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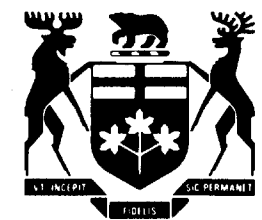
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Ontario
Division of Mines

HONOURABLE LEO BERNIER, Minister of Natural Resources
Dr. J. K. REYNOLDS, Deputy Minister of Natural Resources
G. A. Jewett, Executive Director, Division of Mines E. G. Pyle, Director, Geological Branch

PRELIMINARY MAP P. 969
MINERAL DEPOSITS SERIES

URANIUM AND THORIUM DEPOSITS OF ONTARIO

NORTHWESTERN SHEET

DISTRICT OF KENORA (Patricia Portion)

Scale 1:1,013,760 or 1 Inch to 16 Miles

NTS References: 43 C,D,E,F,K,L,M,N; 53; 54 A,B
ODM Compilation Map: 2201

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Introduction: This map comprises 4 sheets* showing the distribution and classification of Ontario's uranium and thorium deposits. The geological base is the 1 inch to 16 mile (1:1,013,760) Geological Map of Ontario. No radioactive deposits have been reported from the Northwest sheet. Inset maps of the two major camps - Blind River-Elliott Lake and Bancroft at a scale of 1 inch to 4 miles (1:253,440) have been provided.

The classification used (see below and legend) is based on that of Robinson (1958) and is similar to that used in Canadian and International Publications e.g. Lang 1958; Lang et al. 1962; Little 1974; OECD 1973. A more detailed genetic classification of uranium deposits on a world wide basis has been given by Barnes and Haxel (1972) and Canadian deposits have been further discussed by Robertson, D.S., and Lattanzii (1974).

Classification of Deposits: Ontario's radioactive element deposits fall into two broad groupings - those associated with igneous rocks and those which form an integral part of sedimentary rocks. The former may be designated **magmatic deposits** in granites, syenites, or carbonates, the **pegmatite** segregations or apophyses of such bodies, the **metasomatic** bodies in pyroxenites, skarns or fenites, at the margins of these bodies or veins representing the end stage fluids from the parent magmas. Several types may occur together as in the Bancroft Camp (Satterly 1956, Hewitt 1967) related to the same source rock or as at Themo Point-Montreal River area related to different rocks - the Algonian basement pegmatites, and Keweenaw diabase dikes (Wuffield 1955, Robertson 1968a). In recent years many European geologists have proposed that many pitchblende occurrences, formerly assumed to be hydrothermal are actually supergene deposits formed in suitable traps short distances below unconformities representing land surface at the time of enrichment (Gretch 1974).

In many areas assessment or other public data may not be sufficient to permit diagnostic classification of a deposit. In particular, the distinction between igneous and metasomatic pegmatite cannot be made from data available. The only commercial radioactive ore deposits associated with igneous rocks in Ontario are related to the syenitic granites in the Bancroft area. Pegmatite (gray and white) such as in the Setting Net Lake Area (Ayres 1969), have also been investigated. The pitchblende occurrences at Montreal River (Wuffield 1955) are of historic interest because they include the first recorded uranium mineral in Canada and provided one of the major steps to the discovery of Blind River (Lang et al. 1962; Robertson, James A. 1968b).

The most important sedimentary radioactive element deposits in Ontario are the Blind River-Elliott Lake-Agnew Lake deposits (Robertson, James A. 1968a,b, 1969; 1970; Roscoe 1969) which comprise 17 percent of the free world's uranium reserves. These are lower Huronian pyritic oligomictic conglomerates carrying in the matrix the minerals uraninite, brannerite, and monazite from which uranium, thorium, and yttrium can be recovered. At Agnew Lake the mineralogy is uranothorite and monazite and thorium and yttrium are relatively more important than at Blind River-Elliott Lake. The location of individual deposits is controlled by suitable Precambrian (Archean) source areas, ancient drainage channels and shorelines and the location of permo-carboniferous mafic volcanic piles (Robertson, James A. 1969; 1971). All commercial grade (i.e. deposits with proven reserves in excess of one million tons and a minimum recoverable grade of 1 lb. U₃₀₈ per ton at least 75 feet (2.3 m) size in the Metroland Formation of the Elliott Lake Group and are within a few hundred feet stratigraphically of the Early Precambrian (Proterozoic-Archean) unconformity.

Scattered mineralization is found in the shoreward facies of the Mississagi Formation of the Hough Lake Group but grade and continuity are low and thorium content approximates uranium content. In the upper Huronian, red beds are commonly poor in uranium and monazite, carry thorium but almost no uranium (Robertson, James A. 1969; 1971). This attests to a change in chemical, and possibly atmospheric, environment during Huronian time. In the area northeast of the Sudbury basin, Lower Huronian rocks also present a general precise correlation with those of the Blind River-Elliott Lake-Agnew Lake area is not possible (Meyn 1973). Some of the younger, younger deposits of Blind River type are known although there is also uranium mineralization in impure ferruginous sandstone and argillites (Thomson 1960; Robertson, James A. 1968a; Meyn 1973, p.141-142). The role of carbonaceous material in Ontario deposits is minor. Thiochlorite occurs locally in the Blind River deposits and there is trace uranium mineralization in the lignite of the James Bay Lowlands and with anthracite veins near Thunder Bay. The anthracite veins near Thunder Bay may have been derived by lateral spillage from the sedimentary rocks containing them, but are shown on this map as hydrothermal. In 1972, an airborne X-ray spectrometer survey led to the discovery of radioactive hydrocarbon, the uranium probably deposited from groundwater in Paleozoic dolomites in March Township near Ottawa (Jonasson and Dyck 1974).

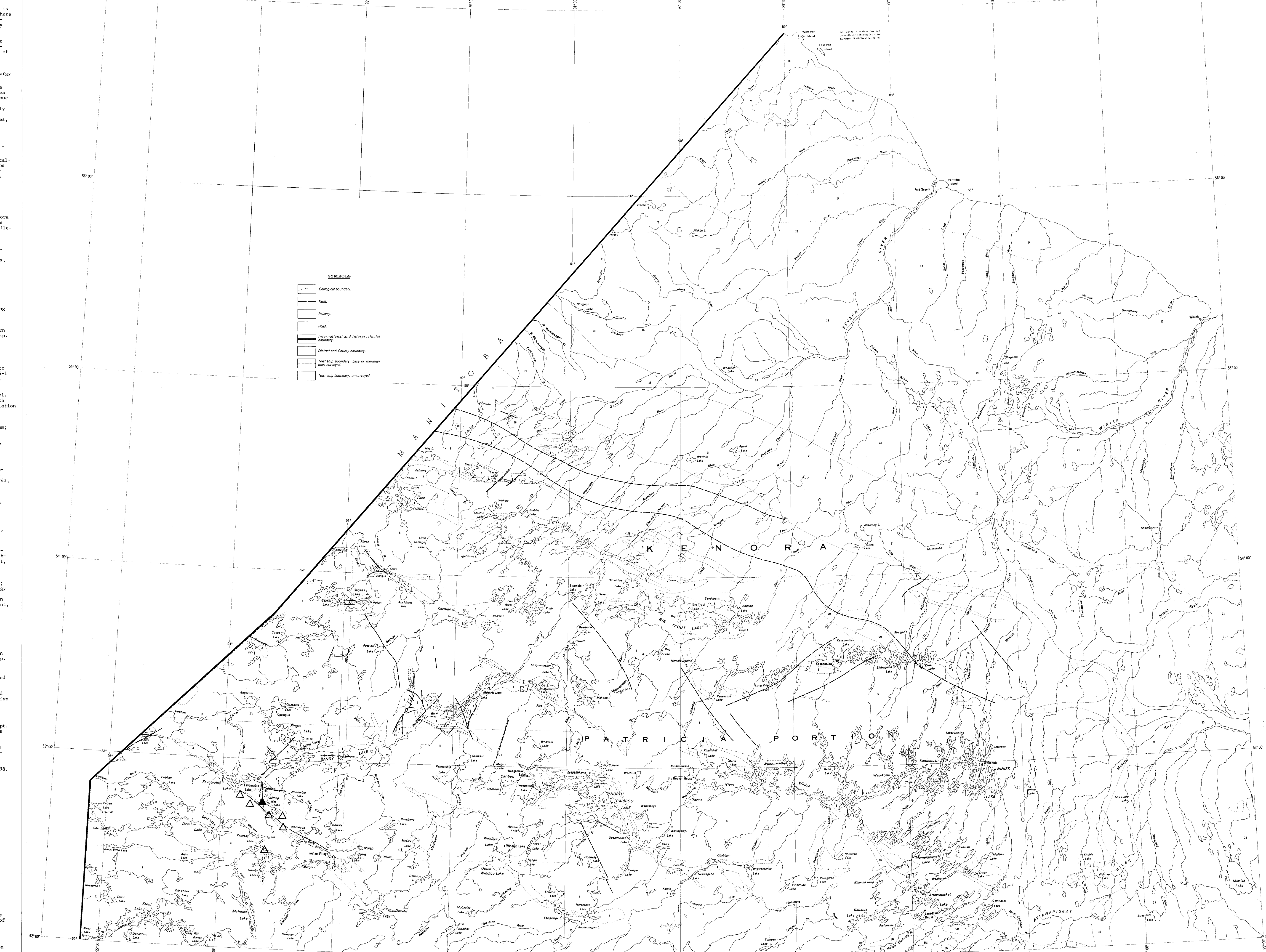
Production: Between 1955 and 1973 the Blind River-Elliott Lake camp has produced (from 12 mines) approximately 1.5 billion dollars worth of uranium and minor amounts of thorium and yttrium from material grading 2 lbs. U₃₀₈ per ton. The maximum production was in 1959, when 12,150 tons U₃₀₈ were produced. In 1973, two mines were operating. Denison Mine produced 1,712 tons U₃₀₈ from ore grading 2.57 lbs. U₃₀₈ per ton and New Quatre Mine produced 2,409 tons U₃₀₈ from ore grading 3.4 lbs. U₃₀₈ per ton (1973 Annual Reports for Denison Mines Limited and Rio Algon Mines Limited), in the Bancroft camp, between 1956 and 1964, four mines produced approximately \$105,000,000 worth of U₃₀₈ (Hewitt 1967, p.1). In material grading more than 2 lbs. U₃₀₈ per ton. Some 90 percent of the production came from the Faraday and Bancroft Mines. The Faraday Mine is on a standby basis. The Agnew Lake Mine, north of Espanola has a developed ore body but decision to start production and build a mill would require a suitable sales contract.

Ontario's current production is more than 4,000 tons U₃₀₈ per year but the known deposits can support production in excess of 14,000 tons U₃₀₈ per year which can be obtained by expanding operating plants; reopening closed plants and some construction of new plants.

Reserves: It is estimated from data available to the public (January 1973), that Ontario deposits, predominantly sedimentary deposits of Blind River-Elliott Lake-Agnew Lake area, contain, approximately 200,000 tons of recoverable U₃₀₈ with a millhead grade of 1.8 lbs. U₃₀₈ per ton and a further 150,000 tons from Blind River-Elliott Lake area with a millhead grade of 1 lb. U₃₀₈ per ton and a cut-off of 1 lb. U₃₀₈ per ton over mining widths. The higher grade uranium reserves also contain at least 100,000 tons of recoverable ThO₂. The higher grade material constitutes some 75 percent of Canada's uranium reserves and 17 percent of the world's reserves recoverable at less than \$10.00 U.S. (1973) per lb. U₃₀₈ (cf. Little 1974; Williams and Little 1974; OECD 1973). It is estimated additional ore (possible ore) and prognosticated ore in the localities of the Blind River-Elliott Lake-Agnew Lake and Bancroft areas may be as much again but extensive and costly exploration must be undertaken before existence of this material can be confirmed and considered part of the reserves. To allow for discovery, development, production and processing, such exploration must be in hand at least 8 years and preferably 10 years before the anticipated start in a reactor. Proven reserves can meet current commitments and projected domestic requirements but new reserves must be found to support the forecasted increase in export demands (particularly if (a) the United States does not maintain their discovery rate, (b) breakeven prices become available by 1985 and (c) if export selling of Canada's reactors includes the selling of fuel).

In September 1974, the Federal Government laid down guidelines on uranium export policy "to provide an orderly growth of the industry while protecting the modest domestic nuclear program" (see Northern Miner 12 Sept. 1974 for discussion and summary).

* P. 969, P. 970, P. 971, P. 972



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SYMBOLS

- Geological boundary
- Fault
- Railway
- Road
- International and Interprovincial
- District and County Boundary
- Township boundary, base or revision (not surveyed)
- Township boundary, unsurveyed

LEGEND

- | | | | | | | | | | | | | | | |
|-----------------|---|--|--|---|--|---|---|--|--|--|---|--|--|--|
| CENOZOIC | QUATERNARY
PLEISTOCENE AND RECENT
Sand, gravel, clay | CRETACEOUS
LOWER CRETACEOUS
Clay, sand, silt, shales, sandstone | PALEOZOIC*
MISSISSIPPIAN
Shale, sandstone | DEVONIAN
UPPER DEVONIAN
Black shales | LOWER DEVONIAN
Sandstone, shales, conglomerate, siltstone, shales, limestone | SILURIAN
UPPER SILURIAN
Limestone, dolomite, argillite, shales | MIDDLE SILURIAN
Dolomite, argillite | LOWER SILURIAN
Sandstone, shales, dolomite | OROVIAN
UPPER OROVIAN
Shale, limestone, dolomite, sandstone | MIDDLE OROVIAN
Limestone, shales | LOWER OROVIAN
Dolomite, limestone | CAMBRIAN
UPPER CAMBRIAN
Conglomerate, granite, schist, gneiss | LOWER AND MIDDLE CAMBRIAN
Conglomerate, granite, schist, gneiss, quartz porphyry | SARAVANIAN
Sandstone, conglomerate, shales |
|-----------------|---|--|--|---|--|---|---|--|--|--|---|--|--|--|

MINERAL DEPOSITS SYMBOLS

Deposit Type	Reasonably Assured Reserves		
	Less than 100,000 tons*	1,000,000 tons	More than 1,000,000 tons
Related to Igneous Rocks			
Magmatic	▽	△	◊
Pegmatitic	▽	△	◊
Metasomatic:			
In skarns;	◇	◇	◇
In fenites;	◇	◇	◇
Veins:			
Hydrothermal;	□	□	□
Supergene	□	□	□
Related to Sedimentary Rocks			
Conglomerate:	○	○	○
Thorium Rich**	○	○	○
Uranium Rich	○	○	○
Thorium Rare	○	○	○
Lignite	○	○	○
Argillites; semi-pelite, greywacke	○	○	○
Carbonaceous Rock	○	○	○

*Includes occurrences for which no reserve data has been submitted or compiled.

Grade is indicated for any of the above symbols in the following way: \circ - coarse grained, uranium rich, size less than 100,000 tons.

(a) Not indicated

(b) less than 0.75 lbs. U₃₀₈/ton

(c) 0.75 lbs/ton - 1.5 lbs. U₃₀₈/ton

(d) more than 1.5 lbs. U₃₀₈/ton

** for these deposits grade is for ThO₂.

LEGEND

- | | | | | | | | | | | | | | | |
|-----------------|---|--|--|---|--|---|---|--|--|--|---|--|--|--|
| CENOZOIC | QUATERNARY
PLEISTOCENE AND RECENT
Sand, gravel, clay | CRETACEOUS
LOWER CRETACEOUS
Clay, sand, silt, shales, sandstone | PALEOZOIC*
MISSISSIPPIAN
Shale, sandstone | DEVONIAN
UPPER DEVONIAN
Black shales | LOWER DEVONIAN
Sandstone, shales, conglomerate, siltstone, shales, limestone | SILURIAN
UPPER SILURIAN
Limestone, dolomite, argillite, shales | MIDDLE SILURIAN
Dolomite, argillite | LOWER SILURIAN
Sandstone, shales, dolomite | OROVIAN
UPPER OROVIAN
Shale, limestone, dolomite, sandstone | MIDDLE OROVIAN
Limestone, shales | LOWER OROVIAN
Dolomite, limestone | CAMBRIAN
UPPER CAMBRIAN
Conglomerate, granite, schist, gneiss | LOWER AND MIDDLE CAMBRIAN
Conglomerate, granite, schist, gneiss, quartz porphyry | SARAVANIAN
Sandstone, conglomerate, shales |
|-----------------|---|--|--|---|--|---|---|--|--|--|---|--|--|--|

MINERAL DEPOSITS SYMBOLS

Deposit Type	Reasonably Assured Reserves		
	Less than 100,000 tons*	1,000,000 tons	More than 1,000,000 tons
Related to Igneous Rocks			
Magmatic	▽	△	◊
Pegmatitic	▽	△	◊
Metasomatic:			
In skarns;	◇	◇	◇
In fenites;	◇	◇	◇
Veins:			
Hydrothermal;	□	□	□
Supergene	□	□	□
Related to Sedimentary Rocks			
Conglomerate:	○	○	○
Thorium Rich**	○	○	○
Uranium Rich	○	○	○
Thorium Rare	○	○	○
Lignite	○	○	○
Argillites; semi-pelite, greywacke	○	○	○
Carbonaceous Rock	○	○	○

*Includes occurrences for which no reserve data has been submitted or compiled.

Grade is indicated for any of the above symbols in the following way: \circ - coarse grained, uranium rich, size less than 100,000 tons.

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** for these deposits grade is for ThO₂.

SOURCES OF INFORMATION

Compilation by James A. Robertson 1973-1974.
Drafting by J.L. Goss 1973-1974.
Drafting by Jan Michalski 1973-1974.

The principal sources of Mineral Deposits information are the Mineral Resource Circulars for Uranium and Thorium Deposits of Northern and Southern Ontario (Robertson 1968; Hewitt 1967). Geological compilation by L.D. Ayres, S.B. Lumbers, V.G. Milne and D.W. Robson in 1970, from published and unpublished maps and reports of the Ontario Division of Mines and the Geological Survey of Canada, unpublished data on file with the Ontario Division of Mines, and the preparation of aeromagnetic maps and other sources. Published in 1971 by the Ontario Department of Mines and Northern Affairs as Map 2201, Ontario Geological Map, Northwest Sheet. Scale 1 inch to 16 miles.

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NOTE: The Ontario Division of Mines would welcome comment, revisions, new data and suggestions for preparation of a second edition of this map. These should be sent to Chief, Mineral Deposits Section, Geological Branch, Ministry of Natural Resources, Queen's Park, Toronto, issued 1975.

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Approved for publication by E.G. Pyle, Director Geological Branch, July 19, 1974.