

LEGEND

HADRYNAN

Hb Gabbro sheet, sills

ALPHEAN

Alp Felsite porphyry

Ag Granite-diorite, diorite, quartz diorite

An Migmatite, granitic gneiss

CAMERON BAY GROUP

cAv Intermediate porphyritic flow, tuff, agglomerate

cAd Red arkose, conglomerate, shale

Ab Gabbro, diorite

SNARE GROUP

sAb Basalt, tuff, minor chert

sAa Quartzite, dolomite, siltstone, shale

EPWORTH GROUP

eAw RECLUSE FORMATION: argillite, shale, greywacke

eAc ROONEST FORMATION: dolomite

eAm OGDICK FORMATION: sandstone, shale, argillite, sandstone

eAo Metamorphosed Epworth Group

Ag Quartz diorite, quartz monzonite, granodiorite, granite, in part porphyritic

An Granite gneiss, migmatite, mixed gneiss involving Yellowknife rocks

cAg Complex of plutonic granitic rocks that may be, in part, older than Yellowknife Supergroup

YELLOWKNIFE SUPERGROUP

yAw Greywacke, shale

yAsd Cordierite-andalusite bearing knotted schist and other metamorphic equivalents of yAw

yAb Intermediate to basic lava, tuff, agglomerate, and un differentiated acidic volcanic rocks

Boundary between Bear and Slave geological provinces

Fault, observed or assumed

Mineral prospect showing principal element(s)

Lake sample site and metal concentration (sediment sieved to minus 250 mesh)

Lake sample site and metal concentration (sediment sieved to minus 100 mesh)

Geochemical concentration contours as ppm

MINERALS

Asbestos sb Molybdenum Mo

Bismuth Bi Nickel Ni

Cobalt Co Silver Ag

Copper Cu Thorium Th

Gold Au Uranium U

Lead Pb Zinc Zn

Geology after unpublished map compiled by J. C. McIlroy, 1971

Field work by R. J. Allan, E. M. Cameron, C. C. Darham, R. Bueson, R. Colley, B. Cumming, G. Lind, D. Mann, C. Priddy, G. Thomas and B. Woronuk

Analyses by J. J. Lynch and J. C. Pedahl

Marginal notes by R. J. Allan and E. M. Cameron

Geochemical contours and metal concentration numbers drawn by computer drum plotter

Geological cartography by the Geological Survey of Canada

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

Bear-map assembled by the Geological Survey of Canada from maps published at the same scale by the Army Survey Establishment R. C. K. in 1961, 1962

Copies of the topographical maps covering this map-area may be obtained from the Canada Map Office, 613 Booth Street, Ottawa, Ontario K1A 0S9

Mean magnetic declination 1973, 38° 31' East, decreasing 8.7" annually. Readings vary from 34° 52' in the SE corner to 38° 42' in the NW corner of the map area

Elevations in feet show mean sea-level

Lake Sediment Geochemistry The use of lake sediments as an aid to mineral exploration and geological mapping within the Canadian Shield is based on two principal concepts of their origin. The first is that the detrital portion of a fine-grained lake sediment is a good composite sample of the rocks in the vicinity of the lake. In perhaps a majority of cases, the material forming the sediment has passed through an intermediate stage as a component of locally derived tills or other glacial sediments before being transported to the lake. The second concept is that the fine-grained particles of the sediment are an excellent medium for the sorption of metal ions released during the weathering of nearby sulphide ore deposits or similar mineralization. Most of the known sulphide deposits in the Bear-Slave survey area show moderate to high degrees of oxidation.

At the wide, reconnaissance, sampling interval used, it is unlikely that many samples will be taken from lakes within the limits of the secondary dispersion halo of a single ore deposit. However, country containing such deposits may be defined by the trace element dispersion from the much more extensive non-economic mineralization that is often associated with economic deposits. Similar trace metal patterns may also be derived from mineralization that is not associated with ore deposits or from rock units of unusual chemical composition.

Lake Sediment Sampling The lake sediment samples were collected by post-hole auger from a helicopter. They were taken near the edge of the lake in water 3 to 5 feet deep. They comprise approximately the top 8 inches of sediment, less the surface layer. Of the variety of sediment types that may occur in lakes, the type of sample sought was of clay to silt grade and low in organic material.

Environmental Effects Certain heavy metals, such as uranium, zinc, and copper, may be enriched in sediments containing organic matter or iron and manganese oxides. The content of Fe and Mn has been determined for all samples, together with an index of the organic content (optical density). These data will be released separately in the form of a composite map. These data may be consulted when assessing anomalous areas on this map. It should be recognized, however, that metal enrichment on these materials is a highly variable phenomenon that depends on a variety of factors, principally the availability of metals in the environment. Also the Fe and Mn content of the sediment is a direct measure of the amount of free oxides present. For these reasons the maps for the heavy metals are not presented on a statistically "corrected" basis. Further, since manganese and iron may be associated with these metals in the original rocks and primary mineralization, "correcting" the data may remove evidence of mineralization from the resulting map. If it is suspected that free oxides or organic material have created a false anomaly, then for those who do not have access to the original samples, the most satisfactory method of checking is to resample the area of the anomaly.

Sample Preparation and Analysis Sediments were dried, then sieved to minus 250 mesh to give a powder suitable for analysis. A few coarse samples were sieved to minus 100 mesh, then ball-milled before analysis.

For the uranium determination, 40mg of the sample was digested on a water bath at 80°C for 1.5 hours with 5 ml. of 8N HCl, plus two drops concentrated HCl. The sample was diluted to 50 ml with metal-free water, well shaken, and allowed to settle. A 0.5 ml aliquot of this solution was placed on a platinum dish and evaporated to dryness. The residue was burned for one minute above a Bunsen flame. This was added 3pm of a K₂CO₃-Na₂CO₃-NaF flux in the proportions 5:5:1. The material was fused for 15 minutes at 600°C, then molded into the form of a disc, cooled in a desiccator, and the uranium content measured by fluorimetry. The detection limit of the method is 0.2 ppm U. Samples measuring less than this are recorded as 0.1 ppm U.

Uranium in the Rocks and Crust of the Survey Area There is a marked difference in uranium content between the Proterozoic rocks of the Bear Province and the Archean rocks of the Slave Province. This has been demonstrated by the work of Falarc and Fabrik (1971) who analyzed composite rock samples from the Harefoot Lake map sheet of the Bear Province and the Fort Enterprise sheet of the Slave Province. The northern half of both these sheets are contained within the survey area. We have reanalyzed their composite samples, including those for which the authors do not report uranium values. The analytical method is similar to that given above, but there is an initial total decomposition of the rocks with hydrofluoric, perchloric and nitric acids. These new data are as follows:

Harefoot Lake (NTS 86C, W1)

Quartz-feldspar porphyry (187 square miles) 7.3 ppm U

Dabase dykes (-) 2.0 ppm U

Undifferentiated gneisses and schists (2 square miles) 2.0 ppm U

Deep level granite to granodiorite (111 square miles) 2.2 ppm U

High level granite, quartz monzonite, monzonite (244 square miles) 4.0 ppm U

Weighted average 4.0 ppm U

Fort Enterprise (NTS 86A)

Volcanic and metavolcanic (104 square miles) 0.7 ppm U

Paragneiss, paragneiss (209 square miles) 1.0 ppm U

Granitic gneiss, migmatite (129 square miles) 1.4 ppm U

High level granite, quartz monzonite, monzonite (176 square miles) 1.7 ppm U

Weighted average 1.5 ppm U

Uranium mineralization is a prominent feature of parts of the Bear Province. Epigenetic uranium mineralization appears to be controlled on both a regional and a local scale by major faults of northeast and northwest trend (Ruzicka, 1971). At the Eldorado Mine at Port Radium pitchblende occurs along a prominent northwesterly fault zone. A variety of minerals have been deposited along with the pitchblende including pyrite, quartz, hematite, nickel and cobalt arsenides, pyrite, barite, siderite, sphalerite, tetrahedrite, bismite, chalcocyanite, pyrite, galena, chalcocyanite, native silver, argentine and silver arsenides. The 1400 m. y. age of the mineralization (Ruzicka, 1971) is younger than the granitic intrusives of the region (1700-1900 m. y.) and is approximately the same age as diabase dykes. Uranium also occurs with extensive stockworks of veins within the Bear Province, of which the Hayrock Mine is an example. These contain a much simpler mineral assemblage. Only hematite, pyrite, and chalcocyanite accompany the pitchblende in the Hayrock deposit. There is no known important uranium mineralization within the Slave Province.

It is apparent from the above that the rocks of the Bear Province will contribute a higher uranium background to the lake sediments of this area than those of the Slave Province. Ore-related anomalies may be superimposed on these higher background levels. Because of the generally complex nature of the uranium-bearing ores, these ores should give multielement anomalies. It appears that Cu may be the metal that most consistently accompanies U, but there may also be anomalies for such elements as Pb, Zn, Ag, Ni, Co, Au, and Y.

Uranium in the Surficial Environment Uranium is readily oxidized to the highly soluble uranyl ion (UO₂²⁺). This, in turn, may form soluble complexes with carbonate ions that are stable at the near neutral pH values characteristic of ground and lake waters of the Canadian Shield. In this form the uranium may migrate considerable distances from its source. In lakes there are a number of processes that may cause the uranium to precipitate in the sediments, namely: in the bottom muds to the insoluble UO₂ reaction with phosphates, arsenates and other anions; sorption onto clay minerals; sorption or coprecipitation with iron and manganese oxide grains; fixation by organic material.

Uranium in Lake Sediments, This Sheet Lake sediments from the Bear Province show a considerable enrichment in uranium compared to the crustal abundances for this element. In the northern half of this map-area, high uranium values are largely confined to the high level granite and volcanic terrane west of the Wopmay Fault. In the southern half of the area high uranium values occur in the country on either side of the fault and even extend into the Slave Province.

The lake sediment data appear to reflect well regional variation in the uranium content of the underlying crust. Thus 197 samples from the north half of the Harefoot Lake sheet average 7.3 ppm U compared with 4.0 ppm U for rocks from the entire sheet. In comparison 250 lake sediments from the north part of the Fort Enterprise sheet contain 2.6 ppm U compared to 1.5 ppm for the composite of 86C and Fabrik (1971).

The uranium anomalies on this sheet appear to have a regular spatial arrangement. Many of them may be placed along two sets of lineaments: one trending northwesterly, the other to the northeast. Some of the more prominent anomalies may lie near to the intersection of lineaments. The lineaments show as chains of lakes, or as rivers, valleys and other linear topographic features. The spatial distribution of uranium is consistent with its occurring within epigenetic veins. If such veins lie along lineaments they will tend to occur under lakes and swamps from which groundwater flow will carry the soluble uranium into lake waters. On the basis of incomplete data for other elements there are four uranium anomalies that are associated with greater than average amounts of other elements including: Cu, Zn, La, Ce, Y, Co, Ni and Pb. These lie respectively north, east, south and west of Harefoot Lake, forming a cluster with an approximate diameter of 24 miles. In view of the multielement character of known uranium ores in the Bear Province the region merits detailed investigation. Some of the anomalies on this sheet may simply be caused by bedrock with a greater than average content of uranium. Thus during any follow-up work the country rock, particularly the granites, should be sampled and analyzed.

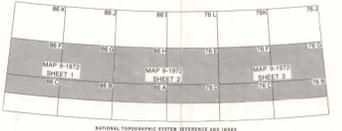
* Geological Survey Paper 73-56, contains a detailed description of the experimental basis for lake sediment sampling in the Shield; the geology and metallogeny of the region; the organization, methods, and costs of the sampling operation; the methods of sample analysis and the references for the articles quoted above.

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Copies of this map may be obtained from the Geological Survey of Canada, Ottawa



MAP 9-1972
SHEET 1
URANIUM CONTENT OF LAKE SEDIMENTS
BEAR-SLAVE OPERATION
DISTRICT OF MACKENZIE
Scale 1:250,000

Miles 0 4 8 12 16
Kilometers 0 4 8 12 16



N.W.T. - DISTRICT OF MACKENZIE
BEAR-SLAVE OPERATION
1:250,000 MAP NO. 9-1972
SHEET 1
1973