Box #1

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Radioactive Mineral Deposits of the Pembroke-Renfrew Area

by
S.L. Masson and J.B. Gordon

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ABSTRACT

This report deals with the geological features of all the reported uranium and thorium occurrences in the Pembroke-Renfrew area of southeastern Ontario. For the purpose of this report, the Pembroke-Renfrew area is that area bounded by Longitude 78° W, the Ottawa River and Longitude 76° W, Latitude 45° N, Algonquin Provincial Park, and Latitude 46° N. It encompasses an area of approximately 14 000 km^2. The towns of Almonte, Arnprior, Bancroft, Carleton Place, Eganville, and Renfrew are located in this area.

The purpose of this study is to encourage exploration and development of the mineral resources in the Pembroke-Renfrew region (NTS 31F). Financial support was provided on a shared basis by the Ontario Ministry of Treasury, Economics and Intergovernmental Affairs, and the Federal Department of Regional Economic Expansion.

There are 118 radioactive occurrences within the study area of which 102 were examined by the authors during the summers of 1977 and 1978. The report consists of a comprehensive description of the geological association and mineral content of the deposits which were examined. In addition, an attempt has been made to determine their mode of origin in order to assess the potential for discovery of additional deposits and to provide guidelines for exploration.

Conversion Factors for Measurements in Ontario Geological Survey Publications

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

CONVERSION FROM SI TO IMPERIAL			CONVERSION FROM IMPERIAL TO SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE—Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in cooperation with the Coal Association of Canada.

Radioactive Mineral Deposits in the Pembroke-Renfrew Area

by

S.L. Masson[1] and J.B. Gordon[2]

INTRODUCTION

In 1977, the Ontario Geological Survey, sponsored by the Ministry of Treasury, Economics, and Intergovernmental Affairs, undertook an integrated three-year program of geoscience surveys and mineral resource studies within the Pembroke-Renfrew region (NTS 31/F, Figure 1) to encourage mineral exploration and development, and to aid government planning and policy guidance.

The role of the Mineral Deposits Section, Ontario Geological Survey, was to undertake field examination and related laboratory studies of the mineral deposits to determine the lithologic, stratigraphic, structural, and metamorphic controls to the distribution and localization of mineral deposits in order to provide guidelines for future exploration. For purposes of these studies the deposits have been grouped into three categories: radioactive deposits, metallic deposits, and industrial mineral deposits.

This report deals only with the radioactive occurrences and it is meant to serve both as a mineral inventory and as a guide to exploration. The results of field investigations and related laboratory studies on the 102 occurrences visited in 1977 and 1978 have been summarized. The report includes descriptive notes on each occurrence and a compilation map (at a scale of 1:126 720) showing the deposits in relation to the particular regional geological features. In the case of the 16 occurrences not visited, property descriptions have been abstracted from reports by previous investigators.

Previous work in the area by the Ontario Geological Survey, formerly the Ontario Department of Mines and Division of Mines) includes the examination of mineral deposits (Satterly 1945; Thomson 1943), detailed and reconnaissance mapping (Hewitt 1954, 1955, 1959; Smith 1958; Peach 1958; Evans 1964; Lumbers 1968, 1976a, 1977; Themistocleous 1978), and Mineral Potential Maps (Springer 1978).

Location

The Pembroke-Renfrew study area encompasses approximately 14 000 km ^{2} (Figure 1) within the Bancroft map sheet, NTS 31/F. It is bounded on the north by the Algonquin Provincial Park, Latitude 46° N. and the Ottawa River; on the east and west by Longitude 76° W. and Longitude 78° W.; and on the south by Latitude 45° N. The towns of Almonte, Arnprior, Bancroft, Carleton Place, Eganville, Pembroke, and Renfrew are located within the area.

History

Mineral exploration and production, which began in the area during the mid-Nineteenth century and continued intermittently over many years, included a wide variety of minerals, both metallic and nonmetallic. Active interest in radioactive minerals dates from about 1922 when uraninite was discovered on the Richardson property (Fission Mine), which is a fluorite deposit near Wilberforce. Between 1929 and 1931 an unsuccessful attempt was made to develop this deposit as a source of radium. Other radioactive deposits were discovered in the mid 1930s, many of which were re-examined during and after World War II but were found to be of little economic interest.

It was the discovery of the promising surface showing of the Centre Lake (Bicroft) deposit in 1952, followed by the discovery of the main ore zone of the Faraday deposit in 1953, that provided the incentive for the major staking and exploration activity that took place in 1954, 1955, and 1956, and led to the discoveries of the Dyno and the Greyhawk deposits in 1955. The Bicroft, Faraday, and Canadian Dyno Mines came into production in 1956, 1957, and 1958 respectively. The Greyhawk Mine ship-

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ped 80 247 tons of ore to the Faraday Mine over a 21 month period beginning in 1957 and continuing until 1959 when the operation was suspended. The Dyno Mine closed in 1960 followed by the closings of the Bicroft Mine in 1963 and the Faraday Mine in 1964. The total production from the Bancroft camp in the period from 1956 to 1964, when all production ceased, was 5500 tons U_3O_8 (4240 mtU), principally from the Bicroft and Faraday Mines. Ore grade was 0.17 percent U_3O_8 with from 0.0225 to 0.2 percent ThO_2.

In 1975, the Faraday Mine was reopened by the newly formed Madawaska Mines Limited. The shaft was deepened from 1350 feet to 1550 feet and the mill capacity was increased from 1400 to 1500 tons per day. The mine resumed operations in August, 1976 at a rate of about 750 tons per day and it is currently operating at the rated capacity of 1500 tons per day for a five day week. Total production from August, 1976 to the end of 1978 was 1,111,516 pounds of U_3O_8 from 752,920 tons of ore. The average recovered grade for this period was 1.47 pounds U_3O_8 pounds per ton. Total production of uranium from the Faraday Mine for the periods 1957 to 1964, and 1976 to 1978, was 6,843,090 pounds U_3O_8 from 3,630,355 tons of ore. The average recovered grade was 1.88 U_3O_8 per ton. The Faraday Mine is the only uranium producer in the Grenville Province of Ontario (Assessment Files Research Office, Ontario Geological Survey, Ontario; Ralph Alexander, Chief Geologist, Madawaska Mines Limited, personal communication).

Previous Work

Geological mapping and mineral deposit studies in the area have been completed by the Geological Survey of Canada and the Ontario Geological Survey. Workers who have completed geological mapping in the study area include Adams and Barlow (1910), Ells (1904), Evans (1964), Hewitt (1954,1955,1959), Hewitt and James (1956), Hewitt and Satterly (1957), Hill *et al.* (1974), Kay (1942), Lumbers (1968, 1977, 1978, 1980), Peach (1958), Quinn (1952), Quinn *et al.* (1956), Reinhardt and Liberty (1973), Satterly (1945), Smith (1958), Themistocleous (1978), and Wilson (1924).

Mineral deposits in the study area, in which radioactive minerals are present in significant amounts, have been described by Ellsworth (1922), Freeman (1936), Hewitt (1967a), Lang *et al.* (1962), Robinson and Hewitt

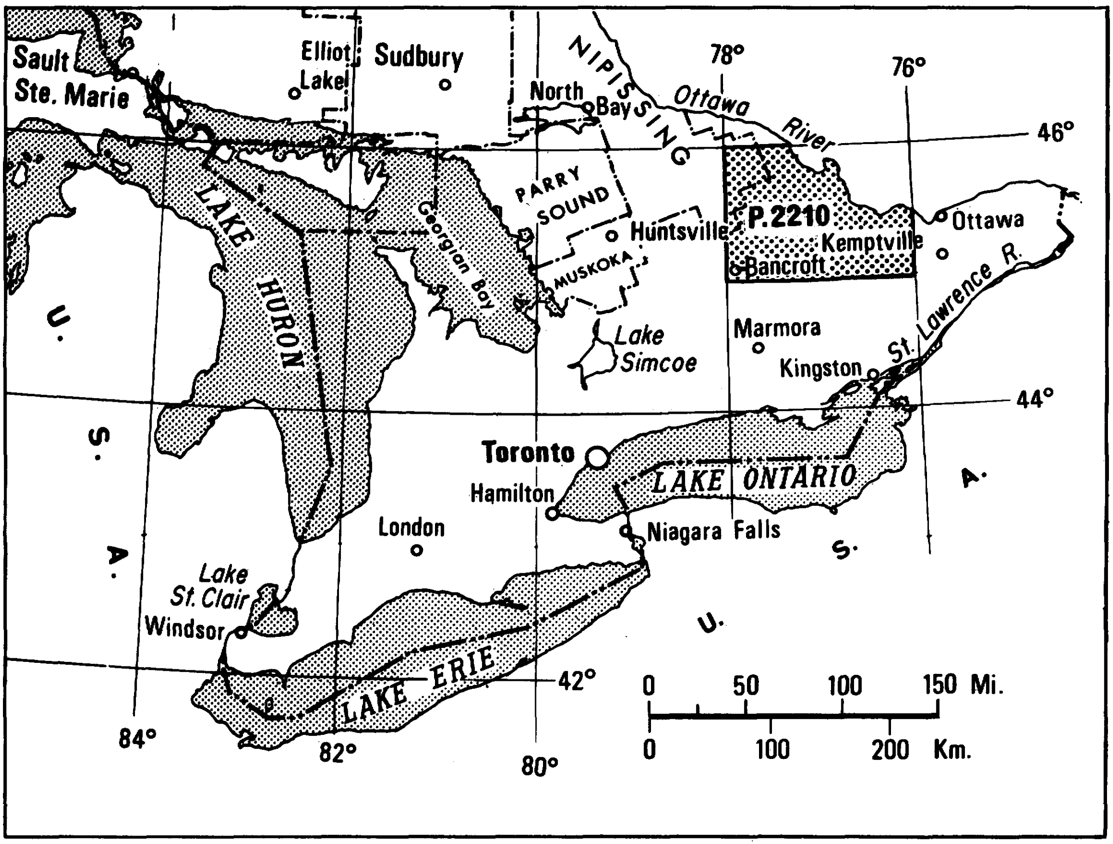


Figure 1—Location of the Pembroke-Renfrew Area.

(1958), Rowe (1952), Satterly (1945, 1957), Steacy *et al.* (1973) and Thomson (1943). Other sources of information include the results of extensive exploration activities by mining companies which is available in the Assessment Files Research Office, Ontario Geological Survey, Toronto, and several important theses on individual mineral deposits which are available in Ontario university libraries, particularly at Carleton University, Queens University, University of Toronto and University of Western Ontario.

Acknowledgements

The authors gratefully acknowledge the information provided by prospectors and residents in the Pembroke-Renfrew area and the unpublished information provided by mining company officials, particularly D.R. Wilson and R. Alexander of Madawaska Mines Limited, Mr. J.F. Church of Canadian Nickel Company; and Mr. R. McDonnell of York River Mines Limited. Assistance in the field was ably provided by R. Vanderhorst and L. Feher. Useful information was obtained from discussions with Mr. J. A. Robertson, Mineral Deposits Section, Ontario Geological Survey, who also provided the authors with access to his private files.

The cooperation and assistance provided by Ministry of Natural Resources personnel in Pembroke, Huntsville and Bancroft were helpful and much appreciated. The authors are indebted to Mr. S.B. Lumbers, Curator of Geology of the Royal Ontario Museum and Mr. E.G. Bright of the Ontario Geological Survey for discussions on regional geology as well as time devoted to informative field trips and Mr. J.F. Davies of Laurentian University for his critical reading of the early draft.

REGIONAL GEOLOGY

The following description of the geology of the Pembroke-Renfrew area is taken largely from recent mapping by Lumbers (1976a, 1977, 1978, 1980) which comprises the most recent compilation of the geology of the Grenville Province in Ontario.

There are two major supracrustal accumulations in the Grenville Province of southeastern Ontario: an older accumulation of clastic metasediments of Middle Precambrian age deposited in the northern part between 2500 m.y. and 1800 m.y. ago and a younger Late Precambrian supracrustal accumulation consisting mainly of carbonate metasediments with minor siliceous metasediments and metavolcanics deposited between 1480 m.y. and 1280 m.y. in the southern part. This sequence is known as the Grenville Supergroup. Intruding the Middle Precambrian metasedimentary sequence in the central part of the province is the Algonquin Batholith, an anorthosite suite which has been dated at 1500 m.y. (S.B. Lumbers, personal communication). The Late Precambrian Supergroup rests unconformably on the south flank of the Late Precambrian Algonquin Batholith and the boundary is marked by a basal arkosic unit.

In the southern and eastern part of the Ontario Grenville Province the Grenville Supergroup rocks are overlain unconformably by Paleozoic rocks of the Ottawa-St. Lawrence Basin. Paleozoic outliers have been preserved in down-dropped blocks within the Ottawa-Bonnechere Graben system which extends across the eastern part of the area in a northwesterly direction through to Lake Nipissing.

The Pembroke-Renfrew study area straddles the unconformity separating the Algonquin Batholith and Middle Precambrian metasediments in the northwestern part of the area from Late Precambrian supracrustal accumulations in the southern part. This unconformity trends southwesterly across the study area and is marked by a basal arkosic sequence.

The Middle Precambrian metasediments, the oldest exposed rocks in the map area, are mainly coarsely recrystallized derivatives of moderately to well sorted arkose sub-arkose, orthoquartzite, aluminous clay-rich sediments and rare iron formation intercalated with thick sequences of impure sandstone. These rocks extend southward from the Mattawa-Deep River area into the northern part of the Pembroke-Renfrew study area (Lumbers 1976a) where they are intruded by the Algonquin Batholith of Late Precambrian age. This batholith underlies much of Algonquin Park, parts of Brudenell, Radcliff, Jones and Lyell Townships and most of Wicklow and Bangor Townships. It consists mainly of quartz monzonite and syenitic rocks, although gabbroic anorthositic and tonalitic phases are locally abundant.

The younger Precambrian supracrustal rocks, the Grenville Supergroup, rest unconformably upon the southern flank of the Algonquin Batholith and Middle Precambrian metasediments. The base of the Supergroup rocks is marked by a basal arkose which trends northeasterly from Maynooth, through Combermere and Golden Lake to the Ottawa River south of Pembroke. In the Golden Lake and Pembroke areas, the basal arkose contains gneissic orthoquartzite and siliceous marble beds up to 1 m thick and show a facies change upward into marble and calc-silicate rocks. Outliers of the basal arkose are present in the batholith as far as 20 km northwest of the unconformity. In central Radcliff Township and southern Bangor and Wicklow Townships, the basal arkose becomes coarser grained and consists of feldspathic micaceous meta-sandstone with a pebble and boulder content and metasediments derived from siliceous and calcareous shales, siltstones and minor siliceous limestones. In Herschel Township north of Bancroft, the trend of the unconformity is disrupted by faulting (S.B. Lumbers, personal communication). Southeast of the Late Precambrian unconformity the basal arkose passes upwards into a carbonate-rich sequence in which marble and calc-silicate rocks greatly predominate over silty, shaly and moderately to well sorted sandy metasediments. In the central and southwestern part of the map area, a major volcanic event within the carbonate basin which took place about 1300 m.y. ago. This is a mafic volcanic sequence which contains subordinate felsic metavolcanic rocks, metawacke, and marble. The base of the volcanic sequence is not exposed but the earliest exposed volcanic rocks have been dated at 1310 m.y. (Lumbers 1967). In the southeastern part of the Pembroke-Renfrew area carbonate metasediments dominate the supracrustal rocks and metavolcanic rocks are rare. The carbonate metasediments are mainly impure calcitic marble, which are intercalated with dolomitic marble in part cherty, particularly in the proximity of the mafic metavolcanic sequence.

As proposed by Bright (1977), the Anstruther Lake Group in the Eels Lake area to the west may be the equivalent of the basal arkose mapped by Lumbers (1976a, 1977, 1978, 1980) in the map area. However further detailed studies will be necessary in these two areas before a definite correlation of the stratigraphy is possible.

Lumbers (1980, p.15-17) summarizes the principal plutonic rocks intruding the Grenville Supergroup as follows:

> Between 1.3 and 1.0 b.y. ago, a large variety of plutonic rocks were emplaced within the carbonate-rich younger accumulation.. . . In approximate order of decreasing age, the following [five plutonic rock] suites are recognized: 1) biotite diorite suite characterized by abundant dioritic rocks, tonalite, and sodic granitic and syenitic rocks, chiefly trondhjemite, granodiorite, albite granite, albite syenite; 2) anorthosite suite consisting of anorthositic and tonalitic rocks and associated monzonitic and granitic rocks (Lumbers 1975); 3) quartz monzonite suite characterized by abundant quartz monzonite and only minor phases of other calc-alkalic intrusive rocks; 4) alkalic suite dominated by alkalic syenite and granite, but containing minor mafic alkalic rocks and nepheline syenite; and 5) syenite-monzonite suite characterized by abundant calc-alkalic syenite and minor monzonite, quartz monzonite, tonalite and gabbro.

The metamorphism and tectonic events, to which the Grenville Province within the study area was subjected, are summarized by Lumbers (1980, p.xi-xii):

> Between 1.1 and 1.0 b.y. ago, the supracrustal and most of the plutonic rocks underwent high rank regional metamorphism that converted these rocks into intensely deformed and coarsely recrystallized gneisses. During this metamorphism, the Algonquin batholith and smaller batholithic bodies within the younger accumulation became diapiric toward the overlying supracrustal rocks causing most of the tectonic deformation not only of the plutonic rocks, but also of rocks of the two supracrustal accumulations. This diapirism accounts for subhorizontal gneissic foliation and recumbent folding dominant in the supracrustal rocks for tens of km around the Algonquin batholith. Variations in metamorphic mineral assemblages developed in the various gneisses seem to correlate best with variations in the level of strain in the gneisses and are indicative of middle to upper almandine amphibolite facies temperature and pressure conditions; locally, a few highly strained intrusive bodies contain granulite facies mineral assemblages. Some intrusions of the quartz monzonite and alkalic suites, most of the intrusions of the syenite - monzonite suite, and granite pegmatite dikes were emplaced during the waning stages of regional metamorphism. During this time, rocks of the alkalic suite, which are concentrated in a major complex close to the unconformity marking the base of the younger accumulation, underwent widespread fenitization marked by the presence of alkalic pyroxene veinlets and alkalic syenite pegmatite. Following termination of the high rank regional metamorphism, the map-area underwent uplift, faulting, mafic intrusive activity, erosion, and deposition of Lower Paleozoic sedimentary rocks. These rocks are now preserved only within the Ottawa-Bonnechere Graben that cuts eastward across all but the southwestern part of the area and is marked by prominent fault systems and subsidiary grabens, swarms of diabase dikes, zones of localized fenitization, and small mafic to ultramafic stocks.

CLASSIFICATION OF RADIOACTIVE MINERAL DEPOSITS

The classification of radioactive deposits employed in this report is based principally on the lithology of the host rocks. It has been adapted from the classifications of Satterly (1957) and Hewitt (1955) and modified to reflect current thinking on uranium genesis in high-rank metamorphic environments and it includes only the types of deposits present in the study area.

The primary divisions in this classification represent the two regional metamorphic regions in the area. Rank of regional metamorphism is probably the most important factor controlling the types of uranium deposits present. In the nonmetamorphic terranes, the known uranium deposits are uraniferous hydrocarbon in sandy dolomite of Cambrian-Ordovician age. In the Middle to Late Precambrian ultrametamorphic terranes, there are a variety of deposits which are distinguished principally on the basis of lithology. This classification is presented in Table 1.

TABLE 1 | CLASSIFICATION OF URANIUM DEPOSITS.

Deposits in Nonmetamorphic Terranes: Lower Paleozoic

- epigenetic, in sandstone-dolomite

Deposits in Metamorphic Terranes: Middle to Late Precambrian

1) associated with granitic rocks
   - in zoned pegmatites
     - a) simple type
     - b) complex type
   - in unzoned pegmatites
     - a) simple type
     - b) complex type
   - in granitic rocks
2) associated with carbonate rocks
   - stratabound deposits in marbles, calc-silicate rocks including pyroxenite. May be reworked syngenetic or introduced during metamorphic-metasomatic activity (skarn)
3) associated with veins
   - a) carbonate veins and pods
   - b) pyroxene and biotite veins

Deposits in Nonmetamorphic Terranes

Sandstone-Dolomite

The sandstone-dolomite-hosted uranium occurrences are stratiform in habit and were deposited in alternating grey sandstone and blue grey dolomite beds of the March Formation of Lower Ordovician age (Grasty *et al.* 1973 and Robertson 1978). The March Formation overlies the Nepean Formation, a Late Cambrian or Early Ordovician sandstone which forms the basal unit of the Paleozoic rocks overlying the Late Precambrian basement. Both formations are important aquifers in the region. Mineralization consists of disseminated grains, of an unidentified uranium hydrocarbon mineral, chalcopyrite, and pyrite. Spatial relationships (i.e. Late Precambrian-Paleozoic unconformity), mineralization, and character of the host rocks are consistent with a supergene origin for those deposits whereby uranium and copper were leached from the nearby Precambrian basement rocks under oxidizing conditions and transported by circulating ground waters through the porous Nepean and March sandstones. The uranium and copper were precipitated in the reducing environment of carbonaceous-rich units of the March Formation.

The best known occurrence of this type is located near South March, west of Ottawa. To date no major economic deposits have been discovered and the potential for this type of deposit has yet to be established. It is reported by Ruzicka and Steacy (1975) that impure psammite in the Ottawa embayment other than the March Formation also carries uranium mineralization. They also found veinlets of hydrocarbon and coffinite in the basement rocks near the Ordovician-Grenville unconformity.

Deposits in Metamorphic Terranes

DEPOSITS ASSOCIATED WITH GRANITIC ROCKS

Deposits associated with granitic rocks are divided into three principal catagories; zoned pegmatites, unzoned pegmatites and granites.

Zoned Pegmatites

GENERAL CHARACTERISTICS

Zoned pegmatites are coarsely (up to 2 m) crystalline, fissure-filling pegmatite dikes, that are usually lenticular pod-shaped bodies. The pegmatites are granitic in composition with minerals segregated into well developed lithological units from wall to core. Zoned pegmatites in the study area are up to 200 m long, 20 m wide, with the vertical dimension, prior to erosion, probably at least equal to the length. Steep to vertical dips are characteristic. They are of Late Precambrian age, emplaced during the waning stages of the Grenville Metamorphic and Orogenic Event.

The following classification of internal structure of zoned pegmatites has been adopted by the United States Geological Survey (Jahns 1955, p.1042):

1. *Zones:* successive shells, complete or incomplete, that reflect to varying degrees the shape or gross structure of the pegmatite body.
   a. Border zone (the outermost zone).
   b. Wall zone.
   c. Intermediate zone or zones.
   d. Core or innermost zone.
2. *Fracture fillings:* units, generally tabular in form, that fill fractures in previously consolidated pegmatite.
3. *Replacement bodies:* units formed essentially by replacement of pre-existing pegmatite, with or without obvious structural control.

Zones are distinguished by differences in mineralogy and texture. They may be complete or discontinuous and may merge or telescope and contacts may be sharp or gradational. Cameron *et al.* (1949, p.16) describes the general features of zones and then discusses the four major zones as follows:

Border or outermost zones are relatively fine-grained selvages that are not more than a few inches thick in most pegmatites. Wall zones, next inside the border zones, generally are coarser and much thicker. Although they actually are the second zones from the margins of pegmatite bodies, they are designated as "wall zones" in recognition of a terminology firmly established in the domestic pegmatite mining industry. Most border zones are of little economic significance, and hence in the industry they have not been distinguished from the adjoining wall zones. The innermost zone, or core, generally occurs at or near the centre of a pegmatite body, commonly as an elongate lens or series of disconnected segments.. . . Any zone between the core and the wall zone is an intermediate zone. There is no theoretical limit to the number of intermediate zones, but few pegmatites contain more than three mappable intermediate zones.. . . Zones, as well as other units, are designated by names that express composition in terms of essential minerals, *e.g.* perthite-quartz pegmatite, plagioclase-quartz perthite pegmatite (Cameron *et al.* 1949, p.20, 21).

Cameron *et al.* (1949, p. 59-61) further observed that pegmatites, from different localities, commonly show similar sequences of assemblages of essential minerals from the walls inward. Few pegmatites contain all the assemblages but those present usually occur from border zone to its core, in the following order:

1. Plagioclase-quartz-muscovite
2. Plagioclase-quartz
3. Quartz-perthite-plagioclase, with or without muscovite, with or without biotite
4. Perthite-quartz
5. Perthite-quartz-plagioclase-amblygonite-spodumene
6. Plagioclase-quartz-spodumene
7. Quartz-spodumene
8. Lepidolite-plagioclase-quartz
9. Quartz-microcline
10. Microcline-plagioclase-lithium micas-quartz
11. Quartz

Fracture fillings are most commonly quartz but may also consist of two or more minerals. Replacement may result from reaction of the pegmatitic melt with the country rock or during a post-magmatic stage involving hydrothermal fluids.

Zoned pegmatites may have two modes of origin.

They may represent the residual product from the crystallization of granitic melts; or they may form from anatectic melts developed by dehydration during high-grade regional metamorphism. In the Bancroft area, all but two pegmatites (the complex type in the Quadeville area) appear to have formed by the latter process.

Cameron *et al.* (1949, p.99) have suggested three principal modes for emplacement of zoned pegmatites:

1. Crystallization of a pegmatitic magma *in situ* with the injection of the magma into an open fissure. Zones may develop in a "restricted system" in which no new material is injected, but some material may escape during crystallization, and some reaction may take place between pegmatite and wall rock.

2. Zoned pegmatites may form by successive deposition in an open system in which there may be changes in pressure, temperature and compositicn of magmatic solutions supplied.

3. Zoned pegmatites may develop in two stages, a magmatic stage during which the pegmatitic magma was injected and crystallized in a more or less restricted system, followed by a hydrothermal stage in which solutions passing through the pegmatite effected replacement in an open system. This late stage hydrothermal replacement is responsible for many replacement units found in homogeneous and zoned pegmatites.

Both simple- and complex-zoned pegmatites are recognized in the study area.

SIMPLE-ZONED PEGMATITES

The simple-zoned pegmatites are characterized by an internal structure consisting essentially of mineral zoning and a mineralogy which is very potassic; potassium feldspar dominates over plagioclase. Fracture fillings and replacement are uncommon. The simple type is by far the most common type of zoned pegmatite in the area, and is the variety which has been mined for feldspar. The internal structure of this type is characterized by four zones, although all zones need not necessarily be present. Satterly (1957, p.8) outlined the zones of this type as follows:

a) Border zone: graphic granite or plagioclase-quartz-microcline-muscovite.

b) Wall zone: plagioclase-quartz-microcline.

c) Intermediate zones; plagioclase-perthite-quartz$\pm$muscovite$\pm$biotite or perthite-quartz.

d) Core zone: quartz.

In the large pegmatite bodies of the MacDonald Mine and the Woodcox Mine and perhaps the Genesee No. 2 Mine, the core zone contained, large masses of carbonate which was interpreted by Ellsworth (1932) as a primary component of the pegmatite.

These pegmatites are also characterized by radioactive minerals of the complex titano-tantalo-columbate group. For this reason, Ellsworth (1932) called the simple-zoned pegmatites the euxenite type. The titano-tantalo-columbate minerals occur in all zones except the core and they are mainly present in the contact areas of the border and wall zones in association with cyrtolite, allanite, and magnetite. In the presence of biotite or muscovite in the intermediate zone, the titano-tantalo-columbate minerals are within or in contact with the mica (e.g. Barr Feldspar Quarry, Dubblestein, and Whytock occurrences). In pegmatites which contain calcite in the core zone such as the MacDonald Mine they may occur as the variety ellsworthite within the carbonate associated with sulfides. Allanite is also a common mineral and is generally concentrated in the border and wall zones, but also occurs irregularly distributed in the intermediate zone. Allanite commonly has inclusions of uranothorite and/or rare-earth bearing Ti, Ta, and Nb minerals. The radioactive variety of zircon cyrtolite is also common, and is associated with the titano-tantalo-columbate minerals in the wall and intermediate zones. Non-radioactive zircon may be present in the border and wall zones. Columbite minerals are common only at the Woodcox Mine, occurring in the intermediate zone adjacent to the wall zone. Rare-earth bearing garnet has been reported from the wall zone of the MacDonald Mine (Ellsworth 1932).

Radioactive minerals in these pegmatites have marked halos of reddish hematite alteration, especially if embedded in feldspar or carbonate. The hematized feldspar immediately next to these radioactive minerals shows intense alteration. Quartz and feldspar enclosing cyrtolite, allanite, and euxenite type minerals are characterized by numerous small fractures radiating out from these radioactive grains. Ellsworth (1932) remarked that this type of fracturing was so pronounced in the Woodcox Mine, where radioactive minerals were both large (up to 500 pounds) and abundant, that much of the pegmatite was altered and hematized. Smoky quartz which is characteristic near radioactive minerals also occurs very commonly near the contact of feldspar masses in the absence of discrete radioactive minerals.

Accessory minerals include: hornblende, pyroxene, biotite, muscovite, garnet, chlorite, magnetite, ilmenite, pyrite, pyrrhotite, sphene, apatite and zircon. Molybdenite which is a minor to common accessory minerals in unzoned pegmatites, is relatively rare in zoned pegmatites.

Fracture filling is generally in the form of quartz or quartz carbonate veins. Replacement phases however are characterized by: a much finer grain size (2 to 15 mm), a dark reddish colour (dusty hematite), a mafic-rich assemblage containing much pyroxene and peristerite, and by the accessory minerals allanite, sphene, zircon, sericite, magnetite plus or minus carbonate and uranothorite. Replacement phases occurring along distinct or indistinct fractures or zones tend to be syenitic and quite sodic. Pautler (1980), in her work on the Thomas occurrence has shown that there is an overall increase in iron due to addition of Fe^{+3} and a decrease in silica along fracture replacement zones. The Thomas, Quade and Bartlett occurrences are examples of simple-zoned pegmatites showing mineralized replacement zones.

COMPLEX-ZONED PEGMATITES

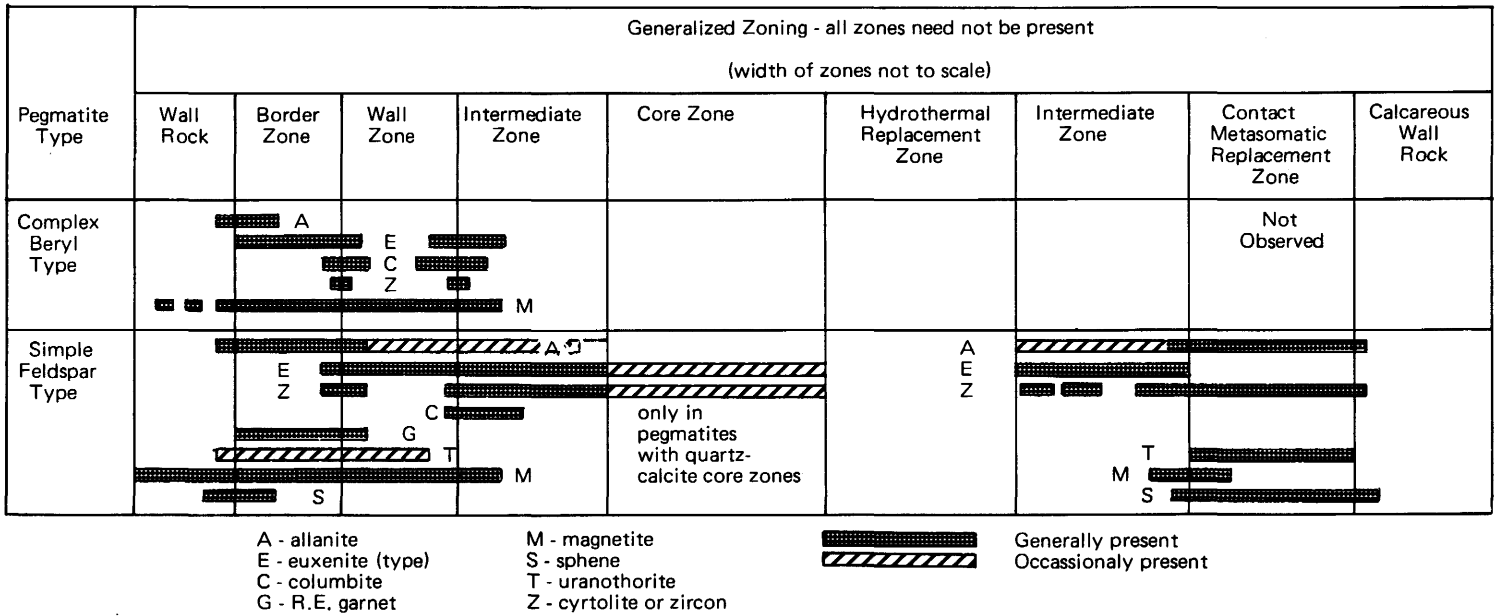
The complex-zoned pegmatites have been locally subjected to hydrothermal replacement, in which case the pegmatite is characteristically soda rich, containing important quantities of albite, peristerite and cleavelan-

TABLE 2 MINERALOGY AND DISTRIBUTION OF RADIOACTIVE AND ASSOCIATED MINERALS IN ZONED PEGMATITES

a) MINERALOGY OF PEGMATITES

Zoned Pegmatite	Minerals: Feldspar	Beryl	Tourmaline	Columbite	Titano - tantalo - columbates	Pyrite & Pyrrhotite	Pyroxene	Sphene	Uranothorite Uraninite
Simple Type	K - rich K > Na	Absent	Rare	Uncommon	Present U - rich	Major accessory	In replacement zones	In replacement zones	Common only in replacement zones or along fractures
Complex Type	Na - rich Na > K	Present	Present in replacement zones	Present	Present, generally U - poor	Very minor accessory	Absent	Absent	Absent

b) DISTRIBUTION OF RADIOACTIVE AND ASSOCIATED MINERALS



dite at the expense of potassic feldspars. The accessory minerals beryl, tourmaline, and ever present columbite distinguish the complex-zoned pegmatite from the simple-zoned pegmatite. The complex pegmatite is generally lighter in colour than the simple pegmatite due to the higher content of sodic feldspar.

In the study area, only two such pegmatites are known by the author and they are located near Quadeville. They are owned by Wall Gem Minerals Limited of Quadeville. Both pegmatites have been described by Hewitt (1967b).

Zoning in the complex-zoned pegmatite is as follows:

1. Wall Zone: albite, quartz, perthite
2. Intermediate Zone I: quartz, albite, biotite
3. Intermediate Zone II: microcline, perthite, beryl
4. Replacement Zone: quartz, cleavelandite, tourmaline
5. Core Zone: quartz

The mineralogy of the complex pegmatites has been described by Ellsworth (1932), Graham (1952) and by Hewitt (1954) and the following minerals have been reported: white and pink albite; pinkmicrocline-perthite; rose, smoky, and white quartz; hornblende; biotite; muscovite; magnetite; columbite-tantalite; lyndochite (a uranium-poor; niobium-rich eschynite); beryl; fluorite; cyrtolite; tourmaline; garnet; monazite; columbium; anatase; molybdenite; specularite; pyrite; and calcite.

Lyndochite occurs with magnetite and allanite, either replacing columbite at the contact of the border zone with the wall rock, or with magnetite and fluorite in microcline-perthite in the intermediate zone near the contact with the wall zone and in the wall zone. Columbite may also occur with magnetite and fluorite in vugs in potassium feldspar. Cyrtolite occurs in albite feldspar in the wall zone associated with euxenite and allanite.

Table 2 shows the major mineralogical differences between the simple-zoned and the complex-zoned pegmatite, displays the distribution of radioactive, rare earth, and other minerals within the different zones of these pegmatites. Uraninite and monazite, rare to uncommon minerals in zoned pegmatites of the area, are not included as their distribution is either unknown or unrelated to pegmatite zoning.

REGIONAL CHARACTERISTICS AND DISTRIBUTION OF ZONED PEGMATITE

Zoned pegmatites containing radioactive minerals occur in three major areas of the Pembroke map sheet: the Hybla area, the Madawaska area and the Quadeville area. Three minor areas containing mineralized zoned pegmatites include the Indian River area west of Pembroke, March Township west of Ottawa, and Miller Township north of Plevna. The country rocks hosting the pegmatites are characterized by a metamorphic grade of upper almandine amphibolite facies. Most of the pegmatite bodies strike in a northeasterly direction, or are part of a cluster which generally shows this trend. This northeasterly trend is parallel to the regional structural direction of the Late Precambrian Grenville Supergroup in Ontario.

The Madawaska area, which includes Dixon, Murchison, and Bangor Townships, and the Indian River area are underlain principally by Middle Precambrian country rocks. Pegmatites in these areas occur mainly in anorthositic, dioritic, and gabbroic phases of the Algonquin granitic Batholith of Late Precambrian age, and less commonly in outliers of the overlying basal arkose of the Grenville Supergroup. The preferential occurrence of these pegmatites within the more mafic phases of the Algonquin Batholith reflects the relatively brittle behaviour of these rocks during the Late Precambrian Grenville Orogenic and Metamorphic Event. Granitic rocks are more likely to adjust to the tectonic metamorphic event by partial melting and plastic flow, whereas the more competent mafic dioritic rocks would fracture, allowing intrusion of the locally generated anatectic melts. Zoned pegmatites within the Algonquin Batholith only occasionally contains radioactive minerals, generally of the euxenite or pyrochlore types, commonly associated with biotite books or potassium feldspar. The biotite books occur in the intermediate and/or wall zones of the pegmatite. Allanite if present occurs in the border zone. The zoned pegmatites in the Algonquin Batholith are of little economic importance for uranium mineralization.

The Whytock-Gray-Elkington deposit in Miller Township is situated in the Late Precambrian Grenville Supergroup sequence, and is similar in some respects to the pegmatites in the Madawaska-Indian River areas. Both occur in gneissic amphibolitic country rocks, and in both areas the radioactive minerals are of the complex titano-tantalo-columbate type, commonly associated with mica books in the intermediate zone of the pegmatite bodies. At the Elkington occurrence the mica is muscovite, whereas in the Madawaska-Indian River areas the mica is biotite. The Elkington pegmatite is the only mineralized zoned pegmatite in the area; unzoned pegmatites in the area are not anomalously radioactive. Although the pegmatite contains uranopyrochlore, the recovery of the radioactive minerals would only be viable as a byproduct of either feldspar mining, or quartz extraction from the waste dumps.

A single occurrence of mineralized zoned pegmatite in March Township west of Ottawa, is reported to contain the mineral uraninite (Ellsworth 1932) which is not characteristic of zoned pegmatites. The only observed uraninite-bearing zoned pegmatite in the study area is the Robson occurrence in the Hybla area. There, uraninite and cyrtolite are associated with fractures and biotite books in a zoned syenite pegmatite intruding syenite gneisses.

The Hybla area, centred in Monteagle Township, has more zoned pegmatites and has accounted for more feldspar production than any other area within the Pembroke-Renfrew map sheet. The dominant northeast strike of many dikes reflects the northeasterly trend of the pegmatite cluster as a whole. The Hybla pegmatite bodies are in a variety of rocks including arkose, marble, paragneiss and syenite gneiss of the Grenville Supergroup. Most pegmatites in this area contain allanite, and occasional masses of pyrochlore or euxenite. A few contain concentrations of allanite, cyrtolite, titano- tantalo-columbate minerals and occasional uranothorite. Some of the enriched pegmatites include the Woodcox, MacDonald, Genesee No. 2, Plunkett North, Peter-Rock West, and Bartlett Mine occurrences. The Woodcox and the MacDonald Mines, which contain the best developed concentrations of radioactive minerals, are the only. deposits that have core zones with a carbonate content. In the MacDonald Mine the carbonate-bearing quartz core (now removed) hosted uranpyrochlore.

The complex beryl-bearing pegmatites in the Quadeville area differ mineralogically from the pegmatites described above. The Quadeville pegmatites in addition to beryl contain minor amounts of columbite and titano-tantalo-columbate minerals such as lyndochite and euxenite which in these pegmatites have a low uranium content. The uranium and thorium are generally concentrated in the refratory mineral cyrtolite, a refractory uraniferous variety of zircon.

Unzoned Mineralized Pegmatites

GENERAL CHARACTERISTICS

In unzoned pegmatites the processes of crystallization have not segregated the minerals into well developed lithological units. Inasmuch as zoned and unzoned pegmatites may show gradational relationships, rudimentary zoning may be present.

The grain size of unzoned pegmatites is considerably smaller than that of zoned pegmatites, although it may be quite variable, ranging even within the same dike from coarse (10 to 30 cm) to fine (less than 2 cm). Grain sizes of less than 5 cm are the most common. Mineralized sections within these pegmatites have a grain size of generally less than l cm. Texturally, unzoned pegmatites are equigranular granitic, although graphic textures are not uncommon, especially in unmineralized pegmatite. Mineralized sections may show cataclastic, fractured, foliated, and lineated features.

Contacts with wall rock vary from sharp to gradational, depending on the wall rock composition as well as the nature of the structure hosting the pegmatite. In some cases contamination by the wall rock has produced irregular and poorly defined boundaries.

Unlike zoned pegmatites which are relatively short, tabular, pod-shaped bodies, the unzoned pegmatites commonly occur as long (up to 1 km), narrow, tabular dikes or sills, or irregular or branching bodies. Average widths are generally quite narrow in comparison to lengths, and may range from l cm to 50 m; pegmatites less than 2 m in width are most common.

The shape of a pegmatite body is determined by the structural control. Joints, faults, bedding or gneissic planes, lithological contacts, and fractures and openings related to folding are important controls on the emplacement of pegmatite. The competency of the wall rocks influences the shape of these dikes. Regular tabular pegmatites are more common in granitic gneisses, amphibolites, and metagabbro, as these rocks tend to fracture cleanly, producing rectilinear openings. Pegmatites intruding carbonate rocks or in heterogeneous units such as intercalated metasediments have a tendency to pinch and swell, forming irregular bodies.

Radioactive mineralization in unzoned pegmatites is characterized by the minerals uranothorite and uraninite, which occur along deformation zones in the pegmatite or in areas of wall-rock reaction. This is in contrast with the titano-tantalo-columbate type mineralization of zoned pegmatites, and suggests important differences in the processes of mineralization. Unzoned pegmatites are divided into simple and complex types, based mainly on mineralogy and morphology.

SIMPLE UNZONED PEGMATITES

The simple unzoned pegmatites which are characteristic of high-grade regional metamorphic supracrustal terrains are relatively homogeneous. Contact metasomatism may occur, as might hydrothermal replacement or alteration, along fractures but the pegmatite for the most part retains its typical pegmatitic textures and relatively unaltered appearance.

Pegmatites of this type are composed dominantly of quartz, microcline, microperthite, and soda plagioclase with a normative composition of albite to oligoclase (quartz monzonites). Common accessory minerals include biotite, muscovite, hornblende, magnetite, pyrite, pyroxene (aegerine augite), allanite, and zircon. Uraninite, uranothorite, cyrtolite, common zircon, and sphene may occur in mineralized portions.

Simple-unzoned pegmatites are commonly pink to dark pink in colour but white to very light pink varieties also occur. Pegmatites which intrude iron-rich silicate rocks, such as biotite-, amphibole-, and magnetite-bearing gneisses are pink to dark pink. Pegmatites which intrude rocks poor in iron silicates, such as marbles or calc-silicate gneisses, are generally white to light pink. Pegmatites in the rust-weathering, pyritic, pyrrhotitic calc-silicate gneisses, which are often interbedded with marble have a yellow tint due to iron hydroxides. Commonly white pegmatites contain pyrite, or the country rocks are pyritic or graphitic, suggesting that the graphite and possibly the pyrite acted as oxygen buffers that inhibited the development of hematite. A large number of white pegmatites are present in the upper units of the Grenville Supergroup, whereas pink-red pegmatites occur in the lower formations, as well as in the Middle Precambrian basement rocks.

Simple-unzoned pegmatites quite commonly host little or no radioactive minerals, and where mineralized, the mineralization is confined to isolated fractures, or along contacts where the pegmatitic melt has reacted with wall rocks. Most of these occurrences are of no economic importance, however a few have an overall tenor of radioactivity which is anomalous, suggesting that hydrothermal enrichment processes have operated. Pegmatites in which late fracturing, shearing and post-magmatic hydrothermal activity have taken place, show a marked increase in uranium content and grades up to 0.5 pounds U_3O_8 have been reported. In white pegmatites, hydrothermal alteration is recognized by silicification and albitization with biotite or chlorite alteration; some hematite alteration may occur. In pink pegmatites, albitization or peristeritization occur typically with hematitization and sericitization, although chlorite and biotite may also develop. Hydrothermal alteration in pink pegmatites is generally accompanied by the introduction of magnetite and allanite. Epidote alteration which is younger than the allanite may be present in pink pegmatites. In both white and pink pegmatites, the radioactive minerals are uraninite, uranothorite, zircon, and allanite; allanite is more abundant in pink pegmatites.

Mineralized zones in the pegmatite appears to follow early fracturing, generally parallel to the dike walls. This early deformation is subtle and often obscured by annealing of quartz, giving the pegmatite a relatively unaltered and homogeneous appearance, although alteration may be pervasive. Commonly these early fracture zones are recognized only by slight increases in quartz content, the lenticular shape of the quartz, and the alignment of biotite flakes. Early deformation of pegmatite developed a discernible foliation.

In a few occurrences, deformation or fracturing of the pegmatite appears to be much later than the pegmatite intrusive event. The mineralized parts are coarse-grained (1 to 5 cm), foliated, and rich in quartz and biotite, and occur in fractures that may be related to late regional structures such as the Ottawa-Bonnechere Graben. Radioactive fractures that are not related to hydrothermal activity but of supergene origin, have been observed in some unzoned pegmatites. In such cases uranium has been leached from outcropping pegmatite, and transported by ground water into fractures where the uranium is reduced and precipitated by secondary iron oxides coating fracture walls. This is a common phenomenon associated with fracturing, joints and exfoliation surfaces. Such surfaces may be coated with the yellow secondary uranium mineral, uranophane.

Examples of simple unzoned mineralized pegmatites include the Bordun, Mell-Quirk and Barton properties. This type of occurrence rarely exceeds an average grade of 0.5 pounds per ton U_3O_8 across mineable sections, making deposits of this type submarginal with present price, cost, and technology.

COMPLEX UNZONED PEGMATITES

The following description is based primarily on Hewitt (1959, p.53-54). Complex-unzoned pegmatites are pegmatites in which the processes of secondary enrichment involving deformation, hydrothermal activity, and wall-rock reactions have been so intense as to have highly modified the normal texture and mineralogy. This type therefore represents extreme alteration of originally simple pegmatites. There is abundant evidence of assimilation of wall rocks, metasomatic replacement, and reaction of earlier facies with later gaseous hydrothermal fluids and residual melts along coeval or post-magmatic shear or fracture zones.

These pegmatites are characterized by multiple facies with lithological units being quite irregular in size, shape, and spatial relationship. Marked changes in lithology and texture commonly occur along the strike of the pegmatite dikes in response to changes in wall-rock composition and magmatic hydrothermal metasomatism; these pegmatites lack the homogeneous nature of the simple unzoned pegmatite. Inclusions in all stages of assimilation characterize these pegmatites, as does gradation in composition from syenite to granite within the same dike. The most diagnostic features of these pegmatites are however, the extensive hydrothermal alteration, deformation, and pink to red colour. The most important uranium deposits in the Bancroft camp including all which have attained production are complex unzoned pegmatites.

The shapes of these bodies are less tabular than the simple unzoned type; they may be lenticular, pod-shaped, or fingering to irregularly branching bodies. In general they are from 25 to 100 m long, 0.5 to 5.0 m wide and extend down dip from 100 to 300 m, commonly forming pipe-like bodies. The smaller dikes generally contain the highest uranium grades. Grain size ranges from medium (2 to 10 cm) to fine (less than 1 cm); the fine-grained pegmatites have the highest uranium content.

Satterly (1957) reported that the most common lithological varieties of the complex pegmatite include: pink leucogranite, commonly magnetite rich; pegmatitic granite, usually peristeritic; pyroxene granite and syenite; pyroxene granite and syenite pegmatite, and cataclastic quartz-rich pegmatites. The unmineralized portions of these pegmatite bodies are light pink to pink, 2 to 10 cm in grain size, and have granitic homogeneous textures and may or may not contain magnetite. These medium-grained homogeneous phases generally assay less than 20 ppm U_3O_8. Uranium-rich phases of the pegmatite occur mainly at the contact with country rocks where they show assimilation and wall-rock reaction and often contain inclusions of country rock. Where wall-rock reaction has occurred, the pegmatite is characterized by mafic-rich assemblages of pyroxene and/or magnetite and the pegmatite may be syenitic. Contact alteration is also characterized by albitization or peristerization, with marked reddening of the feldspars (dusty hematite alteration). At the contact both the pegmatite and the wall rock frequently show: structural deformation as evidenced by shearing or fracturing of the wall rocks and the development of foliated or cataclastic fine-grained textures along the contact of the pegmatite. Early fracturing is generally obscured by annealing during later phases of hydrothermal activity and is now recognized only by the finer grained texture. Mineralization occurs as minute grains of uraninite and uranothorite either along well developed late fractures associated with magnetite, or around grains of pyroxene and magnetite where fracturing has not developed. Mineralization may occur either on the footwall or the hanging wall, commonly reversing position suggesting important structural controls. Mineralized areas near the centre of pegmatite bodies are generally much finer grained than the enclosing unmineralized portions and commonly show deformation characterized by foliated, fractured, or cataclastic textures. Early fracturing, however, may be obscured by later hydrothermal quartz. These zones are quartz rich, and commonly contain magnetite and zircon. Mineralization in the cataclastic zones is characterized by minute grains of uranothorite plus or minus uraninite and allanite, either surrounding grains of magnetite (Fyson *et al.*, 1979) or between grains of feldspar and quartz. Dusty hematite either along grain boundaries or along fracture surfaces impart a deep, pinkish red colour. Peristerite is a common component of these mineralized sections.

Carbonate-rich pyroxene syenite pegmatites are commonly found near calcareous syenites as discrete bodies but they may also occur as phases in pegmatite of syenite of granite composition. They typically contain reddish feldspars, much sodic pyroxene (aegerine, augite, or sodic hedenbergite), sphene, carbonate, zircon, and apatite. The pegmatite is generally quartz poor to syenitic, always pink to red, and hematized. The carbonate may occur interstitially throughout, but is more prevalent in the central portions of the pegmatite. Uranothorite, allanite, cyrtolite, and sphene are common radioactive minerals but uraninite and pyrochlore or betafite may also occur in significant amounts. Although spectacular samples may be obtained, mineralization is commonly too spotty and the dikes are generally too small to form viable deposits. The pegmatite dikes may be up to 20 metres in length and 2 or 3 m in width but average less than 1 m. They appear to represent a transition between true pegmatites and high-temperature carbonate veins. The York River B zone pegmatite, some of the Eagle-Nest pegmatites, and some of the York River D Zone pegmatites represent this variety.

Deposits in the Pembroke-Renfrew area associated with complex pegmatites include the Madawaska (Faraday) Mine, Greyhawk Mine, and the York River, Eagle Nest, Ambis, Mentor, Legris, Cam (Dungannon), and Opeongo occurrences.

REGIONAL CHARACTERISTICS AND DISTRIBUTION OF UNZONED PEGMATITES

In the Middle to Late Precambrian basement complex, the only variety of pegmatite present is the pink, simple, unzoned type which contains no important uranium deposits. The Late Precambrian supracrustal sequence hosts all the uranium-bearing complex pegmatites of which there are two varieties: white and pink. White pegmatite is prevalent in areas dominated by calcareous rocks, whereas the pink variety occurs abundantly in areas dominated by clastic metasediments and where regional metamorphism has reached the upper almandine amphibolite facies.

The uranium-rich complex pegmatites are found in areas of the supracrustal rocks which have been subjected to intense regional deformation; such areas include troughs flanking gneissic domes and granite plutons. Regional stress is expressed as boundary faults at the contacts of these resistant masses and intense strain development in the plutons and adjacent country rocks. Evidence of strain includes shearing of the granite masses along their borders (recognized by biotitic gneisses), and the development of tight folding, shearing, and an increase in the gneissosity of the adjacent country rocks. The contacts of these large masses are the focal areas not only for faulting, but also for pegmatite intrusion renewed structural activation, and pervasive metasomatism. Where the country rocks are shallow dipping, less strained, folding more open, and the faulting less intense, the pegmatites generally show little evidence of structural deformation or mineralization.

Not only does radioactive mineralization in pegmatites reflect regional structural controls, but it is also controlled by lithology and stratigraphy. For example, in the Bancroft area, dominated by marbles and alkalic intrusive rocks, uranium-bearing pegmatites in metasediments contain little or no molybdenum; whereas many of the uranium-bearing pegmatites in the Renfrew area, which intrude volcanic and volcanoclastic metasediments, contain molybdenite. There also appears to be a spatial relationship between pegmatites hosting significant uranium occurrences and the Late Precambrian unconformity. In a zone 20 to 30 km south of the surface expression of the unconformity, uraniferous pegmatites occur in supracrustal rocks (clastic, calc-silicate gneisses, and carbonate rocks) and in the volcanic regime to the south (Figure 2). There is also a spatial association between the uraniferous complex unzoned pegmatites and the syenitic suite of rocks which broadly parallels the trend of the basal arkose.

Deposits in Granite

The word granite, as used in this report is a general term which includes all quartz-bearing, fine- to medium-grained felsic rocks.

Granitic rocks of many ages occur in the region; most are intrusive in origin but some represent recrystallized and partially remobilized arkosic metasediments. Regionally there are no mineralized granitic rocks of Middle Precambrian age. Late Precambrian granitic rocks may be divided into two main types: a quartz diorite suite and a quartz monzonite suite. The quartz diorite suite which includes quartz syenite generally associated with volcanic rocks are not important hosts to uranium mineralization. The quartz monzonite, possibly of anatectic origin occurs in areas of high-grade regional metamorphism and hosts radioactive occurrences. The coarse (1 cm) pegmatitic "granites" are not included here, as they represent fine-grained, simple, unzoned pegmatites which were discussed previously.

The two principal types of radioactive occurrences in granite, siliceous veins and calcareous veins. The siliceous vein type includes quartz-rich pegmatoid veins, and small fracture filling zoned pegmatites and alteration zones in fractures. The calcareous vein type are pyroxene-biotite veins.

SILICEOUS VEINING

The quartz-rich pegmatoid veins closely resembles the cataclastic quartz-rich zones occurring in pegmatite, except that they are hosted by quartz monzonite. They are characteristically quartz rich (65-75 percent) and cataclastic, with a grain size of 2 to 5 mm. They contain up to 15 percent magnetite and 1 to 2 percent zircon. The feldspar content is low (5 to 15 percent) although it tends to be more abundant (20 to 30 percent) in the contact area which is diffuse, suggesting incorporation of wall rock material. These veins are generally less than a metre wide and rarely exceed 15 to 20 m in length. They may occur as a number of parallel bodies *en echelon* in a zone 20 to 25 m wide and in excess of 200 m in length. They are generally vertical with northeasterly trend similar to that of many pegmatites in the region. Uranothorite, uraninite, and allanite, the main uraniferous minerals, are associated with magnetite grains in fractured granite and quartz veins. Small fractures radiating out from grains of zircon and occasionally grains of magnetite are readily observed in hand specimens. Dusty hematite coats the quartz grains and the fractures.

This type of deposit comprises the principal radioactive mineralization of the Mountain Zone on the Eagle Nest property, previously described as pegmatites by Withers (1976). There magnetite- and quartz-rich pegmatoid veins appear transitional between high temperature quartz veins and pegmatites and they are the most important type of mineralization in granites. Although commonly small, the pegmatite veins are well mineralized.

Similar to pegmatoid veins but with some important differences, are the small fracture-filling zoned pegmatites, found in generally small (less than 30 m) sills and dikes of quartz monzonite. Dikes up to 0.5 m are common. There is a transition along fractures from alteration to the development of pegmatite. The pegmatite is typically zoned with a cataclastic quartz-rich core containing uraninite, uranothorite, allanite, magnetite, and zircon and a feldspar-rich border zone. The uraniferous minerals in the fractured core zone were the last to crystallize. These pegmatite dikelets as well as alteration zones along the fractures are characterized by albitization (peristerite), silicification, and by magnetite and hematite alteration. In some hematized radioactive fractures no radioactive minerals were identified by x-ray analyses. The "zoning" in the pegmatite is interpreted as the progressive alteration and deposition along an open fracture by high-temperature hydrothermal fluids. Contacts with the granite host rock may be sharp or gradational. The dikelets vary in orientation but generally follow cooling fractures or late joints or fracture sets. These bodies, although highly radioactive in some areas, are submarginal with grades of less than 0.5 pounds U_3O_8 per ton. The Cam-Lower Dungannon showings located on the top of a hill immediately north of Highway 500 and west of the York River is a good example of this type of mineralization.

CALCAREOUS PYROXENE VEINS

Uraniferous, calcareous, biotitic pyroxene veins occur mainly in granite particularly along the contacts between the granite and the calcareous metasediments or syenite. Where assimilation of the calcareous metasediments and syenite is evident, this type of veining is well developed (e.g. north of Clear Lake in Sebastopol Township). There, veins are bordered by fenite-like alteration envelopes in which pyroxene (sodic hedenbergite or aegerine augite) formed at the expense of quartz and plagioclase. The veins may be up to one metre in width but generally less than 5 cms. The alteration envelopes are up to four times the vein width. Reddish uranothorite occurs within biotite clusters in the central parts of veins. As noted by Withers (1976) there is a sympathetic relationship between the uranium content of the veins and that of the wall rocks. Veins tend to follow regional jointing as well as local fractures and often have an orientation similar to the pegmatites in the area. Radioactive mineralization is erratic in this environment and it is of interest principally as a source of mineral specimens.

REGIONAL DISTRIBUTION OF DEPOSITS ASSOCIATED WITH GRANITES

Radioactive mineralization. associated with granites occurs in the Late Precambrian supracrustal sequence, associated with late structural deformation of quartz monzonitic rocks and hydrothermal metasomatisms. There is also a spatial association with uranium bearing pegmatites, particularly the complex-zoned type.

The calcareous pyroxene veins occur where quartz monzonite has intruded syenitic suite rocks and marble.

DEPOSITS ASSOCIATED WITH CALCAREOUS ROCKS

Uranium mineralization associated with calcareous rocks is divided into two main categories: mineralization in dominantly carbonate rocks, and mineralization in metapyroxenite or calc-silicate rocks.

Deposits in Carbonate Rocks

Mineralization in carbonate rocks is of two main types: disseminated mineralization in siliceous marbles; and mineralization which occurs within or is associated with coarse-grained marble generally in the form of pods or veins.

STRATIFORM DEPOSITS (DISSEMINATED IN MARBLE)

Mineralization in these rocks generally forms stratiform to local crosscutting disseminations in pyritic and/or graphitic silicate marbles. The marble units are generally thin (20 m) and interlayered with pyritic and pyrrhotitic calc-silicate gneisses, meta-pyroxenites, or syenites. Radioactive mineralization is typified by thorianite or uraninite cubes or intergrowths, up to I cm in diameter, in rock composed dominantly of diopside and salmon pink calcite. Biotite, pyrite, and graphite commonly are present. In mineralized areas grain size is generally 2 to 3 mm. Near the contact with siliceous rocks sphene, apatite, zircon, and uranothorite may also be present. Pegmatites intruding mineralized marbles are generally not well mineralized and the scale of mineralization bears little relationship to the size or frequency of the intrusive pegmatites. In some occurrences there are no nearby pegmatites. These observations cast doubt on a strict contact metasomatic of the uranium mineralization. These carbonate-hosted occurrences may display important metasomatic and structural features, such as dusty hematization, or coarse recrystallized portions in mineralized parts. Commonly these mineralized marbles overlie granitic rocks, either granite or meta-arkose. This type of deposit is a potential source of uranium in the Bancroft Camp but the viability of this type of deposit has been lessened, like many of the pegmatite occurrences, by the irregularity of mineralization. The South State (North) deposit is a good example of this type of deposit.

STRATABOUND DEPOSITS (URANIUM IN CARBONATE PODS)

Coarse-grained (1 to 10 cm) recrystallized and mobilized carbonate pods occur within marble units and the mineralized parts are characterized by the presence of pinkish calcite, muscovite or biotite, pyrite, as well as tremolite and diopside. Cubes of uraninite as large as 2 cm, but generally ranging from 1 to 5 mm are spatially associated with biotite and/or pyrite in fractures. Apatite and/or fluorite may be present but these minerals are not common. These deposits normally show gradational contacts with the finer grained host marble but locally they display cross-cutting relationships. The gradational contacts of these coarse-grained bodies of calcite with the host marble is consistent with an anatectic or metasomatic origin, similar to the formation of pegmatite from granitic rocks. Uranium mineralization may occur over large areas but it is characteristically spotty. The Normingo-Cam occurrence in Dungannon Township and the Rockingham occurrence in Brudenell Township are two examples of this type of deposit.

Meta-pyroxenite-Skarn Deposits

Two types of uranium deposits associated with pyroxene-rich rocks are recognized in the study area. These are: metamorphic metasomatic pyroxenite deposits, and contact metasomatic skarn deposits.

Metamorphic metasomatic pyroxenite rocks are not directly related to an intruding igneous body. In general they occur interlayered with carbonate meta-sediments and metasandstones. The metapyroxenite is a greenish coarse-grained (up to 20 cm) rock containing abundant biotite and scapolite. The metapyroxenites are commonly not deformed, showing no foliated textures, even though they may be interlayered with gneissic rocks. These metasomatic rocks are host to uranium mineralization in the Bancroft area, and host to important molybdenum-uranium mineralization in the Pembroke-Renfrew area. Uraninite is the main radioactive mineral and is usually associated with biotite, although it may also be associated with sulfides in molybdenum deposits. Uranothorite is rare and occurs in late pegmatites which cut these deposits. The structural environment of these deposits is similar to that of the unzoned pegmatite type. They are located in areas of intense deformation and pervasive hydrothermal metasomatism in steeply dipping strata bordering large granitic bodies. Widespread scapolization adjacent to many of these deposits attests to the intensity of the metasomatism.

The Zenith (Bagot Township) and Spain (Griffith Township) molybdenite deposits are good examples of this type. The mineralogy and metallogenesis of these deposits are discussed by Karvinen (1973) and by Carter *et al.* (1979). The uranium present in these occurrences would be of economic interest only as a by-product in the recovery of molybdenum. Also, metapyroxenite is intercalated between syenite and marble on the South State property (North Occurrence). There, erratically distributed uraninite is associated with biotite in fractured metapyroxenite. Deposits of this type are restricted to areas of intense deformation and metasomatism in carbonate rocks. Commonly the occurrence may be fault controlled.

Contact metasomatic deposits (skarns) were formed by the reaction of granitic pegmatitic melts with carbonate metasediments. These skarns are composed mainly of biotite, tremolite, actinolite, scapolite, diopside, and carbonate, with minor amounts of apatite, sphene, fluorite, and zircons. Both uraninite and uranothorite may be present. Where mineralized the carbonate is pinkish, likely representing dusty hematite along cleavages and grain boundaries. Skarns of this type in the study area are small and the mineralization is both minor and erratic. The Bonville occurrence in Faraday Township is in part skarn although most radioactive mineralization is in pegmatite.

VEIN OCCURRENCES

Carbonate Veins

There are two types of uraniferous carbonate veins recognized in the study area: the fluorite, apatite-rich pink carbonate veins (Fission type, Satterly 1957); and the calcite, fluorite, apatite, biotite, diopside, hornblende, scapolite veins (Cardiff or Eagle Nest type). Withers (1976) reports that in veins of the Eagle Nest type it is rare to find all assemblages together.

The Fission type is characterized by abundant fluorite and apatite in a pink carbonate matrix, with or without wall-rock selvages of pyroxene. Generally the orange pink colour of the carbonate is more pronounced in the presence of uranium mineralization. Apatite generally forms well developed red to greenish crystals which are commonly oriented parallel to the dike walls. In nonmineralized veins, apatite is variably green to light green; and fluorite, which occurs as stringers in carbonate, is light purple. In mineralized veins, apatite is reddish and fluorite is deep purple to almost black. The only reported uraniferous vein of this type in the study area is the Vaughan occurrence in Ross Township. In this vein uranothorite occurs at the vein contacts in a pyroxene assemblage. Pyroxene is absent at vein contacts in unmineralized veins in the same locality. Satterly (1957) reports that the fluorite apatite veins in the Fission Mine (to the west of the study area) are only mineralized where they have been deformed by shearing.

The Cardiff-Eagle Nest type of carbonate veins are typically zoned , and include an outer feldspar zone, an inner pyroxene zone, and a core mainly of carbonate. The feldspar in the outer zone appears to be derived from the wall rocks. The pyroxene in the inner zone appears to have formed by reaction of the carbonate fluid with the wall rocks. The carbonate core zone may contain biotite, fluorite, apatite, and sphene. Mineralization generally occurs as disseminated uraninite, uranothorite, and allanite, commonly occurring with biotite and pyroxene. Where mineralized the vein may be hematized. There is a positive correlation between the amount of mineralization in the veins with the intensity of deformation and metasomatism in carbonate rocks.

Pyroxene Veins

Pyroxene veins show similarities to carbonate viens but they are usually much smaller, averaging less than 5 cm, and they have only a minor carbonate content. As with carbonate veins, they follow regional joints and fractures, commonly sharing the same attitudes as pegmatites. In the Bonnechere-Eganville area of Renfrew County, pyroxene veins have the same orientation as the Ottawa-Bonnechere Graben, suggesting early stages of graben formation may have occurred in Precambrian time.

Radioactivity in these veins occur only where they intersect granitic or syenitic rocks and it is most pronounced where they cut granite pegmatites. The veins are characterized by extensive fenite alteration of the granitic host rocks. Uranothorite and thorite are the main radioactive minerals in these veins although allanite and uraninite have been reported. A good example of this type of mineralization is the Lake Clear uranium occurrences in Sebastopol and Grattan Townships. Radioactive minerals are common in these veins, but the veins are too small and too dispersed to be economically important.

GENESIS OF URANIUM DEPOSITS IN METAMORPHIC TERRANES

The spatial relationship of unzoned pegmatites and most zoned pegmatites to areas of high-grade regional metamorphism rather than to intrusive granites suggests an anatectic origin. This hypothesis is consistent with the abundance of pegmatite in clastic metasediments as opposed to intrusive granite or carbonate rocks. Furthermore, the abundance of pegmatites in the Late Precambrian supracrustal sequence, is compatible with the hydrous character of the younger metasedimentary rocks an environment conducive to the development of anatectic melts during high-grade regional metamorphism. The age of the pegmatites precludes a genetic connection to the intrusive granites. According to Fyson *et al.* (1979) the pegmatites are about 230 m.y. younger than most of the intrusive granites which have been dated at 1250 m.y.

The genesis of the complex-zoned pegmatite (beryl type) may be more complex than that of the simple-zoned type. The mineralogy, internal structure, and geochemistry of the two types are markedly different. They may represent a more fractionated portion of an anatectic melt derived by partial melting of country rocks containing trace beryllium, or alternatively they may represent a residual component of a crystallizing granitic magma.

The zoning of pegmatites was likely controlled by the shape and relative stability of the openings into which the melts intruded. The pod-shaped bodies of zoned pegmatites indicate that the closed ovoid chambers did not permit immediate degassing, allowing time for differentiation and large crystal growth. The greater width-to-length ratio of the pod-shaped deposits compared with the long, narrow, branching pegmatites which occupy joints, faults and major fractures may also be a factor, as the surface contact per volume of melt is smaller, thereby permitting slower cooling.

Intrusion of pegmatitic melt into the narrow openings would result in comparatively rapid degassing and rapid cooling, permitting at best only crude zoning and development of the finer grained texture characteristic of the unzoned pegmatites.

Radioactive minerals such as the titano-tantalo-columbates are often found in zoned pegmatites and only rarely in unzoned pegmatites. The highly gaseous fluid environment and slow cooling of zoned pegmatites allows migration and concentration of trace amounts of Nb, Ta, Zr, U, Th, and rare earth elements (hereafter REE), and permits the crystallization and growth of minerals composed of these elements. Rapid degassing and fast cooling, typical of unzoned pegmatites, does not allow sufficient time for trace elements to migrate and crystallize as discrete minerals. These elements are dispersed among the rock forming minerals such as sphene, pyroxene, and biotite, where they substitute for common elements or are trapped in minerals with large, open, crystal lattices such as apatite.

The ability to scavenge trace radioactive elements in zoned pegmatites appears to be enhanced in a high CO_2 environment (Wendlund and Harrison 1979). The only two zoned pegmatites, at MacDonald Mine and Woodcox Mine, which have important amounts of carbonate in the core zone also contain the largest concentrations of rare earth and radioactive elements: niobium and tantalum. Similar relationships have been observed in carbonatites which have carbonate core zones and commonly carry important amounts of uranopyrochlore (e.g. the Newman Deposit, Lake Nipissing (Robertson, 1978)). It is not implied that the carbonate-bearing zoned pegmatites under discussion are genetically related to carbonatites, but rather that both have high-temperature volatile phases rich in H_2O, CO_2, and F, which may have scavenged Nb, Zr, REE, U and Th elements.

The textural and mineralogical homogeneity of simple unzoned pegmatites suggest that crystallizing conditions did not permit segregation of the melt into mineralogical and textural units except along contact and border zones. Textural and mineralogical variation may occur in more complex types of unzoned pegmatites. This, however is not the result of segregation crystallization but rather of contact metasomatism and wall-rock reaction, and/or post-magmatic hydrothermal metasomatism in fractured sections of the pegmatite.

Most unzoned pegmatites appear to have been formed from granite melts, although contamination by partial assimilation of certain wall rocks have caused partial to complete syenitization. Late syenitizing fluids of local anatectic derivation have permeated fracture zones within granite pegmatites also causing minor to extensive syenitization. This type of hydrothermal alteration which characterizes complex-unzoned pegmatites is only observed where pegmatites have intruded portions of the stratigraphy in which syenite is present. Pegmatites derived from syenitic melts, such as the corundum and nepheline-bearing varieties, are very poorly mineralized with uranium; they generally contain only widely scattered grains or small local concentrations of allanite and zircon, although pyrochlore and uraninite have been reported from a few occurrences, for example the Craigmont Corundum Mine (Ellsworth 1932). This paucity however is consistent with the very U and Th poor (usually $<$ ppm U_3O_8, $<$ 10 ppm Th) nature of nepheline and corundum syenites.

Uranium enrichment in pegmatites is a two-stage process that includes a primary concentration, and a secondary concentration or enrichment. All the uranium deposits which have supported production in the Grenville Province are the result of this two stage process.

Primary concentration of radioactive minerals in pegmatite is by selective segregation and concentration of granitic components as well as U and Th by partial melting and dehydration of country rock during high grade regional metamorphism. The presence of water, as well as other volatiles, not only lowers the melting temperature of the granitic component, but also makes the melt extremely fluid, allowing easier movement into low pressure areas such as fractures. The partitioning of uranium into a partial melt is a consequence of its large ionic radius and inability to fit into the crystal lattice of rock-forming minerals. As a result the uranium is deposited primarily in cleavages and fractures in these minerals having a special affinity for the mafic minerals. (Dostal and Capedri 1978). Uranium is readily soluble in the oxygenated aqueous environment of pegmatite formation especially in the presence of CO_2, F, and P, which enhance its mobility. The amount of uranium in a pegmatite formed by the anatectic process will depend largely on the content of uranium in the country rocks, as well as the amounts of volatiles such as P, F and CO_2. Although anatectic pegmatites are slightly enriched in uranium relative to other igneous rocks, only those which are derived from country rocks that are slightly or moderately enriched in uranium, will have important primary concentrations. That primary enrichment of pegmatites has occurred by the partial melting of strata with anomalous amounts of uranium, has been well documented, in the lower portion of the Late Precambrian Grenville supracrustal sequence in Quebec (Allen 1971; Tremblay, 1974; Kish 1975, 1977).

Secondary enrichment of uranium in pegmatite may develop under three sets of conditions: 1) residual igneous phases and/or metamorphic metasomatic fluids leaching U, Th, and REE that were originally dispersed throughout the pegmatite and concentrating these elements in fracture zones; 2) contamination of the pegmatite intruding a previously mineralized strata either by assimilation or hydrothermal leaching; and 3) the most important mineralizing process appears to be similar to the first process described above except that the post-magmatic hydrothermal alteration of the pegmatite in fractured portions is caused by hybrid fluids, containing components from both the pegmatite and the country rock.

Simple-unzoned pegmatites appear to have become mineralized by the first process which is indicated principally by the homogeneity of the pegmatite and the relatively simple alteration involving silicification, albitization, and biotite alteration. Pegmatites which have been fractured or sheared become highly pervious to late hydrothermal fluids or post-magmatic metasomatism. If hot gaseous solutions are able to pass through the pervious pegmatite, then uranium will be leached from one area and deposited in another. Hydrothermal alteration of the pegmatite may occur simultaneous with, or slowly after, crystallization of the pegmatite, a process involving residual fluids of the anatectic melts and/or heated meteoric or metamorphic waters. Deposits showing higher concentrations of uranium, fracturing, and hydrothermal alteration apparently followed soon after intrusion and crystallization of the pegmatite. The greater the primary concentration and deformation of the pegmatite, as well as the longevity and pervasiveness of the secondary enrichment process, the greater the chances of forming an economic deposit. Pegmatites with low primary uranium concentration may show enrichment if deformation and post magmatic activity are intensive. For example, pegmatites which have intruded periodically reactivated fault zones, especially during the period of pegmatite intrusion may show secondary enrichment. This appears to be the case of the Bordun occurrence in South Canonto Township and possibly the Mell-Quirke occurrence in Monteagle Township where mineralized pegmatites are spatially associated with thin biotite-schist horizons, possibly representing shear zones.

Simple unzoned pegmatites may also become mineralized by the processes of assimilation and contact metasomatism where they intrude rocks with existing uranium mineralization. It has been observed that pegmatites acquire the mafic mineralogy of the country rocks intruded (Gordon and Masson 1977). For example, if a pegmatite intrudes pyritic rocks, it may contain pyrite (Card occurrence), or if intruding biotite gneisses, it will contain biotite (Barr Feldspar Quarry). It follows that the uranium content of the country rocks may also become incorporated into the pegmatite either by wall-rock reaction and ingestion, or by post-magmatic hydrothermal activity where waters, driven by heat from the cooling pegmatite, circulated through the immediate country rocks and dissolved and redeposited the uranium in fractures in the pegmatite.

Examples of the process of uranium enrichment by assimilation are the pegmatite dikes intersecting the Spain and Zenith uranium-molybdenum deposits. The pegmatite is uraniferous only where it cuts uranium-molybdenum mineralization. Pegmatite dikes adjacent to these deposits are not anomalously radioactive.

Complex pegmatite deposits result from a complex process of hydrothermal enrichment involving deformation, wall-rock reaction, assimilation, and hydrothermal metasomatic alteration by gaseous fluids composed of components derived from the host pegmatite and the country rocks. Uranium is present principally in those fine-grained portions of the pegmatite which are interpreted as annealed fracture zones and/or zones of quenching caused by sudden pressure release in shears or fractures. Later deformation is represented by cataclastic zones.

In the complex unzoned pegmatite (Faraday) uranium is commonly concentrated at the pegmatite contacts in areas where cataclastic textures are well developed; a condition promoting wall-rock reaction during hydrothermal activity and facilitating uranium precipitation. Oxidizing uraniferous hydrothermal fluids circulating through the cataclastic zones would alter the mafic silicates to magnetite, so the solutions would become reducing and uranium would then be precipitated. In most deposits of this type, there are indications that the amount of uranium present is in part dependent on the composition of the country rocks. Masson and Gordon (1979, p. 191) state that the "majority of the uranium deposits of the Bancroft area occur within or adjacent to areas dominated by alkalic granitic and syenitic rocks. Where granites or granite pegmatites have intruded that portion of the stratigraphy containing syenites, the geochemistry of these country rocks [rich in F, P, and CO_2] aids in the mobilization and redistribution of uranium [and Thorium] into mineralized zones. Some of the uranium-rich syenitic pegmatite phases found in some complex deposits may result from a mixing of fenitizing fluids derived from the country rocks with the pegmatitic melt. The high fluorite content in the ore of the Bicroft mine is to be expected, as the country rocks are dominantly syenites." Some mineralized phases of pegmatite in the Faraday deposit, hosted to a large extent by metagabbro, are alkalic suggesting that the syenite rocks underlying the metagabbro may have contributed to the composition of the pegmatite. The uranium content may, in part, have its source in the syenite.

Lithologic and textural varieties of complex mineralized pegmatites can be attributed to: composition of wall rocks involved in wall-rock reaction; deformation as it related to early residual and metasomatic fluids or late hydrothermal fluids; and the extent of contribution of components from the country rocks to the post-magmatic metasomatic or hydrothermal fluids.

Although radioactive minerals and pegmatite mineralogy vary in detail in complex pegmatites, a sequence of events is envisaged in the mineralizing process which gives rise to a variety of mineralogies and lithologies present in any one pegmatite body. Concentration of uranium and thorium in the pegmatite is seen as the result of a complex multi-stage process beginning with the intrusion into fissures of an anatectic pegmatitic melt during high-grade regional metamorphism. In the case of pegmatite dikes with sharp contacts and relatively refractory wall rocks, contact metasomatism was minimal. However, if the pegmatite intruded an active shear zone, or in calcareous rocks, then contamination by assimilation and contact metasomatism was moderate to extensive. The reducing nature of both country rocks and the redox reaction during contact metasomatism and host-rock assimilation would cause precipitation of uranium within the contaminated border zone of the pegmatite, as evidenced by hematite and magnetite alteration of iron silicates. Cataclastic zones, which developed at the pegmatite host-rock contacts during renewed tectonic activity, provided ideal conditions for reaction between the brecciated host rock and circulating metasomatic fluids. During the alteration (oxidation) of the mafic silicates to magnetite and to a lesser degree to hematite, the solutions become reducing and precipitate uranium and thorium. These reactions are consistent with the high magnetite and hematite content commonly associated with uranium mineralization.

Late-stage fracturing after complete crystallization of the pegmatite was followed by hydrothermal activity in cataclastic zones. The mineralogy of the late mineralizing phase indicates that the hydrothermal fluid was essentially water with a high content of silica, sodium, and iron as well as uranium, thorium, and zirconium. Late cataclastic zones contain uraninite, uranothorite, and magnetite, and are characterized by their high quartz and zircon content. In the case of fractures extending into a mafic host rock, hydrothermal alteration takes the form of biotitic quartz-rich pegmatoid which generally has a high uranium content. Examples of this type of mineralization are present in the Faraday and Greyhawk deposits.

The carbonate-bearing syenite pegmatites represent a transition between true pegmatite melt and high-temperature carbonate veins. Spatial relationships indicate that the carbonate component is derived from calcareous syenites or marble, whereas the source of the pegmatite is the granitic country rocks. The provenance of the uranium and thorium is presumably granitic country rocks with a minor contribution from syenite. However, pyrochlore-rich varieties have a high syenite affinity, for example the York River B Zone.

Uraniferous siliceous veins in granite may be the result of either post-magmatitic hydrothermal activity or metamorphic metasomatic hydrothermal activity during high-rank regional metamorphism. Distinguishing them is difficult because the end products are similar.

Post-magmatic hydrothermal activity may develop through autometasomatism or through heat generated by granite on waters of external sources. Autometasomatism Rogers *et al.* is the alteration of igneous intrusions by their own aqueous fluids and vapours and it is commonly associated with albitization and silicification. During alteration, uranium and thorium are released and transported to low pressure cataclastic zones resulting from syntectonic deformation of the cooling granite. Similarly meteoric or metamorphic water from the enclosing metasediments may have reacted with the cooling granite and mobilized uranium. In this case, it is to be expected that there would have been a contribution from the metasediments of elements including U, Th, REE, and Zr as well as mobilizing components such as F, P, and CO_2. This may be an explanation for granites which are intrusive into syenite (rich in F, P, and CO_2) having a greater concentration of radioactive minerals.

Similarly metamorphic metasomatic hydrothermal activity may generate radioactive deposits. Dehydration during high-rank regional metamorphism mobilizes and transports aqueous solutions through fracture systems, leaching U, Th, REE, Na, Si, Fe, and Zr which are redeposited in deformation zones at higher levels. These deposits are in structures which post-date the granite and are younger than those of autometasomatic origin. The zircon-, magnetite-, quartz-rich pegmatitic veins of the

Eagle Nest property (Mountain Zone) are an example of this type. These occurrences have been described as pegmatites but it is doubtful that they represent true pegmatite melts. The authors postulate that the deposits were formed from silica-rich fluids circulating in fractured granite from which quartz, magnetite, zircon, allanite, uraninite, and uranothorite were precipitated. The presence of zircon is evidence that the mineralizing fluids are late stage hydrothermal, for according to Vlasov (1964) zirconium is not concentrated in residual melts but is concentrated at an early stage in biotite, amphibolite, and pyroxene. However, the oxygenated hydrothermal fluids have altered the fractured rocks, breaking down the iron silicates to magnetite and hematite and releasing zirconium to form the silicate zircon. This mechanism is believed to have been operative in the formation of the late-stage siliceous cataclastic zircon-bearing zones in granite and granite pegmatites. It is also suggested that this process is responsible for the formation of uraninite and uranothorite from U and Th tied up originally as trace elements in rock forming minerals.

In general, whether dealing with post-magmatic or metamorphic-initiated process either in granites or pegmatites, late-stage uranium mineralization is characterized by silification, albitization, and magnetite and hematite alteration. Oxidation of the iron reduces the fluid, causing precipitation of uranium as evidenced by uraninite and uranothorite on crystal boundaries and in fractures in the magnetite. Hematization represents further oxidation of the iron and further reciprocal reduction of the fluids. However some hematization occurring in late fractures and as halos around radioactive minerals is the result of oxidation by uranium, and is not the cause of uranium precipitation.

Calcareous mineralization in "granites" apparently results from the leaching of uranium during fenitization. Carbon dioxide-rich fluids alter the granitic wall rocks and mobilize uranium. In the process granite is syenitized through the replacement of quartz, plagioclase and mafic minerals with aegirine-augite or sodic hedenbergite. However because these veins are small (<5 cm) and are not pervasive, mineralization is commonly spotty. The only instance where pervasive pyroxene veining was observed was in some quartz syenites, suggesting they may have represented completely metasomatized granitic rocks. However it is possible that extensive syenitization of some granitic rocks brought on by regional metamorphism could have supplied the mineralizing metasomatic fluids responsible for the formation of skarns and complex-unzoned pegmatites. This may also explain the syenitic geochemical signature of unzoned pegmatites.

In the case of stratiform disseminated uranium in marble, four genetic models are envisaged although only the latter two are considered as likely mechanisms for the concentrations of uranium:

a) contact metasomatic skarn deposits associated with pegmatite. This concept seems unlikely except on a very local scale. The majority of pegmatite bodies intruding mineralized marble are neither well mineralized nor large enough to account for the extent of uranium mineralization in the marble. With some deposits there is no associated pegmatite.

b) syngenetic biogenic precipitation of uranium during deposition of the carbonate. Although abundant graphite makes it tempting to adopt this model, the high Th content of the mineralization suggest that it is unlikely.

c) early epigenetic pre-metamorphic uranium mineralization. The majority of the deposits are located either in areas in which marble and meta-sandstone are interlayered or in marble units adjacent to the basal arkose (i.e. Rockingham Mine). The spatial relationship to the meta-sandstone and arkose implies an early epigenetic origin for the stratiform disseminated uranium in marble. That is, uranium leached by meteoric waters from arkosic rocks (aquifers) prior to the onset of the Grenville Orogeny would have been redeposited in reductive pyritic carbonate rocks, either stratigraphically above or interlayered with the clastic rocks. As the host carbonate rock has been subjected to high rank regional metamorphism and the uranium in all probability has been remobilized to some degree, proof for this model is difficult and it remains speculative at this time. However, uranium deposits of this type have been reported in the Wollaston Fold Belt of Saskatchewan (Tremblay 1978)

d) a synmetamorphic metasomatic model. Many stratiform carbonate hosted uranium occurrences display well developed metasomatism with associated structural deformation. In such deposits, uranium mineralization may be the result of metasomatic fluids circulating through shear or fracture zones in marble in which graphite and pyrite provide a reducing environment for precipitation of uranium. The author has observed that marble deformed by faulting shows a substantial increase in the graphite content. Many uraniferous marble occurrences are located structurally above granitic rocks, a spatial association compatible with a source of the uranium and thorium in metamorphic-metasomatic fluids derived from granite. The high thorium to uranium ratio of these deposits indicates a high-temperature metasomatic origin. Alternatively, this type of deposit may represent a modification of early pre-metamorphic epigenetic uranium mineralization through the process described above.

The pod-shaped variety of strata-bound deposits of uranium in marble represents remobilization through partial melting under conditions of high-rank metamorphism of disseminated uranium in marble as described above.

High-temperature carbonate veins are believed to be anatectically remobilized carbonate from calcareous rocks, principally marble and calcareous syenites. Spatial and geochemical associations indicate that fluorite-apatite-rich carbonate veins are genetically related to calcareous syenite. Uranium and thorium may have their source with the carbonate or alternatively the high CO_2, P, and F content of the veins scavenged uranium through reaction with the wall rocks. The latter concept is favoured as a source of uranium in the Eagle Nest veins in which there is a positive correlation of uranium and thorium in both vein and wall rocks. (Withers 1976; Gordon and Masson 1977, 1978; Masson and Gordon 1979).

Pyroxenite may be formed as a result of metamorphic metasomatic reaction at the contact between chemically dissimilar rocks such as limestone and sandstone. The composition of hydrothermal fluids generated in the reaction is dependant on the chemistry of the rocks involved. In the Pembroke-Renfrew area, where metapyroxenites are associated with uranium-molybdenum occurrences, the mineralization is present in sulphide-rich pockets or in biotitic metapyroxenite at the contact between marble and sulphide-bearing volcanoclastic metasediments and wackes. Dehydration of these rocks during high-rank regional metamorphism released metasomatic fluids which penetrated the fractured zones. These fluids are thought to have been rich in Cl, CO_2, S, and N_2 inasmuch as scapolitization and iron sulphides are associated with uranium-molybdenum mineralization and metapyroxenite (Karvinen 1973). Uranium and molybdenum leached from country rock by oxygenated metamorphic hydrothermal fluids were reduced and precipitated on reaction with country rocks with a high iron-sulphide content (e.g. volcanic rocks). In the case of the Zenith molybdenum-uranium deposit, granite in the immediate area shows radioactive levels of two to three times the background level. It is suggested that the uranium was leached from granite whereas the source of the molybdenum and sulphur was the volcanic rocks. It is interesting that uranium mineralization in the metapyroxenites occurs at marble-granite contacts whereas molybdenum occurs in marble with intercalated volcanoclastic rocks.

Contact metasomatic skarns, unlike metamorphic pyroxenites described above, are true skarns having formed by reaction between intrusive rocks and carbonate metasediments. Greater concentrations of uranium mineralization are associated with the metamorphic type, possibly because hydrothermal metasomatism initiated by metamorphism extends over a greater period of time than contact metasomatism.

Uranium deposits in basal Paleozoic rocks (March Formation) are the epigenetic sandstone-dolomite type in which dissolved uranium in oxygenated ground waters moves through porous sandy beds to be precipitated in a reducing environment at such places where hydrocarbons are present. The source of the uranium is the Late Precambrian Grenville supracrustal sequence which unconformably underlies the Paleozoic rocks in the eastern part of the area.

CONCLUSIONS

Stratigraphic Controls on Uranium Deposition

Stratigraphy has exercised a broad regional control on uranium mineralization in the study area both in concentration of uranium and mineral species. Approximately 85 percent of all reported occurrences and all of the major deposits are located within the lower half of the Late Precambrian supracrustal sequence known as the Grenville Supergroup (Figure 2). In these rocks the principal deposits are in complex-unzoned pegmatites in which the main uranium minerals are uraninite and uranothorite. Within the underlying Middle to Late Precambrian basement complex there are a few minor occurrences in late simple granite pegmatites in which the sparse uranium content is chiefly in rare earth minerals such as allanite and euxenite. In the basal Paleozoic rocks overlying the Grenville Supergroup uranium and copper are associated with concentrations of hydrocarbons in porous sandstone-dolomite of the March Formation.

By far the largest concentrations of uranium in the Grenville Province including all of the production from the Bancroft camp are from the upper three formations of the Hermon Group (Bright 1977, 1979) which is in the lower part of the Grenville Supergroup succession. The Hermon Group underlies the sparsely mineralized Mayo Group, a dominantly carbonate sequence with minor clastic units.

The basal arkose underlying the Hermon Group, hosts numerous granite pegmatites which contain little uranium. The sparse uranium present occurs mainly as isolated crystals in pyroxene veins and small fractures in pegmatite. Higher concentrations of uranium associated with intercalated carbonate rocks are present near the top of the arkose.

One important provenance of uranium in the Late Precambrian supracrustal rocks is probably the Middle to Late Precambrian basement complex which is situated to the north of the study area and is dominated by the Algonquin Batholith. Erosion of the batholith probably contributed a major portion of the clastics comprising the basal arkose of the Late Precambrian Grenville Supergroup. Concomitant with erosion, uranium was leached from the batholith and the basal arkose which may have acted as an aquifer prior to the Grenville Orogeny. It is suggested that uranium, mobilized during the Grenville Orogeny, has been precipitated higher in Grenville Supergroup strata where intercalated calcareous sandstone, siltstone, shale, and limestone represent a more reducing environment than the underlying arkosic sandstone. A similar model was proposed by Tremblay (1978) for disseminated uranium deposits in calc-silicate rocks in the Wollaston fold belt. Tremblay also postulated that uraniferous sediments contributed uranium to anatectic pegmatites. He noted that in the dominantly clastic succession of the Wollaston Domain, pegmatites are uraniferous only in areas where calc-silicate rocks are present. Sibbald *et al.* (1976) and Ray (1977) also describe uranium deposits of the calc-silicate type in the Wollaston domain and ascribe a syngenetic origin to them. The South State, Normingo-Cam, and Rockingham occurrences may represent this type of deposit. Certainly it is very difficult to ignore the proximity and possible significance of a major Late Precambrian (Helikian) unconformity, as elsewhere in the shield (Wollaston Basin, Baker Lake etc) it was a time of major uranium transport and deposition.

In the Mount Laurier Area of Quebec, Allen (1971),

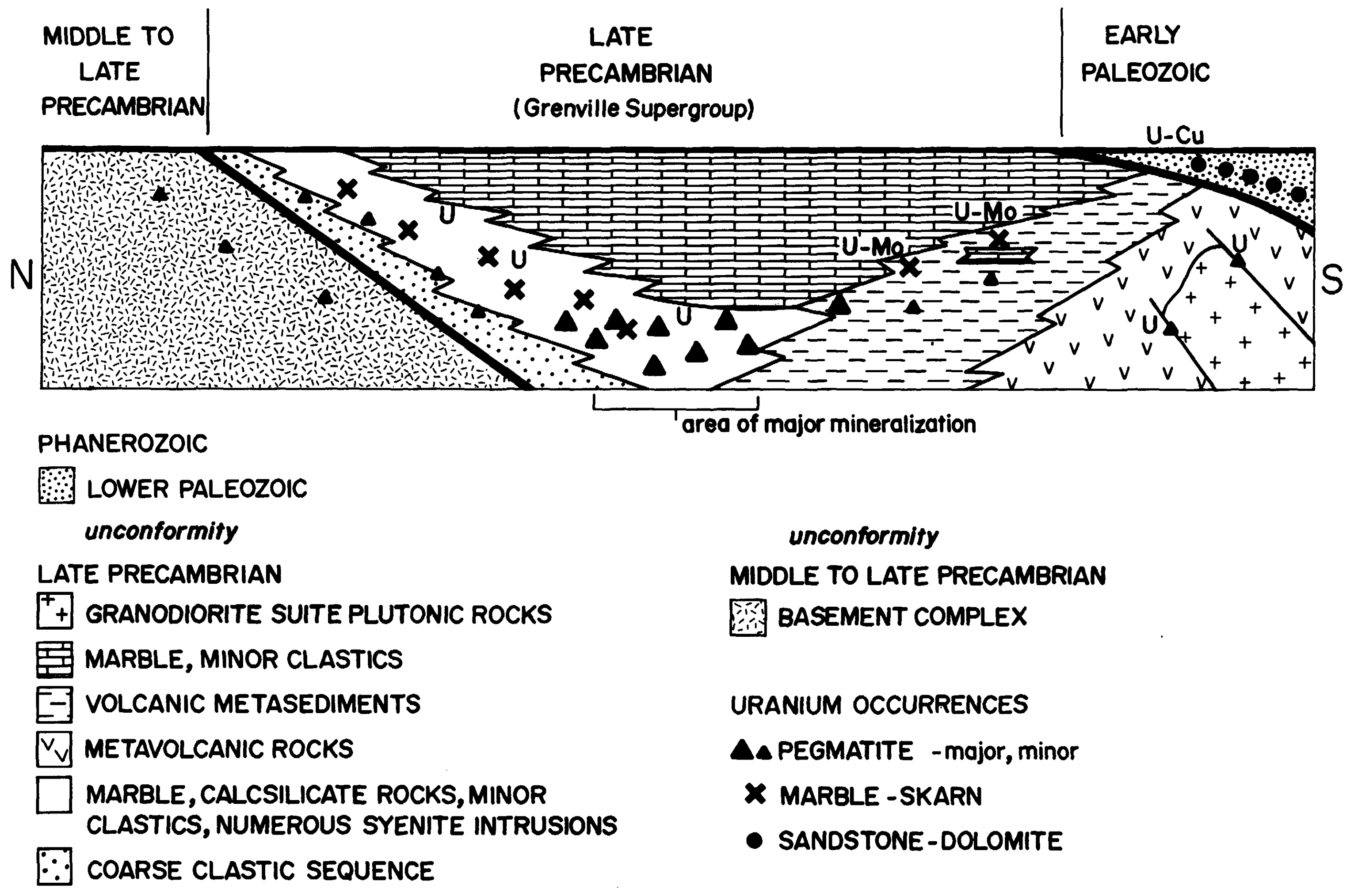


Figure 2—A symbolic sketch relating Uranium Occurrences and Stratigraphy

Tremblay (1974), and Kish (1975, 1977) have shown that biotite gneiss and calc-silicate gneiss near the base of the Grenville supracrustal rocks, are the source of uranium in anatectic uraniferous pegmatites. Allen favours early epigenetic pre-metamorphic precipitation of uranium in these sediments.

Uranium weathered from the basement complex may also have been deposited where the more silty and argillaceous sediments interfinger with sulphide-rich (reducing) wacke and tuffaceous sediments derived from the volcanic regime to the southeast. Anatectic pegmatite melts in this environment of facics change would be expected to be enriched in uranium.

Bright (1977) reporting on his field work in the Eels Lake area, west of Bancroft, makes the observation that most of the uranium deposits are in the pegmatite which cuts the metasediments and metavolcanics of the upper Hermon Group which is characterized by abundant volcanoclastic metasediments, subordinate volcanics, metasandstone, and calcareous metasediments. Bright (1977, 1979) suggests that volcanoclastic tuff and tuffaceous wacke may represent a primary igneous source of uranium in a sedimentary basin. Although there is evidence in the literature in support of uranium leaching from volcanoclastic sediments, uranium is not present in great abundance in other areas of the Grenville Supergroup hosting volcaniclastic sediments. Rather, the close spatial relationship of the Bancroft camp to the Middle - Late Precambrian unconformity and to a volcanogenic regime indicates that: 1) the provenance of uranium in the Supergroup rocks is the basement complex (Algonquin Batholith); and 2) the precipitation of uranium from aqueous solutions in the clastic sediments intercalated with reducing volcanogenic sediments is a major control to first-stage enrichment of uranium in the Grenville rocks.

Bright (1977, 1979) and Gordon and Masson (1978) report that uranium in the Bancroft area shows a direct correlation with syenitic rocks. Bright (1977) has interpreted the syenite gneisses as trachytic tuffs which are known for their high uranium content (approximately 10 ppm). The writers Gordon and Masson (1978) at first supported this hypothesis since the well layered and apparent interbedded nature with marbles strongly suggested sedimentary deposition. However, detailed mapping in the area by Masson in 1979, supported by discussions with S.B. Lumbers who was also working in the area, shows that these well layered syenitic gneisses coincide with areas in which there has been intense deformation. In areas which have been only moderately deformed, relict igneous textures and intrusive relationships indicate that igneous syenites in the area are intrusive rather than volcanic. Detailed mapping (Masson, In preparation) demonstrates that uraniferous pegmatites in the syenite belt are located in areas which have undergone both intense early deformation (Grenville Orogeny) and late stage cataclasis. Whole rock and trace element geochemical analysis of the syenite shows a high carbon dioxide and fluorine content. These components promote the mobility of uranium. Conversely, where the pegmatites and syenitic country rocks are undeformed, the interaction of country rock geochemistry in the granite pegmatite during the late hydrothermal stage is minimal, resulting in unmineralized pegmatite. The role of syenites on uranium deposits in pegmatite as perceived by the authors is in providing mobilizers during the hydrothermal phase. Uranium was not only mobilized and concentrated in zones of deformation within the pegmatite but also significant amounts of uranium were leached from the syenitic country rocks.

The effect of country rock geochemistry on the mineralogy of pegmatites is demonstrated by the zoned pegmatites of this area are exceptionally high in Zr, U, Th, Nb, REE and $CaCO_3$, reflecting the geochemistry of the syenite country rock which surround them. Zoned pegmatites occurring in the Middle Precambrian terrain or in areas of the Lake Precambrian supracrustal sequence where there are no syenites, are not nearly as enriched in these elements. The lack of effect of syenite contribution to the mineralizing process is reinforced by uranium mineralization in southwest Anstruther Township, Hastings County. It shows two important things: 1) there are no syenites present yet there are important zones of mineralization suggesting the syenites are not the major source of uranium and 2) that since the zones are subeconomic the absence of mobilizers derived from the syenite had an effect on the degree and extent of mineralization. Therefore although occurrences in this area shared favourable structural and stratigraphic controls, they lacked the lithological and geochemical controls of deposits in the syenite belt.

In conclusion, the uranium now found in skarns and pegmatites of the Bancroft area probably had a number of ultimate sources: a) the Late Precambrian supracrustal sequence, where much of it may have come from the erosion of the Algonquin Batholith; b) in part from the syenites and c) from quartz monzonite intrusive rocks such as the Faraday Granite. Also the high Th content of many of these deposits is consistent with an anatectic development and high temperature hydrothermal metamorphic driven system.

Conditions Favourable to Uranium Deposition

The principal controls in the formation of ultrametamorphic uranium deposits in the Bancroft-Pembroke area are:

a) pre-metamorphic concentration of uranium within the hydrous supracrustal sequence of the Grenville Supergroup

b) high-rank regional metamorphism of at least the upper almandine amphibolite facies

c) regional deformation including folding, faulting, shearing, and brecciation which provided openings for the emplacement of pegmatite as well as channelways for metamorphic metasomatic fluids and late-stage hydrothermal solutions

d) country rocks in which the geochemistry is conductive to mobilization of uranium such as marble, and fluorine- and phosphorous-rich syenite.

e) the proximity of large granitic bodies (granite or meta arkose) which not only provide material for anatectic pegmatite melts as well as U and Th, but also because of their structural resistance are responsible for the development of considerable strain along their margins, in part related to c) above.

In areas where all of these conditions are present, as at the Bancroft camp, major uranium deposits have formed.

In the opinion of the authors, the deciding factor contributing to the high potential of the Bancroft camp is the presence of syenite. In the Grenville Province of Ontario all uranium production has been from deposits in complex unzoned pegmatite spatially and probably genetically related to syenite. Uraniferous pegmatite, in areas in which syenite is absent but in which all other primary controls are present, have proven to be of marginal grade. Conversely if there are no structural, metamorphic and stratigraphic controls, important mineralization is less probable to occur even if syenites are present.

RECOMMENDATIONS FOR EXPLORATION

Based on conclusions reached in this study, certain areas within the Pembroke Map Sheet are rated as high, moderate, or low potential for uranium exploration.

Areas of High Potential

The most promising exploration area is restricted to the syenite belt of the Grenville Supergroup within 20 km of the surface trace of the unconformity between the supracrustal rocks and the basement complex. Interlayered syenite, amphibolite, marble, and gabbroic rocks which flank potassium-rich granite plutons and which have undergone intense strain, multiphase deformation, and hydrothermal alteration (scalpolitization and potassium metasomatism) are prime targets. The development of skarn, metapyroxenite and anatectic pegmatite within the marginal zone is indicative of conditions favourable to uranium deposition.

The syenite belt which trends through Faraday, Dungannon, Monteagle, and Carlow Townships satisfies all of these conditions. The extension of this belt eastward to the Ottawa River hosts only a few minor uranium occurrences. The absence of large diapiric structures such as the Anstruther, Cardiff, Cheddar and Faraday Domes which together form a larger structure which cross-cuts both the gross stratigraphy of the Late Precambrian supracrustal sequence and the syenite belt may account for the lack of important concentrations of uranium in this area.

Areas of Moderate Potential

Areas of lesser potential as exploration targets but which merit attention are discussed below:

The Griffith area has favourable stratigraphy and lithologies but it remains to be established whether or not structural controls favourable to uranium deposition are present. Areas flanking granite plutons in rocks which include syenite and scapolitic hedenbergite gneisses are considered promising exploration targets.

In the Hurd Lake area south of the Town of Renfrew, a large granite pluton intrudes steeply dipping paragneisses and marble in which molybdenum-uranium mineralization is present. This area contains favourable structural, metamorphic, and metasomatic controls and hosts numerous bodies of pegmatite but syenite is not present.

The unconformity separating the Late Precambrian basement rocks and the Paleozoic cover rocks, in areas where the Nepean and the March formations are represented, offers good prospects for the discovery of uranium-copper mineralization associated with hydrocarbons. An example of this mineralization is the South March deposit, an occurrence of uraniferous hydrocarbon near the base of the Paleozoic rocks in March Township. Sandy dolomite beds of the March Formation host this deposit.

Areas of Low Potential

These areas include: the Middle-Late Precambrian basement complex; and areas of low grade metamorphism (e.g. the Hastings Basin).

Index of Uranium Properties

Township	Deposit Name
Admaston	Dudgeon
Alice	McCoshen
	Woermke No. 1A
	Woermke No. 1B
Bagot	Boicey
	Quilty
	Zavitski
	Zenith Mine
Bangor	Bennet Lake
	Dubblestein
	Thomas
Bromley	Woermke No.2
Brougham	Burns Long Lake
	Legris
	Merchands Lake
	Mud Lake
	Tooey's Lake
Brudenell	Gorman Lake
	Murray
	Quade
	Rockingham Mines
Carlow	Ambis
	Burgess
	Mentor
	Sundstrom North
	Sundstrom South
Dickens	Davis Mica
	Plexman
Dungannon	Cam
	Card
	Highway 500
	McLean
	Normingo
	Ricban
	Rockwell
	Urban Quebec
Faraday	Bonville
	Brascan
	Eagle Nest
	Faraday Mine (Madawaska), Producer
	Goldhawk
	Greyhawk Mine, Past Producer
	Kerr
	Lockwood
	Maclan
	York River A
	York River B
	York River D
	York River E
	York River G
Fraser	Barr Feldspar Quarry
Grattan	Colautti
	Newfoundout
	Grattan Township Occurrences
Griffith	Conrad
	Godin Lake
	Highland Lake

	Jeffers Lake
	Lambert
	Percy
	Spain Molybdenite Mine
Hagarty	Rochefort
	Turpins Bay
Herschel	Peter-Rock West
Horton	Dempsey
	Goshen A
	Goshen B
Lyndoch	Canadian Beryllium Mines and Alloys Limited
	Jamieson Mine
	Price
	Universal Light Metals
March	O'Brien-Fowler
	South March
Miller	Barnet
	Doranium
	Salmond
	Whytock
Monteagle	Bartlett
	Cairns
	Carr
	Ferrill
	Genesee No. 2 Mine
	Genesee No. 2 Mine (South Showing)
	MacDonald Mine
	McCormack Mine
	Mell-Quirke
	Peter-Rock East
	Plunkett North Mine
	Plunkett South Mine
	Quirk
	Robson
	Salmon Trout Lake
	South State (North)
	South State (South)
	Thompson
	Trout Creek (Mrs. Thompson)
	Watson Feldspar Mine
	Welsh Farm
	Woodcox Mine
	Wright
Murchison	Comet Quartz
North Canonto	Mountain Chute
Raglan	Craigmont
	Dodd
	Marquardt
	Webster
Richard	Betz
Ross	Chevrier
	Forester Falls
	Vaughan
	Woermke No. 4
Sebastopol	Lake Clear
	O'Hara
	Opeongo
South Canonto	Bordun
	Honsberger
	Kellar
Wilberforce	James

DESCRIPTION OF PROPERTIES

1. DUDGEON OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Not identified.
ROCK ASSOCIATION
White granite pegmatite intrudes country rocks which are principally paragneisses and marble.
CLASSIFICATION
Simple pink granite pegmatite.
LOCATION
Approximately 14.5 km southwest of the town of Renfrew, in Lot 8, Concession XI, Admaston Township, Renfrew County,
Latitude 45°22'56''N; Longitude 76°50'19''W
UTM 5026850mN, 356100mE; Zone 18
NTS Renfrew 31F/7
ACCESS
The occurrence is located on the N. Davie's farm on the west side of a gravelled township road, 1.3 km south of the village of Shamrock on Highway 132. The showing crosses the farm lane north of the barn and about 300 m from the township road.
PRESENT EXPOSURE
The pegmatite dike is well exposed.
SIZE AND GRADE
Anomalous radioactivity is confined to a small part of the pegmatite and is of low level. A channel sample taken by N. Dudgeon, assayed 0.12% U_3O_8 (radiometric equivalent). Two other samples, grab and chip, both assayed 0.012% U_3O_8.
DESCRIPTION
Geology: White pegmatite dikes intersect obliquely a sequence of marble, siliceous rusty-weathering pyritic gneiss, grey-white biotite gneiss and mafic hornblende-biotite gneiss. These rocks strike 60 to 90° and dip 20 to 30° SE.

The hornblende-biotite gneiss (Sample R77-71-3) has the chemical composition of andesite and may represent either a: metagabbro, metavolcanic or a calcareous metasediment. The rock is composed of 55 percent plagioclase (An_{35}), 22 percent biotite, 8 percent quartz, 8 percent hornblende, 2 percent iron-titanium oxides and traces of pyrite and apatite.

Analysis for trace elements reveals a content of 22 ppm Pb, 25 ppm Zn, 15 ppm Cu, 2 ppm U_3O_8 and 10 ppm Th.

The felsic biotite gneiss represents the contact zone between the mafic hornblende gneiss and the pyritic siliceous gneiss. Chemically, Sample R77-71-1 has the composition of a quartz monzonite but it could also be a feldspathic meta-sandstone or meta-rhyolite. It contains 30 percent quartz, 35 percent plagioclase (An_{25}), 28 percent orthoclase, 6 percent biotite and a minor content of iron oxides and pyrite. Trace element content is 40 ppm Pb, 65 ppm Zn, 6 ppm Cu, 2 ppm U_3O_8 and 10 ppm Th.

The white granite pegmatite is unzoned and fine- to medium-grained. It contains some biotite where it intrudes biotite gneisses and shows rusty weathering where it intersects pyritic gneisses. The pegmatite is quite irregular in form and in places branches into numerous small dikelets. (Fig. 3)
*Mineralization:*Mineralization as indicated by anomalous radioactivity appears to be disseminated throughout the pegmatite, but in places it is concentrated into "hot spots" which do not differ either structurally or mineralogically from the dike. The pegmatite is most radioactive where it is in contact with the hornblende-biotite gneiss.
*Discussion:*Since the pegmatite mineralogically takes on some of the characteristics of the rocks it intrudes, it is possible that the uranium content was also derived from the adjacent country rocks. To test this, two samples of the country rock adjacent to the most radioactive parts of the pegmatite were analyzed for uranium and thorium. (Sample R77-71-3, the hornblende-biotite gneiss, and Sample R77-77-1, the felsic biotite gneiss.) Both samples assayed 2 ppm U_3O_8 and 10 ppm Th, suggesting that there was likely no significant contribution of uranium to the pegmatite from the country rocks in the immediate area.
HISTORY
In 1958, Mr. Norman Dudgeon of Scarborough, Ontario, submitted three samples to the Geological Survey of Canada in Ottawa for radiometric analysis.
REFERENCE
Geological Survey of Canada, Radioactive Resources Division File 31F/7-6

2. McCOSHEN OCCURRENCE

3. WOERMKE NO. 1A OCCURRENCE

4. WOERMKE NO. 1B OCCURRENCE

For descriptions of Deposits 2, 3 and 4 see "Minor Occurrences" listed at the back of this report.

5. BOICEY OCCURRENCE

COMMODITY
Uranium, thorium and molybdenum
RADIOACTIVE MINERALS
Not identified
ROCK ASSOCIATION
The host is pink granite pegmatite in country rock consisting of amphibolite gneisses with minor marble.
CLASSIFICATION
Pink granite pegmatite
LOCATION
Approximately 10 km south-southwest of the town of Renfrew, in lot 28, Concession V, Bagot Township, Renfrew County.
Latitude 45°23'13''N, Longitude 76°42'47''W
UTM 5027100mN, 365900mE; Zone 18N
NTS Renfrew 31F/7

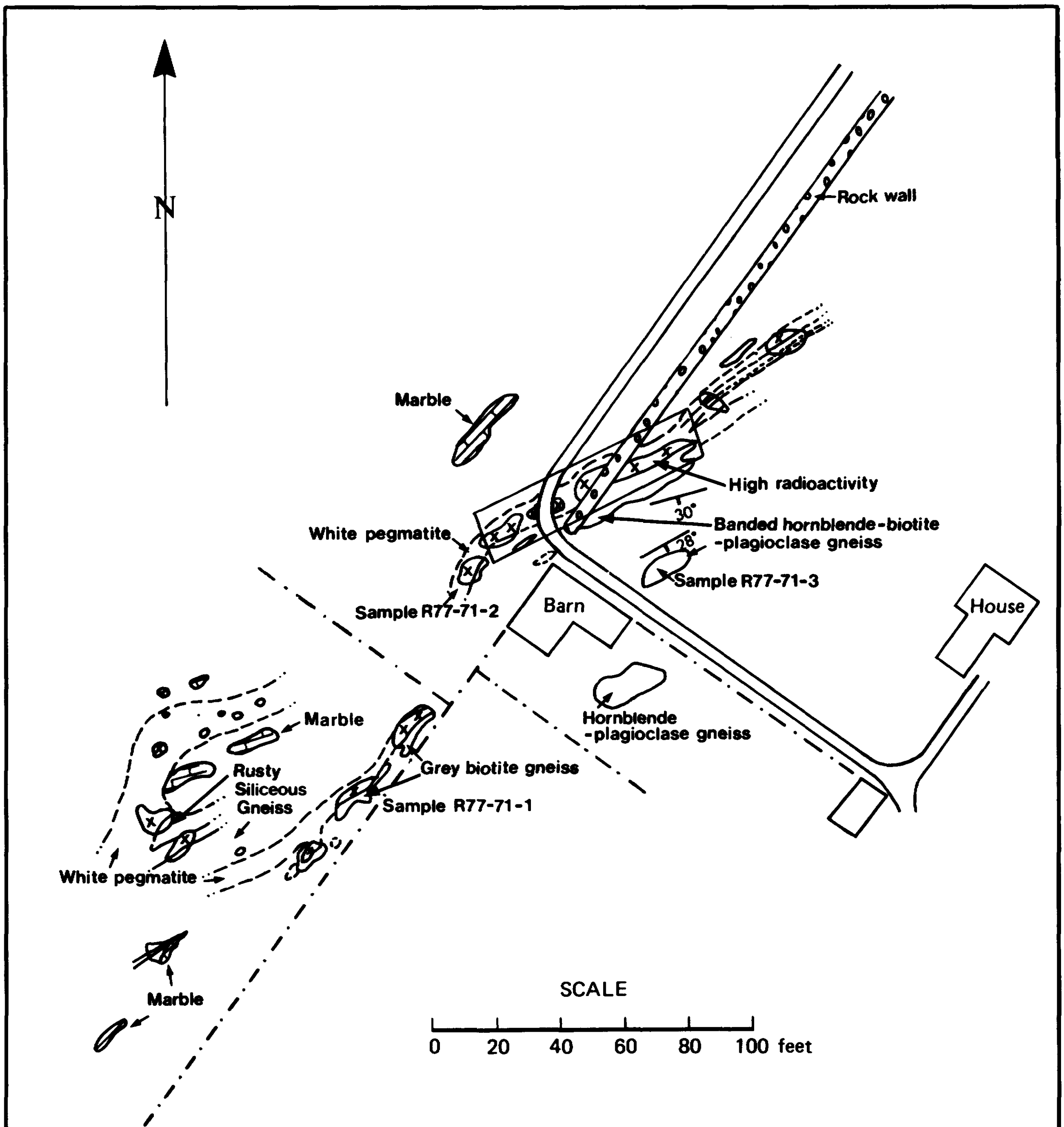


Figure 3 — Geology of the Dudgeon Occurence

ACCESS
The occurrence is in a field 100 m south of the gravel township road, 2.3 km south of Belangers Corner.The township road connects Belangers Corner with Ashdad to the southwest.
PRESENT EXPOSURE
Very good.
SIZE AND GRADE
Anomalous radioactivity is confined to an area 3 m^2 in the pegmatite dike. A selected sample, R77-73-1, assayed 410 ppm U_3O_8 and 268 ppm Th. Together with other similar deposits, this occurrence indicates an association of the marginal zone of the Hurd Lake granite with uranium mineralization.
DESCRIPTION
General Geology: The radioactive granite pegmatite is intrusive into a well-layered amphibolite gneiss of possible volcanic origin which occurs along the west margin of the Hurd Lake granite. The amphibolite gneisses are interbedded with minor marble and paragneisses.
Detailed Geology: A pink granite pegmatite dike with shallow dip cuts steeply-dipping biotite-hornblende gneiss and amphibolite which may represent metavolcanic rocks or metasediments of volcanic origin.

The occurrence is in, and adjacent to, an old pit 3 m by 3.5 m by 1.5 m deep, put down prior to 1940 to test a molybdenum showing. The pit is in pegmatite at the surface, but at a depth of 1 m, it passes into amphibolite gneiss which is rusty-weathering in places due to the presence of minor pyrrhotite and pyrite, principally on east-west fractures with a north dip. Some molybdenite is present in the gneiss, and the occasional fleck was observed in the pegmatite just above the contact with the gneiss. The amphibolite gneiss assays <2 ppm U_3O_8 and <10 ppm Th (Sample R77-73-2).

The radioactive part of the pegmatite is composed of quartz, feldspar, magnetite, zircon and biotite. This portion differs from the main part of the dike in that the coarse-grained ($\cong$5 mm) feldspars are buff-coloured and consist largely of peristerite, whereas the less-radioactive part consists of coarse-grained (5 to 20 mm) pink microcline in a quartz matrix. Since no radioactive minerals were observed, the uranium and thorium content may be present in biotite, zircon and magnetite. The highly radioactive area has a radioactivity level of 2500 cpm , and assays 410 ppm U_3O_8 and 268 ppm Th. The less radioactive main part of the dike measures 500 cpm and assays 150 ppm U_3O_8 and 247 ppm Th (Sample R77-73-3). (Fig. 4)
Chemistry: The radioactive peristerite-bearing part of the pegmatite contains ten times as much sodium as the main part of the pegmatite, and is an albite trondhjemite in composition, with a differential index of 91.17. The main body of the pegmatite is chemically an albite granodiorite with a differential index of 93.01. A high sodium content as well as the presence of peristerite are characteristic of radioactive pegmatites and granites. The main difference between the two phases of the pegmatite is the sodium content; all other elements are more or less equal in amount.

The peristerite pegmatite zone has a slightly higher lead content (85 ppm) than the microcline pegmatite (60 ppm). The higher lead content may be due to additions of radiogenic lead, as rocks richer in K-feldspars, i.e. the less mineralized pegmatite, should normally contain more lead.
HISTORY
Around 1940, a molybdenum occurrence in the pegmatite was tested by a pit 3 by 3 by 1.5 m deep.

In 1959, N. Boicey submitted a sample to the Geological Survey of Canada in Ottawa for radiometric analysis.
REFERENCE
Geological Survey of Canada, Radioactive Resources Division File 31F/7-13.

6. QUILTY OCCURRENCE

See "Minor Occurrences"

7. ZAVITSKI OCCURRENCE

For descriptions of Deposits 6 and 7 see "Minor Occurrences" listed at the back of this report.

8. ZENITH (GOLDYKE) MINE OCCURRENCE

COMMODITY
Molybdenum, uranium and thorium
RADIOACTIVE MINERALS
Uraninite
ROCK ASSOCIATION
The host rock is a skarn developed within marble. The marble is interbanded with biotite, hornblende, and scapolitic and granitic gneisses.
CLASSIFICATION
Metapyroxenite skarn - metamorphic metasomatic type
LOCATION
W1 ½ Lot 28, Concession IV,Bagot Township, Renfrew County, 9.6 km south of the town of Renfrew.
Latitude 45°23'32"N; Longitude 76°42'29"W
UTM 5027700mN, 366500mE, Zone 18
NTS Renfrew 31F/7
ACCESS
A dirt road leads southeast from Belangers Corner off the township road between Admaston and Bagot Townships. After approximately 1.2 km this road turns sharply to the southwest. At this bend a field road leads south to the shaft.
PRESENT EXPOSURE
Poor except for weathered outcrops near the shaft.
SIZE AND GRADE
Mineralization is low grade and erratic. A syenite sample assayed 450 ppm U_3O_8 and 311 ppm Th. Two samples of granite pegmatite taken from the dump averaged 7 ppm U_3O_8 and 23 ppm Th. However Goldyke Mines reports most of the uranium mineralization to occur in metapyroxenite.

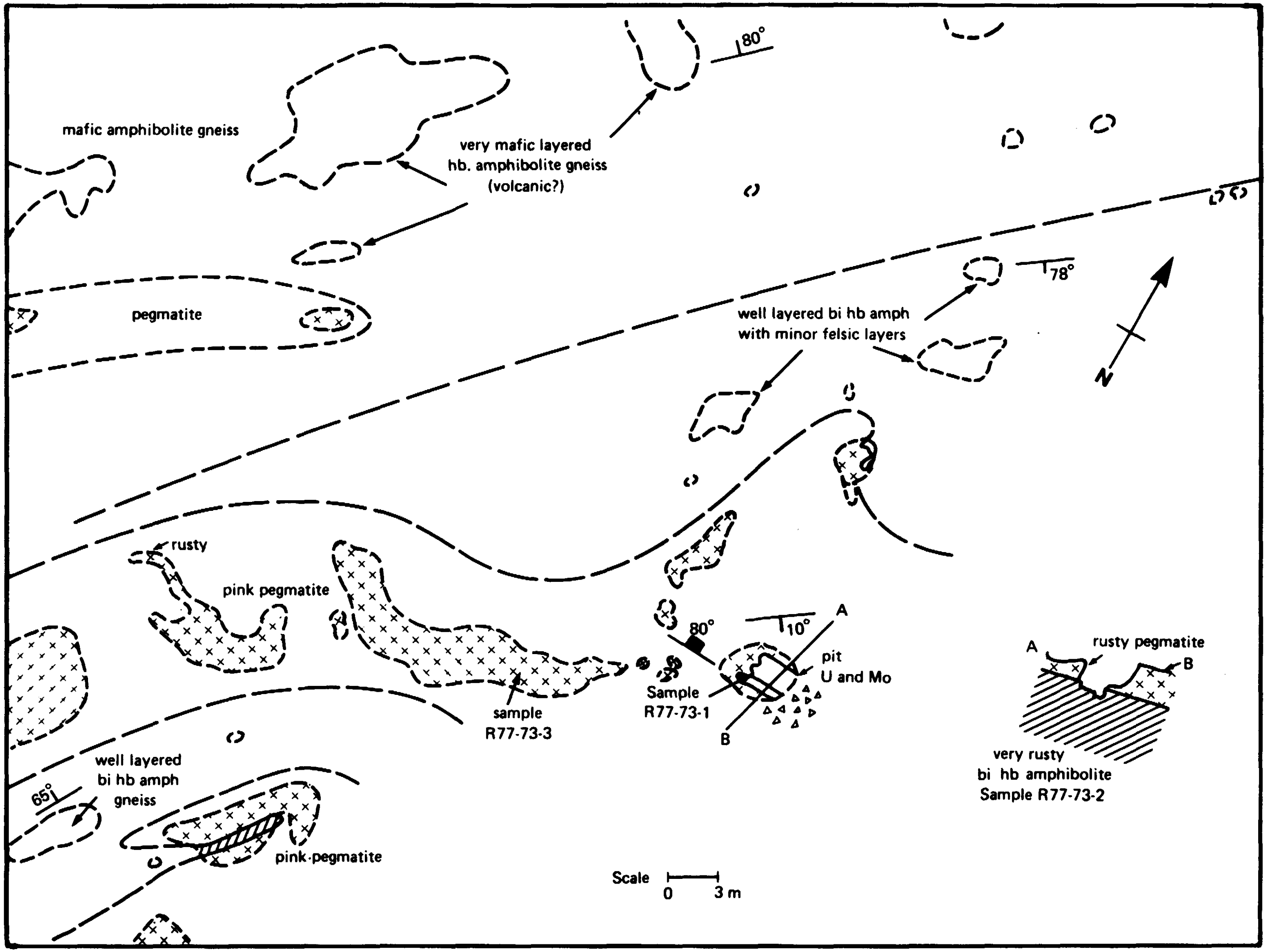


Figure 4 — Geology of the Boicey Occurrence

DESCRIPTION

Geology: The Zenith Mine occurs in a sequence of calcareous metasediments on the western margin of the Hurd Lake Granite, a large body of granite gneiss. The country rocks are marble (with skarn), hornblende gneiss, scapolitic gneiss, granite gneiss and granite pegmatite.

The marble occurs in three thin layers intercalated with the gneisses and consists essentially of calcite with minor diopside, biotite and dolomite. According to Satterly (1945), the mineralized bodies of skarn may have developed within these marble layers.

Units of hornblende gneiss are in contact with all the marble layers. There are three units of hornblende gneiss and they vary in composition from hornblende-oligoclase-rich in the eastern section to a felsic central portion to a locally migmatitic hornblende-rich western counterpart.

The scapolitic gneiss which occurs between two of the marble units, consists mainly of scapolite, quartz and microcline with lesser amounts of pyrite, pyrrhotite and phlogopite.

The granite gneiss (Hurd Lake Granite) is the most common rock in the area; it is well-foliated, fine-grained, light grey to pink in colour and consists mainly of quartz, oligoclase and microcline with minor hornblende, sphene, biotite and magnetite. "The pink granite pegmatite consists mainly of smoky quartz, pink microcline and plagioclase. It crosscuts the metasedimentary rocks and contains many inclusions of skarn, near which the pegmatite commonly contains molybdenite; inclusion-free parts of the pegmatite are unmineralized. These observations suggest that the pegmatite post-dates the skarn and the molybdenite mineralization." (Karvinen 1973)

Mineralization: The pegmatite outside the mineralized area gives readings of up to 400 cpm and the only anomalous zone in the pegmatite occurs where the pegmatite intersects the molybdenite-rich portion of skarn. The radioactive mineral is uraninite.

Discussion: Karvinen (1973) proposed that the skarn or metapyroxenite was not formed by contact metasomatism from an adjacent intrusion or its bordering sills, but by a metasomatic process resulting from high-grade regional metamorphism. Further discussion of this process is found in the main body of this report under metapyroxenite-skarn deposits. If the pegmatites did contain some uranium, during their intrusion into a sulphide-rich or reducing environment, uranium would be preferentially transferred to the iron-rich metapyroxenite, but the writers suggest it is more likely that hydrate pegmatite fluids removed uranium from already uranium-rich host rocks. The pegmatites do not represent a late stage residual melt of the Hurd Lake Granite, but rather are anatectic in origin and represent a late intrusive and metamorphic event.

HISTORY

The Zenith Mine was worked in 1915 by M.J. Paterson and A. W. Taylor on behalf of Sir Henry Pellat. Development consisted of stripping an area 35 x 400 feet; numerous small pits and a large pit 20 feet deep were trenched. Total production in that year was 4500 lbs. of molybdenite ore.

From 1935 to 1943, stripping, trenching, drilling on surface and underground, and mining were done by Phoenix Molybdenite Corporation Limited, Wartime Metals Corporation and Zenith Molybdenite Corporation Limited. The total production in that period was 9073 tons of molybdenite ore.

In 1955, Goldyke Mines drilled 11 holes, totalling 336 feet on the 175-foot level in search of a uranium orebody.

SELECTED REFERENCES

Carter, Colvine, and Meyn (1979,p.253)
Karvinen (1973)
Satterly (1945, p. 73-75)
Vokes (1963, p. 160-161)

9. BENNET LAKE OCCURRENCE

See "Minor Occurrences"

10. DUBBLESTEIN OCCURRENCE

COMMODITY

Uranium, thorium, nobium and tantalum

RADIOACTIVE MINERALS

Pyrochlore

ROCK ASSOCIATION

The host is a granite pegmatite in biotite-hornblende diorite gneiss.

CLASSIFICATION

Zoned pink granite pegmatite – feldspar type.

LOCATION

The north half of Lot 13, Concession X, Bangor Township, Hastings County
Latitude 45°22′12″N, Longitude 77°46′11″W
UTM 5027500mN, 283350mE, Zone 18
NTS Barry's Bay 31F/5

ACCESS

Approximately 6.6 km west on Highway 62 from Combermere, a paved township road leads north and west 4.1 km to the village of Centreview. The showing is on the northwest shore of Balsam Lake, approximately 0.8 km by foot west from the paved township road 1.9 km north of Centrview.

PRESENT EXPOSURE

The showing is well exposed for a length of 20 m but the country rock is only moderately exposed.

SIZE AND GRADE

The pegmatite contains sparse radioactive minerals in masses up to 2 cm, which assay as high as 8.63% U_3O_8. This occurrence is a mineral collecting site.

DESCRIPTION

General Geology: Interlayered biotite-quartz-plagioclase gneisses and biotite-hornblende amphibolite gneisses, with minor rusty-weathering biotite amphibolite gneiss occupy the area north of Balsam Lake. The gneisses are irregularly folded with large changes in strike and dip within metres. These rocks are intruded by granite pegmatite bodies as both sills and dikes. A prominent N57°W striking fracture system with vertical dip has been imposed on all the above rocks.

Detailed Geology: The pegmatite dike, which is relatively flat-lying, shows a well-developed internal zoning with core, intermediate, border and contact zones. The core is composed entirely of milky quartz. The intermediate zone contains abundant quartz, large microcline crystals (1-2 m), and large books of biotite. The border zone consists of intergrowths of quartz and feldspar and is distinguished from the intermediate zone by decrease in the size of microcline crystals to 25 cm, lack of large quartz pods and biotite which is disseminated and in small books. The contact zone, about 10 cm wide, contains minor hornblende which may reflect assimilation of the country rocks. Radioactivity of the pegmatite, with the exception of pyrochlore associated with biotite, was not anomalous. (Figure 5)

The country rocks in the vicinity of the showing are grey to black biotite-hornblende-plagioclase gneisses, with interlayered mafic amphibolite and rusty-weathering amphibolite. Sphene (up to 2%) is present in the gneiss near the contacts with the pegmatite. Samples of the country rock from the hanging wall of the pegmatite have the following compositions:

Yellow-red rusty-weathering biotite-hornblende-plagioclase gneiss (R-77-76-8A) taken from within 25 cm of the pegmatite contact, has a composition of quartz diorite, with a normative plagioclase content of An_{47}. This sample assayed 8 ppm U_3O_8 and<10 ppm Th.

Rusty-weathering biotite amphibolite (R-77-76-8B) from the same area has the composition of a high-iron komatiite. This sample assayed 3 ppm U_3O_8 and<10 ppm Th. The uranium content of both rocks is high considering their mafic composition and it may indicate that the uranium has migrated from the pegmatite to the mafic gneisses.

Mineralization: Radioactive mineralization is associated with the large biotite books in the coarsely-crystallized intermediate zone of the pegmatite. A black vitreous mineral, Sample R-77-76-2, present within biotite books or adjacent to them, was identified as pyrochlore with 1.5% U_3O_8 and 0.8% Th. The microcline surrounding this material is shattered with red coloration caused by hematization. A sample (R-77-76-3) of a less radioactive non-magnetic mineral resembling alunite was also found within a biotite book. It assayed 80 ppm U_3O_8 and 101 ppm Th, but was not identified. Mineral samples assaying as high as 8.63% U_3O_8 have been reported from this dike.

Discussion: The location of the radioactive minerals at the crystal boundaries of the main rock-forming minerals in the pegmatite, as well as being occasionally associated with fractures in pegmatite, indicates that they were among the last minerals to form.

HISTORY

In 1955, Mr. Dubblestein of Barry's Bay, Ontario, submitted samples to the Geological Survey of Canada and Lakefield Research Limited for uranium analysis, which assayed 6.36% and 8.63% U_3O_8. These are probably samples of pyrochlore and not rock samples. He also completed 352 feet of drilling to expose the showing.

REFERENCE

Geological Survey of Canada, Radioactive Resources Division File 31F/5-3.

11. THOMAS OCCURRENCE

COMMODITY

Uranium, thorium and cerium

RADIOACTIVE MINERALS

Allanite and possibly thorite

ROCK ASSOCIATION

Granite pegmatite host in biotite-hornblende-plagioclase gneiss country rock.

CLASSIFICATION

Complex pink granite pegmatite

LOCATION

Approximately 11 km west of Combermere, in the S½ of Lot 13, Concession X, Bangor Township, Hastings County Latitude 45°22′10″N; Longitude 77°45′28″W

UTM 5027450mN, 284050mE, Zone 18

NTS Barry's Bay 31F/5

ACCESS

Approximately 6.6 km west on Highway 62 from Combermere, a paved township road leads north and west 4.1 km to the village of Centreview. The showing is on the south shore of Balsam Lake, approximately 0.3 km by foot west from a point on the paved township road 1.4 km north of Centreview.

PRESENT EXPOSURE

Good outcrop exposure

SIZE AND GRADE

The radioactive mineralization is confined to an area of one square metre of the pegmatite. Sample R-77-76-25 taken from the radioactive portion of the pegmatite assayed 540 ppm U_3O_8 and 1.7% Th.

DESCRIPTION

General Geology: Limited exposures in the immediate vicinity of the occurrence show that the country rocks are gneisses of probable Middle Precambrian age, intruded by late granite pegmatite dikes.

Detailed Geology: A 2 m thick granite pegmatite sill with up to 5 percent magnetite intrudes hornblende-biotite gneisses with minor intercalated units of mafic amphibolite. The gneisses in general dip shallowly to the southeast, but in the area of the pegmatite intrusion, steepen rapidly, becoming isoclinally folded, and striking N75°E. The gneisses display well-developed layering and are in part migmatitic. Petrographic work on the gneisses have shown them to be gneissic trondjemites to quartz diorites. The pegmatite is an albite trondjemite reflecting an anatectic melt of the local country rocks. (Pautler 1980).

The pegmatite for the most part is not anomalously radioactive, but at the western end of its exposure where it crosscuts the gneisses it is very radioactive. The granite sill strikes N75°E, but where it crosscuts the gneisses it follows a northwest cross-fracture.

The radioactive zones or areas appear to be fracture-controlled as much of the mineralized pegmatite occurs along fracture zones 1 to 5 cm thick. These fracture zones are irregular, changing both in strike and dip. The major mineralized fracture cutting the pegmatite is parallel to the original cross-fracture into which the pegmatite intruded and is close to the contact.

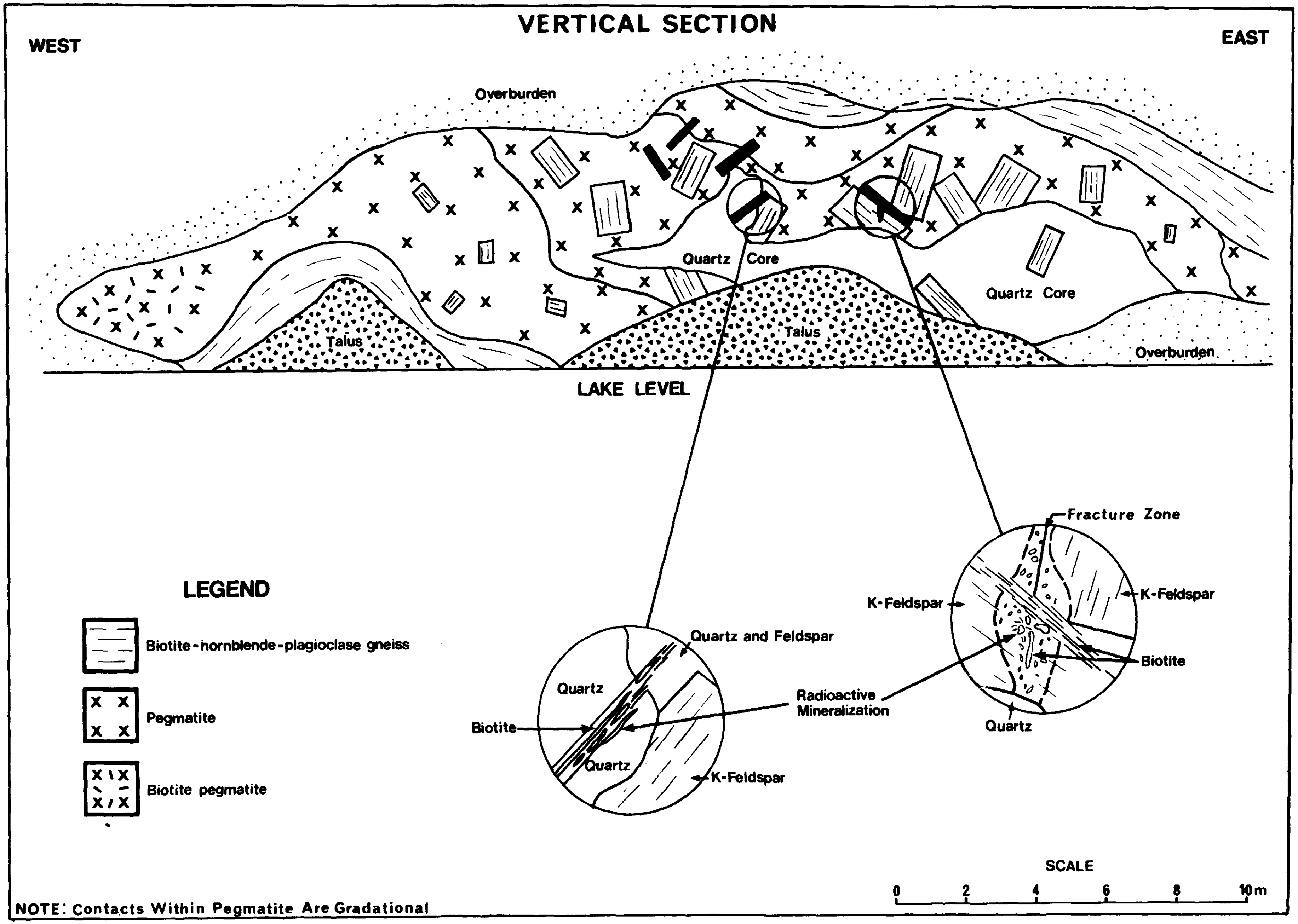


Figure 5 — Geology of the Dubblestein Occurrence.

The pegmatite, which is exposed for 60 m, is crudely-zoned with a medium- to fine-grained (2 to 3 cm) wall zone and a coarse-grained (5 to 20 cm) core zone approximately 25 cm wide. The unmineralized granite pegmatite contains abundant biotite as well as some magnetite and occasional allanite in the wall zone, and mainly coarse magnetite and minor muscovite and allanite in the core zone. The mineralized pegmatite is reddish, fractured, finer-grained and includes abundant allanite, as well as muscovite and magnetite. The most radioactive samples were syenitic, with mainly black allanite, red feldspar and minor green radiating epidote. A sample (R-77-76-15) of allanite assayed 55 ppm U_3O_8 and 2030 ppm Th. Thorite was observed in one sample and may occur as inclusions within the allanite. Paultler (1980) has shown there is a good correlation between U,Th, and REE, and Fluorine. She also demonstrated that Fe^{+3}, Ca and Mg were enriched in the mineralized portion of the dike whereas $Si O_2$ and K_2 were depleted.

HISTORY

In 1955, E. Dubblestein of Barry's Bay submitted a sample of radioactive mineral to Lakefield Research Limited for analysis.

In 1958, Alvin C. Thomas of Grampean, Pennsylvania, U.S.A. drilled 12 diamond drill holes, of which three were over 30 m in depth. The other nine holes were 9.1 to 18.3 m deep. No radioactivity was detected in the core.

REFERENCE

Geological Survey of Canada, Radioactive Resource Division File 31F/5-3
Pautler (1980)

12. WOERMKE NO. 2 OCCURRENCE

13. BURNS LONG LAKE OCCURRENCE

For descriptions of Deposits 12 and 13 see "Minor Occurrences" listed at the back of this report.

14. LEGRIS OCCURRENCE

COMMODITY

Uranium, thorium, niobium and tantalum

RADIOACTIVE MINERALS

Uranothorite, pyrochlore, allanite and zircon

ROCK ASSOCIATION

The host is granite pegmatite cutting calc-silicate gneisses, biotite gneiss, quartzo-feldspathic gneiss, syenite gneiss and syenite.

CLASSIFICATION

Complex pink granite pegmatite

LOCATION

Lot 31, Concession XVIII, Brougham Township, Renfrew County, approximately 7 km southwest of the village of Dacre.

Latitude 45°19′ 57″N; Longitude 77°02′54″W

UTM 5021650mN, 339500mE; Zone 18

NTS Brudenell 31F/6

ACCESS

On Highway 41, approximately 6.1 km southwest of the intersection with Highway 513, a gravelled forest access road leads northwest to the showing, a distance of 1.5 km. Zone A, the main showing, is on the east side of the road.

PRESENT EXPOSURE

Excellent

SIZE AND GRADE

Zone A: The pegmatite is approximately 20 m wide and exceeds 300 m in length. Sampling of trenches across the dike as reported by Imperial Oil Limited give an average grade of 0.02 to 0.025% U_3O_8 and 0.35 to 0.40% Th. Drill core assayed 0.025 U_3O_8 over 1.8 m in the best intersection.

DESCRIPTION

General Geology: The regional geology is shown on Ontario Department of Mines Preliminary Map P.2240, Khartum Area (1978). The immediate area of the deposit is dominated by a mixture of intrusive gneissic syenites, calc-silicate gneisses and clastic siliceous metasediments. The metasediments represent units of the Grenville Supergroup of Late Precambrian age.

Detailed Geology: A sequence of calc-silicate gneisses, biotite gneiss, quartzo-feldspathic gneiss, hornblende syenite gneiss, and syenite trending northeasterly and dipping 48 to 60°SE is intruded by the A Zone radioactive pegmatite striking E-W and dipping vertically.

The calc-silicate gneisses comprise carbonate- and apatite-rich layers with minor layers of hornblende amphibolite and rusty-weathering pyritic siliceous gneiss.

The biotite gneisses exhibit good layering due to slight variations in the biotite or hornblende content which varies from 25 to 45 percent. Amphibolite layers contain up to 70 percent mafic minerals. Minor quartzo-feldspathic layers are difficult to distinguish from granitic sills in this sequence.

Biotite gneiss grades into quartzo-feldspathic gneiss containing subordinate amounts of biotite gneiss. This sequence is extensively granitized and may be the source of the small sills and dikes in the biotite gneisses. These gneisses grade eastward into homogeneous foliated hornblende syenite which in turn grades into migmatitic biotite-feldspar gneiss.

Early anatectic granite sills intrude all the above rocks. Later mafic dikes, 30 to 40 cm wide, were emplaced and subsequently metamorphosed to hornblende-biotite-plagioclase gneisses which are in part schistose.

Younger unaltered diabase, 1 to 6 m wide, cuts across all other rocks except the granite pegmatites which are Late Precambrian in age.

The A Zone Pegmatite: This is a granite pegmatite showing compositional and textural zoning. The contact zone is sharp, only a few cms wide, and is fine- to medium-grained. The intermediate zone, forming the main body of the pegmatite, has grains 2 to 10 cm in size. Local graphic intergrowths are composed of 20 to 30 percent quartz, 50 percent microcline and 20 to 25 percent oligoclase. Quartz content increases toward the centre of the dike where an irregular late quartz-rich phase comprises a fine-grained (2 cm) core characterized by abundant hornblende and magnetite and minor allanite, zircon and pyrochlore.

Reaction between the quartz-rich core and the intermediate zone granite pegmatite has developed a narrow border zone of pink microcline within the intermediate zone and a thin mafic-enriched zone within the core. The late quartz-rich phases may be derived either from residual volatiles in the pegmatite melt or from assimilated country rocks. Both the biotite gneiss and the calc-silicate gneisses are high in H_2O and $CaCO_3$, and may have contributed material to the quartz-rich core.

Mineralization: The highest radioactivity is found in the central part of the pegmatite dike, unlike many pegmatite occurrences in the Bancroft area where enrichment in uranium is mainly along contaminated border zones or associated with inclusions within the dike. The main radioactive minerals are pyrochlore, uranothorite, zircon and allanite, often associated with magnetite and pyroxene. The most radioactive areas are chiefly associated with pyrochlore in the quartz-rich phase. Some similarity of this occurrence to the zoned pegmatites in the Hybla area is seen in the zoning and the abundant pyrochlore.

Characteristic of mineralized areas within the pegmatite are reddened feldspars, radiating fractures around radioactive minerals (especially zircon), abundant mafic minerals, magnetite, and the yellowish quartz-rich phase and their reaction rims.

Chemistry: The cross-cutting relationship of the pegmatite to the country rocks facilitated examination of the spatial relationship between U and Th mineralization in the pegmatite and the U-Th content of the different lithological units of the country rocks. There is more anomalous radioactivity in the west end of the dike where it cuts the calc-

TABLE 3. MAJOR ELEMENT CONTENT (IN PERCENT) AND TRACE ELEMENT CONTENT (IN PPM) OF SOME SAMPLES FROM THE LEGRIS OCCURRENCE.

Major Elements %	R-77-5-5 hbl. amph. from biotite gneiss	R-77-5-6 biotite gneiss	R-77-5-7 hornblende syenite	R-77-5-8 biotite syenite gneiss
SiO_2	43.9	47.3	45.3	45.8
Al_2O_3	8.58	18.3	13.0	16.2
Fe_2O_3	3.38	1.81	6.26	1.68
FeO	7.86	6.45	6.53	5.77
MgO	9.1	5.59	3.56	2.82
CaO	18.1	9.06	9.69	6.88
Na_2O	2.49	4.60	2.61	2.14
K_2O	0.84	2.33	5.17	8.08
TiO_2	1.15	1.10	1.02	0.81
P_2O_5	2.74	0.84	1.38	1.62
S	0.08	0.11	0.03	0.03
MnO	0.19	0.14	0.17	0.12
CO_2	0.32	0.16	2.28	4.18
H_2O^+	0.15	0.19	0.30	0.59
H_2O^-	0.32	0.31	0.33	0.30
Trace Elements (p.p.m.)				
Ba	240	640	5300	3000
Co	30	25	20	15
Cr	40	10	8	20
Cu	35	20	10	$<$ 5
Li	20	25	6	35
Ni	30	20	$<$ 5	$<$ 5
Pb	20	20	20	25
Zn	155	120	170	130
Th	$<$ 20	$<$ 20	30	15
U	10	3	$<$ 2	$<$ 2
Location	W end of Peg	E end of Peg	Central	Central

silicate gneiss and biotite gneiss and also in the extreme eastern part of the dike where it impinges on biotite-rich migmatitic gneisses, than where the pegmatite cross-cuts the quartzo-feldspathic gneiss and syenitic gneisses.

Table 3 shows the analysis of sampling done to test the possibility of a spatial and/or genetic connection of the country rocks with the U and Th content of the pegmatite. In this table, the samples are arranged in order of decreasing uranium content. The analysis shows a positive correlation between the U+Th content with Fe^{+2}, Mg, Ca, Ti, Co and Ni which reflects a higher mafic mineral content. The P_2O_5 content (from apatite) which was expected to correlate strongly with uranium did not reflect the uranium content of the rock. However, the sulfur content indicating reducing conditions and hence a trap for uranium may be more significant.

("Insert Table 3 Legris Occurence")

This analysis tentatively suggests that rocks rich in mafic minerals, and with slightly higher uranium contents, may be correlated spatially with areas of anomalous radioactivity in the pegmatite. Conversely, those parts of the dike with low radioactivity impinge on rocks relatively deficient in mafic minerals, uranium and sulfur. A quick radiometric survey of the dike revealed that the eastern portion is dominantly mineralized by thorium, reflecting the high potassic nature of the nearby country rocks. Uranium is more dominant in the western portion, which is surrounded by low-potassic biotite gneiss, amphibolitic gneiss and calc-silicate gneiss. This may also reflect the presence of quartz-rich phases which are lacking in the eastern part of the dike.

Discussion:Analytical and radiometric data indicate there may be some spatial and genetic relationship of U and Th in the pegmatite and the geochemistry of the country rocks. However field evidence shows that the uranium in the pegmatite is in the central portion of the dike, often associated with what may be residual or replacement phases, rather than along the border zones where it would be expected to occur if lateral secretion of uranium from country rocks had occurred. It is possible that the quartz-rich phases represent contaminated melt, in which case the field evidence and analytical data may not be in conflict.

Pegmatites intruding calcareous and syenitic rocks in this area, as in the Hybla area, are high in pyrochlore minerals. To clearly establish whether a genetic connection exists between the uranium and niobium contents of the country rocks and of the intruding pegmatites requires more geochemical data.

HISTORY

The occurrence was discovered by H. A. Legris of Dacre, Ontario in the 1950s. Imperial Oil Limited performed geological mapping, radiometric surveys and sampling in 1976. This work was followed by three drill holes totalling 126 m in 1977.

REFERENCE

Ontario Geological Survey, Assessment Files Research Office, Toronto: Technical File 2.2177; Brougham Township, Drill Report 13.

Khartum Area, Ontario Geological Survey Preliminary Map P. 2240 (1979)

15. MERCHAND LAKE OCCURRENCE

16. MUD LAKE OCCURRENCE

For descriptions of Deposits 15 and 16 see "Minor Occurrences" listed at the back of this report.

17. TOOEY'S LAKE OCCURRENCE

COMMODITY

Uranium, thorium, niobium and tantalum

RADIOACTIVE MINERALS

Pyrochlore

ROCK ASSOCIATION

The host is granite pegmatite in country rocks comprising marble and pyritic siliceous gneisses.

CLASSIFICATION

Simple pink granite pegmatite

LOCATION

The occurrence is approximately 3.9 km west of the intersection of Highways 41 and 132, in S½ of lot 26, Concession XVIII, Brougham Township, Renfrew County.

Latitude 45°20′16″N; Longitude 77°01′35″W

UTM 5022300mN, 341250mE; Zone 18

NTS Brudenell 31F/6.

ACCESS

The occurrence is on the north side of Highway 41, just west of Tooey's Creek at Tooey's Lake Park.

PRESENT EXPOSURE

Good.

SIZE AND GRADE

The pegmatite is exposed over a strike length of 40 m and widths up to 6 m. Anomalous radioactivity is present over most of the exposed pegmatite, but in places "hot spots" up to 40 000 cpm were recorded.

Analytical results of two selected samples from such "hot spots" are as follows:

Sample	U_3O_8 (ppm)	Th(ppm)	Mineral
R-77-78-1 (pegmatite)	250	5000	pyrochlore
R-77-78-2 (qtz-rich pegmatite)	105	2640	

The thorium and rare earth elements are present in pyrochlore, the radioactive mineral identified.

DESCRIPTION

Geology:The general geology of the area is shown on Ontario Geological Survey Preliminary Map P.2240, Khartum Area (1978).

Pink granite pegmatite intrudes rusty-weathering pyritic siliceous gneiss interlayered with marble. The siliceous gneiss layers vary in thickness from a few cm to several metres and may show good continuity or may be extensively boudinaged. The pegmatite is generally quartz-rich with the development of highly siliceous phases of up to 75 percent quartz.

Mineralization:Areas from 10 to 20 cm^2 to several square metres of high radioactivity are associated with siliceous phases of the pegmatite. Yellow-green alteration associated with the pyrochlore makes these areas readily apparent. The radioactive minerals are primary to the peg-

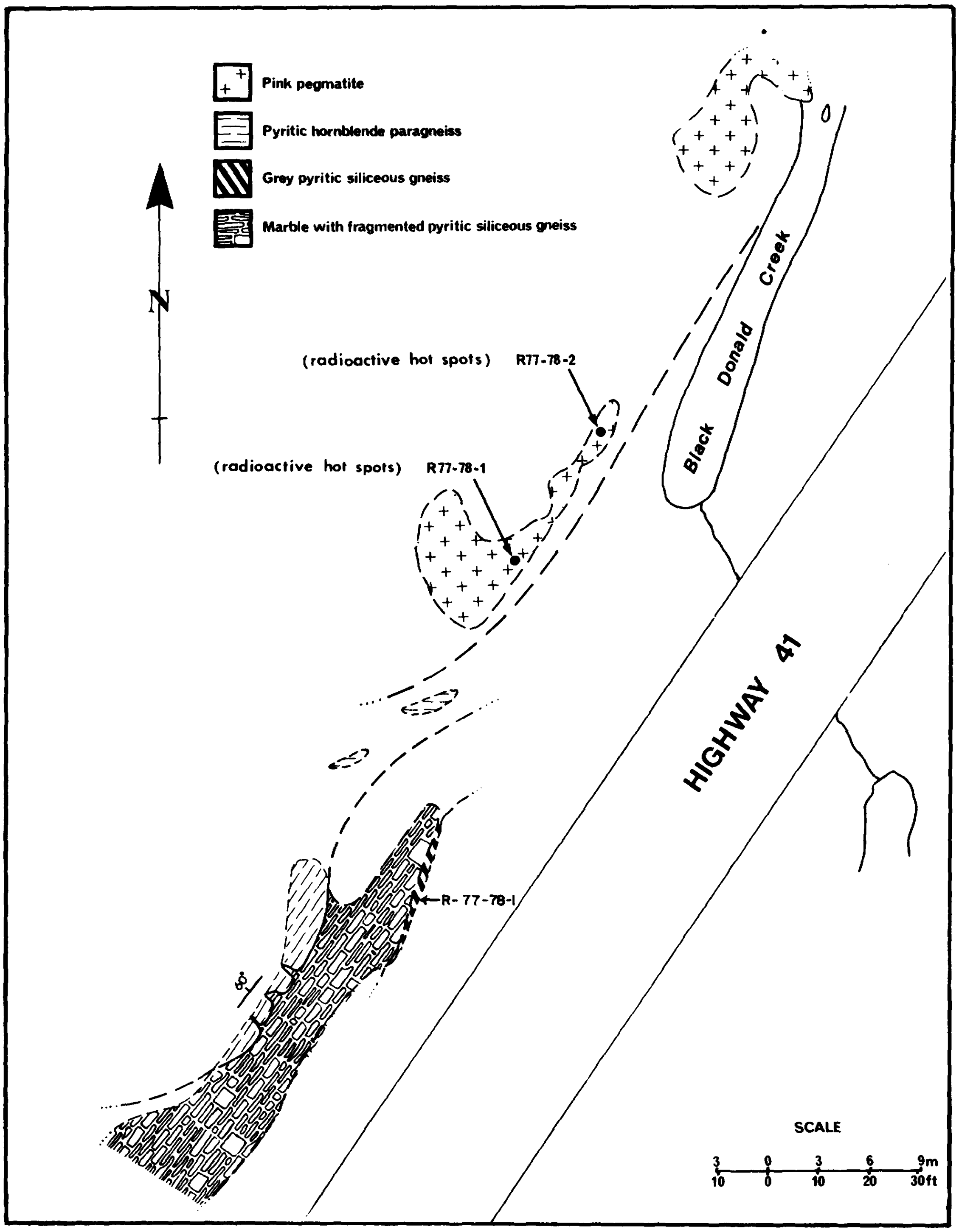


Figure 6 — Geology of the Tooey's Lake Occurrence.

matite, which is consistent with the presence of pyrochlore. Pyrochlore is atypical of the normal simple granite pegmatite; it is more frequently associated with the coarse-grained, zoned, feldspar-rich pegmatites. (Figure 6)

Discussion:A sample of the siliceous gneisses, R-77-78-3, assayed 6 ppm U_3O_8, 10 ppm Th and 75 ppm Zn. The uranium content is considered anomalous.

HISTORY

In 1955, E. R. Woermke of Pembroke, Ontario, submitted two samples to the Geological Survey of Canada in Ottawa for radiometric analysis. The authors sampled the occurrence in 1978.

REFERENCE

Geological Survey of Canada, Radioactive Resources Division File 31F/7-12

Khartum Area, Ontario Geological Survey Preliminary Map P. 2240 (1979)

18. GORMAN LAKE OCCURRENCE

COMMODITY

Uranium, thorium and cerium

RADIOACTIVE MINERALS

Allanite, uraninite (?)

ROCK ASSOCIATION

The host is granite pegmatite intruding biotitic quartzo-felspathic gneisses.

CLASSIFICATION

Simple pink granite pegmatite, calcite scapolite vein.

LOCATION

On an island at the west end of Gorman Lake, Lot 21, Concession X, in Brudenell Township, Renfrew County.
Latitude 45°25′42″N; Longitude 77°25′57″W
UTM 5033200mN, 309700mE; Zone 18
NTS Brudenell 31F/6.

ACCESS

A gravelled township road between Brudenell and Rockingham provides convenient access to Gorman Lake.

PRESENT EXPOSURE

Well exposed, smooth outcrop

SIZE AND GRADE

The occurrence is confined to an area 3m x 6m. A selected sample, R77-79-4, assayed 160 ppm U_3O_8 and 7200 ppm Th. An allanite crystal from the occurrence assayed 750 ppm U_3O_8 (R77-79-6).

DESCRIPTION

General Geology:The occurrence lies near the top of a meta-arkose unit comprising mainly biotitic quartzo-feldspathic gneiss. In this area, the unit represents the lowermost member of the Grenville Supergroup which unconformably overlies Early Precambrian paragneisses and orthogneisses. The meta-arkose is overlain by corundum syenites and calcareous metasandstones and siltstones which grade upward into sandy and silty marble with intercalated sandstone and siltstone. This sequence is intruded by granite pegmatites variable in attitude with respect to the intruded rocks. The pegmatite host rock is located within the meta-arkose unit just below the corundum syenite gneiss.

Detailed Geology:Radioactive mineralization occurs in NE-trending fractures in granite pegmatite which crosscuts biotitic quartzo-feldspathic gneiss. (Figure 7)

Granite pegmatite is light pink and consists of both coarse pegmatitic phases and fine-grained granitic phases. There is much graphic intergrowth of feldspar and quartz in the pegmatitic phases. In most of the pegmatite, the content of mafic minerals is low. The wall zone, which shows incorporation of the biotitic paragneiss country rock, contains a few biotite books ranging in size from 10 to 20 cm. The pegmatite has a radioactivity background level of 100 cps for the U+Th spectrum (T_2). Within the granite pegmatite are quartz-rich phases which give a T_2 count of 300 cps. The quartz occurs as stringers perpendicular to the strike of the quartz-rich phases which occur as narrow sinuous zones with irregular boundaries.

Biotitic quartzo-feldspathic gneiss in contact with the pegmatite is medium-grained, pink, with minor biotite-rich bands, and is slightly migmatitic with segregations (1 to 1.5 cm) of allanite-bearing granite. In thin section this rock shows a composition of 30 percent quartz, 35 percent oligoclase, 10 percent biotite and 5 percent orthoclase and microcline. The plagioclase shows slight sericitic alteration and is embayed by quartz. Accessory minerals are apatite and opaque minerals which may be ilmenite or magnetite. Chemical analysis (R77-79-1) reveals anomalous values for U_3O_8 (10 ppm), Cu (68 ppm), Pb (44 ppm) and Ba (1270 ppm). Thin section also reveals the presence of very small crystals of uraninite. The uraninite usually occurs at grain boundaries of feldspar but is also present within the feldspars. The uraninite is invariably surrounded by a red hematite halo in radiating fractures. An iron oxide (titanomagnetite) is also present.

Mineralization:High radioactivity also occurs along a zone of fractures striking N25°E and dipping 70°NW. The fractures are characterized by epidotization, with abundant scapolite, especially in areas of high radioactivity. (Figure 8)

High radioactive samples from the fracture areas consist of a much altered rock composed mainly of epidote and scapolite with allanite and pyrite.

Petrography: A thin section of the mineralized material revealed the presence of scapolite, epidote, a high-alumina white mica (margarite?), secondary chlorite, metamict allanite and what may have been sphene. There is also much material of unidentifiable mineralogy.

Discussion:The epidote, sphene and scapolite present in the veins suggest a hydrothermal origin related to mobilization of fluids from nearby calcareous sediments. This type of alteration, i.e. scapolite and epidote replacing feldspar in wall rocks, together with the presence of radioactive minerals, has been shown by Withers (1976) to be associated with calcareous veins resulting from the mobilization of volatile constituents within nearby marble beds. Withers noted that radioactive minerals accompanied by this type of alteration occur where calcareous veins cut pegmatites. He also pointed out that these veins follow fractures or joint sets in the country rock. Since

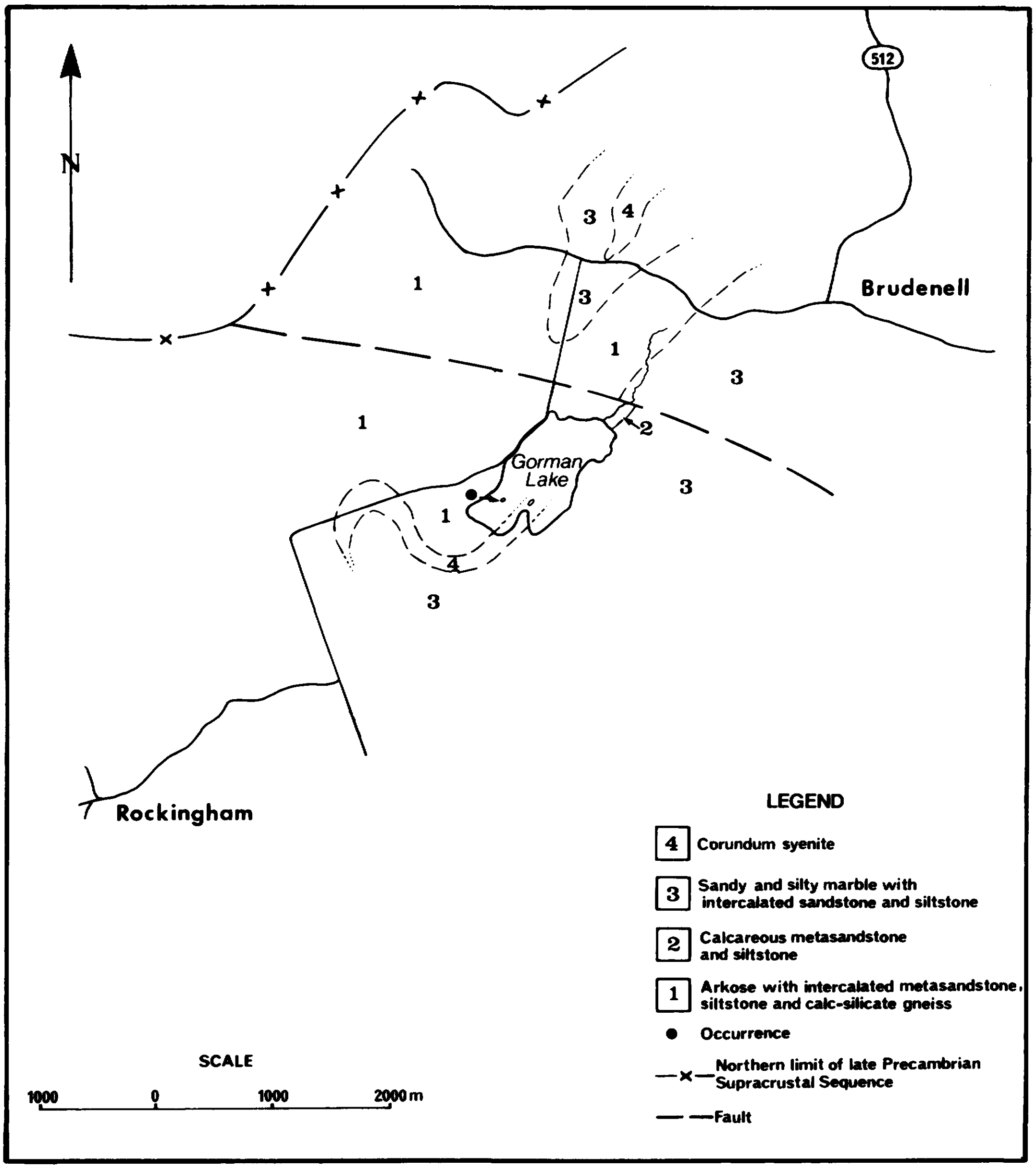


Figure 7 — Geology of the Gorman Lake Area. Geology by S.B. Lumbers (1976).

these veins occur along fractures in the pegmatite, mineralization postdates the crystallization of the pegmatite. It is likely that the mineralization resulted from hydrothermal fluids related to mobilization of volatiles and other elements of the country rocks, especially the marbles, during the waning stages of the pegmatite intrusive event. Many of these calcareous veins become mineralized with radioactive minerals only where they intrude granitic rocks, especially pegmatite, indicating the probable source of the radioactive minerals to be the immediate granitic country rock. Uranium and rare earths from the pegmatite are thought to be incorporated into such minerals as allanite and sphene in the vein.

HISTORY

In 1954, D. J. Drohan put two trenches, 0.6m x 3m, along two parallel radioactive fractures. One sample submitted to the Radioactive Laboratory in Ottawa for identification was reported to contain allanite.

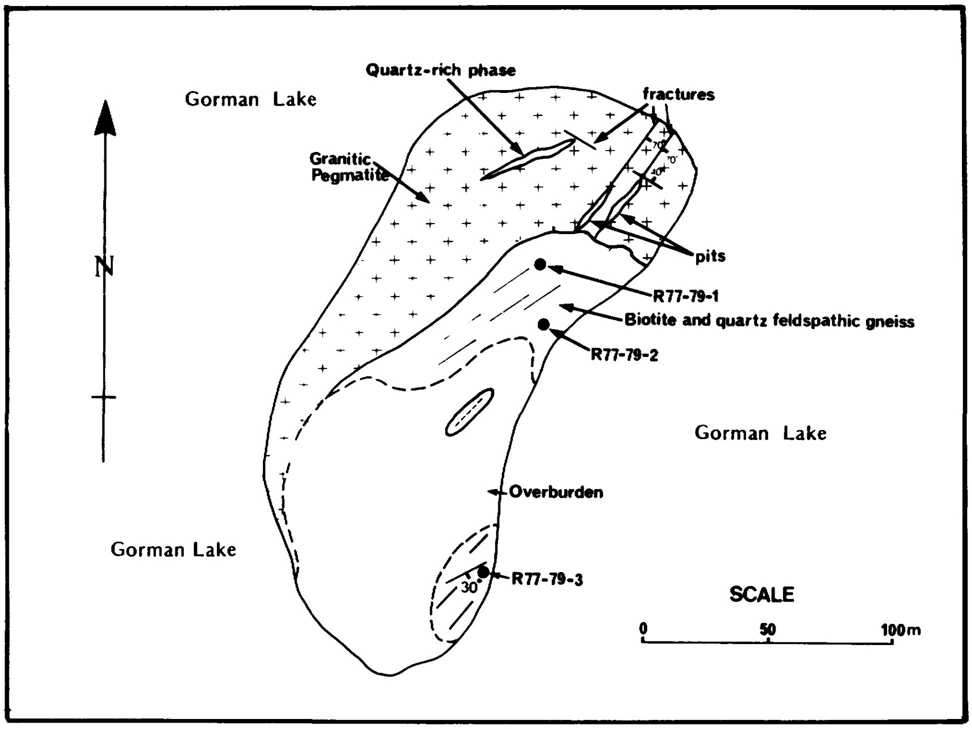


Figure 8 — Geology of the Gorman Lake Occurrence.

SELECTED REFERENCES
Geological Survey Canada, Radioactive Resources Division File 31F/6-13.
Withers (1976)

19. MURRAY OCCURRENCE

See "Minor Occurrences"

20.QUADE OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Unknown
ROCK ASSOCIATION
The host is pink granite pegmatite in country rocks consisting of amphibolite gneiss, biotite gneiss and calc-silicate gneiss.
CLASSIFICATION
Zoned pink granite pegmatite feldspar type
LOCATION
Lot 26, Concession VI, Brudenell Township, Renfrew County.
Latitude 45°23'09"N, Longitude 77°26'17"W
UTM 5028500mN, 309100mE; Zone 18
NTS Brudenell 31F/6.
ACCESS
The occurrence can be reached by taking the gravel road north from Quadeville. It lies 20 m west of the road, at a point 10.4 km north of Quadeville and 2.4 km south of Letterkenny.
PRESENT EXPOSURE
The outcrop is small but the mineralization is well exposed
SIZE AND GRADE
A selected sample, R-77-80-1, assayed 330 ppm U_3O_8 and 2320 ppm ThO_2.
DESCRIPTION
General Geology: The occurrence lies in rocks of early Late Precambrian age. This sequence in this area is made up of meta-arkoses, quartzo-feldspathic metasandstones and metasiltstones, biotite schists, marbles and calc-silicate-rich rocks.
These rocks have been intruded by granites, syenites and gabbros of several ages during the Late Precambrian. The area is traversed by northwest-trending faults of the Bonnechere Graben system. The general geology is shown on Ontario Department of Mines Map 1953-2, Brudenell-Raglan Area (Hewitt 1954) This map does not distinguish true intrusive granites from quartzo-feldspathic paragneisses.
Detailed Geology: The occurrence is located near the centre of a pegmatite dike which crosscuts interlayered biotite-quartz-feldspar gneiss, hornblende amphibolite and calc-silicate gneiss of the Grenville Supergroup. The

coarser central portion of the pegmatite contains almost no mafic minerals and is weakly radioactive, at 200 cpm (T_2). Towards the south wall of the dike, mafic minerals increase, particularly magnetite, pyroxene and sphene. The highest radioactive readings were obtained in a small trench containing high percentages of sphene and magnetite. Since no radioactive minerals were identified, the uranium and thorium content may be present in the mafic minerals. (Fig. 9) The mineralized pegmatite is quite hematitized, with rehealed fractures, whereas the coarse-grained unmineralized pegmatite is light pink and for the most part unfractured.

Discussion: It is proposed that the mafic minerals sphene and pyroxene are not primary to the pegmatite but rather are alteration products caused by alkali and CO_2-rich fluids circulating within the fracture zone. The source of the CO_2 is probably the adjacent calcareous country rock. The uranium and thorium content are believed to be primary to the pegmatite and to have been mobilized and redeposited in the fracture zone by CO_2 in the circulating metasomatic solutions. Withers (1976) has shown that CO_2-rich fluids can mobilize uranium in fractured granite. The mobilized uranium and thorium is believed to be associated with the mafic minerals in the fractured granite. Fyson (1979) has demonstrated that magnetite in fracture zones reduces and precipitates uranium and at the same time is oxidized to hematite. The abundant magnetite and hematite in this pegmatite suggests that this reaction occurred in this occurrence.

HISTORY
Stripping, pitting and some drilling were done in the 1950s by A. E. Quade.

SELECTED REFERENCES
Fyson, Baer, Habib, and Culshaw, (1979)
Geological Survey of Canada, Radioactive Resources Division File 31F/6
Withers, (1976)

21. ROCKINGHAM MINES OCCURRENCE

COMMODITY
Uranium and thorium

RADIOACTIVE MINERALS
Uranothorite and uraninite

ROCK ASSOCIATION
The host is a coarse-grained biotite-diopside marble in country rocks consisting of feldspathic gneisses (meta-arkoses and pyritic meta-sandstones).

CLASSIFICATION
Marble

LOCATION
Lot 24, Concession X, Brudenell Township, Renfrew County, immediately east of a small lake and southwest of Gorman Lake.
Latitude 45°25'20''N, Longitude 77°26'30''W
UTM 5032500mN, 309000mE; Zone 18
NTS Brudenell 31F/6.

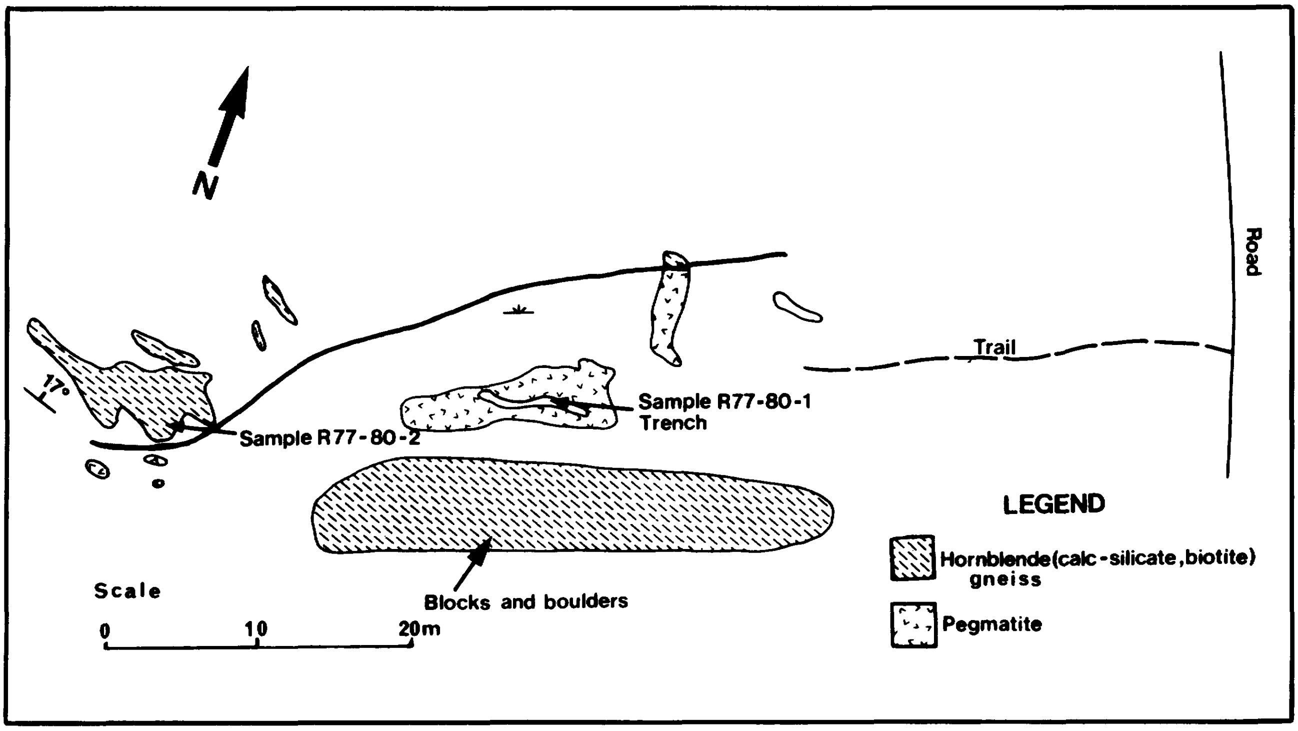


Figure 9 – Geology of the Quade Occurrence

ACCESS
A road heading east from the village of Rockingham ends after approximately 6 km at a T-junction. About 300 m south of this junction a bush road leads east and then north to the occurrence.
PRESENT EXPOSURE
Fair to poor
SIZE AND GRADE
Some areas within the pits and trenches are highly radioactive, but these areas are usually very small and isolated. In 1955, J. R. Macdonald assayed 3 samples with the following results:

	U_3O_8	ThO_2%
1) Radioactive detritus from Discovery Pit	0.17	0.17
2) Selected sample from Discovery Pit	01.3	0.09
3) Selected sample from pit 200 feet south of Discovery Pit	1.37	0.40

Satterly (1957) reported an uranothorite crystal from a metapyroxenite skarn which assayed 20.73% U_3O_8 and 40.37% ThO_2. The writers assayed a small uraninite crystal to be 20% U_3O_8.
DESCRIPTION
General Geology:The regional geology is shown on Ontario Department of Mines Map 1953-2, Brudenell-Raglan Area by D. F. Hewitt. A sequence of early Late Precambrian metasediments of the Grenville Supergroup disconformably overlies Middle Precambrian ortho and paragneiss. At the base of the Grenville is a basal meta-arkose containing minor units of meta-sandstone, calc-silicate gneiss and marble. These units are overlain by a sandy-silty calcite marble, locally pyritic and consisting of 10 to 20 percent biotite and 20 to 60 percent diopside. The metasediments, striking northwesterly and dipping 20 to 40° to the southeast, are intruded by syenites and late Late Precambrian granite pegmatites. The area is traversed by a number of northwest-trending faults related to the Bonnechere Graben Structure to the north. The rocks have been metamorphosed to upper almandine amphibolite facies; some quartzo-feldspathic metasediments resemble granite gneisses. Hewitt's map does not distinguish between intrusive granites and quartzo-feldspathic gneisses, nor does it separate Late and Middle Precambrian rocks. He notes occurrences of corundum to the east at Gorman Lake.
Detailed Geology:Apatite-biotite-diopside marble lies between quartzo-feldspathic rocks: meta-arkose below and rusty gneiss above. The overlying metasediments are rusty due to the presence of pyrite and pyrrhotite (5 to 15 percent), as well as secondary mobilized pyrite in fractures, with increasing pyrite content as the underlying marble is approached. Interlayered with the rusty feldspathic gneiss are thin pyroxenite-carbonate horizons which frequently contain apatite. Some of these units may represent carbonate veins mobilized from the marble below.
Mineralization:Mineralization occurs within the marble and in metamorphic skarn representing the contact area between marble and overlying rusty gneiss. Background radioactivity for marble is 40 cpm (T_2), but in trenches, pits and stripped areas, occasional cubes of uraninite up to 1 cm across give spotty highs of 200 to 2000 cpm (T_2). Uranothorite occurs in skarn areas. The marble, which appears to have the best mineralization, is very coarse-grained with books of biotite of 10 cm size. Diopside is a major component of some layers making up from 20 to 60 percent of the marble. Apatite and pyrite occur as accessory minerals usually associated with diopsidic layers. Pyrite also appears in late fractures cutting the marble.

The abundance of biotite (10 to 20%), its large size, its occurrence as veins cutting the marble, and the coarse-grained nature of the marble itself (10 to 20 cm) suggest that the marble formed under very wet conditions at elevated temperatures. The environment of high temperatures and high fluid and gas pressures allowed the growth of large crystals, and probably also allowed radioactive elements to migrate into and become concentrated in sulphide reducing areas.
Discussion:The formation of these deposits suggests a number of stages of enrichment.

The presence of a basal arkose overlying an older granitic terrain is highly suggestive of conditions for a paleo-sandstone type deposit. The fact that this arkose is overlain by a slightly pyritic marble unit which grades upward into a rusty-weathering pyritic quartzo-feldspathic meta-sandstone is indicative of reducing conditions. The oxidizing (arkose) and reducing (pyritic gneiss and marble) interplay is typical of the type of environment for early epigenetic uranium mineralization. Therefore it is possible that important amounts of uranium may have already been in a first stage of concentration in these sediments prior to metamorphism. The concept that any marble of a similar composition, if mobilized, would result in similar mineralization is rejected, as most marbles are exceptionally low in uranium. It is therefore proposed that high-grade regional metamorphism has redistributed radioactive mineralization, present in low-grade first-stage concentrations, into more reducing areas of the marble and metamorphic skarn in this and other similar occurrences.
HISTORY
Work commenced on the property in August, 1955. This consisted of stripping, rock-pitting, trenching and limited diamond drilling.
SELECTED REFERENCES
Geological Survey of Canada, Radioactive Resources Division File 31F/6-11
Macdonald, J. R.
1956: Rockingham Mines Limited; Engineers Report on the Property, Eastern Ontario Mining Division. Contained in GSC file 31F/6-11.
Satterly (1957,p.18)

22. AMBIS OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uranothorite, uranian hydrocarbon and cyrtolite
ROCK ASSOCIATION
The host rock is a highly-sheared syenite in country rocks

consisting of granite pegmatite, impure marble, paragneisses and granitic gneisses.

CLASSIFICATION

Complex pink pegmatite

LOCATION

The occurrence lies approximately 13 km northwest of Bancroft, in N½ of Lot 17, Concession XII, Carlow Township, Hastings County

Latitude 45°15'28''N; Longitude 77°41'05''W

UTM 5014900mN, 289350mE; Zone 18;

NTS Barry's Bay 31F/5

ACCESS

A gravel road heading east from New Carlow is followed for 4.3 km to a point 120 m west of the junction of Highways 517 and 62. The occurrence lies 250 m south of the road on the south face of a hill.

PRESENT EXPOSURE

Well exposed.

SIZE AND GRADE

Two selected drill-core samples assayed by Ambis Mines Limited averaged 0.016% U_3O_8 and 0.007% U_3O_8 The occurrence is small.

DESCRIPTION

Geology: The occurrence is located near the contact between anatectic meta-arkose and siliceous marble. The area of this contact is intruded by pyroxene granite pegmatite. The above rocks are cut by a shear zone approximately one metre thick. The zone is roughly parallel to the stratigraphic units, which strike northeast and dip 20 to 30° SE. On a local scale, the shear zone is sub-parallel to the gneissosity of the country rocks.

Mineralization: Mineralization occurs in the sheared pegmatite. This mineralized pegmatite is syenitic, deep red in colour (due to hematite), cataclastic, and contains abundant mafic minerals, mainly pyroxene, as well as some sphene and zircon. A selected sample (R-71-8-2) assayed 485 ppm U_3O_8 (≅1 lb.) and 2595 ppm Th. (Fig. 10)

Discussion: Generally, mineralization occurs in pegmatite intruding the granitic gneisses where they are overlain by a carbonate sequence. The unmineralized or poorly-mineralized pegmatites are granitic in composition and unsheared. These pegmatites often have pyroxene reaction selvages where they are in contact with granitic rocks. Within the syenite pegmatite, radioactivity increases with increasing mafic content and hematization, decreasing grain size or shearing, the presence of late cross-cutting jointing, and proximity to the granite pegmatite.

The following sequence of events is proposed. During the waning stages of metamorphism, granitic melt containing Ca, Mg and CO_2 (possibly derived from the nearby calcareous rocks) was intruded. This resulted in the development of pegmatites displaying pyroxene reaction rims in the granitic rocks just below the calcareous rocks. Following consolidation of the granite pegmatite, a shear zone, possibly a fault, developed, allowing metasomatic fluids to enter. These fluids, enriched in Ca, Mg and CO_2 from the nearby carbonates, syenitized the zone by reacting with free silica to form pyroxene and sphene. These fluids also concentrated uranium along the most highly sheared portions of the zone. Since uranium values are highest where the shear zone cuts granite pegmatite, which is itself more uraniferous than the surrounding country rock, the granite pegmatite appears to be the major source of uranium.

The presence of high radioactivity along joints which cut the syenitic pegmatite may represent a later enrichment process.

HISTORY

1958-59: 16 drill holes totalling 345.6m by Ambis Mines Limited.

1964: Five drill holes totalling 322.7 m by Faraday Uranium Mines Limited.

SELECTED REFERENCE

Hewitt (1955)

Ontario Geological Survey, Assessment Files Research Office, Toronto: Technical File No. 63A. 428, :Carlow Tp. Drill Log Report Nos. 11 and 12.

23. BURGESS OCCURRENCE

See "Minor Occurrences"

24. MENTOR (UNION MINING) OCCURRENCES

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Allanite and uranothorite

ROCK ASSOCIATION

The host is granite pegmatite in country rock consisting of marble, calc-silicate gneiss, hornblende gneiss and minor meta-arkose and biotite paragneiss.

CLASSIFICATION

Simple granite pegmatite

LOCATION

Approximately 16.5 km northeast of Bancroft, in Lots 1 and 2, Concession IV, Monteagle Township, and Lot 1, Concession III, Lots 1 and 2, Concession IV, Lots 2, 3 and 4, Concession V, Carlow Township, Hastings County.

Latitude 45°10'00''N; Longitude 77°43'13''W

UTM 5004850mN, 286250mE; Zone 18

NTS Bancroft 31F/4.

ACCESS

At Quirk Lake, 3.1 km north of Musclow, a gravel road leads east for 2.8 km and ends. From there a foot trail leads east to the occurrences, a distance of about 2.5 km. A boat is necessary to reach the east side of the York River.

PRESENT EXPOSURE

Good

SIZE AND GRADE

Mineralization is erratic and low grade

DESCRIPTION

General .Geology: Paragneiss, amphibolite and marble are intruded by pyroxenite, nepheline rocks, syenite and granite. The rocks trend northerly and dip 50 70° east. Numerous dikes and sills of granite pegmatite intrude the above rock units. The Mallard Creek Fault crosses the property from east to west.

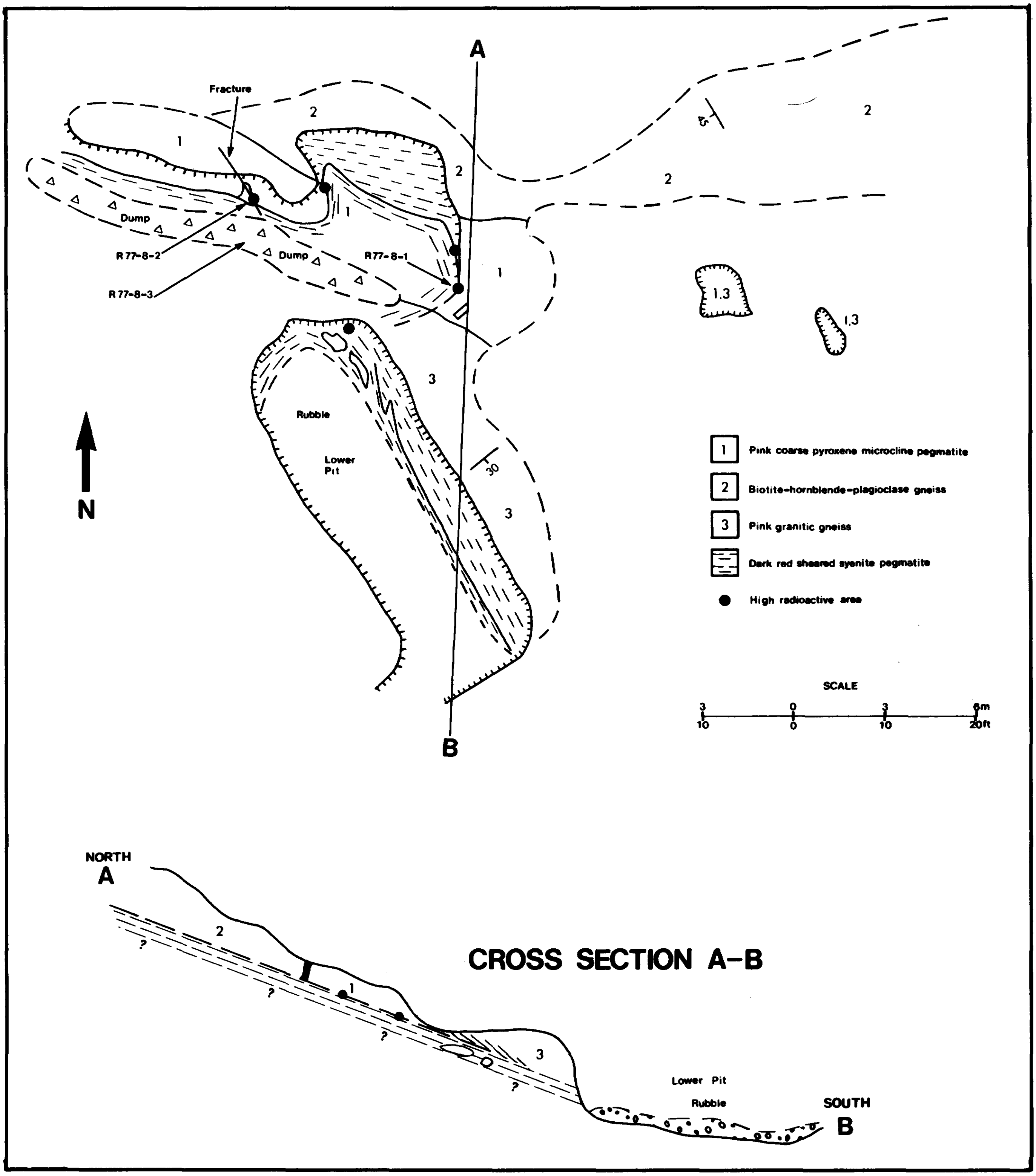


Figure 10 — Geological plan and cross-section of the Ambis Occurrence

Detailed Geology: Several occurrences are described separately below.
At the Island Zone, numerous small pale granite pegmatite dikes intrude calcareous paragneiss with minor limestone and dolomite beds. The rocks strike NNE and dip 40 to 70° to the east. Local anomalous radioactivity is associated with the darker-coloured pegmatites, peristerite and fracturing. The most radioactive pegmatites strike perpendicular to the general trend of the country rock. Allanite and uranothorite are present.

The Carr Zone consists of a series of discontinuous narrow granite pegmatite sills and lenses conformably intruding the paragneiss. It may be an extension of the Island Zone. One lens assayed 0.085% U_3O_8. Uranothorite is present.

Radioactive pink medium-grained leucogranite gneiss is found at the Wash Tub Zone. The gneiss strikes 25° and dips 60° east. Allanite and uranothorite occur as accessories.

The Southwest Wash Tub Zone consists of pale pink leucogranite cutting marble.

Pegmatites at the Pine Hills Zone contain bright red feldspar and continuous, though weak, radioactivity.
Pegmatite dikes 0.6 to 7.6 m wide are exposed at the Flat Zone.

The South Zone consists of weakly radioactive pegmatite dikes 3 to 29 m widé intruding interbanded metasediments.

B. C. Donnan (1955) suggests mineralization of the Carr and Island Zones may have been in part a function of the northwest-trending Mallard Creek Fault which passes between the two zones. Mr. Donnan further states that minor faulting and fracturing associated with well-mineralized pegmatites may be mineralizing structures related to the fault. The fault has an apparent horizontal displacement of 433 m. An excellent description of the work performed on this property as well as the geology can be found in the report by B. C. Donnan.

HISTORY

Mentor Exploration and Development Company Limited performed stripping, trenching, scintillometer and geological surveys in 1955. Eight drill holes for 251.8 m and bulk sampling were done by Union Mining Corporation during 1968-69.

SELECTED REFERENCES

Ontario Geological Survey, Assessment Files Research Office, Toronto, Technical file 63A.297. Includes report by B. C. Donnan.
Satterly (1957; p.136-138)

25. SUNDSTROM (NORTH) OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Allanite

ROCK ASSOCIATION

The host rock is granite to granite gneiss in country rocks consisting of granitic gneisses, amphibolite gneiss and biotite-quartz-plagioclase gneiss.

CLASSIFICATION

Granite

LOCATION

N½ Lot 18, Concession XII, Carlow Township, Hasting County, approximately 40 metres west of the Boulter Road.
Latitude 45°15'35''N; Longitude 77°40'36''W
UTM 5015000mN, 290000mE, Zone 18
NTS Barry's Bay 31F/5.

ACCESS

The occurrence lies 40 m west of the Boulter Road, approximately 450 m northwest of the junction of Highway 517 and Boulter Road.

PRESENT EXPOSURE

Very good

SIZE AND GRADE

A grab sample taken from the dump by Satterly assayed 0.01% U_3O_8 (radiometric).

DESCRIPTION

General Geology: The occurrence is located within a sequence of metasediments comprising meta-arkose, quartzo-feldspathic gneiss (meta-sandstones), amphibolites and marbles. This sequence represents the lower part of the Grenville Supergroup of early Late Precambrian age. These rocks are intruded by small bodies of granite and syenite and by late Late Precambrian pegmatites. The metamorphic grade is upper almandine amphibolite facies. The regional structure generally trends northeastward with fold limbs dipping shallowly to the southeast. The area is traversed by northwest-trending normal faults related to the Bonnechere Graben structure. The general geology is shown on Ontario Department of Mines Map No. 1954-3.

Detailed Geology: The following description of the property is from Satterly (1971):

> The north part of this lot is underlain by a ridge of pink granite gneiss and leucogranite. Parts are graphic granite. Geiger readings are fairly uniform being 500 cpm to occasionally 1000 cpm on fractures. A 20 to 30-foot basalt dike cutting the granite reads 400. At the showing, the granite gneiss is medium- to coarse-grained and consists of pink feldspar, grey to white quartz, sparse altered mafics with accessory titanite and quite abundant allanite. The gneissic structure strikes N 70°E, and dips 30°S. A white coating on fractures is a carbonate. Geiger readings were 1000-3000 and may average 2000. The area reading 1000 or better is 30 feet wide and has an exposed length along strike of 150 feet.

The occurrence was re-examined by the writers in 1977. Satterly's granite gneiss is interpreted as a feldspathic meta-sandstone sequence which grades downward into biotite and hornblende-rich gneisses. The upper portion of this granite gneiss contains minor beds of calc-silicate gneiss. The sequence is overlain by calc-silicate gneisses, skarn and siliceous marble. The granitic gneiss is recrystallized and partially melted to produce a resultant foliated to granitic fabric. This granitic material is generally medium to very coarse-grained, in places pegmatitic with thickness up to 5 m. The radioactive mineralization, particularly allanite, is associated with the very coarse-grained portions. The anatectic nature of this granite is indicated by its inhomogeneity, its stratigraphically interlayered relationship with the gneisses, its lack of persistent sharp contacts and the presence of remobilized country rock intruding the basalt dike.

The quartzo-feldspathic gneiss generally gave radiometric readings of 50 cpm. (T_2) whereas the granitic phases (anatectic melt), especially the pegmatitic layers, gave readings of 250 (T_2). A sample, R77-10N-4, thought to be representative of the unmineralized granite, assayed 1 ppm U_3O_8 and 21 ppm Th. Mineralization was also observed in three fracture zones which trend N45-60°W and dip steeply at 80 to 90° to the northeast.

HISTORY

In 1957, surface trenching on the area was done by H. Sundstrom.

SELECTED REFERENCES

Ontario Geological Survey, Geoscience Data Centre, File SMDR 000237, H. Sundstrom.
Satterly (1971, p.11)

26. SUNDSTROM (SOUTH) OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Uranothorite

ROCK ASSOCIATION

The host rock is a vein of pink calcitic marble in country rocks consisting of various paragneisses, granites and pegmatites.

CLASSIFICATION

Metapyroxenite skarn

LOCATION

S½ Lot 17, Concession XII, Carlow Township, Hastings County, approximately 600 m north of the western boundary of Fosters (Stringer) Lake.
Latitude 45°15′24″N; Longitude 77°40′49″W
UTM 5014700mN, 289700mE, Zone 18
NTS Barry's Bay 31F/5

ACCESS

Approximately 250 m northwest of the intersection of Highway 517 and New Carlow-Boulter County Road, an overgrown bush road is reached on the west side. The occurrence lies 100 m north of the bush road about 600 metres west of the main road.

PRESENT EXPOSURE

Good to poor

SIZE AND GRADE

The size and grade of this showing are difficult to assess due to limited exposure around the pit area. A sample, R-77-10-S-1, selected by the writers, of a highly radioactive area, assayed only 32 ppm U_3O_8 and 322 ppm Th.

DESCRIPTION

General Geology: The occurrence lies within a sequence of metasediments comprising basal meta-arkose, quartzo-feldspathic gneisses (meta-sandstones), calc-silicate gneiss, amphibolite, marble and syenitic rocks. This sequence represents the lower part of the Grenville Supergroup in this area, which is of early Late Precambrian age. The metasediments are intruded by small granitic and syenitic bodies and by late Late Precambrian granite pegmatite and mafic dikes. These rocks are metamorphosed to upper almandine amphibolite facies, and trend northeast with fold limbs generally dipping 20 to 40° to the southeast. The area is traversed by late normal faults trending northwesterly which are related to the Bonnechere Graben Structure. The general geology is depicted on Ontario Department of Mines Map 1954-3, Monteagle and Carlow Townships. It should be noted, however, that this map does not distinguish either between Middle and Late Precambrian sequences or granites of igneous and metamorphic origin.

Detailed Geology: The following description of the occurrence is taken from Satterly (1971):

> A pit, 15 x 10 x 5 feet deep, about 300 feet northwest of a bush road, exposes an almost flat-lying granite gneiss complex of alternating bands of pyroxene-poor leucogranite, pyroxene-rich granite, and patches or lenses of quartz-rich scapolite pegmatite or lenses of salmon-pink calcite. Accessory minerals are titanite, zircon and uranothorite. Geiger readings were 1000 - 3000 and a spot-high of 10 000 where uranothorite was seen.

The authors visited the occurrence in June, 1977. The pit exposes calc-silicate gneisses with locally abundant diopside. These gneisses in the area of the pit dip very gently southward, at <10%. The mineralization was found in small, <20 cm, patches of quartz-rich pegmatite and in irregular patchy calcite veins. The patchy areas contained abundant crystals (1-2 mm) of sphene and black vitreous uranothorite (identified by X-ray powder camera).

The presence of substantial re-mobilized calcite as well as the abundance of scapolite and diopside and the proximity of marble to the south suggest that the host rock is probably a calcareous metasediment. This particular calcareous unit may be correlated to the marble unit at Rockingham Mines. Positive correlation is still uncertain, but there appears to be a string of occurrences along this marble unit either within or along the border represented by igneous contact and metamorphic skarn. It is thought that mineralization results from remobilized portions of this marble unit during high-grade regional metamorphism. The significance of this marble unit is discussed further in this report, in the description of Rockingham Mines, Brudenell Township, Renfrew County.

HISTORY

In 1957, H. Sundstrom opened a pit 15 x 10 x 5 feet deep.

SELECTED REFERENCES

Ontario Geological Survey, Geoscience Data Centre, File SMDC 000238, H. Sundstrom.
Satterly (1971,p.12)

27. DAVIS MICA OCCURRENCE

See "Minor Occurrences"

28. PLEXMAN OCCURRENCE

COMMODITY
Main–feldspar
Minor–uranium and thorium
RADIOACTIVE MATERIALS
Aeschynite
ROCK ASSOCIATION
The host is granite pegmatite in country rocks comprising gneissic granite, biotite quartzo-feldspathic gneiss, biotite-amphibole gneiss and rusty-weathering garnet-biotite gneiss.
CLASSIFICATION
Zoned granite pegmatite-feldspar type
LOCATION
In the south part of Lot 22, Concession I, in Dickens Township, District of Nipissing.
Lattitude 45°31'48"N; Longitude 77°52'30"W
UTM 5045600mN, 275500mE, Zone 18
NTS Round Lake 31F/12
ACCESS
This occurrence is on a high ridge approximately 200 m south of Highway 62, at a point 8 km east of the village of Madawaska and 1 km west of Wolfden Lake.
PRESENT EXPOSURE
Almost 100 percent outcrop in the immediate area of the showing.
SIZE AND GRADE
Anomalous radioactivity is confined to an area 2m x 2m. A radioactive mineral sample submitted to the Harry Weller Laboratory in Cobden assayed 4.39% U_3O_8.
DESCRIPTION
General Geology: The area is underlain by a sequence of south-easterly dipping gneisses of the anorthositic suite of intrusive rocks of the Algonquin Batholith (Lumbers 1976b). North of Highway 62, these rocks are yellowish hornblende-biotite-rich quartz syenite gneisses (R-77-81-1) and are cut by irregular syenite-to-granite pegmatites of anatectic origin. Overlying the syenite gneisses, and exposed in cuts along the highway, are pyritic garnet-biotite-plagioclase gneisses interlayered with minor (4mm - 12 cm) biotite-hornblende-rich units and pyritic layers (4 mm). These gneisses are cut by pegmatite dikes of similar composition but with a lower quartz content. The pegmatites contain large biotite books, garnets up to 3 cm, and pyrite blebs in fractures. A similar biotite-garnet gneiss (R-77-81-4) outcropping south of the highway is very rusty-weathering and contains thin biotite-rich layers. The unit is overlain by garnet-poor biotite-hornblende-plagioclase gneiss with interlayers of amphibolite. A sample of this gneiss (R-77-81-6) is gabbroic in composition and has a normative feldspar content of An_{50}. Despite the well-layered appearance of a paragneiss, the high Ni and Cr contents of 62 ppm and 2000 ppm respectively, suggest an igneous origin.

The above gneisses grade through an intermediate zone of diorite to quartz diorite composition into a well-layered biotite quartzo-feldspathic gneiss of quartz monzonite composition which becomes increasingly migmatitic as it grades into granite gneiss. The rocks south of the highway are cut by two pegmatite dikes, a large unzoned sill-like body which is not anomalously radioactive, and a cross-cutting zoned pegmatite in which radioactive minerals are present.

Detailed Geology: A northwest trending and vertically dipping zoned granite pegmatite dike which transversely intersects the country rock gneisses is host to radioactive minerals. The pegmatite, which was formerly tested as a source of feldspar by trenches to a maximum depth of 4 m, is 1 to 6 m wide and has been exposed for a length of 60 m. The core of the pegmatite is milky white quartz. The intermediate zone is composed of coarse microcline crystals up to 1 m and biotite books up to 40 cm in a quartz matrix. The border zone is a finer-grained phase of the feldspar and quartz intergrowths and in places it is in direct contact with the quartz core. (Figure 11)

Mineralization: The only radioactive minerals noted were found in material removed from a pit (5m x 5m) at the crest of the ridge in the intermediate zone containing large biotite plates. The radioactive minerals examined were black, vitreous to dull and up to 2 cm. These minerals resembled euxenite and recorded 80000 cpm (T_2).

One specimen from the waste dump was enclosed within a fragment from a large feldspar crystal which showed marked hematite staining on the margin of the black mineral.

Discussion: As in other zoned deposits, such as the Barr Feldspar Quarry and the Thomas occurrence, the radioactive minerals appear to show a preference for portions of the pegmatite containing large biotite books. These parts of the pegmatite are among the last to crystallize. It is suggested that the radioactive minerals are primary constituents of the pegmatite and crystallized out of the residual fluid in the presence of iron-rich minerals, such as biotite.

Five samples of the six lithologies cut by the pegmatite were analyzed for trace elements as well as U and Th, in order to determine whether there was any relationship between uranium content of a particular lithology and the extent of mineralization in the pegmatite where it cuts that lithology. The only major elements to show correlation with uranium and thorium are Ca and CO_2. The results are summarized in table 4:

The lithology with the highest U, Th, Ca and CO_2 correlates with uranium and thorium mineralization in the pegmatite. The chemistry of the country rock gneiss indicates that the Ca and CO_2 content is mainly secondary and introduced. It is proposed that the country rock represented by R-77-81-7 which is the highest in uranium (6 ppm), and correlates spatially with uranium mineralization in the pegmatite, is not the source of the uranium, but rather the recipient of uranium-rich volatiles from the pegmatite during the final stages of crystallization. The area of mineralization and zone of coarse crystallization with its high residual volatile content, are co-incident. Uranium-rich volatiles given off during the final stage of consolidation of the pegmatite would follow fractures in the country rock. Therefore, the uranium content of the country rock is most probably derived from the pegmatite rather than the uranium content of the pegmatite having its source in the gneiss. The sharp contacts of the peg-

TABLE 4 | ANALYSIS OF SOME SAMPLES FROM THE PLEXMAN OCCURRENCE

Sample	Lithology	U ppm	Th ppm	Ca %	CO_2 %
R77-81-1	Bi rich Qtz Syenite gneiss	< 2	< 10	2.79	0.06
R77-81-4	Rusty Py Gnt Bi Plag gneiss	4	40	7.01	0.15
R77-81-6	Gnt Bi Hb Plag gneiss (gabbro comp)	< 2	< 10	10.8	0.06
R77-81-7	Bi Qtz Feld gneiss (qtz diorite comp)	6	21	12.9	2.42
R77-81-5	Bi Qtz Feld gneiss (qtz monzonite comp)	< 2	21	1.78	0.06

matite with country rock gneisses and the lack of contamination of the pegmatite by inclusion or assimilation of the gneisses support this conclusion.

HISTORY

pre-1954: Investigated for feldspar content by pitting and trenching

1954: A. E. Plexman submitted a sample of black mineral from the old feldspar pits to Mr. H. Weller of Cobden for radiometric analysis.

SELECTED REFERENCES

Geological Survey of Canada, Radioactive Resources Division File 31F/12-1.

Lumbers (1976b)

29. CAM–LOWER DUNGANNON OCCURRENCE

COMMODITY

Uranium, thorium

RADIOACTIVE MINERALS

Allanite, uranophane, uranothorite and uraninite

ROCK ASSOCIATION

The host is pink granite pegmatite in country rocks consisting of calc-silicate, rusty hornblende and syenitic gneisses. Granite and marble are also present.

CLASSIFICATION

Simple pink granite pegmatite and granite

LOCATION

The occurrence is approximately 9.5 km eastnortheast of the town of Bancroft, in Lots 13 and 14, Concessions XII and XIII, S½ Lot 12, Concession XIII, N½ Lot 12, Concession XII, Dungannon Township, Hastings County.

Latitude 45°04'50''N; Longitude 77°44'42''W

UTM 4995250mN, 283950mE, Zone 18

NTS Bancroft 31F/4

ACCESS

Bush roads leading north from Highway 500 just west of the York River provide access to the property.

PRESENT EXPOSURE

The occurrences are moderately well exposed.

SIZE AND GRADE

Mineralization is either erratically distributed or exists in low-grade concentrations. Chip samples across widths of 2.5 m assayed as high as 2.2 lb/ton U_3O_8; grab samples as high as 5.4 lb/ton. The best drill-hole intersection assayed 0.026% U_3O_8 over 1.5 m.

DESCRIPTION

General Geology: The area is underlain by a NNE-trending sequence of interlayered marble, calc-silicate gneiss, biotite and biotite-garnet paragneisses, meta-arkose and syenitic gneiss. The rocks dip 30 to 50° to the east. The sequence is intruded by sills of syenite, granite and pegmatite. The syenites may be metasomatic or intrusive, but usually only very small bodies show intrusive relationships. It is suggested that many of the paragneisses and meta-arkoses have been syenitized. Metamorphic grade is upper almandine amphibolite, and metasomatism appears to have operated on a very local as well as on a very large scale, especially in the vicinity of calcareous rocks. In general, there is a transition upwards in the sequence from dominantly clastic rocks, i.e. meta-arkoses, in the west, through biotite paragneisses into calc-silicate rocks and marbles to the east. Associated with the marbles are nepheline syenite belts. Only the late granites and granite pegmatites are substantially mineralized as these post-date regional metamorphism. Mineralized pegmatites generally occur in that portion of the stratigraphy dominated by calc-silicate rocks and upper paragneisses.

Detailed Geology: The property contains several showings which are described separately. The name of each showing is the same as the Cam Mines Limited designation.

Showing#5 1S½ Lot 13, Concession XII: A mineralized pink pegmatitic granite body less than 15 m thick dips shallowly southeast. It intrudes interbanded calc-silicate gneiss, rusty gneiss and biotite-amphibolite gneiss near a marble unit. Anomalous radioactivity is found in irregular pegmatitic segregations, coarse-grained sections, biotite-rich areas and small hematized shears. Radioactive areas contain abundant allanite and some zircon and uranophane. Uranothorite was identified in sample R-77-11S-2. The showing was stripped and trenched, both longitudinally and transversely. Sampling along these trenches by Cam has given low uranium values.

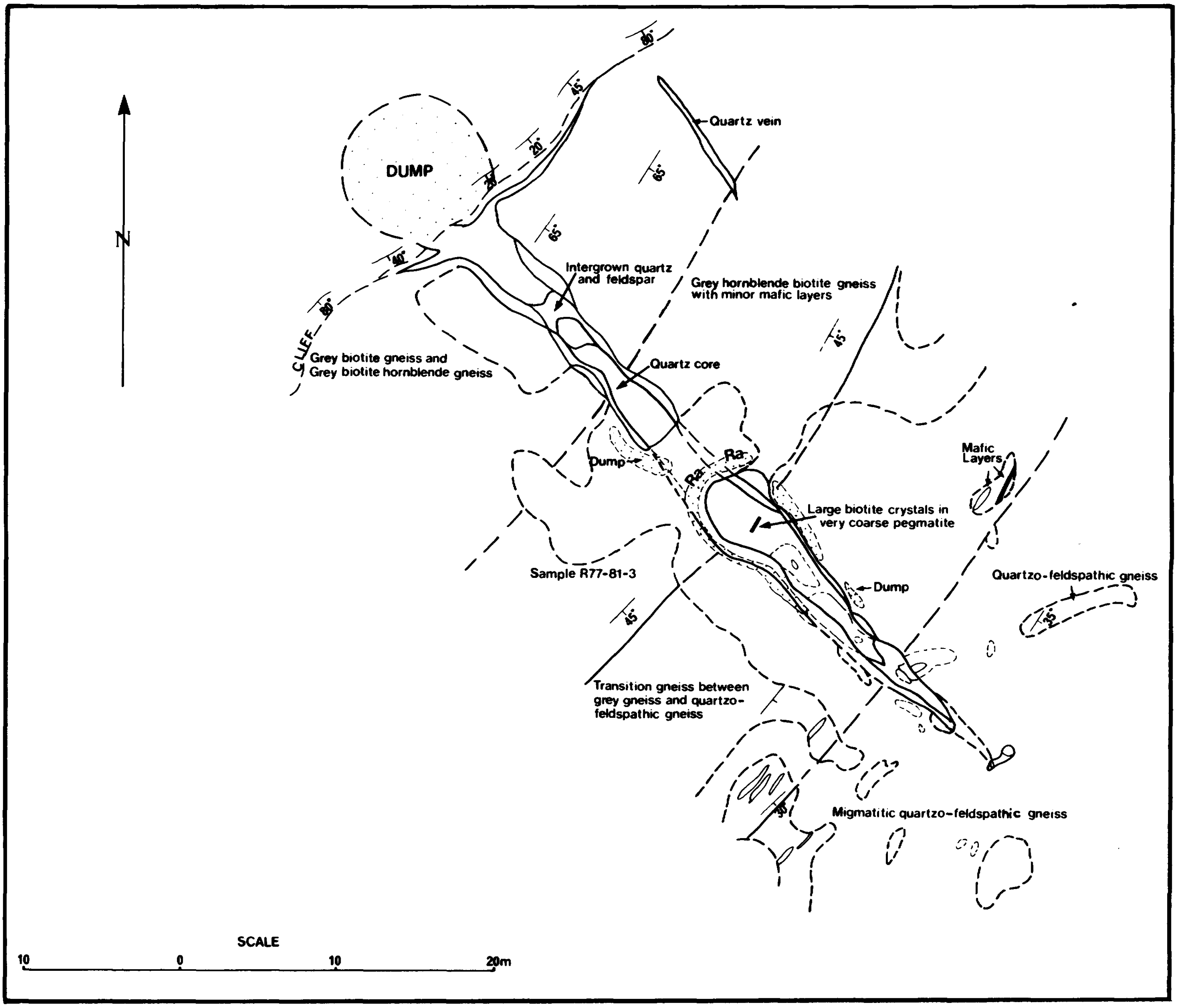


Figure 11—Geology of the Plexman Occurrence.

Showing # S½ Lot 15, Concession XII:A sill of medium-grained granite pegmatite intrudes rusty graphitic biotite syenite gneiss with minor bands of calc-silicate gneiss, amphibolite gneiss and marble. The pegmatite contains weak mineralization along thin shears or isolated blebs. Uranothorite was identified within the pegmatite (sample R-77-11W-1). The country rocks contain anomalous uranium values of 4 to 8 ppm U_3O_8. The pegmatite is at least 2 m thick and exposed for a length of 15 m. A chip sample by Cam across the pegmatite assayed 0.6 lb/ton U_3O_8, but a drill hole encountered only poor mineralization.

Showing #2 S½ Lot 13, Concession XII: About 250 m east-northeast of Showing #5, small (1 m) granite pegmatites with spotty mineralization intruding pink hornblende granite are exposed over an area of 3 x 10 m. Radioactivity is concentrated in hematized rock, often near the pegmatite cores. Peristerite is also associated with mineralization. Uranothorite, uraninite and uranophane were identified in sample R-77-11-Pit No. 2-1. The hornblende granite assayed only 4 ppm U_3O_8 and 16 ppm. Th.

Showing #7 a few tens of metres NW of Showing #2: An easterly-dipping granite pegmatite intrudes yellowish syenitic gneiss and rusty pyritic amphibolite gneiss. The pegmatite is most radioactive along vertical fractures trending approximately 100°. The pegmatite contains allanite, uranothorite and considerable zircon; a pyritic hornblende-rich xenolith contains 390 ppm U_3O_8 and 482 ppm Th. The showing is exposed for 10 m along a cliff face 5 m high. Chip samples across 2 m have given assays ranging from 0.026% to 0.097% U_3O_8 in 5 separate samples. Excellent radioactive specimens can be obtained from the showing.

Showing #4 N½ Lot 13, Concession XIII:A stripped area 15 x 20 m exposes medium-grained pink pegmatitic leucogranite containing allanite, uranophane, uraninite, uranothorite, zircon and sphene. The granite sill, 20 to 30 m thick and dipping 20°E, intrudes interlayered rusty calc-silicate gneiss and garnet-hornblende gneiss. Mineralization is associated with hematization, smoky quartz, peristerite, abundant quartz, east-west trending fractures, and sheared areas parallel to the pegmatite walls. A 3-metre chip sample across the most northerly of 3 trenches assayed 2.2 lb/ton U_3O_8. A 10-metre chip sample across the southerly trench assayed 0.6 lb/ton U_3O_8. The pyritic garnet-amphibole gneiss country rock assayed 3 ppm U_3O_8. Fine granite portions of the pegmatite assayed 10 ppm U_3O_8.

Showing #6 N½ Lot 13, Concession XIII:A pink granite pegmatite 3 to 5 m wide and striking N75°E crosscuts granite. Mineralized pegmatite contains reddened feldspar, clear quartz and abundant biotite. A small pit, 1 x 2 m, has been put into the pegmatite. A grab sample from this showing assayed 0.24% U_3O_8 and 0.16% ThO_2. This assay appears not to be a representative sample as mineralization is spotty.

Showing #3 SE portion of the claim group: This showing gave good readings but is very narrow.

Two other showings not visited by the author but examined by Jurowski in 1968 are described in a company report:

The second occurrence...located...along the west margins of a large inclusion or band of marble...has been opened up by a small trench about 3 feet in diameter...Radioactive minerals are present in a coarse-grained, light-coloured granite pegmatite containing coarse aggregates of fluorite. A chip sample...assayed 1.6 lb. U_3O_8/ton. A grab sample...assayed 4.4 lb/-ton. The east contact of the granite pegmatite dike is...vertical in dip. The dike appears to strike N10°W.

The third occurrence...a narrow syenite dike 1 to 2 feet wide contains an abundance of an unidentified black radioactive mineral. A grab sample...assayed 5.4 lb. U_3O_8/ton. The syenite dike appears to strike in a N-S direction.

Chemistry: The following samples of country rock were taken by the authors in 1977:

Discussion: One very important characteristic of these occurrences along the York River is the consistent association of mineralized pegmatite and sulphide-bearing country rocks, especially the pyritic calc-silicate gneisses. These gneisses occupy a particular stratigraphic horizon along which mineralized granites and granite pegmatites occur.

Another important characteristic is that many of the mineralized pegmatites are sheared or fractured suggesting structural controls are also an important part of the mineralizing process.

Limited data from this and other properties on strike suggest that the calc-silicate rocks are indeed anomalous in their uranium content. However it is uncertain whether the pegmatites are mineralized because they intruded country rocks already containing anomalous

TABLE 5 | TRACE ELEMENT CONTENT OF SOME SAMPLES FROM THE CAM-LOWER DUNGANNON OCCURRENCE

Sample	U_3O_8	Th	V	Cb	Ta	Rb	Sr	Zr	Ce	La	Nd	Y	Yb
	Trace Elements in ppm												
R-77-11W-2	4	16	100	< 30	< .1%	300	480	150	120	< 100	< 100	40	2
R-77-11W-3	8	45	< 10	< 30	< .1%	120	340	100	< 50	< 100	< 100	10	< 2
R-77-Pit 7-2	2	13	< 10	< 30	< .1%	100	260	100	140	< 400	< 100	45	5
R-77-Pit 7-3	390	482	250	< 35	< .1%	60	290	1000	3410	7000	700	150	20
R-77-Pit 4-4	10	38	< 10	< 30	< .1%	110	100	60	< 50	< 100	< 100	10	< 1
R-77-Pit 4-3	3	21	40	< 30	< .1%	10	860	150	120	< 100	200	45	4

Sample R-77-11W-2 is rusty graphitic gneiss; R-77-11W-3, amphibolite gneiss; R-77-Pit 7-2, yellowish syenitic gneiss; R-77-11-Pit 7-3, hornblende-rich rock; R-77-11-Pit 4-4, granite; and R-77-11-Pit 4-3, garnet-hornblende gneiss.

amounts of uranium, or were already mineralized granitic melts that found the reducing environment of the sulfide-bearing rocks conducive to uranium enrichment, especially along sheared or fractured areas of the pegmatites where there might be an interplay of components of both intrusive and country rocks.

HISTORY

P. J. McLean put in seven trenches in 1957. In 1968 a scintillometer survey, stripping, trenching and drilling of three holes totalling 592 feet were performed by Cam Mines Limited.

REFERENCES

Hewitt (1967, p.34)
Ontario Geological Survey, Assessment Files Research Office, Toronto. Technical File 63.2457.

30. CARD OCCURRENCE (CHARLES ROCKWELL)

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Uranothorite and allanite

ROCK ASSOCIATION

The host is yellowish pink granite pegmatite intruding biotite syenite gneiss, marble and rusty pyritic calc-silicate gneiss.

CLASSIFICATION

Simple pink granite pegmatite, pyroxene veins

LOCATION

The occurrence is approximately 7.8 km east of the town of Bancroft, in Lot 18, Concession XI, Dungannon Township, Hastings County
Latitude 45°03'48"N; Longitude 77°45'37"W
UTM 4993200mN, 282500mE, Zone 18
NTS Bancroft 31F/4.

ACCESS

The occurrence is on a ridge in a field 0.5 km east of the Card farmhouse. A farm road turning south from Highway 500, 2.1 km west of the York River bridge, leads to the occurrence.

PRESENT EXPOSURE

Moderately well exposed bulldozed area 200 by 100 m.

SIZE AND GRADE

Spotty radioactivity is present over an area up to 290 m long and 90 m wide. A pegmatite sample assayed 0.03% U_3O_8 (radiometric). Three gneiss samples from nearby country rock assayed 25, 14 and 5 ppm U_3O_8 and 179, 43 and 379 ppm Th, respectively.

DESCRIPTION

General Geology: The occurrence is underlain by metasediments of the Grenville Supergroup of Upper Aphebian or Lower Helikian age. Calc-silicate gneiss, paragneiss, amphibolite and minor marble and syenitic gneiss are present. They have been intruded by small sheet-like bodies of nepheline syenite, syenite and granite. Regional metamorphism up to upper amphibolite and granulite facies has occurred. The rocks generally dip south at 15 to 45°. Late pegmatites and pyroxene veins crosscut all of the above units.

Detailed Geology: Granite pegmatite or pegmatitic granite intrudes syenitic biotite paragneiss, rusty calc-silicate gneiss and marble. Only pegmatitic rock with sulphides, hematite or pyroxene veins present is radioactive. The pyroxene veins are 1 to 4 cm. wide and are generally more radioactive than the pegmatite.

Three areas of high radioactivity were observed on the property. 1) In a test pit at the north end of the property, yellowish pegmatitic granite (2 - 10 mm) occurs in contact with rusty pyritic calc-silicate rocks and biotite gneiss. The rusty-coloured pegmatite contains up to 10 percent allanite in small areas. In sample R-77-12-3 brownish-black uranothorite was also found. 2) The middle pit, 120 m south of the north end of the stripping, is 0.8 m in diameter and 0.2 m deep. Mineralization occurs along fractures which show hematization and deep reddening of the feldspars within the granite pegmatite. A radioactive sample (R-77-12-2) from the pit was found to contain both amber and black uranothorite. Minor uranophane occurred on surface areas. 3) A highly radioactive area limited to an area of 10 cm, occurred on a biotite pyroxene vein where it contained abundant biotite. A sample from this spot (R-77-12-1) contained yellow-brown uranothorite. Surrounding this highly radioactive spot the rock is hematitized to a deep red. The pegmatite in which this pyroxene vein occurs in quite pyritic in the area of the vein.

Chemistry: Three samples of the immediate country rocks were analyzed. The results are shown below:
Samples R-77-12-11 and R-77-12-6 are of pyritic rusty gneiss; R-77-12-5 is of biotite-rich gneiss. The uranium and thorium contents of the above rocks are considered anomalous compared with similar rocks elsewhere in the area. The pyritic calc-silicate gneiss samples were partly weathered.

Discussion: The possiblity that these rusty-weathering pyritic gneisses may have represented an uraniferous horizon is suggested not only by their anomalous uranium

TABLE 6 | TRACE ELEMENT CONTENTS OF SOME SAMPLES FROM THE CARD OCCURRENCE

Sample	U	Th	Nb	Ta	Rb	Sr	V	La	Nd	Y	Yb	Ce	Zr
R-77-12-11	25	179	< 30	< .1%	10	280	< 10	< 100	< 100	50	5	< 50	90
R-77-12-6	14	42	< 30	< .1%	10	410	< 10	< 100	< 100	< 10	< 1	< 50	200
R-77-12-5	5	372	< 30	< .1%	140	1500	90	150	< 100	80	6	410	1000

content but also by the occurrence of other showings, notably Mell-Quirk, Cam, Urban Quebec, Mentor and Ricban, in similar rocks at the same stratigraphic position along strike. Alternatively, these sulphide-bearing metasediments may have offered a reducing environment which mineralized granitic melts found favourable for uranium deposition. In any event the combination has resulted in mineralization.

The pegmatite or pegmatitic granite (it is quite variable) is generally not anomalous unless it shows contamination, especially at the contact area of the rusty pyritic gneisses. Contaminated pegmatite is pyritic and in some places hematitic. Non-pyritic pegmatite (pink) is notably poorly radioactive.

The pyroxene veins are interpreted to represent carbonate-rich fluids mobilized from the country rocks by the intrusion of the hot granitic melts. These fluids are thought to circulate locally during intrusion and later to enter cooling fractures in the pegmatite or joints.

HISTORY

Stripping and pitting in 1957 by Charles Rockwell.

REFERENCE

Hewitt (1967a,p.33-34)

31. HIGHWAY 500 OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Not identified

ROCK ASSOCIATION

The host is granite pegmatite within syenite intruding amphibolite and biotite gneiss.

CLASSIFICATION

Simple pink granite pegmatite

LOCATION

Approximately 7.7 km east of Bancroft, in Lot 18, Concession XI, Dungannon Township, Hastings County
Latitude 45°03′56″N; Longitude 77°45′40″W
UTM 4993650mN, 282600mE, Zone 18
NTS Bancroft 31F/4.

ACCESS

The occurrence is in a road cut on the south side of Highway 500, 2.4 km west of the York River bridge.

PRESENT EXPOSURE

Excellent

SIZE AND GRADE

Anomalous radioactivity is confined to an area 0.25 m wide and a few metres long. A reddish syenite sample taken near the dike assayed 41 ppm U, and 52 ppm Th.

DESCRIPTION

General Geology: The showing is underlain by metasediments of the Grenville Supergroup of Upper Aphebian or Lower Helikian age. These rocks include marble, syenitic biotite gneiss, arkose, calc-silicate gneiss, paragneiss and amphibolite. Small bodies of syenite, granite and possible gabbro intrude the metasediments. The intrusive sheets and metasediments have been metamorphosed to the upper amphibolite facies.

The regional structures generally dip southeast at 15 to 40°. Late granite pegmatites and pyroxene veins cut all of the above rock types.

Detailed Geology: A radioactive pegmatite dike intrudes yellowish syenite. The pegmatite has a quartz core but the margins are composed of only feldspar. The radioactivity is concentrated on a reddish (hematized) fracture. The syenite containing the pegmatite intrudes well-foliated amphibolite and biotite gneiss. Whether the pegmatite is a late acid phase of the syenite or derived from outside it was not determined.

The authors sampled the nearby country rock, a reddish syenite. The following are the analytical results for sample R-77-12-H500:

Trace Elements in ppm

U	Th	Cb	Ta	Rb	Sr	Zr
41	52	<30	.19%0	80	270	150

Ce	La	Nd	Y	Yb	V
<50	<100	<100	<10	<1	<10

The analysis shows anomalous uranium, thorium and tantalum values. Those for zircon and cerium are low.

HISTORY

The occurrence was discovered in 1977 by T. Carter of the Ontario Geological Survey.

REFERENCE

Hewitt and James (1956)

32. McLEAN OCCURRENCE

COMMODITY

Uranium, thorium and molybdenum

RADIOACTIVE MINERALS

Not identified

ROCK ASSOCIATION

The host is leucogranite or granite pegmatite within marble.

CLASSIFICATION

Simple pink granite pegmatite

LOCATION

The occurrence is approximately 12.7 km northeast of the town of Bancroft, in Lots 5 and 6, Concession XVI, Dungannon Township, Hastings County.
Latitude 45°07′29″N; Longitude 77°43′47″W
UTM 5000250mN, 285300mE, Zone 18
NTS Bancroft 31F/4

ACCESS

The occurrence is accessible by boat and is 400 m west of the York River. The gravel road east from Musclow can be taken for 3.5 km. Turning left from this road a bush road leads 2.3 km easterly to the occurrence.

PRESENT EXPOSURE

Probably well exposed

SIZE AND GRADE

The pegmatites are 1.5 to 10.7 m wide and may extend along strike for 457 m. Geiger readings average 2X background, with spot-highs of 13X to 16X. Assays are unavailable.

DESCRIPTION

General Geology: The occurrence is located in north-northeast trending metasediments of the Grenville Supergroup of Late Aphebian to Helikian age. Marbles, calc-silicate gneisses, meta-arkose, biotite paragneiss, minor amphibolite and quartzose gneiss and syenite gneisses are present. These rocks are intruded by small bodies of granite, syenite and late granite pegmatite. The gneisses are metamorphosed to the upper amphibolite facies. The rocks dip 30 to 65° to the southeast. Uranium mineralization is generally confined to pegmatites.

Detailed Geology: The following description is based on Satterly (1957).

Radioactive yellow-brown to pink peristerite leucogranite pegmatite, with sparse pyroxene, intrudes marble. The pegmatite in Lot 5, Concession XVI, is exposed at intervals for more than 457 m and is 1.5 to 10.7 m wide. Irregular lenses of pink calcite are present, with disseminated molybdenite in pyroxenes.

Weak radioactivity occurs in a granite pegmatite 0.9 to 5.2 m wide, intruding marble on Lot 6, Concession XVI. The pegmatite is at least 24.4 m long.

HISTORY

In 1957 P. J. McLean trenched the showings. A scintillometer survey was conducted in 1968 by Cam Mines Limited.

REFERENCE

Ontario Geological Survey, Geoscience Data Centre, Source Mineral Deposits Record 000239. Unpublished property description by Satterly (1957)

33. NORMINGO (CAM) OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Uranium thorianite, uranothorite and uraninite

ROCK ASSOCIATION

The host is pink biotite marble, which occurs with meta-pyroxenite between two leucogranite sills. Hornblende gneiss, rusty pyritic gneiss, biotite schist and diabase also outcrop in the area.

CLASSIFICATION

Stratabound calcite vein (carbonate vein)

LOCATION

The occurrence is approximately 9.0 km northeast of the town of Bancroft, in Lot 14, Concession XVI Dungannon Township, Hastings County.

Latitude 45°07'03"N; Longitude 77°46'27"W

UTM 4999400mN, 281800mE, Zone 18 NTS

Bancroft 31F/4

ACCESS

The occurrence is 40 m west of the gravelled concession road 2.5 km northeast of Vardy. At this point the road turns to follow the boundary between Monteagle and Dungannon Townships.

PRESENT EXPOSURE

Very good.

SIZE AND GRADE

Anomalous radioactivity (10X-17X background) was noted over an area 6m by 9m in the marble. No assays are available.

DESCRIPTION

General Geology: The occurrence lies in a sequence of northeast trending rocks consisting of syenitic gneisses, amphibolites, thin marble units, meta-arkoses and biotite paragneisses. This sequence is intruded by small bodies of granite, syenite and nepheline syenite which most often are in the form of sills. Late dikes of pegmatite and diabase cut all the above rocks. The general geology of the

TABLE 7 | TRACE ELEMENT CONTENTS OF SOME SAMPLES FROM THE NORMINGO (CAM) OCCURRENCE

Sample	Rock Type	U	Th	Ce	Zr	Y	V	La	Yb[1]	Sr	Rb	Nb	Ta	Zn	Pb	Ni
R-77-15-6	Granite (east)	4	46	80	150	20	10	< 100	< 1	200	90	< 30	< 0.1%	N/A[2]	N/A	N/A
R-77-15-5	Granite (west)	2	39	60	300	< 10	15	< 100	< 1	250	140	< 30	< 0.1%	N/A	N/A	N/A
R-77-15-3	Biotite schist	8	47	< 50	200	25	60	< 100	2	30	160	50	< 0.1%	N/A	N/A	N/A
R-77-15-8	Rusty gneiss	8	24	170	200	70	100	< 100	6	1100	10	< 30	< 0.1%	N/A	N/A	N/A
R-77-15-7	Meta-pyroxenite	1	< 10	< 50	150	25	30	< 100	1	45	N/A	< 30	< 0.1%	220	17	< 5
R-77-15-10	Diabase sill	< 1	< 10	550	300	80	250	250	4	350	N/A	< 30	< 0.1%	230	49	11
R-77-15-11	Diabase dike	< 1	16	540	600	70	250	250	5	350	N/A	< 30	< 0.1%	102	43	14
Analytical Method		F[3]	X[4]	X	S[5]	S	S	S	S	S	S	S	S	A[6]	A	A

1 Yb = interference by Ce and Th
2 N/A = not analysed
3 F = fluorimetric
4 X = X-ray fluorescence
5 S = Spectrographic
6 A = Atomic absorption

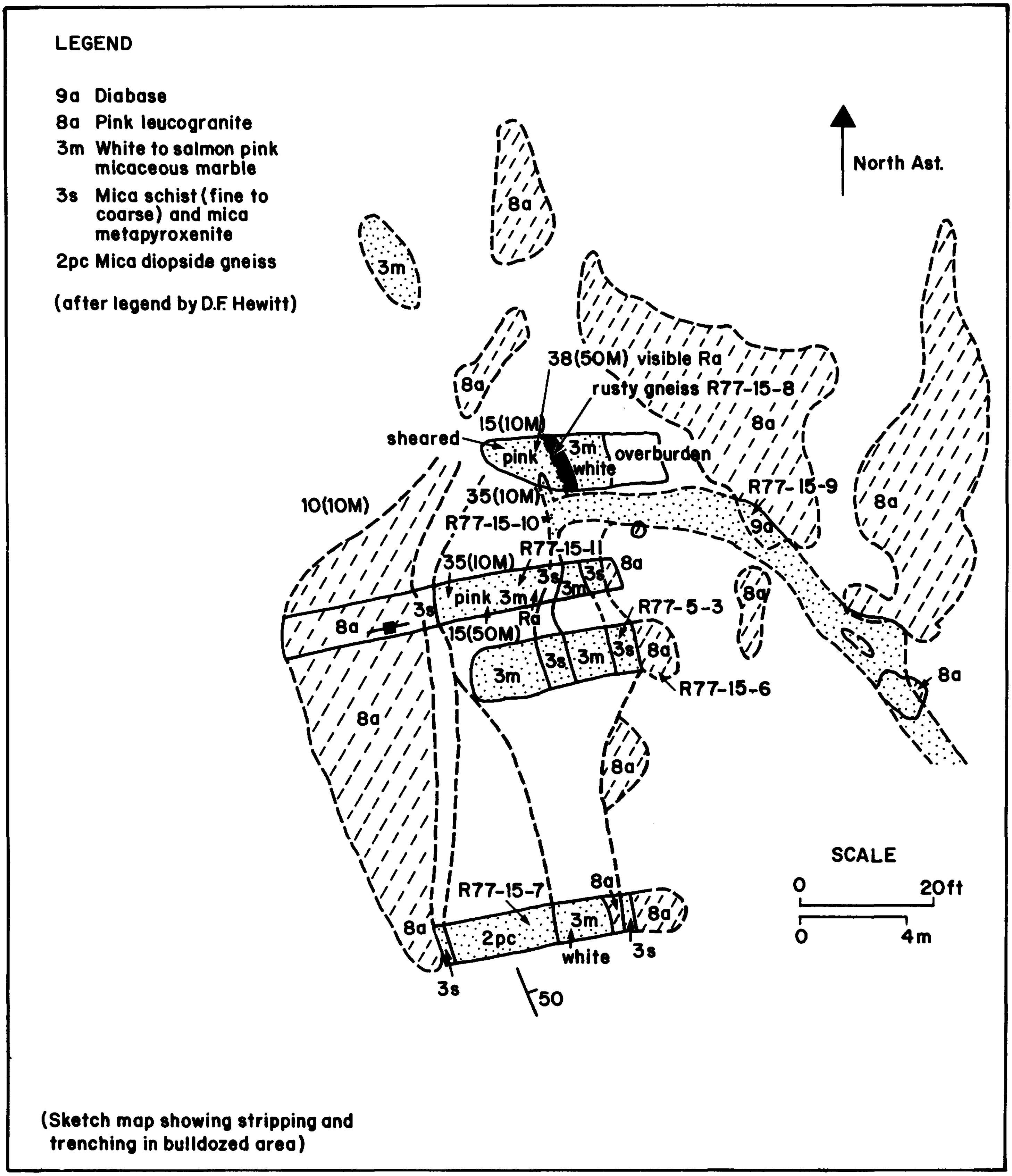


Figure 12 — Geology of the Normingo Occurrence. Modified after Satterly (1954)

TABLE 8 | MAJOR OXIDE CONTENT OF TWO SAMPLES FROM THE NORMINGO (CAM) OCCURRENCE

SAMPLE	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O^+	H_2O^-	CO_2	TiO_2	P_2O_5	S	MnO	Total
R-77-15-10 Diabase Sill	50.3	14.7	6.15	4.82	3.55	6.29	5.11	3.69	0.32	0.44	0.10	2.39	1.63	0.23	0.15	99.9
R-77-15-9 Diabase Dike	49.1	14.7	5.99	5.23	3.63	6.08	4.94	3.70	0.73	0.67	0.25	2.39	1.67	0.22	0.14	99.4

area is shown on Ontario Department of Mines Maps 1954-3 and 1955-8.

Detailed Geology: In 1954, Normingo Mines carried out exploration by exposing a belt, 3-8.5m wide, of micaceous marble and metamorphic mica pyroxenite lying between two sills of pink leucogranite intrusive into hornblende gneiss. The gneiss dips about 50° E.

The radioactive parts of the marble are salmon-pink in colour and gave geiger readings of 10x-17x background, and a few spot high readings greater than 25x. White areas of the marble have negligible radioactivity. The radioactive area of the marble is about 6.1 by 9.1m.(Figure 12)

Mineralization: Uranothorianite and uranothorite have been reported from the property. The uranothorianite consists of U_3O_8 40.0%, ThO_2 - 46.4% and PbO - 8.0% (Robinson and Sabina, 1955). Mineralization is restricted to the pink marble, which is coarser (10 cm) and more micaceous than the white marble. The unmineralized white marble contains phlogopite, while the pink marble contains biotite. Uranothorianite crystals are often clustered around biotite books. The coarse pink biotitic marble is considered a locally-derived vein or "carbonate pegmatite."

Chemistry: A number of samples of country rocks were analyzed for their U, Th and trace element content (Tables 1 and 2) to aid in the development of a genetic model for the occurrence. Sample locations are shown on Figure 13.

From table 7, the uranium contents of the country rocks, with the exception of diabase, are of the same order, although the rusty pyritic calc-silicate gneiss and the biotite schist are slightly higher. The rusty-weathering pyritic gneiss, because of its reducing nature, would offer a favourable depositional environment for uranium. The general affinity of uranium for biotite explains the values obtained for the biotite schist. The high rare earth content of the diabase, as well as its P_2O_5 content, reflects the presence of apatite.

The change in composition of the diabase dike as it becomes a sill on entering the marble is reflected in only slight increases in CaO and Na_2O and lower CO_2 and H_2O content. The major change is the increase of oxidized iron over reduced iron suggesting oxidizing conditions in the carbonate rocks. This, however, may be a secondary feature as the sill is foliated and the dike is not. The effect of the sill on mineralization is limited because of its small size (0.5m thick). It also appears that uranium could not have been derived from the diabase, as it has a very low uranium content.

Discussion: The granite, as well as the diabase, can be eliminated as a source of uranium. Although the granites contain minor amounts of uranium (2-4 ppm), they show little interaction with the carbonate unit other than a thin border zone of biotite schist. Contamination along the border zone is minimal. The granites themselves are poorly radioactive, only 2 or 3 times background.

The source of the uranium may be the carbonate unit itself. The coarse pink biotite marble may be an anatectically-derived "carbonate pegmatite" or vein developed during emplacement of the granites. The coarse nature of the mineralized carbonate and its high biotite content suggest a water-rich crystallization environment. High CO_2 and H_2O pressures at temperatures of high-grade metamorphism would be sufficient to mobilize portions of the marble, collecting in the volatile component uranium which may have been distributed in small but important quantities throughout the calcareous sequence.

HISTORY

In 1954, stripping and trenching of an area 15.2 m x 91.4 m was done by Normingo Mines Limited.

SELECTED REFERENCES

Hewitt and James (1956, p.60)
Robinson and Sabina (1955, p.631)
Satterly, J
1954 Unpublished Private files.
Traill (1970, p.565)

34. RICBAN OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Not identified

ROCK ASSOCIATION

The host is white to pale pink granite pegmatite intruding interbanded marble and quartzo-feldspathic paragneiss.

CLASSIFICATION

Simple white granite pegmatite

LOCATION

The occurrence is approximately 11.3 km northeast of the town of Bancroft, in S1/2 Lot 8, Concession XVI, Dungannon Township, Hastings County.

Latitude 45°06'52''N; Longitude 70°44'21''W
UTM 4999100mN, 284500mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence is accessible by boat, being 0.4 km west of the York River. It is 1.5 km southeast from the east end of the township road between Dungannon and Monteagle Townships.
PRESENT EXPOSURE
Generally well exposed.
SIZE AND GRADE
The pegmatite is at least 400 m long and may be 15 to 20 m thick. The following drill results were reported by Ricban Mines Ltd. (1958-59):

Drill Core Sampling

Hole	Depth of Sample (ft)	Length (ft)	Assay (%U_3O_8)
C-1	251.0	3.0	0.011
C-3	215.0	2.5	0.098
C-3	223.0	1.3	0.024
D-1	169.3	1.5	0.011
D-2		2.2	0.015
D-2		3.5	0.009

Weighted Average: 0.028% U_3O_8

DESCRIPTION
General Geology:The property is underlain by interlayered marble, amphibolite, calc-silicate gneiss, biotite paragneiss, syenitic gneiss, meta-arkose and minor quartzose gneiss. The rocks strike NNE and dip 25 to 65° to the east. The sequence is intruded by nepheline syenite, syenite and granite. Late granite pegmatite cuts all of the above rock units.
Detailed Geology:Numerous pale pink to white granite pegmatite sills and dikes intrude rusty pyritic gneiss and impure marble. The pegmatite sill is composed of feldspar, quartz and minor biotite, sphene, hornblende and pyrite. The pegmatite averages 2 to 3 cm in grain size but has coarse portions up to 18 cm in grain size. Local anomalous radioactivity is associated with rusty pyritic patches and/or fractures within the pegmatite. The pegmatite margins are more rusty, and more radioactive, than the central portions. A sample selected by the authors from a highly radioactive area of pegmatite assayed 430 ppm U_3O_8 and 4990 ppm Th.

A small pit 1.3 m X 4.8 m x 1.5 m deep was put into the pegmatite near its east contact with the pyritic calc-silicate gneisses. Moderate to high radioactivity was observed in this zone.
Discussion:The association of radioactive yellowish rusty pyritic areas of the pegmatite with minor fractures suggests the introduction of sulphides into the pegmatite. This is also suggested by increasing pyrite content in the border phases of the pegmatite where they are in contact with the pyritic calc-silicate gneisses. It is uncertain whether the uranium came with the sulphides from the calc-silicate gneisses or whether the contaminated sulphide portions of the pegmatite produced reducing conditions in these areas. As in other properties which occur along strike, such as the Mell-Quirk, there is an association of uraniferous pegmatites with rusty pyritic calc-silicate and feldspathic rocks which occur interbedded with marbles. These pyritic calc-silicate rocks may have provided a favourable environment for uranium deposition prior to metamorphism and intrusion of the pegmatite. The intrusion of the pegmatites may have merely upgraded the uranium concentration into a different form.
HISTORY
Trenching and drilling of seven holes for 691.4 m was performed by Ricban Mines Limited in 1958-59.
REFERENCE
Ontario Geological Survey, Assessment Files Research Office, Toronto: Technical File 63.2457.

35. ROCKWELL (HAWKINS) OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Not identified
ROCK ASSOCIATION
The host is a biotite veinlet within a complex of biotite syenite, hybrid syenite gneiss and biotite-nepheline-plagioclase gneiss.
CLASSIFICATION
Pyroxene-biotite vein
LOCATION
Lot 20, Concession XI, Dungannon Township, Hastings County, approximately 6.4 km east of Bancroft.
Latitude 45°03'38''N; Longitude 77°45'46''W
UTM 4993200mN, 282500mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence is just south of Highway 500, 3.2 km west of the York River bridge.
PRESENT EXPOSURE
Moderately well exposed
SIZE AND GRADE
The biotite veinlet ranges from 2.5 to 8 cm in width, and is about 2 m long. Selected samples assayed 1.52, 0.05, 0.16 and 0.03% U_3O_8
DESCRIPTION
General Geology:The property is underlain by metasediments of the Grenville Supergroup of Upper Aphebian or Lower Helikian age. These rocks are a mixture of calc-silicate gneiss, marble, biotite and biotite-amphibole gneiss and syenitic gneiss. They have been intruded by small bodies of syenite and granite. Metamorphism to upper amphibolite - granulite facies has occurred. The foliation dips southward at 15 to 45°.
Detailed Geology:A radioactive biotite veinlet crosscuts a complex of biotite syenite, hybrid syenite gneiss and biotite-nepheline-plagioclase gneiss. The vein is exposed in a small test pit.
HISTORY
In 1956, C. W. Rockwell stripped, trenched and sampled the showing.
SELECTED REFERENCES
Geological Survey of Canada, Radioactive Resources Division File Uranium 31F/3-2.
Satterly (1971, p.20)

36. URBAN QUEBEC OCCURENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uraninite
ROCK ASSOCIATION
The host is pink and yellowish pink granite pegmatite in country rock consisting of interlayered biotite paragneiss, calc-silicate gneiss, rusty gneiss and marble.
CLASSIFICATION
Simple pink granite pegmatite.
LOCATION
The occurrence is approximately 3.6 km east of the town of Bancroft, in Lot 14, Concession XI, Dungannon Township, Hastings County
Latitude 45°04'09''N; Longitude 77°44'21''W
UTM 4994050mN, 284350mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence is on top of a hill 300 m north of Highway 500. A road turning into the gravel pit 700 m west of the York River bridge provides access.

PRESENT EXPOSURE
Generally well exposed.
SIZE AND GRADE
An area 370 m by 200 m contains several radioactive pegmatite dikes. Bulk samples assayed 0.037 to 0.20% U_3O_8 (radiometric). Analyses of two samples of the country rock gave results of 14 and 40 ppm U_3O_8, and 51 and 22 ppm Th, respectively.
DESCRIPTION
General Geology:The area is underlain by metasediments of the Grenville Supergroup of Upper Aphebian or Lower Helikian age. Meta-arkose, biotite paragneiss, rusty calc-silicate rock and marble are present. These units are intruded by granite and syenite bodies. All of these rocks are cut by late granite pegmatites.
Detailed Geology:Showings described below have been labelled arbitrarily by the writers.

Showing 17 South: A trench 26 long and 2 to 4 m wide has been opened up on a pegmatite, with 5 m of stripping at the north end. The rusty quartz-rich granite pegmatite intrudes biotite-diopside marble and rusty pyritic siliceous gneiss. Interlayered biotite paragneiss and

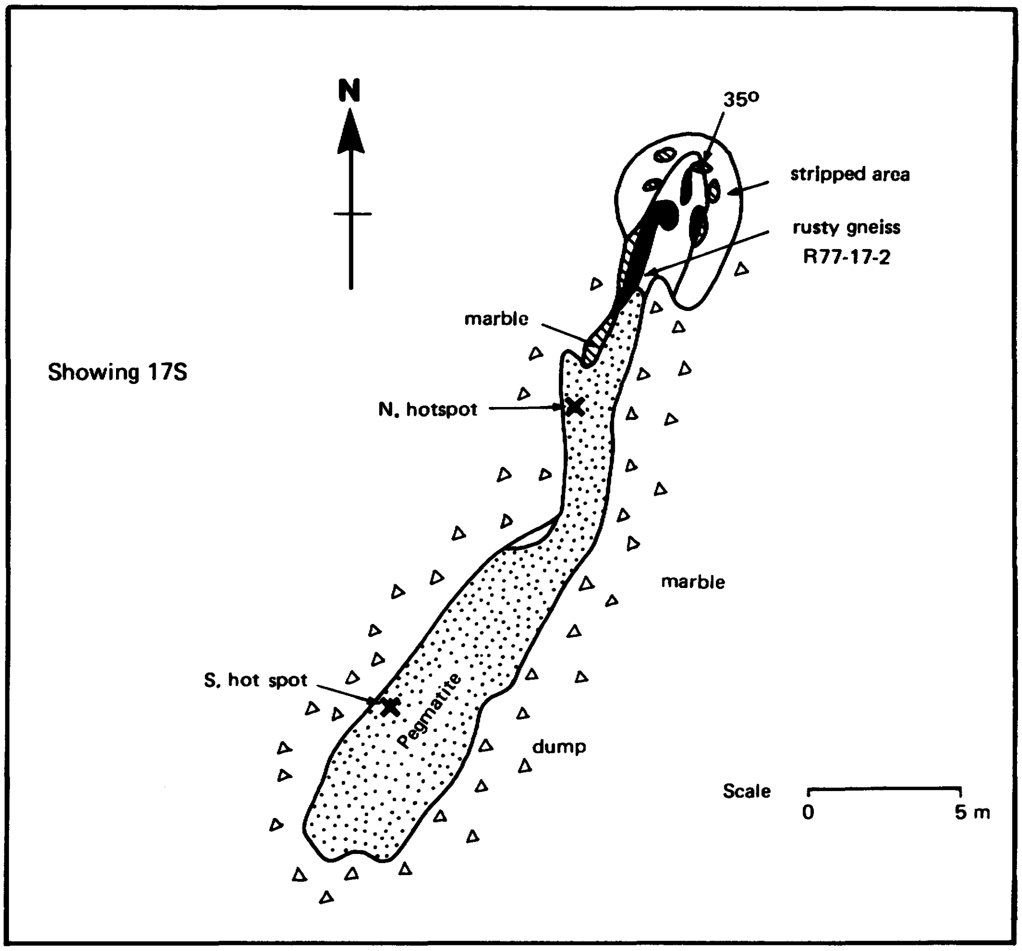


Figure 13 — Geology of Showing 17 South, Urban Quebec Occurrence.

TABLE 9 TRACE ELEMENT CONTENT OF SOME SAMPLES FROM THE URBAN QUEBEC OCCURRENCE. IN PPM UNLESS OTHERWISE SPECIFIED

Sample	Description	U_3O_8	Th	V	Cb	Ta	Rb	Sr	Ce	Zr	La	Nd	Y	Yb
R-77-17-2	rusty weathered biotite gneiss	< 1	22	100	< 30	< .1%	140	370	100	150	< 100	200	30	2
R-77-17-4	biotite-diopside marble	4	< 10	< 10	< 30	< .1%	40	200	< 50	< 10	< 100	< 100	< 10	< 1
R-77-17-7	rusty siliceous unit within marble	14	51	< 10	< 30	< .1%	210	120	80	< 10	< 100	< 100	< 10	< 1
R-77-17c-3	rusty calc-silicate rock	40	22	< 10	< 30	< .1%	120	130	< 50	25	< 100	< 100	< 10	< 1
R-77-17-1	radioactive pegmatite	600	829	< 10	45	< .1%	20	120	< 50	300	< 100	< 100	60	5
R-77-17-6	pyroxene-rich radioactive pegmatite	50	221	< 10		< .1%	540	60	< 50	100	< 100	< 100	15	< 1
R-77-17Na-1	dark pink granite dikelet	68	150	< 10	30	< .1%	580	100	265	600	200	100	60	5

calc-silicate gneisses outcrop west of the pit. These gneisses strike N35°E and dip 30 to 40° to the SE. The yellowish rusty colour of the pegmatite is likely due to contamination from the rusty pyritic gneisses. (Figure 13)

The pegmatite is characterized by abundant altered pyroxene (5-10%), milky quartz, biotite, rusty yellow feldspar and occasional crystals of euhedral sphene. Anomalous radioactivity is associated with the presence of peristerite, abundant quartz and the existence of fracturing. A selected sample R-77-17-1 of radioactive pegmatite assayed 600 ppm U_3O_8 and 829 ppm Th. In the same sample uraninite was identified. A mafic-rich sample of pegmatite (R-77-17-6) assayed 50 ppm U_3O_8 and 221 ppm Th. Three samples of the immediate country rocks were analyzed: R-77-17-2, badly weathered rusty pyritic gneiss, R-77-17-4, biotite diopsidic marble near pegmatite contact and R-77-17-7, rusty pyritic gneiss east of trench area. The results are shown in Table 9. Sample 17-4 away from the pegmatite is anomalously high in U while sample 17-2 from near the contact of the pegmatite is anomalously low.

Showing 17 North a: The showing consists of a small pit 3.8m x 2m x 1m deep. Anomalous radioactivity is associated with dark pink granite dikelets and with a small quartz carbonate vein; both cut light pink granite.

An analysis, shown in Table 9, of the small granite dike (R-77-17-Na-1) gave 68 ppm U_3O_8.

Showings 17 North b, c, d, and e.: The showing consists of pits and trenches (Figure 14). Dikes and sills of pink granite pegmatite intrude a sequence of interlayered biotite paragneiss, calc-silicate gneiss, rusty pyritic gneiss and minor marble units.

In Pit C, pegmatite containing dark pink feldspars and abundant quartz cross-cuts grey syenitic and rusty-weathering pyritic calc-silicate gneiss. The pegmatite is sheared in some areas. Radioactivity is associated with rusty pyritic and sheared areas of the pegmatite.

As radioactive portions of the pegmatite contained pyrite, a sample (R-77-17C-3) of the pyritic gneiss exposed in the pit was analyzed. The results are shown in Table 9. The sample of pyritic gneiss is extremely anomalous in uranium (40 ppm), but because of its close proximity to the pegmatite it may have been contaminated.

HISTORY

1968: Trenching, radiometric and magnetic surveys, bulk sampling and diamond drilling by Urban Quebec Mines Limited.

SELECTED REFERENCES

Hewitt and James (1956)
Satterly (1957)

37. BONVILLE OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Uranothorite, uranophane and betafite

ROCK ASSOCIATION

The hosts are granite pegmatite and actinolite diopside skarn, within country rocks of marble, calc-silicate gneiss, amphibolite and siliceous gneiss.

CLASSIFICATION

Skarn, carbonate veins and complex pink granite pegmatite.

LOCATION

Lots 22 and 23, Concession A, Faraday Township, Hastings County, approximately 9.3 km southwest of Bancroft. Latitude 45°01′04″N; Longitude 77°57′26″W

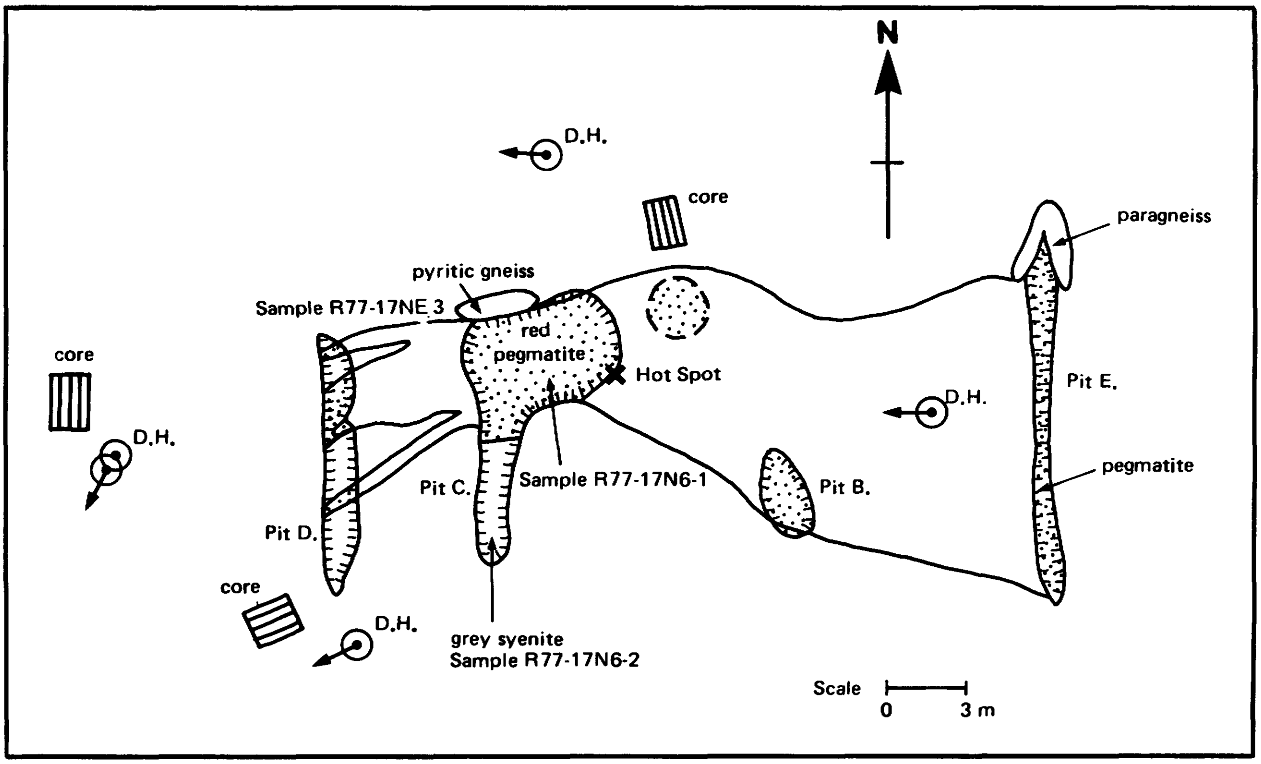


Figure 14 — Geology of Showings 17 North b, c, d, and e, Urban Quebec Occurrence.

UTM 4988950mN, 266950mE, Zone 18
NTS Bancroft 31F/4

ACCESS

The occurrence is 800 m south of the Monck Road, from a point 3.8 km northeast of the settlement of Monck Road.

PRESENT EXPOSURE

Fair to poor

SIZE AND GRADE

Small occurrences of high radioactivity are scattered over a large area.

DESCRIPTION

General Geology: The property is underlain by marble cut by amphibolite, metagabbro, nepheline gneiss, syenite, and granite bodies. These rocks lie on the south border of an extensive area of granite gneiss.

Detailed Geology: The following description is taken from Satterly (1957, p.108):

The surface workings expose radioactive mineral occurrences in pegmatites cutting marble.

A stripping on the west edge of a clearing in Lot 22, Concession A, is 10 by 30 feet. It exposes a pink graphic granite pegmatite with patchy distribution of pyroxene (or hornblende). Fractures at N60°E filled with altered hornblende gave spot-high readings up to 20X. No radioactive minerals were found. Geiger readings were from 2X on the graphic leucogranite pegmatite to 10X on hornblende granite pegmatite. Two small pits have been put down 5 and 10 feet north of the stripping. The north pit had a spot-high geiger reading of 17X. Coarse calcite with hornblende and apatite was noted on the dump from this pit.

The second working is in Lot 23, Concession A, 140 feet at N70°W from the above. It is a stripping 25 feet wide and 50 feet long with a shallow trench 4 feet wide and 30 feet long, adjacent to the east side of the stripping, and a pit at the south end of the stripping. The workings expose a pink, medium- to coarse-grained graphic leucogranite pegmatite. Scattered small pods of salmon-pink calcite with walls of dark-green hornblende are not uncommon. Irregular fractures contain an altered fibrous hornblende and epidote. The leucogranite pegmatite read 7X-10X on the geiger. On the west side of the stripping, one of the fibrous hornblende bands is 1-2 feet wide and has an exposed length of 20 feet. Geiger readings on it were 25X-40X. This band strikes N40°E, but others strike N5°E and N25°E. Samples of radioactive and other minerals from material on the dump apparently from this or similar bands were submitted to Dr. S. C. Robinson of the Geological Survey of Canada for identification by X-ray powder pattern photographs. A yellow coating is identified as beta-uranophane, a black vitreous radioactive mineral as uranothorite, accompanied by pale-blue apatite, and a yellow-brown radioactive mineral occurring in small flattened grains with tremolite, quartz, and feldspar, as pyrochlore.

Also noted in the deposit are pods and lenses, from a few inches to several feet across, of calcite-apatite-hornblende. The calcite is salmon-pink in colour. In such a calcite stringer, in the pit at the south end of the workings, the author noted black laths of uranothorite in epidote.

The writers observed on their visit in 1977 that pyroxene, hornblende, actinolite and epidote were associated with mineralization. The pegmatite often contains inclusions of coarse calcite, hornblende and other mafic minerals.

HISTORY
In 1954, surface work and 25 drill-holes totalling 2941 m were done in Lots 22 and 23, Concession A, by Bonville Gold Mines Limited.
REFERENCES
Hewitt (1967, p.36)
Satterly (1957, p.107-108)

38. BRASCAN OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Not identified
ROCK ASSOCIATION
The host is granite pegmatite in country rocks of marble and paragneiss.
CLASSIFICATION
Simple granite pegmatite, and marble
LOCATION
The occurrence is approximately 3.2 km north of the settlement of Monck Road, in Lot 26, Concession XV, Faraday Township, Hastings County.
Latitude 45°02'31''N; Longitude 77°59'53''W
UTM 4991750mN, 263850mE, Zone 18
NTS Bancroft 31F/4
ACCESS
A bush road 3 km long leads to the occurrence. This road turns north from the Monck Road 1.8 km northeast of Monck Road Settlement.
PRESENT EXPOSURE
Fair
SIZE AND GRADE
Unknown
DESCRIPTION
The following description is based on a property report by L. G. Phelan (1975).

The regional geology is illustrated on Ontario Department of Mines Map 1957-1. The property occupies part of the east flank of a syncline wedged between two large granite bodies: the Faraday and Cardiff plutons. A pronounced northwest-trending linear depression, probably a major fault, bisects the property.

The country rocks are metasediments striking about 310° and dipping 30 to 80° westerly. They include marbles, lime-silicates, pyroxenites, nepheline syenites and syenite gneisses, various hornblende-feldspar-quartz gneisses and massive granite.

Pegmatites occur in all rock types, usually conformable to bedding but also cross-cutting. Uraniferous pegmatite zones are associated with lime-rich and paragneiss horizons. Phelan uses this field evidence to support his contention that the rock type which a pegmatite intrudes determines whether uranium mineralization develops. Lime-rich calc-silicate rocks may provide favourable conditions for uranium deposition from pegmatite melts or they may represent a primary uraniferous horizon.
HISTORY
In 1975, geological mapping, magnetometer, geochemical and radiometric surveys and trenching were carried out by Brascan Holdings.
SELECTED REFERENCES
Phelan, L. G.
1975: Report on Geological and Geochemical Surveys, Brascan Holdings in Bancroft Area, Ontario. Ontario Geological Survey, Assessment Files Research Office, Toronto, Technical File 2.1994.
Satterly (1957)

39. EAGLE NEST OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uraninite, uranothorite, allanite, cyrtolite, sphene
ROCK ASSOCIATION
Host rocks are granitic and syenitic pegmatites, calcite-apatite-biotite veins, pyroxene-biotite veins, and marble. Country rocks are leucogranite, granite gneiss, marble, biotite-amphibolite paragneisses, calc-silicate gneiss and syenite.
CLASSIFICATION
Simple and complex pegmatites, pyroxene and calcite veins, and marble.
LOCATION
The property is located 1.3 km northeast of the village of Bancroft and consists of Lots 69, 70, Hastings Rd., Faraday Township; Lots 66, 69-74, Hastings Rd., Lots 28-30, Concession XV, N1½ Lot 27, Concession XV, S1½ Lots 26-30, Concession XVI, Dungannon Township; and unpatented claims EO 414118, Dungannon Township.
Latitude 45°04'55''N; Longitude 77°50'30''W
UTM 4961350mN, 276280mE Zone 18.
NTS Bancroft 31F/4
ACCESS
Access to the western part of the property is readily obtained via the Eagle's Nest Park Road; and to the eastern part by a township road south of Clark (Clear) Lake.
PRESENT EXPOSURE
Moderately well exposed.
SIZE AND GRADE
Of the numerous disseminated radioactive occurrences, Zones II, III, and IV show ore grades. However, these are over narrow widths and do not offer a large tonnage potential.
DESCRIPTION
Geology: The following description is after Freckelton (1976). There are numerous radioactive occurrences; only the major ones numbered I to VII (Figure 15) will be discussed.

Zone 1 ("Mountain Zone"): A narrow radiometric zone, 1900 feet long and averaging 75 feet wide, is underlain by pink leucogranite. A pegmatite dike outcrops in 2 locations. The pegmatite is blood-red, sheared, and contains coarse inclusions of magnetite and some pyroxene. It appears to dip steeply to the south. The width is variable, attaining a maximum of 2 feet. Uranothorite is the major uranium mineral. Best surface samples assayed 0.01% U_3O_8 and 0.35% ThO_2, and 0.02% U_3O_8 and 0.22% ThO_2. The zone was tested by five diamond drill-holes in 1956.

Zone II: A radiometric zone 100 feet long by 20 feet wide, lying near the marble-migmatite and paragneiss contact, is underlain by marble. A single borehole detected uranium mineralization grading 0.081%, 0.183% and 0.128% U_3O_8 over core lengths of 0.8, 0.3 and 0.4 feet respectively, all within the upper 15.6 feet.

Zones III and IV (Part of the "Pinnacle Zone"): Zone III is a 100 foot by 50 foot radiometric anomaly, which is underlain by hybrid syenite rocks and is located near the syenite-granite contact. Radioactive minerals occur in pyroxenite (calcite-apatite-biotite) veins and a pegmatite dike. The pyroxene veins vary from 3 to 12 inches in thickness, and the longest vein outcrops discontinuously over 30 feet. The pegmatite is blood-red in colour, with coarse pyroxene inclusions. It outcrops over 22 feet but its true thickness could not be determined. Assays of 0.09% U_3O_8 and 0.23% ThO_2, and 0.02% U_3O_8 and 0.02% ThO_2 were obtained from the pegmatite. Assays from the pyroxenite veins showed less than 0.01% U_3O_8.

Zone IV: This is a roughly triangular-shaped area 50 to 200 feet long by 10 to 200 feet wide. It is underlain by granite with the radioactive minerals occurring mainly in pyroxenite veins. The best assay obtained from surface sampling was 0.01% U_3O_8 and 0.01% ThO_2.

Zones III and IV: These seem to be associated with the contacts of a syenite body. Best assays from diamond drilling between the 2 zones showed 0.03%, 0.047% and 0.041% U_3O_8 over core lengths of 0.6, 0.8 and 0.6 feet respectively.

Zone V (Part of the "Pinnacle Zone"): This is a 200 foot by 100 foot radiometric anomaly which is underlain by granite and paragneiss rocks. Uranothorite occurs in pyroxene-calcite-apatite veins up to a foot wide crosscutting paragneiss. Uranium assays of 0.014% U_3O_8 over 0.8 feet and 0.021% U_3O_8 over 0.7 feet were obtained from drill core samples in a pyroxenite vein and a lens of vuggy sulphides respectively. A drill core sample of one of the numerous stringers of secondary pyrite assayed 0.326% Cu, 0.063% Ni and 0.002 ounces Gold per ton.

Zone VI ("Weimar Zone"): Three separate radioactive anomalies occupying an area 400 feet long by 50 to 300 feet wide are underlain by leucogranite. Scattered occurrences of uranium mineralization are found in pegmatite and pyroxenite veins. The best drill core sample assayed 0.065% U_3O_8 over 5 feet, but the overall uranium background was very low, with only 5 samples assaying over 0.005% U_3O_8.

Zone VII ("Mica Zone"): Three discontinuous radioactive anomalies occupy a total area 700 feet long by 50 to 100 feet wide. Assays from surface sampling varied from 0.01% to 0.05% U_3O_8, from uranothorite or thorianite mineralization in pegmatites. A borehole intersected no values greater than 0.002% U_3O_8.

The authors believe that more extensive drilling would be necessary to establish the economic potential of the pegmatites.

*Discussion*Figure 15 shows the different occurrences as classified by R. L. Withers (1976). Of particular interest is the east-west linear feature represented by Zones I, IV and VI. Zones I and VI consist mainly of sheared granite pegmatites suggesting that the mineralization followed a prominent east-west fracture in the granite. Zone IV consists mainly of pyroxene veins within and along the borders of an intrusive syenite body. This body may have disrupted the continuity of the other two zones and redistributed the mineralization in the form of pyroxene veins.

Zone II, a uraniferous marble is similar to the mineralization in the South State (North) Occurrence. The marble in both showings is the same unit which was traced for 5 km during mapping. This suggests a pre-metamorphic enrichment in uranium within the marble band. The South State (South) and Quirk Occurrences are also located along this same marble horizon.

With the exception of the mineralization in marble, most of the occurrences are spatially associated with the leucogranite unit of the "Faraday granite". This spatial association is also seen at the York River E, D, and A zones, which occur in very similar geological conditions.

An excellent discussion on the geology of the property, with special reference to mineralization associated with calcareous veins, can be found in Withers (1976).

HISTORY

1956: Mineralization discovered by A. H. Shore

1956-57: Stripping, rock trenching and 17 diamond drillholes by Eagle's Nest Mines Limited. Six radioactive zones were outlined in the north and south sections. Blasting, sampling and a rough scintillometer survey were undertaken.

1968: Watts Exploration Services carried out a magnetometer survey (uncompleted) over unpatented ground.

1970: A scintillometer survey was completed over the Mountain, Pinnacle and Weimar Zones.

1976: Canadian Nickel Mines Limited carried out geological mapping, magnetic and radiometric surveys, limited sampling and diamond drilling totalling 1515 feet.

SELECTED REFERENCES

Freckelton (1976)

Withers (1976)

Satterly, J.

1957: Unpublished report on Eagle's Nest Mines Ltd. Dungannon and Faraday Twp. On file with the Geoscience Data Centre, Ontario Geological Survey, Toronto

40. FARADAY (MADAWASKA) MINE

COMMODITY

Uranium, thorium and rare earths

RADIOACTIVE MINERALS

Uraninite, uranophane, uranothorite, allanite, euxenite and zircon.

ROCK ASSOCIATION

The hosts are sheared granite pegmatite, pegmatitic granite and syenite pegmatite. These intrude metagabbro, amphibolite, and amphibolite gneiss, biotite gneiss and calc-silicate gneiss. Marble and quartzite are also present.

CLASSIFICATION

Complex unzoned pegmatites

LOCATION

The mine is 7 km southwest of the town of Bancroft in Lots

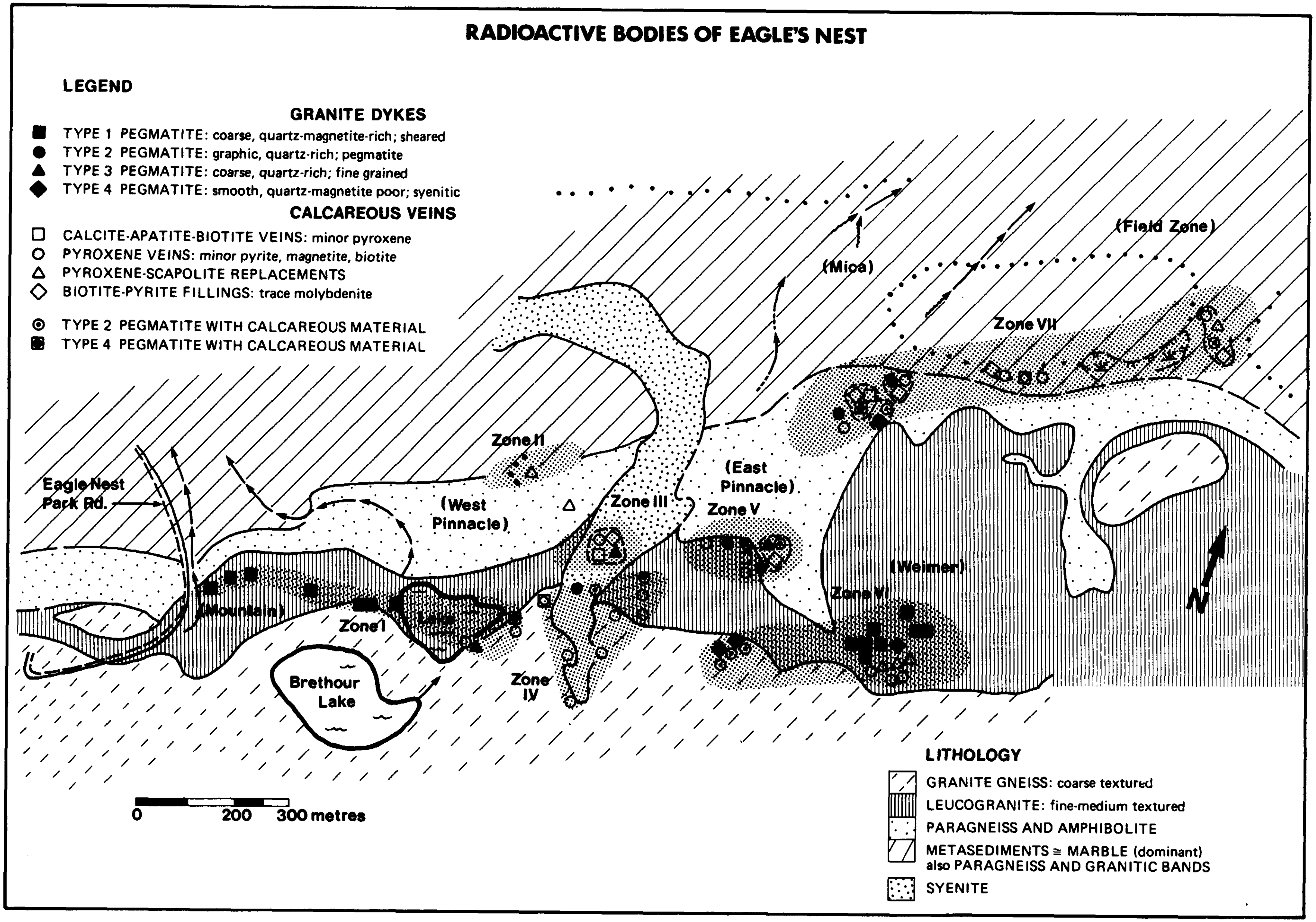


Figure 15—Geology of the Eagle Nest Occurrence. Geology and classification by R.L. Withers (1976).

16 and 17, Concession XI Faraday Township, Hastings County.
Latitude 45°01'15''N; Longitude 77°55'26''W
UTM 4989200mN, 269600mE, Zone 18
NTS Bancroft 31F/4

ACCESS

A gravel road to the mine turns north from Highway 28, seven kilometres southwest of Bancroft.

PRESENT EXPOSURE

Good

SIZE AND GRADE

Extremely irregular pegmatite bodies occupy a zone approximately 1800 m long, 150 m wide. Reserves in excess of 700 000 tons grading 0.159% U_3O_8 were reported in 1968. The mine was reopened in 1976 with proven and probable reserves of 1 023 086 tons at 0.145% U_3O_8.

DESCRIPTION

General Geology: The following description is based upon Bullis (1965). Highly metamorphosed rocks of the Grenville province underlie the property. Amphibolites and paragneisses have been conformably intruded by gabbros and pyroxenites and then by late granite to syenite pegmatites. Granitic gneiss, syenitic gneiss with minor marble bands, metasediments (metagabbro with some marble and quartzite) and granitic rocks with minor gneiss outcrop in the mine area. The rocks strike east-northeast and dip variably to the south.

Detailed Geology: The ore bodies occur within granitic pegmatites intruded along or near the limbs of a combination anticline—syncline. This large tight fold plunges to the southwest and has a well defined fault developed within its middle limb. Gabbro and pyroxenite have been injected into hornblende gneiss, mica-hornblende-quartz-feldspar schist and amphibolite. The metasediments vary greatly in composition, grain size and degree of foliation. They are locally intensely deformed and crenulated. Common accessories within the metasediments are pyrite, magnetite, apatite, calcite, gypsum and/or anhydrite and diopside.

The gabbro and pyroxenite have been foliated and contain zones of tourmaline-scapolite alteration. The metagabbro is composed of hornblende and plagioclase with quartz, scapolite, mica, sphene, magnetite and rare cancrinite. The pyroxenite is mostly augite with some hornblende and chlorite and accessory mica, plagioclase, pyrite and magnetite.

Pegmatites hosting uranium mineralization intrude the metasediments, metagabbro and pyroxenite. They generally conform to foliation but locally cross-cut it. Pegmatite masses are 91.5 to 915 m long, 3 to 46 m wide and some extend down dip more than 300 m. Country rock contacts are discrete to variable over 0.6 m. Many xenoliths to 6 m across are present within the pegmatite, which is only locally sheared and crushed. The pegmatite is composed of feldspar, hornblende-chlorite (after augite), quartz, calcite, magnetite and zircon. Main accessory minerals are mica, titanite, apatite, allanite, tourmaline, uraninite, uranophane and uranothorite. Other accessories include hematite, flourite, pyrite, pyrrhotite, chalcopyrite, euxenite, molybdenite, davidite and rare spencite. Some large pegmatites have vuggy cores containing excellent crystals of minerals such as calcite with gypsum, pyrite, goethite, limonite/hematite, uranophane, flourite and chalcopyrite. Radial shattering of the rock has occurred around radioactive minerals.

Uranium mineralization is associated with hematization (brick red colored rock) and the presence of hornblende and chlorite (after augite). These minerals seem to cause uranium precipitation — no other accessories are necessary for ore deposition. Radioactivity is often concentrated along the footwall, hanging wall and around and between xenoliths of country rock within the pegmatite. Coarse crystalline anhydrite locally indicates uranium mineralization. Narrow pegmatites are often the most radioactive.

HISTORY

A. H. Shore made the initial discovery in 1949. From then to 1952 extensive stripping and trenching were performed. In 1952-53 Faraday Uranium Mines Limited did trenching, geologic mapping, bulk sampling and diamond drilling. Underground development including a 3 compartment shaft sunk to 447.4 m was started in September 1954. The mine was shut down June 30, 1964. Between 1957 and 1964, 2 879 735 tons of ore were milled for 5 596 618 lbs. U_3O_8. The mine was reopened in August 1976, with current production up to 1 500 t.p.d. A summary of production from the mine is presented in Table 10.

SELECTED REFERENCES

Bullis (1965, p.713-721)
Northern Miner
1976: Madawaska begins second life *in* Northern Miner, Sept. 16, 1976, p. 1.
Satterly (1957, p.108-116)

41. GOLDHAWK OCCURRENCE (Showing F of East Group)

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Uraninite and uranothorite

ROCK ASSOCIATION

The host rock is alaskitic granite pegmatite intruding siliceous marble and pink syenitic gneisses.

CLASSIFICATION

Simple pink granite pegmatite.

LOCATION

The occurrence is located near the top of the south side of a very large hill approximately 400 m north of Bentley Lake and 350 m south of the Monck Road, in Lots 13 and 14, Concession A, Faraday Township, Hastings County.
Latitude 45°02'00''N; Longitude 77°55'00''W
UTM 4990550mN, 270300mE, Zone 18
NTS Bancroft 31F/4

ACCESS

Approximately 2.5 km west of Bancroft, the Monck Road leads north from Highway 28, and forks after about 1.3 km. The occurrence lies 350 m south of the southern branch at a point approximately 1.9 km west of the fork.

TABLE 10 | SUMMARY OF PRODUCTION FROM THE FARADAY (MADAWASKA) MINE

YEAR	ORE MILLED (tons[1])	U_3O_8 (pounds[2])	GRADE (pounds U_3O_8 per ton)
1957	261,100	399,428	1.53
1958	439,309	836,770	1.90
1959	529,399	917,285	1.73
1960	468,939	841,917	1.80
1961	339,659	784,565	2.31
1962	306,339	779,789	2.55
1963	355,040	780,382	2.20
1964	177,651	390,814	2.20
1966		624	
1977	295,068	440,753	1.49
1978	375,533	546,998	1.46
1979	390,366	605,533	1.55
TOTAL:	3,938,366	7,324,858	1.85

[1]Tonnage listed are in short tons

[2] Data compiled from information available in the Source Mineral Deposit Records, Geoscience Data Centre, Ontario Geological Survey, Toronto

The deposit may be reached by walking 350 m across country southeasterly from the Monck Road.

SIZE AND GRADE

The pegmatite forms a long linear body, at least 200 m long and 1 to 5 m thick. Numerous places along the pegmatite give readings of 20 to 50 times background, and there are large areas with consistently high readings.

DESCRIPTION

Geology:A long linear pegmatite, 1 to 5 m thick, has intruded along the contact between a siliceous marble unit (Derry Lake) and a slightly calcareous biotite magnetite syenitic rock.

The marble contains thin (2 to 50 cm) interbedded units of rusty-weathering pyritic calc-silicate gneiss which may make up from 30 to 60 percent of the rock. Much of the marble is quite contorted, now forming a marble breccia with a fine grey (graphitic) matrix. The syenitic rock is generally undeformed, although breccia zones are found within 30 m of the contact with the marble, where the syenitic rock becomes quite gneissic. Near the contact with the marble it is interlayered with thin units of mylonitic marble.

The pegmatite for the most part occupies the actual contact, although in some areas it is hosted completely by marble. The pegmatite is fine-grained (1 to 2 cm), rusty or yellowish-pink, and usually devoid of mafics. Where it is hosted by marble, it becomes white and contains some mica. The pegmatite is very sheared in places, generally corresponding with areas of high radioactivity. Some areas of the pegmatite contain very prominent slickensided surfaces, occasionally in more than one direction at almost right angles, suggesting deformation may be due to both folding and faulting. The most prominent direction of the slickensides, from their lineated surfaces, is 130° at 34° to the southeast. Pegmatites along this horizon can be traced as far east as Derry Lake, and all are anomalously radioactive. The pyritic siliceous units of the marble are quite radioactive near these pegmatites.

Discussion:As in many other pegmatites in the Bancroft camp, the deformation of pegmatite appears to be an important factor in mineralization. Hydrothermal enrichment of pegmatite after or during deformation appears to be the main mineralizing process.

HISTORY

Trenching, pitting and diamond drilling by Goldhawk in 1954 (later called Greyhawk) as part of their east or Riddell Lake Group.

SELECTED REFERENCES

Satterly (1957,p.117-118)

Sheppard, E.P.

1955: Geological Report on the Riddell Lake Group. Goldhawk Porcupine Mines Limited. Ontario Geological Survey, Assessment Files Research Office, Toronto, Technical File no. 63A.233.

42. GREYHAWK MINE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Allanite, uranothorite, uraninite, pyrochlore and betafite.
ROCK ASSOCIATION
The host is granite pegmatite intruding amphibolite (metagabbro) with minor amphibolite gneiss, biotite paragneiss and biotite schist.
CLASSIFICATION
Complex unzoned pegmatites
LOCATION
The mine is 4.0 km southwest of the town of Bancroft, in Lots 9, 10, and 11, Concession XII Faraday Township, Hastings County.
Latitude 45°01'51''N; Longitude 77°53'48''W
UTM 4990200mN, 271800mE, Zone 18
NTS Bancroft 31F/4
ACCESS
A gravel road to the shaft turns south from Highway 28 4 km southwest of Bancroft.
PRESENT EXPOSURE
Good
SIZE AND GRADE
In 1959 reserves were estimated at 0.2 million tons grading 0.065% U_3O_8.
DESCRIPTION
General Geology: The property is underlain by diorite, metagabbro, amphibolite, paragneiss and marble. The rocks strike northeast and dip to the southeast. Several faults have been inferred in the area.
Detailed Geology: Radioactive granite pegmatite dikes intrude metagabbro and amphibolite. The following description is based on Satterly (1957).

The metagabbro body is 61 m to 183 m wide, with an average width of 91 m. The rock is dark colored and fine- to medium- grained. Andesine and hornblende with minor scapolite, pyroxene, biotite, microcline, titanite, magnetite, pyrite, tourmaline and rare apatite, carbonate and clinozoisite are present. The metagabbro is hematized over 0.07 to 0.3 m adjacent to well-mineralized pegmatite. Sericitization and chloritization of biotite occur with the hematization. Locally abundant biotite develops in shear zones in the metagabbro. Many well developed northeast to northwest trending fractures, dipping steeply west, occur in the rock. Immediately south of the drifts is a major northeast trending fault.

The pegmatite bodies vary considerably in both size and shape. The dikes vary from 0.3 to 18.3 m wide. Ore shoots within the dikes average 30.5 m long by 1.8 m and have a slope depth of 15.2 to 30.5 m. Pegmatite intrudes along fractures and breccia zones within the metagabbro. The larger pegmatites are sills paralleling foliation (strike N65°E dip 55°S) with local rolls and dip changes. The typical leucogranite pegmatite contains brick red feldspar porphyroblasts 0.6 to 2.5 cm in diameter and sparse pyroxene. Chlorite-coated fractures (sometimes showing shearing) cut the pegmatite. Shears in the rock contain accessory magnetite, titanite, apatite, zircon, allanite, uranothorite, uraninite and pyrochlore.

Unmineralized pegmatite contains very few mafic minerals. Minor accessory magnetite, pyrite and black tourmaline are present. Mineralized granite pegmatite is either of the magnetite-rich or quartz-rich types.

The hanging wall of the pegmatite at No. 101 drift contains a high grade band 0.3 to 1.2 m wide with abundant magnetite. Other accessories are zircon, titanite, apatite, pyrite, allanite and uranothorite. These minerals are deposited along fractures in the feldspar and quartz.

In No. 103 subdrift a shear zone with *lit-par-lit* pegmatite is mineralized. The pegmatite is 0.06 to 0.7 m wide, with an average width of 0.3 m. Biotite schist is abundant near contacts and occurs with magnetite in radioactive sections. Other accessories are zircon, apatite, allanite, pyrite, uranothorite and uraninite.

Irregular mineralized magnetite-hornblende-pyrite bodies occur within magnetite-bearing granite pegmatite in No. 111 drift. Pyrite, zircon, titanite and uranothorite are accessories.

At No. 105 raise fractured quartz-rich patches in leucogranite are stained with hematite. Uranothorite, zircon and allanite are present. The surrounding granite pegmatite contains peristerite feldspar with accessory zircon, titanite, pyrite and uranothorite.

Breccia zones in amphibolite, hanging-wall or footwall enrichments, abundant magnetite, uralitized pyroxenes and deep-red coloured feldspar are the ore zone characteristics listed by Satterly.

Country rocks at the mine were sampled by the authors. Four amphibolite and metagabbro samples assayed 4 to 14 ppm U_3O_8 and less than 10 ppm Th. Two more assayed less than 1 ppm U_3O_8. A sample of biotite gneiss gave results of 100 ppm Th. Marble ran less than 1 ppm U_3O_8 and less than 10 ppm Th. Pyritic quartzo-feldspathic gneiss assayed 12 ppm U_3O_8 and less than 10 ppm Th.
HISTORY
Goldhawk Porcupine Mines Limited performed scintillometer and geological surveys on the property in 1954. Drilling started that year, and in 1956 a 137.2 m shaft was begun. During the period 1955-59 drilling of 189 holes for 19 051.2 m, drifting for 1 819.3 m and crosscutting for 504.9 m were performed. From 1957 to March 31, 1959, 80 247 tons of ore grading 0.069% U_3O_8 was extracted from this property and milled at the Faraday Mine. A summary of this production is shown in Table 11.
SELECTED REFERENCES
Griffith (1967, p.240-243)
Satterly (1957, p.117-121)

43. HOWARD KERR OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uraninite, allanite and uranothorite
ROCK ASSOCIATION
The hosts are tremolitic-diopsidic marble and granite pegmatite.

TABLE 11 | SUMMARY OF PRODUCTION FROM THE GREYHAWK MINE

YEAR	ORE MILLED (tons[1])	U_3O_8 (pounds[2])	GRADE (pounds U_3O_8 per ton)
1957	19,535	21,382	1.09
1958	52,517	78,812	1.50
1959	8,195	10,934	1.33
TOTAL:	80,247	111,128	1.38

[1] Tonnage listed are in short tons.

[2] Data compiled from information available in the Source Mineral Deposit Records, Geoscience Data Centre, Ontario Geological Survey, Toronto.

CLASSIFICATION

Simple unzoned white granite pegmatite and marble

LOCATION

The occurrence is approximately 11.4 km west-southwest of the town of Bancroft, in Lot 28, Concession B, Faraday Township, Hastings County.

Latitude 45°01'03''N; Longitude 77°59'30''W

UTM 4989000mN, 264300mE, Zone 18

NTS Bancroft 31F/4

ACCESS

The occurrence is 150 m north of the Monck Road from a point about 300 m northeast of the hamlet of Monck Road.

PRESENT EXPOSURE

Fairly well exposed

SIZE AND GRADE

Mineralization is erratic and low grade

DESCRIPTION

Geology: The occurrence is described by Satterly (1957, p.121) as follows:

In 1954, Silver Crater Mines Limited, had an option on the farm of Howard Kerr and carried out surface exploration and diamond-drilling in lot 28, concession B, Faraday Township, Hastings County.

In a field to the north of the Monck road in the above mentioned lot a white, fine- to coarse-grained marble shows a faint banding at N60°E, dipping 45°SE.

A small pit, 6 by 8 by 4 feet deep, has been put down on a complex of marble, tremolite rock, and pegmatized rock containing disseminated pyrite. Geiger readings averaged 5X, and in the siliceous marble and pegmatized rock a few grains of allanite and uranothorite were found.

Occurrences of pegmatite in the same field to the north of the pit have been explored by two drill-holes totalling 580 feet. On the surface, pink leucogranite pegmatite is exposed as irregular lenses in fine- to coarse-grained marble which strikes N25°E and dips steeply southeast. Geiger readings were 1X-12X over the limestone and up to 7X on the pegmatite exposures. A spot-high reading of 20X was recorded at one place on a marble-pegmatite contact. Along the contact an occasional pod or lens of very coarse, white calcite with crystals of red apatite and a dark green pyroxene was noted. No radioactivity was recorded from this mineral assemblage.

This occurrence is located in the Bigfools Lake Marble belt, which is part of the Dungannon formation of the Mayo group. The general geology is described by Hewitt (1959) in his report on the Geology of Cardiff and Faraday Townships.

The writers found that high radioactive areas were associated with either the pegmatite dikes or with pyritic tremolitic-diopsidic units within the marble. Two radioactive samples were assayed and identified as uraninite. It was noted that marble on the property shows a considerable amount of flowage manifested by small and large-scale folding. Some of the flowage is thought to post-date the intrusion of the pegmatites as some show various degrees of fragmentation.

The white pegmatite dike in the marble generally yielded higher readings than the marble due to its higher K-content, but most of the pegmatite did not show anomalous radioactivity. Those pegmatites that did show anomalous radioactivity were usually in contact with siliceous units or marbles. Here the mineralization appeared to be restricted to the contaminated contact zone. The writers interpret the above to indicate that the marble or host rock was already mineralized along calc-silicate horizons prior to the intrusion of the pegmatite. Pegmatites which did come into contact with the calc-silicate units caused a further remobilization of uranium, increasing the concentration of uranium at the contact zone.

It is possible that when the pegmatite came into contact with these pyritic calc-silicate horizons, the reducing environment of the pyrite caused uranium from the pegmatite to be deposited preferentially along the contact. However, this does not explain the occurrence of mineralized calc-silicate horizons in marble where there is no pegmatite.

HISTORY

In 1954, two drill holes totalling 176.9 m and a pit 1.8 by 2.4 by 1.2 m deep were put down by Silver Crater Mines Limited.

REFERENCES
Hewitt (1959)
Satterly (1957, p.121)

44. LOCKWOOD OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uraninite and uranothorite
ROCK ASSOCIATION
The host is tremolitic marble
CLASSIFICATION
Marble
LOCATION
The occurrence is approximately 11.6 km west-southwest of the town of Bancroft, Lot 29, Concession A, Faraday Township, Hastings County.
Latitude 45°00′53″N; Longitude 77°59′32″W
UTM 4988700mN; 264250mE Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence is about 150 m east of the Monck Road on the north side of the settlement of Monck Road.
PRESENT EXPOSURE
Good
SIZE AND GRADE
Erratic mineralization
DESCRIPTION
General Geology:This showing is located in the Bigfools Lake Marble belt which is associated with the Dungannon formation of the Mayo Group. The formation in this area consists of tremolitic-diopsidic marbles with interlayered calc-silicate gneiss and para-amphibolite. The calc-silicate gneisses often contain pyrite and pyrrhotite. All of the above rocks are of the upper amphibolite metamorphic grade. The sequence is intruded by late granite pegmatites. The general geology is described in a report on Cardiff and Faraday Townships by D.F. Hewitt (1959). (Fig. 17)
Geology of the property:The following description is taken from Satterly (1957, p.121):

Uranium occurrences in siliceous marble exposed in a field adjacent to the Monck road were explored by test-holes, pits, and trenches, and two diamond-drill holes totalling 444 feet.

The workings and drill-holes explored a knoll of fine- to medium-grained, white marble containing small pods of silicate minerals. Geiger readings on the marble were mainly below 12X, but near the road readings taken in trenches ranged from 10X to a high of 75X. No uranium minerals were found in the decomposed or fresh marble in these trenches, but coarse pink calcite containing apatite was noted in one trench. On the knoll and in a pit near drill-hole No. 2 a tremolite rock containing coarse, pink calcite in lenses or irregular stringers is exposed. Uraninite with accompanying purple-red staining is found in minute grains and cubes, ¼ inch across, in the tremolite rock. Grains of uranothorite occur alone or with uraninite. Spot-high geiger readings of 15X, 20X, and 45X were recorded on these isolated occurrences of uraninite.

Only the core, 0-297 feet in drill-hole No. 2, was examined by the author. The rock is a grey-to-white, fine- to coarse-grained marble, containing various amounts of diopside, phlogopite, tremolite, pyrrhotite, pyrite, and graphite. Stringers of coarse pink calcite, 0.1 to 0.5 feet wide, were noted at four places. Uraninite was noted only once, as a minute grain, at 228.4 feet. The flesh-pink marble around the uraninite grain shows a red discolouration."

The authors visited the showing in August, 1977. Mineralization occurs as small uraninite crystals in coarse tremolitic marble or in meta-amphibolite units composed largely of diopside and tremolite.

A radioactive reading taken with a TVIA spectrometer on some pink calcite containing black radioactive minerals yielded the following:

T_1f (total field)	175 000 cpm
T_2 (U Th)	8 700 cpm
T_3 (Th)	2 200 cpm

DISCUSSION
As there are no intrusive igneous bodies in the immediate area of the showing, the authors assume that the uranium originally occurred within the marble sequence itself. The coarse pink calcite veining and skarn-like tremolitic and diopside patches suggest mobilization of components of these rocks during high-grade regional metamorphism. Uranium, a very mobile element, would be incorporated in any fluid phase developed from these rocks. It is therefore probable that uranium was derived from calc-silicate layers in the marble and was mobilized by fluids of metamorphic origin. Evidence for a similar mechanism can be observed in the Kerr Occurrence, a few hundred metres to the north.
HISTORY
1954 - Two diamond drill-holes totalling 135.4 metres, trenching, test-holes and pits were done by Silver Crater Mines Limited.
SELECTED REFERENCES
Hewitt (1959)
Satterly (1957, p.121)
Satterly, J
1954: Private unpublished files.

45. MACLAN OCCURRENCE

See "Minor Occurrences"

46 – 50. YORK RIVER OCCURRENCES

COMMODITY
Uranium, thorium and niobium
RADIOACTIVE MINERALS
Uranothorite, pyrochlore
ROCK ASSOCIATION
The A, E and D Zones are hosted by granite pegmatite in country rocks of granitic gneiss. The B and G Zones occur in syenite and granite pegmatite in country rocks comprising biotite-amphibolite gneiss, syenite gneiss, marble, and granite and granitic gneiss.
CLASSIFICATION
Complex pegmatites, simple pegmatites, pyroxene veins
LOCATION
The property lies north of the Monck Road and west of

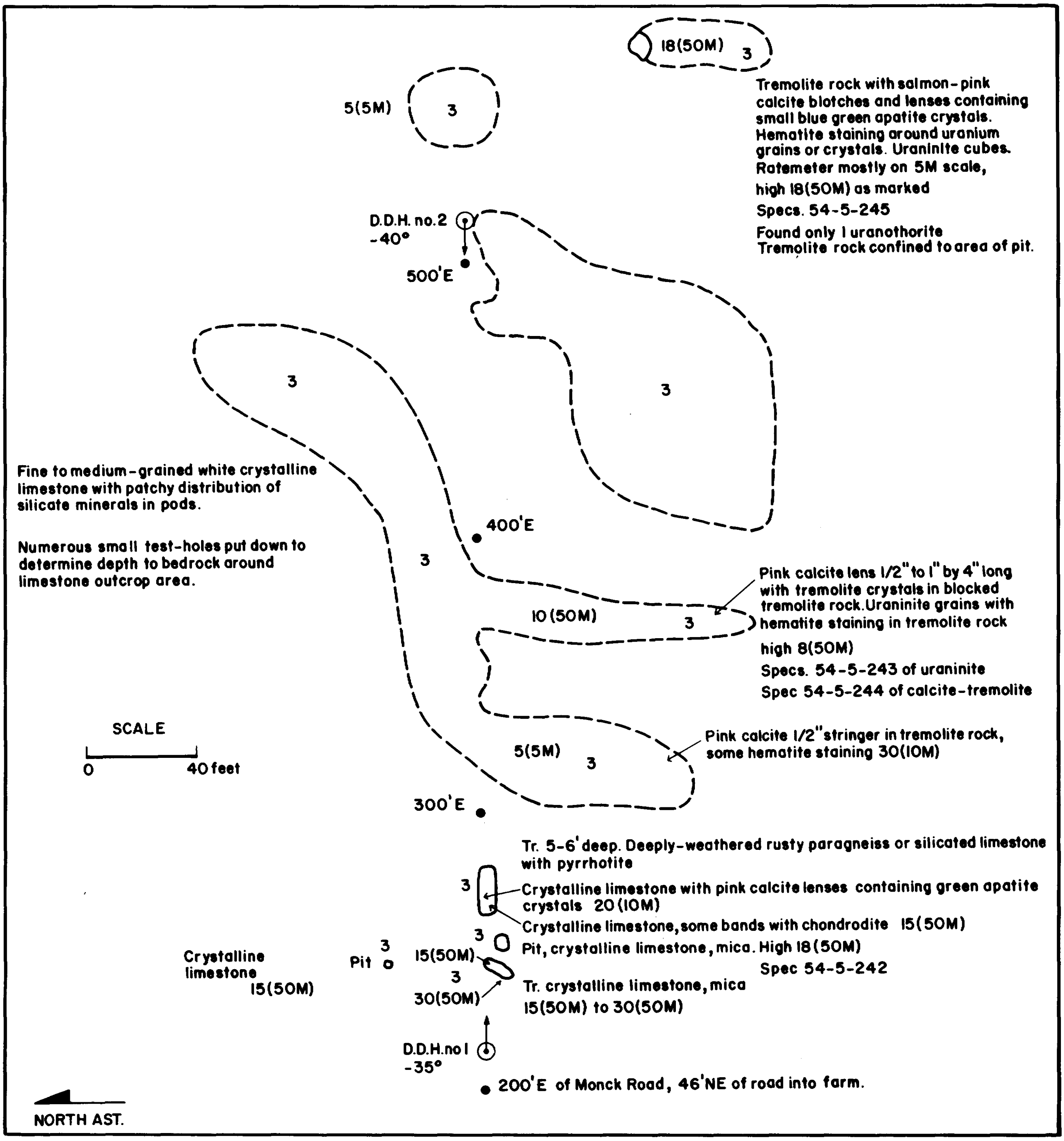


Figure 16 — Geology of the Lockwood Occurrence (after Satterly, 1954)

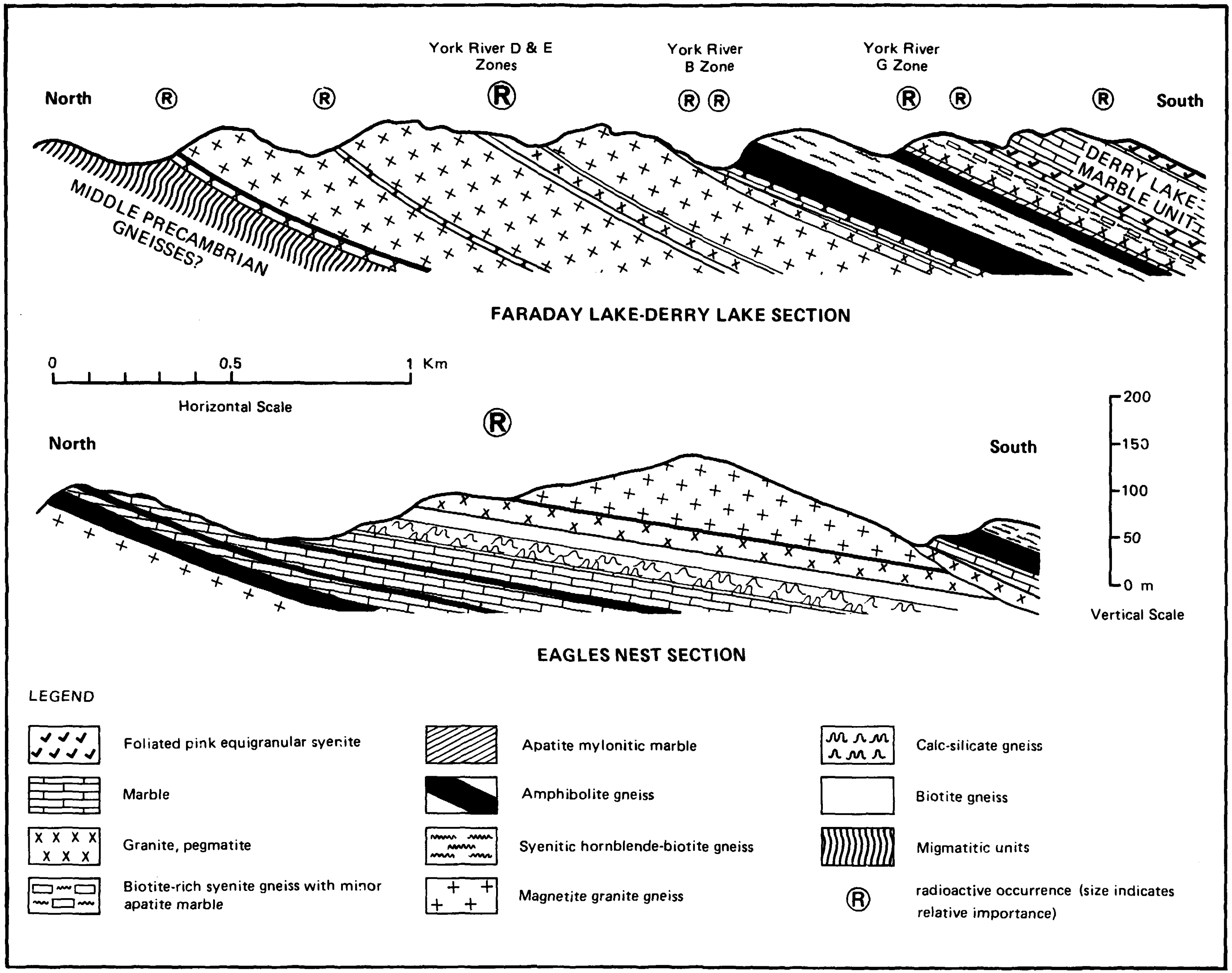


Figure 17 — Geological cross-sections of the York River and Eagle's Nest Occurrences.

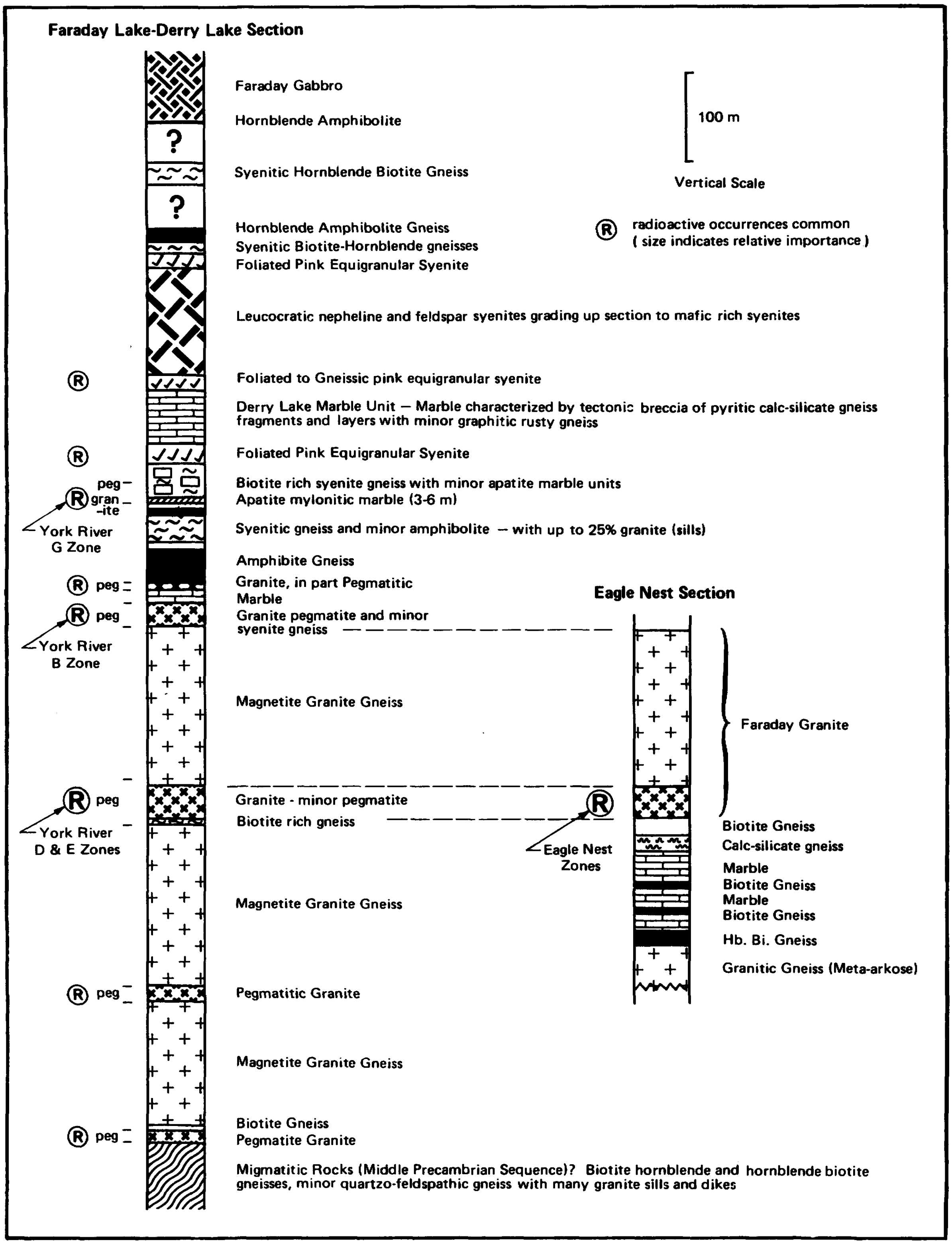


Figure 18 — Geological sections of the York River and Eagle Nest Occurrences

York River, in northeastern Faraday Township, Hastings County.

Zone A — S ½ lots 2, 3 Concession XV
Zone B — N ½ lot 4 Concession B
Zone C — S ½ lots 2, 3 Concession XV
Zone D — S ½ lot 6 Concession XV
Zone E — N ½ lots 9, 10 Concession B
Zone F — S ½ lots 5, 6 Concession B
Zone G — S ½ lot 8 Concession B
NTS Bancroft 31F/4

ACCESS

All zones are accessible by short walks (<½km) from public and private gravel and dirt roads.

PRESENT EXPOSURE

Very well exposed, although some carbonate-bearing pegmatites are well-weathered.

SIZE AND GRADE

Widespread but erratic mineralization occurs in pegmatites up to 2 m wide but averaging less than 0.5 m in width. In the D Zone, limited drilling has intersected 0.825% U_3O_8 over 0.9 feet and 0.163% over 4.4 feet. Further drilling would be necessary to establish the economic potential of the property.

DESCRIPTION

General Geology: The property occurs within a Late Precambrian sequence tentatively correlated with the Anstruther and Herman Groups (Bright 1977) of the Grenville Supergroup. In this area, the rocks are all of upper almandine amphibolite facies and have been subjected to various degrees of folding, thrusting and metasomatism during the Grenville orogeny.

The rocks of this property are part of a succession of northeasterly-trending and southeasterly-dipping granitic gneiss, granite, biotite gneiss, biotite-amphibolite gneiss, calc-silicate gneisses and silicated marble.

The "Faraday Granite" occupies the northern two-thirds of the property. This unit is not homogeneous but comprises granite gneiss, granite, and thin layers (0.2-10m) of biotite and biotite-amphibolite gneisses and schist. These thin mafic units may be in part paragneisses, but some, especially the biotite schist and gneisses, may be recrystallized shear zones which formed subparallel to the present layering. The granite, which generally occurs in proximity to biotite gneiss or schist layers, may be from 15 to 50 m thick. It is chemically similar to the granitic gneiss, but differs in mineralogy and texture. The granite shows no signs of forceful intrusion and is parallel to the granitic and biotitic gneisses (Figure 17) It appears to occupy or represent a major thrust zone. This "paleo-thrust" marks a significant horizon, because it is within, at the contact with, or within 30 to 40 m above this granite that the radioactive pegmatites of the A, C, D and E Zones are found. The magnetite-bearing granitic gneiss may represent an anatectic derivative of the basal meta-arkose of the Grenville Supergroup in this area. It is tentatively correlated with the Anstruther Lake Group, whose meta-arkoses also have a high magnetite content. The granite gneiss is interlayered with a few units of biotite and biotite-hornblende gneisses, which may be migmatitic. The following description of the geology is by Gordon and Masson (1978).

Overlying the Faraday Granite gneiss (meta-arkose?) is a thin sequence composed of highly foliated biotite syenitic gneiss and a thin marble unit (8 to 12 m thick), which contains numerous bodies of granite, granite pegmatite and syenite pegmatite. This zone forms the second most important uranium-bearing horizon and it is within this horizon that the York River B zone occurs. It is apparently conformable in the Faraday Lake section, but in the Eagle Nest section it may represent another paleo-thrust zone [Figure 18]. Unfortunately the zone is usually represented by a depression. This horizon is overlain by a relatively thick section of biotite-amphibolite gneiss which serves as a marker horizon. No significant radioactive occurrences were observed within the amphibolite gneiss.

The amphibolite unit is succeeded by thinly layered syenitic gneisses, which only rarely contain radioactive mineralization. Succeeding the syenitic gneiss is a thin layer of amphibolite, also barren, which is in turn overlain by a thin (3 to 6 m thick) layer of mylonitic apatite marble. This apatite marble is a distinctive marker horizon containing up to 20 percent apatite.

The marble is overlain by calcareous syenite gneisses interlayered with up to 1 m layers of apatite marble. This syenite forms the third radioactive horizon of the section studied. Granite sills and pegmatites which cut this unit are anomalously radioactive. The York River G zone is in this syenite. The interlayered apatite marble in the syenitic sequence may represent a sedimentary phosphatic facies. Phosphatic sediments are known to be associated with uranium mineralization (Udas and Mahadevan 1974), and this hints at a possible stratigraphic source bed for the uranium. On the other hand, mylonitic marble suggests that there has been a major structural adjustment along this zone, as with the other uraniferous zones described.

The phosphatic layer is followed by a pink pegmatitic syenite occasionally nepheline-bearing, which gives only occasional "spot-highs" of radioactivity, and then by the very distinctive marker horizon, the Derry Lake Marble, which presents a very low radioactivity profile except on the south contact where "spot-highs" are present in pyritic granite pegmatites. The marble is overlain by pink, foliated, equigranular biotite syenite, very similar to that below the marble. No radioactive occurrences were observed in this unit.

YORK RIVER A, C, D AND E ZONES

Detailed Geology: These showings occur in the area of the contact between the granite and granite gneiss phases of the Faraday Granite.

In the A Zone, mineralization occurs in pegmatites at the contact, or in granite gneiss just above the contact, and in pyroxene veins. A surface sample assayed 0.09% U_3O_8 and 0.55% Th.

In the C Zone, small, poorly mineralized pegmatites occur in granite and in underlying biotite-amphibolite gneisses.

Small, erratic mineralized pegmatites and fractures of the D Zone occur in the granite gneiss a few tens of metres above the contact with the granite. Stripping and 7 pits or trenches have exposed irregular dikelets of pyroxene or pyroxene granite, pegmatite, calcite, biotite, and narrow fractured zones. Uranothorite in clusters of small rounded prisms or needles has been noted.

Mineralization in the E Zone occurs in numerous but very small sheared magnetite-bearing pegmatites, generally occurring at the upper contact of the granite with the granite gneiss. A barren pegmatite occurs in biotite gneiss at the lower contact of the granite, where it overlies a repeated section of the granite gneiss. A biotitic unit

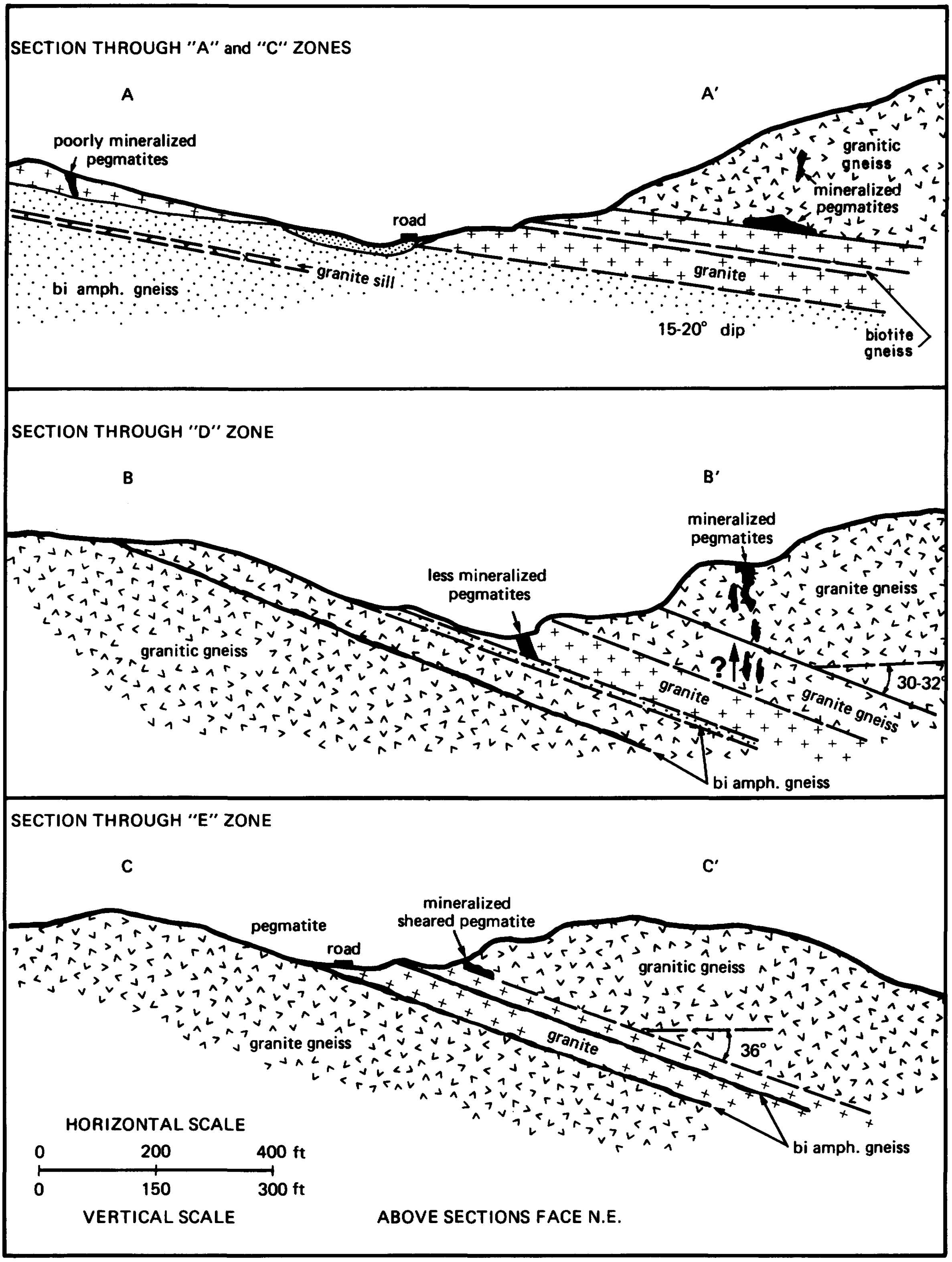


Figure 19 - Cross-sections of the York River A, C, D and E Zones.

within the granite is broken and intruded by anatectic portions of the granite. The zone has been explored by one drill-hole and six trenches.

The following cross-sections of the C and A, D, and E Zones (Figure 19) illustrate the position of mineralized pegmatites relative to the granite (thrust zone?) and the biotite schist and gneisses (recrystallized shear zones). These sketches are schematic; horizontal scale is accurate but no measured sections were taken so vertical scale and thickness are approximated.

DISCUSSION

The cross-sections (Figure 19) show that the important mineralized pegmatites occur in the granite, at the upper contact of the granite, or within 30 to 40 m of the contact in the overlying granite gneiss. The authors believe that the close spatial association of mineralized pegmatite and granite is genetic.

YORK RIVER B AND G ZONES

Detailed Geology: Uranium showings south of the Faraday Granite are spatially associated with two stratigraphic and possibly structural horizons. These are typified by the York River B and G Zones.

Mineralized pegmatites of the B Zone occur near the contact of leucogranite and syenite. The leucogranite immediately overlies the upper granite gneiss of the Faraday Granite. In transition the granite gneiss loses its gneissosity, with an increase in grain size grading into granite pegmatite. The leucogranite zone contains thin sheets of biotite gneiss, which may be interlayered paragneiss, but probably represent recrystallized shear zones. The syenite, in places resembling syenitized leucogranite, grades upward into syenite biotite gneiss. Small intrusive syenite pegmatites occur locally. Some pegmatitic parts of the syenite contain sodic amphibole. One pit has exposed an apatite-bearing carbonate vein which is probably related to a thin (5-10 m) marble horizon occuring about 100m to the west along strike.

Stripping and trenching over an area 300 feet across have exposed erratically-mineralized pegmatites, ranging from hornblende stringers to hornblende syenite pegmatite ±calcite ±apatite. Spot-highs greater than 50x background occur over reddish-brown grains of pyrochlore.

The authors have found many more radioactive occurrences along the same stratigraphic horizon to the west of the B Zone. The possibility that this stratigraphic position represents a zone of thrust faulting, as indicated by steepening dips and mylonitization, is currently under investigation. This zone is characterized by pegmatite intrusions. Some of the pegmatites, as well as small granite dikes and sills, are anomalously radioactive, especially if fractured or sheared.

The G Zone is the largest mineralized granite pegmatite which has intruded a sequence of syenitic gneisses containing inerlayered units of marble. The syenite belt extends eastward through Bancroft and westward along the Monck Road, and is the same belt which hosts the Bicroft Mines occurrence in the Cardiff area. Small radioactive occurrences in granite sills and pegmatites are found all along the belt, especially where it contains interbedded apatite marble units.

Mineralization in the G Zone is largely restricted to within a metre of the upper contact of the granite pegmatite, where it has reacted with overlying apatite marble to form a syenite, although in some areas there appears to be an original syenite horizon separating the pegmatite from the marble. Mineralization is very irregular, occurring in patches and along small fractures in the pegmatite and in the overlying thin syenite. Mineralization is associated with abundant zircon especially along fractures, reddening of feldspars, and abundant pyroxene where the pegmatite is syenitic. Secondary pegmatites, 1 to 3 cm wide, occur along fractures cutting the syenitic pegmatite and the syenite gneiss. They are very radioactive, containing uraninite and uranothorite as well as abundant quartz and zircon. The G Zone has been explored by two trenches about 10 m long, and two diamond-drill holes which produced poor results. (Figure 20).

DISCUSSION

The only probable nearby source of mineralization is the syenite sequence itself. The syenites, and some of the thin marble units, are very rich in apatite, and may be the primary source of uranium, as uranium has been found to be associated with phosphate deposits (Udas and Mahadevan 1974). The intrusion of a granitic melt into this horizon may have concentrated the uranium within the pegmatitic fluids. Alternatively, since phosphorus greatly aids movement of uranium (Langmuir 1978) the high phosphorus content of the country rocks may have assisted concentration of uranium in the upper contact zone of the pegmatite. The author is presently continuing study of this type of deposit. The syenitic gneisses may represent trachytic tuffs, and the biotite amphibolite sequence calcareous paragneisses. These 'paragneisses' are generally high in apatite and sphene and are locally calcareous. The whole sequence contains numerous granite sills. Where the syenitic country rocks are anomalous in their uranium content, granite sills which intrude this area will be quite radioactive. Cross-cutting granite pegmatites dikelets, younger and following a prominant joint direction, are not anomalously radioactive.

HISTORY

1955: Property acquired by Mr. A. H. Shore.

1957: Stripping and trenching mainly on D, B and G Zones; diamond-drilling on the D Zone by York River Uranium Mines Limited.

1977: Inco Metals Limited (Canadian Nickel Mines Limited) carried out geological and geophysical surveys, as well as minor diamond drilling on the D, E and G Zones.

SELECTED REFERENCES

Bright (1977)

Ennis, G.F.

1975: Report on York River Uranium Mines Limited Property, Faraday Township, Hastings County, Bancroft Area, Ontario. An open file, York River Uranium Mines Limited.

Gordon and Masson (1977;1978)

Langmuir (1978, p.17-29)

Lumbers (1975;1976a;1977;1978)

Masson, S.L.

In preparation: M.Sc. Thesis, Laurentian University.

Satterly, J.

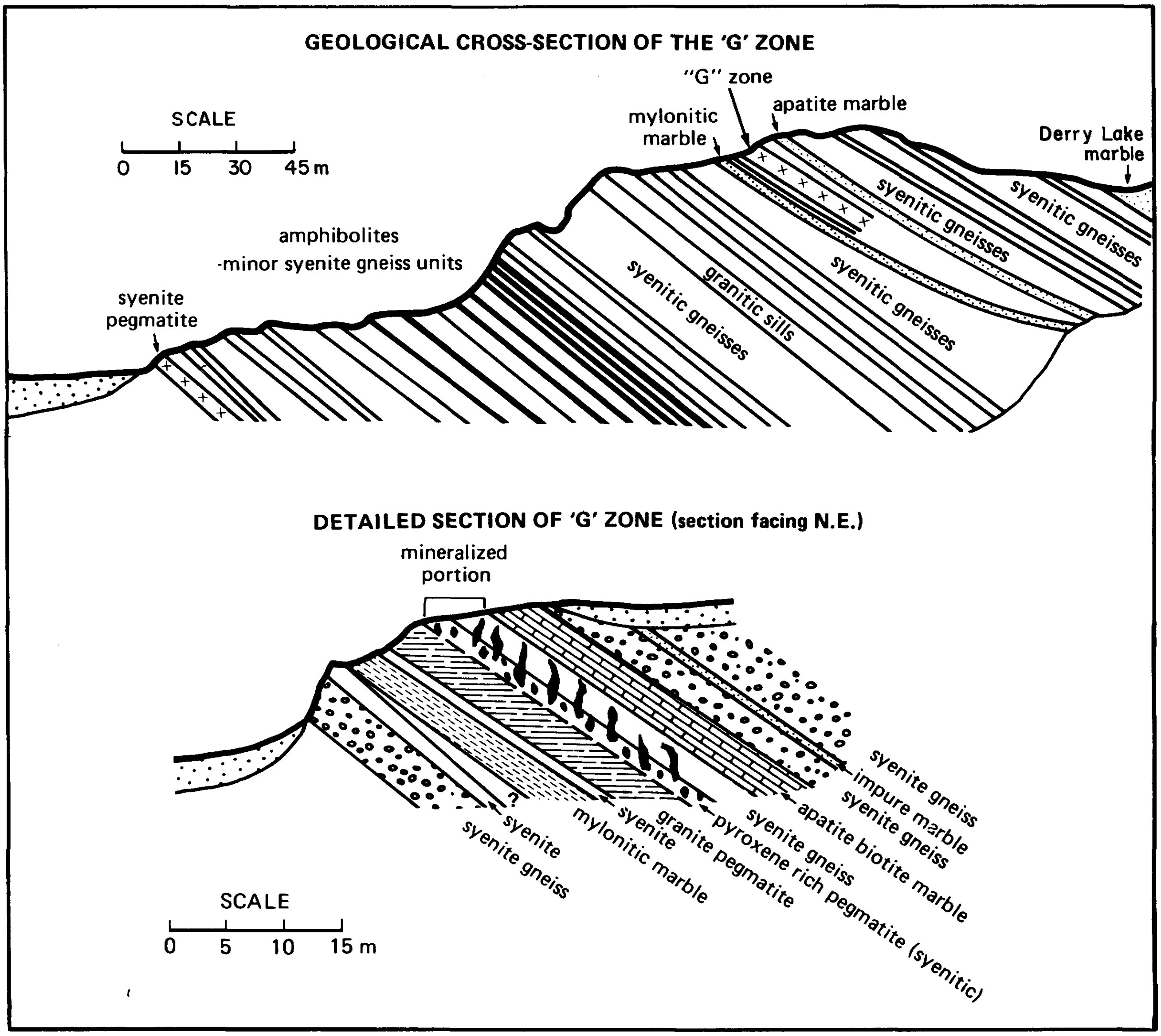


Figure 20 — Cross-section and detailed section of the York River G Zone.

1957: Unpublished report on the York River Property. On file at the Geoscience Data Centre, Ontario Geological Survey, Toronto.
Traill (1970, p.447)
Udas and Mahadevan (1974)
Withers (1976)

51. BARR FELDSPAR QUARRY OCCURRENCE

COMMODITY
Feldspar

OTHER METALS
Uranium, thorium, niobium, tantalum, cerium
RADIOACTIVE MINERALS
Allanite, fergusonite, pyrochlore, uraninite
ROCK ASSOCIATION
The host is a zoned granite pegmatite in country rocks comprising hornblende-biotite gneiss and biotitic quartz-feldspathic gneiss.
CLASSIFICATION
Zoned pink granite pegmatite - feldspar type

LOCATION
Lot 24 N½, Concession XVI, in Fraser Township, Renfrew County.
Latitude 45°46′44″N; Longitude 77°27′46″W
UTM 5072200mN, 308550mE, Zone 18
NTS Pembroke 31F/14

ACCESS
Approximately 2.5 km west on Highway 62 from the village of Alice, a road extends westward 8 km to the C.N.R. mainline. At this point travel is by foot along the C.N.R. for approximately 4 km to Indian. The property is north of Indian via wagon track and trail, a distance of about 3.3 km. to the main quarry.

PRESENT EXPOSURE
The walls of both the main and small quarry are well exposed but the central portions are under water.

SIZE AND GRADE
Anomalous radioactivity is confined to several spot 'highs' in the border phase and a few books of biotite in

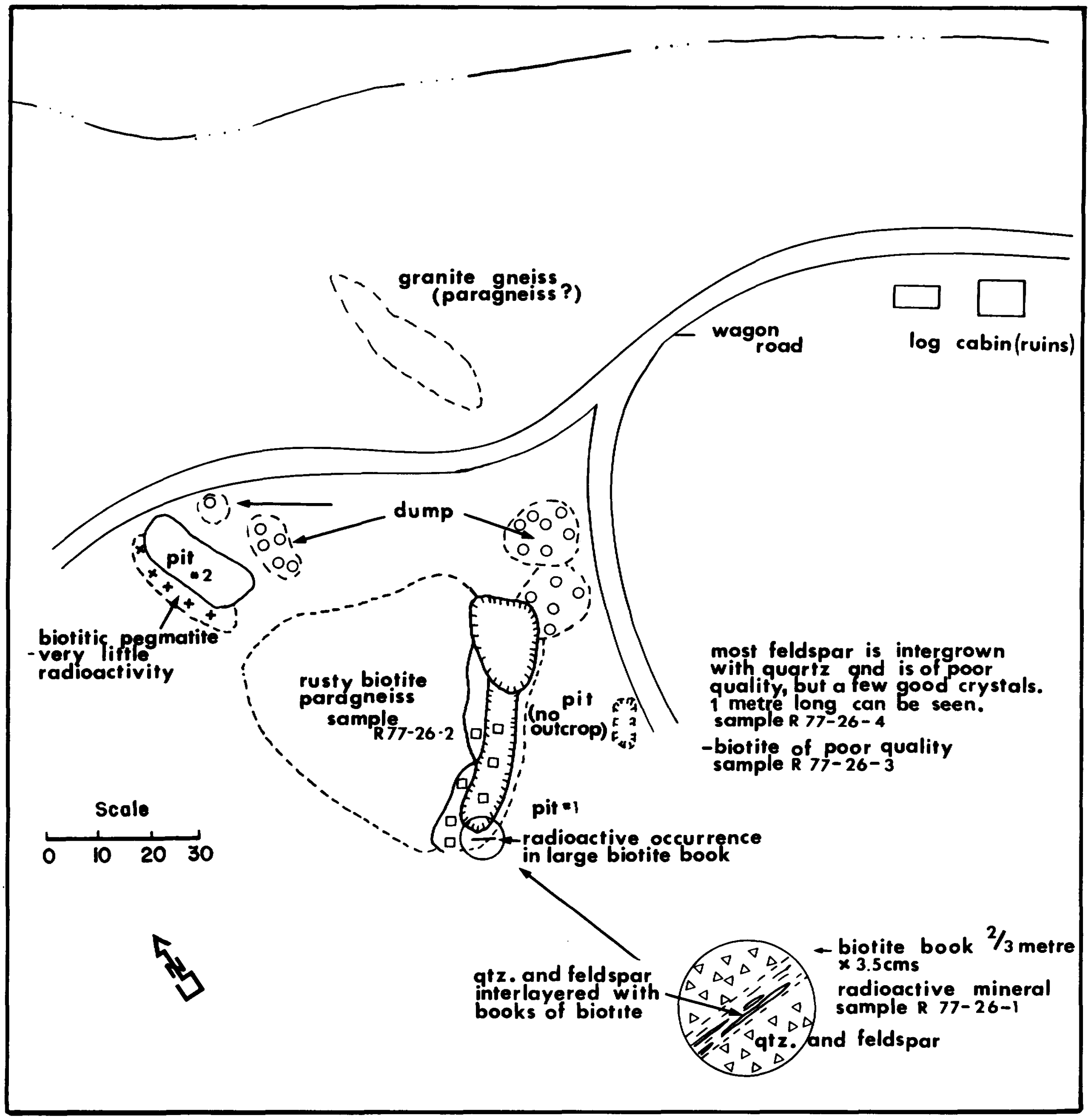


Figure 21 — Geology of the Small Quarry, Barr Quarry Occurrence.

the wall zone. The waste dump showed one spot which was anomalously radioactive. This occurrence appears to contain a very low content of radioactive elements.

DESCRIPTION

General Geology: The country rocks are biotitic granite gneiss, hornblende-biotite gneiss, rusty weathering quartzo-feldspathic gneiss and meta-arkose. The hornblende-biotite gneiss may represent impure sandstone probably of Middle Precambrian age. The granite gneiss may be either a meta-arkose of the same age or is part of the Algonquin Batholith (Lumbers 1976) dated as Late Precambrian. The meta-arkose represents the basal unit of the Grenville Supergroup which is in unconformable contact with the Middle Precambrian paragneisses and the Algonquin Batholith. All the above rocks are intruded by Late Precambrian granite pegmatite dikes.

Description of Workings: Development on this occurrence consists of two quarries, The Main Quarry and the Small Quarry, and numerous pits.

The Small Quarry: The dimensions of the quarry are 20 m x 5 m and 2 m to 9 m in depth with its long axis at N40°E corresponding to the strike of the pegmatite dike. The contact of the pegmatite with the rusty-weathering quartzo-feldspathic gneiss (R77-26-2) is well exposed on the northwest wall of the quarry. The gneisses strike N 10°E and dip 45°E. The pegmatite is composed mainly of white quartz and microcline as graphic intergrowths with large plates of biotite. The radioactive minerals are associated with the biotite which is interlayered with quartz and microcline. Although the biotite plates are up to 80 cms in width, they are very thin, not more than 3.5 cm including the interlayered quartz and feldspar. Only a few biotite plates were found to contain radioactive minerals. The radioactive minerals are black and vitreous and give readings of 1800 cpm on the UTh spectrum (background 150 cpm) and 150 cpm on the Th spectrum. A sample (R77-26-1) of this mineral has been identified as pyrochlore. (Figure 21)

The Main Quarry: The dimensions are 40m x 10m and 2m to 7m deep and it has been developed entirely within pegmatite. The strike of the pegmatite dike varies from north to northeast and it dips to the southeast. The hanging wall is a well-layered hornblende-biotite gneiss (R77-26-5) and probably a metasediment whereas the footwall rocks are granitic biotite gneisses (R77-26-6) with about 15% biotite. It is not clear whether the footwall rocks are paragneisses. The main difference chemically between the hanging wall and footwall rocks is a higher mafic content (Ca, Fe, Mg) and lower silica content in the hanging wall. They have approximately the same feldspar content but the granitic gneisses have more K-feldspar and the mafic gneisses have more plagioclase. The gneisses strike N 55°E and 32°SE.

The pegmatite in the north end of the quarry is composed of large crystals of pink microcline (up to 1m wide) with white quartz. The dike shows well-developed zoning with a quartz core surrounded by crystals of microcline in a quartz matrix. A border zone is composed of graphic intergrowths of quartz and feldspar with some well developed feldspar crystals; in some places it consists of a fine-grained pegmatite (0.5 - 2 cm). The contact with the gneisses is a coarse-grained granite and contains spotty concentrations of magnetite, pyrite, some biotite and the occasional radioactive mineral. At the south end of the quarry, the pegmatite interfingers with the biotite gneiss. This area shows the best development of biotite books (750 cm) with associated radioactive minerals. Some of the biotite plates are buckled. As in the Small Quarry, the biotite plates are interlayered with quartz and feldspar and occasionally are radioactive. Smoky quartz and pyrite are also present in this area.

Radioactive minerals taken from the Main Quarry are described as follows:

Sample R-77-26-8 is a weakly radioactive brown vitreous mineral 8 cm in width. It has been identified as sphene.

Sample R-77-26-9, a black vitreous platy crystal was taken from a biotite plate. It assayed 6.29% U_3O_8 and 1.1% Th. It has been identified as fergusonite.

A brown vitreous mineral (R-77-26-10) submitted for analysis and identification assayed 2.99% U_3O_8 and 0.4% ThO_2. The mineral has been identified as fergusonite.

Samples R-77-26-11, a dull grey cubic mineral taken from the waste dump was tentatively identified as uranothorite or uraninite.

A sample of black mineral submitted by E. R. Woermke of Pembroke to the Harry Weller Laboratory in Cobden in 1954 was tentatively identified as allanite. A radiometric test of the same material by the GSC Radioactive Resources Division showed 0.51% U_3O_8.

DISCUSSION

The biotite, magnetite, pyrite and the radioactive minerals were concentrated mainly at the extremities of the pegmatite dike especially where interfingering of dike and country rock results in contamination of the pegmatite. It appears that the source of the biotite, pyrite and magnetite in the pegmatite is the adjacent country rocks. Frequently the mineralogy of pegmatites reflects that of the host rock, especially in the case of iron minerals.

To test whether uranium might also have had a similar source, three samples (R-77-26-2, -5 and -6) of the country rock were analyzed. These samples of the hanging and foot-wall gneisses show U_3O_8 content of less than 2 ppm and a thorium content of about 10 ppm which demonstrates the very low content of U_3O_8 of the gneisses and indicates that no abnormal amounts of radioactive elements were contributed to the pegmatite by ingestion of the country rock.

The pegmatite itself is an unlikely source of abnormal concentrations of radioactive elements. Aside from a few hot spots in the wall zone associated with biotite books, the pegmatite gives quite low readings (100-200 cpm T_2).

It appears that the presence of these radioactive minerals is not the result of a source rock anomalous in radioactive elements, but rather a 'focused concentration' process, in which these elements, lean primary constituent of the pegmatites, became concentrated in a few selected locations in sufficient amounts to form identifiable mineral species. It is proposed that the radioactive

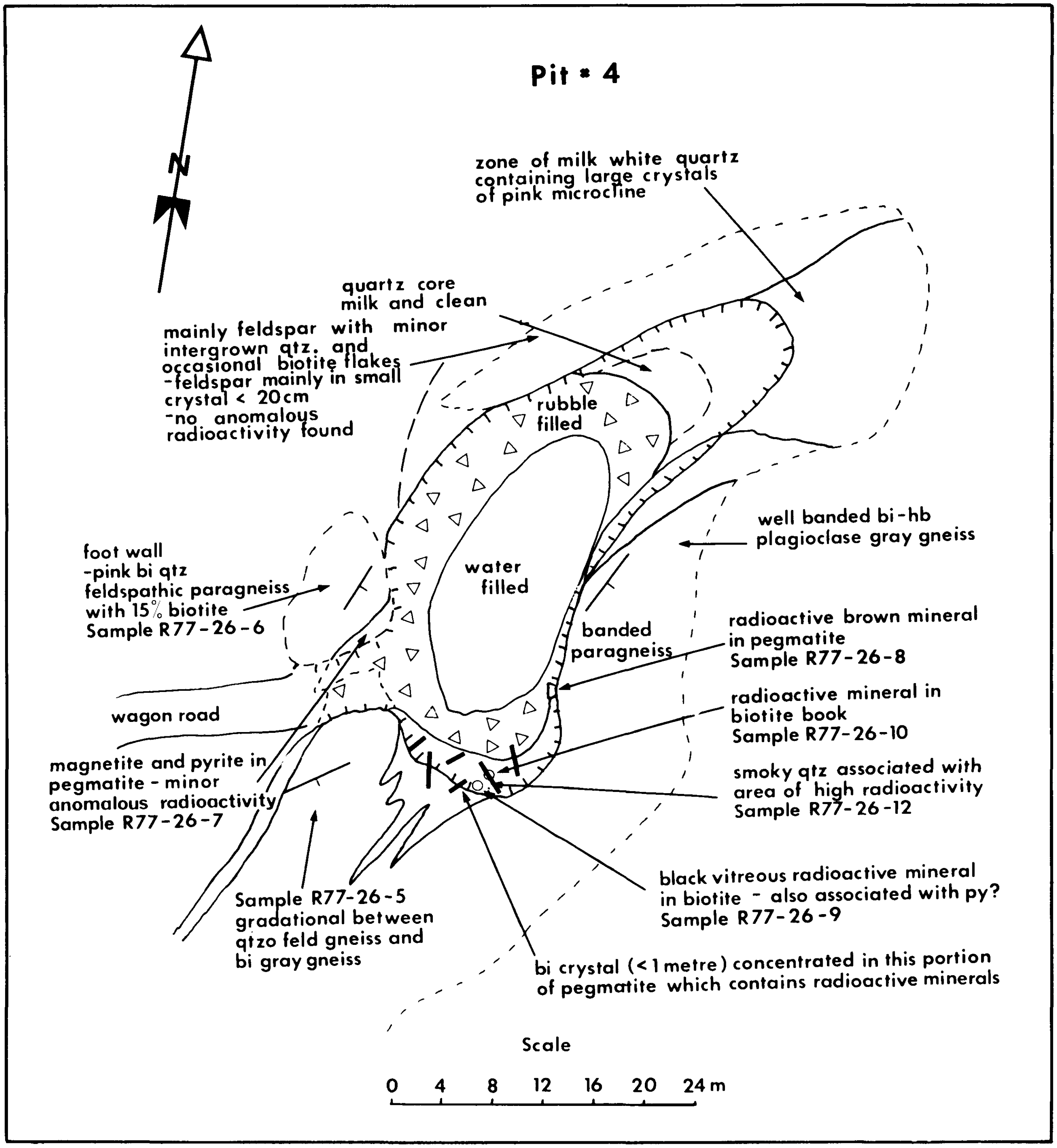


Figure 22 - Geology of the Main Quarry, Barr Feldspar Quarry Occurrence.

elements concentrated in the hydrous phase of the pegmatite would remain in solution until biotite had begun to crystallize providing a preferred locus of deposition for the radioactive minerals. The large size of the biotite plates suggests slow cooling as well as the ability of elements to migrate. Therefore it is suggested that the elements which formed the radioactive minerals migrated to preferred deposition sites, from throughout the hydrous fluid environment of the slowly crystallizing pegmatite. Though some uranium was undoubtedly derived from the gneisses during their partial ingestion by the pegmatite, the presence of niobium and high rare earth suggest the major contribution of these radioactive minerals was from the crystallizing pegmatite melt.

HISTORY

1934-36 W. J. Burr mined 1107 tons of feldspar.

1954 Mr. E. R. Woermke submitted two samples for analyses to the Geological Survey of Canada which assayed 0.51% U_3O_8 and 0.55% U_3O_8. The minerals were tentatively identified as allanite.

SELECTED REFERENCES

Rose (1960)

Satterly (1945, p.37-38)

52. COLAUTTI FELDSPAR OCCURRENCE

53. NEWFOUNDOUT OCCURRENCE (PERCY)

54. GRATTAN TP. OCCURRENCE

55. CONRAD URANIUM OCCURRENCE

56. GODIN LAKE OCCURRENCE

57. HIGHLAND LAKE OCCURRENCE

58. JEFFER'S LAKE OCCURRENCE

59. LAMBERT OCCURRENCE

For detailed descriptions of Deposits 52 - 59 see "Minor Occurrences" listed at the back of this report.

60. PERCY OCCURRENCE

COMMODITY

Uranium, thorium and zirconium

RADIOACTIVE MINERALS

Tentatively identified as uraniferous zircon

ROCK ASSOCIATION

The host is a pink granite pegmatite in country rocks consisting of biotite syenite, biotite-hornblende-syenite gneiss and biotite-syenite gneiss.

CLASSIFICATION

Simple pink granite pegmatite

LOCATION

The occurrence lies approximately 0.7km southwest of Khartum, a settlement on Highway 41 and it is in Lot 22, Concession II, Griffith Township, Renfrew County

Latitude 45°15'36"N; Longitude 77°06'21"W

UTM 5013800mN, 334800mE, Zone 18

NTS Brudenell 31F/6

ACCESS

Approximately 0.8 km southwest of Khartum on Highway 41, a dirt road leads southeasterly to the occurrence, a distance of 400 m.

PRESENT EXPOSURE

Very good

SIZE AND GRADE

The occurrence is in a pegmatite dike 0.35 m wide over an exposed strike length of 4 m. Sample R77-61-3 from the 4cm radioactive core of the pegmatite assayed 860 ppm U_3O_8 and 4000 ppm Th.

DESCRIPTION

In the north half of Lot 22, the rocks are mainly hornblende and biotite syenite gneisses with minor biotite syenite and biotite schist. The south part of the lot is underlain by marble. In the immediate area of the showing, the country rocks are mainly biotite syenite with minor biotite schist, i.e. part of the sequence of rocks in the north part of Lot 22.

The occurrence is in a pink granite pegmatite dike striking north-south and cross-cutting the east-trending syenites. The pegmatite is emplaced in apatite-biotite syenite which has a radioactivity level of 25 cpm (U+Th spectrum). Sample R77-61-1 of the syenite, assayed 2 ppm U_3O_8, 20 ppm Th and 1.2% U_3O_8. It has the chemical composition of oligoclase monzonite.

The pegmatite is roughly zoned with a fine-grained border zone, and intermediate zone of coarse-grained feldspar and quartz, and a core of very red feldspar with quartz, abundant euhedral green zircons up to 6mm, and minor magnetite. The core zone is the source of the anomalous radioactivity and is highly fractured. Readings of 1000 cpm (U+Th), 60-100 cpm Th and 55 000 cpm (U+Th+K) were reported. (Figure 23)

HISTORY

Discovered by O. Percy, Douglas, Ontario

REFERENCE

Lang *et al.* (1962, p.262)

61. SPAIN MOLYBDENITE MINE OCCURRENCE

COMMODITY

Main - Molybdenum

Minor - Uranium and thorium

RADIOACTIVE MINERALS

Uranothorite

ROCK ASSOCIATION

The host is metapyroxenite and granite pegmatite in country rocks consisting of granitic gneisses, hedenbergite gneiss, hornblende-plagioclase gneiss and marble.

CLASSIFICATION

Metapyroxenite skarn - metamorphic metasomatic

LOCATION

The deposit is in Lot 31, Concession IV, Griffith Township, Renfrew County.

Latitude 45°16'44"N; Longitude 77°04'12"W

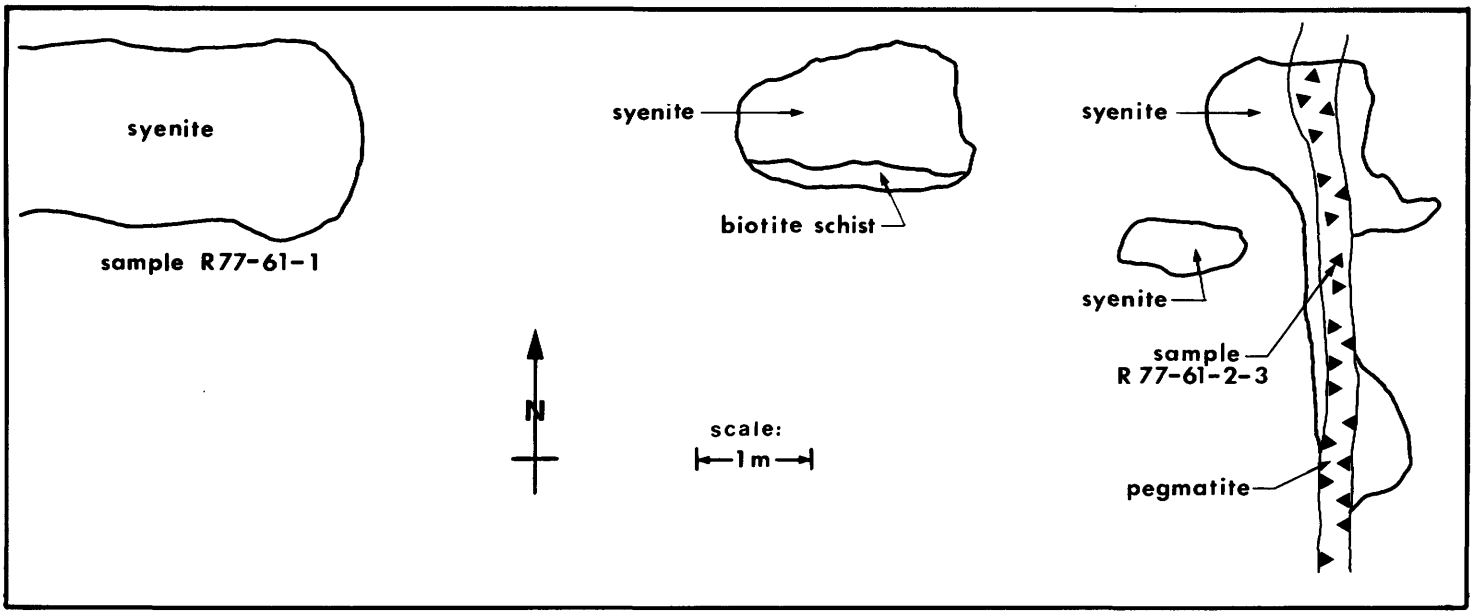


Figure 23 — Geology of the Percy Occurrence.

UTM 5015800mN, 337650mE, Zone 18
NTS Brudenell 31F/6

ACCESS

The occurrence lies a few hundred feet east of Highway 41, about 10 km northeast of the village of Griffith.

PRESENT EXPOSURE

Fair to good

SIZE AND GRADE

Approximately 8050 lbs of pure molybdenite and 600 lbs of concentrate of unknown grade were produced from a pit 100 x 150 x 25 feet.

The grade of uranium mineralization was undetermined. Due to the present demand for both uranium and molybdenum, the area warrants further investigation.

DESCRIPTION

The geology is described by Karvinen (1973). The following is taken from the appendix of his thesis.

GEOLOGY

The rocks exposed in the vicinity of the deposit are granitic gneiss, hedenbergite gneiss, pegmatite, hornblende gneiss and marble.

The granitic gneiss contains layers of migmatitic and pegmatitic granite, and hornblende gneiss. The main minerals present are quartz, oligoclase, microcline and hornblende with minor amounts of magnetite.

The granitic gneiss grades over a distance of a few inches into the overlying body of hedenbergite gneiss which is lenticular in shape and reaches a maximum thickness of about 30 ft. The hedenbergite gneiss is well-foliated, locally layered, medium-grained and homogeneous and has a rusty-weathered surface. It consists predominantly of zoned oligoclase (An_{27}-An_{17}), hedenbergite, microcline and quartz, with lesser amounts of sphene, calcite, hornblende, scapolite, apatite, grains commonly contain cores of scapolite (mizzonite), which also occurs along feldspar grain boundaries. Microcline is present only in layers containing quartz and textures seen in thin section suggest that the microcline has partly replaced plagioclase where it occurs near quartz grains. The thin layers in the gneiss consist mainly of microcline-quartz-oligoclase-hedenbergite and oligoclase-hedenbergite-scapolite. The hedenbergite is normally partly altered to a pleochroic (pale- to dark-green-brown) hornblende. Pyrite and pyrrhotite occur as small, rounded grains disseminated throughout the gneiss.

Two types of pegmatite occur in the vicinity of the deposit: mineralized and unmineralized.

The unmineralized pegmatites:

1. are white to pink in colour
2. are very coarse-grained and consist of smokey quartz, pink microcline and white plagioclase,
3. occur in the grantic gneiss and the hornblende gneiss, and
4. contain no sulphides.

The mineralized pegmatites:

1. are rusty-weathering and brown to orange in colour
2. are very coarse-grained and consist of smokey quartz, hedenbergite, microcline, plagioclase, pyrite, pyrrhotite and molybdenite, and
3. are found only in the mineralized hedenbergite gneiss.

Both types of pegmatite occur in dikes which occupy a prominent joint set (045/90) and range in size from a few inches long and wide to several tens of feet long and a few feet wide. The only important difference between the two types is that the mineralized pegmatite containing

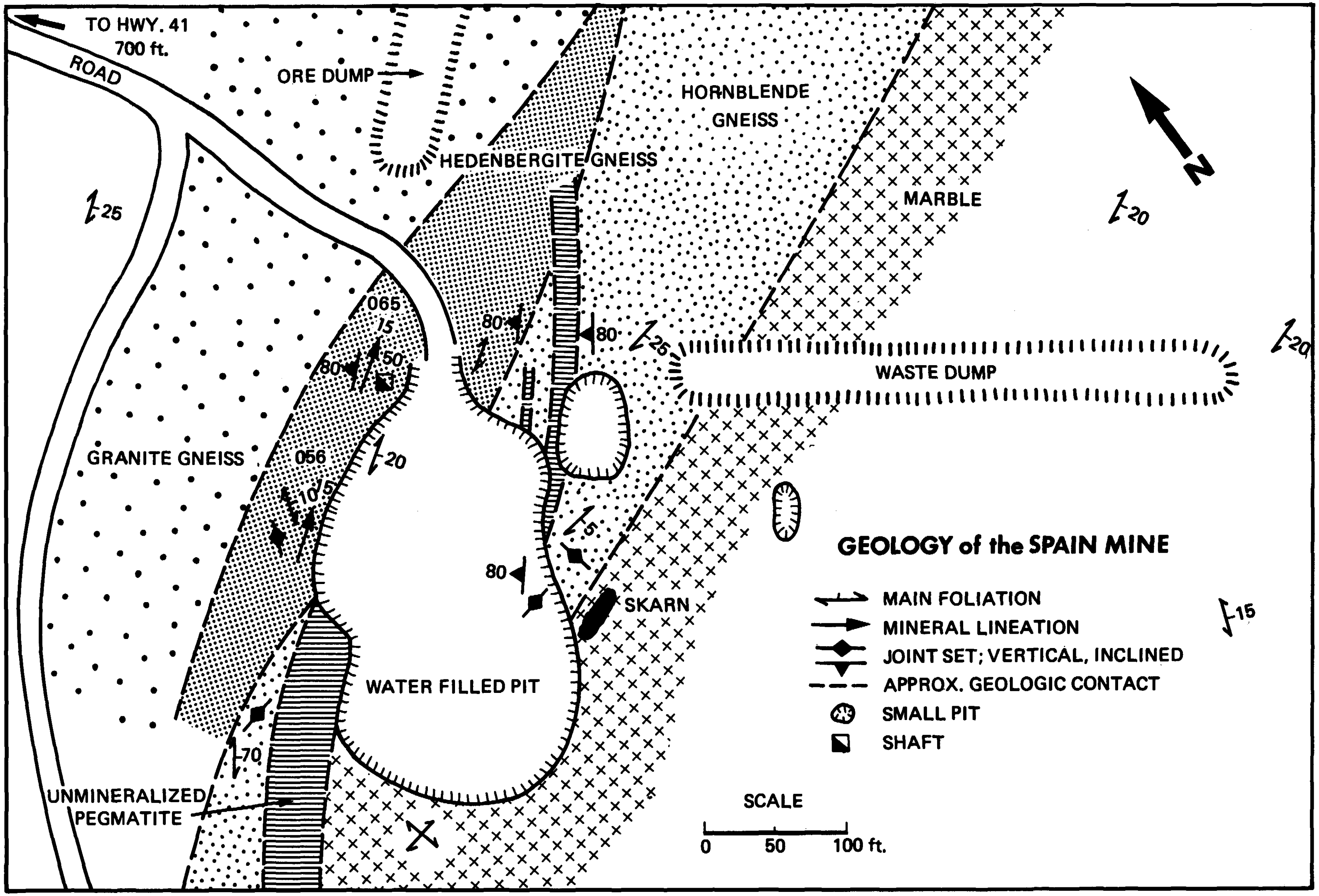


Figure 24 — Geology of the Spain Molybdenite Mine Occurrence. Geology by W.O. Karvinen.

sulphides and hedenbergite occur only in the hedenbergite gneiss, whereas the unmineralized pegmatites occur in the barren country rocks. (Figure 24)

Molybdenite is concentrated in the mineralized pegmatites as erratically distributed, large, rounded flakes up to 10 inches in diameter. Molybdenite is also sparsely disseminated in smaller flakes (-1/4') within the hedenbergite gneiss, especially in the quartz-microcline-rich layers.

Pyrrhotite and pyrite are also much more abundant in the mineralized pegmatites than in the hedenbergite gneiss.

The hedenbergite gneiss grades upward into the overlying unit of hornblende gneiss; the gneiss is black in colour, medium-grained and homogeneous, and consists mainly of hornblende and zoned oligoclase (An_{30}-An_{25}) with small amounts of scapolite, biotite, sphene, chlorite and pyrrhotite. The hornblende is pleochroic from pale-green-brown to dark-green-brown, and is optically identical to the hornblende which rims the hedenbergite in the hedenbergite gneiss. The oligoclase is slightly altered; small irregular grains of scapolite (mizzonite) occur interstitial to the plagiocalse. Quartz and microcline are absent.

The marble unit is about 50 to 75 feet thick and consists of coarse white calcite and lesser amounts of dolomite (6-10%), diopside (0- 3%), muscovite (0-1%) and graphite (0-1/2%).

According to Horwood (1940), an irregular-shaped body of 'metamorphic pyroxenite' (skarn) containing 3 200 tons of low-grade molybdenite ore lies about 10 to 15 ft. below the surface and about 50 ft. southeast of the pit. The skarn occurs along the hornblende gneiss-marble contact and judging by the mineralogical descriptions, it is similar to the scapolite skarns described in this study.

A comparison of the hedenbergite and hornblende gneisses indicates that:

1. quartz and microcline are major constituents in the hedenbergite gneiss but not in the hornblende gneiss,
2. the plagioclase is zoned and of the same composition in both gneisses; textures indicate that the plagioclase have originated from pre-existing scapolite.
3. the hornblende gneiss contains more mafic minerals than does the hedenbergite gneiss,
4. the hornblende gneiss is unmineralized, and
5. the hornblende gneiss contains more A1, Ti, Mg, Ca and Na and less Si and K than the hedenbergite gneiss.

It is suggested that the hornblende gneiss was originally a sedimentary rock which was chemically different from the sediment which is now hedenbergite gneiss. Like the hedenbergite gneiss, the hornblende is thought to be the result of metasomatic reaction between siliceous sediments (shales?) and limestone during regional metamorphism.

DISCUSSION

Field evidence indicates that the pegmatite postdates the molybdenum and uranium mineralization. The pegmatites within the hornblende gneiss are essentially unmineralized whereas the pegmatites in the rusty hedenbergite gneiss contain much sulphide mineralization and occasional anomalous radioactive readings. It is suggested that the intruding pegmatite incorporated minerals present in the country rocks in the formation of the mineralized zones. This implies that there existed a zone of mineralization in the hedenbergite gneiss prior to the pegmatite intrusions.

The origin of the pre-pegmatite uranium mineralization is described in the main body of the report, as well as in the property description of the Zenith Molybdenum Mine. Karvinen (1973) suggested that metasomatic fluids removed molybdenum from the sediments during high-grade regional metamorphism and deposited it in metamorphic metasomatic skarn and metapyroxenite zones.

HISTORY

The mine was first opened in 1912 by J. Legree of Renfrew and it was sold to W.J. Spain of New York in 1915. In 1918 the ownerhsip was taken over by Steel Alloys Corporation. In the period from 1915 to 1919, the mine produced about 8 050 pounds of pure molybdenite and another 600 pounds of concentrate of unknown grade.

In 1939, renewed interest resulted in more stripping, trenching and diamond drilling which disclosed the new 'ore body' in the vicinity. In 1956-66, New Far North Exploration Limited sampled and drilled the deposit, but no significant mineralization was found.

SELECTED REFERENCES

Eardley-Wilmot (1925, p.101-103)
Horwood (1940)
Karvinen (1973)
Satterly (1945, p.83)
Vokes (1963; p.155-158)

62. ROCHEFORT OCCURRENCE

63. TURPINS BAY OCCURRENCE

For detailed descriptions of Deposits 62 and 63 see "Minor Occurrences" listed at the end of this report.

64. PETER-ROCK (WEST) OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Betafite, euxenite, uranothorite and allanite.

ROCK ASSOCIATION

The host rock is a pink granite pegmatite dike in country rocks consisting of biotite and hornblende gneisses.

CLASSIFICATION

Zoned pink granite pegmatite - feldspar type

LOCATION

The occurrence is approximately 11 km north of the town of Bancroft, in Lot 39, Concession VIII Hershel Township, Hastings County.
Latitude 45°08'22''N; Longitude 77°54'39''W

UTM 500415mN; 271200mE; Zone 18
NTS Bancroft 31F/4

ACCESS

The deposit can be reached via a bush road through the H. Hickey farm which is off a gravel township road west of the Hickey Settlement.

PRESENT EXPOSURE

Fair to poor

SIZE AND GRADE

The dike ranges from 0.3 to 3.5 m in width and is exposed for 131 m. Although some samples have assayed 17% U_3O_8, the radioactive minerals form less than 1% of the dike. (Traill 1970)

DESCRIPTION

The following description of the property is taken from Satterly (1957, p.135):

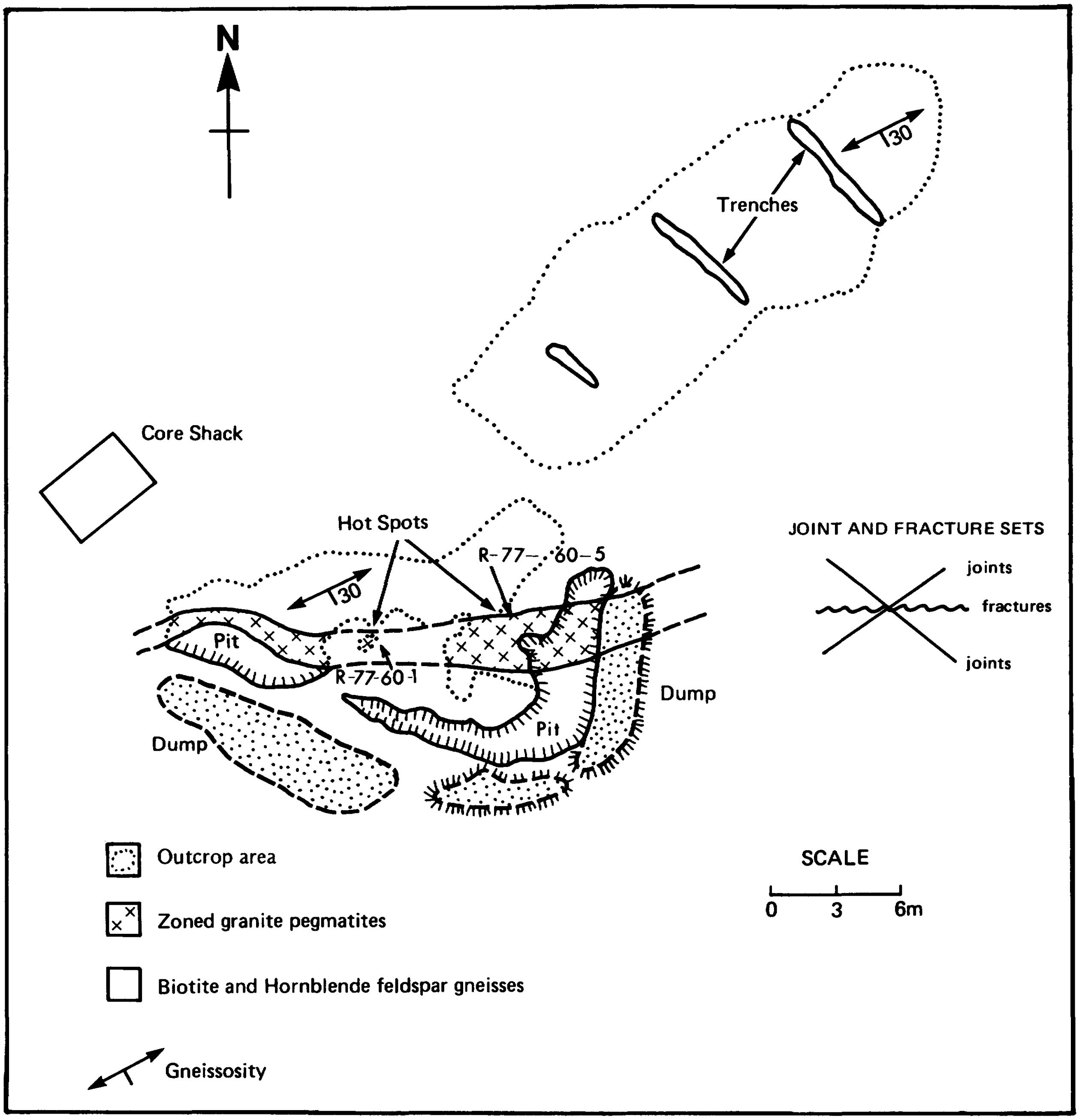


Figure 25 — Geology of the Peter-Rock West Occurrence.

A pegmatite dike exposed in lot 39, concession VIII, has been explored by six small pits or trenches over a length of 430 feet, and by three drill-holes totalling 537 feet.

The property lies within a large area of leucogranite and hybrid granite gneiss cut by granite pegmatite dikes.

The workings expose what may be a continuous granite pegmatite dike of the segregated or zoned type over a length of 430 feet. The dike strikes N 35 to 60°E, dips vertically, and pinches and swells 1 to 11 feet in width. The coarse parts of the dike consist of pink microcline in masses 1 to 4 feet across, grey glassy quartz 1/2 to 2 feet, and occasionally biotite books up to 10 inches across. Geiger readings were 2X-7X and might average 4X. Spot-high readings of 9X-25X and one of 50X were obtained on large grains of radioactive minerals. The radioactive minerals identified are pyrochlore, euxenite, uranothorite, and allanite, often in large grains up to 1 inch across in feldspar or associated with biotite books.

The country rocks consist of hornblende- and biotite-rich gneisses with interlayers of melanocratic to leucocratic units. Granitic layers in the gneiss are irregular, probably derived from the more felsic units by partial melting. These gneisses strike N65°W and dip shallowly (25-30°) to the southwest. (Figure 25).

Radioactive minerals - betafite, euxenite and uranothorite are associated with books of biotite or fracture zones.

The attitudes of the fractures are generally 50 to 55° dipping 80° SE, 80 to 90° dipping 85° SE (mineralized fracture) and 135° dipping vertically.

The radioactive level exceeded 10 000 cpm (T_1) at only three areas; most of the pegmatite gave readings of 2000 cpm (T_1). Two samples (R-77-60-1 and R-77-60-5) of radioactive minerals from the occurrence assayed 1.3% U_3O_8 and 1.66% Th, and 18.4% U_3O_8 and 6000 ppm Th respectively.

HISTORY

In 1955-56, trenches totalling 430 feet in length and three drill-holes totalling 537 feet were completed by Peter-Rock Mining Company Limited.

REFERENCES

Satterly (1957, p.135)
Traill (1970, p.444)

65. DEMPSEY (HIGHWAY 417) OCCURRENCE

COMMODITY

Uranium, thorium, cerium

RADIOACTIVE MINERALS

Allanite, uranothorite, anatase, sphene

ROCK ASSOCIATION

The host is granite pegmatite in country rocks comprising hornblende- biotite gneiss, biotite schist and marble.

CLASSIFICATION

Simple white granite pegmatite.

LOCATION

Approximately 6.5 km southeast of the town of Renfrew, in Lot 1, Concession III, Horton Township, Renfrew County.

Latitude 45°26′49″N; Longitude 76°36′43″W
UTM 5033650mN, 373900mE, Zone 18
NTS Renfrew 31F/7

ACCESS

On Highway 417, 2.6 km southeast of its intersection with Highway 17; the occurrence is on a ridge 0.8 km to the southwest.

PRESENT EXPOSURE

Excellent

SIZE AND GRADE

The dike has an exposed length of 35 m and is 8 m wide. A sample of the pegmatite is reported to assay 0.02% U_3O_8 (radiometric). Two selected samples assayed as follows:

Sample R-78-112-1–520 ppm U_3O_8, 420 ppm Th, 410 ppm Ce

Sample R-78-112-2–125 ppm U_3O_8, 280 ppm Th, 210 ppm Ce

A selected sample of a similar pegmatite to the east gave 460 ppm U_3O_8, 600 ppm Th and 90 ppm Ce (R-78-112-3). The presence of this, and other deposits, in the border zone of the Hurd Lake granite, indicates potential for uranium mineralization along the contact, especially to the immediate west and northwest.

DESCRIPTION

The following is taken from Quinn (1952):

The occurrence consists of thorium and uranium-bearing minerals within a granite pegmatite dike. The dike has a northeast trend and it is intrusive into the Hurd Lake granite about 100 m from its northwest contact with paragneisses and marble of the Grenville Supergroup. The pegmatite is 8 m wide and is exposed for a length of 35 m.

The allanite occurs as dull, black to brownish black bladed crystals. The uranothorite is present as vitreous, greenish black microscopic grains. Other minerals in the pegmatite are quartz, reddish potash feldspar, plagioclase feldspar, magnetite, hematite and microscopic crystals of apatite. Some of the radioactivity is due to potash feldspars and apatite.

Field work in 1978 indicated that the dike does not lie within the Hurd Lake granite mass but intrudes well-layered biotite-hornblende and hornblende-plagioclase gneisses north of the Hurd Lake granite mass. Quinn (1952) describes only one pegmatite, but a number of pegmatites were found in the area, many of which were notably radioactive. (Figure 26).

There appear to be two types of pegmatite in the area. A light pink, almost white variety, is the more important type giving readings in the order of 20 000 to 70 000 cpm (T_1). Minor pink to dark pink dikes, some of which are zoned, give readings in the order of 10 000 to 30 000 cpm (T_1).

At least three important areas of mineralization occur. The most easterly is less than 400 m southwest of Highway 417. It is a light pink rusty-weathered pegmatite occurring as a sill in a sequence of rusty pyritic hornblende-plagioclase gneiss and minor marble. Mineralization is concentrated along fractures or narrow breccia zones in the pegmatite.

A second mineralized area is located approximately 100 m northeast of the main Dempsey dike in a small overgrown pit. Many highly radioactive blocks of broken rock are found on the small dump beside the pit. The mineralization appears to be restricted to narrow zones, 5 to 30 cms wide, in the pegmatite. These zones are characterized by abundant hornblende, sphene, anatase and

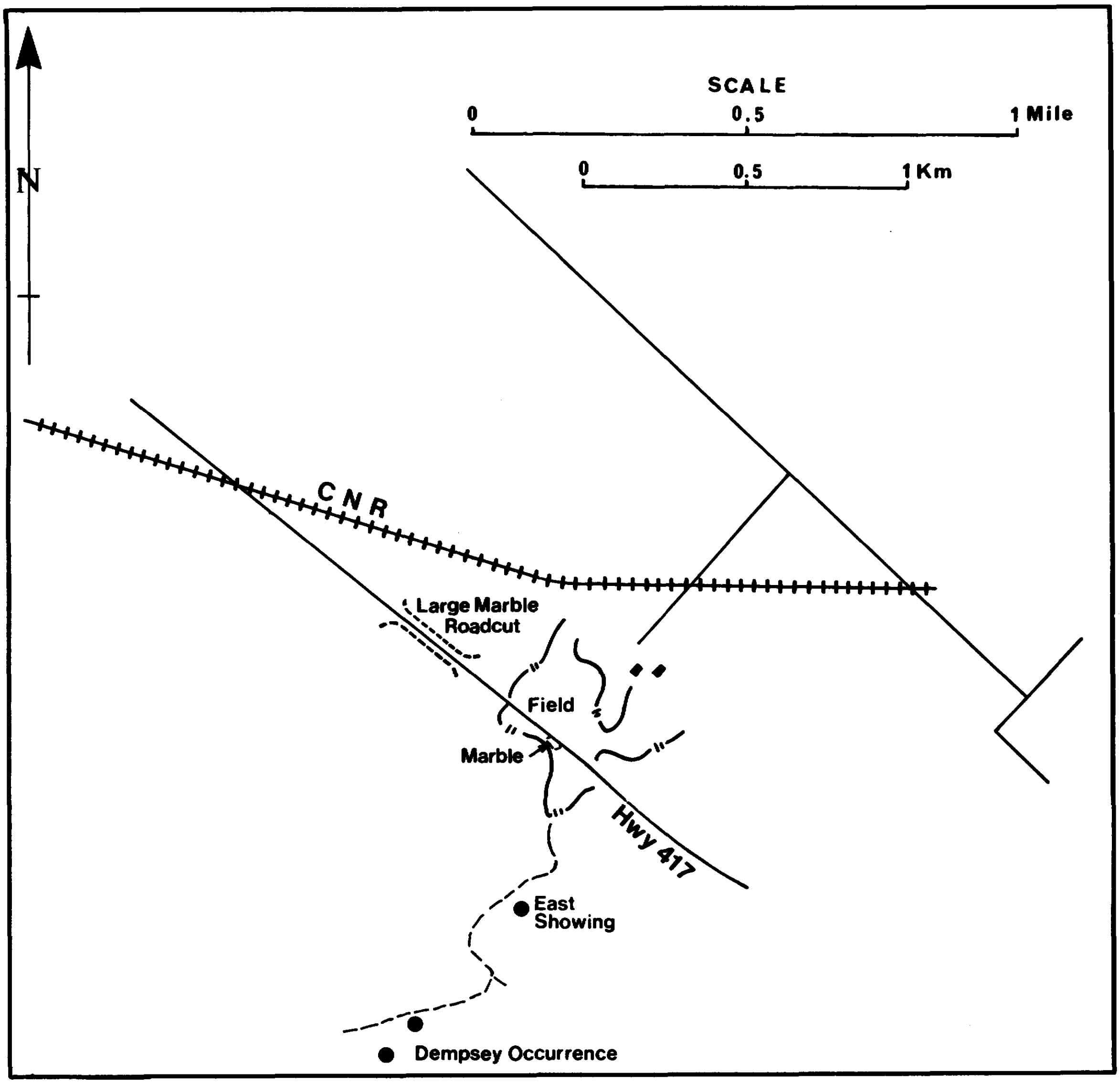


Figure 26 — Location of the Dempsey Occurrence

allanite (5 to 8% mafics). These zones give readings of up to 50 000 cpm (T_1). There are numerous other pits in the same area.

The main Dempsey occurrence contains a number of small pits and trenches, which are partly overgrown. Readings in this area averaged 20 000 to 30 000 cpm (T_1) and as high as 70 000 cpm (T_1). The pegmatite throughout most of the area is foliated.

HISTORY

Circa 1950: Surface work including a shallow pit was done by J. S. Dempsey

REFERENCE

Quinn (1952, p.67)

66. GOSHEN A OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Not identified, probably radioactive zircon

ROCK ASSOCIATION

The host is pink granite pegmatite in country rocks consisting of biotite-hornblende-plagioclase gneiss, hornblende-biotite schist and minor marble.

CLASSIFICATION

Simple pink granite pegmatite

LOCATION
Horton Township, Renfrew County.
Latitude 45°27'00''N; Longitude 76°36'16''W
UTM 503380mN, 374700mE, Zone 18
NTS Renfrew 31F/7.

ACCESS
The occurrence is in a low roadcut on the west side of the highway approximately 5 km southeast of the town of Renfrew on Highway 417 approximately 1.3 km south of a bridge over the C.N.R. tracks.

PRESENT EXPOSURE
Well exposed on fresh surface of rock cut.

SIZE AND GRADE
The radioactivity is confined to a small portion of the pegmatite. A selected sample R77-30-2, from a radioactive "high" spot in the dike assayed 160 ppm U_3O_8 and 647 ppm Th.

DESCRIPTION
General Geology: A sequence of biotite-hornblende gneisses, minor amphibolite and biotite schist which is overlain by marble to the northeast, occupies this area. These rocks belong to the Grenville Supergroup and are of early Late Precambrian age. Intrusive into the paragneisses is the Hurd Lake granite, part of which may be anatectic. The Goshen A occurrence lies approximately 200 m north of the granitic contact and within the amphibolite gneisses. Metamorphic grade in this area is upper amphibolite.

Detailed Geology: The anomalous radioactivity is restricted to a fracture in a granite pegmatite dike 2 to 3 m wide, emplaced in a sequence of interlayered biotite-hornblende-plagioclase gneiss and hornblende-biotite shist. The emplacement of the pegmatite is partially controlled by jointing in the paragneisses with a strike of 175° and dip of 70°E, but this joint pattern is also present in the pegmatite, showing that stresses in the gneiss prior to, or contemporaneous with, the emplacement of pegmatite were still active when the pegmatite consolidated. The joints contain fine epidote, chlorite and hematite.

The dike is an irregular coarse pink granite pegmatite composed mainly of quartz, microcline, plagioclase and hornblende or biotite, depending on the rock type intruded. Abundant hornblende is present in both the border zone and in 20 to 30 cm wide offshoots from the main dike. The assimilation of the country rock is a common feature of pegmatites and where the host rock is biotite-rich, the border zone will be highly contaminated with biotite. A similar process occurs in the case of a hornblende-rich host rock. Apart from abundant hornblende in the border zone, the pegmatite dike shows no zoning. (Figure 27).

Mineralization: A pit 1m x 1m in the pegmatite is located near the contact between biotite schist and biotite-hornblende-plagioclase gneiss. The pegmatite in this location is cut by a fracture 1 cm wide trending N70°W which contains pyrite and chlorite. Where the fracture cuts the pegmatite, the feldspars show marked reddening which extends outward for 10 cm on both sides of the fracture. It is in this area that the highest radioactivity is recorded. Beyond the zone of hematization the feldspars are light pink and radioactivity is not anomalous.

Sample R77-30-2 of radioactive pegmatite is composed of quartz, microcline, biotite, chlorite, zircon and magnetite; it has the chemical composition of albite quartz monzonite with a differentiation index of 96.29. No radioactive minerals, other than possibly zircon, were observed. This sample assayed 160 ppm U_3O_8, 647 ppm Th, and 185 ppm Pb.

A small, 10 cm wide granite pegmatite across the highway is also radioactive and shows reddening of feldspar along a fracture trending N60 - 70°W.

DISCUSSION
The jointing or fracturing at N60 to 70°W has genetic implications for the uranium and thorium mineralization as shown by the hematization of feldspar along the fracture, and anomalous radioactivity which is confined to the immediate area of the fracture. It is suggested that uranium and thorium are not present in sufficient amounts to form minerals, but have been incorporated in the structure of zircons, magnetite and possibly biotite.

Sample R77-30-3 of biotite schist was analyzed to ascertain whether it may have been a carbonaceous shale and possibly enriched in uranium. The analysis indicated that the schist has the composition of a calcic monzonite with < 2 ppm U_3O_8, and 25 ppm Th, and is therefore not a likely source of uranium. The schist has high values for: Ni - 700 ppm; Cr - 2000 ppm; Zn - 165 ppm; Li - 95 ppm and Cu - 65 ppm.

HISTORY
A small pit in the pegmatite is unreported, but appears to be no older than twenty years.

REFERENCE
None

67. GOSHEN B OCCURRENCE

COMMODITY
Uranium and thorium

RADIOACTIVE MINERALS
Not identified, but probably uraniferous magnetite and biotite.

ROCK ASSOCIATION
The host is granite pegmatite in country rocks consisting of grey migmatitic hornblende-plagioclase gneiss with minor quartzo-feldspathic layers.

CLASSIFICATION
Simple pink granite pegmatite

LOCATION
Horton Township, Renfrew County.
Latitude 45°26'55''N; Longitude 76°35'54''W
UTM 5033700mN, 375100mE, Zone 18
NTS Renfrew 31F/7

ACCESS
The occurrence is in a low roadcut on the west side of Highway 417, approximately 5 km southeast of the town of Renfrew, and 1.5 km south of the bridge over the C.N.R. tracks.

PRESENT EXPOSURE
Well exposed on fresh surface of rock cut.

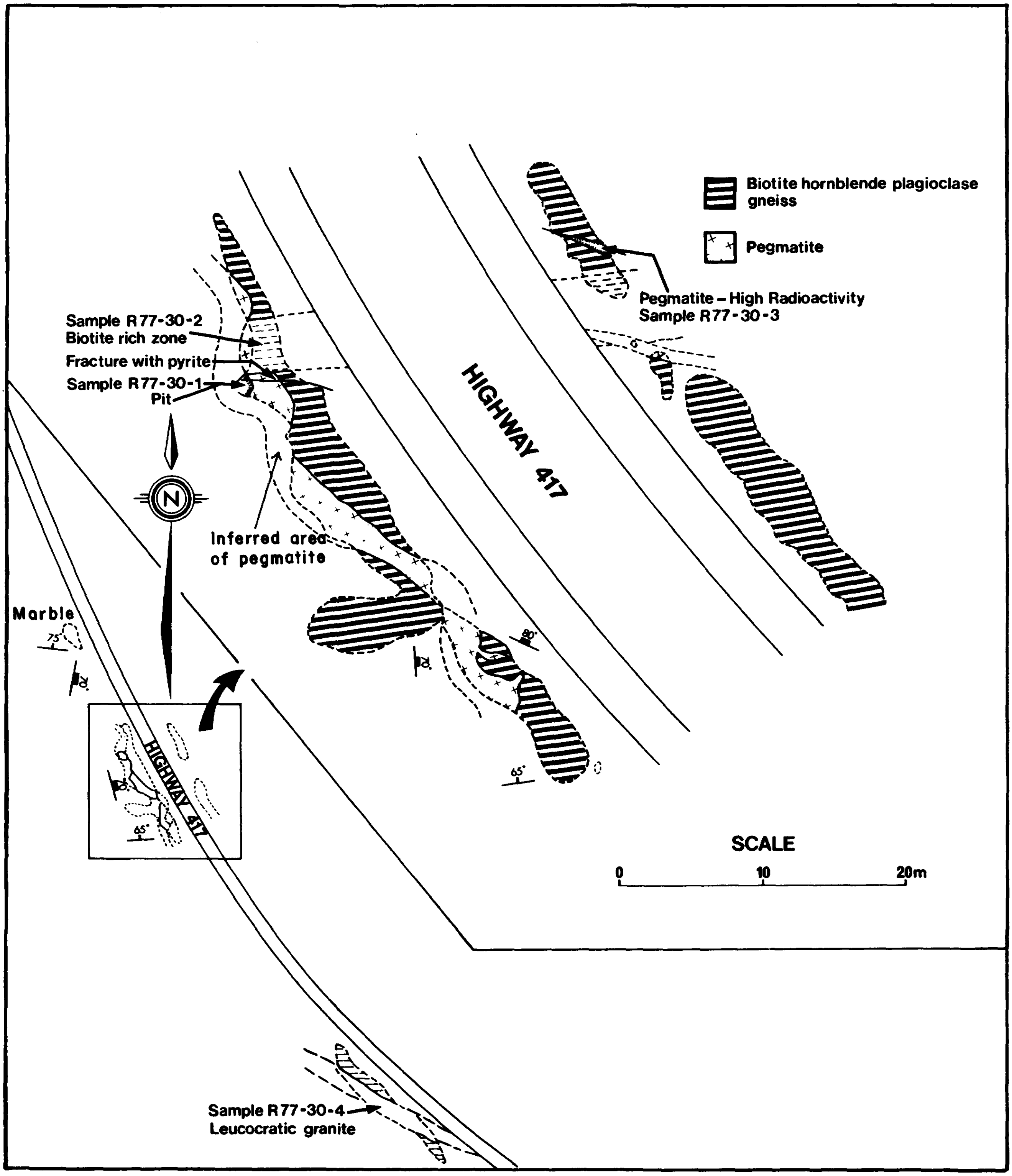


Figure 27 — Geology of the Goshen A Occurrence

SIZE AND GRADE
Radioactivity associated with well-developed jointing and fracturing is widespread but lean. A selected sample assayed 24 ppm U_3O_8 and 426 ppm Th.
DESCRIPTION
General Geology: The occurrence is in a granite pegmatite dike intruding migmatitic gneisses near the north contact of the Hurd Lake granite. Reqional metamorphism is of upper amphibolite grade.
Detailed Geology: Granite pegmatite intrudes grey migmatitic hornblende-plagioclase gneiss with interlayered pink quartzo-feldspathic gneiss which could be either igneous or sedimentary. The migmatites contain 2 to 5 percent magnetite. The pink granite pegmatite contains magnetite especially along the contact with the country rock, and in places tourmaline is present. The pegmatite has a chemical composition of albite quartz monzonite with a differentiation index of 90.52.

The pegmatites are cut by calcite-feldspar veins and display well-developed jointing and fracturing with a strike of N60°W. The calcite veins are characterized by brecciation and what appears to be fenitization. The joints and fractures contain abundant hematite and adjacent potash feldspars display a red staining. This feature is best developed in the pegmatite where the jointing and fracturing are closely spaced. High levels of radioactivity, up to 2500 cpm on the U + Th spectrum, were recorded in the fractured zone, whereas background readings for the pegmatite away from the fracture zone averaged 200 to 300 cpm. Sample R-77-30-8 from the area of closely-spaced jonts assayed 24 ppm U_3O_8 and 426 ppm Th. The calcite-feldspar vein which also followed the jointing, gave high readings on the scintillometer.
Discussion: The Goshen B occurrence is very much like the Goshen A in that the radioactivity is confined to fractures in the pegmatite. Some hydrothermal activity must have been present in the area to give the epidote-chlorite-hematite assemblage in fractures in the case of the Goshen A occurrence, as well as the marked hematitzation of the feldspars in the Goshen B occurrence. Why this occurs only in the granite pegmatite and not the plagioclase gneiss has not been established, but perhaps the potash feldspars of the pegmatite exercise some control over the mineralization associaed with the fracturing. Only two possible uranium-bearing minerals were found to be associated with the anomalous radioactivity, i.e. magnetite and biotite. The assemblage of calcite-feldspar veins with associated fenitization is very much like the description by Withers (1976) of uranium mineralization associated with carbonate veins in the Bancroft area.
HISTORY
The occurrence was discovered by R. Vanderhorst of the Ontario Geological Survey in 1977.
REFERENCES
Withers (1976)

68. CANADIAN BERYLLIUM MINES OCCURRENCE

COMMODITY
Main - Beryl, feldspar and rose quartz
Minor - Uranium, thorium, cerium, niobium, tantalum and rare earths
RADIOACTIVE MINERALS
Euxenite
ROCK ASSOCIATION
The host rock is a granite pegmatite intruding country rocks consisting of interlayered pink hornblende granite gneiss and pink leucrogranite gneiss.
CLASSIFICATION
Zoned and granite pegmatite - beryl type
LOCATION
Lots 30 and 31, Concession XV, Lyndoch Township, Renfrew County.
Latitude 45°19'08''N; Longitude 77°25'30''W
UTM 5021000mN, 309900mE, Zone 18
NTS Brudenell 31F/6
ACCESS
The property can be reached by driving west from Quadeville for 1 ½ miles along the Quadeville-Palmer Rapids Road, turning north at the west end of Eneas (Cameron) Lake, and proceeding 1 ¼ miles by gravel road.
DESCRIPTION
The description of the geology, mineralogy and history is after Hewitt (1954).

The beryl-bearing granite pegmatite is exposed for 600 feet in an east-west direction and has an exposed width of 100 to 150 feet. The walls are not exposed, but based on the trend of zones in the pegmatite, it appears to strike approximately N70°E and to form a flat sheet dipping gently to the south. At the eastern end of the workings, a coarse-grained granite or "micro"-pegmatite with pegmatitc patches is exposed. This may be the footwall country rock of the dike; if so, it appears to be closely associated in age and genesis with the pegmatite, as it is similar mineralogically and contains interstitial anhedral beryl in portions of it.

There are three recognizable zones in the pegmatite: a) an inner zone or core of massive, glassy white, smoky or rose quartz; b) an intermediate zone of pink microcline-perthite feldspar with some quartz; and c) and outer zone of albite and microcline-perthite, with quartz. At the western end of the property the pegmatite is very coarsely crystalline. One area of massive, white to rose quartz measures 75 by 30 feet. Before mining began, a single crystal of pink microcline-perthite measuring about 20 feet x 8 feet x 6 feet containing perhaps 80 tons of feldspar, was noted. In the outer zone there is some graphic intergrowth of feldspar and quartz. In the west workings, quartz and feldspar are the main constituents, and impurities are rare. A little sericite, kaolin, columbite and magnetite were observed.

In the central workings, the quartz, albite, and microcline-perthite do not show such coarse crystallization. Some graphic granite occurs on the south side. Euxenite and magnetite are common.

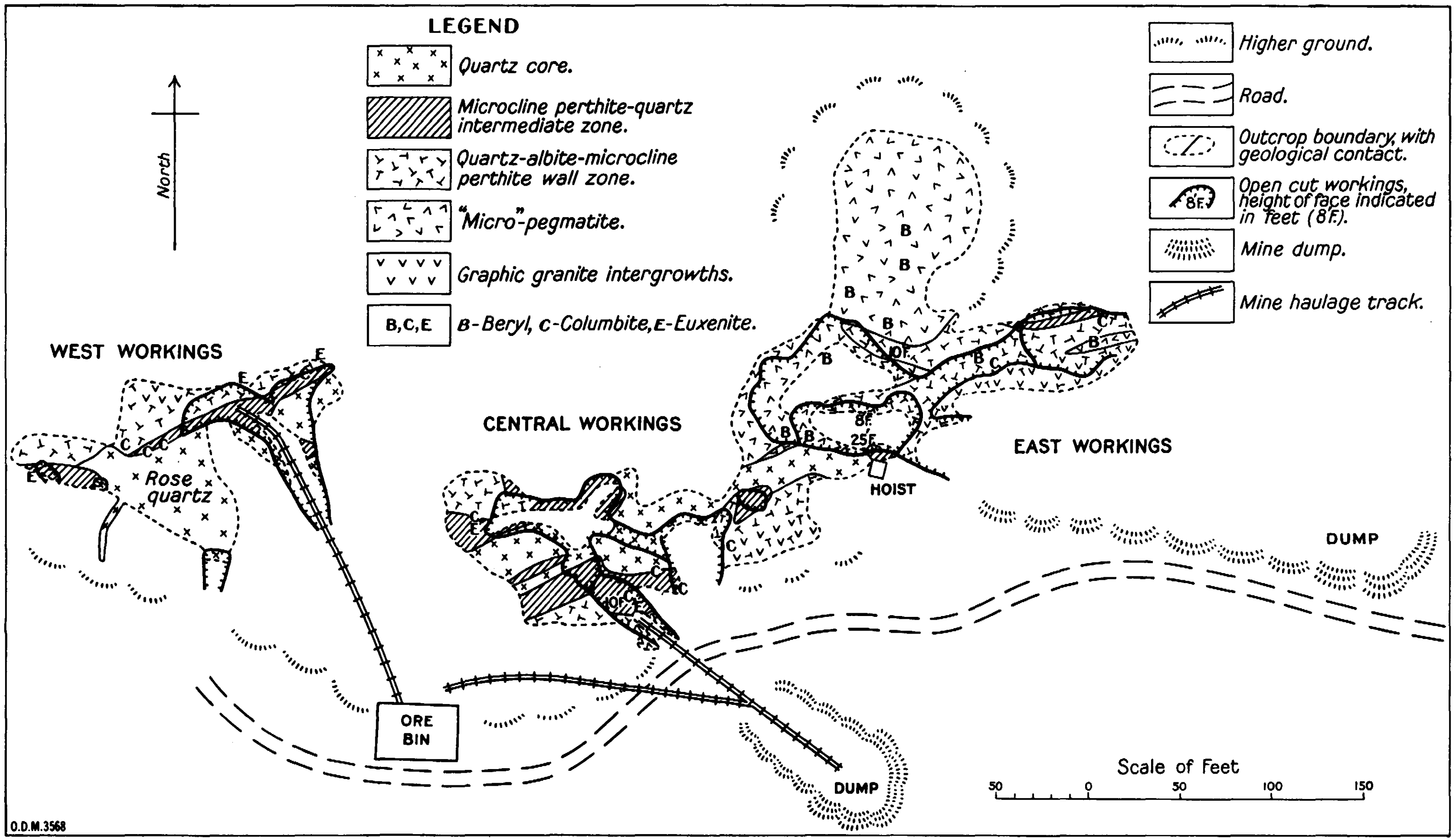


Figure 28 — Geological map of beryl pegmatite, lot 30, Con. XV, Lyndoch Township (from Hewitt 1954, p.43).

In the east workings, beryl crystals are exposed in the feldspar. One beryl crystal from this pit was reported to have measured 8 feet in length with a diameter of 18 inches. Radiating plates of columbite-tantalite occur in pink microcline-perthite adjacent to a zone of graphic granite pegmatite, which forms the outer or hanging-wall zone in this section. On the north side of the east workings, graphic granite and "micro"-pegmatite consisting of quartz, albite, and microcline in ½- to 2-inch crystals are exposed. Hornblende and magnetite are common in the east workings. (Figure 28)

Mineralogy: The following minerals were found in this pegmatite: white and pink albite; pink microcline-perthite; rose, smoky, and white quartz; hornblende; biotite; muscovite; magnetite; columbite-tantalite; euxenite; beryl; fluorite; cyrtolite; molybdenite; specularite; pyrite; and calcite.

Occurrences of beryl, in place, are confined to the east workings. The beryl is opaque and asparagus-green; some crystals up to 8 inches in diameter were seen, but most now exposed are about 2 inches in diameter. Beryl occurring in the "micro"-pegmatite is anhedral and apparently interstitial to quartz and feldspar.

Plates of columbite up to 3 inches in diameter and ¼ inch in width occur in radiating clusters in pink microcline-perthite, sometimes with magnetite.

Dark-brown to black euxenite with a waxy resinous lustre occurs with magnetite in pink microcline-perthite.

Fluorite is often associated with euxenite and bladed columbite.

HISTORY

In 1935 and 1936, Renfrew Minerals Limited developed the east and central workings on the pegmatite dike, producing 675 tons of feldspar. The east workings are 200 feet long and 75 feet wide. The main pit has a face of 25 feet. The central workings extend 130 feet by 80 feet.

In 1948 and 1949, Canadian Beryllium Mines and Alloys Limited opened the west workings, a T-shaped cut 75 x 80 x 8 feet deep, and produced approximately 300 tons of feldspar, which was stockpiled on the property. In 1950, 57 100 pounds of beryl concentrate ($7,882) were sold from the stockpile.

SELECTED REFERENCES

Ellsworth (1932, p.264)
Hewitt (1954, p.42-46)

69. JAMIESON MINE

COMMODITY

Main - Molybdenum and lead
Minor - Uranium, thorium, zinc and copper

RADIOACTIVE MINERALS

Uraninite

ROCK ASSOCIATION

The host is metapyroxenite biotite marble and calcite vein.

CLASSIFICATION

Carbonate vein

LOCATION

This property is on Mining Mountain approximately 10 km northwest of Griffith, a small community on Highway 41, in Lots 5 and 6, Concession VIII, Lyndoch Township, Renfrew County.
Latitude 45°17′45″N; Longitude 77°16′24″W
UTM 5018150mN, 321750mE, Zone 18
NTS Brudenell 31F/6

ACCESS

Approximately 7.7 km northwest from Griffith on a gravelled country road, on the east side of the Madawaska River; a dirt road leads north over the second crossing of the Highland Creek, approximately 4.4 km to a point where the road forks. From here, the left fork leads over the crossing of the Highland Creek to a farm, a distance of about 2.5 km. From the farm, a bush track, 0.8 km long, leads up the west side of Mining Mountain and terminates against an outcrop. The occurrence lies 100 m to the west of the outcrop.

PRESENT EXPOSURE

Outcrop is generally good, but the workings are highly weathered and most of the pit is flooded. The principal rock types can be identified, but it is not possible to obtain a sample of fresh rock.

SIZE AND GRADE

Only a small part of the exposed workings, which are largely flooded, shows anomalous radioactivity in a calcite pyroxenite vein containing pyrrhotite. It was not possible to obtain a fresh sample of this material. A few anomalous "hot spots" on the highly weathered waste dumps were sampled. Sample R77-88-1 (pyroxenite vein?) assayed 3700 ppm and 820 Th. Sample R77-80-4 of biotite marble assayed 3000 ppm U_3O_8 and 430 ppm Th.

DESCRIPTION

General Geology: The occurrence has been emplaced in a sequence of interbedded meta-arkose and biotite marble of the Grenville Supergroup. The grade of metamorphism is upper amphibolite and the arkose is now a quartzo-feldspathic granitic gneiss. These rocks strike approximately N50°E and dip flatly east. Intruding these rocks is a calcite-mica-pyroxenite pegmatitic dike which hosts uranium mineralization.

Detailed Geology: Deep weathering of the outcrops and waste dump material, as well as flooding of the pit have obscured details of the geology in the immediate area of the workings. The following is a description of the deposit by Hewitt (1954, p.75).

> The molybdenite occurs in a calcite-mica-pyroxenite-pegmatite, which strikes roughly N50°E and appears to dip steeply east, cutting the flatly dipping country rock gneisses. The central part of the "vein dike" consists of coarse-grained, pink to salmon calcite. A 5 to 6 foot width of this pink calcite is exposed in the southeast wall of the main cut (south end). Bordering this massive calcite is the mica pyroxenite, carrying pyrite, pyrrhotite and molybdenite. Flakes of molybdenite up to 2 inches in size were noted erratically distributed in massive pyrrhotite and pyrite. Apatite, galena, sphalerite and chalcopyrite occur on the dump.

Eardley-Wilmot (1925) also describes the property as follows:

> The country rocks are various kinds of gneisses, interbedded with crystalline limestone. The gneisses are in many places cut by intrusive granites and pegmatites; the molybdenite deposits occur near the contact with the limestones. The ore body, which has been exposed for a length of 220 feet along its strike

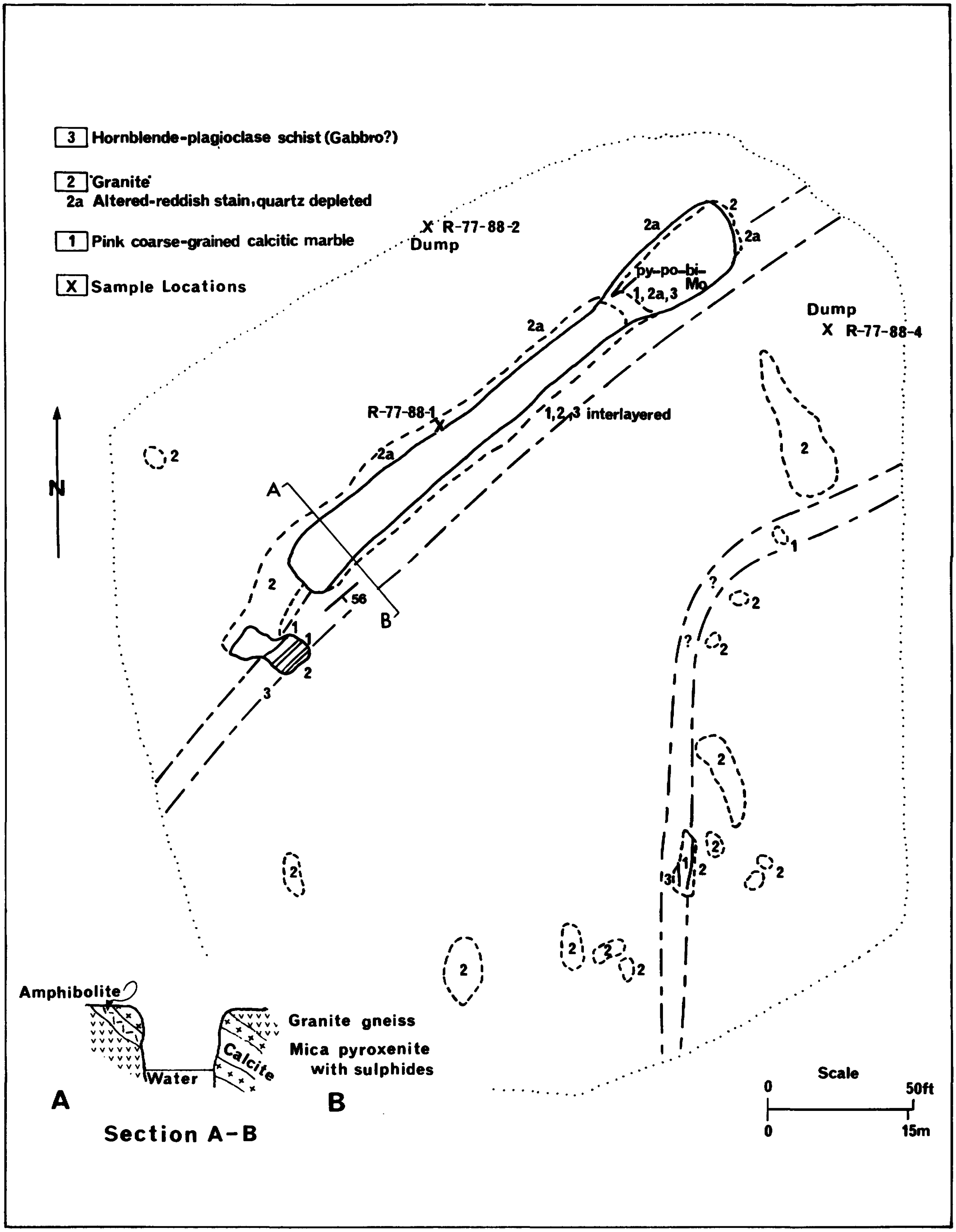


Figure 29—Geology of the Jamieson Molybdenum Mine. Geology by T. Carter, 1977. Cross-section from Hewitt, 1954, p.75.

length, consists of pyroxene and pegmatite outcrops on a ridge of gneiss. Molybdenite in large flakes is intimately associated with pyrite and pyrrhotite of which there is considerable quantity. The three minerals rarely occur in the gneiss or limestone, but are found on the contacts of these rocks or distributed throughout the pegmatite dikes.

Uranium Mineralization: Generally, radioactivity within the mine workings does not show levels much above background, but one small area along the northwest wall of the pit is anomalously radioactive. The high radioactivity at this location occurs in a calcite-pyroxenite vein containing pyrrhotite and much molybdenite in flakes up to 3 cm across. No radioactive minerals were seen. The vein intrudes the silica-deficient granitic gneisses along the northeast wall of the pit.

A few "hot spots" were located on the waste dump northeast of the pit. Most of the radioactive material was weathered to a yellow clay-like product with abundant molybdenite. It is probably altered pyroxenite and vein material. A sample of the highly radioactive material (R77-88-1) assayed 3700 ppm U_3O_8 and 890 ppm Th. The mineral was identified by X-ray powder camera as uraninite.

Two pieces of biotite marble from the waste dump southeast of the pit were found to be anomalously radioactive. Biotite-rich (20 to 30%) parts of the marble are highly radioactive whereas the marble with low biotite content have a low level of radioactivity. Sample R77-88-4 of the biotite-rich marble assayed 3000 ppm U_3O_8 and 430 ppm Th. The radioactive mineral was identified by X-ray powder camera as uraninite.

Mineralogy: Sulphide mineralogy is mainly molybdenite pyrrhotite and pyrite with minor galena and traces of sphalerite and chalcopyrite. Satterly (1945, p.86) described the paragenesis of minerals in vugs in skarn rock:

> In the vugs, the following order of mineral deposition was noted:
> (1) sphalerite in bands to half an inch thick.
> (2) pyrite as a film;
> (3) galena, not always present
> (4) quartz in little, stumpy translucent crystals;
> (5) calcite as rounded semi transparent crystals;
> (6) chalcopyrite in minute crystals in calcite. This mineral may have come from a galena vein in the north pit noted by Eardley-Wilmot (1925).

A radioactive mineral, identified as uraninite, is found both in skarn and biotite-rich marble. Apatite, in calcite vein material is reported by Satterly (1945).

Discussion: The uranium content of the marbles may well be syngenetic since the marbles do not show metasomatic alteration which could be expected if the uranium were introduced. Alternatively, the uranium may have been introduced with the molybdenite and other sulphide minerals during emplacement of the vein and formation of skarn mineralogy. Age determinations on the galena and uraninite would assist in determining the genesis of both uranium and molybdenum in this deposit.

HISTORY

Development: Work was first done on the property in 1907, by R.A. Jamieson of Renfrew and in 1915 to 1916 it was worked under lease by the International Molybdenum Company Limited. "The main workings, located in a clearing on the hilltop, is an open cut 215 feet long and 12-20 feet wide, trending N50°E. The north end of the cut is water filled. It is 20 feet to water level. This water portion of the cut is 60 feet long. The centre is also water filled, and 15 feet of wall is exposed above water level ... an inclined shaft, 65 feet deep, exists here. A second pit, measuring 20 by 5 feet deep, is located 30 feet south of the main cut." (Hewitt 1954, p.74). A second shaft probably located at the north end of the cut, was reportedly sunk in 1928, on a galena vein.

Production: During the latter part of 1915 about 80 tons of hand-cobbed ore was sent direct to Orillia. The greatest part of this was cobbed to 20 or 30 percent MoS_2, and 1 ½ tons was pure flake. In 1916 recorded shipments to Renfrew and Orillia amounted to 73 tons of 3 percent ore, and 12.5 tons of hand-cobbed ore assaying 18 % MoS_2. It is stated that in all, 285 tons of ore containing approximately 12,760 pounds of pure molybdenite was taken from this mine..." (Eardley-Wilmot, 1925, p. 105).

SELECTED REFERENCES

Eardley-Wilmot (1925, p.103-105)
Hewitt (1954, p.74-76)
Satterly (1945, p. 86)

70. PRICE OCCURRENCE

COMMODITY

Major - Beryl and feldspar
Minor - Uranium, thorium, niobium, cerium and rare earths

RADIOACTIVE MINERALS

Euxenite (lyndochite), niobium, cerium and cyrtolite, allanite and anatase.

ROCK ASSOCIATION

The host is a zoned granite pegmatite in country rock consisting of granitic gneisses.

CLASSIFICATION

Zoned granitic pegmatite - beryl type

LOCATION

On the south side of Casey Hill, in Lot 23, Concession XV, Lyndoch Township, Renfrew County.
Latitude 45°19'54"N; Longitude 77°23'27"W
UTM 5022050mN, 312650mNE, Zone 18
NTS Brudenell 31F/6

ACCESS

The property can be reached by road from Quadeville, 1.4 miles north on the Letterkenny Road to the entrance of the mine property. The mine is ¼ mile east of the Letterkenny Road.

PRESENT EXPOSURE

Fair to poor

DESCRIPTION

Geology: The following is after Hewitt (1954).
The country rock is interbanded pink hornblende granite gneiss and pink leucogranite gneiss. These gneisses strike N30°E to N70°E, and dip 20 to 60° SE. Interbanded with these gneisses are flat-lying lenses of pink allanite-titanite granite pegmatite. These granite pegmatite stringers appear to be cut by the beryl-bearing granite peg-

matite. Some layers of biotite schist occur in the granite gneiss.

The beryl-bearing granite pegmatite dike strikes N59°E and appears to dip vertically. The dike is irregular in shape, varying from 4 to 34 feet in width. The dike is constricted at the centre and is divided into two pods that are quite different in structure and texture. (Figure 30) The western pod shows pronounced zoning and coarse crystallization; the eastern pod is largely undifferentiated and relatively fine-grained, with average grain size from 1/2 to 1 inch. The primary zones present in the western pod are: a) a central core of quartz; b) an intermediate zone of microcline-perthite; and c) a wall zone of medium to coarse-grained albite-quartz-microcline-perthite. Replacing these zones and cutting them irregularly is a later age of quartz-cleavelandite-tourmaline.

The quartz core is 80 feet long and has a maximum width of 5 feet; it is composed of massive, milky to smoky, quartz. The microcline-perthite zone consists of massive coarsely-crystallized, 1- to 3-foot crystals of pink microcline-perthite and is 60 feet long. This zone envelops the quartz core. In someplaces along the contact between the quartz and microcline-perthite zones, there is a narrow 1-inch band of 1/4- to 1/2-inch tourmaline crystals in the border of the quartz zone. Stringers of quartz cut this band and penetrate the microcline-perthite zone, apparently indicating a later age for some of the quartz. The wall zone, which is most prominent in the western end of the dike, is medium-grained and is composed predominantly of quartz, pink albite, and microcline-perthite. Beryl, biotite, muscovite, magnetite, allanite, and euxenite also occur in this zone. Cutting across and replacing all three of these primary zones, is a secondary zone of quartz-tourmaline-cleavelandite. The cleavelandite and

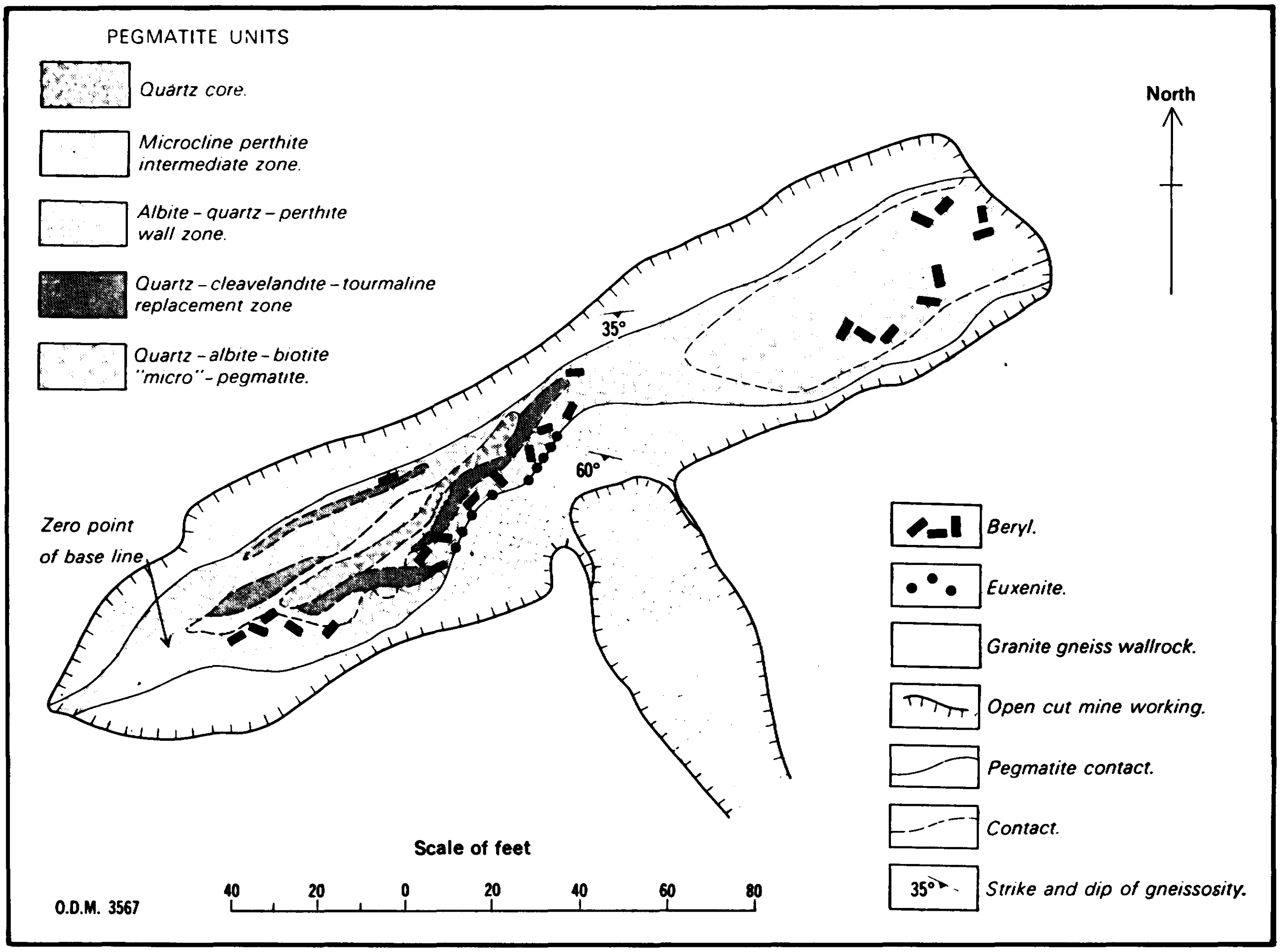


Figure 30 — Geological map of beryl pegmatite, lot 23, Concession XV, Lyndoch Twp. (From Hewitt 1954, p.38)

tourmaline occur in platy rosettes in the quartz and are up to 6 inches in diameter.

The east end of the dike is composed of only two zones. A wall zone, varying in width from 1 to 4 feet, composed of 1- to 6-inch crystals of pink albite, quartz, and microcline-perthite, with some biotite and magnetite, is usually present. The greater part of the dike is made up of a "fine-grained" or "micro"-pegmatite of 1-inch grain size, which has not differentiated into zones. Mineralogically it is composed predominantly of pink albite; microcline, quartz, biotite, beryl, muscovite, and magnetite.

Mineralogy: Euhedral, blue-green beryl crystals occur throughout the dike but are especially common adjacent to the intermediate zone of microcline-perthite. This band of beryl-rich albite-quartz rock has a length of 100 feet and a maximum width of about 10 feet. Beryl also occurs in the "micro"-pegmatite in anhedral grains interstitial to the quartz and feldspar. This mode of occurrence lends support to the view that the east end of the dike cooled rapidly without allowing time for growth of good euhedral crystals.

Ellsworth (1932) gives a detailed discussion of the mineralogy.

Lyndochite, containing inclusions of columbite and intergrown with magnetite, forms a narrow border zone on the south side of the dike. Columbite occurs as thin, flat, disk-shaped masses on cleavages or partings of feldspar. A monazite crystal was found embedded in red microcline. Cyrtolite and columbian anatase have also been identified. Allanite occurs in vitreous, black, platy crystals with lyndochite in the border zone and in the north wall of the dike. Magnetite is a common accessory mineral in the dike and often occurs with euxenite. Massive purple fluorite and green glassy apatite occur with biotite and albite in the north wall of the dike at the east end. Occasional garnet crystals have been noted in feldspar.

HISTORY

In 1898, the granite pegmatite dike was first reported by Willet G. Miller as an occurrence of beryl and columbite.

In 1926, the dike was opened up over a length of 100 feet, a width of 5 to 10 feet, and a depth of 3 to 6 feet. It is estimated that from 2 to 4 tons of beryl crystals were obtained.

In 1939, Canadian Beryllium Mines and Alloys Limited reopened the property for beryl, and the main development took place. The dike was opened for a length of 245 feet along strike by a single open cut. Along the north face of the cut, the depth to the bottom of the pit is 20 to 25 feet; along the south face, the depth is 6 to 15 feet. The width of the cut from rim to rim averages 45 to 50 feet.

SELECTED REFERENCES

Ellsworth (1932, p.228-229)
Hewitt (1954, p.36-46)
Miller (1898)
Rose (1959)

71. UNIVERSAL LIGHT METALS OCCURRENCE

COMMODITY

Uranium, thorium, cerium and rare earths

RADIOACTIVE MINERALS

Allanite

ROCK ASSOCIATION

The host is pink granite pegmatite in country rock consisting of pink biotite-hornblende granitic gneisses.

CLASSIFICATION

Simple pink granite pegmatite.

LOCATION

The occurrence is on the crest of a hill off the Quadeville-Letterkenny Road approximately 1½ miles northwest of Quadeville in Lot 25, Concession XV, Lyndoch Township, Renfrew County.

Latitude 45°19′53″N; Longitude 77°23′47″W
UTM 5022400mN, 312200mE, Zone 18
NTS Brudenell 31F/6.

ACCESS

At a point 2.8 km north of Quadeville along the Quadeville-Letterkenny Road, a bush road heads northeast 0.4 km to the occurrence.

SIZE AND GRADE

The main trench was reported by Hewitt (1954) to contain a zone of pegmatite with a maximum thickness of 4 feet and length of 12 feet, with 10 to 15 percent allanite. An impure sample of allanite (R-77-63-2) obtained from the main trench assayed 0.09% U_3O_8 and 0.42% Th.

DESCRIPTION

General Geology: The occurrence lies in rocks of the Grenville Supergroup of early Late Precambrian age. The area consists of meta-arkoses, quartzo-feldspathic metasandstones and metasiltstones, marbles, amphibolites, and calc-silicate-rich units. These rocks have been intensely metamorphosed to upper almandine amphibolite facies; some of the meta-arkoses and quartzo-feldspathic sediments resemble granite gneiss. The general geology of the property is well described on D. F. Hewitt's map of the Brudenell-Raglan Area, ODM Map 1953-2.

Detailed Geology: The following description is taken from Hewitt (1954, p.83):

> The Universal Light Metals occurrence is located within pink granite pegmatite cutting pink granite, and hornblende granite gneiss. Allanite, zircon, and titanite are common accessories in the pegmatites and granite. The occurrence has been examined by a series of pits, a description of the two main ones is as follows:
>
> At pit B, which measures 10 by 10 by 1 foot deep, allanite occurs in a pink feldspar and quartz with about 5 per cent of small crystals of allanite with red rims and shatter patterns around them. Magnetite and garnet are also present.
>
> In the main pit there is an allanite-rich zone exposed in the south wall of the cut. The zone has an exposed length of 12 feet and a maximum thickness of about 4 feet. The zone is irregular and passes into allanite-poor granite gneiss at either end. Lath-shaped allanite crystals, up to 1 inch in length, make up 10 to 15 percent of the rock. No beryl, columbite or monazite were observed on the property.

The radioactive mineral, allanite, occurs as vitreous black, bladed crystals, associated with sphene, horn-

TABLE 12 | ANALYSES OF SAMPLES OF LYNDOCHITE AND COLUMBITE FROM THE PRICE OCCURRENCE (FROM HEWITT 1954, p.42)

	Sample No. 1	Sample No. 2	Sample No. 3
	Percent	Percent	Percent
SiO_2	0.07		1.28
TiO_2	16.39		5.19
BeO			
Al_2O_3	0.13		
Fe_2O_3	1.32		
FeO	0.77	11.14	10.90
CuO		0.03	
CaO	4.86		0.15
MgO	0.13		
MnO	0.59	10.22	10.24
ZrO_2	0.04		
SnO_2	0.12	0.92	0.56
Cb_2O_5	41.43		55.79
Ta_2O_5	3.94	75.75	15.21
PbO	0.37		
UO_2	0.67		
UO_3	0.04		
ThO_2	4.95		
$(Ce, La, Di)_2O_3$	4.34		
$(Yt, Er)_2O_3$	18.22		
Rare earths		2.00	9.82
H_2O (-110°)	0.06		
H_2O $(+110^{\circ})$	1.90		
Ignition loss	(1.76)		
Total	100.24	100.06	100.14
Specific gravity	4.909		5.431

Sample No. 1 - Lyndochite, lot 23, concession XV, Lyndoch township. Analyst, H.V. Ellsworth; analysis No. XXVIII.

Sample No. 2 - Columbite, lot 23, concession XV, Lyndoch township. H.V. Ellsworth, Analyst, W.L. Goodwin, analysis XII.

Sample No. 3 - Columbite, lot 23, concession XV, Lyndoch township. H.V. Ellsworth, analysis No. XIII. Analyst, E.W. Todd. Specific gravity, T.L. Walker and A.L. Parsons.

blende and irregular hematite-stained fractures. The fractures strike N50°E and 22°SE, subparallel to the regional foliation. Most of the pegmatite contains negligible mafics whereas abundant mafics occur in mineralized zones and thin sills in the granite gneiss. The mafic-rich zones are vein-like with indistinct irregular boundaries (Figure 31).

The pegmatite, like the gneiss, has a prominent foliation though it is less pronounced and dips shallowly to the southeast. The unmineralized pegmatite is pink, usually unfractured, and contains fine- to coarse-grained phases with patches of large feldspar phenocrysts, 10-15 cm long. Background radiation on the majority of pegmatite is 200 cpm (T_2) and 30 cpm (T_3). Samples taken from the mineralized zones gave readings of 850 cpm (T_2) and 125 cpm (T_3) from a TV-1A.

The main radioactive mineral is allanite although sphene and zircon may contain some radioactive elements. In thin section the allanite is often completely metamict.

HISTORY

Circa 1943, Universal Light Metals Company opened a series of pits and trenches. Further stripping and pitting operations were carried out around 1952 by the same company.

SELECTED REFERENCES

Ferguson (1971, p.14)
Hewitt (1954, p. 84-85)

72. O'BRIEN-FOWLER OCCURRENCE

COMMODITY

Main - feldspar
Minor - uranium and thorium

RADIOACTIVE MINERALS

Uraninite

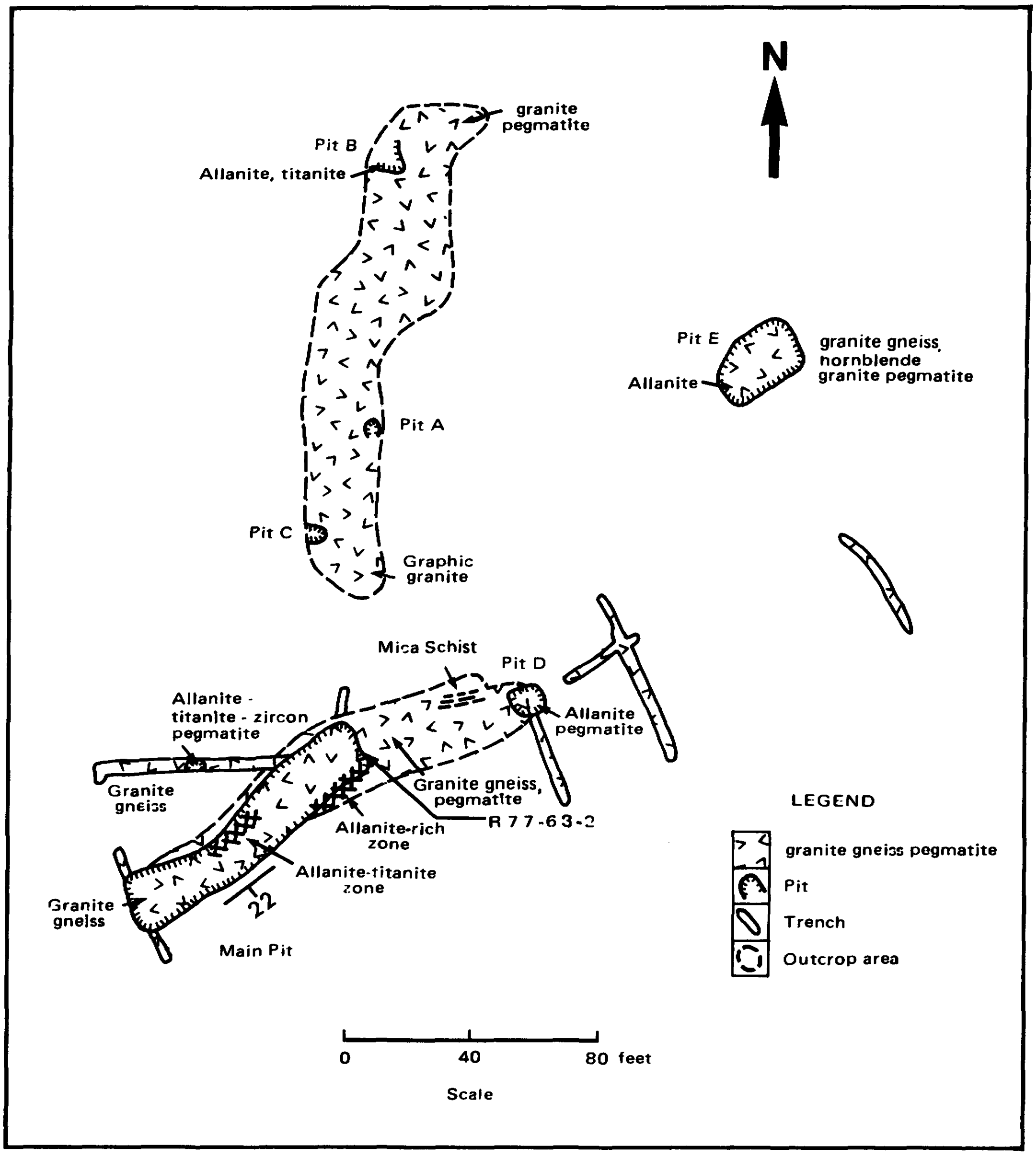


Figure 31 — Geology of the Universal Light Metals Occurrence. (from Hewitt 1954, p. 84)

ROCK ASSOCIATION
The host is a zoned granite pegmatite in country rock consisting of pyroxenite gneiss.
CLASSIFICATION
Zoned granite pegmatite - feldspar type
LOCATION
Lot 6, Concession II, March Township, Carleton County.
Latitude 45°19'25''N; Longitude 75°55'34''W
UTM 5019050mN, 427400mE, Zone 18
NTS Ottawa 31G/5
ACCESS
In the centre of the town of Kanata, which lies about 20 km southwest of Ottawa, a paved road leads southwest from Highway 7 and intersects a gravel road after 2.5 km. The occurrence lies 300 m east of the intersection, and 200 m north of the paved road.
PRESENT EXPOSURE
Very good
SIZE AND GRADE
Uranium occurs sparsely

DESCRIPTION
The following description of the occurrence is taken from Ellsworth (1932):

The dike strikes about north, and cuts highly deformed pyroxenic gneiss. It is about 30 feet wide and has been opened up for a length of 120 feet. It consists of coarsely crystallized, deep pink microcline and quartz with considerable black mica, black tourmaline, and magnetite in places, and small amounts of calcite and fluorite. The uraninite occurred very sparingly as nodules not exceeding one-half inch in diameter in the crystal microcline which was mined for spar. It was not sharply crystallized. The colour was pitch black, the fracture conchoidal, showing that it had undergone the initial stage of alteration.

About 100 feet or so south of the main opening just described there is a smaller pit where a complex radioactive mineral occurs. Black tourmaline is abundant here and the radioactive mineral is in some cases found in the very middle of the tourmaline.

TABLE 13 | ANALYSES OF A SAMPLE OF URANINITE FROM THE O'BRIEN-FOWLER OCCURRENCE (FROM ELLSWORTH 1932, p.268)

PbO	11.61
UO_2	49.44
UO_3	24.28
U_3O_8	
ThO_2	4.92
$(Ce, La, Di)_2O_3$	2.10
$(Yt, Er)_2O_3$	2.30
Fe_2O_3	0.37
MnO	0.02
TiO_2	
BeO	0.05
Al_2O_3	
CaO	1.56
MgO	0.11
SiO_2	0.64
Na_2O	
K_2O	
H_2O	
H_2O (-110°)	0.22
H_2O (+110°)	1.33
He	
Insol	0.16
CO_2	
SO_8	
P_2O_5	
Ignition loss	
	99.11
Sp. gr	8.674

HISTORY
A summary of the history of development is taken from Spence (1932, p.86):

Mining operations were conducted on this property between 1919 and 1921 by Messrs. O'Brien and Fowler, of Ottawa. A small plant was installed . . . and a pit 130 by 30 by 30 feet deep was opened on a 50-foot dike of pink spar containing considerable free quartz and zones of graphic granite.

About 3500 tons of spar is reported to have been shipped from the property. The mine has been idle since 1921.

SELECETED REFERENCES
Ellsworth (1932, p. 203-209)
Spence (1932, p.36)

73. SOUTH MARCH OCCURRENCE

COMMODITY
Uranium and copper
RADIOACTIVE MINERALS
Uranian hydrocarbon
ROCK ASSOCIATION
The host rock for the uranium-copper mineralization is a set of two intraformational conglomeratic units. The country rocks are interbedded sandstone and sandy dolomite of the Paleozoic South March Formation.
CLASSIFICATION
Sandstone - dolomite
LOCATION
S½ lot 12, Concession II, March Township, Carleton County.
Latitude 45°20'56"N; Longitude 75°57'10"W
UTM 5021950mN; 425250mE, Zone 18
NTS Ottawa 31G/5
ACCESS
The occurrence straddles the Old Carp Road approximately 1.7 km southwest of the intersection with Highway 17 which is 0.4 km northwest of the village of South March.
PRESENT EXPOSURE
Generally poor, since outcrops are obscured by soil cover.
SIZE AND GRADE
The anomalous zone covers an area of 100 000 square feet. Laboratory analysis of a composite sample of outcrop material gave values of 175 ppm eU (0.02% U_3O_8) and 3.5 ppm Th indicating a uranium to thorium ratio of 50:1. (Grasty *et al.* 1973)
DESCRIPTION
Geology: The zone of uranium-copper mineralization which is some 2 000 feet long, strikes slightly east of north perpendicular to the regional strike. The anomaly occurs in alternating grey sandstone and blue-grey dolomite of the Ordovician March Formation. These intraformational calcirudite units reflect a much higher porosity than that of the remainder of the March Formation which as a whole is more permeable than the overlying Ordovician Oxford dolomite and underlying Nepean sandstone of Ordovician and Cambrian age.

Drill core samples include 6 to 12 inches of sandy dolomites containing up to 4 percent chalcopyrite (visual estimate) and 0.05% U_3O_8 (calculated from field reading) in the form of an unidentified uranium hydrocarbon. The average concentrations are much lower than this and could not be estimated without further drilling.

According to Grasty *et al.* (1973):

The Cu - U mineralization is emplaced in sandy lenses within the dolomite. The age of the mineralization has not yet been established. The mineralization may have been emplaced by fluids during or shortly after diagenesis or at a much later date.

Discussion: Jonasson and Dyck (1974) carried out studies of geochemical dispersion in this area. They used differing trace element haloes to infer that uranium occuring in deposits such as the South March was probably not derived from the nearby granite pegmatites. This may be only partially true. The porous sandy lenses of the March Formation could have provided a plumbing system sufficiently long-lived that even waters with low uranium concentrations could have formed the occurrence over time. Pegmatites, which lie within the granitic terrain and often contain uranium values of 10 to 400 times that of the country rocks, would have provided an important though partial, source for uranium. Non-correlation of other trace elements, and especially the "unexpected" high zinc values, should not be surprising since different elements are contributed by different lithologies, including marbles which host lead-zinc deposits.
HISTORY
The occurrence was discovered in October, 1972 during a series of test flights of gamma-ray spectrometry surveys carried out by the Geological Survey of Canada. Ground follow-up surveys outlined an anomaly 2000 feet long by 500 feet wide, trending northerly. The radioactivity averaged 10 to 50 times background. During 1973, the Geological Survey of Canada carried out soil and hydrogeochemical surveys outlining a four square mile radon in stream water anomaly plus lesser anomalous zones. Analyses of some uranium-bearing materials in ppm were: U - 60; Zn - 6; Cu - 1500; Ni - 21; Mo - 100; Pb - 30; Se - 0.1.

During 1974 and 1975, Kerr Addison Mines Limited, optioned property in the area and did some exploratory work.
SELECTED REFERENCES
Charbonneau, Jonasson, and Ford (1975, p.229-233)
Ford (1975)
Grasty *et al.* (1973, p. 286-289)
Jonasson and Dyck (1974, p. 61-63)

74. BARNET OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uraninite and possibly allanite and uranothorite
ROCK ASSOCIATION
The host is pink and white granite pegmatite in country rock consisting of marble, amphibolite and calc-silicate gneisses, with minor biotite paragneiss and meta-arkose.
CLASSIFICATION
Simple granite pegmatites

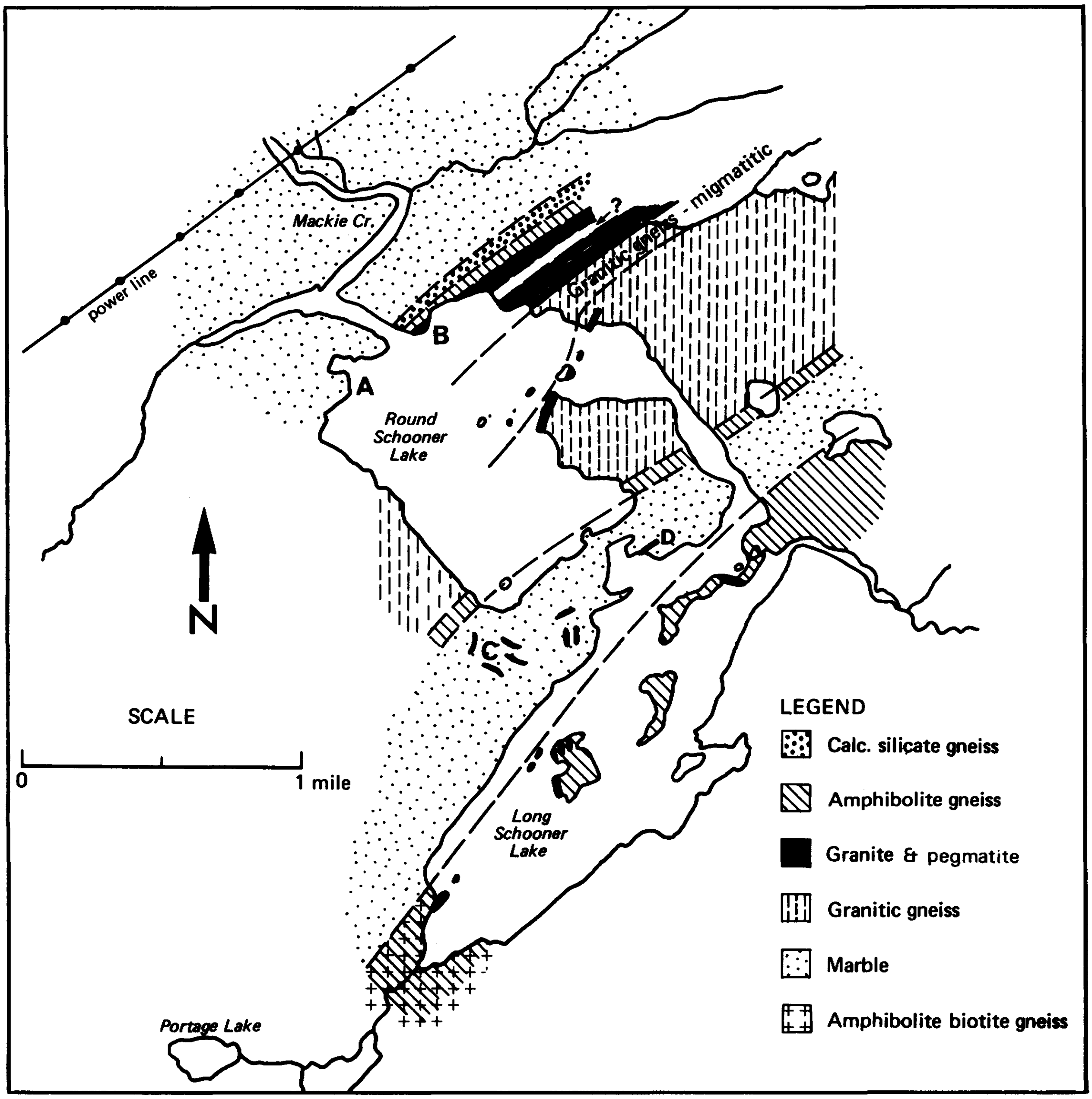


Figure 32 — General geology of the Barnet Occurrence, Schooner Lakes Section.

LOCATION

The occurrences are approximately 10 km east-southeast of the town of Matawatchan, in Lots 33, 34 and 37, Concession XII and Lots 33 and 34 in the west half of Concession XIII, Miller Township, Frontenac County.
Latitude 45°07'37''N; Longitude 76°59'23''W
UTM 4998800mN, 343500mE, Zone 18
NTS Clyde Forks 31F/2

ACCESS

A gravel road heading north from Plevna reaches the east end of Long Schooner Lake. From here a boat is necessary to reach the occurrences on the north shore of Round Schooner Lake.

PRESENT EXPOSURE

Good, especially along the lake shore

SIZE AND GRADE

Mineralized areas are small.

DESCRIPTION

General Geology: The area is underlain by highly metamorphosed (upper almandine amphibolite facies) sediments consisting of marbles, calc-silicate gneisses, plagioclase amphibolites with minor biotite, quartz-plagioclase paragneiss and meta-arkose. These lithologies occur at the north and south ends of Round Schooner Lake. Running through the central portion of the lake is a thick section of granitic rocks, consisting of well-foliated granitic gneisses, migmatitic to layered biotite granitic gneiss, and late granites and granite pegmatites. This granitic sequence is very similar to the rocks of the "Faraday Granite" in the Bancroft Area, and is of approximately the same thickness. All of the above rocks form a unit dipping 20 to 40 degrees to the southeast.

Detailed Geology: Occurrence "A": In an outcrop along shore about 325 m southwest of the outlet of the lake, pink granite gneiss intruding biotite-hornblende-quartz feldspar gneiss is intruded by a small pegmatite vein 20 m long and 1 m wide at the broadest point, pinching out at both ends. The pegmatite is mainly quartz and plagioclase (peristerite in part) with almost 5 percent magnetite ranging from a pinhead to 7.5 cm in grain size. The pegmatite averages 8 to 20 times background except where the pegmatite is fractured. Here it yields very high counts. Near the fracturing the pegmatite changes from a light pink to a yellowish red, due to the presence of hematite and limonite along the fractures. Magnetite occurs chiefly in quartz often surrounding crystals of zircon and bastnaesite. The zircon, which occurs mainly in quartz, is green, 0.5 to 1 mm long and with planar faces even when surrounded by radial fracturing. The radioactive minerals are uraninite, bastnaesite, zircon, and possibly allanite and uranothorite that occur as disseminated small grains in the three major minerals. A sample (R-77-87A-1) from the small, highly fractured, very radioactive portion assayed 490 ppm U_3O_8 and 390 ppm Th.

Occurrence "B" is located 45 m east of the outlet of Round Schooner Lake. Biotite-hornblende-quartz-feldspar gneiss is cut by small bodies of magnetite-quartz-plagioclase pegmatite whose form ranges from even-walled lenticular dikes 15 to 90 cm wide to irregularly shaped masses 3-3.5 m across. Their radioactivity is mostly 2 to 4 times background except at sporadic concentrations of magnetite where radioactivity reaches 20 times background. The pegmatite also contains zircon and pyrite, giving it a spotty, rusty appearance. The sulfides were probably derived from the rusty-weathering pyritic calc-silicate and amphibolitic country rocks. Peristerite, as in the "A" occurrence, is very common near areas of mineralization. The hottest radioactive areas were associated with fractured areas of the pegmatite. A selected sample (R-77-87B-2) of a highly radioactive portion high in magnetite gave an assay of 220 ppm U_3O_8 and 390 ppm Th.

Occurrence "C" is located 225 m south of the southwest corner of Round Schooner Lake on lot 33, Concession XII; an outcrop 10 m by 35 m consists of two bands of pegmatite each with 3 m of exposed width separated by marble. The radioactivity is 1 to 2.5 times background except in an area 1 m^2 that yields 5 times background.

Many other pegmatites are exposed along the shores of Long Schooner Lake but these did not give anomalous readings, with the exception of one in a small bay along the north shore. This white pegmatite cutting marbles gave readings 10 times normal background. The pegmatite dike is 3 m wide. (Occurrence "D").

Structural and Stratigraphic Position of Mineralization: Pegmatites cut all the lithologic units, but only some are mineralized. Aside from secondary enrichment along fractures, the pegmatites vary relative to one another in their radioactivity, reflecting the lithology of the enclosing country rocks, the nearness of certain contacts, and the stratigraphic position of the unit which the pegmatite intrudes. A geological section through the mineralized area (Figure 33) displays the position of uraniferous pegmatities. The Eagle Nest Section displays similarities to the Schooner Lake Section with respect to mineralized pegmatites and is shown alongside it for comparison. Though similar structural and lithological inferences are implied, the writers do not correlate the two sequences.

Although mineralization in the Eagle Nest zones is substantially greater than the Barnet Occurrences there are some important similarities. Stratigraphically, both are underlain by a sequence of interlayered marble calc-silicate gneiss and mafic paragneisses, and overlain by a thin unit of granitic gneiss. In both cases mineralization occurs within 20 metres of this contact. Mineralization in both occurrences occurs in highly-fractured, magnetite-rich pegmatites which contain abundant zircon as well as uraninite, uranothorite and allanite. Most significant is that in both areas the thick granite gneiss unit contains a lower unit of foliated granite with which mineralization is spatially associated.

HISTORY

In 1954 staking and sampling were performed by T. F. Barnet and others.

REFERENCE

Geological Survey of Canada, Radioactive Resources Division File 31F/3-5

75. DORANIUM OCCURRENCE

See "Minor Occurrences"

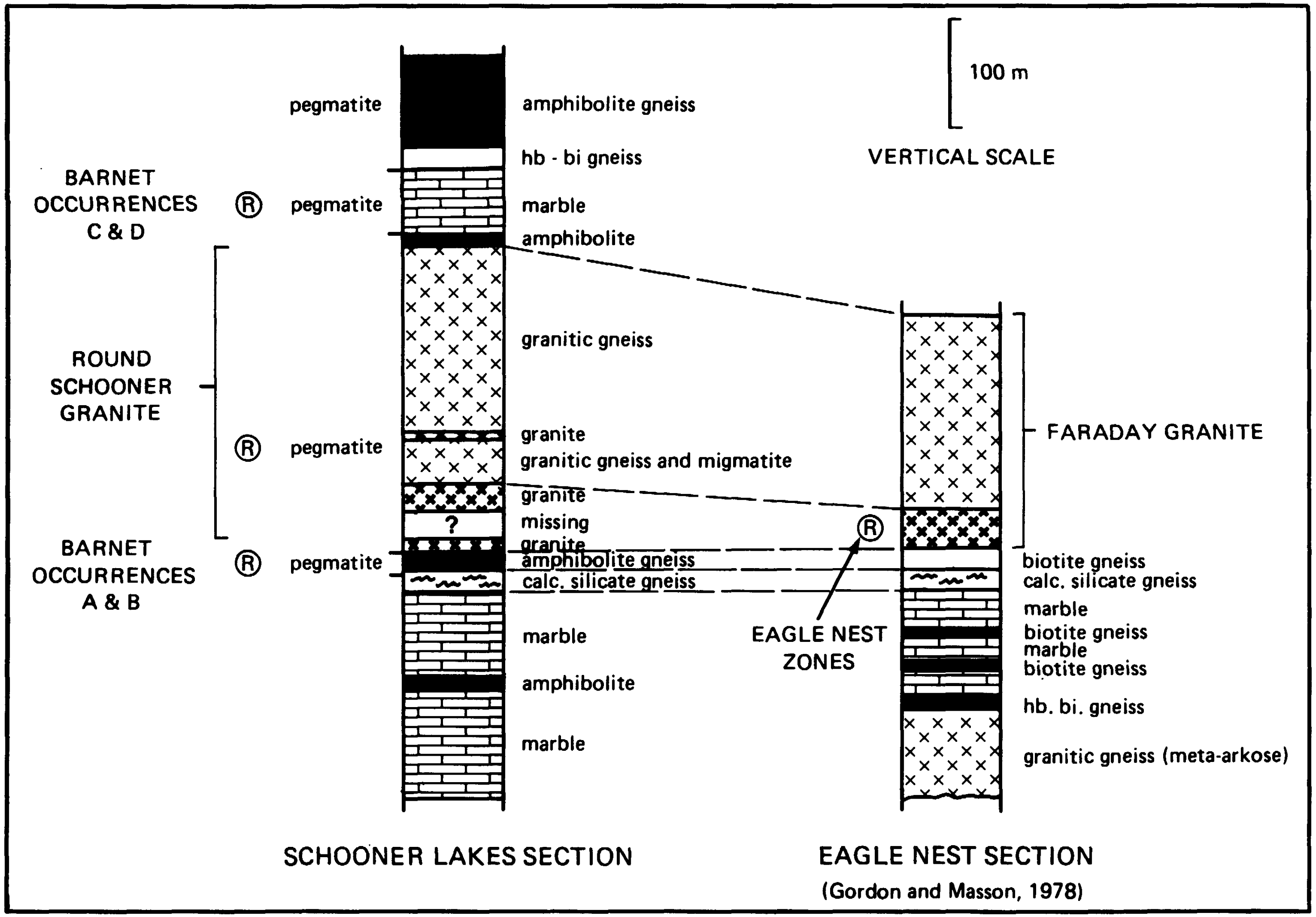


Figure 33 — Geological sections of the Barnet and Eagle Nest Occurrences.

76. SALMOND OCCURENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Not identified
ROCK ASSOCIATION
The host is white to pale pink granite pegmatite in country rock consisting of biotite paragneiss, biotite-garnet-hornblende gneiss, amphibolite, tremolite skarn and marble.
CLASSIFICATION
Granite pegmatite
LOCATION
The occurrence is approximately 7 km southeast of the town of Matawatchan, in the west half of Lot 37, Concession VIII, Miller Township, Frontenac County
Latitude 45°06'34"N; Longitude 77°02'50"W
UTM 4996940mN, 338950mE, Zone 18
NTS Denbigh 31F/3
ACCESS
A hydro line service road heading east from the east end of Quackenbush Lake leads to the occurrence. The lake is 5.9 km south of Matawatchan by gravel road.
PRESENT EXPOSURE
Good
SIZE AND GRADE
The pegmatites contain weak and erratic radioactivity.
DESCRIPTION
General Geology: The property consists of metasediments of the Grenville Supergroup of Upper Aphebian or Lower Helikian age. These metasediments comprise marble, hornblende amphibolites, pyritic calc-silicate gneisses, biotite-garnet-hornblende gneisses, biotite paragneiss and meta-arkose. This sequence is intruded first by granitic bodies later cut by pegmatite and diabase dikes.

All of the above rocks except for the late pegmatite and diabase dikes were subjected to high-grade regional metamorphism of upper almandine amphibolite to granulite facies. The gneisses appear to be openly folded with a general northeast trend; regionally, faults trend north-northeast. There are numerous granite pegmatite bodies but few are anomalously radioactive. Most pegmatites follow fold hinges, faults, joints and stratigraphic horizons.

Detailed Geology: The area of the occurrence contains well-exposed garnet-hornblende-biotite gneisses and biotite-hornblende gneisses, with a few interlayered units of pyritic biotite gneiss. These units generally strike N14°E and dip 60 to 65 degrees to the northwest. Cross-cutting these gneisses at sharp angles are granite pegmatite dikes averaging 1 to 2.5 m thick. The pegmatite is white to pale pink and is composed predominantly of pink microcline and quartz intergrown in a graphic texture. At the contact with the country rocks, the pegmatite is finer-grained and often contains smokey quartz. It is at this contact zone that most of the radioactivity is detected. Almandine garnets, up to 1.5 cm, are found associated abundantly with biotite along this pegmatite border zone. Radioactivity occurs commonly with mafic zones and smoky quartz. (Figure 34).

There are many pegmatite dikes in the area, ranging from less than 0.6 m to 3 m in thickness. They are usually not anomalously radioactive and usually strike north-northeast. The pegmatite dikes follow closely the regional structures, occurring parallel to faults or at the hinges of folds. Other smaller pegmatites follow a prominent east-west joint direction. Mineralized pegmatites appear to be most radioactive where they are in contact with either garnet-biotite gneiss or pyritic calc-silicate gneiss. The migmatitic nature of the hornblende-garnet-biotite gneiss suggests that this gneiss may be the parent of the anatectic melts that produced the pegmatite dikes. Therefore, it can be inferred that pegmatites will occur all along this stratigraphic horizon. Whether they will be mineralized will depend largely on structural controls and the uranium content of the country rocks.
HISTORY
In 1954, K. Salmond sent three samples to the Mines Branch in Ottawa (Geological Survey Canada) for radiometric analysis. The following are the results:

	U_3O_8	estimated U_3O_8
Sample 1	0.038%	0.19%
Sample 2	0.20 %	
Sample 3	1.46 %	1.53%

Samples were also submitted to the Harry Weller Laboratory in Cobden for analysis:

	Beta equivalent	% U_3O_8 Soluble in HNO_3
Sample 1	0.270	0.238%
Sample 2	0.075	
Sample 3	0.040	

REFERENCE
Geological Survey of Canada, Radioactive Resources Division File 31F/3-2

77. WHYTOCK OCCURRENCE

COMMODITY
Feldspar, uranium and rare earths
RADIOACTIVE MINERALS
Pyrochlore and fergusonite or samarskite
ROCK ASSOCIATION
The host is granite pegmatite - intruding biotite paragneiss
CLASSIFICATION
Zoned pink granite pegmatite - feldspar type
LOCATION
The occurrence is approximately 7 km northwest of the village of Plevna, in Lot 15, Southwest Range, Miller Township, Frontenac County.
Latitude 45°00'36"N; Longitude 77°01'05"W
UTM 4985950mN, 339650mE, Zone 18
NTS Denbigh 31F/3
ACCESS
A gravel road heads north from Plevna 7.7 km to the south end of Wensley Lake. From here a bush road 2 km long leads south and west to the occurrence.
PRESENT EXPOSURE
Part of the occurrence is flooded; otherwise, it is well exposed.
SIZE AND GRADE
The wall zones on both sides of the pegmatite are esti-

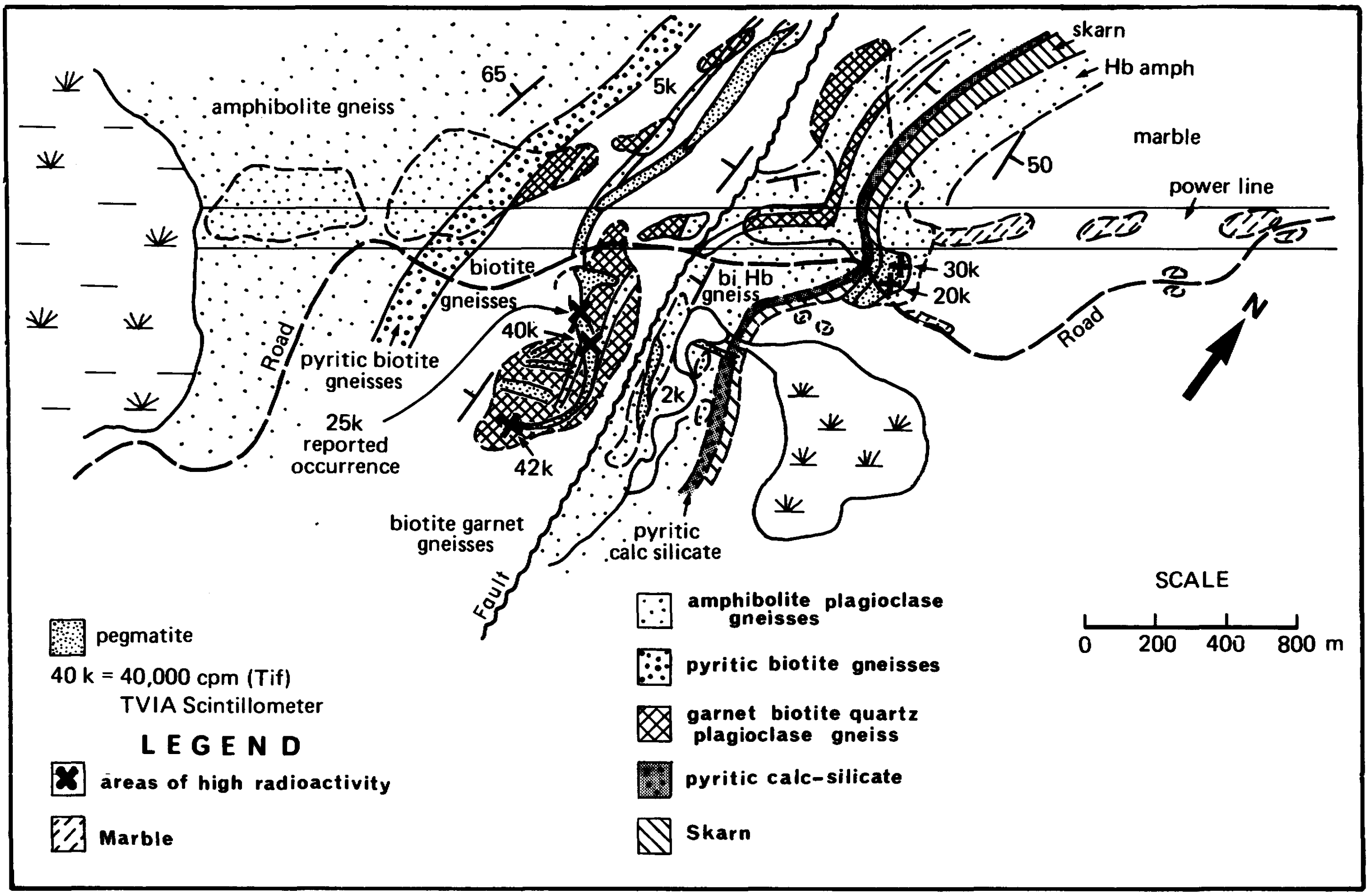


Figure 34 — Geology of the Salmond Occurrence.

mated at 0.1% U_3O_8 over widths of 1.5 to 2.0 m. The pegmatite is exposed for 60 m along strike.

DESCRIPTION

The following description is taken from Satterly (1971, p.2):

Geology:

The pegmatite was developed by an open-cut 30 feet wide and 150 feet long in a northwest-southeast direction. This open-cut is now largely filled with water. A large dump conceals rock exposures to the east, and forest covers them to the west. Limited exposures of pegmatite on both sides of the open-cut indicate that the pegmatite may be a dike about 50 feet wide. It can be traced to the southeast for an additional 120 feet where it passes under a swamp. The country rock is a dark green, fine-grained biotite gneiss, probably a granitized paragneiss. The gneissic structure in an exposure north of the dump strikes N35°E and dips 50°NW. The material on the dump indicates that much quartz and a buff potash feldspar were removed from the open-cut. Such material can be seen in place at the northwest end of the open cut. The present walls of the open cut are graphic granite pegmatite with erratically distributed clusters or radiating sheaths of muscovite up to a foot across. Associated with the mica, either in it, or in feldspar near it, are elongate, rounded or irregular masses of a pitchy-black uranium-bearing mineral from ¼ to 2 inches across. This mineral is identified as pyrochlore by D.A. Moddle, Provincial Assayer. The elongate shape of some specimens suggests to the writer that a second uranium-bearing mineral may be present. [Figure 35]

The dike is believed to be a typical example of a segregated (zoned) pegmatite with a central core of potash feldspar and quartz and a wall zone of graphic granite pegmatite with erratically distributed muscovite. The average geiger reading on this wall zone material is about 30 (1M). Background is about 15 (1M). The dump lying to the east of the open-cut is approximately 100 by 100 feet, and from 1 to 10 feet thick. Geiger readings range from 30 to 40 (1M) with spot-highs on 5M scale on rock containing mica and the uranium-bearing mineral. These geiger readings indicate that the pegmatite has a very low uranium content and that ore-grade material could be obtained only by hand-cobbing material from the wall zone.

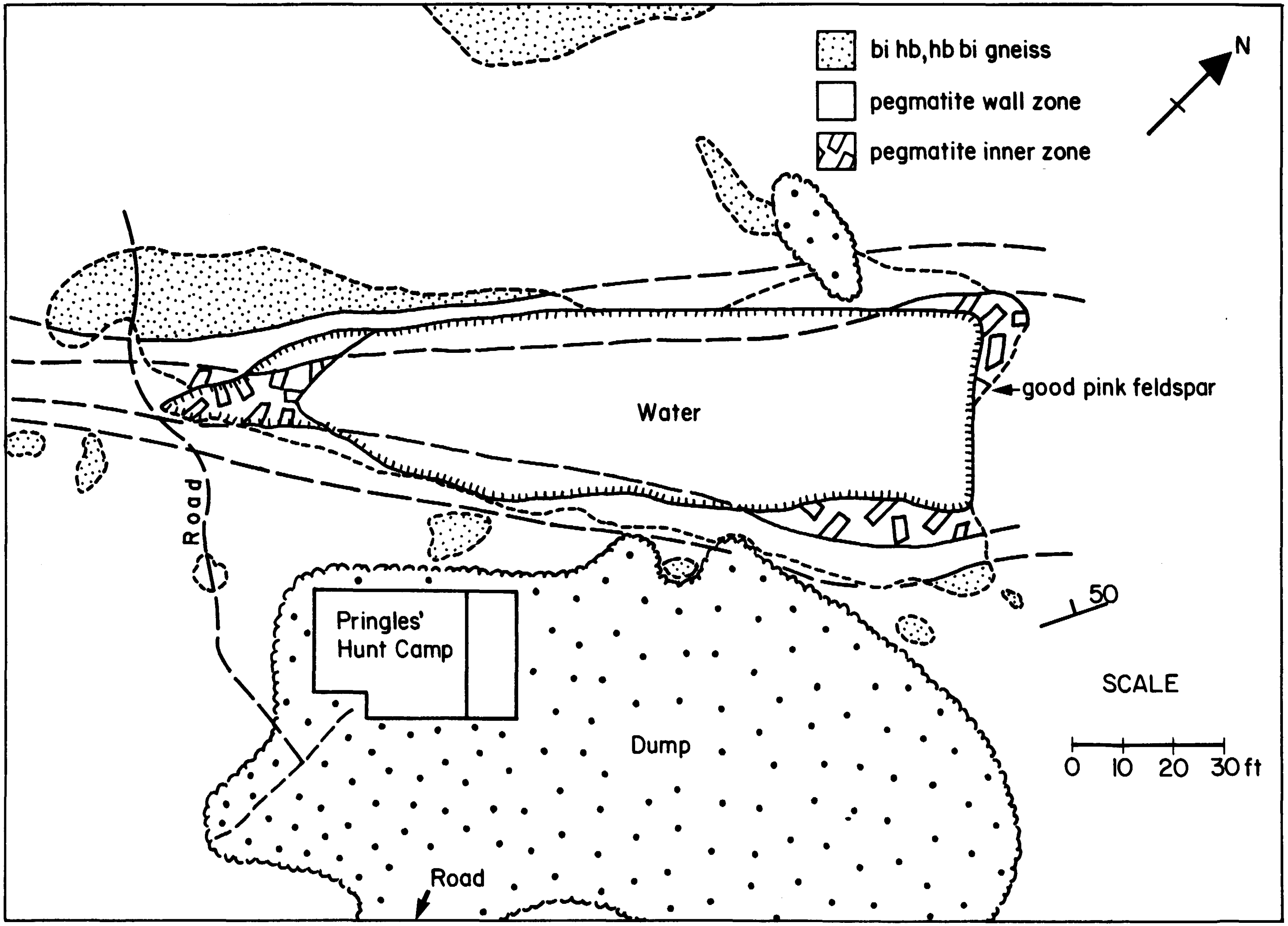


Figure 35 — Geology of the Whytock Occurrence.

During field work the authors found that the exposed wall zone was weakly radioactive, but some samples at the dump were highly radioactive. The radioactive mineral was black and vitreous with size ranging from pin-head to 5 cm but averaging 0.5 to 2.0 cm. It was noted that this mineral was closely associated with books of muscovite in the pegmatite. The pyrochlore mineral appears quite metamict in places, altering enclosing feldspar or mica along radiating fractures surrounding the mineral. These fractures are usually coated with limonite, rather than hematite, which is more usual in occurrences of this type. Quartz rarely hosts the pyrochlore mineral. Although muscovite is the dominant mica, minor amounts of biotite crystals were observed on the dump, probably derived from the contaminated border zone area. The origin of the pyrochlore may be the "focused concentration" process described for the Barr Feldspar Quarry Occurrence.

HISTORY

1954-55: The property was mined for feldspar. An unknown tonnage was sent to N. B. Davies of Buckingham, Quebec.

REFERENCE

Satterly (1971, p.2-3)

78. BARTLETT MINE OCCURRENCE

COMMODITY

Feldspar, uranium, thorium and cerium

RADIOACTIVE MINERALS

Allanite and minor cyrtolite

ROCK ASSOCIATION

The host is pink granite pegmatite in country rocks consisting of hornblende gneiss, syenitic gneiss and hornblende-quartz-feldspar gneiss.

CLASSIFICATION

Zoned pink granite pegmatite - fedlspar type

LOCATION

On the southwest shore of Salmon Trout Lake, in Lot 15, Concession VIII, Monteagle Township, Hastings County.
Latitude 45°10'48"N; Longitude 77°48'27"W
UTM 5006500mN, 279400mE, Zone 18
NTS Bancroft 31F/4

ACCESS

The occurrence can be reached via a cottage road turning north off the gravel road at the southern tip of Salmon Trout Lake. It is 120 m north of this gravel road. (Figure 36)

PRESENT EXPOSURE

Fair to good

SIZE AND GRADE

An anomalously radioactive selected sample assayed 140 ppm U_3O_8 and 2860 ppm Th.

DESCRIPTION

Geology: "The pink granite pegmatite dike strikes N70°E. The dike has a width of about 80 feet with an unknown dip. Its north contact with hornblende granite gneiss - hybrid gneiss - syenite gneiss country rock is exposed on the lakeshore. The north wall of the dike consists of pink graphic granite and closely intergrown feldspar and quartz. Near the centre of the dike pink potash feldspar (microcline perthite) crystals up to 4 feet in diameter can be seen with large masses of milky quartz; many of the large crystals have intergrown laths of quartz throughout. Some hornblende and allanite are present." (Hewitt 1955, p.80).

Mineralization occurs in either the border zone of the zoned pegmatite or in the unzoned pegmatite. The radioactive pegmatite is characterized by its pink to red colouration and its associated mafic minerals, hornblende and allanite. Minor carbonate, zircon, magnetite, molybdenite and apatite also occur with the assemblage. The mafic-rich portion of the pegmatite contains up to 10 percent allanite, 10 percent calcite, 3 percent apatite, and no quartz. The remainder is hornblende and pink-red feldspar. The rock is chemically a calcic monzonite.

Discussion: The lack of quartz in the syenitic phases of the pegmatite is probably due to the reaction between Ca-, Mg- and Fe-rich fluids derived from nearby carbonate rocks and the free silica from the pegmatite producing hornblende. The calcic-rich fluids were most likely mobilized from the calcareous country rocks by the intrusion of the pegamtites, which intermixed with the granitic melt to produce syenitic phases within and along the border zone of the pegmatite. Similar phenomena have been observed in a few other occurrences, such as the Quade, although at that occurrence the calcic-rich fluids replaced a portion of the zoned pegmatite along a fracture zone. In both instances, U, Th, Zr, Ti and rare earths appear to be collected by the calcic fluids producing minerals such as uranothorite, allanite, zircon and sphene as well as much pyroxene or amphibole in these contaminated calcareous syenitic phases.

HISTORY

In 1926, a pit 9.1 m long, 6.1 m wide and 1.8 m deep, was opened up by P. J. Dwyer. In 1951, a small pit, 3 by 4.6 by 1.5 m deep, was opened by K. Bowser, but no production has been reported.

REFERENCES

Hewitt (1955, 49-50)
Spence (1932)
Thomson (1943, p.29)

79. CAIRNS OCCURRENCE

See "Minor Occurrences"

80. CARR OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Allanite and uranothorite

ROCK ASSOCIATION

The host is a pink granite pegmatite in country rock consisting of amphibolite (meta-gabbro) and granite gneiss.

CLASSIFICATION

Simple unzoned pink granite pegmatite.

LOCATION

Lots 7 and 8, Concession III, Monteagle Township, Hast-

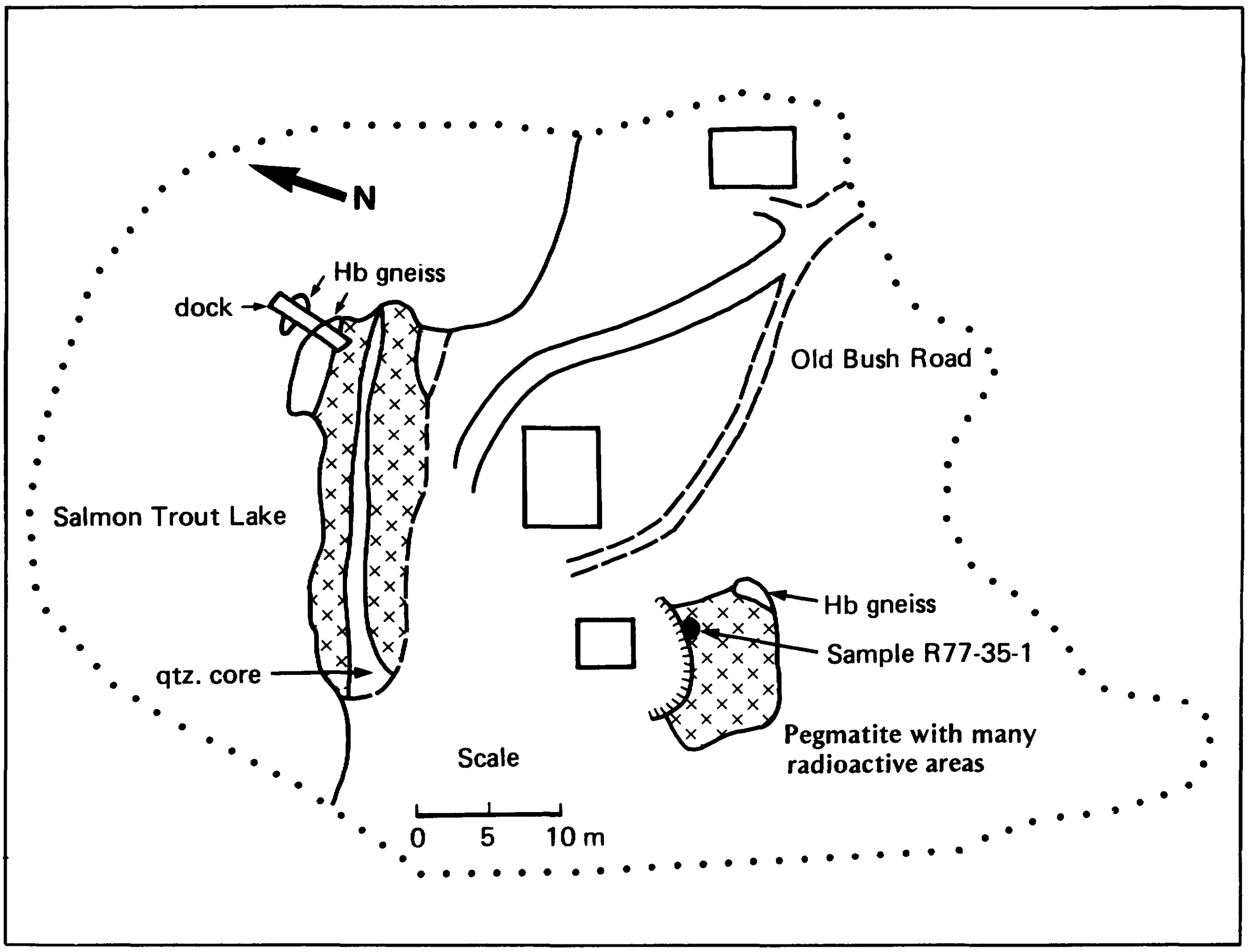


Figure 36 — Geology of the Bartlett Mine Occurrence.

ings County, approximately 4 km northeast of the village of Musclow.
Latitude 45°09'04''N; Longitude 77°45'07''W
UTM 5003100mN, 283650mE, Zone 18
NTS Bancroft 31F/4

ACCESS

The occurrence is readily accessible via the Quirk Lake Concession Road. The occurrence is approximately 150 m south of the concession road on a ridge that runs along the lot boundary.

PRESENT EXPOSURE

Good

SIZE AND GRADE

The mineralized areas are small and spotty. A sample of allanite containing inclusions of uranothorite assayed 180 ppm U_3O_8 and 1% Th.

DESCRIPTION

The occurrence is described by Hewitt (1955, p.69):

The 100-foot stripping exposes a medium- to coarse-grained leuco-granite pegmatite cutting gneissic metagabbro or amphibolite. The pegmatite is exposed for a length of 250 feet on the ridge and pinches out to the south. Its exposed width at the north end of the stripping is about 50 feet. The contact of the pegmatite strikes N25°E.

In the pegmatite are scattered crystals of allanite 1 to 2 by 5 inches in size. In the allanite there are lenses and grains of orange-brown uranothorite. Although the allanite seems to be associated with fractures in the pegmatite, many fractures are present without any allanite.

The allanite is associated with magnetite, abundant quartz (25%), and reddening of surrounding feldspars. A sample of the metagabbro assayed 2 ppm U_3O_8 and 10 ppm Th, whereas samples of amphibolite-plagioclase gneiss to the west assayed <1 ppm U_3O_8 and <10 ppm Th.

HISTORY
Stripping by S. J. Carr in 1954.
REFERENCE
Hewitt (1955, p.69)

81. FERRILL OCCURRENCE

COMMODITY
Rare earths
RADIOACTIVE MINERALS
Allanite
ROCK ASSOCIATION
The host is a pegmatitic granite within hornblende and biotite syenitic gneiss.
CLASSIFICATION
Granite pegmatite
LOCATION
Lots 27 and 28, Concession III, Monteagle Township, Hastings County, approximately 2.5 km northeast of the town of Birds Creek.
Latitude 45°07'07"N; Longitude 77°50'48"W
UTM 4999800mN, 276100mE, Zone 18
NTS Bancroft 31F/4
ACCESS
At approximately 0.8 km north of Birds Creek, a gravelled county road leads east from Highway 62 for approximately 2.3 km to an underground cable station (No. 140). From here a very overgrown bush road leads north to the pit.
PRESENT EXPOSURE
Poor to moderately good
SIZE AND GRADE
The pit is along a hillside and measures 30 X 2 X 3 metres. A 300-pound bulk sample (136 kg) of the pegmatite was concentrated and analyzed. The rare earths contents amounted to 1.6 lbs./ton (Osborne 1931).
DESCRIPTION
The occurrence is described by F.F. Osborne (1931, p.45) as follows:

Allanite is quite abundant in the material mined by J.F. Ferrill . . . It is possible that by concentrating the material, the cerium earths and radium might be recovered. The radioactive shattering around the allanite has made the rock crush easily.

Three hundred pounds of the granitic pegmatite . . . were sent to the Temiskaming Testing Laboratories for a concentrating test. The product obtained from the Wilfley table amounted to 2.15 percent of the whole sample. Under the microscope, it is seen to consist of allanite, titanite, magnetite, zircon and hornblende. The concentrate was analyzed in the laboratories of the Ontario Department of Mines and gave 3.71 percent of rare earth elements. Cerium, thorium and zirconium were detected spectroscopically. This would amount to about 1.6 pounds of the rare earths recoverable from a ton of the granite pegmatite.

The syenitic country rocks yielded radioactive readings on a TVI scintillometer of 3600 cpm T_1f, whereas the granite pegmatite gave readings of 6000 cpm T_1f, 200 T_2 and 80 T_3.

The authors took two samples of the syenitic gneisses which the pegmatite had intruded. Both were high in rare earths: Sample R-77-38-2 assayed 2 ppm U_3O_8, 29 ppm Th and 80 ppm Ce: Sample R-77-38-4 assayed 7 ppm U_3O_8, 26 ppm Th and 330 ppm Ce.

HISTORY
In 1930, J. F. Ferrill submitted a 300-pound bulk sample for analysis, from a small pit on the property.
REFERENCES
Hewitt (1955, p.69)
Osborne (1931, p.45)

82. GENESEE NO. 2 MINE OCCURRENCE

COMMODITY
Main- feldspar
Minor - quartz, uranium, thorium, columbium and tantalum
RADIOACTIVE MINERALS
Pyrochlore
ROCK ASSOCIATION
The host is a zoned pink granite pegmatite dike in country rocks consisting of rusty paragneiss, calcareous amphibolite, siliceous marble, quartzo-feldspathic gneiss and syenitic gneiss.
CLASSIFICATION
Zoned pink granite pegmatite - feldspar type
LOCATION
The occurrence is located immediately south of the gravel road at the south end of Salmon Trout Lake, in S½ lot 14, Concession VIII, Monteagle Township, Hastings County.
Latitude 45°10'42"N; Longitude 77°48'03"W
UTM 5006350mN, 279950mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence can be reached by a township gravel road from either Monteagle Valley or Hybla. The mine entrance is just south of the gravel road at the southeast tip of Salmon Trout Lake.
PRESENT EXPOSURE
Very well exposed.
SIZE AND GRADE
A selected sample (R-77-65-3) of pyrochlore assayed 8.3% U_3O_8 and 610 ppm Th. A second sample (R-77-65-5) containing 2 cm masses of pyrochlore assayed 1800 ppm U_3O_8 and 740 ppm Th.
DESCRIPTION
General Geology:The occurrence is situated in a sequence of metasediments of the Grenville Supergroup.

According to Hewitt (1955, p.48):

A flat-lying body of granite pegmatite outcrops on the face of the ridge. This pegmatite is capped by rusty pyritic paragneiss, limy amphibolite and limestone tectonic breccia, all interbanded with pink and buff granite and syenitic gneisses.

The geology of the area is shown on Hewitt's map of Monteagle and Carlow Townships, Ontario Department of Mines Map 1954-3. This map, however, does not distinguish meta-arkose and quartzo-feldspathic gneisses (meta-sandstones) from the true intrusive granites.

Detailed Geology:The zoned pegmatite dike consists of an outer phase of graphic granite, an inner layer of large phenocrysts of microcline in a matrix of quartz and graphic granite, and a discontinuous core of white quartz. The feldspar is mostly pink microcline and is generally quite pure except where the enclosed pyrochlore has deeply reddened and fractured the surrounding feldspar. The quartz is milky except where it comes into contact with feldspar, where it is smoky. The smaller quartz veins in the pegmatite also consist of smoky quartz. Calcite has been at least partially remobilized to fill fractures in the pegmatite, especially within 5 m of the contact with the marble. Calcite has also been observed apparently intergrown with quartz. Screens of country rock seen in the roof and walls of the workings suggest carbonate was incorporated into the pegmatitic melt. Pyrite also occurs in small amounts in pegmatite. (Figure 31)

The structure of the granite pegmatite dike is not clear from the exposure. Hewitt (1955) describes it as a flat-lying body while Spence (1932) refers to the main workings as a "local swelling".

Mineralization: Thomson (1943) stated that this property has "more possibilities for future production than any other feldspar showing seen in the area — Northern Hastings County."

Radioactive mineralization in the form of pyrochlore generally occurs along fractures within the feldspar or near its contact with quartz. As most of the mineralization occurs along the north wall at approximately the same elevation it may be related to a strong fracture system dipping southward at 5°. Mineralization also is associated with pods and veins of carbonate and yellowish-green mica.

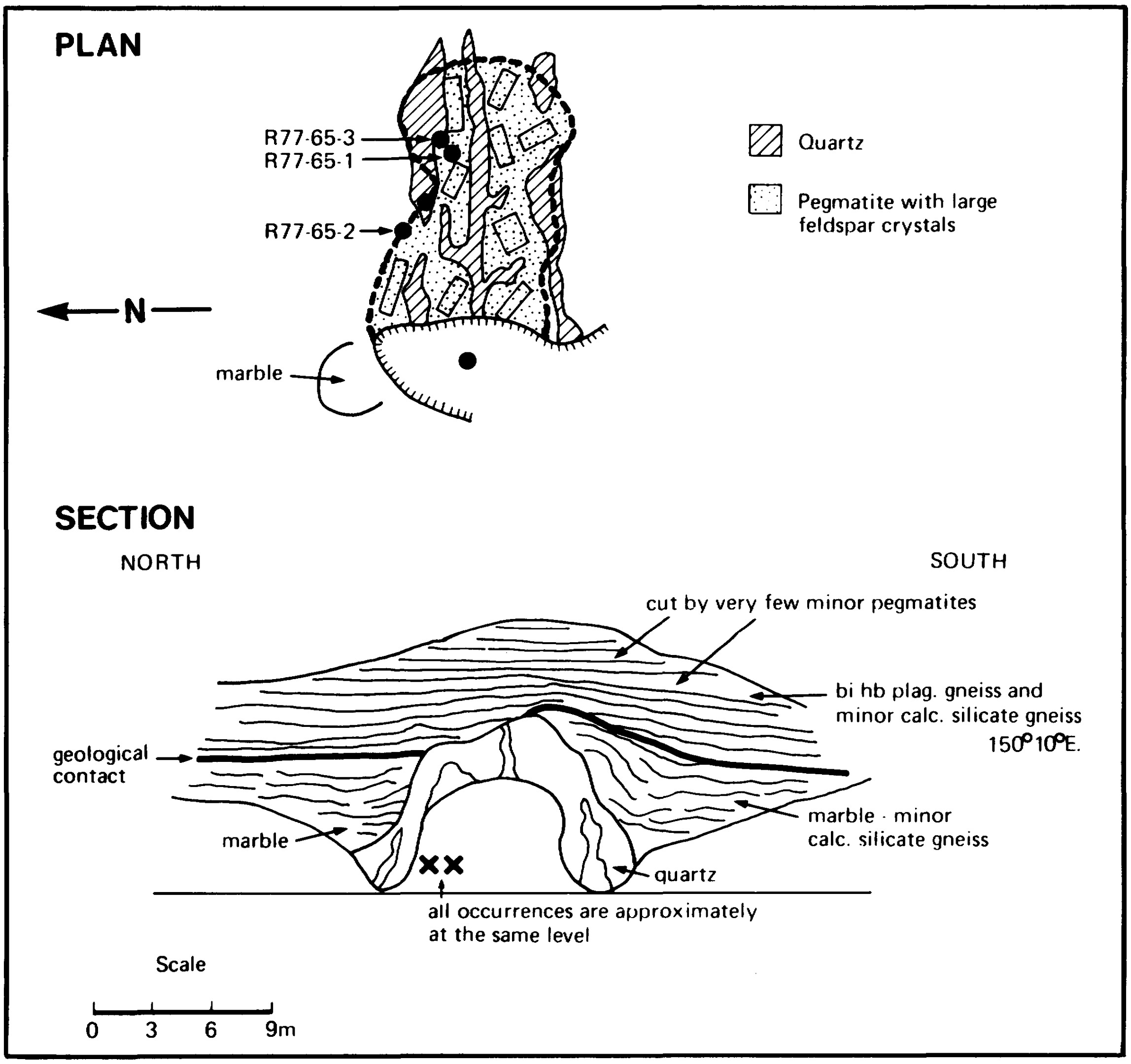


Figure 37 — Geology of the Genesee No. 2 Mine Occurrence.

HISTORY
This property was opened in 1926 by The Genesee Feldspar Company, and production continued until 1931. In the period from 1948 to 1950 the mine was reopened by D. Vardy and W. Jessup. Total production amounted to 2 846 tons.
SELECTED REFERENCE
Hewitt (1955)
Spence (1932)
Vos and Storey (1980, p.299)
Thomson (1943)

83. GENESSE No.2 MINE (SOUTH SHOWING) OCCURRENCE

COMMODITY
Main -feldspar
Minor - uranium and thorium
RADIOACTIVE MINERALS
Uranothorite
ROCK ASSOCIATION
The host is pink granite pegmatite in country rocks consisting of marble, calc-silicate gneiss and calcareous amphibolite gneiss.
CLASSIFICATION
Pegmatite
LOCATION
N½ Lot 14, Concession VII, Monteagle Township, Hastings County.
Latitude 45°10'40''N; Longitude 77°47'59''W
UTM 5006300mN, 280100mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence can be reached by a trail leading about 120 m southeast of the main workings of the Genesee No. 2 Mine. The main workings are just off a gravel road between Monteagle Valley and Hybla at the south end of Salmon Trout Lake.
PRESENT EXPOSURE
Very well exposed
SIZE AND GRADE
Anomalous radioactivity is low. The feldspar in the area is mostly graphic, making the quality much lower than the main workings.
DESCRIPTION
General Geology:The occurrence is situated in a sequence of metasediments of the Grenville Supergroup of early Late Precambrian age. This sequence is composed of meta-arkose, quartzo-feldspathic gneisses (metasandstones), calc-silicate gneisses and marbles. These metasediments are intruded by small granite and syenite bodies and by late Late Precambrian granite pegmatites. The geology of the area is shown on Hewitt's map of Monteagle and Carlow Townships, Ontario Department of Mines Map 1954-3. This map does not distinguish meta-arkose (quartzo-feldspathic gneisses) from the true intrusive granites.
Detailed Geology:The showing is described by Spence (1932): "A small cut 12 feet long on the side of the hill near its base exposes graphic granite pegmatite."

The granite pegmatite cuts siliceous marbles. The anomalous radioactivity is associated with tiny clusters of black crystals thought to be allanite but later identified as uranothorite. The uranothorite occurs in feldspar, often along fractures. The crystals are commonly 3 to 5 mm long and 0.5 to 1 mm in width. Scintillometer readings of T_2 (U + Th) = 700 and T_3 (Th) = 250 indicate that the radioactivity is due mainly to thorium rather than uranium.
HISTORY
Unknown.
The pit was probably opened up by the Genesee Feldspar Company during the 1920s.
REFERENCES
Hewitt (1955, p.48-49)
Spence (1932, p.47)

84. MacDONALD MINE OCCURRENCE

COMMODITY
Main - Feldspar
Minor - Uranium, thorium, niobium, cerium and rare earths
RADIOACTIVE MINERALS
Betafite, uranothorite, allanite and cyrtolite
ROCK ASSOCIATION
The host is a zoned granite pegmatite in country rocks consisting of syenitized and granitized metasediments, calc-silicate gneisses, syenite gneiss, granite gneiss, marble and amphibolite.
CLASSIFICATION
Zoned pink granite pegmatite - feldspar type.
LOCATION
The main workings of the mine are located in Lot 18, Concession VII, Monteagle Township, Hastings County.
Three smaller open cuts are located in Lot 19, Concession VII, just west of the main workings.
Latitude 45°09'56''N; Longitude 77°49'06''W
UTM 5002000mN, 276000mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The property is accessible by following a concession road and then a gravel road north directly to the mine. Hybla is 3.2 km west of the mine.
PRESENT EXPOSURE
Very good
SIZE AND GRADE
According to William Phillips Associates (1956), there remains on the dumps:

6000 tons at	0.1% U_3O_8	(12000 lb)	$87,000
6000 tons at	0.2%Cb_2O_5	(24000 lb)	36,000
40 tons at	3% U_3O_8	(2400 lb)	17,400
40 tons at	6%Cb_2O_5	(4800 lb)	7,200
			$147,600

Further investigation is recommended to determine whether extraction would be economically feasible.
DESCRIPTION
Geology:The following is taken from Hewitt (1955, p.45):

The country rocks in the vicinity of the MacDonald Mine consist of highly syenitized and granitized Grenville metasediments, syenite gneiss, granite gneiss, and pegmatite. The Grenville metasediments consist of paragneiss, amphibolite, and crystalline limestone. These original sediments have been intruded and replaced by the late acid plutonic rocks that are represented in this vicinity by the syenite and leucogranite gneisses. The sediments now consist of feldspathic paragneiss, scapolitic and pyroxenic amphibolite, lime metapyroxenite, silicated limestone, lime silicate skarn, and hybrid granite and syenite gneisses. These are intruded by fine-grained, black lamprophyre dikelets, which may be related in age to the late granite pegmatite.

The late granite pegmatite dikes occupy east-west fractures that cut the country rocks. The main granite pegmatite dike strikes east-west and dips 60 - 70°N. The smaller granite pegmatites to the northwest and west strike N70°E and dip steeply to the north. The structure of the country rock gneisses in the vicinity of the MacDonald pegmatites is extremely variable, and it is difficult to determine their general trend because of local folding. The granite pegmatites are definitely cross-cutting and have sharp though irregular contacts with the country rock. The wall rocks in the immediate vicinity of the granite pegmatite dikes may have been feldspathized to some extent, but the author attributes most of the granitization and metasomatism to an earlier widespread period of acid plutonic activity, which affected the whole region.

SHAPE: The main dike is lens-shaped. At its western end it has a width of 5 feet and rapidly widens to the east and with depth, until a maximum width of about 70 feet is reached towards the centre of the workings. At the eastern end in the lower cut the dike is not well exposed but does not appear to exceed about 25 feet in width.

INTERNAL STRUCTURE: The main dike shows a zonal arrangement of internal units. The units usually present include: (1) a fine-grained graphic granite border zone; (2) a wall zone of medium-grained albite-microcline-quartz pegmatite; (3) an intermediate zone of coarsely crystalline quartz and microcline perthite; and (4) a central core and segregated patches of massive quartz, sometimes containing microcline. The coarsely crystalline salmon-pink to white calcite pods that occur within the dike may have formed about the same time as the latest quartz of the core towards the end of pegmatite stage.

GENERAL DESCRIPTION: Entering the mine from the lower or easternmost cut, the north wall is seen to consist of pink leucogranite gneiss and calcite-amphibole-pyroxene gneiss intruded by pegmatitic stringers. The pegmatite-wall rock contact is exposed, and the border zone of the pegmatite is fine-grained graphic granite pegmatite underlain by a medium-grained quartz-albite microcline pegmatite with crystals 8 to 10 inches in size. At the mouth of the stope a good section is exposed on the west wall. Here the gneiss-pegmatite contact is exposed. It is irregular, and pendants of gneiss extend down into the pegmatite. There is a graphic granite pegmatite zone at the contact followed by medium-grained quartz-albite-microcline, quartz-microcline, and massive quartz towards the south wall near the core of the pegmatite. On entering the stope, pink and white calcite can be seen in the pillar in massive quartz. The open stope has a maximum height of 25 feet from floor to back at a point 30 feet west of the portal. The south wall of the stope consists of coarse-grained quartz and microcline and minor soda spar in crystals 5 to 6 feet in diameter. The north wall and the back of the stope expose medium-grained granite pegmatite, microcline, quartz, and soda spar, in crystals 1 to 2 feet in diameter, with some graphically intergrown quartz and soda spar. Some gneiss is exposed at the base of the south wall and in the back 60 feet west of the portal. Radioactive minerals with shatter haloes, and massive sulphides, occur in the granite pegmatite towards the west end of the stope and in the pillars between the stope and the upper open-cut.

NORTHWEST CUT: The wall-rock gneisses are well exposed along the north wall of the cut and consist of scapolitic and pyroxenic amphibolite, silicated limestone, hornblende syenite, granite gneiss, and pegmatite. The dike-wall rock contact is sharp but irregular. Tongues of pegmatite extend into the amphibolite. The granite pegmatite of the dike is younger than most of the granite pegmatite that occurs interbanded with the amphibolite. At the contact there is a 2- to 3-foot wall zone of graphic granite pegmatite, followed by an intermediate zone of coarse microcline and quartz in crystals up to 6 feet in size. Three feet below the contact within the pegmatite there are several large allanite crystals, averaging 12 inches in diameter, surrounded by marked radial shattering.

Mineralogy: The following is taken from Hewitt (1955, p.46):

> The main minerals of the dike are quartz, microcline perthite, and plagioclase. Some of the largest feldspar crystals measure 15 feet across. Quartz masses up to 30 feet occur. The quartz is milky, glassy, or smokey. The plagioclase ranges from 10 to 20 percent anorthite content. Hornblende, pyroxene, biotite and chlorite occur in the outer zones of the pegmatite. Scapolite is found near the contacts, and abundant dark, red-brown garnet occurs near the walls. Magnetite is the most common metallic oxide; some ilmenite also occurs. Masses of pyrite and pyrrhotite are present on the dump, and minor amounts of chalcopyrite and molybdenite were reported by Ellsworth (1932).

Titanite and zircon are common. The MacDonald Mine is well known for its cyrtolite, a radioactive variety of zircon. The cyrtolite occurs in single crystals or masses of crystals that are up to 1 inch in size and frequently covered with hematite. These crystals show elongated double prisms and shorter pyramidal faces. The cyrtolite often occurs in feldspar or in pink salmon-coloured calcite, which occurs as pods within the quartz of the dike. Associated with the cyrtolite is the radioactive mineral ellsworthite, a hydrous uranium, calcium, iron, titano-tantalo-columbate of the pyrochlore-microlite series. This mineral is waxy yellow-brown to shiny black in colour and commonly occurs in calcite or feldspar. Allanite, in masses up to 1 foot in diameter, also occurs in the dike, and allanite, cyrtolite, and ellsworthite are all frequently surrounded by radial shatter patterns in the adjacent quartz, feldspar, or calcite.

Ellsworth (1932) also reports purple fluorite, uranothorite and galena. Uraninite has also been reported.

HISTORY

This mine was the largest feldspar producer in the Bancroft area. It was opened up by the Pennsylvania Feldspar Company, which was taken over in 1920 by the Verona Mining Company Limited, which in turn was taken over in 1922 by the Genesee Feldspar Company of Rochester, New York, which operated the property until 1928. From 1929 to 1935 some production was reported by Peter MacDonald, from the dumps and from pits on Lot 19.

From 1919 to 1935, total production of feldspar was 35 048 tons.

During the Bancroft uranium rush of the 1950s, the mine was optioned and examined for radioactive minerals by Phillips-Doubt Grubstake Syndicate in 1954. Drifting and cross-cutting from the adit totalled 139 feet, and diamond drilling in seven holes totalled 700 feet.

In 1955, 40 tons of ellsworthite-bearing material were removed, grading 3.5% U_3O_8.

In 1956, Cloudmont Mines Limited conducted scintillometer and magnetometer surveys.

Chemical analysis of the uranothorite gave:

ThO_2	46.33%
UO_3	7.67%
$(Y,Er)_2O_3$	0.36%
$(Ce,La,Di)_2O_3$	0.08%

SELECTED REFERENCES

Ellsworth (1932, p.203-209)
Hewitt (1955, p.43-47)
Hewitt (1967, p.17)
Osborne (1931)
Satterly and Hewitt (1955, p.55-56)

85. McCORMACK OCCURRENCE

See "Minor Occurrences"

86. MELL - QUIRKE (BARTON) OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Allanite, uranothorite, uraninite and uranophane
ROCK ASSOCIATION
The host is white to pale pink granite pegmatite intruding rusty calc-silicate gneisses and marble.
CLASSIFICATION
Simple white granite pegmatite
LOCATION
The occurrence is approximately 4.8 km east of Musclow; in Lots 4 and 5, Concession I, Monteagle Township, Hastings County.
Latitude 45°08'00''N; Longitude 77°43'47''W
UTM 5001200mN, 285400mE, Zone 18
NTS Bancroft 31F/4
ACCESS
A gravel road leads east from Musclow for 3.5 km. From the end of the gravel road, a bush road leads 2.2 km easterly to the occurrence.
PRESENT EXPOSURE
Well exposed in trenches and pits.
SIZE AND GRADE
Three radioactive areas have been identified on the property: the North, Main and South or Boundary showings. The North Showing consists of a dike, at least 213 m by 4 m, with assays averaging about 0.25% U_3O_8 over 104 m of length. The Main Showing extends at least 400 m along strike, with a width of 1.8 to 3.2 m. Assays over 137 m averaged 0.01% U_3O_8. The South Showing consists of narrow (up to 0.6 m wide) pegmatites of unknown strike length with assay values from 0.04 - 0.10% U_3O_8 (radiometric).

DESCRIPTION
General Geology: The property is located within metasediments of the Grenville Supergroup which include marble, para-amphibolite, biotite gneiss, calc-silicate syenitic gneiss, pyritic gneiss, meta-arkose, quartzose gneiss, syenitic gneiss and nepheline syenite. These rocks are intruded by small syenite and granite bodies and by late granite pegmatite. The metasediments generally strike northeasterly and dip 50 to 80° to the southeast. Uranium mineralization in this area appears to be restricted to the late pegmatites.
Detailed Geology:

North Showing: It consists of a fine-grained pink pegmatite dike varying from 3 to 10 m in width. The zone strikes northwesterly and dips near-vertically (Figure 38). Radioactive minerals identified are uraninite, uranothorite and allanite.

On surface the North Showing is more impressive than the Main Showing. In 1975, R. Kidd reported finding an area with total gamma count of 70 000 cpm (40X background); a uranium + thorium count of 1400 cpm (23X background); and a thorium only count of 40 cpm (8X background). These values are approximately twice those found in the Main and South Showing areas.

Figures 39 and 40 show the geology and grade of U_3O_8 through sections in the plane of drill holes 76-2, 76-8 and 76-11, and drill hole 76-9. These sections illustrate the following:

i) The main body of pegmatite is a sill located at the contact between amphibolite schist and grey marble.

ii) Only the main pegmatite carries significant uranium values. Drill holes 75-5 and 75-6 show that small pegmatite dikes cutting cream-coloured marble contain lower values of uranium than the main pegmatite but greater values than pegmatite cutting grey marble, biotite-plagioclase gneiss and quartzite.

iii) In drill-hole 76-9 (Figure 40), two pegmatites intruding biotite schist (meta-pelite) are unmineralized, as is the pegmatite within the clastic quartzite and meta-greywacke. However the pegmatite which occurs precisely at the contact between the pelitic and clastic horizons is mineralized (0.2 lbs/ton over 1.8 m).

Main Showing: It comprises a number of pegmatite sills ranging from 10 cm to 3 metres in width. The pegmatite is white, coarser-grained than the North Showing and often exhibits graphic texture. The pegmatite sills are enclosed in a sequence of rusty marble, meta-greywacke, meta-siltstone and biotite schist. (Figure 40).

Uranium mineralization shows a preference for pegmatite which is relatively fine-grained, sheared, pink and which contains peristerite or high quartz content. Uranium also shows a preference for pegmatite in contact with apatite-bearing biotite schist.

The sheared radioactive pegmatite is very much like the siliceous sheared pegmatite which occurs on the Marquardt Property in Raglan Township. The sheared pegmatite is high in quartz, fine-grained, well-foliated,

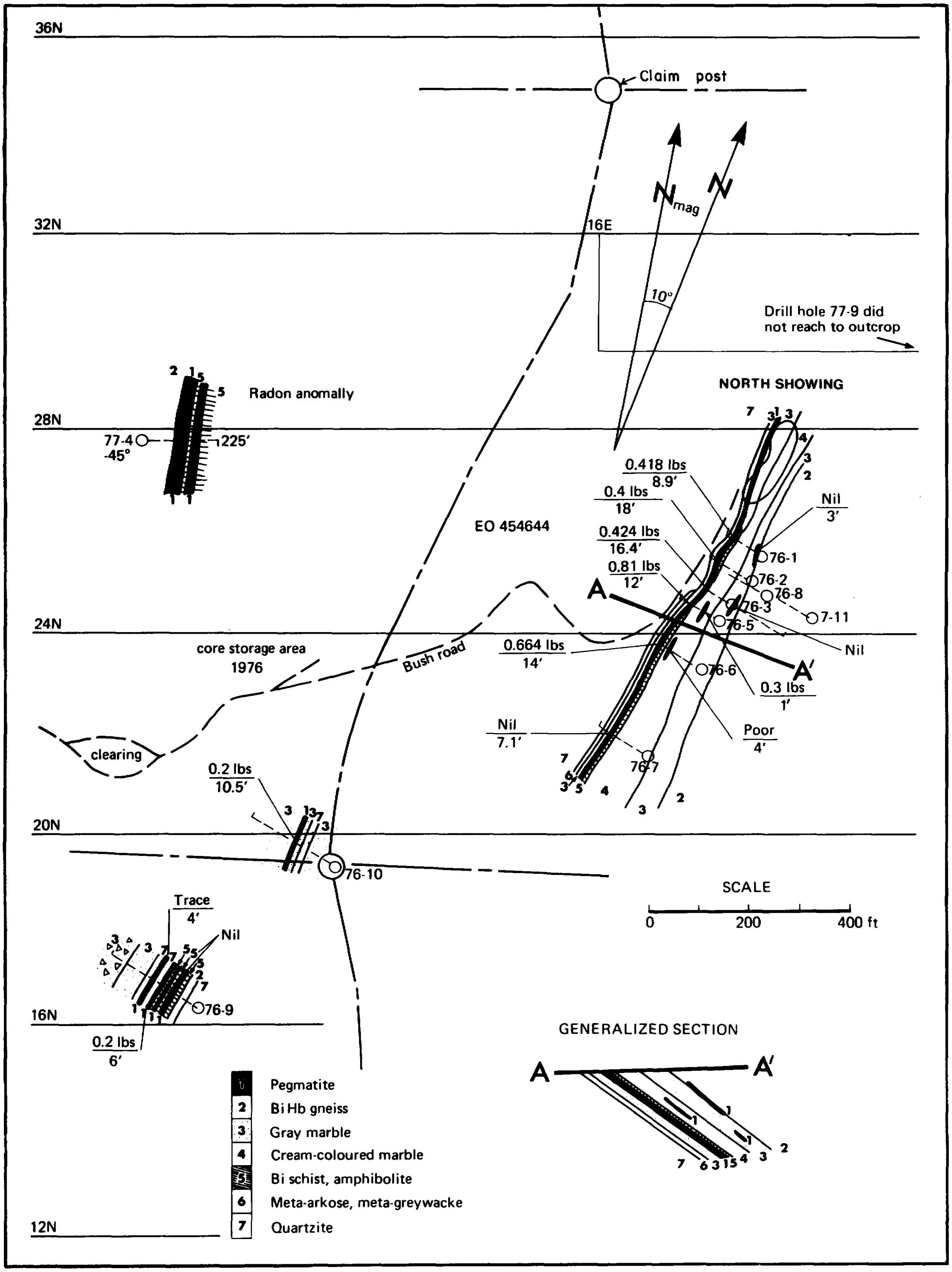


Figure 38 — Geology of the North Showing of the Mell-Quirk Occurrence

lineated with quartz and contains small cubes of uraninite. These rehealed shear zones occasionally have uranophane coatings. These shear zones suggest that structural deformation has played some part in the localization of uranium in the pegmatite.

The Main Showing has a higher percentage of white feldspars, is coarser grained and is not at the same stratigraphic horizon as the North Showing. For these reasons the two showings are thought to be separate occurrences.

South Showing: This showing was originally called the Boundary Showing and was described under the Carr-Quirk-Mellish Property by J. Satterly (1957).

The Boundary Showing is near the south boundary of Monteagle Township, in Lot 6, Concession I. A small pit exposes a rusty-weathering, cream to pale-pink leucogranite pegmatite with sparse chloritization, hornblende and accessory pyrite. No radioactive minerals were identified. Geiger readings were 7 to 8 times background.

A granite gneiss or meta-arkose forms the eastern exposure, followed westerly by calcareous meta-siltstones which grade into a rusty pyritic calc-silicate gneiss. West of this rusty gneiss is a thin unit of biotite-hornblende amphibolite followed by micaceous quartzitic gneiss. The granite pegmatite exposed in this outcrop is a dike, white in colour except where stained by sulfides. Maximum radioactive readings were taken from a fracture in the pegmatite where:

$T_1f = 65{,}000$ cpm $T_2 = 2{,}000$ cpm $T_3 = 200$ cpm

Uranium mineralization is generally associated with pegmatite that cuts the rusty gneisses; this may be a function of the reducing environment of the sulphide-bearing rocks.

The sample analyses shown in Table 14 are from the Main and South Showings.

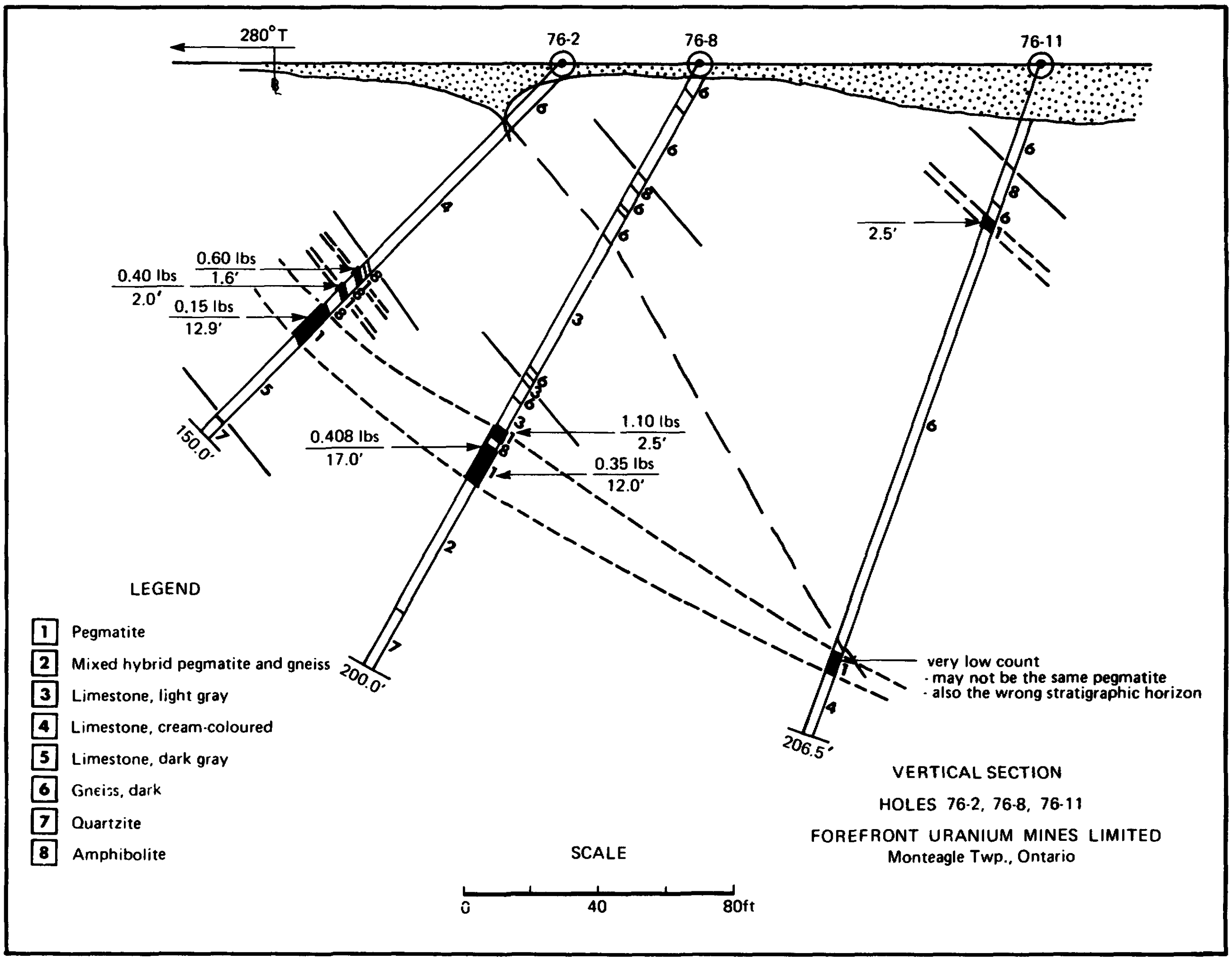


Figure 39 — Vertical section of holes 76-2, 76-8 and 76-11, Mell-Quirk Occurrence.

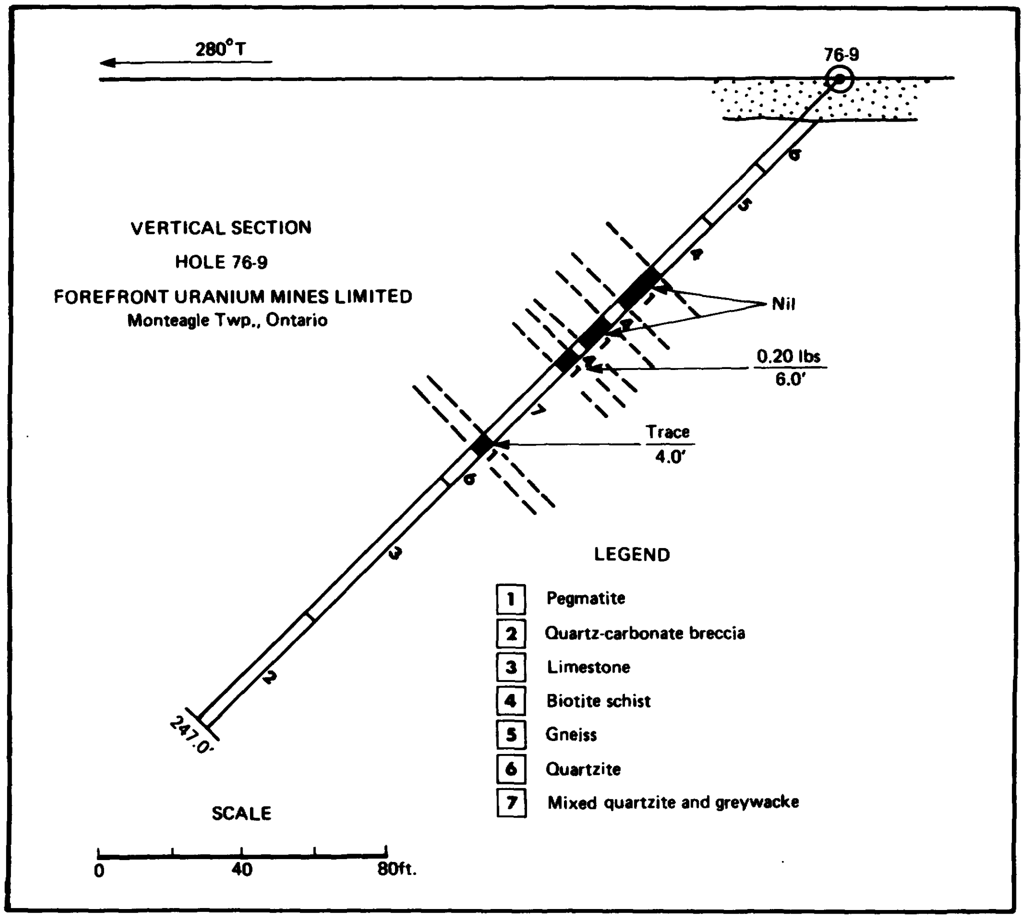


Figure 40 — Vertical section of hole 76-9, Mell-Quirk Prospect.

Conclusions: It is the authors' opinion that stratigraphy plays a very important role in uranium-bearing pegmatite; the fact that the better mineralized pegmatites are sills and not dikes suggests strong stratigraphic control on the uranium mineralization.

Structural controls also appear to be very important in the localization of uranium within the pegmatite. The pegmatites are located at amphibolite-schist contacts where differential stresses cause fracturing in the pegmatite permitting redistribution of uranium by hydrothermal solutions.

HISTORY

1956: Radioactive pegmatites were discovered by S. J. Carr.

1956-57: The area was trenched, bulldozed, stripped and drilled by Mell-Quirke Uranium Mines Limited. Drilling totalled 1,972 feet.

1969: Seven drill-holes totalling 282 feet were put down on the North Showing by Nor-Scan Mining and Service Company Limited.

1975: Re-opening of old trenches, sampling and line cutting were done by Ross Kidd for Forefront Uranium Mines Limited.

1976: Ross Kidd put down eleven drill holes, totalling 2,111 feet. In addition, a radon survey was employed to search for possible mineralization under the overburden.

1977: A drilling program totalling 1 835 feet in 10 holes was carried out to test the anomalies outlined by the radon survey. The work was carried out by Forefront Consolidated Explorations Limited.

SELECTED REFERENCES

Carter, O.F.
1977: Summary Report on 1977 Diamond Drilling Program. Monteagle Township; Forefront Consolidated Explorations Limited. On file, Mineral Deposits Section, Ontario Geological Survey.
Hawkins, S. G.
1957: Geological Report on Mell-Quirk Uranium Mines Limited, Monteagle Township. On file, Mineral Deposits Section, Ontario Geological Survey, Toronto.

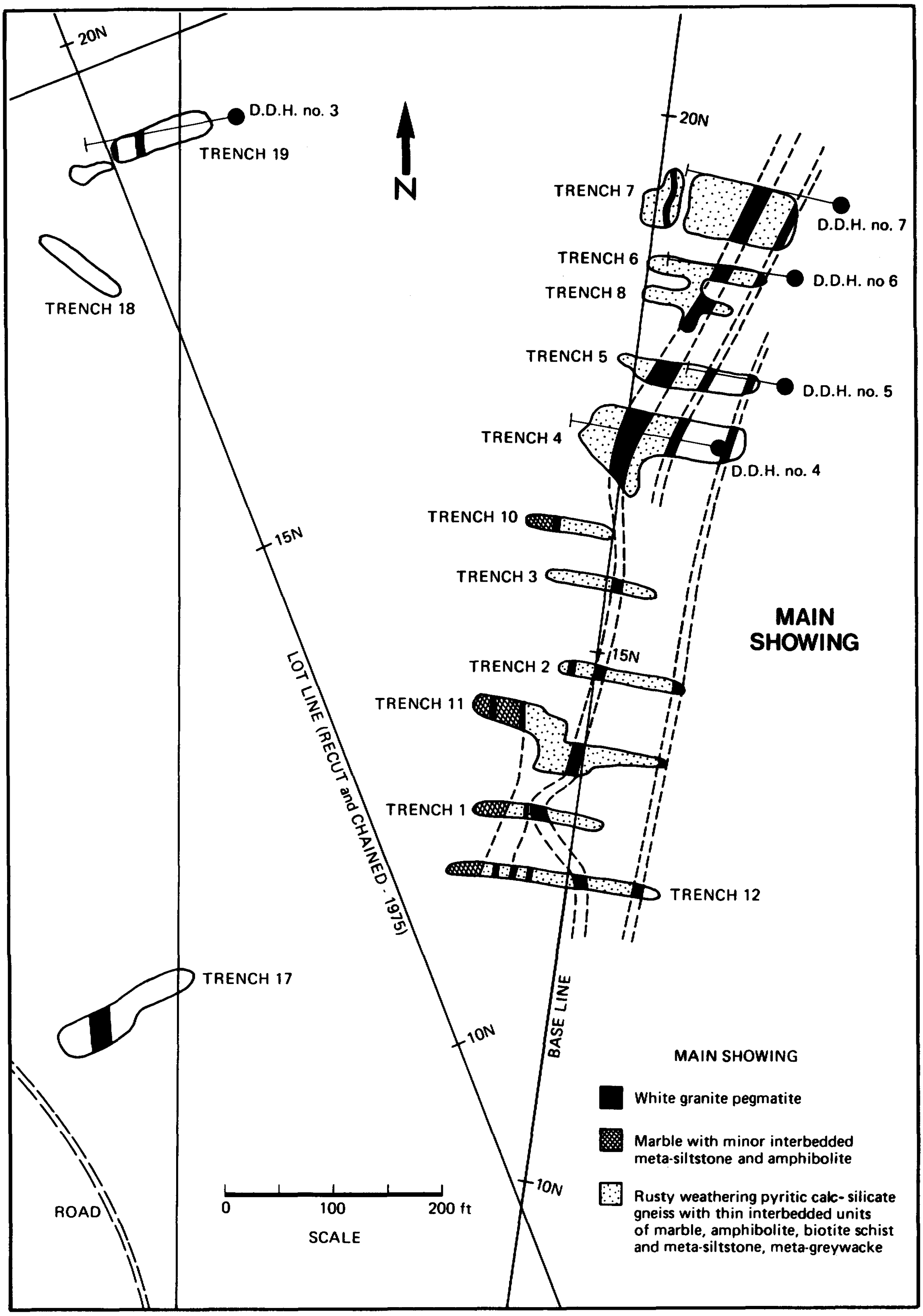


Figure 41 — Geology of the Main Showing of the Mell-Quirk Occurrence.

TABLE 14: URANIUM AND THORIUM CONTENTS OF SOME SAMPLES FROM THE MELL-QUIRKE OCCURRENCE

Sample No.	Location	Rock Type	U_3O_8 (ppm)	Th (ppm)
	South Showing			
R-77-36-1	trench 14	limy meta-siltstone (Ct-hb-bi-fel schist)	1	26
R-77-36-2	14	amphibolite	10	25
R-77-36-4	14	white pegmatite dike	10	28
R-77-36-5	15	meta-silitstone (Hb-bi-fel gneiss)	1	12
R-77-36-7	15	sheared pyritic white-pink pegmatite	3190	3160
	Main Showing			
R-77-36-9	trench 12	rusty pyritic calc-silicate gneiss	1	10
R-77 36-10	11	small marble unit (west end of trench)	3	18
R-77-36-11	4	fine-grained pinkish pegmatite	890	720
R-77-36-12	4	rusty pyritic calc-silicate gneiss	2	35
R-77-36-13	5	calcareous biotite-rich schist	10	27
R-77-36-15	6	ap-py-bi calc-silicate gneiss	7	12
R-77-36-16	7	calc-silicate gneiss at contact with pegmatite	1120	3850

Kidd, R.
1975 September: Report on the Barton Property for Forefront Uranium Mines; Ontario Department of Mines, Open File Report.
1975 November: Report on the Barton Property for Forefront Uranium Mines Limited.
1976 August: Report on the Diamond Drilling Program, Barton Property for Forefront Uranium Mines Limited; (Open File - MEAP E.O. – 18)
1976 November: Report on Radon Survey for Forefront Uranium Mines Limited; (Open File - MEAP E.O. – 21).
Satterly (1957, p.136)

87. PETER-ROCK (EAST SHOWING) OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uranothorite and allanite
ROCK ASSOCIATION
The host is a pink granite pegmatite intruding hybrid granite gneiss and hornblende gneiss.
CLASSIFICATION
Simple unzoned pink granite pegmatite
LOCATION
The occurrence is 2 km west-northwest of Hybla, in the south half of Lot 29, Concession VIII, Monteagle Township, Hastings County.
Latitude 45°09′47″N; Longitude 77°52′47″W
UTM 5004500mN, 273700mE, Zone 18,
NTS Bancroft 31F/4
ACCESS
A bush road leading east from Highway 62 provides access. This road begins just south of Hickey Settlement, seven miles north of Bancroft.
PRESENT EXPOSURE
Moderately well exposed.
SIZE AND GRADE
The mineralization is narrow and low grade.
DESCRIPTION
Geology:The general geology of the property is shown on Ontario Department of Mines Map No. 1954-3, Monteagle and Carlow Townships. The following description of the property is given by Satterly (1957, p.140):

In the south half of Lot 29, Concession VIII, a low cliff face exposes a 3-foot dike of medium-grained, graphic granite pegmatite with a sheared zone 3 - 12 inches above the footwall, very rich in coarse disseminated magnetite in grains ⅛ - 1 ½ inches across. Geiger readings were 10X with spot-highs of 25X. Accessory minerals present are magnetite, biotite, zircon, allanite (altered), and black-to-orange-brown uranothorite. The pegmatite dike strikes N70°E and dips 45°N. The country rock is hornblende gneiss or hybrid granite gneiss which strikes N55°W and dips 55°SW.

The drilling program disclosed a number of narrow pegmatite dikes. The dikes in all the holes are granite pegmatite with variable amounts of accessory pyroxene, biotite, magnetite, pyrite, zircon, and very rarely, orange or black uranothorite. Geiger readings on pegmatite core were 1X - 3X with rare highs to 5X.

A sample of grey granite, one of the country rocks, was assayed for its uranium content. The results revealed that it is of quartz diorite composition and it contained the following trace elements:

U	<2 ppm
Th	15 ppm
Cu	20 ppm
Zn	50 ppm

HISTORY
The exploration was done by Peter-Rock Mining Company Limited. A scintillometer survey was carried out in 1954. In 1955, radioactive showings or anomalies were explored by 10 drill-holes totalling 868 feet.
REFERENCE
Satterly (1957, p.140)

88. PLUNKETT NORTH MINE OCCURRENCE

COMMODITY
Feldspar, uranium, thorium, cerium, niobium and tantalum
RADIOACTIVE MINERALS
Betafite and euxenite (previously identified as ellsworthite and pyrochlore)
ROCK ASSOCIATION
The host is a zoned pink granite pegmatite in country rocks consisting of rusty syenitic gneiss, biotite schist and garnet-biotite syenite.
CLASSIFICATION
Zoned pink granite pegmatite - feldspar type
LOCATION
The occurrence is 3.5 km southwest of Hybla, in the north half of Lot 20, Concession VI, Monteagle Township, Hastings County.
Latitude 45°09'35''N; Longitude 77°49'38''W
UTM 5004450mN, 277750mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence is on the Plunkett farm, 61 m east of the Lot 20 - 21 boundary and 213 m south of the road between Concessions VI and VII. The workings are in a field west of the farm buildings.
PRESENT EXPOSURE
Poor
SIZE AND GRADE
Undetermined.
DESCRIPTION
Geology:The deposit is described by Hewitt (1955, p.40) as follows:

The granite pegmatite consists predominantly of plagioclase, smoky quartz, and pink microcline perthite. Amazonite, ellsworthite, euxenite, titanite, garnet, purple fluorite, and hornblende were also noted in material from the small dump. The country rock is paragneiss and crystalline limestone. The dike is not sufficiently well exposed to determine its size, attitude, or extent.

An irregularly zoned pink pegmatite (1m - 1.5m wide) vein cuts rusty syenitic gneisses and a biotite-plagioclase-rich unit which contains layers of biotite schist. (Figure 42)

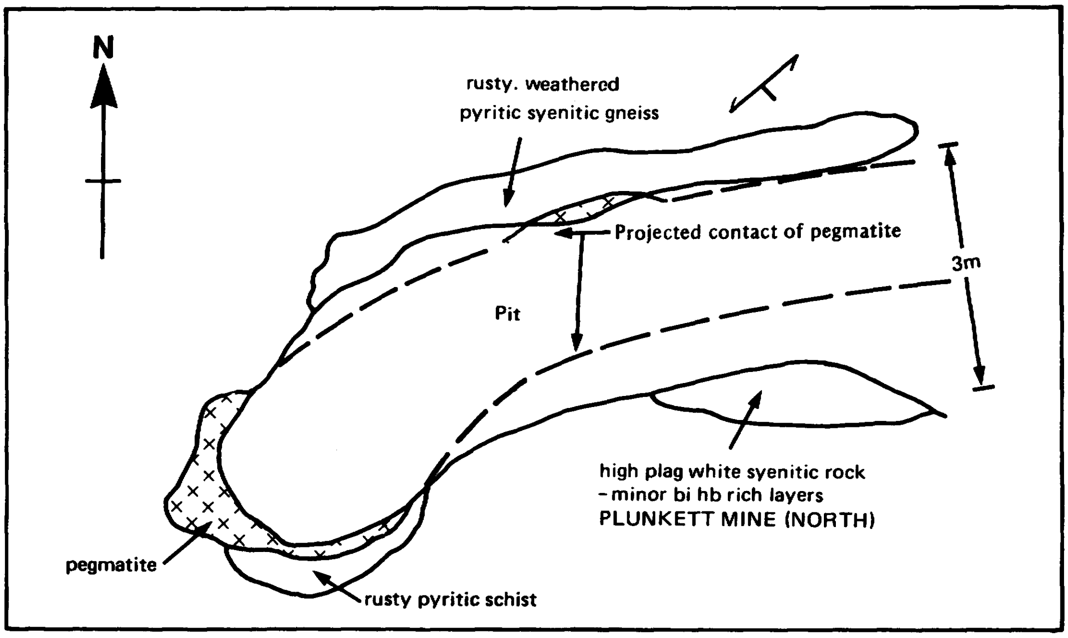


Figure 42 — Geology of the Plunkett North Mine Occurrence.

Mineralization: In the pit, the highest radioactivity is associated with fracture zones less than 5 cm wide. All the high readings were recorded from the south wall. As in other zoned pegmatites, border and wall zones frequently contain abundant radioactive minerals. Samples from the dump containing abundant sphene and pyrochlore suggest that portions of this pegmatite, probably the south border zone, are richly mineralized.
The authors sent four samples of country rock to be assayed. The following are the results:

Sample	Rock Type	U_3O_8	Th ppm
R-77-44N-2	biotite-hornblende schist	4	17
R-77-44N-3	rusty pyritic hornblende syenitic gneiss	5	21
R-77-44N-1	fractured hematized pegmatite	310	5700
R-77-44N-4	white biotite-plagioclase rock	8	31

These values, as well as others obtained in the Hybla area, suggest that the country rocks have a high uranium content. This may explain the frequently anomalous radioactivity of pegmatites in this area.

HISTORY

A pit 3m x 3m x 1m deep was opened up by American Molybdenite Limited in 1921.

REFERENCES

Hewitt (1955, p.40)
Vos and Storey (1980, p.296)

89. PLUNKETT SOUTH MINE OCCURRENCE

COMMODITY

Feldspar, thorium and molybdenite

RADIOACTIVE MINERALS

Allanite, thorite (?) and uranothorite

ROCK ASSOCIATION

The host is zoned pink granite pegmatite in country rocks consisting of rusty feldspathic biotite paragneiss, metapyroxenite, amphibolite and syenitic and granitic gneisses.

CLASSIFICATION

Pink zoned granite pegmatite

LOCATION

The occurrence is on the south half of Lot 20, Concession VI, Monteagle Township, Hastings County.
Latitude 45°09'24''N; Longitude 77°49'34''W
UTM 5004000mN, 277900mE, Zone 18
NTS Bancroft 31F/4

ACCESS

The occurrence is on the Plunkett farm, 61 m east of the Lot 20 - Lot 21 boundary and 610 m south of the road between Concessions VI and VII. A road through the farmyard leads directly to the workings on the south edge of a field.

PRESENT EXPOSURE

Outcrop is moderately well exposed.

SIZE AND GRADE

Undetermined.

DESCRIPTION

Geology: The occurrence is well described by Hewitt (1955, p.40):

> The granite pegmatite dike strikes N 55°E, has a width of 20 to 25 feet, and is stripped for a distance of 175 feet along strike, with both walls well exposed on the flat outcrop surface. It is difficult to determine the dip of the dike owing to the flatness of the outcrop surface, but in the small pit at the northeast end of the dike, the dip appears to be nearly vertical. The country rocks consist of interbanded rusty feldspathic biotite paragneiss, amphibolite, and granite gneiss, with minor amounts of scapolite pyroxenite.
>
> The pegmatite is composed chiefly of graphic granite, with a few pink microcline perthite crystals up to 24 inches in diameter. The dike is not of commercial interest at present owing to the high content of graphic granite and the presence of considerable amounts of hornblende as an impurity. Minerals present in the dike are as follows: graphic granite, abundant; pink microcline perthite, abundant; smokey and milky quartz, abundant; pink and white albite, common; hornblende in 3- 4-inch crystals, common; titanite, common; molybdenite, rare; pyrite, scarce; magnetite, scarce; and allanite, rare to scarce.
>
> A small pit, 25 by 12 feet with a 5-foot face on the southwest side, was opened at the northeast end of the dike. Sixty feet southwest of this pit a branch dike, 10 feet wide, leaves the main dike and runs westward for 20 feet to disappear under drift; some blasting was done on this dikelet.

The authors observed that the country rocks also included pyritic gneiss, metapyroxenite, calc-silicate-hornblende amphibolite gneiss and syenite. It was noted that much of the syenitic and granitic gneisses were migmatitic. The pyritic biotite gneiss was found to strike N55°E and dip 35°SE. Generally, local folding was common in the country rocks near the pegmatite.
Mineralization: High radioactive readings were associated with mafic phases (hornblende) of the pegmatite and with prominent fractures in the pegmatite. One such fracture yielded the following readings on a TV-1A Scintillation counter:

T_1f	>100 000 cpm
T_2	3 300 (U + Th)
T_3	1 500 x 3.5 = (Th)

These readings suggest mainly potassium and thorium. A sample (R-77-44-2) sent for assay from this fracture gave 10 ppm U_3O_8 and 1733 ppm Th, suggesting the mineral present is thorite.

A sample (R-77-44-4) from the mafic sphene hornblende-rich phase of the pegmatite assayed 8 ppm U_3O_8 and 608 ppm Th.

A selected sample (R-77-44S-1) of a very hot spot on the dike assayed 2500 ppm U_3O_8 and 5.2% Th, suggesting the presence of uranothorite.

A sample (R-77-44-3) of the rusty pyritic gneiss assayed 4 ppm U_3O_8 and 40 ppm Th. These values, especially the thorium value, are considered anomalous.

HISTORY

The property was opened by the American Molybdenite Company Limited in 1921. The work consisted of stripping and rock-pitting. Further work was done in 1927 by S. Orser. Two cars of feldspar were reported to have been shipped.

REFERENCE
Hewitt (1955, p.40)

90. H. QUIRK OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uranothorite, thorite
ROCK ASSOCIATION
Mineralization is hosted within carbonate rock, skarn and some granite pegmatite. The country rocks are marble, siliceous marble, metapyroxenite skarn, paragneiss and granite pegmatite.
CLASSIFICATION
Skarn
LOCATION
Lot 12, Concession IV, Monteagle Township, Hastings County
Latitude 45°09'04''N; Longitude 77°46'42''W
UTM 5003250mN, 281600mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence lies about 200 m southwest of Quirk Lake at the south end of a field south of a farmhouse. Gravel roads north from Musclow or south from Monteagle Valley provide ready access.
PRESENT EXPOSURE
Fair, with some overgrown trenches.
SIZE AND GRADE
Samples assayed 0.14, 0.55, 3.55 and 4.48% U_3O_8 equivalent.
DESCRIPTION
General Geology:(from Satterly 1957, p.141)

Exposures in a dozen workings and a few scattered outcrops in the open fields of the farm indicate that the area is underlain by a complex of marble, siliceous marble, skarn, and interbedded paragneiss intruded by thin sills and dikes of syenite pegmatite and leucogranite. The metasediments strike northeast and dip 30 to 60°SE.

Detailed Geology:A description of the detailed geology is in an unpublished report by J. Satterly (1954). This report and accompanying map are on file at the Mineral Deposits Section, Ontario Geological Survey, Toronto.

The following is a summary of the economic geology by Satterly (1957, p.141):

The main showing has been exposed by stripping and trenching over a length of 100 feet north and south. These workings expose biotite and hornblende paragneisses with an undulating dip. Patches of pink granite gneiss sills are exposed in "windows", and at the extreme south end there is a small exposure of overlying hornblende granite pegmatite. Locally, patches of a pyroxene-scapolite skarn or of a calcite-apatite-hornblende-scapolite rock from a few inches to 5 feet across and less than 1 foot thick, are present. The calcite is salmon-pink in colour, often a very deep pink, but fades to cream colour on long exposure. In these patches uranothorite occurs erratically in disseminated orange-brown grains, 1/16 to ½ inch across.

In the other eight workings the rocks exposed are leucogranite, granite gneiss, granite pegmatite, and minor paragneiss, marble and skarn. Geiger readings were low, 2X - 9X.

Sphene, zircon and apatite are very common accessory minerals.

The authors visited the property in July, 1977. Three samples of rock and two radioactive crystals were analyzed. The results are as follows:
The values obtained for the pyritic gneiss are consistent with values obtained for similar country rocks at other occurrences.

Early post-magmatic enrichment in fractured pegmatite is indicated by the presence of uranothorite, zircon and hematization.

The red-brown thorite is from a diopsidic orange calcite pod, whereas the black uranothorite crystal was obtained from scapolite-bearing metapyroxenite rock.
Discussion:Mineralization is generally associated with orange-pink pods of calcite, pyroxene veins, scapolite-bearing pyroxenite or fractured pegmatite. The association of uranothorite with remobilization of carbonate or calcareous fluids has been observed by the writer in numerous occurrences. This mode of mineralization has led the writer to conclude that uranium, and apparently thorium as well, can be mobilized by carbonate-rich solutions, themselves mobilized by the intrusion of granitic melts into calcareous country rocks. In many cases there is evidence that the uranium has been leached from the granitic intrusion by the carbonate fluids, whereas in other instances the country rocks are anomalous in their uranium content and may have had some uranium input.
HISTORY
In 1954 and 1955, stripping, pitting and trenching were done by Harry Quirk and J.E. Quirk.

TABLE 15 | URANIUM AND THORIUM CONTENTS OF SOME SAMPLES FROM THE H.QUIRK OCCURRENCE

Sample	Location on Satterly's map (1954)	Rock Type or Mineral	U_3O_8	Th
R-77-45-3	north part Pit 5, east trench	pyritic hornblende plagioclase gneiss	7ppm	55ppm
R-77-45-2	Pit 4	fractured granite pegmatite	450ppm	9405ppm
P-77-45-4	north part Pit 5, east trench	unfractured hornblende granite pegmatite	37ppm	127ppm
R-77-45-5	west portion Pit 5	reddish-brown thorite	7500ppm	
R-77-45-6	outcrop SW of Pit 5	black uranothorite	8.1%	

REFERENCE
Satterly (1957, p.140-141)

91. ROBSON OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uraninite, cyrtolite and thorite
ROCK ASSOCIATION
The host is a pink biotite syenite pegmatite sill in syenite, nepheline syenite gneiss and granitic gneiss.
CLASSIFICATION
Unzoned to zoned pink syenite pegmatite
LOCATION
The occurrence is on the west shore of Goddard Lake approximately 5 km southeast of Monteagle Valley in Lot 3, Concession III, Monteagle Township, Hastings County.
Latitude 45°09'34"N; Longitude 77°43'57"W
UTM 5004050mN, 285250mE, Zone 18
NTS Bancroft 31F/4
ACCESS
Goddard Lake is accessible via the Quirk Lake Concession Road. Approximately 1 km beyond the last farmhouse is an old bush road running east off the gravel road. This road leads 350 m to the occurrence.
PRESENT EXPOSURE
Moderately well exposed
SIZE AND GRADE
A section of the cliff face, 4.5 X 6 m was blasted by B. Robson in 1955. Geiger counter readings averaged 3 to 5 times background. Mineralization is erratic.
DESCRIPTION
The following description of the geology is given by Satterly (1957, p.141):

The claims are underlain by syenite, nepheline-plagioclase gneiss, granite, granite gneiss, marble, and amphibolite. These rocks form a series of bands striking N25°E and dipping 50 to 70°SE. Geiger readings were from 3X on syenite to 5X on pegmatite, and at the showing, spot-highs up to 75X on clusters of biotite books containing small cubes of uraninite or on uraninite crystals in feldspar.

The uraninite is present as cubes of from ⅛ to a maximum of ½ inch across, and in the feldspar it is surrounded by a red halo of discolouration.

Other accessory minerals in the pegmatite are brown zircon crystals up to ¾ inch in length, and rarely, a little purple fluorite. The zircon crystals were analyzed for their uranium content. It was found in one crystal that the lighter-brown outside part of the crystal contains 0.16% U_3O_8 (chemical) and the darker-brown, inside part of the crystal contains 0.35% U_3O_8. This apparently indicates some leaching of the uranium content of the zircon.

The cliff face appears to be the hanging wall of the syenite pegmatite sill, and the uraninite occurrences are confined to a zone, 10 to 20 feet thick, adjacent to the hanging wall.

The authors visited the occurrence in July, 1977 and found that high radioactivity was associated with biotite clusters up to 25 cm in size containing minor apatite; minor carbonate; reddening of the feldspars; and fractures trending N55°W and dipping 85°NE.

Tourmaline, though not associated with radioactivity, was also found in the pegmatite.

The following samples of country rocks, mineralized pegmatite and uraninite were analyzed for their uranium and thorium content. The results are as follows:

Sample	Rock Type or Minerals	U_3O_8	Th
R-77-46-3	coarse white hornblende syenite	<1ppm	<10ppm
R-77-46-5	biotite-rich syenite gneiss	<1ppm	18ppm
R-77-46-4	pale pink syenite with small red spots	5ppm	15ppm
R-77-46-2a	mineralized syenite pegmatite	2550ppm	2730ppm
R-77-46-2b	mineralized syenite pegmatite	400ppm	2809ppm
R-77-46-6	uraninite-thorite mixture	30.4%	

The mineralized pegmatite was taken from the fractured area. The uraninite - thorite mixture which appeared pure, was reported to contain minor bits of mica and feldspar. The uraninite is black, the thorite red.

The pegmatite reflects chemically the country rocks; both consist of predominantly biotite and feldspar. This is especially true of the pale pink syenite (R-77-46-4) which is the immediate country rock hosting the pegmatite. The pegmatite may be an anatectic melt of this unit.
HISTORY
In 1955, a section of the cliff face in a syenite pegmatite just west of Goddard Lake was blasted down. The work was done by Bruce C. Robson.
REFERENCE
Satterly (1957, p.141-142)

92. SALMON TROUT LAKE OCCURRENCE

'See Minor Occurrences"

93. SOUTH STATE (NORTH) OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uraninite, thorianite
ROCK ASSOCIATION
Mineralization occurs in siliceous marble and metapyroxenite. The area is underlain by granitic gneiss, marble, rusty gneiss and pegmatite.
CLASSIFICATION
Marble, metapyroxenite
LOCATION
Lots 17 and 18, Concession II, approximately 1 km southwest of the village of Musclow, Monteagle Township, Hastings County.
Latitude 45°07'38"N; Longitude 77°47'46"W
UTM 5000700mN, 280100mE, Zone 18
NTS Bancroft 31F/4
ACCESS
A small bush road 0.8 km west of Musclow leads south off the gravel concession road for several hundred metres to the property.
PRESENT EXPOSURE
The pits, trenches and surrounding bedrock are very well exposed.

SIZE AND GRADE

Several radioactive zones over a cleared area 213.5 m by 15.2 m are exposed. Three small pits, all of roughly the same size (3m x 3m x 1.5m) were found. Grab samples taken by South State Uranium Mines Limited assayed 0.05 and 0.41% U_3O_8 (radiometric).

DESCRIPTION

General Geology: The following is a description by Satterly (1957b):

The property is underlain by metamorphic pyroxenite, leucogranite, granite gneiss and granite pegmatite. These rocks strike N30°E and dip 40°SE.

Economic Geology: Radioactive showings are found in the granitic rocks, the mica metamorphic pyroxenite, and in discontinuous lenticular bodies of salmon-pink calcite, pale green diopside and mica. The radioactive mineral is probably uranium thorianite or thorianite, and forms grains, cubes or cube interpenetration twins. The original showing, now known as the B or Dallas Zone, is in a north-south bulldozed clearing 725 feet long. The zone consists of a calcite-diopside-mica band in mica metamorphic pyroxenite or of the latter rock entirely. A central calcite section about 250 feet long is 8 to 20 feet wide, and gave geiger readings of 5 000 to 40 000 and may average 10 000 over a 5-foot width. South of it for 300 feet the rock is mainly mica pyroxenite that reads 1000 to 2000, and north of it for 175 feet a sinuous calcite band, 1 to 5 feet wide, in mica pyroxenite reads 1000 - 5000 with a maximum of 10 000. The last 75 feet to the north is mica pyroxenite with an exposed width of 10 feet reading 1000 - 2000. Background count on marble away from the C zone is 500 cpm. A grab sample, 57-S-19, was taken by the writer at a point reading 13 000.

The A-zone is north and east of the B-zone, and west of the C-zone. The south end of the A-zone is about 75 feet north of the B-zone and is in a large north-south bulldozed clearing about 150 feet wide and 600 feet long. This clearing exposes a mixed assemblage of marble, mica metamorphic pyroxenite, and granite pegmatite. The granite pegmatite forms a number of irregular, lenticular bodies, and the mica pyroxenite + scapolite occurs as pods with widths of 30 to 60 feet at intervals over a length of about 400 feet. These gave geiger readings of 500 to 2,000. At 115 feet north of the south end a small lens of calcite-diopside-mica rock with grains and cubes of uraninite has a spot-high of 40,000 across 1 foot (Sample 57-S-21). Geiger readings of over 5,000 indicate that the lens is about 6 feet in maximum width and has a length of 20 feet. A spot-high of 30 000 across 1 foot was also noted in the pyroxenite at 95 feet north of the south end.

The C or Tiffany zone, to the north and east of B zone, is in a bulldozed clearing 725 feet in length. A radioactive mica-calcite zone and associated mica pyroxenite has widths of 20 to 40 feet, and has been exposed to date over a length of 425 feet. Geiger readings were 500 to 2,000 with random spot-highs across 1 foot of 3,000 to 5,000 and one of 20,000. The background count on grey marble is 500.

Samples 57-S-19 and 57-S-21 were submitted to the Provincial Assay Office for analysis with the following results:

Sample No.	Location	Geiger Reading c.p.m.	Times Back-ground	U_3O_8 (radiometric) percent	U_3O_8 (chemical) percent
57-S-19	B zone	13,000	26X	0.05	---
57-S-21	A zone	40,000	80X	0.41	0.30

Summary and Conclusions: The analysis of Sample 57-S-21 giving an approximate uranium/thorium ratio of 1:1.5 is in keeping with the radioactive mineral being uranium thorianite . . . On the basis of geiger readings on the B zone and the above analyses it is doubtful if the small body of calcite (5 feet wide and 250 feet long) would grade 0.10 percent U_3O_8 (chemical)."

Mineralization occurs mainly in the marbles and metapyroxenite. The marble is locally graphitic, contains pyrite and is interlayered with pyritic calc-silicate gneiss. The pegmatites which cross-cut the sequence are generally much less radioactive than their host rocks and for the most part are not anomalous. The biotite metapyroxenite is a calcareous metasediment and not a skarn formed by reaction with the pegmatite.

Four samples of mineralized rock taken in 1977 were analyzed for uranium and thorium:

Sample	Rock Type	U_3O_8ppm	Th ppm
R-77-47N-1	biotite diopside marble	770	613
R-77-47N-2	mineralized diopsidic marble	3790	1480
R-77-47N-3	biotite-rich metapyroxenite	1320	1410
R-77-47N-4	diopsidic marble	730	260

Remarks: A granite source for the uranium is postulated with hydrothermal fluids of metasomatic origin mobilizing and transporting the uranium into structurally prepared sites in pyritic marble (reducing environment) where it is precipitated.

HISTORY

1956: Stripping by Standard Ore and Alloys Corporation.
1957: Trenching, diamond-drilling, and scintillometer survey by South State Uranium Mines Limited.

REFERENCES

Satterly (1957a, p.142)
Satterly, J.
1957b: Unpublished report on South State Uranium Mines Limited. On file, Mineral Deposits Section, Ontario Geological Survey, Toronto.

94. SOUTH STATE (SOUTH) OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Uranothorite and uranothorianite

ROCK ASSOCIATION

The marble is anomalously high in uranium. Pyroxene veins within the syenite also give anomalous values for uranium. Country rock consists of marble and syenite.

CLASSIFICATION

Marble, pyroxene-biotite veins

LOCATION

N½ Lot 20, Concession I, Monteagle Township, Hastings County.
Latitude 45°06'55"N; Longitude 77°48'09"W
UTM 4999350mN, 279550mE, Zone 18
NTS Bancroft 31F/4

ACCESS

About 1 km west of the village of Musclow, a gravel road leads south. The occurrence lies 1.5 km along this road, on a hill about 300 m west of the road.

PRESENT EXPOSURE

Poor

SIZE AND GRADE

One pit, 4 by 3 m, was observed. The maximum reading from the siliceous marble on the dump on the TVI spectrometer was 24,000 cpm (T_1f). It was assumed that the marble originated from the pit. The pyroxene veins gave a maximum reading of:

T_1f	85 000 cpm
$T_2(U+Th)$	2 600 cpm
$T_3(Th)$	500 cpm

DESCRIPTION

General Geology: The occurrence is situated within a carbonate unit consisting of interbedded marble, paragneiss and para-amphibolite. Flanking this marble unit are granitic gneisses which likely represent arkosic sequences. This northeast trending sequence has been regionally metamorphosed up to amphibolite facies, with local development of anatectic pegmatite. Intrusion of syenite occurs later. The geology of the area is shown on Ontario Department of Mines Map 1954-3, Monteagle and Carlow Townships.

Detailed Geology: Only a few outcrops were observed in the area of mineralization. These consisted of siliceous marble and massive pink syenite. The syenite is cut locally by pyroxene veins which are the result of partial remobilization of the marble unit along fractures. These pyroxene veins contain local concentrations of vitreous red uranothorite. A small overgrown pit, 4 by 3 m, contains a few blocks of mineralized marble. A sample of the pink syenite away from the pyroxene veins assayed 11 ppm U_3O_8 and 65 ppm Th. This marble is discussed further in the description of the South State (North) Occurrence.

HISTORY

In 1956 and 1957, stripping was carried out by Standard Ore and Alloys Corporation.

REFERENCE

Satterly (1956, p.412)

95. THOMPSON FELDSPAR OCCURRENCE

See "Minor Occurrences"

96. TROUT CREEK (MRS. THOMPSON) OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Uranothorite

ROCK ASSOCIATION

The host rocks are pegmatitic granite and pyroxene veins in country rocks consisting of quartzo-feldspathic gneiss, biotite-hornblende-plagioclase gneiss and marble breccia.

CLASSIFICATION

Simple pink granite pegmatite, pyroxene veins

LOCATION

Lots 4 and 5, Concession VII, Monteagle Township, Hastings County.
Latitude 45°11′23″N; Longitude 77°45′14″W
UTM 5007450mN, 283650mE, Zone 18
NTS Bancroft 31F/4

ACCESS

The occurrence is approximately 2.7 km directly east of Monteagle Valley along the township gravel road. It is about 550 m east of the gravel road and 170 m east of the clearing on Mrs. Thompson's farm.

PRESENT EXPOSURE

Fair to good

SIZE AND GRADE

An average sample for the pegmatitic granite assayed 45 ppm U_3O_8 and 266 ppm Th. A second sample from the marble breccia assayed 6 ppm U_3O_8 and 55 ppm Th. Radioactivity in the trench locally reached as high as 60,000 cpm (T_1) and 2 500 (T_2).

DESCRIPTION

General Geology: The occurrence is situated within a sequence of metasediments comprising meta-arkoses, quartzo-feldspathic gneisses (meta-sandstones), calc-silicate gneiss and marble. This sequence represents the lower part of the Grenville Supergroup of early Late Precambrian age. These rocks are intruded by small granitic and syenitic bodies and by a late Late Precambrian granite pegmatite.

The regional structures generally strike north-northeast and dip shallowly to the east.

Detailed Geology: The showing occurs in a pink, foliated granite with minor pegmatitic units. The host rock is cut by pyroxene and pyroxene carbonate veins (1 to 5 cm wide) which appear to have filled the fractures and joints in the area. Radioactivity is significantly higher along these pyroxene veins than in the neighbouring pegmatitic granite. An adjacent carbonate zone contains rounded to angular inclusions of granitic material as well as hornblende amphibolite and hornblende-plagioclase gneiss. This "breccia zone" is approximately 30 to 40 cm thick and is documented by Satterly (1956) as a marble unit. The unit contains clasts ranging from 1 to 30 cm in diameter representing 30 to 40 percent of the rock.

Mineralization is generally restricted to the contact between the marble "breccia" and the granitic units. Radioactivity is associated with proximity to the marble zone as well as reddening of feldspars, an increase in pyroxene and carbonate veining and a decrease in quartz content. Uranothorite is the radioactive mineral occurring throughout the pyroxene veins and in pegmatitic portions of the granite. (Figure 43).

HISTORY

In 1954, blasting, pitting and stripping were carried out by R.H. Thompson and L. Black.

SELECTED REFERENCES

Hewitt (1955, p.70)
Satterly (1957, p.142)

97. WATSON FELDSPAR OCCURRENCE

See "Minor Occurrence"

98. WELSH FARM OCCURRENCE

COMMODITY

Thorium, cerium

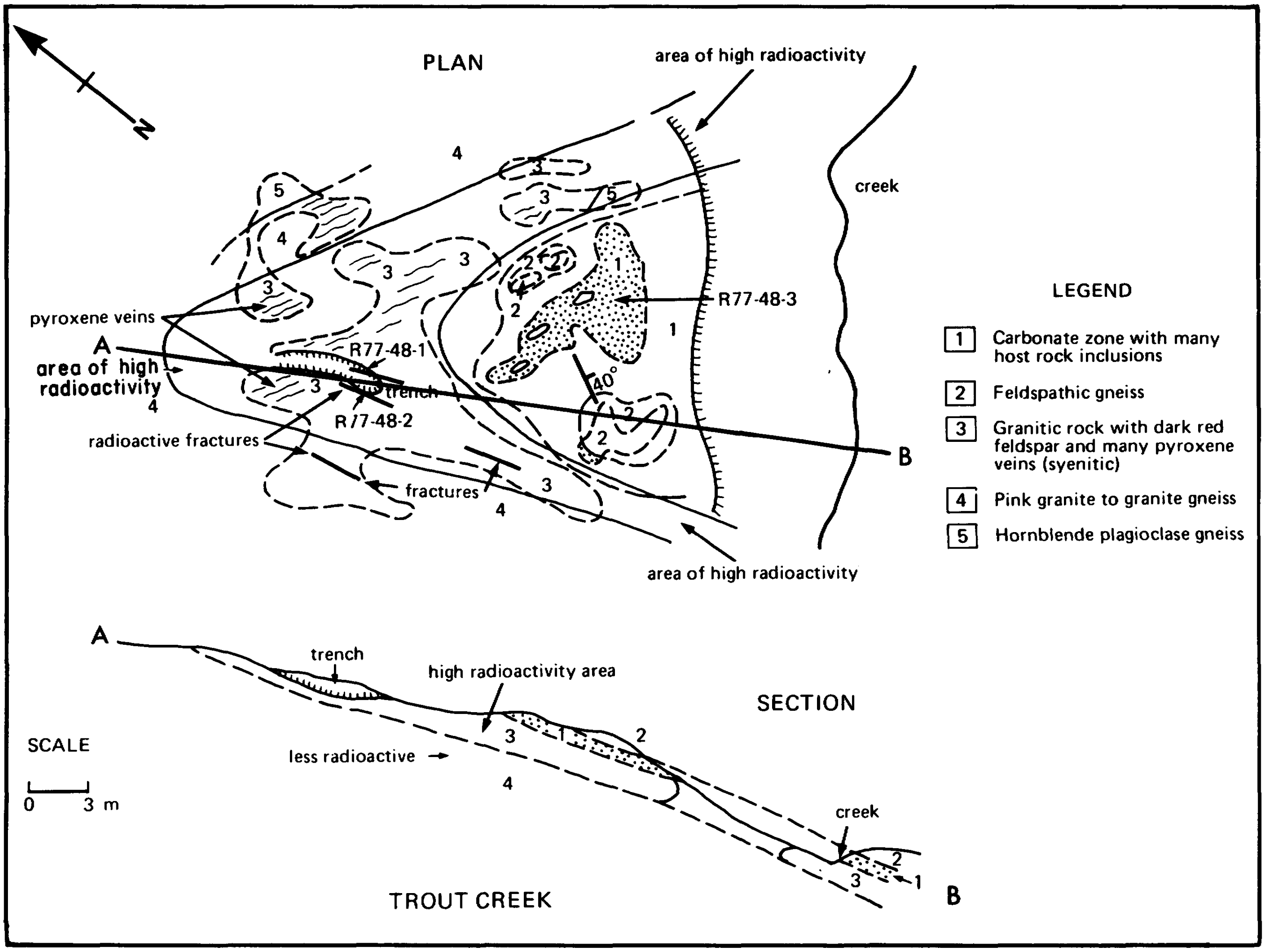


Figure 43 — Geology of the Trout Creek Occurrence

RADIOACTIVE MINERAL
Allanite
ROCK ASSOCIATION
The host is pegmatite emplaced in hornblende plagioclase gneiss.
CLASSIFICATION
Complex granite pegmatite
LOCATION
The occurrence is approximately 2.1 km northeast of Monteagle Valley, in Lot 8, Concession X, Monteagle Township, Hastings County.
Latitude 45°12′28″N; Longitude 77°47′00″W
UTM 5009500mN, 281400mE, Zone 18
NTS Bancroft 31F/4
ACCESS
Approximately 7.5km south of the village of Maple on a gravelled township road, a concession road leads east 1.1 km to a farm road providing access to the Welsh Farm to the south. The occurrence is beside a field stone fence 0.2 km west of the farm road at a point 0.8km south of the concesssion road.
PRESENT EXPOSURE
The occurrence is partially concealed in a pit.
SIZE AND GRADE
Due to lack of exposure, a reliable assessment of this occurrence was not possible. The radioactivity of a sample taken from the dump measured 2500 cpm (U+Th). The only radioactive mineral identified was allanite. A sample of allanite-rich pegmatite assayed 165 ppm U_3O_8 and 2440 ppm Th.
DESCRIPTION
General Geology: The country rocks in the area comprise a sequence of quartzo-feldspathic gneiss, meta-arkose, calc-silicate gneiss, amphibolite and marble belonging to the Grenville Supergroup. The metasediments are intruded by small bodies of syenite, granite and granite pegmatite. The grade of metamorphism is upper alman-

dine amphibolite facies. The gneisses in this area strike N-NNE with shallow easterly dips.

Detailed Geology: Because of poor exposure in the pit, it was not possible to examine the mineralization and its relationship to the host rock in situ. Fly rock close to the pit suggests that the host rock is syenite pegmatite composed of coarse-grained feldspar and hornblende which contains up to 20 percent allanite in masses up to 10 cm in diameter. Hewitt (1955, p. 70) gives the following description:

In a field 700 feet north of the barn on the farm of Mr. Welsh, Lot 8, Concession 10, Monteagle Township, there is a small 8-foot exposure of interbanded amphibolite, pyroxenite, and granite pegmatite. The rock is distinctly gneissic and contains numerous knobs of black vitreous allanite up to 4 inches in diameter. The allanite makes up about 10 percent of the exposure.

High radioactivity levels were recorded only in the immediate area of the showing. The only other exposure in the proximity of the occurrence, a small outcrop of hornblende plagioclase pegmatite, has a radioactivity level of 80 cpm (U+Th).

HISTORY

There is no record of when the occurrence was opened but it is probable that the work was done in the early 1950s when exploration for uranium was most active in the Bancroft area.

REFERENCE

Hewitt (1955, p.70)

99. WOODCOX MINE OCCURRENCE

COMMODITY

Main - feldspar

Minor - uranium and thorium

RADIOACTIVE MINERALS

Betafite, cyrtolite, columbite, pyrochlore and calciosamarskite.

ROCK ASSOCIATION

The host is zoned granite pegmatite in pink leucogranite gneiss.

CLASSIFICATION

Zoned pink granite pegmatite - feldspar type

LOCATION

Lot 17, Concession VIII, Monteagle Township, Hastings County.

Latitude 45°10'44''N; Longitude 77°49'04''W

UTM 5006460mN, 278600mE, Zone 18

NTS Bancroft 31F/4

ACCESS

The occurrence is at the edge of a field approximately 200 m south of a gravel township road, 3.3 km east of Hybla and 3.5 km west of Monteagle Valley.

PRESENT EXPOSURE

Poor

SIZE AND GRADE

Ellsworth (1932) suggested that the radioactive minerals could have formed a valuable by-product had they been saved in the mining for feldspar. Ellsworth also reported that radioactive masses up to 100 lbs were taken from the pegmatite. Although he did not state the concentration of mineralization in the pegmatite, he did add that "nowhere else in Canada have such large individual masses been found in quartz and feldspar." Some of these masses contained from 10 to 16% U_3O_8.

DESCRIPTION

Geology: The following description of the Woodcox Mine is given by Hewitt (1955, p.50):

The granite pegmatite dike trends N60°E, with a nearly vertical dip. The open cut on the dike has a length of 330 feet and an average width of 30 to 35 feet. The cut is filled with water, and very little can be seen of the dike at the present time. Along the south side of the cut, granite pegmatite, the country rock, and a pink leucogranite gneiss, are exposed. This wall-zone pegmatite appears to be composed largely of graphic granite. Along the north side of the cut there are two outcrops of granite pegmatite and one outcrop near the east end showing the contact of the pegmatite with pink leucogranite gneiss. A small exposure of pegmatite near the centre of the cut on the north side exposes large 5- to 6-foot crystals of good grade, pink potash feldspar, with very little associated quartz. The material on the dump shows a considerable amount of medium-grained (4- to 6-inch) mottled pink and white potash spar, as well as some graphic granite. Amazonite, peristerite, hornblende, magnetite, biotite, titanite, pyrite, columbite, ellsworthite, allanite, muscovite, calcite, hematite and epidote were also noted on the dump.

The dike contains a considerable amount of coarsely crystalline pink microcline with massive white quartz. Nodular masses of brown to black radioactive minerals commonly associated with crystals or masses of cyrtolite and columbite are not unusual. These masses in places weighed as much as 100 pounds.

In 1955, J. Satterly visited the property and gave the following report:

Geiger readings taken by the author over the old dumps and pit margins were 2X - 3X with rare spot-highs of 5X, 12X and 20X. A few chips of a black uranium mineral found at these spot-highs were identified as betafite by S.C. Robinson, of the Geological Survey of Canada.

A selected sample collected by the authors in 1977 was identified as pyrochlore and assayed to be 9.23% U_3O and 1.93% Th. A sample of pegmatite containing uraninite, sphene and zircon assayed 2400 ppm U_3O_8 and 720 ppm Th.

Discussion: The abundance of calcite, sphene, hornblende and calcic pyroxene suggests that the pegmatite crystallized in a fluid-gas environment very rich in CO_2. The similar presence of abundant carbonate at this mine and also at MacDonald, Bartlett, Genesee and Plunkett mines, all of which contain uranium-bearing minerals, suggest that CO_2 may play an important role in the collection of U, Th and rare earths in the pegmatite. The above mines appear to be structurally related as they all trend in a northeastward direction. The pegmatites probably formed by the injection of anatectic melts along fractures during the waning stages of high-grade regional metamorphism.

Three basic theories have been proposed for the enrichment of uranium in the zoned pegmatite of the Hybla area:

(1) The presence of carbonate in the anatectic melt

aided the collection and concentration of uranium and rare earths.

(2) The anatectic melt which formed the pegmatite was derived from a sequence already containing radioactive elements.

(3) A combination of (1) and (2). This is favoured by the authors.

HISTORY

The early history has been described by Spence (1932, p.49) as follows:

> This property was worked from 1921 to 1923 by the Feldspar Mines Corporation, the Canadian subsidiary of the Pennsylvania Pulverizing Company, and ranks next to the nearby MacDonald mine in work performed and tonnage shipped.
>
> Work was confined to a single long, open-cast pit, 325 by 40 by 20 feet deep, sunk on a dike of pink spar. The deposit is stated to have yielded about 6,000 tons of high-grade spar. The mine has been idle since 1923 and all the plant has been removed.
>
> Like the MacDonald mine, this mine had yielded a variety of rare-element minerals. Green amazonite spar was encountered in some quantity in the east end of the pit, and a proportion of the quartz present was of exceptionally clear and flawless character.

In 1948 and 1949 the property was examined by Northern Uranium Mines Limited.

In 1955, Metro Minerals and Uranium Mines Limited explored the granite pegmatite dike under the old pit with seven drill-holes totalling 1 472 feet. These holes are reported to have intersected widths of feldspar of 10 to 45 feet.

SELECTED REFERENCES

Ellsworth (1932, p.209)
Hewitt (1955, p.47, 50)
Satterly (1957, p.143)
Spence (1932, p.49)

100. WRIGHT OCCURRENCE

101. COMET QUARTZ OCCURRENCE

For detailed descriptions of Deposits 100 and 101 see "Minor Occurrences" listed at the back of this report.

102. MOUNTAIN CHUTE OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Allanite (?); Sphene (?)

ROCK ASSOCIATION

The host is granite pegmatite intruding marble, garnet amphibolite gneiss and rusty felsic gneiss.

CLASSIFICATION

Simple to complex pink granite pegmatite.

LOCATION

The occurrence is 500 m southeast of the Mountain Chute Dam in Lot 18, Concession IX, North Canonto Township, Frontenac County.

Latitude 45°11'35"N; Longitude 76°54'04"W

UTM 5005950mN, 350650mE, Zone 18

NTS Clyde Forks 31F/2

ACCESS

The occurrence is in a road cut 500 m southeast of the Madawaska River bridge at the Mountain Chute Dam.

PRESENT EXPOSURE

Excellent

SIZE AND GRADE

A radioactive area 1 m by 4 m occurs within a pegmatite 5 m wide exposed for 20 m along strike.

DESCRIPTION

General Geology: The area is underlain by marbles, paragneisses and metavolcanics of the Grenville Supergroup of Upper Aphebian to Lower Helikian age. Metamorphic grade is of the upper almandine amphibolite facies. This sequence is intruded by late granite pegmatites and occasional late diabase dikes. (Figure 44)

Detailed Geology: Country rocks near the occurrence are graphitic and phlogopitic marble with minor amphibolite, garnet amphibolite and rusty felsic gneiss. The rocks strike northeasterly and dip to the southeast. They are intruded by sills and dikes of white granite pegmatite. Sphene and pyrite are common accessory minerals within the pegmatites. Anomalous radioactivity is more consistent in pegmatites within pyritic felsic gneiss than in pegmatite within marble or amphibolite. The radioactivity is associated with fracturing, a rusty surface and dark-coloured rock. The pegmatite contains approximately 20 percent sphene, biotite, a micaceous mineral (chlorite?), a black vitreous mineral (allanite?) and dark plagioclase where it is mineralized.

TABLE 16· URANIUM AND THORIUM CONTENTS OF SOME SAMPLES FROM THE MOUNTAIN CHUTE OCCURRENCE

Sample	Rock Type	U_3O_8	Th (ppm)
R-78-107-2	garnet plagioclase amphibolite gneiss	< 1	< 10
R-78-107-4	rusty-weathering pyritic felsic gneiss	2	40
R-78-107-3	pyritic white - light pink pegmatite	35	10
R-78-107-1	dark-coloured pyritic sphene syenitic pegmatite	230	

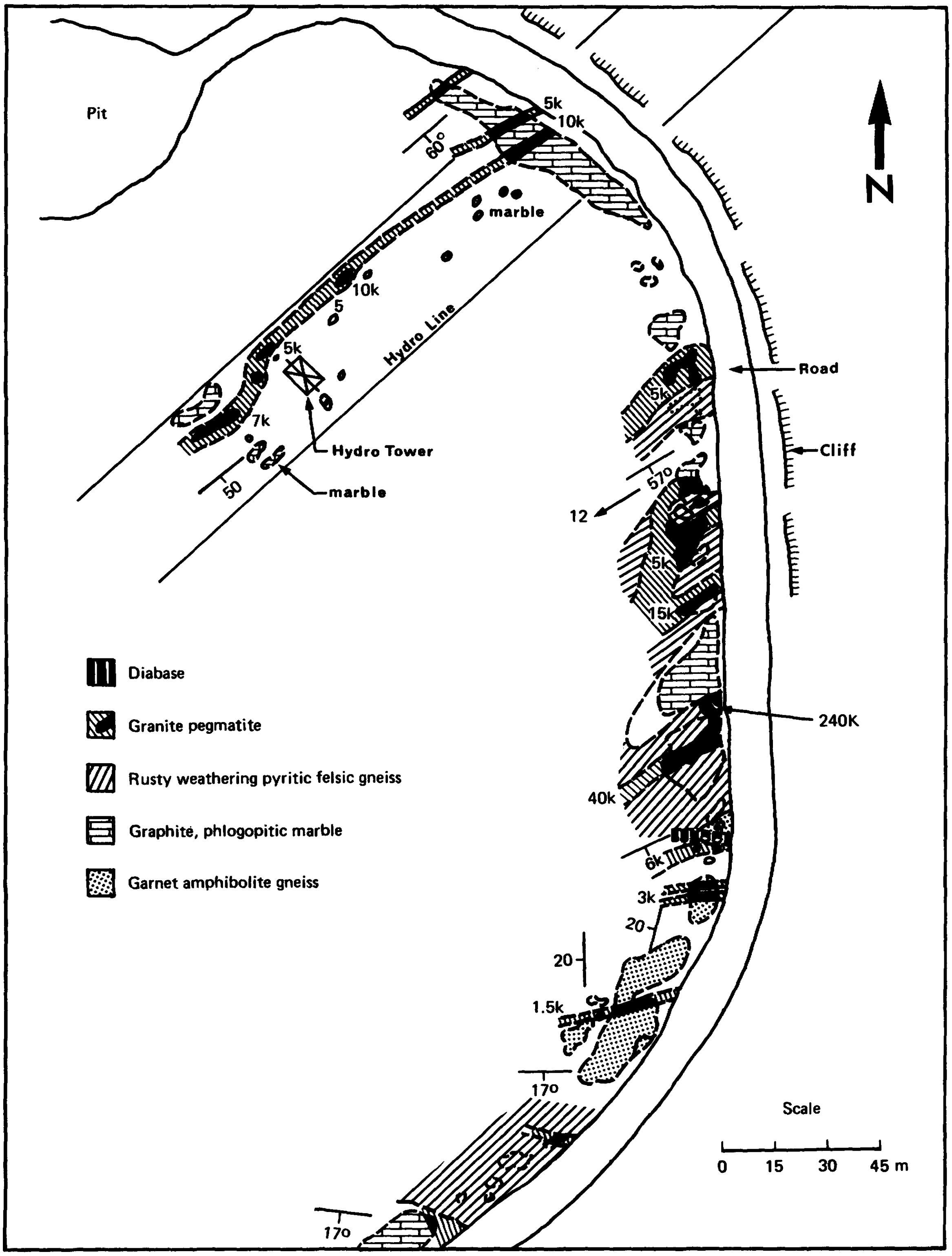


Figure 44 — Geology of the Mountain Chute Occurrence.

Four samples were collected for analysis. The results are shown below:

HISTORY

The occurrence was discovered in 1977 by C. Storey of the Ontario Geological Survey during field mapping. It was examined by the authors in 1978.

103. CRAIGMONT CORUNDUM MINES OCCURRENCE

COMMODITY

Main - Corundum

Minor - Uranium, thorium, niobium and cerium

RADIOACTIVE MINERALS

Allanite, uraninite and euxenite

ROCK ASSOCIATION

The host rocks are pink granite pegmatite and pink corundum pegmatite in country rocks of syenite.

CLASSIFICATION

Simple unzoned syenite and granite pegmatites

LOCATION

The occurrence is located within the abandoned workings of the Craigmont Corundum quarry, in Lots 3 and 4, Concession XVIII, Raglan Township, Renfrew County.

Latitude 45°18'13''N; Longitude 77°36'48''W

UTM 5019800mN, 295100mE, Zone 18

NTS Barry's Bay 31F/5

ACCESS

The quarry is approximately 8 km south of the town of Combermere, and about 1.6 km along a gravel road which runs east from Highway 517 at the Hastings-Renfrew County Border.

PRESENT EXPOSURE

The workings are very well exposed except for a few minor flooded areas.

SIZE AND GRADE

Unknown

DESCRIPTION

General Geology:The following description of the geology of the Craigmont area is given by Satterly (1945, p.32):

> The corundum occurs in a belt of hybrid syenite gneiss, which ranges from a quarter to one and a half miles, in width and has been traced across the northern part of Raglan Township into Radcliffe and Brudenell Townships. It is bounded on the north and south by belts of interbedded paragneiss and crystalline limestone. Owing to the complex folding and lack of detailed field work the extension of this belt to the east has not been worked out. Reported corundum occurrences in Sebastopol Township may be in similar rock types on the extension of the above belt.
>
> The hybrid syenitic gneisses or syenitic migmatites are typically banded pink, white and grey gneisses, in which the corundum occurs as scattered grains or crystals in narrow bands separated from one another by barren bands. The corundum occurs in bands of gneiss, syenite-pegmatites, and nepheline rocks interbanded with the gneisses. The corundum crystals are usually bronzy-brown in colour on a fresh fracture. Most of the crystals are rough-surfaced and barrel-shaped except those found in the nepheline bands, which are smooth-surfaced, sharp-angled and more tapered.

Mineralization:The following description of radioactive mineralization is given by Ellsworth (1932, p.230):

> At Craigmont there are enormous open cuts on the side of a large hill where corundum was formerly mined. Much the greater part of the corundum obtained came from red syenite pegmatite, but some was later obtained from corundum-bearing nepheline rock . . . Minerals seen on the dump or in situ were: magnetite, pyrite, pyroxene, black hornblende, common; black and white mica, occasional; molybdenite, occasional; in flakes up to 2 inches diameter. Calcite occurs moulded on inwardly projecting feldspar crystals and faces. Quartz occurs only rarely and in small amounts lining vugs and probably of secondary origin.
>
> Euxenite or similar complex radioactive minerals and allanite can be found in small amounts throughout the pegmatite workings without much trouble . . . A sample of concentrate . . . under the binocular revealed a few small grains chemical and alpharay tests proved to be unquestionably uraninite . . . Mr. E.B. Clarke, former manager of the mine, informed the writer that there was, according to his estimate, 350,000 tons of tailings from the old operations, of which 200,000 tons still containing 3½ percent corundum could be rehandled. It seems probably, however, that any uraninite originally present will be decomposed by this time, though minerals such as euxenite, etc., may still be recoverable.

During the authors' examination of the property, it was found that light pink to white corundum-bearing syenite pegmatite generally gave radioactive readings of less than 30 cpm (T_2). The only anomalous area found by the writers was a zoned pegmatite with a pink granitic core and syenitic borders which cut the corundum-bearing syenite pegmatite. The radiaoctivity was from the allanite within the granitic core which includes abundant biotite, magnetite and pyroxene. The feldspar is very pink and quartz is smokey. Readings of 800 to 900 cpm (T_2) were obtained from this granitic core. The rest of the pegmatite is syenitic with radioactive levels of 50 cpm (T_2). A selected sample R-77-51-1 from the granitic core assayed <2 ppm U_3O_8 and 650 ppm Th. The radioactive mineral, which is black, vitreous and bladed, was identified by X-ray diffraction as allanite. In another sample of the same rock, values of 20 ppm U_3O_8 and 504 ppm Th were obtained.

HISTORY

The history of the corundum industry in Canada has been reviewed in detail by Eardley-Wilmot (1927):

> The largest corundum deposit in Canada, now known as the Craig mine, was discovered by Henry Robillard in 1876 . . . The Canada Corundum Company, in April 1900, was the first organization to start mining and milling operations for corundum in Canada. Ore . . . was concentrated in a 20-ton mill on the property.
>
> The Craig mine was operated from 1900 to 1907 by the Canada Corundum Company Limited. From 1908 to 1913 the mine was leased to the Manufacturers Corundum Company. On February 3, 1913, the mill at Craigmont was destroyed by fire. In 1919, Corundum, Limited, leased the property . . . and built a new 100-ton mill at Craigmont to treat tailings, of which it was estimated there were 300,000 tons. Grain corundum was produced from December, 1919, until the mill closed down in June, 1921.

REFERENCES

Eardley-Wilmot (1927)

Ellsworth (1932, p.230-231)

Satterly (1945, p.32-33)

104. DODD OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uranothorite
ROCK ASSOCIATION
The host rock is pink biotite pegmatite and the country rock is a metagabbro.
CLASSIFICATION
Simple pink granite pegmatite
LOCATION
The occurrence is located 1.3 km north of the village of Ireland, in Lots 6 and 7, Concession IV, Raglan Township, Renfrew County.
Latitude 45°10'34''N; Longitude 77°32'02''W
UTM 5005400mN, 300900mE, Zone 18
NTS Bancroft 31F/4
ACCESS
The occurrence can be reached by following the gravel road going north from Ireland for approximately 1.3 km. The showing is at a fresh roadcut in pegmatite.
PRESENT EXPOSURE
The pegmatite dike is well exposed.
SIZE AND GRADE
The dike varies from 6.1 to 7.6 m in width but both contacts of the dike are never observed at once so that exact width cannot be determined accurately. The dike is at least 800 m long. It warrants further investigation. The Raglan gabbro body contains a number of these dikes, and due to similarities to the Faraday gabbro, intensive prospecting of this area should be considered. The most radioactive area on the dike was in a freshly blasted outcrop near the road. This suggests that many of the outcrops along the dike may have suffered surface leaching of uranium. The sample obtained from this roadcut assayed 580 ppm U_3O_8 and 1260 ppm Th. A sample sent by E. Price of Pembroke to the Mines Branch in Ottawa assayed 0.41 perent both radiometric equivalent and estimated uranium content. A few chip samples across some 18.3 m of pegmatite assayed privately by Mr. Price were reported to have 0.02% U_3O_8.
DESCRIPTION
Geology: The occurrence consists of a pink biotite granite pegmatite dike in country rocks of metagabbro and amphibolite gneiss. The pegmatite dike outcrops on the road just north of Ireland and extends in a NE-SW direction for at least 800 m.

The pegmatite is most radioactive where abundant biotite is present and near the contacts with the gabbro. High radioactive readings occur in areas along the dike but only at two places did the radioactivity exceed 1000 cpm (T_2) (U + Th). (Figure 45).

A sample sent to Toronto for radioactive mineral identification has been reported to contain uranothorite.
HISTORY
Mr. Earl Price of Pembroke, Ontario, sent three samples to the Mines Branch in Ottawa in 1955 for radiometric tests.
REFERENCE
Geological Survey of Canada Radioactive Resources Division File 31F/SW-2

105. MARQUARDT (HENDERSON) OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uranophane, uraninite and uranothorite
ROCK ASSOCIATION
The host rock is a white pegmatite in country rocks consisting of granite, granitic gneiss, pegmatites and metasediments.
CLASSIFICATION
Simple white granite pegmatite (sheared).
LOCATION
The occurrence is located in Lots 30-35 inclusive in Range V and part of Range VI, Raglan Township, Renfrew County
Latitude 45°13'20''N; Longitude 77°24'36''W
UTM 5010250mN; 310800mE, Zone 18
NTS Denbigh 31F/3
ACCESS
The property is approximately 45 km northeast of Bancroft on Route 500 or approximately 1.6 km northwest of the village of Bruceton. An alternative route is west from Renfrew on Highway 41 through the village of Denbigh which in turn is only 21 km by gravel road directly to the property.
PRESENT EXPOSURE
Well exposed.
SIZE AND GRADE
Five radioactive dikes were studied in detail by Henderson Uranium Mines Ltd., namely Showings Number 1, 2, 3, 4 and 5. A description of these is given in Ontario Geological Survey Source Mineral Deposit Record 000377:

Showing No. 1 is located near the SE corner of claim E.O. 31416. It consists of two parallel, sheared and brecciated pegmatite-filled zones. The west zone is about 25 ft. wide, heavily biotitized in streaks and yields a reading of 2 000 to 5 000 counts per minute (Geiger). The east zone is about 10 ft. wide and yields from 3 000 to 5 000 counts per minute. Assay samples yielded 0.035 to 0.079% U_3O_8 with a selected grab sample returning 0.28% U_3O_8.

Showing No. 2 (claim E.O. 31416 and 31419) is located 2 600 ft. NE of Showing No. 1. This showing is a narrow brecciated pegmatite dike lying outside of the main pegmatitic granite sill. It is heavily biotitized and contains an appreciable amount of fine pyrite, sericite and minor amounts of fluorite. The showing consists of a branching dike; the main branch has an average width of 6 ft. and strikes at N20°E for over 500 ft. The minor branch strikes at N30° E. The dip of the branches varies from 55° to 77° SE. Geiger readings range from 5 000 to 15 000 counts per minute.

Showing No. 3 is located 500 ft. NE of No. 1 and lies within claim E.O. 31417. It consists of a sheared and brecciated pegmatite-filled zone. The zone is well biotitized, has a possible projected length of 700 ft. and reads from 3 000 to 9 000 counts over an average width of 30 ft. A chip sample over 6 ft. returned 0.15% U_3O_8; and a 10 ft. centre cut assayed 0.08% U_3O_8. A grab sample returned 0.09% U_3O_8.

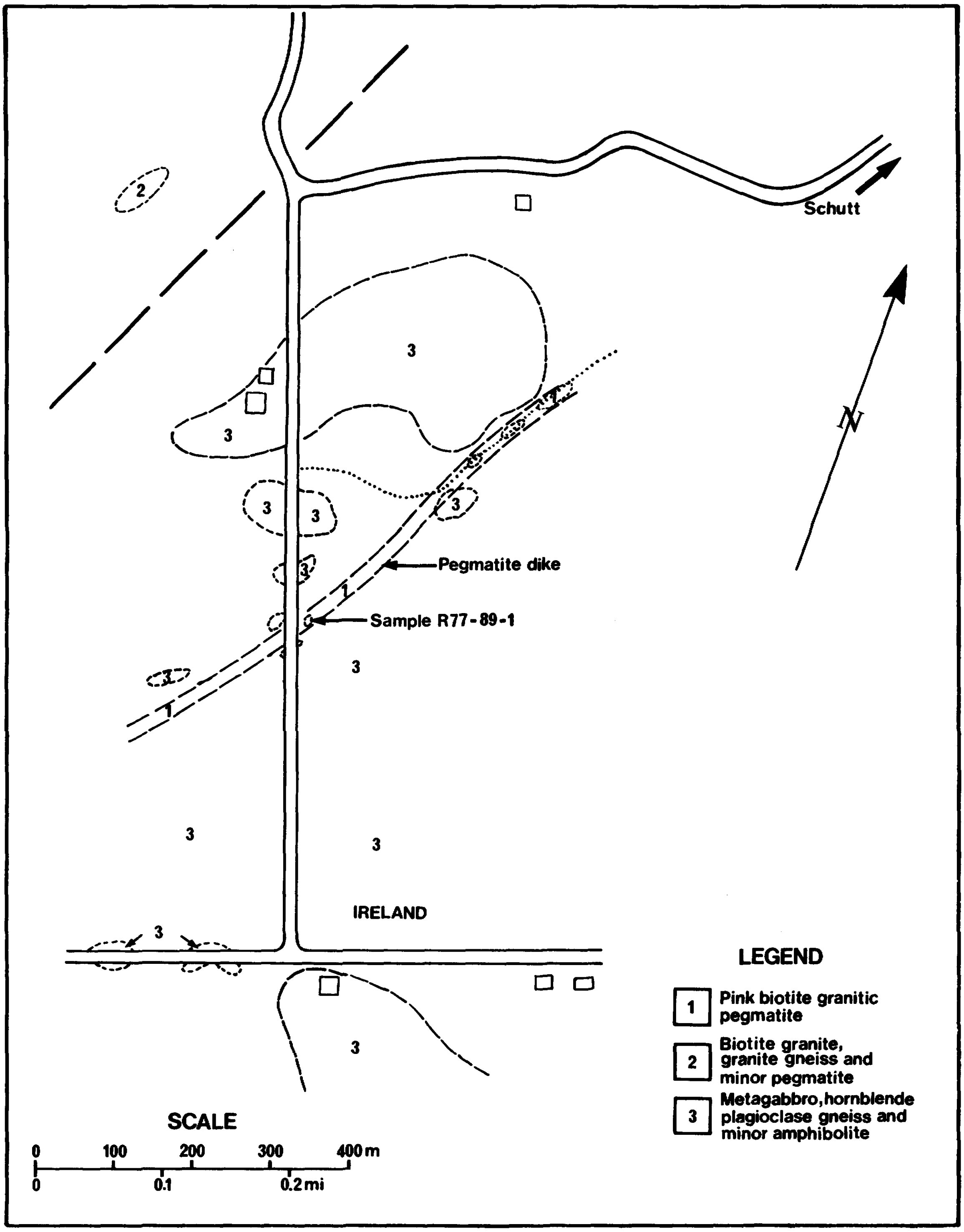


Figure 45 — Geology of the Dodd Occurrence.

Showing No. 4 (claim E.O. 31417) consists of a 40 ft. wide sheared and brecciated zone with an exposed length of 150 ft. which strikes at N20°E. The zone contains much quartz and biotite and reads from 3,000 to 5,000 counts per minute. A representative grab sample assayed 0.22% U_3O_8. Other samples assayed 0.33% and 0.65% U_3O_8.

Showing No. 5 (claim E.O. 31417) is located 2 000 ft. NE of showing No. 1. It is similar to No. 3. A representative grab sample gave 0.13% U_3O_8.

DESCRIPTION

Geology: The following is a descripion of the property by Harris (1958):

> The Henderson Property is underlain by late Precambrian metasedimentary and intrusive rocks. The metasediments consist of impure marbles, plagioclase amphibolites, and a variety of clastic sediments referred to as paragneiss. These rocks are intruded by gabbroic and granitic rocks and by very late pegmatites. The metasediments are for the most part highly folded. In some areas, metasediments with near granitic compositions, have been granitized and partially melted to resemble true intrusive rocks. Only stratigraphy and faint remains of compositional layering indicate their sedimentary origins. The occurrence consists of several parallel pegmatite dikes and/or sills trending N25°E to N35°E through a main pegmatitic sill which trends N30°E and assumes its maximum width of 500 feet on claim 18944. These northeast trending pegmatite bodies occupy fractures parallel to the axis of a series of northeast-trending folds in the granite gneiss complex. Regional faults trending generally northwest cross the area with resultant tangential and cross faulting being common. The pegmatitic zones trending northeasterly thus follow the lines of weakness created by the faults. Further movement along these secondary cross and thrust faults was probably coeval with the entrance of uranium-bearing quartz-rich pegmatite solutions.

Mineralization: Mineralization for the most part is restricted to siliceous, biotite-rich, sheared granite pegmatite. Along the shear zones uranophane stain, amber grains of uranothorite, and often abundant minute cubes of uraninite are observed.

DISCUSSION

Siliceous sheared or fractured mineralized pegmatites are quite common on other properties such as Eagle Nest, Cam's Lower Dungannon, Mentor, and Honsberger, and in both the Madawaska and Greyhawk mines. In most cases, this sheared or fractured portion of the pegmatite is mineralized, suggesting some post-magmatic secondary enrichment process. In some instances mineralization and shearing appears to have occurred soon after crystallization of all or most of the pegmatite. This suggests the introduction of the very last residual quartz-rich fluids, whereas in others such as the Mentor, York River G Zone, Honsberger (in part) or the Marquardt, mineralization appears to be much later, related to faulting or shearing.

There is strong evidence to suggest that the last residual fluids seldom cause this late mineralization. It is more likely some variation of the process, indicated on the Marquardt property, where highly sheared or fractured pegmatite permitted leaching of uranium, and its subsequent precipitation into the negative pressure areas of the shears or fracture zones by circulating hydrothermal solutions. The presence of biotite at the Marquardt property suggests that this process occurred at fairly high temperatures, probably during the waning stages of the pegmatite intrusive event. A similar process can also work in granites and may have formed some of the Cam, York River and Eagles Nest Showings.

HISTORY

1954: The zone now designated as Showing No. 2 was partially stripped and trenched by Henderson Uranium Mines Limited.

1956: Geological, scintillometer and magnetometer surveys, and blasting and stripping by Geo-Technical Development Company Limited on the Henderson Uranium property.

1958: Geological, geiger and scintillometer surveys, and four drill holes totalling 161 feet (2 each at Showing No. 2 and No. 4) by J. J. Harris.

1968: Some trenching and drilling of 11 holes for 3,085 feet by Merland Oil Company of Canada Limited.

REFERENCES

Harris, J.J.
1958: Summary Report on the Henderson U Mines Ltd., Raglan and Lyndoch Townships, County of Renfrew, unpublished Company Report

Ontario Geological Survey, Assessment Files Research Office, Toronto: Technical file 63.798 (Includes company reports).

Ontario Geological Survey, Geoscience Data Centre, File SMDR 000377.

106. WEBSTER OCCURRENCE

107. BETZ OCCURRENCE

108. CHEVRIER OCCURRENCE

For detailed descriptions of Deposits 106, 107 and 108 see "Minor Occurrences" listed at the back of this report.

109. FORESTER FALLS OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Uranothorite

ROCK ASSOCIATION

The host is hornblende pegmatite intruding grey hornblende-biotite granitic gneiss overlain by rusty-weathering pyritic calc-cilicate gneisses.

CLASSIFICATION

Pegmatite

LOCATION

Lots 6 and 7, Concession IX, Ross Township, Renfrew County.

Latitude 45°40'38"N; Longitude 76°45'05"W

UTM 5059500mN, 362300mE, Zone 18

NTS Cobden 31F/10

ACCESS
Approximately 1 km on a paved road southeast of Forester Falls, a dirt road about 300 m long leads east to the C.N.R. mainline. The occurrence is in a rock cut on the right of way approximately 750 m north of the dirt road.
PRESENT EXPOSURE
Very well exposed in railway rock cut.
SIZE AND GRADE
The pegmatite dike is 0.3 m wide and contains very spotty radioactivity. A sample from the area with the highest radioactivity assayed 0.015% U_3O_8 and 0.16% Th.
DESCRIPTION
General Geology: The area is underlain by a sequence of marble, pyritic scapolite diopside gneiss and a grey foliated hornblende-biotite granitic rock. These rocks are openly folded with their axes plunging eastward. Two ages of pegmatite intrude these rocks. The early pegmatites are foliated and frequently occur at the contact of the granitic rock with the scapolitic gneiss, or they may occur as small irregular phases within the granitic rock. The younger pegmatites are fracture fillings with a dike-like appearance and are unmetamorphosed. They are usually less than 0.3 m thick. The younger pegmatites show anomalous radioactivity in contrast with the early pegmatites. The country rocks in this area are also intruded by small veins of calcite, fluorite and apatite which show slightly anomalous radioactivity.
Detailed Geology: Neither the exact location of the original sample submitted to the Radioactive Laboratory in Ottawa by L. Vaughan nor the pegmatite from which it was taken are known. A description of a pegmatite in the immediate area of the original discovery, which was found to be anomalously radioactive and is submitted as representative of the original discovery.

In the immediate area, rusty-weathering pyritic scapolite diopside gneiss is seen to overlie the grey foliated hornblende-biotite granitic rock. Structurally, the rocks occupy and open fold striking due north and plunging at 30 to 40° eastward. Intruding the foliated granitic rock is a narrow (0.3 m) biotite-hornblende granite pegmatite dike striking N20°E and dipping 42°SE. This late unmetamorphosed pegmatite has anomalous radioactivity with spotty readings up to a maximum of 2 000 cpm on the U+Th spectrum (T_2+T_3). (Figure 46).

This pegmatite has sharp contacts with the host rock, displays a crude zoning and has a high mafic content. The hanging wall of the dike consists of quartz and feldspar with large aligned hornblende crystals. The composition of the pegmatite is 60 to 70 percent pink K-feldspar, 10 percent quartz and 10 to 25 percent hornblende and biotite. Analysis of a highly radioactive sample (R-77-55-1) indicates that the radioactivity is associated with biotite and hornblende. Black, anhedral, vitreous grains were identified as uranothorite. The late pegmatites contain substantially more mafic minerals than the early non-anomalous irregular foliated pegmatites.
Petrography and Chemistry: The rusty-weathering pyritic scapolite diopside gneiss overlying the grey granitic rock is believed to be a metamorphosed calcareous sandstone. Analysis of the unit reveals a content of 2 ppm U, 4 ppm Th and 53 ppm Cu. Its composition is 45 percent quartz, 35 percent diopside, 10 percent biotite, 5 percent scapolite, 4 percent pyrite and minor tremolite, sphene and calcite. The grey foliated biotite-hornblende granitic rock is very weakly radioactive giving low readings of 30 cpm (U+Th) on the scintillometer and assaying less than 2 ppm (fluorimetric) and 12 ppm Th (XRF). In thin section, this rock is seen to be composed of 60 percent andesine, 15 percent quartz, 15 percent biotite, 5 percent hornblende and about 5 percent orthoclase with accessory sphene and apatite. It has a well-developed interlocking fabric and is foliated. The composition is that of a quartz diorite.

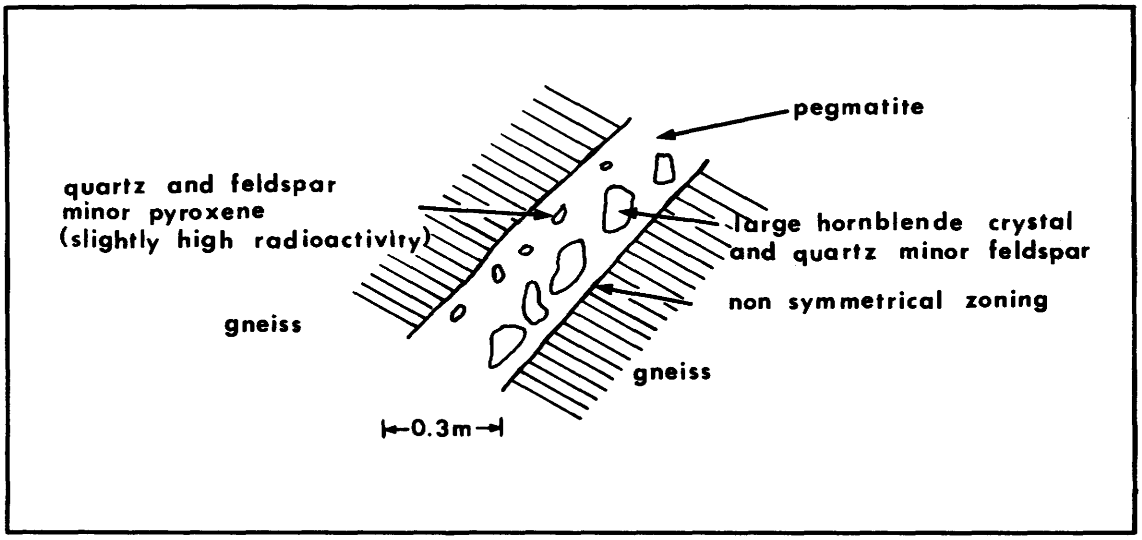


Figure 46 — Pegmatite dike of the Forester Falls Occurrence.

HISTORY
In 1954, L. Vaughan sent samples from this location, then owned by D. White, to the Radioactivity Laboratory in Ottawa for uranium and thorium analysis.
REFERENCE
Geological Survey of Canada Radioactive Resources Division, File 31F/10-14.

110. VAUGHAN OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uranothorite
ROCK ASSOCIATION
Mineralized apatite-fluorite-carbonate veins in syenitic pegmatite adjacent to marble and calc-silicate rocks.
CLASSIFICATION
Apatite-fluorite-carbonate vein
LOCATION
In a railway cut, Lots 2 and 3, Concession VII, Ross Township, Renfrew County.
Latitude 45°42'13"N; Longitude 76°47'11"W
UTM 5062450mN, 360900mE, Zone 18
NTS Cobden 31F/10
ACCESS
Approximately 1.4 km south of the concession road between Wesmeath and Ross Townships, in rock cut on C.N.R. mainline. The showing is just past a farmhouse to the west.
PRESENT EXPOSURE
Well exposed in railway rock cut, but all radioactive rocks are loose fragments from the cut.
SIZE AND GRADE
The veins are small, ranging from 5 cm to 1 m wide, and are very irregular in shape. Not all veins show anomalous radioactivity but those that do are quite high. A selected sample assayed 0.53% U_3O_8 and 1.51% Th. The area of exposure is small and therefore size and extent of these veins is difficult to assess without further work.
DESCRIPTION
General Geology: The area is underlain by marbles, quartzo-feldspathic gneisses, minor biotite-hornblende paragneisses and calc-silicate gneisses. These rocks are intruded by minor pegmatite granite and syenite. In the immediate area of the occurrence, marbles and calc-silicate rocks lie east of the railway tracks and quartzo-feldspathic gneisses and biotite-hornblende gneisses to the west of the tracks. The occurrence is in veins cutting the syenite pegmatite which lies between carbonate rocks and the paragneisses.
Detailed Geology: The railway cut exposes a large pink syenite pegmatite dike cutting hornblende-plagioclase gneiss. The pegmatite has irregular patches and veins of carbonate, fluorite and apatite with accessory pyrite and pyroxene. (Figure 47)
HISTORY
1954: Discovered by L. Vaughan, who submitted samples to the Radioactivity Laboratory in Ottawa for analysis.
REFERENCE
Geological Survey of Canada, Radioactive Resources Division File 31F/10-14.

111. WOERMKE NO. 4 OCCURRENCE

COMMODITY
Uranium and thorium
RADIOACTIVE MINERALS
Uranothorite

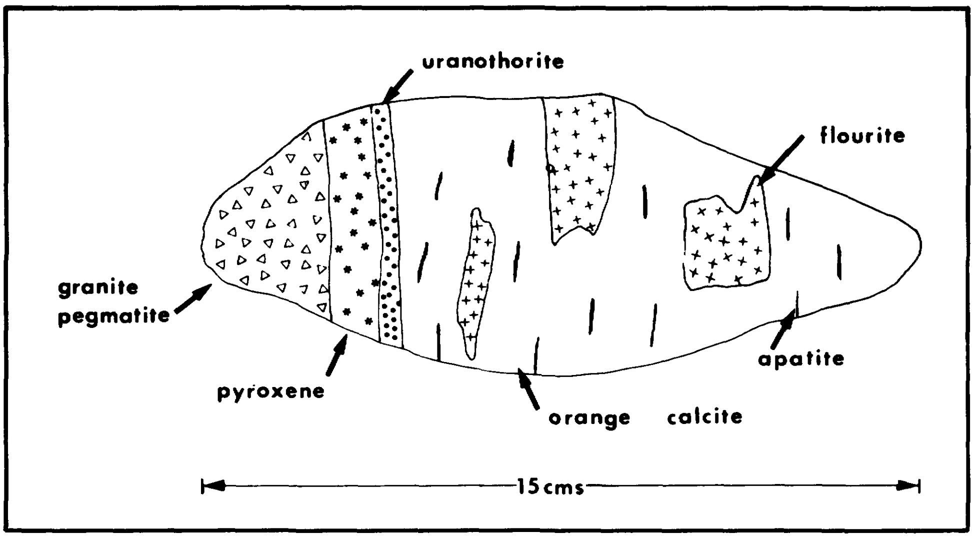


Figure 47 — Sketch of radioactive carbonate vein in pegmatite.

ROCK ASSOCIATION

The host is an apatite-fluorite carbonate vein intrusive into calc-silicate gneiss, granite and amphibolite. The country rocks include calc-silicate gneisses, marble, hornblende amphibolite gneiss, meta-arkose and meta-sandstone.

CLASSIFICATION

Calcite-hornblende-apatite vein

LOCATION

The occurrence is approximately 2 km southeast of the town of Cobden, in NW ¼ Lot 7, Concession II, Ross Township, Renfrew County.

Latitude 45°37'11"N; Longitude 77°51'43"W

UTM 505325mN, 354850mE, Zone 18,

NTS Cobden 31F/10

ACCESS

The occurrence lies on a ridge approximately 488 m N50°E from Highway 17 at a point 1.6 km south of the road between Cobden and Eganville.

PRESENT EXPOSURE

Well exposed on a ridge giving a good cross-section of the host rocks.

SIZE AND GRADE

This occurrence is very lean and spotty. A selected sample, R-77-90-3, assayed 0.014% U_3O_8 and 0.095% Th. The area from which this sample was taken gave a maximum reading of 2000 cpm (U & Th spectrum), confined to a few square centimetres.

DESCRIPTION

General Geology: The area is underlain by calc-silicate gneisses and hornblende gneiss intercalated with meta-arkose and impure meta-sandstone. Intruding the paragneisses are sills and dikes of pink pegmatitic granite as well as potassium feldspar-fluorite-apatite-calcite veins. The radioactive occurrence is associated with one of the fluorite-apatite-calcite veins.

The pegmatitic granite was observed cutting hornblende gneiss at shallow angles. Background radioactivity for the granite is 200 cpm (U + Th) which is not anomalous for this rock type.

Detailed Geology: The apatite-fluorite-calcite veins appear to be stratigraphically controlled and restricted to biotite hornblende calc-silicate gneiss with minor interbedded amphibolite and quartzo-feldspathic gneiss. Although stratabound, they locally exhibit intrusive relationships within 1 to 2 m of contacts. This may be partly due to rock flowage. Intrusive behavior is also shown in local fracture filling perpendicular to the foliation. These fracture fillings are composed predominantly of calcite and minor accessory minerals whereas the mafic minerals, e.g. hornblende and diopside, are very sparse. This is interpreted as late flowage in the fractured host rock. (Figure 48)

Mineralogy: Purple fluorite, a common but minor constituent of these veins is specifically associated with well-developed euhedral diopside. Fluorite and apatite occur together but apatite is much more abundant. Large sphene crystals (10 X 4 cm) were observed and are usually associated with anomalous radioactivity. Hornblende crystals, a major component of the vein, are up to 20 cm in length and usually well-developed. Biotite is abundant and occurs as large books (4 to 5 cm diameter). The biotite is mainly restricted to the paragneisses and marble units. Pyrite occurs sparingly throughout the vein. Calcite is very coarse, in places up to 8 cm.

The radioactive minerals are located in the border zones of the calcite vein near the contact with granitic rocks. A sample consisting of hornblende, mica and sphene in a matrix of coarse calcite was submitted to the Mineral Research Branch, Ontario Geological Survey, for

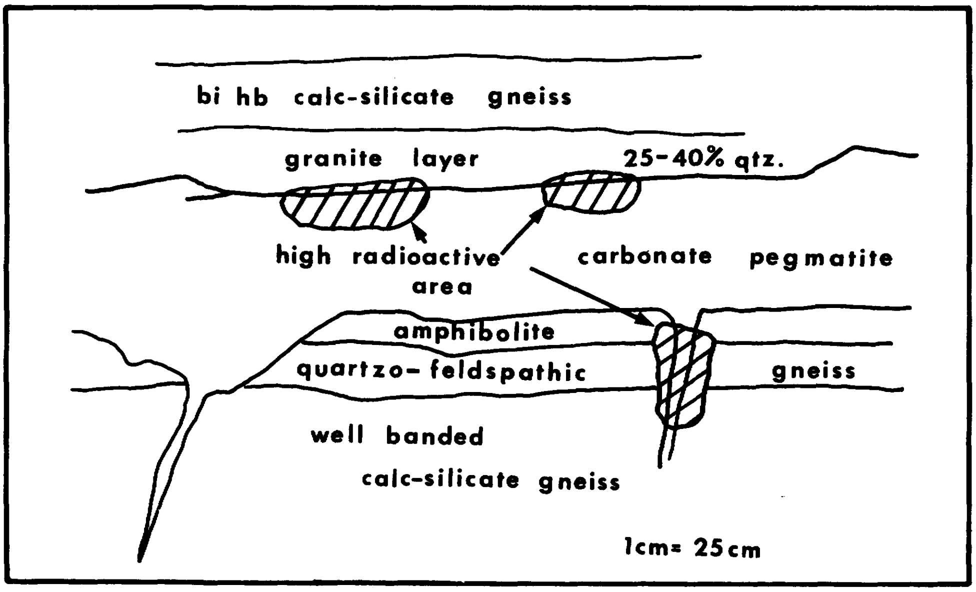


Figure 48 — Cross-section of the Woermke No. 4 Occurrence.

identification of radioactive minerals, and it was reported that a reddish-brown radioactive mineral was located in the siliceous phase, and was identified as uranothorite. The uranothorite was sparsely disseminated through the sample.

HISTORY

Mr. E.R. Woermke of Pembroke submitted a selected sample to Mr. E. Weller of Cobden in 1954 for radiometric analysis. Mr. Weller reported that the sample contained 0.06% U_3O_8 and 0.5% ThO_2 (calculated).

REFERENCE

Geological Survey of Canada, Radioactive Resources Division File 31F/10-12.

112. LAKE CLEAR OCCURRENCES

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Thorite, uranothorite and allanite

ROCK ASSOCIATION

The host rocks are granite pegmatite and pyroxene veins which intrude granite, syenite and meta-arkose.

CLASSIFICATION

Simple pink granite pegmatite, pyroxene veins and granite.

LOCATION

The occurrences are located north of Lake Clear in Lots 28-34, Concessions IX to XII, Sebastopol Township and Lots 31-36 Concessions XIV to XIX, Grattan Township. The main area of mineralization is concentrated in Lots 31 to 34 in Concessions XI and XII Sebastopol Township.

Latitude 45°28′16″N; Longitude 77°09′46″W

UTM 5037500mN, 331300mE, Zone 18

NTS Brudenell 31F/6

ACCESS

Access to all the occurrences is readily obtained via township roads off Highway 512 west of the town of Eganville.

SIZE AND GRADE

The mineralized areas are widely spread and numerous, but usually only a square metre or less in size. Grab samples have assayed as high as 0.68% U_3O_8 but these are selected samples of small concentrations of uranothorite clusters and are not representative of the host rocks in general.

PRESENT EXPOSURE

Most showings are well exposed.

DESCRIPTION

General Geology: The area is underlain by highly metamorphosed metasediments composed dominantly of meta-arkose, with smaller units of marble, paragneiss and calc-silicate rock. The arkosic unit forms the basal portion of the Grenville Supergroup in this area, overlying Middle Precambian metasediments and intrusive rocks. The Supergroup metasediments in the immediate area of the occurrences are intruded by syenitic rocks and by granite. Late granite pegmatites, calcite-apatite-fluorite veins and pyroxene-biotite veins cut all the above rocks. Two major faults of the Ottawa Bonnechere graben system occur immediately south of the occurrences, and another one immediately north of the occurrences.

Detailed Geology: Many of the showings occur in granitic meta-arkose and in gneissic hornblende-biotite syenite which are intruded either by granite pegmatite or by pyroxene veins, but most occur within the border of a body of gneissic pink quartz monzonite, especially where the granite contains many screens and xenoliths of partially assimilated calcareous metasediments.

The radioactive mineral is most commonly uranothorite or thorite and it is generally restricted to pegmatite or pyroxene veins, although some mineralization has been found in fractured granite. The pegmatites appear to be derived from the partial melting of the granite and/or the meta-arkose.

Uranothorite mineralization generally occurs related to fractures or fracture zones in these pegmatites. Mineralization is also common in pyroxene veins. Those veins which cut pegmatite display the best mineralization. Withers (1976) has shown that pyroxene veins which cut granitic country rocks are able to extract uranium from these rocks, forming reddish to black uranothorite. These veins are rather narrow bodies ranging from 1 cm to a metre wide but averaging less than 10 cm. The veins follow preexisting structures such as joints or fractures. A prominent direction in this area is northwest parallel to the graben system. This is interesting as it indicates either that the graben system was an active zone even in Precambrian time, or that the pyroxene veins are possibly of Phanerozoic age.

Pyroxene veins are related to carbonate veins and form by the reaction of a CO_2-rich and calcium-rich fluid with siliceous rocks. Their effect on granitic country rocks resembles fenitization. Quartz and pyroxene surrounding the veins are often replaced by pyroxene, forming a syenite border phase. The veins appear to originate from mobilized carbonate derived either from the partial digestion of calcareous matasediments by granite and/or from high-grade metamorphic processes acting on calcareous rocks interbedded with siliceous rocks such as arkoses.

Discussion: These veins and anatectic granite pegmatites only form small pockets of mineralization of little or no economic importance. However, the regional structure provides a favourable environment for economic mineralization. The pyroxene veins parallel to the nearby major faults suggest that hydrothermal activity existed locally during the early formation of the fault zone and related fractures.

The following analyses are from selected samples taken by the authors from the mineralized showings. Selected samples taken by Themistocleous in 1977 are also included.

The high uranium value of the hornblende-rich paragneiss and the high thorium value of the meta-arkose suggest a primary enrichment in heavy minerals of the basal unit of the Grenville Supergroup. Pegmatites or pyroxene veins developed anatectically from the metasediments would reflect this earlier enrichment.

HISTORY

Many of the occurrences were discovered in 1977 by the Ontario Geological Survey field party under S. G. Themistocleous. In 1978 St. Joseph Explorations Limited, carried

TABLE 17 ANALYSES OF SELECTED SAMPLES FROM THE LAKE CLEAR OCCURRENCES

SAMPLE NO.	LOCATION	ROCK TYPE	U_3O_8	Th
Masson and Gordon (1977)	Sebastopol Township			
R-77-66-1	lot 28 Con. 13	Pegmatite containing uranothorite	1100ppm	2.1%
R-77-66-2	lot 28 Con. 13	Pyroxene Vein with black uranothorite	4600ppm	2.7%
R-77-67-2	lot 34 Con. 12	Pegmatite containing mainly red uranothorite	4800ppm	2.8%
R-77-67-3	lot 34 Con. 12	Meta-arkose (hornblende-bearing granitic rock)	3ppm	64ppm
R-77-68-1	lot 34 Con. 13	Granite Pegmatite	42ppm	791ppm
Themistocleous (1977)				
2	lot 29 Con. 12		0.10%	
3	lot 34 Con. 12	Samples containing mainly the mineral uranothorite	0.68%	
4	lot 34 Con. 12		0.18%	
5	lot 32 Con. 12		0.45%	
6	lot 34 Con. 12		0.37%	
	Grattan Township			
1	lot 33 Con. 16	Mainly uranothorite mineral	0.51%	
Masson and Gordon (1977)				
R-77-69-7	lot 34 Con. 13	Mainly uranothorite mineral	1000ppm	2.0%
R-77-69-3	lot 34 Con. 13	Feldspathic hornblende paragneiss	16ppm	14ppm
R-77-70-1	lot 36 Con. 18	Mainly uranothorite (in pegmatite)	2200ppm	2.0%

out magnetic and radiometric surveys as well as geological mapping in Sebastopol Township. Their option was dropped in 1979.

REFERENCES

Themistocleous (1978)
Withers (1976)

113. O'HARA OCCURRENCE

See "Minor Occurrences"

114. OPEONGO MINE OCCURRENCE

COMMODITY

Main - Uranium and thorium

Minor - Titanium, zirconium, cesium, niobium, yttrium and silver.

RADIOACTIVE MINERALS

Uranothorite, thorite, allanite and sphene

ROCK ASSOCIATION

The host rock is pyroxene-sphene pegmatite in country rock consisting of granitic gneiss.

CLASSIFICATION

Complex pink granite pegmatite, and pyroxene vein

LOCATION

The Opeongo occurrence is on the northeast side of the Opeongo Road approximately 15 km southwest of the town of Eganville in Lot 39, Range C North, Sebastopol Township, Renfrew County.

Latitude 45°25′16″N; Longitude 77°13′03″W

UTM 5031800mN, 326500mE, Zone 18

NTS Brudenell 31F/6

ACCESS

The occurrence can be reached via the gravelled Opeongo Road. It is about 10 m north of the Opeongo Road, approximately 8.4 km southeast of its intersection with Highway 512 and 100 m east of an intersection with a dirt road leading south.

PRESENT EXPOSURE

The pit and immediate area is well exposed.

SIZE AND GRADE

The occurrence is of limited area. A 450-pound bulk sample assayed 0.048% U_3O_8 , 0.038% ThO_2, 10.9% Ti, 1.30% Zr, and 0.035 oz. of Ag per ton (Radioactivity Division Ottawa)

DESCRIPTION

General Geology: The area is underlain by a Middle to Late Precambrian supracrustal sequence. These rocks are predominantly metasediments consisting of biotite-quartz-K-feldspar gneisses, foliated arkose, calcareous sandstone, garnet-biotite-quartz-plagioclase gneiss and marble. The supracrustal sequence is intruded by Middle to Late Precambrian metamorphosed rocks of granitic, syenitic to mafic composition. A second period of intrusion during the Late Precambrian includes unmetamorphosed quartz monzonite, syenite and gabbro. Late dikes of granite pegmatite and diabase mark the last intrusive event.

Foliation and bedding are sub-parallel and trend north to northeast with dips of 10 to 40° east to southeast. Complex isoclinal folds and late northwest-trending faults related to the Ottawa Bonnechere Graben structure prevail through the area.

Detailed Geology: The following description of the occurrence is taken from a report by J.R. MacDonald (1955):

The uranium mineralization occurs in two veins exposed on the north side of the road-cut. The radioactive zones or veins have a length of 7 m and a width of about 25 cm. They are ill-defined as irregular, tabular bodies probably undulating from the plane of their outcrops and dipping approximately 12° in a southward

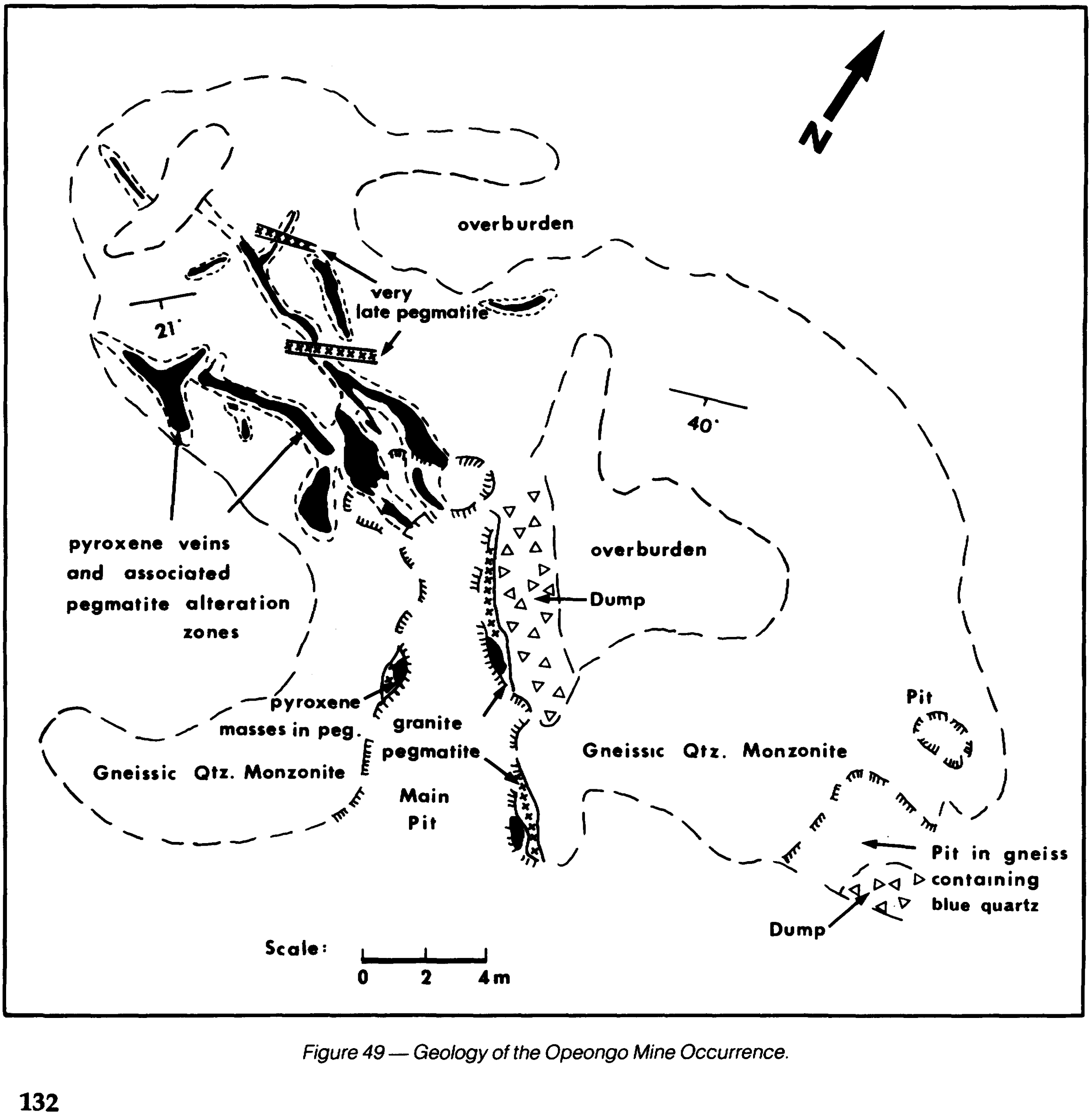


Figure 49 — Geology of the Opeongo Mine Occurrence.

direction. The general trend of the veins is to the west. Locally, indications are that there are extremely high concentrations of the valuable mineral over limited widths; in other locations radioactivity is low and the vein structure is not apparent.

The two radioactive veins appear to be parallel and are separated by barren rock 1 to 2 metres in width. A radioactive occurrence 13 m north of the road and slightly higher in elevation may be part of the same system.

According to Themistocleous (1978), the Opeongo Mine is located at the contact of feldspathic metasediments consisting of migmatitic biotite-quartz-K-feldspar gneiss, and pink gneissic monzonite with local inclusions. The occurrence lies in irregular pyroxene-bearing pegmatite bodies with country rocks consisting of gneissic albite-quartz monzonite and minor oligoclase monzonite interlayered with sphene-biotite gneiss. The quartz monzonite is well-layered in places and has a well-developed foliation, whereas the radioactive pegmatite is massive. This suggests that the country rocks were foliated prior to the intrusion of the pegmatite. The pegmatite is developed either as layers in the gneiss or as sharp cross-cutting dikes. In some areas, where the pegmatite displays an irregular, pod-like nature and gradational contacts, granitic gneiss appears to have been remobilized to form the pegmatite. One objection to the theory of local anatectic development of the pegmatite from the granitic gneiss is the abundance of pyroxene (10-30%) in the pegmatite and the lack of mafic minerals (2-5%) in the granitic gneiss. Therefore, it is more probable that the pegmatites are in part introduced melts. This is supported by the presence of reaction zones in the gneiss similar to fenitization along pyroxene veins which implies that introduced material is in disequilibrium with the country rocks. Further evidence comes from the analysis of uranium and thorium content of the country rocks.

	U_3O_8	Th
Albite-quartz-monzonite gneiss		
Sample R-77-56-5	2 ppm	10 ppm
Biotite gneiss		
Sample R-77-56-4	2 ppm	10 ppm

Based on the above analysis, it is highly unlikely that the radioactive pegmatites originated from the nearby country rocks.

The pegmatite exhibits both gradational and sharp contacts. The pegmatite is composed of up to 30 percent pyroxene, abundant feldspar and quartz, and minor sphene. This sphene often contains small inclusions of allanite and occasionally thorite. Accessory minerals include allanite, uranothorite, thorite, biotite, pyrite, apatite, zircon, garnet and magnetite. MacDonald (1955) reported the presence of the mineral thorianite from the property.

The following is a radioactive analysis and mill test on the composition of a 400-lb. bulk sample performed by the Radioactivity Laboratory, Ottawa for Opeongo Mines Limited:

Feldspar, quartz and biotite	37%
Sphene	40%
Pyroxene	17%
Zircon	5%
Uranothorite, allanite, garnet, pyrite and apatite	0.5%
Magnetite	0.5%

The analysis shows 40 percent sphene in the sample which appears to be very large compared with the amount of sphene observed in the pit. One melanocratic biotite gneiss layer within the gneiss containing abundant sphene was noted to have gradational contact with the pegmatite. The pegmatite contains abundant sphene along the same layer as the adjacent gneiss.

It is possible that the sphene was introduced into the pegmatite by assimilation or anatexis. This sphene-rich layer assayed 22 ppm U_3O_8 and 20 ppm Th.

The large amount of pyroxene in pegmatite is not a common association. The pyroxene occurs here as irregular bodies or as veins. The gneisses near the veins always display the effects of alteration, either as fine dissemination of pyroxene in the gneiss apparently replacing the plagioclase, or as mafic-depleted zones bordering the vein.

Withers (1976) reported the pyroxene veins to be characteristic of carbonate veins intruding granitic gneiss or pegmatite. He suggests that the carbonate is remobilized from calcareous sediments or marble during pegmatite or granite intrusion. Withers studied similar veins in detail on the Eagle Nest property near Bancroft and he wrote: "These pyroxene veins are significantly radioactive over widths of several inches. They are especially radioactive when associated with pegmatite."

Withers further states that these veins "are usually separated from their host rocks by a pyroxene-rich alteration zone similar to that found along calcareous veins."

Radioactive minerals associated within the pyroxene veins are allanite, uranothorite, uraninite and sphene. The

TABLE 18 | ANALYSES OF SELECTED SAMPLES FROM THE OPEONGO MINE OCCURRENCE

Sample	Mineral	U_3O_8	ThO_2	Th
Themistocleous (1977)	Unknown	0.18%		
Satterly (1965)	Uranothorite	10.73%	49.92%	
Masson and Gordon (1977)				
R-77-56-2	Thorite (impure)	0.52%		7.59%
R-77-56-1	Sphene (impure)	360 ppm		590 ppm

latter two are most frequently associated where pyroxene veins cut pegmatite.

Mineralization:The mineralized area is confined to pegmatite, especially to areas rich in sphene and pyroxene. A mineralogical report by the Radioactivity Laboratory, Ottawa, revealed that uranothorite was often intimately associated with pyroxene. Radioactive minerals include brownish-red thorite, black vitreous allanite, grey-black vitreous by waxy uranothorite, reddish-brown sphene and possibly thorianite. Analytical results of some samples taken from the showing are shown in Table 18.

A partial analysis of uranothorite from this showing from Satterly (1957) is presented below:

SiO_2	20.4%
PbO	3.62%
U_3O_8	10.75%
ThO_2	49.92%
Rare Earths	0.41%
Fe_2O_3	2.44%
CaO	2.79%
H_2O	9.48%
C	0.31%
CO_2	0.19%

Total uranium and iron contents calculated as U_3O_8 and Fe_2O_3 respectively.

Discussion:According to the stratigraphy as described by Themistocleous (1978), a thin marble unit exists along strike to the south between the intruding granite and meta-arkose. At the mine, the carbonate unit is not exposed. The pyroxene veins may represent remobilized portions or remnants of this carbonate unit. As these calcareous, likely CO_2-rich solutions or melts reacted with the granitic country rocks, uranium would be collected from the alteration zone and deposited with iron and calcium-rich minerals such as sphene and pyroxene.

HISTORY

MacDonald (1955) examined the property and gave the following description:

> A pit has been completed to a depth of 12 feet below the road . . . Over an area of 75 X 100 feet, blasting has removed 100 tons or so from the wall of the ravine in this section; the resulting muck contains values in uranium and has been stockpiled.

There was no evidence of this stockpile in 1977.

In 1956, a uranium-bearing sample weighing approximately 400 pounds was received by the Radioactivity Division, Ottawa, for chemical and mineralogical analysis as well as a mill test. The results of the report suggest that the ore was too low grade to be economically feasible.

SELECTED REFERENCES

Geological Survey of Canada Radioactive Resources Division, File 31F/6-18.

Honeywell, W.R. and Hughson, M.R.
1956: Report on Preliminary Investigation and Mineralogy of an Ore Sample from Opeongo Mines Limited. Radioactivity Division, Ottawa, Special Report Number SR-471/57.

MacDonald (1955)
Satterly (1957, p.18)
Themistocleous (1978)
Withers (1976)

115. BORDUN OCCURRENCE

COMMODITY

Uranium, thorium and rare earths

RADIOACTIVE MINERALS

Uraninite, uranothorite and uranophane

ROCK ASSOCIATION

The host is pink and white biotite granite pegmatite, in country rocks consisting of biotite granite gneiss with minor amphibolite gneiss and marble.

CLASSIFICATION

Simple pink granite pegmatite.

LOCATION

Lots 2 and 3, S½ Concession V, Lot 4, N½ Concession VI, approximately 7.7 km northwest of the village of Ompah, South Canonto Township, Frontenac County.
Latitude 45°03'09''N; Longitude 76°54'25''W
UTM 4990300mN, 349800mE, Zone 18
NTS Clyde Forks 31F/2

ACCESS

A gravel road heads west, then north from Ompah to Mosque Lake. A service road from there follows the hydro line to Crib Lake. A bush road heading west, then north, from here is followed until a second road is reached. This road leads north to the occurrence.

PRESENT EXPOSURE

Good

SIZE AND GRADE

A composite from 35 selected grab samples assayed 0.05% U_3O_8, 0.38% ThO_2 and 0.5% rare earths. The pegmatites range up to 100 m in width. One radioactive zone measures 30.5 to 183 m wide and 335.5 m long.

DESCRIPTION

General Geology:The general geology is shown on Ontario Department of Mines Map 1956-4, Clarendon-Dalhousie-Darling Area, and is described by Smith (1958):

> Volcanics, limestones (marbles) and other sedimentary rocks have been folded, metamorphosed, and intruded or replaced by plutonic rocks ranging in composition from gabbro to granite. The fold axes trend N40-60°E and tend to plunge easterly at angles of up to 30 degrees. Some beds dip steeply and some are overturned, but dips less than 45 degrees are common.

Intruding all the rocks mentioned above are late granite pegmatites which appear to have been injected up along shear zones. It is in these sheared late granite pegmatites that mineralization occurs.

Detailed Geology:The following description is taken from a company report:

> The rocks underlying the Bordun property are a large igneous intrusive consisting of pink granite gneiss, classed by Smith as Lavant gneiss, and leucocratic granite gneiss, which has been again intruded by numerous dikes of pegmatite. The pegmatites consist of fine-grained leucogranite, coarse microcline and orthoclase granite and syenite, and large crystals of graphic gran-

ite. Along the south boundary of the property, the igneous rocks are in contact with metavolcanics and sediments. A mile east of the property, a band of metasediments and volcanics form an anticlinal fold whose axis strikes southwest across the middle of the Bordun claims, where the dips of bands of Lavant gneiss are from 30 degrees south on the north claims, to vertical near the south boundary. This reflects the continuation of the synclinal axis crossing the property, and confirms the probability that the Lavant gneisses are mainly sediments which are not entirely assimilated by the igneous granite intrusive. There are also narrow bands of grey granite gneiss, which conform to the local strike and dip, and which, at times, is hard to distinguish from the Lavant granite which, although pink, weathers almost white on prominent outcrops.
ECONOMIC GEOLOGY: Mineralization occurs in lenses and tabular bodies within 'crushed' and metamorphosed dikes up to 150 feet wide . . . Uraninite, uranothorite and uranophane and zircon have been identified in typical samples. A composite sample of pulps from the last 35 pit samples was submitted to X-ray Assay Laboratories for analysis, with resulting assays of 0.05% U_3O_8, 0.38% ThO_2, and 0.5% rare earths.

Although the rare earth minerals have not been positively identified, the analyses and known accessory rock minerals of the pegmatites indicate association with monazite, apatite and probably brannerite and euxenite.

The authors visited the occurrence in June 1978. Radioactivity was found associated with biotitic sheared granite pegmatite. The pegmatites with the highest biotite content and the greatest amount of shearing were distinctly more radioactive. In many of the sheared pegmatites, biotite flakes formed a well-developed foliation which was generally parallel to the strike of pegmatite dikes.

The pegmatites intrude a grey biotite granitic gneiss. Generally this gneiss is poorly radioactive but in some areas it was quite anomalous. Such areas were marked by gradually higher quartz and biotite content, and usually occurred within 30 to 40 m of a zone of pegmatite emplacement. The writers believe that much of the biotite in the gneiss was developed during early shearing of the granitic rocks. Quartz was later introduced to fill the shear fractures.

The following analyses are from a number of samples collected by the authors to determine the U_3O_8 and Th values of sheared and unsheared host and country rocks.

Discussion:

1. The pegmatites do not appear to be residual phases or melts from the grey granodioritic gneiss, and were likely emplaced long after the formation of the granitic mass. The pegmatites generally follow a prominent east-north-east fault to shear direction and have little relationship to the primary structure of the granite mass itself.
2. The east-north-east direction of pegmatite emplacement is not only the major structural direction of the area, but also the direction of late shearing of the pegmatite itself. This suggests that pegmatite emplacement occurred after the development of this east-north-east structure. However, the foliated nature (early shearing) of the pegmatite and the development of fractured pegmatite (late shearing) suggest that some of these zones remained active after consolidation or partial crystallization of the pegmatite.
3. The pegmatites, judging from those which are unsheared or foliated, likely already contained important amounts of uranium and thorium, more than the adjacent country rocks, but much less than the amounts now observed in areas of sheared pegmatite.
4. The authors suggest that the shearing permitted the circulation of hot waters through the pegmatite, leaching it in one area and concentrating uranium and thorium in another. Deposition may have been largely a function of pressure and thermal gradients.

Stuckless and Nkomo (1978) in their work on the Granite Mountains of Wyoming, have shown that as much as 70 percent of uranium can be leached from granite, especially if it is sheared, by low-temperature circulating ground waters. These writers found a few samples, containing as high as 1460 ppm U, of this mobilized uranium.

TABLE 19 | URANIUM AND THORIUM CONTENT OF SOME SAMPLES FROM THE BORDUN OCCURRENCE

Sample	Rock Type	U_3O_8	Th ppm
R-78-58-2	grey biotite granodioritic gneiss	1	10
R-78-58-3	grey-black biotite-plagioclase amphibolite	1	10
R-78-58-9	sheared biotite-rich grey granitic gneiss	1	170
R-78-58-11	sheared quartz-rich biotite-rich granitic gneiss	14	50
R-78-58-10	foliated white biotite pegmatite (slightly weathered)	9	220
R-78-58-8	foliated pink biotite granite pegmatite	54	340
R-78-58-6	foliated sheared pink granite pegmatite	210	1760
R-78-58-7	foliated sheared pink granite pegmatite	260	1820
R-78-58-4	foliated biotite-hornblende granite pegmatite (mafic)	630	2360
R-78-58-12	apatite-biotite schist (shear zone 10-15 cm wide)	3800	1.4%

The authors believe that the time of mineralization was immediately subsequent to the fracturing and shearing of the pegmatite, which likely occurred while the rocks were still at elevated temperatures, during the waning stages of the Grenville tectonic event. Structure, therefore, is most likely a major control of mineralization in pegmatites.

HISTORY

In 1969, C. Kehoe carried out a geiger survey, and opened 88 shallow pits. Grab samples of from 5 to 7 pounds were submitted to X-ray Assay Laboratories for analysis.

In September, 1969, Chixex Exploration Services completed a geiger survey. A base line was cut and chained with stations every 200 feet.

In October and November, 1969, Cana Exploration Consultants Limited completed comprehensive and detailed spectrometric radiation surveys on a 500 by 1350-foot area. Some stripping and trenching was done.

In 1976-77, Beach Gold Mines Limited performed geological mapping and diamond drilling.

REFERENCES

Geological Survey of Canada, Radioactive Resources Division File 31F/2-3.

Ontario Geological Survey, Assessment Files Research Office, Toronto: Technical Files 2.2758 and 63E-28.

Smith (1958)

Stuckless and Nkomo (1978)

116. HONSBERGER OCCURRENCE

COMMODITY

Uranium and thorium

RADIOACTIVE MINERALS

Thorite and uranothorite

ROCK ASSOCIATION

The host is pink granite pegmatite intruding grey biotite gneiss, amphibolite and marble.

CLASSIFICATION

Simple pink granite pegmatite

LOCATION

The occurrence is approximately 10 km northwest of the village of Ompah, in Lot 2, S½ Concession VIII, and Lot 4, S½ Concession VII, South Canonto Township, Frontenac County.

Latitude 45°04'29''N; Longitude 76°55'04''W

UTM 4992500mN, 349000mE, Zone 18

NTS Clyde Forks 31F/2

ACCESS

A gravel road heads west, then north from Ompah to Mosque Lake. A service road from here follows the hydro line to Crib Lake. A bush road heading west, then north from here is followed until a second road is reached. This road is taken to a point just south of Croker Lake, 1700 m southeast of the occurrence.

PRESENT EXPOSURE

Moderately well exposed.

SIZE AND GRADE

Assays of trench samples average 0.05% U_3O_8. The showings are spotty or low grade.

DESCRIPTION

General Geology: The property is underlain by high grade (almandine amphibolite facies) metamorphic rocks of the Grenville Supergroup of Upper Aphebian to Lower Helikian age.

Detailed Geology: In Lot 2, Concession VII, gently-dipping granite pegmatite sills and dikes, 5 to 20 m thick, intrude biotite gneiss and rusty gneiss. Radioactivity in the pegmatite is associated with dark pink feldspar, abundant mafic minerals, shearing, smokey quartz and abundant quartz. A selected sample (R-78-57-1) from a small pit assayed 70 ppm U_3O_8 and 690 ppm Th. The radioactive mineral was identified as thorite - uranothorite.

In Lot 4, Concession VII, on a narrow stretch of land between Round Camp and Croker Lakes, numerous radioactive pegmatites intrude granitic biotite gneiss striking NNW and dipping 35° WSW. The pegmatite is sheared and contains abundant biotite and quartz. The shearing may be genetically related to the Croker Lake fault, which strikes east-west along the north shore of the lake. A selected sample (R-78-57-2) from a pit in the pegmatite assayed 71 ppm U_{38} and 200 ppm Th. The radioactive mineral was identified as thorite.

Discussion: Mineralization in the pegmatites is most pronounced where the pegmatites are sheared. The sheared areas are characterized by abundant quartz, increase in mafic minerals, especially biotite, general reddening of the pegmatite and rusty colour due to weathering pyrite, although not all these characteristics need be present. Many of the quartz-rich sheared portions of the pegmatite appear to have been re-activated more than once. Quartz filling older fractures has been re-fractured. Uranium and thorium apparently have been introduced into the sheared portions or concentrated there in one or more stages of enrichment. The simple mineralogy of the shear zone does not suggest a hydrothermal origin from late-crystallizing fluids of an igneous body at depth, but rather a simple metamorphic metsomatism. Remobilization during the waning stages of regional metamorphism would be sufficient to move uranium, thorium, sodium and quartz along a shear zone related to late faulting. The uranium mineralization, therefore, appears to be strongly structurally controlled.

HISTORY

Prospecting and sampling of 21 trenches were done by J.C. Honsberger in 1969. In 1976, Beach Gold Mines Limited performed radiometric surveys and some diamond drilling.

REFERENCE

Ontario Geological Survey, Assessment Files Research Office, Toronto, Technical File No. 63E.20.

117. KELLER OCCURRENCE

See "Minor Occurrences"

118. JAMES OCCURRENCE

COMMODITY
Thorium and uranium
RADIOACTIVE MINERALS
Thorium and magnetite
ROCK ASSOCIATION
The host is granite pegmatite in country rocks comprising mafic biotite-hornblende amphibolite and felsic gneisses.
CLASSIFICATION
Zoned granite pegmatite
LOCATION
Lots 6 and 7, Concession III in Wilberforce Township, Renfrew County.
Latitude 45°30'46''N; Longitude 77°00'46''W
UTM 5041700mN, 342800mE, Zone 18
NTS Golden Lake 31F/11
ACCESS
The occurrence is in a field on the side of a hill, 75 to 100 m west of a house on the west side of a gravelled township road, approximately 1 km north of Knightingdon on the Bonnechere River. Knightingdon is about 5.6 km southeast of Eganville by gravel road along the west bank of the Bonnechere River.
PRESENT EXPOSURE
There are numerous outcrops in the area and the pegmatite is well exposed.
SIZE AND GRADE
The pegmatite is about 1 m wide. Radioactivity levels over an area containing a red vitreous mineral reached 4000 cpm on the U+Th spectrum, and 1000 cpm on the Th spectrum, indicating that the radioactivity is due mainly to thorium with little or no uranium. A sample of mineralized pegmatite from the showing assayed 90 ppm U_3O_8 and 620 ppm Th.

DESCRIPTION
General Geology: The country rocks are interlayered dark grey biotite-hornblende gneiss, light grey felsic gneiss, and minor pink quartzo-feldspathic gneiss and biotite amphibolite. Lumbers (1976) interprets these rocks as meta-arkose and mafic intrusive rocks.
Detailed Geology: The host rock is a pink granite pegmatite 1 m wide, crudely zoned and cross-cutting a light grey felsic gneiss of trondhjemite to rhyodacite composition. The felsic gneiss comprises 60 percent plagioclase (Ab_{25}, An_{75}), 20 percent quartz and 20 percent biotite. The felsic gneiss has a radioactivity level of 40 cpm on the U+Th spectrum and assayed 2 ppm U_3O_8 and 10 ppm Th (R-77-59-2).

The pegmatite contains abundant quartz (30 to 40 percent) with pink to slightly reddish microcline. There is an irregular discontinuous quartz core and a border zone containing magnetite and thorite. (Figure 50)

Fractures trending N45°W and dipping 80°SW cut both the pegmatite and country rock. These fractures parallel a nearby major fault of the Bonnechere Graben and do not display radioactivity levels above background.

Approximately 75 m southwest of the house there is a pit, 2m x 2m, in which a granite pegmatite 20 cm wide is exposed. Readings on the U+Th spectrum were up to 800 cpm. The country rock in this pit is biotite-hornblende gneiss in which fractures strike N40°E and some layers contain up to 3 percent pyrite.
HISTORY
A resident in the area reports that the occurrence was tested with one drill hole in the early 1970s. This work was not reported.
REFERENCES
Lang (1962, p.284)
Lumbers (1976a)

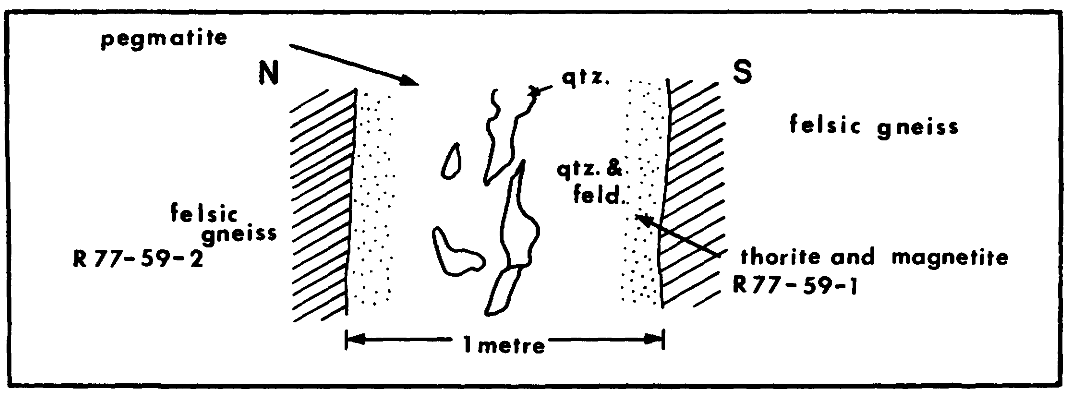


Figure 50 — Mineralized pegmatite of the James Occurrence.

MINOR OCCURRENCES

The following occurrences (Table 20) are of a minor nature. Further information and property descriptions for some of these occurrences are on file with the Mineral Deposits Section of the Ontario Geological Survey in Toronto, Ontario.
Following is a list of abbreviations used in the table:

amp	amphibole
bio	biotite
calc	calcite
cor	corundum
ep	epidote
fel	feldspar
gt	garnet
hb	hornblende
mag	magnetite
mo	molybdenite
mus	muscovite
plag	plagioclase
po	pyrrhotite
px	pyroxene
qtz	quartz
qtzo-fel	quartzo-feldspathic
scap	scapolite
ser	sericite
sph	sphene
tour	tourmaline
zr	zircon

TABLE 20 DETAILED DESCRIPTIONS OF MINOR OCCURRENCES

LOCATION	NAME	TYPE	RADIOACTIVE MINERALS	ASSOCIATED MINERALS	BEST ASSAY	COMMENTS	COUNTRY ROCKS	REFERENCES	REMARKS
ALICE TP. Lot 13, Conc. XV	McCOSHEN Dep. No. 2	Simple granite pegmatite	Euxenite-polycrase				Pink qtzo-fel gneiss, grey hb-bio gneiss	Lang, A. H. (1952) p.149	not located by authors
ALICE TP. Lot 30, Con. VII	WOERMKE # 1A Dep. No. 3	Simple granite pegmatite	Priorite	mag	0.05% U_3O_8		Bio-hb gneiss, Qtzo-fel gneiss	Lang, A. H. *et al.* (1962) p.277 GSC File 31F/4-14	minor occurrence
ALICE TP. Lot 30, Conc. XII	WOERMKE # 1B Dep. No. 4	Simple granite pegmatite	Euxenite, thorite, allanite	mag, zr	0.15% U_3O_8		Granodioritic gneiss	GSC File 31F/4-14	minor occurrence
BAGOT TP. Lot 30, Conc. XII	QUILTY Dep. No. 6	Simple granite pegmatite	Uranothorite?		0.19% U_3O_8		Marble, amphibolite gneiss, calc-silicate gneiss	GSC File 31F/4-14	not located by authors
BAGOT TP. Lot 22, Conc. VI	ZAVITSKI Dep. No. 7	Simple granite pegmatite		bio		Hematitization; fractures	Marble, bio-hb-plag gneiss, hb-plag-amp gneiss	GSC File 31F/7-15	
BANGOR TP. Lot 26, Conc. IV	BENNET LAKE Dep. No. 9	Simple granite pegmatite	Anatase	bio, sph, mag, ab, smoky qtz.	1.69% U_3O_8	Hematitization fractures	Interlayered bio-hb gneiss, qtz-fel gneiss	31F/5-4 GSC File	
BROMLEY TP. Lot 30, Conc. VI	WOERMKE # 2 Dep. No. 12	Simple granite pegmatite	Thorite allanite, cyrtolite		0.09% U_3O_8	Fracture Zone	Pink qtzo-fel gneiss, grey hb-bio gneiss	GSC File 31F/4-14	not located by authors
BROUGHAM TP.	BURNS LONG LAKE AREA Dep. No. 13	Simple granite pegmatite		sph, mag, anatase, py			Syenite, marble, amp-plag paragneiss	OGS Map P. 2240, Khartum Area	not visited by authors
BROUGHAM TP.	MARCHAND LAKE AREA Dep. No. 15	Simple granite pegmatite			0.11% U_3O_8 5.0% Th	Haley Lake Fault passes through the immediate area	Marble, qtzo-fel paragneiss, syenite	OGS Map P. 2240, Khartum Area	not visited by authors
BROUGHAM TP. Lot 18, Conc. IX	MUD LAKE (A. Legris) Dep. No. 16	Simple granite pegmatite	Unknown				Hb-plag gneiss (granodiorite)	Lang, A. H. *et al.* (1962) P. 249	not located by authors
BRUDENELL TP. Lot 34, Conc. IV	MURRAY Dep. No. 19	Simple syenite pegmatite	Allanite	mag, ep	0.048% U_3O_8	Corundum deposit	Pink hb syenite gneiss, white cor-ab syenite pegmatite	GSC File 31F/6-12	
CARLOW TP. Lot 14, Conc. XIV	BURGESS Dep. No. 23	Simple syenite pegmatite	Uraninite			Corundum deposit	Granite gneiss, syenite gneiss, scapolite gneiss	Lang, A. H. (1952) P. 137	
DICKENS TP. S½ Lot 27, Conc. V	DAVIS MICA Dep. No. 27	Zoned granite pegmatite-feldspar type	Monazite euxenite	mus bio			Bio-plag gneiss gneissic monzonite, quartz monzonite	Satterly (1945)	minor occurrence

TABLE 20 CONT'D

LOCATION	NAME	TYPE	RADIOACTIVE MINERALS	ASSOCIATED MINERALS	BEST ASSAY	COMMENTS	COUNTRY ROCKS	REFERENCES	REMARKS
FARADAY TP. Lot 6, Conc. XII	MACLAN Dep. No. 45	Simple granite pegmatite					Metagabbro, marble, hb-amp gneiss	OGS AFRO Tech. File 2.978	little mineralization reported
GRATTAN TP. Lot 22, Conc. VIII	COLAUTTI FELDSPAR MINE Dep. No. 52	Zoned granite pegmatite		tour			Amphibolite, qtz-plag paragneiss, marble	OGS Map P. 1560, Clontarf Area	
GRATTAN TP. Lot 67 South Range	NEWFOUNDOUT (PERCY) Dep. No. 53	Simple granite pegmatite			0.098% U_3O_8	Mount St. Patrick fault runs through the lot	Mylonitic marble, qtzo-fel paragneiss	GSC File 31F/6-9	not located by authors
GRATTAN TP. Lots 15-22 Conc. XIII-XVI	GRATTAN TOWNSHIP OCCURRENCES Dep. No. 54	Simple granite pegmatites, granite, pyroxene veins	Uranothorite	px, bio	0.075% U_3O_8		Meta-arkose small granite bodies	OGS Map P. 1560 Clontarf Area	spotty mineralization
GRIFFITH TP. South of Burns Lake	CONRAD URANIUM MINES Dep. No. 55	Simple granite pegmatite		sph, tour, anatase		80 metres of diamond-drilling	Granodiorite, marble, amp-plag paragneiss	OGS Map P. 2240 Khartum Area	not visited by authors
GRIFFITH TP. East of Godin Lake	GODIN LAKE AREA Dep. No. 56	Simple granite pegmatite					Granodiorite	OGS Map P. 2240 Khartum Area	very spotty and small
GRIFFITH TP. South of Beaver Lake	HIGHLAND LAKE AREA Dep. No. 57	Simple granite pegmatite		mag, sph, anatase			Marble, amp-plag paragneiss qtzo-fel gneiss	OGS Map P. 2240, Khartum Area	
GRIFFITH TP. West of Jeffers Lake	JEFFERS LAKE AREA Dep. No. 58	Meta-pyroxenite skarn	Uranothorite	py, mo, scap			Marble, qtzo-fel paragneiss, amp-plag paragneiss, syenite	OGS Map P. 2240, Khartum Area	not visited by authors
GRIFFITH TP. Lot 17, Conc. X	LAMBERT Dep. No. 59	Simple granite pegmatite		bio	0.06% U_3O_8		Granodiorite	GSC File 31F/6-5	very small pegmatites 1 metre wide
HAGARTY TP. Lot 13, Conc. A	ROCHEFORT Dep. No. 62	Unknown	Allanite			Mount St. Patrick fault runs through lot	Meta-arkose (basal unit of Grenville Supergroup)	Rose, E.R. (1960) p. 37	not located by authors
HAGARTY TP. Lot 2, Conc. XIV	TURPINS BAY Dep. No. 63	Unknown	Allanite			Bonnechere Fault runs throug lot	Bio paragneiss (Middle Precambrian)	GSC Files	not located by authors
MILLER TP. Brule Lake Area	DORANIUM Dep. No. 75	Simple granite pegmatite	Minor allanite			Only weak radioactivity reported	Bio paragneiss, qtzo-fel paragneiss	OGS AFRO Tech. File 63.750	
MONTEAGLE TP. Lot 21, Conc. VII	CAIRNS Dep. No. 79	Zoned granite pegmatite	Pyrochlore	sph, py, smoky, qtz, mag, hb			Marble, syenitic and granitic gneisses, bio-bh paragneiss	Hewitt, D. F. (1955) p. 47	

TABLE 20 CONT'D

LOCATION	NAME	TYPE	RADIOACTIVE MINERALS	ASSOCIATED MINERALS	BEST ASSAY	COMMENTS	COUNTRY ROCKS	REFERENCES	REMARKS
MONTEAGLE TP. Lot 24, Conc. VI	McCORMACK Dep. No. 85	Zoned granite pegmatite	Pyrochlore, allanite	mag, sph bio, hb		Mineralization near fractures	Amphibolite, bio schist, hybrid granite gneiss	Hewitt, D. F. (1955) p. 42	
MONTEAGLE TP. Lot 14, Conc. VIII	SALMON TROUT LAKE Dep. No. 92	Zoned granite pegmatite	Allanite				Para-amphibolite	Hewitt, D. F. (1955) p. 43, 47	
MONTEAGLE TP. Lot 11, Conc. VII	THOMPSON FELDSPAR MINE Dep. No. 95	Zoned granite pegmatite	Allanite	ep, px, hb, ser, sph, mag			Pink qtzo-fel gneiss, amphibolite, limy-pyroxenite, hb syenite gneiss	Hewitt, D. F. (1955) p. 43	
MONTEAGLE TP. Lot 21 Conc. VI	WATSON FELDSPAR MINE Dep. No. 97	Zoned granite pegmatite	Allanite	bio, sph hb			Rusty-weathering paragneiss, marble, para-amphibolite, granite gneiss	Hewitt, D. F. (1955) p. 41	
MONTEAGLE TP. Lot 25, Conc. VI	WRIGHT Dep. No. 100	Zoned granite pegmatite	Allanite	bio, mag, hb, sph			Hb syenite	Hewitt, D. F. (1955) p. 42	
MURCHISON TP. Lots 14, 16 Conc. IV	COMET QUARTZ QUARRY Dep. No. 101	Zoned granite pegmatite-feldspar type	Allanite, euxenite	bio, hb			Anorthositic gabbro	Satterly, J. (1954) p. 120	minor occurrence
RAGLAN TP. Lot 27, Conc. IX	WEBSTER (LIEDTKE MOLY MINE) Dep. No. 106	Pyroxene vein in granite pegmatite	Uranothorite	py, calc, mo, po	0.58% U_3O_8 (radiometric)	Fracture in pegmatite	Marble, calc-silicate gneiss, qtzo-fel paragneiss	Lang, A. H. (1962) p. 277	
RICHARD TP. Lot 2, Conc. XIV	BETZ Dep. No. 107	Zoned granite pegmatite?	Euxenite, fergusonite uraninite				Grey granitic bio gneiss, bio-plag amphibolite	Rose, E.R. (1960) p. 39	not located by authors
ROSS TP. Lot 4, Range 1	CHEVRIER Dep. No. 108	Unknown	Uranothorite				Qtzo-fel gneiss, calc-silicate gneiss	GSC File 31F/10-13	not located by authors
SEBASTOPOL TP. Lot 49, Range C North	O'HARA Dep. No. 113	Unknown-probably pegmatite	Uranothorite	sph	0.13% U_3O_8	Mount St. Patrick fault runs through lot	Calc-silicate gneiss, marble breccia, pegmatite, monzonite	GSC File 31F/6-16	not located by authors
SOUTH CANONTO TP. Lots 8, 9 Conc. VI	KELLAR Dep. No. 117	Simple granite pegmatite	Probably uranothorite	Probably bio	0.005% U_3O_8	Fracturing and shearing	Marble, migmatite, granitized paragneiss, granite gneiss	GSC File 31F/2-2	on strike with Bordun property

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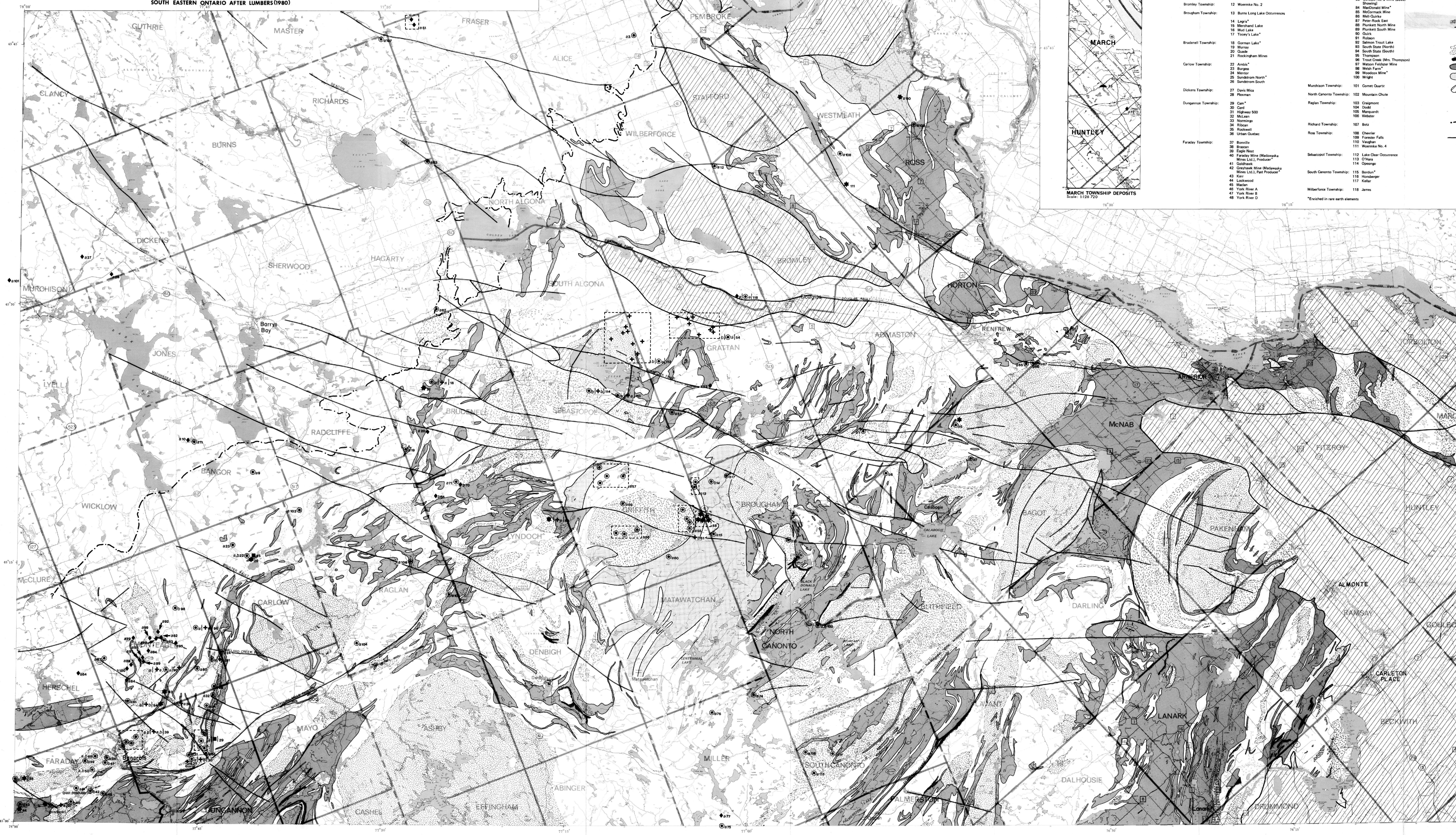
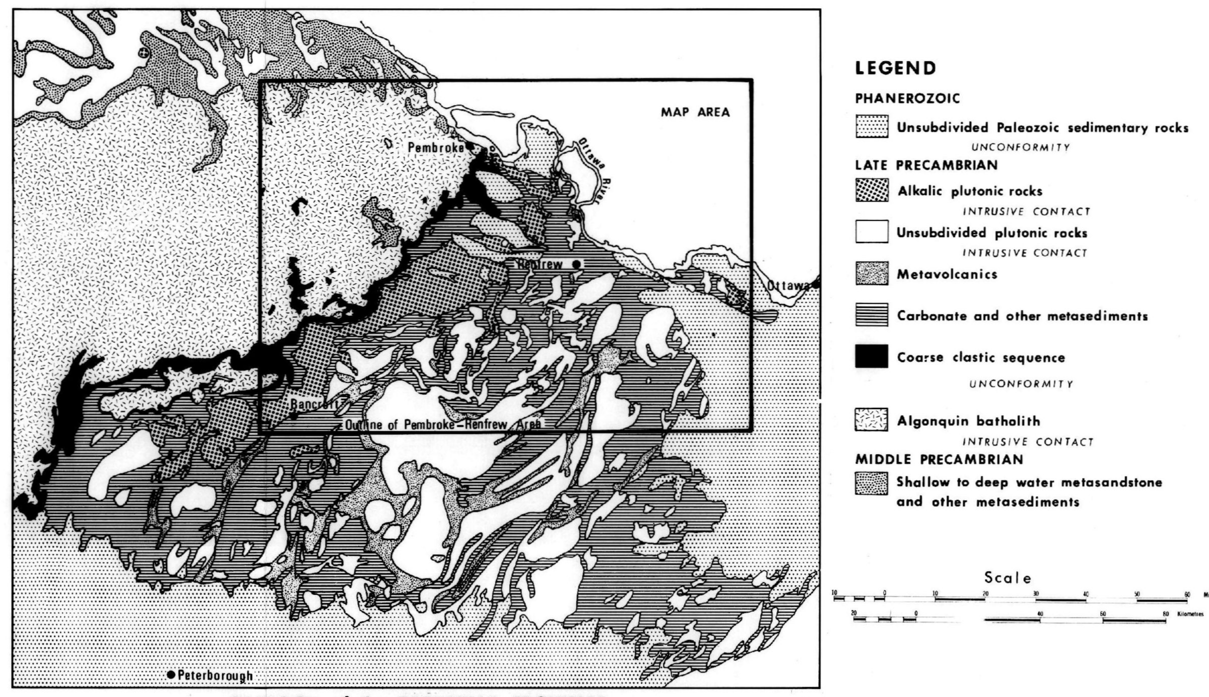
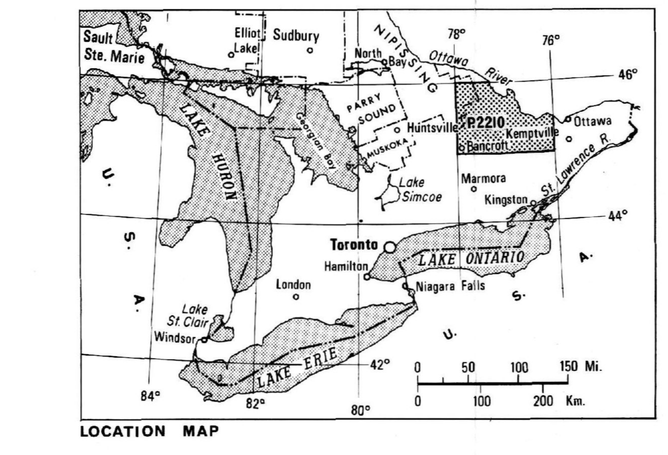
INDEX

No entries are shown for the elements Uranium and Thorium in this index since they are mentioned very frequently in the report.





GEOLOGY of the GRENVILLE PROVINCE SOUTH EASTERN ONTARIO AFTER LUMBERS(1980)



LOCATION MAP

MARCH TOWNSHIP DEPOSITS
Scale: 1:126 720

LIST OF RADIOACTIVE MINERAL DEPOSITS

Admaston Township:	1	Dudgeon
Alice Township:	2	McCoshen
	3	Woermke No. 1A
	4	Woermke No. 1B
Bagot Township:	5	Boicey
	6	Quilty
	7	Zavitski
	8	Zenith Mine
Bangor Township:	9	Bennet Lake
	10	Dubblestein
	11	Thomas*
Bromley Township:	12	Woermke No. 2
Brougham Township:	13	Burns Long Lake Occurrences
	14	Legris*
	15	Merchand Lake
	16	Mud Lake
	17	Tooey's Lake*
Brudenell Township:	18	Gorman Lake*
	19	Murray
	20	Quade
	21	Rockingham Mines
Carlow Township:	22	Ambis*
	23	Burgess
	24	Mentor
	25	Sundstrom North*
	26	Sundstrom South
Dickens Township:	27	Davis Mica
	28	Plexman
Dungannon Township:	29	Cam*
	30	Card
	31	Highway 500
	32	McLean
	33	Normingo
	34	Ribcan
	35	Rockwell
	36	Urban Quebec
Faraday Township:	37	Bonville
	38	Brascan
	39	Eagle Nest
	40	Faraday Mine (Madawaska Mines Ltd.), Producer*
	41	Goldhawk
	42	Greyhawk Mine (Madawaska Mines Ltd.), Past Producer*
	43	Kerr
	44	Lockwood
	45	Maclan
	46	York River A
	47	York River B
	48	York River D
	49	York River E
	50	York River G
Fraser Township:	51	Barr Feldspar Quarry
Grattan Township:	52	Colautti Feldspar Mine
	53	Grattan
	54	Grattan Township Occurrences
Griffith Township:	55	Conrad Occurrences
	56	Godin Lake Occurrences
	57	Highland Lake Occurrences
	58	Jeffers Lake Occurrences
	59	Lambert
	60	Percy
	61	Spain Molybdenite Mine
Hagarty Township:	62	Rochefort*
	63	Turpins Bay*
Herschel Township:	64	Peter-Rock West*
Horton Township:	65	Dempsey
	66	Goshen A
	67	Goshen B
Lyndoch Township:	68	Canadian Beryllium Mines and Alloys Limited
	69	Jamieson Mine
	70	Price
	71	Universal Light Metals
March Township:	72	O'Brien-Fowler
	73	South March
Miller Township:	74	Barnet
	75	Doranium
	76	Salmond
	77	Whytock-Gray-Elkington*
Monteagle Township:	78	Bartlett*
	79	Cairns
	80	Carr
	81	Ferrill*
	82	Genesee No. 2 Mine
	83	Genesee No. 2 Mine (South Showing)
	84	MacDonald Mine*
	85	McCormack Mine
	86	Mell-Quirke
	87	Peter-Rock East
	88	Plunkett North Mine
	89	Plunkett South Mine
	90	Quirk
	91	Robson
	92	Salmon Trout Lake
	93	South State (North)
	94	South State (South)
	95	Thompson
	96	Trout Creek (Mrs. Thompson)
	97	Watson Feldspar Mine
	98	Welsh Farm*
	99	Woodcox Mine*
	100	Wright
Murchison Township:	101	Comet Quartz
North Canonto Township:	102	Mountain Chute
Raglan Township:	103	Craigmont
	104	Dodd
	105	Marquardt
	106	Webster
Richard Township:	107	Betz
Ross Township:	108	Chevrier
	109	Forester Falls
	110	Vaughan
	111	Woermke No. 4
Sebastopol Township:	112	Lake Clear Occurrence
	113	O'Hara
	114	Opeongo
South Canonto Township:	115	Bordun*
	116	Honsberger
	117	Kellar
Wilberforce Township:	118	James

*Enriched in rare earth elements

Ontario
Ministry of Natural Resources
Hon. James A.C. Auld, Minister
Dr. J.K. Reynolds, Deputy Minister

Stock No.: 11965

ONTARIO GEOLOGICAL SURVEY
PRELIMINARY MAP P. 2210
GEOLOGICAL SERIES

RADIOACTIVE MINERAL DEPOSITS OF THE PEMBROKE–RENFREW AREA

SOUTHERN ONTARIO

Scale 1:126 720
Miles 1 0 1 2 3 4 5 6 Miles
Metres 2500 0 5 Kilometres
NTS Reference: 31F

LEGEND

Pegmatoid bodies large
Pegmatoid bodies small
Nepheline gneiss and pegmatite
Large granitoid body
Rusty pyritic graphitic zone
Marble belt-well known
Marble belt-poorly known
Paleozoic cover

SYMBOLS LIST

Limit of Late Precambrian supracrustal sequence (supracrustal sequence to south)
Fault

CLASSIFICATION OF RADIOACTIVE MINERAL DEPOSITS: PEMBROKE AREA

Deposits in Non-Metamorphic Terranes
In sandstone-dolomite

Deposits in Metamorphic Terranes
1) Associated with granitic rocks
In zoned pegmatites
a) simple type
b) complex type
In unzoned pegmatites
a) simple type
b) complex type
In granitic rocks
2) Associated with carbonate rocks
Stratabound deposits in marbles, calc-silicate rocks including pyroxenite. May be reworked syngenetic or introduced during metamorphic-metasomatic activity (skarn)
3) Vein occurrences
a) carbonate veins and pods
b) pyroxene and biotite veins

NOTE: For those deposits in which more than one symbol is shown depicting a deposit site, the first symbol indicates both the location and the principal deposit type. Symbols following in parenthesis denote variations in deposit type present within, or associated with, the principal occurrence.

DEFINITION

For the purpose of this study we have considered all natural concentration of metallic minerals however small in which either radioactive minerals have been identified or assay values of at least 0.02 percent U_3O_8 or Thorium have been obtained.

As many radioactive deposits in the map area contain thorium as well as uranium and as the uranium-thorium ratio may vary significantly even within one deposit, the use of instruments with discriminating capability is strongly recommended.

The locations of most of the mineral deposits are based on field work by S. L. Masson and assistants in 1977 and 1978. Some deposits were not visited and the location of these deposits are based on published maps and reports of the Ontario Geological Survey, the Geological Survey of Canada, and information obtained from the Assessment Files Research Office of the Ontario Geological Survey.

SOURCES OF INFORMATION

Geology of deposits by Masson, S. L. and Gordon, J. B. 1977, 1978.

Geological compilation by C. C. Storey 1978, 1979.

Compilation from Ontario Department of Mines Maps 39h, 52b, 53b, 1953-2, 1954-3, 1955-8, 1956-4, 1957-1, 2031, 2049, 2141, 2228, 2254. Ontario Geological Survey Maps P.1507, P.1560, P.1838, P.2240.

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Unpublished compilation by S. B. Lumbers, 1976.

Geology of Renfrew County; Ontario Geological Survey Open File Report 5282, 1980 by S. B. Lumbers.

Parts of the area are currently under review and some of the features shown may be reinterpreted as a result of this work.

Base map compiled by cartography unit from 1:50 000 National Topographic Series Maps.

Assessment Files Research Office, Ontario Ministry of Natural Resources, Toronto; Geoscience Data Centre, Ontario Geological Survey, Toronto; Resident Geologist's Files, Ontario Ministry of Natural Resources, Huntsville, Kemptville.

Every possible effort has been made to ensure the accuracy of the information presented on this map; however, the Ontario Ministry of Natural Resources does not assume any liability for errors that may occur. Users may wish to verify critical information; sources include both the references listed here, and information on file at the Resident or Regional Geologist's office and the Mining Recorder's office nearest the map area.

"The work reported here is part of a Mineral Resources Assessment Project, Pembroke-Renfrew Region. It was equally funded by the Federal Department of Regional and Economic Expansion and the Ontario Ministry of Treasury and Economics under the Community and Resource Development Subsidiary Agreement."

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Issued 1980

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