



In 2004 and 2005, Sander Geophysics Limited completed four multi-sensor airborne geophysical surveys in the Nahanni River area of the Northwest Territories for Parks Canada (Prairie Creek, Caribou River and Flat River) and the Government of the Northwest Territories (Sikav Range). The Geological Survey of Canada provided survey supervision and quality control. The purpose of the survey was to obtain quantitative gamma-ray spectrometric and magnetic data. The survey was flown over two seasons, from August 26 to October 3, 2004 and the second phase from June 13 to August 20, 2005 using the SGLASAR 350B-3 helicopter, C-GSDH.

Gamma-ray Spectrometric Data
The airborne gamma-ray measurements were made with an Explorer GR820 gamma-ray spectrometer using nine 102 x 102 x 406 mm NaI (Tl) crystals. The main detector array consisted of eight crystals (total volume 33 litres). One crystal (total volume 4.2 litres), shielded by the main array, was 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 from daughter products (²¹⁴Pb for uranium and ²¹⁴Pb 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 (⁴⁰ K)	1360 - 1560 keV
Uranium (²³⁸ U)	1660 - 1860 keV
Thorium (²³² Th)	2610 - 2810 keV

Gamma-ray spectra were recorded at one-second intervals at a planned terrain clearance of 135 m and an air speed of 120 km/h. Noise Reduced 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, the spectra were energy calibrated, and counts were accumulated into the windows described above. Counts from the radon detectors were recorded in a 1600 - 1860 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	56.6 cps% (2004) 60.0 cps% (2005)
Uranium	9.0 cps/ppm (2004) 6.3 cps/ppm (2005)
Thorium	3.7 cps/ppm (2004) 3.2 cps/ppm (2005)

Corrected data were filtered and interpolated to a 100m grid with the 1:500 000 scale and 1:250 000 scale maps. The results of an airborne gamma-ray spectrometry 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 concentration. The total air absorbed dose rate in nanograys per hour was produced from measured counts between 400 and 2810 keV.

Magnetic Data
The helicopter was equipped with a Scriptrix CS-2 cesium vapour magnetic sensor mounted in a bird suspended 30 m below the aircraft. The system recorded readings every 0.1 seconds with a noise level of less than 0.02 nT. Magnetic interferences caused by aircraft maneuvers were compensated using an RAS MADCI Magnetic compensator. Diurnal variations and GPS fluctuations were recorded using a Sander Geophysics Ground Station Recording System. The International Geomagnetic Reference Field was calculated daily and removed for each flight. The airborne magnetometer data was IGRF corrected, using the location, altitude and date of each point. The IGRF was calculated using the IGRF 2000 model.

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
Survey line spacing of 500 m and control line spacing of 4000 m was used for the Prairie Creek, Caribou River and Flat River survey blocks. Survey line spacing of 400 m and control line spacing of 2400 m was used for the Sikav Range survey block. Survey lines were oriented N-S for the Prairie Creek and Caribou River areas. For the Flat River area survey lines were oriented NW-SE and for the Sikav Range survey lines were oriented SW-NE. Survey and control line positions were pre-planned using Sander Geophysics Limited, Smooth Drape software. Terrain clearance was monitored by radar altimeter. Positional data were recorded using a dual frequency Novatel Millennium system. GPS ground station data were combined with airborne GPS data to produce differentially corrected positional data with an accuracy of ±0.5 m.

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

Project Funding
The Prairie Creek, Caribou River and Flat River surveys were funded by Parks Canada through the Mineral and Energy Resource Assessment Project. The Sikav Range survey was funded by the Northwest Territories Geoscience Office. Technical expertise and contract administration were provided by the Radiation Geophysics and Regional Geophysics Sections of the Geological Survey of Canada.

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**GEOPHYSICAL SERIES - NTS 105-I/2 and 105-I/3 - UPPER HYLAND LAKE
NORTHWEST TERRITORIES**

URANIUM / THORIUM MAP

Parks Canada
 Natural Resources Canada
Ressources naturelles Canada



Scale 1 : 50 000 - Échelle 1 / 50 000

Universal Transverse Mercator Projection
North American Datum 1983
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Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983
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URANIUM / THORIUM MAP
UPPER HYLAND LAKE
NORTHWEST TERRITORIES
NTS 105-I/2 and 105-I/3



Digital Topographic Data provided by Geomatics Canada, Natural Resources Canada