allow the operator to monitor the integrity of the system. The data type and sampling interval as provided in Table 4.

Table 3 - Acquisition Sampling Rates

DATA TYPE	SAMPLING
ZTEM	0.1 sec
Magnetometer	0.1 sec
GPS Position	0.2 sec
Radar Altimeter	0.2 sec

2.4.8 Mag Base Station

A combined magnetometer/GPS base station was utilized on this project. A Geometrics Caesium vapour magnetometer was used as a magnetic sensor with a sensitivity of 0.001 nT. The base station was recording the magnetic field together with the GPS time at 1 Hz on a base station computer.

The base station magnetometer sensor was installed at the Mackenzie Airport, (55.302665° , -123.137862°) located 100 meters beside the airport hanger, away from electric transmission lines and moving ferrous objects such as motor vehicles. The base station data were backed-up to the data processing computer at the end of each survey day.

3. PERSONNEL

The following Geotech Ltd. personnel were involved in the project.

Field:

Project Managers:	Les Moschuk (office)
Crew chiefs:	Darren Tuck
System Operators:	Robert Rus Konstantin Tolkach

The survey pilot and the mechanical engineer were employed directly by the helicopter operator – Great Slave Helicopters Ltd.

Pilots:	Adam Kristenson
Mechanical Engineer:	Will Ward

Office:

Data QA/QC:	Nick Venter
Data Processing:	Biljana Milicevic
Final Data QA/QC:	Biljana Milicevic
Reporting/Mapping:	Eric Steffler

Data acquisition phase was carried out under the supervision of Andrei Bagrianski, P. Geo, Surveys Manager. Processing phase was carried out under the supervision of Jean Legault, P. Geo, Manager of Processing and Interpretation. The overall contract management and customer relations were by Paolo Berardelli.

4. DATA PROCESSING AND PRESENTATION

The polygon files used to generate the navigation files for the survey area were provided by the client.

Prior to the flying each day, the magnetic and EM base stations were powered on, in order to record the variations of both magnetic and EM fields (the latter in 2 perpendicular directions) for post flight corrections.

The receiver coil is equipped with 3 GPS antennae and a global positioning system supplies the positional input to a navigational program which assists in aircraft navigation and flight line control. The receiver antenna for navigation is mounted on the helicopter.

Data were collected, pre-processed, merged, and checked in the field by a trained in-field geophysical data processor. These data were then uploaded to a central server situated in the Geotech Ltd offices in Aurora, on a daily basis Final data processing and presentation were undertaken by qualified geophysical processors also from the office of Geotech Ltd. in Aurora, Ontario.

Data compilation and processing were carried out by the application of Geosoft OASIS Montaj and programs proprietary to Geotech Ltd.

4.1 Flight Path

The flight path, recorded by the acquisition program as WGS 84 latitude/longitude, was converted into the WGS 84 Datum, UTM Zone 10 (mean conus) coordinate system in Oasis Montaj.

The flight path was drawn using linear interpolation between x, y positions from the navigation system. Positions are updated every second and expressed as UTM easting's (x) and UTM northing's (y).

4.2 In-field Processing and Quality Control

In-Field data processing and quality control are done on a flight by flight basis by a qualified data processor (see Section 3.0). Processing steps and check up procedures are designed to assure the best possible final quality of ZTEM survey data. A general overview of those steps is presented in the following paragraphs.

The In-Field quality control can be separated into several parts:

a. GPS Data are first examined and evaluated during the GrafMov processing.

b. Raw data, ZTEM viewer phase:

Data can be viewed, examined for consistency, individual channel spectra examined and overall noise estimated in the viewer provided by the ZTEM proprietary software, on the raw flight data and raw base station data separately, on the merged data, and finally on the data that have undergone ZTEM processing.

c. Field Geosoft phase:

Magnetic data, Radar altimeter data, GPS positioning data are re-examined and processed in this phase. Prior to splitting the lines EM data are examined flight by flight and the effectiveness of applying the attitude correction evaluated. After splitting the lines, a set of grids are generate for each parameter and their consistency evaluated. Data profiles are also re-evaluated on a line to line basis. A power line monitor channel is available in order to identify power line noise.

4.3 Grafmov Software

Three GPS sensor (mounted on the airborne receiving loop) measurements were differentially corrected using the Waypoint GrafMov^{TM} software in order to yield attitude corrections to recorded EM data.

4.4 ZTEM Processing

The Z-TEM data were processed using proprietary software. Processing steps consist of the following:

a. Airborne EM, mag, radar altimeter and GPS data are first merged with EM base station data into one file.
b. Merged data are viewed and examined for consistency in an incorporated viewer
c. In the next, processing phase, the following entities are taken into account:
   - the Base station coils orientation with respect to the Magnetic North,
   - the Local declination of the magnetic field,
   - Suggested direction of the X coordinate (North or line direction),
   - Sensitivity coefficient that compensates for the difference in geometry between the base station and airborne coils.
   - Rejection filters for the 60 Hz and helicopter generated frequencies.
d. Five frequencies (In phase and Quadrature components) are extracted from the airborne EM coil response and the base station coils (30, 45, 90, 180 and 360 Hz).
e. For lines other than with a 35° N direction, data were re-projected on to the actual X and Y directions.
f. The ratios between the real parts (in phase) of the vertical Z component (airborne) over the horizontal X component (base station), and Z component over horizontal orthogonal Y component, as well as the ratios of their imaginary parts (quadrature), are calculated. These essentially represent the raw field data output from the EM system.

g. Such processed EM data are then merged with the GPS data, magnetic base station data and exported into a Geosoft xyz file.

Next stage of the in-field data processing is done in a Geosoft ™ environment, using the following steps:

a. Import the output xyz file from the AFMAG processing, as well as the base mag data into one database.
b. Split lines according to the recorded line channel,
c. GPS processing, flight path recovery (correcting, filtering, calculating Bird GPS coordinates, line splitting)
d. Radar altimeter processing, yielding the altitude values in metres.
e. Magnetic spike removal, filtering (applied to both airborne and base station data). Calculation of a base station corrected mag.
f. Apply preliminary attitude corrections to EM data (In phase and Quadrature), filter and make preliminary grids of all channels.

4.5 Final Processing

Final data processing and quality control were undertaken by Geotech Ltd headquarters in Aurora, Ontario by qualified senior data processing personnel.
Final quality control consisted of re-examining all data in order to validate the in-field data processing and to allow for final adjustments to the data.
A base station correction was applied to the magnetic channel. No further processing was done.
Attitude corrections were re-evaluated, and re-applied, on component by component, flight by flight, and frequency by frequency bases. Any remaining line to line system noise was removed by applying a mild additional levelling correction.
Individual Z/X and Z/Y components do not per se exhibit maxima or minima above conductors (i.e., cross-over type anomalies). To present the data from both tipper components, a parameter is calculated termed the DT (Total Divergence) that is analogous to the "Peaker" parameter (Pedersen, et al, 1994).

Total Divergence DT: $DT = DIV(Z/X, Z/Y) = d(Z/X)/dx + d(Z/Y)/Dy$

This DT parameter was introduced by Petr Kuzmin[2] (Geo Equipment Ltd.) and is derived for each of the In Phase and Quadrature components at individual frequencies. These in turn allow for minima over conductors and maxima over resistive zones. DT grids for each of the extracted frequencies were generated accordingly.

2 Ref: Kuzmin et al. (2005)

The divergence gives a clear picture of conductor's location and shape but, as a derivative, it does not preserve some of the long wavelength information and is also sensitive to noise.

As an alternative, a 90 degree phase rotation technique was also applied to the grids of each individual component (Z/X and Z/Y) that transforms bipolar (cross over) anomalies into single pole anomalies with a maximum over conductors, while preserving long wavelength information[3]. The two orthogonal grids are then usually added to obtain a Resulting Phase Rotated (PR)

4.6 Magnetic Data

The processing of the magnetic data involved the correction for diurnal variations by using the digitally recorded ground base station magnetic values. The base station magnetometer data was edited and merged into the Geosoft GDB database on a daily basis. The aeromagnetic data was corrected for diurnal variations by subtracting the observed magnetic base station deviations.

Tie line levelling was carried out by adjusting intersection points along traverse lines. A micro-levelling procedure was applied to remove persistent low-amplitude components of flight-line noise remaining in the data.

The corrected magnetic data was interpolated between survey lines using a random point gridding method to yield x-y grid values for a standard grid cell size of approximately 0.25 cm at the mapping scale. The Minimum Curvature algorithm was used to interpolate values onto a rectangular regular spaced grid.

3 Ref: Lo, et al (2005)

5. DELIVERABLES

5.1 Survey Report

The survey report describes the data acquisition, processing, and final presentation of the survey results. The survey report is provided in two paper copies and digitally in PDF format.

5.2 Maps

Final maps were produced at scale of 1:20,000. The coordinate/projection system used was WGS 84, UTM Zone 10 North. All maps show the flight path trace and topographic data; latitude and longitude are also noted on maps. Mineral claims, provided by the British Columbia Minerals Titles Online BC, are also presented on each map.

The preliminary and final results of the survey are presented as profile plans for the EM data that were generated for individual real (In-Phase) and imaginary parts (Quadrature) of the Z/X and Z/Y components and the corresponding DTs for each of the five frequencies, (30, 45, 90, 180 and 360 Hz), as well as for corresponding Phase Rotated individual components.

Final maps were chosen, in consultation with the client, to represent all collected data, are listed in section 5.3.

Sample map of 1VD, DEM and DT map images at the 45Hz frequency, as well as images of the In Phase profile and Quadrature profile maps (Z/X and Z/Y), are included in this report and presented in Appendix C.

5.3 Digital Data

- Two copies of the data and maps on DVD were prepared to accompany the report. Each DVD contains a digital file of the line data in GDB Geosoft Montaj format as well as the maps in Geosoft Montaj Map and PDF format.

- DVD structure.

  There are two (2) main directories;

  Data contains databases, grids and maps, as described below.
  Report contains a copy of the report and appendices in PDF format.

  Databases in Geosoft GDB format, containing the channels listed in Table 4.

Table 4 - Geosoft GDB Data Format.

Column	Description
GPSLat	Latitude – NAD83 (Decimal degree)
GPSlon	Longitude- NAD 83 (Decimal degree)
RdRAlt	Helicopter Radar Terrain Clearance (metres)
GPSAlt	Elevation- NAD83 (On Receiver) (metres)
Inoise	Powerline Monitor
GPSTime	GPS Time (seconds)
DEM	Digital Elevation Model (meters)
Bx	UTM Easting NAD 83 Zone 10, MEAN CONUS (On Receiver) (meters)
By	UTM Northing NAD 83 Zone 10 , MEAN CONUS (On Receiver) (meters)
Ln	Longitude – NAD 83 (On Receiver) (Decimal degree)
Lt	Latitude – NAD 83 (On Receiver) (Decimal degree)
Mag	Total Magnetic Intensity, basemag corrected, microlevelled (nT)
Mag1	Measured Total Magnetic Intensity
MagBS	Base station mag
xIp_030	Raw extracted In Phase (real) Z/X component ratio for 30 Hz Frequency
xIp_045	Raw extracted In Phase (real) Z/X component ratio for 45 Hz Frequency
xIp_090	Raw extracted In Phase (real) Z/X component ratio for 90 Hz Frequency
xIp_180	Raw extracted In Phase (real) Z/X component ratio for 180 Hz Frequency
xIp_360	Raw extracted In Phase (real) Z/X component for ratio 360 Hz Frequency
xIp_030C	xIp_030 attitude corrected
xIp_045C	xIp_045 attitude corrected
xIp_090C	xIp_090 attitude corrected
xIp_180C	xIp_180 attitude corrected
xIp_360C	xIp_360 attitude corrected
xIp_030Hz	xIp_030 final attitude corrected, levelled, filtered
xIp_045Hz	xIp_045 final attitude corrected, levelled, filtered
xIp_090Hz	xIp_090 final attitude corrected, levelled, filtered
xIp_180Hz	xIp_180 final attitude corrected, levelled, filtered
xIp_360Hz	xIp_360 final attitude corrected, levelled, filtered
xQd_030	Raw extracted Quadrature Z/X component ratio for 30 Hz Frequency
xQd_045	Raw extracted Quadrature Z/X component ratio for 45 Hz Frequency
xQd_090	Raw extracted Quadrature Z/X component ratio for 90 Hz Frequency
xQd_180	Raw extracted Quadrature Z/X component ratio for 180 Hz Frequency
xQd_360	Raw extracted Quadrature Z/X component ratio for 360 Hz Frequency
xQd_030C	Quadrature Z/X for 30 Hz Frequency corrected
xQd_045C	Quadrature Z/X for 45 Hz Frequency corrected
xQd_090C	Quadrature Z/X for 90 Hz Frequency corrected
xQd_180C	Quadrature Z/X for 180 Hz Frequency corrected
xQd_360C	Quadrature Z/X for 360 Hz Frequency corrected
xQd_030Hz	XQd_030 final attitude corrected, filtered levelled channel
xQd_045Hz	XQd_045 final attitude corrected, filtered levelled channel
xQd_090Hz	XQd_090 final attitude corrected, filtered levelled channel

xQd_180Hz	XQd_180 final attitude corrected, filtered levelled channel
xQd_360Hz	XQd_360 final attitude corrected, filtered levelled channel
yIp_030	Raw extracted In Phase (real) Z/Y component ratio for 30 Hz Frequency
yIp_045	Raw extracted In Phase (real) Z/Y component ratio for 45 Hz Frequency
yIp_090	Raw extracted In Phase (real) Z/Y component ratio for 90 Hz Frequency
yIp_180	Raw extracted In Phase (real) Z/Y component ratio for 180 Hz Frequency
yIp_360	Raw extracted In Phase (real) Z/Y component for ratio 360 Hz Frequency
yIp_030C	yIp_030 attitude corrected
yIp_045C	yIp_045 attitude corrected
yIp_090C	yIp_090 attitude corrected
yIp_180C	yIp_180 attitude corrected
yIp_360C	yIp_360 attitude corrected
yIp_030Hz	yIp_030 attitude corrected, levelled, filtered
yIp_045Hz	yIp_045 attitude corrected, levelled, filtered
yIp_090Hz	yIp_090 attitude corrected, levelled, filtered
yIp_180Hz	yIp_180 attitude corrected, levelled, filtered
yIp_360Hz	yIp_360 attitude corrected, levelled, filtered
yQd_030	Raw extracted Quadrature Z/Y component ratio for 30 Hz Frequency
yQd_045	Raw extracted Quadrature Z/Y component ratio for 45 Hz Frequency
yQd_090	Raw extracted Quadrature Z/Y component ratio for 90 Hz Frequency
yQd_180	Raw extracted Quadrature Z/Y component ratio for 180 Hz Frequency
yQd_360	Raw extracted Quadrature Z/Y component ratio for 360 Hz Frequency
yQd_030C	Quadrature Z/Y for 30 Hz Frequency corrected
yQd_045C	Quadrature Z/Y for 45 Hz Frequency corrected
yQd_090C	Quadrature Z/Y for 90 Hz Frequency corrected
yQd_180C	Quadrature Z/Y for 180 Hz Frequency corrected
yQd_360C	Quadrature Z/Y for 360 Hz Frequency corrected
yQd_030Hz	yQd_030 final attitude corrected, filtered levelled channel
yQd_045Hz	yQd_045 final attitude corrected, filtered levelled channel
yQd_090Hz	yQd_090 final attitude corrected, filtered levelled channel
yQd_180Hz	yQd_180 final attitude corrected, filtered levelled channel
yQd_360Hz	yQd_360 final attitude corrected, filtered levelled channel

Electromagnetic B-field and dB/dt data is found in array channel format between indexes 10 – 33, as described above.

- Grids in Geosoft GRD format, as follows:

TMI: Total Magnetic Intensity
TMI_1VD: First Vertical Derivative of TMI
DEM: Digital Elevation Model
YQd_90Hz_PR: Y Quadrature components at 90 Hz Phase Rotated grid
YQd_360Hz_PR:Y Quadrature components at 360 Hz phase routed grid
IP_45Hz_PR: In-Phase Resulting Phase Rotated component grid at 45 Hz
IP_90Hz_PR: In-Phase Resulting Phase Rotated component grid at 90 Hz
IP_180Hz_PR: In-Phase Resulting Phase Rotated component grid at 180 Hz

IP_360Hz_PR: In-Phase Resulting Phase Rotated component grid at 360 Hz
XIP_90Hz_PR: Phase Rotated component grid at 90 Hz
YIP_90Hz_PR: Phase Rotated component grid at 90 Hz
IP_30Hz_DT: Divergence grid calculated from the In-phase components at 30 Hz
IP_45Hz_DT: Total Divergence grid calculated from the In-phase components at 45 Hz
IP_90Hz_DT: Total Divergence grid calculated from the In-phase components at 90 Hz
IP_180Hz_DT: Total Divergence grid calculated from the In-phase components at 180 Hz
IP_360Hz_DT: Total Divergence grid calculated from the In-phase components at 360 Hz
Qd_30Hz_DT: Total Divergence grid calculated from the Quadrature components at 30 Hz
Qd_45Hz_DT: Total Divergence grid calculated from the Quadrature components at 45 Hz
Qd_90Hz_DT: Total Divergence grid calculated from the Quadrature components at 90 Hz
Qd_180Hz_DT: Total Divergence grid calculated from the Quadrature components at 180 Hz
Qd_360Hz_DT: Total Divergence grid calculated from the Quadrature components at 360 Hz

A Geosoft .GRD file has a .GI metadata file associated with it, containing grid projection information. A grid cell size of 50 metres was used.

- Maps at 1:20,000 scale in Geosoft MAP format, as follows:

8242_TMI_1VD: First Vertical Derivative of TMI
8242_TMI: Total Magnetic Intensity (TMI)
8242_DEM: Digital Elevation Model
8242_3D_IP_DT: 3D In-Phase Resulting Phase Rotated grids for 45, 90, 180 and 360 Hz Frequencies.
8242_3D_IP_PR: 3D In Phase DT for 45, 90, 180 and 360Hz
8242_30Hz_IP_DT: 30 Hz In-Phase Total Divergence (DT)
8242_30Hz_QD_DT: 30 Hz Quadrature Total Divergence (DT)
8242_45Hz_IP_DT: 45 Hz In-Phase Total Divergence (DT)
8242_45Hz_QD_DT: 45 Hz Quadrature Total Divergence (DT)
8242_90Hz_IP_DT: 90 Hz In-Phase Total Divergence (DT)
8242_90Hz_QD_DT: 90 Hz Quadrature Total Divergence (DT)
8242_180Hz_IP_DT: 180 Hz In-Phase Total Divergence (DT)
8242_180Hz_QD_DT: 180 Hz Quadrature Total Divergence (DT)
8242_360Hz_IP_DT: 360 Hz In-Phase Total Divergence (DT)

8242_360Hz_QD_DT: 360 Hz Quadrature Total Divergence (DT)
8242_90Hz_IP_PR: 90 Hz In-Phase Resulting Phase Rotated
8242_360Hz_IP_PR: 360 Hz In-Phase Resulting Phase Rotated
8242_XIP_360Hz_PR: 360 Hz Z/X Component In-Phase Rotated
8242_XIP_profiles_XIP_PR:Z/X Component In-Phase Profiles over 90Hz Z/X Component In-Phase Phase Rotated Grid
8242_XQD_profiles_QD_PR:Z/X Component Quadrature Profiles over a 90Hz Z/X Compnent Quadrature Phase Rotated Grid.
8242_YIP_360Hz_PR: 360 Hz Z/Y Component In-Phase Rotated
8242_YIP_profiles_YIP_PR:Z/Y Component In-Phase Profiles over a 90 Hz Z/Y Component In-Phase Phase Rotated Grid.
8242_YQD_360Hz_PR: 360 Hz Z/Y Compnent Quadrature Phase Rotated
8242_YQD_profiles_QD_PR: Z/Y Component In-Phase Profiles over a 90Hz Z/Y Component In-Phase Phase Rotated Grid

Maps are also presented in PDF format.

1:50,000 topographic vectors were taken from the NRCAN Geogratis database at; http://geogratis.gc.ca/geogratis/en/index.html.

- A Google Earth file *"8242_Mt_Milligan.kml"* is included, showing the flight path of each block. Free versions of Google Earth software from: http://earth.google.com/download-earth.html

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

A helicopter-borne ZTEM and aeromagnetic geophysical survey has been completed over the Mt. Milligan Test block in the province of British Columbia, Canada.

The total area coverage is 51.0 km^2. Total survey line coverage is 232 line kilometres. The principal sensors included a Time Domain EM system and a magnetometer. Results have been presented as stacked profiles, anomaly symbols, and contour colour images at a scale of 1:20,000. No formal interpretative discussion is included.

Both the In-phase and Quadrature components of the airborne Afmag Tipper fields (Z/X and Z/Y) were collected, processed and presented together. DT (Div (Z/Xcomp, Z/Ycomp) grids were derived for In-phase and Quadrature components for all five frequencies measured. Corresponding Phase Rotated grids were also created, which contributed to a presentation of our data with long wavelengths preserved. No formal interpretation has been included in this report.

6.2 Recommendations

Based on the geophysical results obtained, a number of interesting structures were identified across the property. The magnetic results may also contain worthwhile information in support of exploration targets of interest. We therefore recommend a detailed interpretation of the available geophysical, in conjunction with the geology, based on structure and possibly using inversion and modelling techniques prior to ground follow up and drill testing.

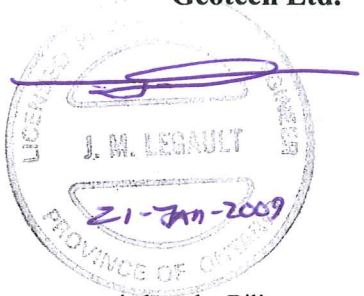
Respectfully submitted[6],

Eric Steffler
Geotech Ltd.

Jean Legault, P. Geo, P. Eng
Geotech Ltd.

Biljana Milicevic, M.Sc. (Geophysics)
Geotech Ltd.

January, 2009



[6]Note: Final data processing and interpretation of the EM and magnetic data were carried out by Biljana Milicevic, M.Sc., from the office of Geotech Ltd. in Aurora, Ontario, under the supervision of Jean Legault, P. Geo, Manager of Data Processing and Interpretation.

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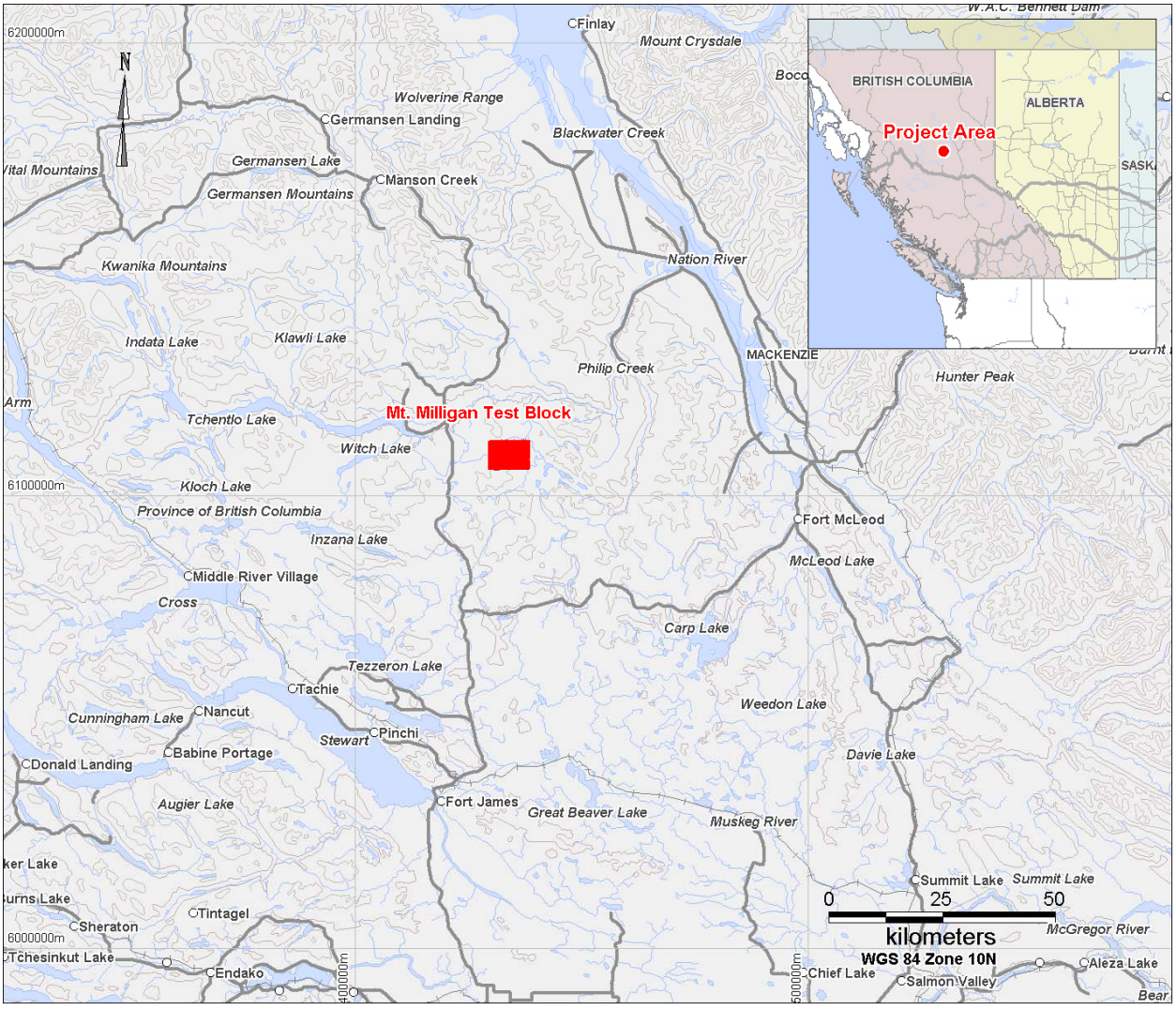
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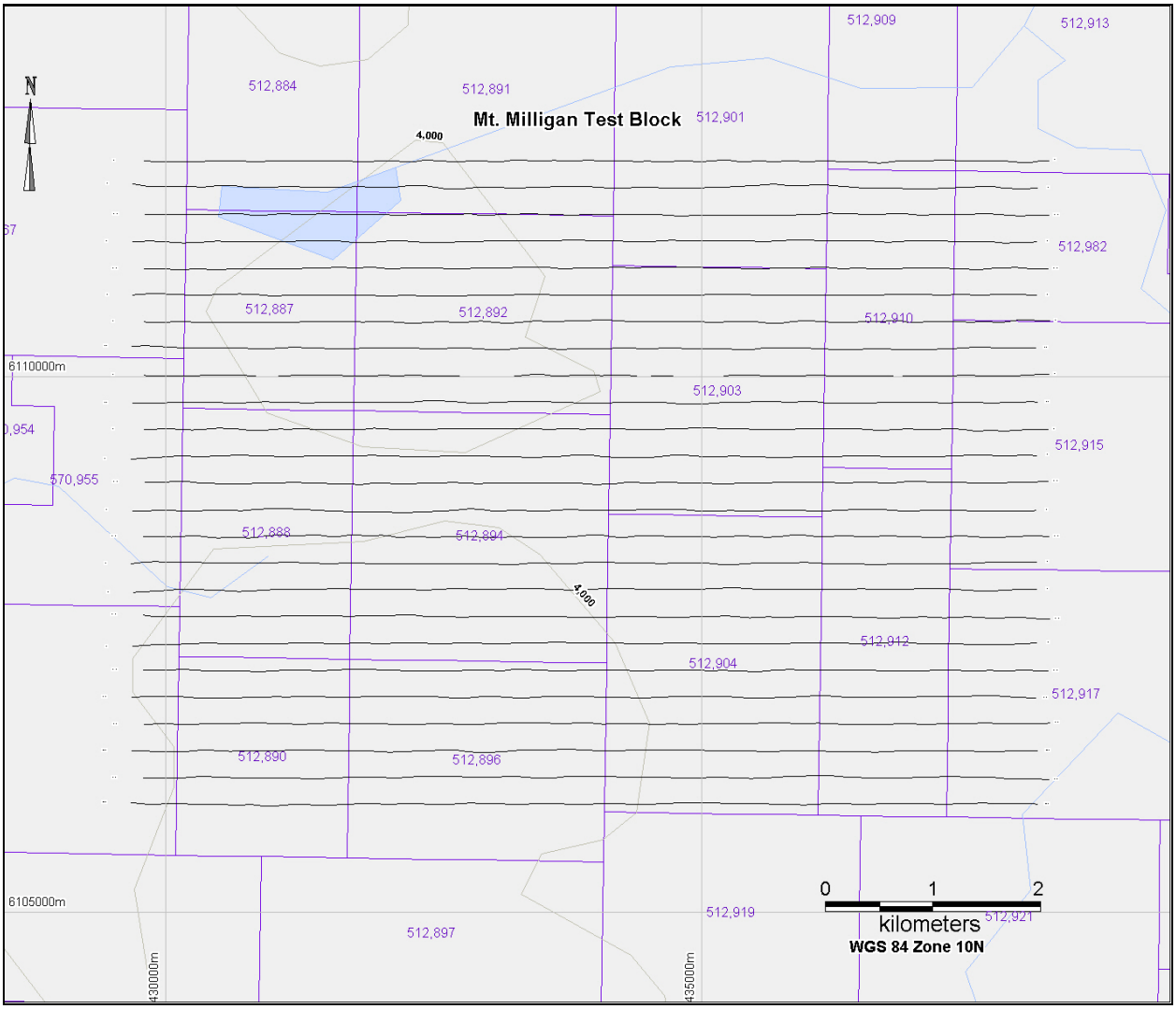
Zhang, P. & King, A.1998. Using magnetotellurics for mineral exploration, Extended Abstracts from 1998 Meeting of Society of Exploration Geophysics.

APPENDIX A

SURVEY BLOCK LOCATION MAP



Survey Overview Location Map.



Mt. Milligan Test Block with British Columbia Mining Claims

APPENDIX B

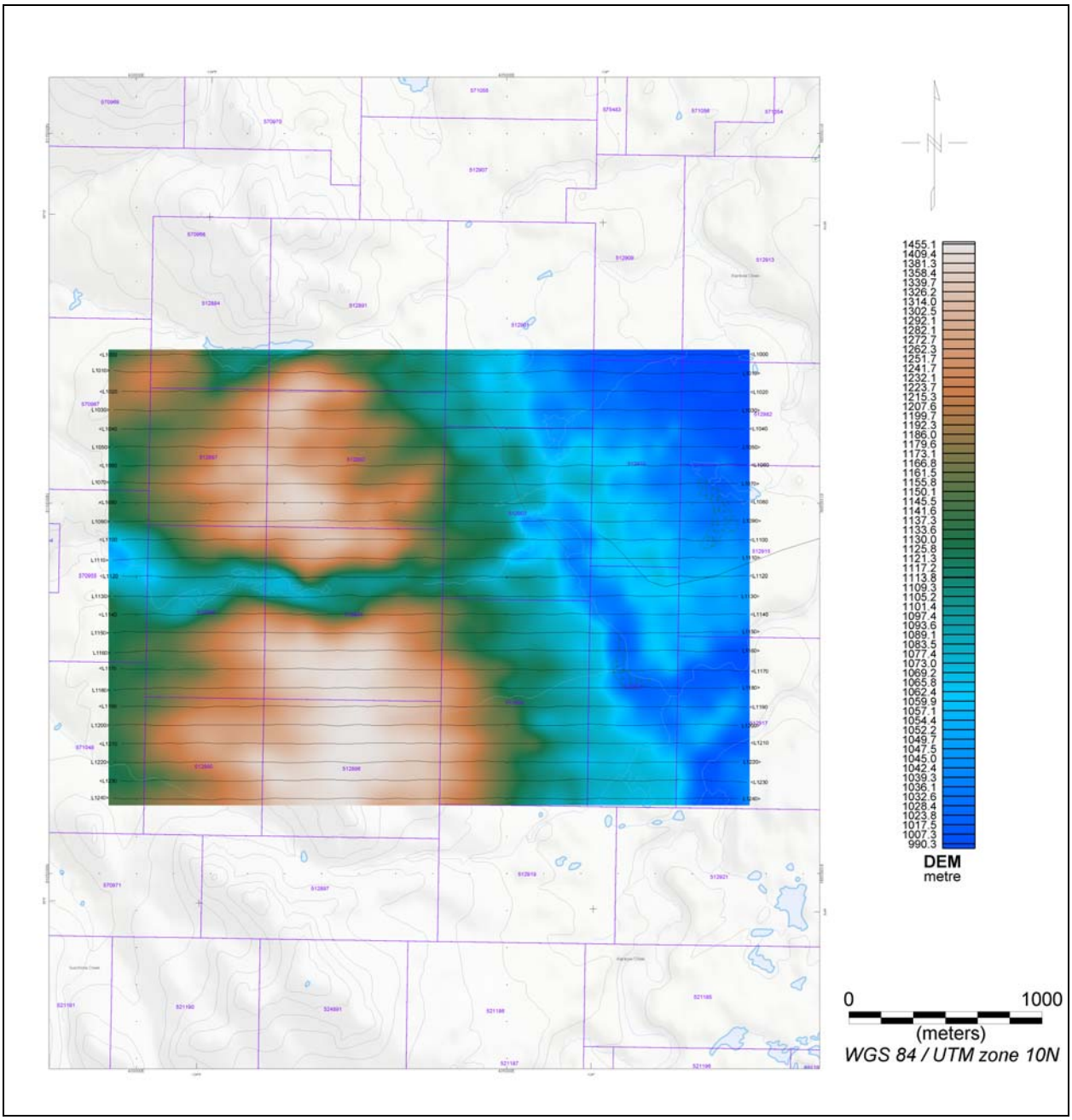
SURVEY BLOCK COORDINATES

(NAD83, UTM Zone 10 North)

Mt. Milligan Test Block	
X	Y
430000	6112000
438000	6112000
438000	6105000
430000	6105000

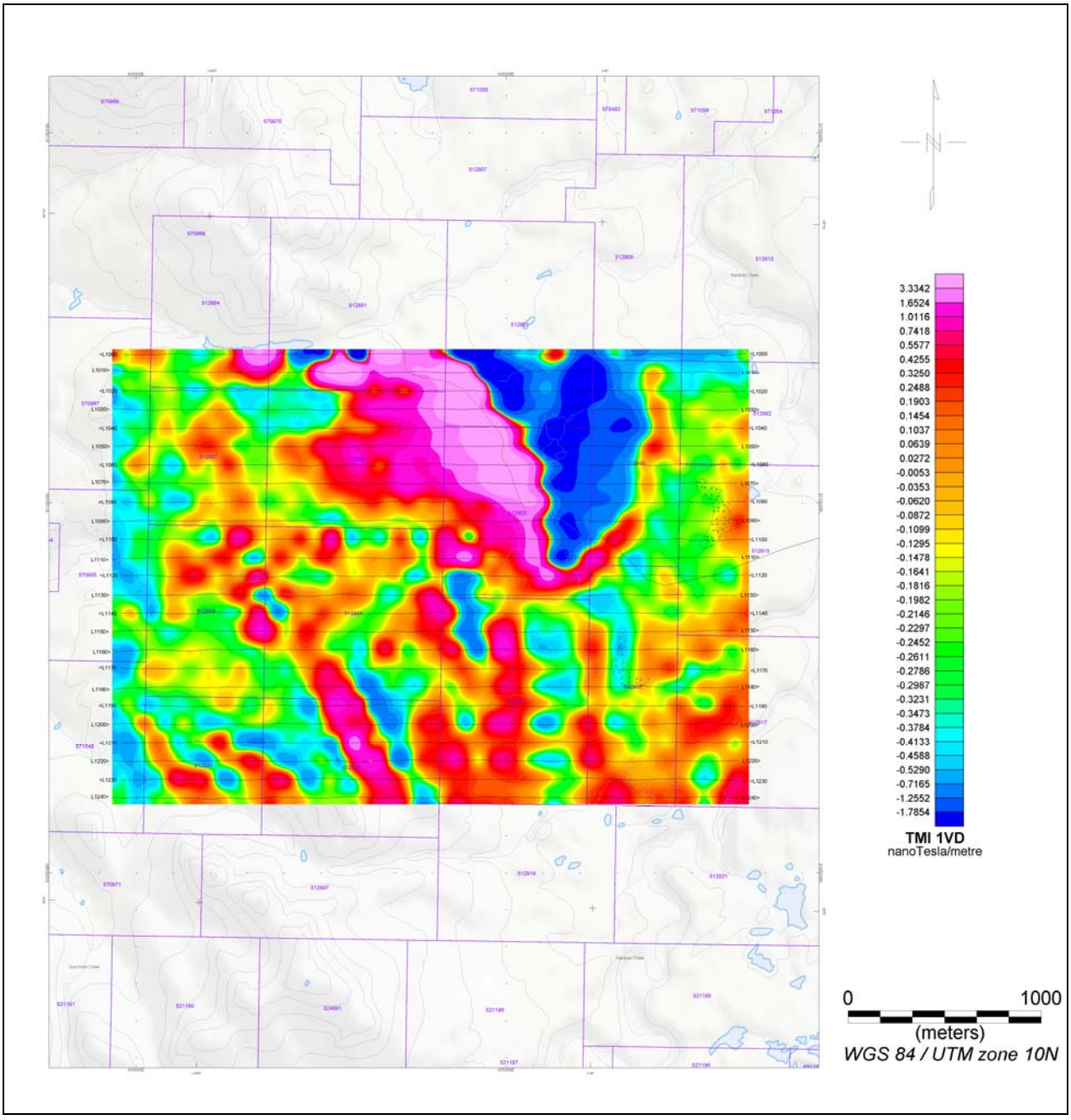
APPENDIX C

GEOPHYSICAL MAPS[1]

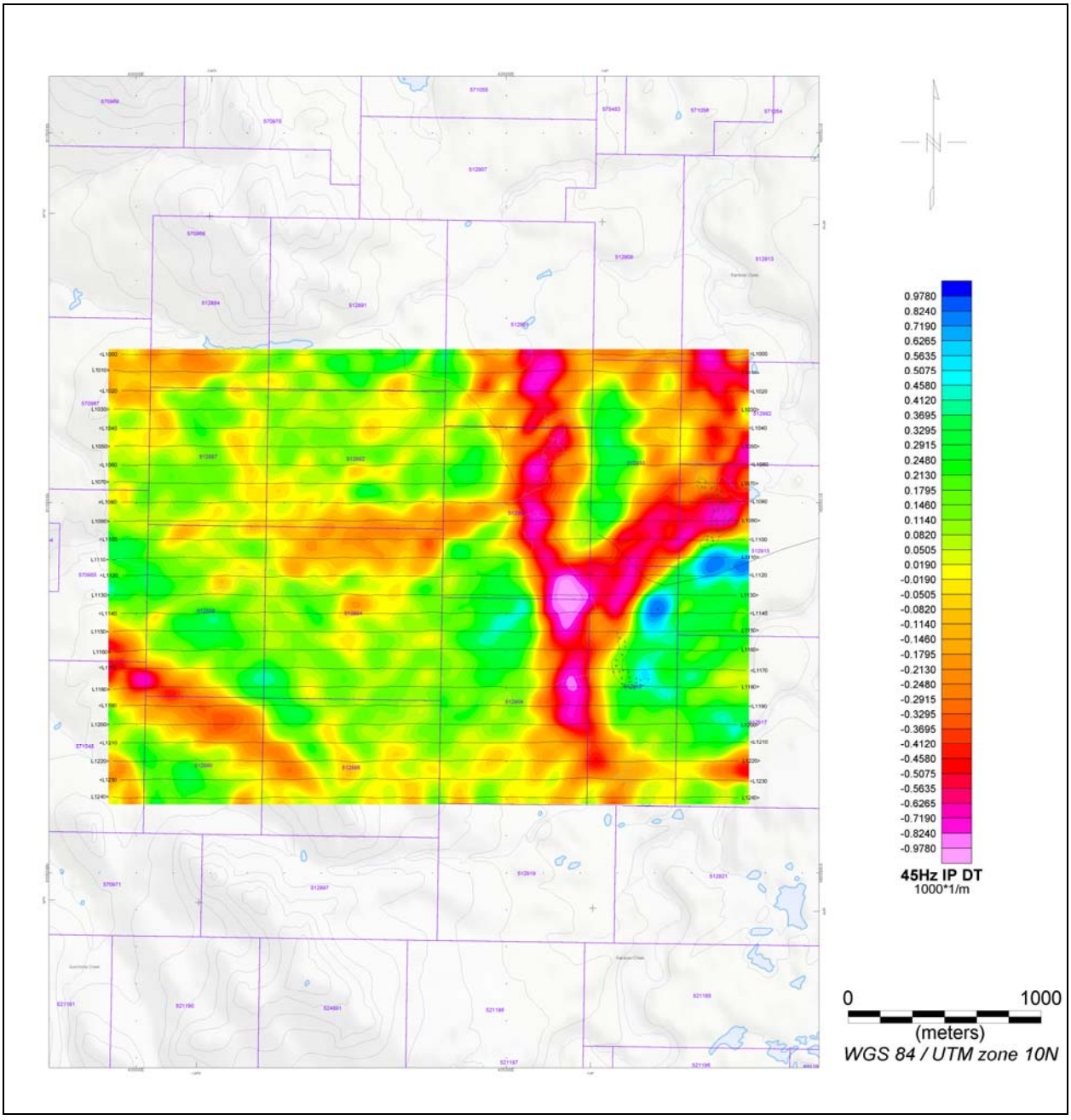


Mt. Milligan Test Block – Digital Elevation Model

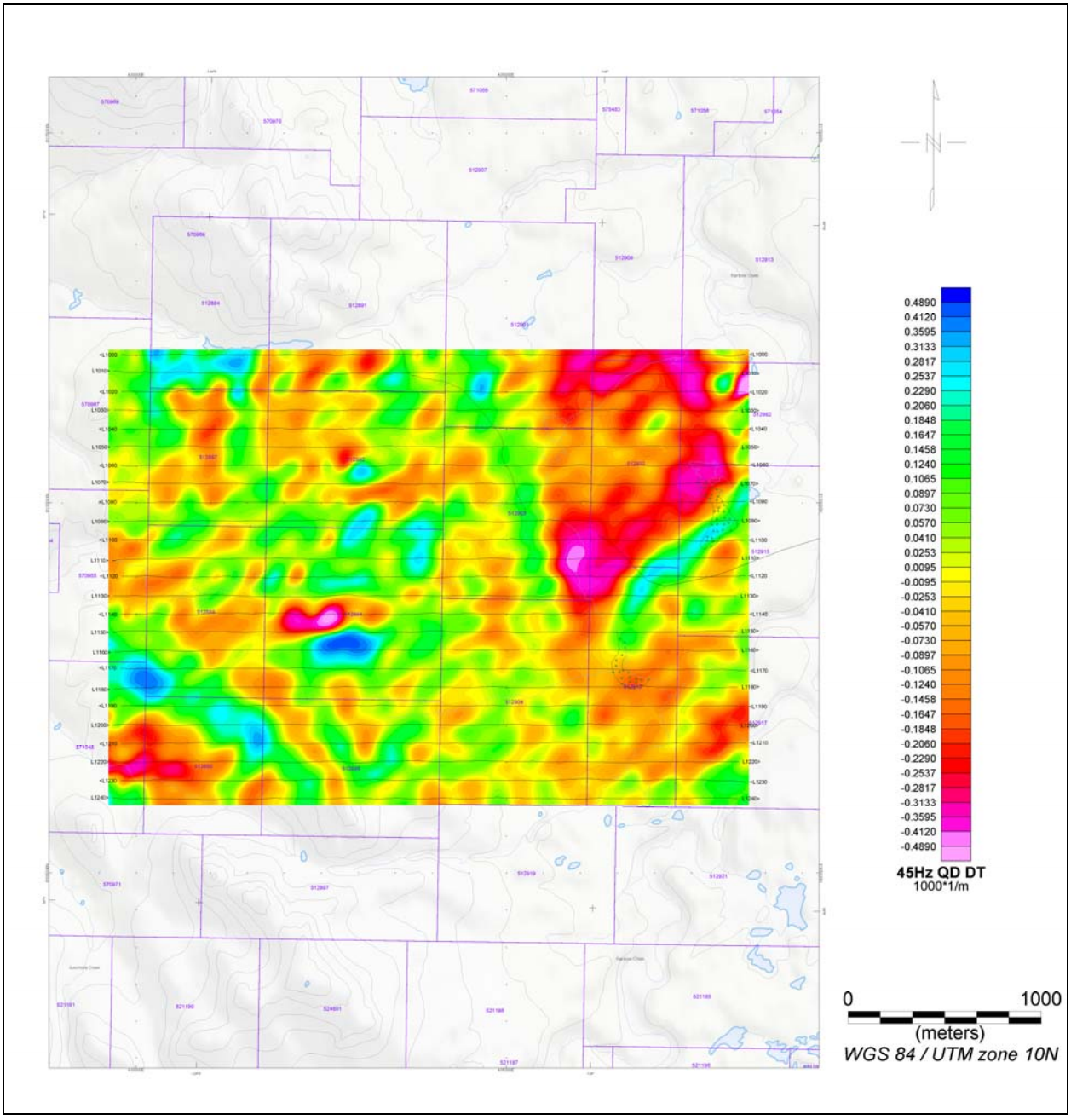
[1] Full size geophysical maps are also available in PDF format on the final DVD



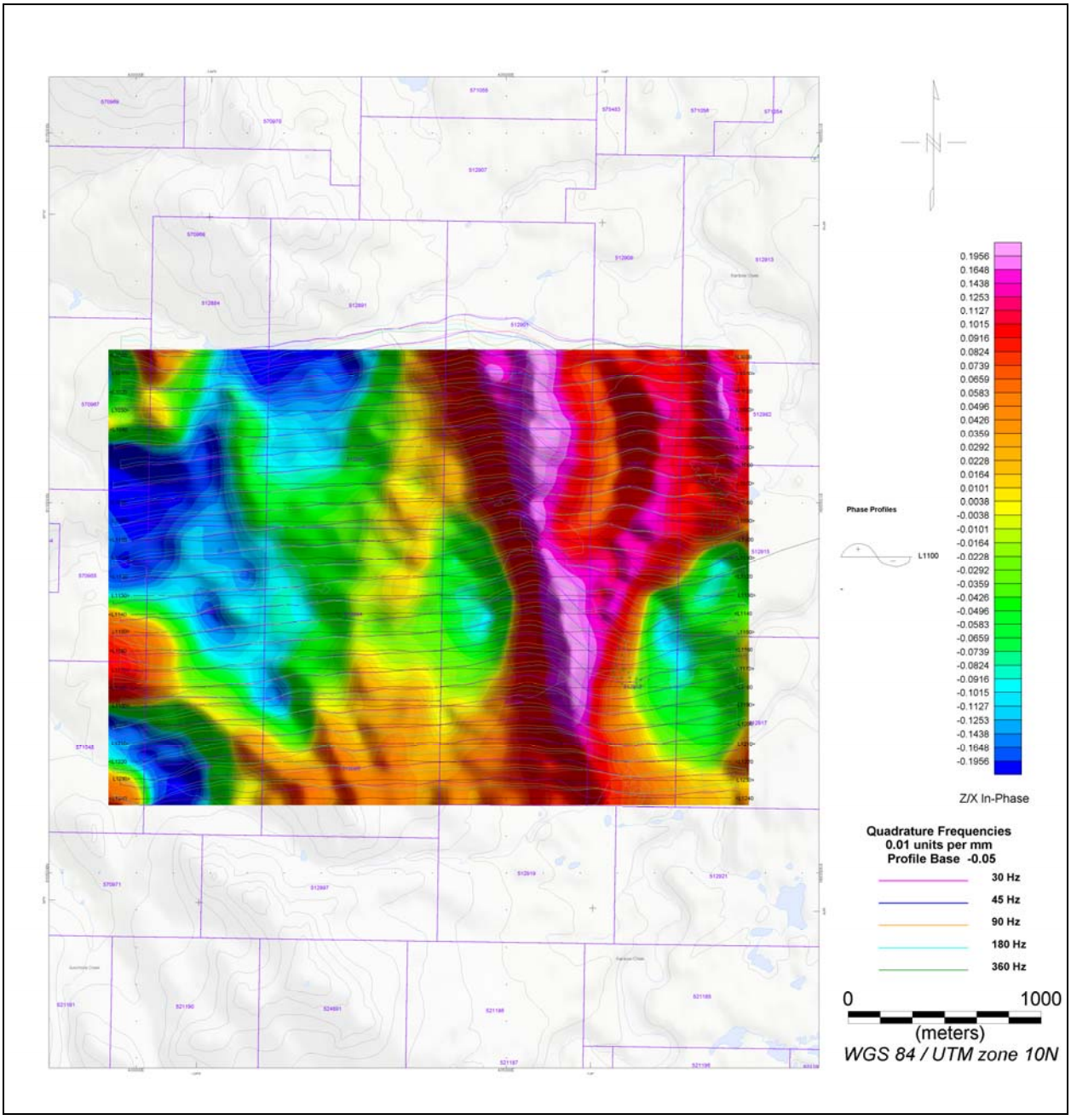
Mt. Milligan Test Block – First Vertical Derivative of the TMI



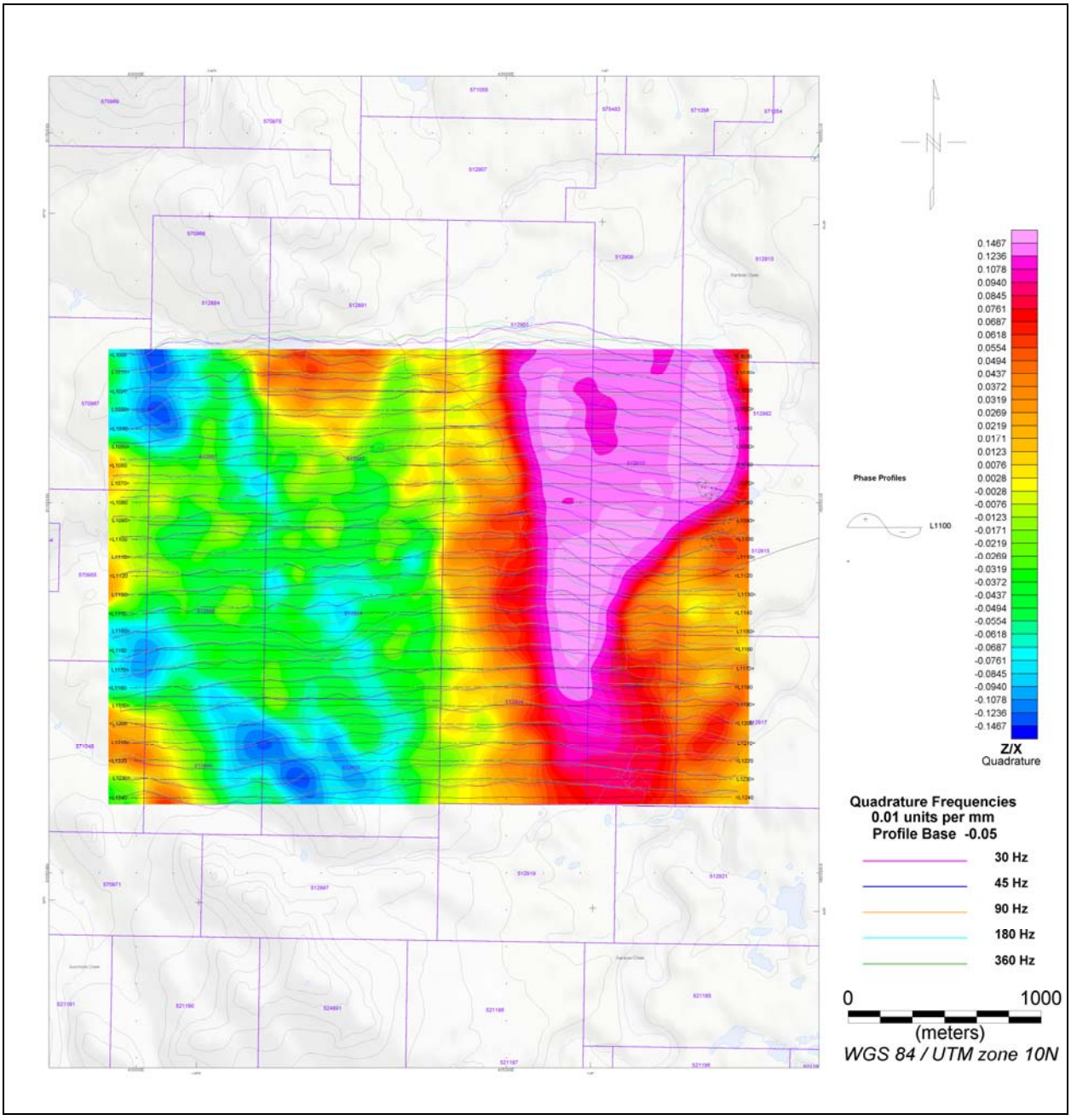
Mt. Milligan Test Block – 45 Hz In-Phase DT



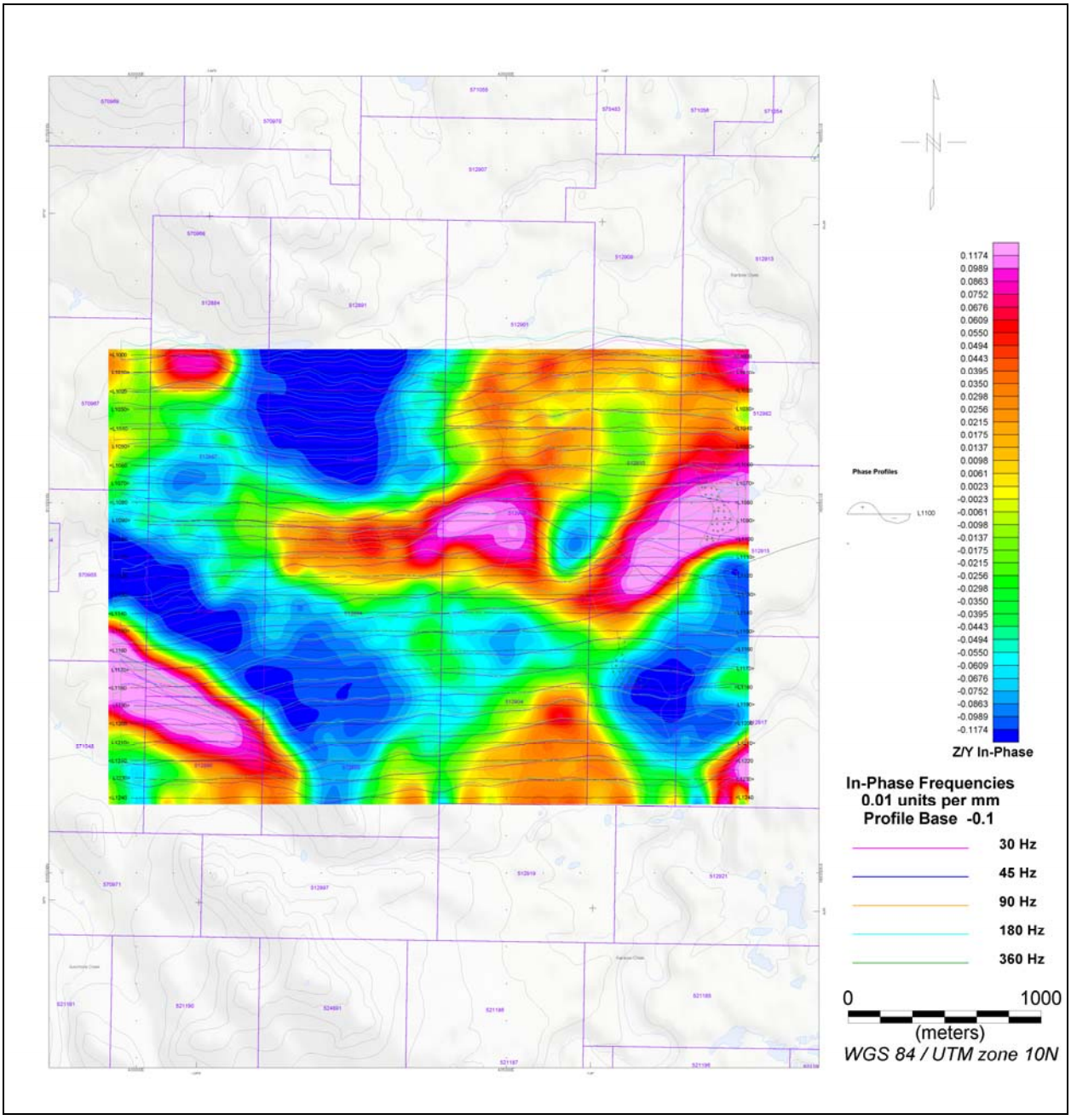
Mt. Milligan Test Block – 45 Hz Quadrature DT



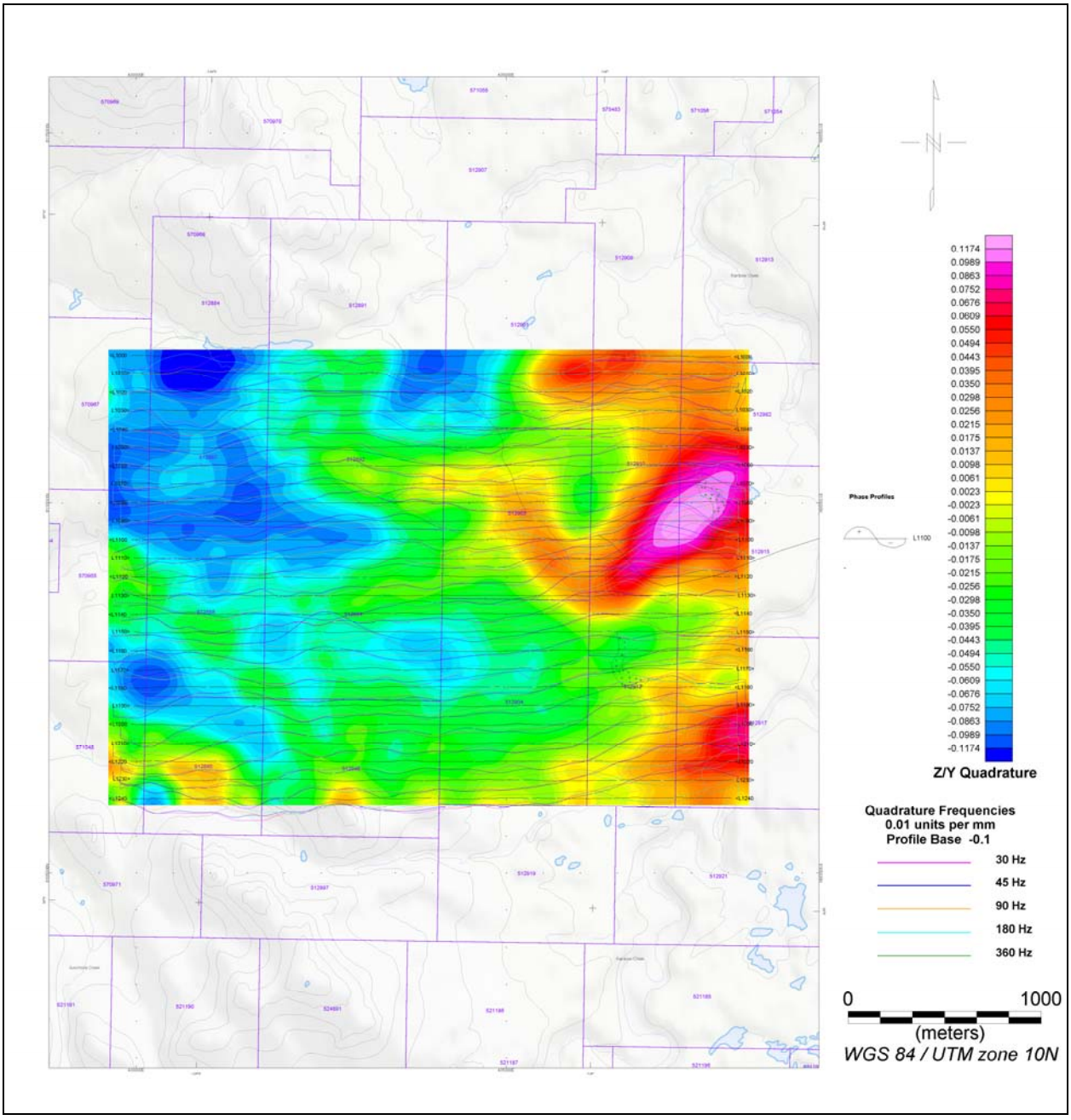
Mt. Milligan Test Block – Z/X Component In-Phase Profiles over a 90 Hz Z/X Component In-Phase Phase Rotated Grid



Mt. Milligan Test Block – Z/X Component Quadrature Profiles over a 9 Hz Z/X Component Quadrature Phase Rotated Grid.



Mt. Milligan Test Block – Z/Y Component In-Phase Profiles over a 90 Hz Z/Y Component In-Phase Phase Rotated Grid



Mt. Milligan Test Block – Z/Y Component Quadrature Profiles over a 9 Hz Z/Y Component Quadrature Phase Rotated Grid.

APPENDIX D

THE ZTEM SYSTEM

The Z-TEM or Z-Axis Tipper Electromagnetic system is Geotech's latest and most sensitive version of airborne Audio Frequency Magnetic (AFMAG) system which uses the natural or passive fields of the Earth as the source of transmitted energy. These natural fields are planar and due to the manner in which they propagate, are horizontal. Any vertical field is caused by conductivity contrasts in the Earth. Geotech's Z-TEM system measures the vertical EM field in the air along the survey lines and makes use of a base station to measure the horizontal fields. The assumption is that the horizontal fields are relatively homogenous over the survey area and the base station location. The vertical EM field is remotely referenced to the horizontal EM fields. The horizontal fields are measured by a set of orthogonal horizontal dipole base station coils (see Figure 1). The proprietary receiver design using the advantages of modern digital electronics and a patented suspension system delivers exceptionally low-noise levels. The result is unparalleled resolution and depth of investigation in deep electromagnetic measurements.



Figure 7 - *the airborne coil shown in the middle of the picture with the base stations in the background. The magnetometer bird is to the right of the airborne coil.*

Key features include:

- superior exploration depth – Over 4000 metres from numerical simulation
- Low frequency of 38 Hertz for penetration through conductive cover
- High Spatial Resolution – 8 to 10 metres along the lines
- Excellent resistivity discrimination and detection of weak anomalies due to the nature of the natural EM fields

The system is easily transportable. It can be disassembled for packaging in relatively small units for shipping to surveys around the world.

In the event of damage to the EM bird in-flight or while being transported between survey sites, the unique design allows the easy replacement of any part of the system in the field. The receiver loop can be assembled or disassembled in slightly over one day.

Recent commercial surveys and surveys flown over test areas have produced reliable and promising results.

SUMMARY REPORT ON HELICOPTER-BORNE
ZTEM TIPPER AFMAG SURVEY RESULTS
over
MT-MILLIGAN TEST BLOCK, January 2009
Mackenzie Region, British Columbia
on behalf of
GEOSCIENCE BC and TERRANE METALS CORP.

1 Introduction

ZTEM (Z-Tipper Axis Electromagnetic) surveys were conducted over the Mt-Milligan Test Block, belonging to Terrane Metals Corp. (Vancouver, BC) and situated in the Mackenzie region of central British-Columbia, from October 15TH to 22ND, 2008, on behalf of Geoscience BC. The ZTEM survey comprised airborne Tipper AFMAG (audio frequency electromagnetics) measurements, as well as aeromagnetics using a caesium magnetometer. The survey consisted of twenty five (25) approx. 8.0 km long, EW oriented flight lines, totaling 200 line-km, that were obtained at nominal 250m line spacings over an approximately 6 x 8 km area (Figure 1). The area was chosen because it hosts the Mt Milligan copper-gold porphyry deposit, containing a Measured and Indicated Mineral Resource of 590.8 Mt at 0.193% Cu and 0.352 g/t Au, totaling 2.52 billion lb copper and 6.70 million oz gold (Terrane Metals Corp. 2008), that is not yet in production, and also because area's geology is well known and available in the public domain - making it an ideal case-history example.



Figure 1: ZTEM Hz Receiver Coil (foreground) and Hx-Hy Reference Coils (background)

The Z-axis tipper measurements of the vertical (Z) component were obtained using Geotech's patented ZTEM induction aircoil system (Figure 2), suspended at approximately 110m elevation above ground level. The vertical component data (Hz) were then ratioed to fixed horizontal field measurements (Hx-Hy) obtained using identical reference coils, that were oriented in the in-line (X) and cross-line (Y) directions, in order to obtain the tipper functions Z/X and Z/Y. The In-Phase

and Quadrature components ZTEM field ratio data were obtained, using Fourier-based, digital signal processing analyses, at 5 frequencies, between 30Hz and 360Hz. The magnetometer was a Geometrics proton-precession model towed at 130m above ground level.

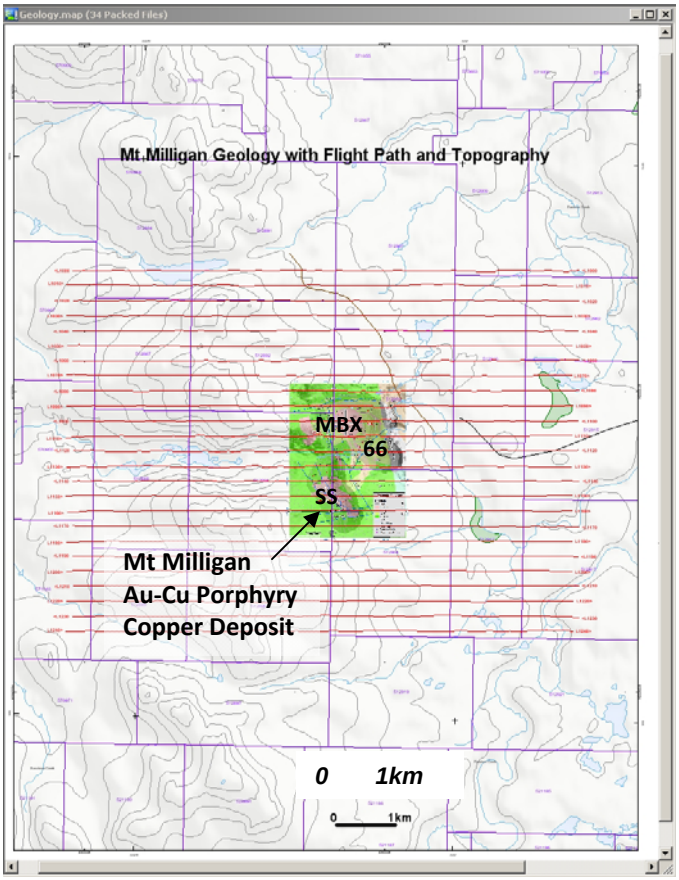


Figure 2: Mt Milligan Test Block ZTEM Flight Lines and Deposit Geology (after Terrane Metals, 2008)

1.1 General Theory

The ZTEM system uses naturally occurring Afmag magnetotelluric fields as the source of the primary fields, and therefore requires no transmitter (Ward, 1959). The fields resemble those from VLF except that they are lower frequency (tens & hundreds of Hz versus tens of kHz) and are not strongly directionally polarized (Labson et al., 1985). These AFMAG EM fields, derived from world wide atmospheric thunderstorm activity, have the unique characteristic of being uniform, planar and horizontal, and also propagate vertically into the earth – to great depth, up to several km, as determined by the magnetotelluric (MT) skin depth, which is directly proportional to the ratio of the bedrock resistivity to the frequency. At the frequencies used for ZTEM, the MT skin depths range between 600m to 2km, assuming a background resistivity of 1k ohm-metres in this region, according to the following equation for skin depth (Vozoff, 1972):

$$\delta_s = 356 * \sqrt{(\rho_A / f)} \text{ metres}$$

if ρ_A = 1k ohm-m, $\delta_s \approx$ 600m at 360Hz and ~2.0km at 30Hz

The other unique aspect of AFMAG fields is that they react to relative contrasts in the resistivity, and therefore do not depend on the absolute conductance, as measured using inductive EM systems, such as VTEM – hence poorly conductive targets, such as alteration zones and fault zones, can be mapped, as well as higher conductance features, like graphitic units. Conversely, resistive targets can also be mapped using AFMAG– provided they are of a sufficient size and contrast to produce a vertical field anomaly. Indeed resistors produce reversed anomalies relative to conductive features. An example of a ZTEM 2D forward model profile response over a conductive body is given in Figure 3.

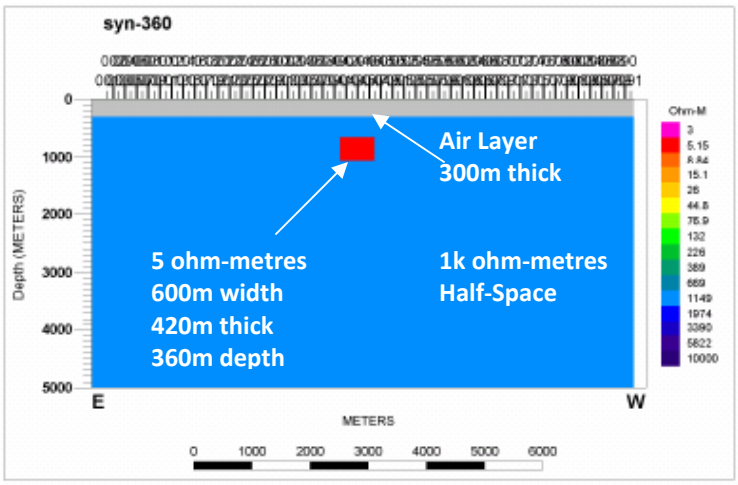


Figure 1. Above: Conductive brick used in test inversion for ZTEM data using ZVERT2D. The gray region is a 300 m thick air layer. Below: Synthetic data and inversion model responses at five frequencies for Z/X response profile along the ground (solid curves) and 300 m in the air (dashed curves). Small open squares are the inversion fits.

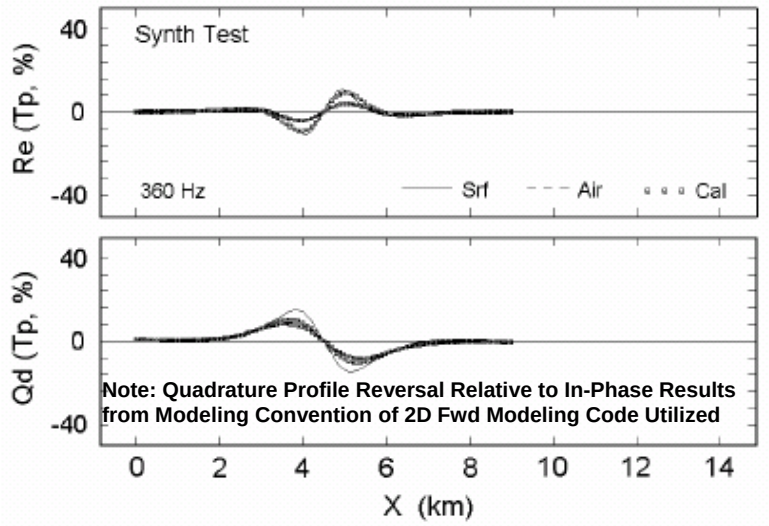


Figure 3: Calculated 2D Forward Model Response for In-Line (Z/X) In-Phase and QP Components over Buried Conductor in Resistive Half Space at 300m Elevation (Ref. Wannamaker, 2008).

1.2 General Geology

The Mt. Milligan project is within the Quesnel Terrane, a Late Triassic to Early Jurassic magmatic arc complex (Terrane Minerals Corp., 2008). The Quesnellia rocks consist of Triassic to Lower Jurassic volcanic and minor sedimentary rocks of Takla Group. The Takla Group in the Mt. Milligan area is mainly comprised of an upper, predominantly volcaniclastic Witch Lake Succession with hosts the Mt. Milligan deposits. The Witch Lake rocks are characterized by volcaniclastic and basaltic andesites that are intruded by coeval Takla Group and younger intrusions. Coeval intrusions comprise most of the Mt. Milligan intrusive complex, which consists dominantly of monzonitic rocks – including the MBX, Southern Star, Goldmark and North Slope stocks, all which host mineralization at Mt. Milligan (see Figure 4).

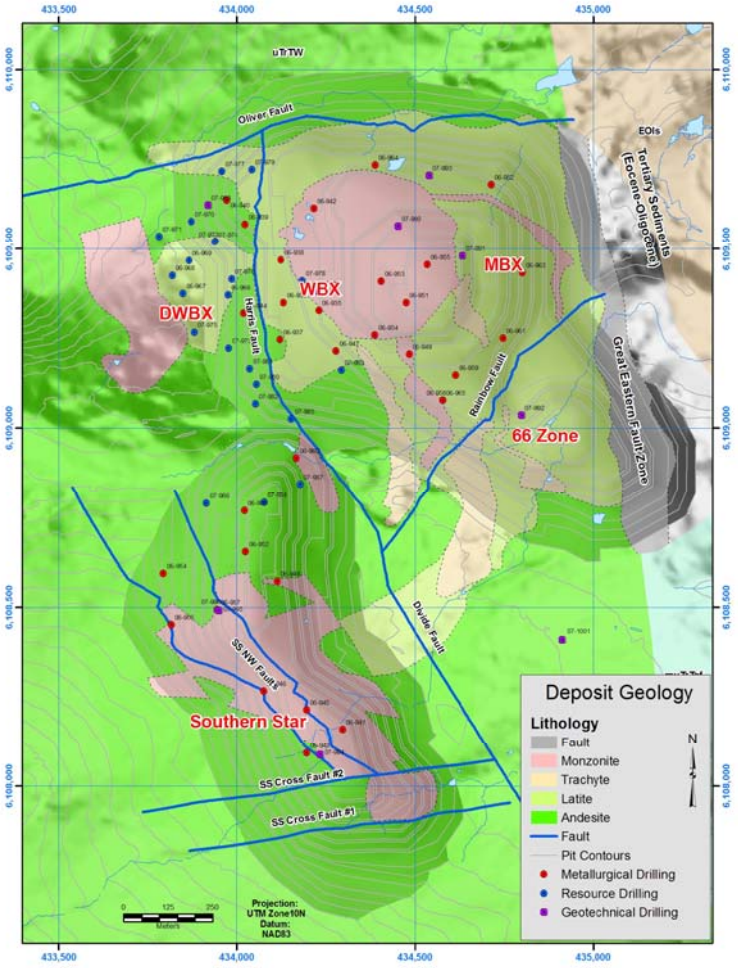


Figure 4: Mt Milligan Geology and Mineralized Zones (Ref. Terrane Metals Corp., 2008)

Mt. Milligan is a tabular, near-surface, alkalic copper-gold porphyry deposit that measures some 2500 metres (m) north-south, 1500 m east-west and is 400 m thick (Terrane Minerals Corp., 2008). It consists of two principal zones, the Main Zone and Southern Star (SS) Zone. The Main Zone

includes four contiguous sub-zones: MBX, WBX, DWBX and 66, all of which are spatially associated with the MBX monzonite stock and Rainbow Dyke (Figures 4-5). The SS Zone is centred on a monzonite stock of the same name and is some 500 m south of the Main Zone.

Main Zone mineralization and associated alteration are primarily hosted in volcanic rocks, whereas in the SS Zone, mineralization is hosted equally in monzonite stock and volcanic rocks. Mineralization in both zones consists of pyrite, chalcopyrite and magnetite with bornite localized along intrusive-volcanic contacts. The pyritic 66 sub-zone is notable in that it is comparatively gold-rich and copper-poor.

Copper-gold mineralization is primarily associated with potassic alteration with both copper grade and alteration intensity decreasing outwards from the monzonite stocks. Pyrite content increases dramatically outward from the stocks where it occurs in association with propylitic alteration, which forms a halo around the potassic-altered rocks. In terms of alteration, Mt Milligan features a poorly developed supergene blanket over the deposit with limited supergene enrichment. Potassic alteration is widespread and occurs principally as massive K-feldspar and biotite replacement of fine-grained matrix in porphyritic tuffs and flows. A phase of propylitic alteration consisting of epidote- calcite+/-pyrite-albite-chlorite in part overprints the potassic alteration.

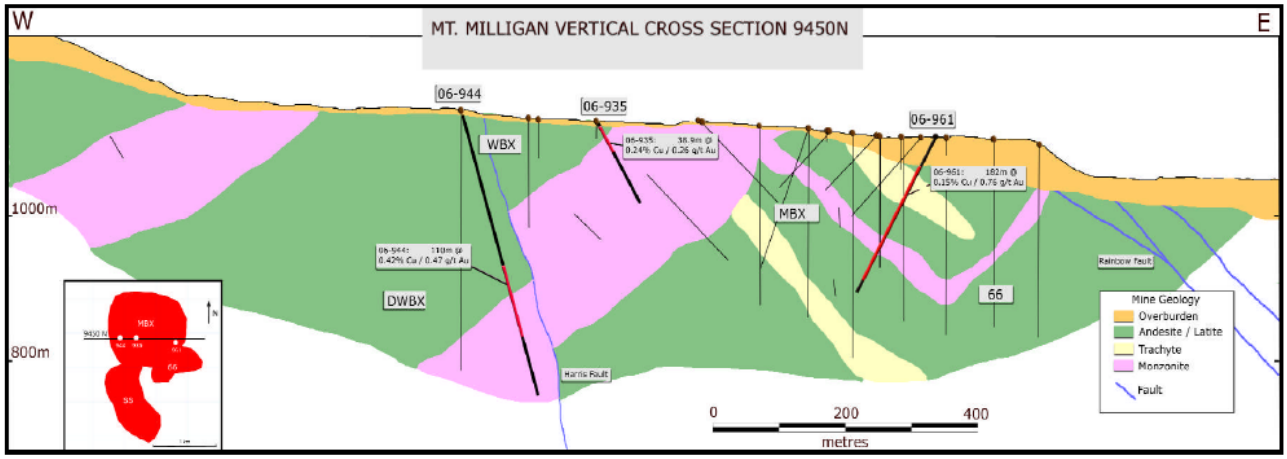


Figure 5: Cross-Section Across MBX Stock at Mt Milligan (Ref. Terrane Metals Corp., 2008)

In terms of structure, At least four episodes of faulting have effected the area, the earliest being the shallow east-dipping Rainbow Fault. Important east-northeasterly trending cross-faults and northwesterly trending, steeply easterly dipping faults separate the MBX stock from the Southern Star stock. The regional Great Eastern Fault truncates mineralization to the east and juxtaposes Takla Group volcanic rocks against Early Tertiary rocks (see Figure 4).

The Main Zone at Mt. Milligan consists of a number of zones partly within and adjacent to the west-dipping MBX stock (Figure 4). The MBX Zone is the most important Cu-Au zone and is situated along the footwall of the stock and along the Rainbow Dyke (Figure 4). The WBX Zone is a

Cu-Au deposit situated along the western hanging wall of the MBX stock. A down-faulted extension to this zone, the DWBX has been displaced vertically along the Harris Fault. To the south, the 66 Zone is essentially gold-only, with a boundary marked by Cu-Au zonation. Mineralization in the Southern Star deposit is hosted in the Southern Star stock. Mineralization extends from the eastern contact of the MBX stock to the Great Eastern Fault.

Mineralization consists of chalcopyrite and lesser bornite and magnetite in areas of potassic alteration, and pyrite in areas of propylitic alteration. Mineralization is best developed in areas of potassic alteration in the footwall. The highest copper-gold grades are related to chalcopyrite adjacent to the MBX and Southern Star stocks. The highest gold grades are in the 66 Zone and are associated with abundant pyrite. Pyrite occurs as disseminations and veinlets, up to 10 to 20%.

1.3 Previous Geophysics

Previous geophysics on the property has included IP surveys which outline primarily the pyritic haloes surrounding the intrusions and mineralized zones. Ground magnetic surveys indicate that the MBX and Southern Star stocks are positive magnetic anomalies, although the MBX stock is within an area strongly influenced by the highly magnetic Mt. Milligan Intrusive Complex to the north. Previously, airborne survey covering the area north and west of the deposit area have included magnetics and VLF-EM. The EM data exhibited a pattern very similar to the IP ground surveys (Terrane Metals Corp., 2008). More recently, VTEM survey were completed in 2007 by Geotech for Geoscience BC as part of the QUEST project

2 Data Presentation

The nature of the AFMAG fields is such that, as with VLF, buried, tabular conductors and resistors produce cross-over responses (see Fig. 3). As such, although the field results are shown as cross-over profiles, additional post-processing is applied to convert these cross-over's into peak responses, to make them more useful as mapping tools. These include 2 types: the 90-degree Phase Rotation (Lo, et. al, 2008) which is a Geosoft-based FFT process applied to the grid data, and the Total Divergence (DT) which is a summative, horizontal derivative process method (Kuzmin, et al., 2005) - both of these have been used in this test case.

The ZTEM field results are presented as plan-view profiles of:

a) In-Phase Z/X component, multi-frequency (30-360Hz) profiles over the mid-frequency (90Hz) Phase Rotated (PR) In-Phase Z/X component grid (see Fig. 6a)
b) In-Phase Z/Y component, multi-frequency (30-360Hz) profiles over the mid-frequency (90Hz) Phase Rotated In-Phase Z/Y component grid (see Fig. 6b).
c) Quadrature Z/X component, multi-frequency (30-360Hz) profiles over the mid-frequency (90Hz) Phase Rotated Quadrature Z/X component grid
d) Quadrature Z/Y component, multi-frequency (30-360Hz) profiles over the mid-frequency (90Hz) Phase Rotated Quadrature Z/Y component grid

The ZTEM processed results are presented as plan-view grids of:

a) In-Phase DT (see Fig. 8) and Quadrature DT grid contour at 90Hz
b) In-Phase Resulting Phase-Rotated (RPR) grid (Fig. 7) and Quadrature PR contour at 90Hz
c) 3D View of the multi-frequency In-Phase DT (45-90-180-360Hz) grid contours, plotted at equivalent skin depth (600 to 2000m depth – assuming 1k ohm-m half-space) with DEM model at surface (Fig. 10).
d) 3D View of the multi-frequency In-Phase Resulting Phase-Rotated (RPR) Grid (45-90-180-360Hz) grid contours, plotted at equivalent skin depth (~600 to ~1700m depth – assuming 1k ohm-m half-space) with DEM model at surface.

In addition to the ZTEM results, the following Magnetic maps are presented as plan-view grids:

e) Total Magnetic Intensity (TMI) grid contour.
f) First Vertical Derivative (Gradient) grid contour (Fig. 9b).

3 Data Analysis

The Mt Milligan area ZTEM results, in particular, showcase the generally high level of data quality, in terms of signal/noise and well defined anomaly resolution. Particularly given the fact that a) the data were obtained in mid-late October, and therefore not at the peak season of sferic activity – hence at best moderate natural field levels expected; and b) the data were obtained using aircraft flying at ~100km/hr, approximately 100m above ground level – hence without significant stacking or additional processing applied.

3.1 Plan view Results

The two In-Phase Tipper profile data (Z/X = In-line – Z/Y = Cross-line) with corresponding 90-degree Phase-Rotated (PR) grids are presented for the 30 to 360 Hz frequencies, in Figure 6, for comparison purposes. The outlines of the Mount Milligan MBX, 66 and SS porphyry deposits are also shown.

There are distinctive differences observed between the Z/X (In-Line) component profile results (Figure 6a), which are most sensitive to structures orientated perpendicular to the In-Line direction- notably the 1-2 major NS structures defined east of the Mt-Milligan porphyry copper deposits, which appear correspond to the known Great Eastern Fault Zone that marks the Tertiary-Quesnel contact. This image contrasts the Z/Y (Cross-line) component profiles (Figure 6b), which are sensitive to structures oriented oblique/parallel to the In-Line flight direction – notably: 1) a probable NW-SE fault structure southwest of Mt Milligan; 2) a possible NE-SW fault structure east of Mt Milligan, and 3) a possible east-westerly structure that bounds the northern edge of the MBX Zone. When the 2 Tippers are combined, using either the PR or DT grid methods, as shown in Figures 7 and 8, the imaging of geoelectric structures becomes omni-directional, with all orientations being highlighted.

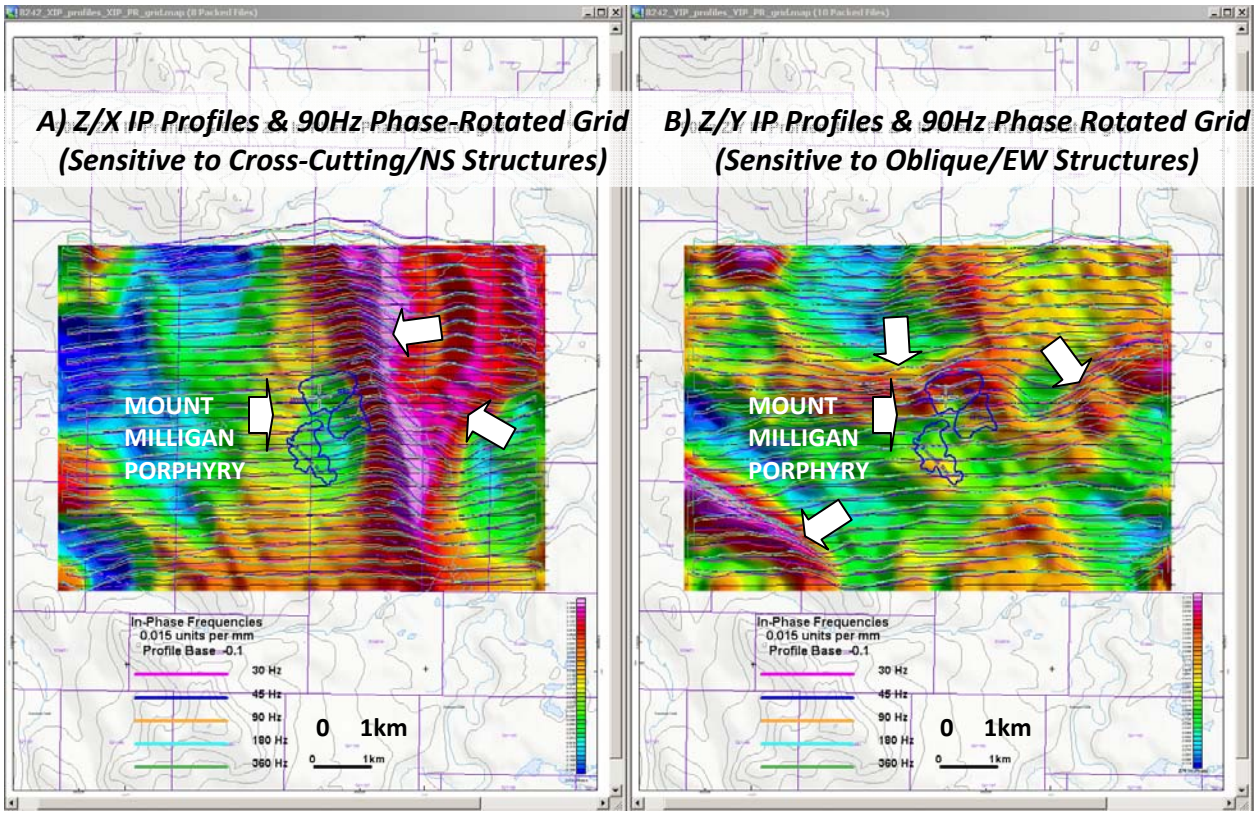


Figure 6: Mt Milligan ZTEM Test Block: In-Phase Z/X Component Profiles over 90Hz Phase-Rotated (PR) Grid (left) versus Corresponding In-Phase Z/Y Profiles and 90Hz PR Grid (right).

The Resulting PR and the DT images shown in Figures 7 and 8 each also demonstrate the notable differences in the frequency-dependence of the responses, that imply resolved differences in the vertical depth of the defined structures– including a) the main NNW-SSE Great Eastern Fault zone contact response, occurring east of Mt Milligan, that progressively weakens from low to high frequency (Fig. 7b & Fig 8b). This might reflect the fact that this is a major geologic/geoelectric contact that more strongly fault-fractured/altered with greater depth penetration. In contrast, the conductive lineament, which appears to be structurally related and that borders the Mt Milligan porphyries to the north (the Oliver Fault – Fig. 4), progressively weakens in strength with decreasing frequency and increasing depth-penetration. This suggests that it relates more to the near-surface geology and not the deep geologic structure below the Mt. Milligan zones. Also highlighted in these images, particularly the RPR grids in Figure 7, is the subtle circular-like high resistivity anomaly that directly coincides with the Mt. Milligan porphyry and might therefore reflect the potassic alteration halo.

Figure 9 shows the 90 Hz In-Phase DT results (Fig 9a), as well as the corresponding calculated 1ST vertical magnetic gradient (CVG) results (Fig. 9b) and compares them both directly with the structural interpretation, taken from Figure 7-8 and shown as an overlay. Clearly, both the DT and the CVG results both map similar inferred fault-fracture structures, including the main NNW-SSE Great Eastern Fault Zone (GEFZ); however there locus of the ZTEM resistivity lows appears to provide stronger evidence of these structures relative to the magnetic results in Figure 9b. The

results showcase the complementary nature of the ZTEM and Magnetic evidence. They also highlight the geologic mapping capability using resistivity contrasts that ZTEM provides.

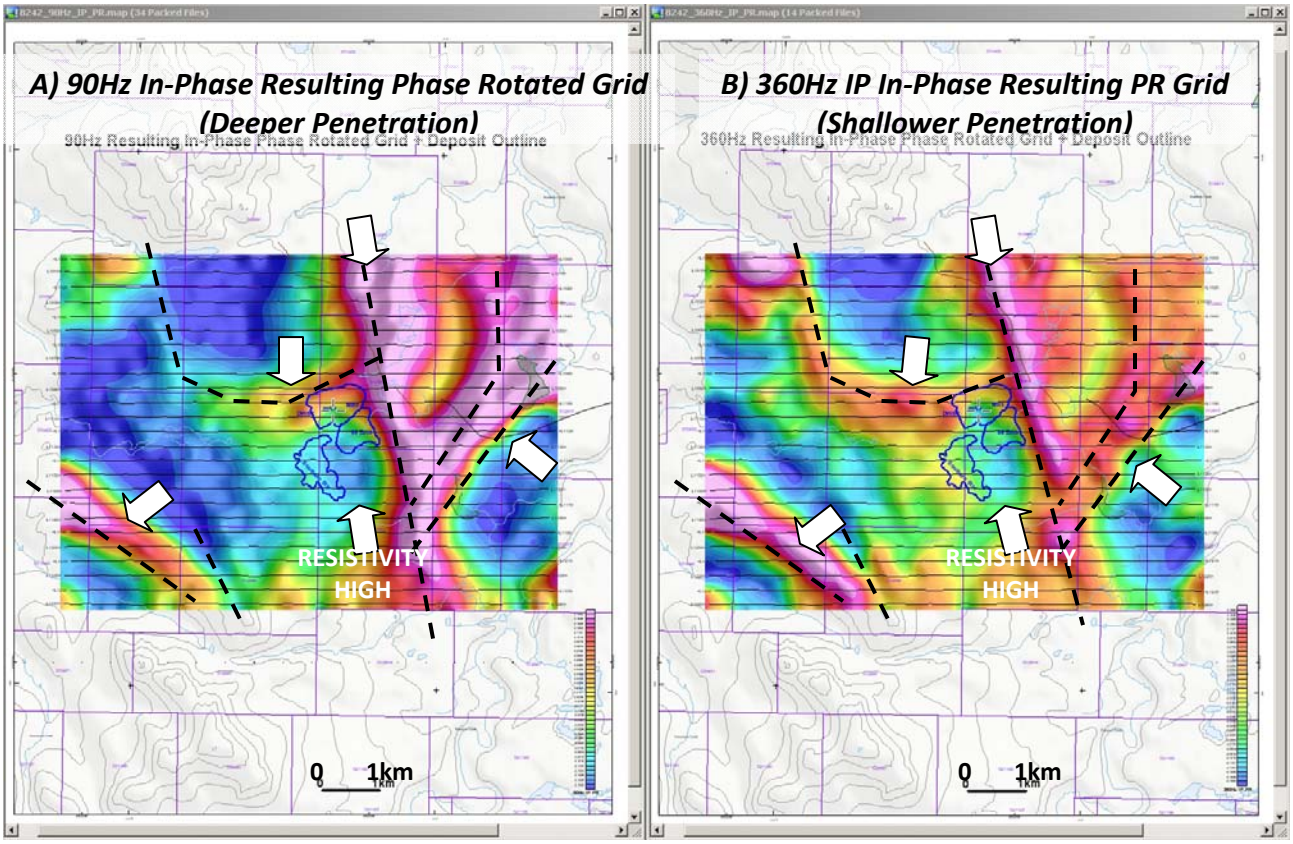


Figure 7: Mt Milligan Test Block: 90Hz In-Phase Resulting Phase Rotated (PR) Grid (left) versus Corresponding 360Hz In-Phase Resulting PR Grid (right) and structural interpretation.

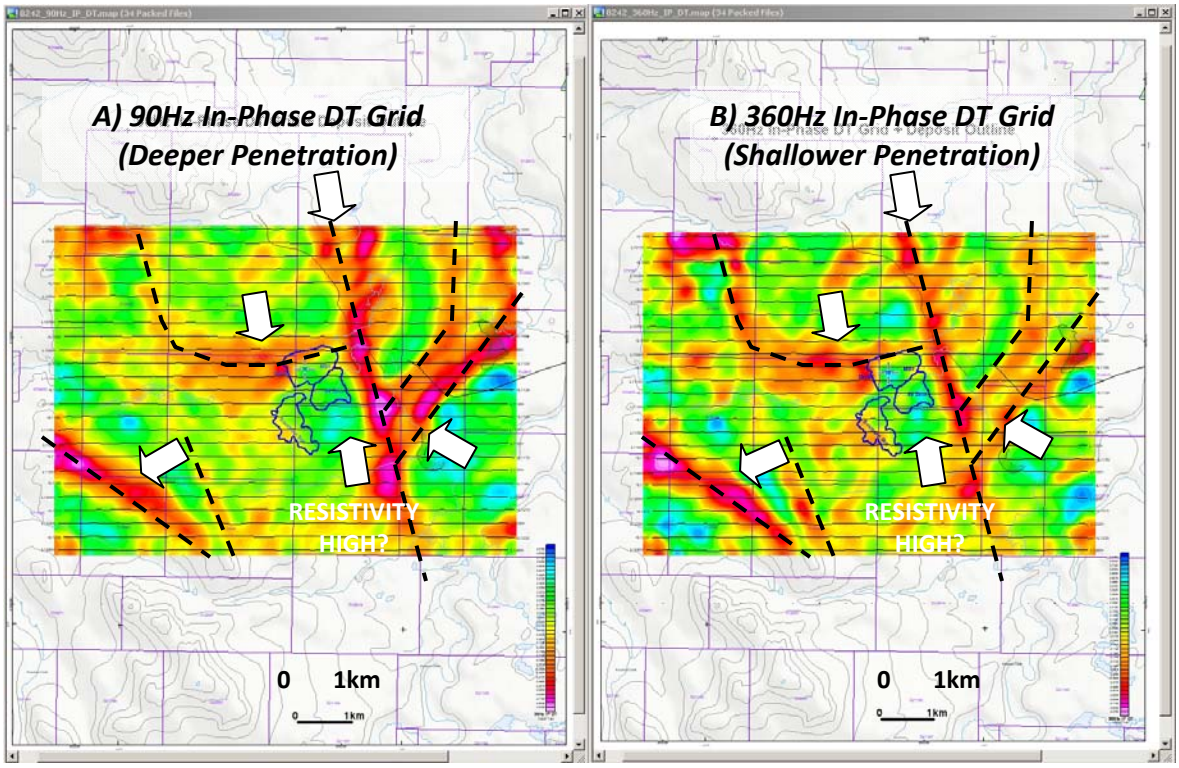


Figure 8: Mt Milligan Test Block: 90Hz In-Phase Total Divergence (DT) Grid (left) versus Corresponding 360Hz In-Phase DT Grid (right).

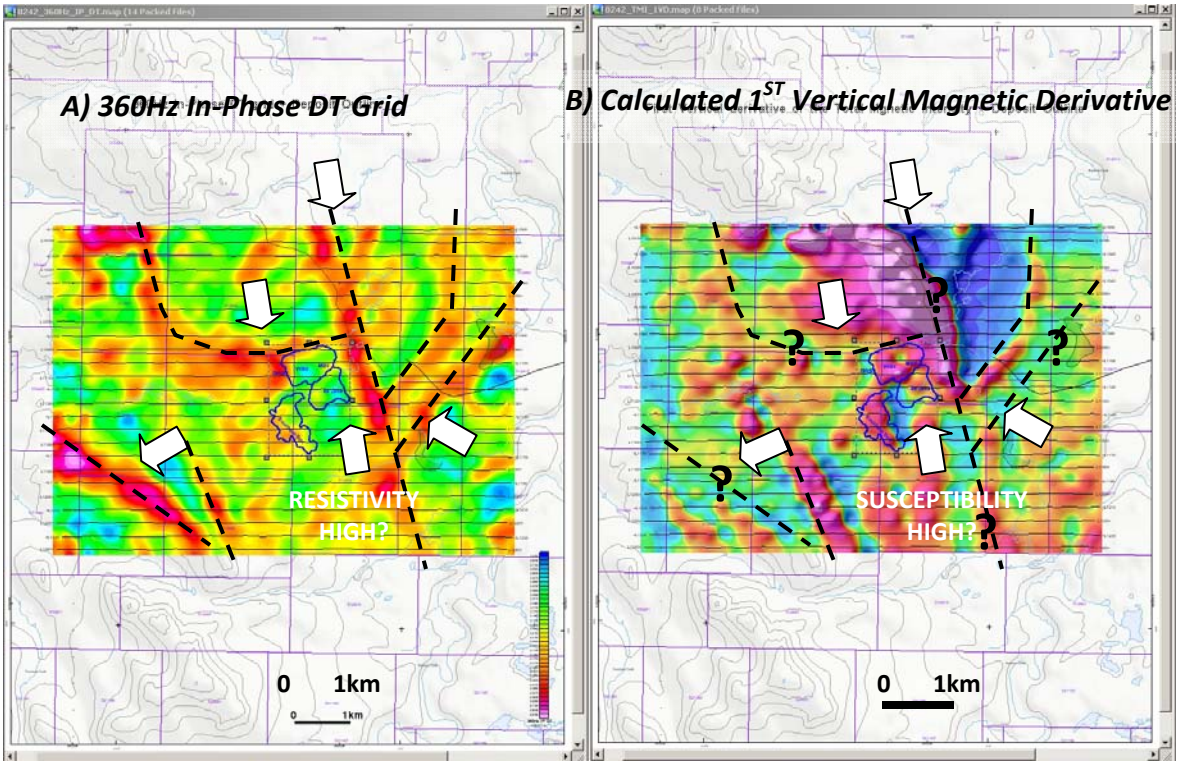


Figure 9: Mt Milligan Test Block: 360Hz In-Phase DT Grid and Interpreted Structures (left) versus Corresponding Calculated 1ST Vertical Magnetic Grid (right).

Figure 10, presents a 3D composite image of the multi-frequency DT's from Mt Milligan plotted at the equivalent MT skin depth, assuming a 1,000 ohm-m average resistivity. As shown, the depth of the DT slices increases with decreasing frequency (360Hz-45Hz) from ~600m to ~1700m.

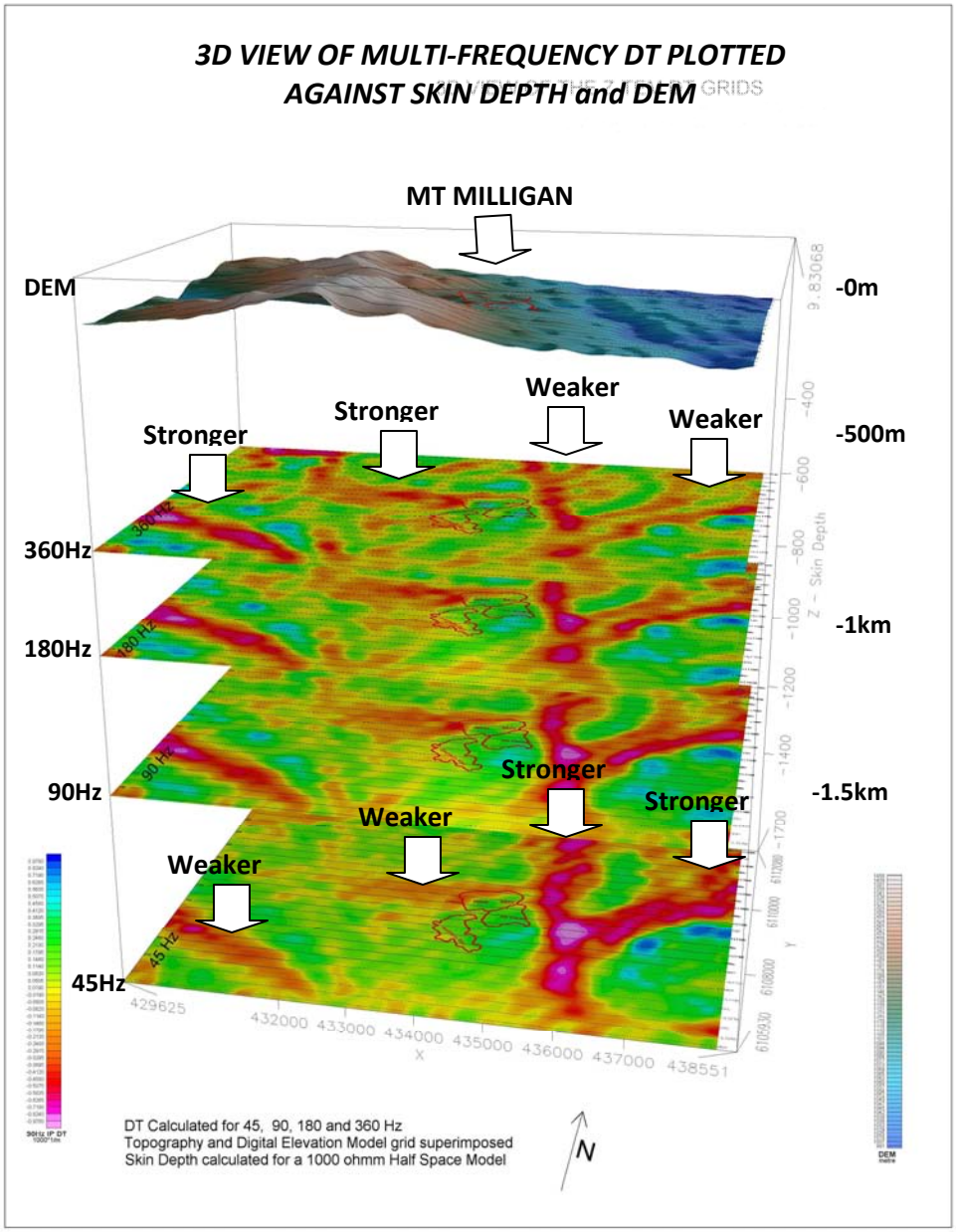


Figure 10: 3D Perspective view of Multi-frequency In-Phase DT's plotted according to MT skin depth (using 1k ohm-m half-space Earth) and DEM model at ground level.

As shown, this image highlights the frequency dependency of the ZTEM responses obtained, hence possible differences in the depth-range – notably the 2 signatures to the west, that include Mt-Milligan, that weaken with progressive depth and therefore suggests that these are structures are closer to the surface; and the 2 easternmost highlighted features that strengthen with depth which therefore suggests that these are major bedrock fault-fracture zones or contacts.

3.2 2D Inversion Analysis

Cross-sectional images of the ZTEM results have been generated using 2D inversion algorithm, in the manner proposed by Perrson et al. (2008) for airborne VLF data. The Zvert2d™ code developed for Geotech Ltd. is based on the Gauss-Newton algorithm of deLugao and Wannamaker (1996) by Prof. Phil Wannamaker at University of Utah. It was specifically modified to take into account the "air" layer between the ZTEM aircoil sensor and the ground level. It is designed to run on a desktop Pentium with 3GHz processor, requiring approximately 20 minutes to execute for a typical ZTEM profile.

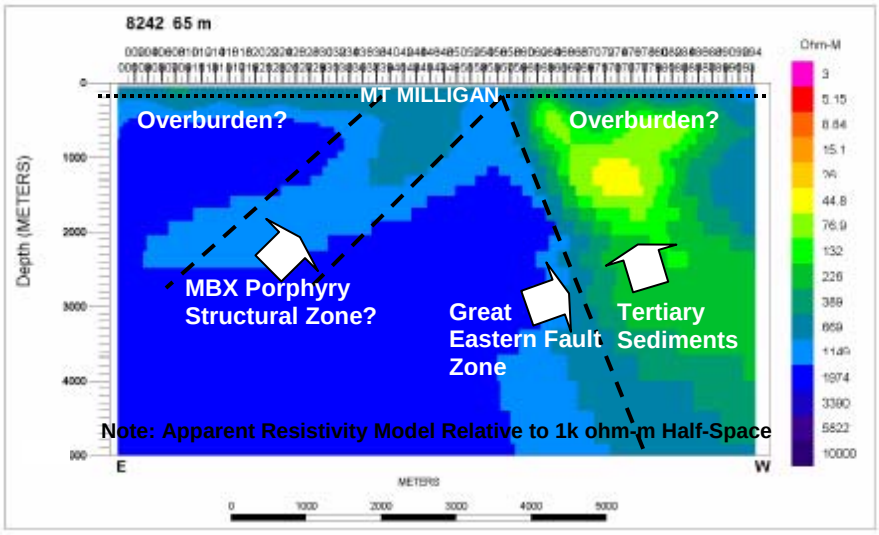


Figure 11 Above: Inversion image for line 8242 with the flight line 65 m above the ground. Below: Observed and computed inversion model responses for line 8242-65m.

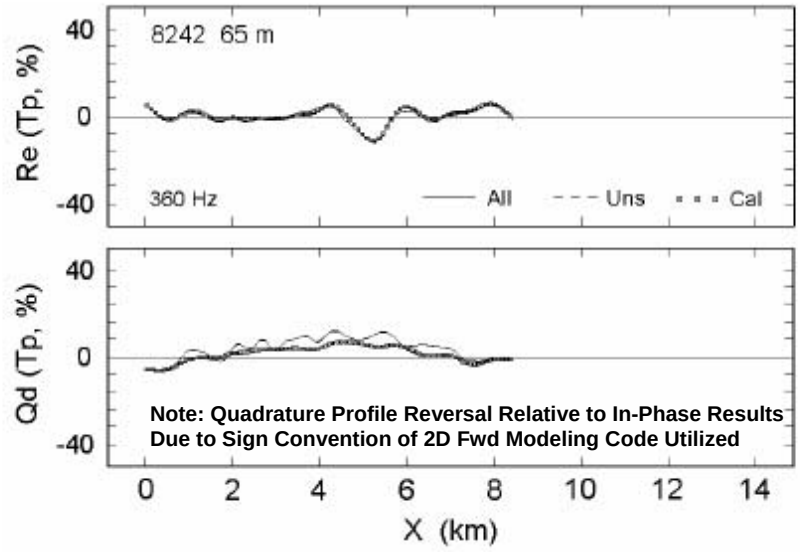


Figure 11: 2D Inversion image with Interpreted Structures and Calculated vs. Observed Z/X profile at 360Hz s for flight line directly over Mt Milligan Deposit, 65m above ground level.

The In-line (Z/X) data for a single line profile, taken directly over the center of the Mt Milligan Main Zone Porphyry (MBX), were used to create the 2D inversion image presented in Figure 11. The input data utilized both the In-Phase and Quadrature Phase data from all five measured frequencies. Due to the impractical nature of the >1000 data points from the ZTEM profile, these were undersampled to 90 points in order to perform the calculation and proved effective. An error of 2% was assigned to the data for inversion. A host of 1000 ohm-metres was assumed for the starting model. Despite non-ideality of the data error, a value of nRMS of close to unity (1.0) was achieved in 4-6 iterations, with starting nRMS values of 5-6.

Figure 11 presents the 2D resistivity cross-section obtained from the Mt Milligan line-profile and the corresponding In-Phase and Quadrature profiles showing the measured vs. 2D forward model data fits at 360Hz, for comparison (note that the Quadrature profile is reversed for convention purposes; ref. Wannamaker, 2008). As shown, the data variation is relatively complex with an initial high-frequency minimum in the In-Phase Z/X profile appearing near x = 5.5 km, and then generally positive values of IP (Z/X) developing over the rightmost portion of the line. This results in a crudely Y-shaped conductive anomaly in the eastern third of the inversion section with the initial high-frequency anomaly responsible for the upper left limb of the Y (Wannamaker, 2008).

This corresponds to the known Tertiary Sediments that lie east of the older Quesnel-Takla rocks that host the Mt Milligan porphyry, whose boundary is marked by the Great Eastern Fault Zone (GEFZ), which appears to be east-dipping. Based on the ZTEM inversion results, the Tertiary sediments extend quite deeply – to below several km depths. Below a thick conductive overburden cover, a moderate resistivity low feature that is centered on the Mt Milligan MBX porphyry copper zone, in the middle of the profile, appears to dip westward and extends to below several km depths – suggesting a structural zone that resembles the geologic cross-section shown in Figure 4. It appears therefore that the 2D inversion image bears a reasonable resemblance to the known geology.

4 Conclusion and Recommendations

The ZTEM test results performed over a known copper-gold porphyry deposit in the north-central BC have highlighted the high quality and high resolution structural and alteration mapping, as well as deep penetration capability of the AFMAG data obtained.

The ZTEM results appear to correlate very well with the known geology, in particular the presence of both major and secondary fault structures and geologic contacts. In addition, the ZTEM results appear to indicate differences in the relative source depth and vertical depth-extent of the defined structures that are geologically plausible.. In particular, the ZTEM results point to the presence of a major NNW-SSE-trending conductive fault or contact structure that cross-cuts the survey area and relates the Great Eastern Fault Zone, east of the Mt Milligan deposits, marking the boundary between the Quesnel Takla group rocks to the west and the younger, down-faulted Tertiary sediments to the east. The Mt. Milligan deposit area itself is marked by a subtle but well-defined circular resistivity high feature, that possibly relates to the potassic alteration halo centred over the porphyry copper zones. As well a weaker, east-westerly low resistivity zone that appears to border the Mt. Milligan porphyries to the north, might relate to the Oliver structural fault zone

or possibly the potassic-propylitic alteration boundary which appears to weaken with depth – suggesting that it relates to the near-surface outcropping geology, rather than a deep feature.

The 2D inversion using the Zvert2d algorithm appears to have been able to compute accurate ZTEM responses in the air and to invert them for reasonable earth resistivity cross section directly over the Main MBX Zone at Mt Milligan. Provided approximate constraints on the host resistivity are available, inversion anomaly positions are more accurate. With poor constraints, trials with a variety of host resistivities are required to judge their dependency. Overall, the Great Eastern Fault Zone and Tertiary sediments are clearly defined, and a possible west-dipping structural zone relating to Mt Milligan porphyry is also suggested that extends to great depth.

We recommend that these ZTEM results be compared with the available geoscientific data, in order to better explain the observed correlations with the known geology. This might include comparisons with any geophysical survey data, in particular, ground EM and possibly also ground magnetotelluric and tipper MT results. We also recommend that additional interpretation of the ZTEM data be attempted, using 2D inversions with geologically-referenced starting models.

Respectfully submitted

Jean M. Legault, M.Sc., P.Eng. P.Geo.
Manager, Data Processing & Interpretation
Geotech Ltd., Aurora ON

Biljana Milicevic, M.Sc.
Geophysical Consultant
Geotech Ltd., Aurora, ON

5. References

De Lugao, P.P., and Wannamaker (1996). Calculating the two-dimensional magnetotelluric Jacobian in finite elements using reciprocity, Geophys. J. Int., Vol. 127, pp. 806-810.

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Ward, S. H. (1959). AFMAG - Airborne and Ground: Geophysics, Vol. 24, pp. 761-787.

GEOTECH LTD.



SURVEY SPECIFICATIONS:

- Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
- Survey Operations Base: Mackenzie, British Columbia
- Nominal Survey Line Spacing: 250 m
- Nominal Survey Line Direction: Azimuth 90°N
- Helicopter Mean Terrain Clearance: 200 metres
- Mean Ground Air Speed: 27 metres/sec
- AFMAG airborne coil: towed 90 m below the helicopter
- Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

- Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

- GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
- GPS Receivers Location: One on the helicopter, three on EM coil
- Radar Altimeter: Terra TRA 3000/TRI 40
- Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

- Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
- Coil dimensions: 7.4 metres diameter
- Coil orientation: Vertical Dipole
- Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

- Magnetometer: GEOMETRICS
- Magnetometer Sensitivity: +/- 0.02 nT
- Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

- Magnetometer: GEOMETRICS
- Base Station Location: Mackenzie Airport

EM BASE STATION

- Two orthogonal square coils
- Coil dimensions: 3.5 metres each side
- Coil orientation: Horizontal Dipole
- Base Station Location: 55°13'32.6 N, 124°11'11.7 W
- Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

- Datum: WGS84 (10 m Mean Conus)
- Projection: Universal Transverse Mercator
- Central Meridian: 123°W (Zone 10N)
- Central Scale Factor: 0.9996
- False Easting/Northing: 500,000m/0m
- Major Axis: 6378206.4
- Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

- Diurnal Subtraction, microlevelling

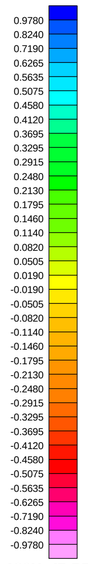
Z-TEM

- Frequencies extracted: 30, 45, 90, 180, 360 Hz.
- Sampling rate: 0.4 sec.
- Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles





180Hz IP DT
1000*1/m

Scale 1:20000
250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

The topographic data base was derived from 1:50,000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
180 Hz In-Phase DT
[d(Z/X)/dX + d(Z/Y)/dY]

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

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MAGNETIC BASE STATION

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MAP PROJECTION

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Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
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Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles

+ L1100 −

0.4890
0.4120
0.3595
0.3133
0.2817
0.2537
0.2290
0.2060
0.1848
0.1647
0.1458
0.1240
0.1065
0.0897
0.0730
0.0570
0.0410
0.0253
0.0095
-0.0095
-0.0253
-0.0410
-0.0570
-0.0730
-0.0897
-0.1065
-0.1240
-0.1458
-0.1647
-0.1848
-0.2060
-0.2290
-0.2537
-0.2817
-0.3133
-0.3595
-0.4120
-0.4890

180Hz QD DT
1000*1/m

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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L1100

0.9780
0.8240
0.7190
0.6265
0.5635
0.5075
0.4580
0.4120
0.3695
0.3295
0.2915
0.2480
0.2130
0.1795
0.1460
0.1140
0.0820
0.0505
0.0190
-0.0190
-0.0505
-0.0820
-0.1140
-0.1460
-0.1795
-0.2130
-0.2480
-0.2915
-0.3295
-0.3695
-0.4120
-0.4580
-0.5075
-0.5635
-0.6265
-0.7190
-0.8240
-0.9780

30Hz IP DT
1000*1/m

Scale 1:20000

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(meters)
WGS 84 / UTM zone 10N

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Mt. Milligan Test Block
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Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

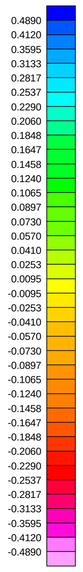
Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles





30Hz QD DT
1000*1/m

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

The topographic data base was derived from 1:50,000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
30 Hz Quadrature DT
[d(Z/X)/dX + d(Z/Y)/dY]

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM
Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER
Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION
Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION
Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
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Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS
Diurnal Subtraction, microlevelling

Z-TEM
Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles





360Hz IP DT
1000*1/m

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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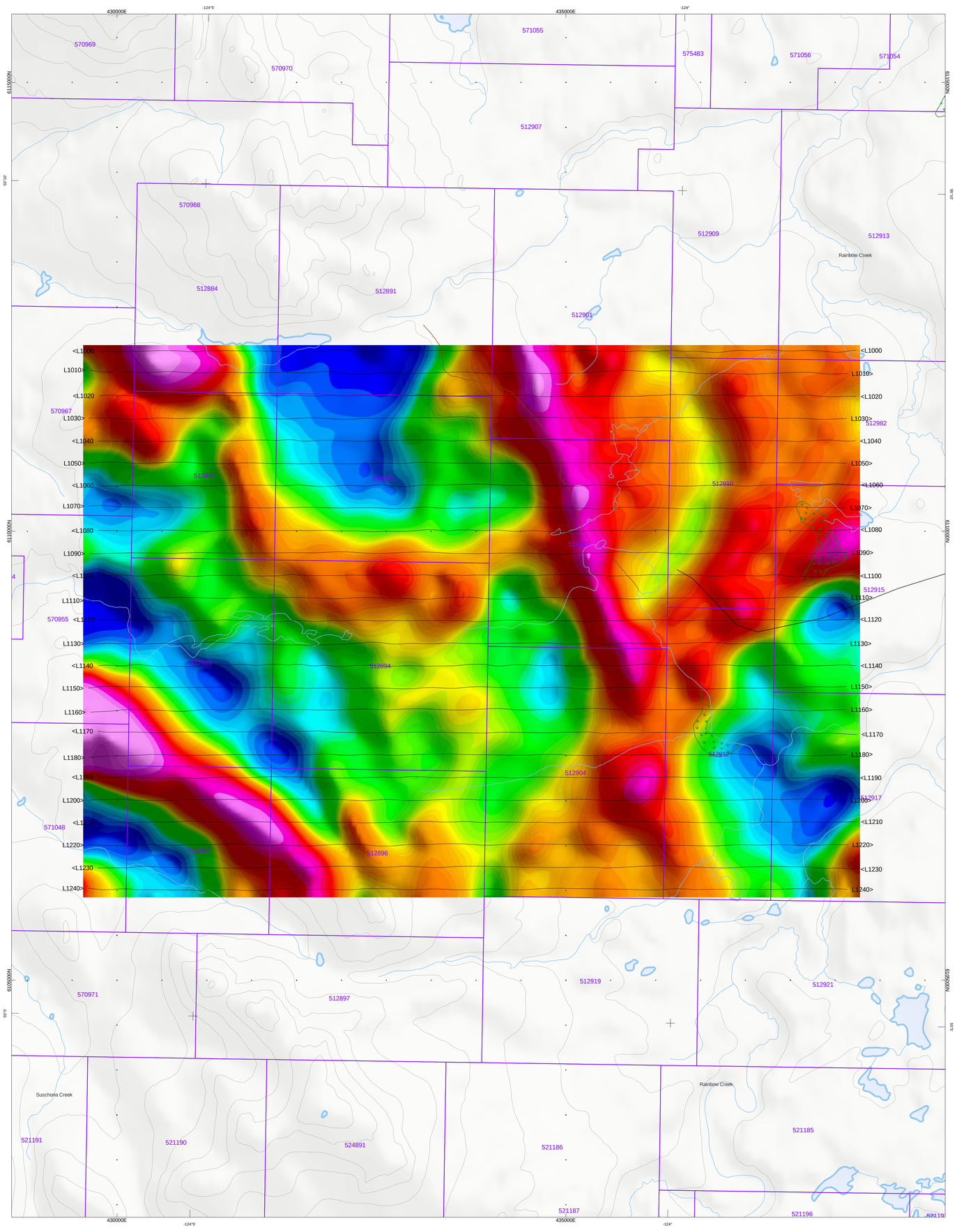
Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
360 Hz In-Phase DT
[d(Z/X)/dX + d(Z/Y)/dY]

Flown and processed by:
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www.geotech.ca

January 2009

Geotech project # 8242



GEOTECH LTD.



SURVEY SPECIFICATIONS:

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Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
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Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
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HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

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Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

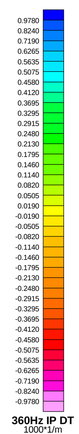
MAGNETICS

Diurnal Subtraction, microlevelling

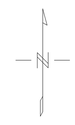
Z-TEM

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DIV(T/I) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles



360Hz IP DT
1000*1/m



Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
360 Hz In-Phase DT
[d(Z/X)/dX + d(Z/Y)/dY]

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www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles

L1100

0.4890
0.4120
0.3595
0.3133
0.2817
0.2537
0.2290
0.2060
0.1848
0.1647
0.1458
0.1240
0.1065
0.0897
0.0730
0.0570
0.0410
0.0253
0.0095
-0.0095
-0.0253
-0.0410
-0.0570
-0.0730
-0.0897
-0.1065
-0.1240
-0.1458
-0.1647
-0.1848
-0.2060
-0.2290
-0.2537
-0.2817
-0.3133
-0.3595
-0.4120
-0.4890

360Hz QD DT
1000*1/m

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
360 Hz Quadrature DT
[d(Z/X)/dX + d(Z/Y)/dY]

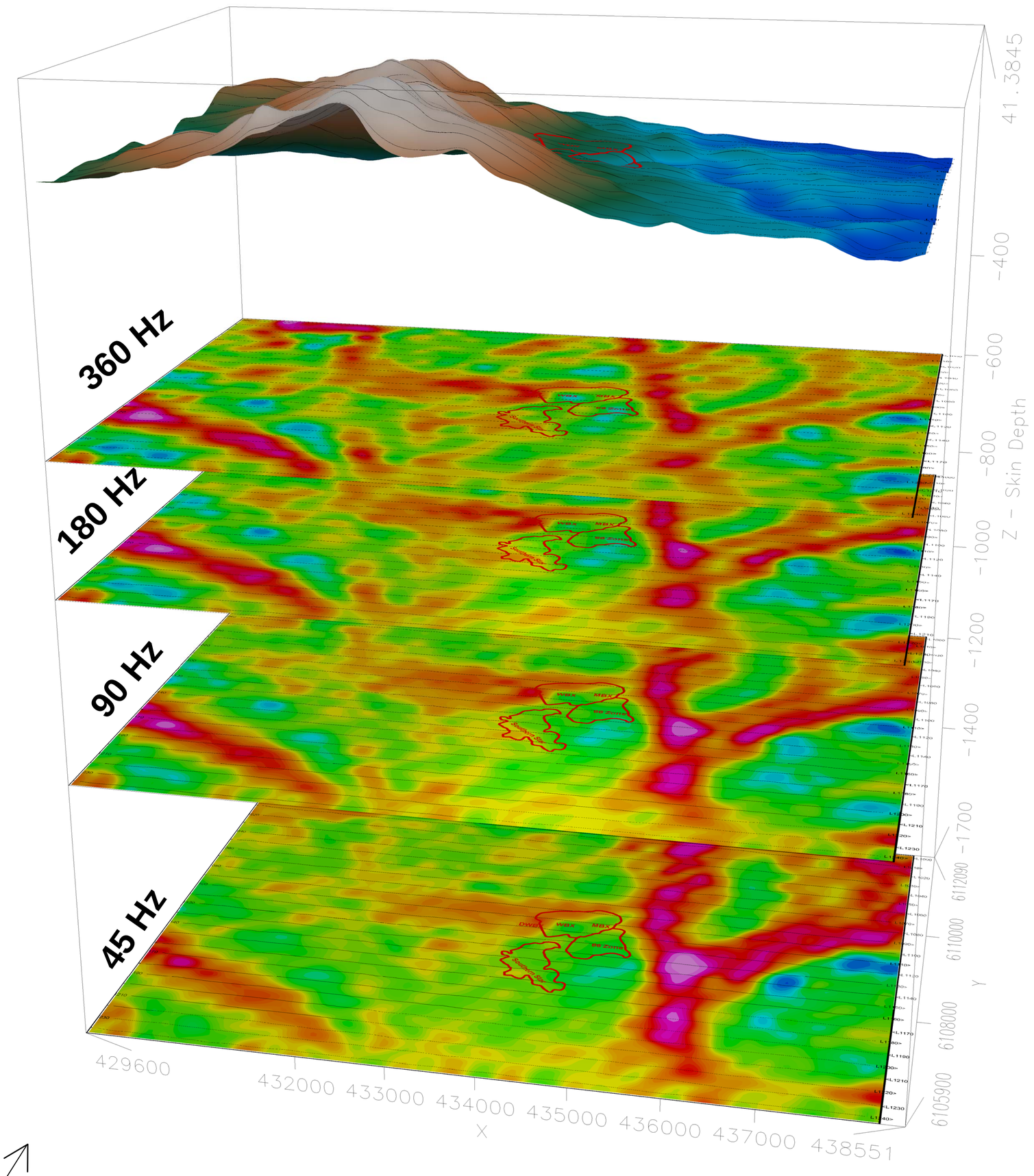
Flown and processed by:
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245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.





DT Calculated for 45, 90, 180 and 360 Hz
Topography and Digital Elevation Model grid (base removed 1400m) superimposed
Skin Depth calculated for a 1000 ohmm Half Space Model

SURVEY SPECIFICATIONS:

- Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
- Survey Operations Base: Mackenzie, British Columbia
- Nominal Survey Line Spacing: 250 m
- Nominal Survey Line Direction: Azimuth 90°N
- Helicopter Mean Terrain Clearance: 200 metres
- Mean Ground Air Speed: 27 metres/sec
- AFMAG airborne coil: towed 90 m below the helicopter
- Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

- Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

- GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
- GPS Receivers Location: One on the helicopter, three on EM coil
- Radar Altimeter: Terra TRA 3000/TRI 40
- Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

- Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
- Coil dimensions: 7.4 metres diameter
- Coil orientation: Vertical Dipole
- Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

- Magnetometer: GEOMETRICS
- Magnetometer Sensitivity: +/- 0.02 nT
- Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

- Magnetometer: GEOMETRICS
- Base Station Location: Mackenzie Airport

EM BASE STATION

- Two orthogonal square coils
- Coil dimensions: 3.5 metres each side
- Coil orientation: Horizontal Dipole
- Base Station Location: 55°13'32.6 N, 124°11'11.7 W
- Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

- Datum: WGS84 (10 m Mean Conus)
- Projection: Universal Transverse Mercator
- Central Meridian: 123°W (Zone 10N)
- Central Scale Factor: 0.9996
- False Easting/Northing: 500,000m/0m
- Major Axis: 6378206.4
- Eccentricity: 0.082271854.

PROCESSING SUMMARY

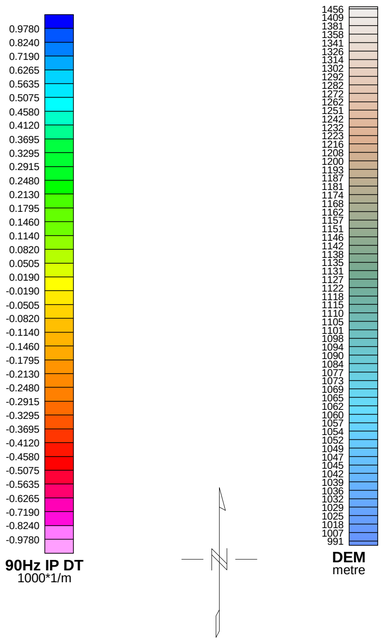
MAGNETICS

- Diurnal Subtraction, microlevelling

Z-TEM

- Frequencies extracted: 30, 45, 90, 180, 360 Hz.
- Sampling rate: 0.4 sec.
- Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

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Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
3D In Phase DT for 45, 90, 180 and 360Hz
[d(Z/X)/dX + d(Z/Y)/dY]

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

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GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
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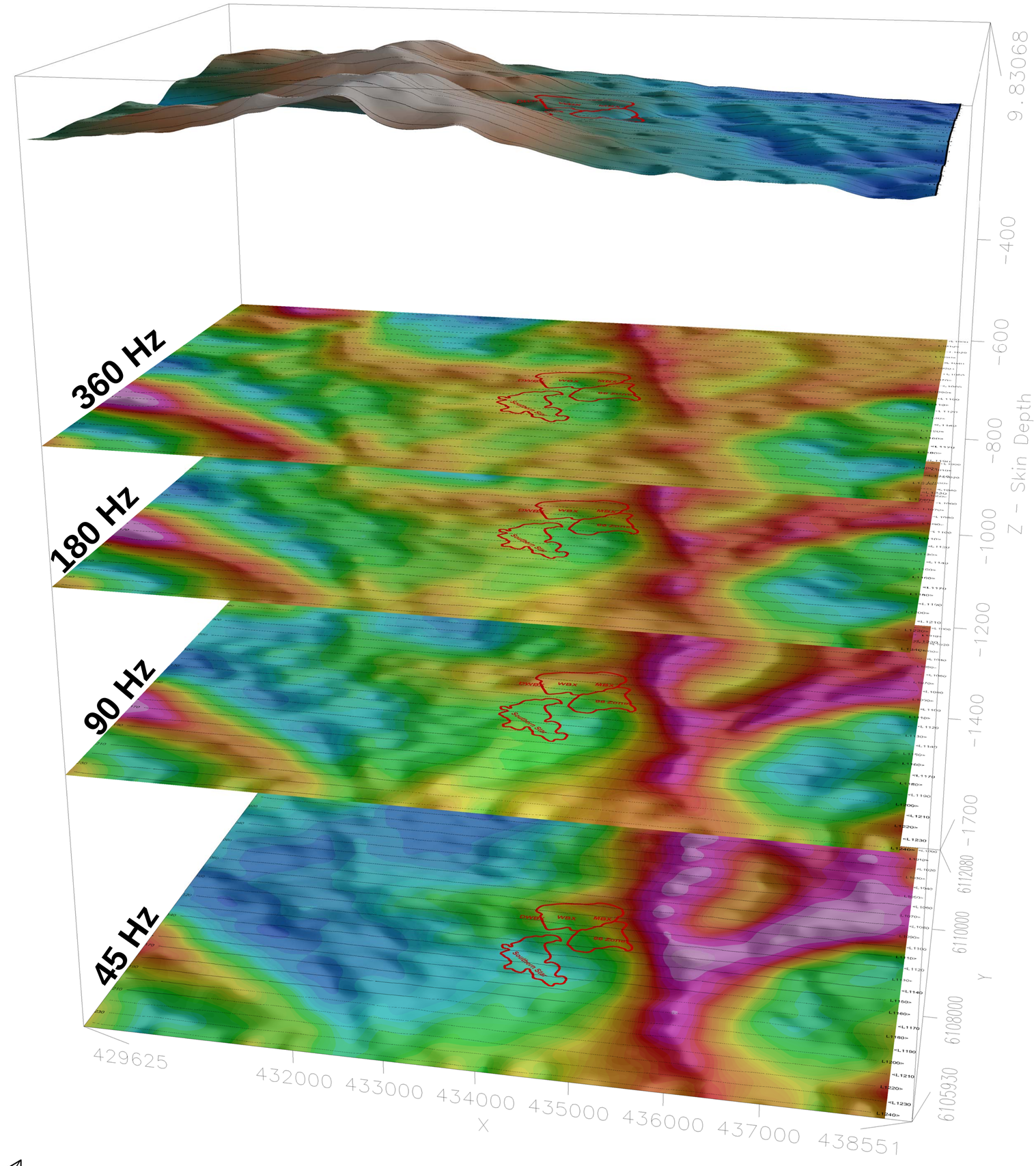
MAGNETICS

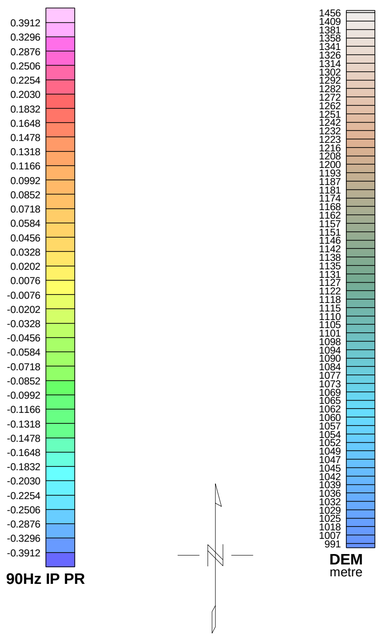
Diurnal Subtraction, microlevelling

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Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
3D In-Phase Resulting Phase Rotated Grids
For 45, 90, 180 and 360 Hz Frequencies

Flown and processed by:
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January 2009

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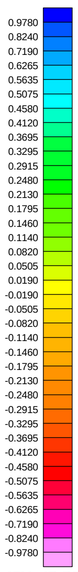
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Phase Profiles





45Hz IP DT
1000*1/m

Scale 1:20000
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Mt. Milligan Test Block
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Geotech Z-TEM System
45 Hz In-Phase DT
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Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
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Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

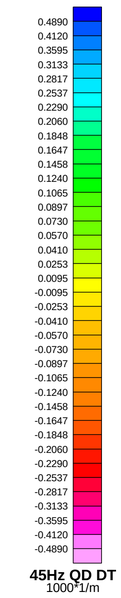
Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles





45Hz QD DT
1000*1/m



Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

The topographic data base was derived from 1:50,000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
45 Hz Quadrature DT
[d(Z/X)/dX + d(Z/Y)/dY]

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM
Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER
Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION
Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION
Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

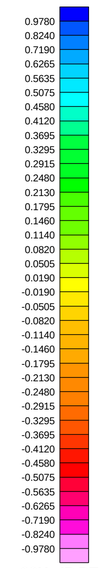
MAGNETICS
Diurnal Subtraction, microlevelling

Z-TEM
Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles





90Hz IP DT
1000*1/m

Scale 1:20000
250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

The topographic data base was derived from 1:50,000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
90 Hz In-Phase DT
[d(Z/X)/dX + d(Z/Y)/dY]

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles

L1100

0.3912
0.3296
0.2876
0.2506
0.2254
0.2030
0.1832
0.1648
0.1478
0.1318
0.1166
0.0992
0.0852
0.0718
0.0584
0.0456
0.0328
0.0202
0.0076
-0.0076
-0.0202
-0.0328
-0.0456
-0.0584
-0.0718
-0.0852
-0.0992
-0.1166
-0.1318
-0.1478
-0.1648
-0.1832
-0.2030
-0.2254
-0.2506
-0.2876
-0.3296
-0.3912

90Hz IP PR

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
90 Hz In-Phase
Resulting Phase Rotated Grid

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

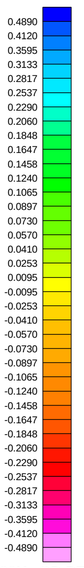
Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

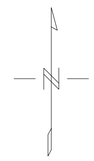
DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles





90Hz QD DT
1000*1/m



Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

The topographic data base was derived from 1:50,000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
90 Hz Quadrature DT
[d(Z/X)/dX + d(Z/Y)/dY]

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Mag Contours

20
100
500

1455.1
1409.4
1381.3
1358.4
1339.7
1326.2
1314.0
1302.5
1292.1
1282.1
1272.7
1262.3
1251.7
1241.7
1232.1
1223.7
1215.3
1207.6
1198.7
1192.3
1186.0
1179.6
1173.1
1166.8
1161.5
1155.8
1150.1
1145.5
1141.6
1137.3
1133.6
1130.0
1125.8
1121.3
1117.2
1113.8
1109.3
1105.2
1101.4
1097.4
1093.6
1089.1
1083.5
1077.4
1073.0
1069.2
1065.8
1062.4
1059.9
1057.1
1054.4
1052.2
1049.7
1047.5
1045.0
1042.4
1039.3
1036.1
1032.6
1028.4
1023.8
1017.5
1007.3
990.3

DEM
metre

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System

Digital Elevation Model

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Mag Contours

20
100
500

59914
59334
58861
58529
58316
58123
57989
57902
57825
57756
57686
57628
57568
57523
57478
57429
57379
57341
57308
57273
57245
57213
57177
57145
57114
57091
57070
57038
56998
56956
56929
56910
56887
56868
56853
56837
56779
56596

TMI
nanoTesla

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System

Total Magnetic Intensity

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
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Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

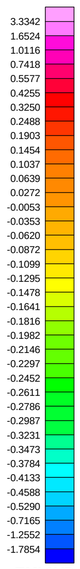
MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
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Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.



TMI 1VD
nanoTesla/metre

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
First Vertical Derivative of the Total Magnetic Intensity

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
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AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

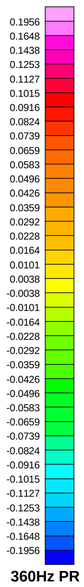
MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
Sampling rate: 0.4 sec.
Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.



360Hz PR

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

The topographic data base was derived from 1:50,000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
360 Hz Z/X Component In-Phase
Phase Rotated Grid

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

90Hz Z/X IP Profiles & 90Hz Z/X Phase Rotated grid

GEOTECH LTD.



SURVEY SPECIFICATIONS:

- Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
- Survey Operations Base: Mackenzie, British Columbia
- Nominal Survey Line Spacing: 250 m
- Nominal Survey Line Direction: Azimuth 90°N
- Helicopter Mean Terrain Clearance: 200 metres
- Mean Ground Air Speed: 27 metres/sec
- AFMAG airborne coil: towed 90 m below the helicopter
- Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

- Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

- GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
- GPS Receivers Location: One on the helicopter, three on EM coil
- Radar Altimeter: Terra TRA 3000/TRI 40
- Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

- Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
- Coil dimensions: 7.4 metres diameter
- Coil orientation: Vertical Dipole
- Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

- Magnetometer: GEOMETRICS
- Magnetometer Sensitivity: +/- 0.02 nT
- Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

- Magnetometer: GEOMETRICS
- Base Station Location: Mackenzie Airport

EM BASE STATION

- Two orthogonal square coils
- Coil dimensions: 3.5 metres each side
- Coil orientation: Horizontal Dipole
- Base Station Location: 55°13'32.6 N, 124°11'11.7 W
- Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

- Datum: WGS84 (10 m Mean Conus)
- Projection: Universal Transverse Mercator
- Central Meridian: 123°W (Zone 10N)
- Central Scale Factor: 0.9996
- False Easting/Northing: 500,000m/0m
- Major Axis: 6378206.4
- Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

- Diurnal Subtraction, microlevelling

Z-TEM

- Frequencies extracted: 30, 45, 90, 180, 360 Hz.
- Sampling rate: 0.4 sec.
- Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles

L1100

Quadrature Frequencies
0.01 units per mm
Profile Base -0.05

- 30 Hz
- 45 Hz
- 90 Hz
- 180 Hz
- 360 Hz

0.1956, 0.1648, 0.1438, 0.1253, 0.1127, 0.1015, 0.0916, 0.0824, 0.0739, 0.0659, 0.0583, 0.0496, 0.0426, 0.0359, 0.0292, 0.0228, 0.0164, 0.0101, 0.0038, -0.0038, -0.0101, -0.0164, -0.0228, -0.0292, -0.0359, -0.0426, -0.0496, -0.0583, -0.0659, -0.0739, -0.0824, -0.0916, -0.1015, -0.1127, -0.1253, -0.1438, -0.1648, -0.1956

Z/X In-Phase

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) Data
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
Z/X Component In-Phase Profiles
Over a 90 Hz Z/X Component In-Phase
Phase Rotated Grid

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

- Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
- Survey Operations Base: Mackenzie, British Columbia
- Nominal Survey Line Spacing: 250 m
- Nominal Survey Line Direction: Azimuth 90°N
- Helicopter Mean Terrain Clearance: 200 metres
- Mean Ground Air Speed: 27 metres/sec
- AFMAG airborne coil: towed 90 m below the helicopter
- Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

- Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

- GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
- GPS Receivers Location: One on the helicopter, three on EM coil
- Radar Altimeter: Terra TRA 3000/TRI 40
- Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

- Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
- Coil dimensions: 7.4 metres diameter
- Coil orientation: Vertical Dipole
- Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

- Magnetometer: GEOMETRICS
- Magnetometer Sensitivity: +/- 0.02 nT
- Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

- Magnetometer: GEOMETRICS
- Base Station Location: Mackenzie Airport

EM BASE STATION

- Two orthogonal square coils
- Coil dimensions: 3.5 metres each side
- Coil orientation: Horizontal Dipole
- Base Station Location: 55°13'32.6 N, 124°11'11.7 W
- Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

- Datum: WGS84 (10 m Mean Conus)
- Projection: Universal Transverse Mercator
- Central Meridian: 123°W (Zone 10N)
- Central Scale Factor: 0.9996
- False Easting/Northing: 500,000m/0m
- Major Axis: 6378206.4
- Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

- Diurnal Subtraction, microlevelling

Z-TEM

- Frequencies extracted: 30, 45, 90, 180, 360 Hz.
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Phase Profiles

L1100

Quadrature Frequencies
0.01 units per mm
Profile Base -0.05

- 30 Hz
- 45 Hz
- 90 Hz
- 180 Hz
- 360 Hz

0.1467
0.1236
0.1078
0.0940
0.0845
0.0761
0.0687
0.0618
0.0554
0.0494
0.0437
0.0372
0.0319
0.0269
0.0219
0.0171
0.0123
0.0076
0.0028
-0.0028
-0.0076
-0.0123
-0.0171
-0.0219
-0.0269
-0.0319
-0.0372
-0.0437
-0.0494
-0.0554
-0.0618
-0.0687
-0.0761
-0.0845
-0.0940
-0.1078
-0.1236
-0.1467

Z/X
Quadrature

Scale 1:20000
250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database

Terrane Metals Corp./Geoscience BC
Mount Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
Z/X Component Quadrature Profiles
Over a 90 Hz Z/X Component Quadrature
Phase Rotated Grid

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

- Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
- Survey Operations Base: Mackenzie, British Columbia
- Nominal Survey Line Spacing: 250 m
- Nominal Survey Line Direction: Azimuth 90°N
- Helicopter Mean Terrain Clearance: 200 metres
- Mean Ground Air Speed: 27 metres/sec
- AFMAG airborne coil: towed 90 m below the helicopter
- Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

- Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

- GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
- GPS Receivers Location: One on the helicopter, three on EM coil
- Radar Altimeter: Terra TRA 3000/TRI 40
- Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

- Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
- Coil dimensions: 7.4 metres diameter
- Coil orientation: Vertical Dipole
- Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

- Magnetometer: GEOMETRICS
- Magnetometer Sensitivity: +/- 0.02 nT
- Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

- Magnetometer: GEOMETRICS
- Base Station Location: Mackenzie Airport

EM BASE STATION

- Two orthogonal square coils
- Coil dimensions: 3.5 metres each side
- Coil orientation: Horizontal Dipole
- Base Station Location: 55°13'32.6 N, 124°11'11.7 W
- Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

- Datum: WGS84 (10 m Mean Conus)
- Projection: Universal Transverse Mercator
- Central Meridian: 123°W (Zone 10N)
- Central Scale Factor: 0.9996
- False Easting/Northing: 500,000m/0m
- Major Axis: 6378206.4
- Eccentricity: 0.082271854.

PROCESSING SUMMARY

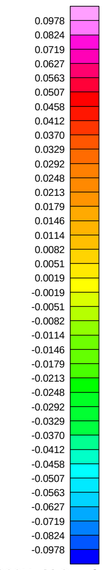
MAGNETICS

- Diurnal Subtraction, microlevelling

Z-TEM

- Frequencies extracted: 30, 45, 90, 180, 360 Hz.
- Sampling rate: 0.4 sec.
- Rotation of the inphase part of the inline and orthogonal components (Z/Xloc and Z/Yloc) on to UTM Eastings and Northings.

DIV(Tilt) calculated: dXcomp/dX+dYcomp/dY for all 5 frequencies.
Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.



360Hz Y Quadrature

Scale 1:20000

250 0 250 500 750 1000 1250 1500

(meters)

WGS 84 / UTM zone 10N

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Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
360 Hz Z/Y Component Quadrature
Phase Rotated Grid

Flown and processed by:
Geotech Ltd.
245 Industrial Parkway North
Aurora, Ontario,
Canada, L4G 4C4
www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
Survey Operations Base: Mackenzie, British Columbia
Nominal Survey Line Spacing: 250 m
Nominal Survey Line Direction: Azimuth 90°N
Helicopter Mean Terrain Clearance: 200 metres
Mean Ground Air Speed: 27 metres/sec
AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

GPS Receivers (4): NovAtel WAAS enabled OEM4-G2-3151W
GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
Azimuth : AzA = N 294° E AzB = N 24° E

MAP PROJECTION

Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
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Phase Rotated Grids (90 deg) calculated from each individual X and Y component grids, for each individual frequency.

Phase Profiles

L1100

In-Phase Frequencies
0.01 units per mm
Profile Base -0.1

30 Hz
45 Hz
90 Hz
180 Hz
360 Hz

0.1174
0.0989
0.0863
0.0752
0.0676
0.0609
0.0550
0.0494
0.0443
0.0395
0.0350
0.0298
0.0256
0.0215
0.0175
0.0137
0.0098
0.0061
0.0023
-0.0023
-0.0061
-0.0098
-0.0137
-0.0175
-0.0215
-0.0256
-0.0298
-0.0350
-0.0395
-0.0443
-0.0494
-0.0550
-0.0609
-0.0676
-0.0752
-0.0863
-0.0989
-0.1174

Z/Y In-Phase

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
Z/Y Component In-Phase Profiles
Over a 90 Hz Z/Y Component In-Phase
Phase Rotated Grid

Flown and processed by:
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245 Industrial Parkway North
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www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

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AFMAG airborne coil: towed 90 m below the helicopter
Airborne Magetometer bird: towed at 70 m below the helicopter

HELICOPTER SPECIFICATIONS

Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

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GPS Receivers Location: One on the helicopter, three on EM coil
Radar Altimeter: Terra TRA 3000/TRI 40
Navigation: GEONAV-3

AIRBORNE ELECTROMAGNETIC SYSTEM

Electromagnetic System: Geotech Z-Axis Tipper (Z-TEM)
Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

EM BASE STATION

Two orthogonal square coils
Coil dimensions: 3.5 metres each side
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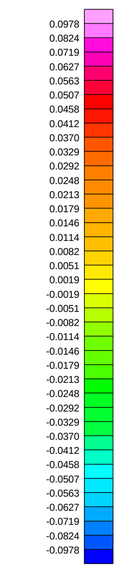
MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

Frequencies extracted: 30, 45, 90, 180, 360 Hz.
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360Hz Y Quadrature

Scale 1:20000

250 0 250 500 750 1000 1250 1500

(meters)

WGS 84 / UTM zone 10N

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Terrane Metals Corp./Geoscience BC
Mt. Milligan Test Block
Mackenzie, British Columbia

Geotech Z-TEM System
360 Hz Z/Y Component Quadrature
Phase Rotated Grid

Flown and processed by:
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www.geotech.ca

January 2009

Geotech project # 8242

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Type: Helicopter Z-Axis Tipper Electromagnetic (Z-TEM), Magnetic towed Bird
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Helicopter Type: Aerospatiale A-Star 350 B2

AIRBORNE INSTRUMENTATION

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Navigation: GEONAV-3

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Coil dimensions: 7.4 metres diameter
Coil orientation: Vertical Dipole
Digitizing rate: 2000Hz

AIRBORNE MAGNETOMETER

Magnetometer: GEOMETRICS
Magnetometer Sensitivity: +/- 0.02 nT
Sampling Rate: 0.2 Hz

GROUND INSTRUMENTATION

MAGNETIC BASE STATION

Magnetometer: GEOMETRICS
Base Station Location: Mackenzie Airport

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Two orthogonal square coils
Coil dimensions: 3.5 metres each side
Coil orientation: Horizontal Dipole
Base Station Location: 55°13'32.6 N, 124°11'11.7 W
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Datum: WGS84 (10 m Mean Conus)
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378206.4
Eccentricity: 0.082271854.

PROCESSING SUMMARY

MAGNETICS

Diurnal Subtraction, microlevelling

Z-TEM

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L1100

Quadrature Frequencies
0.01 units per mm
Profile Base -0.1

30 Hz
45 Hz
90 Hz
180 Hz
360 Hz

0.1174
0.0989
0.0863
0.0752
0.0676
0.0609
0.0550
0.0494
0.0443
0.0395
0.0350
0.0298
0.0256
0.0215
0.0175
0.0137
0.0098
0.0061
0.0023
-0.0023
-0.0061
-0.0098
-0.0137
-0.0175
-0.0215
-0.0256
-0.0298
-0.0350
-0.0395
-0.0443
-0.0494
-0.0550
-0.0609
-0.0676
-0.0752
-0.0863
-0.0989
-0.1174

Z/Y Quadrature

Scale 1:20000

250 0 250 500 750 1000 1250 1500
(meters)
WGS 84 / UTM zone 10N

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