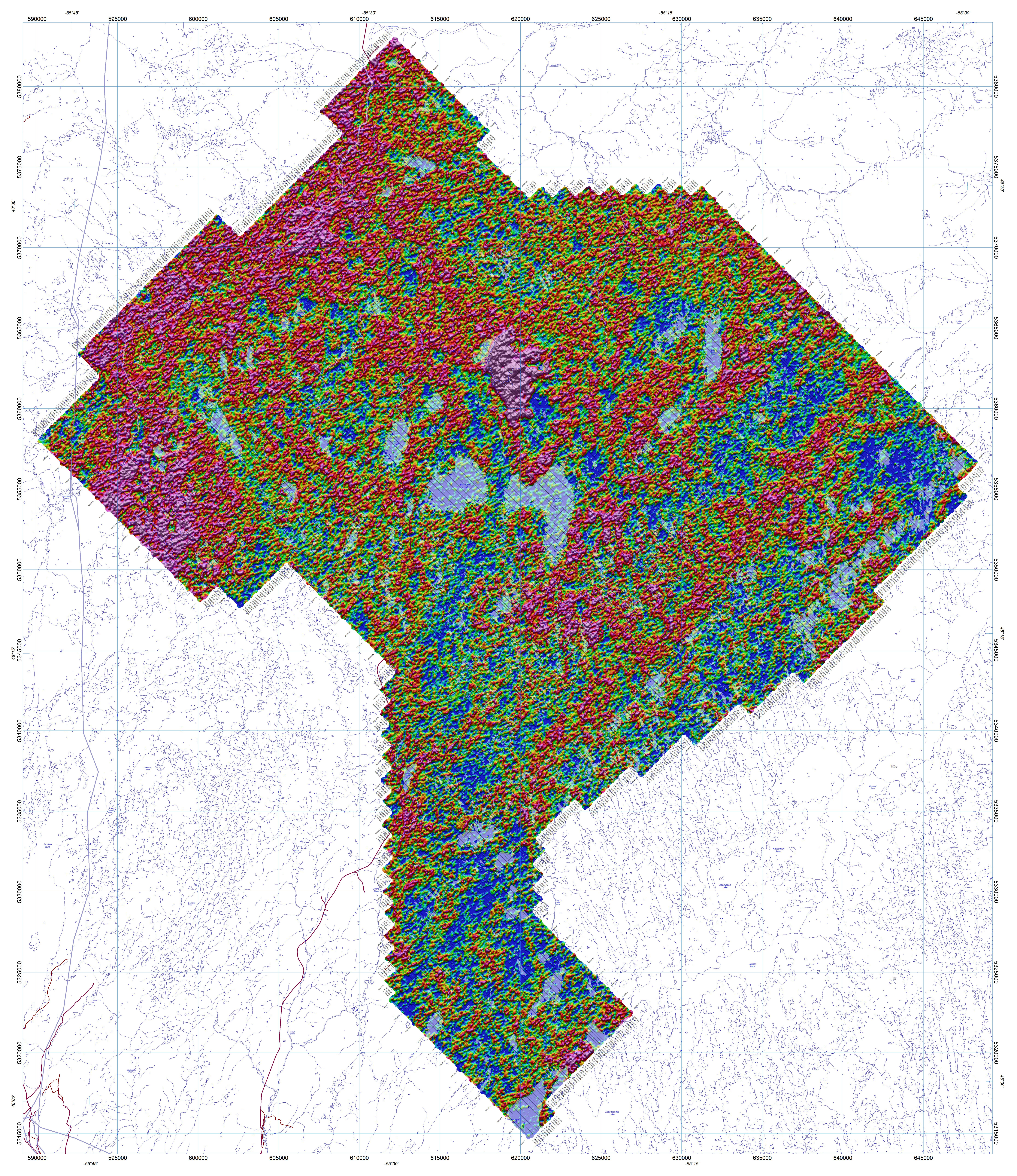

Newfoundland & Labrador
Industry, Energy and Technology

AIRBORNE GEOPHYSICAL SURVEY OF THE GREAT GULL LAKE AREA, NEWFOUNDLAND

Parts of NTS Map Areas
2D/03, 05, 06, 11 and 12

EQUIVALENT URANIUM

MAP 2023-08
Open File 002D/0956
Map 7 of 12

G.J. Kilfoil

ABOUT THE SURVEY

Introduction

This quantitative gamma-ray spectrometric and aeromagnetic airborne geophysical survey of the Great Gull Lake region, Newfoundland, was completed by Novatem Airborne Geophysics. The survey was flown from January 13th to March 8th, 2021 using a single Piper Navajo PA-31 (C-FNWG). The nominal traverse and control line spacings were, respectively, 150 m and 1000 m, and the aircraft flew at a nominal terrain clearance of 90 m at an airspeed between 200 and 270 km/h. Traverse lines were oriented 135° with orthogonal control lines. The flight path was recovered following post-flight differential corrections using precise ephemerides applied to raw data recorded by a Global Positioning System.

Gamma-ray Spectrometric Data

The airborne gamma-ray measurements were made with two Radiation Solutions RSX-5 gamma-ray spectrometers using eight 4.18 litres NaI (Ti) crystals. The main detector array consisted of eight crystals (total volume 33.5 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 continuously adjusted the gain of each crystal by monitoring the natural potassium, uranium, and thorium peaks. Upward crystals provided a small cesium source to supplement the three natural peaks.

Potassium is measured directly from the 1460 kev gamma-ray photons emitted by K(40), whereas uranium and thorium are measured indirectly from gamma-ray photons emitted by daughter products (Bi(214) for uranium and Tl(208) 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, respectively: 1370-1570 keV, 1660-1860 keV and 2410-2810 keV.

Gamma-ray spectra were recorded at one-second intervals. Data processing followed standard procedures as described in IAEA, 1991 and IAEA, 2003. 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 1660 - 1860 keV window and radiation at energies greater than 3000 keV was recorded in the cosmic window. The window counts were corrected for background activity from cosmic radiation, 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 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 the Breckenridge, Quebec calibration range.

Corrected data were interpolated to a 30 m grid interval. 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 magnetic field was sampled 10 times per second using three optically pumped cesium vapour magnetometers (sensitivity = 0.005 nT/√Hz) mounted inside the tail boom and two wingtip pods of the aircraft. This array of sensors form a horizontal gradiometer with a lateral dimension of 15.2 m and a longitudinal dimension of 8.5 m. Differences in magnetic values at the intersections of control and traverse lines were computer-analysed to obtain a mutually levelled set of flight-line magnetic data. The International Geomagnetic Reference Field (IGRF) defined at the average GPS altitude of 90 m for the date February 15, 2021 was then removed. Removal of the IGRF, representing the magnetic field of the Earth's core, produces a residual component related essentially to magnetizations within the Earth's crust. An enhanced version of the levelled magnetic data was calculated by leveraging horizontal and longitudinal gradients to better define short wavelength signal, which was then interpolated to a 30 m grid interval.

The first vertical derivative of the magnetic field is the rate of change of the magnetic field in the vertical direction. Computation of the first vertical derivative removes long wavelength features of the magnetic field and significantly improves the resolution of closely spaced and superposed anomalies. A property of first vertical derivative maps is the coincidence of the zero-value contour with vertical contacts of magnetic units at high magnetic latitudes (Hood,1965).

Acknowledgments

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References

Hood, P.J. 1965: Gradient measurements in aeromagnetic surveying. Geophysics, volume 30, pages 891-902.
International Atomic Energy Agency, 1991: Airborne gamma ray spectrometer surveying. IAEA Technical Reports Series No. 323, 1991.
International Atomic Energy Agency, 2003: Guidelines for radiometric mapping using gamma ray spectrometry data. IAEA-TECDOC-1363, 2003.

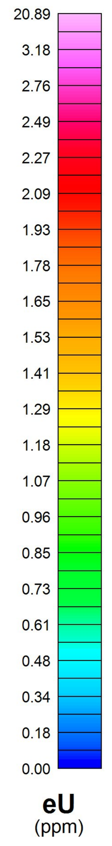
Additional Information

Initial map production and data compilation were performed by Novatem Airborne Geophysics, Mont-Saint-Hilaire, Quebec.
Final map production, contract and project management were provided by the Newfoundland and Labrador Department of Industry, Energy and Technology.

Copies of this map may be obtained from the Geological Survey, Department of Industry, Energy and Technology, Government of Newfoundland and Labrador, PO Box 8700, St. John's, NL, Canada, A1B 4J6.

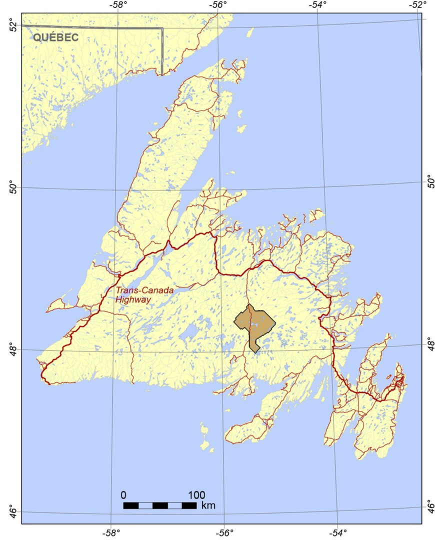
This map is subject to revision and modification. Comments concerning errors or omissions should be adressed/emailed to: pub@gov.nl.ca

Department Website: https://www.gov.nl.ca/iet
Geoscience Online Website: https://gis.gov.nl.ca/

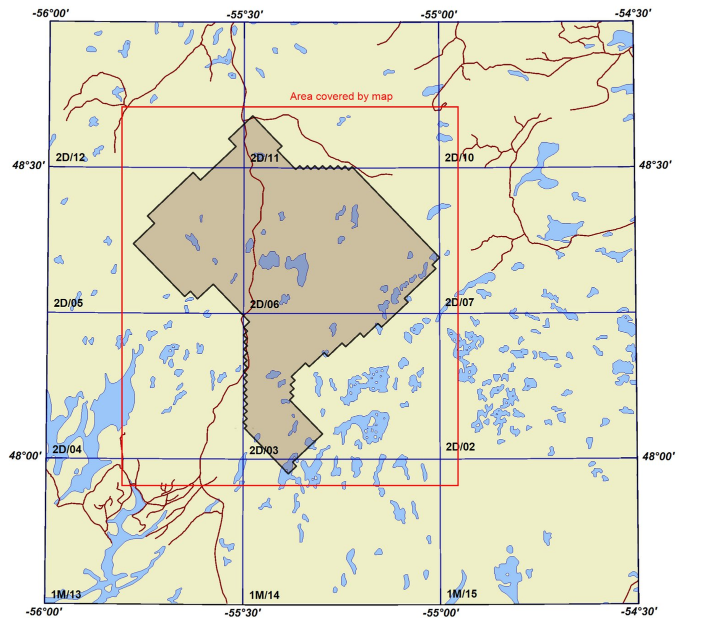


PLANIMETRIC SYMBOLS

Topographic contours
Drainage
Road
Flight line
Building
Transmission line



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND GEOPHYSICAL MAP INDEX



Digital topographic data provided by
Geomatics Canada, Natural Resources Canada

Map image colours are arranged by an equal-area distribution

MAP 2023-08
GREAT GULL LAKE
PARTS OF NTS MAP AREAS 2D/03, 05, 06, 11 AND 12

novatem
airborne geophysics

Scale 1:100000
2000 0 2000 4000 6000
(meters)

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