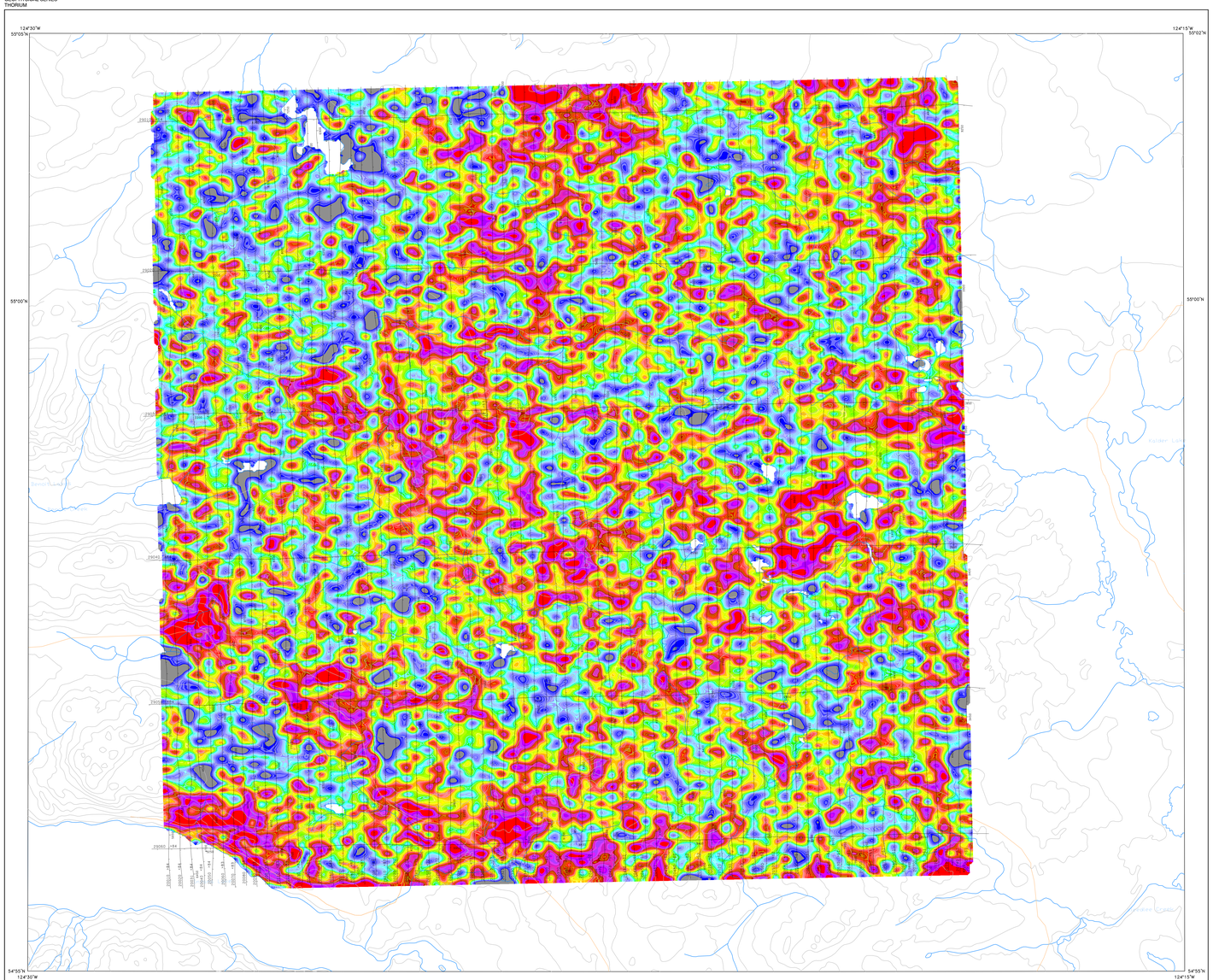
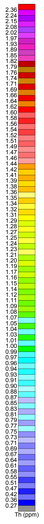
GEOPHYSICAL SERIES
THORIUM





GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

High Sensitivity Airborne Gamma-Ray Spectrometric and Aeromagnetic Surveys
Central British Columbia, 2004 - 2006

In 2004 and 2005, Fugro Airborne Surveys completed nine multi-sensor airborne geophysical surveys in the central region of British Columbia for the Geological Survey of Canada, the British Columbia and Yukon Chamber of Mines, Yekooche First Nation, and five industry partners, including Geoscience BC, Yukon Mining Incentive Program, Northern Rocky Mountain Trench Initiative, and Kinetz Resources Ltd. The Geological Survey of Canada provided survey supervision and quality control. The purpose of the surveys was to obtain quantitative gamma-ray spectrometric and aeromagnetic data. The surveys were flown over two seasons, from September 18 to November 17, 2004 and June 15 to August 8, 2005 using AStar 350-B2 and 350-B3 helicopters, C-GECL and C-FXSC.

Gamma-ray Spectrometric Data

The airborne gamma-ray measurements were made with an Exploranium 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 33.6 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 spectrometer was calibrated to remove spectral overlap 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 in their respective decay chains. Assuming radioactive equilibrium in the uranium and thorium 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 (40K): 1360 - 1560 keV
Uranium (214Bi): 1660 - 1860 keV
Thorium (208Tl): 2410 - 2810 keV

Gamma-ray spectra were recorded at one-second intervals at a planned terrain clearance of 120m or 90m depending on the survey area and an air speed of 125km/h. The total, potassium, uranium and thorium window counts were derived from the recorded 256 channel spectra. During processing, the spectra were energy calibrated, and counts were accumulated into the windows mentioned above. To reduce the statistical uncertainty of the data, the count rate for cosmic 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 survey altitude from nominal terrain clearance were applied to the window data using calibrations prior to conversion to ground concentrations of potassium, uranium and thorium, using factors determined from flights over a calibration range near Ottawa.

Potassium 57.9 cps/% (2004) 56.8 cps/% (2005)
Uranium 8.7 cps/ppm (2004) 8.4 cps/ppm (2005)
Thorium 8.6 cps/ppm (2004) 8.7 cps/ppm (2005)

Corrected data were filtered and interpolated to a 100m grid for the 1:250 000 scale maps and to a 50m grid for the 1:20 000 and 1:50 000 scale maps. The results of an airborne gamma-ray spectrometric survey are affected by several factors including the presence of water, vegetation, 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 410 and 2810 keV.

Magnetic Data

The helicopter was equipped with a Scintrex CS-2 cesium vapour magnetic sensor mounted in a HM1 high-resolution single sensor stinger-mounted system. The system recorded readings every 0.1 seconds with a noise level of less than 0.01 nT. Magnetic interferences caused by aircraft manoeuvers were compensated using an RMS AADC3 Magnetic compensator. Diurnal variations and GPS fluctuations were recorded using a Fugro GF1 base station.

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 levelling network. The International Geomagnetic Reference Field was calculated and removed using a fixed date of October 19,2004 and an altitude of the differentially corrected GPS height for each reading. The data were then micro-levelled using a cubic fit, tie-line levelling and a proprietary 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

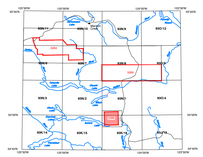
Line spacing and direction for survey and control lines were selected for each block to ensure the best intersection of local geological features. Terrain clearance was monitored by radar altimeter. Positional data were recorded using a dual frequency Novatel Millenium system. GPS groundstation data 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 colour plotters.

Planimetric Symbols

Topographic Contour
Drainage
Roads
Culture
Railway
Flight lines, fiducial — 10100 at 40km



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND GEOPHYSICAL MAP INDEX
SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE ET INDEX DES CARTES GÉOPHYSIQUES

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Natural Resources Canada | Ressources naturelles Canada
Canada

GEOPHYSICAL SERIES - NTS 93N/1, 93K/16 - WITTICHICA CREEK
BRITISH COLUMBIA

THORIUM

Scale 1:20 000 - Échelle 1/20 000
Kilometres 0.5 0 0.5 1.0 1.5 Kilometres

NAD 83 / UTM Zone 10N

Universal Transverse Mercator Projection
North American Datum 1983
© Her Majesty the Queen in Right of Canada 2006

Projection universal transverse 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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2006
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