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Ontario Geological Survey

Report 190

Geology of

Connaught and Churchill Townships

District of Sudbury

by

M.W. Carter

1980

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(back pocket)

Map 2414 (coloured)–Connaught and Churchill Townships.
District of Sudbury.
Scale 1:31 680 or 1 inch to ½ mile.

ABSTRACT

This report describes the geology and mineral occurrences of Connaught and Churchill Townships, in the District of Sudbury. The townships are centred about 10 km northwest of the village of Shining Tree, on Highway 560, and comprise an area of 185 km^2.

Stratigraphically all consolidated rocks in the area are of Precambrian age and range from the Early to Middle and possibly to Late Precambrian. These rocks are mantled by unconsolidated Pleistocene and Recent deposits.

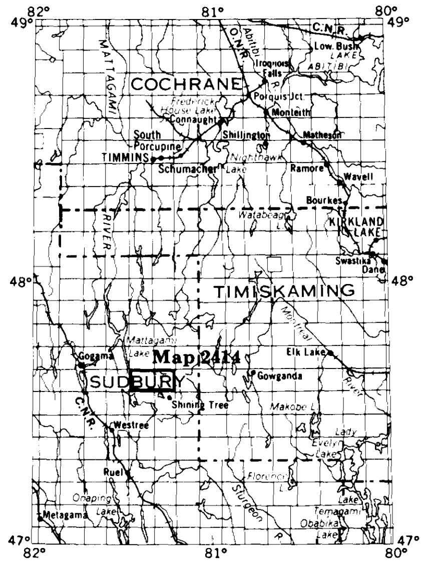

Figure 1–Key map showing location of Connaught and Churchill Townships, District of Sudbury. Scale 1:3 168 000 or 1 inch to 50 miles.

Lithologically the Early Precambrian rocks comprise a metavolcanic and metasedimentary sequence, interlayered with mafic and ultramafic rocks, all of which are intruded by felsic to intermediate plutonic rocks and diabase dikes. The metavolcanics comprise a subalkalic and alkalic suite, the former being by far the more important. The subalkalic metavolcanics range from mafic to felsic in composition, and are dark green, light green, cream, and grey. Alkalic metavolcanics vary from mafic to intermediate in composition, and from dark purple to pink in colour. The metasediments consist of clastic and chemical rocks, argillite being predominant in the former. The latter consists of iron formation and chert. Ultramafic and mafic rocks are minor and comprise serpentinized dunite and gabbro. The felsic to intermediate plutonic rocks occur mainly in southwestern Connaught Township and consist of granodiorite, quartz monzonite, and trondhjemite. Diabase dikes, with a predominant northwest trend, cut all these rocks and may range in age from Early to Late Precambrian. Middle Precambrian rocks are represented by the Espanola Formation of the Quirke Lake Group, the Gowganda Formation of the Cobalt Group, and Nipissing Diabase. The Espanola Formation

consists of limestone and the Gowganda Formation mainly of polymictic conglomerate, best exposed in central and north-central Connaught Township. The Nipissing Diabase comprises diabase, amphibole gabbro, and granophyre, and is best exposed in southeastern and southwestern Churchill Township. The Pleistocene and Recent deposits comprise sand, gravel, muskeg and alluvium which are best exposed in southwestern Connaught Township and along Elephant Head Creek.

Folding in Early Precambrian metavolcanic-metasedimentary rocks is about north-northwest-trending axes in the eastern half of Churchill Township, and about west-trending axes in northwestern Churchill Township and in northern Connaught Township. In southern Connaught Township and southwestern Churchill Township the rocks trend northwest. The Middle Precambrian rocks appear to be flat-lying.

Faulting is prominent in the map-area. The faults trend north-northwest, the most prominent of which are the Michiwakenda Lake Fault and the Elephant Head Lake Fault. These are sinistral wrench faults.

Mineralization consists of gold and copper, the former being more important. The most important gold deposits are the Gosselin and the Knox deposits in Churchill Township, both of which consist of auriferous quartz veins. The Gosselin deposit comprises a northwest-striking vein 1400 m long and the Knox deposit a north-striking vein 300 m long. None of these became producing mines. The most important copper deposit is the Mataris showing which is a disseminated stratabound copper deposit associated with a 150 m long electromagnetic conductor, located in northeastern Connaught Township.

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 co-operation with the Coal Association of Canada.

Geology

of

Connaught and Churchill Townships

District of Sudbury

by

M.W. Carter[1]

Introduction

Location and Accessibility

Connaught and Churchill Townships lie in the District of Sudbury between Latitudes 47°35′ and 47°40′N and Longitudes 81°12′ and 81°20′W. The two townships together comprise an area of 185 km^2, each being 92.5 km^2 in area.

Access is good for Churchill Township, but poor for Connaught Township. Highway 560, an all-weather gravel road which passes through the southeastern corner of Churchill Township, and its branch, the Grassy River Road, which traverses the northeastern corner of the township, allow access to these parts of the map-area. Highway 560 also crosses Michiwakenda Lake at a point 2.2 km east of the southeastern boundary of Churchill Township. Here, canoes can enter the Michiwakenda Lake-Okawakenda Lake system. These lakes are connected by a 160 m portage. By these means the northern and eastern parts of Churchill Township can be reached. Highway 560 also crosses West Shining Tree Lake in north-central Asquith Township and by using canoes the southwestern and western parts of Churchill Township, and the southeastern part of Connaught Township can be reached. The central parts of Churchill Township are best reached by float-equipped aircraft using Saville Lake. Connaught Township is best reached by float-equipped aircraft using Waonga and Mattagami Lakes for the western part, Connaught and Burns Lakes for the central and northern parts, and Elephant Head Lake for the southern part.

The nearest aircraft landing facility is at Gogama, about 30 air km west-northwest of the centre of the map-area.

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[1]Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto, approved for publication by the Chief Geologist, March 15, 1977. This report is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

Physiography

The map-area is generally of low relief, the maximum difference in elevation being about 105 m. The most rugged area lies to the east of Elephant Head Lake in southeastern Connaught Township where steep hills rise to 450 m. The flattest areas occur in southwestern Connaught Township where Quaternary sands blanket the area. The trend of the ridges in regions underlain by the Early Precambrian metavolcanic-metasedimentary rocks shows a marked northwest alignment which reflects the regional strike of the rocks. This is well seen in the southern part of the map-area. Where the strike of these rocks is east-west, as in the northern part of the area, the ridges trend east. The trend of the ridges is also influenced by the direction of faulting which is subparallel to, or at a sharp angle to, the regional strike of the rocks mentioned. The influence of this faulting on ridge trends is seen in the vicinity of Elephant Head Creek and Michiwakenda Lake, which follow the Elephant Head Lake Fault and Michiwakenda Lake Fault respectively.

The height-of-land for the St. Lawrence and Hudson Bay drainage systems trends approximately north-south in the map-area and is located in the eastern part of Connaught Township. The main river west of this line, Elephant Head Creek, flows northward into the Hudson Bay system, whereas the Shining Tree Creek-West Shining Tree Lake, and the Okawakenda Lake-Michiwakenda Lake systems flow east as part of the St. Lawrence drainage basin. The trend of the main waterways: the Mattagami Lake-Waonga Lake system, Elephant Head Creek and West Shining Tree Creek, and Michiwakenda Lake all trend north-northwest, following the direction of faulting in the map-area.

Pleistocene and Recent deposits cover about 25 percent of the map-area, occurring mostly in the western part of Connaught Township. The greatest known thickness of overburden is 9.7 m, (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) and occurs Connaught Township. Outcrop is fairly abundant in eastern Connaught Township and very abundant in Churchill Township.

Previous Geological work

Geological investigations began in the area in 1875 when R. Bell (1875-1876) described the rocks at the southern end of Mattagami Lake, which forms part of the western boundary of Connaught Township. Subsequent examinations in this part of the map-area were by W.A. Parks (1900) and A.P. Coleman (1901). Later investigations were carried out by W.H. Collins (1911; 1917) during the mapping of the Onaping Sheet; by R.B. Stewart in 1911 and 1912 (Stewart 1912, 1913), by P.E. Hopkins in 1919 (Hopkins 1920) and in 1925 by F.L. Finley (1926). The most recent mapping in the area other than by the writer, was in 1933 by H.C. Laird (1934) who also made a separate examination of the mineral deposits of the area in the following year, 1934 (Laird 1935).

From 1912 to 1923 a series of papers appeared in various mining journals concerning the geology and deposits of the West Shining Tree gold area, of which the map-area forms a part. These were by W.R. Hodge (1912); R.E. Hore (1918; 1919a,b,c,d); L.H. Goodwin (1919) and W.H. Weed (1923). The gold deposits of the map-area were also described in a special report by Hopkins (1921).

Present Geological Work

Field work for this project was carried out during the summer of 1973, using vertical aerial photographs at a scale of 1 inch to ¼ mile or 1:15 840 supplied by the Timber Branch, Ontario Ministry of Natural Resources. Pace-and-compass traverses were run at intervals of ¼ mile in areas where outcrop was extensive. Where outcrop was sparse, traverses were run irregularly so as to examine all exposures. Traverses across outcrop areas were run for the most part at right angles to the strike. Logging roads were also used in the search for outcrop. Geological data were recorded directly onto acetate sheets attached to the aerial photographs carried on the traverses. The data were then transferred to 1 inch to ¼ mile or 1:15 840 cronaflex base maps compiled by the Cartography Section of the Geological Branch, and made from Forest Resources Inventory maps of the Silviculture Section, Ontario Ministry of Natural Resources. Two preliminary, uncoloured, geological maps, P.959 and P.960 (Carter 1974a,b) covering Connaught and Churchill Townships respectively, were published in 1974, at a scale of 1 inch to ¼ mile or 1:15 840.

Acknowledgments

During the field work the author was assisted by: A.F. Bau, senior assistant, and A. Grant, L. Kovacs and L. Starzynski, junior assistants. Their help in carrying out the mapping is greatly appreciated.

The author wishes to thank Howard Lovell, Resident Geologist, Ontario Ministry of Natural Resources, Kirkland Lake, for valuable discussions and help during the season; and Mr. and Mrs. G. Cruickshank for their many courtesies and help during the mapping project.

GENERAL GEOLOGY

The lithological units indicated on the map face are listed in Table I in the order of decreasing age as far as this could be established. All consolidated rocks belong to the Early, Early to Late, and Middle Precambrian. These are blanketed by unconsolidated Cenozoic sediments of Pleistocene to Recent age.

Early Precambrian rocks form the local basement and comprise a suite of subalkalic and alkalic metavolcanics, interlayered mafic and ultramafic rocks, and clastic and chemical metasediments. The subalkalic metavolcanics range in composition from basalt to rhyolite and vary in colour from the black and dark green of the mafic rocks, to the light green, and grey-green of the intermediate rocks, to the buff, pale grey, pink, pale yellow, and cream of the felsic rocks. The alkalic metavolcanics, which range from hawaiite to trachyte in composition, vary in colour from black in the mafic rocks to dark and light purple, pale reddish brown and pink of the intermediate rocks. The ultramafic and mafic rocks which are uncommon, are interlayered with the mafic metavolcanics. The ultramafic rocks are serpentinized dunites; the mafic rocks are gabbroic in composition. Contact relationships of the ultramafic rock mass exposed at Gosselin Lake in southeastern Churchill Township were not observed but the body is elongated in the direction of the regional trend of the associated metavolcanics and may be an intrusion or a flow. The gabbro contact was also not observed but the rock is finer grained towards the contact area. This body is believed to be intrusive. The metasediments comprise conglomerate, greywacke, siltstone, chert, argillite, slate, and iron formation. They are best exposed in the northeastern part of Churchill Township, and are absent in the rest of the map-area. All these rocks form an interlayered sequence, the lower part of which occurs in southwestern Churchill Township and southeastern Connaught Township. In these two areas the rocks young northeastward as determined from top determinations on pillowed structures in lavas and graded bedding in subaqueous tuffs. The metavolcanic-metasedimentary sequence can be subdivided into a lower and an upper part based on the composition of the volcanic rocks and the nature of the volcanic activity. In the lower part of the sequence the volcanic rocks are an interlayered, mainly homoclinal series ranging from mafic to felsic in composition. The mafic and intermediate rocks are subaqueous flows; the felsic rocks may be partly pyroclastic. Metasediments in this part of the sequence are rare. In the upper part, which is tightly folded, mafic and felsic rocks are rare; the volcanic rocks are predominantly intermediate and pyroclastics and metasediments are abundant. Iron formation occurs only in this upper part which is best exposed in Michiwakenda and Okawakenda Lakes in Churchill Township, and in the northern half of Connaught Township around Okawakenda, Burns, and Wire Lakes.

The metavolcanic-metasedimentary rocks have been intruded by granitic rocks as indicated by intrusive phenomena observed in the region northeast of Elephant Head Lake. Xenoliths and roof pendants of metavolcanics have been observed in this area.

Early to Late Precambrian rocks are believed by the author to be represented by numerous diabase dikes varying in trend from northwest to north to northeast. These cut both the metavolcanic and metasedimentary rocks and the granitic rocks at Elephant Head Lake and may therefore belong to the Matachewan and Abitibi dike sets (Fahrig, Gaucher, and Larochelle 1965).

Middle Precambrian rocks rest unconformably on the older Early Precambrian rocks and comprise rocks belonging to the Espanola Formation of the Quirke Lake Group, the Gowganda Formation of the Cobalt Group, and Nipissing Diabase. Rocks considered by the author to belong to the Espanola Formation are grey and white limestone consisting of recrystallized calcite. Drill hole data (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) indicate that argillite and quartzite are also associated with the limestone. The formation occurs in one area only, about 0.8 km north-northwest of Elephant Head Lake in southern Connaught Township. The rocks of the Gowganda Formation comprise conglomerate and greywacke, the latter being very

TABLE 1 | TABLE OF LITHOLOGIC UNITS FOR CONNAUGHT AND CHURCHILL TOWNSHIPS

PHANEROZOIC
- CENOZOIC
  - PLEISTOCENE AND RECENT
    - Glacial drift, sand and gravel

Unconformity

PRECAMBRIAN
- MIDDLE PRECAMBRIAN
  - MAFIC INTRUSIVE ROCKS
    - Diabase medium- and coarse-grained, quartz diabase, diabase with pink feldspar, granophyritic diabase, granophyre, amphibole gabbro, diabase with large porphyritic feldspars.

Intrusive Contact

  - HURONIAN SUPERGROUP
    - COBALT GROUP
      - Gowganda Formation
        - Conglomerate, greywacke
    - QUIRKE LAKE GROUP
      - Espanola Formation
        - Limestone, limestone and magnetite

Unconformity

- EARLY TO LATE PRECAMBRIAN
  - MAFIC INTRUSIVE ROCKS
    - Diabase dikes

Intrusive Contact

- EARLY PRECAMBRIAN
  - FELSIC TO INTERMEDIATE INTRUSIVE ROCKS
    - Biotite granodiorite, biotite quartz monzonite, biotite trondhjemite, feldspar porphyry, hornblende porphyry, hornblende-feldspar porphyry, quartz diorite.

Intrusive Contact

  - METAMORPHOSED ULTRAMAFIC TO MAFIC ROCKS
    - Serpentinized dunite, green dolomite-calcite rock, gabbro

Intrusive Contact

  - METAVOLCANICS AND METASEDIMENTS
    - METASEDIMENTS
      - Argillite, siltstone, conglomerate, slate, chert, iron formation (jasper, hematite, magnetite, argillite)
    - METAVOLCANICS
      - Alkalic Metavolcanics
        - Mafic and Intermediate Metavolcanics
          - Trachyte: aphanitic and porphyritic; trachyandesite; aphanitic and porphyritic in hornblende and diopsidic augite, Hawaiite
      - Subalkalic Metavolcanics
        - Felsic Metavolcanics
          - Rhyolite-rhyodacite: aphanitic, amygdaloidal, porphyritic; tuff, lapilli-tuff, tuff-breccia; mylonite, breccia
        - Intermediate Metavolcanics
          - Andesite-dacite: aphanitic, porphyritic, pillowed, amygdaloidal, vesicular and spherulitic; tuff, lapilli-tuff, tuff-breccia, mylonite.
        - Mafic Metavolcanics
          - Basalt: fine- to coarse-grained, pillowed, amygdaloidal, variolitic, porphyritic; quartz basalt; lapilli-tuff, breccia, chlorite schist

subordinate. These rocks are best exposed in central Connaught Township, but quantitatively are not very important. They appear to be flat-lying. The Nipissing Diabase consists of diabase, coarse amphibole gabbro, granophyric diabase, and granophyre, which occur throughout the map-area, but are best exposed in southeastern and southwestern Churchill Township. In Connaught Township the Nipissing Diabase underlies the Gowganda Formation at the Early Precambrian-Middle Precambrian contact. The various exposures of Nipissing Diabase are considered to represent erosional remnants of a once continuous or discontinuous sill.

Cenozoic sediments comprise the youngest rocks in the map-area and are represented by Pleistocene and Recent sand, gravel, muskeg, and alluvium which are best exposed in the southwestern part of Connaught Township. They blanket the older rocks. Two prominent eskers were located: one in eastern Connaught Township trending south-southwest, and about 8 km long; and the other located in western Connaught Township and about 3 km long, and trending south-southeast.

Early Precambrian

METAVOLCANICS AND METASEDIMENTS

Subalkalic Metavolcanics

MAFIC METAVOLCANICS

Lavas

Mafic metavolcanics have been recognized on the basis of colour, texture, hardness, approximate specific gravity, and litho-structures. They are best exposed in the southwestern part of Churchill Township and the southeastern part of Connaught Township. Only rarely are they encountered in other parts of the map-area, e.g. in the extreme northern part of both townships. The rocks are either black or dark green, fine- to medium-grained, and softer than about a hardness of six. They are aphanitic, porphyritic, or pillowed.

In general, exposures did not provide direct evidence for the determination of the thickness of individual flows. However, on the large island at the extreme northern part of West Shining Tree Lake, in southwestern Churchill Township, pillowed structure is well developed on the eastern shore of the island, but only coarse massive structure on the western shore. The island is elongated in the direction of the strike of the rocks and is about 90 m wide. As the rocks dip steeply or vertically, this flow would be approximately 90 m thick. The narrowest flow mapped was about 30 m and therefore the range of the known thickness of

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Photo 1–Pillowed basalt, West Shining Tree Lake, southwest Churchill Township.

the flows is from about 30 to 90 m. On the map, areas underlain by basalt wider than 90 m occur, and from the alternation of pillowed and massive units such areas are regarded as composed of several contiguous flows. Alternation with intermediate and felsic rocks also serves to indicate the thickness of some of the basaltic units.

Pillowed basalts (Photo 1) are very common and are seen to perfection on the islands, and along the shores of West Shining Tree Lake, in southwestern Churchill Township. The pillows are well preserved and range in length from 0.3 m to 1 m, and in width from 15 cm to 46 cm. A well developed rim varying from 1 cm to 5 cm can be seen bordering the pillows. Vesicular structure is common in the pillows, and commonly the spaces between the pillows are infilled with quartz, or fine-grained grey-green chloritic and epidotic material.

Porphyritic flows contain xenocrysts of quartz or phenocrysts of feldspar. The quartz grains are equant, euhedral and about 1 mm across; the feldspars are euhedral, white, and measure up to 2 mm by 3 mm across and occur in a fine- or medium-grained green matrix. In one outcrop at the southern end of the island at the northern end of West Shining Tree Lake in Churchill Township, the feldspars measure up to 35 mm across and show glomeroporphyritic structure.

Amygdaloidal flows contain amygdules about 3 mm across which consist of pink or white calcite and pale greenish chlorite.

Coarse diabasic units occurring among the basalts may represent mafic intrusive sills, but because chilled contacts were not observed the diabasic units were mapped as coarse-grained basalt.

The basaltic breccia is a dark green to black rock consisting of angular frag-

TABLE 2 | MODES OF SELECTED EARLY PRECAMBRIAN SUBALKALIC MAFIC METAVOLCANICS (in percent).

Sample No.	N10-128	O10-6	N9-64b	N10-124
Quartz	7	11	11	2
Plagioclase	18	13	12	2
*Actinolite	8	30	22	12
Epidote	20	15	13	42
Chlorite	45	26	20	28
Clinozoisite	1	4	21	12
Sericite	—	1	1	1
Leucoxene-sphene	1	—	—	1
Plagioclase Composition	Altered+	Altered+	An_8	An_0

*Chloritized in many cases.
+Too altered for determination of composition optically.

N10-128 - Dark green, aphanitic, medium-grained, mafic metavolcanic, west shore of West Shiningtree Lake, southwestern Churchill Tp.

O10-6 - Dark green, aphanitic, medium-grained, mafic metavolcanic, West Shiningtree Lake, south of Jonson Lake, southwestern Churchill Tp.

N9-64b - Dark green, aphanitic, fine-grained, mafic metavolcanic, from northwestern shore of Jonson Lake, southwestern Churchill Tp.

N10-124 - Dark green, aphanitic, fine-grained, mafic metavolcanic, eastern shore of West Shiningtree Lake, southwestern Churchill Tp.

ments of basalt set in a finer grained basaltic matrix. Field occurrence indicated that the rock is probably a flow-top breccia.

The chlorite schist is dark green, fine grained, and foliated, the schistosity being caused by local shearing.

Variolitic basalt is uncommon. The varioles consist of ellipsoidal knobs consisting of pale greenish radiating feldspathic material set in a dark green matrix.

Thin section study of four of the aphanitic rocks indicate that they were metamorphosed under lower greenschist facies (Turner 1968) conditions of regional metamorphism. In hand specimen all the rocks are massive, fine grained and dark green, with a granular texture. In thin section relict intergranular, blastophitic, granoblastic, and amygdaloidal textures were observed. The feldspar laths are all saussuritized to a cloudy brown pseudomorph made up of clinozoisite, but in one section clear parts of the feldspar laths consist of albite (An_8). In rocks with intergranular texture, the intergranular material is of pale green pleochroic actinolite with ragged terminations, associated with clinozoisite, chlorite, leucoxene, quartz, sericite, calcite, and pyrite. The quartz content varies from 2 to 11 percent, saussuritized feldspar from 2 to 18 percent, actinolite from 8 to 30 percent, clinozoisite from 1 to 21 percent, epidote from 13 to 42 percent, and chlorite from 20 to 45 percent. Accessories, consisting of sericite, leucoxene, and pyrite, average 1 percent. The modes of these rocks are given in Table 2. Six of these rocks which were studied in thin section were chemically analyzed. The chemical analyses are shown in Table 3. Samples N10-128, O10-6, N9-64a,

TABLE 3	CHEMICAL ANALYSES (IN WEIGHT PERCENT) AND SPECIFIC GRAVITIES OF ROCK SAMPLES FROM THE EARLY PRECAMBRIAN SUBALKALIC MAFIC METAVOLCANICS.

Sample No.	N10-128*	O10-6*	N9-64a	N9-64b*	N10-137	N10-124*
SiO_2	49.00	49.10	49.10	47.60	46.10	48.70
Al_2O_3	14.50	15.30	14.80	14.70	n.d.	n.d.
Fe_2O_3	1.82	2.23	2.32	1.87	n.d.	n.d.
FeO	9.07	9.15	9.07	9.83	n.d.	n.d.
MgO	9.71	8.45	8.00	8.28	n.d.	n.d.
CaO	9.61	9.71	9.75	11.10	n.d.	n.d.
Na_2O	1.97	1.70	2.97	2.80	n.d.	n.d.
K_2O	0.22	0.10	0.07	0.10	n.d.	n.d.
TiO_2	0.66	0.79	0.91	0.86	n.d.	n.d.
P_2O_5	0.06	0.07	0.10	0.10	n.d.	n.d.
S	0.06	0.07	0.06	0.05	n.d.	n.d.
MnO	0.21	0.20	0.20	0.22	n.d.	n.d.
CO_2	0.85	0.12	0.46	0.24	n.d.	n.d.
H_2O^+	2.72	2.84	2.49	2.78	n.d.	n.d.
H_2O^-	0.20	0.08	0.15	0.18	n.d.	n.d.
TOTAL	100.7	99.9	100.4	100.7	46.1	48.7
Spec. Gr.	2.98	3.03	2.98	2.99	2.97	3.05

*See Table 2 for description and location.

N9-64a - Dark green, aphanitic, fine-grained, mafic metavolcanic, northwestern shore of Jonson Lake, southwestern Churchill Tp.

N10-137 - Dark green, aphanitic, fine-grained, mafic metavolcanic, western shore of West Shiningtree Lake, southwestern Churchill Tp.

Abbreviation:
n.d. - not determined.

and N9-64b have been classified as tholeiitic basalts using the classification of T.N. Irvine and W.R.A. Baragar (1971). Table 6, samples N9-64a and N9-64b were taken from the same exposure and indicate the chemical variation possible within a single outcrop. The chemical analyses show the total sum of H_2O+ and CO_2 to vary within the narrow range of 2.95 to 3.0 percent, and the corresponding SiO_2 content from 47.6 to 49.1 percent. The lithologic aspect of these rocks in the field would lead to their identification as mafic metavolcanics and it therefore appears that in the map-area rocks showing this degree of alteration can be reliably named in the field.

Pyroclastics

The rock described as lapilli-tuff, according to the classification of R.V. Fisher (1966), consists of lapilli-sized fragments of black basaltic rock mixed with

TABLE 4 CHEMICAL ANALYSES (IN WEIGHT PERCENT) OF EARLY PRECAMBRIAN SUBALKALIC MAFIC METAVOLCANICS RECALCULATED TO A WATER-CARBON DIOXIDE-FREE BASIS.

Sample No.	N10-128*	O10-6*	N9-64a**	N9-64b*
SiO_2	50.60	50.70	50.50	48.80
Al_2O_3	15.00	15.80	15.20	15.10
Fe_2O_3	1.88	2.30	2.38	1.92
FeO	9.36	9.45	9.32	10.08
MgO	10.02	8.72	8.22	8.49
CaO	9.91	10.02	10.02	11.40
Na_2O	2.03	1.76	3.05	2.87
K_2O	0.23	0.10	0.07	0.10
TiO_2	0.68	0.82	0.94	0.88
P_2O_5	0.06	0.07	0.10	0.10
S	0.06	0.07	0.06	0.05
MnO	0.22	0.21	0.21	0.23
CO_2	0.00	0.00	0.00	0.00
H_2O^+	0.00	0.00	0.00	0.00
H_2O^-	0.00	0.00	0.00	0.00
TOTAL	100.1	100.0	100.1	100.0

*See Table 2 for descrition and location.
**See Table 3 for description and location.

TABLE 5 CATION PERCENTAGES OF EARLY PRECAMBRIAN SUBALKALIC MAFIC METAVOLCANICS.

Sample No.	N10-128*	O10-6*	N9-64a**	N9-64b*
Si_4+	46.80	47.30	46.70	45.20
Al_3+	16.30	17.40	16.60	16.40
Fe_3+	1.31	1.62	1.66	1.34
***Fe_2+	7.41	7.53	7.38	7.98
Mg_2+	13.81	12.13	11.34	11.71
Ca_2+	9.83	10.02	9.94	11.30
Na_+	3.65	3.17	5.48	5.15
K+	0.27	0.12	0.09	0.12
Ti_4+	0.47	0.57	0.65	0.61
P5+	0.05	0.06	0.08	0.08
S_6+	0.11	0.13	0.11	0.09
TOTAL	100.0	100.1	100.0	99.98

*See Table 2 for description and location.
**See Table 3 for description and location.
***Represents Fe2+ and Mn2+ combined.

andesitic fragments in a black basaltic matrix. The overall composition of the rock is basaltic and because of the variable composition of the fragments the rock is considered to be pyroclastic. This rock-type is rare.

INTERMEDIATE METAVOLCANICS

Included here are andesites and dacites. Like the mafic rocks these are recognized in the field on the basis of colour, hardness, texture, and approximate specific gravity. Fresh and weathered surfaces are lighter green than the mafic rocks, and the fresh surface is finer grained, being generally aphanitic. The diabasic texture seen in some of the basalts is absent. The occurrence of pillowed, amygdaloidal, vesicular, and spherulitic structures serve to indicate their volcanic origin. Both lavas and pyroclastic rocks have been recognized, and where no obvious clastic texture could be observed, the rock has been classed as a lava. Thus some of the aphanitic rocks may be pyroclastic. Flows predominate in the lower part of the sequence, whereas pyroclastic rocks predominate in the upper part. Careful examination of many of the outcrops is required to distinguish flows from pyroclastic rocks.

Lavas

Aphanitic and porphyritic varieties are present. The former occur in the lower part of the metavolcanic sequence interlayered with the basalts and are best exposed in southwestern Churchill Township and southeastern Connaught Township. Porphyritic varieties occur only in the upper part of the sequence, and are best exposed in the northern parts of the two townships.

Thin sections of three megascopically aphanitic types were examined. One of these is a greenish grey aphanite which shows poorly developed pilotaxitic texture and in which lath-shaped grains of oligoclase (An_{16}) showing indented edges are set in a recrystallized quartzofeldspathic matrix containing irregular patches of calcite, scaly sericite, and irregular dusky streaks of leucoxene. A partial chemical analysis of this rock is listed in Table 7, Sample 013-2. The occurrence of quartz in the matrix and the presence of 62 percent silica in this rock indicates that the lavas are of andesitic to dacitic composition. Another example of a megascopically aphanitic type is grey-green in colour and in thin section shows laths of oligoclase (An_{20}) with forked ends, a few phenocrysts of completely saussuritized feldspar, and isotropic chlorite, in an abundant saussuritized feldspathic matrix which appears to have been devitrified glass. Very little quartz is visible in the matrix and the rock is regarded as a meta-andesite. The third sample is dark grey and aphanitic and in thin section shows poorly developed pilotaxitic texture consisting of irregularly oriented lath-shaped clear albite (An_6) in a microgranular quartzofeldspathic recrystallized matrix, in which quartz forms about half of the quartzofeldspathic material. Scattered through the matrix are irregular grains of blue-green actinolite with ragged terminations, irregular dusky pale yellow epidote, calcite, and ilmenite-magnetite altered to leucox-

TABLE 6 NORMATIVE (MOLECULAR, WEIGHT IN PERCENT) COMPOSITION OF EARLY PRECAMBRIAN SUBALKALIC MAFIC METAVOLCANICS.

Sample No.	N10-128*		O10-6*		N9-64a**		N9-64b*	
	Molecular	Weight	Molecular	Weight	Molecular	Weight	Molecular	Weight
Ap	.129	.144	.152	.168	.215	.238	.215	.238
Po	.215	.170	.253	.198	.214	.169	.178	.141
Il	.948	1.294	1.144	1.549	1.302	1.776	1.228	1.675
Or	1.341	1.343	.615	.611	.425	.425	.606	.607
Ab	18.230	17.207	15.870	14.853	27.381	15.820	25.762	24.300
An	31.004	31.048	35.176	34.928	27.575	27.587	27.931	27.952
C	.000	.000	.000	.000	.000	.000	.000	.000
Ac	.000	.000	.000	.000	.000	.000	.000	.000
Mt	1.961	2.724	2.424	3.339	2.491	3.456	2.004	2.781
Hm	.000	.000	.000	.000	.000	.000	.000	.000
Wo	.000	.000	.000	.000	.000	.000	.000	.000
En	20.220	18.270	20.395	18.272	10.569	9.540	1.721	1.554
Fs	9.040	10.733	10.134	11.930	5.394	6.398	.971	1.152
Q	.000	.000	2.281	2.446	.000	.000	.000	.000
Di	9.808	9.557	7.720	7.460	11.352	11.051	14.239	13.866
Fo	1.879	1.586	.000	.000	4.825	4.070	10.938	9.228
Fa	.840	1.027	.000	.000	2.463	3.008	6.173	7.541
Ne	.000	.000	.000	.000	.000	.000	.000	.000
Lc	.000	.000	.000	.000	.000	.000	.000	.000
Kp	.000	.000	.000	.000	.000	.000	.000	.000
He	4.385	4.896	3.836	4.247	5.794	6.462	8.035	8.965
Cc	.000	.000	.000	.000	.000	.000	.000	.000
Ru	.000	.000	.000	.000	.000	.000	.000	.000
Ns	.000	.000	.000	.000	.000	.000	.000	.000
Ks	.000	.000	.000	.000	.000	.000	.000	.000
Cr	.000	.000	.000	.000	.000	.000	.000	.000
Ln	.000	.000	.000	.000	.000	.000	.000	.000
Normative Colour Index								
Molecular	49.08		45.65		44.19		45.31	
Weight	50.09		46.08		45.76		46.76	

Table 6 continued

Differentiation Index				
Molecular	19.57	18.77	27.81	26.37
Weight	18.55	17.91	26.24	24.91
Normative Plagioclase composition				
An%	62.97: labradorite	68.91: labradorite	50.18: andesine-labradorite	52.02: labradorite
Rock Name in the Irvine-Baragar (1971) System	Tholeiitic basalt	Tholeiitic basalt	Tholeiitic basalt	Tholeiitic basalt

*See Table 2 for description and location.
**See Table 3 for description and location.

TABLE 7 CHEMICAL ANALYSES (IN WEIGHT PERCENT), SPECIFIC GRAVITIES, CATION PERCENTAGES, AND NORMATIVE (MOLECULAR AND WEIGHT, IN PERCENT) COMPOSITION OF EARLY PRECAMBRIAN SUBALKALIC INTERMEDIATE METAVOLCANICS.

	Actual		Adjusted*	Cation percentages		Normative Composition		
Sample No.	O13-2	L15-22	L15-22		L15-22		L15-22 Molecular	L15-22 Weight
SiO_2	62.30	60.80	61.80	Si^{4+}	56.30	Ap	.335	.377
Al_2O_3	n.d.†	15.90	16.20	Al^{3+}	17.30	Po	.486	.390
Fe_2O_3	n.d.	0.86	0.87	Fe^{3+}	0.60	Il	.752	1.042
FeO	n.d.	4.54	4.61	** Fe^{2+}	3.59	Or	8.804	8.958
MgO	n.d.	5.41	5.50	Mg^{2+}	7.46	Ab	42.603	40.850
CaO	n.d.	3.76	3.82	Ca^{2+}	3.73	An	17.592	17.896
Na_2O	5.15	4.75	4.83	Na^{+}	8.52	C	.022	.021
K_2O	0.63	1.49	1.51	K^{+}	1.76	Ac	.000	.000
TiO_2	n.d.	0.54	0.55	Ti^{4+}	0.38	Mt	.898	1.267
P_2O_5	n.d.	0.16	0.16	P^{5+}	0.13	Hm	.000	.000
S	n.d.	0.14	0.14	S^{6+}	0.24	Wo	.000	.000
MnO	n.d.	0.10	0.10			En	14.920	13.694
CO_2	2.40	0.20	0.00			Fs	5.347	6.449
H_2O^+	2.90	2.04	0.00			Q	8.241	9.054
H_2O^-	n.d.	0.15	0.00			Di	.000	.000
						Fo	.000	.000
TOTAL	73.40	100.80	100.10	TOTAL	100.00	Fa	.000	.000
Spec. Gr.	n.d.	2.76				Ne	.000	.000
						Lc	.000	.000
						Kp	.000	.000
Normative Colour Index						He	.000	.000
Molecular		21.92				Cc	.000	.000
Weight		22.45				Ru	.000	.000
Differentiation Index						Ns	.000	.000
Molecular		59.65				Ks	.000	.000
Weight		58.86				Cr	.000	.000
Normative Plagioclase Composition, An%:						Ln	.000	.000
		29.23 (oligoclase)						
Rock name in Irvine & Baragar (1971) System:								
Calc-alkaline andesite								

*Adjusted to a water-carbon dioxide-free basis.
**Represents Fe^{2+} and Mn^{2+} combined.
†n.d. = not determined.

O13-2 - Light green, fine-grained intermediate metavolcanic, from northeastern shore of Cryderman Lake, southeastern Churchill Township.

L15-22 - Dark grey, intermediate crystal tuff, near western shore of northern part of Michiwakenda Lake in northeastern Churchill Township.

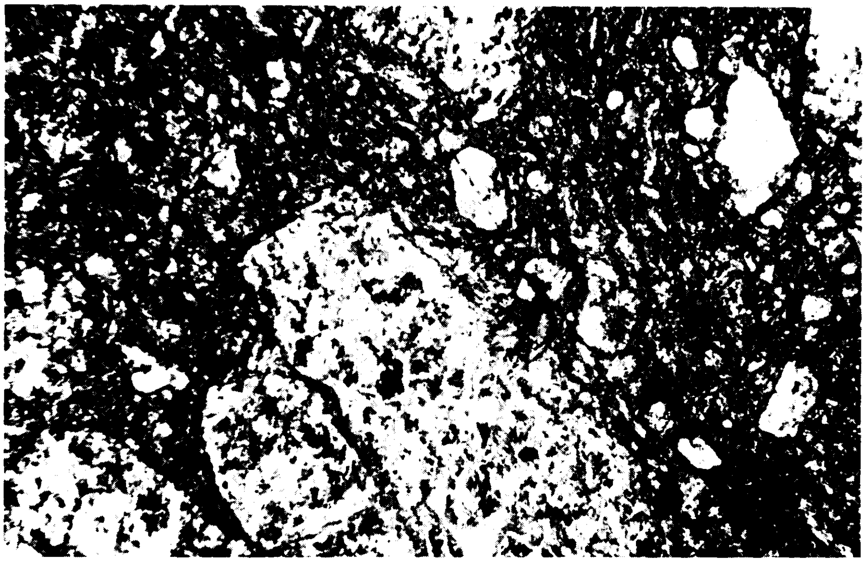

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Photo 2–Photomicrograph of porphyritic andesite, from outcrop 0.4 km north of Picket Lake, north-central Connaught Township.

ene. The matrix comprises 57 percent of the rock, actinolite 31 percent, opaque minerals 8 percent, and calcite 4 percent. Owing to the large quantity of quartz the rock is considered to be a metadacite.

Porphyritic types have phenocrysts of hornblende and feldspar set in a green aphanitic matrix. In an example taken from the upper part of the metavolcanic sequence the phenocrysts measure 1 to 2 mm across. The texture of this rock is shown in Photo 2. The rock has phenocrysts of euhedral and subhedral sericitized plagioclase (13 percent) (An_3) some of which show oscillatory zoning. In addition there is fresh euhedral and subhedral pale brownish green hornblende (10 percent), subhedral slightly chloritized and serpentinized colourless to pale green diopsidic augite (3 percent), and chloritized biotite (1 percent) in a brownish altered cryptocrystalline albitic feldspar matrix (62 percent). Through the matrix are scattered completely altered feldspar microlites, epidote (4 percent) and amygdules consisting of chlorite and chalcedonic silica (7 percent). The rock is considered to be an altered porphyritic andesite.

Vesicular and amygdaloidal varieties show vesicles and amygdules 2 to 3 mm long and 1 mm wide which are infilled with white calcite and pale green chlorite.

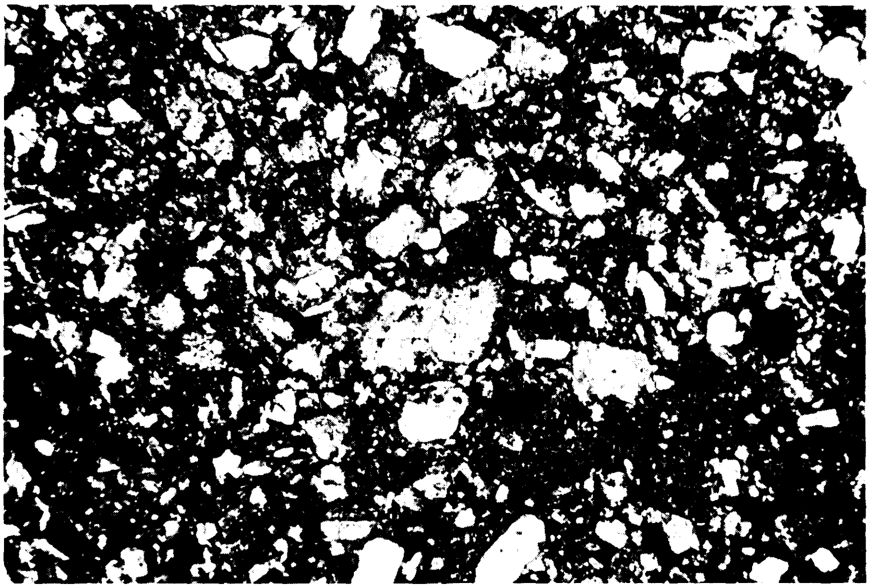
Spherulitic types have spherulites 3 mm across, consisting of pale yellow-green feldspar in a green aphanitic matrix.

Breccias consist of angular fragments of intermediate rock, about 75 mm across, set in a matrix of similar composition. They are regarded as flow-top breccias.

Pyroclastic Rocks

These have been subdivided according to Fisher (1966) on the basis of predominant grain size into tuff, lapilli-tuff, and tuff-breccia. The rocks are green, pale green, or greyish and are well represented along the western shore of Michiwakenda Lake and in the northern part of the map-area especially in the western parts of Okawakenda Lake, the Burns Lake area, and in the Wire Lake region of northwestern Connaught Township. These pyroclastic rocks have been separated from epiclastic rocks by the following criteria. Fine-grained rocks are separated on the basis of (1) the absence of predominantly argillaceous material, (2) the occurrence of subhedral to euhedral feldspars and ferromagnesian minerals similar to those in the flows and lying in a feldspathic rather than an argillaceous matrix, and (3) the similarity of their chemical composition to that of flows. These criteria have been used even where graded bedding, load casting, and flame structures have been observed. In some of the graded beds the uppermost part consists of chert which is considered to be silica precipitated from a volcanic environment. Coarse-grained pyroclastic rocks are distinguished on the basis of the occurrence of angular, subangular, and rounded clasts of predominantly local volcanic rocks set in a nonargillaceous matrix similar to that here regarded as tuff.

The tuff is commonly dark grey on the fresh surface, and weathers to a grey to brownish grey colour. On the weathered surface the clastic nature of these rocks is evident. The clasts consist mostly of crystals of greyish white angular to subrounded feldspar, measuring from 0.5 to 4 mm across. Well developed sedimentary structures such as graded bedding, flame structures, and load casting can be observed at many outcrops. Graded bedding is not always present. The unit then consists of numerous interbanded layers, about 3 mm thick of alternating sand-, silt- or clay-sized pyroclastic material with sharp contacts. These are well exposed along the western shore of Michiwakenda Lake. Three thin sections from the tuff were examined. A complete chemical analysis of one of these is listed in Table 7, Sample O13-2. The texture of this rock is shown in Photo 3. In hand specimen the rock is dark grey on the fresh surface, and on the pale grey weathered surface feldspar crystals 0.5 to 1 mm across can be seen. In thin section the rock consists of euhedral and subhedral sericitized albite-oligoclase (An_{10}, 34 percent), pale brownish green pleochroic hornblende as euhedral and subhedral grains (4 percent), colourless subhedral grains of partly serpentinized and chloritized diopsidic augite (2 percent), chlorite (8 percent), and epidote (1 percent), in a fine-grained, cloudy, brownish cryptocrystalline matrix forming 55 percent of the rock and containing 1 percent of brownish spongy leucoxene. The rock is classed as a calc-alkalic andesite in the classification of Irvine and Baragar (1971). The thin section from another specimen shows angular and subangular subhedral grains of cloudy sericitized albite (An_0, 35 percent), angular, subrounded, and rounded grains of quartz (2 percent) in an altered cryptocrystalline matrix (63 percent) consisting of epidote, chlorite, calcite, chalcedony, pyrite, magnetite, rutile, and leucoxene. The third thin section shows 22 percent of altered, cloudy euhedral and subhedral grains of albite-oligoclase (An_{10}), 2 percent anhedral grains of quartz, and 1 percent irregular areas of chalcedony, set in a dusky cryptocrystalline matrix forming 71 percent of the rock and containing



OGS 10,113

Photo 3–Photomicrograph of andesite crystal tuff, near western shore northern end of Michiwakenda Lake, northeastern Churchill Township.

OGS 10,114

Photo 4–Andesitic lapilli-tuff, from outcrop 0.8 km south of southern shore of Okawakenda Lake, north-central Churchill Township.

OGS 10,115

Photo 5—Dacitic tuff-breccia, from outcrop on small island north of the mouth of West Shining Tree Creek, at Okawakenda Lake, northwestern Churchill Township.

small grains of albite-oligoclase (An_{10}), calcite, chlorite, pyrite, epidote and apatite.

Lapilli-tuff is well exposed on the shores and on the islands in the western part of Okawakenda Lake. It is light green and consists of angular and subrounded lithic fragments of aphanitic and porphyritic intermediate rocks, as described under lavas, set in a pale green, fine-grained, granular and aphanitic matrix (Photo 4). These rocks differ markedly from the tuff as described above in that they have no bedding or banding, are completely unsorted, and have none of the common sedimentary features seen in the tuff. Nevertheless these rocks are intimately interlayered with the bedded tuff. The grain size of the clasts ranges from 6 mm to about 60 mm, but the commonest size range is from 6 mm to 25 mm. The matrix is made up of clasts mostly of crystals of feldspar approximately 2 mm across.

Tuff-breccia,(Photo 5), with clasts greater than 64 mm set in a fine- to medium-grained matrix occurs in the upper part of the metavolcanic sequence and is best exposed in the northern part of the map-area in western Okawakenda Lake. These rocks are not very common. The blocks are angular, subrounded, and rounded. No vesicular chilled margins could be seen. The blocks consist of porphyritic and aphanitic intermediate volcanic rocks ranging from 60 to 170 mm across set in a matrix of finer lithic material of intermediate composition. These rocks are generally completely unsorted, but rarely a rude bedding can be observed. At an outcrop on The Hydro Electric Power Commission transmission line just beyond 0.4 km south of Wire Lake in northwestern Connaught Township, the blocks (which are rounded) consist of granitic clasts about 150 mm

OGS 10,116

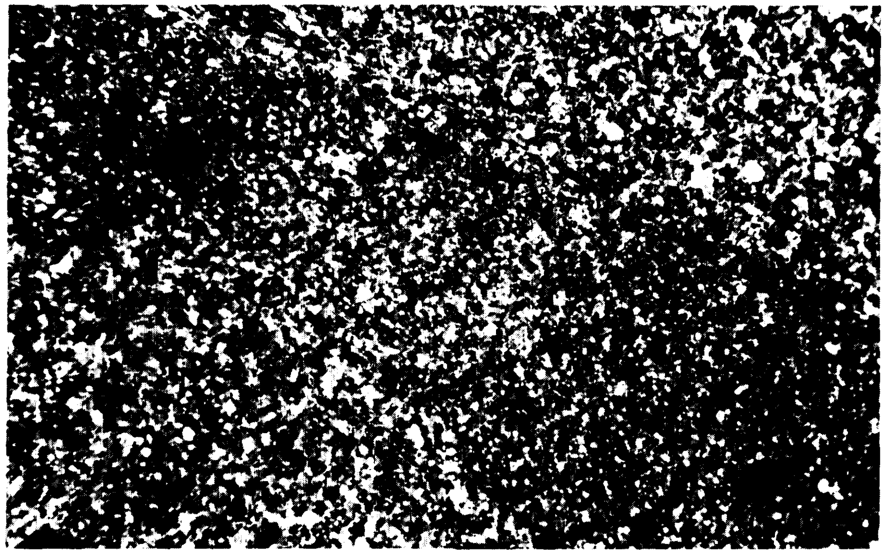
Photo 6–Photomicrograph of mylonite, from outcrop on The Hydro Electric Power Commission road south of eastern end of Wire Lake, northwestern Connaught Township.

across. The unit is interlayered with aphanitic intermediate flows and bedded tuff and it is believed by the author that these granitic clasts are derived from a granitic pre-volcanic basement by explosive vent activity. The granitic rocks to the south are intrusive into the metavolcanics.

In regions of localized shearing, foliated and banded schists or mylonites are present. They are best exposed in the northwestern part of Connaught Township. The schists are green, fine-grained, and consist of chlorite. The mylonite is a very fine grained banded green rock, consisting of alternating bands of pale yellow epidotic material 2 mm wide, and dark green bands about 5 mm wide. The texture of this rock is shown in Photo 6. In thin section sinuous bands of chlorite, epidote, sphene, and wispy leucoxene, alternate with bands of crushed granular quartz and calcite, and wider extremely fine-grained cloudy quartzo-feldspathic bands. The rocks are considered to be derived from the intermediate tuff.

FELSIC METAVOLCANICS

Felsic metavolcanics have been recognized in the field on the basis of a combination of the following characteristics: colour, colour index, hardness, and approximate specific gravity. They vary in colour from dark grey to pale grey, yellow and pale yellow, and pale pink. They have an estimated colour index of less than 10, and can barely or not at all be scratched by a penknife. Pillowed struc-



OGS 10,117

Photo 7–Photomicrograph of porphyritic rhyolite, showing blastoporphyritic texture, from outcrop 150 m east-northeast of the eastern end of Beilby Lake, southeastern Churchill Township.

tures are absent. The rocks comprise flows and pyroclastics, but flow structures were not observed in the field, and rocks which do not show clastic structure at outcrop or in thin section are classed as flows. Pyroclastic rocks are classified according to Fisher (1966). The felsic metavolcanics are well distributed throughout the map-area but are better developed in the lower part than the upper part of the sequence. They form units varying in width from approximately 30 m to about 460 m.

Lavas

Rocks regarded as flows are those showing no clastic texture at outcrop. They are aphanitic and porphyritic. Some of these aphanitic types may be tuff. The texture of a megascopically aphanitic type is shown in Photo 7. This rock is typical of the pale yellow felsic metavolcanics. It shows blastoporphyritic texture and consists of phenocrysts of quartz set in a granular recrystallized quartzofeldspathic sericitic matrix containing calcite. The quartz phenocrysts comprise less than 1 percent of the rock. The chemical analysis is listed in Table 8, Sample N13-28, the adjusted chemical analysis in Table 8, Sample N13-28, and the norm in Table 9, Sample N13-28. The total content of CO_2 and total H_2O is 4.31 percent and thin section study shows the rock to be altered. This rock is classed as a calc-alkaline andesite in the Irvine-Baragar (1971) classification, although the adjusted silica content is 73 percent. The rock is classed as a rhyolite on the basis

TABLE 8 | CHEMICAL ANALYSES (IN WEIGHT PERCENT), SPECIFIC GRAVITIES, AND CATION PERCENTAGES OF ROCK SAMPLES FROM THE EARLY PRECAMBRIAN SUBALKALINE FELSIC METAVOLCANICS.

	Actual		Adjusted*			Cation percentage	
Sample No.	N13-28	O9-10	N13-28	O9-10		N13-28	O9-10
SiO_2	70.20	67.10	73.10	69.00	Si^{4+}	69.00	63.70
Al_2O_3	14.70	16.90	15.30	17.40	Al^{3+}	17.00	18.90
Fe_2O_3	0.73	0.76	0.76	0.78	Fe^{3+}	0.54	0.54
FeO	1.30	1.05	1.35	1.08	†Fe^{2+}	1.09	0.87
MgO	1.65	1.70	1.72	1.75	Mg^{2+}	2.42	2.41
CaO	2.42	2.95	2.52	3.03	Ca^{2+}	2.55	3.00
Na_2O	1.97	3.88	2.05	3.99	Na^+	3.75	7.15
K_2O	2.72	2.53	2.83	2.60	K^+	3.41	3.07
TiO_2	0.21	0.20	0.22	0.21	Ti^{4+}	0.16	0.14
P_2O_5	0.09	0.10	0.09	0.10	P^{5+}	0.07	0.08
S	0.01	0.04	0.01	0.04	S^{6+}	0.02	0.07
MnO	0.03	0.04	0.03	0.04		0.00	0.00
CO_2	2.84	2.30	0.00	0.00		0.00	0.00
H_2O^+	1.47	0.99	0.00	0.00		0.00	0.00
H_2O^-	0.26	0.27	0.00	0.00		0.00	0.00
TOTAL	100.60	100.80	99.98	100.00		100.00	99.90
Spec. Gr.	2.71	2.67					

*Adjusted to a water-carbon dioxide free basis.
†Represents Fe^{2+} and Mn^{2+} combined.

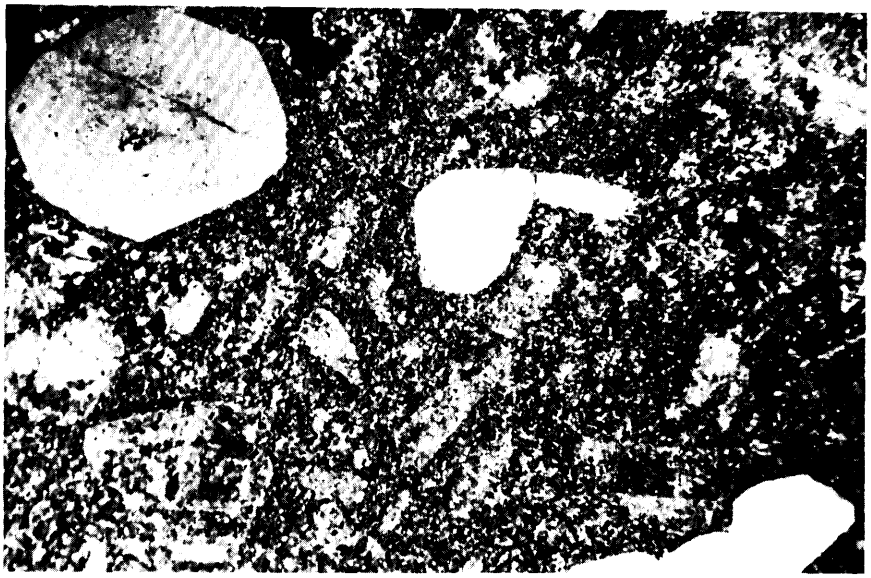
1. Pale yellow, aphanitic, felsic metavolcanic, outcrop 150 m east-northeast of eastern end of Beilby Lake, southeastern Churchill Tp.
2. Pale grey, porphyritic, felsic metavolcanic, containing quartz phenocrysts, near mid-western shore of Jonson Lake in southwestern Churchill Tp.

of its petrographic characteristics. It is believed by the author that alkalies have been lost during alteration, resulting in an inconsistent chemical classification. Porphyritic types as mapped are megascopically porphyritic, but as described here are either megascopically porphyritic or aphanitic, the porphyritic texture being seen in thin section in some aphanitic types but not seen in hand specimen. The megascopically porphyritic specimen chemically analyzed is grey in colour and has phenocrysts of quartz 2 mm across. The texture of this rock is shown in Photo 8. In thin section the rock shows phenocrysts of euhedral, rounded, and subrounded quartz and altered euhedral feldspar in a microcrystalline quartz matrix containing calcite and sericite. The quartz shows wavy extinction owing to strain. The feldspar is sericitized, but the least altered plagioclase grains are albite (An_7). The only ferromagnesian mineral is biotite which is bleached and chloritized, showing magnetite granules along the rim and cleavages. The rock consists of 1 percent quartz phenocrysts, 15 percent orthoclase

TABLE 9 NORMATIVE (MOLECULAR, WEIGHT IN PERCENT) COMPOSITION OF EARLY PRECAMBRIAN SUBALKALIC FELSIC METAVOLCANICS.

Sample No.	N13-28*		O9-10*	
	Molecular	Weight	Molecular	Weight
Ap	.200	.217	.215	.239
Po	.037	.029	.142	.113
Il	.310	.415	.286	.391
Or	17.064	16.755	15.348	15.391
Ab	18.761	17.358	35.731	33.763
An	12.113	11.889	14.343	14.379
C	5.013	4.508	2.971	2.729
Ac	.000	.000	.000	.000
Mt	.810	1.102	.815	1.133
Hm	.000	.000	.000	.000
Wo	.000	.000	.000	.000
En	4.832	4.279	4.814	4.354
Fs	1.299	1.512	.761	.905
Q	39.562	41.936	24.574	26.604
Di	.000	.000	.000	.000
Fo	.000	.000	.000	.000
Fa	.000	.000	.000	.000
Ne	.000	.000	.000	.000
Lc	.000	.000	.000	.000
Kp	.000	.000	.000	.000
He	.000	.000	.000	.000
Cc	.000	.000	.000	.000
Ru	.000	.000	.000	.000
Ns	.000	.000	.000	.000
Ks	.000	.000	.000	.000
Cr	.000	.000	.000	.000
Ln	.000	.000	.000	.000
Normative Colour Index				
Molecular	7.25		6.68	
Weight	7.31		6.78	
Differentiation Index				
Molecular	75.39		75.65	
Weight	76.09		75.76	
Normative Plagioclase Composition, An%	39.23: andesine		28.64: oligoclase	
Rock name in Irvine & Baragar (1971) System	Calc-alkaline andesine		Calc-alkaline dacite, high alumina	

*See Table 8 for description and location.



OGS 10,118

Photo 8–Photomicrograph of porphyritic rhyolite, near mid-western shore of Jonson Lake, southwestern Churchill Township.

feldspar, 24 percent albite (An_7), 57 percent quartzofeldspathic matrix, 1 percent biotite, and 2 percent combined pyrite and leucoxene. The chemical analysis is listed in Table 8, Sample 09-10, the adjusted chemical analysis in Table 8, Sample 09-10,and the norm in Table 9, Sample 09-10. The rock appears fresh in hand specimen but the total content of CO_2 and H_2O is 3.29 percent, and thin section examination shows the rock to be altered. In the classification of Irvine and Baragar (1971) the rock is classed as a high alumina calc-alkaline dacite. The megascopically nonporphyritic specimen is dark grey and in thin section is porphyritic consisting predominantly of feldspar phenocrysts. The latter are set in a microcrystalline quartzofeldspathic matrix containing sericite, calcite, scattered grains of apatite and epidote, and pale green chlorite filling irregular spaces in the groundmass. The rock is made up of 5 percent orthoclase feldspar phenocrysts, 18 percent albite-oligoclase (An_{10}), 74 percent matrix, and 3 percent accessory leucoxene, epidote, and chlorite. One of these porphyries consists of phenocrysts of micropegmatite enclosing sericitized untwinned feldspar in a sericitized, microcrystalline, quartzofeldspathic matrix containing chlorite, calcite, muscovite, and opaque minerals.

Pyroclastic Rocks

In the map legend, rocks are coded as pyroclastic where clastic texture is observed at outcrop. Some of the aphanitic rocks mapped as flows may be tuff and

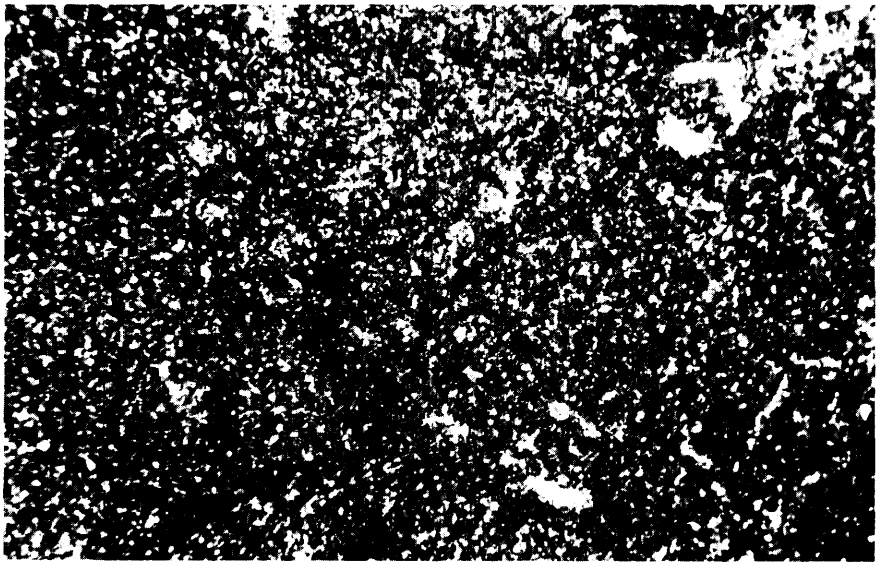


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Photo 9–Photomicrograph of rhyolite tuff, western shore of Michiwakenda Lake, northeastern Churchill Township.

so the distribution of tuff may be greater than shown.

The texture of an aphanitic tuff is shown in Photo 9. The rock is greyish green and aphanitic in hand specimen. The texture is cryptocrystalline and the rock contains fragments of sericitized feldspar and quartz. Irregular areas of calcite are scattered through the rock. The texture of the coarser tuff is shown in Photo 10. The rock is greenish grey and represents the matrix of a lapilli-tuff and consists of grains of quartz and feldspar approximately 0.5 mm across. Thin section shows angular and subangular grains of quartz and feldspar in a sericitized quartzofeldspathic matrix containing calcite, chlorite, and pyrite. The quartz grains show wavy extinction owing to strain and comprise 51 percent of the rock. Orthoclase feldspar comprises 7 percent, albite (An_6) 3 percent, the matrix 38 percent, and chlorite 1 percent.

Coarse pyroclastic rocks comprise lapilli-tuff and tuff-breccia. These rocks are best developed in the western part of Okawakenda Lake. They contain lapilli and blocks of felsic and intermediate metavolcanics set in a fine- to medium-grained quartzofeldspathic matrix. The lapilli and blocks are angular, subrounded, and rounded, and are greyish green. The fragments are of the volcanic rocks present in the area and described under lavas. Bedding is lacking.

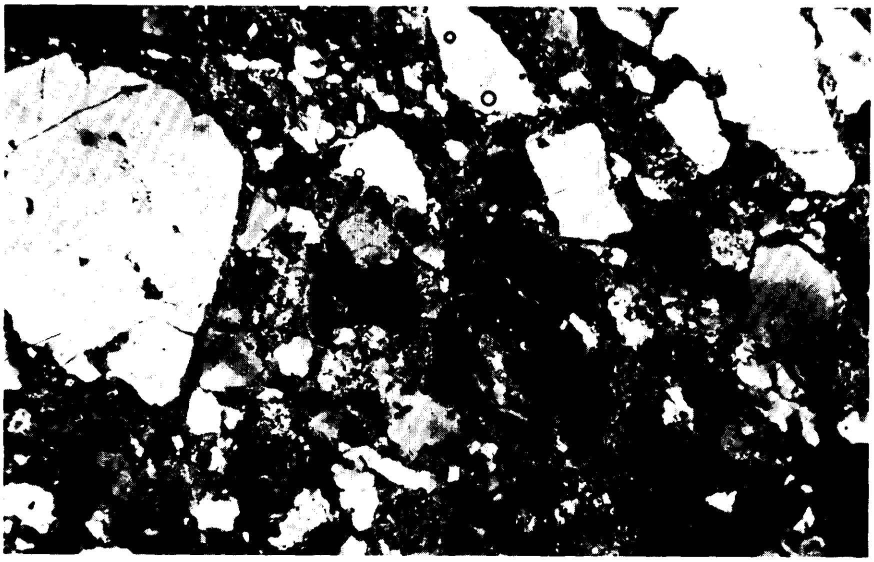

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Photo 10–Photomicrograph of coarse felsic tuff, from outcrop 1 km east-southeast of lake 2 km east of Wire Lake, northwestern Connaught Township.

Alkalic Metavolcanics

MAFIC AND INTERMEDIATE METAVOLCANICS

Mafic Lavas

The recognition of one example as mafic in the field was based on the same criteria as for the subalkaline rocks, but its classification as alkalic is based on chemical analysis.

The chemical analysis of the rock is given in Table 10, Sample N13-35, the adjusted analysis in Table 11, Sample N13-35, and the norm in Table 13, Sample N13-35. The rock is black and aphanitic in hand specimen. Thin section study shows the rock to be recrystallized with relict intergranular-intersertal texture consisting of randomly oriented microlites of oligoclase (An_{20}) enclosing altered ferromagnesian material represented by cloudy epidote, sericite, chlorite, and titano-magnetite showing alteration to leucoxene. A few microphenocrysts of oligoclase (An_{20}) also occur within the section. Many of the microlites show forked ends (Photo 11). The rock has been classed as a tholeiitic andesite in the Irvine and Baragar (1971) classification. However, a plot on the silica-alkalies diagram

TABLE 10 | CHEMICAL ANALYSES (IN WEIGHT PERCENT) AND SPECIFIC GRAVITIES OF EARLY PRECAMBRIAN ALKALIC MAFIC AND INTERMEDIATE METAVOLCANICS.

	Mafic	Intermediate	
Sample No.	N13-35	M7-19	N14-1
SiO_2	50.70	51.90	53.50
Al_2O_3	15.00	15.20	13.30
Fe_2O_3	2.84	3.28	3.18
FeO	10.40	5.30	3.89
MgO	5.68	6.38	9.64
CaO	6.33	6.04	6.23
Na_2O	4.75	3.51	3.32
K_2O	0.12	3.37	3.47
TiO_2	1.29	0.94	0.60
P_2O_5	0.16	0.44	0.47
S	0.08	0.02	0.01
MnO	0.36	0.15	0.14
CO_2	1.08	1.82	0.22
H_2O^+	2.49	1.50	2.06
H_2O^-	0.45	0.10	0.16
TOTAL	101.70	100.00	100.20
Spec. Gr.	2.90	2.78	2.84

N13-35 - Greenish black, aphanitic, mafic metavolcanic, about 0.4 km south of Beilby Lake, southeastern Churchill Tp.

M7-19 - Brown, medium-grained, porphyritic, intermediate metavolcanic, containing phenocrysts of dark green hornblende, 0.8 km southeast of Connaught Lake, Connaught Tp.

N14-1 - Purple, medium-grained, porphyritic, intermediate metavolcanic, containing phenocrysts of dark green pyroxene, a small island near western shore of the southern end of Michiwakenda Lake, southeastern Churchill Tp.

using the dividing line of G.A. Macdonald (1968) shows the rock to be alkalic. This divider was used as it gave a more consistent separation for alkalic-subalkalic rocks. In view of the total silica content of about 52 percent and normative andesine, this rock is considered to be a hawaiite, especially as its chemical character in some respects is more similar to the analysis of hawaiite given in Appendix II of the paper by Irvine and Baragar (1971). The rock is altered and contains 4.02 percent of CO_2 and H_2O combined, and this could account for the significant differences in CaO, K_2O and TiO_2 from the analysis of hawaiite as given by Irvine and Baragar (1971, Appendix II).

TABLE 11 CHEMICAL ANALYSES OF EARLY PRECAMBRIAN ALKALIC MAFIC AND INTERMEDIATE METAVOLCANICS RECALCULATED TO A WATER-CARBON DIOXIDE-FREE BASIS.

	Adjusted Weight Percentage		
	Mafic	Intermediate	
Sample No.	N13-35*	M7-19*	N14-1*
SiO_2	51.90	53.70	54.70
Al_2O_3	15.40	15.70	13.60
Fe_2O_3	2.86	3.40	3.25
FeO	10.70	5.49	3.98
MgO	5.82	6.61	9.86
CaO	6.48	6.25	6.37
Na_2O	4.86	3.63	3.40
K_2O	0.12	3.49	3.55
TiO_2	1.32	0.97	0.61
P_2O_5	0.16	0.46	0.48
S	0.08	0.02	0.01
MnO	0.37	0.16	0.14
TOTAL	100.10	99.90	99.95

*See Table 10 for sample descriptions and locations.

TABLE 12 CATION PERCENTAGES OF EARLY PRECAMBRIAN ALKALIC MAFIC AND INTERMEDIATE METAVOLCANICS.

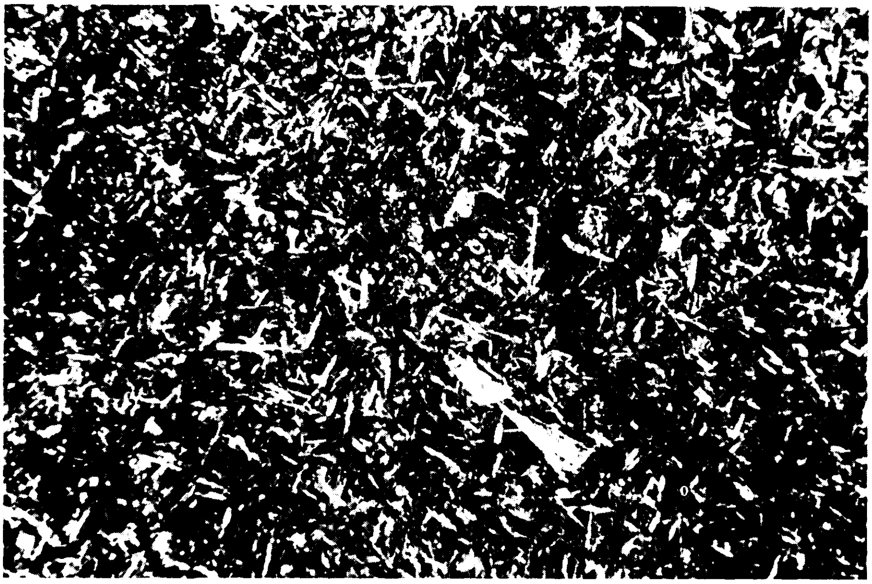
	Mafic	Intermediate	
Sample No.	N13-35*	M7-19*	N14-1*
Si^{4+}	48.10	49.40	49.70
Al^{3+}	16.80	17.10	14.60
Fe^{3+}	1.99	2.35	2.22
†Fe^{2+}	8.60	4.34	3.13
Mg^{2+}	8.03	9.05	13.34
Ca^{2+}	6.44	6.16	6.20
Na^{+}	8.74	6.48	5.98
K^{+}	0.15	4.10	4.11
Ti^{4+}	0.92	0.67	0.42
P^{5+}	0.13	0.35	0.37
S^{6+}	0.14	0.04	0.02
TOTAL	100.00	100.00	100.10

†Represents Fe^{2+} and Mn^{2+} combined.
*See Table 10 for sample descriptions and locations.

TABLE 13 | NORMATIVE (MOLECULAR, WEIGHT IN PERCENT) COMPOSITION OF EARLY PRECAMBRIAN ALKALIC MAFIC AND INTERMEDIATE METAVOLCANICS.

	Mafic		Intermediate			
Sample No.	N13-35*		M7-19*		N14-1*	
	Molecular	Weight	Molecular	Weight	Molecular	Weight
Ap	.343	.380	.947	1.057	.986	1.115
Po	.285	.225	.071	.057	.035	.028
Il	1.841	2.508	1.346	1.850	.838	1.166
Or	.727	.727	20.485	20.652	20.571	20.998
Ab	43.691	41.147	32.389	30.767	29.876	28.737
An	19.733	19.717	16.200	16.327	11.160	11.388
C	.000	.000	.000	.000	.000	.000
Ac	.000	.000	.000	.000	.000	.000
Mt	2.988	4.142	3.524	4.927	3.332	4.717
Hm	.000	.000	.000	.000	.000	.000
Wo	.000	.000	.000	.000	.000	.000
En	6.352	5.726	6.146	5.589	8.766	8.071
Fs	5.155	6.107	1.668	1.993	1.041	1.259
Q	.000	.000	.000	.000	.000	.000
Di	5.022	4.883	7.326	7.184	11.972	11.888
Fo	5.401	4.550	6.220	5.285	8.942	7.693
Fa	4.384	5.347	1.688	2.077	1.061	1.322
Ne	.000	.000	.000	.000	.000	.000
Lc	.000	.000	.000	.000	.000	.000
Kp	.000	.000	.000	.000	.000	.000
He	4.076	4.541	1.989	2.234	1.421	1.617
Cc	.000	.000	.000	.000	.000	.000
Ru	.000	.000	.000	.000	.000	.000
Ns	.000	.000	.000	.000	.000	.000
Ks	.000	.000	.000	.000	.000	.000
Cr	.000	.000	.000	.000	.000	.000
Ln	.000	.000	.000	.000	.000	.000
Normative Colour Index						
Molecular	35.22		29.91		37.37	
Weight	37.80		31.14		37.73	
Differentiation Index						
Molecular	44.42		52.87		50.45	
Weight	41.87		51.42		49.74	
Normative Plagioclase Composition, An%	31.11: andesine		33.34: andesine		27.20: oligoclase	
Rock name in Irvine & Baragar (1971) System	Tholeiitic andesite					

*See Table 10 for description and location.



OGS 10,121

Photo 11–Photomicrograph of hawaiite, 0.4 km south of Beilby Lake, southeastern Churchill Township.

Intermediate Lavas

Porphyritic examples are shown in Photos 12 and 13. In hand specimen the hornblende trachyandesite shows lath-shaped phenocrysts of hornblende 6 mm by 2 mm set in a dark mauve, fine-grained matrix. In thin section this rock consists of euhedral phenocrysts of fresh hornblende (24 percent) pleochroic from pale green to pale yellow, and less plentiful altered euhedral sericitized feldspar phenocrysts in a sericitized and calcitized feldspathic matrix. Unaltered parts of the plagioclase are andesine (An_{36}) forming 2 percent. The matrix comprises 72 percent of the rock and consists of microlites of oligoclase (An_{20}) in a felsitic groundmass of orthoclase feldspar, calcite, and quartz. Accessory pyrite, ilmenite-magnetite, leucoxene, and apatite comprise 3 percent of the rock. This rock is surprisingly fresh in thin section. Chemically (Table 10, Sample N13-35) the rock is a trachybasalt, potassic series in the classification of Irvine and Baragar (1971, Appendix II). On the basis of the silica content, the rock would compare better with a trachyandesite or tristanite (Irvine and Baragar 1971). The second rock studied, and shown in Photo 13, is purple and porphyritic. Phenocrysts of equant dark green pyroxene are set in a purple, fine-grained matrix. In thin section the rock shows porphyritic-pilotaxitic texture, with euhedral and subhedral fresh, almost colourless, diopsidic augite set in a matrix containing laths of oligoclase-andesine (An_{30}) enclosed in orthoclase feldspar and containing a few

OGS 10,122

Photo 12–Photomicrograph of hornblende trachyandesite, from outcrop 0.8 km south-southeast of Connaught Lake, Connaught Township.

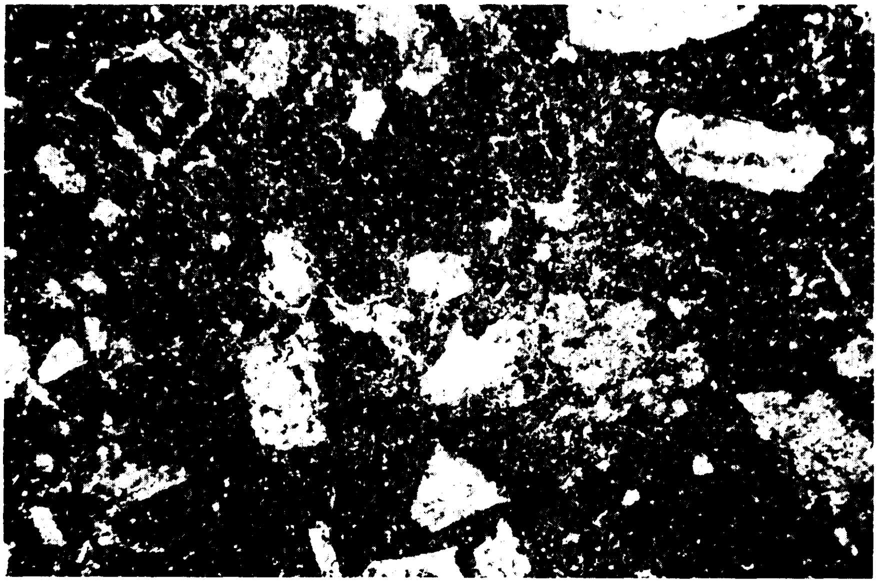
OGS 10,123

Photo 13–Photomicrograph of pyroxene (diopsidic-augite) trachyandesite, from small island near western shore of southern end of Michiwakenda Lake, southeastern Churchill Township.

grains of quartz. The matrix also contains scattered chloritized biotite and irregular areas of chlorite resembling amygdules. This rock is hardly altered as observed from thin section study and the total content of CO_2 and total H_2O is 2.28 percent as listed in the chemical analysis Table 10, Sample N14-1. The adjusted analysis of this rock is given in Table 11, Sample N14-1, and its norm in Table 13, Sample N14-1. The rock is classed as a trachybasalt, potassic series in the Irvine and Baragar (1971) classification. The texture and silica content would lead the author to classify the rock as a trachyandesite or tristanite. For this reason these rocks are considered to be intermediate and not mafic. The high barium and strontium contents as listed in Table 16, Samples M17-19 and N14-1 support the alkalic classification of these rocks as these elements would replace potassium and so lead to a high relative concentration of these elements in these alkaline rocks.

A group of feldspar porphyries varying in colour from pale pink to red, to dark red, to dark purple occurs interlayered with the subalkalic metavolcanics. These rocks are well developed in northeastern Connaught Township. Quartz phenocrysts are not visible in hand specimen. Volcanic structures are generally not apparent, but at one exposure on the west end of Okawakenda Lake, fragmental structure was observed. Intrusive relationships were not seen and these rocks are regarded as extrusive. Thin section study shows these rocks to be considerably altered; the feldspar in the phenocrysts, though euhedral, is for the most part completely sericitized. The cryptocrystalline matrix consists predominantly of feldspar, quartz grains being only sparingly present. The texture of a typical example is shown in Photo 14. The rock consists of 36 percent altered euhedral feldspar phenocrysts, 64 percent microcrystalline quartzofeldspathic matrix, and less than 1 percent ilmenite-magnetite. Where the feldspar phenocrysts have been only partly sericitized in one of these rocks the composition of the plagioclase in the phenocrysts is albite (An_8) and comprises 42 percent of the rock with matrix amounting to 56 percent of the rock. Accessory minerals are ilmenite-magnetite, chloritized biotite, and apatite which total 1 percent. The complete analysis of the rock shown in Photo 14 is given in Table 14, Sample L8-1b, along with partial analyses of similar rocks. The rocks show an intermediate range of silica content (Williams *et al.* 1955, p.27) and the example shown in Photo 14 is classed as a calc-alkaline dacite in the Irvine and Baragar (1971) classification system. All the other rocks whose partial analyses are given in Table 14 plot in the subalkaline field using the silica-alkalies diagram and the dividing line proposed by Irvine and Baragar (1971). However, these rocks are highly altered, and because of their megascopic similarity to similar looking but unaltered rocks known to be alkalic in adjacent areas (Carter 1977) they are classed as alkalic rocks and are considered by the writer to be trachytes. They differ markedly in appearance from the subalkaline dacites and have a lower content of silica (and a concomitant absence of quartz phenocrysts) than the calc-alkaline rhyolites.

Whereas the above rocks are considered to be extrusive, one occurrence located on the east shore of the promontory in Esther Lake, central Connaught Township, may be intrusive. This rock is medium grained, massive, and does not show any extrusive features. It consists of grains of pink feldspar 1 mm across and lath-shaped hornblende 2 mm long by 0.5 mm wide. The outcrop is small, and no intrusive contacts were observed. In thin section the rock shows hypi-



OGS 10,124

Photo 14–Photomicrograph of porphyritic trachyte, from outcrop at northern end of Chris Lake, notheastern Connaught Township.

diomorphic granular texture consisting of 2 percent anhedral quartz, 30 percent anhedral orthoclase, 12 percent anhedral and subhedral albite (An_2) which is only slightly altered, 36 percent predominantly euhedral but also subhedral hornblende, 17 percent interstitial pale green chlorite, 2 percent calcite, and 1 percent of combined epidote, sphene, and leucoxene-sphene after titanomagnetite. The hornblende is pleochroic in shades of green and yellow.

Metasediments

These rocks comprise argillite, chert, siltstone, conglomerate, slate, and iron formation. They occur in the upper part of the Early Precambrian metavolcanic-metasedimentary sequence and are best exposed in the northeastern quadrant of Churchill Township along the western shores of Michiwakenda Lake.

CLASTIC METASEDIMENTS

The argillite is black, very fine grained and intimately associated with graded greywacke-like tuff. In the region between Okawakenda Lake and Michi-

TABLE 14 CHEMICAL ANALYSES (IN WEIGHT PERCENT) AND SPECIFIC GRAVITIES OF EARLY PRECAMBRIAN ALKALIC INTERMEDIATE METAVOLCANICS.

Sample No.	L8-1b	L7-1a	L10-25	L10-26b	L10-28	M12-45
SiO_2	63.30	53.60	63.60	65.90	60.10	63.60
Al_2O_3	16.50	n.d.	n.d.	n.d.	n.d.	n.d.
Fe_2O_3	0.99	n.d.	n.d.	n.d.	n.d.	n.d.
FeO	2.30	n.d.	n.d.	n.d.	n.d.	n.d.
MgO	2.95	n.d.	n.d.	n.d.	n.d.	n.d.
CaO	3.24	n.d.	n.d.	n.d.	n.d.	n.d.
Na_2O	5.12	2.81	3.10	3.00	5.61	4.99
K_2O	1.59	1.74	2.82	1.86	1.01	2.00
TiO_2	0.38	n.d.	n.d.	n.d.	n.d.	n.d.
P_2O_5	0.12	n.d.	n.d.	n.d.	n.d.	n.d.
S	0.01	n.d.	n.d.	n.d.	n.d.	n.d.
MnO	0.06	n.d.	n.d.	n.d.	n.d.	n.d.
CO_2	2.30	3.20	1.50	3.40	1.45	2.80
H_2O^+	1.36	4.17	2.32	1.76	1.66	1.29
H_2O^-	0.32	n.d.	n.d.	n.d.	n.d.	n.d.
TOTAL	100.50	65.50	73.30	75.90	69.80	74.70
Spec. Gr.	2.69					

L8-1b - Dark red, porphyritic, intermediate metavolcanic with pink feldspar phenocrysts, northern end of Chris Lake, northeast Connaught Tp.

L7-1a - Dark purple, aphanitic, intermediate metavolcanic, about 0.4 km east-northeast of Picket Lake, northern Connaught Tp.

L10-25 - Dark purple, porphyritic, intermediate metavolcanic, north shore at west end of Okawakenda Lake, northeast Connaught Tp.

L10-26b - Purple, porphyritic, intermediate metavolcanic, extreme east end of Okawakenda Lake, northeast Connaught Tp.

L10-28 - Dark red, porphyritic, intermediate metavolcanic, with phenocrysts of yellow feldspars and green altered ferromagnesian minerals, east shore of west end of Okawakenda Lake, northeast Connaught Tp.

M12-45 - Light purple, porphyritic, intermediate metavolcanic, with phenocyrsts of greyish white feldspar, (0.4 km) north-northeast of Saville Creek-Saville Lake intersection, central Churchill Tp.

Abbreviation

n.d. - not determined.

TABLE 15 CHEMICAL ANALYSIS (RECALCULATED TO A WATER-CARBON DIOXIDE-FREE BASIS), CATION PERCENTAGES AND NORMATIVE (MOLECULAR, WEIGHT, IN PERCENT) COMPOSITION OF AN EARLY PRECAMBRIAN ALKALIC INTERMEDIATE METAVOLCANIC ROCK.

Sample No.	L8-1b**					
	Chemical Analysis		Cation percentages		Normative Composition	
					Molecular	Weight
SiO_2	65.60	Si^{4+}	59.90	Ap	.257	.288
Al_2O_3	17.10	Al^{3+}	18.40	Po	.035	.028
Fe_2O_3	1.03	Fe^{3+}	0.70	Il	.541	.747
FeO	2.38	*Fe^{2+}	1.87	Or	9.606	9.740
MgO	3.06	Mg^{2+}	4.16	Ab	46.955	44.864
CaO	3.36	Ca^{2+}	3.28	An	15.620	15.834
Na_2O	5.30	Na^+	9.39	C	.840	.780
K_2O	1.65	K^+	1.92	Ac	.000	.000
TiO_2	0.39	Ti^{4+}	0.27	Mt	1.057	1.487
P_2O_5	0.12	P^{5+}	0.10	Hm	.000	.000
S	0.01	S^{6+}	0.02	Wo	.000	.000
MnO	0.06			En	8.319	7.609
CO_2	0.00			Fs	2.455	2.950
H_2O^+	0.00			Q	14.316	15.672
H_2O^-	0.00			Di	.000	.000
				Fo	.000	.000
TOTAL	100.10	TOTAL	100.00	Fa	.000	.000
				Ne	.000	.000
Normative Colour Index				Lc	.000	.000
Molecular:	12.37			Kp	.000	.000
Weight:	12.79			He	.000	.000
Differentiation Index				Cc	.000	.000
Molecular:	70.88			Ru	.000	.000
Weight:	70.28			Ns	.000	.000
Normative Plagioclase Composition, An%				Ks	.000	.000
	24.96 (oligoclase)			Cr	.000	.000
Rock name in Irvine & Baragar (1971) System				Ln	.000	.000
Calc-alkaline dacite, high alumina						

*Represents Fe^{2+} and Mn^{2+} combined.
**See Table 14 for description and location.

wakenda Lake it has been metamorphosed to slate. The chemical analysis of a typical example of argillite is given in Table 17. A thin section shows a laminated structure, consisting of very small elongated chips of quartz, feldspar, and pale yellowish micaceous grains set in an almost isotropic matrix containing irregular elongated spongy brownish streaks of leucoxene and grains of pyrite.

Siltstone resembles the argillite except that it is coarser grained, as shown by the weathered surface, which is pale brown. The fresh surface is also lighter grey than the argillite, with which it is interlayered. The texture of a typical example is shown in Photo 15. The thin section shows the rock to consist of angular, subangular, and some examples of subrounded grains of quartz, completely sericitized and carbonatized grains of feldspar, in a cloudy argillaceous matrix containing chlorite, secondary silica, and opaque grains of leucoxene and minor pyrite.

Conglomerate is best exposed on the large unnamed island in the eastern part of Okawakenda Lake, at a small outcrop on the eastern shore of the southeastern end of the peninsula in the northern part of Michiwakenda Lake, and at the northern end of Cochrane Lake, central Churchill Township. The conglomerate consists of rounded clasts of felsic and intermediate metavolcanics ranging from 10 to 20 cm across in a dark grey, greywacke matrix. The exposure in Michiwakenda Lake consists of pebbles 2 to 4 cm across of quartz and felsic volcanics set in a fine greywacke matrix. The Cochrane Lake conglomerate consists of rounded clasts of felsic volcanic rocks ranging from 5 to 6 cm in size in a greywacke matrix. All these units are interlayered with metavolcanics, but the clasts do not show any chilled edges or vesicular structure. These units may represent laharic deposits. They differ from the tuff-breccia in the nature of the matrix. In the tuff-breccia the matrix consists of grey or pale green siliceous volcanic material, whereas in the conglomerate as described here the matrix is dark grey to black argillaceous material. The matrix of these rocks is shown in Photo 16, which also shows part of a volcanic pebble. The rock consists of angular, subangular, and subrounded grains of quartz, orthoclase feldspar, and plagioclase (the most basic being An_8), and chalcedonic silica in a brownish argillaceous matrix containing calcite and irregular opaque grains consisting of leucoxene and pyrite.

CHEMICAL METASEDIMENTS

Chert occurs as black or grey units interlayered with the argillite, greywacke, and siltstone. It is not very abundant, but forms individual beds about 2 to 15 m thick. Irregular polygonal fractures can be observed on weathered surfaces and when this is emphasized by deep weathering the irregular fracturing produces a pseudoclastic appearance causing the rock to appear deceptively like a lapilli-tuff. This fracturing cannot easily be seen on the fresh surface. A thin section cut from such a rock shows it to be fine grained, with a grey siliceous matrix crossed by straight cracks healed by coarser silica. The siliceous matrix is cloudy and brownish and contains irregular brownish spongy streaks of leucoxene. Away from the fractures, curved, more coarsely crystalline siliceous material occurs showing aggregate extinction. These may be glass shards.

TABLE 16 SELECTED TRACE ELEMENTS IN PPM IN EARLY PRECAMBRIAN SUBALKALIC AND ALKALIC METAVOLCANICS.

	Subalkalic Metavolcanics							Alkalic Metavolcanics			
	Mafic				Intermediate	Felsic		Mafic	Intermediate		
Sample No.	N10-128[1]	O10-6[1]	N9-64a[2]	N9-64b[1]	L15-22[3]	N13-28[4]	O9-10[4]	N13-35[5]	M7-19[5]	N14-1[5]	L8-1b[6]
Ag	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Au											
As											
Ba	110	80	80	100	520	300	480	80	980	1300	210
Be	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 2	< 2	< 1
Bi											
Co	45	45	40	45	20	< 5	< 5	45	25	30	8
Cr	310	240	240	240	220	5	20	180	130	560	35
Cu	130	140	90	100	40	5	20	110	55	30	6
Ga	20	10	10	20	20	20	20	20	20	10	20
Hg											
Li	10	8	6	6	10	< 3	4	3	4	20	6
Mn											
Mo	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Nb											
Ni	120	100	85	95	100	< 5	10	70	30	100	15
Pb	10	< 10	10	10	60	15	15	10	20	20	< 10
Rb											
Sb											
Sc	60	60	70	70	40	20	20	60	50	50	30
Sn	3	3	2	4	2	2	2	2	3	2	2
Sr	30	30	30	20	50	20	30	40	100	100	30
Ti											
V	200	200	300	300	200	10	20	300	200	200	40
Y	40	40	50	40	30	40	20	50	40	50	20

Table 16 continued

Zn	95	85	95	95	85	20	35	420	110	100	50
Zr	30	30	80	60	50	50	30	70	90	100	70

[1]See Table 2 for description and location.
[2]See Table 3 for description and location.
[3]See Table 7 for description and location.
[4]See Table 8 for description and location.
[5]See Table 10 for description and location.
[6]See Table 14 for description and location.

TABLE 17 CHEMICAL ANALYSIS (ACTUAL AND ADJUSTED TO A WATER-CARBON DIOXIDE-FREE BASIS), CATION PERCENTAGES AND NORMATIVE (MOLECULAR, WEIGHT, IN PERCENT) COMPOSITION OF A BLACK, VERY FINE GRAINED ARGILLITE INTERLAYERED WITH EARLY PRECAMBRIAN METAVOLCANICS. SAMPLE NUMBER M16-1 COLLECTED FROM WESTERN SHORE OF MICHIWAKENDA LAKE, ABOUT 1 200 m SOUTHEAST OF WEST SHINING TREE CREEK AT OKAWAKENDA AND MICHIWAKENDA LAKES.

Chemical Analysis in weight percent	Actual	Adjusted	Cation percentages	
SiO_2	56.30	58.80	Si_4+	55.10
Al_2O_3	16.90	17.60	Al_3+	19.50
Fe_2O_3	1.05	1.10	Fe_3+	0.77
FeO	9.67	10.10	*Fe_2+	8.05
MgO	4.95	5.17	Mg_2+	7.21
CaO	1.87	1.95	Ca_2+	1.96
Na_2O	2.62	2.74	Na_+	4.97
K_2O	1.13	1.18	K+	1.41
TiO_2	0.72	0.75	Ti_4+	0.53
P_2O_5	0.22	0.23	P_5+	0.18
S	0.21	0.22	S_6+	0.38
MnO	0.17	0.18		
CO_2	0.75	0.00		
H_2O^+	4.32	0.00		
H_2O^-	0.17	0.00		
TOTAL	101.00	100.00	TOTAL	100.10
Spec. Gr.	2.80			

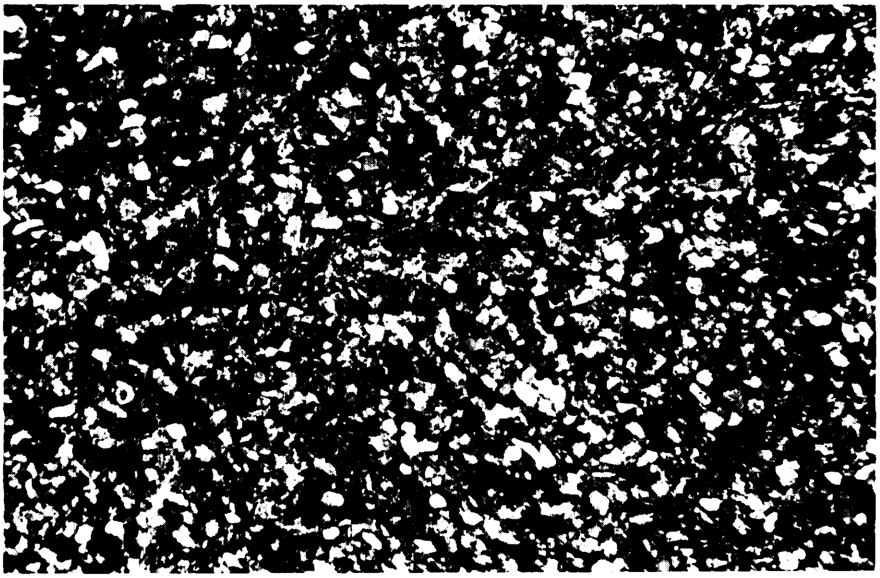
Normative Composition (in percent) Norms	Molecular	Weight	Trace Element Composition ppm	
Ap	.486	.533	Ag	<1
Po	.770	.602	Au	
Il	1.059	1.429	As	
Or	7.056	6.984	Ba	180
Ab	24.834	23.161	Be	<1
An	8.276	8.189	Bi	
C	9.790	8.875	Co	40
Ac	.000	.000	Cr	360
Mt	1.159	1.591	Cu	65
Hm	.000	.000	Ga	20
Wo	.000	.000	Hg	
En	14.427	12.880	Li	25
Fs	13.496	15.833	Mn	
Q	18.646	19.924	Mo	<1
Di	.000	.000	Nb	
Fo	.000	.000	Ni	210
Fa	.000	.000	Pb	70
Ne	.000	.000	Rb	
Lc	.000	.000	Sb	

Table 17 continued

Normative Composition (in percent)			Trace Element Composition ppm	
Norms	Molecular	Weight		
Kp	.000	.000	Sc	60
He	.000	.000	Sn	5
Cc	.000	.000	Sr	20
Ru	.000	.000	Ti	
Ns	.000	.000	V	200
Ks	.000	.000	Y	50
Cr	.000	.000	Zn	100
Ln	.000	.000	Zr	80

Normative plagioclase composition: 24.99 (oligoclase)
Colour index: Molecular: 30.14; Weight: 31.73

*Represents $Fe_{2}+$ and $Mn_{2}+$ combined.



OGS 10,125

Photo 15–Photomicrograph of siltstone, from outcrop 0.8 km north of eastern end of Perkins Lake, southeastern Churchill Township.

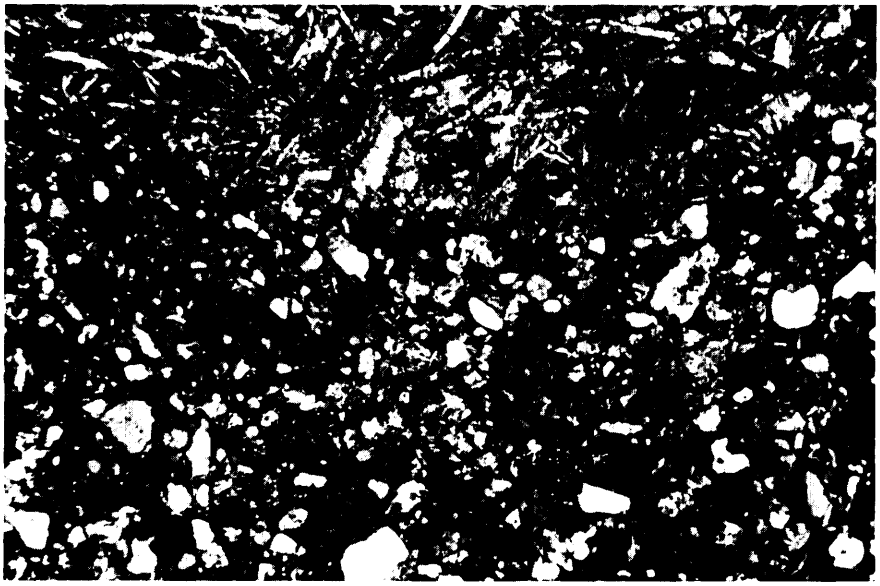


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Photo 16–Photomicrograph of matrix of conglomerate from outcrop on small island about 0.4 km east of large island in eastern Okawakenda Lake, north-central Churchill Township.

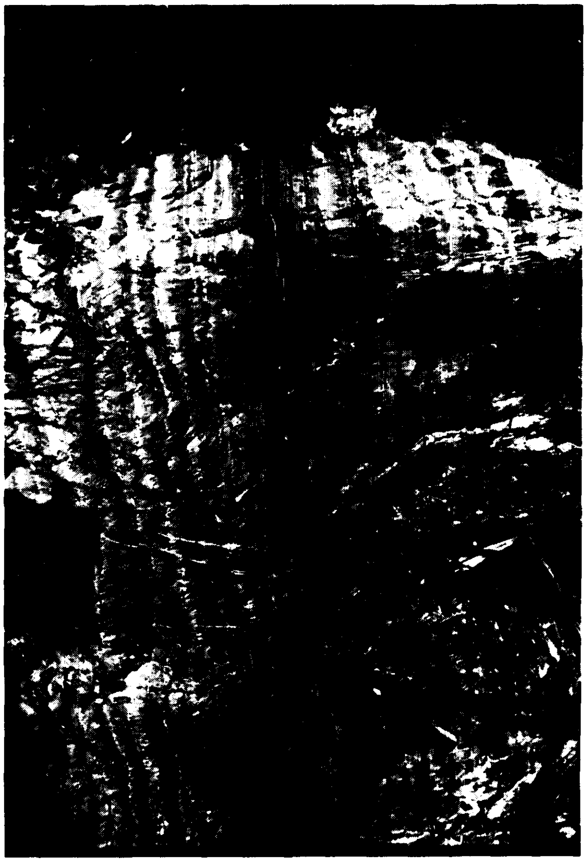

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Photo 17–Interbanded iron formation and argillite, from outcrop near southern end of large island in eastern part of Okawakenda Lake, north-central Churchill Township.

Iron Formation

Iron formation consists of interbanded layers varying from 2 mm to 64 mm of argillite, hematite, magnetite, and black chert (Photo 17). These narrow bands together form composite iron formation units which are up to 50 m wide. Such iron formation is best developed at the southeastern end of Okawakenda Lake and along the western shores of Michiwakenda Lake. In an exposure at the northeastern shore of Perkins Lake, in southeastern Churchill Township, argillite is absent and the iron formation comprises hematite, jasper, and white chert, containing pyrite in blebs 3 mm across as disseminated grains and amounting to 30 percent. The iron formation horizon just west of the Grassy River Road, consists entirely of hematite in an exposure 2 m across.

OGS 10,128

Photo 18–Photomicrograph of serpentinized dunite, from outcrop at northwestern shore of Gosselin Lake near southern boundary of Churchill Township, southeastern Churchill Township.

METAMORPHOSED ULTRAMAFIC TO MAFIC ROCKS

These rocks consist of gabbro and serpentinized dunite and occur in the lower part of the metavolcanic sequence as concordant bodies. They are not numerous and are of small areal extent.

The quartz gabbro at Cryderman Lake in southeastern Churchill Township is a coarse-grained, grey-green rock with laths of black augite, 3 mm long and 1 mm wide. The exposure is 106 m long by 30 m wide. In thin section the rock shows relict gabbroic texture and consists of 4 percent quartz, 76 percent completely altered feldspar, 15 percent fresh augite, 3 percent pale green chlorite, 1 percent epidote, and 1 percent leucoxene after ilmenite. The feldspar occurs as broad laths, brownish and almost opaque from alteration. The altered material is white by reflected light and is considered to be kaolinitic.

Serpentinized dunite occurs at Gosselin Lake on the northeastern and northwestern shores of the lake. They form one body which is elongated in a northwest direction parallel to the trend of the surrounding metavolcanics. The rock is aphanitic, blue-black on the fresh surface and pale brown on the weathered surface. Spinifex texture and rude polygonal jointing were observed in the outcrop. In thin section the rock is composed almost entirely of serpentinized olivine, with minor talc, chlorite, and calcite (Photo 18). The serpentine mineral is

TABLE 18 — CHEMICAL ANALYSIS (ACTUAL AND ADJUSTED TO A WATER-FREE BASIS), SPECIFIC GRAVITY, CATION PERCENTAGES, AND TRACE ELEMENT COMPOSITION OF LIGHT GREEN MASSIVE 'GREEN CARBONATE' ROCK, SAMPLE NUMBER O13-6, 0.4 km SOUTHEAST OF GOSSELIN LAKE NEAR HIGHWAY 560, SOUTH-EASTERN CHURCHILL TOWNSHIP.

Chemical Analysis (in weight percent)	Actual	Adjusted	Cation percentages		Traces (ppm)	
SiO_2	49.80	51.80	Si^{4+}	47.20	Ag	< 1
Al_2O_3	9.80	10.19	Al^{3+}	10.94	Au	30 (ppb)*
Fe_2O_3	1.45	1.51	Fe^{3+}	1.03	As	
FeO	5.27	5.48	*Fe^{2+}	4.32	Ba	410
MgO	5.80	6.03	Mg^{2+}	8.19	Be	< 1
CaO	11.90	12.40	Ca^{2+}	12.10	Bi	
Na_2O	2.29	2.38	Na^+	4.20	Co	35
K_2O	0.75	0.78	K^+	0.91	Cr	1300
TiO_2	0.59	0.61	Ti^{4+}	0.42	Cu	20
P_2O_5	0.06	0.06	P^{5+}	0.05	Ga	15
S	0.02	0.02	S^{6+}	0.04	Hg	
MnO	0.18	0.19			Li	20
CO_2	8.25	8.58	CO_2	10.67	Mn	
H_2O^+	2.41	0.00			Mo	< 1
H_2O^-	0.21	0.00			Nb	
					Ni	680
TOTAL	98.80	100.00	TOTAL	100.10	Pb	15
Spec. Gr.	2.77				Rb	
					Sb	
					Sc	15
					Sn	2
					Sr	200
					Ti	
					V	50
					Y	60
					Zn	100
					Zr	250

*Represents Fe^{2+} and Mn^{2+} combined.

1. Light green, massive 'green carbonate' from 0.4 km southeast of Gosselin Lake, near Highway 560, southeastern Churchill Township.

antigorite. The original olivine grains are outlined by small granules of magnetite which also fill curved cracks traversing the serpentine.

About 0.4 km southeast of Gosselin Lake, outcrops occur of a dense, fine-grained rock, light emerald green on the fresh surface and with a specific gravity of 2.77. The rock weathers to a dark brown pitted surface, presenting a ridge and furrow pattern, the grooves following the direction of foliation, which here trends northwestward parallel to the regional structure. A thin section was made from one sample which shows allotriomorphic granular texture, the rock being made up primarily of dolomite and quartz, the latter showing wavy extinction owing to strain and accessory interstitial calcite. In addition, chromite occurs as scattered rectangular and interstitial grains. Major and trace element analyses of another sample located 60 m away from the first is given in Table 18. The very high chromium and high nickel contents associated with the high amount of dolomite suggests a genetic relationship with the serpentinized dunite nearby at Gosselin Lake. It is probable that this green carbonate is a hydrothermal, carbon dioxide-metasomatic alteration product of the serpentinized dunite (Turner and Verhoogen 1960, p.578-581). It is for this reason that this rock type is included here. The gold content is 30 ppb.

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

Felsic to intermediate intrusive rocks occur predominantly in central, southern, and southwestern Connaught Township. Similar rocks also occur at Gosselin Lake in southeastern Churchill Township near the Churchill-Asquith Townships boundary. In Connaught Township the exposures are sparse and widely scattered, outcrops being most numerous only in the area to the west of Connaught Lake, in central Connaught Township. The Gosselin Lake stock is small, the exposures forming a body about 900 m long and 200 m wide, and elongated in the direction of the regional trend of the metavolcanics. Small irregular masses and narrow dikes of felsic intrusive rocks also occur independent of these main masses cutting the metavolcanic-metasedimentary rocks. The granitic rocks are classified according to the system of L.D. Ayres (1972).

In Connaught Township the most important rock type is a pink, coarse-grained, massive granitic rock best exposed in the outcrops west of Connaught Lake and east of Elephant Head Lake. A much less common facies is a pale green, coarse-grained, massive type exposed at the southwestern shore of Waonga Lake.

Two thin sections of the pink granitic rock were studied. One of these taken from exposures at The Hydro Electric Power Commission transmission line at the southern boundary of Connaught Township consists of 28 percent quartz, 32 percent oligoclase (An_{11}), 34 percent orthoclase-perthite, 2 percent microcline, and 4 percent biotite. All these minerals show wavy extinction owing to strain. The plagioclase is dark grey and brownish in its central parts and is kaolinized, sericitized, and saussuritized. The ratio of alkali feldspar to total feldspar is almost 1:2 and with 28 percent quartz the rock is therefore a biotite quartz monzonite. The other sample taken from the outcrops west of Connaught Lake consists of 54 percent quartz, 10 percent orthoclase, 34 percent sericitized and epidotized oligoclase (An_{13}), 1 percent green biotite and chloritized biotite, and 1 percent accessory ilmenite-magnetite, leucoxene and apatite. The ratio of alkali feldspar to total feldspar is about 1:4 and with 54 percent quartz the rock is a biotite granodiorite.

Only one exposure of the pale green granitic rock was located, at Waonga Lake. This rock contains 50 percent quartz, 2 percent orthoclase feldspar, 40 percent sericitized albite (An_5), 1 percent chloritized biotite, and 7 percent calcite.

The quartz grains are marginally crushed and show wavy extinction. With 50 percent quartz and an alkali feldspar-total feldspar ratio of 1:21 and biotite as the ferromagnesian mineral, the rock is classed as a biotite trondhjemite. Thus the granitic rocks in Connaught Township are made up of quartz monzonite, granodiorite, and trondhjemite.

Various feldspar, hornblende, and hornblende-feldspar porphyries were found associated sparingly with the granitic rocks of Connaught Township. These are brownish rocks with phenocrysts of white or pink feldspar varying from 2 to 7 mm across, and acicular hornblende 3 by 1 mm set in a fine- to medium-grained, reddish brown or brownish matrix. Some of these rocks also occur away from the main mass and have intruded the metavolcanics. Because of lithological and petrographical similarity these rocks are all considered to be hypabyssal representatives of the granitic rocks. Two thin sections from these rocks were studied, one from within the main granitic body at the eastern shore of Elephant Head Lake, the other just beyond 0.4 km from the main body and cutting basalt at Elephant Head Lake. The rock from the pluton consists of white and pink feldspar phenocrysts and black hornblende in a brown, fine-grained matrix. It consists of 1 percent quartz phenocrysts, 15 percent euhedral and subhedral orthoclase-perthite phenocrysts, and 4 percent euhedral and subhedral pale yellow, brownish and green hornblende. In addition there is chloritized and epidotized biotite as rectangular phenocrysts, with accessory apatite, sphene, epidote, and leucoxene comprising 2 percent, in a microgranular orthoclase feldspar-quartz matrix forming 43 percent of the rock. About half of the matrix is granular quartz, the other half being orthoclase. The other rock which has a finer-grained matrix, consists of 3 percent rounded quartz phenocrysts, 17 percent euhedral albite (An_7) phenocrysts, 8 percent euhedral and subhedral hornblende, 66 percent orthoclase-quartz microgranular matrix, and 3 percent epidote, leucoxene, and apatite.

Quartz diorite was not found in outcrop during the survey but the rock type is mentioned in the drill core logs from drilling done by Pioneer Consultants at the Saville Showing in southern Connaught Township (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). No description was given.

The Gosselin Lake mass consists of pink massive aphanitic and porphyric granitic rocks resembling the biotite granodiorite at Elephant Head Lake.

Early to Late Precambrian

MAFIC INTRUSIVE ROCKS

Diabase Dikes

Black, medium-grained, magnetic diabase dikes, varying from 15 m to 45 m wide and weathering to a dark reddish brown colour, occur throughout the map-area. These dikes vary in trend from N45W to N20E, the prevalent direction being N20W. The longest dike occurs in northern Churchill Township. It is exposed intermittently for about 6 km and varies in trend from N40W to north. The diabase is of uniform appearance and generally nonporphyritic, but at a lake 0.4 km west of Cryderman Lake in southeastern Churchill Township the diabase shows glomeroporphyritic texture. The phenocrysts are of yellow feldspar up to 3 cm across. Where contacts have been seen the diabase is chilled to a very fine grained basaltic rock.

Three thin sections were examined. One from a rock taken from a dike on the eastern shore of the large island in eastern Okawakenda Lake (northeastern Churchill Township) is black and fine grained and contains ovoid patches of pyrite 2 mm across. In thin section this rock shows rude intergranular texture and contains 4 percent anhedral, interstitial quartz, 67 percent patchily altered saussuritized labradorite (An_{56}) laths, 23 percent augite showing alteration to pale yellow epidote which forms 12 percent, 4 percent pyrite, and 2 percent chlorite after augite. The other two thin sections were made from specimens from the same dike to show the possible variation. This dike cuts metavolcanics on the eastern shore of Jonson Lake in southwestern Churchill Township. One sample is medium grained, the other fine grained. The medium-grained rock is black and moderately magnetic, and contains less than 1 percent visible, finely divided pyrite. Thin section examination showed 4 percent interstitial irregular anhedral quartz grains, 34 percent patchily sericitized and epidotized labradorite (An_{54}) as laths, 15 percent altered interstitial micropegmatite, 40 percent augite altered in places to epidote, hornblende, and pale green chlorite, and 3 percent magnetite occurring as hexagonal grains. The fine-grained diabase is black and also magnetic, and in thin section shows subophitic texture. The rock consists of 3 percent anhedral interstitial quartz, 38 percent partly sericitized and epidotized andesine-labradorite (An_{50}), 37 percent chloritized and epidotized augite, 6 percent micropegmatite, and 2 percent ilmenite altered to leucoxene.

Middle Precambrian

HURONIAN SUPERGROUP

Quirke Lake Group

ESPANOLA FORMATION

In the valley of Elephant Head Creek 0.8 km north-northwest of its entrance to Elephant Head Lake, limestone occurring as white and grey recrystallized calcite is exposed over an oval-shaped area 245 m long by 150 m wide. The outcrop just north of the river shows bedding in one place which strikes N20W and dips 15 degrees northeast. The outcrop south of the river shows minor upright folds of wave-length about 0.6 m and amplitude about 0.3 m. The limestone is associated with magnetite, and where its contact with rhyolite was seen the contact was interpreted to be unconformable. Diamond drill holes within the area underlain by limestone encountered argillite, quartzite, diorite, and magnetite associated with it (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

This was the only place within the map-area that limestone was observed. It was not found interlayered with the metavolcanics, nor was it found associated with exposures of the Gowganda Formation. It is suggested by the author that this limestone represents an outlier of the Espanola Formation as defined by Robertson (Robertson *et al.* 1969). The Saville copper showing formerly owned by Royal Agassiz Mines Limited (10) is associated with it.

Cobalt Group

GOWGANDA FORMATION

Within the map-area the Gowganda Formation is represented mainly by polymictic conglomerate. Greywacke is a very minor rock type. The formation is almost entirely confined to Connaught Township where it occurs in the north-central part of the township at and north of Connaught Lake and Burns Lake. Only one small exposure of conglomerate was found in Churchill Township. This was on the Grassy River Road, 0.4 km along the road northwest of the Macmurchy-Churchill township boundary.

The conglomerate in all areas is a massive polymictic conglomerate consisting of well rounded clasts of pink granitic rock (the most abundant rock-type), quartzite, and felsic metavolcanics. In Connaught Township the clasts form about 20 percent of the rock by volume, and are set in a fine-grained dark green matrix of greywacke, siltstone, or argillite. These clasts vary in size from about 5 cm to 30 cm, and for the most part are matrix supported. In the Churchill Township exposure the rock is brownish rather than dark green, the matrix being quartzitic and consisting of quartz and feldspar. The clasts here form only about 5 percent by volume and range from 10 cm to 30 cm in length.

Greywacke as an independent member is rare but was observed interlayered with the conglomerate at the northwestern shore of Connaught Lake and at an exposure just beyond 0.4 km northwest of Burns Lake, Connaught Township. The rock is medium grained, massive, and dark greyish green to black. No banding or graded bedding was observed in the rock.

MAFIC INTRUSIVE ROCKS

Nipissing Diabase

Diabase mapped as "Nipissing Diabase" occurs ubiquitously in the map-area, the most important occurrences are in southeastern and southwestern

Churchill Township and in central Connaught Township. It occurs capping hills in southeastern and southwestern Churchill Township, where the diabase lies between the 370 m and 400 m contours. These disconnected exposures of diabase are considered to represent erosional remnants of a generally flat-lying sill originally covering much of the map-area, and intruded at the unconformity between the Early Precambrian metavolcanic-metasedimentary rocks and the Middle Precambrian Gowganda Formation.

The typical diabase is a massive, medium- to coarse-grained black rock, which may contain irregular red grains of feldspar 0.5 mm to 1 mm across. It has been mapped as "diabase with pink feldspar". A thin section cut from the least altered-looking rock and containing red feldspar grains shows large laths of augite altered to a yellow and yellowish green chlorite, interpenetrating laths of epidotized, sericitized, and carbonatized plagioclase consisting of albite (An_2) pseudomorphs. Both the pyroxene and feldspar enclose interstitial anhedral quartz, chlorite, epidote, and leucoxene-sphene after ilmenite.

In southeastern Churchill Township the diabase shows a granophyric facies which is a mottled dark red–dark green rock occurring as irregular areas within the diabase. A thin section of this rock type shows a graphic intergrowth of quartz and sericitized feldspar containing some laths of altered albite, and containing irregular patches of pale green chlorite, calcite, and ilmenite altered to leucoxene and sphene. The altered feldspar material is mottled white and light red by reflected light.

Granophyre consists of a pale pink feldspathic rock in which ferromagnesian material is less than 3 percent or absent. It occurs as irregular areas up to 1 m across in the diabase.

A coarse-grained amphibole facies also occurs, and is best developed in southwestern Churchill Township. The amphibole occurs as grains 3 mm across. In thin section the rock consists of pale green pleochroic actinolite with ragged terminations, some grains of which show wavy extinction owing to strain. The actinolite is altered in places to chlorite, and completely or partly encloses altered, lath-shaped, euhedral sericitized and epidotized albite (An_8) pseudomorphs containing irregular patches of calcite. Interstitial anhedral grains of epidote and magnetite are scattered through the rock.

Quartz diabase is not a common rock type. Examples occur in north-central Connaught Township as part of the sill-like masses. The rock is similar to the unaltered, nonporphyritic diabase, except that it is much coarser grained. The quartz is in grey subhedral grains about 1 to 2 mm across.

Porphyritic diabase is also only sparingly represented. Only one occurrence was noted and this was on the middle part of the western shore of Oddur Lake in southwestern Churchill Township. The rock is unaltered, black and medium-grained, with glomeroporphyritic yellow feldspar phenocrysts 0.6 cm in diameter.

Cenozoic

QUATERNARY

Pleistocene and Recent

The Cenozoic is represented by Quaternary deposits comprising sand, gravel, muskeg, and alluvium belonging to the Pleistocene and Recent epochs.

Till consisting of sand and gravel occurs as patches on higher ground seen at road cuts along Highway 560. The material consists of boulders of intermediate and felsic metavolcanics associated with yellow-weathering, sandy clay.

Sand covers about one third of Connaught Township in the southwestern and western parts of the township. It consists of a glistening white and yellow sand which in places forms narrow, east-west ridges about 60 m wide. Sand associated with some gravel also comprises two south-trending eskers, one 8 km long in eastern Connaught Township; the other 3 km long in western Connaught Township. In the region between Esther and Little Esther Lakes, large areas are covered by sand on either side of the longer esker.

Muskeg covers extensive areas in the southwestern part of Connaught Township in regions underlain by the granitic rocks.

Alluvium occurs principally along Elephant Head Creek in Connaught Township (Ontario Dept. Lands and Forests 1971).

STRUCTURAL GEOLOGY

Folding

EARLY PRECAMBRIAN METAVOLCANICS-METASEDIMENTS

Evidence for folding in the map-area was derived from the shape of pillow structures in the mafic and intermediate metavolcanics, banding in iron formation, and the occurrence of such primary structures as graded bedding and load casting in metasediments and pyroclastic rocks.

In the northern part of Churchill Township the rocks are folded about an axis trending N35W. in the region east of the Michiwakenda Lake Fault in northeastern Churchill Township. Just west of this fault the rocks are tightly folded about curving axes convex to the northeast. Farther west the axes trend east and maintain this trend westwards into Connaught Township up to its western boundary. The tight folding occurs in the upper part of the sequence. The region just west of the Michiwakenda Lake Fault is one of considerable disturbance attributed to the effects of faulting. In this area the fold axes are observed to plunge 40 degrees to the south-southeast, and may be a response to a subvertical component of movement on the fault. In the lower part of the sequence in southwestern Churchill Township and southeastern Connaught Township the rocks are predominantly homoclinal striking on average N40W and facing northeast with a steep to vertical dip. There seems to be a difference in fold style within the sequence: broad open folding of the sequence as a whole with tight folding of the upper part, to give a synclinorial structure. Overturning of the rock units has occurred in both parts of the sequence.

Faulting

Evidence for faulting in the map-area was based on the observation of lineaments on air photographs, shearing effects at outcrops, and the study of stratigraphic relationships and aeromagnetic contours.

Two major, well-defined faults were observed within the map-area. These are the Michiwakenda Lake Fault and the Elephant Head Lake Fault. Two other somewhat less important faults are the Little Esther Lake Fault and the Waonga Lake Fault (the least important). Owing to the paucity of outcrop in western Connaught Township and the extensive mantle of Quaternary deposits, the Waonga Lake Fault is not so well defined. These faults are subparallel to each other, Michiwakenda Lake Fault trending on average N20W, the others N10W.

Michiwakenda Lake Fault shows left-lateral separation of about 6 km based on the matching of an important rhyolite unit at the top of the lower part of the metavolcanic-metasedimentary sequence. This amount of separation compares well with a similar displacement of 5.8 km on this fault noted in Fawcett Township and based on the shift of the contact of the Granite Lake pluton on either side of the fault (Carter 1973). On this basis the fault is considered by the author to be a sinistral wrench fault.

If the granitic rocks on the east side of Elephant Head Lake are the displaced eastern part of the granitic rocks on the west side of the lake, then the Elephant Head Lake Fault is also a sinistral wrench fault.

The Little Esther Lake Fault and the fault 0.8 km to the east of it are all considered by the author to show left-lateral separation.

Waonga Lake Fault is almost entirely in granitic rocks in Connaught Township, and owing to the extensive mantle of glacial deposits, the horizontal separation associated with this fault could not be deduced. Evidence for the fault is the shearing in the vicinity of its trace at the northern end of Nabakwasi Lake on the southern boundary of Connaught Township.

Numerous other northwest-trending lineaments occur in southwestern Churchill Township. North-northwest-trending lineaments also occur in southeastern Connaught Township. Some of these are associated with shearing and may be less important faults or shears. In southwestern Churchill Township these lineaments are subparallel to the strike of the rocks, but are at a sharper angle to the regional trend in southeastern Connaught Township.

ECONOMIC GEOLOGY

History of Exploration

Exploration activity in the two townships was carried out mainly for gold and copper deposits. Gold exploration was concentrated mainly in Churchill Township and copper exploration primarily in Connaught Township. The preponderance of underlying granite and the extensive glacial cover in southwestern Connaught Township restricted exploration activity to the northeastern part of this township. Recorded prospecting in the map-area as a whole began in 1911 and was continuous to the present time except for a short break between 1936 and 1945.

CONNAUGHT TOWNSHIP

Recorded exploration activity began in 1913, and was carried out for gold and copper but especially for the latter. In that year according to H.C. Laird (1934, p.67) "John Mataris discovered copper mineralization about three-quarters of a mile southwest of the extreme west end of Okawakenda Lake, on what is now mining claim T.R.S.3556. In 1916, several deep test pits were sunk, ...In 1927, Noah Timmins took an option on the property and drilled one 200-foot hole....". This deposit (see Geological Map, back pocket, Property No. 4) is located between Mataris and Clapper Lakes in northeastern Connaught Township. No further activity occurred until 1956 when Earl Kelly drilled and logged 13 holes for a total depth of 729 feet at the site of the former Banks claim (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Later in the year Lundberg Explorations Limited carried out an aeromagnetic survey for Montgarry Explorations Limited. This was followed by a ground electromagnetic survey that revealed several conductive shears. In 1957, Bardyke Mines Limited retained Patricia Drilling Limited to drill nine holes for a combined length of 3,812 feet on the deposit; copper, silver, and gold mineralization was detected (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Exploration work on the deposit was resumed in 1965 when the property, optioned to Monarch Gold Mines Limited, was magnetically and electromagnetically surveyed by Scope Mining and Exploration Consultants Limited. Mineralization was found to be associated with brecciation in the felsic metavolcanics, which was coincident with a conductive zone. Diamond drilling was recommended to test the anomaly, and two holes totalling 750 feet in length were drilled by Continental Drilling Company in 1965 (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). In 1970, six more holes were drilled by Gome Diamond Drilling Limited to an aggregate length of 1,644 feet for Coniston Copper Mines Limited (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake), who had also carried out an induced polarization survey. In 1971, further drilling, geochemical soil sampling, and an electromagnetic survey were carried out by Coniston Explorations and Holdings Limited (4). Exploration activity was continued on the deposit by this company until 1973.

Laird (1934, p.67) stated that in the northern part of the township "In 1927, Lloyd Foster did considerable surface work on two parallel bands of iron formation occurring on a trail leading northwest from the north end of Burns lake....".

Laird (1934, p.67) further stated that "In November, 1933, J.C. Mahon staked a group of 12 claims lying between Wire lake and Elephanthead creek. The group is centred about a small boss of feldspar porphyry....". These claims were located in northwestern Connaught Township.

Bagamac Mines Limited (2), in 1947, began exploration work on their property in the northern part of the township with geomagnetic and geological surveys. These resulted in tne discovery of several magnetic anomalies, but most were considered to be due to diabase dikes. On those which were believed to be of economic interest, electromagnetic ratiometer surveys were conducted on selected ones in ten separate areas in 1949. An important conductor, considered to be due to mineralization,was located in the vicinity of Wire Lake in the northwestern part of the township. In the same year further magnetometer, electromagnetic, and self-potential surveys were carried out that suggested that only minor disseminated sulphide mineralization (pyrite, pyrrhotite and chalcopyrite) was present, and that the property did not warrant further investigation (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

In 1950, Duvay Gold Mines Limited (5) drilled five holes totalling 662 feet on their claims located in the central part of the township (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

In 1957, four drill holes totalling 1,438 feet were completed on the Saville property, 0.8 km north-northwest of the northern end of Elephant Head Lake (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Later, but prior to 1961, five further holes were drilled on the property for a total of 248 feet (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Then in 1971 Royal Agassiz Mines Limited (10) carried out blasting on the showing.

In 1967, Murky Fault Metal Mines Limited (9) carried out magnetometer, self-potential, and electromagnetic surveys on their property in northeastern Connaught Township; two strong self-potential anomalies were located (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) but no further work was done on the property.

In 1970, Amax Exploration Incorporated carried out an airborne geophysical survey of Connaught Township (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) and the results of this work led to ground exploration follow-up programs by other exploration companies. Thus, in 1971, Amalgamated Rare Earths Mines Limited (on a property now held by Mid-North Engineering Services Limited, 8) and Active Mines Limited (1) carried out ground magnetic and electromagnetic surveys of their properties at Esther and Burns Lakes respectively. On the Burns Lake property a 1,200-foot long electromagnetic anomaly related to disseminated pyrite and chalcopyrite mineralization was recorded. A soil geochemical survey was followed by drilling in 1971 and 1972 when five drill holes totalling 1,212 feet were drilled. Minor pyrite, pyrrhotite, chalcopyrite, sphalerite and magnetite were recorded from some of the holes (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

CHURCHILL TOWNSHIP

Exploration activity was carried out mainly for gold and the earliest recorded work was for 1912 when gold was first discovered in the area on claim W.D.1157 (now 342854) by Fred Gosselin, H. Frith, and C. Speed. In this deposit gold occurs in quartz veins that straddle the Churchill-Asquith township boundary, between Highway 560 and Speed and Firth Lakes. In 1911 or 1912, V. Pakowsky optioned the property and carried out considerable exploration work consisting of trenching, pitting, and systematic sampling. In 1913, Gosselin Gold Mines Limited was incorporated and acquired the property. Further trenching and sampling were done by this company in 1928 and 1929; by McIntyre Porcupine Mines Limited probably in the 1930s; and by Sylvanite Gold Mines Limited in 1937. No drilling was recorded and development work appeared to have ceased by 1937. In 1958, the property was under option to Bolduc Gold Mines Limited and was last sampled in 1959. It is now held by W. McBride (14).

In 1916, The Mining Corporation of Canada Limited held an option on the former Gold Corona or Queen of Sheba Property, now the W.D. Jorgenson (13) property, in southeastern Churchill Township. It is located about a 0.4 km northeast of Beilby Lake, where gold was found associated with quartz and pyrite in iron formation. Development work consisted of trenching and the sinking of a 40-foot shaft on the main vein at the southeastern corner of claim TRS3645. In 1925, systematic channel-sampling was done and later, in 1945, Wright-Hargreaves Mines Limited had an option on the property. The latter drilled 13 diamond drill holes for a combined length of 1,761 feet (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). No intersections of interest were found and no further work was done.

In 1918, J.A. Knox discovered the Kingsley Vein, an auriferous quartz vein near the western shore of the southern end of Michiwakenda Lake on claim TRS4105. The property was acquired by Herrick Gold Mines Limited and developed by trenching, pitting, and sampling. A 10 by 7 foot vertical two-compartment shaft was sunk to a depth of 300 feet, with levels at 50 feet, 100 feet, 200 feet and 300 feet. Over 1,000 feet of lateral work and 3,000 feet of diamond drilling from four holes were carried until work ceased in 1923 (Finley 1926). Grantland Gold Limited held the property from about 1936, and Triton Explorations Limited from 1969.

In 1918, The Churchill Mining and Milling Company Limited was formed and carried out considerable surface prospecting on veins discovered by J.A. Knox on claim TRS3774, ¼ mile east of Beilby Lake. A pit was sunk to 38 feet, and a 7 by 9 foot vertical two-compartment shaft was sunk to 110 feet in 1934 on the Main or Churchill or No.3 Vein. A level was set up at 109 feet on this shaft and 70 feet of drifting and 154 feet of crosscutting were done (Sinclair *et al.* 1936, p.92). Operations were suspended in 1936.

In 1971, Royal Mining Corporation (16) carried out a magnetic and electromagnetic survey on their property in southeastern Churchill Township west of

Cryderman Lake. The survey defined several rock units and an east-west shear. In the same year Winnebago Mines Limited carried out similar surveys in the southeastern corner of the township on the present C.M. Hames (11) property, in a search for gold and porphyry-copper mineralization. A magnetic anomaly was found, but no further exploration work was carried out on this property.

Character of Deposits

Mineral deposits in the map-area comprise copper, gold, and iron. In general these deposits can be grouped as follows:

1) concordant stratabound;
2) concordant vein-type;
3) discordant vein-type;
4) contact metasomatic;
5)unclassified.

CONCORDANT STRATABOUND DEPOSITS

Copper

The Coniston Explorations and Holdings Limited (Mataris Prospect) (4) in northeastern Connaught Township consists of disseminated pyrite, chalcopyrite, bornite and covellite, and sphalerite in "andesite, dacite, and rhyolite flows, and rhyolite breccias; tuffs and agglomerates" (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The deposit is located at the contact between brecciated, dark grey, silicified felsic and intermediate metavolcanics which strike N70W in the upper part of the metavolcanic-metasedimentary sequence. The mineralized zone at the surface is long and wide with an east-west strike (Resident Geologist's Files, Ministry of Natural Resources, Kirkland Lake). This direction is subparallel to the trend of the lithological units and the geological setting of the deposit suggests that this could be a stratabound deposit, the genetic control being that of deposition during volcanic activity.

Gold

The C.M. Hames property (Cochrane Occurrence) (11) in southeastern Churchill Township occurs in banded, oxide-facies iron formation which strikes N45W and dips 75 degrees southwest. Mineralization consists of disseminated patches of pyrite 0.6 cm across and amounting to 30 percent. The iron formation is interlayered with felsic and intermediate metavolcanics of the upper part of the metavolcanic-metasedimentary sequence, which strike N45W. Since the mineralized zone parallels the trend of the iron formation, which is itself conformable with the regional structural trend, this deposit is also regarded as a stratabound deposit. It is suggested by the author that iron formation and gold in this formation are genetically related to the volcanic activity.

Iron

Iron occurs as oxide-facies Algoma-type iron formation consisting of interbanded layers of black and grey chert, jasper, hematite, magnetite, pyrite, argillite, and siltstone concordant with the enclosing metavolcanic-metasedimentary rocks.The pyrite content is variable, and pyrite may be absent altogether. Within the map-area, iron formation was mapped in northeastern and southeastern Churchill Township. It occurs in horizons varying from about 2 to 45 m in width, and extending up to 2.5 km along strike as lensoid beds. Iron formation was also mapped in north-central Connaught Township 0.4 km west of Picket Lake by Laird (1934).

The iron occurs as hematite mainly, but also as magnetite, in bands varying from 5 mm to about 64 mm thick. Only the exposures north of Burns Lake i.e. the L. Foster (6) occurrence have been prospected. In southeastern Churchill Township at a point 0.8 km south-southeast of Perkins Lake iron formation was found by the author to contain up to 30 percent pyrite as disseminated grains 3 mm across. In the extreme northeastern part of Churchill Township, just west of the Grassy River Road, an exposure of iron formation about 2 m across consists entirely of hematite. No sampling of iron formation was carried out during the survey.

CONCORDANT VEIN-TYPE DEPOSITS

Copper

The McBride Occurrence (14) is a concordant vein-type copper deposit located on claim L339370 in southeastern Churchill Township. The deposit consists of disseminated chalcopyrite amounting to 5 percent in a 0.6 m wide quartz vein, 9 m long, which strikes N50W parallel to the trend of the enclosing brecciated, white-weathering, aphanitic rhyolite. No shearing was observed by the writer.

Gold

The Gosselin Occurrence (14) consists of two quartz veins, the Main or Gosselin Vein and the Discovery Vein located at Speed and Frith Lakes at the south-central boundary of Churchill Township. The Main Vein is 2.5 km long, 2 to 20 m wide, strikes N15W which is almost parallel to the enclosing rocks, and dips 60 degrees west which is, opposite the dip of the enclosing rocks. The Discovery Vein is 700 m long and 1 to 2 m wide. It strikes N73W into the Main Vein but the dip is unknown. The veins are in altered pillowed basalt and rusty-weathering iron-magnesium-calcium carbonate cut by felsite or rhyolite. Mineralization consists of gold, silver, pyrite, chalcopyrite, and telluride.

The trend of the Main or Gosselin Vein is parallel to the regional trend of the metavolcanics, and it is associated with shearing subparallel to its trend. On these grounds the localization of mineralization is considered by the author to be structurally controlled in response to shearing parallel to the layering in the volcanic rocks.

DISCORDANT VEIN-TYPE DEPOSITS

These deposits are associated with shearing and with photo-lineaments which trend at a sharp angle to the regional structural trend. It is believed by the author that these deposits are structurally controlled and as such are related to movements following the formation of the lithological units.

Copper

The Goldhurst Resources Incorporated Occurrence (7) at Little Esther Lake in southeastern Connaught Township is associated with the Little Esther Lake Fault and lineaments parallel to it. The deposits occur in "a silicified zone in a fault breccia" (Regional Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) and in a quartz-carbonate vein in fragmented rock.

Gold

Most of the gold deposits in the map-area occur in fractures or shears discordant with the regional structural trend. Important examples are the Knox Prospect (17), the Churchill Prospect (17), and the Gold Corona Occurrence (13).

The Knox Prospect (17) is located near the western shore of the southern end of Michiwakenda Lake and comprises the Kingsley Vein, which strikes north at a sharp angle to the enclosing rocks over a distance of 1,000 feet at the surface, and extends to a depth of 800 feet with a steep dip to the west. The Kingsley Vein consists of bluish quartz lenses 3 to 6 m long, and up to 5 m wide in a well developed schistose zone thought to be a fault, and containing fine pyrite, carbonate, chlorite, and talc. The vein cuts conglomerate, slate, rhyolite, and reddish trachybasalt host rocks of the upper part of the metavolcanic-metasedimentary sequence.

The Churchill Prospect (17) is located in southeastern Churchill Township just over 0.4 km east-northeast of Beilby Lake. It consists of four quartz veins, the most important being the Number 3 or Churchill Vein. This is a shear-type quartz vein 300 feet long and 2 to 3 feet wide at the surface, striking N80E, and dipping 75 degrees south. It is enclosed in Early Precambrian pink and buff rhyolite which is porphyritic in places. Mineralization consists of gold and pyrite.

The Gold Corona Occurrence (13) lies 90 m west of the Churchill Deposit. It consists of a shear-type quartz vein 120 m long and 2 m wide at the surface, which strikes north and dips 70 degrees west. The gangue material consists of quartz and the vein cuts the enclosing rocks at a sharp angle. The country rock is rhyolite, iron formation, and minor basalt of the upper part of the metavolcanic sequence, which here strikes N45W and dips 75 degrees southwest. The gold is associated with pyrite and quartz in the iron formation.

CONTACT METASOMATIC DEPOSITS

Copper

The Royal Agassiz Mines Limited (Saville Occurrence) (10) is located 0.8 km north-northwest of the northern end of Elephant Head Lake at the south-central boundary of Connaught Township. It is a vein-type deposit consisting of massive chalcopyrite, bornite, pyrite, and pyrrhotite, and magnetite in calcite gangue. The deposit is associated with limestone considered by the writer to belong to the Espanola Formation of the Quirke Lake Group overlying Early Precambrian metavolcanics. The vein is 10 to 12 feet wide, strikes N10W, and dips 80 degrees northeast.

Although no intrusive igneous body is exposed at the deposit and the granitic rocks are of Archean age, Nipissing Diabase has intruded Cobalt Group rocks to the north in central Connaught Township, and it is considered that the contact metasomatic effects were produced by an unexposed intrusive body of Nipissing Diabase. Diorite and quartz diorite are recorded in the drill logs from the deposit (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake), and this diorite may represent altered Nipissing Diabase. Further, the occurrence of tremolite, actinolite, epidote, and magnetite associated with the recrystallized calcite and the ores suggest a skarn-type deposit. The granitic rocks close to the deposit are pre-Huronian and cannot therefore be the cause of the metasomatism. Also recorded in the drill logs are argillite and quartzite, associated with limestone. Similar deposits of this type have been referred to by Robertson (1963, p.27; 1968, p.34), Robertson and Card (1972, p.26-27), and Card and Innes (1973, p.114-116; 1974, p.133, 137).

UNCLASSIFIED DEPOSITS

Copper

Because of insufficient data the Active Mines Limited (1) and the Jonsmith Mines Limited (12) occurrences are considered here.

The Active Mines Limited (1) occurrence consists of copper, lead, and zinc mineralization associated with a 1,200-foot long electromagnetic conductor (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) located in northern Connaught Township, 0.8 km south of Burns Lake; and associated with the Gowganda Formation of the Cobalt Group and metavolcanics. Drilling of the deposit for Active Mines Limited disclosed analyses of 1.71 percent Cu over 1.6 feet in a quartz vein enclosed in argillite and quartzite, and 0.73 percent Cu and 0.11 percent Zn across 1 foot in dacite (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

The Jonsmith Mines Limited (12) Occurrence is located about 2.5 km northwest of Saville Lake in Churchill Township. Its precise location is not known as it was not located during the survey. It is reported that a grab sample analyzed 2.57 percent Cu (Northern Miner 1971b). Nothing is known about the character of this deposit, but it occurs in a region underlain by Early Precambrian mafic to felsic metavolcanics cut by a north-northwest-trending diabase dike.

Recommendations for Prospectors

Deposits of copper, gold, and iron occur in the map-area. Concordant stratabound copper deposits (see Mataris Prospect, 4) are likely to occur in the upper part of the metavolcanic-metasedimentary sequence at contacts between felsic and intermediate metavolcanics in northern Connaught and Kelvin Townships. Copper mineralization should also be sought at faults and photo-lineaments which cross the map-area in a north-northwest direction (see Goldhurst Resources Incorporated, 7, occurrence). Copper mineralization is also associated with the Espanola Formation limestone (Saville Occurrence, 10) in the area and is probably related to metasomatism by Nipissing Diabase. Gold deposits commonly occur in shears (Knox and Churchill Prospects, 17) and Gosselin Occurrence (14), associated with felsic metavolcanics interlayered with mafic volcanic rocks in the lower part of the sequence and with shearing in iron formation (Gold Corona Occurrence, 13). Iron formation in the area occurs in the upper part of the metavolcanic-metasedimentary sequence as conformable stratigraphic units.

Description of Properties, Deposits, and Explored Areas

ACTIVE MINES LIMITED (1)

In 1973, Active Mines Limited, incorporated in 1971, held 13 contiguous unsurveyed unpatented claims in north-central Connaught Township , straddling Burns Lake. The claims are numbered L293126 to L293129, L293375 to L293377, and L279215 to L279220.

Exploration on the property was prompted by the discovery of two airborne electromagnetic conductors on the claims following an aerial geophysical survey in the area in 1970 by Amax Exploration Incorporated. Both anomalies were said to occur in that area of the claims underlain by the Gowganda Formation of the Middle Precambrian, but it was concluded that the anomalies were a reflection of conductive bodies occurring in the underlying Early Precambrian rocks. Accordingly, magnetic, electromagnetic and a Cu-Zn-Pb geochemical survey were carried out on the property by H. G. Harper, Consultants, in 1971. Two important electromagnetic conductive zones were obtained, one of which was 1,200 feet long and was associated with minor chalcopyrite found at three points along it. Pyrite was also associated with the second conductor. In the geochemical survey, sampling was concentrated over areas of electromagnetic response underlain by the Early Precambrian metavolcanics. It was found that the 1,200 feet long conductive zone was associated with high copper and lead metal values, and the second with a modest zinc metal anomaly (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Drilling was carried out in the winter of 1971 to 1972 for Active Mines Limited by Continental Diamond Drilling Company during which time five drill holes totalling 1,212 linear feet were drilled, yielding occurrences of pyrite, pyrrhotite, and magnetite associated with quartz veins in argillite and quartzite with dacitic metavolcanics (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). In two of the holes, analyses of 1.71 percent Cu over 1.6 feet and 8.73 percent Cu and 0.11 percent Zn across 1.0 feet were reported (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

BAGAMAC MINES LIMITED [1949] (2)

During 1947, Bagamac Mines Limited held 124 unsurveyed and unpatented claims which were subsequently allowed to lapse. The claims were grouped into 10 blocks located along the entire northern part of Connaught Township and included the Mataris showing (see property Number 4).

In 1947, a magnetic survey and a geological survey were carried out over the entire property by Mining Geophysics Corporation Limited. The magnetic survey was undertaken "to extend the known geology, outline the diabase dikes, and obtain possible indications of mineralization...." (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). In 1949 Mining Geophysics completed an electromagnetic survey. Later in the year self-potential surveys were carried out to check the electromagnetic results. The ground magnetic surveys indicated numerous diabase dikes in the areas studied. Prospecting revealed pyrite, pyrrhotite, and chalcopyrite mineralization along narrow shears and in quartz veins (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The most important electromagnetic results were obtained in the vicinity of Wire Lake where an apparent drag fold had been delineated by magnetic methods. However, the combined results of the geophysical surveys indicated only weak disseminated sulphide mineralization (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Even over the Mataris deposit the amount of mineralization seemed to be small and localized (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

Current mapping by the author shows that the claims are underlain by east-striking Early Precambrian subalkalic mafic to felsic metavolcanics and alkalic intermediate metavolcanics.

R. AND Y. COLLINS, L. MARINO, D. McKINNON, AND B. TODD [prior to 1972] (3)

Prior to 1972, 32 unsurveyed claims were held by the above persons in central Connaught Township about 1.5 km west-southwest of Burns Lake. The claims were since allowed to lapse.

An electromagnetic survey had been carried out over the property by Geoterrex Limited for the owners and two anomalous zones were discovered. Current mapping has shown that the claim group is underlain by felsic metavolcanics of the Early Precambrian sequence. No follow-up exploration work was reported.

CONISTON EXPLORATIONS AND HOLDINGS LIMITED (4)

(Mataris Prospect)

In 1973 Coniston Exploration and Holdings Limited held 31 contiguous unsurveyed claims numbered: L292524 to L292533, L293090 to L293094, L255680 to L255684, and MR36958 to MR36961, MR39417 to MR39418, MR41956 to MR41957, MR41959 to MR41961, located in northeastern Connaught Township. The claim group includes the former Mataris property which comprised claims TRS3556, TRS3557, TRS3655, TRS4100, TRS4101, and TRS4102; the McRae property, claim MR36960; part of the Monarch Gold Mines Limited property; part of the Bardyke Mines Limited group; the Banks property; the Montgarry Explorations Limited property; and the Coniston Copper Mines Limited property.

The original deposit, located between Mataris and Clapper Lakes, was discovered on claim TRS3556 (now MR36961) in 1913 by John Mataris (Laird 1934, p.67). The earliest exploration work was carried out in 1916 when "several test pits were sunk....In 1927, Noah Timmins took an option on the property and drilled one 200-foot hole" (Laird 1934, p.67). Apparently no further exploration was undertaken until 1956 when Earl Kelly drilled and logged nine vertical holes ranging from 39 feet 6 inches to 67 feet in length on the showing (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Later in the same year Lundberg Explorations Limited carried out an aeromagnetic survey of the area for Montgarry Explorations to establish formational trends. On the basis of the results of this work an electromagnetic survey was subsequently completed in November 1956. In 1957 Bardyke Mines Limited retained Patricia Drilling Limited to drill nine holes for a combined length of 3,812 feet on the deposit. Exploration work was taken up again in 1965 when the property, optioned to Monarch Gold Mines Limited, was magnetically and electromagnetically surveyed by Scope Mining and Exploration Consultants Limited. A conductive zone was located and diamond drilling was recommended. This was carried out in the same year by Continental Drilling Company when two holes totalling 750 feet were drilled. In 1970, six further holes were drilled by Gome Diamond Drilling Limited for a total length of 1,644 feet for Coniston Copper Mines Limited. The latter had also carried out an induced polarization survey and from 1971 the company, now known as Coniston Exploration and Holdings Limited, carried out geochemical soil sampling, an electromagnetic survey, and diamond drilling. Four holes of unreported length were drilled by 1973.

The original deposit was described by Laird (1934, p.67) as occurring in a "dark coloured, aphanitic, brecciated or fragmental type of rock...." showing "vesicular structure" in places. The rock "consists mainly of quartz, a pale-greenish chloritic material, and glass; tiny flow structures are very much in evidence....The mineralized zone attains a width of 100 feet and has been traced for several hundred feet. Among the minerals observed on the rock dump were pyrite, chalcopyrite, azurite, malachite, bornite, covellite and sphalerite. Generally speaking, the mineralization is rather disseminated and has a strong tendency to occur in tiny fractures and little pockets in the otherwise massive rock. Interesting gold values are said to have been obtained from this deposit....". Later surface exploration showed "disperse and intermittent copper values over an E-W strike length of 210 feet and a horizontal width of 120 feet ... Diamond drilling...(showed) the presence of copper intermittently over a horizontal N-S width of 260 feet. The zone of copper mineralization is open in both strike directions and down dip" (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Ground electromagnetic work indicated that "the sulphides occur in small lenses and blebs surrounded by non-conductive gangue..." and that "associated with the mineralization in the brecciated volcanics is a conductive zone extending to the east within an area of acid volcanic rocks" (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The overall results of exploration work, however, confirmed that the deposit consists of disseminated pyrite, chalcopyrite, bornite, and covellite consisting of "two cupriferous zones dipping about 30NW at shallow depth" (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The host rocks were "andesite, dacite, and rhyolite flows, and rhyolite breccias, tuffs, and agglomerates" (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The most recent available information indicates that there is an EM conductor associated with the previously drilled copper zone "about 500 feet in length and the drilled length of the copper zone about 100 feet" (Northern Miner 1971c). Mapping during the present survey showed that the deposit is located at the contact of Early Precambrian felsic and intermediate metavolcanics striking N70W. Various estimates of grade have been given in the company reports. Drilling by Earl Kelly in 1956 returned a best intersection of 12.35 percent Cu, with 0.06 ounce Au, and 1.88 ounce Ag per ton over 18 inches (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Drilling by Bardyke Mines Limited in 1957 returned a best intersection of 3.31 percent Cu, with 0.01 ounce Au, and 0.93 ounce Ag per ton over 5 feet (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Gome Diamond Drilling Limited on behalf of Coniston Copper Mines Limited obtained 1.13 percent Cu with minor added silver "values" over 30 feet as its best intersection in 1970 (Northern Miner 1970b). Drilling by Coniston Explorations and Holdings Limited indicated a best intersection of 0.86 percent copper over 16 feet in 1973 (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

DUVAY GOLD MINES LIMITED [1950] (5)

In 1950, Duvay Gold Mines Limited held 10 claims in central Connaught Township 0.8 km west of Connaught Lake. The claims were since allowed to lapse. During 1950, five diamond drill holes were drilled for a total length of 662 feet by L. Gamble. Acidic lava, talc schist, and iron pyrites were intersected in the holes, but the location of the claims indicated that, from current geological mapping, the claim group was underlain by granitic rocks. However, the drill holes might have intersected roof pendants of the surrounding metavolcanics. The mineralized area was known as The Cousineau Showing.

L. FOSTER [1927] (6)

In 1927, L. Foster held a set of claims in northern Connaught Township about 0.4 km north of the northern end of Burns Lake. The claims were allowed to lapse.

The showings were not relocated during the current mapping but were described by Laird (1934, p.67) as follows: "In 1927, Lloyd Foster did considerable surface work on two parallel bands of iron formation occurring on a trail leading northwest from the north end of Burns Lake. The bands are highly disturbed, strike approximately east-west and consist of sugary quartz, limonite material, and massive pyrite."

No record of this work was on file at the Resident Geologist's Office at Kirkland Lake, and no further work was reported.

GOLDHURST RESOURCES INCORPORATED (7)

In 1973, Goldhurst Resources Incorporated held 12 contiguous unpatented mining claims numbered L341921 to L341927 inclusive, and L342560 to L342564 inclusive about Little Esther Lake at the middle of the eastern boundary of Connaught Township.

General prospecting and surface exploration were carried out on the property by the owners in 1973 consisting of pitting, trenching, and stripping. Two deposits were described on the property on the western shore of the lake in the company report (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) as follows:

> A silicified zone in a fault breccia with chalcopyrite mineralization has been located on the southwest shore of Little Esther Lake in claim 342562. This zone is in evidence for thirty feet along the

shore line when it is covered by the lake on both ends. The lake also obscures its width as in low water only a six-foot width could be seen.

A parallel structure, also with chalcopyrite mineralization, has been located by stripping some thirty feet to the south, also in claim 342562. Three spots were opened up over a strike length of 130 feet with a width of 5 feet. The east end of the showing goes into the lake and the west end is hidden by swamp and heavy overburden.

Both zones appear to be more heavily mineralized to the west and an assay of 2.34 percent copper in a representative grab sample has been obtained.

No map of the property is on file to show the location of the showings but during the field mapping of the map-area a showing on the western shore of the lake was observed by the senior assistant. The deposit consisted of chalcopyrite and bornite in quartz-carbonate veins in fragmental andesite. This is probably the more southerly showing referred to above in the company report.

MID-NORTH ENGINEERING SERVICES LIMITED (8)

In 1973, Mid-North Engineering Services Limited held 16 contiguous unsurveyed claims in east-central Connaught Township along the northern part of Esther Lake. The claims are numbered L279137, L279140 to L279146, and L279207 to L279214. This claim group was formerly held by Amalgamated Rare Earth Mines Limited in 1970.

Interest in the claim group followed the discovery of an electromagnetic conductor on the property during an airborne electromagnetic survey carried out by Amax Exploration Incorporated in 1970 (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The property is underlain by Early Precambrian metavolcanics. Magnetic and electromagnetic surveys were carried out in 1971 by H.G. Harper, Consultant, for Amalgamated Rare Earth Mines Limited and both magnetic and electromagnetic anomalies were discovered. Those magnetic anomalies which showed a northeast trend were interpreted as due to the occurrence of diabase dikes. Five electromagnetic conductors were discovered. The most promising economically was said to be 1,600 feet long, appeared to coincide with the airborne anomaly and was associated with streaks of pyrite (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Another conductor was reported as being 2,800 feet long striking across the trend at the formations. It was interpreted as a shear (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

MURKY FAULT METAL MINES LIMITED [1967] (9)

In 1967, Murky Fault Metal Mines Limited held one claim located about 0.4 km northeast of the northern end of Burns Lake in north-central Connaught Township. The claim has since lapsed.

Geophysical work comprising self-potential, magnetometer and electromagnetic surveys were carried out in 1967 by J.L. Tindale, Consultant, for the owners of the property. Two strong anomalies were located by the self-potential survey, which it was considered could be due to "veins or dissemination of sulphides, or graphitic material" (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Magnetometer and horizontal coil electromagnetic work failed to further delineate the responses (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

Mapping during 1973 by the author shows that the property is underlain by Early Precambrian intermediate metavolcanics cut by a northwest-trending diabase dike.

ROYAL AGASSIZ MINES LIMITED [1971] (10)

(Saville Occurrence)

During 1971, Royal Agassiz Mines Limited held 64 unsurveyed claims in Connaught Township between Elephant Head Lake and Connaught Lake. These claims were allowed to lapse in 1972. The group included the former McLean property (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake) and Saville property MR24746 to MR24759, located within 0.8 km of the northern end of Elephant Head Lake. During 1957, Pioneer Consultants drilled, for M.W. Saville, four diamond drill holes for a total length of 1,438 feet on a copper-magnetite-calcite deposit on the property. Aplite, andesite, and quartz diorite were intersected in the core and mineralization consisted of pyrite, magnetite, and sulphide, associated with crystallized calcite (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Analyses from a magnetite section of the core showed 0.01 oz/ton Au over a width of 0.91 feet from one hole, and 0.05 percent copper over 3.35 feet from a section of pyrite of another hole (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

Sometime prior to 1961 McLean had five diamond drill holes put down in the same area for a combined length of 248 feet. Calcite, magnetite and minor chalcopyrite were intersected (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). In 1971, Royal Agassiz Mines Limited carried out blasting on the showing, and the following report was given on the deposit (Northern Miner 1971a, p.3):

> The showing, where blasted into, is at least 12 feet wide, with the walls yet to be determined. Striking northwest-southeast, it is in a rhyolite host rock and lying up against a strong band of iron formation.
>
> A grab sample taken by Mr. Robbins from a 4.0-foot massive section within the trench assayed 10.80 percent copper, 0.23 percent zinc, 4.90 ozs. silver and 0.10 oz. gold per ton. Likewise, a grab sample from the lower grade disseminated material in the wall returned 1.52 percent copper, 0.04 percent zinc, 0.72 ounce silver, and 0.07 ounce gold.

A grab sample taken by the author, and analyzed by the Geoscience Laboratories, Ontario Geological Survey, contained 0.11 oz/ton gold, 1.01 oz/ton silver, and 3.0 percent copper with 840 ppm zinc and 10 ppm lead.

It was subsequently reported (Northern Miner 1972) that the claims were dropped "after drilling and geophysical work produced inconclusive results". No account of this work was filed for assessment credit.

The deposit was visited during the current mapping and was found to be located near the contact of the granitic rocks and Early Precambrian rhyolitic metavolcanics in Espanola limestone. The deposit consists of a 3.0 to 3.7 m wide calcite vein striking N10W and dipping 80 degrees northeast. Mineralization consists of magnetite and massive chalcopyrite, pyrite, bornite, malachite and azurite associated with recrystallized calcite, tremolite, actinolite, and epidote and lying near aphanitic light pink rhyolite.

C.M. HAMES (11)

(Cochrane Occurrence)

During 1973, C.M. Hames held 28 unsurveyed claims comprising two blocks in southeastern Churchill Township: a northern group consisting of 10 claims numbered L344934 to L344947, L354571 to L354577; and a southern group comprising 18 claims numbered L282378 to L282385, and L285160 to L285169. No assessment work is filed for this property.

The northern group included surveyed claims TRS3699, TRS3712, and TRS3713; the former Cochrane and Corona Group of claims (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Concerning the Cochrane Claim, on which gold mineralization was noted, Hopkins (1920, p.41) described the occurrence viz.:

> The Cochrane claim (3712) lies northwest of the Churchill group. On the western part of the claim, within 100 feet of the west line, gold has been found in a vein one foot in width striking northeasterly, in porphyritic greenstone. A few hundred feet northeast of this showing, a white sugary quartz vein about 10 inches in width, cuts across banded iron formation. The quartz contains much finely disseminated pyrite and numerous small particles of gold.

These veins were not located by the writer but near the southeastern part of the claim iron formation was seen. It is 1.8 m wide where exposed, and consists of black and white chert bands varying from 15 cm to 30 cm in width (which comprise the Cochrane Vein) alternating with magnetite bands 15 cm wide. The strike of the bands is N40W with a dip to the southwest of 75 degrees. Disseminated patches of pyrite up to 0.6 cm across constitute about 30 percent of the iron formation. Current mapping by the author indicates that the claim is underlain by Early Precambrian rhyolite, andesite, and iron formation which are unconformably overlain by Middle Precambrian Nipissing-type diabase. The iron formation forms a horizon at least 0.8 km long trending N40W. During the summer of 1973, the showing was drilled by Falcon Gold Mines Limited but no assessment work was as yet filed by the company.

Concerning the southern group of claims no assessment work has been filed, but current mapping by the author has shown that the western part of the set of claims is underlain by northwest-striking Early Precambrian metavolcanics ranging from basalt to rhyolite in composition. The eastern part of the group is underlain by Middle Precambrian Nipissing-type diabase, granophyre, and granophyric diabase. This southern group of claims included those formerly held by Winnebago Mines Limited, a company incorporated in 1970. In 1971, geophysical work consisting of ground magnetic and ground electromagnetic surveys was carried out in a search for base metals by T. Gledhill, Consultant. No natural conductive anomalies were detected, but one magnetic anomaly was located and it was recommended that it be tested by diamond drilling. No further work has since been filed for the property.

JONSMITH MINES LIMITED OCCURRENCE [1971] (12)

During 1971, Jonsmith Mines Limited held 20 unsurveyed claims in west-central Churchill Township centred about 1.6 km northwest of Saville Lake, four of which were on option. The claims were not in good standing in 1973 .

The claim group is underlain by Early Precambrian mafic to felsic metavolcanics which are reported to be cut by a north-northwest-trending diabase dike. The metavolcanics trend northwest and consist mostly of basalt. No exploration data are filed for the group but a "grab sample assayed 2.57 percent copper, it was reported" (Northern Miner 1971b, p.18). The grab sample was apparently taken by Jonsmith Mines Limited.

W.D. JORGENSON (13)

(Gold Corona Occurrence)

During 1973, W.D. Jorgenson held three unsurveyed and leased claims numbered: TRS3577, TRS3578, and TRS3645 in southeastern Churchill Township between Beilby and Perkins Lakes. These claims formed part of the original Gold Corona, or Black Tiger or Queen of Sheba Property (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). In 1916, Mining Corporation of Canada Limited held an option on the property. In 1936, they were held jointly by S. Cochrane, W.E. Werrett, and D. Ulfland and in 1945 Wright-Hargreaves Mines Limited held an option on the group (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

Current mapping by the author has shown that the claim group is underlain mainly by felsic metavolcanics of Early Precambrian age, which form part of a thick felsic unit trending northwest. Minor basalt, iron formation, and andesite-dacite of the same age are interlayered with the felsic metavolcanics. All these rocks are overlain by sill remnants of Nipissing Diabase of Middle Precambrian age. On the eastern part of the property shearing was observed in the metavolcanics, the schistosity trending N60W and dipping from 52 degrees north to the vertical.

In 1919, the showings were examined by Hopkins (1920, p.42) who described them as follows:

> A vein some eight feet wide, and apparently dipping 70° to the west, has been exposed, by trenching, along the east boundary of 3645. The vein has been folded and brecciated, with small offshoots extending out on either side, one of which contains gold. Some of the veinlets in the banded iron formation also contain visible gold. A third vein has a northeasterly strike, and where it passes through the banded iron formation, gold could be seen. The sulphides in the iron band were probably the precipitating agent for the gold.

Assay results reported in 1916, when the property was under option to Mining Corporation of Canada Limited, showed $10.00 gold over 20 inches (gold at an unknown price per ounce, Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The property was later drilled in 1945 when it was under option to Wright-Hargreaves. During this time 13 diamond drill holes were drilled for a combined length of 1,761 feet (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The best intersection from this drilling gave $7.70 gold over 1 foot (gold at $35.00 per ounce, Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

W. McBRIDE (14)

(Gosselin Occurrence, McBride Occurrence)

In 1973, W. McBride held 11 claims in southeastern Churchill Township comprising a group of eight contiguous unsurveyed claims lying between Frith and Gosselin Lakes and numbered L342849 to L342854, L367773, and L367775; one claim straddling the eastern part of Beilby Lake; and two contiguous claims, one numbered L104641 (surveyed) and the other straddling Highway 560 about 0.8 km south of Beilby Lake.

The group of eight claims held by McBride, together with two adjoining claims held by O. McDiarmid (15) included the former Gosselin Gold Mines Limited property which contained claim WD1157 (L342854, Churchill Township) where gold was discovered in 1912 (Collins 1917, p.112) by Fred Gosselin, H. Frith, and C. Speed.

Soon after the discovery of gold, V. Pakowsky of Duluth, Minnesota took an option on the property in 1911 or in 1912, and carried out considerable exploration work consisting of trenching, pitting, stripping, and systematic sampling. This work led to the discovery of at least six different veins, but the option was allowed to lapse in 1912. In 1913, Gosselin Gold Mines Limited was incorporated and acquired the property, but exploration activity ceased by 1918. Further trenching and sampling were done by Gosselin Gold Mines Limited in 1928 and 1929; by McIntyre Porcupine Mines Limited probably in the 1930s; and by Sylvanite Gold Mines Limited in 1937. No drilling was ever carried out on the property and development work appeared to have ceased by 1937. In 1958, the property was under option to Bolduc Gold Mines Limited and was last sampled in 1959 (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). During the summer of 1973 Noranda Gold Mines Limited was engaged in a program of line-cutting on the property preparatory to geophysical surveying.

Current mapping by the author shows that the property is underlain by Early Precambrian metavolcanics comprising pillowed basalt belonging to the lower part of the metavolcanic-metasedimentary sequence. The regional trend of the rocks is N45W.

Original descriptions of the property were given by Collins (1912, p.249-250) and Stewart (1912, p.275), both of whom examined the original showings in 1911. The showings were again examined in 1919 by Hopkins (1920, p.52) when they were best exposed and were described by him thus:

> The rocks consist of Keewatin altered pillow lava and rusty weathering iron-magnesium-calcium carbonate cut by felsite or rhyolite and granite porphyry of Algoman(?) age. The gold-bearing veins occur in all these rocks and in some of the contacts between the porphyry and older rocks. A large vertical quartz vein, from one to twenty feet wide, with offshoots, can be traced for 650 feet in a N15°W direction from claim 2365 to a small lake on 2196. The quartz appears again on the north side of the lake on 2135 [erratum, 2195 now L842854-author] in the form of several large lenses along the same general direction for 450 feet. The largest of these quartz masses is 160 feet long and 65 feet wide at its broadest part, and contains a showing of gold. Directly west of this vein on claim 2135 [erratum, 2195-author] there are parallel lenses in the schist, which carry visible gold. In the north-east corner of 2196 several large lenses of quartz containing gold occur in felsite. Usually the veins in the felsite and also in the rusty carbonate are in the form of numerous stringers distributed in an irregular manner. The quartz in these various deposits has a white or rose colour. It is frequently brecciated, and contains numerous tiny veinlets of transparent quartz which may have some bearing on the gold values. The richest values appear to be on the edges of the quartz masses. Gold was seen in many parts of the various veins. Pyrite and chalcopyrite are quite abundant in places. The deposits are large, and portions of them are fairly well mineralized and apparently warrant further development.

In summary, the deposit may be described in the following way on the basis of the results of later exploration activity: the deposits consist of two veins, the Main or Gosselin Vein and the Discovery Vein, the latter lying to the east of and branching off southeastwards from the Main Vein. The Main Vein is 1½ miles long and straddles Churchill and Asquith Townships. In Churchill Township, it is 4,600 feet long, 1.6 to 65 feet wide, strikes N15W, and dips approximately 60 degrees west. It consists of white or rose quartz, which is commonly brecciated, and occurs in altered pillow lava, and rusty-weathering, iron-magnesium-calcium carbonate, cut by felsite or rhyolite. Mineralization consists of gold, silver, pyrite, chalcopyrite, and telluride. The best assay obtained in 1922 showed 4 ounces Au and 20.1 ounces Ag per ton (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Resampling in 1959 gave assay values of 0.21 ounce Au per ton over 7.8 feet yielding $7.35 per ton (gold at $35.00 per ounce, Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). The Discovery Vein, which is entirely in Churchill Township, is 2,300 feet long and 4 to 6 feet wide. It strikes N73W into the Main Vein but the dip is unknown. Assay values are not available.

The remaining claims held by McBride, TRS 3671 (L340649) and L104641 and L339370 are underlain by pale yellow and pink aphanitic and porphyritic rhyolite with a northwest trend belonging to the Early Precambrian, and Nipissing Diabase of Middle Precambrian age. Trenches have been put down on the two southern claims i.e., L104641 and L339370 in rhyolite outcrops and in addition, drilling and blasting have been done on claim L104641. The showing on claim L339370 was examined by the writer. It consists of a trench sunk on a quartz vein; the trench trends N50W, is 0.6 m wide and 9 m long, and exposes the vein which dips 80 degrees south. Vein material consists of quartz and chlorite with disseminated chalcopyrite amounting to 5 percent. The vein is emplaced in a white, aphanitic rhyolite which is brecciated in places.

O. McDIARMID (15)

In 1973, O. McDiarmid held two contiguous unsurveyed claims numbered L366017 and L366018 in southeastern Churchill Township about 0.2 km west of Gosselin Lake. No assessment work was filed for the property.

Current mapping by the author shows that the property is underlain by Early Precambrian mafic metavolcanics. The southern part of the property contains part of the Discovery Vein previously described in the W. McBride property (14).

ROYAL MINING CORPORATION [1971] (16).

In 1971, Royal Mining Corporation held 12 contiguous unsurveyed claims in southeastern Churchill Township between Cryderman Lake and Gosselin Lake which were since allowed to lapse. The property included the former surveyed claim TRS3636 (L5030) held by C.M. McCrea.

Geological and geophysical mapping were carried out by Barringer Research Limited for the Corporation in 1971. Mapping during the 1973 field season by the author indicated that the claim group is underlain by Early Precambrian metavolcanics ranging in composition from basalt to dacite, the latter showing pillowed structure. Interlayered with these are serpentinized dunite and a dense, heavy, pale green rock, weathering to a dark rusty brown pitted surface and known as "green carbonate" (an impure magnesium-iron-lime carbonate, Hopkins 1920). All these rocks have been intruded by pink biotite granodiorite, granite porphyry, gabbro, and north-northwest-trending diabase dikes. Middle Precambrian Nipissing Diabase occurs capping hills in the northwestern part of the claim group. The geophysical surveys carried out by Barringer Research Limited consisted of ground magnetic and ground electromagnetic surveys. A summary of their results is as follows:

> The geophysical survey defined several rock units composed of mafic to intermediate metavolcanics, porphyritic granite, gabbro, microdiorite and diabase. A shear zone trending in an east-west to east-northeast direction and located immediately north of Highway 560, has been indicated by the electromagnetic and magnetic survey. Shallow, sandy overburden conditions should not have hampered the electromagnetic survey and any conductors of importance should have been outlined by the electromagnetic survey. The felsic intrusive (porphyritic granite) in the southwest part of the property does not appear to be similar to other felsic bodies in the area that contain sulphide mineralization (i.e. the quartz porphyries) (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

TRITON EXPLORATIONS LIMITED (17).

(Knox Prospect, Sutherland Claims, Churchill Mining and Milling Company Limited Prospect)

In 1973, Triton Explorations Limited held a group of 24 leased claims located in southeastern Churchill Township between Ribble and Perkins Lakes and numbered: TRS3173, TRS3548, TRS3554, TRS3555, TRS3741, TRS3773, TRS3774, TRS4044, TRS4096 to TRS4098, TRS4105 to TRS4108, TRS4117, TRS4361 ½, TRS4480, TRS4481, TRS8548, TRS8623 to TRS8625, and WD1407. This group included the former properties of Herrick Gold Mines Limited (later held by Grantland Gold Limited) on which was located the Knox Prospect, Churchill Mining and Milling Company Limited, Ronda Gold Mines Limited, and the Sutherland Claims.

Knox Prospect

The group of six contiguous surveyed claims TRS4096 to TRS4098 and TRS4105 to TRS4107, was formerly held by the Herrick Gold Mines Limited and contained the Knox Prospect. The group is located in the southeastern part of Churchill Township on Michiwakenda Lake. It was on claim TRS4105 of this group that J.A. Knox in 1918 first found auriferous quartz veins (Hopkins 1920, p.43), the most important of which was called the Kingsley Vein. The property was first known as the Knox Claims in 1918 before it was acquired by Herrick Gold Mines Limited in 1919. Grantland Gold Limited later acquired it in about 1936.

Development work consisted of trenching, pitting, and stripping. A 10 foot by 7 foot vertical two-compartment shaft was sunk to a depth of 300 feet with levels at 50 feet, 100 feet, 200 feet and 300 feet. Over 1,000 feet of diamond drilling from four holes were carried out until work ceased in 1923 (Finley 1926).

The main vein on the property, the Kingsley Vein (No.1 or Main Vein) strikes north-south, extends for 1,000 feet on the surface and to a depth of 800 feet with a steep dip to the west. It consists of bluish free-milling quartz as lenses 10 to 200 feet long, and up to 18 feet wide in a well developed schistose zone thought to be a fault. The schist zone contains visible gold, fine pyrite, carbonate, chlorite, and talc. The vein was reported to cut conglomerate, slate, rhyolite, and reddish lamprophyre host rocks (Hopkins 1920, p.43). Average grade at the surface was $10.20 gold per ton (gold at $28.00 per ounce, 1933 price) from channel and selected samples (Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake). Gold was also encountered in the diamond drill holes averaging $19.75 per ton from eight sections at depths of 610 feet, 770 feet, and 170 feet on the vein (gold at $20.67 per ounce, Resident Geologist's Files, Ontario Ministry of Natural Resources, Kirkland Lake).

Sutherland Claims

Claims TRS8623 and TRS8624 comprised the Sutherland Claims, and lie in the southwestern corner of the Triton Explorations Limited property. Two diamond drill holes were drilled in 1956 for a combined length of 208 feet by an unknown driller. Carbonatized rock was encountered in the holes.

Churchill Mining and Milling Company Limited Prospect

Claims TRS3741, 3773, 4044 and 3774 comprised the former Churchill Mining and Milling Company Limited property. This company was incorporated in 1918 and exploration and development work continued intermittently until finally suspended in 1936. The work consisted of the sinking of a pit 38 feet deep on one of the veins and a 7 foot by 9 foot vertical two-compartment shaft to a depth of 110 feet on the north or No. 3 vein (Sinclair *et al.* 1935, p.82; Laird 1935, p.40). A level was set up at 109 feet on this shaft and 70 feet of drifting and 154 feet of crosscutting were done (Sinclair *et al.* 1936, p.92).

On the basis of current mapping by the author the mineralized area is underlain by Early Precambrian metavolcanics consisting of pink and buff coloured rhyolite which is porphyritic in places. The rhyolite is part of a large unit trending northwestwards occurring near the top of the lower part of the metavolcanic sequence. The geology and the deposits were previously described by Hopkins (1920, p.41) and Laird (1934, p.70-72) when the showings were available for examination. The showings were all on claim TRS3774 and consisted of four quartz veins striking N80E, the most important of which was the No.3 vein. This vein was 300 feet long and 2 to 3 feet wide at the surface, dipped 75 degrees south and was classified as a fissure-type vein by Laird (1934), enclosed in a shear striking S80E. Mineralization consisted of gold and pyrite. Assays from channel samples from the No.1 vein gave 0.86 oz Au/ton over 4 feet and 0.80 oz Au/ton over 4 feet from No.3 vein (Laird 1934, p.72). Seventeen hundred feet east of these veins was another vein 4 to 6 inches wide striking N80E and dipping 75 degrees north. This vein was directly on strike with the other veins and indicated "the possibility of a strong vein system being picked up in the intervening low ground" (Laird 1934, p.72).

The following is a more detailed description of the deposit given by Laird (1934, p.70-71) when he visited it in 1933:

> The south vein, known as No.1, and that part of No.3 vein east of the fault occur in a light-coloured rhyolite or quartz porphyry, which is somewhat sheared at S80°E. This porphyry, which is probably a differentiated portion of the large granitic mass lying to the south, occurs as a narrow tongue pinching out a few hundred feet to the north of the showing. Locally it is intersected by irregular stockworks of narrow quartz stringers, which are reported to carry low values in gold. The veins are of the fissure type and are definitely later than the porphyry, since they cut it. The north-south faults displacing the veins belong to a late system of north-south fracturing characteristic of the whole region. In the case of the adjoining properties, Gold Corona, Herrick, and Wasapika, the north-south fractures carry the gold-bearing quartz veins, but on the Churchill property the east-west fractures are in this respect the important ones.

A. WIERMEIR (18)

During 1973, A. Wiermeir held four contiguous unsurveyed claims numbered: L345877 to L345879, and L345883 in southeastern Churchill Township between Gosselin and Jepson Lakes. No assessment work was filed for the property but geological mapping by the author during the summer of 1973 indicated that the area is underlain by Early Precambrian basalt and andesite-dacite having a regional northwest trend. A pit 1.2 m by 0.6 m by 0.6 m was observed in the basalt, but no mineralization was seen by the author.

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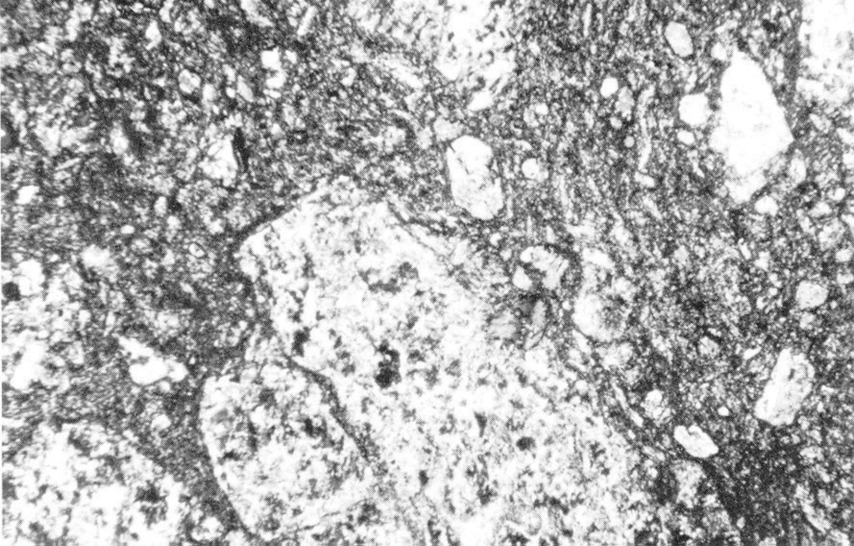
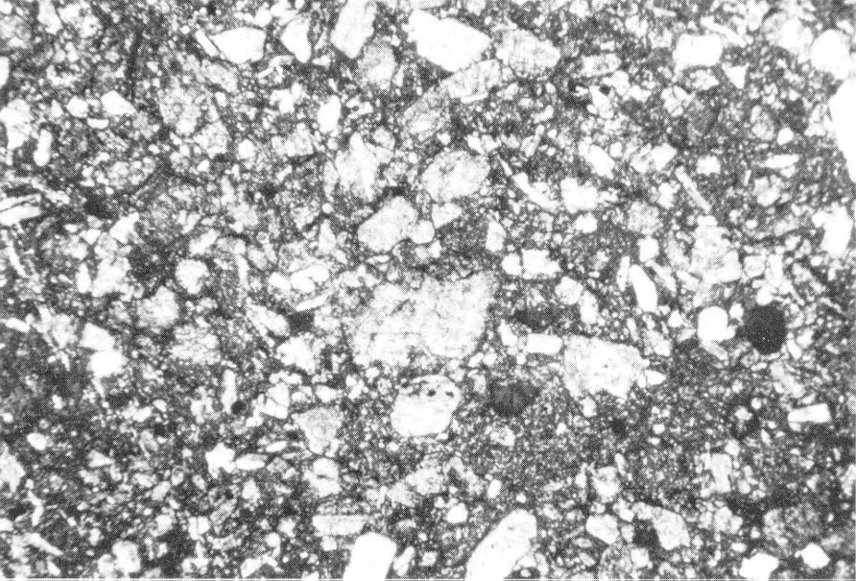
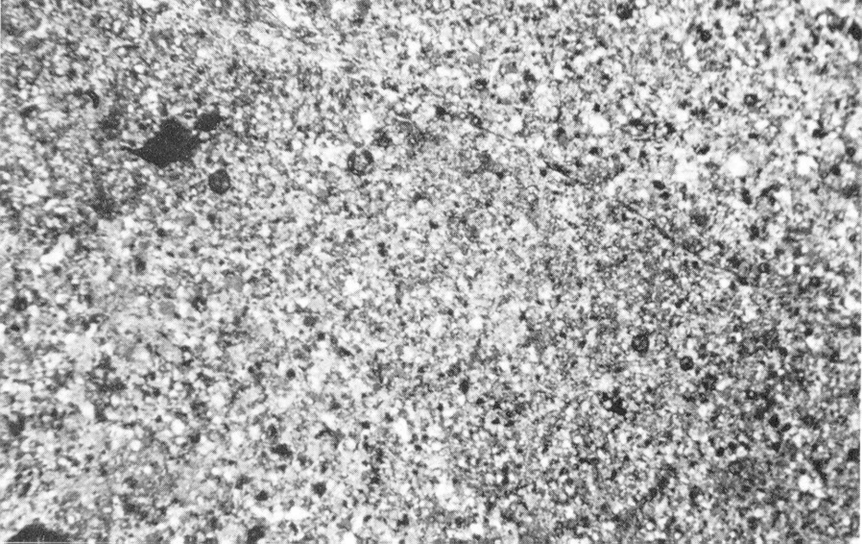
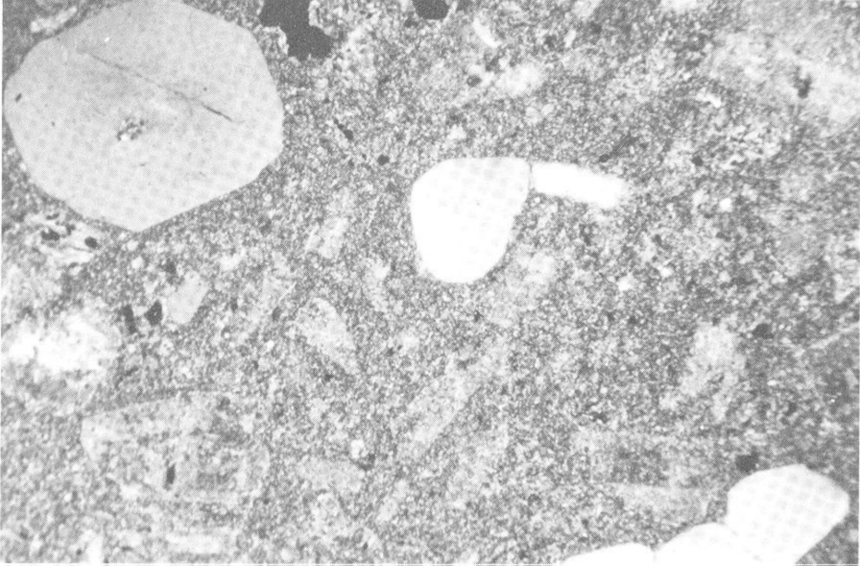
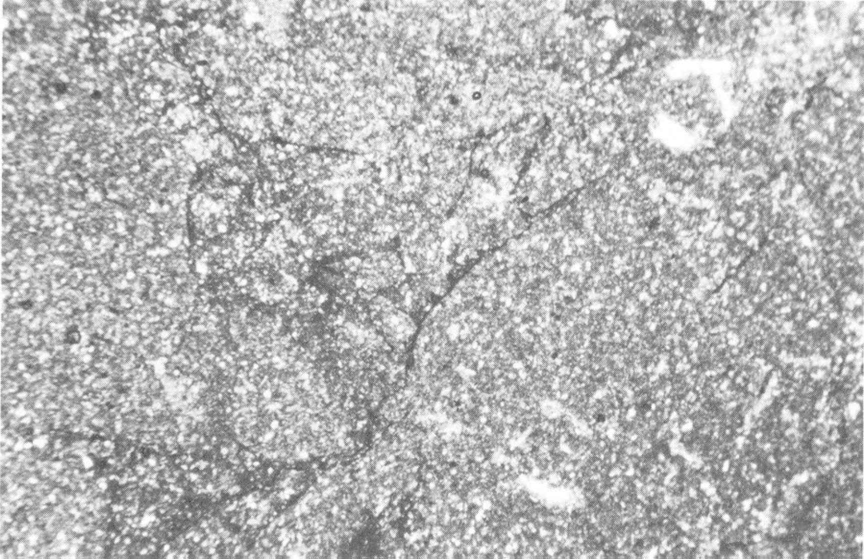
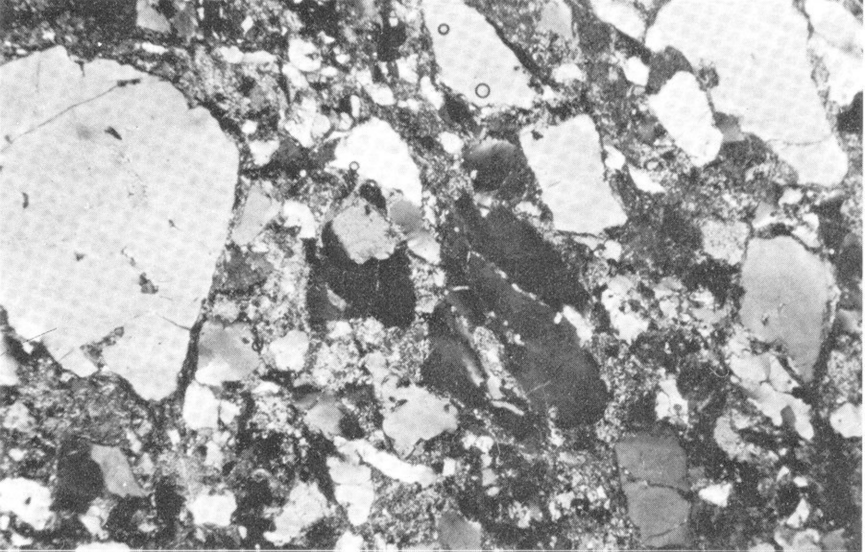


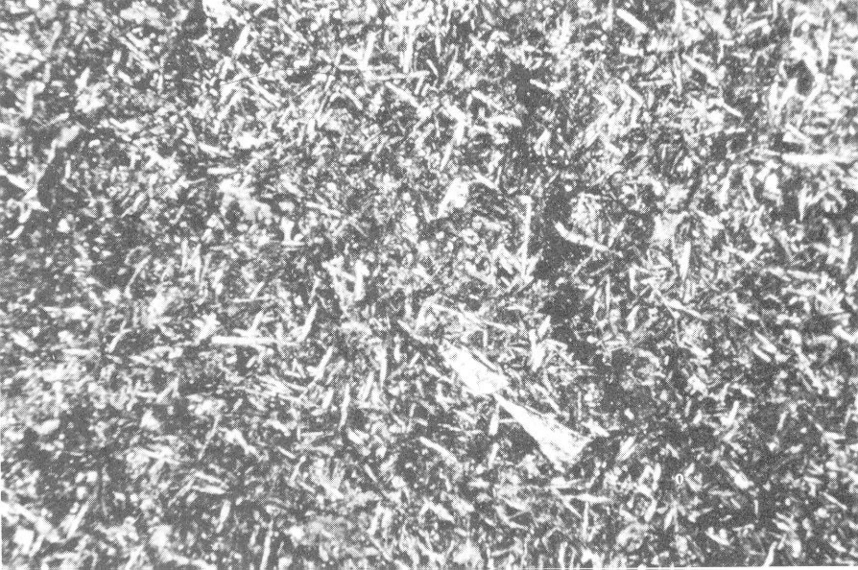


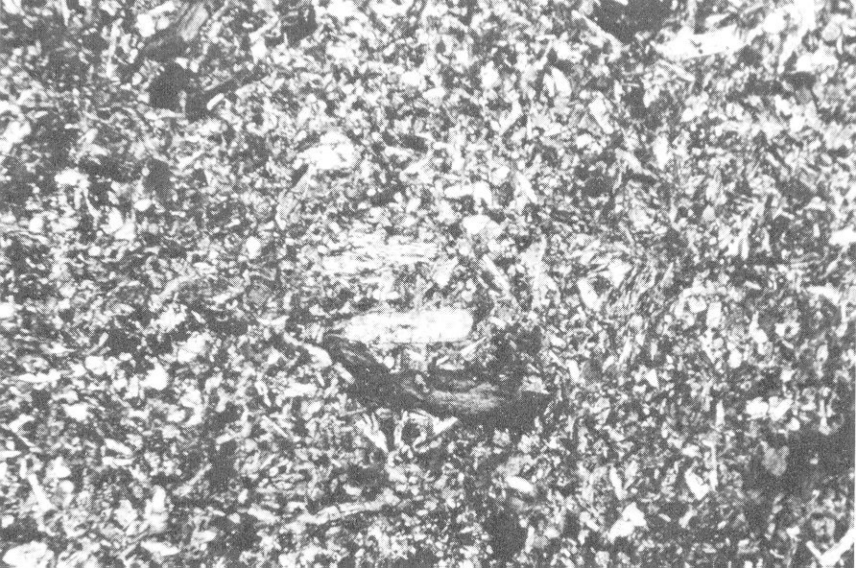


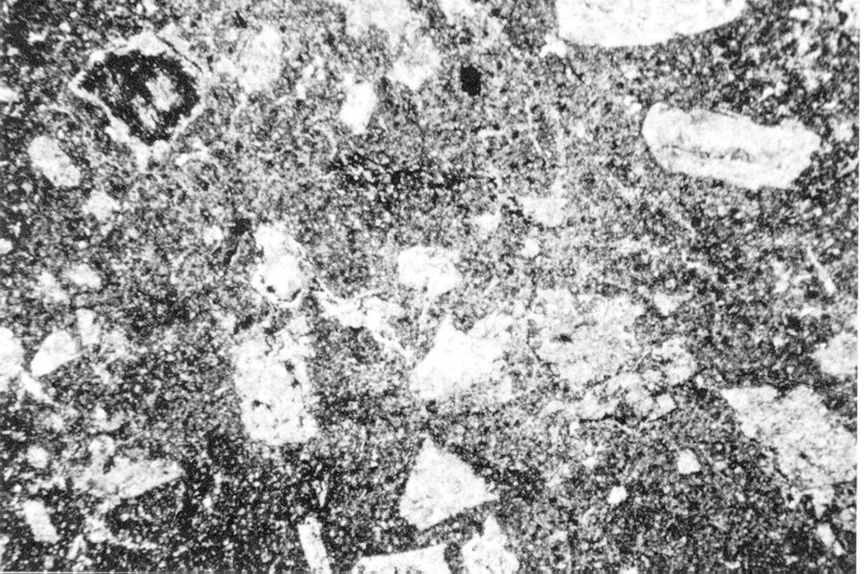


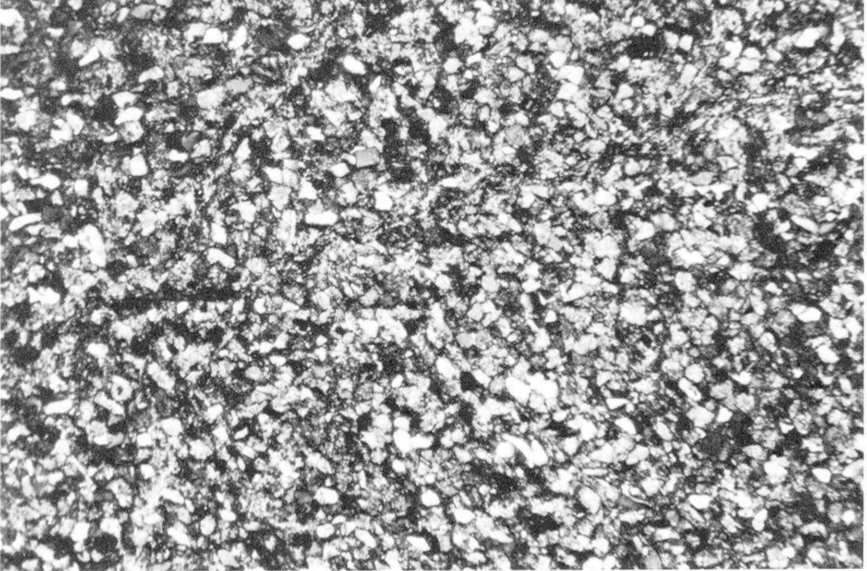


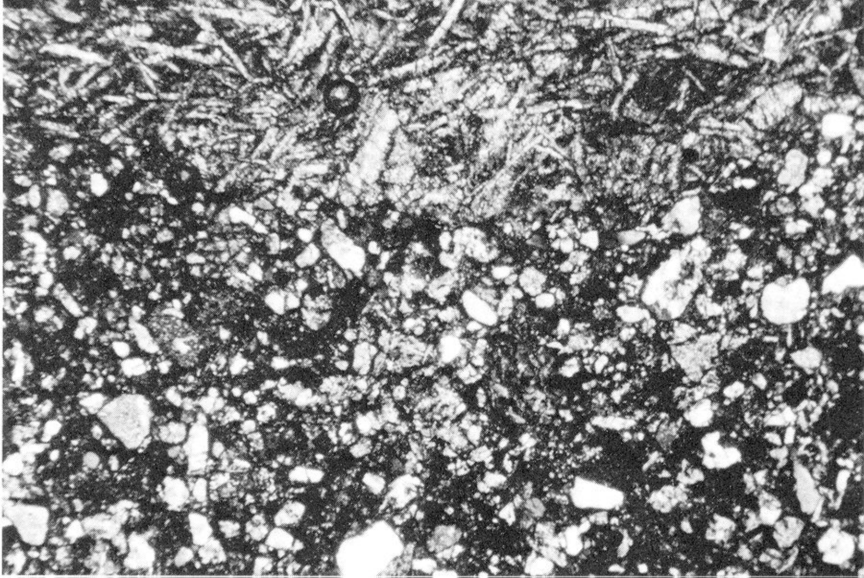


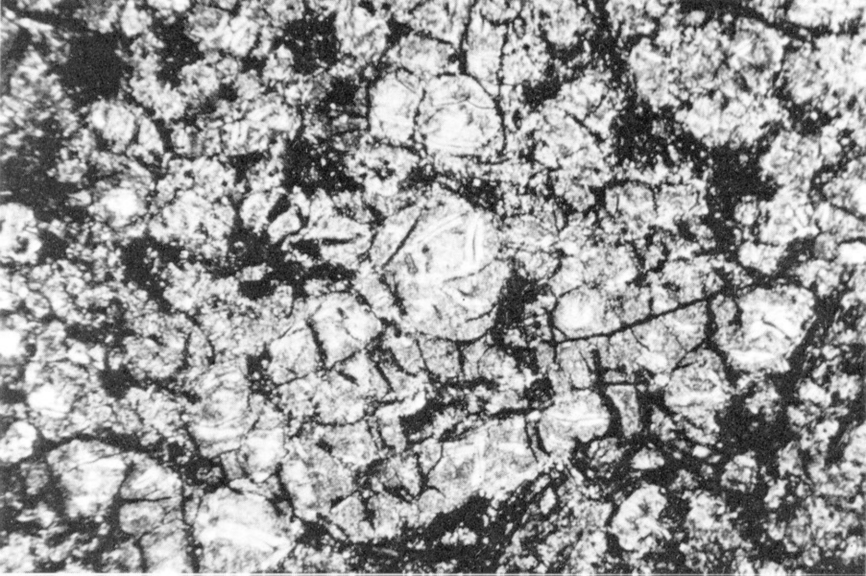












Ministry of Natural Resources
Ontario

Hon. James A. C. Auld
Minister

Dr. J. K. Reynolds
Deputy Minister

Ontario Geological Survey
Map 2414
Connaught and Churchill Townships

Scale, 1 inch to 50 miles
N.T.S. Reference 41 P/11

LEGEND

PHANEROZOIC

CENOZOIC[a]

QUATERNARY

PLEISTOCENE AND RECENT

Glacial drift, sand, silt, gravel, muskeg.

PRECAMBRIAN[b]

MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS
(Nipissing Diabase)

11
- 11a Diabase, medium-grained.
- 11b Quartz diabase.
- 11c Diabase with pink feldspar.
- 11d Diabase, granophyric.
- 11e Diabase, coarse-grained.
- 11f Granophyre.
- 11g Amphibole gabbro.
- 11h Diabase with large porphyritic feldspars.

INTRUSIVE CONTACT

HURONIAN

COBALT GROUP

GOWGANDA FORMATION

10
- 10a Conglomerate.
- 10b Greywacke.

CONTACT INDETERMINATE

QUIRKE LAKE GROUP

ESPANOLA FORMATION

9
- 9a Limestone.
- 9b Limestone, magnetite.

UNCONFORMITY

EARLY TO LATE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

8
- 8 Diabase.

INTRUSIVE CONTACT

EARLY PRECAMBRIAN

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

7
- 7a Biotite granodiorite.
- 7b Biotite quartz monzonite.
- 7c Biotite trondhjemite.
- 7d Hornblende porphyry.
- 7e Hornblende-feldspar porphyry.
- 7f Quartz diorite.
- 7g Feldspar porphyry.

INTRUSIVE CONTACT

METAMORPHOSED ULTRAMAFIC TO MAFIC ROCKS

6
- 6a Dunite, serpentinized.
- 6b Gabbro.
- 6c Green dolomite-calcite rock (green carbonate).

INTRUSIVE CONTACT

METAVOLCANICS AND METASEDIMENTS

METASEDIMENTS

5
- 5a Argillite.
- 5b Chert.
- 5c Siltstone.
- 5d Conglomerate.
- 5e Slate.

IF
- IF Iron Formation (black chert, magnetite, hematite, argillite).

ALKALIC METAVOLCANICS

INTERMEDIATE METAVOLCANICS

4
- 4 Unsubdivided.
- 4a Flows, aphanitic.
- 4b Flows, porphyritic in feldspar.
- 4c Flows, porphyritic in hornblende.
- 4d Flows, porphyritic in pyroxene.
- 4e Hawaiite.

SUBALKALIC METAVOLCANICS

FELSIC METAVOLCANICS

3
- 3 Flows, unsubdivided.
- 3a Flows, aphanitic.
- 3b Flows, porphyritic.
- 3c Tuff.
- 3d Lapilli-tuff.
- 3e Tuff-breccia.

INTERMEDIATE METAVOLCANICS

2
- 2 Andesite-dacite, unsubdivided.
- 2a Flows, aphanitic.
- 2b Flows, porphyritic.
- 2c Flows, pillowed.
- 2d Flows, amygdaloidal, vesicular.
- 2e Tuff.
- 2f Lapilli-tuff.
- 2g Tuff-breccia.
- 2h Breccia.
- 2j Spherultic.
- 2k Schist.
- 2m Mylonite.

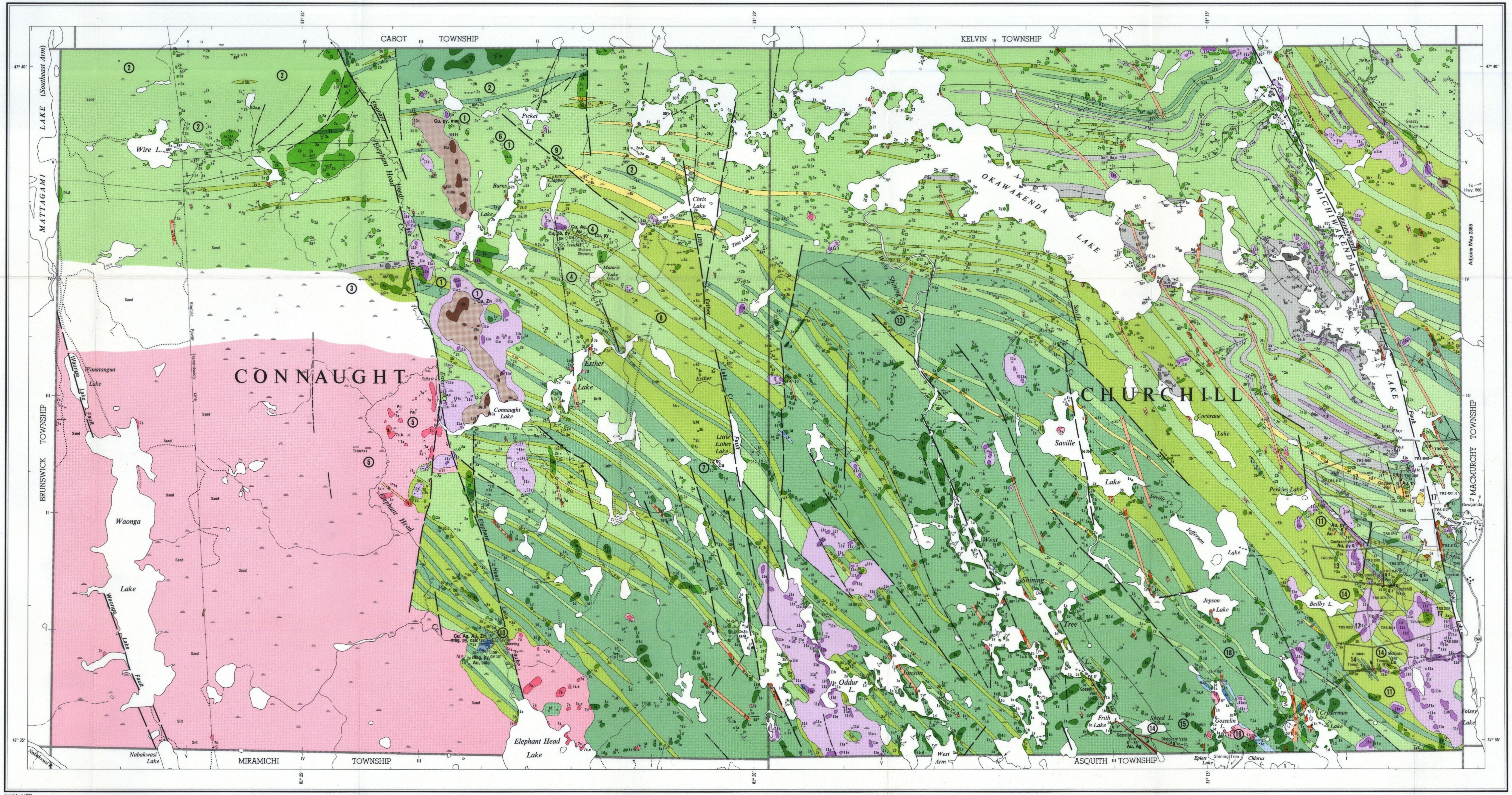
MAFIC METAVOLCANICS

1
- 1 Unsubdivided basaltic metavolcanics.
- 1a Fine-grained and aphanitic flows.
- 1b Pillowed flows.
- 1c Amygdaloidal flows.
- 1d Coarse-grained flows.
- 1e Lapilli-tuff.
- 1g Quartzose metabasalt.
- 1h Glomeroporphyritic flows.
- 1j Breccia.
- 1k Porphyritic flows.
- 1m Variolitic flows.
- 1n Chlorite schist.

Ag	Silver.
Au	Gold.
calc	Calcite.
Cu	Copper.
mag	Magnetite.
po	Pyrrhotite.
py	Pyrite.
q	Quartz.
qc	Quartz carbonate.
Zn	Zinc.

[a]Unconsolidated deposits. Cenozoic deposits are represented by the lighter and uncoloured parts of the map.

[b]Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown respectively in deep and light tones of the same colour.



Published 1978

SOURCES OF INFORMATION

Geology by M. W. Carter and assistants, Geological Branch, 1973.
Geology is not tied to surveyed lines.

Assessment work files, O.D.M. Resident Geologist's Office, Kirkland Lake.

Aeromagnetic map 285G ODM-GSC.
Aeromagnetic map 7076G Geological Survey of Canada.

Ministry of Natural Resources (O.D.M.), maps 29a, 43c., 2205.

Preliminary maps (O.D.M.) P.959, Connaught Township, and P.960, Churchill Township, issued 1974, scale 1 inch to ¼ mile, and P151.

Cartography by D. G. James and assistants, Surveys and Mapping Branch, 1978.

Base map derived from maps of Forest Resources Inventory, Surveys and Mapping Branch.

Magnetic declination in the area was approximately 8° West, 1966.

Ontario Geological Survey
Map 2414

CONNAUGHT AND CHURCHILL TOWNSHIPS

SUDBURY DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

Chains 80 60 40 20 0 1 2 Miles
Metres 1000 0 1 2 3 Kilometres
Feet 1000 0 5,000 10,000 Feet

PROPERTIES, MINERAL DEPOSITS

CONNAUGHT TOWNSHIP

1. *Active Mines Ltd.*
2. *Bagamac Mines Ltd. [1949].*
3. *Collins, R. and Y., Marino, L., McKinnon, D., & Todd, B. (prior to 1972).*
4. *Coniston Explorations and Holdings Ltd. (Mataris Prospect).*
5. *Duvay Gold Mines Ltd. [1950].*
6. *Foster, L. [1927].*
7. *Goldhurst Resources Incorporated.*
8. *Mid-North Engineering Services Ltd.*
9. *Murky Fault Metal Mines Ltd. [1967].*
10. *Royal Agassiz Mines Ltd. (Saville Occurrence) [1971].*

CHURCHILL TOWNSHIP

11. *Hames, C. M. (Cochrane Occurrence).*
12. *Jonsmith Mines Ltd. Occurrence [1971].*
13. *Jorgenson, W. D. (Gold Corona Occurrence).*
14. *McBride, W. (Gosselin Occurrence, McBride Occurrence).*
15. *McDiarmid, O.*
16. *Royal Mining Corporation [1971].*
17. *Triton Explorations Ltd. (Knox Prospect, Churchill Mining and Milling Co. Ltd. Prospect).*
18. *Wiermeir, A.*

Information current to December 31st, 1973.

Only former properties on ground now open for staking are shown where exploration information is available — a date in square brackets indicates last year of exploration activity. For further information see report.

SYMBOLS

- Glacial striae.
- Esker.
- Small bedrock outcrop.
- Area of bedrock outcrop.
- Bedding, top unknown; (inclined, vertical).
- Bedding, top indicated by arrow; (inclined, vertical, overturned).
- Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).
- Lava flow; top (arrow) from pillows shape and packing.
- Schistosity; (horizontal, inclined, vertical.)
- Foliation; (horizontal, inclined, vertical).
- Banding; (horizontal, inclined, vertical).
- Geological boundary, observed.
- Geological boundary, position interpreted.
- Geological boundary, deduced from geophysics.
- Fault; (observed, assumed), Spot indicates down throw side, arrows indicate horizontal movement.
- Lineament.
- Jointing; (horizontal, inclined, vertical).
- Drag folds with plunge.
- Anticline, syncline, with plunge.
- Drill hole; (vertical, inclined).
- Drill hole; (projected vertically, projected up dip). Overburden shown.
- Vein. Width in inches.
- Shaft; depth in feet.
- Swamp.
- Building.
- Motor road. Provincial highway number encircled where applicable.
- Other road.
- Trail, portage, winter road.
- Township boundary with milepost, approximate position only.
- Mining property, surveyed. Boundary approximate position only.
- Mineral deposit; mining property unsurveyed.
- Surveyed line, approximate position only.