

High Sensitivity Airborne Gamma-Ray Spectrometric and Aeromagnetic Surveys
Cree Lake, Saskatchewan

In 2006, Sander Geophysics Limited completed a multi-sensor airborne geophysical survey of the Cree Lake area, Saskatchewan, for the Geological Survey of Canada and Saskatchewan Industry and Resources. The purpose of the survey was to obtain quantitative gamma-ray spectrometric and aeromagnetic data. The survey was flown from July 28 to September 5, 2006 using Britten Norman Islander aircraft, registration G-GSCX.

Gamma-ray Spectrometric Data
The airborne gamma-ray measurements were made with an Exploranium GR820 gamma-ray spectrometer using fourteen 102 x 102 x 406 mm NaI (TI) crystals. The main detector array consisted of twelve crystals (total volume 50.4 litres). Two crystals (total volume 8.4 litres), shielded by the main array, were used to detect variations in background radiation caused by atmospheric radon. The system constantly monitored the natural thorium peak for each crystal, and using a Gaussian least squares algorithm, adjusted the gain for each crystal.

Potassium is measured directly from the 1460 keV gamma-ray photons emitted by ⁴⁰K, whereas uranium and thorium are measured indirectly from gamma-ray photons emitted by daughter products (Bi²¹⁴ for uranium and Tl²⁰⁸ for thorium). Although these daughters are far down their respective decay chains, they are assumed to be in equilibrium with their parents; thus gamma-ray spectrometric measurements of uranium and thorium are referred to as equivalent uranium and equivalent thorium, i.e. eU and eTh. The energy windows used to measure potassium, uranium and thorium are:

Potassium (K [*])	1370 1570keV
Uranium (U ^{**})	1660 1860keV
Thorium (Th ^{***})	2410 2810keV

Gamma-ray spectra were recorded at one-second intervals at a planned terrain clearance of 125 m and an average air speed of 216 km/h. Noise Adjusted Singular Value Decomposition (NASVD) analysis was carried out on the full spectrum 256 channel data to reduce statistical noise in the windowed data. During processing counts were accumulated into the windows described above. Counts from the radon detectors were recorded in a 1600 - 1600 keV window and radiation at energies greater than 3000 keV was recorded in the cosmic window. The window counts were corrected for dead time, and for background activity from cosmic radiation; the radioactivity of the aircraft and atmospheric radon decay products. The window data were then corrected for spectral scattering in the ground, air and detectors. Corrections for deviations of altitude from the planned terrain clearance and for variation of temperature and pressure were made prior to conversion to ground concentrations of potassium, uranium and thorium, using factors determined from flights over a calibration range near Ottawa.

Potassium	102.4 cps/m
Uranium	8.5 cps/ppm
Thorium	5.2 cps/ppm

Corrected data were filtered and interpolated to a 100m grid for final map production. The results of an airborne gamma-ray spectrometer survey represent the average surface concentrations that are influenced by varying amounts of outcrop, overburden, vegetation cover, soil moisture and surface water. As a result the measured concentrations are usually lower than the actual bedrock concentrations. The total air absorbed dose rate in nanorays per hour was produced from measured counts between 400 and 2810 keV.

Magnetic Data
The Islander aircraft was equipped with a Geometrics G-822A cesium vapour magnetic sensor mounted in a stinger to the rear of the aircraft. The system recorded readings every 0.1 seconds with a noise level of less than 0.01 nT. Magnetic interferences caused by aircraft maneuvers were compensated using an RMS-A-D-C-M magnetic compensation. Diurnal variations were recorded on cesium vapour magnetometers.

After editing the survey data, the intersections of traverse and control lines were determined and the differences in the magnetic values were computed, analyzed and manually verified to obtain the leveling network. The International Geomagnetic Reference Field was calculated and removed using a fixed date (2005 14 08) and an altitude of 610m for each data point. The corrected magnetic data was interpolated to a 100m grid using a minimum curvature algorithm. The first vertical derivative grid was calculated from the corrected total magnetic intensity grid using a FFT based frequency domain filtering algorithm.

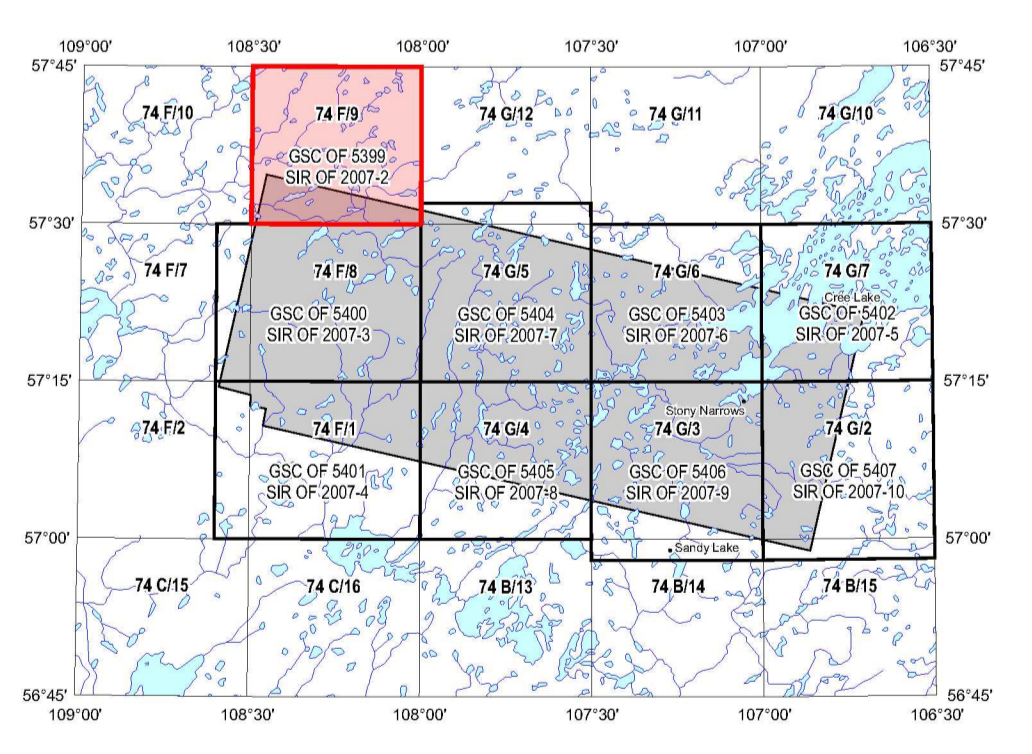
Positional Data
The 400 m spaced survey lines were oriented to a heading of 105 degrees and the 3000 m spaced control lines were oriented to a heading of 15 degrees. Survey and control line positions and elevations were pre-planned using Sander Geophysics Limited Smooth Drapes software. Positional data were recorded using a Novatel E-M4. GPS ground station data were combined with airborne GPS data to produce differentially corrected positional data with an accuracy of 2 to 5 m.

Data Presentation
Colour levels and contours were calculated for each grid and combined with map surround information to create postscript plot files, which were plotted using HP DesignJet 1050c colour plotters.

This airborne geophysical survey and the production of this map were funded by the Government of Saskatchewan's Mineral Exploration Incentive Program.

PLANIMETRIC SYMBOLS

Topographic Contour	
Drainage	
Wetland	
Permanent Ice	
Roads	
Trails	
Flight Line	



Saskatchewan Industry and Resources

Natural Resources Canada / Ressources naturelles Canada

Location Map

GEOPHYSICAL SERIES
WOLVERNAN LAKES 74 F/9, SASKATCHEWAN
CREE LAKE GEOPHYSICAL SURVEY, SASKATCHEWAN

THORIUM / POTASSIUM

Scale 1 : 50 000 - Échelle 1 / 50 000

km 1 0 2 4 km

Universal Transverse Mercator Projection
North American Datum 1983
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Projection transversale universelle de Mercator
Système de référence géodésique nord-américain, 1983
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Digital Topographic Data provided by Geomatics Canada, Natural Resources Canada

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COMMISSION GÉOLOGIQUE DU CANADA
2007
SHEET 7 OF 10
FEUILLET 7 DE 10

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THORIUM / POTASSIUM
GEOLOGICAL SURVEY OF CANADA
WOLVERNAN LAKES 74 F/9
SASKATCHEWAN
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