Natural Resources Canada | Ressources naturelles Canada

GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

DESCRIPTIVE NOTES

This Radioactivity Map of New Brunswick is one of eight 1:500 000 regional compilation maps that include 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 maps). The data used in this compilation were acquired as part of the National Uranium Reconnaissance Program (NURAM), from airborne surveys conducted between 1976 and 1988. The surveys were flown by the Geological Survey of Canada (GSC) and contracted aircraft, using federal and joint federal-provincial government funding. Most data were originally published as 1:50 000 line contour or colour interval maps and stacked profiles, as GSC Open Files or Geophysical Series Maps.

The regional surveys (Figure 1) were flown at 1000 metre line spacing were collected using 50 litres of sodium iodide detectors, at a nominal terrain clearance of 120 metres. Figure 1 is compiled from data collected along flight lines spaced at 5000 metre intervals. The provincial map is compiled from data collected along flight lines spaced at 1000 metres. However, the additional detailed airborne surveys were flown with flight lines spaced between 200 and 300 metres. These detailed surveys are shown as coloured rectangles on the regional maps and include: A) Bathurst, B) Restigouche, C) Kedgewick, D) Holmes Lake, E) Mount Pleasant and F) Chaleur Bay. Figures 2 and 3 are compiled from detailed surveys flown at 200 metre line spacing of radioactive element signatures, supporting more detailed interpretation. Figure 2 is compiled from the three northern New Brunswick detailed surveys, Bathurst, Restigouche and Kedgewick. Figure 3 is compiled from the Mount Pleasant detailed survey. Figures 2 and 3 display data using equal-interval colour intervals. Figures 2 and 3 display data using independent colour intervals to support more detailed interpretation.

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 commonly referred to as equivalent uranium and equivalent thorium.

Standard energy windows were used to record the gamma ray counts. These are 1370-1470 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 overlap from ^{40}K and ^{208}Tl; and air and detector/arc deviations of altitude from the planned terrain clearance; temperature and pressure variations.

These maps depict radioactivity emanating within the upper 30 cm of the earth's surface, 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.

Airborne gamma ray spectrometry provides valuable geochemical information provided by variations in potassium, uranium and thorium concentrations presented in a contour grid format supports mapping of bedrock and surficial geology and mineral exploration, at regional and local scales (Shives et al., 1995). More detailed interpretation is encouraged through the use of the original line data, available from the Geological Survey of Canada.

The radioactive element patterns depicted in this compilation correlate with known geological features in several areas. Uranium and thorium are commonly concentrated in felsic rocks, such as granites, felsic volcanic rocks, gneisses, evaporites, or their influence on derived sedimentary rocks or unconsolidated Quaternary sediments. In southern New Brunswick, various granitic phases within the St. George batholith (McLeod, 1990) can be discriminated, in terms of their uranium and thorium signatures, and mapped in detail. The Late Devonian Mount Pleasant caldera (McCutcheon, 1993) produces well defined patterns which are reflected in the overlying, locally derived till cover, but are masked completely by a prominent south-trending dispersion of exotic glacial material (Fronk and Seaman, 2002) derived from Carboniferous sedimentary rocks north of the caldera. Polymetallic Sn-W mineralization within the caldera, and a number of small uranium occurrences are associated with discrete eU anomalies. Similar Sn-W and U mineralization is associated with the Late Devonian Pluton Suite (Thomas et al., 2000). These areas of felsic eU concentrations produce high eU/eTh ratio anomalies, which are rare elsewhere throughout the Province.

Within bimodal Siluro-Devonian volcanosedimentary sequences in the Jacquet River area in the northern part of the Province, felsic lithologies produce elevated eTh patterns, providing useful mapping guides. Within this belt, the effect of epithermal alteration associated with base and precious metals is expressed as a prominent low-eTh/K ratio anomaly (Broome et al., 1987; Broome and Whalen, 1997; Shives et al., 1997).

The greatly increased spatial resolution provided by the three multi-sensor surveys in the Bathurst-Restigouche-Kedgewick areas (Figure 2) supports radiometric definition of many of the mafic and felsic lithologies within these areas. The patterns provide regional and local geological context for the base metal mineralization within the Bathurst camp, and for the gold mineralization in the Restigouche area (Bradley et al., 2000) and other anomalies (Thorne et al., 2002).

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

REFERENCES

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

McCutcheon, S.R.
1990: The Late Devonian Mount Pleasant caldera complex: stratigraphy, mineralogy, geochemistry and geologic setting of Sn-W deposit in southwestern New Brunswick; Unpublished Ph.D. thesis, 609 p., Dalhousie University, Halifax, Nova Scotia.

McLeod, M.J.
1990: Geology, geochemistry and related mineral deposits of the Saint George Batholith, Charlotte, Queens and Saint John counties, New Brunswick; New Brunswick Department of Natural Resources and Energy, Mineral Resources, Mineral Resource Report 5, 169 p.

Fronk, A.G. and Seaman, A.A.
2002: Glacial geology traverse from Fredericton to the Fundy Coast. R.K. Pickerill and D.R. Lentz, eds, Guidebook to Field trips in New Brunswick and western Maine: NEIGC (New England Intercollegiate Geological Conference), p. B3-1 to B3-21.

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

Shives, R.B.K., Charbonneau, B.W., and Ford, K.L.
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, 1068 p.

Thomas, M.D., Walker, J.A., Keating, P., Shives, R., Klas, F., and Goodfellow, W.D.
2000: Geophysical atlas of massive sulphide signatures, Bathurst mining camp, New Brunswick; Geological Survey of Canada, Open File 3887, 105 pages.

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 standard

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

Digital base map from data compiled by Geomatics Canada, modified by ESS Info

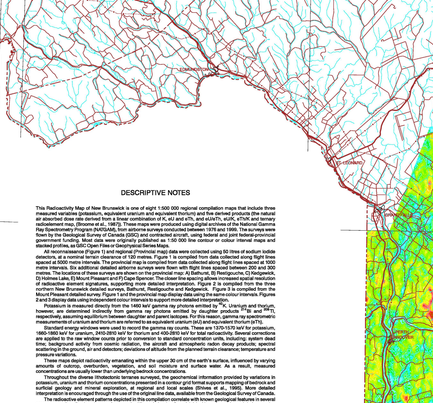
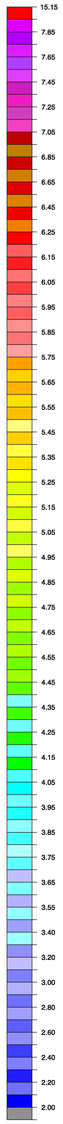


Figure 1. eTh/K ratio map compiled from reconnaissance, 5000 metre line spaced, airborne gamma ray spectrometry data.



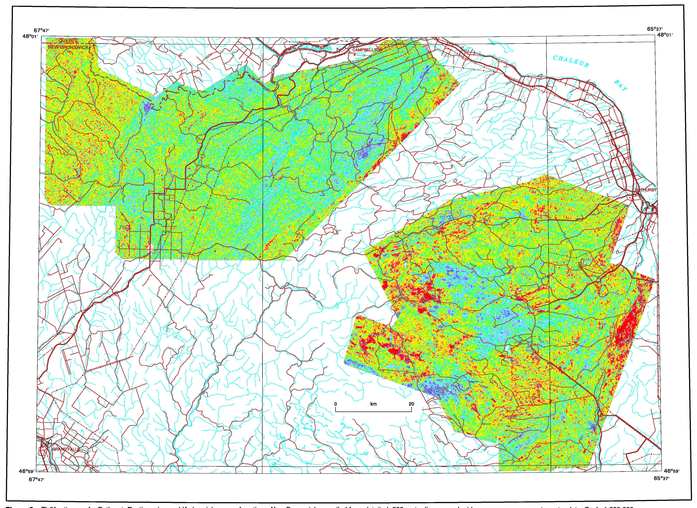


Figure 2. eTh/K ratio map for Bathurst, Restigouche, and Kedgewick areas of northern New Brunswick compiled from detailed, 200 metre line spaced, airborne gamma ray spectrometry data. Scale 1:500 000.

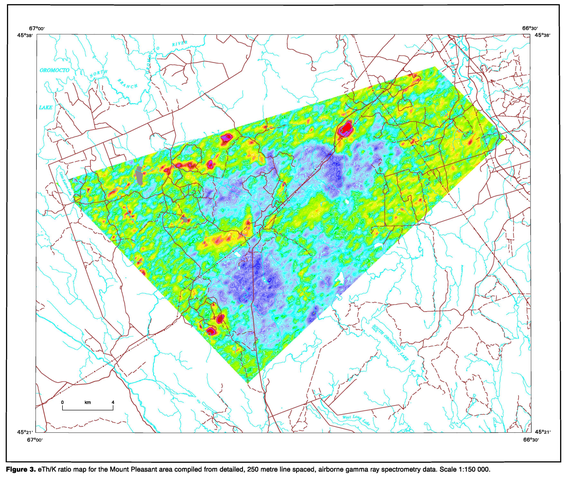
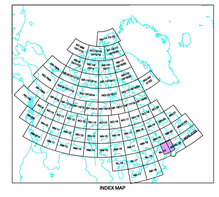


Figure 3. eTh/K ratio map for the Mount Pleasant area compiled from detailed, 250 metre line spaced, airborne gamma ray spectrometry data. Scale 1:150 000.



eTh/K ratio
OPEN FILE 4500
AIRBORNE GAMMA RAY SPECTROMETRY COMPILATION

NEW BRUNSWICK

NEW BRUNSWICK

Scale 1:500 000/Échelle 1/500 000

kilometres 10 0 10 20 30 40 kilometres

Universal Transverse Mercator Projection
North American Datum 1927
© Her Majesty the Queen in Right of Canada 2004

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1927
© Sa Majesté la Reine du chef du Canada 2004

OPEN FILE
DOSSIER PUBLIC
4500
GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
2004

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.

Recommended citation:
Carson, J.M., Holman, P.B., Ford, K.L., Grant, J.A., and Shives, R.B.K.
2004: Airborne Gamma Ray Spectrometry Compilation, eTh/K ratio New Brunswick, New Brunswick; Geological Survey of Canada, Open File 4500, scale 1:500 000.

Canada