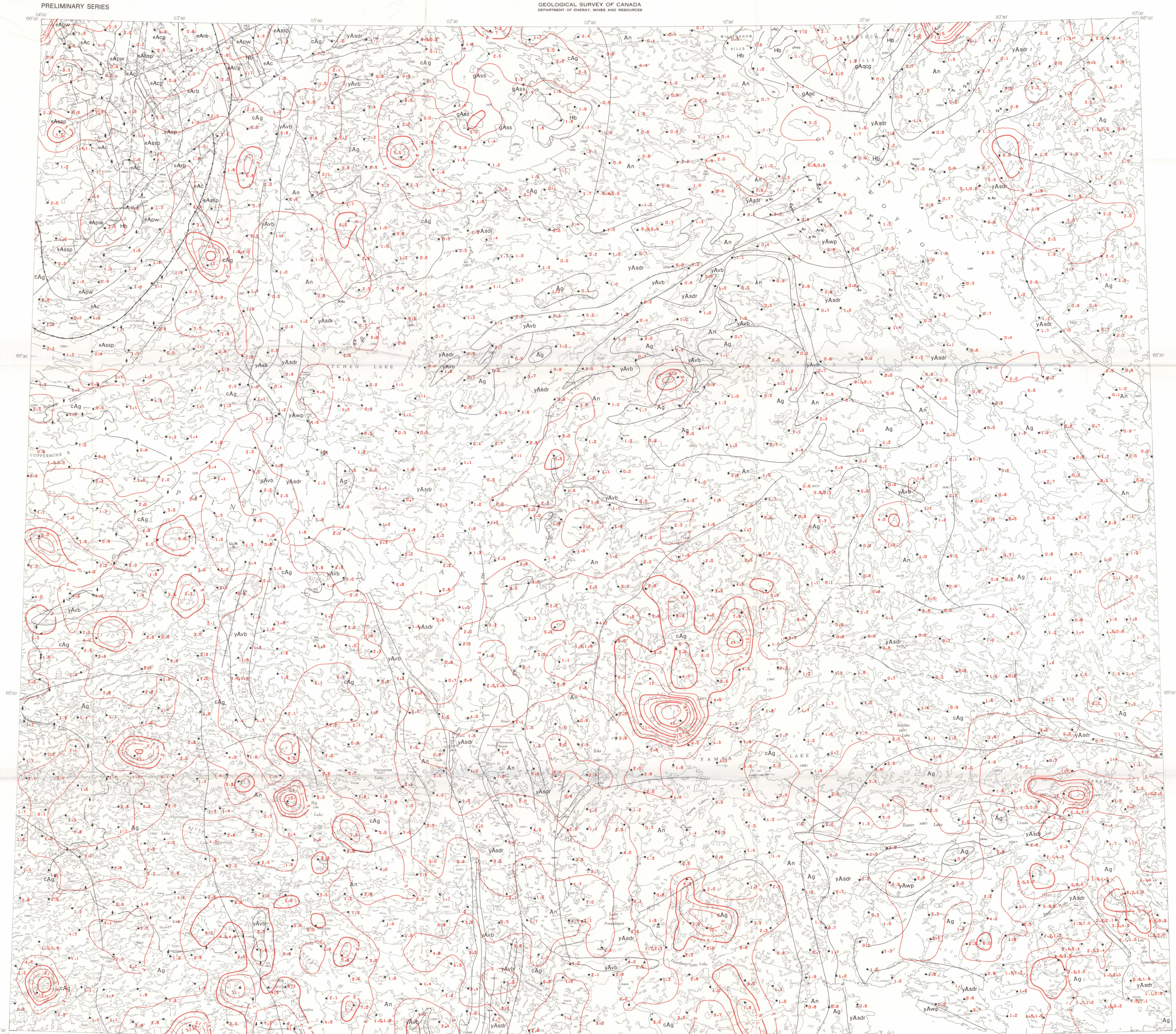
PRELIMINARY SERIES

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES



LEGEND

PROTEROZOIC

HADRYNIAN

Hb	Gabbro sheets, sills

APHEBIAN

GOULBURN GROUP

gAss	BROWN SOUND FORMATION: red siltstone, shale, sandstone
gApc	PEACOCK HILLS FORMATION: shale, dolomite, sandstone
gAqcg	BURNSIDE RIVER FORMATION: quartzite, conglomerate

EPWORTH GROUP

eArb	TAKIYUAK FORMATION: red sandstone, shale
eAcp	COWLES LAKE FORMATION: limestone, shale
eApw	RECLUSE FORMATION: argillite, shale, greywacke
eAc	ROCKNEST FORMATION: dolomite
eAssp	ODJICK FORMATION: sandstone, shale, argillite, andesite

ARCHEAN

Ag	Quartz diorite, quartz monzonite, granodiorite, granite. In part porphyritic
An	Granitic gneiss, migmatite, mixed gneisses involving Yellowknife rocks
cAg	Complex of plutonic granitic rocks that may be, in part, older than Yellowknife Supergroup

YELLOWKNIFE SUPERGROUP

yAwp	Greywacke, shale
yAsdr	Cordierite-andalusite bearing knotted schist and other metamorphic equivalents of yAwp
yAvb	Intermediate to basic lava, tuff, agglomerate, and undifferentiated acidic volcanic rocks

Boundary between Bear and Slave geological provinces ......

Fault, observed or assumed ......

Approximate position of treeline ......

Syncline ......

Mineral prospect showing principal element(s) ...... Au ×

Lake sample site and metal concentration (sediment sieved to minus 250 mesh) 2.5

Lake sample site and metal concentration (sediment sieved to minus 100 mesh) 20

Geochemical concentration contours as ppm 5

MINERALS

Copper	Cu	Iron	Fe
Gold	Au	Nickel	Ni

Geology after unpublished map compiled by J. C. McGlynn, 1971

Field work by R. J. Allan, E. M. Cameron, C. C. Durham, R. Benson, R. Colley, B. Cumming, G. Lund, D. Mann, C. Pride, G. Thomas and B. Woronuk

Analyses by J. J. Lynch and J. C. Pelchat

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

Base-map assembled by the Geological Survey of Canada from maps published at the same scale by the Army Survey Establishment R. C. E. in 1962, 1964

Copies of the topographical maps covering this map-area may be obtained from the Canada Map Office, 615 Booth Street, Ottawa, Ontario K1A 0E9

Mean magnetic declination 1972, 34°20' East, decreasing 8.2' annually. Readings vary from 31°54' in the SE corner to 37°11' in the NW corner of the map-area

Elevations in feet above mean sea-level

MARGINAL NOTES*

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 8 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 sediment samples 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 examined when assessing anomalous areas on this map. It should be recognised, 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 a sediment is not 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 or 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, 400mg of the sample was digested on a water bath at 90° C for 1.5 hours with 6 ml. of 4N HNO_3 plus two drops concentrated HCl The sample was diluted to 20 ml with metal-free water, well shaken, and allowed to settle. A 0.2 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. To this was added 3gm of a K_2CO_3-Na_2CO_3-NaF flux in the proportions 5:5:1. The sample was fused for 10 minutes at 650° C, then molded into the form of a disc, cooled in a dessicator, and the uranium content measured by fluorimeter. 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 Ores 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 Eade and Fahrig (1971) who analyzed composite rock samples from the Hardisty 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:

Hardisty Lake (NTS 86C, W½)

Quartz-feldspar porphyry (157 square miles) .... 7.2 ppm U

Diabase dykes (-) .... 2.0 ppm U

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

Deep level granite to granodiorite (1111 square miles) ...... 5.2 ppm U

High level granite, quartz monzonite, monzonite (344 square miles) .... 8.0 ppm U

Weighted average .... 6.0 ppm U

Fort Enterprise (NTS 86A)

Volcanics and metavolcanics (104 square miles) .... 0.7 ppm U

Paragneiss, paraschist (209 square miles) .... 1.0 ppm U

Granitic gneiss, migmatite (1926 square miles) .... 1.4 ppm U

High level granite, quartz monzonite, monzonite (1750 square miles) .... 1.7 ppm U

Weighted average .... 1.5 ppm U

Uranium mineralization is a prominent feature of parts of the Bear Province. Epigenic uranium mineralization appears to be controlled on both a regional and a local scale by major faults of northeast and southeast strike (Ruzicka, 1971). At the Eldorado Mine at Port Radium pitchblende occurs along a prominent northeasterly fault zone. A variety of minerals have been deposited along with the pitchblende including apatite, quartz, hematite, nickel and cobalt arsenides, pyrite, barite, siderite, sphalerite, tetrahedrite, bornite, chalcopyrite, galena, rhodochrosite, native silver, argentite 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 within extensive stockwork zones within the Bear Province, of which the Rayrock Mine is an example. These contain a much simpler mineral assemblage. Only hematite, pyrite, and chalcopyrite accompany the pitchblende in the Rayrock 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, As, La and Y.

Uranium in the Surficial Environment Uranium is readily oxidized to the highly soluble uranyl ion (UO_2^{++}). This, in turn, may form soluble complexes with carbonic 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: reduction in the bottom muds to the insoluble UO_2; reaction with phosphates, arsenates and other anions; sorption onto clay minerals; sorption or coprecipitation with iron and manganese oxide gels; fixation by organic material.

Uranium in Lake Sediments, This Sheet Lake sediments from Sheet 2 show distinctly lower levels of uranium and much lower geochemical "relief" than those of Sheet 1:

	Sheet 1	Sheet 2	Sheet 3
Number of Samples	1241	1293	1349
Arithmetic Mean	5.3	1.9	1.3
Geometric Mean	2.7	1.4	0.7
Standard Deviation	12.8	2.1	3.3

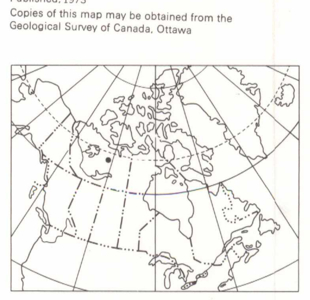
There is a marked westward increase in uranium across the survey area. While this is, in part, due to high uranium associated with Proterozoic rocks of the Bear Province, the area underlain by the Archean of the Slave Province also shows an increase to the west.

The largest and most prominent uranium anomaly within Sheet 2 is near Yamba Lake. It contains samples with up to 45 ppm U. On the basis of preliminary results for other elements, this area is also enriched in Li, Zn and Pb. The rocks here have been mapped as biotite-quartz monzonite and granodiorite (Bostock, 1967). Another anomaly that is smaller and weaker occurs near Little Marten Lake, again in granitic rocks. It is not associated with notably anomalous contents of any of the other elements that have been measured to date.

Most of the other areas enclosed by the 5 ppm U contour are small, being centred around a single anomalous sample. These anomalies very largely occur in areas that are underlain by granitic rocks. In most cases the uranium anomaly is not associated with high contents of other elements. Two exceptions to this generality are a sample located 5 miles W.S.W. of Paul Lake and another on the eastern flank of the Peacock Hills. In both cases the samples contain relatively high amounts of Li, Zn, Cu, Co and Ni.

* Geological Survey Paper 72-50, 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.

Published, 1973
Copies of this map may be obtained from the Geological Survey of Canada, Ottawa



INDEX MAP

MAP 9-1972

SHEET 2

URANIUM CONTENT OF LAKE SEDIMENTS
BEAR-SLAVE OPERATION

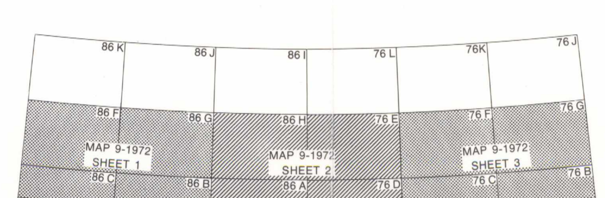
DISTRICT OF MACKENZIE

Scale 1:250,000

Miles 4 0 4 8 12 Miles

Kilometres 6 0 6 12 18 Kilometres

Printed by the Surveys and Mapping Branch



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

MAP 9-1972
SHEET 2
URANIUM
BEAR-SLAVE OPERATION
DISTRICT OF MACKENZIE

N.W.T. - DISTRICT OF MACKENZIE
BEAR SLAVE OPERATION
1:250,000 MAP NO. 9-1972
SHEET 2
1973.