

**EQUIVALENT THORIUM CONCENTRATION**

This map was compiled from data obtained during a combined aeromagnetic and gamma-ray spectrometric survey commissioned by the Northwest Territories Geoscience Office (NTGO) and carried out by Goldak Airborne Surveys from August 29 to October 12, 2007. The survey covered portions of NTS map sheets 86 C, E and F and is known as the Southwestern Wopmay Orogen Block.

Goldak Airborne Surveys used a Piper PA-31 Navajo aircraft. The nominal terrain line spacing was 400 m with control lines spaced 2.5 km apart. Nominal traverse line clearance was 125 m. Real-time Global Positioning System (GPS) as well as radar and barometric altimeters were used to maintain direction and altitude during flight. The flight path was recovered by applying a post-flight differential GPS correction. A digital elevation model was calculated using the altimeter data and corrected GPS height.

**Radiometric Data**

A Radiation Solutions RSI-500 1024 channel spectrometer was installed inside the aircraft. It was connected to a main, downward-looking NaI detector with a total volume of 50.34 litres and an upward-looking detector of 8.39 litres. The system automatically monitors the natural thorium peak from the downward-looking crystal to adjust the gain continually during flight. Counts from the main detector were recorded at one second intervals in 1024 contiguous channels in the 0 to 3 MeV range, plus one channel for >3 MeV. The upward-looking detector recorded counts only in the uranium window (1660-1860 keV) to monitor atmospheric radon.

After energy calibrations, counts were accumulated into five energy windows corresponding to emissions from potassium (1370-1570 keV), uranium (1660-1860 keV), thorium (2340-2810 keV), total radioactivity (410-2810 keV) and cosmic radiation (>3000 keV). The potassium (K) window counts the 1460 keV gamma-ray photons emitted by  $K^{40}$ . Uranium and thorium, on the other hand, are measured indirectly by counting photons emitted from daughter products  $^{214}Pb$  and  $^{214}Bi$  respectively, assumed to be in equilibrium with their parents. The counts and derived concentrations are therefore referred to as equivalent uranium (eU) and equivalent thorium (eTh).

Radar altimeter data were de-spiked and converted to effective height using the measured temperature and barometric pressure.

Window counts were corrected for live time, then for aircraft and cosmic background, using cosmic stripping coefficients determined experimentally from altitude stack data.

Corrections for the effects of atmospheric radon used eU count rates from the upward-looking detector as well as downward eU count rates acquired twice daily along test lines flown at survey altitude. The K, eU and eTh window counts were corrected for spectral overlap due to scattering in the ground, air, and detectors (Compton scattering), using coefficients determined from surveys by measurements over calibration pads. All window count data were then corrected to a constant height of 125 m. The K, eU and eTh window counts were reduced to apparent elemental concentrations using experimentally determined sensitivities. An estimate of the natural air-absorbed dose rate (NADR) from geological sources was made from the three apparent concentrations.

All coefficients and equations can be found in the contractor's report, available digitally from NTGO.

Grids of NADR in  $\mu\text{C}y\text{h}^{-1}$ , K % eU ppm and eTh ppm (Sheets 1 to 4) were created by interpolating the line data to 100 m cells using a minimum curvature algorithm. A ternary radiometric map (Sheet 5) was created by assigning a specific color to each of K (magenta), eU (yellow), and eTh (cyan), and representing the relative concentrations of these three elements by mixing of the three colors. The final color grid was modulated in intensity according to the exposure rate, which was obtained from the total count measurements.

Concentration ratios were calculated in the line data by the following procedure: sample points where K % concentrations were less than 0.25% were dropped; for both elements (numerator and denominator) the concentrations at adjacent points on each side of a data point were summed until both sums exceeded set thresholds; ratios were calculated using these sums. This method reduces differences in the error between sample points.

The K, eU and eTh grids were used as inputs to a routine which calculated the concentration ratio grids using a similar algorithm but utilizing a circular search pattern. A potassium threshold of 0.15% was used to minimize holes in the grids. The results are displayed as eU/Th, eU/K, and eTh/K (Sheets 5 to 7).

**Magnetic Data**

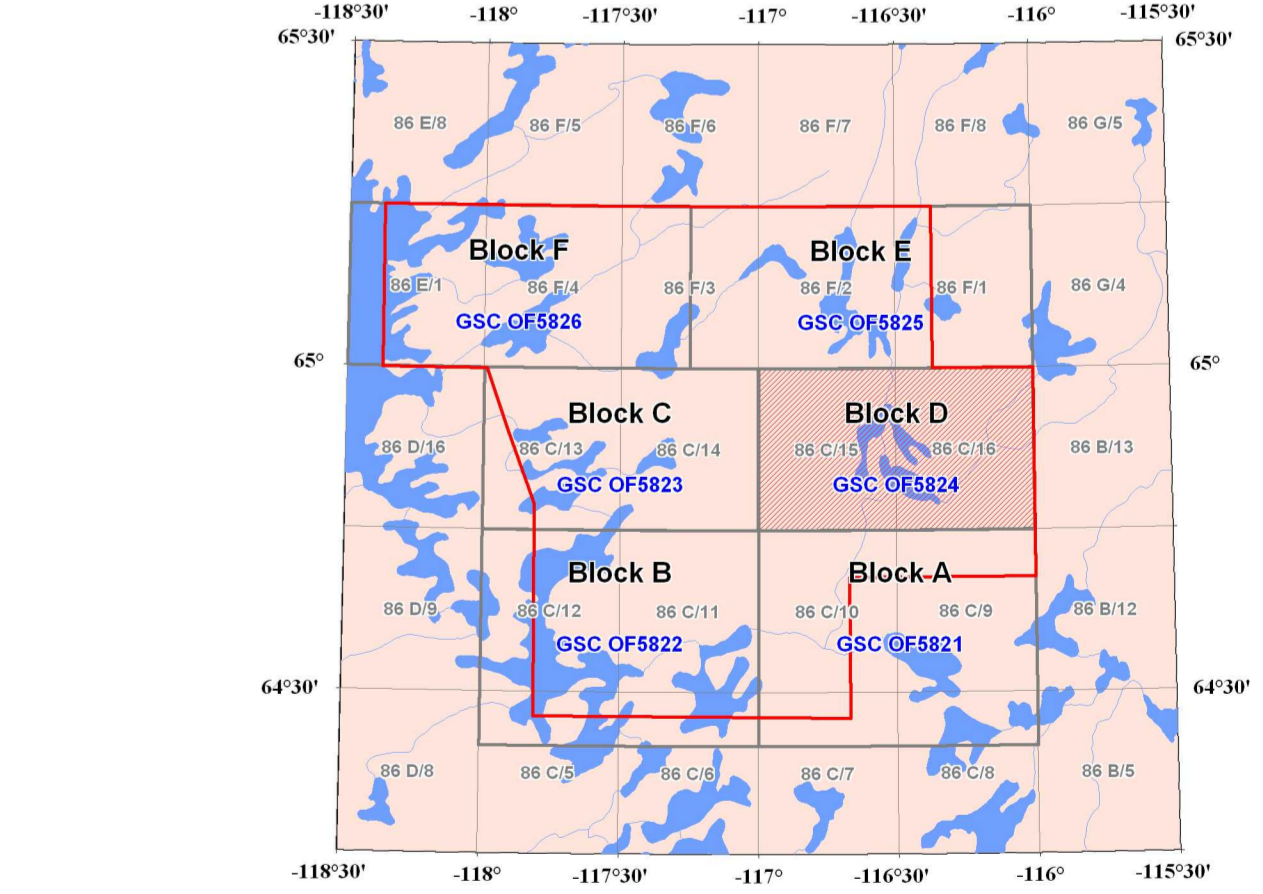
The aircraft was equipped with three Geometrics cesium vapour magnetometers with a sensitivity of 0.005 nT. The magnetometer sensors were located in the tail boom and in wingtip pods. Lateral separation of the wingtip sensors was 14.8 m and effective longitudinal separation was 9.8 m. Total field data were sampled at 10 Hz.

After editing the survey data, the intersections of control and traverse lines were established and differences in the magnetic values were computer analyzed and manually checked to obtain the level network. The levelled magnetic field values were interpolated to a 100 m grid, utilizing the measured horizontal gradients to improve the between-line correlation. The International Geomagnetic Reference Field has been removed from the total magnetic field for the year 2007.72 at an altitude of 42.1 metres to produce the Residual Total Magnetic Field (Sheet 8). The first vertical derivative was calculated from the final residual total magnetic field grid using Fourier transforms (Sheet 10).

**Publication**

Maps from this survey were jointly published by the Northwest Territories Geoscience Office (NTGO) and the Geological Survey of Canada (GSC). The maps are available from NTGO as NWT Open File 2008-02 and from the Geological Survey of Canada as GSC Open File 5824. The digital version of all maps from this Southwestern Wopmay Orogen airborne geophysical survey, the digital profiles and gridded data are available for download from the NTGO and GSC web sites.

- Sheet D-1 Natural Air Absorbed Dose Rate
- Sheet D-2 Potassium Concentration
- Sheet D-3 Equivalent Uranium Concentration
- Sheet D-4 Equivalent Thorium Concentration
- Sheet D-5 Ratio of Equivalent Uranium to Equivalent Thorium
- Sheet D-6 Ratio of Equivalent Uranium to Potassium
- Sheet D-7 Ratio of Equivalent Thorium to Potassium
- Sheet D-8 Ternary Radioelement Map
- Sheet D-9 Horizontal Gradient Enhanced Residual Total Magnetic Field
- Sheet D-10 First Vertical Derivative of the Magnetic Field



Southwestern Wopmay Orogen  
parts of 86 C, 86 E, and 86 F

Block D

Equivalent Thorium Concentration

NWT Open File 2008-02 Sheet D-4  
1:50 000

Project administered by the Northwest Territories Geoscience Office (NTGO) through the Department of Industry, Tourism and Investment, Government of the Northwest Territories. Funding provided by the Strategic Investments in Northern Economic Development (SINED) program of Indian and Northern Affairs Canada.

Contract specifications and technical standards developed by the NTGO, Yellowknife, Northwest Territories and the Geological Survey of Canada (GSC), Ottawa, Ontario. Data quality control procedures performed at the GSC by F. Hise and J. Caran.

GSC's involvement is a contribution to NTGO and to the Northern Mineral Development Program of the Earth Sciences Sector, Natural Resources Canada.

Operational procedures, data acquisition, processing, compilation and map production carried out by Goldak Airborne Surveys, Saskatoon, SK (S06ak).

Map design by NTGO, GSC and Goldak.



**OPEN FILE  
DOSSIER PUBLIC**  
5824

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2008

SHEET 4 OF 10  
FEUILLET 4 DE 10

**Airborne Magnetic and Gamma-ray Spectrometric Survey of the Southwestern Wopmay Orogen  
Northwest Territories, parts of NTS 86 C, 86 E and 86 F**

NWT Open File 2008-02 Sheet D-4  
GSC Open File 5824 Sheet 4 of 10

**Equivalent Thorium Concentration**

Block D  
NTS 86 C/15 and 86 C/16

Scale 1:50 000

**LEGEND**  
Map Elements

- Flight path with Line numbers, Right direction, and GPS line ticks
- Hydrography

Paper and digital copies of this map and the other maps in the Open File digital geophysical and navigation data digital elevation model, and the contractor's report are available from:

Northwest Territories Geoscience Office  
615 Booth Street, Ottawa, ON, K1A 0S9  
Tel: (613) 993-5232; Fax: (613) 993-5697  
E-mail: info@ntgo.gov.nt.ca

or from:

Geophysical Data Centre, Geological Survey of Canada  
615 Booth Street, Ottawa, ON, K1A 0S9  
Tel: (613) 993-5232; Fax: (613) 993-5697  
E-mail: info@gsd.nrcan.gc.ca

Digital copies of the maps and data from this project can be downloaded from either NTGO or GSC web sites at:  
<http://www.ntgo.gov.nt.ca>  
<http://gdi.nrcan.gc.ca/eromag>

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