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DEPARTMENT OF MINES

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Geology of Townships 143 and 144

By
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Geological Report No. 4

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TABLE OF CONTENTS

Geological Report No. 4

PHOTOGRAPHS

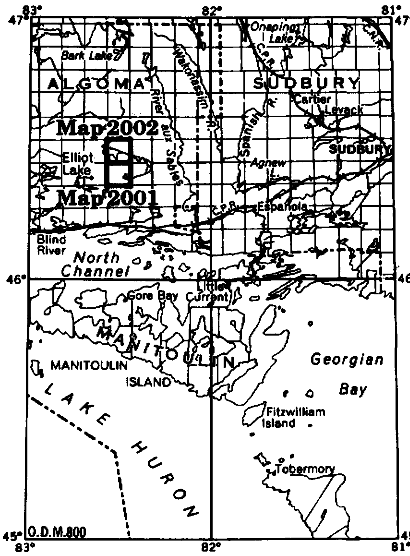
MAPS AND FIGURES
(in the text)

GEOLOGICAL MAPS AND CHARTS
(in the map case)

ABSTRACT

This report on Townships 143 and 144, District of Algoma, describes the stratigraphy, structure, and economic geology of part of the Quirke syncline of the Blind River area. The field work was carried out in 1957 by semi-detailed mapping using air photographs.

The oldest Precambrian rocks are Keewatin(?) volcanics, pyroclastics, basic intrusives, and sediments, including lean iron formation, cut by Algoman intrusions. The intrusions are divided into early sodic granite gneiss and late massive quartz-monzonite, granodiorite, and granite. The granite–metavolcanics contacts are eroded with the development of valleys.



Key map showing location of Townships 143 and 144. Scale, 1 inch to 50 miles.

Huronian sedimentation, showing northern overlap, began with coarse-grained sediments derived from weathered granite. Uraniferous, pyritic, quartz-pebble conglomerate was deposited in valleys, followed by conglomerates, quartzites, siltstones, and limestones, all derived from the northwest and accumulated in cold shallow water (Bruce Group). These are overlain unconformably by a heterogeneous assemblage of conglomerates, siltstones, and quartzites formed under subglacial conditions (Cobalt Group).

These rocks were gently folded, with an axis striking N.80°W. and plunging 1°–12°W. Faults and joints were developed parallel to the bedding (thrust faults), parallel to the axial plane (the south side having moved up), and northwest or northeast faults (typically strike-slip faults caused by north-south compression) are also developed.

The youngest Precambrian rocks are Keweenawan differentiated diabase sills and dikes with associated sulphides and albitic or chloritic alteration. These intrusions were followed by additional folding and faulting.

During the Pleistocene the glaciers removed soil and deposited till and gravel.

Uranium ores occurring in the area are believed to be of placer origin, possibly modified during diagenesis and by later low-grade metamorphism. There is no evidence of uranium mineralization being associated with the Keweenawan diabase. No post-Huronian granites were found in or near the area.

There are three potential uranium producers in the area. Gravel is the only other deposit of economic interest.

Geology of Townships 143 and 144
District of Algoma

BY

James A. Robertson[1]

INTRODUCTION

During the 1957 field season an Ontario Department of Mines field party undertook the geological mapping of Townships 143 and 144 in the Blind River uranium area. Both townships form part of the Improvement District of Elliot Lake.

The southwest corner of Township 143 is 5 miles east of Elliot Lake, which is 20 miles north of Spragge and 25 miles northeast of Blind River. Both Spragge and Blind River lie on the north shore of Lake Huron, being served by the Trans-Canada Highway (No. 17) and the Canadian Pacific Railway (Sault Ste. Marie branch). Blind River is 90 miles from Sault Ste. Marie and 100 miles from Sudbury. Highway No. 108, which serves Elliot Lake and the nearby mines, runs north from highway No. 17, 19 miles east of Blind River. Two companies located on Lake Lauzon just east of Blind River provide aeroplane transportation.[2]

Semi-detailed mapping on a scale of 1 inch to 1,320 feet was plotted on transparent acetate sheets attached to air photographs and subsequently transferred to a base map using a sketchmaster. Control was provided by readily identified points and surveyed claim lines. All the township posts for Township 143 were located; the northwest post for Township 144 could not be found, and the northeast post was considered too inaccessible.[3]

Although prospecting has been carried out in the district since 1846, mainly for copper, gold, and iron, it was not until the discovery of uranium near Lake Lauzon east of Blind River, in 1953, that the area became important. Subsequent exploration revealed uranium in commercial quantities in Townships 149 and 150 and to a lesser extent in Townships 143 and 144. The Panel, Can-Met, and Stanrock mines are on Quirke Lake in the western part of Township 144.

Acknowledgments

Able assistance was given by Philip Simony, Jack Johnson, Raymond Balgalvis, Malcolm Fraser, and David Morris. Mr. Simony was responsible for about half the mapping.

The field staff of Can-Met Explorations Limited, Stanrock Uranium Mines Limited, Northspan Uranium Mines Limited (Panel Division), and Algom Uranium Mines Limited (Nordic Division), greatly assisted the party in the field. Staffs of these and other companies with properties in the area willingly gave the author the benefit of their experience.

[1]Postgraduate student, Queens University, Kingston, 1957.

[2]One company only is now operating.

[3]The township post was not found by the author when he visited the locality in 1958.

The author also wishes to acknowledge the help and guidance given by J. P. McDowell, who was also working in the area for the Ontario Department of Mines; P. J. Pienaar, working for the Geological Survey of Canada; and E. M. Abraham who had mapped Townships 149 and 150 the previous summer. J. E. Hawley of Queen's University made many useful suggestions and criticisms. J. W. Ambrose, also of Queen's University, gave the author considerable advice on structural problems.

Means of Access

Numerous lakes, trails, and old lumber roads make access relatively easy. Quirke Lake and an old lumber road along the Serpent River to the east provide access to the central and northern part of Township 144. A motor road to the Panel mine on the north shore of Quirke Lake has recently been extended eastward to Quirke Lodge at the mouth of the stream entering Quirke Lake. The southeastern part of Township 144 is reached by short portages from Quirke Lake into Teasdale or Ouellette lakes. Rangers Lake is best reached by a trail leading from Nook Lake on the Serpent River east of Quirke.

A motor road that joins highway No. 108 winds around the southwest arm of Quirke Lake to reach the Can-Met and Stanrock mines on the prominent peninsula on the south side of the lake. A trail leading to the Nasco property from this road passes close to Little May Lake. The channel between this lake and May Lake is navigable. A good road, 60 chains long, connects May and Hough lakes. From the east end of Hough Lake, a wagon road leads to the north end of Pecors Lake. Alternatively it is possible to make short portages from Hough to Tees, Tees to Vanhorn lakes, and thence to the east arm of Pecors Lake. A motor road from the Algom Nordic mine in Township 149 runs due east to the west arm of Pecors Lake. Roads running south from this road give access to the southern part of the area. An old lumbering road runs south from just east of the west arm of Pecors Lake towards Depot Lake in Proctor township.

Highway No. 108 cuts across the southwest corner of Township 143. Quirke, Rangers, Teasdale, Ouellette, McCabe, Hough, May, Pecors, Poppy, Flying Goose, and Stinson Lakes are all suitable for light planes.

Previous Geological Work

Although much geological work had been carried out in the area of the north shore of Lake Huron, notably by Murray, Ingall, Logan, Leith, Pumpelly, Van Hise, and Alexander and N. H. Winchell, it was not until 1914 that W. H. Collins began the mapping of the Blind River area. A full bibliography covering the early work in the north shore area is given by Collins (1925). This early work had revealed the presence of Proterozoic (Huronian) sediments overlying granites (Algoman) and greenstones (Keewatin), but confusion had arisen over long-distance correlations.

Collins, aided by T. T. Quirke and later by P. Eskola, attempted to correlate the geology of Bruce Mines with that of Sudbury by mapping and correlating a series of closely spaced areas between the two localities. The Blind River area was mapped by Collins in the years 1914–16, and additional work was done by Eskola in 1922 (Collins 1925, map).

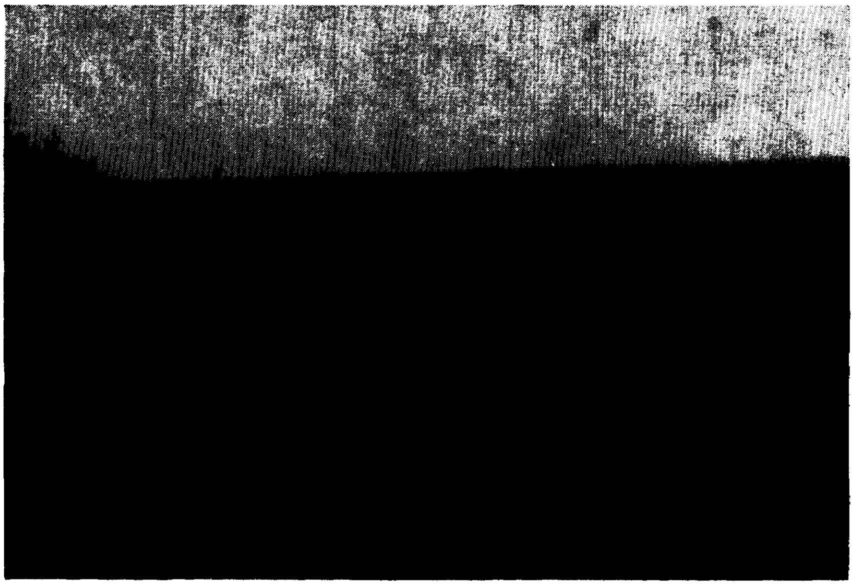
Collins divided the Huronian into the Bruce Series consisting of an intermittent basal conglomerate (Ramsey Lake), Mississagi Quartzite, Bruce Conglomerate, Bruce Limestone, Espanola Greywacke, Espanola Limestone, and Serpent Quartzite, and the unconformably overlying Gowganda Formation of the Cobalt Series, composed of conglomerates, quartzites, and greywackes.

TABLE I—COMPARISON OF STRATIGRAPHICAL NOMENCLATURES USED IN THE BLIND RIVER AREA

<table>
<tr><th colspan="2">Collins (1925)</th><th colspan="2">Abraham (1956)</th><th colspan="2">Roscoe (1956 and 1957)</th><th colspan="2">Robertson (1957)</th></tr>
<tr><th>Series</th><th>Formation</th><th>Group</th><th>Formation</th><th>Group</th><th>Formation</th><th>Group</th><th>Formation</th></tr>
<tr><td>Cobalt</td><td>Gowganda</td><td>Cobalt</td><td>Gowganda</td><td>Dunlop</td><td>Gowganda</td><td>Cobalt</td><td>Gowganda</td></tr>
<tr><td rowspan="7">Bruce</td><td>Serpent</td><td rowspan="7">Bruce</td><td>Serpent</td><td rowspan="3">Quirke</td><td>Serpent</td><td rowspan="7">Bruce</td><td>Serpent</td></tr>
<tr><td>Espanola</td><td>Espanola</td><td>Espanola</td><td>Espanola</td></tr>
<tr><td>Bruce</td><td>Bruce</td><td>Bruce</td><td>Bruce</td></tr>
<tr><td rowspan="4">Mississagi</td><td>Upper Mississagi</td><td rowspan="2">Mississagi</td><td>Ten Mile</td><td>Upper Mississagi</td></tr>
<tr><td rowspan="2">Middle Mississagi</td><td>Whiskey</td><td>Middle Mississagi</td></tr>
<tr><td rowspan="2">Elliot</td><td>Nordic</td><td rowspan="2">Lower Mississagi</td></tr>
<tr><td>Lower Mississagi</td><td>Matinenda</td></tr>
<tr><td colspan="2">Pre-Huronian</td><td colspan="2">Pre-Huronian</td><td colspan="2">Pre-Huronian</td><td colspan="2">Pre-Huronian</td></tr>
</table>

In the Quirke Lake–Elliot Lake area the structure is a west-striking, gently west-pitching synclinal development of the Huronian, resting on eroded granites and greenstones. To the south of this there is a complementary anticline, but to the south and east, along the shore of Lake Huron, the geology was complicated by faulting and the presence of granitic masses that may be post-Huronian in age (Collins 1925. Quirke and Collins, 1930). In this latter area Coleman (1914) and Collins (1925; 1936) recognized a sedimentary series lying between the Keewatin and the granites. The lithology of this series (named the Sudbury Series) resembles that of the Huronian, and A. C. Lawson (1929) argued that much of the Sudbury Series was in fact Upper Huronian. Recent mapping (O.D.M. 1957, inset G) has shown that, between Spragge and Algoma, rocks formerly mapped as the Sudbury Series are in continuity with definite post-Mississagi rocks.

However, the early mapping was not continuous. Thompson (1953a, p. 12) has pointed out, as (a) one stratigraphic unit can show great lithological variation



Looking south from southwestern part of Township 143, showing typical regional topography with lack of major relief.

and (b) different units can show markedly similar lithology, geological terminology and correlation in the district have become largely incomprehensible. Thompson (1953a, p. 13) has therefore suggested the establishment of local successions, leaving the correlation to await completion of detailed structural mapping. However, since within the Blind River area itself these difficulties do not arise, Collins' nomenclature will be retained in this report with only slight modification.

The Ontario Department of Mines has published reports and maps on the areas immediately north and east of the Quirke syncline (Douglas 1926, pp. 34-49. Harding 1941. Moore and Armstrong 1945).

Since the discovery of uranium, in 1953, in the district, intensive field work has been carried out. Mining companies have undertaken considerable diamond-drilling and a certain amount of surface mapping.

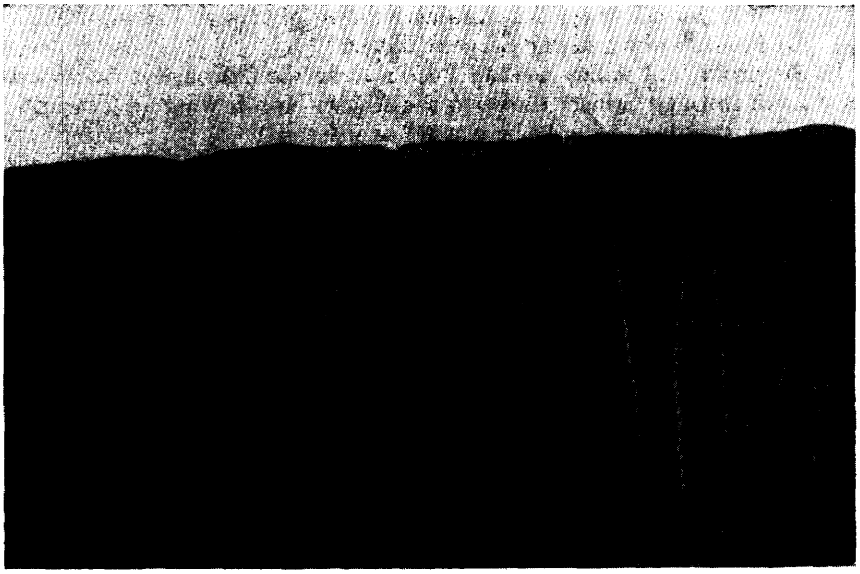
During the field seasons of 1953-55, the Department mapped the south limb of the anticline (Abraham 1953. Robertson 1961. O.D.M. 1957, inset G).

In 1954-55 the Department published a series of aeromagnetic maps covering the district. Each map covers a township on a scale of 1 inch to ¼ mile; on these maps radioactivity anomalies are indicated.

In 1956, Townships 149 and 150 were mapped, and a regional study of the Mississagi Quartzite was begun (Abraham 1956. McDowell 1957).

The Geological Survey of Canada has conducted a study of the subsurface geology with particular reference to the distribution and origin of the uraniferous beds at or near the base of the Mississagi Quartzite. S. M. Roscoe (1956; 1957) has suggested a modified stratigraphical nomenclature for the area, but as yet this has not received wide support. Table I shows a comparison of the nomenclature used by Collins, Roscoe, Abraham, and the author.

Geologists and mineralogists working for the mining companies have published several papers, chiefly on the ore deposits, in which general accounts of the regional geology are given.



Looking northwest from southwestern part of Township 143; scarp of Lower Mississagi Quartzite in Townships 143 and 149.

Topography

The region shows the topographical features characteristic of the North Shore district—a lack of major relief contrasted with a ruggedness in detail (Collins 1925. Quirke 1917). A remarkable uniformity in the skyline (photos, pp. 4, 5) is a reflection of the late Precambrian peneplanation of the shield. The greater part of the area rises to between 1,300 and 1,400 feet, although in the extreme southern part of the area, over the pre-Huronian greenstones, the elevations are between 1,100 and 1,200 feet. However, in detail the region is very broken, and the actual relief may be as much as 450 feet, although generally it is 200–300 feet. High ground is developed over the harder, more siliceous rocks and above massive diabase intrusions, whereas prominent low areas develop over soft argillaceous rocks, e.g. the argillites at the Panel mine (see photo, page 16) and south of the Algom Pecors Lake road (see photo, page 14) and the greenstones. Other low areas have developed along important joints or faults.

Drainage

Drainage in the granites north of Quirke Lake is controlled by east-west, north-south, and northwest joints. Water from Rochester Lake passes through a series of small lakes before entering Quirke Lake slightly east of the Panel mine. A stream from Cormier Lake flows into Nook Lake on the Serpent River east of Quirke Lake. The Serpent River itself forms the main drainage of the area. The river flows from Quirke Lake round the syncline via Nook Lake to Whiskey Lake, in Townships 138 and 137, and then to the south end of Pecors Lake whence it cuts across the greenstones in the southeast corner of Township 143, reaching Lake Huron at Spragge after passing through Proctor, Shedden, Lewis, and Spragge townships.

Poppy Lake drains into the southwest arm of Quirke Lake. Water from Flying Goose, Elephant, and Canyon lakes flows through McCabe Lake into May Lake. A stream from Ouellette Lake passes via Halfmoon and Little May lakes into May Lake. May Lake drains by way of Hough, Tees, and Vanhorn lakes, into Pecors Lake and the Serpent River.

In the prominent valley west of Pecors Lake the drainage is westward from Pardee Lake through Stinson Lake to the Algom Nordic mine in Township 149. Several other streams can only be classed as intermittent.

Resources

The area lies east of the main uraniferous belts of the Quirke syncline, but the eastward extension of the Quirke orebody penetrates the west-central area of Township 144. The Panel, Can-Met, and Stanrock mines are the only producers in the area. Conecho Mines Limited and Roche Mines Limited lying to the east of Panel and Can-Met have marginal to submarginal ore. Possible byproducts from the ore include thorium and rare earths. Submarginal ore also occurs between Algom Nordic Mine and Pecors Lake with a trough of marginal ore running southeast from Pardee Lake.

The Bruce Limestone is considered a possible source of lime for use in the extraction plants at the mines.

Gravel and sand deposits are poorly developed in the area. Extensive pits have been opened between the southwest arm of Quirke Lake and McCabe Lake and also south of the Algom-Pecors road near the boundary of Townships 149 and 143. Other areas of sandy drift lie southeast of McCabe Lake, west of May Lake, along the Pecors road between Pardee and Pecors lakes, and possibly west of Hough Lake. A separate field party collected sand and gravel samples for detailed study (Belcher and Smith 1957).

Quirke Lake provides water for use in the mines, mills, and housing near that lake. Water for the Algom Nordic mine is pumped from the west arm of Pecors Lake to Pardee Lake whence it flows by Stinson Lake to the mine. This source of water is also used by the mines to the north of Algom Nordic. Mine tailings are discharged into lakes and swamps that have no outlet to the lake or the Serpent River drainage system. The lakes provide excellent facilities for boating, canoeing, fishing, and swimming.

Lumbering was formerly a major industry in the area, and there are remains of log chutes and dams along the Serpent River and May Lake–Pecors Lake drainage systems. At present no lumbering is being carried out in the area. Bush is generally mixed in type, with birch, poplar, spruce, and maple predominating. Cedar, balsam, and tamarack are found in swampy areas.

Wild life abounds within the area, and Township 144 lies within the Mississagi Provincial Forest. Deer, moose, bear, foxes, and partridges are common. Beaver have multiplied in recent years, and several streams and swamps have been dammed since 1949, when the air photographs were taken.[1]

GENERAL GEOLOGY

As indicated, the area mapped includes part of the Quirke syncline, the nose of which is well exposed in Townships 137 and 138 immediately to the east (Douglas 1926. Collins 1925).

Within the syncline the normal Huronian sequence is well exposed, and the various units in both limbs can be easily traced. Pre-Huronian granites lie to the north of Quirke Lake, and greenstone and sediments form a belt a mile wide along the south boundary of Township 143.

Surface mapping and drill-data have shown that it is now possible on the basis of lithology to divide the Mississagi Quartzite into at least three units. (Abraham 1956. McDowell 1957. Roscoe 1957.) (See Table I.) All three of these are exposed on the south limb, but on the north limb in Township 144, the lowermost is cut out by overlap against the granite.

Collins' mapping of the Bruce Conglomerate and the Espanola Formation was found to be substantially correct, though additional outcrops were found in the May Lake and Hough Lake–Pecors Lake areas.

As Collins (1925, p. 72) and Roscoe (1957, p. 13) have pointed out, in the eastern part of the area the contact between the Gowganda and Serpent formations appears to be gradational, whereas in the western part the relationship is undoubtedly unconformable. Northeast of May Lake, quartzites and conglomerates shown as Serpent on Collins' map have been mapped as Gowganda.

After the deposition of the Cobalt Group the area was folded and faulted. Dikes and bodies of Keweenawan (Nipissing-type) quartz diabase and gabbro were then intruded. There is some slight post-diabase faulting.

It is generally supposed that the Precambrian shield was flooded by shelf seas during the lower Palaeozoic, since when it has remained a stable positive area. Rejuvenation probably took place during the Laramide revolution, and the present immature topography developed at the expense of the Precambrian peneplane prior to the Pleistocene glaciation. (Eardley 1951. Quirke 1917, pp. 9–12).

Glaciation removed the soil that had developed and substituted an irregular deposit of clay, sand, gravel, and till. Although the major drainage shows marked geological control, the intermittent streams and swamps show a lack of structural control characteristic of glaciated regions. Glacial rounding and polishing of outcrops, scouring of softer beds, striae, and chattermarking are common. These indicate that glaciation was about S.15°W.

[1]New air photos were taken in 1957.

TABLE OF FORMATIONS

CENOZOIC

RECENT:	Swamp, lake, and stream deposits.
PLEISTOCENE:	Gravel, sand, till.

Great Unconformity

PRECAMBRIAN

PROTEROZOIC:

Keweenawan:	Quartz diabase, gabbro, diabase, lamprophyre.

Intrusive Contact

Huronian:

Cobalt Group:

Gowganda Formation: Arkose, conglomerate, greywacke.

Unconformity

Bruce Group:

Serpent Formation:	Quartzite, conglomerate.	
Espanola Formation	Espanola Limestone. Espanola Greywacke. Bruce Limestone.	
Bruce Formation:	Bruce Conglomerate.	
Mississagi Formation	Upper:	Quartzite, arkose.
	Middle:	Argillite. Conglomerate.
	Lower:	Greywacke (in south). Arkose, quartzite. Uraniferous conglomerate

Great Unconformity

ARCHEAN:

	Pre-Huronian soils.
Algoman:	Granite and granodiorites.

Intrusive Contact

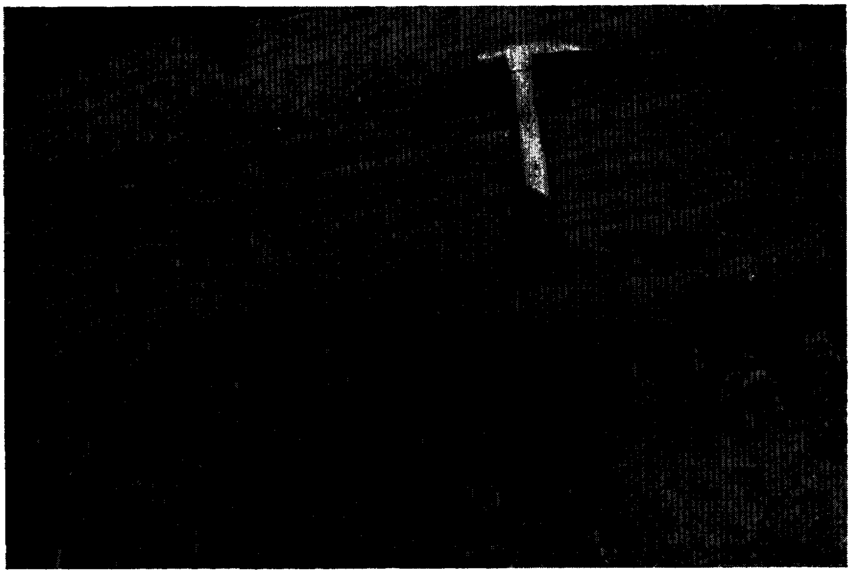
Keewatin?:	Sediments, volcanics, intrusives.

Archean

KEEWATIN ?

The oldest rocks exposed are a heterogeneous sequence of sediments and volcanics intruded by pre-Huronian diabase. These are exposed in a mile-wide belt along the south boundary of Township 143.

At the southeast corner of Ryan Lake, on the west boundary of Township 143, lie greenstones, lean iron formation, greywacke, quartzite, and thin-bedded rhyolites striking southeast and dipping 50°–60°NE. The greenstones are massive plagioclase-ferromagnesian rocks with minor disseminated sulphide; the greywacke, quartzites, and iron formations show crumpling with the development of secondary quartz carrying minor sulphide. The more argillitic beds show slaty



Keewatin(?) magnetite iron formation and quartzite; east of Ryan Lake, Township 143.

cleavage parallel to the bedding and are chloritized. The iron formation occurs in 80-foot-wide zones and consists of magnetite, chert, and quartz in layers approximately ¼ inch thick but with occasional beds up to a foot thick (see accompanying photo). The outcrop is coincident with the position of a marked high on the aeromagnetic map. This anomaly continues northwest into Township 149 indicating continued presence of iron formation below the Huronian unconformity. (O.D.M. 1954.) The rhyolite is a greenish grey, sugary textured rock when fresh but is yellow-green when weathered. On the weathered surface, flow banding and orientated quartz fragments are revealed.

To the northeast the sequence passes upwards to quartzites, schistose greywackes, phyllites, and sericite schists with scattered grits and thin conglomerates. There are also thin bands of basic rock, some of which have cavities filled with quartz, calcite, or chlorite, and which probably represent amygdaloidal basalts and andesites. Bodies consisting of massive, fine- to medium-grained, basic diabase cut across the structure. Similar diabase may be observed in Township

150 north of Quirke Lake, although these bodies have been mapped as Keweenawan by E. M. Abraham (1956). In the East Bull Lake area, Moore and Armstrong (1945, pp. 6, 7) used the term Haileyburian for similar diabasic rocks that cut Keewatin(?) greenstone but are in turn cut by Algoman syenite and granite. Eastwards the strike gradually swings towards the east, and the dip steepens to 70 degrees, the cleavage remaining parallel or nearly parallel to the bedding. The number of dikes and irregular masses of basic intrusives increases to the south of Pecors Lake. Some of these show diabasic texture and at first sight resemble Keweenawan diabases, but in general they are finer grained, more basic looking, and more highly altered. In the same region there are a few cross-cutting porphyrite dikelets probably related to the granodioritic phase of the Algoman granite. Immediately to the south of Pecors Lake, east of the west arm, there are scattered exposures of low-grade iron formation again giving rise to anomalies on the aeromagnetic map. Small amounts of pyrite, pyrrhotite, and chalcopyrite are found south of Pecors Lake particularly in or close to pre-Huronian diabase. Samples taken by Teck Exploration Company Limited from test pits contained traces of nickel, but nothing of economic interest was discovered (*cf.* Moore and Armstrong 1945, p. 6).

In Township 143, about ¼ mile to the south of the boundary of the Huronian, there are several exposures of a massive conglomerate with pebbles of white granite up to 6 inches in diameter, angular to subangular blocks of iron formation, greenstone, and greywacke set in a chloritized greywacke matrix with scattered grains of white and smoky quartz. At one place this conglomerate was seen to truncate quartzite and chlorite schist and to have a dip of about 5°N. Hart *et al.* (1955, p. 261) have suggested that this conglomerate might be younger than the Algoman granite. On one outcrop, pre-Huronian-type diabase definitely cuts this conglomerate. If Moore and Armstrong are correct in assigning such diabase to pre-Algoman age then the conglomerate would also be pre-Algoman.

North of the conglomerate there is a series of andesites and basalts. These are massive but have a few amygdules filled with quartz, calcite, or chlorite. The amygdules and occasional pillows indicate that the flows are right way up with a gentle northerly dip. Nowhere are these lavas exposed in contact with the above mentioned conglomerate, but on structural grounds and on the basis of drilling results, it is believed that they are younger.

Drill-hole evidence indicates that chloritized greenstone representing volcanic rocks underlies the whole of Township 143 and the southern part of Township 144. These rocks are much sheared and fractured; secondary quartz, calcite, pyrite, pyrrhotite, and chalcopyrite have been introduced. A greenstone-bearing conglomerate has been observed in the Can-Met mine.[1] The distribution of greenstone under Quirke Lake is very erratic, and it appears that the granites have stoped off large blocks. Again the presence of secondary carbonate, quartz, and sulphides (particularly pyrrhotite) is characteristic.

The regional trend of the boundary zone between the granite and the greenstone appears to be about S.75°E.

In the granites north of Quirke Lake and the Serpent River there are a few scattered inclusions of greenstones, rhyolite, and iron formation (Collins 1925, p. 20), but these are not as numerous as in Township 150 (Abraham 1956). Mapping was not continued for more than a mile north of Quirke Lake. However, Greenstones and quartzites occur in the northwest corner of Township 144 and continue into Township 145 (Collins 1925. Harding 1941, p. 4).

[1]J. Hogan, mine geologist Can-Met, personal communication.

ALGOMAN

Granites

To the north of Quirke Lake and the Serpent River lie granites of Algoman age. These are massive and contain few inclusions. There is a wide range in lithology including grey granodiorites, pink granites, quartz-monzonite, porphyries, and red potash granites. Coarse porphyries, with phenocrysts of microcline and plagioclase up to 1½ inches long, are well developed near both east and west boundaries of Township 144, but the rocks are predominantly medium- to coarse-grained equigranular. The pink to red quartz-monzonite and granites grade into each other and into the porphyries, and thus all are variations of the same magma. Aplitic and pegmatitic segregations and dikes are rare and are of simple mineralogy—feldspar and quartz and a little mica. The common minerals are microcline (perthite and occasionally orthoclase are also found), oligoclase, quartz (commonly bluish), biotite and, more rarely, hornblende. Oligoclase is commonly altered to sericite and clinozoisite, whereas the microcline remains fresh. The ferromagnesian minerals are altered to chlorite (penninite) and epidote. Hornblende is found near inclusions and in the granodiorites. Muscovite is found in the potash granite. Accessory minerals, separated and identified by the author, include allanite, augite, apatite, epidote, fluorite, iron oxides, monazite, titaniferous magnetite, tremolite, sphene, zircon, and zoisite (*cf.* Roscoe 1957, p. 4). Idiomorphic sulphides, mainly pyrite and chalcopyrite but also pyrrhotite and galena, have been recovered in heavy mineral separations, but it is not clear whether these are primary accessories or not.

When weathered the rocks, particularly those richer in potash, take on a brick-red coloration. As these rocks are fresher than the granodiorites they may possibly be somewhat younger. There has been a tendency to regard such granites as Killarnean, i.e., post-Huronian in age (Harding 1950. Moore and Armstrong 1945). However, no evidence has been found in the Quirke syncline of a post-Huronian granite, indeed the Huronian rests with pronounced unconformity on both red and grey granites alike.

The aeromagnetic map of Township 144 shows numerous radioactive anomalies over the red granitic rocks north of Quirke Lake. These were linked with the higher ground rather than with any local variations in rock type. It is of interest that aeromagnetic maps for other townships in the Blind River area that are underlain by pre-Huronian grey granodioritic rocks, greenstone, and hybrid rocks show no such concentration of radioactivity anomalies (O.D.M. 1954). From previous work and reconnaissance-type surveys in adjacent areas it is known that the potash granites are found in broad elliptical zones surrounded by granodiorites and hybrid rocks. Aplites and pegmatites cut all types but are more common outside the potash granite areas.

These relationships indicate that the potash granite is rather later than the granodiorite. It is not clear to what extent the radioactivity is due to the breakdown of potassium to argon and to what extent it is due to the decay of uranium and thorium concentrated in the accessory minerals, particularly zircon, monazite, and allanite.

POST-ALGOMAN INTERVAL

The Huronian rests with marked unconformity on the granites and greenstones. The boundary surface, although irregular, is approximately parallel to the bedding of the Huronian (Charts A, B, C, D, map case).

Along the north shore of Quirke Lake and in drill core, a transition zone between the granites and the basal Mississagi can be observed. (Roscoe 1957, pp. 4, 5. Collins 1925, pp. 30, 31, and Fig. 3.).

The plagioclase feldspars of the granite become yellow, owing to the development of sericite, and the ferromagnesian minerals disappear. This passes upwards into a yellow-green, unsorted, quartz and potash feldspar aggregate set in a sericite matrix with rare, scattered fragments of vein quartz and partially weathered granite. This material grades into the sorted sediments of the overlying Mississagi and is taken to represent a pre-Huronian soil or regolith developed during subaerial weathering. This transition zone, depending on later sorting, is up to 50 feet thick but is generally less than 20 feet.

Transition zones can be seen over both grey and pink granites, confirming apre-Huronian age for the latter.

Core sections also show development of crumbly chloritic material between the greenstones and the sediments. North of the greenstone belt, i.e. along the north shore of Quirke Lake and along the Serpent River, there is a marked overlap of the Mississagi on to the basement where apparently higher ground had formed due to the more resistant nature of the granite.

Thus, after the intrusion of the Algoman granites, the area was exposed to a prolonged period of subaerial denudation, resulting in the formation of a peneplane, some of the soils of which have been preserved.

Proterozoic

HURONIAN

Apart from the area north of Quirke Lake and the Serpent River, and a mile-wide strip along the south margin of Township 143, the whole area is underlain by gently folded sedimentary rocks of Huronian age. These rocks consist of conglomerate, quartzite, arkose, greywacke, argillite, siltstone, and limestone. The rocks are only slightly metamorphosed, and original structures such as bedding, cross-bedding, ripple marks, and mud cracks are perfectly preserved. The Huronian is subdivided as indicated in the table of formations on page 8.

Bruce Group

MISSISSAGI FORMATION

This is the oldest member of the Huronian, and since its lowermost beds contain the uranium ore of the district, it is the one in which most interest has been taken. The formation can be divided into three units (see page 8) on the basis of lithology and structure. The lowermost unit is a series of conglomerates and arkoses with, in the south only, development of argillites and greywackes at the top. The middle unit consists of a conglomerate overlain by argillite and greywacke, and the upper unit consists of quartzite and feldspathic quartzite.

Lower Mississagi

The Geological Survey of Canada is at present engaged in a detailed study of the Lower Mississagi. J. P. McDowell (1957) has studied the sedimentary features of the formation under the auspices of the Ontario Department of Mines. Table I incorporates a comparison of the nomenclatures used by Roscoe, Abraham, and the author.

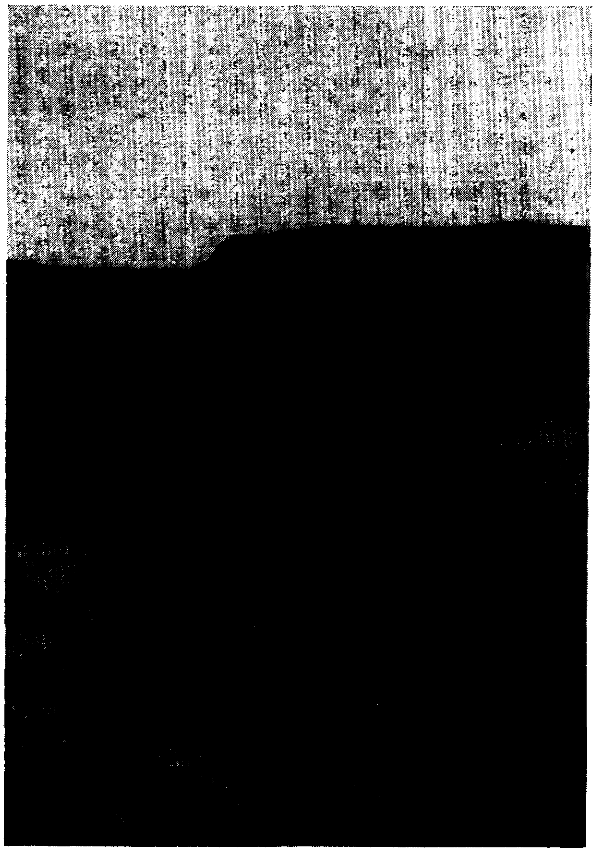
The Lower Mississagi is well exposed on the south limb of the syncline as a scarp and dip slope to the south of the Pecors Lake road. However, it is not exposed in Township 144 owing to the northward overlap of the Mississagi on to the basement. Drill-hole data, especially near the margins of the syncline, are fairly complete. It is convenient to divide the unit into two—a lower conglomerate and arkose sequence, and an upper argillite-greywacke assemblage only present in the Flying Goose Lake–Pecors Lake area. Roscoe (1957) has termed these the Matinenda and Nordic formations.

Although there is a general southward thickening of the lower (or Matinenda) unit, reaching a maximum of 600–700 feet, south of the Pecors Lake road, the unit is characterized by basins and channels of greater thickness (Roscoe 1957, Fig. 3). Thus between the Panel No. 2 shaft and Can-Met the Lower Mississagi is 200–250 feet thick whereas to the east at Teasdale Lake, and immediately south of Can-Met, it is reduced to 50–100 feet. Between the south end of the southeast bay of Quirke Lake and Halfmoon Lake it is apparently missing. Between Poppy and May lakes it is about 200–300 feet, but is again missing between Elephant and Hough lakes. At Flying Goose Lake there is 500–550 feet of Lower Mississagi, increasing southwards to 600–700 feet along the southern outcrop between the west township boundary and Pecors Lake. From Pardee Lake a zone about ¼-mile wide and some 50–100 feet thicker than the adjacent rocks strikes southeast. To the northwest of the lake the channel bifurcates and dies out, one branch running east-west immediately north of Stinson Lake and the other northwest towards the east end of Flying Goose Lake. Between the west end of Pecors Lake and Vite Point the unit thins, and on the west side of the point it is absent. It is again present on the east side of the point and thickens towards the township boundary. It will be seen that these areas of greater deposition are parallel or subparallel to the known directions of structural importance in the basement. (See pages 9 and 10 and Table IV.) It is probable that differential pre-Huronian erosion on the basement was the controlling factor in the development of these zones.

The lowermost 60–120 feet consists of moderately sorted, coarse-grained, green-weathering arkose, interbedded with pebbly quartzite and oligomictic conglomerate lenses. These conglomerates are 1–12 feet thick and consist dominantly of well-rounded, well-sorted, quartz cobbles up to 6 inches in diameter, but generally about 1–3 inches. They may also contain iron formation similar to that found in the basement, granite, rhyolite, and greenstone. These conglomerates carry uranium and thorium minerals and up to 15 percent pyrite. Where there is a basal conglomerate the non-quartz boulders are more common, and sorting and rounding are poor. Drill-hole evidence indicates that the conglomerates are both more numerous and thicker in the areas of greater deposition. Indeed several drill holes remote from those areas contain no conglomerate.

Above the conglomeratic zones there lie a series of greenish arkoses passing upwards into brown-weathering feldspathic quartzites and white quartzites. Crossbedding is from the northwest, and McDowell (1957) gives the regional direction of deposition of the Lower Mississagi as 158 degrees.

The second or upper unit of the Lower Mississagi (Nordic Formation of Roscoe) consists of argillite, impure quartzite, and greywackes with thin conglomerates above the typical lower quartzite; however, the outcrop is obscured by drift. Under Pardee and Stinson lakes the assemblage is about 250 feet thick, a mile to the north it is about 90 feet, and 2 miles north, at Flying Goose Lake, it is absent. Eastward the unit thins out under Pecors Lake and is absent ¼ mile north of Vite Point, but on the east boundary of Township 143 it has regained a thickness of 70 feet. Roscoe (1957, p. 8) regards the Nordic Formation as a deeper-water equivalent of the upper Matinenda of the north



Scarp of Upper Mississagi Quartzite overlying Middle Mississagi argillite and greywacke; west of Vanhorn Lake, Township 143.

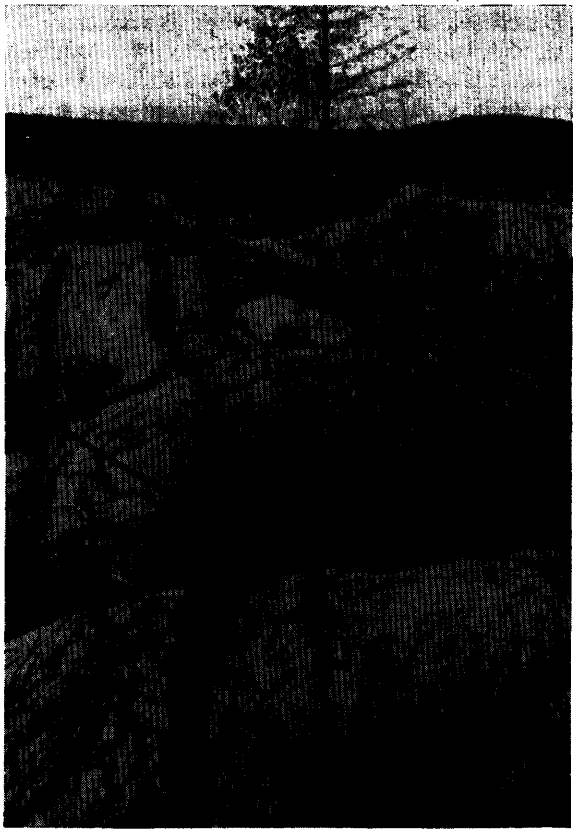
belt; the author agrees with this. (See Table I.) McDowell (1957, p. 6) and Abraham (1956) have on the other hand, placed the Nordic unit in the Middle Mississagi.

Middle Mississagi

The Middle Mississagi consists of a basal boulder conglomerate overlain by argillites and greywackes.

The conglomerate contains boulders, cobbles, and pebbles of granite (white predominant over red), quartzite, and greenstone, and fragments of quartz and feldspar set in a matrix that grades upwards from a siliceous greywacke to siltstone. Bedding planes are characterized by mud cracks. Within the area described the conglomerate is exposed only on the north shore of Quirke Lake and the Serpent River; in the south, drift obscures the outcrop.

On the north shore of Quirke Lake the conglomerate lies on the granite; Collins (1925, p. 38) mistook this for the oldest Huronian conglomerate. In the central area it lies on Lower Mississagi quartzite, and in the south on the Nordic argillites and greywackes, but near Blind River it overlies quartzites. Roscoe (1957 pp. 9, 10) regarded this conglomerate as "the most important horizon marker within the Lower Huronian succession," and used it as the basis for his division of the Mississagi.



Nearly vertical Upper Mississagi Quartzite with thin arkose bands; east of Tees Lake, Township 143.

The Middle Mississagi Conglomerate ranges in thickness from 3 feet to 60 feet, but locally between Flying Goose and Pardee lakes it may reach 200 feet (Roscoe 1957). There is a gradual increase in thickness from north to south.

The conglomerate grades up to a finely laminated siltstone or argillite. Occasional boulders and pebbles are found; these depress and cut across the inferior laminae, whereas the superior laminae are attenuated, suggesting that the pebbles were dropped from floating ice. The argillites pass upwards through a series of interbedded argillites, greywackes, and impure quartzites to the quartzites of the Upper Mississagi.

Owing to their great susceptibility to weathering, the argillites tend to form low ground, for example the Panel valley (photo, p. 16) and the Serpent valley in the north and the Stinson-Pecors valley in the south, and are only exposed in cliff sections capped by quartzite, as on the north side of the Stinson-Pecors valley, or by diabase, as near Nook Lake. The greywackes and argillites are characterized by graded bedding and ripple marks indicating shallow-water deposition. The thickness of the argillite-greywacke sequence ranges from 100 to 300 feet in the Quirke Lake–Serpent River area, increasing southward at a rate of approximately 90 feet per mile to 700–800 feet on the south limb along the Pecors Lake road. Both the argillites and the greywackes as well as the complete sequence show this southerly increase.

Drilling near the west end of Pecors Lake does not penetrate these beds; neither are the beds exposed at surface, since they are covered by the west arm of the lake. At the Algom pumphouse they are reduced to 500 feet, at the junction of the arm and the main lake they cannot exceed 120 feet, but from Vite Point to the east township boundary, drilling shows that they once again attain 700 feet.

Construction camp at Panel mine, looking west. Right: Algoman granite, with patches of Middle Mississagi conglomerate. Centre: Middle Mississagi Argillite eroded to form a valley. Left: Upper Mississagi arkose.

Upper Mississagi

The Upper Mississagi is exposed on the north limb at the Panel uranium mine (photo above), the northerly islands in Quirke Lake, and between the Serpent River and Teasdale Lake. It is also exposed as a belt 1½ miles wide, along the south limb from Canyon Lake to Hough Lake and Vanhorn Lake, and from Pecors Lake to the east township boundary.

On the north limb it consists of 700–1,000 feet of medium- to coarse-grained, yellow-green to grey, feldspathic quartzite, and quartzite. The crossbedding is dominantly from the northwest, but McDowell (1957, fig.5) has also recorded both easterly and northeasterly crossbedding.

Drilling indicates that the upper quartzites are 1,500 feet thick near Flying Goose, May, and Hough lakes.

North of the Pecors Lake road the Middle Mississagi is capped by white-weathering, medium-grained, moderately feldspathic quartzite (see photo, p. 14) passing upwards and eastwards to medium- to coarse-grained, crossbedded arkoses and quartzite with bedding defined by thin seams of greenish-weathering sericitic arkose (see photo, p. 15).

Scattered pebbles and pebble bands with quartz and chert up to an inch in diameter are not uncommon. Ripple marking and torrential type crossbedding (the planar crossbedding of McDowell (1957, p. 13)) are indicative of shallow-water deposition. The crossbedding is again dominantly from the northwest, though northeast crossbedding has been found (McDowell 1957, fig. 5).

From a regional statistical study of crossbedding, thickness of bedding, and type and size of pebbles, McDowell (1957) has concluded that the Upper Mississagi was derived from a source lying between 130 and 250 miles west-northwest of Thessalon. The regional direction of crossbedding in the Upper Mississagi is S.71°E. as against S.22°E. for the Lower (McDowell 1957, fig. 16). The significance of this is not yet clear; either, coupled with the transgressive nature of the Middle conglomerate, it would point to a regional disturbance in Middle Mississagi time, or it might indicate that, as sedimentation proceeded, basement topography exerted less distorting influence. Pettijohn (1957, pp. 469–80) gives the direction of crossbedding in the Mississagi at Bruce Mines as S.80°E. and that in the Lorrain (upper Cobalt) at Bruce Mines as S.17°E. and at La Cloche as S.3°E., suggesting that although the source was dominantly northwest there was, with time, a northward shift.

TABLE II—DATA ON CURRENT DIRECTIONS IN THE HURONIAN

Stratigraphic Unit	Direction (astronomic)	Authority
Lorrain:		
Bruce Mines	S.17°E.	Pettijohn (1957)
La Cloche	S.3° E.	Pettijohn (1957)
Average	S.10°E.	Pettijohn (1957)
Serpent:		
Quirke Lake Area	S.50°E.	Simony (1958)
Mississagi:		
Upper Mississagi	S.71°E.	McDowell (1957)
Mississagi (at Bruce Mines)	S.80°E.	Pettijohn (1957)
Lower Mississagi	S.22°E.	McDowell (1957)

Between the east end of Flying Goose Lake and the southeast shore of Elephant Lake a conglomerate dike some 15 feet wide striking slightly west of north is exposed for ⅜ of a mile; the lineament is visible on air photographs. The contact with the quartzite is sharp. The conglomerate consists of fragments, up to 2 inches across, of reddish granite, pink feldspar, and both white and smoky quartz set in a rusty-weathering, greenish grey, siliceous greywacke matrix containing pyrite (up to 5 percent). A smaller but similar dike was reported on the north shore of Pecors Lake. These observations are at variance with those of Collins (1925, p. 53) that such features have not been found below the Espanola Formation.

BRUCE FORMATION

Bruce Conglomerate

The Mississagi Quartzite is followed, apparently conformably, by a conglomerate. In drill core it is often difficult to find a contact, and quartzite grades into conglomerate by increase in the number of pebbles (*cf.* Collins 1925, pp. 45, 46). However, at the surface the contact is sharp. Moreover occasional boulders of a Mississagi-type quartzite have been found, suggesting that, locally, the relationship is that of disconformity.

In the north limb the conglomerate forms east-striking ridges at the southwest and southeast corners of Teasdale Lake. The contact with the overlying Bruce Limestone is not exposed, but drill holes indicate the conglomerate to be 60–100 feet thick. Here the conglomerate consists of pebbles and boulders of granite (white in marked predominance over red), granite gneiss, greenstone, and rare quartzite, and also fragments of quartz, chert, jasper, and white feldspar scattered in a medium- to coarse-grained, dark-grey to black, quartzite to siliceous greywacke matrix characterized by subangular grains of smoky quartz up to 1/10 inch across. Interstitial pyrite, on weathering, gives rusty stains, but this is much less conspicuous than at the west end of Quirke Lake (*cf.* Collins 1925, p. 46).

Owing to the highly siliceous nature of the matrix, particularly in the lower part of the formation, pebbles and boulders tend to weather more rapidly than the adjacent rock, giving the conglomerate a characteristic pitted surface. Laminated bedding, and the presence of lime in the matrix have been observed in the upper part of the formation.

Although the rock is generally similar to the Middle Mississagi Conglomerate it can be distinguished by its more massive and more siliceous character, by the conspicuous smoky quartz-grains, the pitted surface, the normal lack of laminations, and by the general presence of pyrite.

In the central part of the area, drilling shows that the conglomerate may be as much as 150 feet thick. Bruce Conglomerate is poorly exposed from Canyon Lake to Hough Lake, and although both contacts are nowhere visible, it is probably less than 20 feet thick. Pebbles are smaller and more scattered, whereas the matrix is lighter grey and more quartzose than in the north. On the headland at the west end of Pecors Lake the Bruce Conglomerate is represented by less than six inches of light-grey quartzose grit. At the northeast corner of the lake it resumes its normal character and is about 20 feet thick, thence it strikes east and thickens to approximately 50 feet at the township boundary.

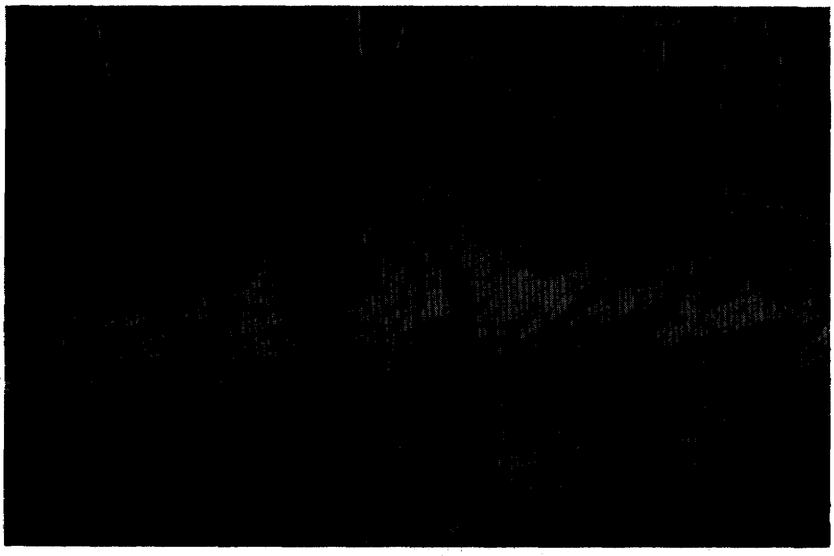
ESPANOLA FORMATION

Above the Bruce Conglomerate, and conformable with it, are limestones and mudstones. In the Quirke Lake area a threefold division is possible, but elsewhere Collins found it impossible to make this distinction and used the term Espanola Formation for the sequence (Collins 1925, p. 54).

Bruce Limestone

The Bruce Conglomerate–Bruce Limestone contact is not exposed in the area mapped except for one locality at the head of Pecors Lake where the Bruce Conglomerate is represented by six inches or less of quartzose grit. Exposures and drilling in Township 149 near the Stanleigh mine and highway No. 108, some 2 miles north of Elliot Lake, show that the Bruce Conglomerate passes upwards through a black, non-conglomeratic, non-calcareous, siliceous greywacke, 5–10 feet thick, into well-bedded limestone and siltstone. Drilling indicates that this limestone unit, the Bruce Limestone, ranges in thickness from 100 to 150 feet over the greater part of the area; however, where exposed on the south limb, the formation cannot exceed 80 feet, and at the northwest end of Pecors Lake it is not more than 25 feet.

On the north limb the limestone is exposed at the east end of Roman Island, and also at the base of a diabase sill forming a cliff that runs east from the southeast shore of Teasdale Lake. The rock consists of alternating cream-coloured limestone and grey calcareous siltstone. The bands range from 1/10 inch to several inches in thickness, the limestone bands generally being thicker than the adjacent siltstone bands. Differential weathering gives the rock a characteristic ribbed surface. (See photo, below.) Commonly it exhibits dragfolding in which the upper limb has moved upwards and northward relative to the lower; this folding is such as would be expected to form in an incompetent rock during the folding of the syncline. There are exposures of highly corrugated Bruce Limestone against diabase to the south of Conecho Point on Quirke Lake. Although it is not clear whether these exposures are country rock or xenoliths, the dragging indicates an upward movement of the diabase relative to the limestone.



Thinly-bedded Bruce Limestone near Denison Mine, Quirke Lake, Township 150. Note dragfolds (lower centre).

Bruce Limestone is also exposed on the south limb where it generally forms a slight scarp to the north of the Bruce Conglomerate; its contacts are not visible. Northeast of the west end of Hough Lake, and at the west end of Pecors Lake, the carbonate-rich bands take on a blue-grey colour and weather to a dark reddish brown. The reaction to acid is much less vigorous than that of the typical Bruce Limestone. These are the characteristics of ferruginous dolomite. It is interesting to note that this rock type has been found only where the unit shows marked thinning. The dolomite is probably due to original deposition, either chemical or biogenic, in shallow water. Where relatively pure and free of phosphorus the Bruce Limestone could provide lime for use in the extraction plants at the mines.

Espanola Greywacke

The Bruce Limestone passes upwards into a thinly bedded, fine-grained, calcareous to non-calcareous, siltstone with occasional beds of greywacke, quartzite, and conglomerate. Although the dominant rock type is actually a siltstone, Collins used the term greywacke in the field (Collins 1925, p. 51), and this has been retained in the literature. Drill and surface information indicate the unit is

400–500 feet thick, but between McCabe and Benedict lakes it is reduced to 200–300 feet, and at the northwest end of Pecors Lake to about 200 feet increasing eastwards to 400–500 feet.

On the north limb, Espanola Greywacke is exposed on Roman Island, on the islands east of the Can-Met mine, and between Teasdale and Ouellette lakes; on the south limb, it is exposed from McCabe Lake to May Lake, and northwest of Pecors Lake to the east boundary of Township 143.

The lowermost part of the formation is characterized by the presence of breccia beds. These are made up of closely packed angular blocks of laminated greywacke with random orientation in a fine-grained, structureless, calcareous matrix (Collins 1925, p. 52 and photo, p. 143). These are believed to be intraformational breccias formed prior to, or during, induration of the rock (*cf.* Pettijohn 1956, p. 192).

Gently folded and faulted Espanola Limestone; west side of large island in Quirke Lake, northwest of Can-Met mine, Township 144. Dark bands are ferruginous dolomite.

On the south island, east of the Can-Met mine, there is a conglomerate that is rather similar in type to the Bruce and Middle Mississagi conglomerates. Outcrop shows the conglomerate to be in general conformable contact, but on the east side of the island the conglomerate is seen occupying a fracture in the greywacke below. The contact between the rock types is not sharp, suggesting the rocks were only partially consolidated at the time of fracturing. Drill-hole evidence shows that the conglomerate varies rapidly in thickness but underlies much of the southeast arm of Quirke Lake. Collins (1925, p. 53) has described several conglomerate dikes in the Espanola Formation and ascribed them to contemporaneous earthquake action. A somewhat similar conglomerate, 5–10 feet thick, is intermittently exposed on the south limb from McCabe Lake to halfway between McCabe and Hough lakes. In the same area there is a well-marked feldspathic quartzite bed some 20 feet thick. The upper part of the sequence is characterized by ripple marks and mud cracks.

Espanola Limestone

The uppermost member of the Espanola Formation is the Espanola Limestone. On the north limb this is exposed on the islands northwest of the Can-Met mine (photo, p. 20), on the shore of Quirke Lake near Can-Met, on the north shore of Ouellette Lake, and a few outcrops between Ouellette and Rangers lakes where it is 150–200 feet thick. On the south limb of the Quirke syncline the Espanola Limestone is in general poorly exposed. The following variations in thickness were observed:

Between	Feet
McCabe and May lakes	100 to 150–200
May Lake and Hough Lake (N.)	less than 20
Vanhorn Lake and Hough Lake (E.)	50 to 150
Hough Lake (E.) and east boundary of Township 143	130–180

The marked reduction in thickness (and possibly local total absence) between May and Hough lakes is partly due to decreased sedimentation and partly to pre-Cobalt erosion.

The Espanola Limestone is characterized by beds up to 2 feet thick of blue-grey, brown-weathering, ferruginous dolomite interbedded with limestone and siltstone. The Espanola Greywacke passes upwards into the Espanola Limestone by increase in the number and thickness of "brown bands." Like the Bruce Limestone, though on a larger scale, the Espanola Limestone gives rise to ribbed surfaces due to differential weathering.

On the islands in Quirke Lake the brown beds cannot be traced continuously since they pass into structureless siltstone with disconnected limestone blocks. These, like the breccias in the greywacke, are considered to be intraformational. Wherever exposed, the Espanola Limestone shows gentle folding (see photo, p. 20) so that strikes and dips cannot be projected. It is not clear whether these folds are due to slumpage or to folding during the formation of the syncline, but, since the strike of these folds parallels the local regional strike, the author prefers the second suggestion.

Ripple marks and mud cracks indicate that the Espanola Formation was laid down in shallow water, and the thin bedding and fine grain indicates slow accumulation. The presence of intraformational breccias, slumpage structures, conglomeratic dikes, and lenses indicate that the area was subject to disturbance. It is believed that the dolomite has formed as the result of chemical or biogenic deposition in shallow water rather than from metasomatic replacement of original limestone.

SERPENT FORMATION

Serpent Quartzite[1]

The type area for this member is Quirke Lake (Collins 1925, p. 55). On the north limb the Serpent Quartzite is well exposed on the south shore of Quirke Lake, and less well exposed on Ouellette and Rangers lakes; on the south limb it forms a broad belt running east and northeast from McCabe and Poppy lakes to May, Halfmoon, and Lizotte lakes, and a relatively narrow strip running east from Hough Lake.

Although the upper Serpent and lower Gowganda are similar, in the east-central part of the area, it is clear that the Serpent gradually reduces in thickness

[1]P. Simony, who undertook a study of the Serpent quartzite for a B.Sc. thesis at McMaster University, has generously placed the data gathered for this work at the author's disposal.

from north to south. The Serpent is entirely missing on the south limb to the west of the area (Abraham 1956), and within the area Gowganda Conglomerate rests on Espanola Limestone between May and Hough lakes.

The Espanola Limestone passes upwards through calcareous siltstone and impure quartzite, ranging in thickness from a few inches to 15 feet, into a well-bedded (bedding being 4–6 feet) cross-laminated quartzite (Collins 1925, pp. 55, 56. Roscoe 1957, p. 12). The latter consists of alternating laminae, $\frac{1}{16}$–$\frac{1}{4}$ inch thick, of white feldspathic quartzite and yellowish-white feldspathic quartzite with a slightly calcareous cement. This cement tends to dissolve on weathering, and the calcareous laminae are represented by shallow grooves which, having caught wind-blow dust, are readily visible (Collins 1925, p. 56). In these grooves individual quartz grains are visible, and they are seen to be well rounded and sorted. In drill core the calcareous bands have a pale yellow colour. On the shore

Lower Serpent Quartzite, laminated calcareous quartzite; south of Hough Lake, Township 143.

of Quirke Lake, a little over $\frac{1}{4}$ mile west of the Can-Met shaft, the basal part of the laminated quartzite is seen to be brecciated. Once again this is an intraformational breccia. (See photo, p. 23.) This laminated quartzite is 180 feet thick at Quirke Lake between the Can-Met and Stanrock mines; about 250 feet thick at Ouellette Lake, 3 miles west of the above locality; and 400 feet thick at the east end of Hough Lake, 4 miles due south of the east end of Ouellette Lake.

The lower Serpent is followed by a coarse-grained, massive, arkosic grit with a slightly calcareous cement. This grit has proved a useful marker horizon and, like the laminated quartzite, thickens in a southerly direction.

The grit is followed by massive, white, feldspathic quartzite grading upwards to pinkish, silty quartzite and quartzite with argillitic and conglomeratic bands. Where the quartzite is not silty it resembles the Upper Mississagi Quartzite; this is most marked on the south shore of Hough Lake and to the east of Vanhorn Lake where the two types are brought into juxtaposition by faulting. The pink-weathering, more silty varieties containing hematite resemble quartzites in the overlying Gowganda Formation. The lower part of the sequence is characterized by scattered pebbles, mostly of white granite and up to 3 inches in diameter.

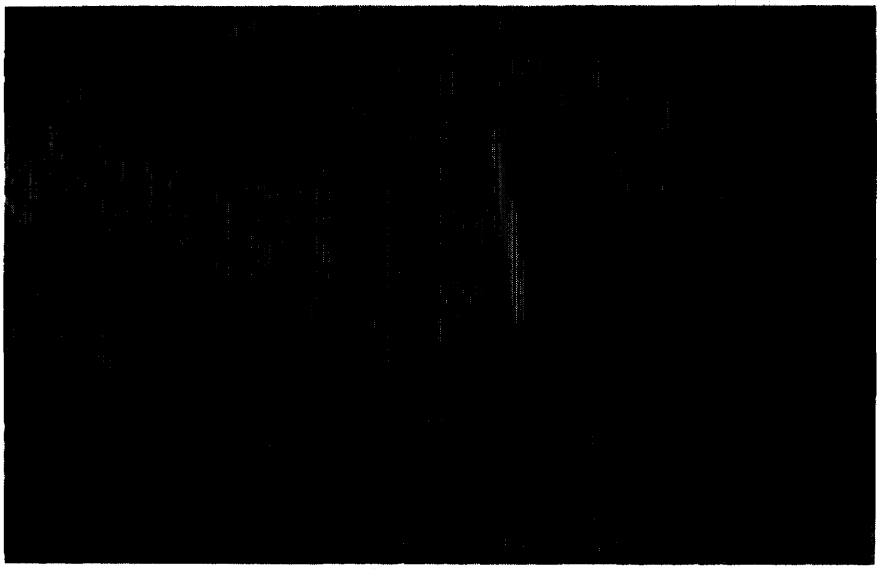
In the upper part of the succession, notably on the southeast arm of Quirke Lake and near Hough Lake, there are beds, ½ inch to 1 foot thick, of fine-grained, yellow-green quartzite with a sugary texture and a weathered surface resembling glazed porcelain. The thinner beds are broken and disrupted presumably as the result of intraformational brecciation. Near Hough Lake these brecciated yellow bands help to distinguish the Serpent Quartzite from the Upper Mississagi, beside which it is exposed as a result of faulting. Other distinguishing features of the Serpent Quartzite are convex and festoon rather than planar crossbedding, the presence on bedding of minute mud cracks and small-amplitude ripple marks (see photo, p. 24), and a lack of scattered quartz and chert pebbles.

Intraformational breccia near the base of the Serpent Quartzite; ½ mile west of Can-Met No. 1 shaft, Township 144.

Thin-section study shows that the quartzite is characterized by overgrowth of quartz, though often the original outline of the grains is preserved. Both plain quartz and the interlocking quartz characteristic of metamorphic rocks have been observed. Other minerals identified are microcline, orthoclase, perthite (slightly altered to clay minerals) and acid plagioclase (generally altered), tourmaline, zircon, sericite, and muscovite. Secondary sericite and pyrite, the latter replacing quartz were also observed.

Current direction as deduced from ten measurements on crossbedding and five on ripple marks indicate an average current direction of S. 50° E. with source in all cases in the northwest quadrant. It may be noted that this value lies between those given by Pettijohn (1957) and McDowell (1957) for the Upper Mississagi, and that by Pettijohn (1957) for the Lorrain, and thus confirms the idea of a steady northward swing in current direction with time. (See table, p. 17.)

To the northeast of Rooster Rock, i.e. on the Stanrock and Can-Met properties, the Serpent Formation is 500–800 feet thick, increasing to about 1,100 feet on the southeast arm of Quirke Lake and decreasing to 550 feet south of Ouellette Lake. South of Quirke Lake drilling results show rapid variation in thickness between 400 and 900 feet. Along the east shore of May Lake it ranges from 900 feet in the north to zero at the south end. From the east end of Hough Lake to the east township boundary the Serpent is about 700 feet thick. The variation in thickness is probably due to pre-Cobalt folding and erosion, though in the May Lake–Hough Lake area there was probably reduced sedimentation, as with all earlier Huronian formations in that vicinity.



Ripple-marks and mud cracks in Serpent Quartzite; southwest of Lizotte Lake, Township 143.

Cobalt Group

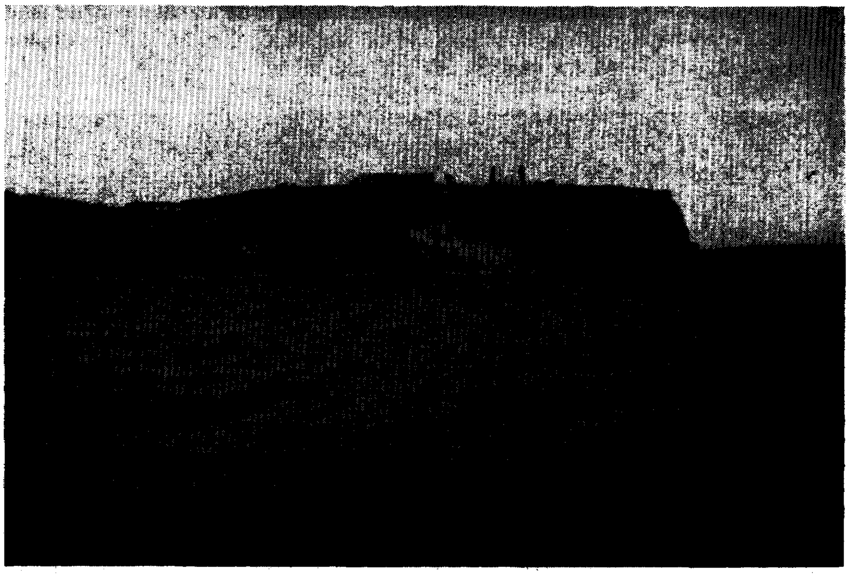
GOWGANDA FORMATION

A heterogeneous assemblage of conglomerates, greywackes, siltstones, and quartzites, generally correlated with the Cobalt Group of the Gowganda district, which is of glacial origin, overlies the Serpent Quartzite. It is not possible to trace individual beds or units.

The Gowganda Formation is the youngest sedimentary formation exposed in the area, but owing to post-Huronian erosion the full succession is not present. The maximum thickness attained is some 800 feet, between the Stanrock housing site and the southwest arm of Quirke Lake.

On the south shore of Quirke Lake, near the Can-Met and Stanrock mines, dense boulder conglomerate lies in marked unconformity on Serpent quartzite. The conglomerate is well exposed at Rooster Rock, the prominent 300-foot cliff on which the Stanrock surface plant is located. (See photo, p. 25.) Here, angular to subangular boulders of red granite, white granite gneiss, greenstone, and diabase up to 6 feet across, well rounded cobbles of similar material, and pebbles of white quartz, chert, and jasper, are scattered in a medium- to fine-grained, dark-green to black, greywacke to siliceous greywacke matrix.

Occasional sandstone layers, 6 inches to 1 foot thick, define the bedding, particularly near lake level. North of the mine the conglomerate is seen to truncate the bedding of the Serpent (photo, below) with a southerly dip some 3 degrees greater than that of the Serpent. To the east of the Stanrock No. 2 shaft there is evidence of a large depression in the Serpent quartzite that has been filled with conglomerates, mudstones, and quartzites. The basal member as exposed in the Stanrock shaft[1] (C.I.M. 1957, p. 13) contains blocks up to 10 feet in diameter of disoriented Serpent quartzite.



Rooster Rock and the Stanrock mine, Quirke Lake, Township 144, from the north. Contact of Gowganda Conglomerate (dark) on Serpent Quartzite (light) is exposed (left centre).

The basal contact remains distinct (with boulder conglomerates lying on quartzite) when traced east to the Can-Met mine, thence around the southeast arm of Quirke Lake, then to the east side of Halfmoon Lake, then west to Poppy Lake, and southwest to the boundary of Townships 143 and 149 immediately north of McCabe Lake.

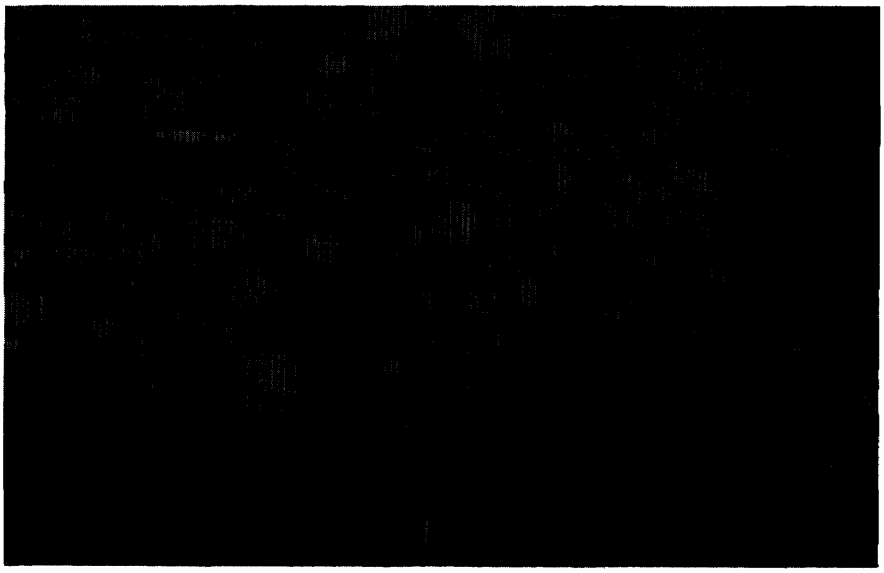
In the area bounded by Ouellette, Halfmoon, Rangers, and May Lakes it is difficult to define the base of the Cobalt with certainty because the lower part of the formation is made up of interfingering whitish quartzite and greywacke conglomerates, many of which contain numerous well-rounded boulders of white granite (photo, p. 26). The photo on p. 27 shows a massive unsorted boulder conglomerate south of Ouellette Lake, which is definitely within the Cobalt Group. The quartzites are similar to those developed in the upper Serpent but are finer grained, less calcareous, contain more argillaceous material, and show neither crossbedding nor ripple marks. The conglomerates, whilst unlike the typical (red granite) conglomerates of most of the Gowganda, are more like Cobalt rocks than those conglomerates sporadically developed in the Serpent Formation.

In accordance with the criteria used in mapping Townships 149 and 150 the lowermost conglomerate was taken to be the base of the Cobalt Group. Roscoe

[1]Fred Barnes, mine geologist Stanrock, personal communication.

(1957, fig. 2 and p. 13) however has placed such conglomerates in the Serpent and has concluded that the contact is interfingering and that this is "incompatible with the concept of a regional erosional break between the Bruce series and Cobalt series." However, as Collins (1925, p. 72) has pointed out, the local appearance of conformity is more apparent than real—the regional relationships of the Gowganda to the Bruce Group undoubtedly indicate an intervening period of folding, and erosion.

The upper conglomerates in this area contains red granite, like those in the Quirke Lake area. It may be noted that in Township 149, where there is no doubt of the unconformable relationship of the Cobalt Group the basal member is locally characterized by white granite boulders, as on highway No. 108, 2 miles north of Elliot Lake townsite, and on the Stanleigh property.



Well-sorted and rounded Lower Gowganda Conglomerate; west of Halfmoon Lake,Township 144.

On the east side of May Lake, boulder conglomerates resting on typical white Serpent quartzites pass laterally into thinly bedded siltstone and pink-weathering, grey, silty quartzites 1–2 feet thick lying on white-to-pink Serpent Quartzite. Between May and Hough lakes Gowganda conglomerate can be seen lying unconformably on Espanola Limestone and in one outcrop on Espanola Greywacke. Between the east end of Hough Lake and the east boundary of Township 143 boulder greywacke conglomerate lies on white feldspathic quartzites and pink-weathering silty quartzites of the Serpent Formation. Between Poppy Lake and the Can-Met road there are interbedded conglomerates and white-weathering, fine-grained, grey quartzites; around the southeast arm of Quirke Lake and near Corner Lake there are several exposures of massive, medium-grained, pink, ferruginous, arkosic quartzite interbedded with greywacke conglomerate. Such quartzite is more common in Townships 149 and 150. These quartzites are rarely crossbedded, and no determinations of current direction were made. A pink quartzite dike approximately 2 feet wide and striking north was observed on the north shore of the small bay to the north of the May Lake diabase.

The Cobalt conglomerates can be distinguished from those lower in the sequence by the predominance of pink and red, as opposed to white, granitic rocks. Moreover, the distribution and sorting of the boulders is extremely erratic. The matrix is very fine-grained and generally chloritic rather than quartzose, therefore the pebbles and boulders of siliceous rocks weather less rapidly than the matrix and protrude above it. Lamination of the matrix is common but in this area is generally indistinct. (Varved conglomerates like parts of the Middle Mississagi Conglomerate are found elsewhere in the Blind River area.) A vertical or near-vertical cleavage is usually poorly developed. The presence of the lamination and the cleavage causes the Cobalt conglomerate and greywackes to weather into elongate triangular fragments or "pencils".

Unsorted Gowganda Conglomerate; west of Sorley Lake, Township 144.

Folding and erosion of the Bruce Group prior to the deposition of the Cobalt Group are indicated by the following:

1) The unconformable relations exposed, both at surface and by drilling, on the Can-Met property and Stanrock properties.
2) Rapid vertical variation in thickness of Serpent Quartzite in drill holes near Poppy Lake.
3) Exposures on the east side of May Lake, where the Serpent ranges from 50 to 400 feet in thickness, and those between May and Hough lakes, where conglomerate rests on any one of Serpent Quartzite, Espanola Limestone, or Espanola Greywacke.
4) Truncation of Cobalt rocks over the Bruce Group in the Crotch Lake–Sherriff Lake area of Township 149 (Abraham 1956. Collins 1925, map).

Bedding is poor and is often better seen at a distance than on the outcrops themselves. The impossibility of tracing beds for any distance, and the marked lack of homogeneity of the greywacke conglomerate beds point to special conditions of formation. Although it is doubtful whether there is a regional basal tillite as postulated by Collins (1925, p. 73), the rocks in question probably accumulated under glacial or subglacial conditions.

KEWEENAWAN

The youngest rocks in the district are intrusive quartz diabase, quartz gabbro, gabbro, and lamprophyre, all of which are generally correlated with the Keweenawan and Nipissing diabases. No olivine diabase, which is the last stage of Keweenawan igneous activity (Collins 1925, pp. 82–86), has been identified. Diabase dikes generally less than 80 feet wide and trending slightly south of east, east-west, and northwest are common; the latter more so in the areas of basement outcrop. A few dikes are also found trending slightly east of north.

There is no apparent lithological difference between the various sets. Near Flying Goose Lake an east dike cuts a northwest one; however, in the region north of Quirke Lake dikes may swing from one trend to another or bifurcate, each branch following one of the trends. It is therefore concluded that there is no real age difference between the dikes of different directions.

A number of sills ranging in composition from diabase to diorite are exposed, mainly in the eastern part of the area. East of Quirke Lake there are a series of sill-like bodies, the largest of which forms a canoe-shaped structure underlying Teasdale and Ouellette lakes. A prominent mass, 500 feet thick and with sill-like contacts, is exposed on the southeast shore of May Lake. Several masses lie between the Teasdale Lake and May Lake bodies, the general distribution paralleling the bedding round the syncline. A sill, 500–700 feet thick and dipping northwards at approximately 30 degrees, forms a prominent ridge running east-west immediately south of Flying Goose Lake. This sill, the Nordic sill, has been traced across most of Township 149 to the east boundary of Township 143, east of the north end of Pecors Lake. A large mass of gabbro can be followed from the southwest corner of Township 143 eastwards, where it gradually swings northeast paralleling the south limb of the syncline.

Nowhere within the present area have dikes been shown to cut sills, or vice-versa. Neither have dikes been observed to merge with sills, though the distribution of diabase would suggest that this takes place. The lithology of the chilled parts of the sills resembles that of the dikes. It is therefore tentatively concluded that the dikes and sills were part of the same magma and were intruded at the same time.

Biotite and hornblende lamprophyre dikes, up to 10 feet thick, sometimes fresh and sometimes chloritized and sheared, are often seen in core (Roscoe 1957, p. 15) but have not been seen at surface. It should be pointed out that in drill core there is also considerable evidence of diabase intrusion, which does not reach the present surface.

In hand specimen and field relations the Keweenawan rocks show the same characteristics throughout the Blind River area and indeed throughout the whole north shore of Lake Huron (Collins 1925).

The dikes and sills show chilled margins being frequently chloritized. The central parts of dikes show an ophitic texture with white-weathering plagioclase laths 1/10–1/4 inch long. Rarely, in the wider dikes the central parts are composed of a medium-to coarse-grained, equigranular or gabbroic rock. Quartz, up to 7 percent, and minor disseminated pyrite, chalcopyrite, and occasional pyrrhotite may also be observed. Thin-sections from near Blind River show that the pyroxenes, augite and pigeonite, both occur.

In the gabbroic masses the diabasic margins pass into equigranular gabbro consisting of black pyroxene and white feldspar with minor quartz, and an occasional fleck of biotite. In the coarser-grained phases the gabbro passes into a diorite consisting of subidiomorphic, bluish-green to black hornblende crystals up to an inch long, and white to greenish plagioclase. Thin-sections of similar rocks north of Lake Lauzon, near Blind River, show that chlorite, minor amounts of biotite, magnetite, apatite, and a myrmekitic intergrowth of quartz and acid plagioclase are also present.

"Red rock" (granophyres) and aplites, the normal end stage of Keweenawan differentiation (Collins 1925, pp. 77–82. Collins 1913, p. 82. Bowen 1910), are not common. Normally, diabase dikes have little or no obvious effect on the country rock. Two dikes in the basement, one just north of the Panel surface plant, and one about 10 chains north of the Serpent River, have prominent dark quartz eyes up to ½ inch long. An outcrop in Township 150 near the east boundary shows all gradations between normal diabase with inclusions of granite and a similar massive diabase with numerous quartz eyes, a rock which is evidently the result of assimilation of granite by the diabase. At a number of localities northeast of Corner Lake, boulders of red granite similar to those of the adjacent Gowganda conglomerates were observed in the diabase. It is assumed that this phenomenon is due to the preferential assimilation and alteration of the greywacke matrix of conglomerate xenoliths.

Quartzite, both Serpent and Mississagi, may be recrystallized close to contacts, particularly to contacts with sills. They may also be fractured and turned pink due to albitization, where fractured chlorite develops along the fractures.

Impure limestones and greywackes near diabase contacts may show a marked development of green epidote. This is particularly true at the west end of the Ouellette diabase sill. Calcareous Espanola Greywacke on a small island in Quirke Lake shows this development of epidote.

STRUCTURAL GEOLOGY

The post-Huronian structural elements may be divided as follows:

1) The major fold—the Quirke syncline.
2) Minor folding.
3) Joints.
4) Faults:
    - Thrust faults.
    - Vertical or near-vertical faults.
5) Diabase dikes.
6) Diabase sills.

1. Quirke Syncline

The major structural feature of the area is the Quirke syncline, the axis of which crosses the area just north of the south boundary of Township 144.

The Quirke syncline has been mapped for more than 30 miles along strike. Within this length, apart from the effects of a crossfold in the southeast corner of Township 144, the fold has a reasonably uniform strike of N.70°–85°W., being typically N.80°W. On the north limb dips range from 15°–60°S., being typically 20°–40°S.; at the nose on Whiskey Lake, 30°–35°W.; and on the south limb, 10°–30°N., but normally less than 20°N. The fold is, therefore, asymmetric with steeper dips on the north limb than on the south. The outcrop of the south limb is twice to three times the width of the north limb, but this is due in part to the greater thickness of sediment on the south limb.

The beds exposed on the north limb, from the Panel mine to the east boundary of Township 144, strike uniformly at N.80°W., with dips of 16°–45°S., averaging 25°S. (*cf.* Hart *et al.*, 1955, p. 262.) On surface the beds closest to the basement dip more steeply than those farther south. In the Panel mine the dip is about 16 degrees; in the Can-Met mine, 20 degrees; and in the Stanrock mine, about 16–18 degrees.

Normally the beds exposed on the south limb strike east-west and dip north at between 10 and 35 degrees, averaging 23 degrees (Hart *et al.*, 1955, p. 262), but northeast of Pecors Lake the beds swing northeast towards the nose of the syncline. The south limb is broken by several faults, notably by the Hough Lake fault, which displaces the east side 70 chains south. The argillite of the Middle Mississagi has cleavage developed parallel to the bedding. In the area north of Stinson Lake, P. Pienaar[1] has observed on bedding planes in the Mississagi lineations normal to the axis of the syncline ('*a*' lineations). This indicates that the fold was formed as the result of a north-south compression, and during folding the beds moved over each other. This type of folding is often termed "pack of cards" folding.

Cross-sections incorporating drill-hole data (see Charts A, B, and C, map case) indicate that the axial area is a broad flat-lying zone striking slightly south of east. P. Pienaar has come to the same conclusions from a study of structure contour maps.

On the basis of surface observations, the observed fact that diamond-drill holes deflect up the dip of the beds, and the contour map of the basement-Huronian contact (Roscoe 1957, fig. 3), an approximate position for the trace of the axial plane across the southern part of Township 144 has been plotted on the map. Taking the basal unconformity, the base of the Bruce Conglomerate, and the base of the Cobalt Formation as datum horizons, the average plunge was determined.

On the west shore of Whiskey Lake the plunge is 28°W., at the west side of Batty Lake, 25°W., and at Corner Lake, 15°W. Between Corner and Halfmoon lakes, both a northeasterly-striking, northeasterly-plunging, crossfold and the Hough Lake fault structures locally reverse the plunge of the Quirke syncline, and on their northwest side displace the fold to the northeast. From Halfmoon Lake across the southwest arm of Quirke Lake to the south shore of Dunlop Lake, the axis strikes about N.80°W. and plunges west at less than one degree. These figures are in general agreement with those of previous writers: Collins describes the structure as a ". . . shallow syncline which widens and pitches westward at an angle of two to five degrees. The nose on Whiskey Lake is tilted up more steeply. This fold . . . is slightly symmetrical. Its northern limb dips 25–40 degrees and southern one 15–30 degrees." Hart *et al.* (1955, p. 262) gives the following data on the dips of the Mississagi quartzite as it is traced round the nose of the syncline:

Quirke Lake	25°S.
Whiskey Lake	22°W.
Pecors Lake	25°N.
Algom Nordic	18°N.

and states: "Thus the apparent synclinal axis is a curving E.-W. line lying closer to the north limb than to the south limb. The synclinal axis appears to plunge west at about 5 degrees."

[1]Oral communication.

2. Minor Folds

Minor folds are common in the area and may be divided thus:

Drag folds—particularly in the incompetent rocks—probably associated with the formation of the syncline.
Possible slumpage folds in the Espanola Formation.
Small folds congruent with the syncline
Gentle buckles and folds in the axial area.
Gentle folds associated with diabase intrusion or with faults.

At several points on the north shore of Quirke Lake the Middle Mississagi argillite-conglomerate contact is folded against the Algoman granite basement, and a vertical or nearly vertical cleavage is developed in the argillite. Thus, in exposures along the Panel road and north of the storage and camp areas at the Panel mine there is a well marked cleavage in argillite, with dips ranging from 60°N. to vertical. In the same area argillite lies between the conglomerate and the granite (a reversal of the normal stratigraphic sequence), and the contact between the two sedimentary units is parallel to the cleavage observed in the argillite. At the east end of the bay, north of Panel No. 1 shaft, cleavage in argillite dips steeply north, and the contact between the conglomerate and the argillite is again being overturned, although on the hillside north of the lake sporadic patches of Middle Mississagi conglomerate are seen in normal relationship to the granite. About 1¼ miles east of the Panel housing site sporadic exposures show argillite with a cleavage that dips S.70°–80°N. Possibly the rocks have been dragfolded against the granite as a result of compressive movements from the south. The cleavage strikes parallel to the north limb of the syncline; and the structures in question, the folds and cleavage, were probably formed by the same forces that formed the syncline.

Plastic-type folding has been observed in the Bruce Limestone, particularly on Quirke Lake. The forms of the folds show that the upper limbs moved northwards relative to the lower (see photo, p. 19). However, Hart *et al.* (1955, p. 262) state: ". . . gentle crumpling in thin bedded limestones on Quirke Lake is probably due to preinduration slumping and folding." This view is also held by P. Pienaar[1] from observations, in Township 150, that the sense of movement of such plastic folding is not unilateral. Further observation to determine whether such folding is dragfolding or slumpage folding is required.

The Espanola Limestone (as noted on page 21), is generally poorly exposed, and the dips and strikes cannot be projected. However, where well exposed, as on the islands in Quirke Lake (photo, p. 20) northwest of the Can-Met mine, and on the shores of May Lake, the limestone is folded into symmetrical anticlines and synclines. These appear to pitch at both ends, and the strike of the axial planes parallels the local regional strike. These folds indicate that the Espanola Limestone was too incompetent to yield by fracturing and bedding plane slip as did the Mississagi Quartzite, but too competent to yield by plastic flow as did the Bruce Limestone. (See Table IV.)

In the May Lake area, in addition to the small-scale folding within the Espanola Limestone itself, the Espanola and Serpent formations are folded about axes striking slightly north of east. These folds die out both to the east and to the west and apparently represent ribbing on the south arm of the syncline (see Chart B, map case). Collins and Eskola (Collins, 1925, map) did not recognize

[1]Personal communication.

these folds; consequently their interpretation of the geology along the southern limb must be revised. Access to the area has been much improved, as a result of the recent development of the region, and detailed investigations are now possible. Formerly structural information was obtained only along navigable streams; now the area is covered by cut claim lines run perpendicular to the strike at approximately 20-chain intervals.

As indicated previously (p. 30) drill-hole evidence indicates that the axis of the main fold rises and falls in a small crossfold near Halfmoon Lake. This is also suggested by the distribution of the Cobalt Group near that lake. To the northeast of Halfmoon Lake lies the southeast arm of Quirke Lake. This arm has a pronounced southeast trend, and Cobalt and Serpent formations on the southwest side dip southwest whereas on the northeast side they dip south. A prominent but broad magnetic anomaly extends from the south limit of Quirke Lake, through Halfmoon and May lakes to the southeast end of Pecors Lake (O.D.M. 1955) Joubin and James (1957, p. 311) have suggested that in this area there is a steeply dipping reverse fault possibly filled with diabase. Although there may be faulting in Quirke Lake no further evidence for faulting on this trend was discovered. Diabase is not exposed at surface except at the south end of May Lake where the diabase seen is apparently a sill. The anomaly strikes at right angles to the axial plane of the folds observed in the May Lake area. It is suggested that these various structural features observed at surface are reflections either of an unexposed diabase intrusive or of some feature in the basement, such as a ridge of iron formation over which folding has taken place.

Between May Lake, Ouellette Lake, and the east margin of the area, the Cobalt Group is gently folded. The axes of the folds are generally parallel to that of the syncline. In this area there are a number of diabase masses, the contacts of which apparently parallel structure in the country rocks. Thus a canoe-shaped syncline in Serpent and Gowganda formations south of Ouellette Lake is apparently a reflection of the form of the diabase sill as determined from drill-hole evidence (see Chart B, map case). Exposed contacts and a drill hole in the diabase at the southeast end of May Lake indicate that it is a sill at least 500 feet thick with Gowganda conglomerates and quartzites, 650 feet thick, dipping underneath it. The diabase mass northwest of Rangers Lake is surrounded by beds of the Cobalt Group, which dip inwards towards the diabase. Although evidence is more scanty, the two diabase masses west of Rangers Lake apparently have similar structural relationships; all four masses may represent remnants of a single large diabase sill now largely eroded (Chart C, map case).

On the east shore of Quirke Lake, south of Conecho Point, beds of Bruce Limestone exposed sporadically against the Ouellette diabase sill are severely contorted; in the same area Espanola Limestone is dragfolded against the diabase. On Conecho Point, Mississagi Quartzite is slightly fractured. At the east end of Ouellette Lake, Espanola Greywacke, somewhat contorted and baked, dips west at 30 degrees; this appears to be the plunge of the east end of the canoe-shaped diabase sill. These small-scale structures were possibly formed as a result of the diabase intrusion.

Beds adjacent to faults have been dragged. This is true of the faults intersecting the south limb of the syncline, and particularly so of the Hough Lake reverse fault. Such dragging has given rise to reverse dips in the Espanola Formation on the west side of the creek between May and Hough lakes, and vertical dips in the Mississagi Formation south of Hough Lake and east of Tees Lake.

3. Joints

Attitudes of joints were not recorded in the field, but the following generalizations can be made:

a) In sedimentary rocks, particularly quartzites and conglomerates, joints are perpendicular to bedding.

b) In dikes, joints are perpendicular to contacts.

c) In sills the best developed joints are parallel to the contacts.

d) Joints are particularly well developed in siliceous rocks close to faults and dikes.

e) To the north of Quirke Lake, drainage is along east-, northwest-, and north-trending lineaments, which may represent either faults or major joints. In the same area several quartz veins up to one foot in width occur in shear zones trending N.40°–60°E.

4. Faults

A number of faults enter or are contained entirely within the area. Although normal or reverse faults are the more common, at least one major thrust fault, the Quirke Lake thrust, has been identified.

THRUST FAULTS

The Quirke Lake thrust on the north limb of the syncline is the largest, most important thrust fault in the area. Thrust faults may also occur in the May Lake area and near the nose of the syncline.[1] The Murray Fault, a reverse fault, pre-Keweenawan diabase in age, which dips steeply southward and which is the most important structural feature between Sudbury and Sault Ste. Marie, lies some 20 miles to the south.

Quirke Lake Fault

A major thrust has been traced along the north limb of the syncline from the west boundary of Township 150 to Conecho Point on Quirke Lake. S. W. Holmes, chief geologist for Consolidated Denison and Can-Met, reports in a written personal communication:

> The surface trace of the fault is located approximately 100 feet south of Denison No. 2 shaft [east side of Twp. 150] and strikes at 100° thence to Conecho Point passing just south of the Panel service shaft. At Consolidated Denison the fault dips 27°S and cuts our Number 2 shaft at a depth of 1251 feet. Here it was charactised by 50 feet of alternating breccia zones and blocky ground. At the very sole of the thrust a zone of gauge, one foot thick, with lenses of crushed quartzite occurred. In the lower sheet immediately below, the ground was blocky but not extensively fractured. Considerable water was encountered in the fault zone and shaft-sinking was delayed by three months. At Can-Met the fault passed through the shaft at a depth of 1900 feet and was located in the upper part of the argillite. The argillite has yielded by shearing and development of considerable chlorite. No water was encountered and the approximate dip of the fault was 22°. . . . At Denison the net slip is at least eight hundred feet and at Can-Met it would be approximately 5–7 hundred feet.

The direction of net slip is not given but is assumed to be normal to the strike of the fault. The fault strikes parallel to the north limb of the syncline. No evidence of the fault has been found in drill holes east of Conecho Point. The fault flattens out down dip; in the Spanish American mine, south of Denison,

[1]Personal communications from R. T. Pountney and P. Pienaar.

it dips 17°S., and in the Stanrock mine, southwest of the Can-Met mine it dips 18°S. At the Stanrock mine the ore layer is repeated in consequence of the thrusting for a width of 1,200 feet. The vertical separation of the two sheets of ore in the area of overlap ranges from 130 feet on the west side, to 30 feet on the east side of the property.[1] The fault is shown on the cross-section (Chart A. map case).

Within the area described in this report the age relationships of the thrust have not been established.

May Lake Area

In addition to the Quirke Lake thrust there are some indications of thrusting in the May Lake area. Roscoe (1956, p. 16) has made the following observations:

> Repetitions of sections of the Whiskey formation are indicated in a drill-hole between Ouellette Lake and May Lake. There are also several repetitions of Bruce conglomerate, Bruce limestone, and Espanola greywacke contacts in a hole at May Lake. Some of these repetitions might be due to folding or to steeply-dipping reverse faults.

The repeated sequence of Espanola and Serpent formations on May Lake, interpreted by the author as a series of gentle wrinkles on the south limb of the syncline (Chart B, map case), may, in light of the above, represent thrust masses. This might also account for the relatively thick Serpent section at the northeast end of the lake.

VERTICAL FAULTS

Vertical or nearly vertical faults follow two dominant trends: slightly east of north and slightly south of northwest. Minor east-west and northeast faults also occur. Underground and drill-hole evidence indicates that small faults, both normal and reverse, along all these directions are more common than is indicated by surface work. The faults were mapped on the basis of lineaments visible on the air photographs, together with evidence found in the field such as displacement of outcrop, or the presence of shearing, shattering, or small-scale faulting in the adjacent rocks. In general, dips of faults could not be determined from surface exposures, and where given are based on drill-hole evidence.

North-Trending Faults

Six faults striking north were observed within the map area; all six lie in Township 143. Three lie near Canyon Lake on the west limit of the area, two near Benedict Lake in the centre, and the sixth near Tees Lake near the east limit. The Hough Lake fault is pre-diabase in age and probably represents a faulted dragfold possibly congruent with the main syncline, whereas the other five faults are all post-diabase in age.

North of the area mapped, but still within Township 144, several north-south lineaments, which influence the drainage, are apparent on the air photographs; these may be either major joints or faults.

A number of north-trending faults occur in Township 150 north of the Serpent River, in the Huronian near the Algom Quirke mine, and in the Huronian northwest of the Consolidated Denison mine (Abraham 1956). Information on dips and throws is not given, but for four faults near the Consolidated Denison mine both right-hand and left-hand strike separations are indicated.

[1]Fred Barnes, mine geologist Stanrock, personal communication.

CANYON LAKE FAULTS

A fault shown on the map of Township 149 trending S.20°E. between McCabe and Canyon lakes continues into Township 143. It appears to displace both a diabase dike and the Bruce Limestone–Bruce Conglomerate sequence some 5 chains south on the east side. Its southward extension may be marked by a prominent lineament that strikes S.40°E. from the southeast arm of Canyon Lake to the small lake west of Stinson Lake.

At the east end of Canyon Lake a second fault, with an average strike of N.15°E., displaces both the sediments (Upper Mississagi to the Espanola Limestone) and a diabase intrusive some 10 chains north on the east side, that is, in the opposite sense to the fault mentioned above. The fault is cut off by the northwest extension of the Pecors Lake fault. Any northerly extension beyond the Pecors Lake fault would underlie McCabe Lake and might account for the north trend of the west shore line at the north end of the lake.

Fifteen chains east of the northeast corner of McCabe Lake a possible fault zone strikes S.10°E. through Serpent quartzite.

BENEDICT LAKE FAULTS

At Benedict Lake the Bruce and Espanola formations are folded into a gentle anticline plunging northwards. A lineation trending N.10°–15°E. is visible on the air photographs of this area. Approximately ¼ mile south of the lake the outcrop of the Bruce Limestone and Bruce Conglomerate is displaced 5 chains to the north on the east side of the fault, but at the south shore of the lake the displacement of the Espanola Greywacke is only one chain. The fault probably dies out under a swamp north of the lake, because farther to the north Serpent quartzite is undisturbed. Collins shows this fault on Map No. 1970 but gives it a considerably greater displacement in the opposite sense. However, between this fault and the creek between May and Hough lakes, Collins' interpretation of the structure has required revision (see pp. 31, 32). The relationship of the fault to diabase is not clearly demonstrated, but the fault may be younger.

Some 10 chains east of the above-mentioned fault an outcrop on the east bank of the stream flowing out of Benedict Lake is crossed by a fault, which separates Bruce Limestone and Bruce Conglomerate resting on Upper Mississagi Quartzite, which is cut by a diabase dike, on the west side, from Upper Mississagi Quartzite on the east side. This fault could not be traced for any distance. Its throw is evidently in the reverse sense to that of the main Benedict Lake fault.

HOUGH LAKE FAULT

This is the largest and most important northerly-striking fault exposed in the map area. From the southeast corner of Tees Lake the fault strikes N.20°E. across the mouth of the east bay of Hough Lake to the creek between May and Hough lakes where it swings to N.35°E. The northeasterly extension of the fault is hidden by diabase at the east end of May Lake. The south end of the fault is obscured by the Nordic diabase and the Pecors Lake fault. No evidence of a southerly continuation into the basement was found.

The fault zone is exposed at the southeast arm of Tees Lake. Mississagi quartzite exposed in a cliff along the north shore of the arm, dips 30°N., but when followed north and east the Mississagi dips at about 85°E. (see photo, p. 15). This is followed by crushed greywacke and Espanola Limestone, dipping 70°–80°W. with, near the base of the exposure, a recrystallized mass of quartzite. East of this zone, which is not more than 30 feet wide, Serpent Quartzite dips gently north in normal relation to Espanola Greywacke; the Espanola Limestone is obscured by drift. East of this all members from the Upper Mississagi to the Serpent Quartzite are exposed swinging northeast along the northwest shore of Pecors Lake, but at the north end of the lake it reverts to the normal east-west strike. The effective horizontal displacement is 70 chains south on the east side. On the south shore of Hough Lake, upper Serpent is exposed close to Upper Mississagi. The Mississagi beds swing sharply from the regional easterly strike and dip of 40°N., to a north strike and vertical dip. On the point, west of the two islands in Hough Lake, the trace of the fault is marked by a well developed vertical cleavage and quartz veins in limy argillite. On the west side of the point Bruce Limestone and Mississagi Quartzite (the Bruce Conglomerate is almost missing) are cut by several small faults. To the north the fault passes through the swamp in the creek between May and Hough lakes. On the north shore of this swamp Espanola Limestone and Gowganda Conglomerate can be seen dipping under Espanola Greywacke with a reverse dip between 70° and 80°W., whereas on the east side there are exposures of massive Cobalt conglomerate dipping gently northwards.

The structure is apparently a large dragfold with the attenuated limb cut out by a reverse fault. (See Chart D, map case.).

South of Hough Lake and east of Tees Lake the vertical displacement appears to be about 1,500 feet east, whereas to the north, near the swamp between May and Hough lakes, it is about 900 feet. At the southeast end of May Lake the continuation of the fault is hidden by diabase; northeast of this there is no further indication of faulting.

This fault is probably pre-diabase in age, and may be contemporaneous with the main folding of the syncline.

Northwest Faults

Three northwest-striking faults have been mapped in the area: the Nook Lake fault, the Spanish American fault, and the Pecors Lake fault. Of these the Spanish American fault, which is a reverse fault dipping steeply north, may be partially pre-diabase in age, whereas the Nook Lake and Pecors Lake faults are post-diabase. The Pecors Lake fault is vertical, and the Nook Lake fault probably so.

NOOK LAKE FAULT

A very prominent valley crosses the north basement running at N. 60°W. from Nook Lake, on the Serpent River. Diabase dikes traced to the west side of the valley are not observed on the east side. It is, therefore, probably a post-diabase fault.

SPANISH AMERICAN FAULT

The surface trace of this fault passes between the two Spanish American shafts (Abraham 1956), and on the east side of the adjacent arm of Quirke Lake it forms a prominent linear feature running at S.60°–70°E. from just north of the Stanrock housing site to the northwest end of May Lake. The southeastern part of the fault, and the northwestern extension beyond the Spanish American mine, are filled with diabase. The contact on the northeast side is sheared, indicating that at least some post-diabase movement has taken place. At the Spanish American mine the fault dips 60°–70°N. and has a reverse throw of about 100 feet. Moreover at the Spanish American mine this fault cuts the Quirke Lake Thrust. It may well be that the greater part of the movement is post-diabase. North of Little May Lake the cleavage dips 85° NE., and the throw measured on the Serpent-Gowganda contact is 30 feet. The fault probably dies out under May Lake (Charts A and B, map case).

PECORS LAKE FAULT

Another lineament striking approximately N.60°W. can be traced, on photographs, from the north of Elephant Lake to Pecors Lake, in Township 143. Southwest of Hough Lake the lineamant can be followed through a large wooded area although there is little or no outcrop. Observations made on outcrops near Elephant Lake close to the lineament confirm the presence of a fault and suggest that here it is vertical. Similar vertical schistosity is observed in Mississagi quartzite west of Vanhorn Lake. Near Elephant Lake the strike separation is approximately 7 chains southeast on the northeast side, and the throw is 160 feet to the northeast. As the fault appears to cut the Lake Nordic–Pecors Lake sill southeast of Hough Lake (Chart B, map case), some movement on it is probably post-diabase.

Vite Point on the southwest shore of Pecors Lake lies on strike with the fault, but no evidence of northwesterly faulting was found. However, as noted below, northeasterly faulting may possibly have displaced the Pecors Lake fault past the point. The fault thus appears to die out in Pecors Lake as shown on the inset map on the mineral map of Ontario (O.D.M. 1957, inset G) (see also Charts A, B, and C, map case). Bateman (1955, p. 368, fig. 4) has suggested that this fault may continue to the southeast and pass into the Webbwood fault. The problem will probably be solved during the mapping of Township 137.[1] A number of minor northwesterly faults were noted at the northwest end of Pecors Lake.

Northeast Faults

Northeast faults occur in the district (Roscoe 1957, p. 16), and an important northeast fault, which is post-diabase in age, strikes northeast from the mouth of the Mississagi River, 2 miles west of Blind River, to McGivern Lake but then swings east and passes approximately ⅛ mile south of the area described in this report (O.D.M. 1957, inset G). However, no important faults with this trend have been confirmed, in spite of the occurrence on the south limb of a number of lineaments visible on air photographs.

A prominent lineament runs northeast from the Algom gravel pit on the Pecors road across the Lake Nordic diabase and the east end of Flying Goose Lake, and is terminated at or near the Pecors fault. A similar but shorter lineament runs northeast from the west end of Stinson Lake.

On the southwest corner of Vite Point on Pecors Lake a small fault trends northeast across a narrow diabase dike. This direction is parallel to the side of the point, and it is possible that such a fault, unexposed, could deflect the Pecors Lake fault past the point.

East-West Faults

Four or possibly five faults of unknown age relative to diabase, were observed with east-west strike. These are the Lexindin fault, through the southwest bay of Quirke Lake, the Lizotte Lake fault, and the Nasco fault, which lies south of Poppy Lake; a fourth fault may lie in Quirke Lake between the shore and the first island northwest of the Can-Met mine, and a fifth crosses the Stanrock property along the lineament followed by the road to the No. 2 shaft.

Faults of this group are essentially parallel to the axial plane of the syncline, and both the Lexindin and Lizotte Lake faults lie very close to the postulated surface trace of the axial plane.

[1]Subsequent mapping has failed to show any continuation.

LEXINDIN FAULT

In the Lexindin drill hole south of the southwest bay of Quirke Lake, the Bruce Limestone and Bruce Conglomerate are repeated within a vertical distance of 308 feet, and a shear zone with an inclination of 70 degrees to the core axis was observed at 1,894 feet from the collar.[1] In Township 150, Abraham (1956) has shown a fault striking eastwards into the southwest arm of Quirke Lake. This is probably the same fault observed in the Lexindin hole and may be responsible for the east-west elongation of the southwest arm of Quirke Lake.

LIZOTTE LAKE FAULT

A prominent valley runs at about S.74°E. from Halfmoon Lake to Lizotte Lake. This may be the surface expression of one of the reverse faults suggested by Roscoe, (1957, p. 16) in the San Antonio hole east of Halfmoon Lake.

NASCO FAULT

A diabase dike running N.80°W. across the centre of the Nasco property ¼ mile south of Poppy Lake is sheared along its north side, indicating that there is possibly a pre-diabase fault along which renewed movement has taken place.

FAULTS NEAR STANROCK MINE

A prominent lineament striking S.80°E. is observed on the Stanrock and Can-Met properties, and shattering was observed in Serpent quartzite, some 12 chains north of the Stanrock No. 2 shaft.

At the northwest corner of the headland about ½ mile west of the Can-Met surface plant, the dip of the Serpent quartzite suddenly increases from 20°S. to 40°S. On the south shore of an island 4 chains north of the headland, quartz veins strike east. An east-striking fault, north side down, may pass through the channel between the headland and the island.

5. Diabase Dikes

Diabase dikes, most of which are 20–80 feet wide, are common throughout the area. They are characteristically straight, although in the granite terrane to the north of Quirke Lake they tend to be less uniform in size and direction. There many of them fork, and this feature, combined with lack of evidence of replacement, indicates that they were intruded along pre-existing fractures and faults.

The dikes fall, according to their strike, into three or possibly four major groups. As noted on page 28 all were probably intruded at essentially the same time.

The directional groupings are:

1) East of north, to northeast.
2a) East. } i.e. parallel to the axis
2b) 10°–20° south of east. } of the syncline.
3) Northwest.

Group 1

Dikes of this group are poorly developed within the map area, and the best examples lie to the north of Quirke Lake.

[1]P. Pienaar, personal communication.

Group 2

Dikes striking east and slightly south of east are common throughout the area except in the southern part of Township 143. Three dikes striking at N.80°E., two of which lie southeast of the southwest bay of Quirke Lake and the third between May and Square lakes, probably belong to this group, because the axis of the syncline is slightly deviated in these areas (see p. 30).

Group 3

Dikes striking northwest are most common in the northern part of Township 144, and in the southwest part of Township 143. Sporadic dikes on this trend occur in the syncline, particularly in the Spanish American fault. Several northwest-trending dikes occur east of the Algom Nordic mine. Traced southeast beyond the Huronian sediments they strike parallel to the bedding in the basement. Where the bedding in the basement swings east these dikes also change strike.

6. Diabase Sills

The large gabbroic mass, the King's Lake gabbro, exposed along the south margin of the map area, is probably a sill, which may have fed the dikes that lie to the northwest of it. (See Chart A, map case.)

The other diabase sills in the area have been mentioned in the description of the Keweenawan, and their relationships to minor folds and their distribution close to the nose of the syncline have also been noted (see pages 29 and 31, and Collins (1925, map)).

Interpretation

As precise data, particularly on dips of joints, faults, and dikes, are rather scanty, only tentative efforts at a structural analysis are possible. A more complete analysis, which would require data from the whole district, not from only two townships, would form a subject for further research. Because all the diabase was apparently intruded at the same time (see p. 28) this intrusion forms a convenient time standard. In the area described in this report the Spanish American fault, and possibly the Nasco fault have at least some pre-diabase movement. It may be noted that the Murray Fault and associated faults near Blind River have been shown to be pre-diabase in age (Robertson, 1956[1]). Although it has not been proven, it is possible that many of the diabase dikes in the area are intruded along faults and not merely along joints.

Table III gives a summary of the known features of the faulting within the area.

From the relationships described it is seen that the post-Huronian structural history of the area was as follows:

Folding.

Intrusion of diabase along joints and faults, which may have developed either during the folding of the syncline or between the formation of the syncline and the intrusion of the diabase.

Renewed faulting.

FOLDING

This is the most important and significant of the events in the structural history of the area. Beds of differing rock types and competencies are represented in the area, and the following table lists some of these, in order of decreasing competence, with the dominant method by which they deformed.

[1]The maps accompanying Robertson's thesis have been superseded by Ontario Department of Mines' maps Nos. P-71, P-72, and P-73.

TABLE III—SUMMARY OF FAULT RELATIONSHIPS

Fault	Strike and (Dip)	Movement	Type	Relationship
THRUST FAULTS:				
Quirke Lake	N.80°W.	S. side moved N.	Thrust.	Cut by diabase; outcrop displaced by north and northwest faults.
May Lake ?	...	?	?	?
VERTICAL OR STEEP FAULTS:				
North Group:				
Canyon Lake	N.20°W.	E. side moved S.	Strike-slip.	Displaces diabase.
Canyon Lake	N.15°E.	E. side moved N.	Strike-slip.	Displaces diabase, cut by Pecors Lake fault?
Canyon Lake	N.15°W.	?	?	In Serpent Quartzite only.
Benedict Lake	N.10°–15°E.	E. side moved N.	Strike-slip.	Not clear; may be younger than diabase cut by Pecors Lake fault.
Benedict Lake	N.10°E.	E. side moved S.	Strike-slip.	Displaces diabase.
Hough Lake	N.25°–35°E. (80°W.)	E. side moved down and W.	Reverse, in limb of drag.	Pre-diabase, pre-Pecors Lake fault.
Northwest Group:				
Nook Lake	N.60°W. (vertical)	E. side moved S.	Strike-slip.	Post-diabase.
Spanish American	N.50°–60°W. (60°–70° in NW. vertical in SE.)	S. side moved up	Reverse, vertical to SE.	Post-Quirke Thrust partially filled with diabase, dies out to SE.
Pecors Lake	N.60°W. (vertical)	NE. side moved SE.	Vertical.	Post-diabase, post-north faults.
Northeast Group: (not proven within area)	...	...	...	...
East Group:				
Near Stanrock	N.80°W.	...	?	?
Near Stanrock	East	N. side moved down	?	?
Lexindin	East (70°S.)	N. side moved down	Reverse.	?
Lizotte Lake	N.74°W.	?	Reverse?	?
Nasco	N.70°W.	?	?	Along diabase contact.

TABLE IV—RELATION OF ROCK TYPE TO MODE OF DEFORMATION

	Rock Type	Dominant Method of Deformation
Competent	Granite.	Jointing, faulting (vertical), cataclastic fracturing.
↓	Quartzite and conglomerate (Mississagi, Serpent, Bruce, and Gowganda)	Jointing, faulting, bedding-plane slip, cataclastic fracturing.
↓	Greywacke.	Jointing, bedding-plane slip, strain-slip cleavage.
↓	Espanola Limestone.	Jointing,faulting,concentric folding
↓	Argillite.	Bedding-plane slip, strain-slip cleavage—local plastic flow.
Incompetent	Bruce Limestone.	Plastic flow.

The presence of bedding-plane slip (normal to the axial plane of the Quirke syncline), dragfolding, and thrust and reverse faults striking parallel to the axis indicate that the formative compressional forces acted at right angles to the axial plane i.e., just north of east.

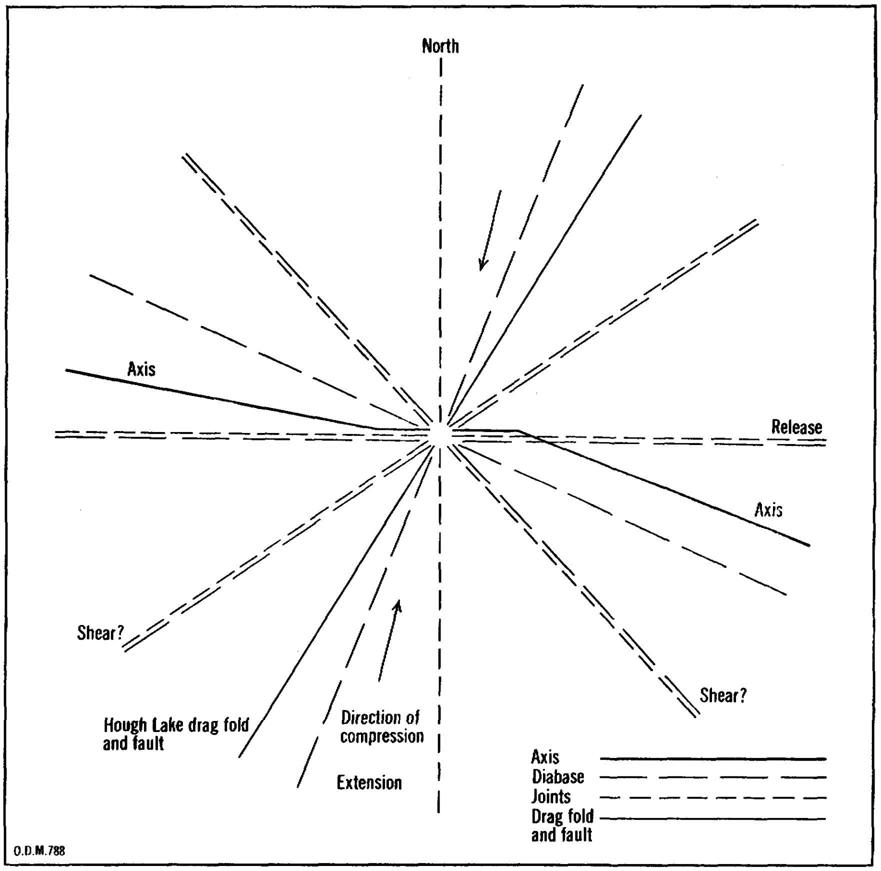
The northeasterly quartz-bearing shear fracture (see p. 33) and a northeasterly fracture intruded by diabase may represent a direction of shear at approximately 45 degrees to the direction of compression. The northwest dike fractures could represent the shear joints conjugate to the above. They make an angle of rather more than 45 degrees with the known direction of compression. However, it has already been shown (p. 39) that some of these dikes that cut across the Huronian-Keewatin(?) contact are parallel to the structures in the Keewatin(?). Probably forces along the bedding of the greenstone, the principal structural weakness of these rocks, were transmitted to the overlying Huronian rocks and, therefore, the jointing direction was somewhat modified. The poorly developed north-striking pre-diabase joints would represent a–c fractures. The east-and slightly south-of-east-striking dikes filled fractures, which had developed parallel to the axial plane (b–c fracture), and opened on release of the compressive forces.

These relationships are indicated in the diagram (p. 42). The presence of a strong thrust fault on the north limb (p. 33), of the possible dragfolding against the granite along the north shore of Quirke Lake (p. 31), the steeper dip of the north limb (pp. 29, 30), and the greater development of dragfolds in the Bruce Limestone on the north limb than on the south (p. 31) indicate that the overriding forces came from the south, and that the granitic block north of Quirke Lake acted as a buttress.

This is also the sense of movement on the Murray and associated faults (Collins 1925, p. 104. Robertson 1960[1]), which lie along the north shore of Lake Huron, some 20 miles to the south of the map area. The Grenville Front, the southwesterly extension of which probably lies farther south under Lake Huron (Johnston 1954, pp. 1047-74 and Plate I) has the same sense of movement as the Murray Fault. It has been suggested that the folding of the Quirke syncline was due to the diminished foreland forces associated with the Killarney or Grenville orogeny (Quirke and Collins 1930).

Release of these forces allowed the fracture system to open and permitted the intrusion of the Keweenawan diabase.

[1]See also Ontario Dept. Mines maps Nos. P-71, P-72, P-73.



Comparison of strike-directions of the structural elements of the Quirke syncline that are older than the Keweenawan diabase dikes.

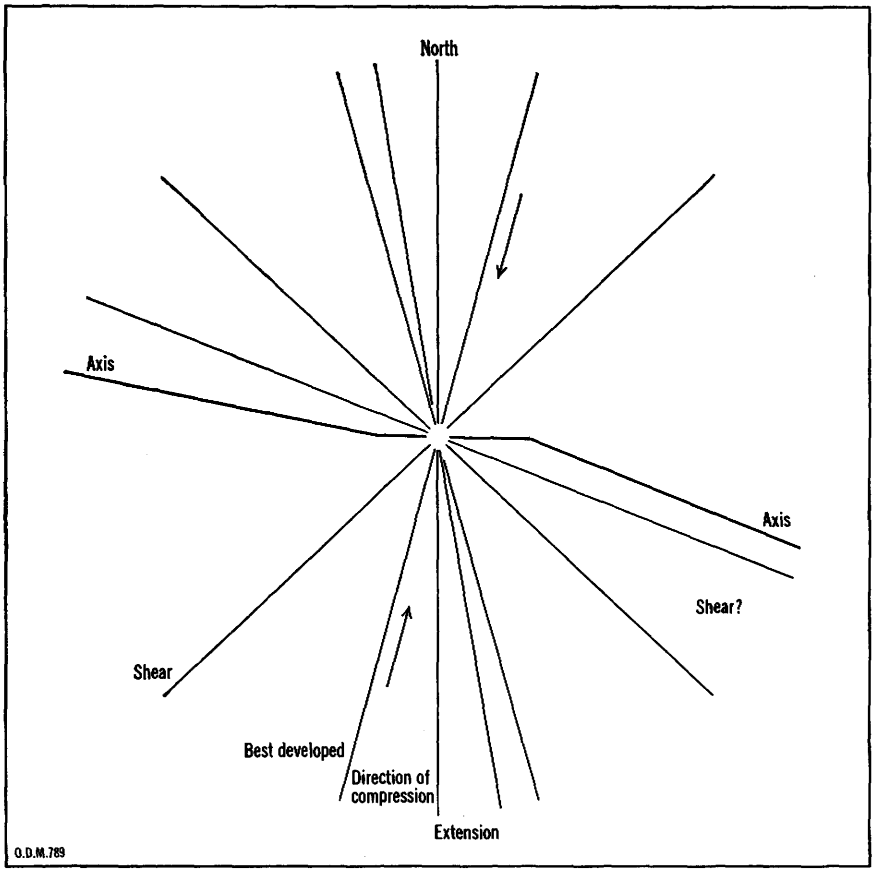
POST-DIABASE FAULTING

However, as indicated in Table III, a number of faults displace diabase dikes, and a number of diabase dikes are sheared along one margin, indicating that post-diabase faulting has taken place. The north-striking faults on the south limb, except for the Hough Lake fault, the possible northeast-striking faults, the Pecors Lake fault, the Nook Lake fault, and some of the movement on the Spanish American fault, belong to this later period of disturbance.

As the north-striking faults on the south limb displace diabase dikes in the same manner as the sediments they are strike-slip faults. Northeast lineaments crossing diabase have been noted, but it has not been possible to show whether these are faults or merely joints. The Pecors Lake fault is a strike-slip fault (northeast side southeast) but is rather later in age than the north-striking faults, and the exact nature of the Nook Lake fault is unknown. Renewed movement took place on the Spanish American fault.

The strike directions of these features have been plotted on the figure opposite and it will be seen that they bear a close resemblance to those of the pre-diabase structure shown in the figure above.

This would suggest that post-diabase faults and joints were formed by forces similar to those that had formed the earlier structures. It may be that these later forces represented "after pulses" of the earlier.



Comparison of strike-directions of the structural elements of the Quirke syncline that are younger than the Keweenawan diabase dikes.

ECONOMIC GEOLOGY

Uranium

Townships 143 and 144 lie to the east of the main uranium producing area. Of the two major ore zones outlined by diamond-drilling, one, the Quirke ore zone, extends into the area and underlies the greater part of Quirke Lake. The only mines in the area, Panel (Northspan Uranium Mines Limited), Can-Met Exploration Limited, and Stanrock Uranium Mines Limited, are on this zone.

Logging of core shows that oligomictic conglomerates and, to a lesser extent, interbedded quartzite and arkoses of the Lower Mississagi are radioactive owing to the presence of uranium and thorium. However, ore grade (approximately 0.1 percent U_3O_8) is only attained where the pebbles are closely packed and appreciable pyrite is present. Under such conditions the quartz pebbles show marked darkening due to radioactive bombardment. Possible byproducts from the ore beds include thorium for use in thorium-magnesium alloys, and rare earths.

Drilling indicates that a bed, 10–15 feet thick, of ore-grade uraniferous conglomerate underlies central Quirke Lake as indicated on the map of Township 144

(No. 2002, map case). Submarginal ore continues to the southeast and terminates beneath the central part of Teasdale Lake and at the west end of Ouellette Lake.

Thin beds of conglomerate with slight mineralization were encountered at depth in drilling near the southeast end of Poppy Lake. Uraniferous conglomerates are found on the south limb of the syncline in Township 143, in the vicinity of Pecors Lake and on the Millaqua and Pardee properties, as indicated on the map (No. 2001, map case).

Considerable work has been done on the mineralogy of the deposits. Published accounts (see references below) deal mainly with specimens from the Algom Quirke mine in Township 150 and the Pronto mine in Long township. However, unpublished work indicates that the ore character is uniform. The uranium is found as brannerite (a complex uranium rare-earth titanite) and uraninite. Thucholite, a secondary uranium hydrocarbon found at the Algom Quirke mine, has not been found in the mines in Township 144. Where exposed at surface, as at Pronto, Algom Quirke, and the Pardee property in Township 143, the deposit has oxidized, producing sulphuric acid, which dissolved the uranium minerals. In such areas the rocks are iron stained and may contain secondary uranium minerals (Joubin 1956, p. 431. Joubin and James 1957, p. 156 *et seq.*).

Where the conglomerates are ore bearing they are characterized by the presence of sulphides, dominantly pyrite up to 15 percent, but also with appreciable amounts of pyrrhotite and chalcopyrite with minor arsenopyrite, galena, molybdenite, and sphalerite. The following heavy minerals are also found in the conglomerates: anatase, apatite, cassiterite, chromite, gold, fluorite, hematite, ilmenite, magnetite, monazite, rutile, scheelite, sphene, and zircon (malacon, and more rarely cyrtolite) (Abraham 1953. Arnold 1954. Holmes 1956, p.116. Joubin and James 1956.[1] Traill 1954. Roscoe 1957, pp. 18, 19. C.I.M. 1957, pp. 10, 15-18).

As with the similar Rand deposits in South Africa there has been much discussion over the formation of the ores. Bateman (1955, p. 370) and Joubin[2] cite the high uranium-thorium and titanium-iron ratios, the association with sulphides, and the late igneous activity in the district in favour of an epigenetic origin. C. F. Davidson (1957, p. 688) shows that the mineralogy, geochemistry, and geological setting of both the Blind River and the Rand deposits are similar and suggests that both are hydrothermal in origin, the mineralization of the Blind River area possibly being linked to a period of granitization late in the history of the Huronian geosyncline. Abraham (1953) and McDowell (1957, p. 31) regard the ore as syngenetic and Holmes (1956, p. 116) has suggested a syngenetic origin modified by later hydrothermal activity. In the guide compiled by the geologists of the mining companies and issued for the Sixth Commonwealth Mining Congress Tour (C.I.M. 1957) evidence is given in favour of a placer origin.

There are very close relations between the basement structures, the zones of greater deposition of the Lower Mississagi, and the orebodies (see Table V and page 13). It is suggested that pre-Huronian differential erosion formed valleys in the pre-Huronian surface, which later became the locus of deposition for conglomerates and arkoses. The association in these conglomerates of normal heavy minerals suggests an accumulation by placer concentration from the pre-Huronian granite complex.

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[1]Joubin and James provided the author with additional information in personal communications.

[2]Personal communication.

It may be noted that other conglomerates in the district, i.e. the Middle Mississagi, Bruce, and Cobalt, do not carry markedly high uranium values, though all, and particularly the Bruce, carry pyrite. The sericitic matrix of the Lower Mississagi conglomerates is similar to the sericitic material found in the paleosol formed on the basement and was probably derived from it; there is no reason to suppose that it was produced by the passage of hydrothermal solutions.

Quartz veins are not conspicuous in the district and bear no relationship to the uranium deposits, again suggesting a lack of post-Mississagi hydrothermal activity. Within the Blind River area there is no indication that the Keweenawan diabase is a possible source of ore-bearing solutions. Indeed, within both the Pronto and Lake Nordic (renamed Lacnor) mines ore-bearing zones have been metamorphosed with a drop in grade close to diabase.[1] Moreover, there is no indication that the Killarney granite provided a source; and there is no post-Huronian granite developed within or near the Quirke syncline. Thus the author subscribes at present to the syngenetic theory of origin.

TABLE V—DIRECTIONAL PROPERTIES OF URANIUM-BEARING ZONES

Zone	Direction (astronomic)	Authority
1. QUIRKE ZONE (Townships 144 and 150):		
North boundary, in Township 150	108°	E. M. Abraham 1956
North boundary, in Township 144	107°	
South boundary, in Township 150	128°	E. M. Abraham 1956
South boundary, in Township 144	cuts off	
Average trend of Quirke zone	114°	
Average trend of north contact of greenstone	105°	
Average trend of zone of thicker deposition of Matinenda Formation	110°	S. M. Roscoe 1957
Crossbedding of Lower Mississagi	not known	
2. NORDIC ZONE (Township 149):		
North boundary	142°	E. M. Abraham 1956
South boundary	130°	E. M. Abraham 1956
Average	136°	
Average trend of south contact of greenstone	129°	E. M. Abraham 1956
Trend of zone of thicker deposition of Matinenda Formation	130°	S. M. Roscoe 1957
Crossbedding of Lower Mississagi	130°	Estimated from J. P. McDowell 1957
3. PARDEE ZONE (Township 143):		
Northwest boundary, marginal	124° (swings east)	
Southwest boundary, marginal	126°	
Southwest boundary, submarginal	127°	
Average	126°	
Bedding of Keewatin	130° (swings to 100° in east)	
Crossbedding in Lower Mississagi	124°	Estimated from J. P. McDowell 1957

[1]S. W. Holmes and J. P. McDowell, personal communications.

TABLE VI—ORE RESERVES IN TOWNSHIPS 143 AND 144

Property	Tonnage	Grade (U_3O_8)	Authority
		percent	
Algom Quirke (1)	....	......	....
Algom (Pecors Lake)	?	0.046	Company prospectus, 1954
Can-Met (drill-proven)	6,000,000	0.1	Company geologist
Conecho	2,000,000	0.07	Company
Millaqua	5,390,000	0.07	Company
Nasco	?	0.06	Company
Panel	5,764,889	0.108	Company
Roche	?	marginal	Company
St. Marys	?	0.05	Company
Stanrock	7,509,148	0.106	Company geologist

CONTRACTS

Property	Contract	Mill Capacity	Source
		tons	
Can-Met	$79,061,082	3,000	Company
Panel	(2)	3,000	....
Stanrock	$96,000,000	3,000	Company geologist

(1) No information on area in Township 144.

(2) Included in Northspan.

Sulphides

In addition to the sulphides characteristic of the main ore zones it may be noted that no rock is really free of minor disseminated sulphide mineralization. It is generally thought that this mineralization consisting of pyrite, chalcopyrite, and minor nickeliferous pyrrhotite is associated with the Keweenawan diabase. It may be pointed out that pyrrhotite mineralization is characteristic of the pre-Huronian diabase. However, nowhere within the present area are there sulphide deposits of economic significance.

Iron Formation

The occurrence of low-grade iron formation in the Keewatin(?) has aroused some interest. A number of prospects were opened northwest of Whiskey Lake i.e. to the northeast of the present map-area (Douglas 1926, pp. 46, 48). Prospectors have reported isolated occurrences of iron formation near Rochester Lake in the unmapped part of Township 144.

In 1951–53, Teck Exploration Company Limited carried out an extensive exploration program for sulphides and iron formation within an area lying between the Pecors Lake–Depot Lake tote road, the east boundary of Township 143, the south boundary of Township 143, and the present boundary between the Algom Pecors property and the Vite property.

Geological and geophysical mapping were carried out. At least 19 holes, totalling some 8,300 feet, were drilled; most of these were located in a broad zone striking east across the central part of the area. Two holes were drilled from the north shore of Pecors Lake, and one near the south township line west of the Serpent River.

Disseminated sulphides, mainly pyrite and non-nickeliferous pyrrhotite, were found to be present in sediments and diabase-like rocks, and in quartz or quartz-carbonate veins and stringers. Chalcopyrite and sphalerite were more rarely observed. There was no indication that these minerals occurred in sufficient concentration to be of economic interest.

Iron formation, not more than 20 feet thick, was identified and traced for 400 feet on surface in the central part of the property within ¼ mile of the south shore of Pecors Lake. Three drill holes, collared at the northeast end of a small lake ¾ mile due south of Vite Point, intersected this bed. Two drill holes in the northwest corner of the area encountered magnetite bands in cherty to quartzitic sediments on strike with the iron formation observed on the Algom property.

Quartz Vein

A vertical quartz vein striking N.15°E. on the south bank of the Serpent River, ¼ mile east of the east end of Quirke Lake, has been trenched over a distance of 5 chains to a depth of 6 feet. The trench is now overgrown, and the quartz is iron-stained. Only minor sulphide mineralization is present.

Description of Properties

ABETA MINING CORPORATION

This company holds a block of 25 surveyed claims in the southwest corner of Township 143 and the adjacent part of Township 149.

The southern part of the property is underlain by Keewatin volcanics and sediments, including a zone of low-grade magnetite iron formation upon which no development has been carried out. These rocks form the ridge separating the Nordic and the Pardee conglomerate-bearing valleys.

During the period October 1953 to June 1954, 15 holes, totalling 4,241 feet, were drilled by the Mining Corporation of Canada for J. P. McVittie on the ground now held by Abeta. All the holes were collared in Lower Mississagi quartzite. Holes Nos. 1–9 were drilled at intervals of about 400 feet along the strike of the sediments and some 250 feet north of a small lake on the Huronian-basement contact. Holes Nos. 12–15 were collared along strike some 800 feet north of the first row. Holes Nos. 10 and 11 lie between the two rows at the east side of the property.

This drilling showed that in the eastern part of the property the basement was some 50–100 feet higher in elevation than in the west.

The more westerly holes in both rows intersected several beds of radioactive, oligomictic conglomerate, but the beds became thinner and much less radioactive to the east.

According to company drill logs the two westerly holes of the north row gave maximum grades of 0.09 percent U_3O_8 over 5 feet, and 0.14 percent U_3O_8 over 4 feet.

ALGOM URANIUM MINES LIMITED

Pecors Lake (West Property)

Sixty-one claims of the Pecors Lake (West Property) lie within Township 143. The property is reached by a motor road from the company's Nordic mine to the west end of the west arm of Pecors Lake.

The area is underlain by the Mississagi formations, the individual units of which show marked thinning. Bruce, Espanola, and Serpent formations are exposed in the northwest corner of the property. East-striking diabase dikes and a sill cross the area. A north-northeasterly reverse fault dipping steeply west, the Hough Lake fault, is exposed in the northwest corner. This fault is cut off to the south by the Pecors Lake fault. Minor faulting exposed at surface and in core shows that the area has been subject to considerable stress.

The company has carried out surface mapping, geophysical exploration, and line cutting. R. C. Hart reports in the company prospectus for 1954:

> On the west side of Pecors Lake an excellent exposure of radioactive conglomerate occurs over a length of 600 feet. Ten drill holes completed here spaced widely over an area 1,800 feet long and 1,100 feet wide indicate a grade of 0.046 percent U_3O_8 over a width of 4.9 feet.

Two deep holes were drilled from the northeast shore of Pecors Lake. The more westerly hole reached basement at 1,497.8 feet and was stopped at 1,506 feet in andesite. The Lower Mississagi is represented by 95.3 feet of fine-grained, well washed quartzite. No oligomictic conglomerate or radioactivity was recorded. The more easterly hole reached greenstone basement at 1,369.4 feet and bottomed at 1,860 feet, still in greenstone. Between 1,305 and 1,346 feet, seven radioactive, oligomictic conglomerate bands were intersected. A 1.3-foot band at 1,310.7 feet contained 0.035 percent U_3O_8 and 0.03 percent ThO_2. A 7.5-foot band at 1,338.5 feet contained 0.025 percent U_3O_8 and up to 0.035 percent ThO_2.[1]

Water for the Algom Nordic, Lake Nordic (now Lacnor), and Milliken Lake mines is pumped from Pecors Lake to Pardee Lake, whence it flows to the Algom Nordic mine.

Quirke Lake Property

Eleven claims at the east end of the Algom Quirke property lie within Township 144, to the west of Northspan's Panel property. Drilling on neighbouring properties suggests that ore-grade deposits underlie the southern part of the property as indicated on the geological map (No. 2002, map case).

CAN-MET EXPLORATIONS LIMITED

This company holds 35 patented claims on Quirke Lake and on the prominent headland on the south shore. It is reached by a gravel motor road joining highway No. 108, some 6 miles north of Elliot Lake. Surface geology consists of Gowganda, Serpent, and Espanola formations striking east and dipping 15°–20°S.

Eleven drill holes were completed by March 1956. According to the management this work disclosed ore in a bed of conglomerate, 15 feet thick, striking N.65°W. and dipping 20°S. Company officials estimate reserves of at least 6,000,000 tons grading 0.1 percent U_3O_8. On these results the company was awarded a contract for $79,061,082, to be delivered by 1963.

In order to develop this ore, two shafts 500 feet apart were sunk: the No. 1 or west shaft, a two-compartment service and ventilation shaft, was sunk to 2,216 feet; the No. 2 or east shaft, a three-compartment production shaft, was sunk to 2,395 feet. (The ore bed lies at 2,000 feet.) A haulageway connecting the two shafts has been driven at about the 2,100 foot horizon, and development northward has begun.

A mill to handle 3,000 tons per day was completed in October 1957, and the first shipment of concentrates was made two months later.

The Quirke Lake thrust is intersected in the shafts at a depth of 1,900 feet and lies in the Middle Mississagi argillite. It strikes N.80°W., dips 22°S., and has a net slip of 5–700 feet. Several minor normal and reverse faults transect the orebody.

[1]All grades are from company drill logs.

CONECHO MINES LIMITED[1]

The property consists of 36 surveyed and 4 unsurveyed claims on the northeast arm of Quirke Lake in Township 144, and the west end of Teasdale Lake. In 1954-55 a diamond-drilling program was carried out, which indicated: "A minimum of 2,000,000 tons of material averaging 1.4 lbs. of U_3O_8 per ton across an average width of six feet."[2] Surface exposures show the Middle Mississagi resting on the granitic basement north of Quirke Lake, a thick diabase sill in Upper Mississagi quartzite between Quirke and Teasdale lakes, and Bruce and Espanola formations southwest of Teasdale Lake.

CONSOLIDATED CALLINAN FLIN-FLON MINES LIMITED

This company's holding consists of 20 surveyed claims at the west end of Hough Lake in Township 143. A tractor road connects Hough Lake with the Pecors Lake road. Development has consisted of surface mapping and a diamond-drill hole, which reached basement at 1,600 feet but with negative results.

The area is underlain by poorly exposed Upper Mississagi quartzite, and the southwest corner of the property is traversed by the Pecors Lake fault.

LEXINDIN GOLD MINES LIMITED

This company's holding, totalling 18 surveyed claims, lies to the southwest of the southwest bay of Quirke Lake, and its area is divided between Townships 143, 144, 149, and 150. The gravel road connecting the Stanrock and Can-Met mines with highway No. 108 runs across the property providing easy access.

The property is largely underlain by sand and gravel. Sporadic outcrops of Gowganda boulder greywacke conglomerate are found near the south margin of the property. In 1955 a deep hole, vertical at collar, was drilled giving the following data:[3]

Footage	Description
0– 20....	Casing.
20– 394....	Gowganda conglomerate.
394– 399....	Gowganda greywacke, coarse grained.
399–1,287....	Serpent quartzite.
1,287–1,600....	Espanola Limestone.
1,600–1,724....	Bruce Limestone and greywacke, thin bedded.
1,724–1,830....	Bruce conglomerate.
1,830–1,845....	Bruce limestone, white to grey, bedded 70°/core.
1,845–1,894....	Bruce limestone, brecciated, and thin corrugated beds.
1,894–1,903....	Fault schist.
1,903–1,908....	Bruce limestone.
1,908–2,108....	Bruce conglomerate.
2,108–2,138....	Bruce greywacke.
2,138–2,520....	Mississagi quartzite and impure quartzites.
2,520–2,612....	Diabase dike.
2,612–3,007....	Mississagi quartzite.

The fault intersected at 1,894 feet has been termed the Lexindin fault (see p. 38). (Chart A, map case.)

After completion of the hole to basement (without intersecting economically significant uraniferous conglomerate) no further development was undertaken.

[1]Merged into Consolidated Frederick Mines Ltd. in August 1957.

[2]E. L. Evans, unpublished company report, 1955.

[3]Company log submitted for assessment credit. The information used in plotting the hole on the map was provided by P. J. Pienaar while engaged on work for the Geological Survey of Canada.

MAGOMA MINES LIMITED

This group consists of 18 unsurveyed claims at the east end of Hough Lake.

Surface exposures show the whole sequence from the Middle Mississagi to the Gowganda. The claims lie along the Hough Lake reverse fault, and the area has been subjected to considerable movement.

A diamond-drill hole collared on the south shore of the east bay of Hough Lake entered Lower Mississagi quartzite at 2,142 feet and was terminated in this member at 2,146 feet.[1]

MENTOR EXPLORATION AND DEVELOPMENT COMPANY LIMITED

The company owns 17 claims between the Stanrock property and the southwest end of Quirke Lake in Township 144. Rocks exposed are conglomerates and arkoses of the Gowganda Formation. The Spanish American fault crosses the area. Surface work and surveying have been carried out.

A drill hole, vertical at the collar, was collared at 1,140 feet elevation; according to the management it gave the following results:

Footage	Description
0– 216....	Gowganda Formation.
216–1,164....	Serpent Formation.
1,164–1,594....	Espanola Limestone and Espanola Greywacke.
1,594–1,725....	Bruce Limestone.
1,725–2,028....	Bruce Conglomerate.
2,028–3,479....	Upper Mississagi Quartzite.
3,479–4,095....	Middle Mississagi Argillite.
4,095–4,161....	Middle Mississagi Conglomerate.
4,161–4,375....	Lower Mississagi Arkose.
(No radioactive zones)	
4,375–4,415....	Greenstone.
4,415..........	End of hole.

TRO PARI TEST

2,500 feet	N.6½°W.	55°
4,000 feet	N.8° W.	45°

ACID TEST

1,000 feet	87°
2,000 feet	71°
3,000 feet	53°
4,000 feet	42°

MILLAQUA MINES LIMITED

This property, consisting of 38 patented claims, lies immediately to the east of the property of Pardee Uranium Mines Limited. Access is provided by the Pecors road and numerous drill roads; from the west end of Pardee Lake a drill road runs towards the northeast corner of the property.

The rocks exposed include the uppermost lava series of the basement, the arkoses and conglomerates of the Lower Mississagi, the complete Middle Mississagi sequence in the cliff north of the Pecors road, and, in the northern part of the area, the Nordic diabase sill cutting quartzite of the Upper Mississagi.

Diamond-drilling indicated[2] the presence of 5,390,000 tons of ore averaging 0.07 percent U_3O_8. Reports on two diamond-drill holes, PA-22 and PA-29, as filed for assessment work credit, give the following results:

[1]Company drill log.

[2]Company drill logs.

Hole PA-29 was drilled north at an angle of 75 degrees and reached the basement at 797 feet (length of hole). The hole intersected the main conglomerate at 742–750.3 feet and gave assays as follows:

Footage	U_3O_8	ThO_2
	percent	percent
742 –744.7 = 2.7	0.60	2.60
744.7–746.7 = 2.0	0.60	2.60
746.7–749.0 = 2.3	1.60	1.80
749.0–750.3 = 1.3	0.20	0.60

Hole PA-22 was drilled north at an angle of 75 degrees and reached the basement at 851 feet (total length of hole). The hole intersected the main reef at 818.6–824.3 feet and gave assays as follows:

Footage	U_3O_8	ThO_2
	percent	percent
818.6–820.8 = 2.2	0.05	1.00
820.8–824.3 = 3.5	0.10	2.00

An adit was driven in an outcrop of Lower Mississagi and basement rocks located ½ mile south of the east end of Pardee Lake, and bulk samples for test purposes were taken. No further work has been done since 1955.

NASCO COBALT SILVER MINES LIMITED

In a written communication the company stated: "The property consists of 29 claims in Twp. 143 [surrounding Poppy Lake] on which all assessment work necessary for patent including survey has been completed. Three diamond drill holes have been completed to basement." Hole No. 1 near the southwest corner of Poppy Lake revealed "only scattered radioactivity . . . in a total thickness of 339 feet of quartzite." Hole No. 2, some 4,600 feet east of No. 1, "cut several bands of typical quartz pebble conglomerate over a true thickness of 110 feet . . . the best assay obtained was 0.06 percent U_3O_8 over 2 feet." The hole was wedged, and a further intersection was obtained. "The best assay obtained was 0.038 percent U_3O_8 over 5 feet of core." In Hole No. 3, about 2,140 feet east of No. 2, "mineralization occurred between 3,242 feet–3,420 feet vertical depth and the best assay obtained was 0.065 percent over two feet of core."

A summary log for the most westerly of the three holes is given below:

Footage	Description
0– 3	Casing.
3– 993	Serpent Quartzite.
993–1,340	Espanola Limestone and Espanola Greywacke.
1,340–1,500	Bruce Limestone.
1,500–1,568	Bruce Conglomerate.
1,568–3,216	Upper Mississagi Quartzite.
3,216–3,794	Middle Mississagi Argillite.
3,794–3,905	Middle Mississagi Conglomerate.
3,905–4,242	Lower Mississagi Quartzite.
4,242–4,278	Greenstone.
4,278	End of hole.

NORGOLD MINES LIMITED

This company has two holdings within the area. The larger consists of 10 claims in Township 144 immediately to the south of the Can-Met property, and the smaller consists of 4 claims in the northwest corner of Township 143 west of Poppy Lake. Both properties are underlain by Gowganda conglomerate and quartzites. The Spanish American fault passes through the larger group; on this group two diamond-drill holes, hole No. 1 to 3,552 feet and hole No. 2 to 3,874 feet, have been put down, but with no results of any interest.

NORTHSPAN URANIUM MINES LIMITED

Panel Property

This property consists of 36 claims, the greater part of which underlie Quirke Lake, in Township 144. It is reached by a motor road along the north shore of Quirke Lake. According to the management, diamond-drilling disclosed ore reserves of 5,764,889 tons averaging 0.108 percent U_3O_8. The mineralization occurs in a zone 12 feet thick, which strikes N.75°W. and dips 14°S. As all the ore lies under Quirke Lake it was necessary to establish the shafts on islands in Quirke Lake. No. 1 shaft, a six-compartment production shaft, was sunk from an island close to the north shore of the lake and connected to it by a causeway. This shaft was put down to 1,102 feet but is now being extended to 1,800 feet. No. 2 shaft, a three-compartment ventilation and service shaft, is situated on a small island in Quirke Lake and has been sunk to 1,250 feet. The shafts are connected by a partly inclined drive 2,733 feet long. A mill to handle 3,000 tons per day has been constructed and began operating in December 1957.

PARDEE URANIUM MINES LIMITED

This group consists of 36 surveyed and 4 patented claims in the western part of Township 143. The Pecors road and drill roads provide access to the property.

Rocks exposed include the uppermost lava member of the Keewatin(?) (p. 10), the arkoses and conglomerates of the Lower Mississagi, the complete Middle Mississagi sequence in the cliff north of the Pecors road, and, in the northern part of the area, the Nordic diabase sill cutting quartzite of the Upper Mississagi.

Diamond-drilling carried out under the auspices of Calder-Bousquet gave the following results:[1]

The main oligomictic conglomerate horizons average 10 feet in thickness and lie 40–70 feet above the basement. The average grade from 9 intersections ranging from 0.0287 percent U_3O_8 to 0.064 percent U_3O_8 was 0.0437 percent U_3O_8.

A number of holes also intersected a basal conglomerate, up to 9 feet in thickness, which peters out 1,000 feet down dip. Laterally this bed does not extend to the Millaqua property but may extend to the east margin of the Abeta group. The average grade obtained from three holes was 0.037 percent U_3O_8. A fourth hole intersected 1.2 feet grading 0.159 percent U_3O_8.

A third bed lies some 80–100 feet above basement but is intermittent. The only assay for this bed gave 0.038 percent U_3O_8 over a width of 3.1 feet.

[1]Company drill logs.

PENFIELD URANIUM MINES LIMITED

The company holds a block of 42 patented claims in the northwestern part of Township 143 and adjoining parts of Townships 144 and 149. Serpent Quartzite and Gowganda conglomerate are exposed at the northern limit, and Espanola Limestone in the southeast corner. Diamond-drilling was carried out to a depth of 3,750 feet, with negative results.

PICTON URANIUM MINES LIMITED

This company holds 40 claims in Townships 143 and 137, northeast of the north end of Pecors Lake. The whole sequence from Upper Mississagi to Gowganda is well exposed; it strikes slightly north of east and dips 30°N. In a written communication the management stated: "In 1955 a diamond-drill hole . . . encountered argillite at 1,747 feet and diabase at 2,199 feet. The hole was abandoned at 2,350, still in diabase."

PLUM URANIUM AND METAL MINING LIMITED[1]

This company's holding consists of a block of 76 surveyed claims in the central part of Township 143, to the south of May Lake and north of Hough Lake. A tractor road connects Hough and May lakes. In the western part, easterly-striking, northerly-dipping strata from the Upper Mississagi to the Middle Serpent are sporadically exposed. Considerable small-scale folding about northeast axes is visible along the shore of May Lake. The Hough Lake reverse fault enters the area but is apparently obscured by a prominent sill-like diabase mass at the south end of May Lake. East of the fault there are exposures of Gowganda quartzite and conglomerate cut by thin, east-striking diabase dikes.

Four shallow and two deep holes were collared on the property. Hole PX-4, collared ¼ mile north of the west end of Hough Lake, gave the following data:[2]

Description	Thickness Feet
Upper Mississagi Quartzite	1,549
Middle Mississagi Argillite	268
Diabase	60
Middle Mississagi Greywacke	109
Diabase	475
Middle Mississagi Greywacke	496
Middle Mississagi Conglomerate	3
Lower Mississagi Quartzite	116
Basement contact (at 3,051 feet)	
Greenstone	15
End of hole at 3,066 feet	

No radioactive conglomerate was encountered in the Lower Mississagi.

A second deep hole (F.1), collared 38 chains east of the south end of May Lake, gave the following:

Description	Thickness Feet
Diabase	501
Gowganda Formation	463
Serpent Quartzite	253
Espanola Limestone and Espanola Greywacke	865
Bruce Limestone	72
End of hole at 2,154 feet	

[1]Merged into Consolidated Frederick Mines Ltd. in August 1957.
[2]Company drill logs.

ROCHE MINES LIMITED

This group consists of 17 patented claims on the southeast arm of Quirke Lake and the west end of Ouellette Lake, in Township 144. Serpent Quartzite is exposed round Quirke Lake, and Espanola Greywacke is exposed to the north of Ouellette Lake. The western nose of the Teasdale-Ouellette diabase sill is exposed between Quirke and Ouellette lakes; it is evident that this has had considerable disruptive and metamorphic effects on the adjacent strata. (Pages 29, 32.)

Five diamond-drill holes have been completed to basement. The management have stated in a written communication that two of these "had good widths of commercial grade."

RON-ROY URANIUM MINES LIMITED

This holding comprises 9 unsurveyed claims underlying Quirke Lake to the southwest of the Stanrock mine. The property extends into Township 150.

Gowganda conglomerates and quartzites, striking east and dipping 15°–35°S., are exposed on the shore of Quirke Lake near the east boundary.

In 1956 a drill hole was collared near the northeast corner of the property. This was stopped at 480 feet without leaving the Gowganda Formation.

ST. MARYS URANIUM MINES LIMITED

The company owns 29 patented claims in Townships 149 and 143, in the vicinity of Flying Goose and Canyon lakes. The rocks exposed are east-striking, north-dipping Upper Mississagi quartzites cut by diabase dikes. A diamond-drill hole (E.2) drilled jointly with New Jersey Lead and Zinc Corporation,[1] was put down near the southeast corner of the property, 1,000 feet east of the township line. The management stated, in a written communication, that this: "Gave values of the general nature of 0.05 [percent U_3O_8] over a width of some 30 feet." They also stated that a second hole (E.1) "at the western section of the south boundary showed some radioactivity but this was spotty and could not be averaged as the hole above."

Hole E.2 gave the following results:[2]

Footage	Description
0 – 40	Casing.
40 – 631.7......	Upper Mississagi Quartzite.
631.7–1,201.5......	Middle Mississagi Argillite.
1,201.5–1,291.2......	Middle Mississagi Conglomerate.
1,291.2–1,504.6......	Lower Mississagi (Nordic) Argillite.
1,504.6–2,099.9......	Lower Mississagi Quartzite (pebble bands).
2,099.9–2,105.0......	Argillite (basement).
2,105...............	End of hole.

SAN ANTONIO GOLD MINES LIMITED

The group consists of 80 surveyed claims in Townships 144 and 143, between Ouellette and May lakes.

The axis of the Quirke syncline passes through the centre of the property. A subsidiary syncline associated with the Ouellette-Teasdale sill occupies the northern part of the property. Further subsidiary folding with a northeast strike

[1]Former holders of the Pardee property.

[2]Company drill logs.

is apparent to the south around May Lake. The rocks exposed are quartzite and conglomerate of the Gowganda Formation resting on Serpent Quartzite. Espanola Limestone is exposed in anticlinal cores on May Lake. (Chart B, map case.)

Development work in 1955 included 6 vertical drill holes. Their locations and logs are given below:[1]

Drill hole No. 1 is located on the south shore of Teasdale Lake just east of section-line D-E. (See map No. 2002, map case.)

Drill hole No. 2 is collared on the promontory at the west end of the small lake just east of Halfmoon Lake.

Drill hole No. 3 is situated slightly east of the half-way position between holes Nos. 1 and 2.

Drill hole No. 4 is located on the headland on the west side of the narrows of central May Lake, Township 143.

Drill hole No. 5 lies on the north shore of May Lake to the northeast of No. 4.

Drill hole No. 6 is collared on the south shore of central Ouellette Lake.

Hole No. 1
Collar Elevation 1,103 feet.
Plunge at 1,800 feet 80°N.

Footage	Description
0– 60	Espanola Greywacke.
60– 190	Bruce Limestone.
190– 248	Bruce Conglomerate.
248– 427	Upper Mississagi Quartzite.
427– 805	Diabase.
805–1,682	Upper Mississagi Quartzite.
1,682–1,956	Middle Mississagi Argillite.
1,956–1,987	Middle Mississagi Conglomerate.
1,987–2,027	Lower Mississagi Quartzite.
2,027–2,040	Regolith.
2,040–2,051	Granite.
2,051	End of hole.

Hole No. 2
Collar Elevation 1,205 feet.
Plunge at 2,600 feet 59°N.

Footage	Description
0– 230	Serpent Quartzite.
230– 314	Espanola Limestone.
314–1,081	Espanola Greywacke.
1,081–1,204	Bruce Limestone.
1,204–1,293	Bruce Conglomerate.
1,293–2,936	Upper Mississagi Quartzite.
2,936–3,229	Middle Mississagi Argillite.
(Fault)	
3,229–3,340	Quartzite.
3,340–4,354	Middle Mississagi Argillite.
4,354–4,449	Diabase.
4,449–4,501	Middle Mississagi Argillite.
4,501–4,518	Middle Mississagi Conglomerate.
4,518–4,530	Regolith.
4,530–4,547	Greenstone.
4,547	End of hole.

[1]Company drill logs.

HOLE NO. 3
Collar Elevation 1,225 feet.
Plunge at 1,100 feet 73°.

Footage	Description
0– 257........	Gowganda Conglomerate.
257– 380........	Serpent Formation.
553–1,292........	Espanola Formation.
1,292	End of hole.

HOLE NO. 4
May Lake
Plunge at 1,400 feet 79°S.

Footage	Description
0– 710........	Espanola Formation.
710– 748........	Bruce Conglomerate.
748–2,275........	Upper Mississagi Quartzite.
2,275–2,630........	Middle Mississagi Argillite.
	(*End of available log*).

HOLE NO. 5
May Lake
810 feet—end of hole; full log not available.

HOLE NO. 6
Ouellette Lake

Footage	Description
0– 20........	Casing.
20– 546........	Serpent Quartzite.
546– 730........	Espanola Limestone.
730– 927........	Espanola Greywacke.
927–1,370........	Diabase.
1,370–1,481........	Bruce Limestone.
1,481–1,633........	Bruce Conglomerate.
1,633–2,644........	Upper Mississagi Quartzite.
2,644–2,945........	Middle Mississagi Quartzite.
2,945–3,010........	Core missing.
3,010–3,090........	Greenstone.
3,090	End of hole.

SAND RIVER GOLD MINING COMPANY LIMITED

The company reports that: "The property consists of 24 claims in Twps. 144 and 138 (about ½ mile east of Teasdale Lake)."

The whole sequence from Algoman granodiorite to Serpent Quartzite is exposed on the property. Diabase sills are numerous.

According to the company: "A diamond-drill hole was drilled on common boundary between Rockwin Mines Ltd. [who formerly held ground in the area] property and our group to the east." Results are given below:

Footage	Description
0– 6.......	Casing.
6– 165.......	Espanola Limestone.
165– 395.......	Espanola Greywacke.
395– 612.......	Bruce Limestone.
612– 899.......	Diabase.
899–1,026.......	Bruce Conglomerate.
1,026–2,022.......	Upper Mississagi Quartzite.
2,022–2,094.......	Diabase.
2,094–2,108.......	Upper Mississagi Quartzite.
2,108–2,124.......	Middle Mississagi Argillite.
2,124–2,139.......	Diabase.
2,139–2,285.......	Lower Mississagi Quartzite.
2,285–2,290.......	Lost core.
2,290–2,396.......	Greenstone regolith.
2,396–2,446.......	Greenstone.
2,446	End of hole.

Tro Pari tests at 1,000 feet gave a dip of 74° on N.1°W., and at 2,000 feet a dip of 58° on N.12°E.

Oligomictic conglomerate bands were observed between 2,310 and 2,334 feet. Only faint radioactivity was recorded, and no samples were assayed.

A series of three holes was drilled by Sand River Gold Mining Company Limited in the vicinity of Nook Lake, but only one of these (N.1) was located within Township 144. This hole was collared due north of the deep hole and some 2,000 feet west of the west end of Nook Lake, and was drilled at N.14°E. with a plunge of 45°. Results were as follows:

Footage	Description
0– 5......	Casing.
5–246......	Upper Mississagi Quartzite.
246–308......	Diabase.
308–479......	Badly broken core—diabase and sediments.
479–725......	Diabase.
725	End of hole.

SPAN-NORTH MINING CLAIMS LIMITED

This property is located between the southeast bay of Quirke Lake and Half-moon Lake in Township 143. The axis of the Quirke syncline crosses the southern part of the property. Gowganda Conglomerate lies unconformably on Serpent Quartzite, and a diabase sill-like intrusive lies in the northeast corner. No deep drilling has been undertaken.

STANATOMIC URANIUM MINES LIMITED

(See Stancan Uranium Corporation)

STANCAN URANIUM CORPORATION

This company has extensive holdings in Townships 149 and 143. Sixty claims, including those later allotted to Stanatomic Uranium Mines Limited (a Stancan controlled subsidiary), lie in Township 143, in the vicinity of McCabe, Elephant, and Flying Goose lakes.

All units from the Upper Mississagi to the Serpent Quartzite are exposed, striking east and dipping north. Easterly- and southeasterly-striking diabase dikes cross the property. The chief structural feature is the Pecors Lake fault, which crosses the area. The Benedict Lake fault runs close to the east margin of the property.

In addition to surface mapping and surveying, three diamond-drill holes have been drilled on the property. One (Z-5-1), drilled at the west end of the south margin of the property, on Flying Goose Lake, was completed to 2,590 feet. A second (Z-5-2), drilled just north of the east end of Elephant Lake, reached greenstone at 2,985 feet. The third (B-1-1) is located near the east margin of the Stanatomic property, some ¾ mile north of Elephant Lake. The logs of these holes are given below:[1]

HOLE B-1-1
Vertical

Footage	Description
0– 219	Serpent Formation.
219– 675	Espanola Limestone and Espanola Greywacke.
675– 770	Bruce Limestone.
770– 881	Bruce Conglomerate.
881–1,491	Upper Mississagi Quartzite.
1,491	End of hole.

HOLE Z-5-1
Vertical

Footage	Description
0 – 705	Upper Mississagi Quartzite.
705 –1,285.5	Diabase.
1,285.5–1,331	Upper Mississagi Quartzite.
1,331 –1,957.5	Middle Mississagi Argillite.
1,957.5–1,967.2	Middle Mississagi Conglomerate.
1,967.2–2,339	Lower Mississagi Quartzite (Argillitic sections).
2,339 –2,608.2	Lower Mississagi Quartzite.
2,608.2–2,616	Transition zone.
2,616 –2,717	Greenstone.
2,717	End of hole.

HOLE Z-5-2
Vertical

Footage	Description
0 – 176	Bruce Formation.
176 –2,007	Upper Mississagi Quartzite.
2,007 –2,735.5	Middle Mississagi Argillite.
2,735.5–3,000	Lower Mississagi Quartzite.
(Quartz-pebble horizons between 2,915 and 2,936 feet)	
3,000 –3,005	Transition zone and greenstone.
3,005	End of hole.

[1]Summarized from logs filed for assessment work.

STANROCK URANIUM MINES LIMITED

This property consists of 22 patented claims and is located on the south side of Quirke Lake. It is adjoined by Spanish American (Northspan) on the west, by Can-Met Explorations on the northeast, and by Consolidated Denison on the north. Access is by motor road, which joins the Can-Met road about ½ mile to the east.

There are two vertical shafts at the Stanrock mine, both collared in Gowganda Conglomerate. The No. 1 shaft section is as follows:[1]

DESCRIPTION	THICKNESS Feet
Gowganda Conglomerate	560
Serpent Quartzite	580
Espanola Limestone + Espanola Greywacke	470
Bruce Limestone	100
Bruce Conglomerate	120
Upper Mississagi Quartzite	1,130
Middle Mississagi Argillite + Middle Mississagi Conglomerate	220
Lower Mississagi Quartzite (including 10 feet of uraniferous conglomerate)	170
Pre-Huronian basic schist.	

Fred Barnes reports in a written communication:

> Exploration began in 1955 and nine diamond-drill holes were completed to the ore zone. On the basis of the nine drill intersections the indicated ore was calculated at 7,509,148 tons with an average U_3O_8 content of 0.106 percent. A contract for $96,000,000 worth of U_3O_8 concentrates was obtained from Eldorado.

The ore occurs in a bed 10 feet thick or more, which strikes N.67°W. and dips 18°S. The Quirke Lake thrust, having a strike of N.67°W. and a dip of 18°S., repeats the ore over a width of 1,200 feet. The vertical separation of the thrusted ore is 130 feet on the west side, to 30 feet on the east side of the property.

Mr. Barnes describes the mine thus:

> Two shafts are being prepared on the property the production shaft (3 compartments) has been bottomed at 3,378 feet. The service shaft (2 compartments) will be bottomed about December 23rd at a depth of about 2,960 feet. From the shafts, which are located 797 feet apart on a north-south line, haulageways will be driven westward on a 12 percent grade.

A mill to handle 3,000 tons per day has been constructed on the top of Rooster Rock, a cliff towering some 300 feet above Quirke Lake and which forms one of the most imposing landmarks of the area. Production began in March 1958.

---

[1]Fred Barnes, mine geologist Stanrock, written communication.

VITE URANIUM MINES LIMITED

Pecors Property

The company holds 43 unsurveyed claims in the southeast corner of Township 143. The property is traversed by the old lumber road from Pecors Lake to Depot Lake.

Sheared Middle Mississagi conglomerate and siltstones and Keweenawan diabase are exposed on a prominent headland (Vite Point) on the southwest shore of Pecors Lake. The rest of the land claims lie on the Keewatin(?) rocks of the basement. The dominant rock types are quartzite, greywacke, and lean iron formation. These are cut by northwest-trending Keewatin(?) diabase dikes containing minor disseminated pyrite, chalcopyrite, and pyrrhotite, and by Keweenawan rocks without mineralization. The claims were originally held by Teck Exploration Company Limited who reported:[1]

> The drilling done under our direction indicated an iron formation and showed a small amount of nickel but no uranium.

The claims were transferred to Vite Uranium Mines Limited, who carried out diamond-drilling on Vite Point. Four holes revealed rapid variation in thickness of the Lower Mississagi, probably indicating a basement high. The two northeasterly holes intersected thin beds of low-grade uraniferous conglomerate; however, the property has been idle since 1955.

---

[1]Written communication to the author.

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INDEX

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Townships 143-144 Report.
Charts A, B, C, D.
Geological Sections.

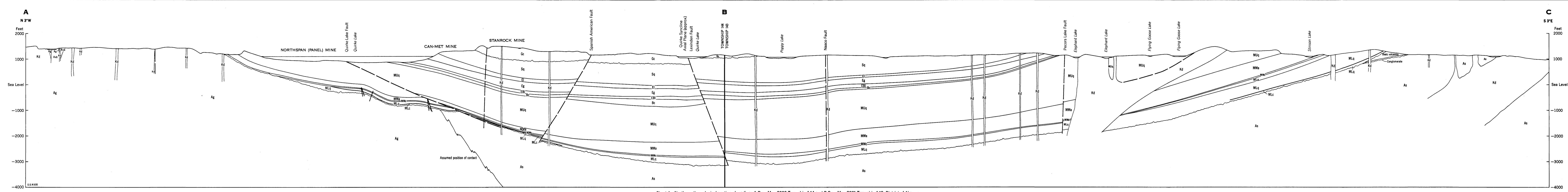


Chart A—North-south geological section along lines A-B on Map 2002 Township 144 and B-C on Map 2001 Township 143, District of Algoma.

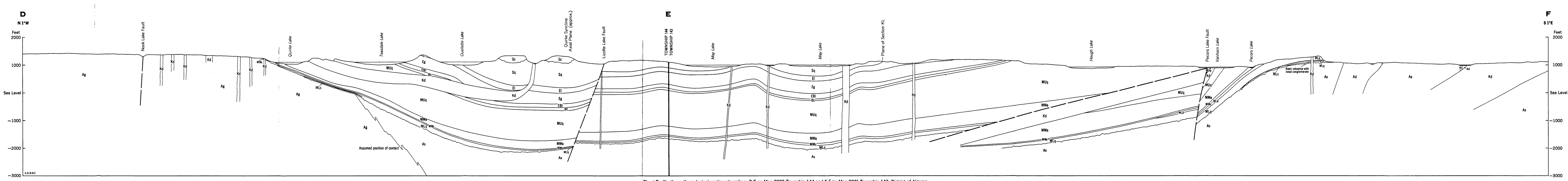


Chart B—North-south geological section along lines D-E on Map 2002 Township 144 and E-F on Map 2001 Township 143, District of Algoma.

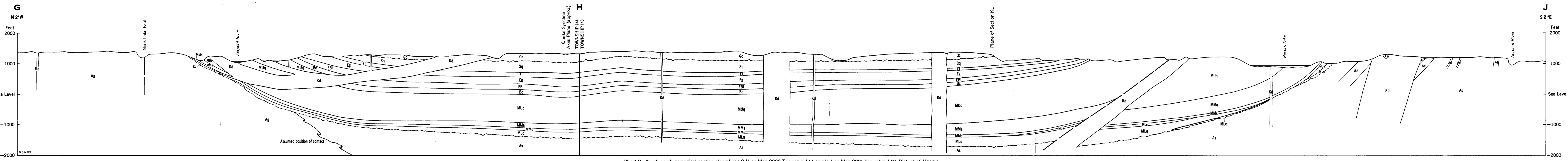


Chart C—North-south geological section along lines G-H on Map 2002 Township 144 and H-J on Map 2001 Township 143, District of Algoma.

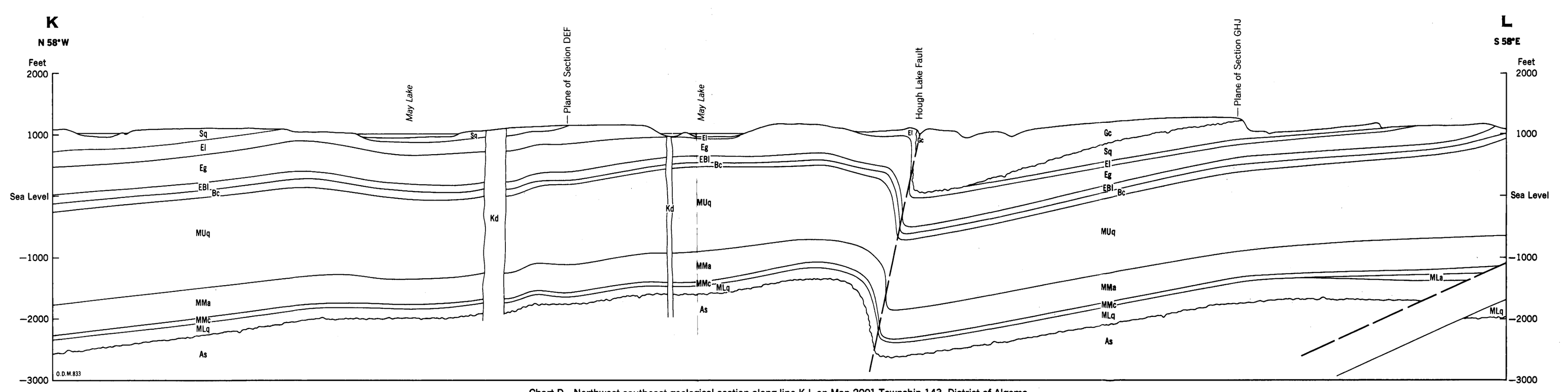


Chart D—Northwest-southeast geological section along line K-L on Map 2001 Township 143, District of Algoma.

VERTICAL GEOLOGICAL SECTIONS

TOWNSHIPS 143 AND 144

DISTRICT OF ALGOMA

Scale 1:15,840 or 1 Inch to ¼ Mile

LEGEND

CENOZOIC

Not indicated.

GREAT UNCONFORMITY

PRECAMBRIAN

PROTEROZOIC

KEWEENAWAN

Kd Diabase.

INTRUSIVE CONTACT

HURONIAN

COBALT GROUP

GOWGANDA FORMATION

Gc Conglomerate, quartzite, greywacke.

UNCONFORMITY

BRUCE GROUP

SERPENT FORMATION

Sq Quartzite.

CONFORMABLE CONTACT

ESPANOLA FORMATION

El Espanola Limestone.

Eg Espanola Greywacke.

EBl Bruce Limestone.

CONFORMABLE CONTACT

BRUCE FORMATION

Bc Conglomerate.

CONFORMABLE CONTACT

MISSISSAGI FORMATION

Upper

MUq Quartzite.

Middle

MMa Argillite, greywacke.

MMc Conglomerate.

Lower

MLa Argillite.

MLq Feldspathic quartzite.

MLc Uraniferous quartz-pebble conglomerate.

GREAT UNCONFORMITY

ARCHEAN

ALGOMAN

Ag Granite and allied rock types.

INTRUSIVE CONTACT

KEEWATIN ?

Ad Diabase.

INTRUSIVE CONTACT

Avb Basic metavolcanics.

*As Metasediments and metalavas.**

*Basic metalavas difficult to distinguish from basic intrusives (Ad).

SYMBOLS

Geological boundary.

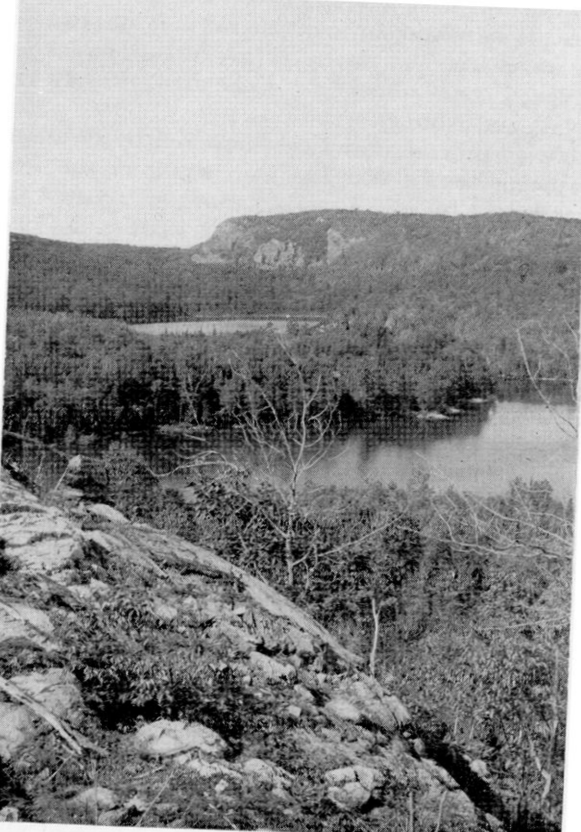
Unconformity.

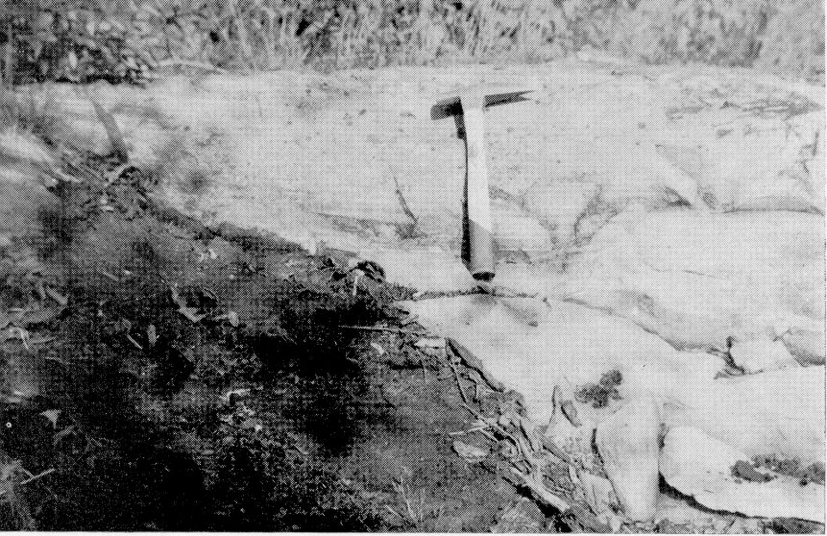
Fault.

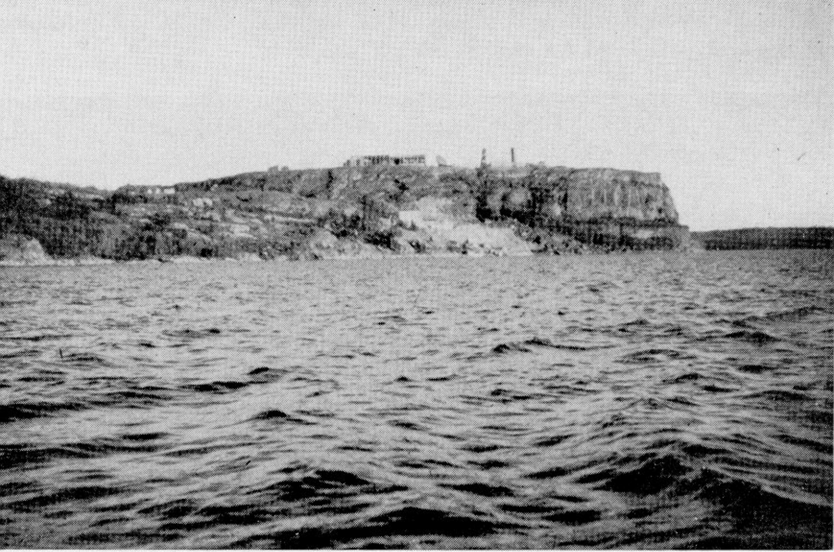
SOURCES OF INFORMATION

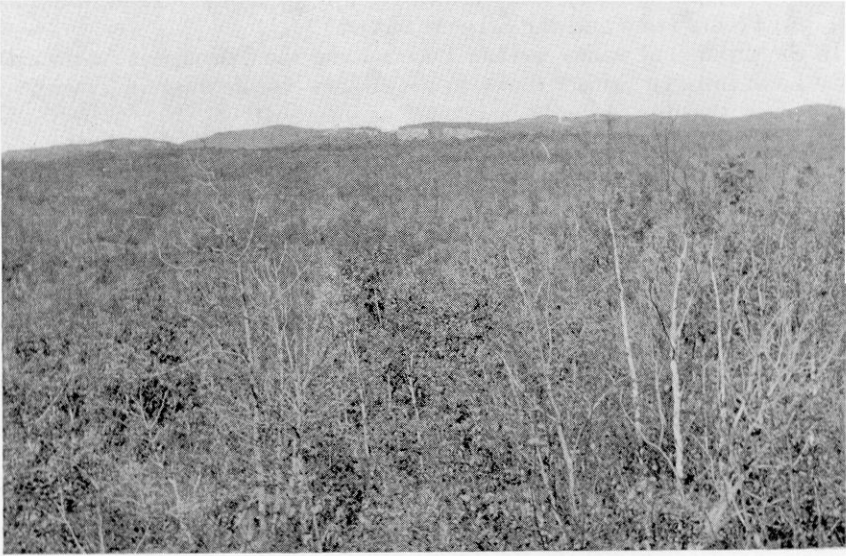
Geology by J. A. Robertson, 1957.

Geological and drilling plans of mining companies.





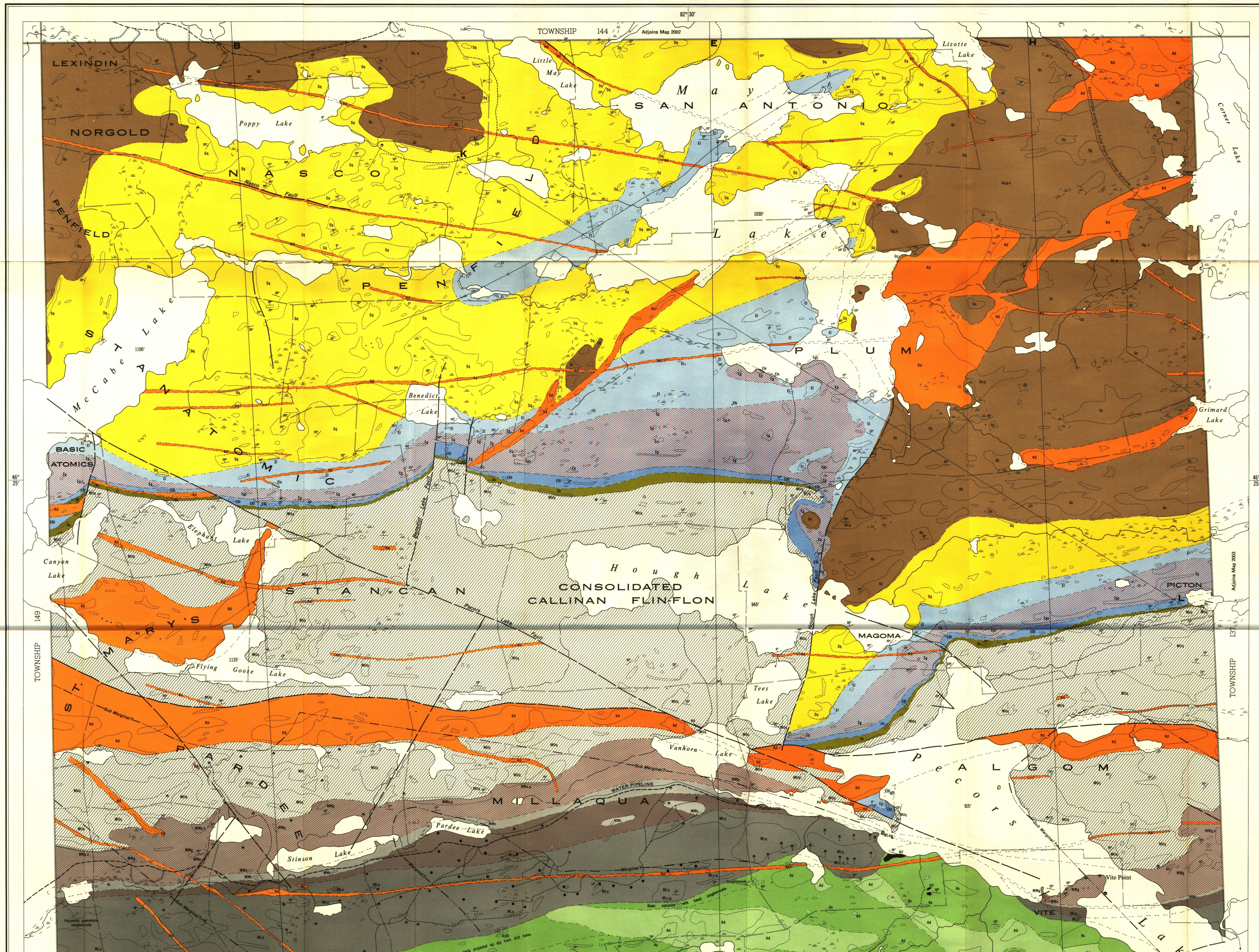


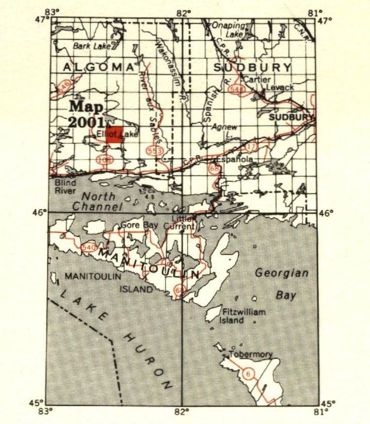


ONTARIO
DEPARTMENT OF MINES

HON. JAMES A. MALONEY, *Minister of Mines*
H. C. Rickaby, *Deputy Minister* M. E. Hurst, *Provincial Geologist*

Map 2001
TOWNSHIP 143





Scale, 1 inch to 50 miles

SYMBOLS

975′	*Approximate altitude in feet above mean sea level.*
	Muskeg or swamp with boundary.
108	*Highway with number.*
	Motor road.
	Wagon road.
	Small rock outcrop.
	Boundary of rock outcrop.
	Geological boundary, defined.
	Geological boundary, assumed.
23°	*Strike and dip*
45°	*Strike and dip of overturned bedding; beds face in direction of arrow and dip in direction of loop.*
	Horizontal bedding.
	Synclinal axis.
	Anticlinal axis.
	Direction of plunge of fold axis, crest line or trough line.
	Fault, indicated or assumed.
	Township boundary, approximate location.
	Mining property boundary, approximate location. Some properties are not outlined.
	Shaft, vertical.
	Open cut, quarry, gravel pit.
	Adit.
	Drill hole which intersected uraniferous quartz-pebble conglomerate of ore grade.
	Drill hole which intersected uraniferous quartz-pebble conglomerate of marginal to sub-marginai grade.
	Drill hole which intersected little or no uraniferous quartz-pebble conglomerate.
	Drill hole not completed to pre-Huronian basement rock.
	Assumed boundary of uraniferous quartz-pebble conglomerate of ore grade.
	Assumed boundary of uraniferous quartz-pebble conglomerate of marginal to sub-marginal grade.

LEGEND

CENOZOIC

RECENT*

Swamp and stream deposits.

PLEISTOCENE*

Sand, gravel and clay.

GREAT UNCONFORMITY

PRECAMBRIAN

PROTEROZOIC

KEWEENAWAN

Kd *Diabase, gabbro and diorite, cut by later acidic and basic dikelets.*

INTRUSIVE CONTACT

HURONIAN

COBALT GROUP

GOWGANDA FORMATION

Gc *Polymictic conglomerate with or without interbedded quartzite, argillite, siltstone.*
Gq *Feldspathic quartzite.*
Gg *Greywacke, siltstone, argillite, with or without some conglomerate and quartzite.*

UNCONFORMITY

BRUCE GROUP

SERPENT FORMATION

Sq *Feldspathic quartzite, subgreywacke.*
Sc *Polymictic conglomerate.†*

CONFORMABLE CONTACT

ESPANOLA FORMATION

Espanola Limestone

El *Dolomitic limestone and interbedded siltstone.*
Elx *Dolomitic limestone breccia.*

Espanola Greywacke

Eg *Calcareous argillite, siltstone, greywacke.*
Egx *Brecciated calcareous argillite, siltstone, greywacke.*
Ec *Polymictic conglomerate.*
Eq *Quartzite.*

Bruce Limestone

EBl *Limestone with some interbedded siltstone.*

CONFORMABLE CONTACT

BRUCE FORMATION

Bc *Polymictic conglomerate.*

CONFORMABLE CONTACT

MISSISSAGI FORMATION

Upper Mississagi

MUq *Feldspathic quartzite, arkose.*

Middle Mississagi

MMg *Greywacke with minor argillite and siltstone.*
MMa *Argillite, siltstone, with minor greywacke.*

MMc *Polymictic conglomerate.*

Lower Mississagi

MLa *Argillite, siltstone, greywacke.*

MLq *Feldspathic quartzite, arkose, including some lenses of polymictic greenstone conglomerate.*
MLc *Oligomictic (quartz-pebble) conglomerate.*

GREAT UNCONFORMITY

ARCHEAN

Agr *Granitic regolith.** †*

ALGOMAN

Ag *Granite, granodiorite, and allied rock types with or without basic inclusions.†*
Agp *Granite porphyry.†*
Ap *Porphyrite.*

INTRUSIVE CONTACT

KEEWATIN ?

Ad *Gabbro, amphibolite, diabase.*

INTRUSIVE CONTACT

Avb *Undifferentiated basic metavolcanics.†*

As *Sediments, slightly metamorphosed: Quartzite, greywacke, tuff and agglomerate, and minor basic lavas.****

Ar *Rhyolite.*

Aif *Lean iron formation.*

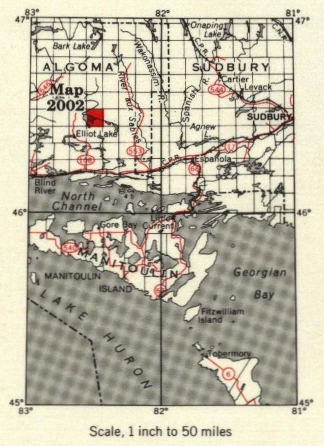
ONTARIO

DEPARTMENT OF MINES

HON. JAMES A. MALONEY, *Minister of Mines*

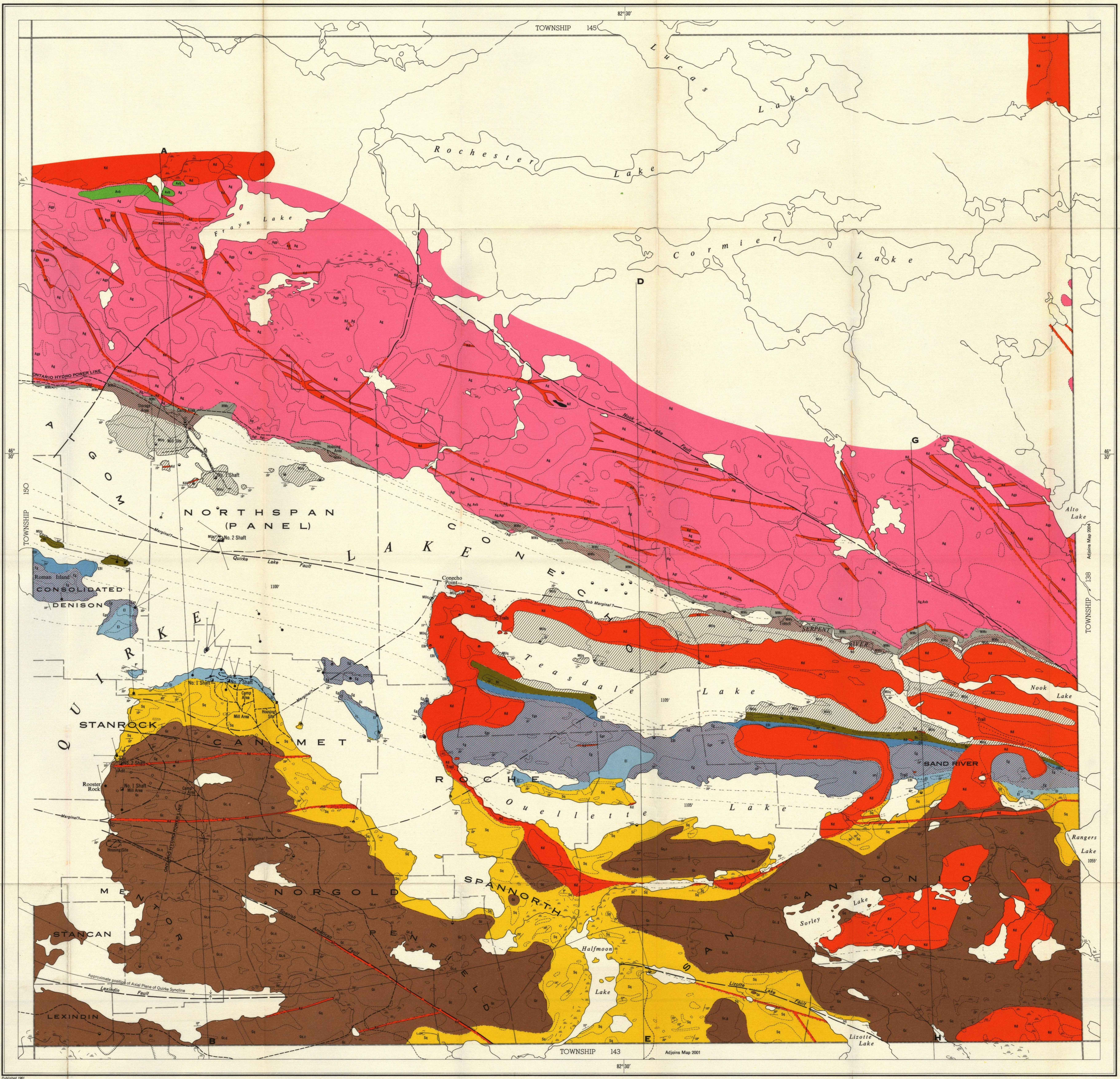
H. C. Rickaby, *Deputy Minister* M. E. Hurst, *Provincial Geologist*

Map 2002
TOWNSHIP 144



SYMBOLS

945′	*Approximate altitude in feet above mean sea level.*
	Muskeg or swamp with boundary.
108	*Highway with number.*
	Motor road.
	Wagon road.
	Small rock outcrop.
	Boundary of rock outcrop.
	Geological boundary, defined.
	Geological boundary, assumed.
	Strike and dip.
	Synclinal axis.
	Anticlinal axis.
	Direction of plunge of fold axis, crest line or trough line.
	Fault, indicated or assumed.
	Township boundary, approximate location.
	Mining property boundary, approximate location. Some properties are not outlined.
	Shaft, vertical.
	Open cut, quarry, gravel pit.
	Adit.
	Drill hole which intersected uraniferous quartz-pebble conglomerate of ore grade.
	Drill hole which intersected uraniferous quartz-pebble conglomerate of marginal to sub-marginal grade.
	Drill hole which intersected little or no uraniferous quartz-pebble conglomerate.
	Drill hole not completed to pre-Huronian basement rock.
	Assumed boundary of uraniferous quartz-pebble conglomerate of ore grade.
	Assumed boundary of uraniferous quartz-pebble conglomerate of marginal to sub-marginal grade.



LEGEND

CENOZOIC

RECENT*

Swamp and stream deposits.

PLEISTOCENE*

Sand, gravel and clay.

GREAT UNCONFORMITY

PRECAMBRIAN

PROTEROZOIC

KEWEENAWAN

Kd *Diabase, gabbro and diorite, cut by later acidic and basic dikelets.*

INTRUSIVE CONTACT

HURONIAN

COBALT GROUP

GOWGANDA FORMATION

Gc *Polymictic conglomerate with or without interbedded quartzite, argillite, siltstone.*
Gq *Feldspathic quartzite.*
Gg *Greywacke, siltstone, argillite, with or without some conglomerate and quartzite.*

UNCONFORMITY

BRUCE GROUP

SERPENT FORMATION

Sq *Feldspathic quartzite, subgreywacke.*
Sc *Polymictic conglomerate.*

CONFORMABLE CONTACT

ESPANOLA FORMATION

Espanola Limestone

El *Dolomitic limestone and interbedded siltstone.*
Elx *Dolomitic limestone breccia.†*

Espanola Greywacke

Eg *Calcareous argillite, siltstone, greywacke.*
Egx *Brecciated calcareous argillite, siltstone, greywacke.*
Ec *Polymictic conglomerate.*
Eq *Quartzite.†*

Bruce Limestone

EBl *Limestone with some interbedded siltstone.*

CONFORMABLE CONTACT

BRUCE FORMATION

Bc *Polymictic conglomerate.*

CONFORMABLE CONTACT

MISSISSAGI FORMATION

Upper Mississagi

MUq *Feldspathic quartzite, arkose.*

Middle Mississagi

MMg *Greywacke with minor argillite and siltstone.†*
MMa *Argillite, siltstone, with minor greywacke.*

MMc *Polymictic conglomerate.*

Lower Mississagi

MLa *Argillite, siltstone, greywacke.†*

MLq *Feldspathic quartzite, arkose, including some lenses of polymictic greenstone conglomerate.†*
MLc *Oligomictic (quartz-pebble) conglomerate.†*

GREAT UNCONFORMITY

ARCHEAN

Agr *Granitic regolith.***

ALGOMAN

Ag *Granite, granodiorite, and allied rock types with or without basic inclusions.*
Agp *Granite porphyry.*
Ap *Porphyrite.†*

INTRUSIVE CONTACT

KEEWATIN ?

Ad *Gabbro, amphibolite, diabase.†*

INTRUSIVE CONTACT

Avb *Undifferentiated basic metavolcanics.*

As *Sediments, slightly metamorphosed: Quartzite, greywacke, tuff and agglomerate, and minor basic lavas.***†*

Ar *Rhyolite.†*

Aif *Lean iron formation.*

**The Recent and Pleistocene deposits are not differentiated on this map. They occur in areas not mapped as outcrop.*

***Fossil soil developed during Eparchean interval.*

****Minor basic lavas difficult to distinguish from basic intrusives (Ad).*

† These rocks do not occur on this sheet area.

SOURCES OF INFORMATION

Geology by J. A. Robertson and assistants, 1957.

Cartography by D. F. Jupe and R. B. Robinson, Ontario Department of Mines, 1960.

Base map derived from maps of the Forest Resources Inventory (first edition), Ontario Department of Lands and Forests, with additional information by J. A. Robertson to 1957.

The magnetic declination in this area was approximately 6°W., 1957.

Published 1961

Map 2002

TOWNSHIP 144

DISTRICT OF ALGOMA, ONTARIO

Scale 1:15,840 or 1 Inch to ¼ Mile

Chains 20 10 0 ¼ ½ ¾ 1 Mile

Feet 1000 0 1000 2000 3000 4000 5000 Feet

Metres 100 0 0.2 0.4 0.6 0.8 1 Kilometre