GM 64157

HIGH RESOLUTION AEROMAGNETIC AND GAMMA-RAY SPECTROMETRIC SURVEY, OPINACA NORTH PROJECT

Aeromagnetic and Gamma-Ray Spectrometric Survey

OPINACA NORTH PROJECT

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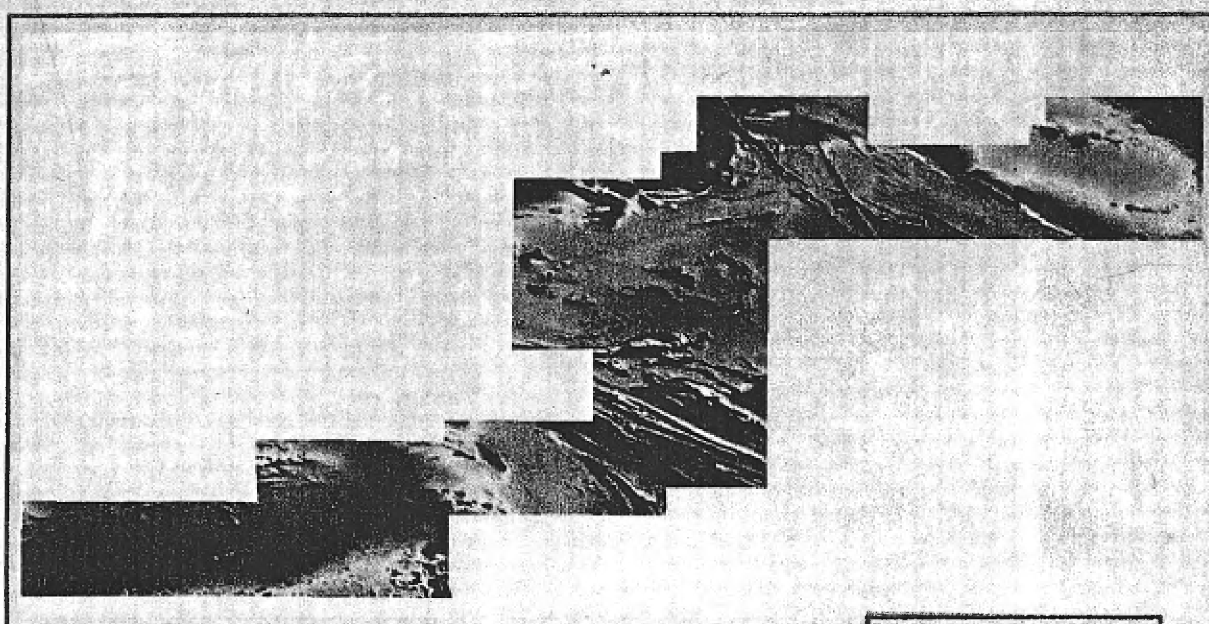
G.D.S. GEO DATA SOLUTIONS Inc.

Project Ref.: P07-033 **Final Technical Report**

October 2008



DIOS EXPLORATION INC.

High Resolution Aeromagnetic and Gamma-Ray Spectrometric Survey

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FINAL TECHNICAL REPORT

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1.0 INTRODUCTION

Early in June 2007, **GEO DATA SOLUTIONS GDS INC. (GDS)** was awarded contract P07-033 by **DIOS EXPLORATION INC. (DIOS)**. The contract required **GDS** to carry out a high-resolution Airborne Magnetic and Gamma-ray Spectrometric (AGS) survey on 4 blocks (East, Central-East, Central-West and West) located in the James Bay area, Northern Quebec.

Traverse lines were oriented North-West with a spacing of 100 metres while control-lines were oriented East-West with a spacing of 1 000 metres. The survey was flown with a helicopter mean ground clearance of 43.5 metres (figure 3). Blocks flown are shown on figures 1 and table 2 defines their co-ordinates. Table 1 shows survey specifications with flight numbers.

The field base of operation were set up at the Pourvoirie Mirage, which is located approximately 200 km North-East of the survey areas, and LG2, which is located approximately 100 km North-West of the survey areas.

Excluding calibration and test flights, 21 flights were needed to cover the survey areas with a total of 4 253 line-km flown. The first production flight began on October 16th, 2007 (flight #1) and the last flight ended on July 18th, 2008 (flight #34).

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

Table 1: Line-km Flown

BLOCK	Traverse Spacing (m)	Tie-Line Spacing (m)	Flight Number	Total (km)
East	100 N-S	1 000 E-W	5,6 and 9 to 20	2 493
West	100 N-S	1 000 E-W	1,2,3,5,6,7,8,13,15 and 17 to 20	1 569
Central East	100 N-S	1 000 E-W	20, 34	67
Central West	100 N-S	1 000 E-W	20	124
			Total (km)	**4 253**

Table 2: Block Coordinates (WGS84, zone 18N)					
BLOCK	Vertex	Latitude	Longitude	X(m)	Y(m)
EAST	1	52°38'35.66"	-75°.37'01.12"	458 223	5 832 539
	2	52°40'16.77"	-75°37'00.47"	458 262	5 835 663
	3	52°40'16.71"	-75°30'01.20"	466 137	5 835 600
	4	52°41'23.90"	-75°30'01.06"	466 154	5 837 676
	5	52°41'23.90"	-75°24'30.99"	472 351	5 837 637
	6	52°41'46.04"	-75°24'29.76"	472 378	5 838 321
	7	52°41'45.91"	-75°20'01.12"	477 421	5 838 291
	8	52°43'05.66"	-75°20'01.09"	477 433	5 840 755
	9	52°43'05.66"	-75°22'31.07"	474 619	5 840 769
	10	52°46'08.91"	-75°22'31.09"	474 648	5 846 431
	11	52°46'08.90"	-75°18'01.04"	479 709	5 846 407
	12	52°46'38.90"	-75°18'01.04"	479 713	5 847 334
	13	52°46'38.89"	-75°17'01.05"	480 837	5 847 329
	14	52°47'38.89"	-75°17'01.07"	480 844	5 849 183
	15	52°47'38.89"	-75°11'55.68"	486 564	5 849 164
	16	52°46'46.85"	-75°11'55.76"	486 558	5 847 556
	17	52°46'46.86"	-75°07'01.04"	492 080	5 847 544
	18	52°47'08.90"	-75°07'01.04"	492 081	5 848 225
	19	52°47'08.89"	-75°06'31.05"	492 643	5 848 224
	20	52°47'38.89"	-75°06'31.01"	492 645	5 849 151
	21	52°47'38.89"	-75°01'55.68"	497 802	5 849 146
	22	52°45'05.65"	-75°01'55.68"	497 800	5 844 411
	23	52°45'05.67"	-75°14,55.74"	483 175	5 844 440
	24	52°40'35.66"	-75°14'55.70"	483 147	5 836 097
	25	52°40'35.66"	-75°17,55.72"	479 766	5 836 110
	26	52°40'05.66"	-75°17,55.73"	479 762	5 835 183
	27	52°40'05.66"	-75°24,25.74"	472 436	5 835 219
	28	52°38'35.66"	-75°24'25.75"	472 420	5 832 438
CENTRAL EAST	1	52°47'32.93"	-75°27'33.14"	469 004	5 849 060
	2	52°49'13.25"	-75°27'34.20"	469 004	5 852 160
	3	52°49'13.62"	-75°25'55.42"	470 853	5 852 160
	4	52°47'33.30"	-75°25'54.43"	470 853	5 849 060
CENTRAL-WEST	1	52°48'28.08"	-75°32'30.56"	463 446	5 850 803
	2	52°50'08.40"	-75°32'31.80"	463 446	5 853 903
	3	52°50'09.10"	-75°29'53.04"	466 417	5 853 903
	4	52°49'45.80"	-75°29'52.77"	466 417	5 853 183
	5	52°49'45.91"	-75°29'25.79"	466 922	5 853 183
	6	52°48'05.59"	-75°29'24.66"	466 922	5 850 083
	7	52°48'05.43"	-75°30'03.27"	466 199	5 850 083
	8	52°48'28.73"	-75°30'03.53"	466 199	5 850 803
WEST	1	52°41'58.38"	-75°42'02.64"	452648	583 9079
	2	52°44'59.72"	-75°42'01.23"	452729	584 4682
	3	52°44'58.37"	-75°48'02.67"	445952	584 4711
	4	52°46'30.65"	-75°48'01.69"	446002	584 7562
	5	52°46'31.15"	-75°35'27.51"	460134	584 7441
	6	52°46'01.61"	-75°35'27.33"	460130	584 6528
	7	52°46'02.25"	-75°27'25.68"	469157	584 6482
	8	52°44'28.74"	-75°27'27.53"	469104	584 3593
	9	52°44'29.01"	-75°29'57.91"	466284	584 3620
	10	52°43'58.39"	-75°29'57.35"	466288	584 2674
	11	52°43'58.40"	-75°30'57.32"	465163	584 2682
	12	52°41'28.39"	-75°30'57.31"	465130	583 8047
	13	52°41'28.39"	-75°40'02.69"	454891	583 8131
	14	52°41'58.39"	-75°40'02.67"	454900	583 9058

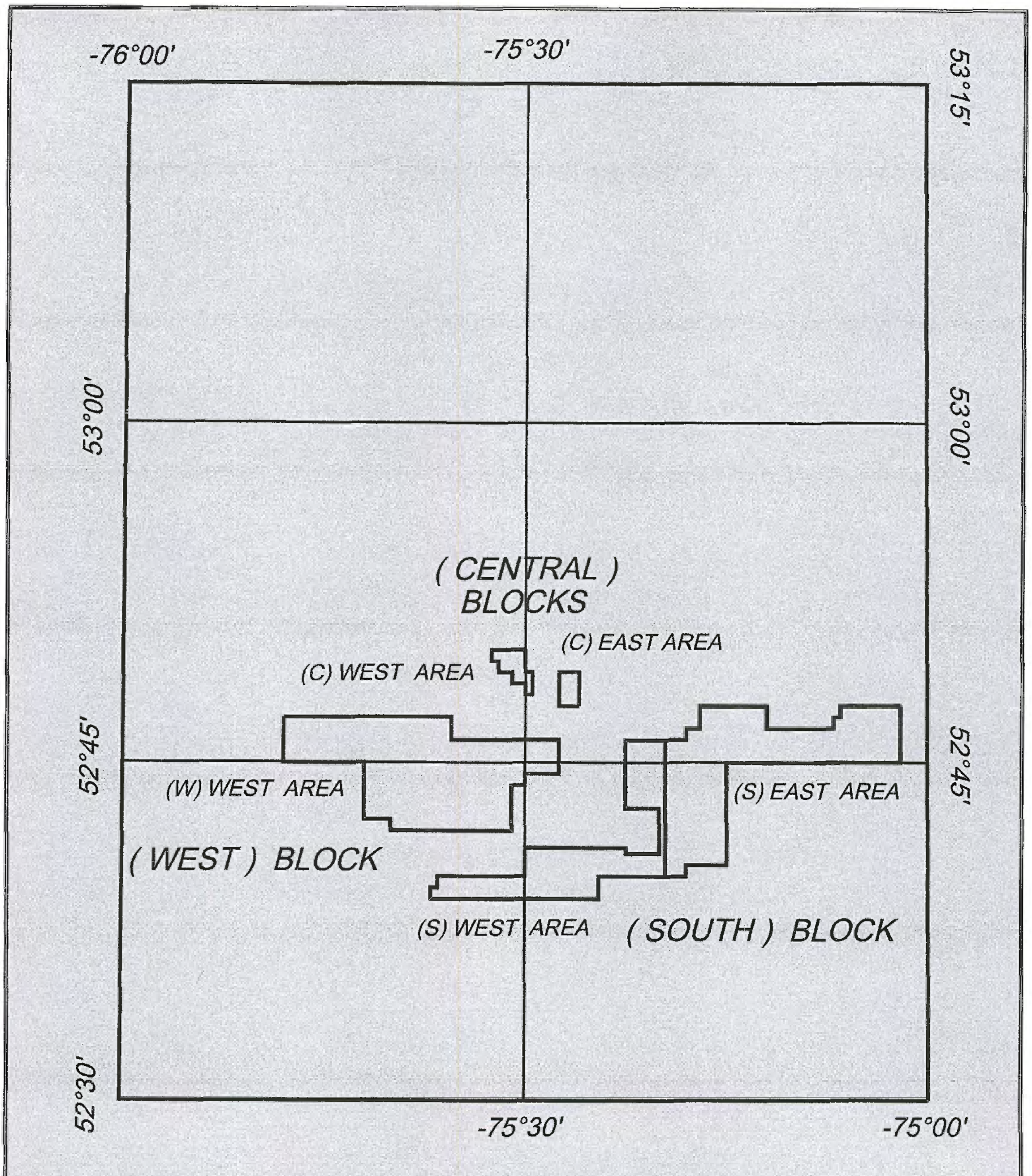

Figure 1: Survey Location

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2.0 SURVEY SPECIFICATIONS

Airborne survey and noise specifications for the Opinaca North project are as follows:

a) traverse line spacing and direction
- flight line spacing: 100 m
- flight line direction: North-South

b) control line spacing and direction
- control line spacing: 1 000 m
- control line direction: East-West

c) terrain clearance
- helicopter mean terrain clearance: 43.5 m
- spectrometer mean terrain clearance: 43.5 m
- magnetometer mean terrain clearance: 43.5 m

d) Re-flights and turns
- actual line-spacing could not vary by more than 50 % from the indicated spacing over a distance of more than 1 km. The minimum length of any survey line was 3 km.
- all reflights of line segments intersected at least two control lines

e) Soil moisture
- no gamma-ray spectrometric survey was flown during or for 3 hours after measurable precipitation
- in the event of heavy precipitation yielding more than 2 cm of ground soaking rain, flying should be suspended for at least 12 hours after end of precipitation or until soil returns to its "normal" moisture level

f) magnetic diurnal variation
- A maximum tolerance of 5.0 nT (peak to peak) deviation from a long chord equivalent to a period of one minute for the magnetometer base station

g) magnetometer noise envelope
- in-flight noise envelope could not exceed 0.5 nT, for straight and level flight
- base station noise envelope could not exceed 0.2 nT

3.0 AIRCRAFT, EQUIPMENT AND PERSONNEL

3.1 Aircraft and Geophysical On-Board Equipment

Aircraft:	Bell 206 LR	
	Mean Survey Speed:	35 m/sec
	Mean Ground Clearance:	43.5 metres

Gamma-ray Spectrometric System: Radiation Solutions RSX-5
Downward-looking crystal: 16 litres
Upward-looking crystal: 4 litres
Self-calibrating and automatic gain control which eliminates the use of radioactive sources in the field
Recording at a rate of 1 Hz, the:

- total, potassium, uranium and thorium counts
- entire 256 channel spectra

Magnetometer: Geometrics Cesium split-beam total field magnetic sensor installed in a stinger (figure 2) with a sensitivity of 0.01 nT, a sampling rate of 10 Hz and a resolution better than 0.025 nT per measurement. The sensor tolerates gradients up to 10 000 nT/m, and operates in a range from 20 000 nT to 100 000 nT. A 0.5 nT noise envelope was not exceeded over 500 metres line-length without a reflight.

Magnetometer Base Station: A GEM GSM-19 Overhauser magnetometer base station was mounted in a magnetically quiet area. The base station measures the total intensity of the earth's magnetic field in units of 0.01 nT at intervals of 1 second, within a noise envelope of 0.10 nT. The base station magnetometer was located near the base of operation at the following coordinates:

Fuel Cash:	Longitude: -75.0909364° Latitude: 52.8529624°	Mean Value: 57 550.20 nT
LG2:	Longitude: -77.7162080° Latitude: 53.6297020°	Mean Value: 57 403.87 nT
Mirage:	Longitude: -76.0067050° Latitude: 52.7363091°	Mean Value : 57 428.15 nT

Digital Acquisition System: RMS DAARC500 Data Acquisition System

Radar Altimeter: TRA-3000, accuracy 2%, sensitivity one foot, range 0 to 2,500 feet, 1 sec. recording interval

Baro Altimeter: Honeywell

Electronic Navigation:	Real-Time dual-frequency Novatel GPS receiver differentially corrected with Omnistar System, 0.2 sec. recording interval, accuracy better than ±5 metres.

Figure 2: Stinger Installation of the Magnetometer Sensor

3.2 Personnel

The general management of the project was monitored offsite by Mr. Mouhamed Moussaoui, **GDS**'s President. Mr. Saleh El Moussaoui was responsible for the field data processing to ensure that the work was carried out according to contractual specifications. The final data evaluation and processing was carried out at the Laval **GDS** office by Mr. François Caty and Mr. Carlos Cortada. Survey crew and office personnel are listed in table 3.

Table 3: Field and Office Crew

Position	Name
Project Manager	Mr. Mouhamed Moussaoui, P.Eng.
Field data quality control	Mr. Saleh El Moussaoui
Field Operator	Mr. Pierre Filion
Pilot	Mr. André Durand
Office Data Verification & Final Processing	Mr. François Caty (spectro. data) Mr. Carlos Cortada (magnetic data)
Survey Report	Mr. Camille St-Hilaire, P.Geo

4.0 SURVEY SCHEDULE AND BASE OF OPERATION

The survey area was made of 4 blocks with a flight line bearing (North-South) selected to run perpendicular to the average trend of the local geological structures. The field base of operation were set up at the Pourvoirie Mirage, which is located approximately 200 km North-East of the survey areas, and LG2, which is located approximately 100 km North-West of the survey areas.

The survey was flown in two steps, from October 16^{th} to 30^{th}, 2007 and from June 14^{th} to July 18^{th}, 2008.

5.0 DATA ACQUISITION

The following tests and calibrations were performed prior to the commencement and during the survey flying:

- Altimeter calibration
- Figure of Merit
- AGS calibrations for:
    - Compton stripping coefficients;
    - aircraft and cosmic backgrounds;
    - height attenuation coefficient;
    - radioelement sensitivities;
    - radon removal parameters.

These calibrations and tests were flown either near the Breckenridge test site or over the survey site, as part of the start-up and monitoring procedures. Details of each test and their results are given in Appendix A.

Periodic AGS tests were performed as follows:

- test line (daily pre- and post flight)
- background-over-water

After each day, profiles were examined as a preliminary assessment of the noise level of the recorded data. Altimeter deviations from the prescribed flying altitudes were also closely examined.

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

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

Checking all data for adherence to specifications was carried out in the field by **GDS**'s field geophysicist.

6.0 DATA COMPILATION AND PROCESSING

6.1 Base maps

Base maps of the survey area were plotted from topographic maps of the Department of Natural Resources Canada at a scale of 1:50 000.

Projection description

Datum:	WGS84
Projection:	Universal Transverse Mercador (UTM Zone 18N)
Central Meridian:	75° West
False Easting:	500 000
False Northing:	0
Scale Factor:	0.9996

6.2 Processing of the Positioning Data (GPS)

The raw GPS data were recovered and corrected from spikes. The resulting corrected latitudes and longitudes were then converted from the WGS-84 spheroid. A point-to-point speed calculation was then done from the final X, Y coordinates and reviewed as part of the quality control. The flight data were then cut back to the proper survey line limits and a preliminary plot of the flight path was done and compared to the planned flight path to verify the navigation. The positioning data were then exported to the other processing files.

6.3 Processing of the Altimeter data

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

6.4 Processing of the Base Station Data

Recorded magnetic diurnal data from the magnetometer base station were reformatted and loaded into the OASIS database. After initial verification of the integrity of the data from statistical analysis, the appropriate portion of the data was selected to correspond to the exact start and end time of the flight. The data were then checked and corrected for spikes using a fourth difference editing routine. Following this, interactive editing of the data was done, via a graphic editing tool, to remove events caused by man-made disturbances. A small low pass noise filter (30 seconds) was then applied. The final processing step consisted of subtracting result from the airborne magnetic data as a pre-levelling step. The average of the Total Field Magnetic Intensity measured at the Base Station was 57 750.2 nT.

6.5 Processing of the Airborne Magnetic Data

The airborne magnetic data were reformatted and loaded into the OASIS database. After initial verification of the data by statistical analysis, the values were adjusted for system lag. The data were then checked and corrected for any spikes using a fourth difference editing routine and inspected on the screen using a graphic profile display. Interactive editing, if necessary, was done at this stage. Following this, the long wavelength component of the diurnal was subtracted from the data as a pre-levelling step. A preliminary grid of the values was then created and verified for obvious problems, such as errors in positioning or bad diurnal. Appropriate corrections were then applied to the data, as required.

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

6.5.1 Micro-Levelling

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

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

Once the micro levelling process was applied, colour-shaded images were studied to verify that the residual line noise has been minimized, and that new line noise has not been introduced. The micro level correction grid was reviewed to confirm that no significant geological signal had been removed.

The final stage was to sample the correction grid and apply these corrections to the magnetic profile data.

6.5.2 Total Magnetic field and First Vertical Derivative Grids

The reprocessed total field magnetic grid was calculated from the final reprocessed profiles by a minimum curvature algorithm. The accuracy standard for gridding was that the grid values fit the profile data to within 0.01 nT for 99.99% of the profile data points. For all the blocks, the grid cell size was 25 metres.

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

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

6.6 AGS Data Processing

The Airborne Gamma-ray Spectrometric data was subjected to primary quality control, complete data reduction, gridding and imaging in the field during the data acquisition phase. The final processing procedure starts by analysing the raw, 256-channel spectra to reduce statistical noise using a spectral component analysis technique (NASVD).

Subsequent processing consists of:

- refining the various parameters used for ROI (region-of-interest) data reduction;
- reducing the whole dataset with increased attention to detail;
- statistical and image evaluation of the reduced data;
- adjustment to the data reduction as necessary;
- applying micro-levelling to the gridded data and transferring adjustments to profile data;
- preparing the required products.

6.6.1 Data Processing Overview

GDS utilizes an ***improved*** methodology for AGS data reduction based on the standard techniques outlined in the following references:

- IAEA-Tecdoc-1363, *Guidelines for radioelement mapping using gamma ray spectrometric data*;
- AGSO Record 1995/60, *A Guide to the Technical Specifications for Airborne Gamma-Ray Surveys*.
- IAEA-TECDOC-1363, "Guidelines for radioelement mapping using gamma ray spectrometry data" (July 2003).

The parameters used for this processing were based on those determined during the calibration and testing phase of the survey (see Appendix A) and on subsequent analysis of the whole AGS data set including background-over-water measurements. The primary AGS data consists of the

256 channel spectra collected at 1 Hz for both the downward-looking (16 litres) and upward-looking (4 litres) crystal packs. The major data reduction stages are:

- NASVD analysis of the 256 channel AGS spectra
- Appropriate filtering of auxiliary data (ground clearance, temperature, pressure and cosmic)
- Calculation of effective height (at STP = "Hstp")
- Background removal (aircraft, cosmic and atmospheric radon)
- Compton stripping (spectral unfolding)
- Adjustment for height attenuation
- Conversion to radioelement ground concentrations (TC, K U, TH)
- Gridding and evaluation
- Calculation of derivative products

Each of the radioelement results: total count (TC); potassium (K); uranium (U); and thorium (TH) were evaluated using statistical and image analysis techniques.

6.6.2 NASVD Statistical Noise Reduction

GDS's personnel have extensive experience with the application of Noise Adjusted Singular Value Decomposition (NASVD), which was initially developed by Hovgaard and Grasty (1997), and evaluated in depth by Minty (2003). NASVD was applied to both the downward and upward 256-channel spectra in order to reduce statistical noise. A formulation of the method modelled on that of Minty was used.

The noise–reduced spectra were used to extract new TC, K, U and TH and UPU (upward-looking uranium) ROI count rates, which then have less noise than the original raw ROI. For the uranium measurement, in particular, it is possible to achieve a significant reduction in statistical noise.

NASVD analysis results in a more precise measure of the radioelement ground concentrations, which improves the discrimination between different geologic units with similar concentration values. However, no significant improvement occurs for the total count measurement since it already incorporates a major part of the gamma-ray spectrum. The improved maps or images can reveal patterns and shapes previously hidden or barely discernible in the noise.

6.6.3 Filtering

All primary data was edited in the field to eliminate rare instances of spikes, noise or corrupted data points. During data reduction, appropriate filtering was applied to selected AGS fields in order to match measurement parameters to the primary gamma-ray data and/or improve accuracy.

6.6.4 Ground Clearance

Aircraft ground clearance was well maintained during this survey. AGS data is quite sensitive to height of the spectrometer above ground. The effective height at STP (Hstp) is used in data reduction. Note that the mean ground clearance (43.5 m) is quite close to the planned survey height of 40 m (figure 3). The maximum value (129 m) is well within the accepted limits for statistically meaningful AGS data (detector volume 16 litres). Accordingly, it was not necessary to reject any

AGS data points due to extreme height.

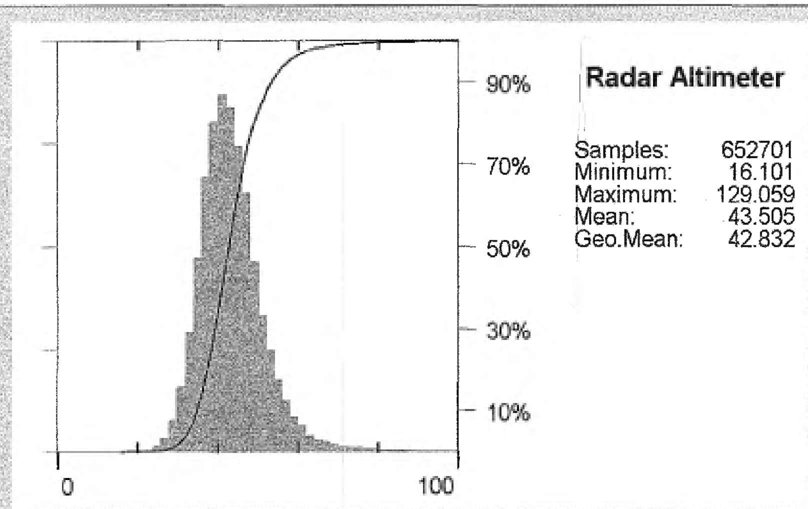

Figure 3: Spectrometer Ground Clearance

6.6.5 Atmospheric Radon Background Removal

The upward-looking detector method was used to remove the effects of atmospheric radon from the downward spectrometer count rates. The determination of the coefficients to be applied in this process, are described in Appendix A. The upward-looking spectrometer measures count rates in a "uranium" ROI. The statistics of these counts are improved by NASVD analysis.

The atmospheric radon levels, during this survey, fell within the expected range of concentrations.

In order to determine the AGS system response to atmospheric radon, a series of data were collected at survey height over the larger lakes in the survey area. All measurement points were at least 500m from shore, which results in negligible gamma contribution from the land. The background-over-water measurements (BOW) were made under a range of times-of-day and weather conditions in order to encounter a range of atmospheric radon concentrations. The resulting data are analyzed to obtain:

(a) Radon response coefficients for use with the upward-looking radon-removal technique;
(b) An improved estimate of the aircraft background.

6.6.6 Gridding

Total Count, uranium, thorium and potassium contributions were gridded using a minimum curvature algorithm (*Oasis Montaj*) with controls optimized for AGS data. A grid cell size of ¼ of the line spacing was used. Tie lines were not included in the gridding process. The grids were evaluated at all stages using image analysis techniques.

7.0 FINAL PRODUCTS

7.1 Maps

One paper copy of the following final maps was delivered to **DIOS** at a scale of 1:20 000 for each block:

(a) Potassium Percent (colour interval)
(b) equivalent Uranium parts per million (colour interval)
(c) equivalent Thorium parts per million (colour interval)
(d) Total Count (colour interval)
(e) Ratio et the eqU/eqTh
(f) Ratio of the K/eqTh
(g) Shaded Magnetic Total Field (colour interval)
(h) Shaded Magnetic First Vertical Derivative (colour interval)

GDS provided also the PDF formats of these maps.

7.2 Final digital archive of line data

Three copies of geophysical, positional and environmental data were delivered in Geosoft compatible format on DVD with gamma-ray spectrometric data reproduced at 1 second intervals. Appendix B describes the archive content.

7.3 Miscellaneous

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

8.0 CONCLUSION

The Opinaca North survey was completed outside the estimated time frame. Due to bad weather and a helicopter incident, the survey was completed in two phases, the 2007 from October 16th to 30th, phase and the 2008 phase from June 14th to July 18th.

All airborne and ground-based records were of excellent quality. Magnetic data acquisition was done in good diurnal conditions. It was found that even though diurnal was within specifications, diurnal subtraction was not good enough to level the data and, in fact, good intersections were required to produce a reliable final data set.

The noise level for the measured Total Magnetic Field was well within the accepted limits, determined from the fourth difference of the lagged, edited airborne magnetic data.

The acquisition of the Gamma-Ray Spectrometric data was done in excellent weather conditions. The atmospheric radon levels fell within the expected range of concentrations. Final maps and database show that the noise level is very low on all the spectrometric channels.

GPS results proved to be of high quality. The flight path was surveyed accurately and the speed checks showed no abnormal jumps in the data. The helicopter was able to remain within the ±20 metre elevation differences at the traverse/control line intersections.

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

Respectfully Submitted,

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

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APPENDIX A

TESTING AND CALIBRATION

1.0 FIGURE OF MERIT TEST

F. O. M. TEST (Everton)			
Project #:	P07-033	**Date:**	June 21st, 2008
Client:	DIOS	**Location:**	Everton, James Bay
Operator:	Pierre Filion	**Radar**	TRA 3500
Compiled By:	Saleh El Moussaoui	**Configuration:**	Stinger

MAGRAW = UNCOMPENSATED MAG TAIL SENSOR
MAGCOMP = COMPENSATED MAG TAIL SENSOR
VALUES DETERMINED USING 6 SECONDS (6 FIDUCIALS) HIGH PASS FILTER
VALUES DETERMINED USING MAXIMUM PEAK TO PEAK OF EACH MANEUVER

NORTH (360°)	Line Number	MAGRAW	MAGCOMP
PITCH	S360	7.219	0.250
ROLL		2.878	0.191
YAW		1.551	0.114
		11.649	**0.554**

EAST (90°)	Line Number	MAGRAW	MAGCOMP
PITCH	S90	1.734	0.113
ROLL		1.312	0.160
YAW		0.624	0.071
		3.669	**0.345**

SOUTH (180°)	Line Number	MAGRAW	MAGCOMP
PITCH	S180	1.094	0.127
ROLL		3.351	0.200
YAW		1.681	0.078
		6.127	**0.406**

WEST (270°)	Line Number	MAGRAW	MAGCOMP
PITCH	S270	3.792	0.198
ROLL		6.951	0.239
YAW		1.742	0.135
		12.485	**0.572**

TOTAL VALUES	MAGRAW	MAGCOMP
	33.93	1.876
	Improved Ratio	18.08

F. O. M. TEST (LG2)			
Project #:	P07-033	**Date:**	June 11th, 2008
Client:	DIOS	**Location:**	LG2, James Bay
Operator:	Pierre Filion	**Radar**	TRA 3500
Compiled By:	Saleh El Moussaoui	**Configuration:**	Stinger

MAGRAW = UNCOMPENSATED MAG TAIL SENSOR
MAGCOMP = COMPENSATED MAG TAIL SENSOR
VALUES DETERMINED USING 6 SECONDS (6 FIDUCIALS) HIGH PASS FILTER
VALUES DETERMINED USING MAXIMUM PEAK TO PEAK OF EACH MANEUVER

NORTH (360°)	Line Number	MAGRAW	MAGCOMP
PITCH	S360	6.637	0.207
ROLL		6.548	0.168
YAW		2.421	0.149
		15.606	**0.524**

EAST (90°)	Line Number	MAGRAW	MAGCOMP
PITCH	S90	6.662	0.172
ROLL		3.647	0.097
YAW		3.647	0.132
		13.956	**0.401**

SOUTH (180°)	Line Number	MAGRAW	MAGCOMP
PITCH	S180	5.241	0.140
ROLL		8.990	0.116
YAW		2.513	0.126
		16.744	**0.383**

WEST (270°)	Line Number	MAGRAW	MAGCOMP
PITCH	S270	6.116	0.154
ROLL		11.673	0.254
YAW		5.144	0.149
		22.933	**0.556**

TOTAL VALUES	MAGRAW	MAGCOMP
	69.239	1.864
	Improved Ratio	37.14

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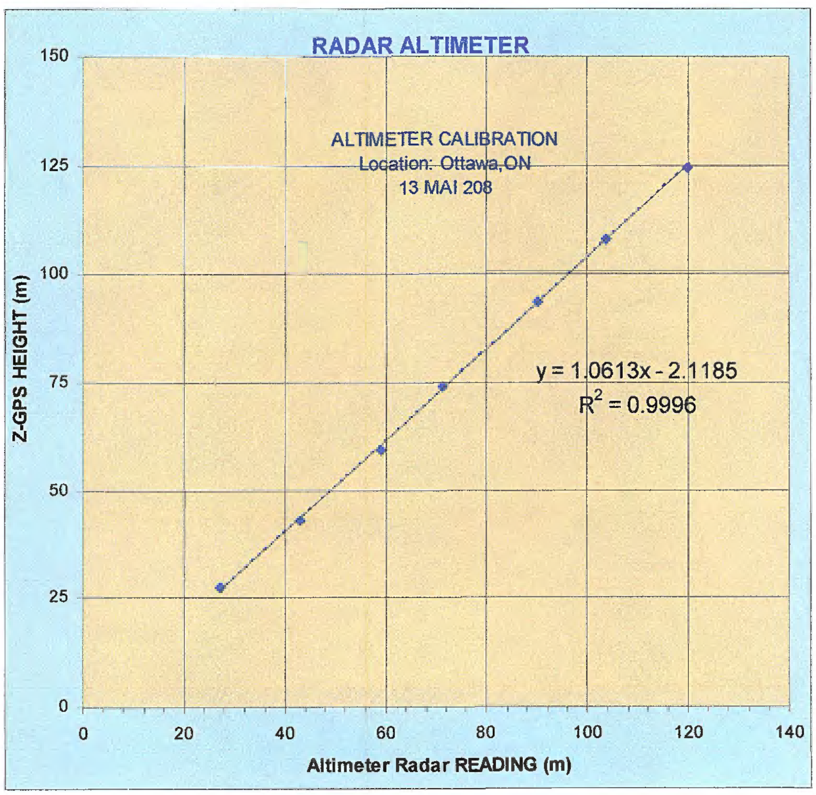
2.0 RADAR ALTIMETER TEST

RADAR ALTIMETER TEST			
Project #:	P07-033	**Date:**	Mai 13th, 2008
Client:	DIOS	**Location:**	Ottawa, ON
Operator:	Pierre Filion	**Helicopter**	Bell 206 LR
Compiled By:	Saleh El Moussaoui	**Configuration:**	Stinger

Planned Radar Altitude (feet)	Radar Altitude (m)	Baro mbr	GPS Hight (m)	Z-GPS Values (m)
0			0.000	62
100	27.182	1007.853	27.371	89.371
150	42.908	1005.82158	42.823	104.823
200	59.0823	1003.682	59.562	121.562
250	71.165	1002.053	74.023	136.023
300	89.995	999.558	93.988	155.988
350	103.573	997.765	107.901	169.901
400	119.793	995.696	124.705	186.705



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3.0 AIRBORNE GAMMA-RAY SPECTROMETRY

Airborne Gamma-Ray Spectrometry (**AGS**) requires careful calibration on proper facilities and/or under particular environmental conditions. Three major radiometric calibrations are reported here, namely:

- **Dynamic Calibration Range** (dcr) measurements, which evaluate the altitude attenuation coefficients and the radioelement sensitivity of the airborne spectrometer system.
- **Cosmic Flight,** which is used to determine the aircraft background values and cosmic coefficients.
- **Background-0ver-Water** (bow) measurements, used to determine the spectrometer response to airborne radon.

Measurements were made in accordance with **GDS** procedures for AGS data acquisition, which were designed in accordance with: IAEA technical report series No. 323, "Airborne Gamma Ray Spectrometer Surveying"; AGSO Record 1995/60, "A Guide to the Technical Specifications for Airborne Gamma-Ray Surveys"; and IAEA-TECDOC-1363, "Guidelines for radioelement mapping using gamma ray spectrometry data" (July 2003).

4.0 AGS STANDARDS

This section provides information on a range of standard values and terminology used by **GDS** for AGS data acquisition.

4.1 Gamma Peak Positions

GDS maintains the gamma-ray spectrometer so that:

- the spectrometer (channel number) versus (gamma energy) relationship is linear and fixed (stable) in the energy range of interest (400 – 3,000 keV).
- the channel versus energy intercept equals zero.

The gamma peak positions thus remain constant and for the most important peaks are:

SOURCE NAME	PEAK ENERGY (keV)	POSITION (channel no.)
Rn (radon / Bi-214)	609	51.1
Cs-137	662	55.5
K (potassium / K-40)	1460	121.5
U (uranium / Bi-214)	1764	147.5
TH (thorium / Tl-208)	2615	218.5

Note that the peak positions are provided to 0.1 channel accuracy.

4.2 Energy ROI (Regions of Interest)

The airborne radiometric technique requires measurement of count rates for specific energy regions (ROI or windows) in the natural gamma-ray spectrum. The standard energy regions (in accordance with IAEA 323) and the corresponding channel limits are:

DOWNWARD SPECTROMETER ENERGY ROI				
DESIGNATION	ENERGY LIMIT (keV)		CHANNEL LIMIT (inclusive)	
	Lower	Upper	Lower	Upper
Total Count = **TC**	410	2810	34	233
Potassium = **K**	1370	1570	115	130
Uranium = **U**	1660	1860	139	155
Thorium = **TH**	2410	2810	202	233
Upward Uran. = **UPU**	1660	1860	139	155
Cosmic = **COS**	3200	infinity		

4.3 DYNAMIC CALIBRATION RANGE

Dynamic calibration range (dcr) measurements were performed with the helicopter in AGS survey configuration, over the Breckenridge range near Ottawa, on June 22nd, 2007.

The range was flown by acquiring data on a series of 8 passes over its 9 km length, at constant ground clearances ranging from 120 to 800 feet. These passes alternated between the land and adjacent fresh water sections of the range. The measurements where used to determine altitude attenuation coefficients and radioelement sensitivities.

4.4 Altitude Attenuation

The airborne data from Breckenridge were checked for quality, edited and divided into lines for each pass. Mean values were calculated for each pass over the water. The AGS ROI was then corrected for background (aircraft, cosmic and radon) by subtracting the mean over-water values from the corresponding (same height) over-land data values.

The ground clearance was then converted to an equivalent height at standard temperature and pressure – "H_{STP}". The K, U and TH ROI were corrected for spectral overlap using the stripping coefficients measured. Finally the mean processed values for the over-land portions of the range were calculated. The results of this processing are:

GEO DATA SOLUTIONS Inc.

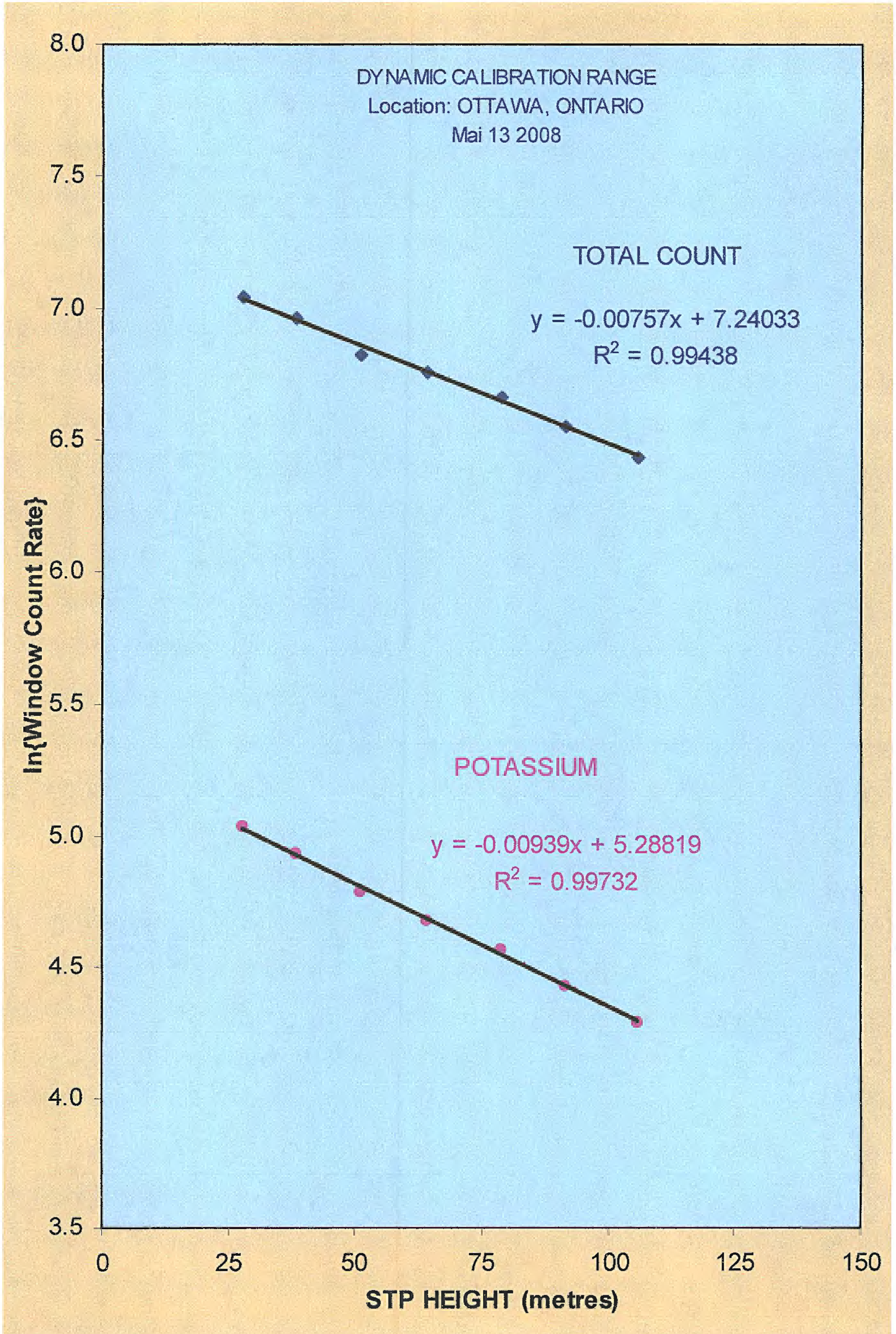
BRECKENRIDGE RESULTS For BELL 206 LR

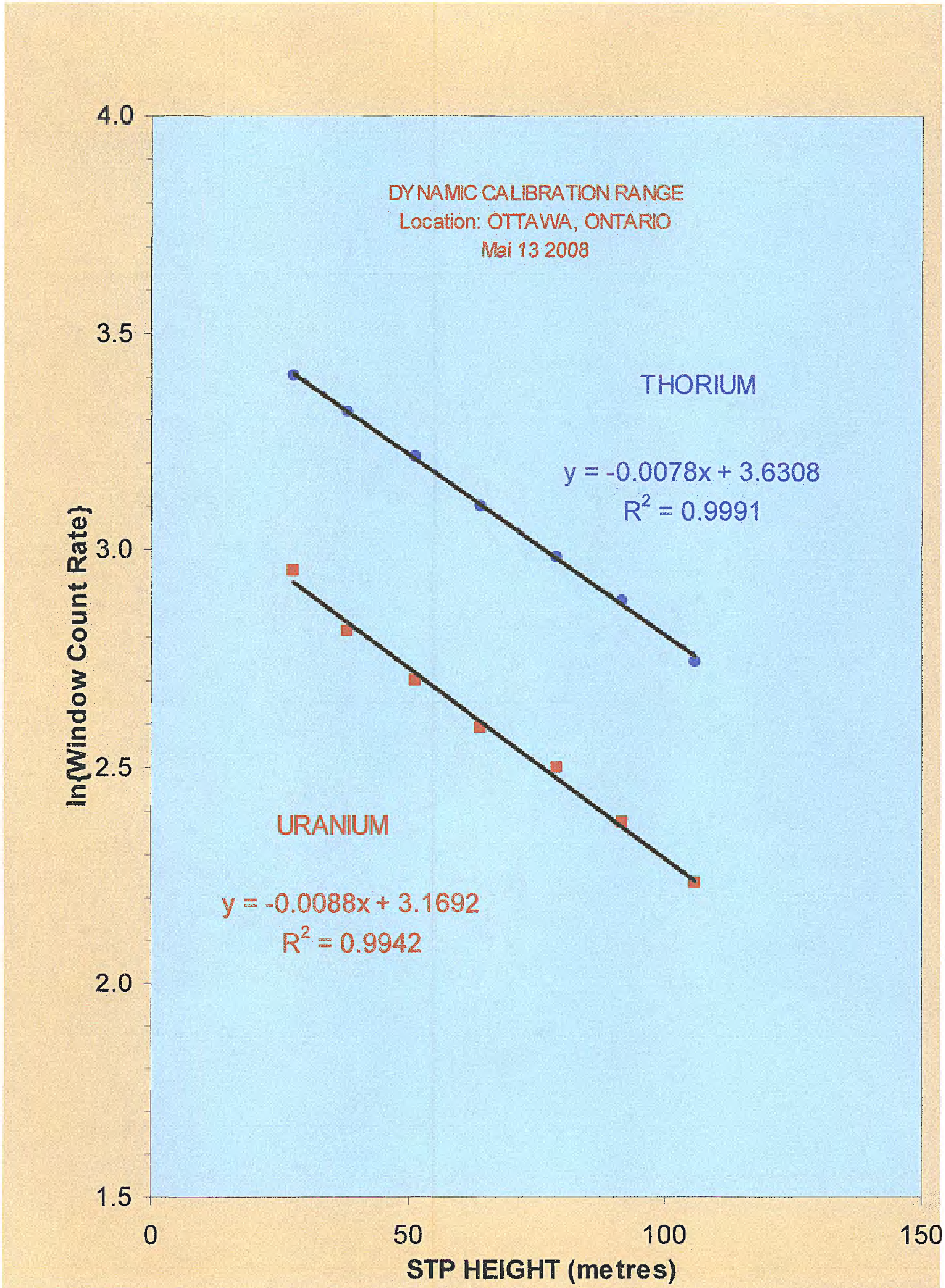
Project #: P07-033
Client: DIOS
Pilot: Christophe Saragoza
Operator: Pierre Filion
Compiled By: Saleh El Moussaoui

Date: May 13th, 2008
Location: Ottawa (Ontario)
Helicopter: Bell 206 LR
Configuration: mag. and spectro.

LINE	HSTP	TC	K	TH	U	Radarm
1000	27.63	1143.187211	153.8886	30.00139	19.1560454	30.395357
1500	38.3018	1052.855532	139.23	27.62503	16.7	42.31209126
2000	51.15203	916.899225	119.6735	24.91149	14.8921373	56.6903856
2500	64.05279	856.41572	107.5406	22.21344	13.3377916	71.92237343
3000	78.7752	782.3914843	96.39011	19.77152	12.1834842	87.4864253
3500	91.51033	698.70438	84.07512	17.86086	10.7037037	102.332152
4000	105.766	624.7587257	73.01521	15.56348	9.33	118.5469706

LINE	HSTP	ln TC	ln K	ln TH	ln U	NO OF POINTS
1000	27.63	7.04	5.04	3.40	2.95	112
1500	38.3018	6.96	4.94	3.32	2.82	115
2000	51.15203	6.82	4.78	3.22	2.70	113
2500	64.05279	6.75	4.68	3.10	2.59	101
3000	78.7752	6.66	4.57	2.98	2.50	114
3500	91.51033	6.55	4.43	2.88	2.37	118
4000	105.766	6.44	4.29	2.74	2.23	115


DYNAMIC CALIBRATION RANGE
Location: OTTAWA, ONTARIO
Mai 13 2008
TOTAL COUNT
y = -0.00757x + 7.24033
R2 = 0.99438
POTASSIUM
y = -0.00939x + 5.28819
R2 = 0.99732
ln{Window Count Rate}
STP HEIGHT (metres)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
0
25
50
75
100
125
150



DYNAMIC CALIBRATION RANGE
Location: OTTAWA, ONTARIO
Mai 13 2008
THORIUM
y = -0.0078x + 3.6308
R2 = 0.9991
URANIUM
y = -0.0088x + 3.1692
R2 = 0.9942
ln{Window Count Rate}
STP HEIGHT (metres)
4.0
3.5
3.0
2.5
2.0
1.5
0
50
100
150

4.5 COSMIC CALIBRATION FLIGHT

It is important for the cosmic flight to be conducted in a location that will minimize the presence of airborne radon. This is difficult anywhere over a landmass, since radon is constantly being released from soil and rocks. The cosmic flight was performed over lake a huge fresh water body.

The purpose of the cosmic flight is to:

1. perform an accurate measurement of the relationship between the cosmic ROI (all gamma-rays of energy greater than 3.2 MeV) and the lower energy radiometric ROI TC, K, U, TH and upward uranium (UPU)

2. provide an ***initial*** measure of the aircraft background.

Primary ROI data is re-extracted, when necessary, in order to improve the energy definition. The data for each altitude was evaluated for quality. Mean values were then extracted. They are listed in the table below.

Summary of COSMIC calibration test mean values

Date: May 14th, 2008 — Data have been livetime corrected, except for the Cosmic-counts
Helicopter: Bell 206 LR
Location: Superior Lake, Thunder Bay, ON

NOMINAL ELEVATION AGL (feet)	COSMIC COUNT (cps)	DOWNWARD SPECTROMETER WINDOWS				UPWARD "UPU" (cps)
		TC (cps)	K (cps)	U (cps)	TH (cps)	
2966	94.6909	145.8135	13.7574	6.215517	5.277	1.5805
4097.736	105.654	161.489361	14.739	7.13	6.17553	1.9255
5067.946	118.82524	177.7037	15.928	7.818	7.899	2.04918
5962.3139	137.5101	203.26	17.25	9.1111	8.61	2.35858
7028.76	159.9289	233.0273	19.25136	10.53	9.9876	2.69
7963.263	184.3448	263.0862	20.87356	12.0747	12.00574	3.16
8991.5569	214.1075	298.5913	22.7741	13.51612	13.46236	3.51
9972.7917	253.1497	339.99509	25.7598	15.8823	16.299	4.13

ROI	AIRCRAFT BACKGROUND (cps)	COSMIC COEFFICIENT
TC	43.29	1.181
K	7.388	0.072
U	0.947	0.059
TH	0.061	0.063
UPU	0.234	0.015

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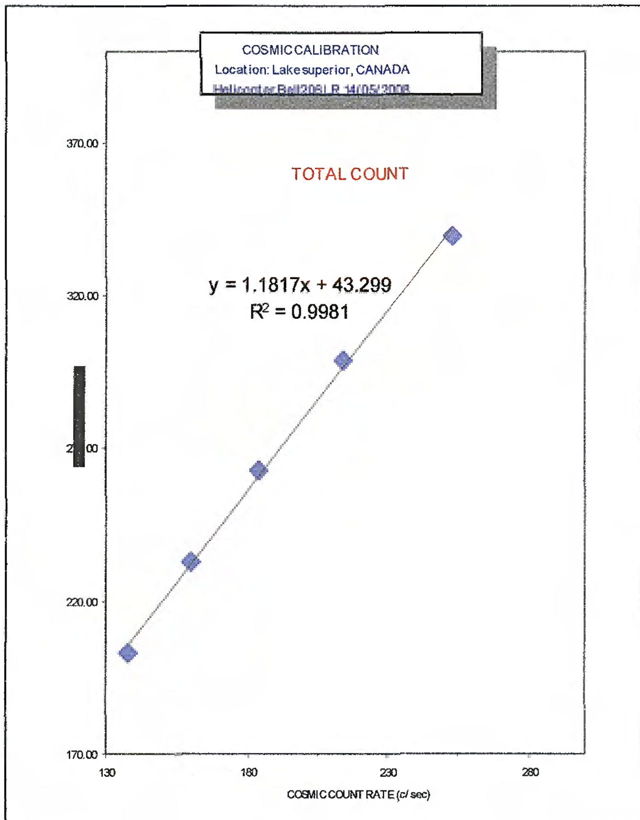
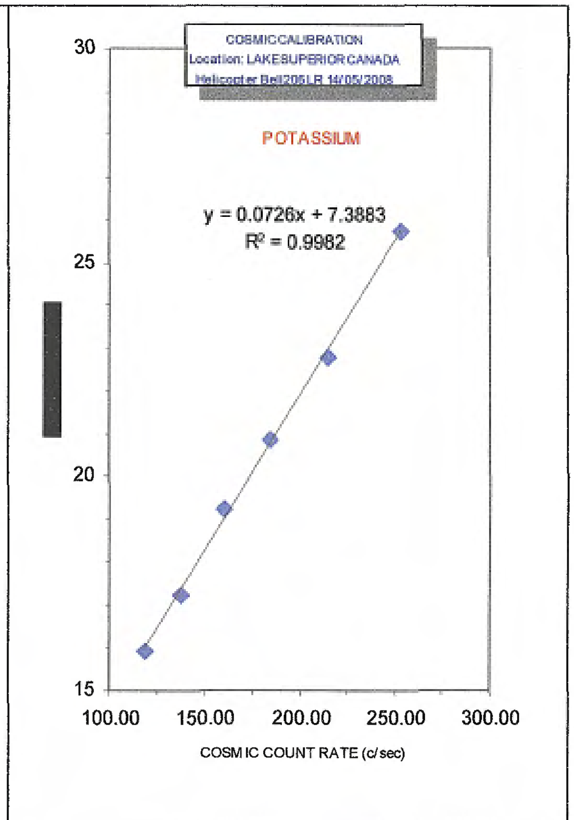
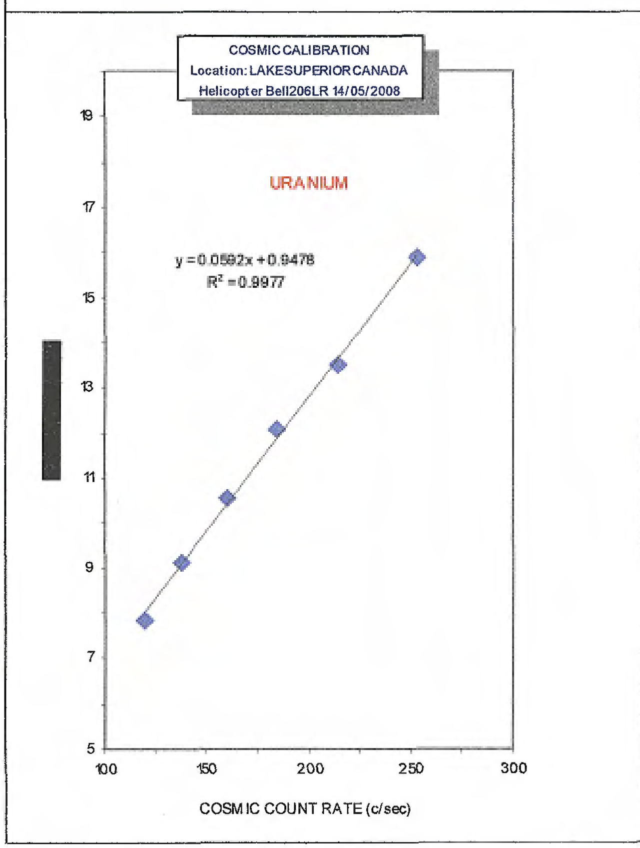
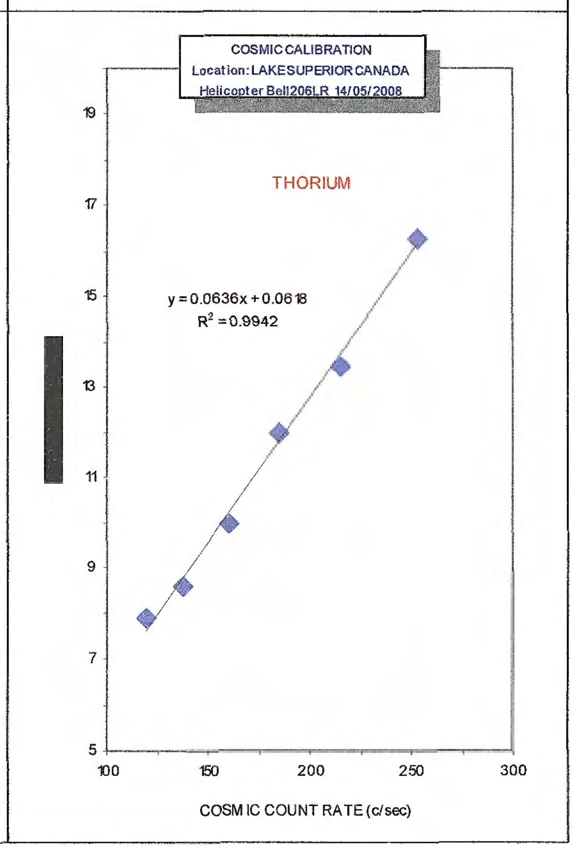

COSMIC CALIBRATION
Location: Lakesuperior, CANADA
TOTAL COUNT
y = 1.1817x + 43.299
R² = 0.9981
370.00
320.00
220.00
170.00
130
180
230
280
COSMIC COUNT RATE (c/sec)


COSMIC CALIBRATION
Location: LAKESUPERIOR CANADA
POTASSIUM
y = 0.0726x + 7.3883
R² = 0.9982
30
25
20
15
100.00
150.00
200.00
250.00
300.00
COSMIC COUNT RATE (c/sec)


COSMIC CALIBRATION
Location: LAKESUPERIOR CANADA
Helicopter Bell206LR 14/05/2008
URANIUM
y = 0.0592x + 0.9478
R² = 0.9977
19
17
15
13
11
9
7
5
100
150
200
250
300
COSMIC COUNT RATE (c/sec)


COSMIC CALIBRATION
Location: LAKESUPERIOR CANADA
Helicopter Bell206LR 14/05/2008
THORIUM
y = 0.0636x + 0.0618
R² = 0.9942
19
17
15
13
11
9
7
5
100
150
200
250
300
COSMIC COUNT RATE (c/sec)

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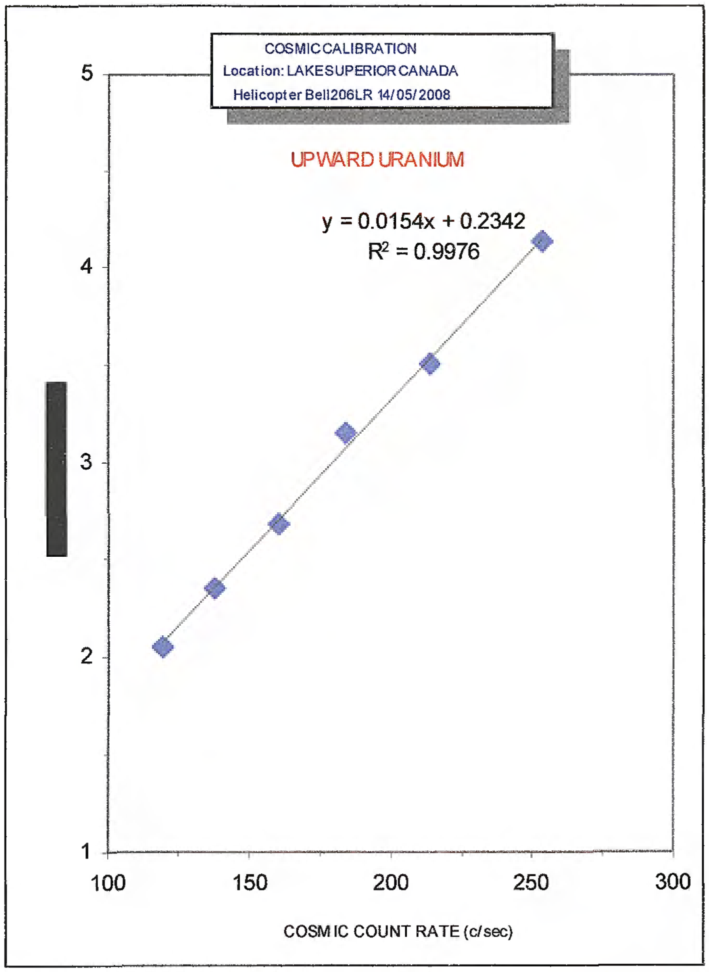
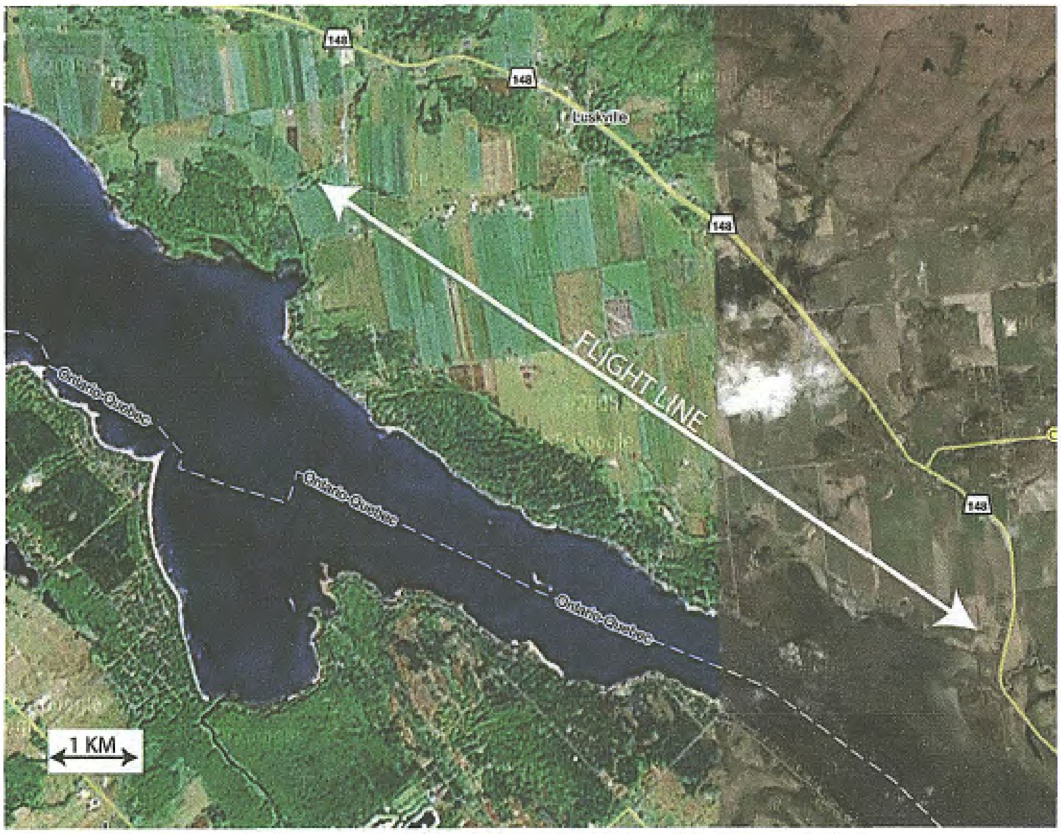


ROI	AIR ATTENUATION (per metre at STP)	SENSITIVITY
TC	-0.0075	18.5
K	-0.0093	66.0085
U	-0.0088	10.3633
TH	-0.0078	3.364

BRECKENRIDGE DYNAMIC CALIBRATION RANGE



LOCATION:

- Adjacent to Ottawa River, approximately 12 km northwest of the city of Ottawa.

LAND LINE:

- Geology: Non-marine clay developed from underlying marine clay during the last stages of the Champlain Sea and during subsequent estuarine and fluvial periods. It is probable that the gamma-ray signature of the clay is due to radioactive heavy minerals in the small amount of sandy matter enclosed within it.
- Homogeneity: highly uniform over its length and width.
- Length: 8.8 km.
- Altitude: 68 m ASL

WATER LINE:

- Background-over-water is measured over the adjacent Ottawa River. The water line extends to the west of the above map. Minimum width = 1.5 km. Length = 9 to 10 km.

APPENDIX B

PROFILE DATABASE ARCHIVE CHANNEL DEFINITIONS AND GRID ARCHIVE DEFINITIONS

Magnetic Channel
(Oasis Montaj GDB format)

General line information:		
Line	Unit	Line number
Flt		Flight number
Date		Flight date (yyyy/mm/dd)
Clocks and system synchronization:		
Fiducial	Sec	Fiducial
TimeGPS	Sec	Edited GPS time (second after midnight)
Edited GPS channels		
X84_Z18	Metre	Easting, WGS-84 UTM Z18N
Y84_Z18	Metre	Northing, WGS-84 UTM Z18N
Zgps	Metre	MSL GPS altitude
Longitude	Deg	Original Longitude, WGS-84
Latitude	Deg	Original Latitude, WGS-84
Radar altimeter		
radarm	Metre	Radar Altimeter
DTM	Metre	Digital Terrain Model (from Zgps and Radar)
Ground Mag base station data		
Base	nT	Original, (in Block area) unedited primary mag base station
Basef	nT	Filtered Base
Mag TMF data		
Magc	nT	Mag despiked
drift	nT	Diurnal correction removed
Magbc	nT	Diurnal corrected Mag (magc-drift)
Corlev	nT	Tie line levelling correction
Maglev	nT	Tie line leveled Mag
Cormicro	nT	Microleveling correction
Magmicro	nT	Micro leveled Mag

xx_Mag_Final.grd	Total Magnetic Field grid
xx_Grad_Final.grd	Total Magnetic Field first vertical derivative grid
xx_Dios_final.gdb	Magnetics Geosoft database

Where xx is the block name (Gridding cell size is 25 m)

Radiometrics Channels
(Oasis Montaj GDB format)

General line information:		
Line		Line number
Flt		Flight number
Date		Flight date (yyyy/mm/dd)
General line information:		
Fiducial	Sec	Fiducial
TimeGPS	Sec	UTC time in second after midnight
GPS channels		
X84_z18	m	Easting, WGS-84 UTM Z18N
Y84_z18	m	Northing, WGS-84 UTM Z18N
Z84	m	MSL GPS altitude
Longitude	Deg	Longitude, WGS-84
Latitude	Deg	Latitude, WGS-84
Altimeter		
Radarm	m	Radar Altimeter
Baro	mBar	Barometric Altimeter
Temp	Celcius	Air temperature
Radiometric Data:		
RadarSTP	m	Ground distance corrected to STP
LTime	msec	Live Time
STime	msec	Sample Time
Cosmic	cps	Cosmic counts
upU	cps	Upward Uranium counts
Down	cps	Down detectors spectrum (256 channels)
Up	cps	Up detector spectrum (256 channels)
TC	cps	Total counts
K	cps	Potassium counts
TH	cps	Thorium counts
U	cps	Uranium counts
TCcorr	nGy/h	Total radiometric dose rate
Kcorr	%	Potassium concentration
THcorr	ppm	Equivalent Thorium concentration
Ucorr	ppm	Equivalent Uranium concentration
UTH		Uranium/Thorium ratio
KTH		Potassium/Thorium ratio

Dios_xx_TCcorr.grd	Total radiometric dose rate grid
Dios_xx_Kcorr.grd	Potassium concentration grid
Dios_xx_THcorr.grd	Equivalent Thorium concentration grid
Dios_xx_Ucorr.grd	Equivalent Uranium concentration grid
Dios_xx_UTH.grd	Uranium/Thorium ratio grid
Dios_xx_KTH.grd	Potassium/Thorium ratio grid
Dios_xx_Spectro.gdb	Radiometrics database

Where "xx" is the block name (Gridding cell size is 25m)