# HELIBORNE HIGH RESOLUTION AEROMAGNETIC SURVEY

# QUEST-NORTHWEST PROJECT AREA, BC
## Geoscience BC Report 2013-03; Block 3

**For:**


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|---|---|


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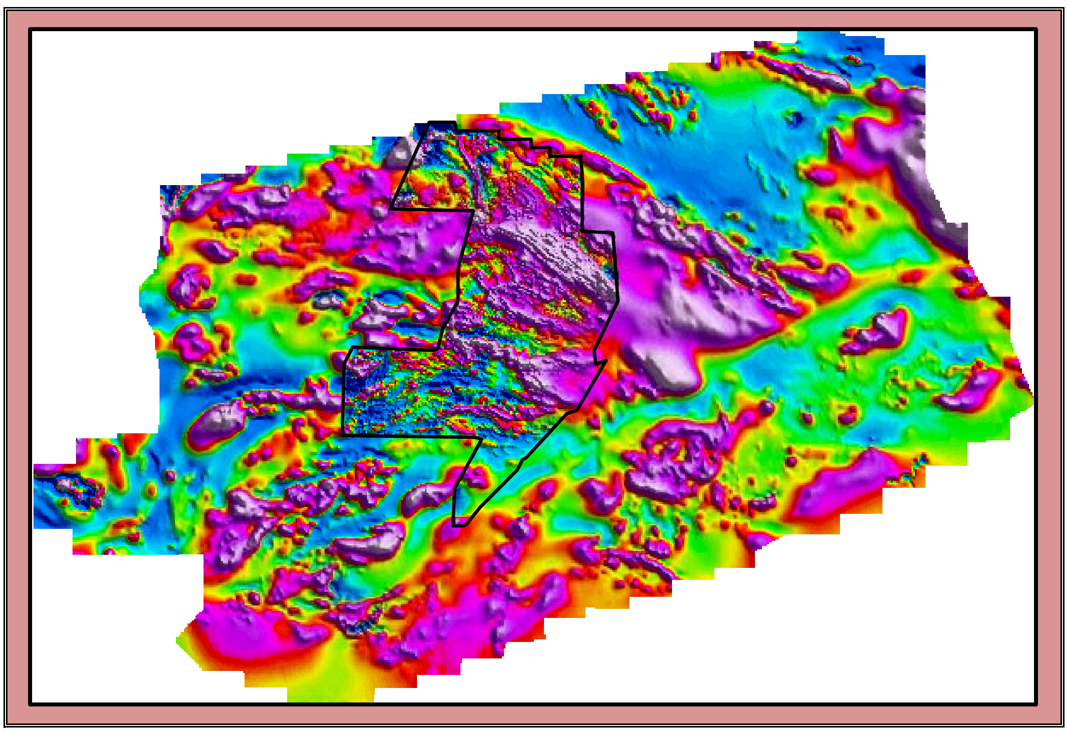
**Project Ref.: P12-026** **Final Technical Report**

**January 2013**



# GEOSCIENCE BC

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## QUEST-NORTHWEST PROJECT AREA, BC
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# FINAL TECHNICAL REPORT

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# 1.0 INTRODUCTION

On July 26th, 2012, **Geo Data Solutions GDS Inc** (**GDS**) was awarded project P12-026 by **Geoscience BC** (**GBC**). The project entailed **GDS** to carry out a high-resolution helicopter borne magnetic survey on a single block (**Quest-Northwest Block 3**) located at **Iskut**, British Columbia.

The base of operations was set up at **Iskut**, which is located in the Northeastern part of the survey area (see figure 1).

Table 1 presents survey specifications, table 2 presents block co-ordinates and figure 2 shows the theoretical flight path. Lengths of any traverse or tie-line were adjusted to a minimum of 3 km.

The **GDS**'s survey was executed from July 27th to August 6th, 2012. Excluding calibration and test flights, 18 production flights were needed to cover the requested areas. Total number of line-km flown was 5 746 line-km. This number includes **Block 3** and 7 Infill traverses oriented N30°E.

The Infill traverse (in red on figure 2) were flown over the previously **New Chris Minerals Ltd** survey flown by **SkyTEM** and **Aeroquest** in 2011 and 2012 (grey area on figure 2) in order to complete these surveys. The Infill Traverses were levelled and a new grid (using Gridbool, from Geosoft) was created with the **New Chris Minerals Ltd** data in December 2012 and January 2013.

Stable weather conditions were observed during the data acquisition period.

In terms of altitude, topography in the survey area is classed as rugged (figure 3), ranging from 700 metres to more than 2 100 metres. The **Block 3** was flown following a pre-defined flight surface having a rate of climb and descent of 20% and a nominal ground clearance of 80 metres. Altitude was ultimately controlled at the discretion of the helicopter pilot with safety held in priority consideration

The magnetometer sensor was mounted in a stinger fixed to the helicopter (figure 4).

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

| Table 1: Survey Specifications | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Block** | **Traverse Line** | | | **Tie Lines** | | | **Total Line-km** |
| | **Azimuth** | **Line-km** | **Spacing** | **Azimuth** | **Line-km** | **Spacing** | |
| **Block 3** | N90ºE | 5 120 | 250 m | N00ºE | 556 | 2 500 m | **5 676** |
| **Infill Traverses** | N30°E | 70 | | | | | **70** |
| | | | | | | **TOTAL** | **5 746** |

| Table 2: Survey area coordinates | | | | | |
|---|---|---|---|---|---|
| **Vertex** | **Longitude** | **Latitude** | **Vertex** | **Longitude** | **Latitude** |
| **1** | 129º 34' 05" W | 57º 44' 16" N | **7** | 130º 17' 25" W | 57º 44' 16" N |
| **2** | 129º 48' 14" W | 57º 39' 58" N | **8** | 130º 18' 47" W | 57º 39' 58" N |
| **3** | 130º 13' 16" W | 57º 34' 55" N | **9** | 130º 20' 07" W | 57º 34' 55" N |
| **4** | 130º 14' 15" W | 57º 34' 41" N | **10** | 130º 21' 08" W | 57º 34' 41" N |
| **5** | 130º 14' 54" W | 57º 34' 35" N | **11** | 130º 22' 24" W | 57º 34' 35" N |
| **6** | 130º 15' 25" W | 57º 34' 34" N | **12** | 130º 23' 01" W | 57º 34' 34" N |
| and many points along the eastern limits of Mt Edziza provincial park protected area | | | | | |
| **13** | -130º 25' 16" W | 57º 50' 36" N | **15** | 129º 46' 11" W | 57º 55' 57" N |
| **14** | -130º 24' 24" W | 57º 50' 42" N | | | |
| and many points along the North-West limits of another protected area | | | | | |

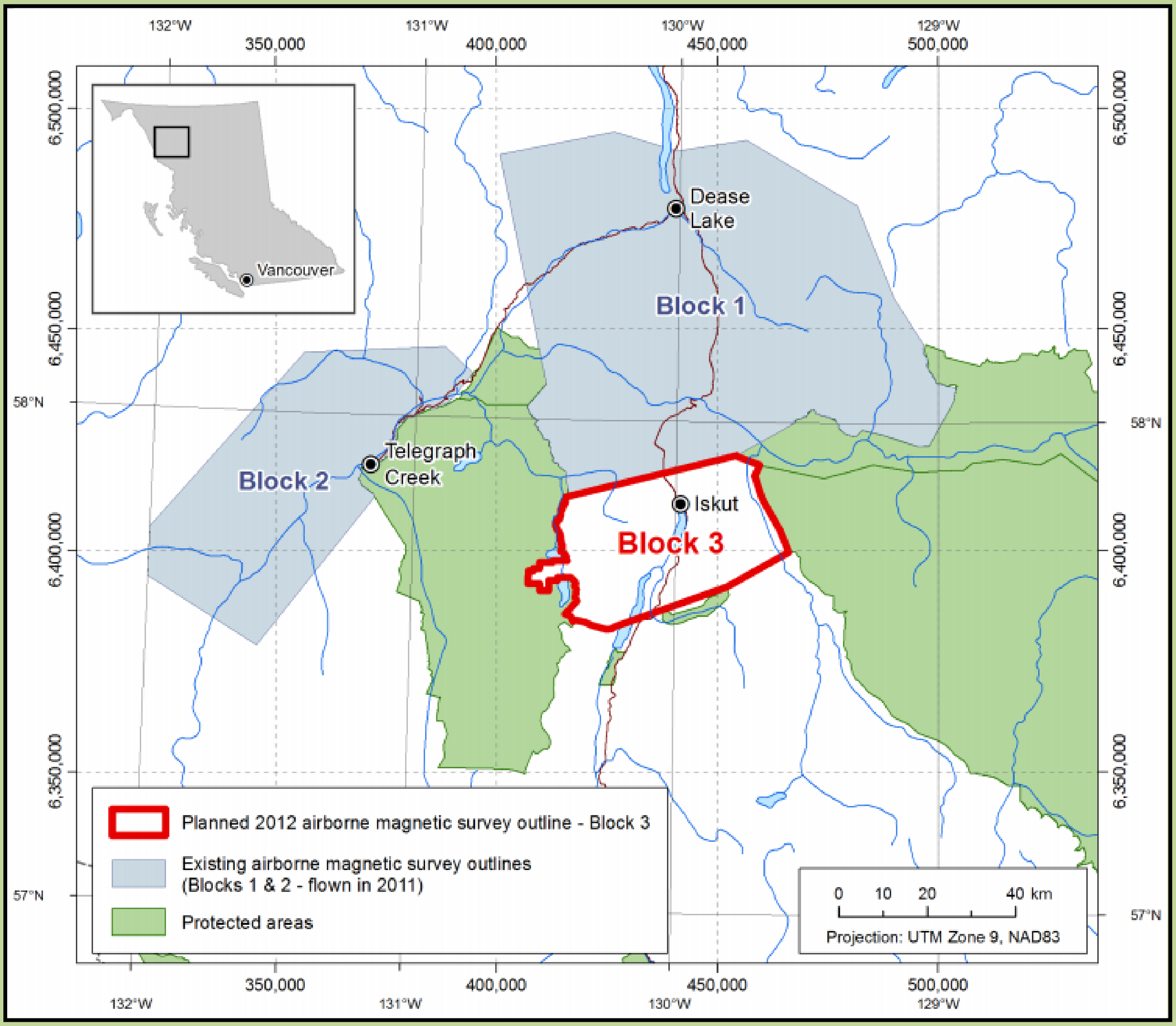


**Figure 1: Block 3 Location**

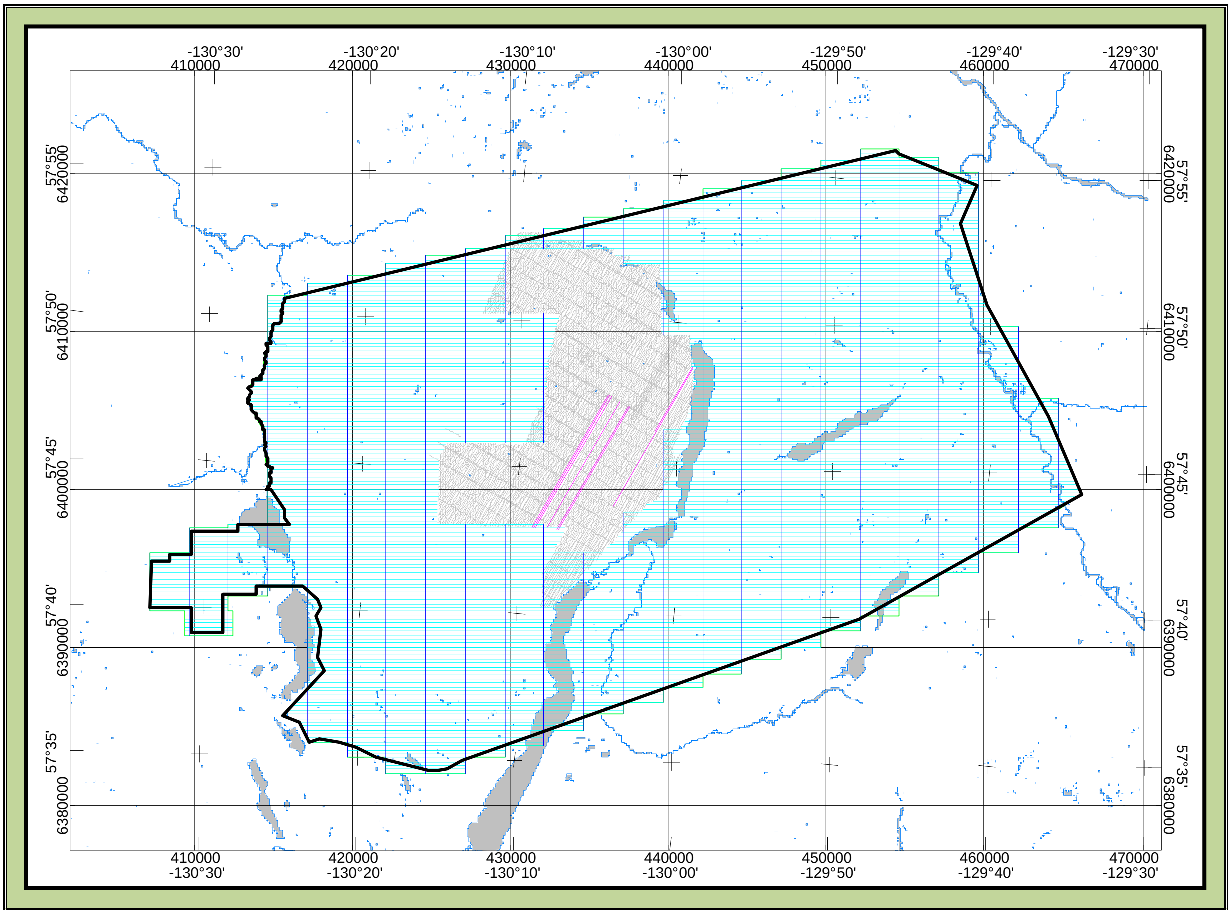


**Figure 2: Block 3 Theoretical Flight Path and Infill Traverses (in red)**

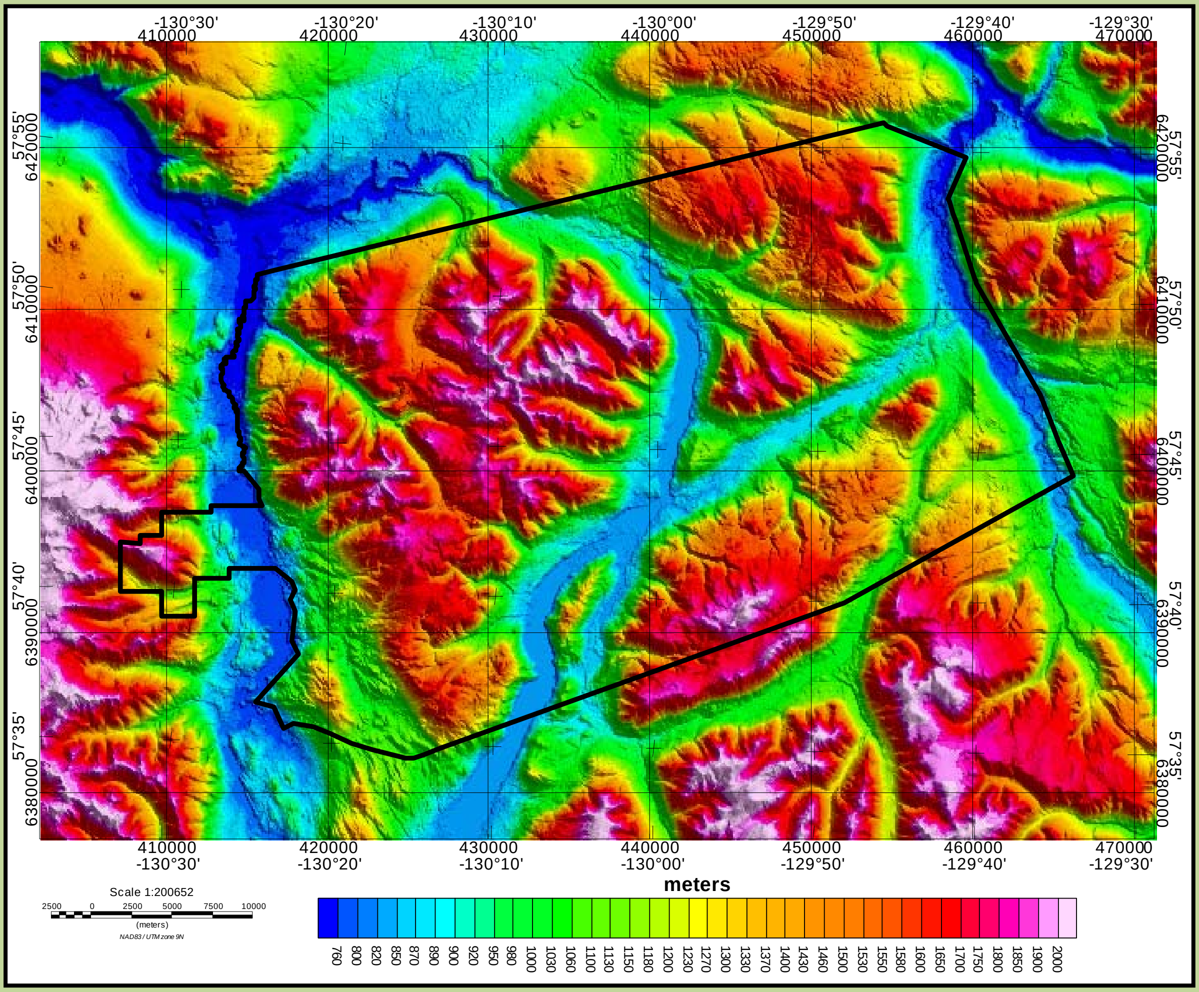


**Figure 3: Block 3 Topographic Relief**

## 2.0 SURVEY SPECIFICATIONS

Airborne survey and noise specifications were as follows:

a) Number of line-km flown, traverse spacing and direction
   - Table 1 presents the number of line-km flown and traverse/tie-line spacing and directions.

b) Nominal terrain clearances
   - A smooth drape surface was followed with a nominal ground clearance of 80 metres and a rate of climb of 20%. Figure 8 presents a histogram of the helicopter ground clearance.

c) Nominal Speed
   - The helicopter nominal speed was 125 km/hr. Under these conditions, the distance between samples along survey lines is typically 3.4 m. Figure 9 presents a histogram of the helicopter speed.

d) magnetic diurnal variation
   - A maximum tolerance of 10 nT (peak to peak) deviation from a long chord equivalent to a period of 5 minutes at the magnetometer base station was respected during all the survey period.

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

f) Re-flights and turns
   - line-spacing did not vary by more than 50 % from the nominal spacing over a distance of more than 1.5 km. The minimum length of any survey line was 3 km.
   - all reflights of line segments intersected at least two control lines.

# 3.0 HELICOPTER, EQUIPMENT AND PERSONNEL

## 3.1 Helicopter

Figure 4 presents the Astar 350 B2 helicopter technical specifications and capacity.

## 3.2 Equipment

**Magnetometer:**

A Geometrics Cesium split-beam total field magnetic sensor was installed at the end of a stinger fixed to the helicopter (figure 4). Its characteristics are: Sensitivity of 0.01 nT, Sampling rate of 10 Hz, Resolution better than 0.025 nT per measurement. The sensor tolerates gradients up to 10 000 nT/m, and operates in a range from 20 000 nT to 100 000 nT. The noise envelope did not exceed 0.5 nT over 500 metres line-length without a reflight.

**Magnetometer Base Station:**

A GEM GSM-19 Overhauser magnetometer base station (figure 5) was mounted in a magnetically quiet area at the base of operation. The base station measured the total intensity of the earth's magnetic field in units of 0.01 nT at intervals of 1 second, within a noise envelope of 0.10 nT.

The Magnetic Field mean value obtained at the base station was 56 933 nT. Co-ordinates of the base station were:    Lat.: 57.814185°N   Long.: 129.965825°W

| | |
|---|---|
| Type | Astar 350 B2 |
| Power | 641 shp |
| Powerplant | Turbomeca Arriel 1 B series turbine |
| Number of main rotor blades | 3 |
| Average cruising speed | 135 MPH |
| Maximum charge | Internal: 4630 lbs |
| | External: 4960 lbs |
| Aircraft empty eight | 2850 lbs |
| Maximum range | 410 miles |
| Fuel consumption | 170 l/hr |
| External sling load | 1650 lbs |
| FOM | lower than 2.5 nT |

**Figure 4: The Astar 350 B2 helicopter**

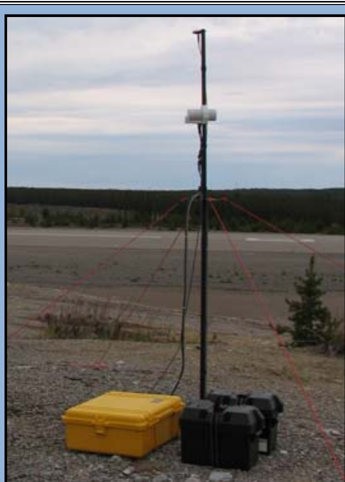


**Figure 5: Base station magnetometer and console**

**Magnetic Compensator and Data Acquisition System (figure 6):**

The magnetic field generated by the aircraft was compensated using a RMS DAARC500 Automatic Aeromagnetic Digital Compensator system. The DAARC500 is an instrument used to compensate or correct in real time for the magnetic interference caused by the aircraft itself and aircraft manoeuvring in the Earth's magnetic field, when using inboard-mounted high sensitivity magnetometers. The compensation accounts for the effects of permanent magnetism, induced magnetism, Eddy currents and also heading errors caused by the sensor themselves. It provides a frequency bandwidth of DC to 0.9 Hz, frequencies of most interest to the geophysicist. Other bandwidths are optionally available. Signals from magnetometers are digitized faithfully without aliasing or phase distortion.

The DAARC500 is based on many years of research and development on automatic aeromagnetic compensation by the National Aeronautical Establishment (NAE), a division of the National Research Council of Canada. Following the transfer of technology, RMS Instruments continued with the development resulting in an instrument which is extremely reliable, capable of accepting the Larmor frequencies of up to four high sensitivity magnetometers, and is based on a sophisticated compensation algorithm which is extremely robust.

The DAARC500 incorporate a sophisticated and flexible data acquisition system. Geophysical instruments and sensors may be directly connected to the DAARC500, via 8 Outputs and Inputs high speed RS232 digital ports, 16 analogic Inputs ports and an Ethernet port. Incoming data are real time processed. All acquired data are synchronized through a GPS receiver pulse-per-second (PPS).


**Figure 6: Magnetic compensator and Data Acquisition System**

**GPS and Navigation System:**

Table 3 describes the airborne GPS system, which provided both real-time navigation and flight-path recovery (figure 7).

Post-flight differential correction of the raw GPS data was done using the Natural Resources Canada online GPS processing service CRSR-PPP (Canadian Spatial Reference System - Precise Point Positioning).

| Table 3: The GPS Navigation System | |
|---|---|
| **Item** | **Specifications** |
| GPS Manufacturer | Novatel |
| Model | DL-V3 Dual-freq L1/L2 |
| Serial Number | NBV07400024 |
| Frequency | 1 hertz |
| Number of Channels | 12 |
| Sampling Interval | 2 Hz |
| Navigation System | AGNAV (LiNAV) |


**Figure 7: Novatel GPS receiver and AGNAV Linav navigation system**

**Radar Altimeter**

A frequency-modulated radio altimeter was used for measuring accurately distances between helicopter and ground. Table 4 presents its technical characteristics.

| Table 4: The Radio Altimeter Specifications | |
|---|---|
| **Item** | **Specifications** |
| Manufacturer | Free Flight |
| Model | TRA 3000 |
| Minimum range | 0 to 800 metres |
| Accuracy: | 5 % |
| Sensitivity: | 10 mV/m |
| Digital resolution: | 0.1 metre |

**Ancillary Equipment**

Ancillary equipment included Computer workstation, complement of spare parts and test instruments.

### 3.3 Personnel

The general management of the project was monitored offsite by Mr. Mouhamed Moussaoui, **GDS**'s President. Mr. Saleh Elmoussaoui was responsible for the field data quality control to ensure that the work was carried out according to contractual specifications. Final data evaluation and processing were performed at the Laval **GDS**'s office by Ms My Phuong Vo. Survey crew and office personnel are listed in table 5.

**Table 5: Field and Office Crew**

| Position | Name |
|---|---|
| Project Manager | Mr Mouhamed Moussaoui, Ing. |
| Data quality control | Mr Saleh Elmoussaoui |
| Field Operator | Mr Jamal Ez-Ziani |
| Pilot | Mr Ralph Greenaway |
| Final Processing | Ms My Phuong Vo |
| Survey Report | Mr Camille St-Hilaire, P.Geo |

## 4.0 SURVEY SCHEDULE

The survey was flown over a single block with flight line bearing selected to run perpendicular to the average trend of the local geological structures.

Survey steps were:

| | |
|---|---|
| Mobilization: | July 26$^{th}$, 2012 |
| Survey: | July 27$^{th}$ to August 6$^{th}$, 2012 |
| Demobilization: | August 7$^{th}$, 2012 |
| Number of Flights: | 18 |

Preliminary results were delivered to **GBC** on August 7$^{th}$ while final maps and data were sent early in September 2012.

## 5.0 DATA ACQUISITION

The following tests were performed before or after survey production.

**FOM Magnetometer Test:**

Effects of helicopter manoeuvres (roll, pitch and yaw) are determined by a FOM test (Figure of Merit). The test is performed over a magnetically quiet zone, at high altitude. It consists of flying ±10$^{o}$ rolls, ±5$^{o}$ pitches and ±5$^{o}$ yaws peak to peak along North, South, East and West headings over periods of 4-5 seconds. The compensation Figure of Merit (FOM) for the helicopter is calculated by summing up the peak-to-peak amplitudes of these 12 magnetic signatures. FOM test results are presented in appendix A.

**Quality Control**

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

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

Quality of GPS navigation was controlled by recovering the helicopter flight path.

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

# 6.0 DATA COMPILATION AND PROCESSING

## 6.1 Base maps

The base map of the survey area was plotted from topographic maps of the Department of Natural Resources Canada at a scale of 1:50 000.

**Projection description**

| | |
|---|---|
| Datum: | NAD83 |
| Projection: | UTM Zone 9N |
| False Easting: | 500 000 |
| False Northing: | 0 |
| Scale Factor: | 0.9996 |

## 6.2 Processing of Base Station data

Recorded magnetic diurnal data from the magnetometer base station were reformatted and loaded into the OASIS database. After initial verification of the integrity of the data from statistical analysis, the appropriate portion of the data was selected to correspond to the exact start and end time of the flight. Data were then checked and corrected for spikes using a fourth difference editing routine. Following this, interactive editing of the data was done, via a graphic editing tool, to remove events caused by man-made disturbances. A small low pass noise filter (30 seconds) was then applied. The average of the Total Field Magnetic Intensities measured at the Base Station was 56 933 nT.

## 6.3 Processing of the Positioning Data (GPS)

The raw GPS data were recovered and corrected from spikes. The resulting corrected latitudes and longitudes were then converted to the local map projection and datum (Nad83). A point-to-point speed calculation was then done from the final X, Y coordinates and reviewed as part of the quality control. The flight data were then cut back to the proper survey line limits and a preliminary plot of the flight path was done and compared to the planned flight path to verify the navigation. The positioning data were then exported to the other processing files.

## 6.4 Processing of the Altimeter data

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

## 6.5 Processing of Magnetic data

The airborne magnetic data were reformatted and loaded into the OASIS database. After initial data verification by statistical analysis, positions were adjusted for system lag. Data were then checked and corrected for any spikes using a fourth difference editing routine and inspected on the screen using a graphic profile display. Interactive editing was done at this stage.

The long wavelength component of the diurnal (section 6.2) was subtracted from the data as a pre-levelling step. Preliminary grids of the total field and first vertical derivative were created and verified for obvious problems, such as errors in positioning or bad diurnal. Appropriate corrections were then applied to data, as required.

An altitude correction was applied to the total field magnetic intensity by using the vertical gradient pre-filtered with a 2-sec. low-pass filter. This correction was done by downward or upward continuation of the field around the drape surface. Histogram of the ground clearance is shown on figure 8.

Then, the levelling consisted of calculating positions of the control points (intersections of traverses and tie lines), calculating elevation and magnetic differences at the control points and applying a series of levelling corrections to reduce misclosures to zero. New grids of the values were then created and checked for residual errors. Any gross errors detected were corrected in the profile database and the levelling process repeated (table 6).

A micro-levelling was finally applied in order to removes minor imperfections visible on shadow images (clipping ±5 nT, Butterworth filter cutoff = 500, degree = 8). This produced grids of exceptional aesthetic quality with no degradation of the high frequency content of the data.

The International Geo-Reference Field (IGRF) was removed from the Total Magnetic Field Intensity. Model used was 2010, survey date August 1$^{st}$, 2012, elevation 1 468 metres.

A Geosoft database was created with channels described in appendix B (Standard Processing Database).

| Table 6: Magnetic Levelling Steps | | | |
|---|---|---|---|
| **Pass** | **Filter** | **Control** | **Traverse** |
| **1** | Trend(0) | x | x |
| **2** | Trend(0) | x | x |
| **3** | Trend(0) | x | x |
| **4** | Trend(1) | x | x |
| **5** | Trend(1) | x | x |
| **6** | Butterworth(25000,6) | x | |
| **7** | Butterworth(5000,8) | | x |
| **8** | Butterworth(10000,6) | x | |
| **9** | Butterworth(2500,8) | | x |
| **10** | Butterworth(2500,6) | x | |
| **11** | Butterworth(1000,8) | | x |
| **12** | Butterworth(500,6) | x | |

## 6.6 Levelling/Merging of the 7 Infill Lines with the Aeroquest Survey

Difficulties:

1) The 7 Infill lines were flown with a drape of 20% and a minimum ground clearance of 80 metres while the **Aeroquest** survey was flown following the topographic relief and closer to the ground surface.
2) An altitude correction was firstly applied on the **Aeroquest**'s Tie-Lines (because they were not flown at the same level of the **Aeroquest**'s traverses). The Tie-Lines were then levelled with the Aeroquest's traverses and finally used in the levelling of the 7 Infill Lines.

The levelling and merging process included the following steps:

- Removing of the International Geo-Reference Field (IGRF) from the **Aeroquest**'s data (model used was 2010, date September 17th 2011, Z=1 424.8 metres).
- Altitude correction of the **Aeroquest**'s Tie-Lines.
- Levelling of the **Aeroquest**'s Tie-Lines by using the **Aeroquest**'s traverses.
- Removing of the IGRF from the 7 Infill Lines (model used was 2010, date August 5th 2012, elevation 1 634 metres).
- Altitude correction of the 7 Infill Line.
- Tie-Line Levelling of the 7 Infill Lines with the **Aeroquest**'s Tie-Lines.
- Micro-levelling.
- Re-calculation of the altitude correction using the vertical gradient.
- Re-Tie-Line levelling of the 7 Infill Lines with the **Aeroquest**'s data.
- Reset of the original values of all the **Aeroquest**'s data (only the 7 Infill lines have been modified)

For the need of the final map, Gridbool was used with the **GDS** Block 3 grid and **New Chris Minerals** grid with priority to the **New Chris Minerals** data over the overlapping areas. This final grid has been delivered to **GBC** but on the final maps, both grids and contours were independently superimposed.

## 6.7 Residual Total Magnetic field and First Vertical Derivative Grids

The residual total magnetic field grids were calculated from the final reprocessed profiles by a minimum curvature algorithm. The accuracy standard for gridding was that the grid values fit the profile data to within 0.0001 nT for 99.99999% of the profile data points. Grids have a grid cell size of 62.5 metres.

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

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

# 7.0 FINAL PRODUCTS

The following parameters were processed:

- Residual Total Magnetic Field data
- Calculated First Vertical Derivative of the Residual Total Magnetic Field data
- Digital Elevation Model data

## 7.1 Grids:

- Block 03 grid (cell: 62.5 m)
- SkyTEM/Aeroquest/GDS infill grid (cell: 25 m) named "New Chris"
- SkyTEM/Aeroquest/Infill Lines/GDS Block 3 (cell: 25 m)

## 7.2 Maps:

**GDS** made the base map from information present on published topographic maps. Each map was produce at a scale of 1:50 000 displaying base-map features, flight path and UTM co-ordinates. Three paper copies of the following final maps were delivered to **GBC**:

- Shaded Residual Total Magnetic Field (contour and colour interval)
- Shaded Magnetic First Vertical Derivative (colour interval)

All final map products were also delivered in PDF and Geotiff formats at resolution suitable to accurately reproduce plotted products.

## 7.3 Final digital archive of line data:

**GDS** produced three copies of a CD-ROM containing digital archives and maps (PDF and Geotiff formats). Digital archives, described in Appendix B, contain the Geosoft database of all survey data. The database is referenced to the standard UTM co-ordinates for the area.

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

## 7.4 Miscellaneous

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

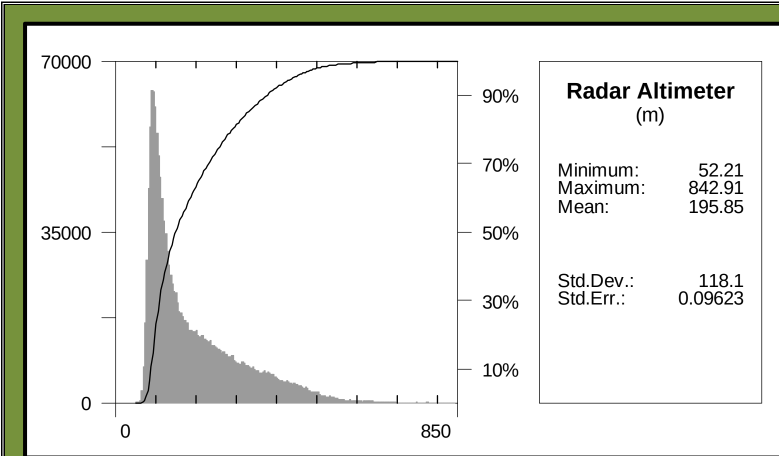


**Figure 8: Histogram of the Helicopter Ground Clearance**

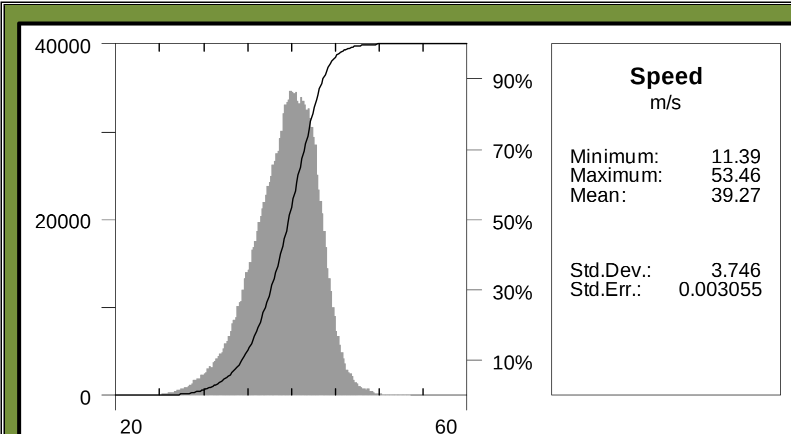


**Figure 9: Histogram of the Helicopter Speed**

## 8.0 CONCLUSIONS

Flown from July 27th to August 6th, 2012, by **Geo Data Solutions GDS Inc**. over the Block 3 and 7 Infill Lines, the helicopter borne aeromagnetic survey was completed inside the estimated time frame.

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

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

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

In January 2013, the **GDS**'s seven Infill Lines were levelled and merged to the **New Chris Minerals Ltd** data flown by SkyTEM and Aeroquest in 2011 and 2012.

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

Respectfully Submitted,


Camille St-Hilaire, M.Sc.A.
P.Geo. 339

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# APPENDIX A

# TESTING AND CALIBRATION

# GEODATA SOLUTIONS GDS INC.
# FOM TEST

| | | | |
|---|---|---|---|
| Configuration: | Front Stinger | Date: | July 26th, 2012 |
| Altitude: | 3 000 m | Helicopter: | Astar B2 |
| Pilot : | Ralph Greenaway | Location : | Iskut, BC |

| **North (360º)** | **Uncompensated mag (nT)** | **Compensated mag (nT)** | **Improv. Ratio** |
|---|---|---|---|
| PITCH | 5,914 | 0,232 | 25,49137931 |
| ROLL | 23,522 | 0,13 | 180,9384615 |
| YAW | 7,953 | 0,119 | 66,83193277 |
| TOTAL | 37,389 | 0,481 | 77,73180873 |
| | | | |
| **East (90º)** | **Uncompensated mag (nT)** | **Compensated mag (nT)** | **Improv. Ratio** |
| PITCH | 4,856 | 0,411 | 11,81508516 |
| ROLL | 22,704 | 0,134 | 169,4328358 |
| YAW | 3,903 | 0,199 | 19,61306533 |
| TOTAL | 31,463 | 0,744 | 42,28897849 |
| | | | |
| **South (180º)** | **Uncompensated mag (nT)** | **Compensated mag (nT)** | **Improv. Ratio** |
| PITCH | 5,783 | 0,186 | 31,09139785 |
| ROLL | 25,857 | 0,172 | 150,3313953 |
| YAW | 8,356 | 0,099 | 84,4040404 |
| TOTAL | 39,996 | 0,457 | 87,51859956 |
| | | | |
| **West (270º)** | **Uncompensated mag (nT)** | **Compensated mag (nT)** | **Improv. Ratio** |
| PITCH | 5,239 | 0,233 | 22,48497854 |
| ROLL | 27,559 | 0,167 | 165,0239521 |
| YAW | 7,401 | 0,17 | 43,53529412 |
| TOTAL | 40,199 | 0,57 | 70,5245614 |
| **RESULTS** | **Uncomp. mag (nT)** | **Comp. Mag (nT)** | **Improv. Ratio** |
| | **149,047** | **2,252** | **66,18428** |

# APPENDIX B

# PROFILE DATABASE ARCHIVE AND CHANNEL/FILE DESCRIPTION

# Block 3 Magnetic Line archive channel description

**(Quest3_GBC.gdb)**

| Channel | Description | Sampling | Unit |
|---|---|---|---|
| date | Flight date | 10Hz | yyyy/mm/dd |
| flt | Flight number | 10Hz | |
| line | Line number | 10Hz | |
| UTC | UTC time in second after midnight | 10Hz | second |
| xrt | Raw real time easting UTM, NAD83, Zone 9N | 10Hz | meters |
| yrt | Raw real time northing UTM, NAD83, Zone 9N | 10Hz | meters |
| zrt | Raw real time GPS elevation (MSL) | 10Hz | meters |
| lon | Post-processed longitude, NAD83 | 10Hz | dd.mm.ss.s |
| lat | Post-processed latitude, NAD83 | 10Hz | dd.mm.ss.s |
| x | Post-processed easting UTM, NAD83, Zone 9N | 10Hz | meters |
| y | Post-processed northing UTM, NAD83, Zone 9N | 10Hz | meters |
| z | Post-processed GPS elevation – orthometric MSL | 10Hz | meters |
| raltlc | Corrected radar altimeter | 10Hz | meters |
| drape | Drape surface used for height navigation | 10Hz | meters |
| DTMc | Digital Terrain Model (levelled) | 10Hz | meters |
| baseao | Base A diurnal data original (main base mag) | 10Hz | nanoteslas |
| basea | Filtered main base mag | 10Hz | nanoteslas |
| mfluxX | Fluxgate X component | 10Hz | nanoteslas |
| mfluxY | Fluxgate Y component | 10Hz | nanoteslas |
| mfluxZ | Fluxgate Z component | 10Hz | nanoteslas |
| MBu | Raw uncompensated mag | 10Hz | nanoteslas |
| MBul | Lagged uncompensated mag | 10Hz | nanoteslas |
| MBc | Raw compensated mag | 10Hz | nanoteslas |
| MBclc | Compensated mag (lagged and de-spiked) | 10Hz | nanoteslas |
| drift_LF | Low-frequency diurnal correction | 10Hz | nanoteslas |
| magbc | Magnetic field, diurnally corrected | 10Hz | nanoteslas |
| coralt | Altitude correction | 10Hz | nanoteslas |
| magalt | Magnetic field, corrected by altitude | 10Hz | nanoteslas |
| corlvl | Cumulative tie line mag levelling adjustment | 10Hz | nanoteslas |
| maglvl | Levelled mag | 10Hz | nanoteslas |
| cormicro | Microleveling correction | 10Hz | nanoteslas |
| magmicro | Microleveled mag (TMI) | 10Hz | nanoteslas |
| igrf | International geo-referenced field (model 2010; 2012/08/01) | 10Hz | nanoteslas |
| magres | Mag IGRF removed (residual) | 10Hz | nanoteslas |

# New Chris Minerals Magnetic Line archive channel description

**(Merged_NewChris.gdb)**

| Channel | Description | Sampling | Unit |
|---|---|---|---|
| **Common to all datasets** | | | |
| Line | Line number | 10Hz | |
| Flight | Flight number | 10Hz | |
| Date | Flight date | 10Hz | yyyy/mm/dd |
| DTM | Digital Terrain Model | 10Hz | meters |
| Lon | Post-processed longitude, NAD83 | 10Hz | dd.mm.ss.s |
| Lat | Post-processed latitude, NAD83 | 10Hz | dd.mm.ss.s |
| X | Post-processed easting UTM, NAD83, Zone 9N | 10Hz | meters |
| Y | Post-processed northing UTM, NAD83, Zone 9N | 10Hz | meters |
| Z | Post-processed GPS elevation – orthometric MSL | 10Hz | meters |
| Magres | Residual mag field, IGRF removed, final levelled magnetic data | 10Hz | nanoteslas |
| **SkyTEM (Line ranges: L100101-113360, L200101-202001)** | | | |
| Fid | Unique Fiducial number | | |
| DateTime | Number of days since 1900-01-01 and seconds of the day | 10Hz | ddddd.sssss |
| Time | Time | 10Hz | hhmmss.sss |
| AngleX | Angle in flight direction | 10Hz | degrees |
| AngleY | Angle perpendicular to flight direction | 10Hz | degrees |
| GdSpeed | Ground speed | 10Hz | km/t |
| Height | Filtered height measurement | 10Hz | meters |
| Alt | DGPS altitude | 10Hz | meters |
| IGRF | Calculated IGRF – Model 2010 | 10Hz | nanoTeslas |
| dec | Calculated IGRF – magnetic declination model 2010 | 10Hz | degrees |
| inc | Calculated IGRF – magnetic inclination model 2010 | 10Hz | degrees |
| Bmag_raw | Magnetic base station data | 10Hz | nanoTeslas |
| Diurnal | Magnetic base data GRF corrected | 10Hz | nanoTeslas |
| Mag_raw | Raw edited magnetic data | 10Hz | nanoTeslas |
| Mag_fil | Filtered magnetic data | 10Hz | nanoTeslas |
| Mag_Corr | Heading and lag corrected magnetic data, IGRF removed | 10Hz | nanoTeslas |
| RMF | Residual mag field, IGRF removed, final levelled magnetic data | 10Hz | nanoTeslas |
| TMI | Total magnetic intensity, final levelled magnetic data<br>- IGRF: June 1, 2012 and mean sea level = 1620 m | 10Hz | nanoTeslas |
| **AeroQuest (Line ranges: L10970, 21390, T19020-19220)** | | | |
| emfid | AeroDAS Fiducial number | 10Hz | |
| UTCtime | UTC time | 10Hz | hh:mm:ss.s |
| Galt | GPS altitude of Mag bird | 10Hz | meters |
| Ralt | Radar altimeter | 10Hz | meters |
| Basemag | Base station total magnetic intensity | 10Hz | nanoTeslas |
| IGRF_g | International geo-referenced field model 2010<br>- Sept 17, 2011 at 1424.8m | 10Hz | nanoteslas |
| Mag | Final levelled total magnetic intensity | 10Hz | nanoteslas |

**GDS (Line range: L30010 - L30390)**

| | | | |
|---|---|---|---|
| Fid | Fiducial number | | |
| UTC | UTC time in second after midnight | 10Hz | second |
| xrt | Raw real time easting UTM, NAD83, Zone 9N | 10Hz | meters |
| yrt | Raw real time northing UTM, NAD83, Zone 9N | 10Hz | meters |
| zrt | Raw real time GPS elevation (MSL) | 10Hz | meters |
| z_adjusted | Simulated Z for altitude correction | 10Hz | meters |
| Ralt | Corrected radar altimeter | 10Hz | meters |
| drape | Drape surface used for height navigation | 10Hz | meters |
| baseao | Base A diurnal data original (main base mag) | 10Hz | nanoteslas |
| basea | Filtered main base mag | 10Hz | nanoteslas |
| mfluxX | Fluxgate X component | 10Hz | nanoteslas |
| mfluxY | Fluxgate Y component | 10Hz | nanoteslas |
| mfluxZ | Fluxgate Z component | 10Hz | nanoteslas |
| MBu | Raw uncompensated mag | 10Hz | nanoteslas |
| MBul | Lagged uncompensated mag | 10Hz | nanoteslas |
| MBc | Raw compensated mag | 10Hz | nanoteslas |
| MBclc | Compensated mag (lagged and de-spiked) | 10Hz | nanoteslas |
| drift_LF | Low-frequency diurnal correction | 10Hz | nanoteslas |
| magbc | Magnetic field, diurnally corrected | 10Hz | nanoteslas |
| IGRF_g | International geo-referenced field model 2010 - August 5, 2012 at 1634 m | 10Hz | nanoteslas |
| Mag_Cor | Unlevelled magnetic field with IGRF removed | 10Hz | nanoteslas |
| coralt | Altitude correction | 10Hz | nanoteslas |
| magalt | Magnetic field, corrected by altitude | 10Hz | nanoteslas |
| corlvl | Cumulative tie line mag levelling adjustment | 10Hz | nanoteslas |

# File list and descriptions

(Database and grids are in Geosoft format and in NAD83 UTM zone 9)

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| | |
|---|---|
| GDS_GeoscienceBC_QNW3.pdf | Technical report |
| Files list description.pdf | This file |

**\Database**

| | |
|---|---|
| Quest3_GBC.gdb | Geoscience BC QNW Block 3 Magnetic database |
| Merged_NewChris.gdb | Merged New Chris surveys Magnetic database |
| Channels list description.pdf | Databases field description |

**\Grids\GBCBlock3**

| | |
|---|---|
| Magres_GBCblock3.grd | QNW Blk 3 Residual Total Magnetic Field grid (62.5m) |
| FVDmagres_GBCblock3.grd | QNW Blk 3 First vertical derivative of the magnetic field grid (62.5m) |
| DTMc_GBCblock3.grd | QNW Blk 3 Digital Terrain Model grid (62.5m) |

**\Grids\NewChris**

| | |
|---|---|
| Magres_NewChris.grd | New Chris Residual Total Magnetic Field grid (25m) |
| FVDmagres_NewChris.grd | New Chris First vertical derivative of the magnetic field grid (25m) |

**\Grids\Merged**

| | |
|---|---|
| Magres_Merged.grd | QNW Blk 3 and New Chris merged Residual Total Magnetic Field grid (25m) |
| FVDMagres_Merged.grd | QNW Blk 3 and New Chris merged First vertical derivative of the magnetic field grid (25m) |

**\Maps**

| | |
|---|---|
| GBC-2013-03-01 MAG.pdf | 1:50000 Residual Total Magnetic Field map (PDF) |
| GBC-2013-03-01 MAG.tif | 1:50000 Residual Total magnetic Field map (GeoTiff, 300 dpi) |
| GBC-2013-03-02 FVD.pdf | 1:50000 First Vertical Derivative map of the Magnetic Field (PDF) |
| GBC-2013-03-02 FVD.tif | 1:50000 First Vertical Derivative map of the Magnetic Field (GeoTiff, 300 dpi) |