

**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 a Britten Norman Islander aircraft, registration C-GSGX.

**Gamma-ray Spectrometric Data**  
The airborne gamma-ray measurements were made with an Exporanum GR820 gamma-ray spectrometer using fourteen 102 x 102 x 406 mm NaI (Tl) crystals. The main detector array consisted of twelve crystals (total volume 50.4 litres). Two crystals (total volume 3.4 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 <sup>40</sup>K, whereas uranium and thorium were measured indirectly from gamma-ray photons emitted by daughter products (<sup>214</sup>Pb for uranium and <sup>214</sup>Pb 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 ( <sup>40</sup> K)	1370-1570 keV
Uranium ( <sup>238</sup> U)	1660-1860 keV
Thorium ( <sup>232</sup> Th)	2410-2810 keV

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 1600-1800 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/ppm
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 calcium, overburden, vegetation cover, soil moisture and surface water. As a result the measured concentrations are usually lower than the actual bedrock concentration. The total air absorbed dose rate in nanograys 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 sling to the rear of the aircraft. The system recorded readings every 1.5 seconds with a noise level of less than 0.1 nT. Magnetic interference caused by aircraft maneuvers were compensated using an RMS AADC11 Magnetic compensator. Diurnal variations were recorded using a cesium vapour magnetometer.

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 delay (20% to 25%) and an altitude of 130 m 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.

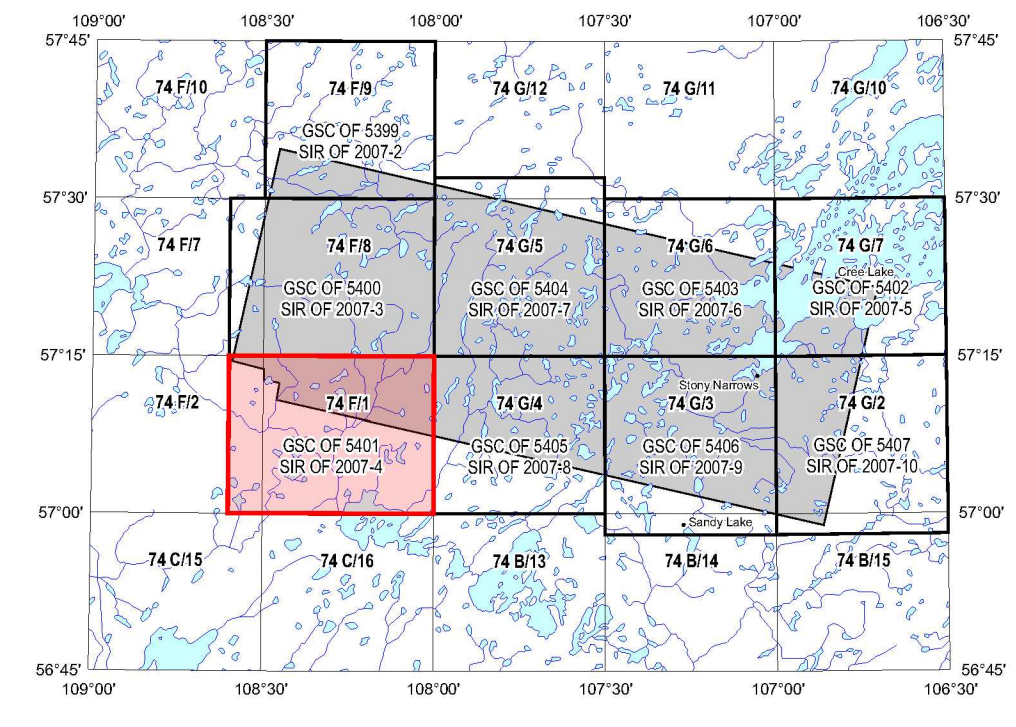
**Positional Data**  
The 400 m spaced survey lines were oriented to a heading of 105 degrees and the 3000 m spaced control lines were oriented to a heading of 15 degrees. Survey and control line positions and elevations were pre-planned using Sander Geophysics Limited Smooth Drape software. Positional data were recorded using a Novatel EM4. GPS ground station data were combined with airborne GPS data to produce differentially corrected positional data with an accuracy of 2 to 3 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**

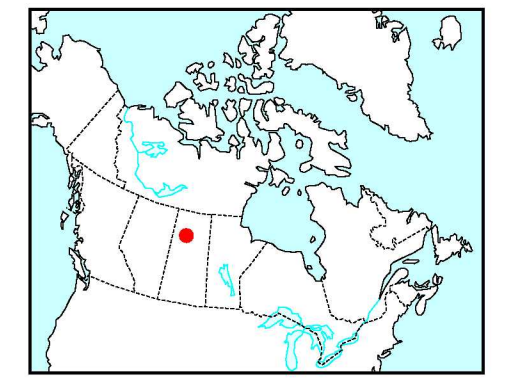
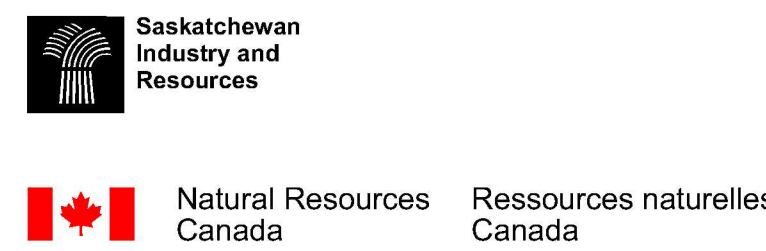
- Topographic Contour
- Drainage
- Wetland
- Permanent Ice
- Roads
- Trails
- Flight Line



**GEOPHYSICAL SERIES  
NEFF LAKE 74 F/1 and 74 F/2, SASKATCHEWAN  
CREE LAKE GEOPHYSICAL SURVEY, SASKATCHEWAN  
FIRST VERTICAL DERIVATIVE  
OF THE MAGNETIC FIELD**

Scale 1 : 50 000 - Échelle 1 / 50 000

Universal Transverse Mercator Projection  
North American Datum 1983  
© Her Majesty the Queen in Right of Canada 2007



**OPEN FILE DOSSIER PUBLIC 5401**  
GEOLOGICAL SURVEY OF CANADA  
COMMISSION GÉOLOGIQUE DU CANADA  
2007  
SHEET 10 OF 10  
FEUILLE 10 DE 10

Authors: Buckle, J.L., Carson, J.M., Coyle, M., Ford, K.L., Delaney, G., and Slimmon, W.  
Data acquisition, compilation and map production by Sander Geophysics Limited, Ottawa, Ontario.  
Contract and project management by the Geological Survey of Canada, Ottawa, Ontario.

Recommended citation:  
Buckle, J.L., Carson, J.M., Coyle, M., Ford, K.L., Delaney, G., and Slimmon, W.  
2007. Geophysical series: Neff Lake 74 F/1 and 74 F/2, Saskatchewan; Cree Lake Geophysical Survey, Saskatchewan; Geological Survey of Canada, Open File 5401; Saskatchewan Industry and Resources, Open File 2007-4; scale 1:50 000.

**FIRST VERTICAL DERIVATIVE OF THE MAGNETIC FIELD**  
GEOPHYSICAL SERIES  
NEFF LAKE 74 F/1 and 74 F/2  
SASKATCHEWAN  
74 F/1 and 74 F/2