Natural Resources Canada | Ressources naturelles Canada

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 either in black line contour and stacked profile formats, or colour interval maps, as 1:50 000 GSC Open File and Publication releases.

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 oriented flight lines spaced at 300 and 500 metres, respectively. The closer line spacing supports increased resolution of the radioactive patterns in these areas.

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).

Three 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 pressure variations.

This Open File consists of eight 1:1 000 000 regional compilation maps of three measured variables (potassium, equivalent uranium and equivalent thorium), a ternary radioelement map, and a total count radioactivity map, derived from a linear combination of K, eU and eTh, and eU/eTh, eU/K, eTh/K and ternary radioelement maps). 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.

These maps depict radioactivity emanating from the upper 30 cm of the earth's surface. The data represent average surface concentrations, influenced by varying amounts of outcrop, overburden, vegetation, and soil moisture, and by 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 supports 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 southern coast of Newfoundland is underlain by granitic rocks of the Devonian Burin Peninsula Batholith (Taylor, 1979; Burgess, Sauchuk, Ashley and Francois (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 lithologies. The area of highest radioactivity along the south coast of Newfoundland is associated with the Francois granite. Considerable internal zonation within the Francois granite is best displayed on the ternary radioelement map (Broome et al., 1987).

Airborne gamma ray spectrometry have also detected areas of potassium enrichment associated with felsic volcanic rocks in the Cambrian-Ordovician rocks of coastal and north-central Newfoundland. These results prompted re-surveying of two areas with closer line spacing, to improve anomaly resolution (Figures 1 and 2). Ground gamma ray spectrometry studies (Ford, 1993; Shives et al, 1995) 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 in the Tulks Volcanic Belt (Figure 2).

The ability of gamma ray spectrometry to detect, quantify and map potassium alteration associated with Volcanic Massive Sulphide (VMS) deposits is important, as well demonstrated implications for mineral exploration and geological mapping (Shives et al., 1995).

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 (ESS Info). This base map was digitized from the Digital Chart of the World (DCW) from Environment Systems Research Institute (ESRI). The two detailed figures are in a UTM projection supplied by Geomatics Canada, providing similar geographic accuracy but 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 ESS Info., and is presented for reference purposes only.

The Radiation Geophysics Section acknowledges Drs. A.G. Darnley, K.A. Richardson, G. Bristow and R.L. Grasty for their contributions to program development and technical leadership.

REFERENCES

Broome, J., Conaon, J.M., Grant, J.A., and Ford, K.L.
1987: A modified ternary radioelement mapping technique and its application to the South Coast of Newfoundland; Geological Survey of Canada, Paper 87-14.

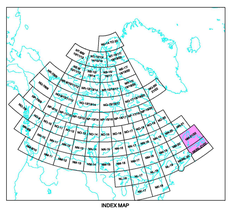
Ford, K.L.
1993: Application of gamma-ray spectrometry to exploration for VMS deposits in the Robert's Arm Group and Tulks Volcanic Belt, central Newfoundland; in Report of Activities 1993, Newfoundland and Labrador Department of Mines and Energy, Geological Survey Branch, p. 12–13.

O'Brien, S.J., Dickson, W.L., and Blackwood, R.F.
1996: Geology of the central portion of the Hermitage Flexure area, Newfoundland; in Current Research, Newfoundland Department of Mines and Energy, Mineral Development Division, Report 96-1, p. 199–208.

Santaguida, F., Ford, K.L., and Hannington, M.D.
1996: The identification of potassic alteration zones associated with massive sulfide mineralization in volcanic rocks, central Newfoundland; in Winnipeg '96 – Abstracts; Geological Association of Canada.

Shives, R.B.K., Ford, K.L., and Charbonneau, B.W.
1995: Applications of gamma-ray spectrometric/magnetic/VLF-EM surveys – Workshop Manual; Geological Survey of Canada, Open File 3061, 82p.

Shives, R.B.K., Ford, K.L., and Charbonneau, B.W.
1997: The detection of potassic alteration by gamma-ray spectrometry – Recognition of alteration related to mineralization; p. 741–752, *in* Proceedings of Exploration 97: Fourth Decennial International Conference on Mineral Exploration, edited by A.G. Gubins, 1068p.



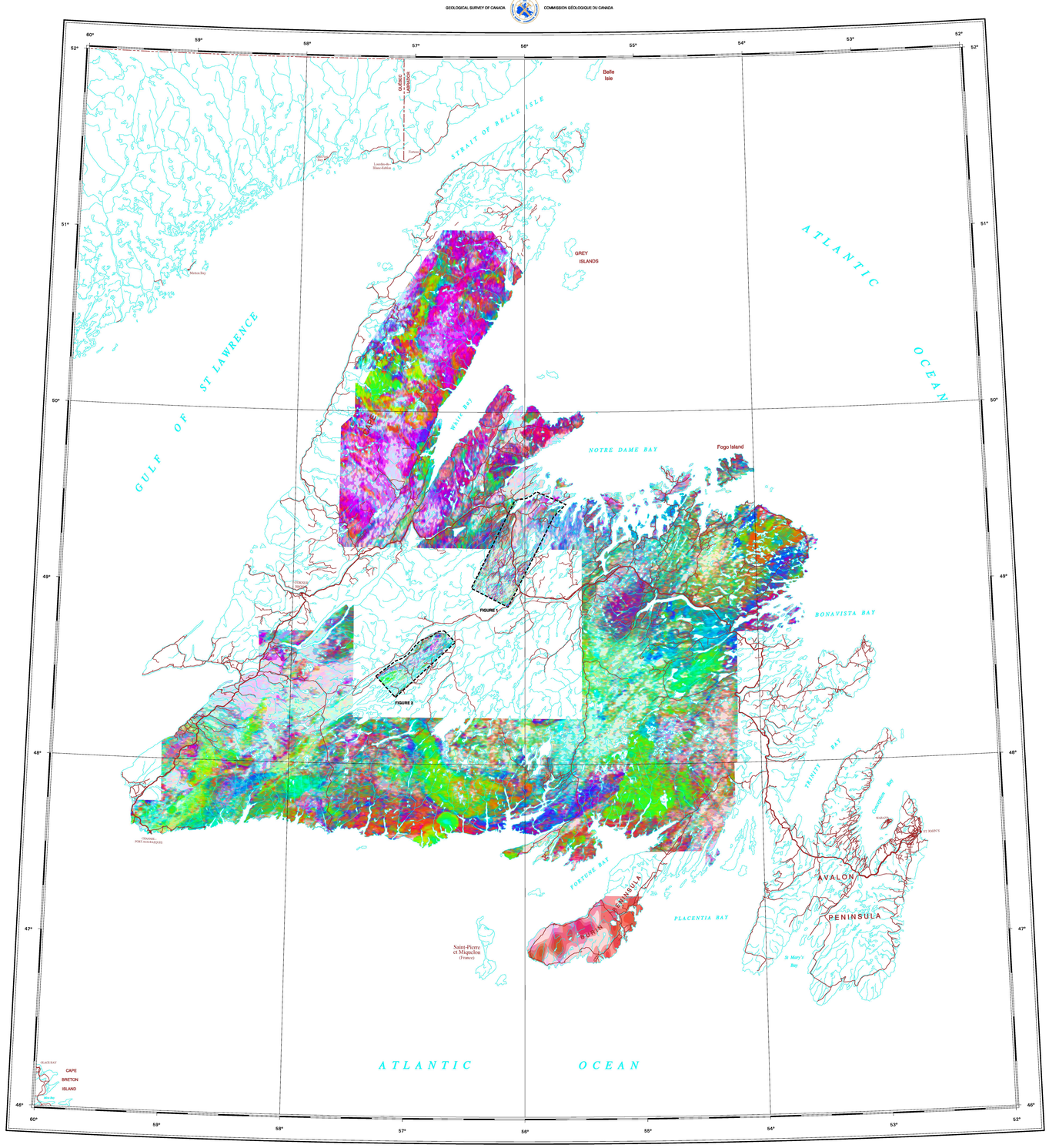
Geophysical compilation by J.M. Carson, P.B. Holman, K.L. Ford, J.A. Grant, and R.B.K. Shives

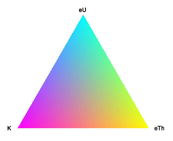
Digital cartography by J.A.Y. Pratt, Earth Sciences Sector Information Division (ESS Info)

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





Ternary Radioelement Map
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
© Sa Majesté la Reine du chef du Canada 2003

NATGAM

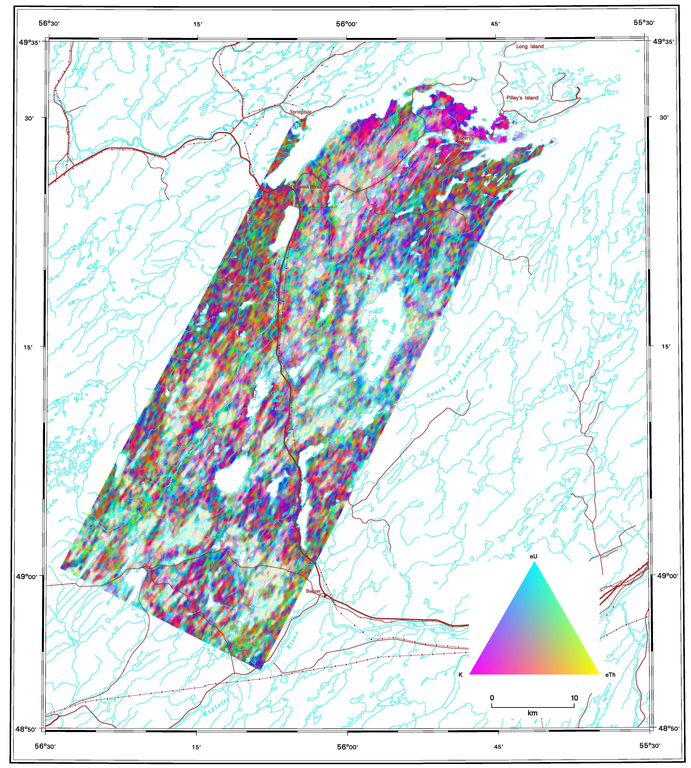


Figure 1
Ternary Radioelement Map
GREAT GULL LAKE

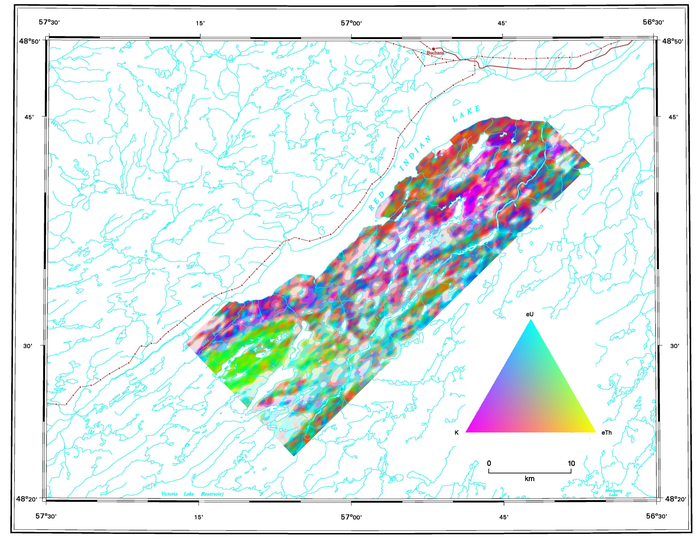


Figure 2
Ternary Radioelement Map
TULKS VOLCANIC BELT

OPEN FILE
DOSSIER PUBLIC
4463
GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
2003
SHEET 8 OF 8
FEUILLET 8 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 8 of 8, Airborne Gamma Ray Spectrometry Compilation

Recommended citation:
Carson, J.M., Holman, P.B., Ford, K.L., Grant, J.A., and Shives, R.B.K.
2003: Airborne Gamma Ray Spectrometry Compilation, Island of Newfoundland, Newfoundland and Labrador; Geological Survey of Canada, Open File 4463, scale 1:1 000 000.

Canada