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GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

These new radioactivity maps were produced using the digital archives of the National Gamma Ray Spectrometry Program (NATGAM), from data collected between 1974 and 1996. The surveys were flown by Geological Survey of Canada (GSC) and contracted aircraft, using Federal and joint Federal-Provincial government funding. All data were originally published in stack line contour and stacked profile formats, or colour interval maps, as 1:50 000 GSC Open File reports listed in the References.

The data were collected using 50 litres of sodium iodide detectors, at a nominal terrain clearance of 120 m. For most of the surveyed area, flight lines were spaced at 1000 metre intervals. In the southern Burin Peninsula, reconnaissance-scale data were collected along east-west flight lines spaced at 5000 metre intervals. For the Great Gull Lake area (Figure 1) and Tulks Volcanic Belt (Figure 2) detailed coverage was obtained using northwest-southeast flight lines spaced at 250 and 500 metres, respectively. The closer line spacing supports increased spatial resolution of radioactive element signatures.

Potassium is measured directly from the 1460 keV gamma ray photons emitted by ^{40}K. Uranium and thorium, however, are determined indirectly from gamma ray photons emitted by daughter products (^{214}Bi and ^{208}Tl), respectively, assuming equilibrium between daughter and parent isotopes. For this reason, gamma ray spectrometric measurements of uranium and thorium are referred to as equivalent uranium (eU) and equivalent thorium (eTh).

Standard energy windows were used to record the gamma ray counts. These are 1370-1570 keV for potassium, 1660-1860 keV for uranium, 2410-2810 keV for thorium and 400-2810 keV for total radioactivity. Several corrections are applied to the raw window counts prior to conversion to standard concentration units, including: system dead time; background activity from cosmic radiation, the aircraft and atmospheric radon decay products; spectral scattering in the ground, air and detectors; deviations of altitude from the planned terrain clearance; temperature and barometric pressure.

This Open File consists of eight 1:1 000 000 regional compilation maps of three measured variables (potassium, equivalent uranium and equivalent thorium) and five derived products (the natural air absorbed dose rate derived from a linear combination of K, eU and eTh, and eU/eTh, eU/K, eTh/K and ternary radioelement map). Included with each regional compilation map are two figures that depict more detailed patterns resulting from the closer line spaced surveys in the Great Gull Lake and Tulks Volcanic Belt areas. The data for these two areas are presented at a scale of 1:250 000 with colour intervals determined separately to highlight the more detailed patterns.

Gamma ray spectrometry measures the radioactivity of the top 30 cm of the ground. The data represent average surface concentrations, influenced by varying amounts of outcrop, overburden, vegetation, and soil moisture and surface water. As a result, measured concentrations are usually lower than underlying bedrock concentrations.

Throughout the diverse lithotectonic terranes surveyed, the geochemical information provided by variations in potassium, uranium and thorium concentrations assists mapping of bedrock and surficial geology and mineral exploration, at regional and local scales. More detailed interpretation is possible through the use of the original line data, available from the Geological Survey of Canada.

The 1:1 000 000 compilation map illustrates a variety of geological features. For example, the area along the south coast of the Island of Newfoundland is dominated by a variety of granitic complexes including the North Bay, Burgeo, Gaultois, Ackley and Pinnacle (O'Brien, et al., 1996). Each complex displays a variety of radioactive element characteristics that enable discrimination of various phases within and between them, and their host rocks (Ford, 1993). The most distinctive is the Pinnacle granite, which is characterized by high levels of uranium and granite. Considerable internal zonation within the Pinnacle granite is best displayed on the ternary radioelement map (Broome et al., 1987).

Airborne gamma ray spectrometry surveys have also detected areas of potassium enrichment associated with felsic volcanic sequences in several areas of central and north-central Newfoundland. These results prompted re-examination of two areas, the Great Gull Lake and Tulks Volcanic Belt areas (Figures 1 and 2). Ground gamma ray spectrometry studies (Ford, 1993; Shives et al., 1993) in these and other areas have shown a strong association between elevated potassium concentrations and massive sulphide deposits, including those on Pilley's Island and Long Island north of Roberts Arm (Figure 1) and on the Tulks Volcanic Belt (Figure 2).

The Pilley's Island ground studies indicate that the strongest potassium enrichment is associated with altered and mineralized dacitic flows and pyroclastics that are hydrothermally brecciated and contain sulphide stringers, but do not appear pervasively sericitized (Santagudia et al., 1996). In the Tulks Volcanic Belt, potassium anomalies are associated with flat-lying, unaltered rhyolite flows and pyroclastics (Figure 2). Here, the potassium enrichment is exposed at the surface. Although ground studies in the Belt (Ford, 1993; Shives et al., 1997) indicate that a significant component of the radioactive element variations represent a primary lithological signature, local potassic alteration can still be identified. The alteration is commonly best recognized as low values on corresponding eTh/K ratio maps, indicating an unusual, non-lithological addition of potassium, relative to thorium.

The utility of gamma ray spectrometry to detect, quantify and map potassium alteration associated with VHMS and other mineral deposits is important, well demonstrated implications for mineral exploration and geological mapping (Shives et al, 1998).

The base map data for this open file was derived from three sources. The Island of Newfoundland is based on a 1:1 000 000 Universal Transverse Mercator (UTM) projection supplied by the Newfoundland and Labrador Department of Mines and Energy, with modifications by Earth Sciences Sector Information Division (ESSI Info). This base provides geographic accuracy comparable with bases used during geophysical data acquisition. Bases for the Great Gull Lake and Tulks Volcanic Belt areas (Figures 1 and 2) are digitized from 1:250 000 topographic maps, with improved topographic detail. The base information for Quebec, Labrador was reproduced at 1: 1 000 000 from the Digital Chart of the World (DCW) from Environment Systems Research Institute (ESRI), with modifications by ESSI Info., and is presented for reference purposes only.

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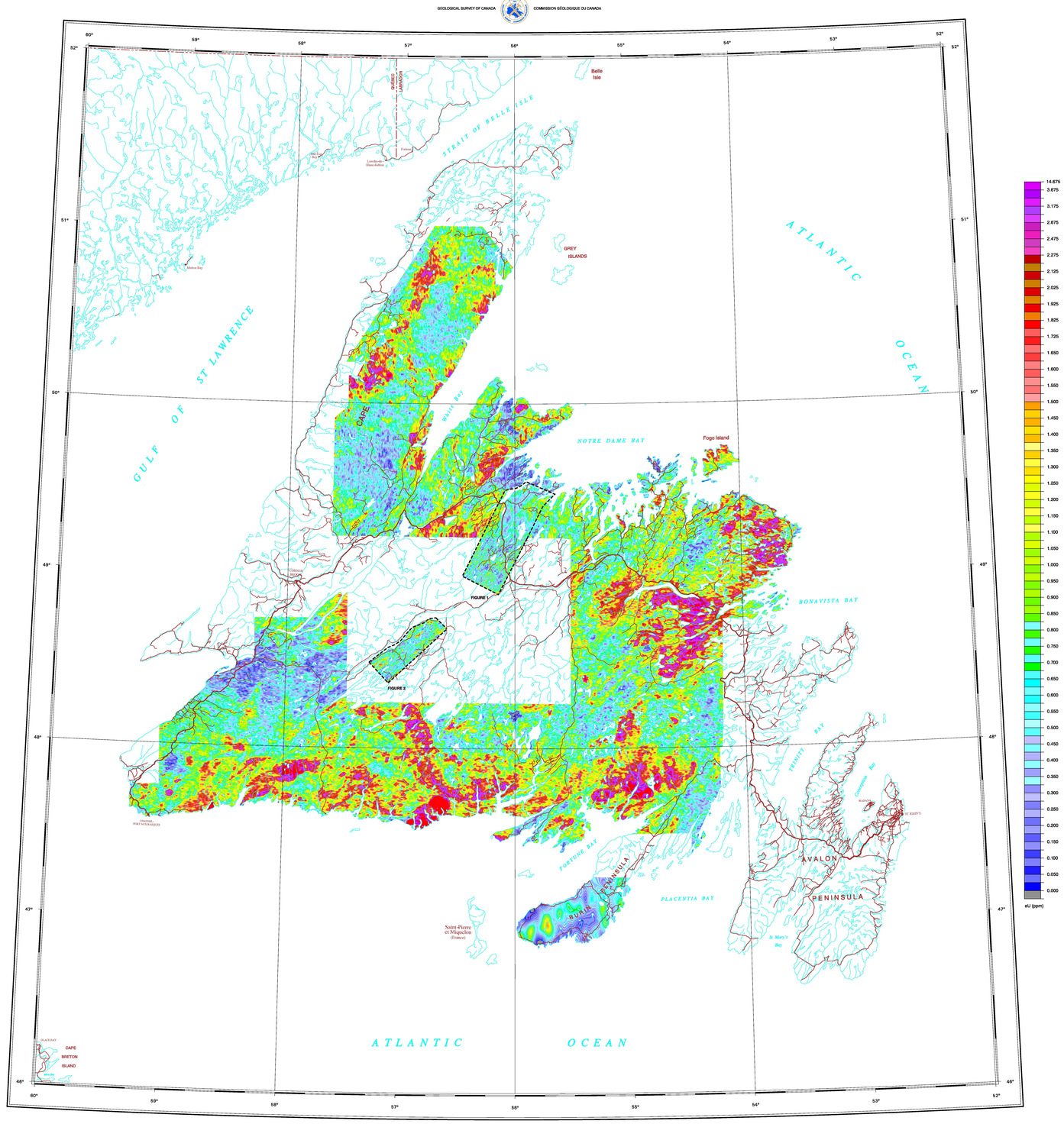
Geophysical compilation by J.M. Carson, P.B. Holman, K.L. Ford, J.A. Grant, and R.B.K. Shives

Digital cartography by J.A.Y. Pratt, Earth Sciences Sector Information Division (ESS Info)

This map was produced from processes in conformance with the Cartographic Services Section Quality Management System, Ottawa, registered to the Quality System ISO 9001: 2000 standards

Any revisions known to the user would be welcomed by the Geological Survey of Canada

Digital base map for parts of Quebec, Labrador and Nova Scotia at the scale of 1:1 000 000 from the Digital Chart of the World (DCW) from Environment Systems Research Institute (ESRI), with modifications by ESS Info. Digital base map for Figure 1 and Figure 2 at the scale of 1:250 000 from data compiled by Geomatics Canada, with modifications by ESS Info



equivalent Uranium
OPEN FILE 4463
AIRBORNE GAMMA RAY SPECTROMETRY COMPILATION

ISLAND OF NEWFOUNDLAND

NEWFOUNDLAND AND LABRADOR

Scale 1:1 000 000/Échelle 1/1 000 000

kilometres 25 0 25 50 75 kilometres

Universal Transverse Mercator Projection
North American Datum 1927
© Her Majesty the Queen in Right of Canada 2003

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1927
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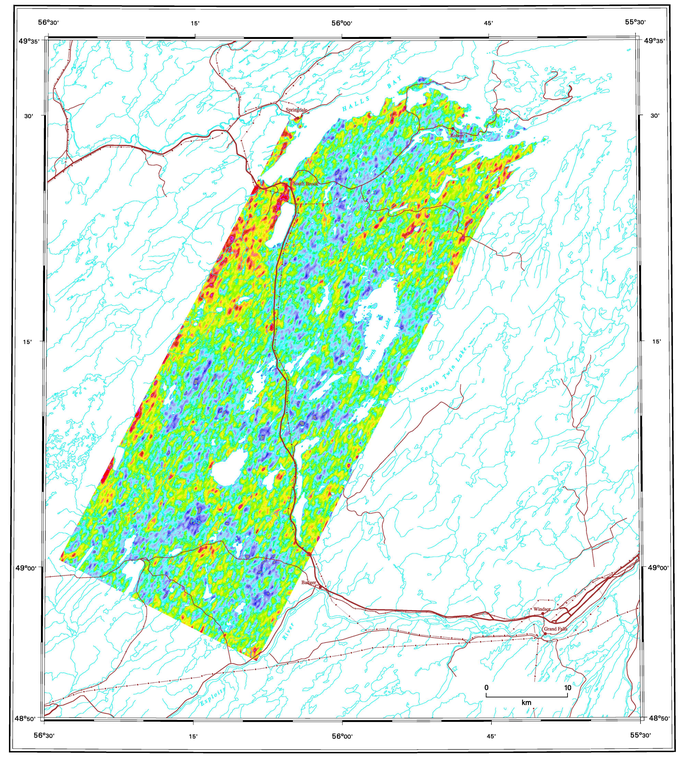

Figure1
equivalent Uranium
GREAT GULL LAKE

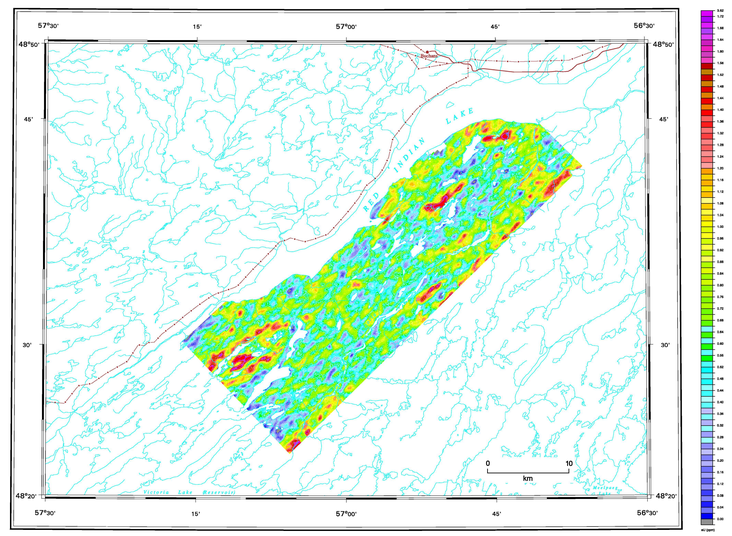

Figure2
equivalent Uranium
TULKS VOLCANIC BELT

OPEN FILE
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2003
SHEET 3 OF 8
FEUILLET 3 DE 8

Open files are products that have not gone through the GSC formal publication process.

Les dossiers publics sont des produits qui n'ont pas été soumis au processus officiel de publication de la CGC.

Sheet 3 of 8, Airborne Gamma Ray Spectrometry Compilation

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