ONTARIO DEPARTMENT OF MINES

AND NORTHERN AFFAIRS

Geological Report 99

Geology of the
Eby and Otto Area
District of Timiskaming

By

H. L. LOVELL

1972

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DEPARTMENT OF MINES
AND NORTHERN AFFAIRS

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Publications of the Ontario Department of Mines and Northern Affairs
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are obtainable through the
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Parliament Buildings, Queen's Park, Toronto, Ontario
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The Ontario Government Bookstore
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Parts of this publication may be quoted if credit is given to the Ontario Department of Mines and Northern Affairs. It is recommended that reference to this report be made in the following form:

Lovell, H.L.
1972: Geology of the Eby and Otto Area, District of Timiskaming; Ontario Dept. of Mines and Northern Affairs, GR99, 30p. Accompanied by Map 2239, scale 1 inch to ½ mile.

1,000–699–1971cc

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ABSTRACT

This report deals with an area extending to within three miles of the productive Kirkland Lake gold mines. Despite its favourable location and long history of exploration, no important production has been obtained from the map-area, most of which was first mapped in detail in connection with this report.

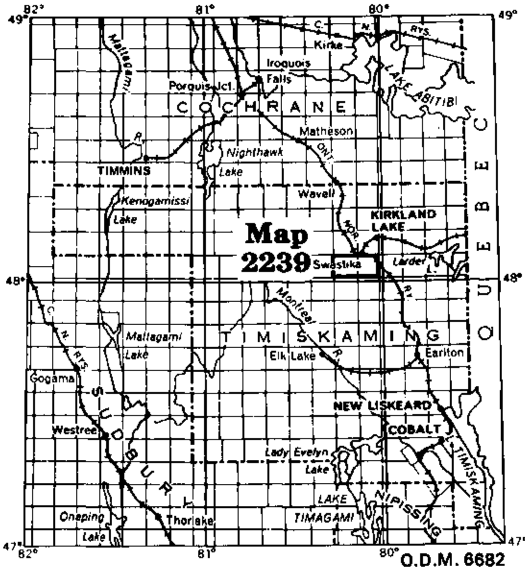

Figure 1—Key map showing location of Eby and Otto Townships and the northern part of Marquis Township. Scale, 1 inch to 50 miles.

The map-area forms part of the "Abitibi" belt of mafic to felsic metavolcanics and metasediments, including iron formation similar to the taconite iron ore at the nearby Adams Mine. The metavolcanics and metasediments are isoclinally folded around the felsic and mafic plutons in the map-area.

Among the felsic intrusive rocks are syenitic rocks similar to those containing the gold ore at Kirkland Lake. In addition, gold-bearing green and brown carbonate rocks similar to the gold-bearing carbonate ore at Kerr Addison Mines Limited, 20 miles farther east, form extensive (in places cross folded) belts in the map-area. These belts have been explored thoroughly only in some places along the Larder Lake Fault.

Parts of the pyrite-pyrrhotite facies of iron formation contain low percentages of copper and zinc, and traces of nickel near ultramafic intrusions.

The igneous stock of alkalic composition in Otto Township contains appreciable amounts of nepheline in several places along its northern contact, and is slightly radioactive in three localities. Ages of 1,730 ± 50 m.y, using Rb-Sr whole rock analyses (Purdy and York 1968), were determined recently for the Otto Stock. These ages are much younger than the Algoman age the stock was formerly thought to be.

Sand and gravel are abundant, particularly in the esker in Eby Township.

Geology of the

Eby and Otto Area

District of Timiskaming

By

H. L. Lovell[1]

INTRODUCTION

The northeastern part of the map-area is 3½ miles south of Kirkland Lake. Eby, Otto, and Marquis Townships are each 6 miles square, but, in Marquis Township, only a 1½-mile strip adjacent to the northern boundary was mapped. The part of Eby Township near the shore of Kenogami Lake, as well as the northern halves of lots 8, 9, 10, 11, and 12 of Otto Township, concession VI, were mapped in 1939 and 1944 by W.E. Gerrie and J.E. Thomson respectively, (Thomson 1948). The remainder of Eby Township was mapped by the author (Lovell) and assistants in 1967. The remainder of concession VI and all of concession V of Otto Township were mapped by K.D. Lawton and assistants in 1955. Their field notes were compiled by John Ramsden and Howard Lovell in 1965. Most of Otto Township, concession IV, was mapped by John Ramsden in 1965. The remainder of concession IV, the three southern concessions of Otto Township, and the northern part of Marquis Township were mapped by Howard Lovell and assistants during 1968.

The settlement of Kenogami Lake extends south from Grenfell Township into Eby Township, on the east shore of Kenogami Lake.

Tarzwell extends west from Pacaud Township into Marquis Township, on the east shore of Round Lake.

The map-area, much of which was settled for purposes of farming and logging, is traversed by Highways 11, 112, and 66, as well as concession, lot line, and logging roads, the Ontario Northland Railway, and electric power transmission and telephone lines. The map-area is also traversed by the natural gas pipeline of the Trans-Canada Pipe Lines Limited with branches to Swastika and the Adams Iron Mine of Jones and Laughlin Mining Company Limited, which is in Boston Township to the east of Otto Township. The map-area was first explored for silver by prospectors fanning out from Cobalt. Instead of silver, gold was discovered near the shore of Otto Lake in 1906 (five years before the discovery of gold three miles further northeast at Kirkland Lake). The discovery was named the "Swastika" Gold Mine, after the lucky charm worn by one of the white women in the area at the time of the discovery. During the gold rush periods at Kirkland Lake (after the First and Second World Wars and after the price of gold was raised in 1933), the northern parts of Eby and Otto Townships were fairly thoroughly prospected for gold, but no important producer in addition to the Swastika Mine was discovered.

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[1]Resident Geologist, Ontario Department of Mines and Northern Affairs, 4 Government Road East, Kirkland Lake. Accepted for publication by the Chief Geologist, 2 October 1969.

Exploration for base metals has been limited and haphazard, consisting mainly of drilling a hole or two to test a few of the anomalies turned up by airborne magnetic and electromagnetic surveys.

FIELD WORK

Base maps of the townships were prepared by the Cartography Section, Geological Branch, Ontario Department of Mines and Northern Affairs, from Forest Resources Inventory maps of the Ontario Department of Lands and Forests. These were provided at the scale of 1 inch to ¼ mile, as were photographs from the Department of Lands and Forests. Roads, trails, the shorelines of lakes, and rock outcrops shown on the air photographs were mapped. Many of the outcrops had been islands and reefs in Pleistocene glacial Lake Barlow-Ojibway, and are readily discernible on the air photographs against the background of soil of "The Little Clay Belt." Presumably, therefore, few outcrops escaped examination during the field mapping in connection with this report.

Two uncoloured preliminary geological maps of the map-area, P.448 (Lovell 1968) and P.501 (Lovell 1969b) at a scale of 1 inch to ¼ mile, were published by the Ontario Department of Mines.

ACKNOWLEDGMENTS

During the mapping of Eby Township in 1967, the writer was assisted by Brian Cutt, and for a few days by R.J. Rupert. Apart from minor alterations and additions by the writer, the geology on and near the shore of Kenogami Lake is an exact reduction to the present map-scale from Map 1946-1 (Thomson 1948).

During the mapping of the southern half of Otto Township and the northern part of Marquis Township in 1968, the writer was assisted by E.P. Giovanella, R.W. McBean, and for a few days at the end of the field season by D.W. Rutherford. Otto Township, concession IV, was mapped by John Ramsden in 1965, with alterations and additions by the writer and assistants in 1968. The geology of the northern halves of Otto Township concession VI, lots 8, 9, 10, 11, and 12 was taken from Map 1945-1 (Thomson 1948) and reduced to the present map-scale. The mapping of the remainder of Otto Township, concessions V and VI was done by K.D. Lawton and assistants in 1955, and their field maps and notes were compiled by John Ramsden and the writer in 1965.

K.D. Lawton's Ph.D. thesis (1954) was used extensively for the General Geology in this report.

In addition, the writer used mining company reports from the assessment files of the Resident Geologist's office of the Department of Mines and Northern Affairs, Kirkland Lake.

PREVIOUS GEOLOGICAL WORK

In 1902, L.L. Bolton (1903) worked at Round Lake and along the Blanche River. E.L. Bruce (1912) compiled the geology of the Swastika gold area, including the two northern concessions of Otto Township. In 1919, H.C. Cooke (1919) of the Geological Survey of Canada, mapped the Kenogami, Round, and Larder Lakes areas, including Eby Township, and reported on platinum finds in the western part of Otto Township. In 1913, A.G. Burrows and P.E. Hopkins (1914) mapped the Kirkland Lake and Swastika gold areas, including the northern part of Otto Township. In 1935, W.S. Dyer (1935) mapped Eby Township.

TOPOGRAPHY

The map-area is less than 8 miles south of the divide between the James Bay watershed and the St. Lawrence watershed. Except for a narrow strip, predominantly of bedrock, that extends across the northern part of Otto Township and the northeastern part of Eby Township, the outcrops in the map-area are mainly in the northern part of "The Little Clay Belt" plain. The overburden in Eby Township includes an esker-delta complex. Relief in most of the map-area is low, with a few exceptions such as the hill east of Otto Lake used by the Kirkland Lake ski club, and some hills of syenitic rock west of Round Lake.

NATURAL RESOURCES

Small stands of merchantable young spruce are on the clay lowlands, and jackpine are on the sandy esker and on thin soil covering bedrock.

Several moose, fox, beavers, and muskrats were seen during the field season.

Summer cottages are numerous along the sand beaches of Round and Kenogami Lakes. The Ojibway name "Kenogami" means "long lake", referring to its 5½-mile length striking northwest into Grenfell Township.

One-quarter to one-third of the map-area is currently or potentially good farmland. Apart from the swampy silt and clay lowlands, the farmland is now or has been cleared and farmed. If in the near future, the farms are not integrated into economically sized larger holdings suitable for raising beef or dairy cattle, they will probably revert to forested land, a trend that has already begun for the poorer farms. Whether destined to produce farm or forest products, draining the swamps would increase productivity appreciably.

INHABITANTS

About 350 people live in the map-area, most of them near Round and Kenogami Lakes. Most of the original settlers were Finnish and Swedish farmer-loggers. Many of their descendants have migrated to centres of employment outside the map-area.

GENERAL GEOLOGY

The map-area is in the "Abitibi" belt (Goodwin 1966) of Precambrian volcanic, sedimentary, and intrusive rocks that extend from southwest of Timmins, Ontario, to Chibougamau, Quebec. There are representatives in the map-area of every major division of rocks of the Precambrian stratigraphic column for the northern part of northeastern Ontario.

ARCHEAN

Metavolcanics

Keewatin-type metavolcanic rocks underlie about two-thirds of Eby Township and one-quarter of Otto Township. They range in composition from basalt to rhyolite, and in metamorphic grade from lower greenschist facies to almandine-amphibolite facies, the latter a contact metamorphic product near felsic intrusions. All types of metavolcanics are interlayered, each "bed" actually being lenticular in form, so single units are discontinuous along strike and down dip. Stratigraphic zones such as those of interbedded mafic and felsic tuffs and iron formation, however, can be followed for long distances along strike. The following description is from Cooke (1922, p.8):

The following section across the tuff band south of Otto lake illustrates the type of composition of the tuff bands; although on account of the lenticular nature of the bedding the section along this line is not identical with that which would be obtained along another line. The section is from north to south, reading down, and as the south side is stratigraphically the lower, the section, reading up, gives the order of deposition. The widths are approximate, determined by pacing, not measured with a tape.

Basalts

	Feet
Fine-grained, thin-bedded tuffs, somewhat impregnated with pyrite	6
Coarse tuffs, containing fragments up to 1 inch	70
Thin-bedded tuffs	22
Basalt	93
Coarse tuffs, basalt fragments up to several inches, with an occasional granite pebble	400
Mud rock, rather coarse-grained	30
Coarse, pebbly tuff, 20 feet, grading downward imperceptibly into fine, thin-bedded tuff, 80 feet	100
Iron formation, banded silica and magnetite	43
Basalt	30
Iron-formation, banded silica and magnetite	35
Thin-bedded tuffs	90
Thick-bedded, massive tuff, grain 1 mm. average	60
Finer-grained tuff, with basalt and granite pebbles	3
Thick-bedded tuff, grain averaging 1 mm.	156
Black slate and greywacke, impregnated with pyrite	40
Light grey, thin-bedded tuffs	40
Sandy tuff, impregnated with pyrite	57
Fine-grained blackish tuff, contains much biotite	6
Black slate, heavily pyritized	6

Table 1 | TABLE OF LITHOLOGIC UNITS

CENOZOIC

PLEISTOCENE AND RECENT

Silt, clay, sand, gravel

Unconformity

PRECAMBRIAN

PROTEROZOIC

LATE MAFIC INTRUSIVE ROCKS (NIPISSING OR KEWEENAWAN)

Diabase

Intrusive Contact

HURONIAN

COBALT GROUP

GOWGANDA FORMATION

Conglomerate, arkose, greywacke, argillite

Unconformity

ALKALIC INTRUSIVE ROCKS

Syenite, quartz syenite, porphyritic syenite, nepheline syenite, granite, aplite dikes, lamprophyre, diorite

Intrusive Contact

ARCHEAN

MAFIC INTRUSIVE ROCKS (MATACHEWAN OR NIPISSING)

Diabase

Intrusive Contact

FELSIC INTRUSIVE ROCKS (ALGOMAN)

Granite, porphyritic granite, granodiorite, granodioritic gneiss, syenite and trachyte

Intrusive Contact

EARLY MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS (HAILEYBURIAN, EARLY ALGOMAN, AND KEEWATIN)

Serpentinite, peridotite, gabbro, diorite

Intrusive Contact

METASEDIMENTS (TIMISKAMING AND KEEWATIN)

Conglomerate, quartzite, greywacke, tuff, agglomerate, breccia

Unconformity and Interbedding

FELSIC METAVOLCANICS (KEEWATIN)

Rhyolite, dacite, dacite porphyry, iron formation, silicic tuff, agglomerate

MAFIC METAVOLCANICS AND METASEDIMENTS

Basalt, andesite, andesite porphyry, dacite, chloritic mafic tuff, agglomerate, amphibolite, garnet-epidote amphibolite, amphibolite gneiss, biotite-garnet-pyroxene amphibolite

Grey, thin-bedded tuff	31
Coarse breccia, heavily pyritized in lower 135 feet	170
Light grey, thin-bedded tuffs	60
	1,578
Basalt flow, at least	330

To the south of the last basalt flow the edge of the syenite batholith occurs, so that there is no means of ascertaining definitely whether there were more tuffs or not. Some of the hybrid rock —formed at this place by interaction of the syenite and the older rocks—have a closer resemblance to hybrids elsewhere produced by interaction of syenite and tuff than those produced from syenite and basalt.

The well-bedded nature of the finer-grained tuffs indicates that they were deposited in a body of fairly deep water; and the lenticular nature of the bedding, together with the prevalent lack of crossbedding, suggests that the body of water was in gentle motion—a motion sufficiently great to cause erosion of the fine sandy and silty tuffs that were being laid down, and prevent them forming beds of uniform thickness over large horizontal distances, but not so great as to cause crossbedding, formation of short thick lenses, or obliteration of the bedding. The condition is such as to suggest gentle currents such as tidal currents or perhaps bottom currents in a large lake. The thickness of the tuff beds, nearly 1,500 feet, makes it difficult to conceive of their deposition in a lake, however, so that it seems necessary to assume that the basin in which they were laid down was marine.

Keewatin and Timiskaming-type metavolcanics and metasediments of the Kirkland Lake area range in age from 2,343 to 2,368 ± 48 million years using Rb-Sr whole rock analyses (Fairbairn *et al.* 1966).

MAFIC METAVOLCANICS

Contact metamorphosed mafic tuffs (plagioclase-garnet-epidote amphibolite and amphibolite gneiss) near the syenitic stock in Otto Township and the Round Lake Batholith underlie the other metavolcanics, and are the oldest rocks in the map-area. Most mafic metavolcanics other than the contact metamorphosed mafic tuffs are typical Keewatin-type rocks of the lower greenschist (plagioclase-chlorite) facies. They consist of tuff and agglomerate; pillowed and massive basalt and andesite; and porphyritic (white feldspar phenocrysts and fragments), amygdaloidal, and variolitic varieties.

The typical Keewatin-type mafic metavolcanics contain the following minerals: chlorite; secondary hornblende, actinolite, and tremolite; sericitized and saussuritized albite, oligoclase, and andesine; carbonate minerals; quartz; augite; biotite; magnetite and leucoxene; zircon. In this rock the chlorite and amphibole (mainly hornblende) constitute 35 to 55 percent, plagioclase 25 to 35 percent, quartz 0 to 20 percent, and epidote (and sericite and saussurite) 0 to 15 percent. In the metavolcanic rocks which are unaltered by younger intrusions and which are of the greenschist metamorphic facies, the amphibole is small euhedral tabular and prismatic green hornblende grains about 0.5 mm long. Intergrown with the hornblende are small rounded plagioclase grains an average of 0.1 mm in diameter. Little of the feldspar is twinned. In some places, fine-grained quartz is intergrown with the plagioclase. Also present in some of the metavolcanic rocks are augite, sericite, and carbonate. Pillow selvages consist of epidote, chlorite, carbonate, and, in some places, garnet.

Closer to the alkalic igneous stock in its metamorphic aureole, the typical Keewatin-type mafic metavolcanics are metamorphosed to amphibolite and amphibolite gneiss. In these rocks, the plagioclase and hornblende grains are larger, and small rounded grains of augite are more numerous, mainly in aggregates intergrown with and replacing the hornblende. With decreasing distance from the stock, the proportion of augite to hornblende is greater and the augite grains are larger. Within 500 feet of the contact of the stock, syenitic material has penetrated the mafic volcanic tuff, producing injection gneiss.

The injection gneiss is a *lit-par-lit* gneiss made up of pink and black bands. The mineralogical composition of the gneiss is as follows: microline and microline microperthite; albite; muscovite and sericite; epidote; carbonate; garnet; biotite; augite; apatite; magnetite; sphene. The following quotation is from Lawton (1954, p.138):

> The igneous portion of the gneiss is highly feldspathic, being composed almost entirely of microcline and a very small amount of albite. In gneiss having a high feldspar content, microcline is arranged in a mosaic of fresh lens-shaped grains. In some thin-sections a little peripheral granulation is apparent along some of the microcline grain-boundaries. At 50 to 100 feet or more from the contact, the feldspar content is lower and the microcline occurs as lens-shaped masses or in rather sinuous bands. Albite is not an abundant constituent of the injection gneiss, being virtually absent in some sections. Some microperthite is developed, but albitization of microcline is not nearly as extensive as it is in igneous phases of the stock. In addition, albite occurs in some sections as a very finely crystallized mosaic of fresh, untwinned grains around some of the large microcline crystals. It commonly displays this same habit in the interior of the stock. As well as replacing microcline, albite corrodes biotite and pyroxene. Thus, its habit is much the same as in the intrusive proper though developed on a much more restricted scale. As in the stock itself, it is believed to have been formed at a late or deuteric stage in the crystallization history of the stock. Masses of alteration product believed to represent original nepheline occur in some parts of the injection gneiss. The nepheline is discussed in the section on alkalic intrusive rocks.
>
> At distances of 50 feet or more from the contact, the proportion of mafic country rock material is higher and gneissic banding is strong. Petrographic study of samples from this section of the gneiss shows the mafic bands to be composed of fresh, coarse augite grains of subhedral outline. Fresh, brown, tabular grains of biotite also occur, together with garnet, apatite, magnetite and sphene. The garnet has a greenish brown to deep brown colour and an index of refraction considerably greater than 1.80, suggesting it to be andradite. As was stated above, no hornblende occurs in the injection gneiss, and the country-rock in close proximity to the stock apparently was composed largely of pyroxene at the time of injection of syenite magma into it. The pyroxene comprising the mafic bands is unstable in contact with the feldspathic layers as there is evidence of reaction between them along the junction. Fresh, brown laths of biotite replace the augite. They penetrate into the middle of the mafic bands, but also having a marked tendency to be crystallized in sinuous aggregates flanking the mafic bands, along their contact with the feldspathic layers. In some sections, garnet occurs with biotite, often as pseudomorphic aggregates after pyroxene. The biotite and garnet appear to be developed by reaction between the syenite and mafic bands. The injected syenitic material has mostly contributed potash, alumina and silica, and the pyroxene-lime, iron and magnesia. Near the contact with syenite, the highly feldspathic gneisses contain little or no pyroxene and original mafic bands are represented by parallel trains of biotite crystals and some garnet.
>
> Accessory minerals are fairly abundant in the injection gneiss, totalling up to 10 percent or more of the rock in some cases. Apatite is very coarsely crystallized and magnetite is abundant.

Amphibolite and amphibolite gneiss lie also between banded tuff and granodioritic gneiss of the Round Lake Batholith. Where exposed in the southeastern part of Eby Township, the contact between banded tuff and amphibolite gneiss is gradational and conformable. It is thought that the amphibolite gneiss is banded tuff that has undergone contact metamorphism caused by the Round Lake Batholith.

In Grenfell Township (Thomson 1948, Map 1946-1; Lovell 1968), about 0.4 mile north of the Kenogami Bridge over the Blanche River, an outcrop on the west side of Highway 11 contains a good exposure of the Archean-Proterozoic great angular unconformity. Beginning with the underlying formation at the northwestern part of the outcrop, near the ditch, the Archean stratigraphic column is: mafic metavolcanics and above these flow top breccia, glomeroporphyritic mafic metavolcanics (spotted lava), and pillowed mafic metavolcanics with tops to the southwest. These steeply dipping metavolcanics are overlain by Gowganda conglomerate dipping gently south.

FELSIC METAVOLCANICS

Felsic metavolcanics are interbedded with mafic metavolcanics and carbonate rocks, and are concentrated in a belt around the northern contact of the Otto Township alkalic igneous stock. The rocks underlying the felsic metavolcanics are mafic metavolcanics, but in many places along the intrusive contact the mafic metavolcanics were apparently obliterated by the igneous intrusion, leaving the felsic metavolcanics in contact with the stock.

The felsic metavolcanics range in composition from dacite to rhyolite. Dacite tuff and agglomerate predominate, and rhyodacite tuff and agglomerate comprise most of the remainder of the felsic metavolcanics. The dacite and rhyodacite are hard, fine-grained, greenish grey to pale greyish white rocks that weather to pale brownish green and pale brownish grey. The major mineral constituents are plagioclase, mica, carbonate minerals, and epidote. In Eby Township, concession III, lot 4, S½, from south to north across the two outcrops, the steeply dipping rhyodacite grades from predominantly tuff to rhyodacite tuff and agglomerate interbanded with magnetite, which constitutes the oxide (magnetite-chert) facies of iron formation. Interbedded with the magnetite-chert facies and the pyrite-pyrrhotite facies of iron formation are mafic tuff and green siliceous carbonate rock. The carbonate rock seems to constitute the local equivalent of the carbonate facies of Algoma-type iron formation as described by Gross (1965, p.90), Goodwin (1961), and Ridler (1969).

Also interbedded with the felsic metavolcanic rocks are carbonatized rocks (including the green carbonate rock mentioned above) that were probably originally carbonate sedimentary rocks (Brock 1907, p.207). They are approximately conformable in strike and dip to the strata with which they are interbedded. However, the carbonate rocks apparently underwent most of the shearing, fault displacements, and volume changes that took place during and since the folding of the Archean volcanic and sedimentary rocks. In addition, they have undergone regional metamorphism during and since Archean time. The original carbonate sedimentary rocks have, thereby, acquired many intrusive characteristics, so that during field mapping and mining operations they and adjacent formations have been regarded as "carbonatized rocks". Such carbonate rocks are good marker strata, for example the green and brown carbonate rocks that underlie the southeast bay of Kenogami Lake and outcrop in Eby Township, concession V, lot 5, west of the junction of Highway 66 with the logging road leading to the south shore of the bay. Other examples of carbonate marker strata are in Otto Township, interbedded with the volcanic rocks north of the contact of the Otto Township syenitic stock. The iron formation is part of a stratigraphic zone traceable from Eby Township across Otto Township to Boston Township, in which the Adams Iron Mine is situated. Conformably overlying the iron formation in Eby Township, concession III, lot 4, is "Highway 11 basalt" (Ridler 1969, p.36) of a younger volcanic cycle.

Metasediments

The Timiskaming-type metasediments consist of: conglomerate; quartzite and greywacke; tuff and agglomerate; trachyte, trachyte agglomerate, and breccia. In places these rocks are separated by an unconformity from the Keewatin-type metavolcanics, and elsewhere they are interbedded, and probably closely related.

The conglomerate, greywacke, and tuff were described as follows (Thomson 1948, p.8):

> The conglomerate everywhere contains rounded to ovoid boulders and pebbles. Sorting in the boulder conglomerate is fair to poor, but the thin bands of pebble conglomerate exhibit a fair degree of sorting. In certain areas there is a remarkably uniform alternation of clean-cut beds of well-sorted pebble conglomerate and greywacke. Pebbles and boulders of porphyries (acid to basic type), syenite, granite, felsite, rhyolite, trachyte, greenstone, diorite and gabbro, quartz, jasper, chert, and rhyolite are found in the conglomerate. Light-weathering types, such as porphyries, syenite, and rhyolite, predominate. Pink trachyte pebbles are abundant and closely resemble the typical trachytic volcanics of the map areas. Probably the most remarkable feature of the conglomerate is the consistent occurrence of red jasper pebbles both across and along the entire belt of Timiskaming sediments in the map areas. The jaspers scarcely ever constitute more than from 2 to 5 percent of the pebble content but are scarcely ever absent. The matrix of the conglomerate is usually a sandy greywacke or grit containing the same mineral assemblage as the normal greywacke.

Thomson continued (1948, p.9):

> Greywacke is typically a massive, grey-weathering, medium- to fine-grained rock. The massive variety generally contains a few thin beds of grit or pebble conglomerate. Hand specimens of the greywacke generally show angular grains of quartz, and microscopic examination indicates that these may constitute from 10 to 50 percent of the rock. The remainder is largely composed of feldspar fragments, chlorite, and carbonate material. Thinly bedded greywacke, showing gradation across the beds from coarser sandy grains at the base to fine-grained clayey material at the top, is found only on rare occasions. It occurs at a few points along the south contact of the sedimentary series.
>
> Where the conglomerate or greywacke has undergone intensive shearing it has been changed to a glossy, cream-coloured schist owing to the development of sericite and carbonate material.

Thomson further said (1948, p.9):

> Surface exposures of typical tuff show a pinkish or reddish colour owing to the abundance of grains, crystals, and fragments of pink feldspar or pink trachyte in the rock. Much of it is bedded, and crude cross-bedding is often seen; but cross-bedding sufficiently developed to indicate the tops of beds is rarely found. Fragments of pink trachyte are almost invariably present. In certain places these trachytic inclusions are as large as pebbles or boulders and are as well rounded as the boulders in an ordinary conglomerate. This variety has been named tuffaceous conglomerate by A. MacLean and Wm. Gerrie. The bedding, sorting, and rounding of fragments provide evidence that the tuff and tuffaceous conglomerate are water-laid deposits.

The following description is from Cooke (1922, p.10-11):

> The conglomerate was studied closely in a railway-cut about a quarter mile south of Kenogami station, where it overlies the Keewatin trachyte already described. It is crowded with pebbles, particularly near the base, where they form 75 to 80 percent of the total mass. The pebbles vary in diameter, up to a foot, but the majority are from 1 to 4 inches. They are mostly well rounded and worn. About half of them are longer in one direction than the other, presumably on account of their original bedded structure, and the long axes commonly lie parallel to the plane of bedding of the conglomerate. All the pebbles are massive, so far as observed, except some composed of the underlying trachyte, which are slightly schistose. Approximately 50 percent of the pebbles are of the light-coloured cherty tuff which accompanies the Keewatin lava flows in many places; some of them may be rhyolite. Basalts and gabbros make up 35 to 40 percent, the gabbro probably from the coarser-grained parts of basalt flows. The remaining 10 to 15 percent consist of red jasper, banded chert, porphyry, and the underlying trachyte, with here and there one of reddish granite and syenite. In the upper parts of this bed, which is 400 feet thick, there is slightly greater variety among the pebbles. Quite a number are to be found of a quartz porphyry common among Keewatin rocks, and greyish granite pebbles are also fairly common. The matrix of the conglomerate is a rather coarse grit, composed of the smaller fragments of the rocks that supplied the pebbles.
>
> The conglomerate is massive and unsheared. It has, however, been jointed a good deal, and faulted slightly in a number of places. It is overlain by a bed, at least 125 feet thick, of massive greywacke containing an occasional pebble.

Cooke (1922, p.5) further described a rock in the area:

> An unusual rock occurs in a railway-cut about a quarter mile south of Kenogami station. It is a porphyritic rock of a purplish-brown tinge, containing numerous phenocrysts of reddish feldspar and hornblende embedded in a fine-grained matrix. The hornblende phenocrysts are all small, rarely exceeding ½ mm in diameter; but the feldspar phenocrysts may attain lengths of 3 or 4 mm. The rock, which may be termed trachyte, has a brecciated structure like that of a flow breccia, and under the microscope is seen to be full of spherulites. It is, therefore, a lava, but as all the specimens obtained proved to be so highly altered that the original minerals were indeterminable, its composition was not more exactly determined. The trachyte is placed in the Keewatin because it underlies the Timiskaming conglomerate, and rounded, slightly schistose pebbles of it are numerous in the conglomerate close to the base.

Early Mafic and Ultramafic Intrusive Rocks

Massive medium- to coarse-grained mafic and ultramafic rocks in the map-area consist of intrusive stocks, dikes, and sills. Some coarse-grained central parts of flows were probably placed in this map-unit because of inability to distinguish between the two very similar types of rock. Distinguishing the Haileyburian-type mafic and ultramafic intrusive rocks from the Keewatin-type volcanic rocks seems to be mainly an effort to distinguish intrusive rocks from extrusive rocks that are genetically related and mineralogically similar.

The largest area of Haileyburian-type rocks is a diorite stock in the northeastern part of Eby Township and the adjacent part of Otto Township. The diorite is medium to coarse grained and porphyritic, with hornblende prisms with a maximum diameter of ½ inch. Other minerals present are plagioclase, and, in places, quartz 'eyes'. The texture is ophitic. The various types of diorite grade into each other in some places, and, elsewhere, small dikes of one type of diorite cut another type of diorite.

Felsic Intrusive Rocks

All felsic intrusive rocks of Archean age are presumed to be genetically related to the Round Lake granitic batholith. The northern contact of the Round Lake granitic batholith strikes east from the southern part of Eby Township through Otto Township along the southern shore of Round Lake, from which the name of the batholith is derived.

The two main phases of the Round Lake Batholith are: older grey-black quartz diorite to oligoclase granite, and younger, pink, hornblende granite.

The older phase is represented by the rock-cut in Marquis Township on the west side of Highway 11, about 500 feet south of the bridge across Crooked Creek near its junction with the Blanche River. The quartz diorite and oligoclase granite contains quartz, plagiociase, hornblende, biotite, and epidote. The quartz is present as coarsely crystallized aggregates of interlocking grains, with very little admixture of other minerals. The grains of plagioclase are deeply embayed and corroded by quartz. About 3.5 percent of the rock is biotite, and other mafic minerals (hornblende, chlorite, and epidote) constitute 2 to 4 percent of the rock.

The hornblende granite facies contains tabular plagioclase and hornblende, with irregularly shaped grains of quartz and microcline filling the interstices. Some large poikilitic grains of microcline occupy interstices beween earlier crystallized plagioclase, hornblende, and quartz. Sphene is concentrated along grain boundaries of the major mineral constituents.

Sills, dikes, and flows of syenite, trachyte, and mafic syenite in the two northern concessions of Eby and Otto Townships are listed in the map legend (see Map 2239, back pocket) along with felsic intrusive rocks of the Round Lake Batholith. The syenitic rocks, however, are similar to the syenitic rocks of the Otto Stock described below, and might be genetically related.

In the southeastern part of Eby Township, the northeastern part of Blain Township, and along the southern boundary of Otto Township, the contact phase of the Round Lake Batholith is a grey to pink granodioritic gneiss. In particular in the southeastern part of Eby Township and the northeastern part of Blain Township, the gneissosity is uniform and parallel to the bedding in the nearby tuffs.

A tongue of granite extends northwestward from the mid-southern part of Eby Township. The granite is pink and slightly porphyritic, and, where exposed, its contact phase is different from the typically gneissic contact phase of the Round Lake Batholith. The contact phase of this granitic body is well exposed in Eby Township, concession 1, lot 11. It is a good example of an intrusive contact with no chilled margin because, presumably, the intrusive and host rocks were at similar temperatures. The intrusive breccia typical of this contact consists of a granitic matrix in which there are angular to subrounded fragments of mafic rock. The angular mafic rock fragments resemble the mafic tuff and probably are inclusions of local country rock. The subrounded mafic rock fragments are coarser grained and might represent more highly digested mafic country rock, possibly transported from a hotter area of the intrusion. Diorite also is present, truncating the tuff abruptly along a sharp crosscutting contact. The diorite is cut by the granitic rock.

Ages determined for rocks of the Round Lake Batholith a short distance southeast of the map-area are: 2,390 m.y. using Rb-Sr whole rock analyses (Purdy and York 1968); 2,530 m.y. using Rb-Sr whole rock analyses (Fairbairn 1966); 2,605 m.y. using K-Ar biotite (Lowdon *et al.* 1963); 2,570 m.y. and 2,550 m.y. using K-Ar biotite and Rb-Sr biotite analyses respectively (Aldrich and Wetherill 1960). These ages are within the range obtained for "Algoman" intrusive rocks of the Kirkland Lake area.

Mafic Intrusive Rocks

East from the type-area at Matachewan, "Matachewan" diabase dikes are progressively less numerous. Thus a few "Matachewan" diabase dikes are in Eby Township, but very few were found in Otto Township. The "Matachewan" diabase here as elsewhere forms north-trending dikes filling faults parallel to the Mattagami River Fault System (Kirwan 1969). The Matachewan diabase has dark grey or rusty brown weathered surfaces and greyish black fresh surfaces. The diabase is gabbro with diabasic texture in which pyroxene occupies interstices between lath-shaped grains of white feldspar.

PROTEROZOIC

Alkalic Intrusive Rocks

A series of four alkalic stocks occur in a line trending east from Matachewan to Larder Lake. The stocks are centred in Cairo, Otto, Teck, Lebel, and McElroy Townships. The Otto Stock, which occupies most of Otto Township and parts of Eby and Marquis Townships, is described in detail by Lawton (1954, p.81-157). The Otto Stock is about 6 miles in diameter, and ranges in composition from quartz syenite and syenite to nepheline syenite. In addition, the stock contains many black and green inclusions of Archean volcanic and sedimentary rocks.

The quartz syenite, syenite, granite, and related types make up the bulk of the stock. The rocks are pink coarse-grained syenite and porphyritic syenite with a high proportion of phenocrysts with an average length of ¾ inch. On weathered surfaces, feldspar grains stand out as tabular crystals, and quartz, where present, stands out as irregularly shaped grains. Weathering has bleached the reddish pink feldspar to a pale pink, to a maximum depth of ½ inch. Small dark pyroxenes are sparsely disseminated through the syenitic rocks, as well as spindle-shaped to rounded inclusions of country rocks metamorphosed to biotite, amphibole, and pyroxene. The inclusions are an average of 1 to 2 inches long, but some are much larger.

The syenitic rocks are composed of tabular grains of euhedral to subhedral feldspar (80 to 90 percent), and other minerals interstitial to the feldspar. Most of the feldspar is microperthite, and the other minerals are: quartz, in irregular masses corroding the feldspar grains; pyroxene; amphibole; and minor amounts of the accessories apatite, sphene, zircon, and magnetite. The microperthite is made up of albite and slightly lesser amounts of microcline. The albite ranges in composition from Ab_{91} An_9 to Ab_{97} An_3. Both the microline and the albite are unaltered. The pyroxene, a pale green tabular aegirine-augite, forms 3 to 14 percent of the syenitic rocks, and some of the pyroxene grains are poikilitic, having inclusions of microcline. The pyroxene has undergone some replacement by acicular to prismatic pale green hornblende, which forms less than 3 percent of the syenitic rocks. Apatite and sphene form about ½ percent of the syenitic rocks, and zircon and magnetite are rare.

The Otto Stock is surrounded by a contact metamorphic aureole, about ¼ mile in width, that is most highly developed along the northern contact of the stock. Here, the outer parts of the aureole have undergone recrystallization and development of new mineral assemblages, and the inner parts have been transformed into *lit-par-lit* injection gneiss. Nepheline occurs in some of the injection gneiss and in some syenite sills in Archean rocks. The nepheline syenite is described in this report in the section on industrial minerals. Radioactive minerals, including allanite, are present in a pegmatite dike cutting altered country rock in the Highway 11 rock-cut through the northern contact of the Otto Stock.

In contrast to the northern contact of the Otto Stock, wall-rocks along the southern contact are not highly metamorphosed or injected by syenite, but xenoliths are numerous. Rounded inclusions are present particularly near contacts and roof pendants, but also distributed throughout most of the Otto Stock. The inclusions are of two types: greenish black recrystallized fragments, some with "core and mantle" structure; and xenoliths of schist or banded tuff, with feldspathized interbands. Both the core and the mantle of the "core and mantle" structure are unaltered. The core consists of a matted intergrowth of long prismatic crystals and fibrous aggregates of pale greenish grey tremolite, and the mantle or reaction rim consists of brownish black felted biotite. According to Lawton (1954, p.157):

> The mantle of brown biotite is regarded as a reaction rim. The presence of this feature shows that inclusions exhibiting it, have had an origin outside the rock enclosing them. The tremolitic cores are plainly derived from something else, probably basic flow rocks. Potash, alumina and perhaps silica were contributed by the melt, with lime and magnesia derived from the inclusion. The freshness of the biotite rim, the absence of secondary chlorite and the complete freshness of the hornblende core, lead to the conclusion that the alteration took place during consolidation of the syenite.

"Pebble-bearing dikes" (Lawton 1954, p.157) are present in Otto Township concession II, lot 4, S½, SE¼ on the north shore of Round Lake; in concession I, lot 8, N½, SE¼; in Marquis Township, in the large peninsula in the southwestern part of Round Lake; in the rock-cut on Highway 11, 3,500 feet north of the bridge across Crooked Creek. The "pebble-bearing dikes" are short, irregular, fracture fillings, a maximum of 50 feet in width. They cut syenite and country rocks and are composed of rounded to subangular inclusions of country rocks in a matrix of syenite and syenitized rocks. The inclusions consist largely of a core of fresh prismatic and fibrous tremolite crystals enveloped in a mantle of biotite.

More pervasive contamination of the syenite by inclusions of country rocks might explain the origin of the lamprophyre dikes associated with the Otto Stock. Good exposures of the lamprophyre dikes, as well as mafic syenite dikes, are in the road-cuts on Highway 112 near Dane. The lamprophyre dikes are dark grey, and about 2 feet in average width. Mineral constituents are biotite, augite, hornblende, tremolite, albite, microcline, calcite, apatite, magnetite, and sphene. A slightly lesser degree of contamination of syenite with country rocks might explain the origin of the diorite in the western part of the Otto Stock. This type of diorite, much of it intermingled with syenite, occurs in Eby Township, concession II, lot 1, and concession III, lots 1 and 2.

A gradation exists between all rocks of the Otto Stock; from relatively slightly digested xenoliths in syenite, through the above type of diorite, and ultimately to mafic syenite, nepheline syenite, and lamprophyre. Some aspects of the gradation are shown in the large inclusion or roof pendant centred in Otto Township, concession II, lot 10. In parts of this inclusion farthest from its contact, the rock is massive fine- to medium-grained greyish black diorite or andesite. Its mineral constituents are: andesine (AB_{60} to $_{65}$) 3 to 20 percent; hornblende 30 to 40 percent; augite 25 to 30 percent; biotite 10 to 30 percent; and accessories, magnetite and apatite. Closer to the contact, the hornblende is recrystallized to euhedral porphyroblasts. Closer still, the rock is feldspathized, and hornblende is almost absent. The mineral constituents here are: biotite 40 percent; albite 30 percent; and augite 25 percent. The appearance of this rock is similar to a breccia, owing to intimate penetration by veinlets of albite with minor amounts of microcline.

Until recently, the youngest felsic intrusive rocks in the Kirkland Lake area were thought to be Algoman in age, such as the Round Lake granitic batholith (2,390±80 m.y., Rb-Sr whole rock analyses, Purdy and York 1968). The Otto Stock was thought to be an offshoot of the Round Lake Batholith, which extends into the southern part of the map-area. However the petrology of the Otto Stock is markedly different from that of the Round Lake Batholith, and the Otto Stock is much younger (1,730±50 m.y., Rb-Sr whole rock analyses, Purdy and York 1968).

Huronian

COBALT GROUP

Gently dipping sedimentary rocks of the Cobalt Group are present in the northern part of Eby Township. These rocks are of the type of lower Gowganda Formation referred to as "Coleman Formation" by R. Thomson (1957). They are gently dipping, poorly sorted, poorly bedded, immature sediments consisting mainly of arkose and conglomerate. Excellent exposures of Coleman (Gowganda) conglomerate exist along Highway 11 at Kenogami Lake, short distances north and south of the bridge over the Blanche River. South of the bridge, evidence of sorting of finer grained clastic sediments (arkose and greywacke) by water exists at the northern and southern ends of the rock exposures in the road-cuts. In the middle and major portion of the rock in the road-cuts, there is conglomerate containing a heterogeneous assemblage of pebbles, cobbles, and boulders of numerous rock types and of great variety in shape, size, and roundness. The immaturity, heterogeneity of source rocks, and low degree of sorting by water, of chemical weathering, and of rounding of clasts during transportation indicate transportation by a very competent medium in an environment mainly of physical weathering with sorting of the finer grained sediments at the site of deposition. These sedimentary rocks seem, therefore, to represent a terminal moraine reworked to some extent by a proglacial body of water.

The sharp angular erosional unconformity between these and Archean rocks is described in the section on mafic volcanic rocks. The Gowganda conglomerate on Highway 11 south of the Kenogami bridge contains boulders from source rocks of similar appearance to phases of the nearby Otto syenitic stock. If the boulders are from the Otto Stock, the age of the Gowganda conglomerate is less than $1,730 \pm 50$ m.y., the age of the Otto Stock (Purdy and York 1968).

Late Mafic Intrusive Rocks

Several northeast-trending diabase dikes are in the map-area. The northeast-trending dike in Grenfell Township, 4,000 feet northeast along the road that branches from Highway 11 south of the Kenogami bridge, seems to cut the Cobalt sedimentary rocks. The northeast-striking diabase dikes in Eby Township near the south shore of Kenogami Lake might also be Proterozoic, but do not intrude Cobalt sedimentary rocks and so their age is not known. These dikes might be Nipissing in age, but more probably are of the "Abitibi" type (Fahrig *et al.* 1965) or the "Porcupine-Mattagami" group (Archbold 1965, p.9). The diabase consists of both olivine- and quartz-bearing gabbro. In most of the gabbro, the texture is diabasic. The age for the Abitibi dikes is 1,230 m.y. as determined by biotite K-Ar analyses, (Fahrig 1964, p.935).

CENOZOIC

Pleistocene and Recent

Most of the map-area is covered by silt and clay of the northern reaches of "The Little Clay Belt" which was deposited in the Pleistocene glacial Lake Barlow. Some of this land is being farmed, but much is not cleared or drained.

Sand and gravel occurs in an esker-delta complex in the eastern part of Eby Township, and in drumlins. The esker-delta complex is part of the Butler Lake Esker, which trends south from north of the Bourkes area (Lovell 1969, p.15). The south-western flank of a broad delta centred in Eby Township, concession II, lot 4 was reworked by the waters of glacial Lake Barlow to form terraced ancient beaches. Drumlins are most prominent in "The Little Clay Belt" south of Kenogami Lake.

Glacial striae indicate that the ice came from the northwest and moved approximately S20E.

STRUCTURAL GEOLOGY

FOLDS

The Archean metavolcanics and metasediments are folded steeply, with attitudes conforming roughly to the nearest contacts of the Round Lake Batholith and the Otto Stock. Thus, synclines and anticlines extend *en echelon* from the south-eastern part of Eby Township, between the Round Lake Batholith and the Otto Stock, to the northwestern part of Eby Township. Formations in the northeastern part of Eby Township and the northern part of Otto Township strike generally east, conforming to the contact of the Otto Stock. The folds in the northern part of Eby Township and along the contact of the Round Lake Batholith probably result from regional deformation during Archean time. The crudely circular pattern of folds around the Otto Stock results from distortion of the original Archean fold pattern by the intrusion of the stock.

The Otto Stock is the most prominent structural feature in the map-area. It is an almost circular intrusion about 6 miles in diameter, with a contact metamorphic aureole (garnet-epidote-amphibolite grade of metamorphism as contrasted to the chlorite-albite grade of regional metamorphism) a maximum of ½ mile wide. Miarolitic cavities occur in the syenite, and some of the biotite-pyroxene-garnet amphibolite in the stock are considered to be roof pendants of highly metamorphosed country rock. For the above reasons, the writer considers the stock to be mesozonal to epizonal intrusion injected into Archean metavolcanics and metasediments.

As elsewhere in the Kirkland Lake area, most of the shearing and schistosity in the map-area is parallel to the bedding, and probably results from shearing stresses set up during isoclinal folding.

FAULTS

A prominent north-striking fault offsets the western half of the Otto Stock about 1½ miles south, relative to the east half. This fault transects regional northwest-striking faults and lineaments of the Lake Timiskaming Rift Valley (Lovell and Caine 1970) several of which cross the map-area. Centred on one northwest-striking fault, about 2 miles north of Round Lake, is a circular depression 3,500 feet in diameter (Photo 1). The feature is inside the Otto Stock, and the outcrops both inside and outside the depression are medium-grained syenite, coarse-grained syenite, and lamprophyre. Possibly the depression marks the location of a younger related stock, or the junction of several joints and faults.

The Larder Lake Fault has been thought to extend through the northern part of Eby Township (Thomson 1948, p.28), and some drilling for gold has been done to intersect parts of its presumed extension.

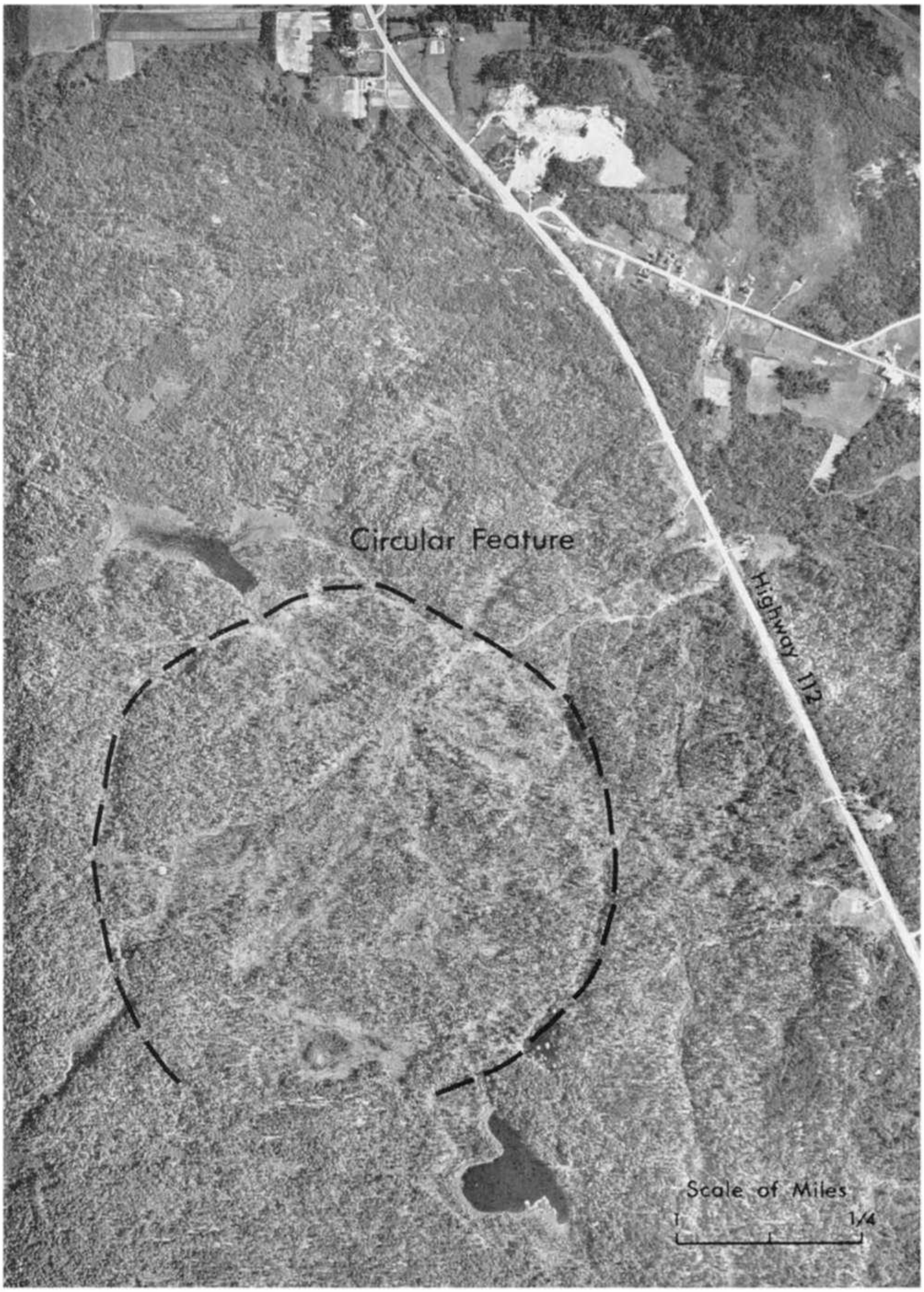
ECONOMIC GEOLOGY

One of the two earliest gold discoveries in the Kirkland Lake-Larder Lake area, both of which were in 1906, was on the northwest shore of Otto Lake. The discovery on Otto Lake became the Swastika Mine (now owned by Gateford Mines Limited), which produced some gold and silver. The only other metallic mineral production recorded for the map-area is a small amount of gold and silver from the mine of Baldwin Consolidated Mines Limited. In addition, platinum was reported in the map-area. (Cooke 1922, p.14).

Sand and gravel deposits have been worked, mainly as a source of road-fill.

RECOMMENDATIONS TO PROSPECTORS

Three facies of iron formation are present in the map-area: magnetite-chert, graphite-pyrite-pyrrhotite, and carbonate. In many places the "iron formation" is very low grade (less than 15 percent iron). As a stratigraphic zone, however, it is apparently continuous across the length of the map-area except where truncated by the Round Lake Batholith in the southwestern part of Eby Township. The iron formation extends across a considerable breadth of the map-area as well, as a result of repetition by folding. Thus, iron formation extends east from Eby Township, concession 111, lot 6 all along the northern contact of the Otto Stock, and also extends east from west of the southeast bay of Kenogami Lake to Vigrass and Otto Lakes, with limbs both north and south of the large diorite stock. The gold-bearing green and brown carbonate rocks are not confined to the area of the "Larder Lake Fault" as heretofore suspected, but rather constitute the carbonate facies of the widespread iron formation. Most of the exploration for gold has been concentrated in syenite, trachyte, and carbonate rocks along the Larder Lake Fault, so most of the carbonate rocks have not been thoroughly explored. Where covered by overburden, large areas of carbonate rocks can be detected because they form gaps in the series of magnetic and electromagnetic anomalies that outline the iron formation.



ODM8578

Photo 1—Airphotograph showing circular feature in the Otto Township Alkalic igneous stock, scale, 1 inch to ¼ mile.

Parts of the graphite-pyrite-pyrrhotite facies of iron formation contain low percentages of copper, zinc, and minor amounts of nickel. Because much of this facies of iron formation is magnetically and electromagnetically anomalous, and the total percentages of sulphides in the base metal zones are lower than in the barren zones, drilling based on geophysical work has proved disappointing. Surface prospecting, soil and bedrock geochemistry, and greater use of geology during interpretation of geophysical work should provide more rewarding drill targets.

In three areas near its northern contact, the Otto Stock contains nepheline. One area is in Otto Township, concession V lot 10, S½ and lot 11, S½. The second area, in Otto Township concession V, lot 8, S½, was described by Cooke (1922, p.12) as follows:

> The basic parts of the syenite, whatever their origin, are strung out into gneissic bands several feet in width, and these bands are highly impregnated with nepheline. The nepheline content varies between 30 to 40 percent, the remainder consisting of albite with about 25 percent of ferromagnesian minerals, which include brown biotite, aegirine, and, in some thin sections, aegirine-augite, with accessory magnetite, apatite, and titanite. Anatase and rutile were also identified in some of the sections.

The third area, ½ mile north of the community of Dane in Otto Township, concession V, lots 1, 2, and 3 consists of occurrences of nepheline in a northwest-trending band of syenite almost 1 mile long and 800 feet wide.

DESCRIPTION OF PROPERTIES

Gold and Silver

EBY TOWNSHIP

Baldwin Consolidated Mines Limited (1)

In Eby Township, concession VI, lot 1, N½, NW¼, lot 2, N½, and lot 3, N½, NW¼, NE¼, and SE¼, Baldwin Consolidated Mines Limited, which was formed in 1946, explored gold mining possibilities on property acquired from Baldwin Kirkland Gold Mines Limited, Lucky Kirkland Gold Mines Limited, Kelmac Mines Limited, and Sylvanite Gold Mines Limited. As well as in Eby Township, Baldwin Consolidated Mines Limited holds ground in parts of Grenfell Township, which is north of Eby Township, and Teck Township, which is east of Grenfell and north of Otto Townships. However most of the work was done in Eby Township.

The property, which took its name from the prospector who first discovered gold on it, has been active at various times since 1911. Underground work was first done in 1917 to 1918, when a two-compartment shaft was sunk to 200 feet. In 1934, Lucky Kirkland Gold Mines Limited dewatered the shaft. On the Rosa Brown claim (L17990, Eby Township, concession VI, lot 1, N½, NW¼) eight shallow holes (a total of 1,897 feet) were drilled during or before 1945 to investigate the main zone, but gave no assays of sufficient value to be of interest (G.L. Holbrooke 1945).

The following description of the property is by J.E. Thomson (1948, p.36 and 37).

Development by previous owners consisted of surface-trenching, some 12,000 feet of surface and underground drilling, and underground exploration from a shaft located on the north half of lot 2, concession VI, Eby Township. The 2-compartment shaft was sunk 420 feet, and four levels were opened at 100-feet intervals. Some 4,000 feet of drifting and crosscutting was done, mostly on the 200- and 300-foot levels. This work covered a 500-foot length of the lava-sediments contact zone. Crosscuts were driven 340 feet north on the 2nd level and 350 feet south on the 3rd level. An ore shoot, 60 feet in length, was located on the 3rd level and stoped to a height of 45 feet. A 20-foot length of ore on the 2nd level is considered to be the upward extension of the ore shoot on the 3rd level.

The earlier developments on the property have been described by Burrows and Hopkins [1923, p.52] and Dyer [1935, p.52-53].

After acquiring the property in 1946, Baldwin Consolidated Mines dewatered and sampled the old workings; the surface and underground geology were mapped in detail, and a series of short underground holes, totalling 1,300 feet, were drilled. A considerable part of the information given below was obtained from a report by G.L. Holdbrooke [1945], consulting geologist of the company, July, 1947.

General Geology

The surface geology of the property is indicated on map No. 1946-1. Sediments of the Timiskaming series cover most of the northern part of the claims, and Keewatin volcanics and intrusive diorite lie to the south. The sediments consist mainly of interbedded conglomerate and greywacke; a band of red arkose forms a prominent marker horizon in this series. The Keewatin volcanics are andesitic in composition and locally show poorly developed pillows. Bodies of syenite, basic syenite, and syenite porphyry are found along the lava-sediments contact zone. Underground these bodies show local alteration.

Structure

In the vicinity of the mine workings the Keewatin-Timiskaming contact has been folded to an overturned position. The Larder Lake fault may follow this contact . . ., but, . . ., this structure leaves the contact east of the shaft and continues along the railway cut. If this is so, the contact as found in the mine workings and westward would represent an unconformity. On the surface the lava-sediments contact is not well exposed near the shaft or to the west, but it is seen in the mine workings. Here the contact shows a medium amount of carbonatization, but the alteration is erratically distributed. . . . a sheared zone angles across the contact, but away from this disturbance at the west end of the mine the contact is tight and unfaulted.

The north crosscut on the 2nd level would not quite reach the assumed location of the Larder Lake fault. . . . A few hundred feet farther north a strong fault zone underlies the Blanche river. This has been investigated by one short drill-hole and shows strong shearing, carbonatization, silicification, and mineralization; several low gold values were reported. The work of the company geologists suggest that the Larder Lake fault may underlie the Blanche river rather than follow the zone of shearing along the railway cut. Additional development work will be necessary before it can be definitely stated which of these is the main fault zone.

Different sets of sheared zones and faults cut across the rock formations on surface and underground. Certain sheared zones strike about N.65°E. and dip very steeply south. In places, these contain zones of barren quartz-carbonate stringers but are probably pre-ore structures. Two sets of late post-vein faults are shown on the mine plans. One set strikes N.15°-35°E. and dips steeply to the southeast; these faults show displacements of less than 10 feet. This set is cut by faults striking about N-85°E. with a fairly flat northerly dip; horizontal displacements of 100 feet or more occur along these faults. The only gold values of economic importance found on the property to date occur where the N.20°E. set of faults cut the vein system.

Veins

According to G.L. Holbrooke [formerly of Sylvanite Gold Mines Limited, private report], there are two different ages of vein material in the mine workings. The earlier consists of numerous irregular quartz-carbonate veinlets in a sheared zone. The later veins occur as a system of narrow quartz veins trending about N65°E. and dipping about 70°S. This vein system has a length of about 250 feet and rakes to the east. These veins contain a small amount of pyrite and range in width from a few inches to more than 2 feet. In detail, the veins tend to roll and branch in both plan and section. It is in the principal vein of this system, where the N20°E. fracturing and faulting is prominent, that the best gold values are found. Native gold is seen in the stopes on the 2nd and 3rd levels. In addition, there is a set of small, poorly developed cross-veins that show a general north-south trend.

Production was obtained from the Baldwin property in 1929 and 1938, consisting of a total of 81 tons of gold ore worth $1,247 (Arnoldi 1949, Table II).

The property has been dormant since 1947.

Mrs. Cora K. Barker (2)

This property, Eby Township, concession V, lot 5, N½, NW¼, is described under the George W. Walters property (20).

Mrs. Donna Cain (3)

In Eby Township, concession V, lot 8, S½, SW¼, some geological mapping was done by Sylvanite Gold Mines Limited in January, 1941. Most of the claim is covered by soil of "The Little Clay Belt".

Dominion Gulf Company [circa 1952] (4)

In Eby Township, concession V, lot 9, N½, NW¼ and SW¼, lot 9, S½, NW¼, lot 10, N½, and lot 11, N½, SE¼, Dominion Gulf Company did considerable work in 1952. The work consisted of geological and magnetometer surveys, and two diamond drill holes. The result was to indicate the extent of the Kirkland Lake-Larder Lake belt of Archean sedimentary rocks covered by the soil of "The Little Clay Belt".

Morris Fishkin (5)

In 1965, in Eby Township, concession V, lot 2, S½, SW¼, a hole drilled to a depth of 121 feet with a bearing 360 degrees and a dip of 60 degrees intersected 'lava' containing quartz, epidote, and pyrite with a little chalcopyrite and sphalerite.

Drilling for Morris Fishkin in concession III, lot 2, N½, SW¼ is described under W. Stewart (14).

Aage Hansen (6)

In Eby Township, concession III, lot 5, S½, SW¼, three short holes with an aggregate depth of 326 feet were drilled in 1963 and 1964 on the property of Aage Hansen. The holes were spaced within 200 feet of each other and were drilled along an east-west axis on the fringe of the iron formation. The core logs mention 'lava', quartz, and some mineralization.

Angus Johnson [circa 1938] (7)

In Eby Township, concession IV, lot 3, S½, NE¼ and SE¼, Angus Johnson did some surface work and sampling in three pits over a 500-foot length in a dike cutting greenstones. In a letter to Sylvanite Gold Mines Limited in 1938, he reported assays of $2 to $6 in gold per ton (gold about $20 U.S. per ounce). A brief examination of the claims was carried out by Sylvanite Gold Mines Limited.

Max Kaplan and R.J. Hahn (8)

In Eby Township, concession IV, lot 12, N½, NW¼ and NE¼ and concession V, lot 12, S½, NW¼, SW¼, and SE¼, the Graff-Kaplan-Hahn property was mapped in detail in 1944 by Sylvanite Gold Mines Limited [1964]. In 1946 to 1947, surface work was done by Red Shirt Larder Gold Mines Limited [1959]. A 40-foot shaft was sunk, and some diamond drilling done. As well as other rock types and vein material, the dump contains Archean conglomerate, the westernmost Timiskaming-type sedimentary rocks known in the Kirkland Lake-Larder Lake area. Farther west, the Archean rocks are covered by Cobalt sedimentary rocks.

Keevil Mining Group Limited (9)

In Eby Township, concession III, lot 3 except the NW¼ of the N½, and concession III, lot 4, S½, work was done in 1964 and 1965 by Keevil Mining Group Limited. The work, follow-up of an airborne geophysical survey, consisted of geological, magnetometer, and vertical loop electromagnetometer surveys, and subsequent diamond drilling of anomalies. Three holes were drilled. According to the company, the core of one hole for a total of 1,508 feet has 70 feet containing 18.8 percent soluble Fe in magnetite and the core of all three holes have several 5- to 10-foot lengths of iron formation containing 0.02 to 0.03 percent copper. One hole was reported to have similar percentages of zinc as well.

In 1958, Belcher Mining Corporation Limited acquired an option on 2,400 acres in Eby Township including part of what became the Keevil property. The results of the work are not known by the writer.

Lemu Investments (10)

In Eby Township, concession V, lot 4, S½, NW¼ and NE¼, J.A. Lumsden, who held the claims in 1944, stated that in the southwestern part of his claim, a prospector's shaft was sunk to a depth of 40 feet on a red porphyry dike. According to Lumsden, in 1944, (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario) a pink quartz vein at the bottom of the shaft contained $5.00 worth of gold (gold at about $35 U.S. per ounce) over the whole width of the shaft.

Mundy [circa 1938] (11)

In Eby Township, concession IV, lot 11, N½, NE¼, three grab samples from quartz stringers varying in width from ½ inch to 8 inches were taken, in 1938, by Erie Canadian Mines Limited from old filled-in pits on one of the Mundy claims. Results reported were trace, $0.40, and $0.80 cents worth of gold per ton (gold at about $35 U.S. per ounce).

Preston Mines Limited (12)

In Eby Township, concession III, lot 8, N½, work was done in 1949 and 1950 by Preston Mines Limited which was then known as Preston East Dome Mines Limited. The work consisted of geological mapping, followed by three drill holes (total of 588 feet) to test a shear zone containing minor quartz and concentrated pyrite with gold across a width of 2 feet and an exposed length of 25 feet. The drilling intersected syenite, mafic volcanic rocks, quartz stringers, pyrite, and small amounts of gold (0.01 to 0.10 ounces of gold per ton across 0.5 to 1.0 foot). (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario).

Martin Rogick, Amelia Clark, and Richard Elliott (13)

In 1939, in Eby Township, concession VI, lot 4, S½, NW¼ and NE¼, and lot 5, S½, NW¼ and NE¼, Martin Rogick, Amelia Clark, and Richard Elliott owned claims. Following the discovery in 1938 of several large angular pieces of gold-bearing float in concession VI, lot 5, S½, NE¼, gold was found in bedrock, and Pioneer Gold Mines Limited diamond drilled 14 holes (most of them along an east-west direction) in the vicinity of the showing and on the adjacent Brookband property, and obtained many intersections of about $2.00 in gold per ton (gold at about $35. U.S. per ounce) across 2 feet. (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario).

During 1939, trenching uncovered new showings at the contact of syenite and carbonate rocks cut by numerous quartz stringers containing pyrite and visible gold. Assays of grab samples from the showings on claim L18227 ranged from $2.00 to

$17.00 in gold per ton (gold at about $35. U.S. per ounce) (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario). Sylvanite Gold Mines Limited optioned the claims and, in 1939, mapped them in detail. Beaucoeur obtained an option and drilled at least nine holes. The highest grade intersections were in two of three holes drilled from one drill set-up; $22.40 in gold per ton across 2.0 feet, and $24.58 across 10.0 feet (gold at about $35. U.S. per ounce) (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario).

In 1944, Siscoe Gold Mines Limited obtained an option, and four holes with an aggregate depth of 1,878 feet were drilled along a north-south direction on the Rogick property and on the claim of Burtho Gold Mines Limited in Kenogami Lake near the headland in lot 6, S½, NE¼ (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario). Gold in the Siscoe drill holes was very low grade, the best intersection being about $1.00 per ton across 20 feet (gold at about $35. U.S. per ounce).

W. Stewart (14)

The W. Stewart property is located in Eby Township, concession III, lot 2, N½, SW¼, which formerly belonged to Harry O. Feick of Kitchener. A number of trenches and pits were sunk. The main pit, 10 feet deep, is in a gossan of limonite and cellular quartz. A sample from the bottom of the pit, where the massive pyrite and quartz is 10 feet wide, yielded an assay of 40.91 percent sulphur, 36.82 percent iron, 0.015 percent arsenic, 0.20 percent zinc, and 20.41 percent insoluble material (Janes 1952, p.74). A hole drilled to a depth of 940 feet in 1968 for Morris Fishkin (5) intersected iron formation consisting of interbedded rhyolite tuff, graphite, and pyrite-pyrrhotite with some chalcopyrite.

Diane C. Strome (15)

In Eby Township, concession VI, lot 1, N½, NE¼, and Otto Township, concession VI, lot 12, N½, NW¼ and NE¼, as well as adjacent parts of Grenfell and Teck Townships, work was done in 1929 by Matabanick Kirkland Gold Mines Limited. The work consisted of 8,000 feet of surface trenching and the sinking of a 50-foot shaft. Matabanick Kirkland Gold Mines Limited was reorganized as Kelly-Kirkland Mines Limited. The former Kelly-Kirkland claims now belong to Diane C. Strome.

In 1939, geological and geophysical investigations disclosed a well-mineralized quartz and porphyry vein and three mineralized dikes (The Northern Miner 1939, p.839). Some shallow holes, followed by deeper holes, were drilled to test the mineralization. At that time, the property was held by Kelly-Kirkland Mines Limited, an amalgamation of Blanche River Kirkland Gold Mines Limited and Matabanick Kirkland Gold Mines Limited.

In 1960, a summer edition of the Northern Daily News, Kirkland Lake, carried a story that G.H. Babcock discovered a copper-gold showing on the bank of the Blanche River in 1959. G.H. Babcock, who was president of Gravimetric Surveys Limited and a director of Kelly-Kirkland Mines Limited at the time, said a gravity survey indicated a gravity anomaly below the river bed.

In 1964, interest in the property stemmed from an unconfirmed report that a high gold assay was obtained from a grab sample of a quartz vein temporarily exposed in a trench opened up to install the Kirkland Lake branch of the natural gas pipeline of Trans-Canada Pipe Lines Limited. In 1966, a short hole was drilled under Highway 66 by Kerr Addison Mines Limited.

Sylvanite Gold Mines Limited [*circa 1945*] *(16)*

In Eby Township, concession V, lot 7, N½, NW¼ and SW¼ and all of concession V, lot 8, geological mapping and 1,360 feet of diamond drilling was done by Sylvanite Gold Mines Limited in 1945. The drilling disclosed little mineralization, although a grab sample from a pit in quartz-veined green carbonate rock near the northwest corner of claim L18402, concession V, lot 7, N½, NE¼, yielded an assay of 3.60 dwts. (20 dwts. equals 1 Troy oz.) worth of gold per ton (gold at about $35. U.S. per ounce).

In Eby Township, concession V, lot 2, N½, SW¼ and SE¼, samples assayed by Sylvanite indicated trace to $0.80 worth of gold per ton (gold at about $35. U.S. per ounce) in a zone in carbonate rock 30 feet wide.

In Eby Township, concession IV, lot 2, N½, NE¼, samples indicated trace to $0.80 worth of gold per ton (gold at about $35. U.S. per ounce) across 2 to 4 feet of a quartz-veined zone in schist. (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario; Holbrooke 1945).

Taylor Gold Mines Limited (17)

In Eby Township, concession V, lot 3, N½, NE¼ and SE¼, and S½, NW¼ and NE¼, a magnetometer survey was done, in 1966, by Geophysical Engineering and Surveys Limited. A high anomaly striking east to N45E was outlined across the two southern claims and according to the company was due to magnetite-rich sections within the basic flows or possibly lean iron formation zones. The northwestern edge of a high anomaly was discovered near the southeastern corner of the southeastern claim.

Todora Kirkland Prospecting Syndicate [*circa 1948*] *(18)*

In Eby Township, concession V, lot 1, N½, SW¼ and SE¼, and in adjacent Otto Township, concession V, lot 12, N½, SW¼, seven holes with a total footage of 3,002 feet were drilled in 1930 on these properties that belonged to Swastika Kirkland Mines Limited and Cheltonia-Kirkland Mines Limited. Chalcopyrite, molybdenite, and gold in quartz stringers and quartz porphyry were reported in drill core from a shear zone in volcanic rocks and iron formation.

In the early days, on the Otto Township claim the "Cheltonia" shaft was collared south of the shear zone and sunk to a depth of 112 feet, but crosscutting from the shaft did not advance far enough to intersect the mineralized zone, according to a

1948 report by J.B. Taylor for the Todora Kirkland Prospecting Syndicate. According to the Todora Kirkland report, four grab samples from a pit or pits yielded assays of 5.32 to 13.39 percent copper.

After detailed geological mapping by Macassa Mines Limited in 1948, four holes, two of which were diamond drilled for a total of 1,368 feet, showed intersections of copper (maximum 2.36 percent copper across 0.7 feet) and negligible gold. One hole was drilled by Little Long Lac Explorations for Wright-Hargreaves Mines Limited to check hole No. 7 drilled in 1930. The Wright-Hargreaves results cast doubt on the possibility of ore grade width in copper, nickel, gold, silver, and cobalt being present. The best intersection by Wright-Hargreaves was 0.32 percent copper across 3.5 feet. References: ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario. File on Todora Kirkland Prospecting Syndicate accompanied by drill hole plan (by Macassa Mines Limited), scale 1 inch to 40 feet. File on Little Long Lac Exploration with core log analysis.

Ago and Ellen Vagolaide (19)

In Eby Township, concession VI, lot 6, S½, SW¼ and SE¼, the mining rights, in 1968, belonged to Ago and Ellen Vagolaide. In 1947 to 1948, the geology was mapped and eight holes were drilled by Burtho Gold Mines Limited on the Vagolaide claims and the four adjacent claims to the west and north (i.e., concession VI, lot 6, S½, NW¼ and NE¼, and concession VI, lot 7, S½, NW¼ and SE¼). The eight holes (total footage 5,066 feet) were drilled to test the ground to get into the vicinity of fault zones crossing the property. Four holes spaced along 4,300 feet cut the northern fault zone; two holes were put down through the syenite and carbonate rock of the southern fault zone. No gold is known to have been in the drill core, but both of the fault zones were marked by shearing, brecciation, carbonatization, local mud seams, and some quartz veins and stringers. On this basis, Thomson (1948, p.29) postulated that the northern zone might be the Larder Lake Fault.

George W. Walters (20)

In Eby Township, concession VI, lot 5, S½, SW¼ and SE¼, and concession V, lot 5 except the N½, NW¼, and in concession IV, lot 5, N½, NE¼, considerable work has been done during the past 50 years. The three northern claims, on which most of the work has been done, were patented by Charles J. Walters in 1917. The other claims of the present group were patented in 1920, 1932, and 1934.

In 1935, Erie Canadian Mines Limited optioned the property, and mapped and prospected it. Two quartz veins on the two northern claims were sampled, and one gold assay of $6.00 per ton was reported (gold at about $35. U.S. per ounce) (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario). The sample was taken across a 30-inch width of a quartz vein containing iron sulphides and molybdenite. The vein strikes north and dips 70 west through basalt.

In 1938, the property and the "Reed claim" (concession V, lot 5, N½, NW¼) were developed by D.M. Hogarth and associates (Mrs. Cora K. Barker, Property No. 2). Surface work indicated the presence of gold in concession V, lot 5, N½, NE¼. Eight holes (total footage about 3,000) were drilled to test the carbonate rocks. According to T.L. Wells, engineer in charge of development in 1938 (Thomson 1948, p.53), bulk samples from "No. 1" trench at the east end of the carbonate body yielded assays of 2.74 ounces and 0.06 ounce of gold per ton. The gold is in narrow quartz stringers, in visible but finely divided form. A drill hole under the trench failed to disclose interesting values; some of the other holes contained a little gold.

OTTO TOWNSHIP

Mrs. Helen Bottrell (21)

In Otto Township, concession VI, lot 4, N½, SE¼, old overgrown pits and trenches attest to prospecting for gold during the early days of exploration in the Kirkland Lake area. In 1950, the claim belonged to Mrs. Agnes Mulligan, but, in 1968, it belonged to Mrs. Helen Bottrell.

Graphitic chert and tuff or slate interbedded with mafic volcanic rocks contain lenses of pyrite and pyrrhotite. Small lamprophyre dikes and sills are also present. In places, the rocks are cut by carbonate stringers containing sphalerite.

Chavigny Gold Mines Limited (22)

In Otto Township, concession VI, lot 6, S½, NW¼, two holes (1,043 and 945 feet) were drilled by Chavigny Gold Mines Limited during 1948. The holes were drilled to test anomalies obtained by a geophysical survey, and detected 0.04 ounces of gold per ton in rusty altered greenstone from 200 to 202.5 feet in drill hole No. 1. Three additional holes brought the total footage of drilling to 5,800 feet (The Northern Miner 1949, p.192). Sludge from lost core of drill hole No. 3 between 230 and 237.5 feet contained 0.02 ounces of gold per ton.

W.M. Cochrane (23)

In Otto Township, concession I, lot 8, N½, NE¼ and SE¼, prospecting was done by W.M. Cochrane. The showing in the southwestern part of the property consists of chalcopyrite blebs and specular hematite in quartz carbonate gash veins cutting syenite and a greyish pink feldspar porphyry dike. The dike, about 4 feet wide, strikes N5E and dips vertically.

A second showing is near the southern edge of a syenitic outcrop, about 600 feet north of an old shack. A few narrow quartz stringers striking about northeast and dipping steeply west contain a few grains of pyrite, chalcopyrite and specular hematite. In 1950, grab samples contained $0.35 in gold per ton (gold at about $35. U.S. per ounce). (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario).

About 300 feet farther northwest, the syenitic rocks contain many rounded inclusions of micaceous "greenstone". Some of the inclusions contain very small amounts of copper and gold, according to W.S. Savage (1950 ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario).

About 600 feet north of the second showing, an irregular vein on glassy white quartz cuts the southwest side of a syenitic hill. The vein strikes N45E and dips vertically, and contains feldspathic inclusions and hematite stain. According to W.M. Cochrane, (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario) the vein contains galena, and $1.40 in gold per ton (gold at about $35. U.S. per ounce).

Gateford Mines Limited (24)

In Otto Township, concession VI, lot 9, N½, claims now owned by Gateford Mines Limited contain the site of the Swastika Mine, the first gold discovery (in 1906) in the area west of Larder Lake. In 1910, 1911, and 1913, the Swatiska Mine produced $11,457 worth of gold from 2,190 tons of ore milled (Arnoldi 1953, p.16).

In June 1941, when Golden Gate Mining Company Limited acquired the claims from Crescent Kirkland Gold Mines Limited, underground workings had been opened to a depth of 400 feet. In 1941 and 1942, a small amount of gold was mined from the main shaft workings and an adit to the south, on the shore of Otto Lake. This gold was obtained from small rich flat-lying veins near surface. From 1943 to 1945, considerable surface diamond drilling was done, and then the shaft was dewatered and deepened to 663 feet. Lateral work was done on two levels, which were driven east. Development was carried on until 1945, when the mine was closed. In 1946, the name of the company was changed to Kirkland Golden Gate Mines Limited. In 1947, production from milling 6,288 tons of ore from the former Crescent Kirkland property was worth $42,507 (Thomson 1948, p.49).

In 1950, Kirkland Golden Gate Mines Limited was reorganized to Gateford Mines Limited. Total production from 1910 until 1947 from the combined Teck (not described in this report) and Otto Townships properties owned by Gateford Mines Limited amounted to $1,062,619 from 103,693 tons of ore milled (Arnoldi 1953, p.16, Kirkland Golden Gate and Swastika Mines statistics combined).

The International Nickel Company of Canada Limited (25)

In Otto Township, concession VI, lot 5, N½, NW¼, Inco drilled a hole to a depth of 342 feet in 1968, presumably to test an electromagnetically conductive zone. A broad zone of graphitic schist, chert, and tuff is interbedded with volcanic rocks in the part of Otto Township near the Ontario Northland Railway. The zone is a type of iron formation, containing pyrite nodules as well as blebs and stringers of pyrite and pyrrhotite. Some base metals are associated with the pyrite and pyrrhotite, and some are in carbonate veins cutting the iron formation. The core log for the Inco drill hole, which is approximately along strike from the iron formation, lists graphitic schist, gabbro, and "weak mineralization". A sludge sample from the drill site contained 0.04 percent zinc.

William Simpson (26)

In Otto Township, concession IV, lot 1, S½, William Simpson reported radioactivity in 1953. The long rock-cut along Highway 11 shows syenite, and syenite porphyry containing feldspar phenocrysts up to 1 inch in length. Numerous small irregular black lamprophyre dikes cut the syenitic rocks. On the average, the radioactivity of the syenitic rocks is twice the normal background, and may be as high as three times.

In the long rock-cut along Highway 11 northwest from the Simpson property, concession IV, lot 2, N½, some of the syenite and lamprophyre are slightly radioactive.

Diane C. Strome (27)

(See Diane C. Strome property 15 in Eby Township).

Todora Kirkland Prospecting Syndicate *[circa 1948] (28)*

(See Todora Kirkland Prospecting Syndicate, property 18 in Eby Township).

Platinum

In Otto Township, concession IV, lot 12, northern part, and concession V, lot 12, southern part, Cooke (1919, p.19E) reported discoveries of platinum in a band of tuffs and agglomerates. The band of tuffs and agglomerates is about 1,300 feet wide at the discoveries, strikes about N60E, dips almost vertically, and lies between Keewatin-type basalt flows. Tops are to the north. The band was traced by K.D. Lawton for 2 miles southwest into Eby Township and east to Otto Township, concession V, lot 6. In lot 6, the band is faulted about 1 mile to the north, from whence it extends to and across Boston Township east of Otto. The band consists of interbedded mafic and felsic tuffs and agglomerates, as well as carbonate rocks and iron formation. The iron formation consists of pyrite and pyrrhotite in graphitic slate, tuffs, and chert, and of interbanded chert, red jasper, and magnetite.

Prospectors claimed that, "in picked samples they obtained values in gold, silver, platinum, and nickel, none of them singly high enough to constitute an ore, but together giving a good return" (Cooke 1919, p.19E). At the time of Cooke's visit, no attempt had been made to sample the deposits systematically. According to prospector Bill Brookbank of Kirkland Lake, one assay by D. Jones, Haileybury assayer, of a sample submitted many years ago by prospector "Bobby" Adair, amounted to more than $100 worth of platinum per ton.

Nepheline Syenite

Nepheline syenite was found in three areas along the northern contact of the Otto syenitic stock. The nepheline syenite was described by Lawton (1954, p. 141 to 144) as follows:

Field study indicates that the nepheline has a two-fold occurrence (a) as a constituent of sill-like masses of nepheline syenite, intruded into volcanics and injection gneiss adjacent to the contact of the stock and (b) as a constituent of injection gneiss, developed by intimate penetration and replacement of country rock by syenitic magma. The two occurrences are closely related, and south of Otto lake the succession of rock types along the border is complex and it is difficult in some cases to distinguish the sill-like intrusions from highly altered country rock.

The principal area of nepheline development occurs in lots 7 and 8, con. V, of Otto Township. In this general area, nepheline syenite occurs as narrow sill-like masses about two feet wide. In hand specimen this syenite is a massive, fine grained rock, dark grey in colour. It is usually flecked with dark green grains of pyroxene. In some cases, these narrow sills are porphyritic, being composed of large pink phenocrysts of microcline about one-half inch long set in a dark grey, fine grained groundmass. The mineralogical composition is as follows: microcline, nepheline (or its altered equivalent), aegirine-augite, biotite, muscovite, epidote, garnet, magnetite, sphene, apatite. Microcline is fresh and unalbitized. Pyroxene occurs as fresh tabular grains, in some cases being replaced by biotite and garnet. Nepheline is generally partly or wholly altered.

Larger masses of nepheline syenite gneiss occur near the boundary between lots 7 and 8, con. V. In hand specimen, it is a pale pinkish grey gneiss given a speckled appearance by the presence of dark mafic minerals. It has a medium-grained, uniform texture and weathers to a pale greyish pink shade. A characteristic feature is the occurrence of large tabular feldspar crystals up to one-half inch long scattered here and there through the rock. These are conspicuous on weathered surface. This rock type may be traced westward from lot 8 (con. V) for over one-half mile. Its eastward extension is not known. Because of poor exposure, its width is not known either, however it certainly exceeds 100 feet. On weathered surfaces, nepheline exhibits its characteristic bluish grey weathering habit.

Nepheline associated with the syenite gneiss has a three fold occurrence: (a) as a constituent of the gneiss itself, scattered irregularly through it (b) as a constituent of pegmatitic veinlets cutting the syenite gneiss. These veinlets are not large (up to a foot long and not exceeding one-half inch in width) and may be quite irregular. Some of the veinlets are 'vuggy', with pink grains of tabular feldspar projecting into a cavity filled largely by nepheline. (c) as a constituent of narrow mafic dike rocks cutting the syenite gneiss.

A thin section of the nepheline syenite gneiss had the following composition: nepheline—25% (all percentages estimated); microcline and microcline microperthite—50%; albite—15%; augite, aegirine-augite, biotite, scapolite (10% combined); apatite and sphene. The gneissic foliation is quite strong in thin section and the texture is fine to medium-grained. The nepheline is quite fresh. Apatite is fairly abundant as coarse sized grains.

The pegmatitic veinlets cutting the syenite gneiss have about the same composition as the gneiss; though they are coarser grained and texturally, more massive. A thin section of one of these veinlets had the following composition (percentages estimated): microcline, microcline microperthite, and albite 65%, nepheline 15%, scapolite 10%, biotite and aegirine-augite 10%, apatite and sphene. All the minerals, including the nepheline, are quite fresh.

Mafic dike rocks cutting the syenite gneiss also have the same composition as the gneiss but a higher relative proportion of mafic minerals (mainly aegirine-augite and augite). Apatite is abundant as coarse sized grains.

Associated with the nepheline syenite gneiss are outcrops of nepheline bearing rocks which appear to be of hybrid origin. Mafic minerals are abundant and the rocks are quite strongly foliated. Nepheline is generally irregular in its distribution through these rocks and in places, amounts to over 50% of them.

The nepheline occurring in the syenite gneiss, pegmatitic veinlets, mafic dikes and hybrid rocks described above is generally quite fresh. It occurs as irregular-shaped grains intergrown with albite and microcline microperthite. Judging from its habit, nepheline was one of the last minerals to crystallize.

In lot 9, along the small road running south from Otto lake, nepheline occurs in narrow sills of syenite and in hybrid rocks. Here, the nepheline or its altered equivalent is generally subordinate in amount, and may exhibit a "myrmekitic" habit in which it occurs as worm-like, often radiating veinlets replacing microcline. The nepheline is highly altered here and exhibits three general types of alteration (a) a fine-grained, brown, fibrous alteration product with the following optical properties: parallel extinction, index of refraction lower than microcline, and maximum birefringence of first order yellow. This is believed to be a zeolite. (b) a micaceous alteration in which the mineral occurs as scaly aggregates. It has the following optical properties: length fast, maximum birefringence at top of first order or low second order, index of refraction less than microline, extinction X, C—0-10°. Grains of this mineral of sufficient size to permit determination of an optic sign were not available. (c) another micaceous type of alteration, is composed of scaly grains of white mica.

Lawton's comments on the origin of the nepheline were as follows (1954, p.147):

In postulating an origin for the nepheline-bearing rocks along the border of the Otto stock, the following facts are significant: (a) nepheline is apparently confined entirely to the zone of injection and reaction along the contact of the stock. However, it is not extensively developed and is not characteristic of the entire border zone. It has been recognized only along the north edge, in the area south of Otto Lake, and in the vicinity of Dane station. (b) nepheline does not occur in syenite within the stock proper, even in sections close to the contact. (c) judging from its habit, nepheline was one of the last minerals to crystallize. The occurrence of nepheline under these circumstances indicates relatively local desilication of the parent syenite magma through reaction with the country rock.

The zone of tuff, agglomerate, and iron formation north of the Otto Stock contains much interbedded carbonate rock of the green and brown varieties that are widespread in the Kirkland Lake area. The location of the nepheline syenite and nepheline gneiss at the periphery of the syenitic stock, and the foliation of the nepheline-bearing rocks being parallel to that of the formations outside the contact of the stock, indicate to the writer (Lovell) that if the nepheline is not an original constituent of the Otto syenitic intrusion, the desilicating agent for the formation of nepheline might well have been the carbonate country rock.

Some parts of the nepheline-bearing rocks and adjacent formations are radioactive. In Otto Township, concession V, lot 3, N½, concession V, lot 8, S½, and concession V, lot 11, S½, W.S. Savage, former Ontario Department of Mines Resident Geologist at Kirkland Lake, reported (ODMNA assessment work files, Resident Geologist's office, Kirkland Lake, Ontario) average scale readings on a scintillometer to be 15 in the 'lavas', whereas average normal readings for the syenite were 25. A number of isolated spot readings in the syenite were twice or three times normal; and small red feldspathic dikes cutting the 'lavas' gave readings five to ten times normal.

Sand and Gravel

Sand and gravel are abundant, in particular in the Butler Lake Esker, (which trends south through the eastern part of Eby Township), but also in drumlins. The ancient shoreline of the delta centred in Eby Township, concession II, lot 4 consists of well-sorted sand.

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INDEX

ONTARIO
DEPARTMENT OF MINES
AND NORTHERN AFFAIRS
HONOURABLE LEO BERNIER, *Minister*
D. P. Douglass, *Deputy Minister* J. E. Thomson, *Director, Geological Branch*

SYMBOLS

- *Glacial striae.*
- *Esker.*
- *Small bedrock outcrop.*
- *Area of bedrock outcrop.*
- *Bedding, top unknown; (inclined, vertical).*
- *Lava flow; top (arrow) from pillows shape and packing.*
- *Schistosity; (horizontal, inclined, vertical).*
- *Gneissosity, (horizontal, inclined, vertical).*
- *Geological boundary, observed.*
- *Geological boundary, position interpreted.*
- *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.*
- DH *Drill hole; (vertical, inclined).*
- *Vein, vein network. Width in inches.*
- 420′ *Shaft; depth in feet.*
- MA *Magnetic attraction.*
- RA *Radioactivity.*
- 66 *Motor road. Provincial highway number encircled where applicable.*
- *Other road.*
- *Trail, portage or winter road.*
- *Building.*
- *Township boundary, approximate position only.*
- *Surveyed line, approximate position only.*
- *Property boundary, approximate position only.*
- 6 (12) *Mining property; (surveyed, unsurveyed). See list of properties.*

LIST OF PROPERTIES

EBY TOWNSHIP

1. *Baldwin Consolidated Mines Limited.*
2. *Barker, Mrs. Cora K.*
3. *Cain, Mrs. Donna.*
4. *Dominion Gulf Company [circa 1952].*
5. *Fishkin, Morris.*
6. *Hansen, Aage.*
7. *Johnson, Angus [circa 1938].*
8. *Kaplan, M., and Hahn, R. J.*
9. *Keevil Mining Group Limited.*
10. *Lemu Investments.*
11. *Mundy [circa 1938].*
12. *Preston Mines Limited.*
13. *Rogick, Martin; Clark, Amelia; and Elliott, Richard.*
14. *Stewart, W.*
15. *Strome, Diane C.*
16. *Sylvanite Gold Mines Limited [circa 1945].*
17. *Taylor Gold Mines Limited.*
18. *Todora Kirkland Prospecting Syndicate [circa 1948].*
19. *Vagolaide, Ago and Ellen.*
20. *Walters, George W.*

OTTO TOWNSHIP

21. *Bottrell, Mrs. Helen.*
22. *Chavigny Gold Mines Limited.*
23. *Cochrane, W. M.*
24. *Gateford Mines Limited.*
25. *International Nickel Company of Canada Limited, The.*
26. *Simpson, William.*
27. *Strome, Diane C.*
28. *Todora Kirkland Prospecting Syndicate [circa 1948].*

Date in square brackets, refers to last major work.

SOURCES OF INFORMATION

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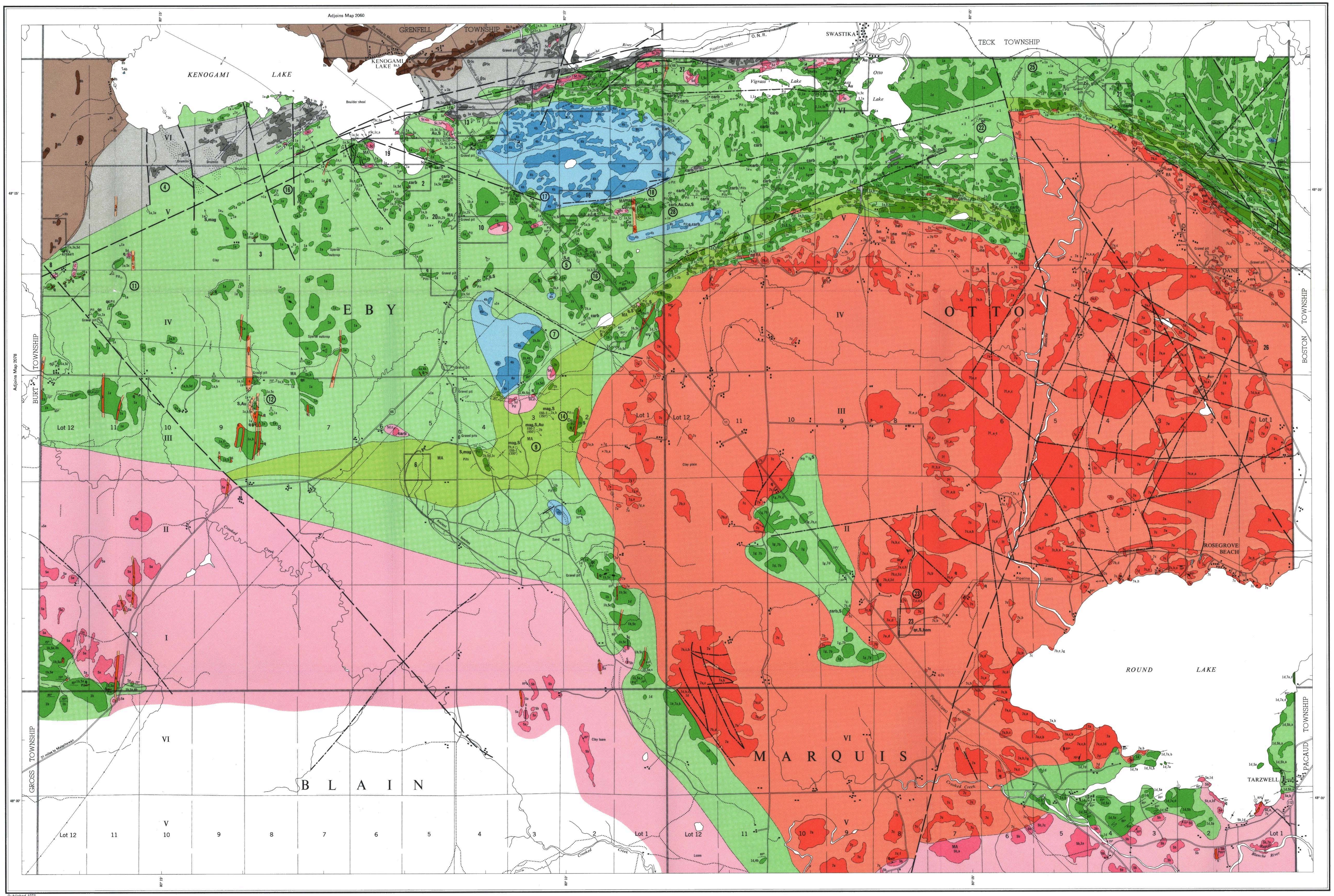
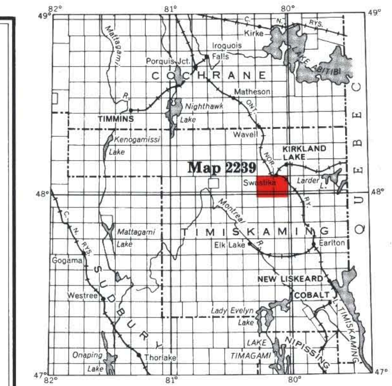
Magnetic declination in the area was approximately 9°27′W in 1969.



Published 1971



Scale, 1 inch to 50 miles

N. T. S. reference 41P/16, 42A/1

LEGEND

CENOZOIC[a]

PLEISTOCENE AND RECENT
Silt, clay, sand, gravel.

UNCONFORMITY

PRECAMBRIAN[b]

PROTEROZOIC

LATE MAFIC INTRUSIVE ROCKS (NIPISSING OR KEWEENAWAN)

9 *Diabase.*

INTRUSIVE CONTACT

HURONIAN

COBALT GROUP

GOWGANDA FORMATION

8a *Conglomerate.*
8b *Arkose, greywacke, argillite.*

UNCONFORMITY

ALKALIC INTRUSIVE ROCKS

7a *Coarse-grained syenite, syenite porphyry, pegmatite.*
7b *Mafic syenite, syenite contaminated by country rocks.*
7c *Medium-grained syenite, aplite dikes.*
7d *Syenite with numerous xenoliths and autoliths.*
7e *Lamprophyre.*
7f *Quartz syenite, granite.*
7g *Diorite.*

INTRUSIVE CONTACT

ARCHEAN

MAFIC INTRUSIVE ROCKS (MATACHEWAN OR NIPISSING)

6 *Diabase.*

INTRUSIVE CONTACT

FELSIC INTRUSIVE ROCKS (ALGOMAN)

5a *Granite, porphyritic granite, granodiorite.*
5b *Granodioritic gneiss.*
5c *Syenite and trachyte.*
5d *Mafic syenite and mafic trachyte.*

INTRUSIVE CONTACT

EARLY MAFIC AND ULTRAMAFIC ROCKS (HAILEYBURIAN, EARLY ALGOMAN, AND KEEWATIN)

4a *Serpentinite, peridotite.*
4b *Gabbro, diorite.*

INTRUSIVE CONTACT

METASEDIMENTS (TIMISKAMING AND KEEWATIN)

3a *Conglomerate.*
3b *Quartzite, greywacke.*
3c *Tuff, agglomerate, minor amounts of trachyte agglomerate, breccia.*

UNCONFORMITY AND INTERBEDDING

FELSIC METAVOLCANICS (KEEWATIN)

2a *Rhyolite, dacite.*
2b *Iron formation, silicic tuff, agglomerate.*
2c *Dacite porphyry, amygdaloidal and spherulitic dacite.*

MAFIC METAVOLCANICS AND METASEDIMENTS

1 *Unsubdivided mafic volcanics.*
1a *Basalt, andesite.*
1b *Chloritic mafic tuff, agglomerate.*
1c *Altered (bleached, carbonatized) volcanic and sedimentary rocks.*
1d *Amphibolite, garnet-epidote amphibolite, amphibolite gneiss.*
1e *Andesite porphyry, amygdaloidal and spherulitic dacite.*
1g *Biotite-garnet-pyroxene amphibolite.*

Au	*Gold*
carb	*Carbonate*
Cu	*Copper*
gf	*Graphite*
hem	*Hematite*
mag	*Magnetite*
ne	*Nepheline*
q	*Quartz*
qc	*Quartz-carbonate*
S	*Sulphide mineralization*
Zn	*Zinc*

[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured parts on the map.*

[b] *Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown. Where in places a formation is too narrow to show colour and must be represented in black, a short black bar appears in the appropriate block.*

Map 2239

EBY-OTTO AREA

TIMISKAMING 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