AEROBUS LAKE AREA

Ontario Airborne Geophysical Surveys
Magnetic, Electromagnetic and Radiometric Data
Geophysical Data Set 1240

Ontario Geological Survey
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CREDITS

List of accountabilities and responsibilities:

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- Steve Munro, Senior Geophysicist, Scott Hogg & Associates Ltd. (SHA), Toronto, Ontario, responsible for the reprocessing of this data set
- Tom Watkins, Team Leader, Publication Services Section, Ontario Geological Survey, MNDM – managed the project-related hard copy products
- Desmond Rainsford, Geophysicist, Precambrian Geoscience Section, Ontario Geological Survey, MNDM – managed the project-related digital products
- Terraquest Limited, Markham, Ontario – data acquisition and data compilation.

DISCLAIMER

To enable the rapid dissemination of information, this digital data has not received a technical edit. Every possible effort has been made to ensure the accuracy of the information provided; however, the Ontario Ministry of Northern Development and Mines does not assume any liability or responsibility for errors that may occur. Users may wish to verify critical information.

CITATION

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

Ontario Geological Survey 2012. Ontario airborne geophysical surveys, magnetic, electromagnetic and radiometric data, grid and profile data (ASCII and Geosoft® formats) and vector data, Aerobus Lake area—Purchased data; Ontario Geological Survey, Geophysical Data Set 1240.

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.

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1 INTRODUCTION

As part of an ongoing program to acquire high-quality, high-resolution airborne geophysical data across the Province of Ontario, the Ontario Ministry of Northern Development and Mines (MNDM) does, from time to time, issue Requests For Data (RFD) in order to purchase existing proprietary data held by mining companies. Purchase of existing data complements new surveys commissioned by the MNDM.

The purchase of data is attractive because of the low cost of acquisition relative to flying new surveys.
The money used to purchase the data can be reinvested in exploration. The data are assessed for quality prior to purchase and are reprocessed to meet the common formats and standards of other Ontario geophysical data. Once reprocessed these data are then made public.

Ranking and valuation of submitted airborne geophysical survey data sets were based on the following criteria:

- date of survey – recent surveys were favoured over older surveys because of improved acquisition technology, greater data density and improved final products.
- survey method – magnetometer surveys, without supplementary radiometrics or very low frequency (VLF), were given the lowest rating in this category; airborne electromagnetic (AEM) and magnetometer were given the highest; the objective was to acquire data that complements what is already available in the public domain, with emphasis on exploration rather than mapping.
- location of area
    - data sets occurring within areas already surveyed or scheduled for survey were selected only if they added significantly to the acquired data sets,
    - proximity or coincidence of the survey block with areas having restricted land use designations affected the value assigned to that survey,
    - consideration was given to data sets that were collected in remote areas where logistical costs are very high.
- line spacing – detailed surveys were normally accorded a higher rating than reconnaissance surveys.
- quality of data – data quality, processed products, and adherence to correct survey specifications had to be up to normal industry standards.
- survey size – data sets comprising less than 1000 line-km were selected only if they fell in very strategic locations.
- other criteria –factors such as apparent mineral significance, previous exploration activity and land availability were also considered in making the final selection.

2 SURVEY LOCATION AND SPECIFICATIONS

This report describes a fixed-wing magnetic gradiometer, VLF electromagnetic and gamma spectrometer survey located approximately 60 km northwest of Dryden, Ontario. The survey was flown on behalf of Delta Uranium Inc. and was conducted by Terraquest Ltd., Ontario. The survey was completed on July 9, 2008.

The survey was flown with a 150° to - 330° line direction with 100 m line spacing. Total survey coverage was 6412 line-km. The map below (Figure 1) shows the location of the survey area.

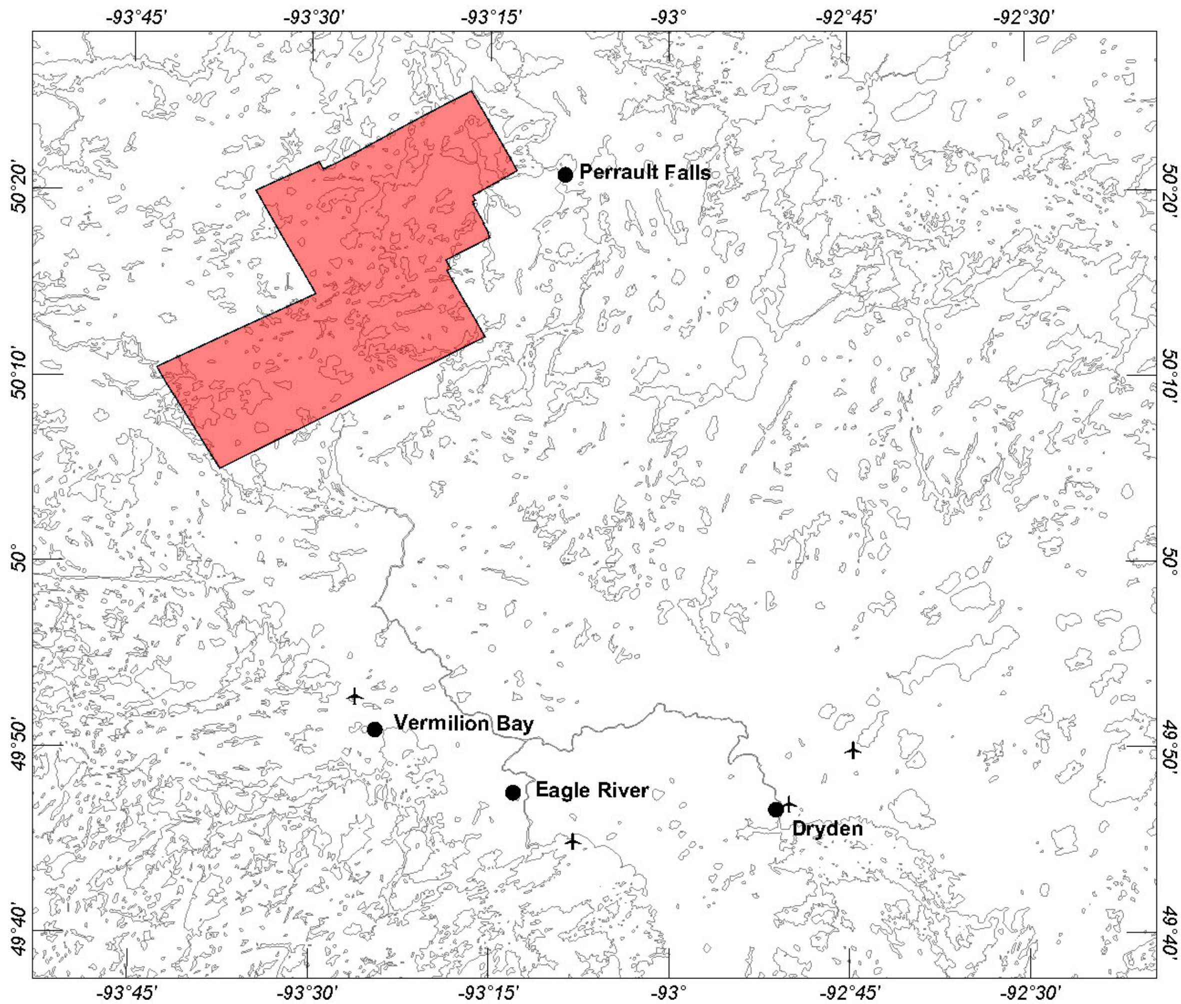

Figure 1 – Survey Index Map

The table below summarizes the flight specifications

Parameter	Specification
Aircraft Speed	288 km/hr
Sampling Interval	6-8m (10Hz)
Flight-line Interval	100 m
Flight-line Direction	150/330 degrees
Control-line Interval	2000 m
Control-line Direction	224/064 degrees
Aircraft MTC	70 m
Mag Sensor MTC	70 m

3 AIRCRAFT, EQUIPMENT AND PERSONNEL

Aircraft

Airplane: Navajo PA31-325 CR
Owner-Operator: Terraquest Ltd.

Installation of the geophysical and ancillary equipment was carried out by Terraquest Ltd.

Magnetometers

The Terraquest magnetic gradiometer system utilizes three cesium vapour magnetometers.

Model	CS-3
Manufacturer	Scintrex Ltd.
Resolution	0.001 nT counting at 0.1 per second
Sensitivity	+/- 0.005 nT
Dynamic Range	15 000 to 100 000 nT
Fourth Difference	0.02 nT
Recorded Sample Rate	0.1 seconds
Noise Envelope	0.10 nT (Tail Mag)

A magnetometer was installed at each wingtip, within a pod extending outwards. The third magnetometer was installed in a tail stinger. The lateral separation between the two wingtip sensors was 14.6 m. The longitudinal (wing centre to sensor) separation was 9.2 m.

A three-axis fluxgate magnetometer was installed in the tail stinger, for use in post-flight compensation.

Model	W/FM100G2-1F
Manufacturer	Billingsley Magnetics
Axial Alignment	> Orthogonality > +/- 1 degree
Accuracy	< +/- 0.75% of full scale (0.5% typical)
Field Measurement	+/- 100 000 nanotesla
Linearity	< +/- 0.015% of full scale
Sensitivity	100 microvolt/nanotesla
Noise	< 12 picotesla RMS/–Hz @ 1 Hz

VLF System

The geophysical equipment included a VLF system proprietary to Terraquest Ltd. The XDS VLF-EM System employs 3 orthogonal, air-core coils mounted in the pod of the tail stinger, and coupled with a receiver-console, tuned to receive a range of 22.0 kHz to 26.0 kHz (which includes both Cutler Maine NAA (frequency 24 kHz) and Seattle WA NLK (frequency 24.8 kHz), and measures the X, Y and Z directions of the VLF field. The vertical field is referenced to the line coil.

Model	XDS
Manufacturer	Terraquest Ltd.
Parameters Measured	X, Y and Z components, absolute field
Frequency Range	22.0 - 26.0 kHz
Gain	Constant gain setting
Filtering	No filtering

Gamma-Ray Spectrometer

A gamma-ray spectrometer system was also included with the survey equipment.

Model	RSX-5
Manufacturer	Radiation Solutions Inc..
Downwards Volume	12 X 256 cubic inches down
Upwards Volume	2 X 256 cubic inches up
Software	Real Time Data Collection
Energy Detection Range	50 KeV to 3 MeV
Collected Spectrum	512 Channels
Signal Sampling	20 MHz by internal 12 bit A to D for each detector

Radar Altimeter

Model	KRA-10A
Manufacturer	King
Serial Number	071-1114-00
Accuracy	5% up to 2500 feet
Calibrate Accuracy	1%
Output	Analog for pilot Converted to digital for data acquisition

Barometric Altimeter

Model	LX18001AN
Manufacturer	Sensym
Source	coupled to aircraft barometric system

Navigation System

Model	LiNav
Manufacturer	AgNav Inc.
Main Display	LCD Moving map display
Line	Generates and follows survey lines
Input	GPS with corrections; up to 10 Hz
Media	USB memory stick

GPS Differential Receiver

Model	Ag132
Manufacturer	Trimble
Antenna Blade	Helical
Channels	12
Position Update	0.5 second for navigation
Sample Rate	1 second
Accuracy	~ 3 meters

Data Acquisition and Compensation System

Model	DAARC 500
Manufacturer	RMS Instruments
Operating System	QNX 6.3 or greater
Front End Magnetic Processing	Resolution 0.32 pT; system noise <0.1 pT; sample rate 60 640, 800 m or 1280 Hz
Compensation	Improvement Ratio (total field) 10-20 typical
Input Serial	8 isolated RS232 channels; ASCII and Binary formats
Input Analog	16 bit, self calibrating A/D conv.
Output/Recording	Rate 10, 20 or 40 Hz; Serial up to 115.2 kbps

Base Station

A base station was set up at the Dryden airport, away from cultural interference. The base station consisted of a cesium vapour magnetometer, GPS receiver and a Hewlett Packard iPAQ PDA to log the data. The base station data was logged at 2Hz. GPS time was recorded for eventual merging with the survey data.

Magnetometer

Model	CS – 2
Manufacturer	Scintrex
Sensitivity	0.01 nT
Noise Envelope	0.05 nT
Sampling Interval	1 second

GPS Receiver

Manufacturer	Deluo
Type	L1, C/A code
Antenna	Built in patch
Logging Rate	1 per second

Personnel

The following personnel were involved with the survey.

Field

Pilots: Bob Beaulac
Jim McLarty

Operator:	Mike Murphy
Geophysicist:	Carolyn Boone

Office

Chief Geophysicist:	Allen Duffy
Geophysicist:	Patrick Marchesi
Manager:	Charles Barrie

4 CONTRACTOR DATA PROCESSING

Quality Control

The field data were transmitted, via Internet, back to the offices of Terraquest for quality control and tolerance inspection. This included any corrections to the flight path, making flight path plots, importing the base station data, creating a database on a flight-by-flight basis, and posting the data. All data were checked for continuity and integrity. Any errors or omission or data beyond tolerances were flagged for re-flight and the crew was notified ready for their flight in the morning.

Magnetic Data Processing

Raw magnetic data were initially compensated for aircraft motion effects prior to calculating measured longitudinal and lateral magnetic gradients. The lateral magnetic gradient was calculated by subtracting the left wing sensor reading from the right wing sensor reading and dividing the resulting value by the tip-to-tip separation (14.6 metres), yielding the measurement expressed as nT/m. The longitudinal gradient was similarly calculated by subtracting the tail sensor measurement from the average of the wing-tip values normalized by the wing-centre to tail sensor separation (9.2 metres). Both gradients were “DC shifted” by subtracting the median value on a line-by-line basis and converted from aircraft-centric to survey grid orientation by selectively inverting (multiplying by -1) in the south and westbound directions.

In the final correction process, the compensated tail sensor magnetic data were initially corrected with standard tie-line intersection levelling by tying the survey lines to the tie lines using Geosoft software. The total field was gridded and micro-levelled in the Fourier domain to reduce any linear noise along the flight path without degrading the geologic signal.

VLF Electromagnetic Processing

The Terraquest XDS-VLF system was in the developmental stage and as such only basic processing was been performed on this data. The x, y and z components of the XDS-VLF-EM data in the range of 22.0 to 26.0 kHz (which include Cutler and Seattle transmitter signals), were inverted, normalized, mean levelled and micro-levelled. The data were gridded with a cell size of 25 m and presented as contour plots of the Line Field (Vcx) coil, Ortho Field (Vcp) coil and Vertical Field (Hcp).

During the final processing it was observed that the expected peak type anomaly changed to a cross-over type anomaly during flight 13 only in the Line component data. In a post survey investigation a short circuit was discovered in the receiver console. The post flight 13 data were rectified during processing by applying a derivative type formula (Fraser Filter) to convert the cross-over nature to peak type anomalies. In order to be uniform across the map, the data prior to flight 13 was then treated with a first vertical derivative to provide consistent resolution.

Radiometric Data Processing

The radiometric data were processed according to guidelines established in the definitive International Atomic Energy Agency, report (IAEA 1991). The following specifics were performed:

- Recorded as a 512 channel spectrum, the four raw integral (or "terrestrial") windows (Total Count, Potassium, Uranium and Thorium) were initially generated by summing the recorded counts between their appropriate channel limits – as specified below:

  512 Channel ROI definitions (based on 0-511 channel indices):

	Channel Window	Energy Window (MeV)
Total Count:	69 - 469	0.41 – 2.81
Potassium:	229 - 262	1.37 – 1.57
Uranium:	277 - 310	1.68 – 1.86
Thorium:	402 - 469	2.41 – 2.81
Cosmic	511	> 3.0

- Since the Radiation Solutions Inc. RSX-5 Spectrometer does not suffer from conventional measurement "dead time", no discrete correction for this effect need be applied.

- The raw count rates were corrected for static and ambient background sources (Aircraft, Cosmic and Radon) by using measurements from the frequent over-water crossings encountered during the survey and from pre- and postflight over-water "background" lines (where geologic radiation sources are suppressed).

- The background corrected measurements were corrected for Compton Scattering by application of "Stripping Coefficients" experimentally determined in a specific calibration exercise using standard large-scale radio-element sources.

- Count rates were further adjusted by correction to constant terrain clearance (altitude attenuation correction). This correction step includes the application of exponential attenuation coefficients, specific to each of the four integral windows, determined during a specific calibration procedure.

- As additionally recommended by the Geologic Survey of Canada (GSC), the final corrected count rates were passed through an optimized filter, sometimes referred to as a 'Savitsky-Golay' filter, designed to reduce sample overlap effects. This five-point convolution filter has the following (normalized) coefficients:

  -0.0857, 0.3429, 0.4857, 0.3429, -0.0857

- Corrected radiometric data are delivered both as count rates (counts per second) and as effective ground units by application of sensitivity factors determined experimentally over the GSCs test range (Breckenridge Calibration Range, Ottawa).

5 FINAL DATA COMPILATION AND PROCESSING

Base Maps

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

Projection Description

Datum:	NAD83 (Canada)
Ellipsoid:	GRS80
Projection:	UTM Zone 15N (CM=93° W)
False Northing:	0 m
False Easting:	500 000 m
Scale factor:	0.9996

Magnetic Data Processing

The contractor provided raw magnetic profile data for each of the three sensors (both compensated and uncompensated). Although they applied various levelling procedures to the tail sensor data (base station subtraction, tie line network levelling and microlevelling), they only included a ‘final’ data channel. A grid of this final profile data was created and a preliminary vertical derivative grid was calculated for initial investigation. It was intended that any small, residual level errors be corrected with a final microlevel application (in addition to the contractor’s corrections). Small positional errors were noted in some areas of the map, however, and trying to remove the appearance of these errors by filtering the data would result in significant distortion of anomalies. Such errors should ideally be addressed prior to any microlevelling.

A profile channel of the contractor’s total levelling correction was calculated by subtracting the final data from the raw, compensated data. It was noted that considerable microlevelling had been performed. It was decided that the microlevelling should be redone, rather than added to. An ideal starting point would be the tie line network levelled data, but that was not available. A method was devised to recreate a suitable starting point for the supplemental processing.

The median value of the total contractor correction was removed on a line by line basis and set aside. Values in the leftover AC correction component, with an absolute value greater than 2.5 nT were deleted and gaps in the profile were interpolated. This AC component was filtered to create a profile limited to amplitudes less than 3 nT and wavelength no shorter then 3000 m. The median correction profile was added to the filtered AC profile and added to the raw tail profile data. This preliminary, “levelled” profile was gridded and inspected.

Additional positional errors that had been reduced by the first microlevel correction were noted. Groups of lines were selected and various small lags were applied to the magnetic profile data. For some lines, the data was lagged 0.1 seconds. Other lines were lagged 0.2 seconds, while another group of lines were lagged –0.1 seconds. Some errors could not be corrected with a constant lag and remained in the data. A final micro level correction was calculated.

An elliptical reject filter, aligned with the flight lines, was first applied to the gridded lag-corrected data. This filter removes features with a long wavelength in the flight line direction, but a short wavelength in the transverse direction. While removing the unwanted residual levelling errors, it also significantly distorts higher amplitude anomalies.

In order to minimize the effect on real anomalies, the flight path was "threaded" through the filtered grid and a database profile channel was created from the grid. The difference between the input magnetic profile and this filtered profile was calculated. The difference profile was clipped to the amplitude of the observed noise in the grid. A half cosine roll-off filter was then applied to this channel and a final correction profile was derived. The correction profile was limited in amplitude to +/- 6 nT and wavelengths greater than 500 m.

GSC Levelling

The final step in the magnetic processing was to level the data set to the 200 m Ontario Master grid, which has been compiled and levelled to the 812.8 m magnetic datum from the Geological Survey of Canada. The levelling process must retain all the detail of the newer low-altitude survey and only make corrections on the order of 10 km or more. To accomplish this, a variation on a method developed by Patterson, Grant and Watson (Reford et al. 1990) was used. The procedure was as follows:

The final total magnetic data were gridded at a 200 m cell size and upward continued to a height of 305 m, to match the nominal terrain clearance of the Ontario master grid. The difference between the upward continued grid and the Ontario master grid was calculated. An FFT 2-D low-pass filter was applied to a grid of the difference, which retained wavelengths longer than 10 km. This filtered grid was re-gridded at a 20 m cell size and the flight path was threaded through the grid to create a correction profile. This long wavelength correction profile was subtracted from the final magnetic channel to great a GSC-levelled (mag_gsclevel) channel.

Magnetic Gradient Levelling

The contractor provided lateral (wingtip) and longitudinal magnetic gradient profile data. The median value for each profile had been subtracted on a line by line basis. A final microlevel profile correction was applied to the contractor data.

Gradient Enhanced Gridding

The final magnetic data was gridded using the GT-Grid algorithm. GT-Grid was developed by Scott Hogg & Associates Ltd. and uses measured horizontal transverse and longitudinal magnetic gradient profiles, together with the total field or residual field profile to produce a total field grid (or residual total field grid) that simultaneously honours all three measurements.

Second Vertical Derivative Grid

The second vertical derivative of the total magnetic field was computed to enhance small and weak near-surface anomalies and as an aid to delineate the contacts of the lithologies having contrasting susceptibilities. The location of contacts or boundaries is usually traced by the zero contour of the second vertical derivative map.

The calculation was done in the frequency domain by combining the transfer function of the second vertical derivative and a half cosine roll-off filter with a 100 m cut-off wavelength.

Keating Correlation Coefficients

Possible kimberlite targets are identified from the residual magnetic intensity data, based on the identification of roughly circular anomalies. This procedure is automated by using a known pattern recognition technique (Keating 1995), which consists of computing, over a moving window, a first-order regression between a vertical cylinder model anomaly and the gridded magnetic data. Only the results where the absolute value of the correlation coefficient is above a threshold of 75% were retained. On the magnetic maps, the results are depicted as circular symbols, scaled to reflect the correlation value. The most favourable targets are those that exhibit a cluster of high amplitude solutions. Correlation coefficients with a negative value correspond to reversely magnetised sources.

The cylinder model parameters are as follows:

Cylinder diameter: 200 m
Cylinder length: infinite
Overburden thickness: 6 m
Magnetic inclination: 75.78°N
Magnetic declination: 0.21°E
Magnetization scale factor: 100
Model window size: 10 by 10 cells (400 by 400 m)
Model window grid cell size: 40 m

It is important to be aware that other magnetic sources may correlate well with the vertical cylinder model, whereas some kimberlite pipes of irregular geometry may not. The user should study the magnetic anomaly that corresponds with the Keating symbols, to determine whether it does resemble a kimberlite pipe signature, reflects some other type of source or even noise in the data e.g. boudinage (beading) effect of the bi-cubic spline gridding. All available geological information should be incorporated in kimberlite pipe target selection.

VLF-EM Grids

The contractor-provided channels of XDS VLF-EM data were gridded using a bi-cubic spline algorithm. An elliptical reject filter was applied in the Fourier domain.

Radiometric Grids

To supplement the contractor-provided radiometric data, a profile channel of the ratio of potassium over equivalent thorium was created. To avoid division by zero (or near-zero) artefacts, the equivalent thorium data was clipped at a minimum of 0.5 ppm prior to the calculation. The following data were gridded using a bi-cubic spline algorithm:

Total count
Potassium
eUranium
eThorium
Potassium / eThorium

Negative values in the grids, introduced by either the radiometric processing or the gridding algorithm were removed and the missing data interpolated. Finally, a 5 by 5 Hanning convolution filter was applied to each grid.

Ternary Image

A ternary map image map was created, using the final radiometric grids. A Red, Green, Blue, Intensity (RGBI) scheme was used.

To better display the relative concentrations, the grids were sum-normalised using the formulae:

$$K_{norm} = \frac{K}{K + eU + eTh}$$

$$eU_{norm} = \frac{eU}{K + eU + eTh}$$

$$eTh_{norm} = \frac{eTh}{K + eU + eTh}$$

The denominator of the normalization factor (K + eU + eTh) was limited values greater than 1.

The RGBI colouring used the following colour transforms:

Red (R):	K_{norm} (%), data limits of 0 to 1, equal area histogram
Green (G):	eU_{norm} (ppm), data limits of 0 to 1, equal area histogram
Blue (B):	eTh_{norm} (ppm), data limits of 0 to 1, equal area histogram
Intensity (I):	total count (nGy/h), data limits of 99% of data values, logarithmic

6 FINAL PRODUCTS

The following products are included in the compilation:

Map products at 1:20 000

- Colour residual magnetic field grid with contours and flightlines, plotted on a planimetric base
- Shaded colour image of the second vertical derivative of the magnetics and Keating kimberlite coefficient anomalies on a planimetric base
- Ternary RGBI radioelement image, with flightlines and thumbnail images of K, eU, eTh and TC on a planimetric base
- Colour VLF EM vertical component grid with contours and flightlines, plotted on a planimetric base

Profile databases

- Database with EM, radiometric and magnetic data sampled at 10 samples per second in both Geosoft® GDB and ASCII format.
- Raw full-spectrum radiometric data sampled at 1 sample per second in both Geosoft® GDB and ASCII format.

Kimberlite coefficient database

- Keating kimberlite coefficient anomaly databases in both Geosoft® GDB and ASCII CSV format.

Data grids

Data grids, in both Geosoft® GRD and GXF formats, gridded from coordinates in UTM Zone 15, NAD83 datum, of the following parameters:

- GSC-levelled magnetic field
- Second vertical derivative of the GSC levelled magnetic field
- Digital elevation model
- Total count
- Potassium
- Equivalent thorium
- Equivalent uranium
- Potassium / equivalent thorium ratio
- VLF-EM vertical component
- VLF-EM inline component
- VLF-EM ortho component

GeoTIFF images:

- Colour residual magnetic field grid plotted on a planimetric base
- Shaded colour image of the second vertical derivative of the magnetic grid and Keating kimberlite coefficient anomalies on a planimetric base
- Total count grid on a planimetric base
- Potassium grid on a planimetric base
- Equivalent uranium on a planimetric base
- Equivalent thorium on a planimetric base
- Potassium/Equivalent thorium on a planimetric base
- RGBI ternary image of K/eTh/ U and TC
- VLF-EM vertical component on a planimetric base
- VLF-EM inline component on a planimetric base
- VLF-EM ortho component on a planimetric base

DXF vector files

- Flight path
- Keating kimberlite coefficient anomalies
- Residual magnetic field contours
- VLF-EM vertical component contours

Project report

- Provided as Microsoft® Word (*.doc)* and portable document format (*.pdf)* files.

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Reford, S.W., Gupta, V.K., Paterson, N.R., Kwan, K.C.H., and Macleod, I.N. 1990. Ontario master aeromagnetic grid: A blueprint for detailed compilation of magnetic data on a regional scale; *in* Expanded Abstracts, Society of Exploration Geophysicists, 60th Annual International Meeting, San Francisco, v.1, p.617-619.

APPENDIX A GENERAL ARCHIVE DEFINITION

Survey 1240 was carried out using Terraquest Ltd. magnetic gradiometer, XDS-VLF and gamma spectrometer system mounted on a fixed wing platform.

Data File Layout

The files for the Aerobus Lake Geophysical Survey 1240 are archived on a single DVD. 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:

- ASCII (GXF) grids
    - total (residual) field magnetics (gradient enhanced)
    - second vertical derivative of the total field magnetics
    - VLF vertical component
    - VLF in-line component
    - VLF ortho component
    - total count spectrometer
    - potassium
    - equivalent uranium
    - equivalent thorium
    - potassium / equivalent thorium ratio
    - digital elevation model (DEM)

- Keating correlation (kimberlite) database (ASCII CSV format)

- DXF files:
    - flight path
    - Keating correlation (kimberlite) anomalies
    - total field magnetic contours
    - VLF vertical component contours

- GEOTIFF images
    - colour total field magnetics with base map
    - colour shaded relief of second vertical derivative with base map
    - colour VLF vertical component with basemap
    - colour VLF in-line component with basemap
    - colour VLF ortho component with basemap
    - colour total count with basemap
    - colour percent potassium with basemap
    - colour equivalent uranium with basemap
    - colour equivalent thorium with basemap
    - colour potassium / equivalent thorium ratio with basemap
    - radiometric ternary image with basemap

- Geosoft® Binary (GRD) grids
  - total (residual) field magnetics (gradient enhanced)
  - second vertical derivative of the total field magnetics
  - VLF vertical component
  - VLF in-line component
  - VLF ortho component
  - total count spectrometer
  - potassium
  - equivalent uranium
  - equivalent thorium
  - potassium/equivalent thorium ratio
  - digital elevation model (DEM)

- Keating correlation (kimberlite) database (Geosoft® GDB format)

- ASCII Profile data
  - Profile database of spectrometry, electromagnetic and magnetic data (10 Hz sampling) in ASCII (XYZ) format
  - Profile database of raw 512 channel radiometric spectrum data (1 Hz sampling) in ASCII (XYZ) format

- Binary Profile data
  - Profile database of spectrometry, electromagnetic and magnetic data (10 Hz sampling) in Geosoft® GDB format
  - Profile database of raw 512 channel radiometric spectrum data (1 Hz sampling) in Geosoft® GDB format

- Survey report (Microsoft® Word (*.doc*) and portable document format (*.pdf*) files)

<u>Coordinate Systems</u>

The profile and Keating coefficient data are provided in two coordinate systems:

- Universal Transverse Mercator (UTM) projection, Zone 15N, NAD83 datum, Canada local datum
- Latitude/longitude coordinates, NAD83 datum, Canada local datum

The gridded data are provided in one UTM coordinate system:

- Universal Transverse Mercator (UTM) projection, Zone 15N, NAD83 datum, Canada local datum

Profile Data

The profile data are provided in two formats, one ASCII and one binary:

ASCII

Aerobus.xyz	ASCII file of spectrometry, electromagnetic and magnetic data, sampled at 10 Hz
Alspec512.xyz	ASCII file of raw 512 channel radiometric spectrum data, sampled at 1Hz

Binary

Aerobus.gdb	Geosoft® OASIS Montaj™ binary database file (no compression) of spectrometry, electromagnetic and magnetic data, sampled at 10 Hz
Alspec512.gdb	Geosoft® OASIS Montaj™binary database file (no compression) of raw 512 channel radiometric spectrum data, sampled at 1Hz

APPENDIX B PROFILE ARCHIVE DEFINITION

The line profile databases aerobus.xyz/gdb (both file types contain the same set of data channels) are summarised as follows:

Channel Name	Description	Units
x_nad83	easting in UTM co-ordinates, NAD83 zone 15N	metres
y_nad83	northing in UTM co-ordinates, NAD83 zone 15N	metres
long_nad83	longitude, NAD83 datum	decimal-degrees
lat_nad83	latitude, NAD83 datum	decimal-degrees
gps_z_raw	raw GPS Z	metres
fiducial	fiducial	seconds
time_gps	GPS time	seconds
line	database line number	
radar_raw	raw radar altimeter	metres above terrain
dem	digital elevation model	metres above sea level
mag_base_raw1	raw magnetic base station 1 data	nanoteslas
mag_base_raw2	raw 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_raw_right	raw magnetic field from right wingtip sensor	nanoteslas
mag_comp_right	compensated magnetic field from right wingtip sensor	nanoteslas
mag_raw_tail	raw magnetic field from tail sensor	nanoteslas
mag_comp_tail	compensated magnetic field from tail sensor	nanoteslas
mag_lag	compensated, edited and lag corrected magnetic field from tail sensor	nanoteslas
mag_lev	levelled magnetic field from tail sensor	nanoteslas
mag_final	micro-levelled magnetic field from tail sensor	nanoteslas
mag_gsclevel	GSC levelled magnetic field from tail sensor	nanoteslas
mag_grad_lat_raw	raw lateral horizontal magnetic gradient (from wingtip sensors)	nanoteslas/metre
mag_grad_lat_cor	microlevelling correction for lateral horizontal magnetic gradient	nanoteslas/metre
mag_grad_lat_final	levelled lateral horizontal magnetic gradient (from wingtip sensors)	nanoteslas/metre
mag_grad_long_raw	raw longitudinal horizontal magnetic gradient	nanoteslas/metre
mag_grad_long_cor	microlevelling correction for longitudinal horizontal magnetic gradient	nanoteslas/metre
mag_grad_long_final	levelled longitudinal horizontal magnetic gradient	nanoteslas/metre
air_temp	outside air temperature	degrees Celsius
cosmic_raw	raw cosmic window	counts per second
total_count _raw	raw total count window	counts per second
potassium_raw	raw potassium window	counts per second
thorium_raw	raw equivalent thorium window	counts per second

uranium_raw	raw equivalent uranium window	counts per second
total_count_cor	windowed total count	counts per second
potassium_cor	windowed potassium	counts per second
uranium_cor	windowed uranium	counts per second
thorium_cor	windowed thorium	counts per second
total_count_final	micro-levelled total air-absorbed dose rate	nanograys per hour
potassium_final	micro-levelled potassium	percent
euranium_final	micro-levelled equivalent uranium	parts per million
ethorium_final	micro-levelled equivalent thorium	parts per million
k_over_eth	ratio of potassium over equivalent thorium	
linetotal	raw XDS line component	millivolts
orthototal	raw XDS ortho component	millivolts
verttotal	raw XDS vertical component	millivolts
line_final	processed XDS line component	millivolts
line_final_vd	processed XDS line component(normalized vertical derivative presentation for improved continuity)	millivolts
ortho_final	processed XDS ortho component	millivolts
vert_final	processed XDS vertical component	millivolts

The line profile databases alspec512.xyz/gdb (both file types contain the same set of data channels) are summarised as follows:

Channel Name	Description	Units
x_nad83	easting in UTM co-ordinates, NAD83 zone 15n	metres
y_nad83	northing in UTM co-ordinates, NAD83 zone 15n	metres
long_nad83	longitude, NAD83 datum	decimal-degrees
lat_nad83	latitude, NAD83 datum	decimal-degrees
fiducial	fiducial	fiducial
line	line	database line number
Spc_rawd	raw downward looking 512 channel gamma ray spectrum	counts per second
Spc_rawu	raw upward looking 512 channel gamma ray spectrum	counts per second

APPENDIX C KEATING CORRELATION ARCHIVE DEFINITION

Kimberlite Pipe Correlation Coefficients

The Keating kimberlite pipe correlation coefficient data are provided in two formats; ASCII and binary.

Both file types contain the same set of data channels, summarized as follows:

Channel Name	**Description**	**Units**
x_nad83	UTM easting - NAD83, zone 15N	metres
y_nad83	UTM northing - NAD83, zone 15N	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

APPENDIX D GRID ARCHIVE DEFINITION

<u>Gridded Data</u>

The gridded data are provided in two formats, one ASCII (*.gxf*) and one binary (*.grd*)

The grids are summarized as follows:

All grids are NAD83 UTM Zone 15N, with a grid cell size of 20 by 20 m.

ALMAG83.grd/.gxf	– GSC levelled residual magnetic intensity
AL2VD83.grd/.gxf	– Second vertical derivative of residual magnetic intensity
ALDEM83.grd/.gxf	– Digital elevation model
ALTC83.grd/.gxf	– Radiometric total count
ALK83.grd/.gxf	– Percent potassium
ALU83.grd/.gxf	– Equivalent uranium
ALTH83.grd/.gxf	– Equivalent thorium
ALK_over_TH83	– Potassium over thorium ratio
ALVLFV83.grd/.gxf	– VLF-EM vertical component
ALVLFI83.grd/.gxf	– VLF-EM inline component
ALVLFO83.grd/.gxf	– VLF-EM ortho component

APPENDIX E GEOTIFF AND VECTOR ARCHIVE DEFINITION

GeoTIFF Images

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

ALMAG83.TIF	– GSC-levelled residual magnetic intensity
AL2VD83.TIF	– Second vertical derivative of GSC levelled residual magnetic intensity with Keating coefficient symbols
ALTC83.TIF	– Total Count
ALK83.TIF	– Potassium
ALU83.TIF	– Equivalent uranium
ALTH83.TIF	– Equivalent thorium
ALK_over_TH83.TIF	– Potassium over equivalent thorium
ALTERN83.TIF	– Potassium, uranium, thorium, total count ternary image
ALVLFV83.TIF	– VLF-EM vertical component
ALVLFI83.TIF	– VLF-EM inline component
ALVLFO83.TIF	– VLF-EM ortho component

Vector Archives

Vector line work from the maps is provided in DXF ASCII format using the following naming convention:

ALPATH83.DXF	– Flight path of the survey area
ALKC83.DXF	– Keating correlation targets
ALMAG83.DXF	– Contours of the residual magnetic intensity in nanoteslas
ALVLFV83.DXF	– Contours of VLF-EM vertical component