ONTARIO GEOLOGICAL SURVEY

Geophysical Data Set 1083

Ontario Airborne Geophysical Surveys
Aeromagnetic Gradiometer and Gamma-Ray Spectrometric Data
Separation Lake Area

by

Ontario Geological Survey

2017

Ontario Geological Survey
Ministry of Northern Development and Mines
Willet Green Miller Centre, 933 Ramsey Lake Road,
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CREDITS

List of accountabilities and responsibilities.

- Jack Parker, Senior Manager, Earth Resources and Geoscience Mapping Section, Ontario Geological Survey (OGS), Ministry of Northern Development and Mines (MNDM)—accountable for the geophysical survey projects, including contract management
- Edna Mueller–Markham, Senior Consulting Geophysicist, Paterson, Grant and Watson Limited (PGW), Toronto, Ontario, Geophysicist under contract to MNDM—responsible for the airborne geophysical survey project management, quality assurance (QA) and quality control (QC)
- Tom Watkins, Manager, Publication Services Unit, GeoServices Section, Ontario Geological Survey, MNDM—managed the project-related hard-copy products
- Desmond Rainsford, Geophysicist, Earth Resources and Geoscience Mapping Section, Ontario Geological Survey—responsible for final quality assurance (QA), quality control (QC) of published digital products
- Goldak Airborne Surveys, Saskatoon, Saskatchewan – data acquisition and data compilation

DISCLAIMER

CITATION

Parts of this publication may be quoted if credit is given. It is recommended that reference to this publication be made in the following form:

Ontario Geological Survey 2017. Survey report on Separation Lake area, 88p. [PDF document]; *in* Ontario airborne geophysical surveys, magnetic gradiometer and gamma-ray spectrometric data, grid and profile data (ASCII format) and vector data, Separation Lake area, Ontario Geological Survey, Geophysical Data Set 1083a.

Ontario Geological Survey 2017. Survey report on Separation Lake area, 88p. [PDF document]; *in* Ontario airborne geophysical surveys, magnetic gradiometer and gamma-ray spectrometric data, grid and profile data (Geosoft® formats) and vector data, Separation Lake area, Ontario Geological Survey, Geophysical Data Set 1083b.

NOTE

Users of OGS products are encouraged to contact those Aboriginal communities whose traditional territories may be located in the mineral exploration area to discuss their project.

1. Introduction

The airborne survey contract was awarded through a Request for Proposal and Contractor Selection process. The system and contractor selected for the survey area were judged on many criteria, including the following:

- applicability of the proposed system to the local geology and potential deposit types
- aircraft capabilities and safety plan
- experience with similar surveys
- QA/QC plan
- capacity to acquire the data and prepare final products in the allotted time
- price-performance

2. Survey Location and Specifications

2.1. SURVEY GENERAL GEOLOGY AND LOCATION

The Separation Lake survey covers a large area of Archean rocks belonging to the Superior Province. The bedrock geology within the survey area, is characterized by 3 subprovinces oriented east-west. From north to south the subprovinces are the Uchi, English River and Winnipeg River. The bedrock geology for the area is shown in Figure 1. The regional geology is described in detail by Stott and Corfu (1991), Breaks (1991) and Beakhouse (1991).

The geology of the northern part of the area comprises the southern portion of the Red Lake greenstone belt and a large extent of granitoid rocks, both belonging to the Uchi subprovince. A sliver of volcanic rocks, located near the western edge of the survey, makes up part of the Bee Lake greenstone belt. Numerous gold occurrences are known in both greenstone belts, most notably in the Red Lake greenstone belt which hosts a number of producing and past-producing gold mines.

The English River Subprovince occupies the central part of the survey area and is separated from the Uchi Subprovince by the Sydney Lake–Lake St. Joseph fault system. The English River Subprovince is dominated by metasedimentary rocks which are intruded by the granitoids of granitic, granodioritic and tonalitic composition. Few volcanic rocks are found in the English River. A number of copper and nickel occurrences have been identified in the Werner Lake area, near the Manitoba border. The most significant is the Gordon Lake nickel, copper, palladium mine which operated briefly in the 1960s. The southern part of the survey area is underlain primarily by granitoids of granitic, granodioritic, dioritic, monzonitic and tonalitic composition. Supracrustal rocks are not abundant and are mostly within gneissic suite geology.

2.2. SURVEY SPECIFICATIONS

The Separation Lake survey area specifications and tolerances are as follows.

1. Line spacing and direction for the magnetic gradiometer survey
    - the nominal flight-line spacing is 200 m.
    - flight-line direction 0°.
    - maximum deviation from the nominal flight-line location could not exceed 50 m over a distance greater than 2000 m.
    - minimum separation between two adjacent lines could be no smaller than 150 m or larger than 250 m.
    - for each survey flight, adjacent lines must be flown separately and in opposite directions. A racetrack-flying pattern is not permitted.

2. Control-line spacing and direction
   - the nominal control line spacing is 2000 m, perpendicular to the traverse line direction.
   - control-line direction 90°.
   - along each survey boundary (if not parallel with the flight-line direction).
   - maximum deviation from the nominal control line location could not exceed 50 m over a distance greater than 2000 m.

3. Terrain clearance of the magnetometers
   - nominal terrain clearance is 100 m and will be consistent with safety of aircraft and crew.
   - altitude tolerance limited to ±15 m, except in areas of severe topography.
   - altitude tolerance limited to ±10 m at flight-line–control-line intersections except in areas of severe topography.

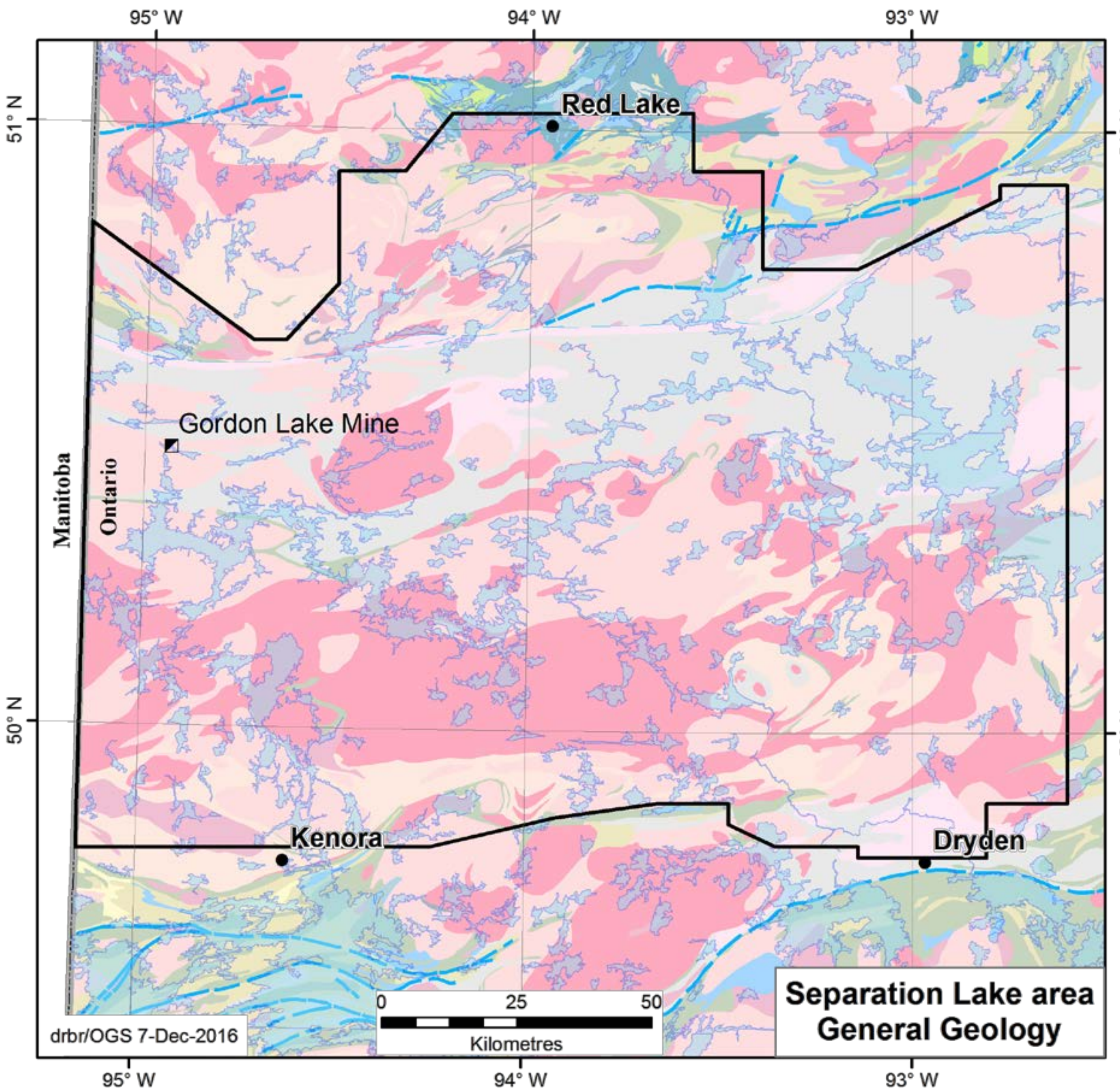

Figure 1. A map showing the bedrock geology and location of the Separation Lake survey area (outlined in black) (*from* Ontario Geological Survey 2011).

4. Terrain clearance of the magnetometers
    - nominal terrain clearance is 100 m and will be consistent with safety of aircraft and crew.
    - altitude tolerance limited to ±15 m, except in areas of severe topography.
    - altitude tolerance limited to ±10 m at flight-line–control-line intersections except in areas of severe topography.

5. Aircraft speed
    - nominal aircraft speed is 65 to 85 m/sec.
    - aircraft speed tolerance limited to ±10.0 m/sec, except in areas of severe topography.

6. Magnetic diurnal variation
    - could not exceed a maximum deviation of 3.0 nT peak-to-peak over a long chord equivalent to 1 minute.

7. Magnetometer noise envelope
    - in-flight noise envelope, calculated using a non-normalized 4th difference, shall not exceed 0.1 nT, for straight and level flight.
    - heading error not to exceed 2.0 nT.
    - base station noise envelope, calculated using a non-normalized 4th difference, shall not exceed 0.1 nT.

8. Reflights and turns
    - all reflights of flight-line segments intersected at least 2 control lines.
    - all turns at the end of flight lines or control lines took place beyond the survey or block boundaries.

3. Aircraft, Equipment and Personnel

3.1. AIRCRAFT

C-GJBB:

Type:	Piper® Navajo® PA-31
Owner / Operator:	Goldak Airborne Surveys
Mean Survey Speed:	75 m/s
Gradiometer Separation:	14.8 m lateral/8.8 m longitudinal

C-GJBG:

Type:	Piper® Navajo® PA-31
Owner / Operator:	Goldak Airborne Surveys
Mean Survey Speed:	75 m/s
Gradiometer Separation:	14.8 m lateral/8.8 m longitudinal

C-GLDX:

Type:	Cessna® Caravan® 208
Owner / Operator:	Goldak Airborne Surveys
Mean Survey Speed:	75 m/s
Gradiometer Separation:	18.3 m lateral/11.2 m longitudinal

3.2. AIRBORNE EQUIPMENT

Aircraft Magnetometers:

Manufacturer:	Geometrics®
Type and Model Number:	Cesium G-822A
Range:	20 000 to 90 000 nT
Sensitivity:	0.005 nT
Sampling Rate:	10 Hz

Real-time Magnetic Compensator (C-GJBB and C-GJBG):

Manufacturer:	RMS Instruments Limited
Type and Model Number:	AADCII
Range:	20 000 to 100 000 nT
Resolution:	0.001 nT
Sampling Rate:	10 Hz

Real-time Magnetic Compensator (C-GLDX):

Manufacturer:	RMS Instruments Limited
Type and Model Number:	DAARC500
Range:	20 000 to 100 000 nT
Resolution:	0.001 nT
Sampling Rate:	10 Hz

Digital Acquisition System:

Manufacturer:	Goldak Exploration Technology
Type and Model Number:	GEDAS
Sampling Rate:	10 Hz
Data Format:	GEDAS binary

Radiometric System:

Manufacturer:	Radiation Solutions Inc.
Type and Model Number:	RS-500 Digital Gamma Array Spectrometer
Detector Volume:	33.6 L downward, 8.4 L upward
Channels:	1024
Sample rate:	1 Hz

Positioning Cameras:

Manufacturer:	Panasonic
Model:	GPKR402 HRSV
Lens:	WV-LR4R5 4.5 mm
FOV:	1040 by 1300 feet at 1000 feet AGL

Barometric Altimeter:

Manufacturer:	Setra Systems, Inc.
Type and Model Number:	270
Range:	–1000 to 10 000 feet
Resolution:	1 m
Sampling Rate:	10 Hz

Primary Radar Altimeter:

Manufacturer:	Thompson
Type and Model Number:	CFS 530A
Range:	0 to 8000 feet

Resolution:	1 m
Accuracy:	2%
Sampling Rate:	10 Hz

Secondary Radar Altimeter:

Manufacturer:	Terra
Type and Model Number:	TRA3000 – TRI40
Range:	40 to 2500 feet
Resolution:	3 m
Accuracy:	5 to 7%
Sampling Rate:	10 Hz

Navigation System:

Manufacturer:	Goldak Exploration Technology Ltd.
Type and Model Number:	GEDAS
Displays:	10″ colour LCD graphical display Graphic LCD pilot indicator

GPS Positioning System:

Manufacturer:	NovAtel® Inc.
Type and Model Number:	OEM4 dual-frequency ProPak™
System Resolution:	1 m
Overall accuracy:	3 m in real-time; <1 m post-corrected

Attitude Detection System (C-GJBB & C-GJBG):

Manufacturer:	NovAtel® Inc.
Type and Model Number:	OEM4 dual-frequency ProPak™ (×3)
Overall accuracy:	<1° +/- 0.2°

Inertial Navigation System (C-GLDX):

Manufacturer:	NovAtel® Inc.
Type and Model Number:	SPAN-CPT
Overall accuracy:	0.1°

3.3. BASE STATION EQUIPMENT

Base Station Magnetometers:

Manufacturer:	GEM Systems, Inc.
Type and Model Number:	Overhauser GSM-19W
Range:	20 000 to 120 000 nT
Sensitivity:	0.01 nT
Sampling Rate:	1 Hz

GPS Receiver:

Manufacturer:	NovAtel® Inc.
Type and Model Number:	OEM4 dual-frequency ProPak™
System Resolution:	1 m
Overall accuracy:	3 m in real-time; <1 m post-corrected

3.4. PERSONNEL

Pilots:
Jay Mathieson
Cam Petrie
Rob Bartlett

Co-Pilots / Instrument Operators:
Mike Heit
Josh Patterson
Sean McSweeny

Field Data Processors:
Bill Heath
Abbas Shaikh

Aircraft Engineer:
Daniel Leppington

Data Processing Manager:
Glen Carson

General Manager:
Ben Goldak

4. Data Acquisition

4.1. ACQUISITION SUMMARY

Goldak Airborne Surveys (Goldak) was selected by the Ministry of Northern Development and Mines (MNDM) to conduct the Separation Lake area horizontal magnetic gradient and gamma-ray survey.

The principal geophysical sensors were 3 high-sensitivity, optically pumped cesium split-beam magnetometers and a gamma-ray spectrometer linked to 42 L (33.6 L downward-looking and 8.4 L upward-looking) sodium iodide detectors. Ancillary equipment included a GPS navigation system with GPS base station, a digital imaging system, temperature and pressure sensors, radar altimeters and 2 base station magnetometers.

A pre-planned drape surface was prepared for the survey to guide the aircraft over the topography in a consistent manner, as close to the minimum clearance as possible. The drape surface was prepared with digital elevation model (DEM) data obtained from the Shuttle Radar Topography Mission. The DEM included an extension beyond the survey boundary to allow the aircraft to achieve the drape clearance before coming on line. The drape surface created was constrained to a maximum a climb and descent gradient of 5% and a maximum rate of change of 0.7 %/s.

The survey was flown as a single block with the traverse lines oriented north-south and the control lines situated perpendicular to the traverse lines. The traverse-line spacing was 200 m, whereas the control-line spacing was 2000 m. Additional control lines were flown along the off-angle survey borders. Total survey coverage was 117 487 line-kilometres.

Two magnetic base stations were installed for the duration of the survey. Both stations sampled the magnetic field at 1 Hz with a GPS time base and logged data to an external flash drive. The first, equipped with a VHF radio link to the field office to facilitate real-time diurnal monitoring, was set-up in a wooded area on the outskirts of Kenora. The second was installed approximately 10 km northeast of Kenora airport. A ground reference GPS station, used for post-flight differential corrections, was installed on the roof of the Nature's Inn and logged GPS data at 1 Hz. The precise position of the station antenna was determined by collecting 12 hours of data then submitting the data to the NRCan online Precise Point Positioning (PPP) service.

Goldak utilized 3 of its aircraft for this survey; registrations C-GJBB, C-GJBG and C-GLDX; and based its operations out of Kenora, Ontario. All 3 aircraft and the field crew arrived in Kenora on July 10th, 2016. Following set-up of ground reference stations and onsite calibrations, survey operations began on July 14th. To complete the project, 107 production flights were performed in addition to the 34 flights required for calibrations. The survey of the Separation Lake area was completed on September 23rd.

Field logs detailing production, status and weather conditions were kept and forwarded to the MNDM quality assurance authority on a weekly basis and are included as Appendix C.

4.2. PRESURVEY TESTS AND CALIBRATIONS

The following tests and calibrations were performed prior to data acquisition.

- System lag verification ("lag test")
- Magnetometer heading check
- Compensation figure of merit ("FOM") check
- Altimeter calibration ("radar stack")
- Stripping ratio calibration ("pad test")
- Cosmic calibration
- Altitude attenuation and sensitivity calibration

The pad tests took place in the Goldak hangar (Saskatoon, Saskatchewan) using their set of calibrated test pads. The altitude attenuation and sensitivity calibration was flown over the Geological Survey of Canada (GSC)–approved Danielson calibration range, approximately 100 km south of Saskatoon. Radar stack and lag tests were flown in Saskatoon. The heading tests were flown over the GSC magnetic observatory site near Meanook before commencement of data collection. Several figure of merit flights were undertaken over an area of relatively low magnetic gradient centred approximately 30 km northeast of Kenora. Further details of these tests are described in 7.1.1 and their results are provided in Appendix A.

4.3. SURVEY TESTS AND CALIBRATIONS

The following tests and calibrations were performed during the survey.

- Compensation figure of merits
- Radiometric repeat test line
- Radiometric over-water test line
- Radiometric system resolution tests
- Radiometric system sample checks

The system resolution tests and sample checks were performed pre-flight at the Kenora airport. The radiometric overwater and repeat test lines were flown before and after each survey flight in the Kenora area. Further details of these tests are described in 7.1.1 and their results are provided in Appendix A.

4.4. POSTSURVEY TESTS AND CALIBRATIONS

The following tests and calibrations were performed following survey completion.

- System lag verification
- Compensation figure of merit
- Altimeter calibration

The post survey figures of merit tests were performed in same area as the pre-survey calibration. The postsurvey lag and altimeter calibrations were performed in Saskatoon. Further details of these tests are given in 7.1.1 and their results are provided in Appendix A.

5. Data Compilation and Processing

5.1. PERSONNEL

The following personnel were involved in the compilation of data and creation of the final products:

Processing Manager:	Glen Carson
Field Data Processors:	Bill Heath
	Abbas Shaikh

5.2. BASE MAPS

Base maps of the survey area were supplied by the Ontario Ministry of Northern Development and Mines.

5.2.1. PROJECT DESCRIPTION

Datum:	North American Datum 1983 (NAD83)
Ellipsoid:	Geodetic Reference System 1980 (GRS80)
Projection:	UTM 15N
Central Meridian:	93°W
False Northing:	0 m
False Easting:	500 000 m
Scale Factor:	0.9996

5.3. PROCESSING OF POSITIONAL AND ALTITUDE DATA

Processing of the positioning data takes place in the field and is performed on a post-flight basis. The following procedures are included in positioning and altitude data processing.

1. The raw airborne GPS data are corrected using the corresponding GPS base station data and the NovAtel® Inc. Waypoint® GrafNav® GNSS Post-Processing software suite.
2. The corrected GPS North American Datum 1983 (NAD84) longitude, latitude and altitude are merged into a Geosoft® database with aircraft flight data and re-projected to the local UTM datum (NAD83). Velocity is then calculated from the corrected positions. Corrected UTM co-ordinates are trimmed to online.
3. The primary radar altimeter data is lagged by 0.9 seconds and the secondary radar altimeter data is lagged by 3.0 seconds.
4. The digital elevation model is calculated by subtracting the radar altimeter data from the GPS

altitude data.

5. Attitude information is derived from 3 GPS receivers mounted on the tail, cabin and right wingtip. Moving baseline software by Waypoint® is used to compute the relative positions of the antennae. By determining the relative apparent positions of the front–right and front–tail antenna pairs and comparing to the known reference geometry of the aircraft, the pitch, roll, azimuth and yaw of the aircraft are calculated to better than 0.5° precision.

In addition, all quality-control checks, described in 7.1.2, are performed at this time.

5.4. PROCESSING OF THE MAGNETIC DATA

5.4.1. INITIAL FIELD PROCESSING

Processing of the magnetic data begins in the field where the raw magnetic, positioning and altitude data from the aircraft acquisition systems are first imported into a Geosoft® Oasis montaj™ database on a line basis. The magnetic base station data, logged during the corresponding flight time, were then merged with the flight data for display and quality control checks. An initial system latency correction, determined from the pre-survey lag tests is then applied.

The raw, measured magnetic gradients are normalized using the known aircraft sensor separations and aircraft direction to give consistently signed gradient values in units of nT/m. A correction matrix, derived from the attitude data, is then applied scaling them to provide true longitudinal and transverse gradient values parallel to and perpendicular to the ideal line direction.

Quality-control procedures described in section 7.1.2 are also performed at this time.

5.4.2. CONTROL-LINE LEVELLING

The intention of control-line levelling is to apply a smoothly varying function to the measured data, which results in nearly identical values at the intersections of traverse and control lines. The most significant component of the correction is to accommodate the diurnal variation of the magnetic field. Other sources of error are altitude errors, GPS positioning errors and system drift.

Levelling of the total field data consists of the following steps:

1. Calculation of the positions of the survey-line–control-line intersection points and the extraction of mismatch values of the magnetic data between the line and control lines at these points.
2. A refinement of the initial lag correction by statistical analysis of intersection mismatch values.
3. An iterative application of corrections, based on best fit, first-order linear trends of mismatch values (with outliers removed), on the traverse and control lines until the resulting corrections approach zero.
4. An iterative application of long-wavelength corrections on traverse and control lines determined by applying median and low-pass filters to the remaining intersection mismatches (with outliers removed) and then using Akima spline interpolation between the now-filtered intersection mismatch values. This enhances and isolates correction “features” that span several intersections. The lengths of the filters are based on the traverse-line–control-line intersection separations. In this case, the initial filter lengths spanned 10 control-line intersections on survey lines and 50 survey-line intersections on control lines. The number of intersections spanned is reduced in increments to an appropriate minimum until the correction approaches zero.
5. Calculation of the first vertical derivative from the gridded data of the intermediate levelled total

field using a 2-D fast Fourier transform (FFT) operator.

6. An altitude correction derived by multiplying the calculated vertical gradient by the aircraft's deviation from the planned surface height is then applied to the original unlevelled magnetic data.
7. Steps 1 to 3 are then repeated using the altitude-corrected magnetic data.
8. Manual inspection of the remaining intersection mismatches and reducing it to zero (where appropriate) by applying the necessary corrections to either the survey or tie lines. Special attention is paid to ensuring that the overall correction profiles are as smooth as possible and that there is no line-to-line correlation in the correction profiles, which implies a misapplied correction.
9. The second vertical derivative of the total field grid is analyzed to ensure that the corrections are sufficient and appropriate. Features that appear along the survey lines in the second vertical derivative may be the result of over-correction or under-correction. In either case, the solution is to revise the correction profile at those intersections.

5.4.3. Calculation and Removal of the International Geomagnetic Reference Field

The International Geomagnetic Reference Field (IGRF) was calculated using the 2015 model year with a constant date of August 18, 2016 (roughly the mid-point of the survey) as the reference date. A constant altitude of 493.3 m, the mean altitude over the course of the survey, was specified as the elevation. This value was subtracted from the tie-line levelled data to obtain the residual magnetic field data.

5.4.4. Microlevelling of the Magnetic Data

After control line levelling, any residual flight line noise or "corrugation" in the magnetic field data was further reduced using Paterson, Grant and Watson's microlevelling technique. This technique first involves the generation of line-to-line noise profiles by applying frequency domain sixth-order, high-pass Butterworth filter and a directional cosine filter perpendicular to the flight-line direction to the gridded data. This "decorrugation" grid is then sampled back into the database. The initial noise profile data is then limited to a user-defined maximum amplitude and then filtered using a Naudy–Dreyer nonlinear filter to obtain the microlevelling correction. Finally, the correction and gridded microlevelled data are inspected to ensure no geological signal was removed and an overall improvement in the gridded data was achieved.

The following parameters in the Paterson, Grant and Watson Ltd. "Miclev" routine were used:

- Decorrugation wavelength cutoff: 1000 m
- Decorrugation grid cell size: 40 m
- Naudy filter length: 400 m
- Naudy filter tolerance: 0.0001
- Amplitude limit: 8 nT

5.4.5. Geological Survey of Canada Data Levelling

In 1989, as part of the requirements for the contract with the Ontario Geological Survey (OGS) to compile and level all existing Geological Survey of Canada (GSC) aeromagnetic data (flown prior to 1989) in Ontario, Paterson, Grant and Watson Limited developed a robust method to level the magnetic data of various base levels to a common datum provided by the GSC as 812.8 m grids. The essential theoretical aspects of the levelling methodology were fully discussed in Gupta et al. (1989) and Reford et al. (1990).

The method was later applied to the remainder of the GSC data across Canada and the high-resolution airborne magnetic and electromagnetic surveys flown by the OGS. It has since been applied to all newly acquired OGS aeromagnetic surveys.

a) Terminology

Master grid: refers to the 200 m Ontario magnetic grid compiled and levelled to the 812.8 m magnetic datum from the Geological Survey of Canada

GSC levelling: the process of levelling profile data to a master grid, first applied to GSC data

Intra-survey levelling or microlevelling:
refers to the removal of residual line noise described earlier in this chapter; the wavelengths of the noise removed are usually shorter than tie-line spacing

Inter-survey levelling or GSC levelling:
refers to the level adjustments applied to a block of data; the adjustments are the long wavelength (in the order of tens of kilometres) differences with respect to a common datum, in this case, the 200 m Ontario master grid, which was derived from all pre-1989 GSC magnetic data and adjusted, in turn, by the 812.8 m GSC Canada-wide grid

b) The GSC Levelling Methodology

The GSC levelling methodology is described below:

Several data processing procedures are assumed to be applied to the survey data prior to levelling, such as microlevelling, IGRF calculation and removal. The final levelled data are gridded at 1/5 of the line spacing. If a survey was flown as several distinct blocks with different flight directions, then each block is treated as an independent survey.

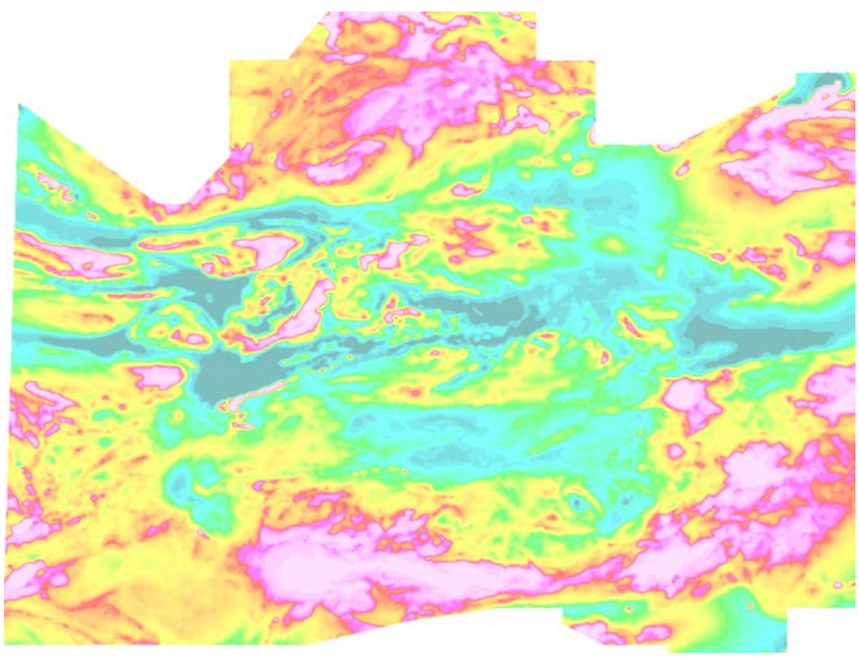

Figure 2. Ontario master aeromagnetic grid (Ontario Geological Survey 1999) windowed to the sample data set to be levelled for the Separation Lake survey area.

The steps in the GSC levelling process are as follows.

1. Create an upward continuation of the survey grid to 305 m.
   Almost all recent surveys (1990 and later) to be compiled were flown at a nominal terrain clearance of 100 m or less. The first step in the levelling method is to upward continue the survey grid to 305 m, the nominal terrain clearance of the Ontario master grid (Figure 2).
   The grid cell size for the survey grids is set at 100 m. Since the wavelengths of level corrections will be greater than 10 to 15 km, working with 100 m or even 200 m grids at this stage will not affect the integrity of the levelling method. Only at the very end, when the level corrections are imported into the databases, will the level correction grids be regridded to 1/5 of line spacing.
   The unlevelled 100 m grid is extended by at least 2 grid cells beyond the actual survey boundary, so that, in the subsequent processing, all data points are covered.

2. Create a difference grid between the survey grid and the Ontario master grid.
   The difference between the upward-continued survey grid and the Ontario master grid, regridded at 100 m, is computed (Figure 3). The short wavelengths represent the higher resolution of the survey grid. The long wavelengths represent the level difference between the 2 grids.

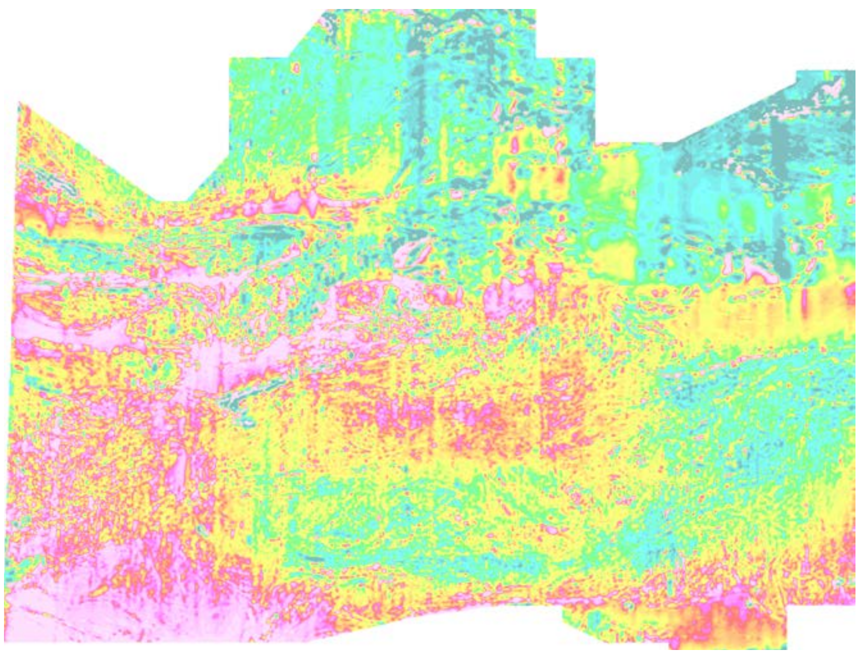

Figure 3. Difference grid (between survey grid and master grid), shown for the Separation Lake survey area.

3. Rotate difference grid so that flight-line direction is parallel with grid column or row, if necessary.
4. Apply the first pass of a nonlinear filter (Naudy and Dreyer 1968) of wavelength on the order of 15 to 20 km along the flight-line direction. Reapply the same nonlinear filter across the flight-line direction.
5. Apply the second pass of a non-linear filter of wavelength along the flight-line direction. Reapply the same nonlinear filter across the flight-line direction.
6. Rotate the filtered grid back to its original (true) orientation (Figure 4).

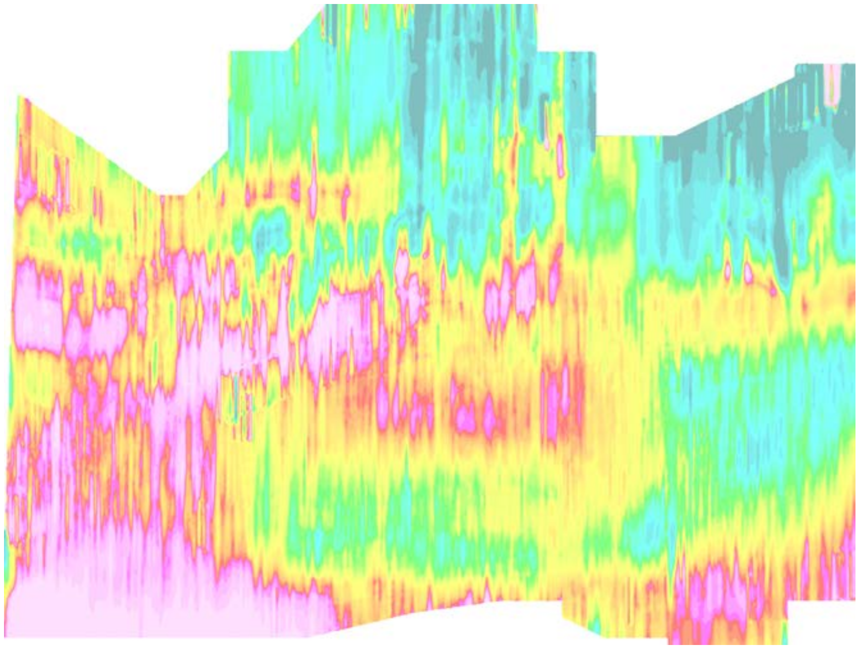

Figure 4. Difference grid after application of nonlinear filtering and rotation, shown for the Separation Lake survey area.

7. Apply a low-pass filter to the nonlinear filtered grid.
   Streaks may remain in the non-linear filtered grid, mostly caused by edge effects. They must be removed by a frequency-domain, low-pass filter with the wavelengths in the order of 12 km (Figure 5).

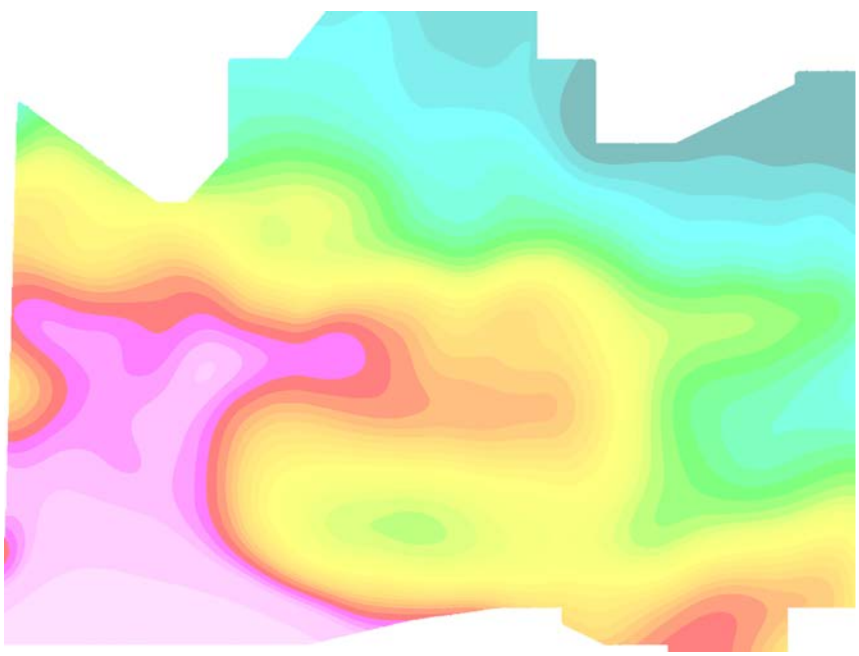

Figure 5. Level correction grid shown for the Separation Lake survey area.

8. Regrid to 1/5 line spacing and import level corrections into database.
9. Subtract the level correction channel from the unlevelled channel to obtain the level corrected channel.

10. Make final grid using the gridding algorithm of choice with grid cell size at 1/5 of line spacing.

c) Survey Specific Parameters

The following GSC levelling parameters were used.

- Upward continuation distance: 205 m
- First pass nonlinear filter length: 30 000 m
- Second pass nonlinear filter length: 15 000 m
- Low-pass filter cut-off wavelength: 10 000 m

5.4.6. PROCESSING OF MEASURED MAGNETIC GRADIENTS

Processing of the magnetic gradient data consists of the following steps:

1. Attitude correction, as described in section 5.4.1, is performed before levelling the gradient information. The effect of attitude on a particular measurement is dependent on the magnitude of the local gradient and the degree of deviation from straight and level flight. This compound effect cannot be accounted for by tie-line levelling of the data, as it is both nonsystematic and at a much shorter wavelength than the tie-line separation. Correcting the data for attitude before levelling insures that levelling corrections are kept to a minimum.
2. Horizontal gradients are calculated from the gridded total field data, sampled into the database and subtracted from the measured, rotated gradients.
3. A 31 second median filter followed by a 31 second low-pass filter is applied to the difference and then added back to the measured gradient. This ensures that the lower wavelengths accurately represent the regional field, which is otherwise difficult to achieve.

5.4.7. GRADIENT-ENHANCED GRIDDING

Gradient enhancement of the residual magnetic field grid was achieved using Goldak’s Gradient Variable Trend (GVT) gridding algorithm, which utilizes the horizontal gradients to guide the between-line interpolation of the data to generate a more realistic image free of artifacts and irregularities present in grids generated from minimum curvature algorithms.

5.4.8. CALCULATION OF VERTICAL DERIVATIVES OF THE RESIDUAL MAGNETIC FIELD

The final grid of the residual magnetic field values is then used as input to create the second vertical derivative of the GSC levelled gradient-enhanced residual magnetic grid. The calculation is done in the frequency domain by combining the transfer function of the second vertical derivative and a small low-pass filter (250 m, Order 8 low-pass Butterworth filter) aimed at attenuating the high frequency signal enhanced by the second derivative operator, without aliasing the geological signal.

5.4.9. CALCULATION OF THE KEATING COEFFICIENTS

The magnetic signatures of kimberlite pipes are approximately circular anomalies. Through pattern recognition analysis of a moving window, first-order regression between the analytic signal of the residual magnetic field grid and the theoretical signature of a magnetic vertical cylinder, correlation coefficients are derived (Keating 1995). Where the correlation meets some threshold, the location, magnitude and sign of the correlation, expressed as a percentage are retained and can be plotted on a magnetic map. Increasing values in magnitude of the coefficient signify a goodness of fit with a cylindrical model, whereas sign signifies the direction of magnetization as some kimberlite pipes acquired magnetization during a time of geomagnetic field reversal.

The Keating coefficients were calculated using the Oasis Montaj™ executable kimberlite.gx with the following parameters:

- Flying Height: 100 m
- Depth to Top 107 m
- Overburden 7 m
- Correlation Threshold: 0.75
- Grid Cell Size: 100 m
- Window Size 17 × 17 cells
- Radius 100
- Magnetization 100
- Field Inclination: 75.32°
- Field Declination: 0.07°E

5.5. PROCESSING OF RADIOMETRIC DATA

All radiometric raw channels were background corrected from overwater background line segments, flown pre- and post-flight, in the field for initial quality control.

The processing methodology was as described in the IAEA report, *Airborne Gamma Ray Spectrometer Surveying* (International Atomic Energy Agency 1991). In this case, no energy calibration or dead-time correction was done as the dead time is typically much less than 0.1% with the Radiation Solutions Inc. system.

5.5.1. SPECTRAL NOISE REDUCTION

Statistical noise reduction in the radiometric data was accomplished via Noise-Adjusted Singular Value Decomposition (NASVD) using Goldak's GETNASVD software utility based on the procedure developed by Hovgaard and Grasty (1997). In the process, groups of observed spectra are first scaled to yield a constant variance in each channel. These adjusted groups of spectra are then factorized to component matrices using a singular value decomposition (SVD) routine such that

$$N = USV^T$$

where,

N = adjusted data matrix of size n samples by m channels

S = m by n matrix where the diagonal elements are the ranked singular values of N

U = orthogonal n by n matrix

V = m by m matrix the columns of which represent principle components of N

The bulk of the original signal is contained in the lower order components while the higher order components can be regarded as statistical noise. By reconstructing the data using only the lower order components, "smoothed" spectra are produced free of the statistical noise contained in the higher order components. Count rates in the total count, potassium, thorium and uranium windows are then extracted from these noise-reduced spectra and imported to an Oasis montaj™ database for further processing.

5.5.2. Filtering of the Cosmic and Upward Uranium Channels

Variations in the cosmic channel are of long wavelength and usually attributed to changes in altitude or atmospheric conditions. A 200-point low-pass filter is applied on a flight-by-flight basis to the cosmic channel to allow for a smooth correction, free of statistical noise in the process described in the next section. Similarly, the upward uranium channel, used in the correction of atmospheric radon, is highly susceptible to statistical noise due to generally low count rates. A 30-point low-pass filter, again on a flight-by-flight basis, is applied to the upward-looking uranium channel.

5.5.3. Cosmic Background Corrections

Radiation in the 3 to 6 MeV range, the cosmic channel, is attributed to non-Earth sources and can be considered as pure noise, in that it has no relationship with the desired geological signal. As such, it can be measured independently and used to remove the cosmic component in lower energy windows.

Theory suggests that the cosmic measurement should increase linearly as altitude increases, provided there is no contamination from radon. Methodology for the removal of the cosmic background involves a cosmic calibration flight where measurements are taken at a variety of heights from 3500 to 12 000 feet altitude. Linear regressions are derived for each of the regions of interest relative to the cosmic channel. The slope yields the "cosmic stripping ratio" and the y intercept is, in theory, the aircraft background.

The correction applied is then expressed as

$$N_i = (a_i * C) + b_i$$

where,

N_i = cosmic correction in the i'th channel;

a_i = cosmic stripping ratio in the i'th channel;

C = counts in cosmic window (3 to 6 MeV);

b_i = aircraft background in the i'th channel.

However, in practice, the aircraft background derived in this fashion can be unreliable.

The cosmic stripping ratios for each aircraft determined from the respective cosmic calibration flights are listed below. A complete summary of the tests are listed in Appendix A.

Table 1. Cosmic Stripping Ratios

	C-GJBB	C-GJBG	C-GLDX
a_{TC}	1.10084	1.10768	1.08348
a_K	0.06235	0.06485	0.06053
a_U	0.05057	0.05096	0.05162
a_{Th}	0.06940	0.06773	0.06801
a_{UpU}	0.01214	0.01369	0.01340

5.5.4. Aircraft Background Corrections

The aircraft background, derived from the cosmic calibration test described in section 5.5.3., is not reliable, likely because of the small number of data points in each flight and some nonlinearity in the relationship between counts in the cosmic and ROI (region of interest) windows at lower altitudes. It is also difficult to obtain a data set that is untainted by radon contamination. As an alternative, an iterative process was used to determine the final aircraft backgrounds. Initially, a background value of zero is assumed for each channel and cosmic and radon corrections are applied. Then, the overwater repeat lines are averaged for each aircraft and added to the background. The process is repeated until the overwater values average zero.

The values below are the final backgrounds applied as determined from the above method and are not those from the cosmic calibration flight.

Table 2. Aircraft Backgrounds

	C-GJBB	C-GJBG	C-GLDX
b_{TC}	73	78.2	60.75
b_K	18.2	19.7	15.24
b_U	0.85	0.9	0.4
b_{Th}	-2.33	-2.19	-2.3
b_{UpU}	0.36	0.33	0.21

5.5.5. Radon Background Corrections

Radon concentrations vary from flight to flight and are affected by weather and topography. A variety of methods can be used to model and remove this signal. The upward detector, which is mostly shielded from geologic signal by being centred above 4 downward detectors, is used to estimate the contribution of atmospheric radon into the downward uranium channel, Ur, and overwater tests are used to determine the ratio between radon in the uranium window and radon contributions to the other windows.

After cosmic and background corrections have been applied, the signal detected over water is solely due to atmospheric radon. Overwater “backgrounds” are flown at the beginning and end of every flight to collect data with a variety of ambient radon concentrations.

These data are averaged and analyzed to solve the following equations by linear regressions:

$$u_r = a_U * U_r + b_U$$
$$K_r = a_K * U_r + b_K$$
$$Th_r = a_{Th} * U_r + b_{Th}$$
$$TC_r = a_{TC} * U_r + b_{TC}$$

where,

u_r= the radon component in the upward U window

K_r , U_r , Th_r , TC_r = the radon components in the various windows of the downward detectors

(where K = potassium; U = uranium; Th = thorium; TC = total count)

a_i = coefficients are the calibration constants determined by linear regression;

b_i = coefficients are now near-zero after removal of aircraft and cosmic backgrounds.

The a_i coefficients, determined by linear regression of count rates in the i’th window to downward uranium count rates of the overwater test data for each aircraft, are given in Table 3.

Table 3. Radon Component Ratios

	C-GJBB	C-GJBG	C-GLDX
a_{TC}	15.706	14.587	15.272
a_K	0.877	0.779	0.837
a_{Th}	0.034	0.046	0.073
a_u	0.306	0.272	0.290

The radon contribution to the downward uranium window, U_r, can be determined from

$$U_r = \frac{(u - a_1 * U - a_2 * Th + a_2 * b_{Th} - b_U)}{(a_U - a_1 - a_2 * a_{Th})}$$

Where,

u =count rate in the upward uranium window;

U, Th =count rates in the uranium and thorium windows;

a_U =ratio of upward uranium counts to downward uranium counts in the overwater data;

a_{Th} =ratio of thorium counts to downward uranium counts in the overwater data;

b_U, b_{Th} =the small non-zero background in the uranium and thorium channels after removal of cosmic and aircraft backgrounds;

a_1, a_2 =covariance coefficients that relate counts in the downward uranium and thorium channels to counts in the upward uranium channels. These are determined in the following process.

The signal measured in the upward uranium window is made up of a contribution from atmospheric radon and a geologic component due to radioactive sources in the ground. This component (u_g) has a linear relationship with the downward uranium (U_g) and thorium (Th_g) given by

$$u_g = a_1 * U_g + a_2 * Th_g$$

Values of u_g, U_g and Th_g are found by analyzing the differences in count rates in each window for adjacent sections of survey lines. Differences between count rates are found at some interval, m, in the upward and downward uranium and thorium channels. Where the overall radioactivity was decreasing, as evidenced by the difference in the total count window, the sign of the differences was reversed.

$$U_g = (U_n - U_{n+m})$$

$$Th_g = (Th_n - Th_{n+m})$$

$$u_g = (u_n - u_{n+m})$$

The differences then are accumulated over the entire survey to determine the calibration factors for upward uranium to downward uranium and thorium for sources in the ground by solving the simultaneous linear equations:

$$\sum(u_g * U_g) = a_1 * \sum(U_g)^2 + a_2 * \sum(U_g * Th_g)$$

and

$$\sum(u_g * U_g) = a_1 * \sum(U_g * Th_g) + a_2 * \sum((Th_g)^2$$

where the summation is carried out over all (n) points in the database. The following coefficients were determined for each aircraft:

Table 4. Radon Ground Component Coefficients

	C-GJBB	C-GJBG	C-GLDX
a_1	0.0396	0.0495	0.0491
a_2	0.0577	0.0417	0.03931

5.5.6. SPECTRAL STRIPPING CORRECTIONS

The spectra of the potassium, uranium and thorium series overlap. Because of this, each spectral window contains counts due to each of the other windows. This can be corrected by “stripping” the data using coefficients derived by obtaining measurements over concrete pads with known radioelement concentrations. Each crystal pack was tested prior to the survey with Goldak's calibrated test pads. The first 3 coefficients vary with height above ground; the attenuation values used are standard values from the IAEA reports.

Table 5. Stripping Ratios

	C-GJBB	C-GJBG	C-GLDX	Δ / m
α	0.30025	0.29796	0.29421	0.0004895
β	0.44555	0.43718	0.43574	0.0006469
γ	0.79853	0.79890	0.79877	0.0006874
a	0.04842	0.05245	0.05046	
b	-0.00180	0.00002	-0.00186	
g	0.00716	0.01098	-0.00014	

Given the background corrected count rates in the potassium, uranium and thorium windows (N) and stripping matrix (S) the stripped count rates in each window (A) can be calculated as follows:

$$A = S^{-1}N$$

or

$$\begin{bmatrix} K_{strip} \\ U_{strip} \\ Th_{strip} \end{bmatrix} = \begin{bmatrix} 1 & \gamma & \beta \\ g & 1 & \alpha \\ b & a & 1 \end{bmatrix}^{-1} * \begin{bmatrix} K_{bg} \\ U_{bg} \\ Th_{bg} \end{bmatrix}$$

which yields:

$$K_{strip} = \frac{Th_{bg} * (\alpha * \gamma - \beta) + U_{bg} * (a * \beta - \gamma) + K_{bg} * (1 - a * \alpha)}{\det(S)}$$

$$U_{strip} = \frac{Th_{bg} * (g * \beta - \gamma) + U_{bg} * (1 - b * \beta) + K_{bg} * (b * \alpha - g)}{\det(S)}$$

$$Th_{strip} = \frac{Th_{bg} * (1 - g * \gamma) + U_{bg} * (b * \gamma - a) + K_{bg} * (a * g - b)}{\det(S)}$$

where,

$$\det(S) = 1 - g * \gamma - a * (\gamma - g * \beta) - b * (\beta - \alpha * \gamma)$$

5.5.7. Calculation of Effective Height

The height of the detectors must be corrected to standard temperature and pressure (STP) height to account for the attenuating properties of changes in air density on count rates. This effective height, h_e, is calculated from the formula below:

$$h_e = h * \left(\frac{273.15}{T + 273.15}\right) * \left(\frac{P}{1013.25}\right)$$

where,

h = the observed height above ground level (AGL) in metres
T = temperature in degrees Celsius
P = barometric pressure in millibars

5.5.8. Height Attenuation Correction and Conversion to Radioelement Concentrations

Each aircraft was flown over the Geological Survey of Canada–approved Danielson test range, located approximately 100 km south of Saskatoon, Saskatchewan, to determine its respective system sensitivities and height attenuation coefficients. These parameters are installation specific and relate to the detector crystal packs used, the aircraft and the location of the equipment within the aircraft. A calibrated meter was used to traverse the test range while the aircraft was flying over at several altitudes. The data are background corrected by immediately flying over nearby water at the same height. They are then stripped and reduced to survey height. The system sensitivities are the ratios of counts to the measured concentrations. Each attenuation coefficient is then derived from the exponential relationship between the stripped counts at the various heights.

Table 6. Altitude Attenuation Coefficients

	C-GJBB	**C-GJBG**	**C-GLDX**
Total Counts (c/s/m)	-0.007223	-0.007012	-0.007244
Potassium (c/s/m)	-0.009186	-0.008962	-0.009133
Uranium (c/s/m)	-0.007769	-0.007873	-0.007554
Thorium (c/s/m)	-0.007112	-0.006895	-0.007483

Table 7. Radioelement Sensitivities

	C-GJBB	**C-GJBG**	**C-GLDX**
Total Counts (c/s/nGy/h)	27.56	27.39	26.60
Potassium (c/s/%)	77.91	78.47	75.16
Uranium (c/s/ppm)	7.97	7.79	7.78
Thorium (c/s/ppm)	4.50	4.44	4.39

The survey data in each window are first reduced to the observed count rate at standard temperature and pressure (STP) height and then scaled by the sensitivity to determine the final ground concentration, C, using the following equation

$$C = \frac{n_0 e^{-\mu(H-h)}}{S}$$

where,

n_0 = stripped count rate
e = Euler's constant
μ = window attenuation coefficient
H = nominal survey terrain clearance
h = standard temperature and pressure (STP) height above ground of observation
S = sensitivity

5.5.9. Calculation of the Elemental Ratios

Because corrected count rates frequently go to zero or even negative values over water, a simple mathematical ratio is not meaningful and is not useful in the calculation of elemental ratios. The standard procedure is to sum neighbouring points until some threshold, equivalent to 100 counts, is met in both the numerator and denominator and then calculate the ratio. If the threshold isn't reached within 50 samples, then the point is ignored. This minimizes the statistical error in the data and cleans up the "blow-ups" that would occur when the denominator went to zero. Additionally, no ratio is calculated at locations where the potassium concentration is less than 0.25%.

The ratio grid was derived in a similar fashion from the grids of elemental concentrations. In this case, the values are summed at an increasing radius from the centre point until the threshold is met or a maximum radius of 1000 m is reached. At each step, 4 more points were added to the sum, to account for the circular symmetry. No ratio was calculated where the potassium counts were less than 100.

5.5.10. Generation of the Ternary Radioelement Image

The ternary map is produced by scaling the distribution of uranium, potassium and thorium against cyan, magenta and yellow, respectively. In this case, the data were processed using the Goldak's GETTern software utility, which normalizes the data and applies an optimum colour distribution. The settings used with the GETTern software were designed to mimic the output of the S_Tergen algorithm described in Broome et al. (1987).

6. Final Products

The following products were delivered to the MNDM.

1. Profile Databases

Databases, in both Geosoft® *gdb* and ASCII *xyz* format, of the following were provided:

- Magnetic line data archive
- Radiometric line data archive
- Radiometric line data spectra array archive
- Keating coefficient archive

2. Gridded Data

Grids, in both Geosoft® *grd* and Grid Exchange *gxf* formats, gridded from co-ordinates in UTM Zone 15N, NAD83, of the following data:

- digital elevation model
- total magnetic field from the tail sensor
- GSC levelled gradient-enhanced residual magnetic field
- second vertical derivative of the GSC levelled gradient-enhanced residual magnetic field
- measured lateral horizontal gradient
- measured longitudinal horizontal gradient
- total air-absorbed dose rate
- potassium concentration
- equivalent uranium concentration
- equivalent thorium concentration
- potassium over equivalent thorium ratio

3. Project Report

- Provided in portable document format (*pdf*) and Word document (*doc* or *docx*)

4. Flight Videos

- The digitally recorded video from each survey flight are provided in a compressed binary format on an external hard drive. The flight videos are not provided as part of the published geophysical data set.

5. Maps

Digital 1:50 000 scale maps (NAD83, UTM Zone 15N) in Geosoft® MAP format, with a topographic layer, of the following:

- colour-filled contours of residual magnetic field and flight lines
(with the following tile names and layout, where "m828xx" indicates OGS Map 828xx):

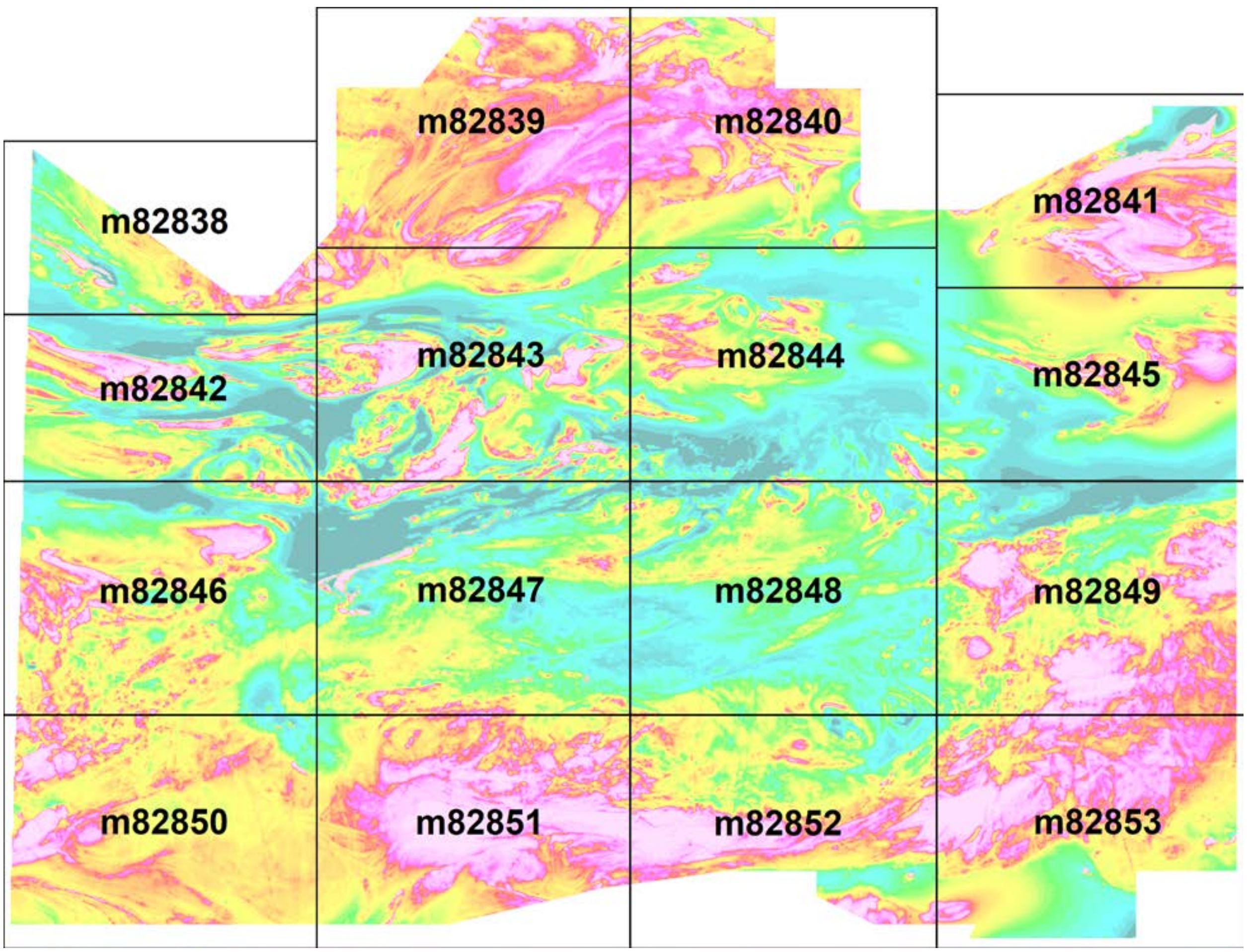

Figure 6. Colour-filled contours of the residual magnetic field-themed maps for the Separation Lake survey area. The tile layout is shown with associated map numbers where "m82XXX" indicates OGS Map 82XXX.

- shaded colour of the second vertical derivative of the residual magnetic intensity with Keating coefficients (with the following tile names and layout, where "m828xx" indicates OGS Map 828xx):

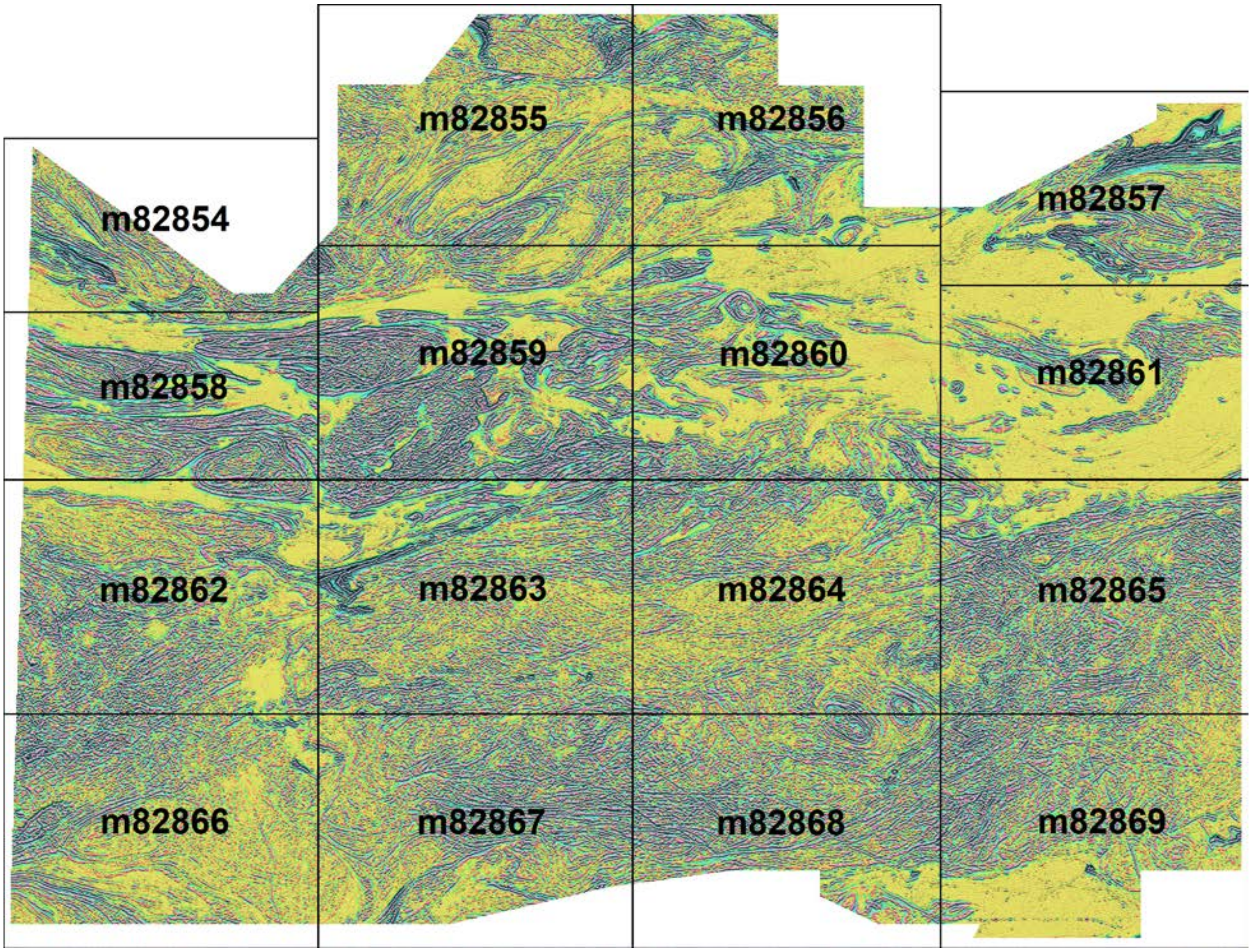

Figure 7. Shaded colour image of the second vertical derivative of the residual magnetic field with Keating coefficients themed maps for the Separation Lake survey area. The tile layout is shown with associated map numbers where "m82XXX" indicates OGS Map 82XXX.

- histogram-equalized ternary red, green and blue radioelement image with inset images of percent potassium, equivalent uranium, equivalent thorium and dose rate (with the following tile names and layout, where "m828xx" indicates OGS Map 828xx):

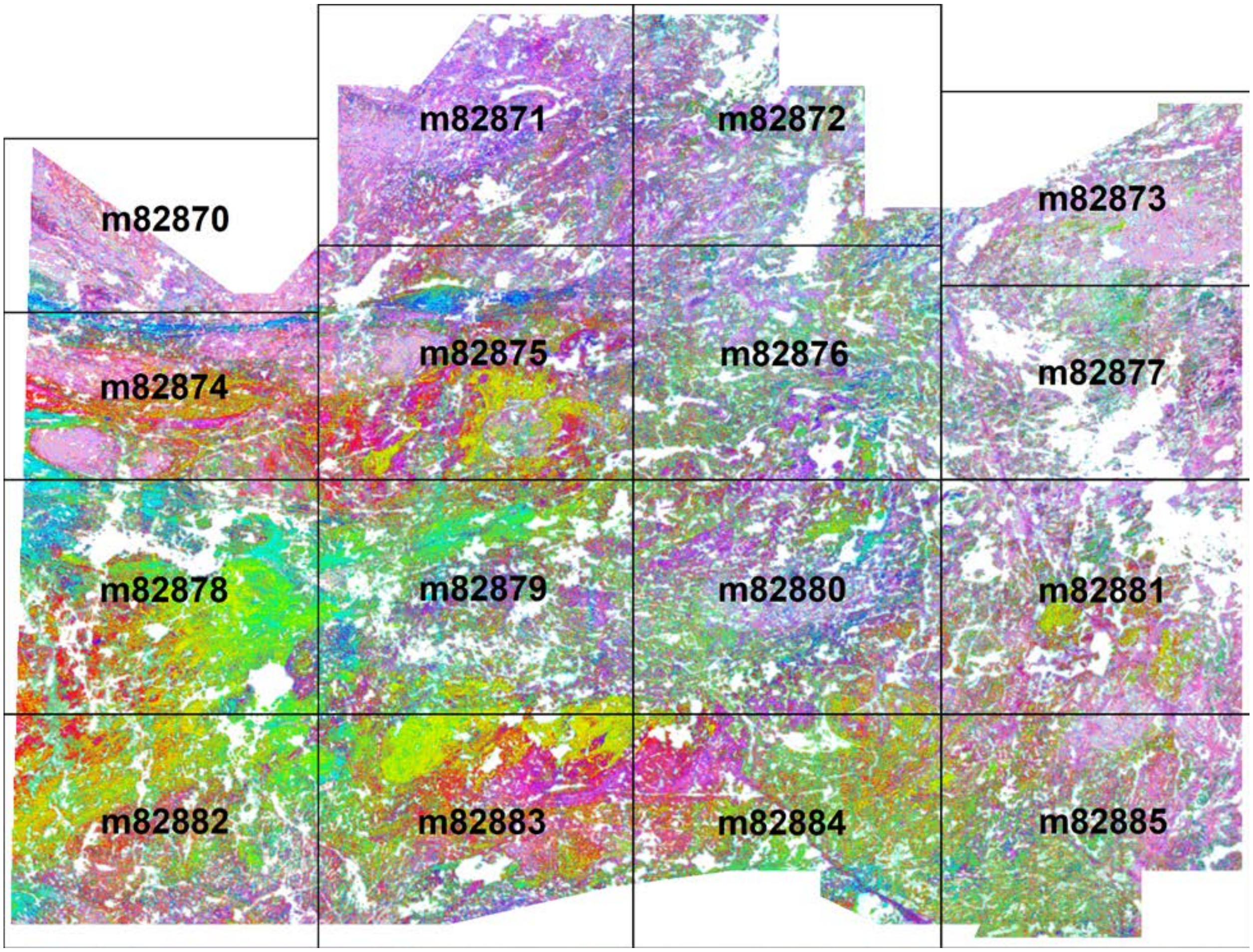

Figure 8. Ternary radioelement image themed maps showing histogram-equalized ternary red, green and blue radioelement image with inset images of percent potassium, equivalent uranium, equivalent thorium and dose rate. The tile layout is shown, for the Separation Lake survey area, with associated map numbers, where "m82XXX" indicates OGS Map 82XXX.

The digital map files are not provided as part of the published geophysical data set, but are published separately in PDF format.

7. Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) were undertaken by the survey contractor Goldak and PGW, as well as MNDM. Stringent QA/QC is emphasized throughout the project so that the optimal geological signal is measured, archived and presented.

7.1. SURVEY CONTRACTOR

Important checks are required during the data acquisition stage to ensure that the data quality is kept within the survey specifications. The following lists, in detail, the standard data quality checks that were performed by Goldak during the course of the survey.

7.1.1. TESTS AND CALIBRATIONS

The full results of the tests and calibrations described below can be found in Appendix A.

1. Lag Tests

   To verify the magnetic system latency, the survey aircraft conducted lag tests. These tests involve flying multiple passes over a known magnetic feature and comparing the position of the observed magnetic peaks with the known position of the target.

   Both prior to commencement and after completion of the survey, all aircraft performed this over a tower approximately 22 km SW of Saskatoon, SK. The calculated system latencies from these tests were determined to be consistent between the pre- and post-survey values and were consistent with previous tests performed by each aircraft.

2. Radar Altimeter Calibration

   The radar altimeter calibration and verification were performed by acquiring altitude data from several passes of increasing altitude over a runway at Saskatoon International Airport. The radar altimeter of the aircraft was confirmed to have a linear relationship with and within acceptable range of the GPS height.

3. Compensation Figure of Merit Test

   Compensation calibrations determine the magnetic influence of aircraft and its manoeuvres. During the compensation calibration flight, the aircraft performs sets of 3 pitches (±5°), rolls (±10°), and yaws (±5°), while flying in the 4 flight-line directions at high altitude over a magnetically quiet area. The coefficients calculated from the calibration are applied to the acquired magnetometer data to measure the effectiveness of the compensation system in mitigating the magnetic interference.

   The total compensated signal noise resulting from the 12 manoeuvres, referred to as the Figure of Merit (FOM), is calculated from the maximum peak-to-peak value resulting from each manoeuvre. A new compensation calibration must be performed after any aircraft or system modifications that may affect the aircraft's magnetic field interference

   In all calibrations performed by the aircraft, the resultant figures of merit for the tail and wing-tip sensors were below the specified threshold of 1.5 nT.

4. Heading Test

   To verify system accuracy and acceptable heading error, a heading test was performed over the GSC magnetic observatory at Meanook, AB, prior to commencement of the survey. The aircraft performed 2 passes in each cardinal direction directly over the observatory and the aircraft measured total field was compared against the observatory data.

For the calibration performed, the calculated heading errors were minimal and the absolute accuracies were within the contract threshold of 10 nT.

5. Spectrometer Stripping Calibration

To determine the stripping ratios of each detector, calibrations were done at Goldak's hangar using pads calibrated according to the method by Grasty and Minty (1995). Four concrete pads, 3 embedded with the ROI radioelements and one "bare" pad for background corrections, were placed beneath detector packs installed in the aircraft. Data were then accumulated for approximately 30 minutes. The averaged count rates can then be used to compute the 6 stripping ratios for each spectrometer.

6. Spectrometer Dynamic Calibration Range

Each aircraft performed a calibration flight over Goldak's GSC approved calibration range near Danielson, SK to determine the radiometric system sensitivities and altitude attenuation factors. The aircraft repeated a 10 km test line and an adjacent overwater line (for background corrections) at altitudes of 60 to 270 m in 30 m increments.

Simultaneously, actual ground concentrations were measured by a ground crew equipped with a calibrated hand-held RSI™ RS-230 BGO spectrometer. At 8 predetermined stations along the survey test line, four 120-second sample accumulations were acquired, each approximately 15 m apart. The processed measurements are then averaged giving the ground concentrations in each window for the test line.

7. Cosmic Calibration

High-altitude cosmic calibration flight was performed by the aircraft after commencement of the survey. In this test, the aircraft climbed from 1500 m to 3500 m in increments of 500 m and accumulated approximately 10 minutes of data at each altitude. The resultant data determined the linear relationship between counts in the cosmic window and each region of interest window.

8. Radon Calibration

Radon background was monitored through the use of two upward looking detectors. Coefficients used in modelling the radon contribution in the ROI windows were calculated using data collected from an overwater test line flown before and after each survey flight.

7.1.2. Daily Quality Control

1. Navigation Data

   In a Geosoft® Oasis montaj™ database, the corrected GPS data are inspected for gaps and positioning error as indicated by anomalous velocity changes or vertical offsets. The real-time positions are compared to the post-corrected positions for integrity check.

   Flight path is examined to detect horizontal deviations that exceed tolerances. Computed velocity is inspected and confirmed to be within tolerances.

   The radar altimeter and barometric altimeter data are inspected for anomalous conditions. The computed digital elevation model is compared against known topographical data. Vertical navigation is checked for deviations from the pre-determined flight surface that exceed tolerances.

2. Magnetic Data

   Goldak Airborne Survey data acquisition system is designed to allow the second pilot to monitor data quality at all times. Both pilots have been trained to operate the equipment and recognize data problems. Automated systems are also in place to draw their attention to anomalous conditions. In addition, the field processor is continually monitoring the magnetic base station via radio link to be on the alert for poor diurnal conditions. The field processor maintains scheduled communication with the aircraft for flight-following purposes and to update the flight crew on weather and diurnal conditions.

   Post-flight, the magnetic and measured gradient data are inspected on a line-by-line basis for gaps, spikes and other anomalous conditions. Magnetic noise levels are monitored using the fourth digital difference and visually. The magnetic base station data are examined for deviations that exceed the contract stated peak-to-peak magnitude and chord lengths. Reflights are assigned where necessary.

   A frequency domain plot of the uncompensated and compensated magnetic data is generated through fast Fourier transform on a line-by-line basis and inspected. Through this, the general ongoing performance of the magnetic compensation can be evaluated and any aircraft system-induced magnetic noise can be easily discerned.

   Grids of the total field and horizontal gradient data, along with flight path plots, are examined daily to visually compare the correlation of data between lines and across flights.

3. Radiometric Data

   Onsite, weather conditions were continuously monitored to ensure that no radiometric survey took place within 4 hours after measurable precipitation or 12 hours after heavy precipitation.

   Prior to each survey flight, the field crew performed 2 system verification tests. The results of these system verification tests are plotted in Appendix A.

   Source Tests: While the aircraft sat stationary, a ^{232}Th source was placed in a cradle attached to the aircraft beneath the spectrometer detector pack and data were collected for 2 minutes. The sample was then removed and data were again collected for 2 minutes for background determination. The results analyzed and plotted to ensure consistent sensitivities throughout the survey.

   System Resolution Test: A ^{232}Th source was used determine the full width–half amplitude (FWHM) of the 2615 keV photopeak, expressed as a percentage, as a measure of system performance. In all tests performed, FWHM of the photopeak remained well below the contract specified threshold of 7%.

   Before and after each radiometric survey flight, a repeat line was flown as an additional measure of system consistency throughout the survey as well as consistency between aircraft.

   During a survey flight, the flight crew is presented with a diagnostic display of the radiometric acquisition system showing a combined spectra and status of each detector crystal. In the event of anomalous system state or error, a visual alert is displayed.

   Post-flight, the radiometric data were viewed in profile format. The data were checked for any gaps, erroneous detector crystal states or stabilization errors. Any records that show an error in detector state were removed and scheduled for re-flight if needed. Rough background correction estimates were removed from the ROI channels and the data were displayed in grid format to check for coherence.

7.1.3. Near-Final Field Products

Near-final products of the profile and gridded magnetic and radiometric data were made available to the QA/QC Geophysicist during visits to the survey site, for review and approval, prior to demobilization.

7.1.4. Quality Control in the Office

1. Review of field processed data

The general results of the field processing and calibrations were reviewed at regular intervals during the course of the survey and following completion.

2. Review of the final processed data

The results of the levelling of the magnetic data are reviewed on a line-by-line basis through inspection of the total correction profile and intersection mismatch values. Final grid products are visually and statistically inspected for overall quality and validity.

The final radiometric processing is reviewed on a line-by-line basis through inspection of the numerous correction profiles and final processed channels. Statistical plots of the overwater test line and repeat line data are generated to ensure proper background correction coefficients. Final grids are again inspected for quality and validity.

7.1.5. Interim Products

Archive files containing the raw and interim processed profile data and the gridded data were provided to the QA/QC geophysicist for review and approval.

After approval of the interim data, the 1:50 000 maps were created and verified for registration, labelling, dropping weights, general surround information, etc. The corresponding digital files were provided to the QA/QC data manager for review and approval.

7.2. QA/QC GEOPHYSICIST

The QA/QC geophysicist received data on a regular basis throughout the data acquisition, focusing initially on the data acquisition procedures, base station monitoring and instrument calibration. As data were collected, they were reviewed for adherence to the survey specifications and completeness. Any problems encountered during data acquisition were discussed and resolved.

The QA/QC checks included the following:

1. Navigation Data

- appropriate location of the GPS base station
- flight-line and control-line separations are maintained, and deviations along lines are minimized
- verify synchronicity of GPS navigation and flight video
- all boundary control lines are properly located
- terrain clearance specifications are maintained
- aircraft speed remained within the satisfactory range
- area flown covers the entire specified survey area
- real-time corrected GPS data does not suffer from satellite induced shifts or dropouts
- GPS height and radar/laser altimeter data are able to produce an image-quality Digital Elevation Model

- GPS and geophysical data acquisition systems are properly synchronized
- GPS data are adequately sampled.

2. Magnetic Data

- appropriate location of the magnetic base station, and adequate sampling of the diurnal variations
- heading error and lag tests are satisfactory
- magnetometer noise levels are within specifications
- magnetic diurnal variations remain within specifications
- spikes and/or drop-outs are minimal to non-existent in the raw data
- filtering of the profile data is minimal to non-existent
- preliminary levelling produces image-quality grids of total magnetic field and higher order products (e.g., second vertical derivative)

3. Radiometric data

- consistency between daily test lines
- consistency between daily fixed source and static background measurements
- shifts in radioelement concentrations between flights
- precipitation limitations are observed
- the energy resolution is confirmed daily with ^{232}Th and, using the 2615 keV photopeak of ^{232}Th, a total system resolution better than 7% is maintained
- gamma-ray peaks properly located in the energy spectrum

The QA/QC geophysicist reviewed interim and final digital and map products throughout the data compilation phase, to ensure that noise was minimized and that the products adhered to the QA/QC specifications. This typically resulted in several iterations before all digital products were considered satisfactory. Considerable effort was devoted to specifying the data formats and verifying that the data adhered to these formats.

7.3. MINISTRY OF NORTHERN DEVELOPMENT AND MINES

MNDM prepared all of the base map and map surround information required for the hard copy maps. This ensured consistency and completeness for all of the geophysical map products. The base map was constructed from digital files of the 1:50 000 NTS map sheet series.

MNDM worked with the QA/QC geophysicist to ensure that the digital files adhered to the specified ASCII and binary file formats, that the file names and channel names were consistent, and that all required data were delivered on schedule. The map products were carefully reviewed in digital and hard copy form to ensure legibility and completeness.

MNDM and the QA/QC geophysicist provided the magnetic profile and gridded data guidelines for Goldak as part of the GSC levelling process.

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Appendix A. Test and Calibration Results

1. LAG TESTS

Lag Test Analysis

Project	OMNDM SL
Flight	11
Aircraft	C-GJBB
Date	2016-07-06
Julian Day	189

Pilot	Mathieson
Copilot	
Processor	Carson

Test Summary

MB Average Lag	0.4
MR Average Lag	0.3
ML Average Lag	0.3

Test Location	Near Saskatoon, SK
Feature Easting	370603
Feature Northing	5767235

Air Time	1
Test Time	0.3
Ferry Time	

Test Results

Bottom Tail Magnetometer (MB)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	E	370631	5767228	84.4	29.52	0.35
2	W	370575	5767242	74.6	28.19	0.38
3	E	370635	5767230	83.5	32.01	0.38
4	W	370576	5767243	74.7	27.82	0.37
5	S	370598	5767204	77.3	32.11	0.42
6	N	370608	5767267	80.3	31.71	0.39
7	S	370595	5767206	77.0	30.17	0.39
8	N	370606	5767264	77.4	29.13	0.38

Right Wing Magnetometer (MR)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	E	370623	5767230	84.4	21.08	0.25
2	W	370583	5767240	74.6	20.73	0.28
3	E	370626	5767232	83.5	23.70	0.28
4	W	370583	5767241	74.7	20.36	0.27
5	S	370599	5767211	77.3	24.39	0.32
6	N	370606	5767259	80.3	23.71	0.30
7	S	370597	5767214	77.0	22.47	0.29
8	N	370604	5767257	77.4	21.48	0.28

Left Wing Magnetometer (ML)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	E	370623	5767230	84.4	21.08	0.25
2	W	370583	5767240	74.6	20.73	0.28
3	E	370626	5767232	83.5	23.70	0.28
4	W	370583	5767241	74.7	20.36	0.27
5	S	370599	5767211	77.3	24.39	0.32
6	N	370606	5767259	80.3	23.71	0.30
7	S	370597	5767214	77.0	22.47	0.29
8	N	370604	5767257	77.4	21.48	0.28

Lag Test Analysis

Project	OMNDM SL
Flight	4
Aircraft	C-GJBG
Date	2016-07-05
Julian Day	187

Pilot	Mathieson
Copilot	
Processor	Carson

Test Summary

MB Average Lag	0.4
MR Average Lag	0.3
ML Average Lag	0.3

Test Location	Near Saskatoon, SK
Feature Easting	370603
Feature Northing	5767236

Air Time	0.7
Test Time	0.3
Ferry Time	

Test Results

Bottom Tail Magnetometer (MB)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370600	5767208	78.1	28.23	0.36
2	N	370609	5767262	76.4	26.67	0.35
3	S	370594	5767208	74.6	29.32	0.39
4	N	370606	5767265	76.2	29.72	0.39
5	W	370575	5767241	76.7	28.43	0.37
6	E	370630	5767232	77.5	27.90	0.36
7	W	370574	5767241	72.7	29.19	0.40
8	E	370633	5767231	75.0	30.68	0.41

Right Wing Magnetometer (MR)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370601	5767215	78.1	20.45	0.26
2	N	370607	5767254	76.4	19.03	0.25
3	S	370596	5767215	74.6	21.87	0.29
4	N	370604	5767258	76.2	22.18	0.29
5	W	370582	5767239	76.7	20.77	0.27
6	E	370623	5767233	77.5	20.18	0.26
7	W	370581	5767239	72.7	21.93	0.30
8	E	370626	5767233	75.0	23.21	0.31

Left Wing Magnetometer (ML)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370601	5767215	78.1	20.45	0.26
2	N	370607	5767254	76.4	19.03	0.25
3	S	370596	5767215	74.6	21.87	0.29
4	N	370604	5767258	76.2	22.18	0.29
5	W	370582	5767239	76.7	20.77	0.27
6	E	370623	5767233	77.5	20.18	0.26
7	W	370581	5767239	72.7	21.93	0.30
8	E	370626	5767233	75.0	23.21	0.31

Lag Test Analysis

Project	OMNSM SL
Flight	7
Aircraft	C-GLDX
Date	2016-07-06
Julian Day	188

Pilot	Pitre
Copilot	Mathieson
Processor	Heath

Test Summary

MB Average Lag	0.54
MR Average Lag	0.4
ML Average Lag	0.4

Test Location	22 kn SW of YXE
Feature Easting	370601
Feature Northing	5767236

Air Time	1
Test Time	0.3
Ferry Time	

Test Results

Bottom Tail Magnetometer (MB)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	N	370609	5767277	76.4	42.02	0.55
2	S	370593	5767197	73.3	40.41	0.55
3	N	370611	5767272	74.7	37.40	0.50
4	S	370592	5767198	68.8	39.63	0.58
5	E	370638	5767226	75.0	37.96	0.51
6	W	370563	5767247	65.9	39.89	0.61
7	E	370638	5767227	75.2	38.22	0.51
8	W	370566	5767245	68.6	36.72	0.54

Right Wing Magnetometer (MR)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	N	370606	5767263	76.2	26.75	0.35
2	S	370595	5767204	73.3	33.08	0.45
3	N	370609	5767265	74.7	29.93	0.40
4	S	370595	5767211	68.8	25.87	0.38
5	E	370631	5767228	75.0	30.46	0.41
6	W	370575	5767244	65.8	26.74	0.41
7	E	370631	5767229	75.2	30.70	0.41
8	W	370579	5767242	68.6	23.00	0.34

Left Wing Magnetometer (ML)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	N	370606	5767263	76.18	26.75	0.35
2	S	370595	5767204	73.33	33.08	0.45
3	N	370609	5767265	74.72	29.93	0.40
4	S	370595	5767211	68.78	25.87	0.38
5	E	370631	5767228	74.96	30.46	0.41
6	W	370575	5767244	65.83	26.74	0.41
7	E	370631	5767229	75.23	30.70	0.41
8	W	370572	5767244	68.61	29.86	0.44

Lag Test Analysis

Project	OMNDM SL
Flight	148
Aircraft	C-GJBB
Date	2016-09-29
Julian Day	274

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Test Summary

MB Average Lag	0.4
MR Average Lag	0.3
ML Average Lag	0.3
MT Average Lag	

Test Location	Tower SW of Saskatoon
Feature Easting	370603
Feature Northing	5767236

Air Time	0.8
Test Time	0.3
Ferry Time	

Test Results

Bottom Tail Magnetometer (MB)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370589	5767201	81.4	37.54	0.46
2	N	370605	5767267	71.7	31.15	0.43
3	S	370591	5767206	79.2	32.96	0.42
4	N	370603	5767266	74.1	29.93	0.40
5	S	370589	5767205	79.6	34.24	0.43
6	N	370605	5767267	72.3	30.71	0.42
7	W	370565	5767251	80.8	40.43	0.50
8	E	370627	5767232	71.8	24.66	0.34
9	W	370572	5767245	79.8	31.90	0.40
10	E	370629	5767230	72.2	26.19	0.36
11	W	370572	5767244	78.9	31.75	0.40
12	E	370628	5767232	72.4	24.95	0.34

Right Wing Magnetometer (MR)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370591	5767209	81.4	29.54	0.36
2	N	370601	5767253	71.7	17.29	0.24
3	S	370592	5767213	79.2	25.17	0.32
4	N	370600	5767252	74.1	15.81	0.21
5	S	370591	5767213	79.6	26.49	0.33
6	N	370601	5767253	72.3	16.67	0.23
7	W	370581	5767247	80.8	24.58	0.30
8	E	370620	5767234	71.8	17.49	0.24
9	W	370580	5767243	79.8	23.94	0.30
10	E	370622	5767232	72.2	18.97	0.26
11	W	370580	5767242	78.7	23.86	0.30
12	E	370621	5767233	72.4	17.73	0.24

Left Wing Magnetometer (ML)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370591	5767209	81	29.54	0.36
2	N	370601	5767253	72	17.29	0.24
3	S	370592	5767213	79	25.17	0.32
4	N	370600	5767252	74	15.81	0.21
5	S	370591	5767213	80	26.49	0.33
6	N	370601	5767253	72	16.67	0.23
7	W	370581	5767247	81	24.58	0.30
8	E	370620	5767234	72	17.49	0.24
9	W	370580	5767243	80	23.94	0.30
10	E	370622	5767232	72	18.97	0.26
11	W	370580	5767242	79	23.86	0.30
12	E	370621	5767233	72	17.73	0.24

Lag Test Analysis

Project	OMNDM SL
Flight	146
Aircraft	C-GJBG
Date	2016-09-29
Julian Day	273

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Lag Test Summary

MB Average Lag	0.4
MR Average Lag	0.3
ML Average Lag	0.3

Test Location	Tower SE of YXE
Feature Easting	370603
Feature Northing	5767236

Air Time	0.8
Test Time	0.2
Ferry Time	

Lag Test Analysis

Bottom Tail Magnetometer (MB)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	N	370604	5767262	73.1	25.77	0.35
2	S	370587	5767202	78.8	38.09	0.48
3	N	370603	5767263	72.8	26.62	0.37
4	S	370586	5767200	78.2	39.53	0.51
5	N	370606	5767265	75.6	28.74	0.38
6	S	370587	5767202	81.0	37.70	0.47
7	W	370566	5767248	78.6	39.09	0.50
8	E	370631	5767229	75.3	29.11	0.39
9	W	370568	5767249	78.0	37.48	0.48
10	E	370631	5767232	74.3	28.20	0.38
11	W	370567	5767247	77.7	37.99	0.49
12	E	370634	5767234	74.2	31.07	0.42

Right Wing Magnetometer (MR)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	N	370602	5767255	73.1	18.67	0.26
2	S	370588	5767209	78.8	30.44	0.39
3	N	370601	5767256	72.8	19.60	0.27
4	S	370590	5767215	78.2	24.42	0.31
5	N	370604	5767257	75.6	21.25	0.28
6	S	370589	5767210	81.0	29.83	0.37
7	W	370581	5767245	78.4	23.49	0.30
8	E	370617	5767232	75.3	14.07	0.19
9	W	370583	5767246	78.0	22.10	0.28
10	E	370624	5767234	74.3	20.80	0.28
11	W	370582	5767243	77.7	22.50	0.29
12	E	370620	5767237	74.2	16.56	0.22

Left Wing Magnetometer (ML)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	N	370602	5767255	73.1	18.67	0.26
2	S	370588	5767209	78.8	30.44	0.39
3	N	370601	5767256	72.8	19.60	0.27
4	S	370590	5767215	78.2	24.42	0.31
5	N	370604	5767257	75.6	21.25	0.28
6	S	370589	5767210	81.0	29.83	0.37
7	W	370581	5767245	78.4	23.49	0.30
8	E	370617	5767232	75.3	14.07	0.19
9	W	370583	5767246	78.0	22.10	0.28
10	E	370624	5767234	74.3	20.80	0.28
11	W	370582	5767243	77.7	22.50	0.29
12	E	370620	5767237	74.2	16.56	0.22

Lag Test Analysis

Project	OMNDM SL
Flight	148
Aircraft	C-GLDX
Date	2016-09-29
Julian Day	274

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Lag Test Summary

MB Average Lag	0.5
MR Average Lag	0.4
ML Average Lag	0.4
MT Average Lag	

Test Location	Tower SW of Saskatoon
Feature Easting	370603
Feature Northing	5767236

Air Time	0.9
Test Time	0.3
Ferry Time	

Lag Test Analysis

Bottom Tail Magnetometer (MB)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370583	5767194	83.8	46.33	0.55
2	N	370607	5767273	74.6	36.78	0.49
3	S	370584	5767191	82.0	49.12	0.60
4	N	370611	5767272	76.6	36.85	0.48
5	S	370588	5767193	82.5	45.08	0.55
6	N	370606	5767273	75.1	36.85	0.49
7	W	370559	5767253	80.3	47.45	0.59
8	E	370641	5767230	75.9	38.33	0.50
9	W	370553	5767248	82.0	50.90	0.62
10	E	370640	5767227	77.0	38.15	0.50
11	W	370557	5767251	81.0	48.15	0.59
12	E	370639	5767228	76.1	36.40	0.48

Right Wing Magnetometer (MR)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370585	5767202	83.8	38.24	0.46
2	N	370605	5767265	74.6	29.42	0.39
3	S	370587	5767207	82.0	33.13	0.40
4	N	370609	5767265	76.6	29.19	0.38
5	S	370590	5767202	82.5	36.91	0.45
6	N	370605	5767266	75.1	29.45	0.39
7	W	370574	5767249	80.3	31.58	0.39
8	E	370626	5767233	75.9	23.20	0.31
9	W	370569	5767244	82.0	34.50	0.42
10	E	370625	5767230	76.9	22.75	0.30
11	W	370573	5767247	81.0	32.02	0.40
12	E	370631	5767230	76.1	28.78	0.38

Left Wing Magnetometer (ML)						
Pass	Direction	Peak X	Peak Y	Velocity	From Tower	Lag
1	S	370585	5767202	83.8	38.24	0.46
2	N	370605	5767265	74.6	29.42	0.39
3	S	370587	5767207	82.0	33.13	0.40
4	N	370609	5767265	76.6	29.19	0.38
5	S	370590	5767202	82.5	36.91	0.45
6	N	370605	5767266	75.1	29.45	0.39
7	W	370574	5767249	80.3	31.58	0.39
8	E	370626	5767233	75.9	23.20	0.31
9	W	370569	5767244	82.0	34.50	0.42
10	E	370625	5767230	76.9	22.75	0.30
11	W	370573	5767247	81.0	32.02	0.40
12	E	370631	5767230	76.1	28.78	0.38

2. RADAR ALTIMETER CALIBRATIONS

Radar Altimeter Calibration Analysis

Project	OMNDM SL
Flight	12
Aircraft	C-GJBB
Date	2016-07-06
Julian Day	189

Pilot	Mathieson
Copilot	
Processor	Carson

Calibration Summary

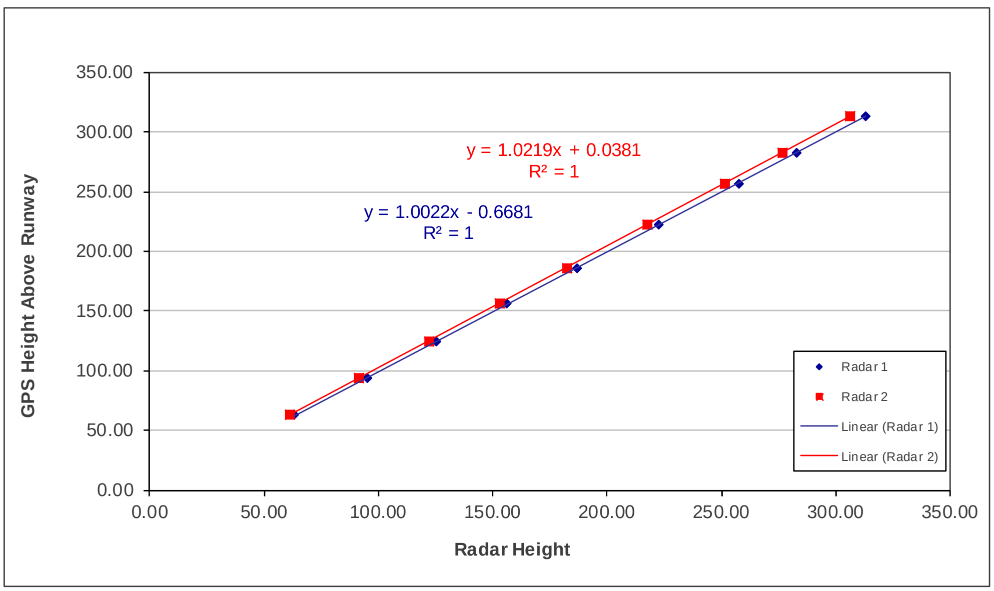
Runway Height	502
Tail Height	3.5

Test Location	Saskatoon Airport
Radar 1 Type	Thompson-CFS ERT160
Radar 2 Type	Terra TRA-30

Radar 1 Scale Factor	0.998
Radar 2 Scale Factor	1.022

Calibration Results

PASS (ft)	GPSAlt	RAlt 1	RAlt 2	Hgt AGL	RAlt 1 Scale	RAlt 2 Scale
200	568.27	63.04	61.35	62.77	0.996	1.023
300	599.16	94.85	91.53	93.66	0.988	1.023
400	630.51	125.10	122.04	125.01	0.999	1.024
50	662.07	156.37	153.31	156.57	1.001	1.021
600	691.86	187.12	182.77	186.36	0.996	1.020
700	727.97	222.34	217.67	222.47	1.001	1.022
800	762.67	257.44	251.57	257.17	0.999	1.022
900	788.10	282.85	276.79	282.60	0.999	1.021
1000	818.63	312.96	306.01	313.13	1.001	1.023



Radar Altimeter Calibration Analysis

Project	OMNDM SL
Flight	3
Aircraft	C-GJBG
Date	2016-07-05
Julian Day	187

Pilot	Mathieson
Copilot	
Processor	Carson

Calibration Summary

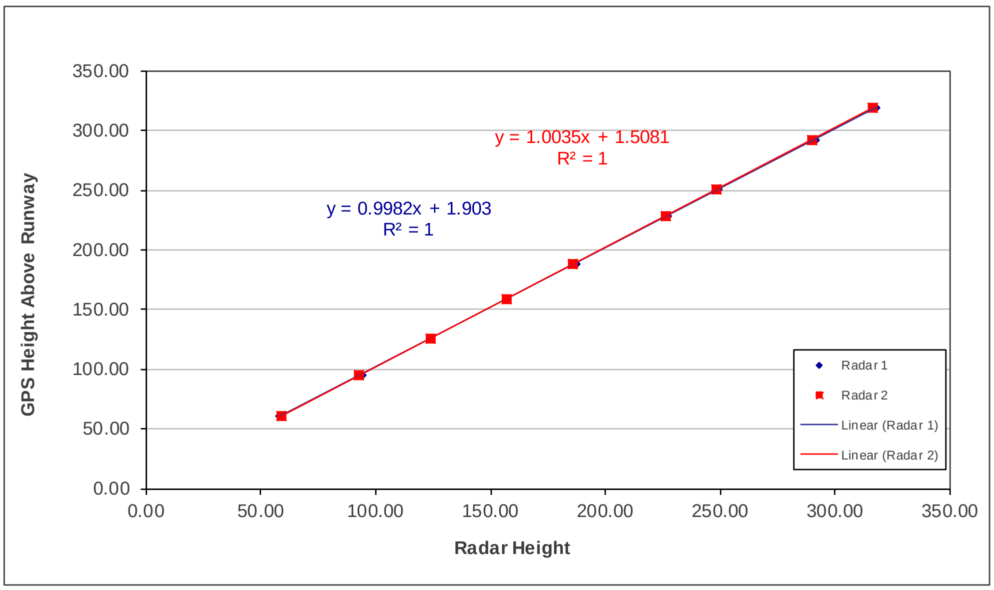
Runway Height	502
Tail Height	3.5

Test Location	Saskatoon Airport
Radar 1 Type	Thompson-CFS ERT160
Radar 2 Type	Terra TRA-30

Radar 1 Scale Factor	1.012
Radar 2 Scale Factor	1.014

Calibration Results

PASS (ft)	GPSAlt	RAlt 1	RAlt 2	Hgt AGL	RAlt 1 Scale	RAlt 2 Scale
200	566.41	58.51	59.13	60.91	1.041	1.030
300	600.17	93.80	92.90	94.67	1.009	1.019
400	631.74	124.20	124.17	126.24	1.016	1.017
500	664.27	156.97	156.77	158.77	1.011	1.013
600	693.46	186.89	185.77	187.96	1.006	1.012
700	734.06	227.02	226.28	228.56	1.007	1.010
800	755.81	248.87	248.10	250.31	1.006	1.009
900	797.74	290.98	290.03	292.24	1.004	1.008
1000	824.78	317.69	316.26	319.28	1.005	1.010



Radar Altimeter Calibration Analysis

Project	OMNDM SL
Flight	6
Aircraft	C-GLDX
Date	2016-07-06
Julian Day	188

Pilot	Pitre
Copilot	Mathieson
Processor	Heath

Calibration Summary

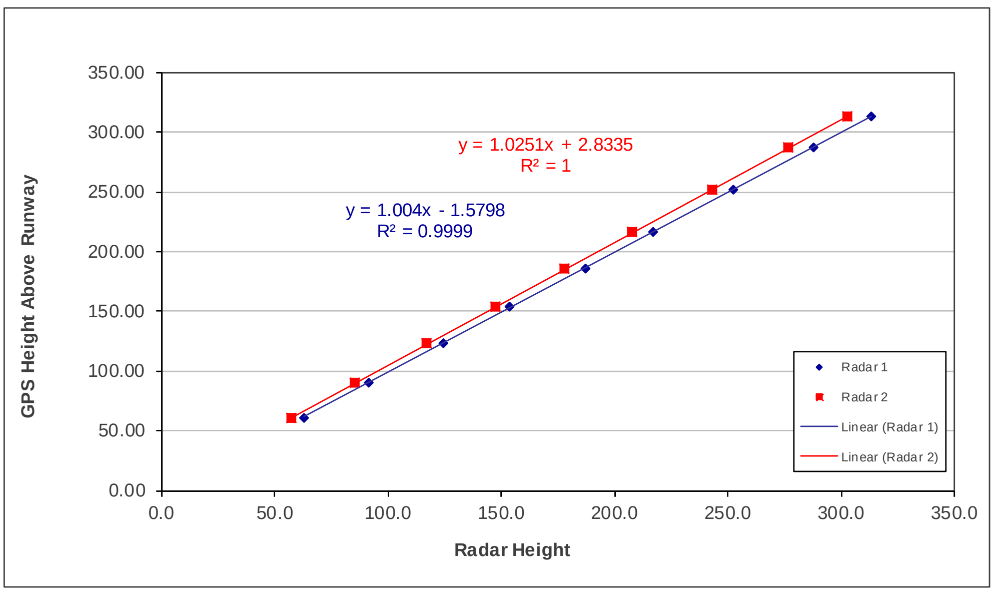
Runway Height	502
Tail Height	1.6

Test Location	Saskatoon
Radar 1 Type	Thompson-CFS ERT160
Radar 2 Type	Terra TRA-30

Radar 1 Scale Factor	0.993
Radar 2 Scale Factor	1.046

Calibration Results

PASS (ft)	GPSAlt	RAlt 1	RAlt 2	Hgt AGL	RAlt 1 Scale	RAlt 2 Scale
200	564.8	62.9	57.0	**61.20**	**0.973**	**1.073**
300	593.9	91.4	85.3	**90.26**	**0.988**	**1.058**
400	626.6	124.3	117.0	**123.03**	**0.990**	**1.052**
500	657.4	153.4	147.3	**153.84**	**1.003**	**1.045**
600	688.9	186.9	178.2	**185.27**	**0.991**	**1.040**
700	719.8	216.8	207.9	**216.18**	**0.997**	**1.040**
800	755.4	252.6	243.1	**251.75**	**0.997**	**1.036**
900	790.4	287.5	276.9	**286.76**	**0.997**	**1.036**
1000	816.7	313.0	302.6	**313.10**	**1.000**	**1.035**



Radar Altimeter Calibration Analysis

Project	OMNDM SL
Flight	149
Aircraft	C-GJBB
Date	2016-09-29
Julian Day	274

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Calibration Summary

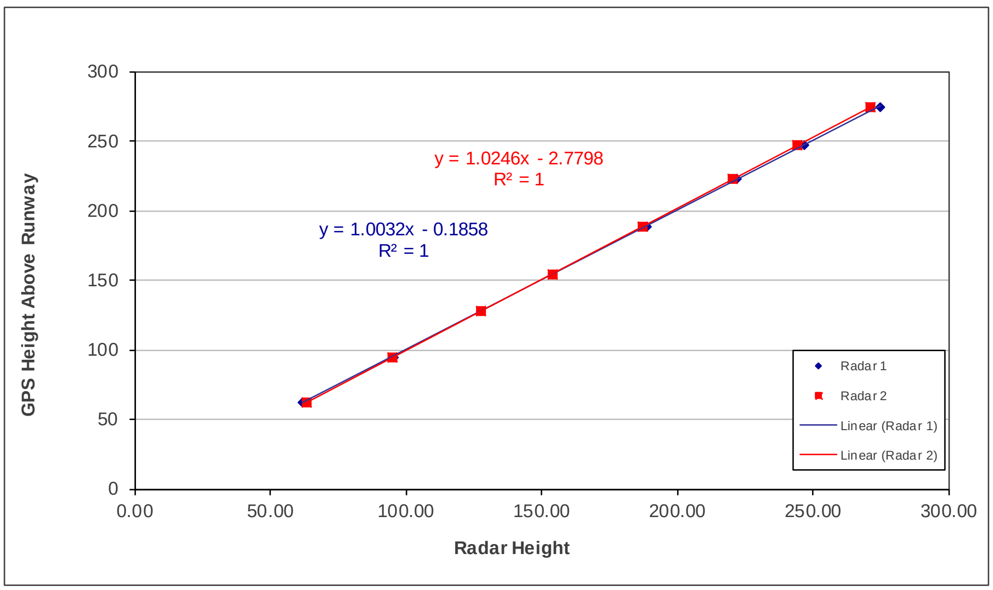
Runway Height	501.5
Tail Height	3.5

Test Location		Saskatoon Rwy 15-33
Radar 1 Type		Thompson-CFS ERT160
Radar 2 Type		Terra TRA-30

Radar 1 Scale Factor	1.002
Radar 2 Scale Factor	1.004

Calibration Results

PASS (ft)	GPSAlt	RAlt 1	RAlt 2	Hgt AGL	RAlt 1 Scale	RAlt 2 Scale
1	566.93	61.72	63.22	61.93000249	1.003	0.980
2	599.48	95.20	94.85	94.47570467	0.992	0.996
3	633.20	127.74	127.70	128.2042416	1.004	1.004
4	659.59	153.74	153.88	154.5930828	1.006	1.005
5	693.54	188.40	186.84	188.540702	1.001	1.009
6	728.05	221.95	219.98	223.0525588	1.005	1.014
7	752.33	246.52	244.16	247.3254582	1.003	1.013
8	779.68	274.57	270.97	274.682564	1.000	1.014



Radar Altimeter Calibration Analysis

Project	OMNDM SL
Flight	147
Aircraft	C-GJBG
Date	2016-09-29
Julian Day	274

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Calibration Summary

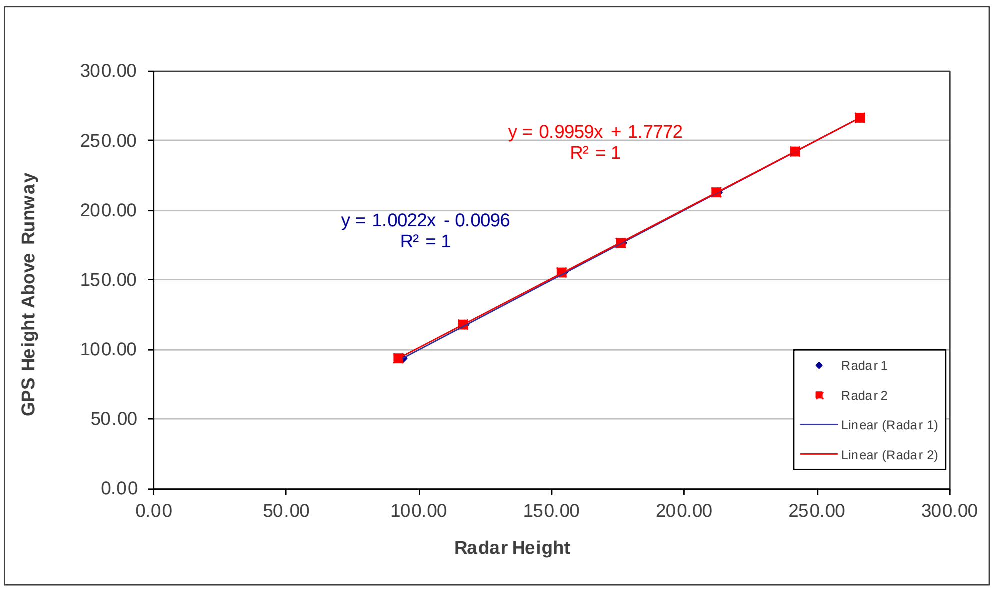
Runway Height	501.5
Tail Height	3.5

Test Location	Saskatoon Rwy 15-33
Radar 1 Type	Thompson-CFS ERT160
Radar 2 Type	Terra TRA-30

Radar 1 Scale Factor	1.002
Radar 2 Scale Factor	1.007

Calibration Results

PASS (ft)	GPSAlt	RAlt 1	RAlt 2	Hgt AGL	RAlt 1 Scale	RAlt 2 Scale
1	598.27	93.63	91.99	93.27	0.996	1.014
2	622.92	117.32	116.60	117.92	1.005	1.011
3	659.76	154.13	153.52	154.76	1.004	1.008
4	681.88	176.48	175.85	176.88	1.002	1.006
5	717.91	212.31	211.82	212.91	1.003	1.005
6	747.27	241.57	241.45	242.27	1.003	1.003
7	771.32	266.14	265.81	266.32	1.001	1.002



Radar Altimeter Calibration Analysis

Project	OMNDM SL
Flight	149
Aircraft	C-GLDX
Date	2016-09-29
Julian Day	274

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Calibration Summary

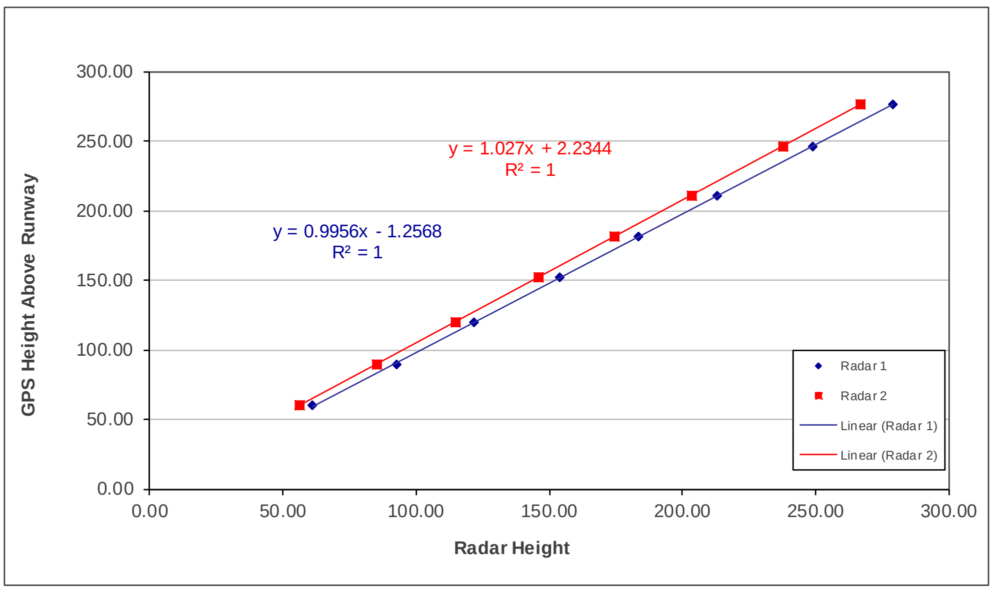
Runway Height	501.5
Tail Height	1.6

Test Location	Saskatoon Rwy 15-33
Radar 1 Type	Thompson-CFS ERT160
Radar 2 Type	Terra TRA-30

Radar 1 Scale Factor	0.99
Radar 2 Scale Factor	1.04

Calibration Results

PASS (ft)	GPSAlt	RAlt 1	RAlt 2	Hgt AGL	RAlt 1 Scale	RAlt 2 Scale
1	563.02	61.15	56.16	59.92	0.980	1.067
2	593.09	92.46	85.51	89.99	0.973	1.052
3	623.10	121.48	114.64	120.00	0.988	1.047
4	655.21	153.74	145.85	152.11	0.989	1.043
5	684.36	183.58	174.37	181.26	0.987	1.040
6	714.08	212.92	203.17	210.98	0.991	1.038
7	749.63	248.81	237.97	246.53	0.991	1.036
8	779.40	279.01	266.82	276.30	0.990	1.036



3. COMPENSATION FIGURES OF MERIT

Compensation / Figure of Merit Test Analysis

Project	OMNDM SL
Flight	71
Aircraft	C-GJBB
Date	2016-08-10
Julian Day	223

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Test Summary

MB FOM	0.80
MR FOM	1.31
ML FOM	1.31

Test Location	Kenora
Reason for Comp / FOM	Return from Degaussing

Air Time	1.3
Test Time	1.3
Ferry Time	0

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.06	0.14	0.08	0.11	0.39
Roll	0.1	0.03	0.03	0.04	0.20
Yaw	0.03	0.08	0.03	0.07	0.21
Sum	0.19	0.25	0.14	0.22	0.80

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.09	0.2	0.11	0.13	0.53
Roll	0.11	0.09	0.07	0.07	0.34
Yaw	0.08	0.12	0.09	0.15	0.44
Sum	0.28	0.41	0.27	0.35	1.31

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.11	0.14	0.1	0.13	0.48
Roll	0.15	0.16	0.06	0.1	0.47
Yaw	0.1	0.1	0.09	0.07	0.36
Sum	0.36	0.40	0.25	0.30	1.31

Compensation / Figure of Merit Test Analysis

Project	OMNDM SL
Flight	18
Aircraft	C-GJBG
Date	2016-07-10
Julian Day	193

Pilot	Mathieson
Copilot	Heit
Processor	Heath

Test Summary

MB FOM	1.19
MR FOM	1.44
ML FOM	1.45

Test Location	Kenora
Reason for Comp / FOM	Start of Project

Air Time	0.7
Test Time	0.7
Ferry Time	0

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.18	0.1	0.14	0.12	0.54
Roll	0.06	0.03	0.04	0.04	0.17
Yaw	0.08	0.2	0.05	0.15	0.48
Sum	0.32	0.33	0.23	0.31	1.19

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.21	0.15	0.15	0.1	0.61
Roll	0.09	0.06	0.04	0.09	0.28
Yaw	0.12	0.19	0.1	0.14	0.55
Sum	0.42	0.40	0.29	0.33	1.44

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.23	0.15	0.13	0.11	0.62
Roll	0.11	0.12	0.13	0.07	0.43
Yaw	0.1	0.14	0.05	0.11	0.40
Sum	0.44	0.41	0.31	0.29	1.45

Compensation / Figure of Merit Test Analysis

Project	OMNDM SL
Flight	17
Aircraft	C-GLDX
Date	2016-07-10
Julian Day	193

Pilot	Pitre
Copilot	McSweeny
Processor	Heath

Test Summary

MB FOM	0.71
MR FOM	1.28
ML FOM	0.77

Test Location	Kenora
Reason for Comp / FOM	Project Start

Air Time	
Test Time	
Ferry Time	

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.03	0.06	0.06	0.09	0.24
Roll	0.02	0.07	0.06	0.03	0.18
Yaw	0.03	0.12	0.02	0.12	0.29
Sum	0.08	0.25	0.14	0.24	0.71

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.13	0.12	0.1	0.14	0.49
Roll	0.04	0.06	0.06	0.06	0.22
Yaw	0.11	0.13	0.11	0.22	0.57
Sum	0.28	0.31	0.27	0.42	1.28

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.13	0.07	0.05	0.06	0.31
Roll	0.05	0.04	0.06	0.04	0.19
Yaw	0.02	0.1	0.04	0.11	0.27
Sum	0.20	0.21	0.15	0.21	0.77

Compensation / Figure of Merit Test Analysis

Project	OMNDM SL
Flight	80
Aircraft	C-GJBG
Date	2016-08-15
Julian Day	228

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Test Summary

MB FOM	0.99
MR FOM	1.49
ML FOM	1.46

Test Location	Kenora
Reason for Comp / FOM	Recompensating after engine change

Air Time	1
Test Time	1
Ferry Time	0

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.17	0.13	0.08	0.12	0.50
Roll	0.04	0.03	0.04	0.02	0.13
Yaw	0.04	0.15	0.04	0.13	0.36
Sum	0.25	0.31	0.04	0.27	0.87

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.14	0.19	0.12	0.19	0.64
Roll	0.1	0.05	0.09	0.07	0.31
Yaw	0.11	0.14	0.13	0.16	0.54
Sum	0.35	0.38	0.34	0.42	1.49

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.17	0.16	0.11	0.13	0.57
Roll	0.08	0.14	0.07	0.05	0.34
Yaw	0.15	0.15	0.09	0.16	0.55
Sum	0.40	0.45	0.27	0.34	1.46

Compensation / Figure of Merit Test Analysis

Project	OMNDM SL
Flight	120
Aircraft	C-GJBG
Date	2016-09-13
Julian Day	257

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Test Summary

MB FOM	0.87
MR FOM	1.29
ML FOM	1.42

Test Location	Kenora
Reason for Comp / FOM	Left Mag replaced

Air Time	1
Test Time	1
Ferry Time	0

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.08	0.09	0.08	0.08	0.33
Roll	0.07	0.03	0.05	0.03	0.18
Yaw	0.08	0.12	0.05	0.11	0.36
Sum	0.23	0.24	0.18	0.22	0.87

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.09	0.13	0.1	0.13	0.45
Roll	0.14	0.07	0.07	0.11	0.39
Yaw	0.09	0.13	0.1	0.13	0.45
Sum	0.32	0.33	0.27	0.37	1.29

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.13	0.1	0.1	0.14	0.47
Roll	0.08	0.1	0.07	0.13	0.38
Yaw	0.12	0.22	0.11	0.12	0.57
Sum	0.33	0.42	0.28	0.39	1.42

Compensation / Figure of Merit Test Analysis

Project	OMNDM SL
Flight	121
Aircraft	C-GJBB
Date	2016-09-13
Julian Day	257

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Test Summary

MB FOM	0.70
MR FOM	1.32
ML FOM	1.42

Test Location	Kenora
Reason for Comp / FOM	Tail mag Replaced

Air Time	1.1
Test Time	
Ferry Time	1.1

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.12	0.06	0.05	0.04	0.27
Roll	0.03	0.01	0.09	0.03	0.16
Yaw	0.07	0.08	0.05	0.07	0.27
Sum	0.22	0.15	0.19	0.14	0.70

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.12	0.1	0.11	0.07	0.40
Roll	0.08	0.09	0.08	0.05	0.30
Yaw	0.1	0.23	0.12	0.17	0.62
Sum	0.30	0.42	0.31	0.29	1.32

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.09	0.11	0.07	0.12	0.39
Roll	0.18	0.13	0.12	0.11	0.54
Yaw	0.11	0.2	0.11	0.07	0.49
Sum	0.38	0.44	0.30	0.30	1.42

Compensation / Figure of Merit Test Analysis

Project	OMNDM SL
Flight	143
Aircraft	C-GJBB
Date	2016-09-28
Julian Day	272

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Test Summary

MB FOM	0.83
MR FOM	1.40
ML FOM	1.24

Test Location	Saskatoon
Reason for Comp / FOM	End of Project

Air Time	1
Test Time	
Ferry Time	1

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.1	0.07	0.08	0.1	0.35
Roll	0.05	0.04	0.03	0.05	0.17
Yaw	0.08	0.09	0.06	0.08	0.31
Sum	0.23	0.20	0.17	0.23	0.83

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.11	0.11	0.07	0.12	0.41
Roll	0.07	0.06	0.06	0.07	0.26
Yaw	0.19	0.21	0.13	0.2	0.73
Sum	0.37	0.38	0.26	0.39	1.40

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.09	0.12	0.09	0.1	0.40
Roll	0.12	0.1	0.07	0.11	0.40
Yaw	0.07	0.15	0.1	0.12	0.44
Sum	0.28	0.37	0.26	0.33	1.24

Compensation / Figure of Merit Test Analysis

Project	Ear Falls
Flight	145
Aircraft	C-GJBG
Date	2016-09-29
Julian Day	273

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Test Summary

MB FOM	0.74
MR FOM	1.19
ML FOM	1.47
MT FOM	
GX FOM	
GY FOM	
GZ FOM	

Test Location	Saskatoon
Reason for Comp / FOM	End of Project

Air Time	
Test Time	
Ferry Time	

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.07	0.08	0.07	0.05	0.27
Roll	0.1	0.05	0.03	0.03	0.21
Yaw	0.04	0.1	0.04	0.08	0.26
Sum	0.21	0.23	0.14	0.16	0.74

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.13	0.1	0.08	0.12	0.43
Roll	0.17	0.09	0.08	0.07	0.41
Yaw	0.1	0.07	0.07	0.11	0.35
Sum	0.40	0.26	0.23	0.30	1.19

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.14	0.09	0.08	0.17	0.48
Roll	0.16	0.14	0.09	0.12	0.51
Yaw	0.1	0.15	0.12	0.11	0.48
Sum	0.40	0.38	0.29	0.40	1.47

Compensation / Figure of Merit Test Analysis

Project	Ear Falls
Flight	144
Aircraft	C-GLDX
Date	2016-09-28
Julian Day	272

Pilot	Mathieson
Copilot	Patterson
Processor	Heath

Test Summary

MB FOM	0.55
MR FOM	1.43
ML FOM	0.65
MT FOM	
GX FOM	
GY FOM	

Test Location	Saskatoon
Reason for Comp / FOM	End of Project

Air Time	0.9
Test Time	
Ferry Time	0.9

FOM Analysis

Bottom Tail Magnetometer (MBc)					
	North	East	South	West	Sum
Pitch	0.06	0.05	0.06	0.06	0.23
Roll	0.02	0.04	0.05	0.05	0.16
Yaw	0.04	0.04	0.04	0.04	0.16
Sum	0.12	0.13	0.15	0.15	0.55

Right Wing Magnetometer (MRc)					
	North	East	South	West	Sum
Pitch	0.07	0.12	0.13	0.09	0.41
Roll	0.07	0.18	0.08	0.09	0.42
Yaw	0.18	0.14	0.11	0.17	0.60
Sum	0.32	0.44	0.32	0.35	1.43

Left Wing Magnetometer (MLc)					
	North	East	South	West	Sum
Pitch	0.04	0.04	0.06	0.06	0.20
Roll	0.07	0.07	0.04	0.06	0.24
Yaw	0.06	0.04	0.05	0.06	0.21
Sum	0.17	0.15	0.15	0.18	0.65

4. HEADING TESTS

Heading Test Analysis

Project	OMNDM SL
Flight	10
Aircraft	C-GJBB
Date	2016-07-06
Julian Day	189

Pilot	Mathieson
Copilot	
Processor	Carson

Test Summary

MB Mean Offset	-4.87
MB Mean N/S Error	0.29
MB Mean E/W Error	0.14
MB Mean Error	0.22
MR Mean Offset	-5.37
MR Mean N/S Error	0.72
MR Mean E/W Error	0.08
MR Mean Error	0.40
ML Mean Offset	-9.31
ML Mean N/S Error	0.26
ML Mean E/W Error	0.33
ML Mean Error	0.30

Test Location	Meanook, AB
Station Offset	

Air Time	5.1
Test Time	0.3
Ferry Time	

Test Results

Bottom Tail Magnetometer (MB)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	N	72101.4	57257.94	57262.57	-4.63	0.33	N-S
2	S	72201.6	57257.24	57262.20	-4.96		
3	N	72308.6	57257.59	57262.20	-4.61	0.31	N-S
4	S	72392.7	57257.81	57262.73	-4.92		
5	N	72492.5	57257.93	57262.56	-4.63	0.25	N-S
6	S	72579.0	57257.94	57262.82	-4.88		
7	W	72690.0	57258.60	57263.51	-4.92	0.05	E-W
8	E	72787.6	57259.12	57263.99	-4.86		
9	W	72879.1	57259.53	57264.66	-5.13	0.32	E-W
10	E	72968.8	57260.15	57264.97	-4.81		
11	W	73053.2	57260.15	57265.14	-4.99	0.06	E-W
12	E	73143.0	57259.90	57264.95	-5.05		

Right Wing Magnetometer (MR)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	N	72101.4	57257.56	57262.57	-5.01	0.74	N-S
2	S	72201.6	57256.46	57262.20	-5.74		
3	N	72308.6	57257.20	57262.20	-5.00	0.70	N-S
4	S	72392.7	57257.03	57262.73	-5.70		
5	N	72492.5	57257.54	57262.56	-5.02	0.73	N-S
6	S	72579.0	57257.07	57262.82	-5.75		
7	W	72690.0	57258.19	57263.51	-5.33	0.01	E-W
8	E	72787.6	57258.65	57263.99	-5.34		
9	W	72879.1	57259.18	57264.66	-5.48	0.19	E-W
10	E	72968.8	57259.68	57264.97	-5.29		
11	W	73053.2	57259.74	57265.14	-5.40	0.03	E-W
12	E	73143.0	57259.52	57264.95	-5.43		

Left Wing Magnetometer (ML)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	N	72101.4	57253.15	57262.57	-9.42	0.20	N-S
2	S	72201.6	57252.98	57262.20	-9.22		
3	N	72308.6	57252.78	57262.20	-9.42	0.27	N-S
4	S	72392.7	57253.58	57262.73	-9.15		
5	N	72492.5	57253.17	57262.56	-9.39	0.32	N-S
6	S	72579.0	57253.75	57262.82	-9.07		
7	W	72690.0	57254.50	57263.51	-9.02	0.46	E-W
8	E	72787.6	57254.51	57263.99	-9.48		
9	W	72879.1	57255.26	57264.66	-9.41	0.06	E-W
10	E	72968.8	57255.50	57264.97	-9.47		
11	W	73053.2	57256.03	57265.14	-9.11	0.47	E-W
12	E	73143.0	57255.38	57264.95	-9.57		

Heading Test Analysis

Project	OMNDM SL
Flight	26
Aircraft	C-GJBG
Date	2016-03-23
Julian Day	

Pilot	Mathieson
Copilot	
Processor	Carson

Test Summary

MB Mean Offset	-5.04
MB Mean N/S Error	0.39
MB Mean E/W Error	0.12
MB Mean Error	0.25
MR Mean Offset	-2.31
MR Mean N/S Error	0.04
MR Mean E/W Error	0.08
MR Mean Error	0.06
ML Mean Offset	-1.98
ML Mean N/S Error	0.08
ML Mean E/W Error	0.05
ML Mean Error	0.06

Test Location	Meanook, AB
Station Offset	

Air Time	5.2
Test Time	0.3
Ferry Time	

Test Results

Bottom Tail Magnetometer (MB)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	S	66077.9	57320.06	57325.12	-5.06	0.36	N-S
2	N	66200.4	57321.25	57325.95	-4.70		
3	S	66316.3	57319.30	57324.42	-5.12	0.47	N-S
4	N	66443.1	57319.05	57323.71	-4.66		
5	S	66566.8	57317.30	57322.47	-5.17	0.35	N-S
6	N	66698.7	57317.08	57321.90	-4.83		
7	W	66845.8	57316.47	57321.64	-5.18	0.13	E-W
8	E	66972.0	57315.70	57320.74	-5.04		
9	W	67380.8	57311.16	57316.25	-5.09	0.18	E-W
10	E	67617.2	57314.95	57320.22	-5.27		
11	W	67791.8	57320.21	57325.34	-5.13	0.04	E-W
12	E	68000.9	57315.60	57320.77	-5.17		

Right Wing Magnetometer (MR)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	S	66077.90	57322.71	57325.12	-2.41	0.08	N-S
2	N	66200.40	57323.61	57325.95	-2.33		
3	S	66316.30	57322.10	57324.42	-2.32	0.01	N-S
4	N	66443.10	57321.38	57323.71	-2.33		
5	S	66566.80	57320.08	57322.47	-2.39	0.03	N-S
6	N	66698.70	57319.48	57321.90	-2.42		
7	W	66845.80	57319.46	57321.64	-2.18	0.08	E-W
8	E	66972.00	57318.65	57320.74	-2.10		
9	W	67380.80	57314.00	57316.25	-2.25	0.15	E-W
10	E	67617.20	57317.83	57320.22	-2.39		
11	W	67791.80	57323.07	57325.34	-2.27	0.01	E-W
12	E	68000.90	57318.48	57320.77	-2.28		

Left Wing Magnetometer (ML)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	S	66077.90	57323.07	57325.12	-2.06	0.08	N-S
2	N	66200.40	57323.97	57325.95	-1.98		
3	S	66316.30	57322.43	57324.42	-1.99	0.05	N-S
4	N	66443.10	57321.77	57323.71	-1.94		
5	S	66566.80	57320.47	57322.47	-2.00	0.12	N-S
6	N	66698.70	57319.78	57321.90	-2.12		
7	W	66845.80	57319.79	57321.64	-1.85	0.01	E-W
8	E	66972.00	57318.89	57320.74	-1.86		
9	W	67380.80	57314.30	57316.25	-1.95	0.09	E-W
10	E	67617.20	57318.18	57320.22	-2.04		
11	W	67791.80	57323.34	57325.34	-2.00	0.04	E-W
12	E	68000.90	57318.80	57320.77	-1.96		

Heading Test Analysis

Project	Ear Falls
Flight	8
Aircraft	C-GLDX
Date	2016-07-06
Julian Day	188

Pilot	Petrie
Copilot	
Processor	Carson

Heading Test Summary

MB Mean Offset	-5.17
MB Mean N/S Error	0.50
MB Mean E/W Error	0.10
MB Mean Error	0.30
MR Mean Offset	-3.88
MR Mean N/S Error	0.68
MR Mean E/W Error	0.31
MR Mean Error	0.49
ML Mean Offset	-5.55
ML Mean N/S Error	0.57
ML Mean E/W Error	0.52
ML Mean Error	0.55

Test Location	Meanook, AB
Station Offset	

Air Time	5
Test Time	0.3
Ferry Time	

Heading Test Analysis

Bottom Tail Magnetometer (MB)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	N	69883.1	57253.86	57258.65	-4.79	0.64	N-S
2	S	70067.8	57256.27	57261.70	-5.42		
3	N	70262.1	57258.58	57263.46	-4.88	0.40	N-S
4	S	70442.2	57258.16	57263.44	-5.28		
5	N	70629.5	57258.85	57263.79	-4.94	0.48	N-S
6	S	70813.5	57256.67	57262.09	-5.42		
7	W	71097.1	57254.76	57259.98	-5.22	0.11	E-W
8	E	71272.5	57254.74	57259.85	-5.11		
9	W	71462.5	57256.13	57261.45	-5.32	0.09	E-W
10	E	71634.2	57255.46	57260.69	-5.23		
11	W	71816.1	57256.11	57261.38	-5.27	0.12	E-W
12	E	71987.1	57256.98	57262.13	-5.15		

Right Wing Magnetometer (MR)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	N	69883.1	57255.28	57258.65	-3.37	0.95	N-S
2	S	70067.8	57257.38	57261.70	-4.31		
3	N	70262.1	57259.87	57263.46	-3.59	0.39	N-S
4	S	70442.2	57259.45	57263.44	-3.99		
5	N	70629.5	57260.27	57263.79	-3.52	0.70	N-S
6	S	70813.5	57257.87	57262.09	-4.22		
7	W	71097.1	57255.89	57259.98	-4.09	0.43	E-W
8	E	71272.5	57256.19	57259.85	-3.66		
9	W	71462.5	57257.34	57261.45	-4.11	0.25	E-W
10	E	71634.2	57256.83	57260.69	-3.86		
11	W	71816.1	57257.36	57261.38	-4.03	0.23	E-W
12	E	71987.1	57258.34	57262.13	-3.80		

Left Wing Magnetometer (ML)

Pass	Direction	Time	Meas TF	Base TF	Offset (nT)	Heading Error (nT)	Heading
1	N	69883.1	57253.60	57258.65	-5.04	0.75	N-S
2	S	70067.8	57255.90	57261.70	-5.79		
3	N	70262.1	57258.19	57263.46	-5.27	0.45	N-S
4	S	70442.2	57257.72	57263.44	-5.72		
5	N	70629.5	57258.48	57263.79	-5.31	0.52	N-S
6	S	70813.5	57256.26	57262.09	-5.83		
7	W	71097.1	57254.20	57259.98	-5.78	0.51	E-W
8	E	71272.5	57254.57	57259.85	-5.28		
9	W	71462.5	57255.49	57261.45	-5.95	0.56	E-W
10	E	71634.2	57255.29	57260.69	-5.40		
11	W	71816.1	57255.54	57261.38	-5.84	0.49	E-W
12	E	71987.1	57256.78	57262.13	-5.35		

5. SPECTROMETER STRIPPING CALIBRATIONS

Ground Pad Calibration

Project	OMNDM SL
Flight	NA
Aircraft	C-GJBB
Detectors	5504 /5506
Date	2016-06-28

Pilot	NA
Copilot	NA
Processor	Carson

Calibration Results

DPU 5506 Stripping Ratios	
α	0.3025
β	0.4463
ϒ	0.7937
a	0.0478
b	-0.0021
g	0.0063

DPU 5504 Stripping Ratios	
α	0.2980
β	0.4448
ϒ	0.8033
a	0.0490
b	-0.0015
g	0.0080

Calibration Data

	Known Pad Concentrations			
Window	BG (Bare)	K	U	Th
K (%)	0.86	9.77	1.02	0.82
U (ppm)	0.99	0.9	53.7	2.15
Th (ppm)	2.64	2.57	3.43	121

	DPU 5506			
Window	BG (Bare)	K	U	Th
K (c/s)	137.8	316.2	210.5	184.0
U (c/s)	23.1	24.1	110.5	55.9
Th (c/s)	25.3	24.9	30.2	127.3

	DPU 5504			
Window	BG (Bare)	K	U	Th
K (c/s)	152.5	329.0	230.4	200.9
U (c/s)	24.6	25.9	117.5	58.6
Th (c/s)	26.9	26.6	32.2	134.1

Ground Pad Calibration

Project	OMNDM SL
Flight	NA
Aircraft	C-GJBG
Detectors	5552 / 5553
Date	2016-06-28

Pilot	NA
Copilot	NA
Processor	Carson

Calibration Results

DPU 5552 Stripping Ratios	
α	0.3064
β	0.4435
Ɣ	0.8077
a	0.0541
b	-0.0004
g	0.0131

DPU 5553 Stripping Ratios	
α	0.2895
β	0.4309
Ɣ	0.7902
a	0.0508
b	0.0005
g	0.0089

Calibration Data

	Known Pad Concentrations			
Window	BG (Bare)	K	U	Th
K (%)	0.86	9.77	1.02	0.82
U (ppm)	0.99	0.9	53.7	2.15
Th (ppm)	2.64	2.57	3.43	121

	DPU 5552			
Window	BG (Bare)	K	U	Th
K (c/s)	140.8	292.4	200.5	181.0
U (c/s)	23.0	24.9	93.3	51.9
Th (c/s)	25.5	25.4	29.9	115.0

	DPU 5553			
Window	BG (Bare)	K	U	Th
K (c/s)	149.1	391.4	251.6	212.2
U (c/s)	23.7	25.6	147.7	68.1
Th (c/s)	26.4	26.4	33.6	170.4

Ground Pad Calibration

Project	OMNDM SL
Flight	NA
Aircraft	C-GLDX
Detectors	5621 / 5407
Date	2016-07-04

Pilot	NA
Copilot	NA
Processor	Carson

Calibration Results

DPU 5621 Stripping Ratios	
α	0.2910
β	0.4311
ϒ	0.8008
a	0.0489
b	-0.0013
g	0.0013

DPU 5407 Stripping Ratios	
α	0.2974
β	0.4404
ϒ	0.7967
a	0.0520
b	-0.0024
g	-0.0016

Calibration Data

	Known Pad Concentrations			
Window	BG (Bare)	K	U	Th
K (%)	0.86	9.77	1.02	0.82
U (ppm)	0.99	0.9	53.7	2.15
Th (ppm)	2.64	2.57	3.43	121

	DPU 55621			
Window	BG (Bare)	K	U	Th
K (c/s)	136.1	323.8	215.3	185.9
U (c/s)	22.3	22.4	116.8	57.5
Th (c/s)	25.8	25.5	31.2	139.5

	DPU 5621			
Window	BG (Bare)	K	U	Th
K (c/s)	143.9	300.0	209.2	184.5
U (c/s)	23.1	22.7	101.4	51.7
Th (c/s)	26.2	25.7	30.8	116.9

6. SPECTROMETER DYNAMIC CALIBRATION RANGE

Radiometric Calibraton Range

Aircraft	C-GJBB
Date	2016-07-09
Project	OMNDM SL

Pilot	Mathieson
Copilot	Heit
Processor	Carson

Calibraton Summary

Alititude Attenuation Coefficients	
Total Counts (c/s/m)	-0.007223
Potassium (c/s/m)	-0.009186
Uranium (c/s/m)	-0.007769
Thorium (c/s/m)	-0.007112

Sensitivities	
Total Counts (c/s/nGy/h)	27.6
Potassium (c/s/%)	77.9
Uranium (c/s/ppm)	8.0
Thorium (c/s/ppm)	4.5

Calibration Data

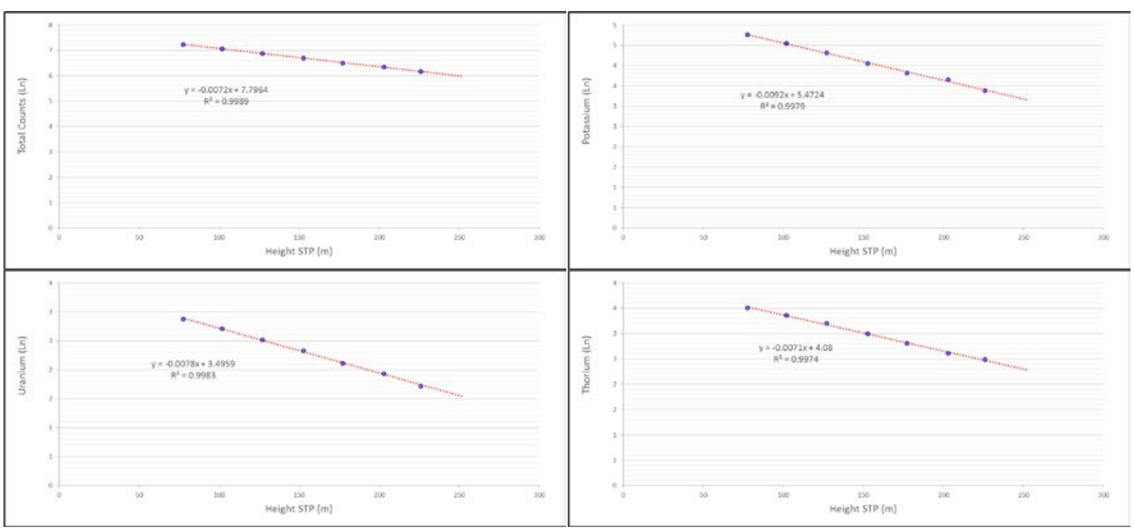
Test Line Data

Radar Alt (m)	Effective Height (m)	GPS Alt (m)	TC (c/s)	K (c/s)	U (c/s)	Th (c/s)
92.6	77.6	688.1	1715.2	181.2	43.9	44.3
121.8	101.8	717.5	1496.8	154.3	39.1	39.7
152.6	127.2	747.7	1306.1	131.4	35.5	35.5
183.8	152.8	777.5	1171.0	112.3	34.0	31.2
213.9	177.3	807.1	1065.6	99.1	33.2	27.7
245.5	202.9	837.7	966.9	89.1	30.2	24.8
274.0	226.0	864.8	899.6	80.1	30.5	23.4

Background Line Data

Radar Alt (m)	Effective Height (m)	GPS Alt (m)	TC (c/s)	K (c/s)	U (c/s)	Th (c/s)
92.0	77.4	642.5	337.3	32.4	14.8	9.8
122.1	102.4	679.3	352.7	32.6	16.2	10.2
153.3	128.3	710.6	376.3	34.3	17.4	10.3
183.0	152.7	739.7	392.4	35.7	18.1	10.6
214.4	178.4	771.4	405.6	36.6	19.1	10.4
245.1	203.4	802.0	403.8	34.4	18.9	10.9
275.3	227.9	832.0	413.4	36.8	19.5	10.5
305.5	252.1	863.2	428.1	37.5	21.0	11.4

Ground Truth Concentrations	
Total Counts (nGy/h)	42.8
Potassium (%)	1.2
Uranium (ppm)	1.9
Thorium (ppm)	6.5



Calibraton Range Flight

Aircraft	C-GJBG
Date	2016-07-09
Project	OMNDM SL

Pilot	Bartlett
Copilot	McSweeny
Processor	Carson

Calibraton Results

Alititude Attenuation Coefficients	
Total Counts (c/s/m)	-0.007012
Potassium (c/s/m)	-0.008962
Uranium (c/s/m)	-0.007873
Thorium (c/s/m)	-0.006895

Sensitivities	
Total Counts (c/s/nGy/h)	27.4
Potassium (c/s/%)	78.5
Uranium (c/s/ppm)	7.8
Thorium (c/s/ppm)	4.4

Calibration Data

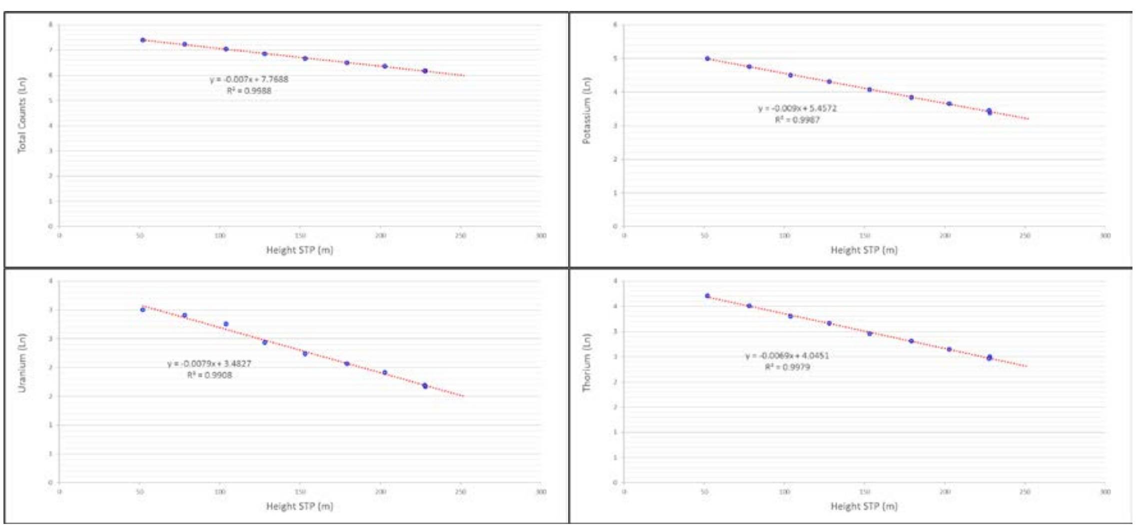
Test Line Data

Radar Alt (m)	Effective Height (m)	GPS Alt (m)	TC (c/s)	K (c/s)	U (c/s)	Th (c/s)
61.6	52.2	661.4	2080.8	225.1	56.5	52.9
92.8	78.3	689.8	1823.9	189.0	51.7	45.4
123.4	103.8	720.2	1588.9	157.5	46.9	39.2
152.8	128.1	748.8	1426.7	138.9	44.4	35.6
183.3	153.2	777.7	1292.9	120.9	42.8	31.7
215.1	179.2	809.1	1168.8	107.0	40.3	29.1
243.8	202.6	837.0	1088.6	97.0	38.4	26.4
274.8	227.5	866.4	1031.4	89.6	39.1	24.4

Background Line Data

Radar Alt (m)	Effective Height (m)	GPS Alt (m)	TC (c/s)	K (c/s)	U (c/s)	Th (c/s)
92.3	78.2	650.6	465.1	41.1	22.2	9.9
123.1	103.9	681.6	487.6	41.9	23.7	10.4
153.5	129.2	711.9	494.5	42.2	23.8	10.2
183.8	154.3	741.6	492.2	42.6	24.6	10.7
215.4	180.1	773.8	501.9	41.7	25.4	10.8
243.5	202.9	802.0	523.0	43.8	26.2	11.2
275.4	228.9	833.1	523.2	44.7	26.0	11.3
304.4	252.2	862.6	522.1	44.7	26.2	10.8

Ground Truth Concentrations	
Total Counts (nGy/h)	42.8
Potassium (%)	1.2
Uranium (ppm)	1.9
Thorium (ppm)	6.5



Calibraton Range Flight

Aircraft	C-GLDX
Date	2016-07-09
Project	OMNDM SL

Pilot	Petrie
Copilot	Patterson
Processor	Carson

Calibraton Results

Alititude Attenuation Coefficients	
Total Counts (c/s/m)	-0.007244
Potassium (c/s/m)	-0.009133
Uranium (c/s/m)	-0.007554
Thorium (c/s/m)	-0.007483

Sensitivities	
Total Counts (c/s/nGy/h)	26.6
Potassium (c/s/%)	75.2
Uranium (c/s/ppm)	7.8
Thorium (c/s/ppm)	4.4

Calibration Data

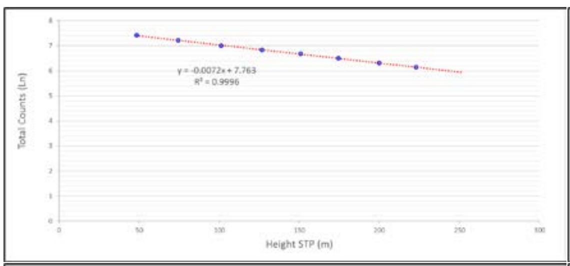
Test Line Data

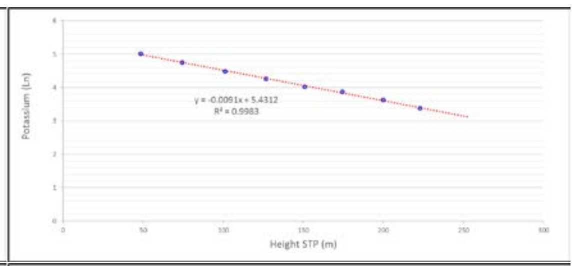
Radar Alt (m)	Effective Height (m)	GPS Alt (m)	TC (c/s)	K (c/s)	U (c/s)	Th (c/s)
57.9	48.6	657.6	2061.9	220.8	53.8	52.1
89.1	74.5	686.6	1774.5	182.6	49.5	45.3
121.5	101.2	717.3	1541.5	150.3	44.7	39.3
152.7	126.8	747.1	1364.6	129.5	41.5	34.7
182.5	151.0	778.3	1200.4	110.1	36.9	30.8
211.4	174.4	808.5	1065.3	98.3	33.1	27.8
243.0	200.0	838.8	958.1	85.9	31.5	24.7
271.8	223.0	869.9	867.3	75.7	29.6	22.3

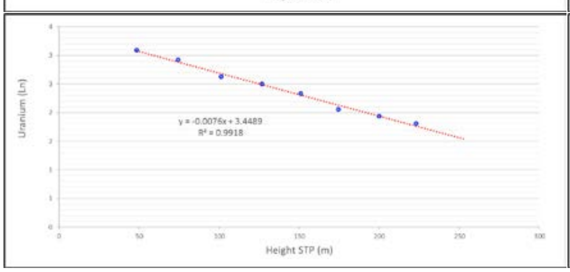
Background Line Data

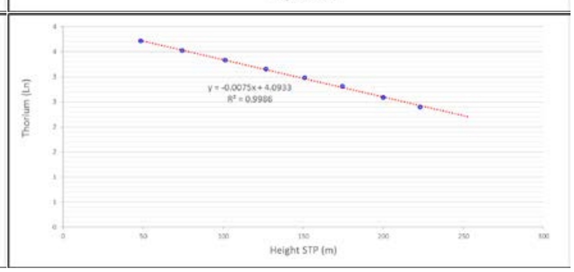
Radar Alt (m)	Effective Height (m)	GPS Alt (m)	TC (c/s)	K (c/s)	U (c/s)	Th (c/s)
89.0	74.6	646.8	411.1	33.8	20.2	9.8
119.3	99.8	675.8	409.0	33.4	20.0	10.1
152.7	127.3	707.3	433.9	35.5	21.4	10.5
182.9	152.0	737.5	401.0	33.5	19.0	10.7
213.2	176.6	768.9	405.6	33.3	19.9	10.4
245.0	202.4	798.3	418.5	34.1	19.8	10.3
276.8	228.0	829.0	394.8	32.9	19.1	10.7
307.7	252.7	860.4	419.7	34.8	20.4	10.8

Ground Truth Concentrations	
Total Counts (nGy/h)	42.8
Potassium (%)	1.2
Uranium (ppm)	1.9
Thorium (ppm)	6.5









7. COSMIC CALIBRATIONS

Cosmic Calibration

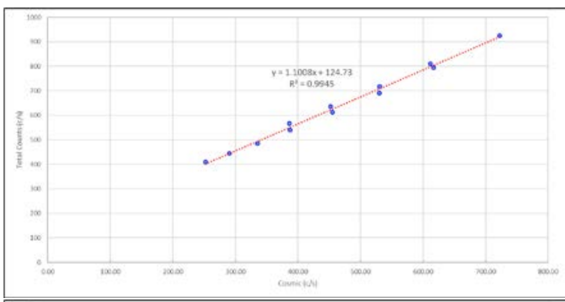
Aircraft	C-GJBB		Pilot	Mathieson
Date	2016-07-21		Copilot	Heit
Project	OMNDM SL		Processor	Carson

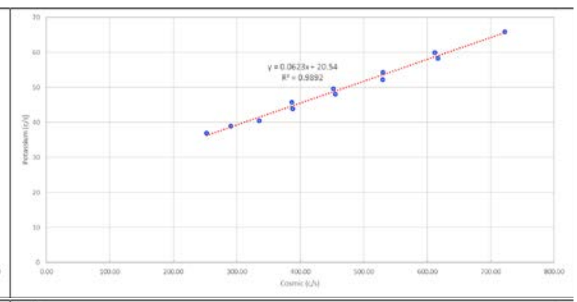
Calibration Results

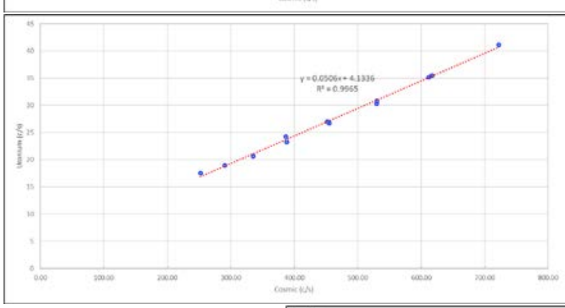
	Slope	Intercept	R^2
TC	1.1008	124.7334	0.9945
K	0.0623	20.5403	0.9892
U	0.0506	4.1336	0.9965
Th	0.0694	-3.2295	0.9989
UpU	0.0121	1.0922	0.9921

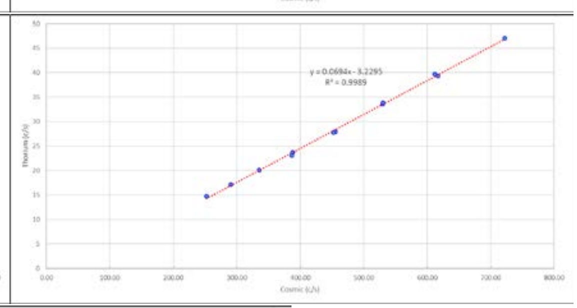
Calibration Data

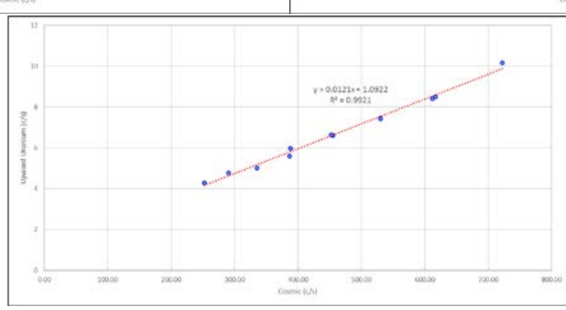
Line	GPS Alt	Cosmic	TC	K	U	Th	UpU
1	1556	252.25	409.14	36.91	17.55	14.72	4.29
2	1870	290.61	444.90	38.95	18.95	17.09	4.77
3	2192	335.46	484.55	40.44	20.66	20.07	5.00
4	2504	387.74	540.49	43.88	23.27	23.71	5.96
5	2828	454.94	611.96	48.00	26.68	27.94	6.61
6	3150	529.91	690.60	52.17	30.33	33.60	7.45
7	3473	616.80	794.50	58.20	35.43	39.30	8.49
8	3800	722.29	924.03	65.80	41.12	47.02	10.16
9	3457	611.97	809.44	59.93	35.21	39.71	8.39
10	3150	530.42	717.23	54.30	30.83	33.82	7.42
11	2826	451.93	635.89	49.53	27.02	27.82	6.63
12	2510	386.50	566.64	45.68	24.25	23.07	5.60











Cosmic Calibration

Aircraft	C-GJBG
Date	2016-07-17
Project	OMNDM SL

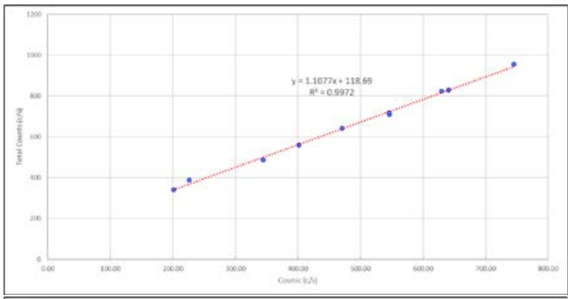
Pilot	Mathieson
Copilot	Heit
Processor	Carson

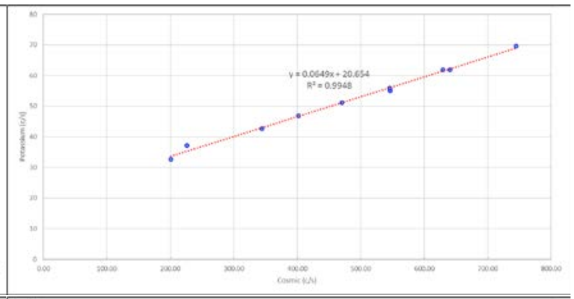
Calibration Results

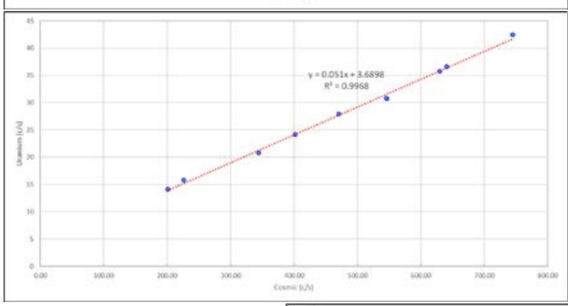
	Slope	Intercept	R^2
TC	1.1077	118.6870	0.9972
K	0.0649	20.6540	0.9948
U	0.0510	3.6898	0.9968
Th	0.0677	-1.9870	0.9988
UpU	0.0137	0.8484	0.9944

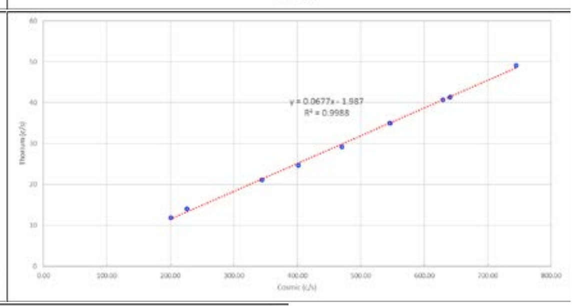
Calibration Data

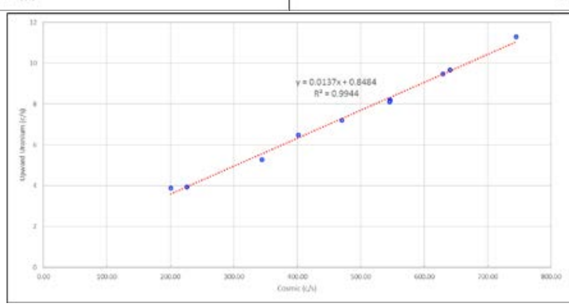
Line	GPS Alt	Cosmic	TC	K	U	Th	UpU
1	1220	226.35	388.02	37.14	15.79	14.01	3.94
2	2152	344.45	486.07	42.66	20.78	21.09	5.28
3	2472	401.79	558.72	46.79	24.13	24.66	6.48
4	2788	470.16	642.48	51.07	27.91	29.24	7.19
5	3105	545.97	708.07	54.99	30.70	34.92	8.20
6	3434	640.61	829.21	61.90	36.56	41.35	9.66
7	3736	744.86	954.25	69.61	42.44	49.05	11.28
8	3384	629.48	822.84	61.93	35.74	40.72	9.48
9	3088	545.26	716.84	55.90	30.78	34.94	8.10
10	1214	201.12	341.93	32.60	14.15	11.88	3.89











Cosmic Calibration

Aircraft	C-GLDX
Date	2016-07-16
Project	OMNDM SL

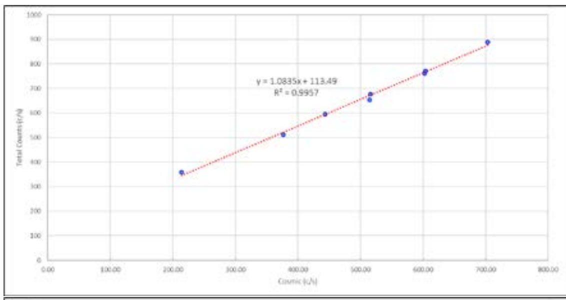
Pilot	Petrie
Copilot	Patterson
Processor	Carson

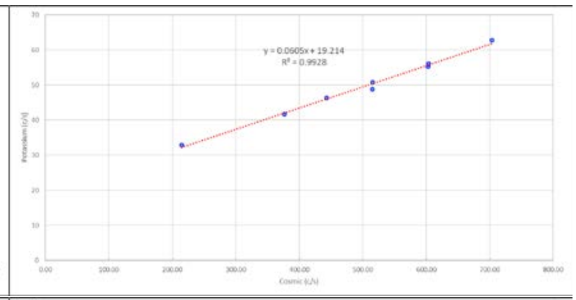
Calibration Results

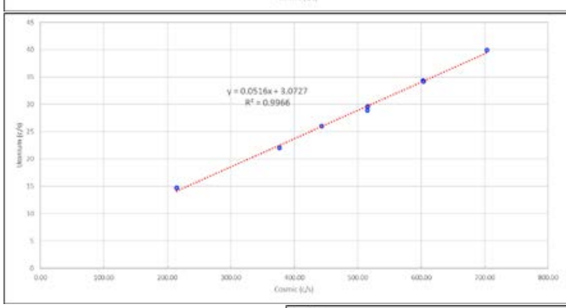
	Slope	Intercept	R^2
TC	1.0835	113.4907	0.9957
K	0.0605	19.2140	0.9928
U	0.0516	3.0727	0.9966
Th	0.0680	-2.2123	0.9985
UpU	0.0134	0.8171	0.9851

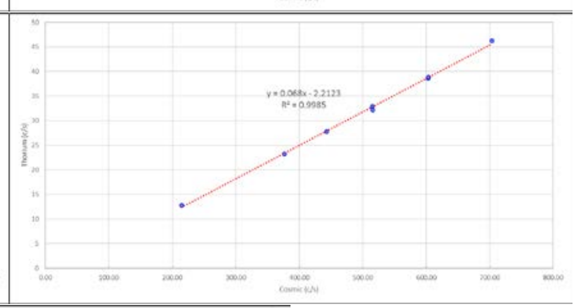
Calibration Data

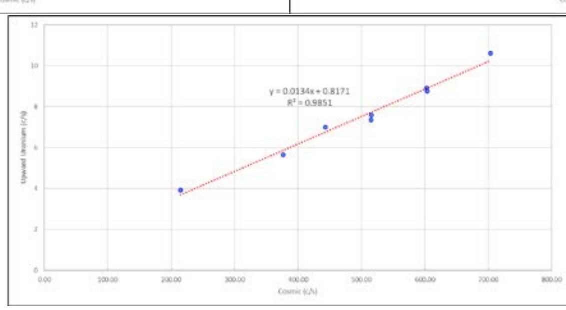
Line	GPS Alt	Cosmic	TC	K	U	Th	UpU
1	3055	514.89	652.61	48.76	28.88	32.88	7.36
2	3365	602.65	761.00	55.32	34.34	38.59	8.91
3	3681	703.54	889.00	62.70	39.95	46.26	10.60
4	3363	603.52	771.52	56.01	34.20	38.85	8.77
5	3052	516.00	676.06	50.76	29.59	32.21	7.60
6	2748	443.21	594.26	46.28	25.99	27.78	6.99
7	2418	376.30	511.90	41.64	22.06	23.22	5.65
8	1169	214.49	358.00	32.84	14.73	12.82	3.92



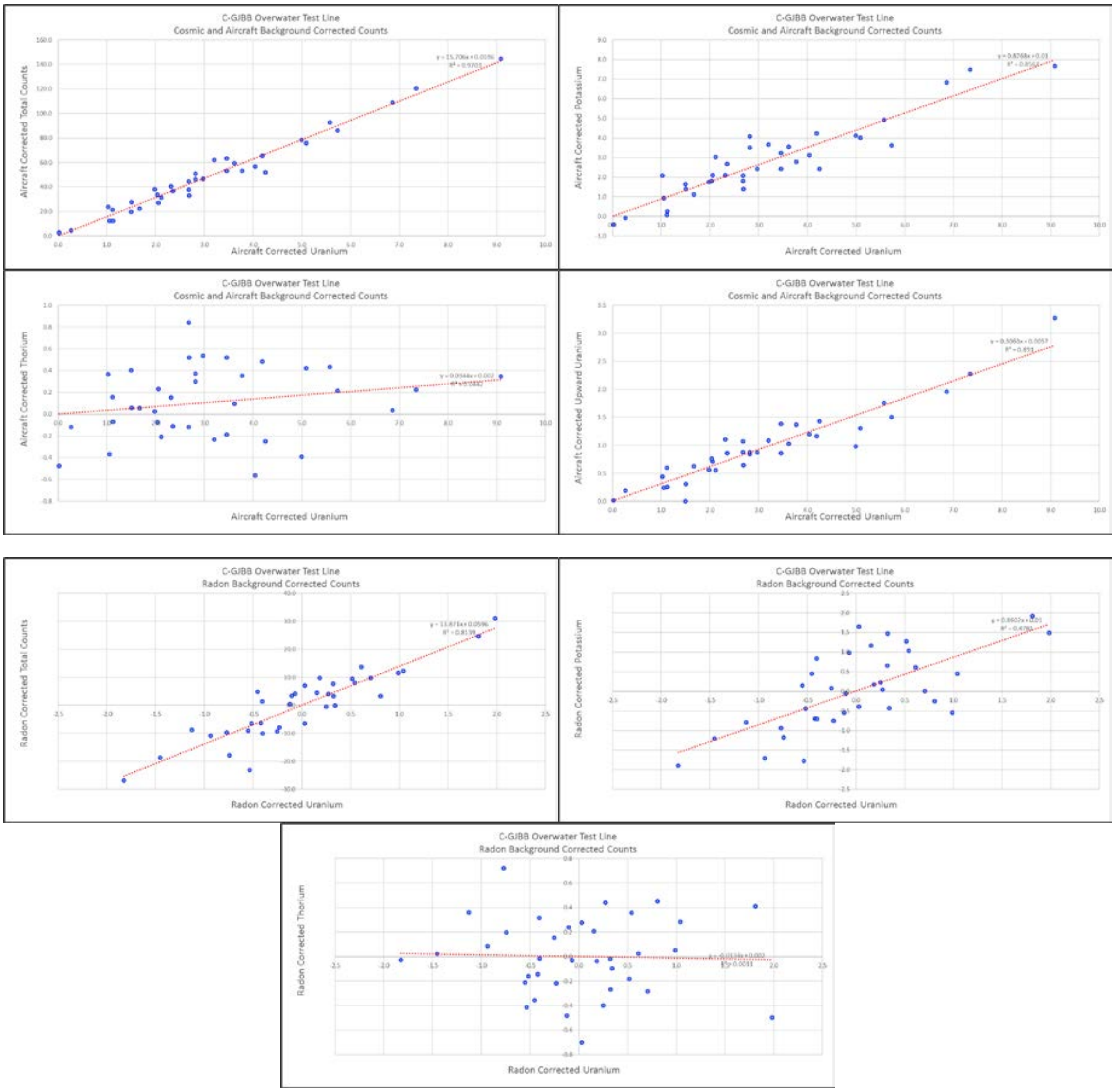


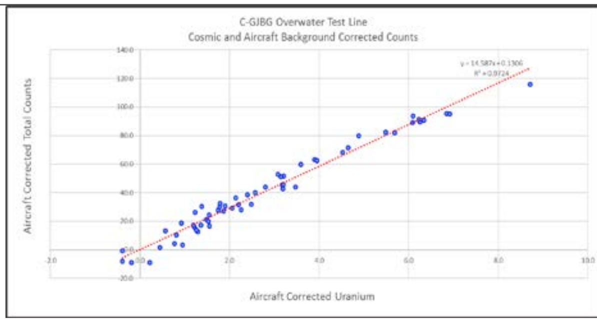


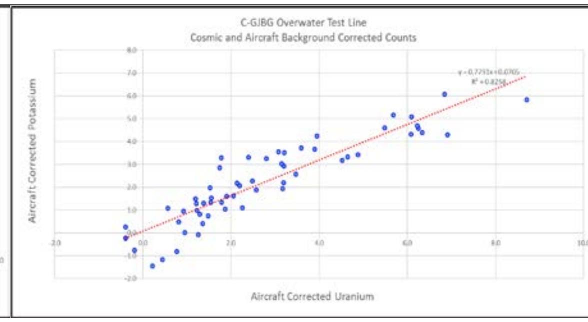


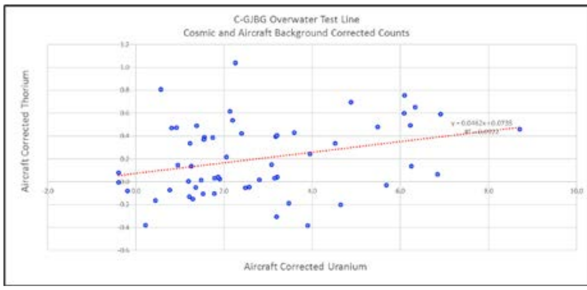


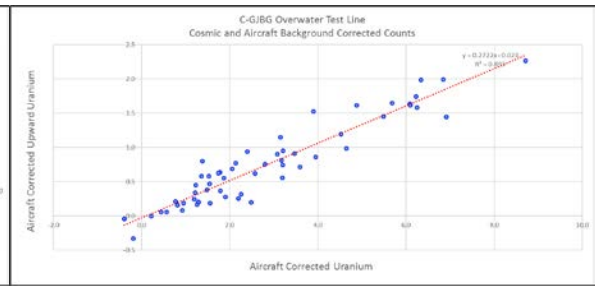
8. AIRCRAFT AND RADON BACKGROUND CALIBRATION

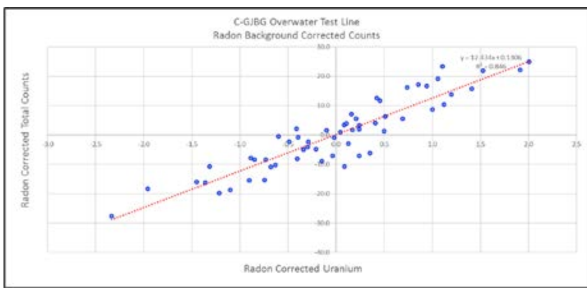


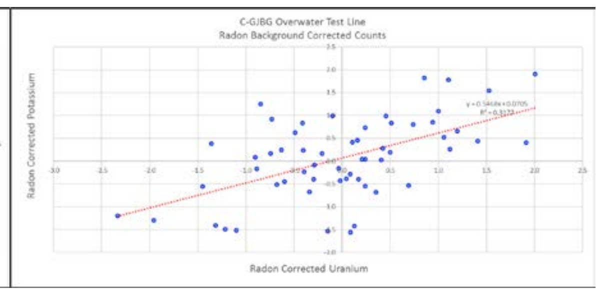

C-GJBG Overwater Test Line
Cosmic and Aircraft Background Corrected Counts
Aircraft Corrected Total Counts
Aircraft Corrected Uranium

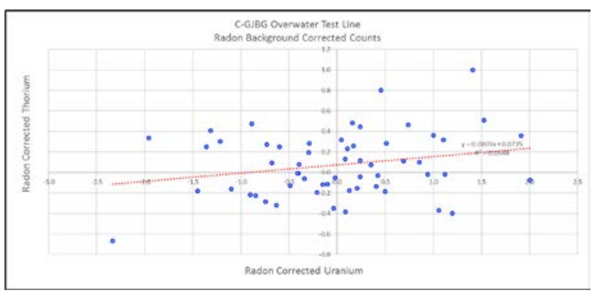

C-GJBG Overwater Test Line
Cosmic and Aircraft Background Corrected Counts
Aircraft Corrected Potassium
Aircraft Corrected Uranium

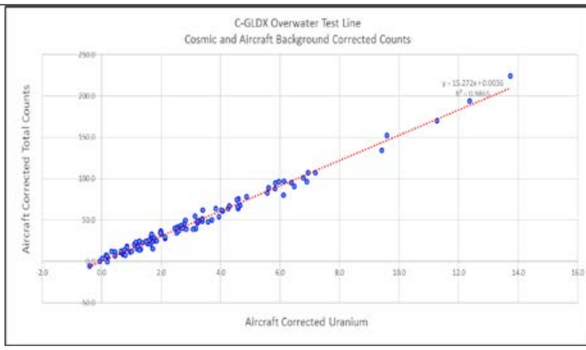

C-GJBG Overwater Test Line
Cosmic and Aircraft Background Corrected Counts
Aircraft Corrected Thorium
Aircraft Corrected Uranium

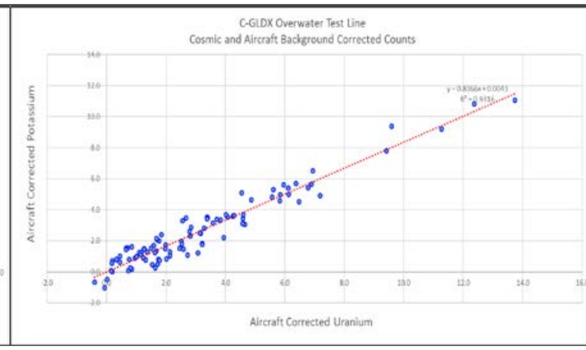

C-GJBG Overwater Test Line
Cosmic and Aircraft Background Corrected Counts
Aircraft Corrected Upward Uranium
Aircraft Corrected Uranium

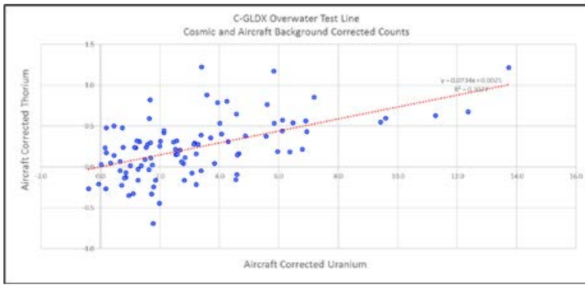

C-GJBG Overwater Test Line
Radon Background Corrected Counts
Radon Corrected Total Counts
Radon Corrected Uranium

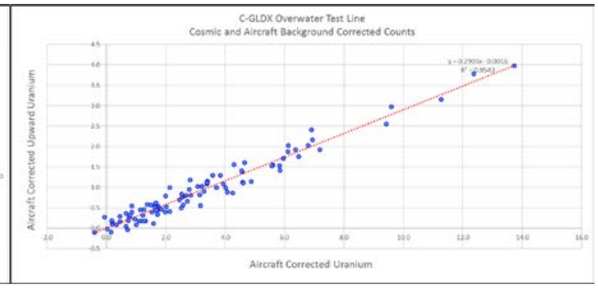

C-GJBG Overwater Test Line
Radon Background Corrected Counts
Radon Corrected Potassium
Radon Corrected Uranium

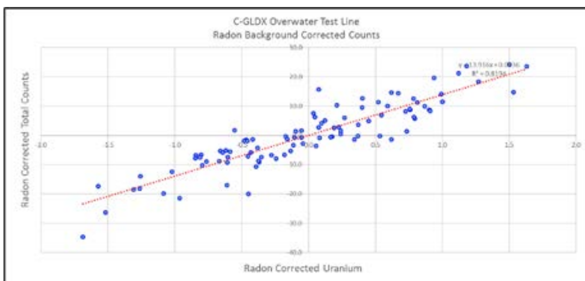

C-GJBG Overwater Test Line
Radon Background Corrected Counts
Radon Corrected Thorium
Radon Corrected Uranium

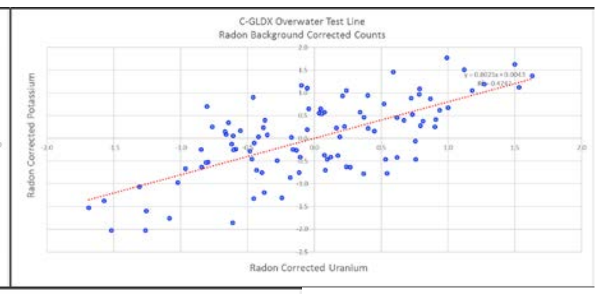

C-GLDX Overwater Test Line
Cosmic and Aircraft Background Corrected Counts
Aircraft Corrected Total Counts
Aircraft Corrected Uranium

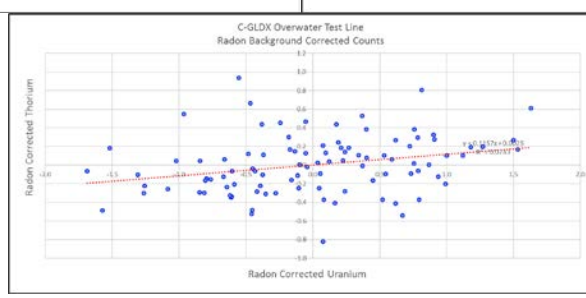

C-GLDX Overwater Test Line
Cosmic and Aircraft Background Corrected Counts
Aircraft Corrected Potassium
Aircraft Corrected Uranium


C-GLDX Overwater Test Line
Cosmic and Aircraft Background Corrected Counts
Aircraft Corrected Thorium
Aircraft Corrected Uranium

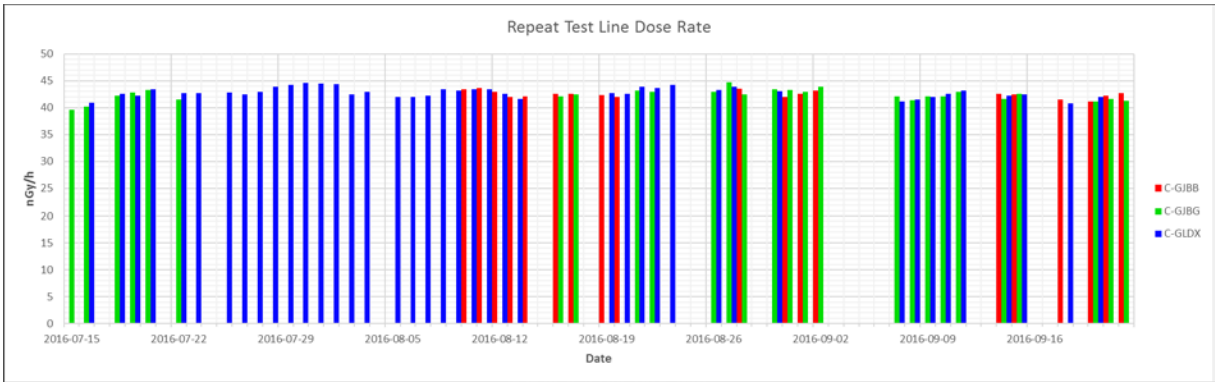

C-GLDX Overwater Test Line
Cosmic and Aircraft Background Corrected Counts
Aircraft Corrected Upward Uranium
Aircraft Corrected Uranium

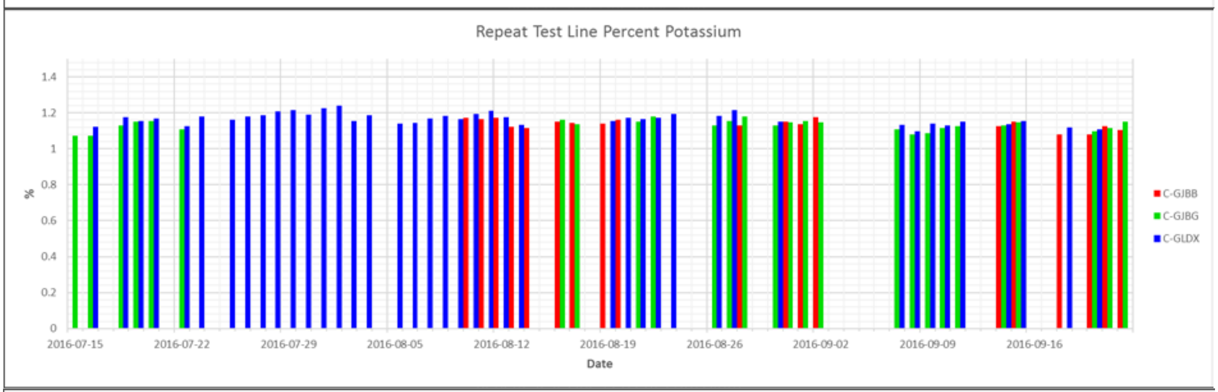

C-GLDX Overwater Test Line
Radon Background Corrected Counts
Radon Corrected Total Counts
Radon Corrected Uranium

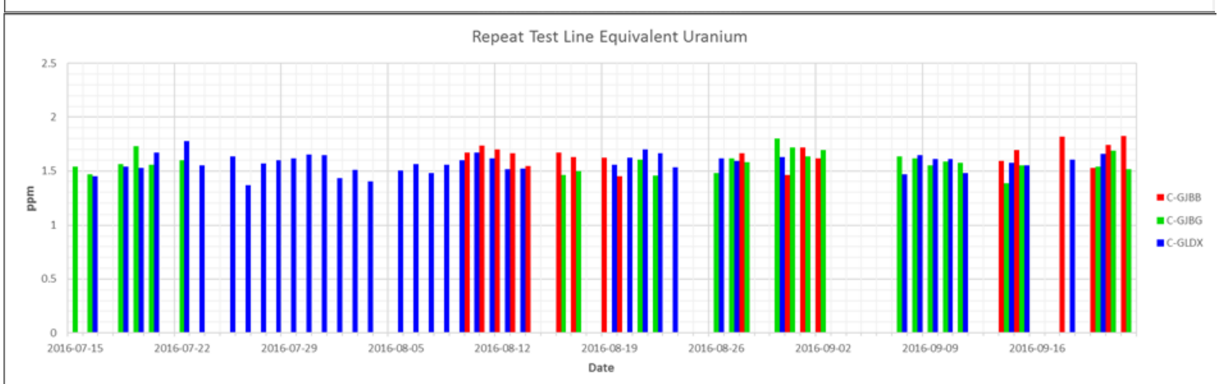

C-GLDX Overwater Test Line
Radon Background Corrected Counts
Radon Corrected Potassium
Radon Corrected Uranium

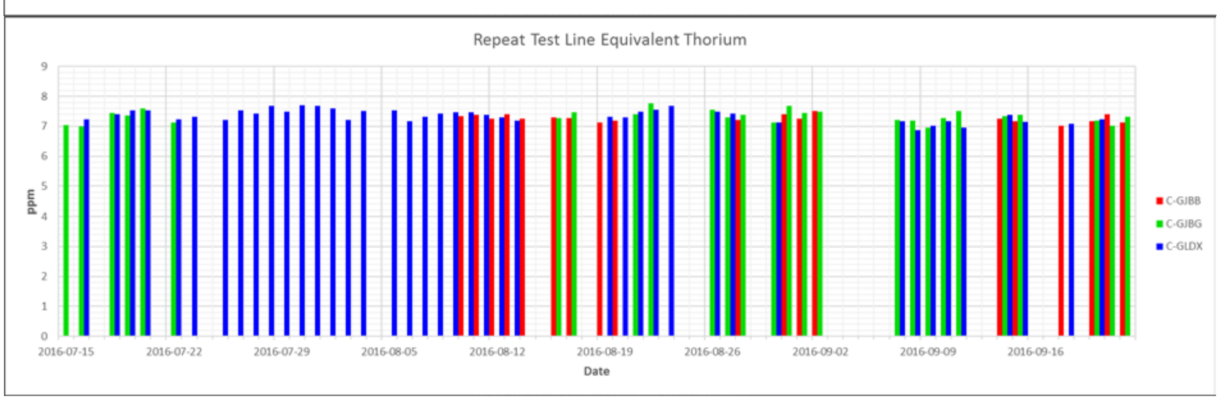

C-GLDX Overwater Test Line
Radon Background Corrected Counts
Radon Corrected Thorium
Radon Corrected Uranium

9. REPEAT TEST LINE

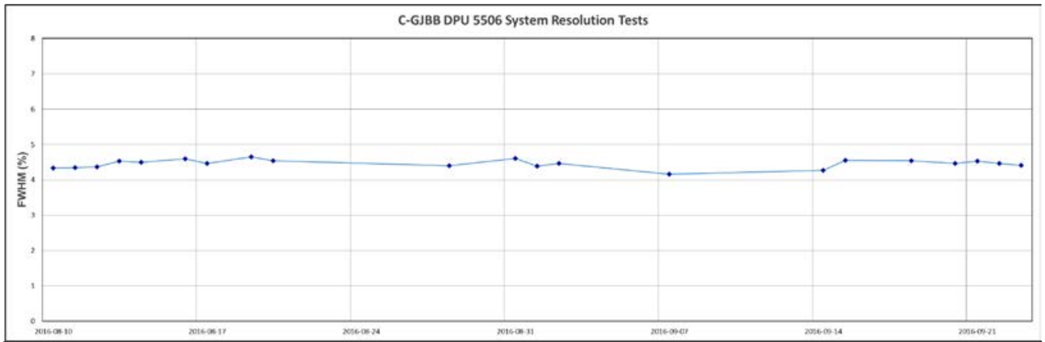


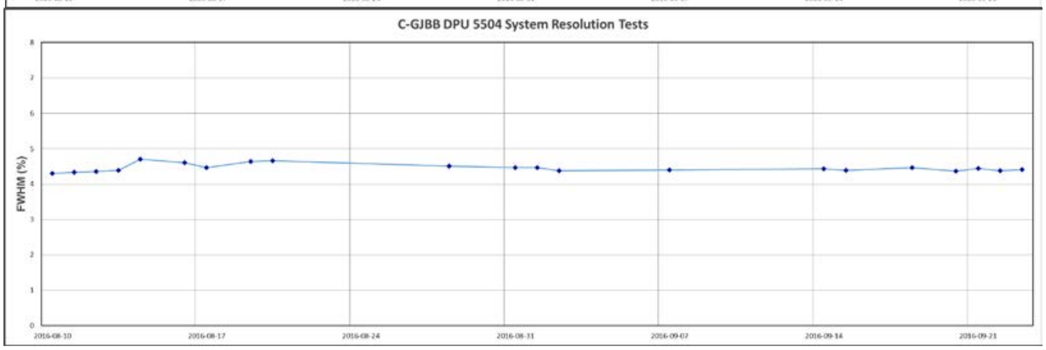


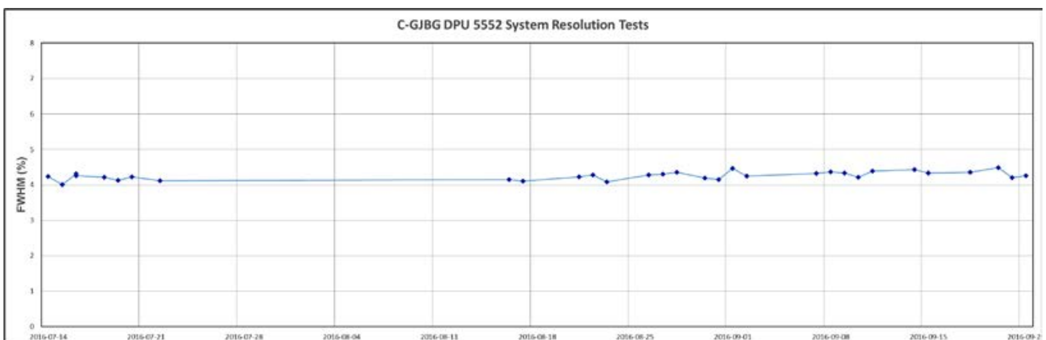


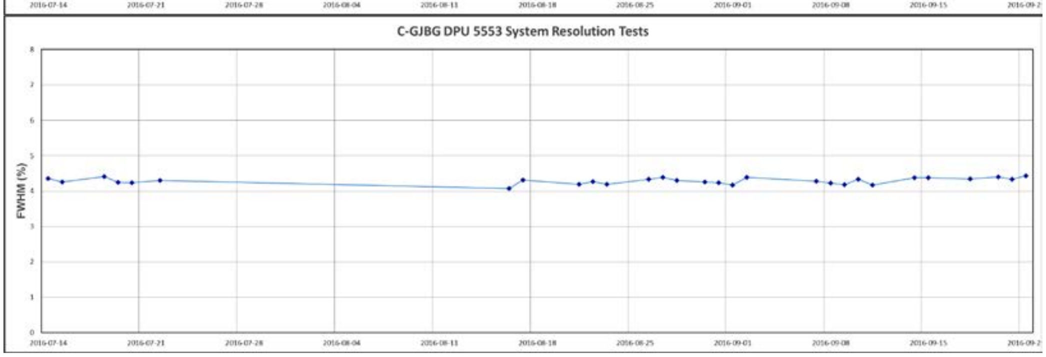


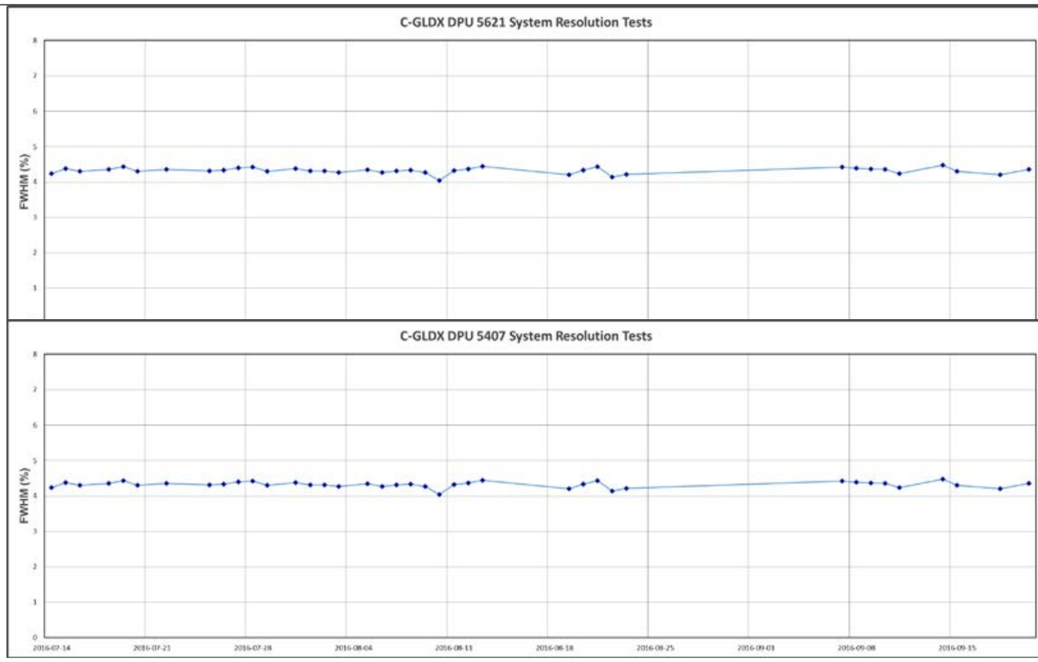
10. SYSTEM RESOLUTION TESTS










C-GLDX DPU 5621 System Resolution Tests
FWHM (%)
C-GLDX DPU 5407 System Resolution Tests
FWHM (%)
2016-07-14
2016-07-21
2016-07-28
2016-08-04
2016-08-11
2016-08-18
2016-08-25
2016-09-01
2016-09-08
2016-09-15

Appendix B. Archive Definitions

The data in Geophysical Data Set 1083 (GDS 1083a and 1083b) are derived from surveys using magnetic gradiometry and gamma-ray spectrometric systems mounted on fixed-wing platforms and carried out by Goldak Airborne Surveys.

1. ARCHIVE LAYOUT

The files for the Separation Lake geophysical survey are archived on 2 DVDs and sold as separate products, as outlined below:

Type of Data	Magnetic and Gamma-Ray Spectrometric
Format	Grid and Profile Data (DVD)
ASCII	Geophysical Data Set (GDS) 1083a
Geosoft® Binary	Geophysical Data Set (GDS) 1083b

The content of the ASCII and Geosoft® binary file types are identical. They are provided in both forms to suit the user's available software. The survey data are divided as follows.

Geophysical Data Set 1083a (DVD)

a) ASCII (*.gxf*) grids

- digital elevation model
- total magnetic field
- "GSC levelled" gradient-enhanced residual magnetic field
- second vertical derivative of the "GSC levelled" gradient-enhanced residual magnetic field
- measured lateral (across line) horizontal magnetic gradient
- measured longitudinal (along line) horizontal magnetic gradient
- total air absorbed dose rate
- potassium
- equivalent thorium
- equivalent uranium
- percent potassium / equivalent thorium ratio

b) Vector (*.dxf*) files

- flight path
- "GSC levelled" gradient-enhanced residual field magnetic contours
- Keating coefficients

c) GeoTIFF seamless map images

- "GSC levelled" gradient-enhanced residual magnetic field with planimetric base
- shaded second vertical derivative of the "GSC levelled" gradient-enhanced residual magnetic field with planimetric base
- total air absorbed dose rate with planimetric base
- potassium with planimetric base
- equivalent thorium with planimetric base
- equivalent uranium with planimetric base
- potassium, thorium, uranium ternary image with planimetric base

d) ASCII (*.xyz*) data

- profile database of magnetic data (10 Hz sampling) in ASCII XYZ format
- profile database of gamma-ray spectrometric data (1 Hz sampling) in ASCII XYZ format
- profile database of gamma-ray spectrometric data array (1 Hz sampling) in ASCII XYZ format
- database of Keating coefficients in ASCII CSV (comma-separated values) format

e) Survey report in portable document format (*.pdf*)

Geophysical Data Set 1083b (DVD)

a) Geosoft® binary (*.grd*) grids

- digital elevation model
- total magnetic field
- second vertical derivative of the residual magnetic field
- "GSC levelled" gradient-enhanced residual magnetic field
- second vertical derivative of the "GSC levelled" gradient-enhanced residual magnetic field
- measured lateral (across line) horizontal magnetic gradient
- measured longitudinal (along line) horizontal magnetic gradient
- total air absorbed dose rate
- potassium
- equivalent thorium
- equivalent uranium
- potassium over equivalent thorium ratio

b) Vector (*.dxf*) files

- flight path
- "GSC levelled" gradient-enhanced residual field magnetic contours
- Keating coefficients

c) GeoTIFF seamless map images

- "GSC levelled" gradient-enhanced residual magnetic field with planimetric base
- shaded second vertical derivative of the "GSC levelled" gradient-enhanced residual magnetic field with planimetric base
- total air absorbed dose rate with planimetric base
- potassium with planimetric base
- equivalent thorium with planimetric base
- equivalent uranium with planimetric base
- potassium, thorium, uranium ternary image with planimetric base

d) Geosoft® (*.gdb*) binary data

- profile database of magnetic data (10 Hz sampling) in Geosoft® GDB format
- profile database of gamma-ray spectrometric data (1 Hz sampling) in Geosoft® GDB format
- profile database of gamma-ray spectrometric data array (1 Hz sampling) in Geosoft® GDB format
- Keating coefficients in Geosoft® GDB format

e) Survey report in portable document format (*.pdf*)

2. CO-ORDINATE SYSTEMS

The profile data are provided in 2 co-ordinate systems:

- Universal Transverse Mercator (UTM) projection, Zone 15N, NAD83 datum, Canada local datum
- latitude/longitude co-ordinates, NAD83, Canada local datum

The gridded data are provided in Universal Transverse Mercator (UTM) projection, Zone 15N, NAD83 datum, Canada local datum

3. LINE NUMBERING

The line numbering convention for survey data provided in GDS 1083 is as follows:

- Line numbers are 2 to 5 digits with the last digit indicating part or revision number i.e., line 10 is the first line of the survey followed by line 20; should line 10 be in 2 parts, the first is 10 and the second is 11. Similarly, should line 220 have been reflown, it will be in the database as line 221.
- Traverse lines are in the range from 10 to 9190 in increments of 10
- Orthogonal control lines are in the range from 80010 to 80700 in increments of 10.
- Control lines flown along the survey block boundary range from 90010 to 90070 in increments of 10.
- In the Geosoft® OASIS montaj™ binary database, traverse lines are designated with a leading character "L" and control lines are designated with a leading character "T".

4. DATA FILES

The survey data files are provided as follows:

SLMAG.gdb	Geosoft® Oasis montaj™ uncompressed binary database file of the magnetic data, sampled at 10 Hz
SLMAG.xyz	ASCII file of the magnetic data, sampled at 10 Hz
SLSPEC.gdb	Geosoft® Oasis montaj™ uncompressed binary database of the gamma- ray spectrometric data, sampled at 1 Hz
SLSPEC.xyz	ASCII file of the gamma-ray spectrometric data, sampled at 1 Hz
SLSPEC1024.gdb	Geosoft® Oasis montaj™ uncompressed binary database file of the gamma-ray spectrometric data array, sampled at 1 Hz
SLSPEC1024.xyz	ASCII file of the gamma-ray spectrometric data array, sampled at 1 Hz (5 parts "A" to "E")
SLKC.gdb	Geosoft® Oasis montaj™ uncompressed binary database file of the Keating coefficients
SLKC.csv	ASCII file of the Keating coefficients

The contents of SLMAG.xyz/gdb (both file types contain the same set of data channels) are summarized as follows.

Channel Name	Description	Units
aircraft	Aircraft registration	-
date	Local date	YYYY/MM/DD
flight	Flight number	-
line_number	Full flightline number (flightline and part numbers)	-
line	Flightline number	-
line_part	Flightline part number	-
fiducial	Fiducial	-
time_utc	UTC time	seconds after midnight
gps_x_raw	Raw GPS X	metres
gps_y_raw	Raw GPS Y	metres
gps_z_raw	Raw GPS Z	metres
gps_x_final	Differentially corrected GPS X (NAD83 datum)	decimal-degrees
gps_y_final	Differentially corrected GPS Y (NAD83 datum)	decimal-degrees
gps_z_final	Differentially corrected GPS Z (NAD83 datum)	metres above sea level
x_nad83	Easting in UTM zone 15 N co-ordinates using NAD83 datum	metres
y_nad83	Northing in UTM zone 15 N co-ordinates using NAD83 datum	metres
lon_nad83	Longitude using NAD83 datum	decimal-degrees
lat_nad83	Latitude using NAD83 datum	decimal-degrees
radar1_raw	Raw radar altimeter 1	metres above terrain
radar2_raw	Raw radar altimeter 2	metres above terrain
radar_final	Corrected radar altimeter	metres above terrain
dem	Digital elevation model	metres above sea level
mag_base1_raw	Raw magnetic base station 1 data	nanoteslas
mag_base2_raw	Raw magnetic base station 2 data	nanoteslas
mag_base1	Corrected magnetic base station 1 data	nanoteslas
mag_base2	Corrected magnetic base station 2 data	nanoteslas
fluxgate_x	X-component field from the compensation fluxgate magnetometer	nanoteslas
fluxgate_y	Y-component field from the compensation fluxgate magnetometer	nanoteslas
fluxgate_z	Z-component field from the compensation fluxgate magnetometer	nanoteslas
mag_raw_left	Raw magnetic field from left wingtip sensor	nanoteslas
mag_comp_left	Compensated magnetic field from left wingtip sensor	nanoteslas
mag_lag_left	Comp’d, edited and lag corrected magnetic field from left wingtip	nanoteslas
mag_raw_right	Raw magnetic field from right wingtip	nanoteslas
mag_comp_right	Compensated magnetic field from right wingtip	nanoteslas
mag_lag_right	Comp’d, edited and lag corrected mag. field from right wingtip	nanoteslas
mag_raw_tail	Raw magnetic field from tail sensor	nanoteslas
mag_comp_tail	Compensated magnetic field from tail sensor	nanoteslas
mag_lag_tail	Compensated, edited and lag corrected mag. field from tail sensor	nanoteslas
mag_diurn1_tail	Diurnally-corrected magnetic field from tail sensor	nanoteslas
mag_diurn2_tail	Diurnally-corrected magnetic field from tail sensor	nanoteslas
igrf	Local IGRF field	nanoteslas
mag_lev_tail	Tie-line levelled magnetic field from tail sensor	nanoteslas
mag_miclev_tail	Micro-levelled, tie-line levelled magnetic field from tail sensor	nanoteslas
mag_final_tail	Micro-levelled, IGRF corrected magnetic field from tail sensor	nanoteslas
mag_gsclevel_tail	GSC levelled magnetic field from tail sensor	nanoteslas
grad_raw_lat	Raw lateral horizontal mag. gradient (from wingtip sensors)	nanoteslas/metre
grad_comp_lat	Compensated lateral horizontal mag. gradient	nanoteslas/metre
grad_lag_lat	Lagged, compensated lateral horizontal mag. gradient	nanoteslas/metre
grad_rot_lat	Attitude corrected lateral horizontal mag. gradient	nanoteslas/metre
grad_lev_lat	Levelled lateral horizontal mag. gradient	nanoteslas/metre
grad_raw_lon	Raw longitudinal horizontal mag. gradient (from wingtip sensors)	nanoteslas/metre

Channel Name	Description	Units
grad_comp_lon	Compensated longitudinal horizontal mag. gradient	nanoteslas/metre
grad_lag_lon	Lagged, compensated longitudinal horizontal mag. gradient	nanoteslas/metre
grad_rot_lon	Attitude corrected longitudinal horizontal mag. gradient	nanoteslas/metre
grad_lev_lon	Levelled longitudinal horizontal magnetic gradient	nanoteslas/metre
pitch	Aircraft pitch	degrees
roll	Aircraft roll	degrees
yaw	Aircraft yaw	degrees
azimuth	Aircraft azimuth	degrees

The contents of SLSPEC.xyz/.gdb (both file types contain the same set of data channels) are summarized as follows.

Channel Name	Description	Units
aircraft	Aircraft registration	-
date	Local date	YYYY/MM/DD
flight	Flight number	-
line_number	Full flightline number (flightline and part numbers)	-
line	Flightline number	-
line_part	Flightline part number	-
fiducial	Fiducial	-
time_utc	UTC time	seconds after midnight
gps_x_final	Differentially corrected GPS X (NAD83 datum)	decimal-degrees
gps_y_final	Differentially corrected GPS Y (NAD83 datum)	decimal-degrees
gps_z_final	Differentially corrected GPS Z (NAD83 datum)	metres above sea level
x_nad83	Easting in UTM zone 15 N co-ordinates using NAD83 datum	metres
y_nad83	Northing in UTM zone 15 N co-ordinates using NAD83 datum	metres
lon_nad83	Longitude using NAD83 datum	decimal-degrees
lat_nad83	Latitude using NAD83 datum	decimal-degrees
radar1_raw	Raw radar altimeter 1	metres above terrain
radar2_raw	Raw radar altimeter 2	metres above terrain
radar_final	Corrected radar altimeter	metres above terrain
dem	Digital elevation model	metres above sea level
baro_press	Barometric pressure	millibars
baro_press_final	Low-pass filtered barometric pressure	millibars
temperature	Outside air temperature	degrees Celsius
temperature_final	Low-pass filtered outside air temperature	degrees Celsius
height_stp	Standard temperature-pressure height	metres
live_time_down	Downward looking gamma-ray spectrometer live time	microseconds
live_time_up	Upward looking gamma-ray spectrometer live time	microseconds
cosmic_raw	Raw cosmic window	counts per second
uranium_up_win	Raw upward-looking uranium window	counts per second
uranium_up_nasvd	Upward-looking uranium window from NASVD processed spectrum	counts per second
radon_final	Final radon	counts per second
total_count_win	Raw total count window	counts per second
potassium_win	Raw potassium window	counts per second
uranium_win	Raw uranium window	counts per second
thorium_win	Raw thorium window	counts per second
total_count_nasvd	Total counts window from NASVD processed spectrum	counts per second
potassium_nasvd	Potassium window from NASVD processed spectrum	counts per second
uranium_nasvd	Uranium window from NASVD processed spectrum	counts per second
thorium_nasvd	Thorium window from NASVD processed spectrum	counts per second
total_count_final	Final natural air-absorbed dose rate	nanograys per hour
potassium_final	Final potassium	percent

Channel Name	Description	Units
euranium_final	Final equivalent uranium	parts per million
ethorium_final	Final equivalent thorium	parts per million
k_over_th	Ratio of potassium over equivalent thorium	percent/parts per million

The contents SLSPEC1024.gdb/.xyz (both file types contain the same set of data channels) are summarized as follows.

Channel Name	Description	Units
aircraft	Aircraft registration	-
date	Local date	YYYY/MM/DD
flight	Flight number	-
line_number	Full flightline number (flightline and part numbers)	-
line	Flightline number	-
line_part	Flightline part number	-
fiducial	Fiducial	-
time_utc	UTC time	seconds after midnight
x_nad83	GPS X in UTM zone 15 N co-ordinates using NAD83 datum	metres
y_nad83	GPS Y in UTM zone 15 co-ordinates using NAD83 datum	metres
lon_nad83	Differentially corrected GPS X (longitude - NAD83 datum)	decimal-degrees
lat_nad83	Differentially corrected GPS Y (latitude - NAD83 datum)	decimal-degrees
spd	Raw 1024-channel downward gamma-ray spectrum (array channel)	counts per second
spu	Raw 1024-channel upward gamma-ray spectrum (array channel)	counts per second

The contents of SLKC.csv/.gdb (both file types contain the same set of data channels) are summarized as follows.

Channel Name	Description	Units
x_nad83	Easting in UTM zone 15 N co-ordinates using NAD83 datum	metres
y_nad83	Northing in UTM zone 15 N co-ordinates using NAD83 datum	metres
lon_nad83	Longitude using NAD83 datum	decimal-degrees
lat_nad83	Latitude using NAD83 datum	decimal-degrees
corr_coeff	Correlation coefficient	percent x 10
pos_coeff	Positive correlation coefficient	percent
neg_coeff	Negative correlation coefficient	percent
norm_error	Standard error normalized to amplitude	percent
amplitude	Peak-to-peak anomaly amplitude within window	nanoteslas

5. GRID FILES

All grids are NAD83 UTM Zone 15N with a grid cell size of 40 m and are summarized as follows:

SLDEM83.gxf/.grd	Digital elevation model
SLMAG83.gxf/.grd	Total magnetic field
SLLAG83.gxf/.grd	Measured Lateral (across line) Horizontal Magnetic Gradient.
SLLON83.gxf/.grd	Measured Longitudinal (along line) Horizontal Magnetic Gradient.
SLGMAGGSC83.gxf/.grd	"GSC levelled" Gradient Enhanced Residual Magnetic Field.
SLG2VDMAGGSC83.gxf/.grd	Second Vertical Derivative of the "GSC levelled" Gradient-Enhanced Residual Magnetic Field.
SLTC83.gxf/.grd	Natural Air Absorbed Dose Rate
SLK83.gxf/.grd	Potassium,
SLTH83.gxf/.grd	Equivalent Thorium
SLU83.gxf/.grd	Equivalent Uranium
SLKTHRATIO83.gxf/.grd	Potassium/equivalent Thorium ratio

*Note: *.gxf - Geosoft® uncompressed ASCII grid exchange format*
**.grd - Geosoft® Oasis montaj™ uncompressed binary grid file*

6. GEOREFERENCED IMAGE FILES

Geographically referenced colour images, incorporating a base map, are provided in GeoTIFF format for use in GIS applications.

SLGMAGGSC83.tif	“GSC levelled” gradient-enhanced residual magnetic field grid + planimetric base
SLG2VDMAGGSC83.tif	Shaded second Vertical Derivative of the “GSC levelled” gradient-enhanced residual magnetic field grid + planimetric base
SLTC83.tif	Total count grid + planimetric base
SLK83.tif	Potassium grid + planimetric base
SLU83.tif	Equivalent Uranium grid + planimetric base
SLTH83.tif	Equivalent Thorium grid + planimetric base
SLTERN83.tif	Potassium, Uranium, Thorium ternary image

7. VECTOR FILES

Vector line work from the maps is provided in DXF (v.12) ASCII format using the following naming convention:

- SLPATH83.DXF Flight path
- SLKC83.DXF Keating coefficients
- SLMAG83.DXF Residual magnetic contours

The layers within the DXF files correspond to the various object types found therein and have intuitive names.

Appendix C. Operational Reports

Goldak Airborne Surveys Operations Report

OGS Ear Falls

July 04 to July 10

2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Bartlett	Mathieson	Pitre
Copilot:	Patterson	Heit	McSweeny
Processor:	Heath		
Base:	Natures's Inn - Kenora		
Contact:	306-290-3881		

Summary	
Project Total	117090
Remaining	117090
Flown this week	
Flown to date	0
Percent Complete	0%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon July 04		C-GJBB												
		C-GJBG												
		C-GLDX												
Tues July 05	3	C-GJBG												Radar Stack
	4	C-GJBG												Lag Test
	5	C-GJBG												Meanook
Wed July 06	6	C-GLDX												Radar Stack
	7	C-GLDX												Lag Test
	8	C-GLDX												Meanook
	9	C-GJBB												Radar Stack
	10	C-GJBB												Lag Test
	11	C-GJBB												Meanook
Thurs July 07	13	C-GJBB												Test Comp
		C-GJBG												
		C-GLDX												
Fri July 08		C-GJBB												
		C-GJBG												
		C-GLDX												
Sat July 09	14	C-GJBB												Calibration Range
	15	C-GJBG												Calibration Range
	16	C-GLDX												Calibration Range
Sun July 10	17	C-GLDX		0.7		0.7								Comp/FOM passed
	18	C-GLDX		0.7		0.7								Comp/FOM rejected
	19	C-GLDX		0.7		0.7								Comp/FOM rejected
														All crew, except AME, arrive in Kenora

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	0	2.1	0	2.1	0	0	0
Total to Date	0	2.1	0	2.1	0	0	0

Goldak Airborne Surveys Operations Report

OGS Ear Falls

July 11 to July 17
2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Bartlett	Mathieson	Pitre
Copilot:	Patterson	Heit	Mcsweeny
Processor:	Heath		
Base:	Nature's Inn - Kenora		
Contact:	306-290-3881		

Summary	
Project Total	117090
Remaining	112244
Flown this week	4846
Flown to date	4846
Percent Complete	4%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon July 11		C-GJBB								100				Rain/Low Cloud all day
		C-GJBG												Base Stn 2 Established
		C-GLDX												
Tues July 12	20	C-GJBB		1.3		1.3								Failed - Weather knocked them out of block
		C-GJBG												
		C-GLDX												
										90				Rain until 8 am local, high wind, low cloud, tubulence.
Wed July 13		C-GJBB								100				Bad Weather All Day
		C-GJBG								100				
		C-GLDX								100				
Thurs July 14	21	C-GLDX					1134	1134						
	22	C-GJBG	0.6			0.6								Returned to base before collecting data
	23	C-GJBB		0.6		0.6								Comp
	24	C-GJBB		0.6		0.6								Comp
Fri July 15	25	C-GJBB			2.3	2.3								Comic Attempted. Spectrometer console failed
	26	C-GLDX	0.5		4.6	5.1	1141	1141						
	27	C-GJBG	0.8		5.4	6.2	1241	602	639					
	28	C-GJBB		0.8		0.8								Comp Flight
Sat July 16	29	C-GJBB	0.7		3.5	4.2	779	779						
	30	C-GJBG	1.0		5.3	6.3	1190	1190						
	31	C-GLDX	3.5			3.5								Cosmic Flight
												100		Spectrometer Console U/S
Sun July 17	32	C-GJBG			4.0	4.0						100		Cosmic Flight
		C-GLDX								100				Rain in block throughout day
		C-GJBB										100		Spectrometer Console U/S

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	7.1	3.3	25.1	35.5	5485	4846	639
Total to Date	7.1	5.4	25.1	37.6	5485	4846	639

Goldak Airborne Surveys Operations Report

OGS Ear Falls

July 18 to July 24
2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Bartlett	Mathieson	Pitre
Copilot:	Patterson	Heit	McSweeny
Processor:	Heath		
Base:	Nature's Inn Kenora		
Contact:	306-290-3881		

Summary	
Project Total	117090
Remaining	96976
Flown this week	15268
Flown to date	20114
Percent Complete	17%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon July 18	33	C-GJBG	0.9		4.1	5.0	924	924						
	34	C-GLDX	0.7		4.7	5.4	1191	1191						
	35	C-GJBG	0.9		5.4	6.3	1364	1364						
												100		Waiting on RSI Console
Tues July 19	36	C-GLDX	0.6		4.9	5.5	1222	1222						
	37	C-GJBG	1.0		5.7	6.7	1354	1354						
	38	C-GJBG			4.4	5.3	1037	962	75		15			Sporadic diurnal bust later in flight
												100		Waiting on RSI console
Wed July 20	39	C-GLDX	0.4		5.3	5.7	1334	1334						
	40	C-GJBG	0.8		4.6	5.4	1104	1104						
		C-GLDX										100		Waiting on RSI console
														Fuel quarantine at CYQK due to incident with non Goldak aircraft
														lifted mid day
Thurs July 21	41	C-GLDX	0.2		5.0	5.2	1135	1135						
	42	C-GJBG	1.2		4.6	5.8	1111	1111						
	43	C-GJBB												RSI Console retuned, installed. Cosmic flight
	44	C-GJBB		4.0		4.0								Compensation - failed on right wing
Fri July 22	45	C-GLDX	0.5		4.9	5.4	1256	1256						
	46	C-GJBG	1.0		5.8	6.8	1306	1306						
	47	C-GLDX	0.4		1.0	1.4	250	250						
Sat July 23	48	C-GLDX	0.5		3.0	3.5	755	755						
		C-GJBG								10		100		JBG Oil leak. AME tending to issue
		C-GJBB												JBB returned to YXE to diagnose Right Comp issue
														Bartlett takes JBB; McSweeney resigns.
Sun July 24		C-GJBB								100		100		In Saskatoon for de-magnetizing
		C-GJBG								100		100		Grounded, Oil leak
		C-GLDX								100				Low cloud, high winds/turbulence in block

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	9.1	4	63.4	77.4	15343	15268	75
Total to Date	15.6	9.4	88.5	115	20828	20114	714

Goldak Airborne Surveys Operations Report

OGS Ear Falls

July 25 to July 31

2016

Aircraft and Crew			
Aircraft:	C-GLDX	G-GJBG	C-GJBB
Pilot:	Mathieson		
Copilot:	Patterson	Heit	
Processor:	Heath		
Base:	Nature's Inn, Keewatin, ON		
Contact:	306-290-3881		

Summary	
Project Total	117090
Remaining	86993
Flown this week	9983
Flown to date	30097
Percent Complete	26%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon	49	C-GLDX	0.5		5.2	5.7	1256	1256						
July 25		G-GJBG										100		Oil leak
		C-GJBB										100		Compensation problems
Tues	50	C-GLDX	0.6		5.2	5.8	1256	1256						
July 26		G-GJBG										100		Oil leak issue requires major engine work. Engine removed
		C-GJBB										100		Compensator issue
Wed	51	C-GLDX	0.7		4.1	4.8	1005	1005						
July 27	52	C-GLDX	0.5		4.1	4.6	1005	1005						
		C-GJBB										100		
		C-GJBG										100		
Thurs	53	C-GLDX	0.5		4.2	4.7	1007	1007						
July 28	54	C-GLDX	0.6		4.2	4.8	1018	1018						
		C-GJBB										100		
		C-GJBG										100		
Fri	55	C-GLDX	0.5		5.3	5.8	1298	1298						
July 29		G-GJBG										100		
		C-GJBB										100		
Sat	56	C-GLDX	0.5		4.5	5.0	1071	1071						
July 30		G-GJBG										100		
		C-GJBB										100		
Sun	57	C-GLDX	0.5		4.3	4.8	1067	1067						
July 31		G-GJBG										100		
		C-GJBB										100		

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	4.9	0	41.1	46	9983	9983	0
Total to Date	20.5	9.4	129.6	161	30811	30097	714

Goldak Airborne Surveys Operations Report

OGS Ear Falls

August 01 to August 07
2016

Aircraft and Crew		
Aircraft:	C-GLDX	
Pilot:	Mahieson	Petrie
Copilot:	Patterson	Heit
Processor:	Heath	
Base:	Nature's Inn Kenora	
Contact:	306-290-3881	

Summary	
Project Total	117090
Remaining	77760
Flown this week	9233
Flown to date	39330
Percent Complete	34%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon August 01	58	C-GLDX	0.6		4.3	4.9	1078	1078						
Tues August 02	59	C-GLDX	0.6		4.5	5.1	1078	818	260		20			
Wed August 03	60	C-GLDX	0.6		4.3	4.9	1076	1076						
	61	C-GLDX	4.3		0.5	4.8	1073	1073						
Thurs August 04		C-GLDX								100				Low cloud, high winds, 15 mm rain overnight
Fri August 05	62	C-GLDX	0.8		4.0	4.8	1001	937	64					Last line broken due to Wx. Reflown in full following flight - no efficiancy to be gained by not flying full line
Sat August 06	63	C-GLDX	0.6		4.2	4.8	1067	1067						
	64	C-GLDX	0.6		4.2	4.8	1064	1064						
Sun August 07	65	C-GLDX	0.6		4.2	4.8	1062	1062						
	66	C-GLDX	0.5		4.3	4.8	1058	1058						

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	9.2	0	34.5	43.7	9557	9233	324
Total to Date	29.7	9.4	164.1	204.7	40368	39330	1038

Goldak Airborne Surveys Operations Report

OGS Ear Falls

August 08 to August 14
2016

Aircraft and Crew		
Aircraft:	C-GLDX	C-GJBB
Pilot:	Mathieson	Petrie
Copilot:	Patterson	Heit
Processor:	Heath	
Base:	Natures' Inn, Kenora	
Contact:	306-290-3881	

Summary	
Project Total	117090
Remaining	63650
Flown this week	14110
Flown to date	53440
Percent Complete	46%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon	67	C-GLDX	0.6		5.9	6.5	1350	1350						
August 08	68	C-GLDX	0.6		4.3	4.9	1052	1052						
Tues	69	C-GLDX	0.5		4.7	5.2	1134	1134						
August 09		C-GJBB											100	
Wed	70	C-GLDX	0.6		5.3	5.9	1311	1311						
August 10	71	C-GJBB		1.3		1.3								Comp - Passed
	72	C-GJBB	0.5		4.7	5.2	1172	1172						
Thurs	73	C-GLDX	0.5		5.3	5.8	1306	1306						
August 11	74	C-GJBB	0.5		5.2	5.7	1296	1296						
Fri	75	C-GLDX	0.8		4.5	5.3	1141	1141						
August 12	76	C-GJBB	0.9		2.9	3.8	601	601						
Sat	77	C-GLDX	0.7		4.7	5.4	1130	1130						
August 13	78	C-GJBB	0.6		4.5	5.1	1096	1096						
Sun	79	C-GJBB	6.0		0.5	6.5	1521	1521						
August 14		C-GLDX											100	

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	12.8	1.3	52.5	66.6	14110	14110	0
Total to Date	42.6	10.7	216.6	271.3	54478	53440	1038

Goldak Airborne Surveys Operations Report

OGS Ear Falls

August 15 to August 21

2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Mathieson	Petrie	
Copilot:	Patterson	Heit	
Processor:	Heath		
Base:	Nature's Inn - Kenora		
Contact:	306-290-3881		

Summary	
Project Total	117090
Remaining	53094
Flown this week	10556
Flown to date	63996
Percent Complete	55%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon August 15	80	C-GJBG		1.0		1.0								Comp Flight
		C-GJBB								100				Rain
		C-GLDX								100				
Tues August 16	81	C-GJBG	0.8		4.0	4.8	993	993						
	82	C-GJBB	0.6		3.7	4.3	909	909						
		C-GLDX											100	
Wed August 17	83	C-GJBG	0.7		4.4	5.1	1043	1043						
	84	C-GJBB	0.6		5.7	6.3	1404	1404						
		C-GLDX											100	
Thurs August 18		C-GJBB								100				Rain, low cloud all day
		C-GJBG								100				
		C-GLDX								100				
Fri August 19	85	C-GLDX	0.8		4.3	5.1	893	893						
	86	C-GJBB	0.6		6.0	6.6	1285	1285						
		C-GJBG										100		JBG scheduled maintenance
Sat August 20	87	C-GJBB	0.5		4.8	5.3	946	946						
	88	C-GLDX	0.6		3.1	3.7	782	782						
		C-GJBG										100		JBG scheduled maintenance
Sun August 21	89	C-GLDX	0.8		5.0	5.8	1302	1302						
	90	C-GJBG	4.5		0.7	5.2	999	999						
		C-GJBB										100		Schedule Maintennace

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	10.5	1	41.7	53.2	10556	10556	0
Total to Date	52.8	11.7	258.3	324.5	65034	63996	1038

Goldak Airborne Surveys Operations Report

OGS Ear Falls

August 22 to August 28

2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Mathieson	Petrie	
Copilot:	Patterson	Heit	
Processor:	Heath		
Base:	Nature's Inn - Kenora		
Contact:	306-290-3881		

Summary	
Project Total	117090
Remaining	44135
Flown this week	8959
Flown to date	72955
Percent Complete	62%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon August 22	91	C-GLDX	0.7		5.1	5.8	1181	1181						
	92	C-GJBG	0.9		4.6	5.5	1044	1044						
		C-GLDX												
Tues August 23	93	C-GLDX	0.7		1.1	1.8	260	260						Returned - Rain
		C-GJBG								100				
		C-GJBB												
Wed August 24		C-GJBB								100				Rain, Low Cloud
		C-GJBG								100				
		C-GLDX								100				
Thurs August 25		C-GJBB								100				Rain, Low Cloud
		C-GJBG								100				
		C-GLDX								100				
Fri August 26	94	C-GLDX	0.7		5.3	6.0	1314	1314						
	95	C-GJBG	0.8		4.5	5.3	1072	1072						
		C-GJBB											100	
Sat August 27	96	C-GLDX	0.5		3.7	4.2	906	906						
	97	C-GJBG	0.7		4.4	5.1	1052	1052						
		C-GJBB											100	
Sun August 28	98	C-GJBB	0.7		4.5	5.2	1063	1063						
	99	C-GJBG	0.9		4.3	5.2	1067	1067						
		C-GLDX											100	

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	6.6	0	37.5	44.1	8959	8959	0
Total to Date	60.2	11.7	295.8	368.6	73993	72955	1038

Goldak Airborne Surveys Operations Report

OGS Ear Falls

August 29 to September 04
2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Mathieson	Petrie	
Copilot:	Patterson	Heit	
Processor:	Heath	Shaikh	
Base:	Nature's Inn Kenora		
Contact:			

Summary	
Project Total	117090
Remaining	35196
Flown this week	8939
Flown to date	81894
Percent Complete	70%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon August 29		C-GJBB								100				Rain until midday.
		C-GJBG												
		C-GLDX												
Tues August 30	100	C-GJBG	0.5		5.6	6.1	1332	1332						
	101	C-GLDX	0.8		5.1	5.9	1290	1290						
		C-GLDX											100	
Wed August 31	102	C-GJBB	0.8		5.5	6.3	1386	1386						
	103	C-GJBG	0.8		5.3	6.1	1298	1298						
		C-GLDX												
Thurs September 01	104	C-GJBB	0.9		5.2	6.0	1272	1272						
	105	C-GJBG	1.0		5.1	6.1	1287	1287						
		C-GLDX											100	
Fri September 02	106	C-GJBB	0.7		2.8	3.5	576	576			60			Fligh terminated due to unsettled magnetics
	107	C-GJBG	0.8		2.2	3.0	498	498			60			Fligh terminated due to unsettled magnetics
		C-GLDX											100	
Sat September 03		C-GJBB								100	60			Turbulance / Active magnetics
		C-GJBG												
		C-GLDX												
Sun September 04		C-GJBB								100				Rain
		C-GJBG								100				
		C-GLDX								100				

Weekly Total	6.22	0	36.79	43.01	8939	8939	0
Total to Date	66.42	11.7	332.6	411.6	82932	81894	1038

Goldak Airborne Surveys Operations Report

OGS Ear Falls

September 05 to **September 11**

2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Petrie	Patterson	
Copilot:	Heit	Mathieson	
Processor:	Shaikh		
Base:	Natures Inn, Kenora, ON		
Contact:			

Summary	
Project Total	117090
Remaining	22554
Flown this week	12642
Flown to date	94536
Percent Complete	81%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon September 05		C-GJBB								100				Low visibilty/clouds, Heavy precipitation
		C-GJBG								100				
		C-GLDX												
Tues September 06		C-GJBB								100				Low visibilty/clouds, wet ground
		C-GJBG												
		C-GLDX												
Wed September 07	108	C-GJBB										100		JBB flight terminated due to system problem
	109	C-GJBG	0.9		5.1	6.0	1287	1287						
	110	C-GLDX	0.7		5.2	5.9	1288	1288						
Thurs September 08	111	C-GJBG	0.9		5.2	6.1	1287	1287						
	112	C-GLDX	0.8		5.1	5.9	1285	1285						
		C-GJBB											100	
Fri September 09	113	C-GJBG	1.0		5.1	6.1	1293	1293						
	114	C-GLDX	0.7		5.1	5.8	1216	1216						
		C-GJBB											100	
Sat September 10	115	C-GJBG	1.1		4.2	5.3	1095	1095						
	116	C-GLDX	0.5		5.4	5.9	1282	1282						
		C-GJBB											100	
Sun September 11	117	C-GJBG	1.0		5.3	6.3	1327	1327						
	118	C-GLDX	0.7		5.2	5.9	1282	1282						
		C-GJBB											100	

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	8.3	0	50.9	59.2	12642	12642	0
Total to Date	74.72	11.7	383.5	470.8	95574	94536	1038

Goldak Airborne Surveys Operations Report

OGS Ear Falls

September 12 to September 18

2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Mathiseon	Patterson	Petrie
Copilot:	Biesenthal	Heit	Forsberg
Processor:	Heath		
Base:	Natures's Inn - Kenora		
Contact:	306-290-3881		

Summary	
Project Total	117090
Remaining	12116
Flown this week	10438
Flown to date	104974
Percent Complete	90%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon September 12		C-GJBB								100				Rain until modday, low cloud all day
		C-GJBG												
		C-GLDX												
Tues September 13	119	C-GLDX	1.1		4.3	5.4	1092	1092						
	120	C-GJBG		1.0		1.0								Comp flight, passed
	121	C-GJBB				1.1								Comp flight, passed
Wed September 14	122	C-GJBG	1.0		5.5	6.5	1342	1342						
	123	C-GJBB	1.2		4.7	5.9	1179	1179						
	124	C-GLDX	0.7		5.2	5.9	1282	1282						
Thurs September 15	125	C-GJBB	1.1		4.5	5.6	1129	1129						
	126	C-GJBB	0.9		5.9	6.8	1184	1184						
	127	C-GLDX	0.6		4.7	5.3	1103	1103						
Fri September 16		C-GJBB								100				Heavy rain throughout the day
		C-GJBG								100				
		C-GLDX								100				
Sat September 17		C-GJBB								100				Low ceiling all day
		C-GJBG												
		C-GLDX												
Sun September 18	128	C-GLDX	0.7		4.9	5.6	1175	1175						
	129	C-GJBB	1.1		3.8	4.9	952	952						
	130	C-GJBG	1.0		4.0	5.0								System error

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	9.4	1	47.5	59	10438	10438	0
Total to Date	84.12	12.7	431	529.8	106012	104974	1038

Goldak Airborne Surveys Operations Report

OGS Ear Falls

September 19 to **September 25**

2016

Aircraft and Crew			
Aircraft:	C-GJBB	C-GJBG	C-GLDX
Pilot:	Mathiseon	Patterson	Petrie
Copilot:	Biesenthal	Heit	Forsberg
Processor:	Heath		
Base:	Natures's Inn - Kenora		
Contact:	306-290-3881		

Summary	
Project Total	117090
Remaining	-1412
Flown this week	13528
Flown to date	118502
Percent Complete	101%

			Flight Times (h)				Production (km)			Unservicability (%)				
	Flight	Aircraft	Ferry	Test	Survey	Total	Flown	Accepted	Rejected	Weather	Diurnal	Equipent	Crew	Notes
Mon September 19		C-GJBB								100				Rain
		C-GJBG								100				
		C-GLDX								100				
Tues September 20	131	C-GLDX	0.6		4.7	5.3	1175	1175						
	132	C-GJBB	1.1		4.9	6.0	1260	1260						
	133	C-GJBG			4.7	5.8	1153	1153						
	134	C-GLDX	0.7		4.8	5.5	1182	1061	121					
Wed September 21	135	C-GJBB	1.0		5.3	6.3	1170	1170						
	136	C-GJBG	1.0		4.8	5.8	1170	1170						
		C-GLDX												
Thurs September 22	137	C-GJBB	0.9		5.7	6.6	1357	1357						
	138	C-GJBG	0.9		5.8	6.7	1440	1440						
		C-GLDX												
Fri September 23	139	C-GJBB	0.7		5.3	6.0	1100	1100						
	140	C-GJBG	0.8		4.4	5.2	1097	1097						
	141	C-GJBB	0.5		4.1	4.6	858	858						
	142	C-GJBG	0.9		2.9	3.8	687	687						
Sat September 24		C-GJBB												
		C-GJBG												
		C-GLDX												
Sun September 25		C-GJBB												
		C-GJBG												
		C-GLDX												

	Ferry	Test	Survey	Total	Flown	Accepted	Rejected
Weekly Total	9.1	0	57.4	67.6	13649	13528	121
Total to Date	93.22	12.7	488.4	597.4	119661	118502	1159