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Geology of Townships 137 and 138  
District of Algoma

By  
JAMES A. ROBERTSON

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Geological Report No. 10

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TORONTO

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Blind River Area, geological sketch map.	
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Please insert this errata slip on page v of your  
 Geological Report No. 10, Geology of Town-  
 ships 137 and 138.

**Errata**

For Table II of page 32 read Table III.  
 There is no Table IV.  
 Figures facing pages 85 and 87 should be  
 transposed.

## ABSTRACT

This report describes the stratigraphy, structure, and economic geology of the nose of the Quirke syncline in the Blind River area. Semi-detailed mapping using air photographs was carried out in 1958.

The area is divided into three parts: (1) the greater part of Township 138 consisting of Algoman "granites"; (2) the southeastern part of Township 137 comprising Keewatin(?) metavolcanics and metasediments; and (3) the remainder of the area, underlain by a syncline of unmetamorphosed Huronian sediments.

The oldest Precambrian rocks are Keewatin(?) volcanics, pyroclastics, sediments including iron formation, and basic intrusives. These were intruded by, and included in, Algoman "granites," which are divisible into early sodic gneissic granodiorite and late massive potassic quartz monzonite. The region was then eroded; valleys formed along Algoman-Keewatin(?) contacts and in the softer Keewatin(?) rocks.

Huronian sedimentation, showing northern overlap, began with coarse-grained sediments derived from the weathered granite. Uraniferous quartz-pebble conglomerate was deposited in the valleys. Conglomerates, quartzites, siltstones, and limestones, all derived from the northwest and accumulated in cold shallow water, make up the lower Huronian or the Bruce Group. The Bruce Group is overlain unconformably by the Cobalt Group, a heterogeneous assemblage of conglomerates, siltstones, and quartzites formed under subglacial conditions.

These rocks were folded about an axis striking N.80°W. and plunging 30°W., decreasing westwards to 15°W. Diabase sills were intruded into tensional regions of the fold. Faults and joints were developed parallel to the bedding (thrust faults), parallel to the axial plane (south side up), and with northwest or northeast strike (strike-slip faults indicative of north-south compression). During relaxation of the compressive forces, fractures were intruded by diabase. Albitization, chloritization, and the introduction of sulphide mineralization are associated with the diabase intrusions and show marked structural control.

Pleistocene glaciation resulted in removal of soil and deposition of till and gravel.

Extensive prospecting has revealed the presence of copper, gold, iron, lead, nickel, and uranium, but there is no mineral production. The uranium deposits are believed to be of syngenetic origin, possibly modified during diagenesis or low-grade metamorphism. There is no evidence of uranium mineralization associated with the diabase. No post-Huronian granite was found within, or near, the area.

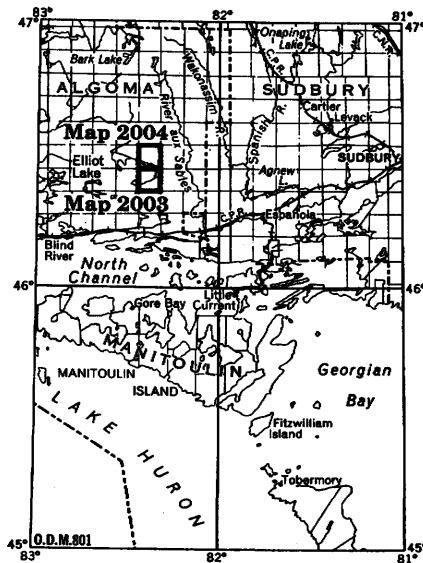
# Geology of Townships 137 and 138

By

James A. Robertson<sup>1</sup>

## INTRODUCTION

During the 1958 field season an Ontario Department of Mines field party undertook the geological mapping of Townships 137 and 138 and part of Deagle township (formerly Township 136), in the eastern part of the Blind River uranium area in the District of Algoma.



Key map showing the location of Townships 137 and 138. Scale, 1 inch to 50 miles.

The southwest corner of Township 137 lies some 11 miles east of Elliot Lake, and the southeast corner lies about 20 miles northwest of Massey. Massey is 55 miles west of Sudbury, and is served by highway No. 17 (the Trans-Canada Highway) and the Sault Ste. Marie branch of the Canadian Pacific Railway. The lumber town of Espanola lies some 15 miles east of Massey; Blind River lies 50 miles west of Massey. From Massey a partially improved gravel road (highway No. 553) follows the valley of the River aux Sables to Ritchie Falls, some 45 miles north. Twenty miles north of Massey a privately maintained, unimproved road runs west to Whiskey Lake, the largest lake in Townships 137

<sup>1</sup>Post-graduate student, Queen's University, 1958.

## Geology of Townships 137 and 138

and 138. Highway No. 108, serving Elliot Lake and the uranium mines nearby, runs north from highway No. 17, 19 miles east of Blind River. Subsidiary roads connect highway No. 108 to Quirke Lake and Pecors Lake, from both of which access to the present area can be gained on foot or by water.

Two companies based on Lake Lauzon just east of Blind River provide air transportation. At present, harbour facilities on the North Shore of Lake Huron are poor.

Mapping was carried out by running pace-and-compass traverses at 20-chain intervals. The observations were plotted on a scale of 1,320 feet to 1 inch, on transparent acetate sheets attached to air photographs and subsequently transferred to a "cronaflex" base map, using a sketchmaster. Control was provided by easily identifiable points and where possible by surveyed claim lines. All the corner posts for Township 137 were found, but neither the northwest nor the northeast post of Township 138 was located.

Prospecting has been carried out in the area since 1846, and minor occurrences of copper, gold, and iron have been known since that time. In 1951 and 1952 extensive work was done by Teck Exploration Company Limited on the copper deposits of the area. Much of the area was staked after the discovery of uranium near Blind River in 1953; during the next three years, diamond-drilling and other development work were carried out, but the results were disappointing, and many of the claims have been allowed to lapse.

### **Acknowledgments**

Able assistance was given by D. S. Sinclair, J. M. Johnson, Raymond Balgalvis, Paul Roberts, and R. A. Dodge. Messrs. Sinclair and Johnson were each responsible for about one-third of the mapping, and Mr. Balgalvis for much of the drafting. The field staff of Algom Uranium Mines Limited and the office staffs of Rio Tinto Management Services and Teck Exploration Company Limited kindly permitted the author access to company reports on mapping and other exploratory work carried out in the area. Staffs of these and other companies with properties in the area willingly gave the author the benefit of their experience.

The author also wishes to acknowledge the hospitality and the many services rendered to the members of the field party by Mr. and Mrs. L. Prior of Redwood Lodge, Whiskey Lake; L. W. Houle, manager of the Red and White store in Massey; and G. D. Morris of Algoma Mills.

J. E. Hawley and J. W. Ambrose, both of the staff of Queen's University, and P. J. Pienaar, a graduate student at the university with considerable knowledge of the Blind River area, made many useful suggestions and criticisms for which the author is most grateful.

### **Means of Access**

The only satisfactory means of access in the area is by way of the river and lake systems and the connecting trails. Both the Serpent River and the West River aux Sables flow through the area, and these rivers, originally used during logging operations, still form the principal means of communication.

The Serpent River enters Township 138 at Nook Lake, 2 miles north of the southwest post, whence it flows slightly south of east to Kindle Lake and thence to

Whiskey Lake, which is the most important lake in the area. Whiskey Lake has an arcuate shape and is about  $6\frac{1}{2}$  miles long. From the southwest end of the lake the river runs south of west to the southeast end of Pecors Lake, whence it runs in a general southerly direction, entering Lake Huron near Spragge. Early in the field season it was possible to navigate the river from Whiskey Lake to Pecors Lake, but later, when the water level had dropped, this was no longer possible, and a tractor road lying slightly south of the river was then used.

Another arcuate lake, Batty Lake, lies about  $\frac{1}{2}$  mile west of Whiskey Lake and is connected with it by means of a shallow creek (Batty Creek) and two portages. It is possible to portage from the north end of Batty Lake to the southeast extension of Kindie Lake. From Corner Lake, in the northwest corner of Township 137, a stream flows eastward to the west end of McCool Lake. A stream flows north from a point on the north shore of McCool Lake, about  $\frac{1}{2}$  mile west of the east end, to the southeast corner of Rangers Lake, which lies southwest of, and parallel to, Kindie Lake. A stream flows north from the middle of the north shore of Rangers Lake to the southwest corner of Kindie Lake. Short portages connect the above-mentioned lakes. In addition a portage connects the east end of Rangers Lake with the east end of Kindie Lake.

The West River aux Sables enters Township 138 some  $1\frac{1}{2}$  miles west of the northeast corner and flows in a meandering course close to the east boundary of the township, finally turning eastward and out of the area about  $2\frac{1}{2}$  miles north of the southeast corner of Township 138. The river is navigable by light canoe from a point on the Massey road 5 miles east of Whiskey Lake to about 2 miles south of the northeast corner of Township 138. Thence an old lumber trail runs northwest along the northeast bank of the river. About  $\frac{3}{4}$  mile northwest of the point where the West River aux Sables flows out of the area a small tributary stream (Wiggly Creek) can be followed northwest to Bellmore Bay on Wiggly Lake. This stream together with old lumber roads in the area formerly provided the route to Wiggly Lake. The route used now consists of a trail running north from the west end of Whiskey Lake to Trap Lake, which lies about  $\frac{1}{4}$  mile south of Wiggly Lake. From the northwest end of Wiggly Lake a series of small lakes and intervening portages lead to Cormier Lake in northeast Township 144.

In addition to the above, a disused lumber road, which connected Quirke Lake in Township 144 with the Massey tote road (now highway No. 553) at the east end of Whiskey Lake, can be traced around the north shores of Kindie and Whiskey lakes. However, as it is overgrown, much work would be required before it could be used.

Whiskey, Kindie, Rangers, McCool, Corner, Batty, and Wiggly lakes are suitable for light aircraft.

### **Previous Geological Work**

Since the discovery of copper at Bruce Mines in 1846, the North Shore of Lake Huron has been the scene of much geological activity; this included prospecting and also regional mapping by the officers of the Geological Survey of Canada (Logan 1863) and the description of mineral deposits by the Ontario Department of Mines (Carter 1905; Corkill 1906).

Although much geological work has been carried out in the area of North Shore of Lake Huron, notably by Murray Ingall, Logan, Leith, Pumpelly, Van Hise, and Alexander and N. H. Winchell, it was not until 1916 that W. H. Collins

## Geology of Townships 137 and 138

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.

About the beginning of the century, copper deposits were found in the Whiskey Lake area. These included the Peyton Prospect on the west shore of Whiskey Lake just south of the stream from Batty Lake, a quartz-galena-chalcopyrite vein on Campbell Island in Whiskey Lake, a quartz-chalcopyrite vein network between Whiskey and Kindle lakes just west of the portage connecting the lakes, and similar veins in the vicinity of McCool and Corner lakes and to the west of Batty Lake. Development work and exploration were carried out intermittently on these deposits.

The discovery, in 1912, of gold in a quartz vein on the Peyton Prospect renewed interest in the area, which was then visited by A. P. Coleman of the Ontario Bureau of Mines, who described the principal mineralized localities and gave a generalized account of the geology (Coleman 1913, pp. 146-54).

W. H. Collins of the Geological Survey of Canada studied the geology of the area between Bruce Mines and Sudbury with a view to correlating the two mineraliferous areas. The method employed was to map a series of closely spaced areas, and subsequently correlate the locally established sections. Whiskey Lake was chosen as one of these areas and was mapped by Collins in 1914-16 and by Eskola in 1922; this together with the adjacent area of Blind River formed the basis for map No. 1970 (The Blind River Area) of the Geological Survey of Canada. The results of the regional work were published in 1925 and incorporated as Memoir 143 (The North Shore of Lake Huron) and map No. 155A (Lake Huron sheet).

Collins divided the Huronian into the Bruce series consisting of an intermittent basal conglomerate, the Mississagi quartzite, the Bruce conglomerate, the Espanola formation, and the Serpent quartzite and the unconformably overlying Cobalt series made up (in the Blind River area) of the Gowganda formation (boulder conglomerate and quartzite) and the Lorrain quartzite.

In the Quirke Lake-Whiskey Lake-Elliot Lake area the structure was shown to be a west-striking, gently west-pitching, synclinal development of the Huronian resting on eroded granite and greenstone. South of this there was an anticline, but to the south and east along the shore of Lake Huron the geology was complicated by faulting (the principal fault was called the Murray Fault) and the presence of granite masses, which were considered to be post-Huronian in age (Collins 1925: Quirke and Collins 1930).

For the Sudbury area Coleman (1914, pp. 202-36) and Collins (1925, pp. 22-29; 1936) recognized a sedimentary series lying between the Keewatin and the granite. This series was termed the Sudbury series.

In 1924 economic interest in the area revived, and the Peyton Prospect passed into the hands of J. S. Wilson. The prospect was sampled both by Wilson and by G. V. Douglas who visited prospects in the area on behalf of the Ontario Department of Mines. As part of his examination Douglas made a reconnaissance map of the adjacent area (Douglas 1926, pp. 34-49). However, the material assayed, although it yielded erratic gold values, proved disappointing, and the property remained idle. (*See* Table V, p. 77.)

In 1929, A. C. Lawson (1929) argued on structural and lithological grounds that much of the so-called Sudbury series was in fact the Cobalt series of the Upper Huronian.

In 1943, Moore and Armstrong (1945) mapped a block of four townships to the east of Whiskey Lake. Within this area they identified a gabbroic intrusive older than the Algonian granite but younger than the Keewatin(?) and also suggested the presence of a post-Huronian granite.

In 1950, Teck Exploration Company Limited began examination of the copper prospects in the area. Drilling was carried out on the McCool Lake, the Reynolds, and the Batty-Whitefish properties; trenching and surface work were also carried out. This work indicated that the mineralized zones were not sufficiently large for mining.

The early mapping was not continuous, and there was much confusion over terminology and correlation. Thomson (1953a; 1953b) has pointed out (1) that different conglomerates have similar lithological characteristics and that some of these had been mistakenly correlated by Collins; moreover, (2) that some of the quartzite units show greater variations within themselves than between each other and thus are also unsuitable for use as markers. In order to avoid use of a chaotic terminology, Thomson used a "simplified classification" denoting each unit by a letter, and leaving the question of correlation to await completion of detailed regional mapping. However, within the Blind River area these difficulties do not arise, as Collins' nomenclature will be retained in this report with only slight modification. (See Tables I and III.)

Prospecting in the greenstone south of Pecors Lake has revealed low-grade iron formation and the presence of chalcopyrite and disseminated nickeliferous pyrrhotite within the greenstone complex.

With the discovery, in 1953, of uranium at the east end of Lake Lauzon, the eastern part of the District of Algoma was the scene of a staking rush, and the greater part of the townships under discussion was staked. During 1954-56 a certain amount of diamond-drilling and other development work was carried out; this however proved disappointing, and most of the ground has been allowed to lapse. The only substantial area now held lies between Whiskey and Pecors lakes where submarginal uraniferous deposits have been encountered by drilling.

Since the discovery of the Blind River uranium field, both the Ontario Department of Mines and the Geological Survey of Canada have undertaken considerable field work in the area; the former being concerned primarily with the regional geology, and the latter more specifically with the geology of the ore deposits.

During the field seasons of 1953-55 the Ontario Department of Mines mapped the south limb of the anticline. In the course of this work it was found that Collins' mapping required modification in the following respects:

- 1) A conglomerate and a limestone traced from Chiblow Lake in Patton township to south of Pronto mine (Long township) were shown to be the Bruce Conglomerate and Bruce Limestone respectively.
- 2) The tracing of these markers in the Lake Lauzon area proved that the rocks in the Algoma Mills-Spragge area were Huronian and not Sudbury Series.

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

Collins (1925)		Abraham (1956)		Roscoe (1956 and 1957)		Robertson (1957)		
Series	Formation	Series	Formation	Group	Formation	Group	Formation	
Cobalt	Gowganda	Cobalt	Gowganda	Dunlop	Gowganda	Cobalt	Gowganda	
	Serpent		Serpent		Serpent			
	Espanola		Espanola	Quirke	Espanola		Espanola	
	Bruce		Bruce		Bruce		Bruce	
Bruce	Mississagi	Bruce	Upper Mississagi	Mississagi	Ten Mile	Bruce	Upper Mississagi	
			Middle Mississagi		Whiskey		Middle Mississagi	
			Lower Mississagi	Elliot	Nordic		Matinenda	Lower Mississagi
Pre-Huronian		Pre-Huronian		Pre-Huronian		Pre-Huronian		

- 3) It was shown that the principal fault in the area, the Murray Fault, was a reverse fault dipping steeply south and lying along the north shore of Lake Huron between Algoma and Spragge, rather than along Lake Lauzon as suggested by Collins.
- 4) Minor structure, faulting, and stratigraphical detail not shown on Collins' map were recorded (Abraham 1953; 1957: Robertson 1956).

Early in 1955 the Ontario Department of Mines published a series of aeromagnetic maps covering the Algoma uranium area, but Townships 137 and 138 were not included in this survey, though Townships 143 and 144 immediately to the west were so included. In 1956, J. P. McDowell (1957) began a regional study of the Mississagi Quartzite, and the field work for this project was completed in 1957. This revealed that the Mississagi quartzites were laid down by south-easterly currents derived from a source northwest of Thessalon.

In 1956 the Department's field party began mapping the Quirke Lake syncline. In 1956, Townships 149 and 150 were mapped; in 1957, Townships 143 and 144 (Abraham 1956: Robertson 1961); and in 1958, Townships 137 and 138.

In the period 1956-57 a photogeological survey supplemented by field and laboratory work was made of the Pleistocene and Recent deposits of the Quirke Lake area (Belcher and Smith 1957). Although the map does not include Townships 137 and 138, the deposits in the two areas are similar.

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. (Roscoe 1956; 1957.) In these publications Roscoe introduced a modified nomenclature for use in the Blind River area. Table I shows a comparison between the stratigraphical nomenclatures used by Abraham, Roscoe, and the author.

Consulting geologists and geologists working for mining companies in the area have also published a number of papers on the area.

## **Topography**

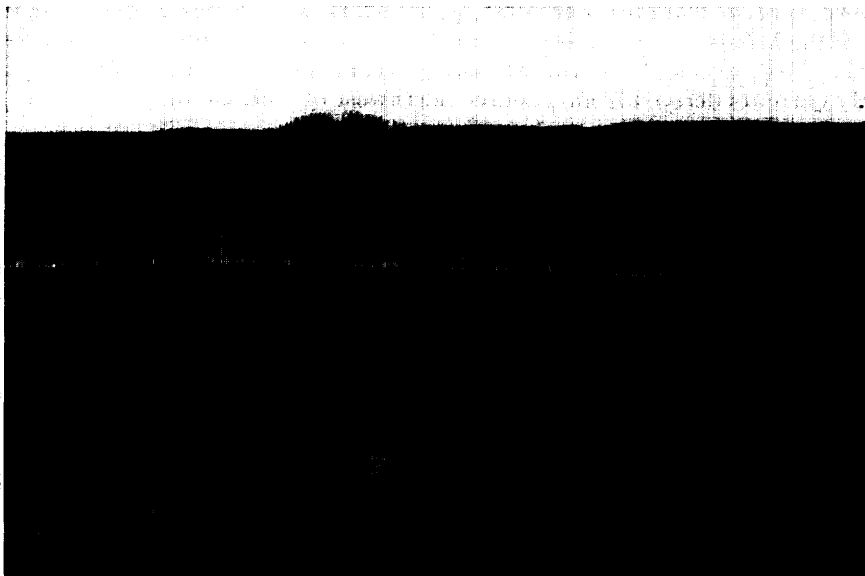
The region shows the topographical features characteristic of the North Shore of Lake Huron; these are a lack of major relief contrasted with a ruggedness in detail. A remarkable uniformity in the skyline (*see* photo on page 8) is a reflection of the late Precambrian peneplanation of the shield.

However, the area can be divided into three sectors on the basis of topographical features, the Serpent River and Whiskey Lake drainage system forming the dividing boundary. In the first sector, north of the river, the general level of the land surface is 1,200-1,400 feet. Drainage is along east-west and northwest-southeast, and to a lesser extent, north-south lineaments. In the eastern part of this sector the West River aux Sables and its tributaries flow through a relatively broad valley floored with drift. The second sector lies south and east of the Serpent River system. Here the elevation is 1,100-1,200 feet, and the topography is gently undulating. Drainage is along the same trends as noted in the first sector but is very sluggish, and the streams are frequently blocked by beaver dams. Scattered swamps are common and form the most readily identifiable positions visible on air photographs. The third sector is enclosed by the Serpent River system and the west boundary of the area. Here the general land level is about

## Geology of Townships 137 and 138

1,300–1,400 feet, with the valley bottoms at about 1,100 feet. The physiography is made up of a series of scarps and intervening dip slopes paralleling the Serpent River. The drainage is generally parallel to the scarps.

Each of these three physiographic units is a reflection of the geology. Thus the first sector overlies the outcrop of the pre-Huronian granite and granite gneiss complex; the second, a steeply-dipping series of Keewatin(?) metalavas and metasediments; and the third, the synclinal development of Huronian sediments, of which the harder members or intruded diabase sills form the scarps.



View looking north over the narrows near the east end of Kindle Lake (Whiskey Lake, right background), Township 138; illustrating lack of major relief in the land surface.

### **Drainage**

As already noted, the drainage systems of both the Serpent River and the West River aux Sables form the principal means of access in the area. There is a very close relationship between the geological features, such as jointing or the outcrop of softer beds, and the drainage. Formerly both rivers were used to float logs, but dams and chutes located within the area have fallen into disrepair.

### **Resources**

The area mapped lies to the east of the uraniferous belts of the Quirke syncline. Low-grade uranium-bearing conglomerates are known to occur in the south between Pecors and Whiskey lakes, and again southeast of Whiskey Lake.

Scattered outcrops of very low-grade magnetite iron formation are found in the greenstone complex south of the Serpent River in Township 137. A number of copper prospects in the vicinity of the synclinal axis have been known for about 60 years; one of these on Campbell Island in Whiskey Lake also contains lead. A gold prospect between Batty and Whiskey lakes aroused considerable interest

about the end of World War I. However, development on all these prospects showed that the mineralization was not extensive. Sand and gravel are developed along the West River aux Sables and in the lake bottoms. A stiff blue clay is found at shallow depths in the Whiskey Lake and the McCarthy Lake (Deagle township) areas.

The Serpent River system is used to provide water for communities south and west of the map-area. Water for use in the surface plant at the Algom-Nordic mine is pumped from Pecors Lake. Consequently the dumping of tailings and sewage from the mines in the Quirke Lake area is strictly controlled to keep contamination of the water at a minimum. To facilitate this the whole of the Serpent River system has been included in the Improvement District of Elliot Lake.<sup>1</sup> The lakes provide excellent facilities for boating, canoeing, fishing, and swimming. A tourist camp, run by L. Prior of Massey, has been established at the east end of Whiskey Lake, and a number of the residents of Massey have built summer cottages in the same area.

Lumbering was formerly a major industry in the area, and there are remains of log chutes and dams along the Serpent River and West River aux Sables systems. At present no lumbering is being carried out in the area. The forest is generally mixed in type, with birch, poplar, spruce, pine, and maple predominating. Cedar, balsam, and tamarack are found in swampy areas. Stands of soft wood suitable for lumbering operations are found west of Batty Lake, but exploitation of these is handicapped by the inaccessibility of the area.

Wild life abounds within the area. The adjacent Townships 144, 130, and 131 all lie within the Mississagi Provincial Forest. Deer, moose, bear, foxes, porcupines, skunks, wolves, partridges, and ducks are common. Beaver have multiplied in recent years, and several streams, particularly in the northwestern and southeastern parts of the area, have been dammed since the air photographs were taken in 1949.

## GENERAL GEOLOGY

The rocks exposed within the map area belong to five major groups:

- Pleistocene and Recent gravels, tills, and swamp deposits.
- Keweenawan gabbro, diorite, diabase, and lamprophyre intrusions.
- Huronian unmetamorphosed sediments.
- Algoman granites and granite gneisses.
- Keewatin(?) lavas, greenstones, and minor sediments.

The oldest rocks exposed within the area are found to the south of the Serpent River system. These consist of pillow and amygdaloidal lavas, massive lava, minor tuff, agglomerate, greywacke, iron formation, and quartzite, all cut by gabbroic intrusives. Rocks of this assemblage are normally referred to as the Keewatin, but this term has little correlational significance.

The second group consists of granites and granite gneiss, exposed north of the Serpent River and again in Deagle township near McCarthy Lake. Massive, red, equigranular to porphyritic granites are exposed in the western part of Township 138, and are continuous with the massive granites mapped to the north of Quirke Lake. (Harding 1941, p. 6; Robertson 1961, p. 11.) In the eastern part of Township 138 the granites are gneissic, typically grey in colour, and have numerous inclusions of basic material derived from the Keewatin(?).

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<sup>1</sup>Townships 137 and 138 were removed from this jurisdiction in 1959.

## Geology of Townships 137 and 138

South of the greenstone belt, granitic rocks are again developed in the vicinity of McCarthy Lake (Deagle township). Here inclusions are abundant, and the granite-greenstone boundary is transitional in character.

The third group consists of the Huronian sediments. These are well exposed, and the various units can be readily traced around the nose of the syncline. The lowest unit of the Bruce Group (Lower Huronian) is the Lower Mississagi consisting of quartzites and conglomerates both oligomictic and polymictic. Owing to overlap, the Lower Mississagi is thicker in the south than in the north where locally it may be completely missing. In the south (between Pecors and Whiskey lakes) this member has a minor development of uraniferous oligomictic conglomerate. To the north of Pecors Lake there is a restricted development of argillite and greywacke at the top of the Lower Mississagi. The Middle Mississagi is formed of a basal conglomerate of rather variable thickness overlain by an argillite-greywacke sequence, which thickens from north to south. The Middle Mississagi Conglomerate was mistaken by both Collins (1925, p. 38) and Douglas (1926, p. 41) for the oldest Huronian conglomerate. The Upper Mississagi is made up of quartzites and feldspathic quartzites; this is overlain by a siliceous polymictic conglomerate—the Bruce Conglomerate. The Bruce Conglomerate passes upwards into the Bruce Limestone, a finely bedded, alternating series of white limestone and calcareous siltstone, followed by a thinly laminated, calcareous to non-calcareous siltstone—the Espanola Greywacke, which in turn passes into a well-bedded series of siltstones and brown-weathering dolomitic limestones—the Espanola Limestone. In localities other than the Quirke syncline it is not always possible to distinguish the last three units from each other, therefore Collins (1925, p. 17) grouped them as the Espanola Formation. The Espanola Formation is overlain by a massive white quartzite—the Serpent Quartzite.

The Bruce Group is overlain unconformably by boulder greywacke conglomerates, greywackes, and thin ferruginous arkosic quartzites, all of the Gowganda Formation. The Gowganda Formation is the basal member of the Upper Huronian or Cobalt Group, which both Collins and Coleman believed to be of glacial or subglacial origin.

After the deposition of the Cobalt Group the area was folded and faulted. Closely associated with this was the intrusion of nearly vertical diabase dikes and sills (or flat-lying dikes) of quartz diabase and diorite. The sills are associated with thrust faults and may be slightly earlier than the dikes. There is some slight post-diabase faulting.

The Shield was flooded by shelf seas during Lower Palaeozoic time, 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 (Quirke 1917, pp. 9-12; Eardley 1951).

During the Pleistocene, glaciation removed the soil that had accumulated, and substituted an irregular and discontinuous mantle of clay, sand, and gravel. Although the major drainage pattern shows marked geological control, the intermittent streams and swamps show the lack of structural control characteristic of glaciated regions. Glacial rounding, polishing of outcrop surfaces, scouring of the softer beds and joint planes, and the development of striae and chattermarks are common. These features indicate that the average direction of glaciation was S.15°W.

**TABLE OF FORMATIONS**

**CENOZOIC**

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

*Great Unconformity*

**PRECAMBRIAN**

**PROTEROZOIC**

Keweenaw: Quartz diabase, gabbro, diorite, lamprophyre.

*Intrusive Contact*

Huronian:

Cobalt Group:  
 Gowganda Formation: Conglomerate, arkose, greywacke.

*Unconformity*

Bruce Group:

Serpent Formation: Serpent Quartzite.

Espanola Formation	Espanola Limestone. Espanola Greywacke. Bruce Limestone.
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Bruce Formation:	Bruce Conglomerate.
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	Upper: Quartzite, arkose, Greywacke.
	Middle { Argillite. Conglomerate.
Mississagi Formation	Lower { Greywacke (in south) Arkose, quartzite. Polymictic conglomerate in south. Uraniferous conglomerate. Local basal polymictic con- glomerate.

*Great Unconformity*

**ARCHEAN**

Pre-Huronian soils.

Algoman: Granites, granite gneisses with basic inclusions.

*Intrusive Contact*

Keewatin?: Sediments, volcanics, intrusions.

**Archean**

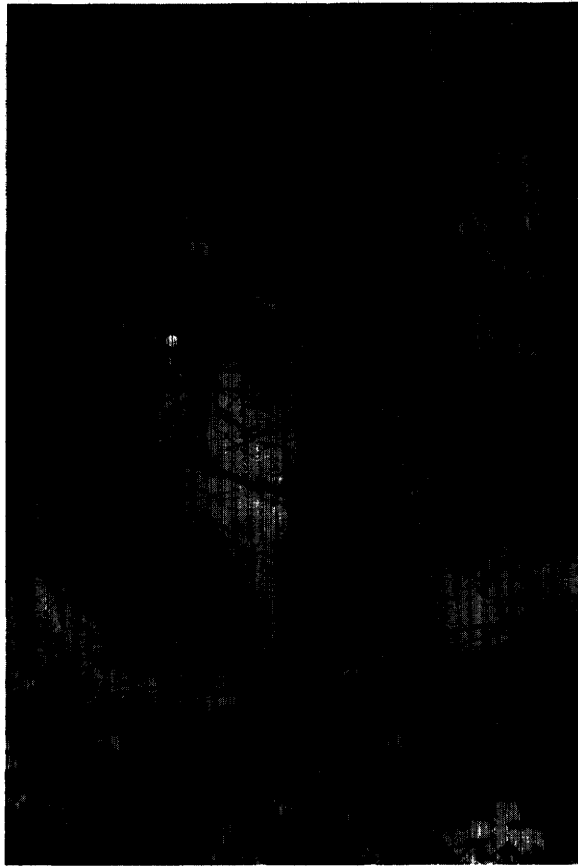
**KEEWATIN ?**

The Keewatin(?) consisting of an assemblage of basic volcanics and minor sediments is well exposed in the southeastern part of Township 137. Bodies of partially assimilated Keewatin(?) rocks are found throughout the granite complex in the northern part of Township 138. The north contact with the granite is

## Geology of Townships 137 and 138

not exposed, but drillhole evidence in Townships 144 and 138 indicates that this is a transitional zone, with granitic material intruding and replacing brecciated Keewatin(?). The boundary zone strikes slightly south of east, in all probability close to the course of the Serpent River. On the east side of Whiskey Lake, the boundary zone passes just south of Campbell Island.

The south boundary, which is better exposed, is transitional in character. A broad zone of granite with abundant inclusions is exposed in Deagle township. The information available at present indicates that this boundary has a regional



Pillow lava; southeast of Whiskey Lake, Township 137.

strike of about N.80°W. The Keewatin(?) thus is exposed in a belt 7 miles wide striking about N.80°W., with transitional boundaries on both sides with the younger Algoman granite. To the west this belt passes into the area mapped by the author in 1957 (Robertson 1961). When traced farther to the west, the boundaries of the greenstone belt apparently underlie the uraniferous conglomerates of the Quirke Lake and Nordic Lake orebodies. (Abraham 1956: Robertson 1960, pp. 69, 208).

Within the present area the Keewatin(?) consists dominantly of basic volcanics with intercalated sediments, all striking about N.80°W. and dipping 40°-70°N. It was not found possible on the basis of surface outcrops to divide

the formation into sub-units as had been done in Township 143 (Robertson 1961, p. 10).

Towards the north of the belt and again in the south—the latter being the eastward continuation of the rocks mapped in 1957—greywacke and associated sedimentary rocks dominate the sequence. However, in these rocks it was not generally possible to determine tops. In the pillow lavas, which form the greater part of the Keewatin(?), it was possible to determine tops from the shapes of pillows, distribution of pillows, and from vesicles and amygdules. Near Whiskey Lake, it was found that the lavas faced south, but that in the southeast corner of Township 137 and westwards along the south boundary of the township the lavas faced north. This confirms the presence of a syncline in the Keewatin(?) first postulated by Moore and Armstrong (1945, p. 6).



Flow breccia in Keewatin lava; east of Whiskey Lake, Township 137.

The axial plane of this syncline apparently strikes at about N.80°W., but the dip of the axial plane and the plunge, if any, of the fold-axis are unknown.

As already indicated, the chief rock type is a pillow lava; this was originally basic in character, probably andesitic basalt, but has since been metamorphosed to a rock high in chlorite. The original structures such as pillows (*see* photo opposite), flow breccias (*see* photo, this page), amygdules, and vesicles are generally visible on glaciated surfaces, which have retained their polish, or on cliff faces that have been protected from weathering. Pillows range in size from 3 inches to 4 feet, the pillows in any one flow normally being uniform in size. For  $\frac{1}{2}$  inch in from the surface the pillow is frequently discoloured or rusty and may be vesicular, but the inner part is fine-grained and usually dark-green and, in hand specimen, indistinguishable from the groundmass of the rock. On some outcrops, especially those south of the Serpent River west of Whiskey Lake, the pillow lava is seen to grade into a massive, medium- to coarse-grained, dark-green to black rock consisting of black pyroxene and white-to-greenish, lath-like feldspars. At first sight this rock resembles the diabase of the Keweenaw;

## Geology of Townships 137 and 138

however, it can be distinguished from this by its more basic character and its structural relationship with the pillowed lava. Both on surface and in drillholes it is possible to trace this massive diabasic rock into the pillowed and more chloritic variety.

Thin sections show that in the upper parts of lava flows the feldspars are more or less completely altered to clay minerals, and the ferromagnesian to chlorite plus epidote and iron oxide. Amygdules may be represented by circular or elliptical areas free from chlorite, or with a concentration of iron oxides and dusty material, or with a zonal arrangement of iron oxide, epidote, and quartz. In the centre of the flows an ophitic texture prevails, with partially altered intermediate to basic feldspar enclosed by pyroxene that has been completely altered to green hornblende and subsequently in part to chlorite and epidote. Titaniferous magnetite or magnetite is the principal accessory. These rocks are distinguished from the somewhat similar Keweenawian diabase by the extent of alteration, the lack of free quartz, the abundance of magnetite, and the presence of disseminated pyrrhotite as well as pyrite and chalcopyrite.

In addition to the massive phase of the lava flows there are rocks more properly termed gabbros, which apparently cut across the regional structure. These normally consist of pyroxene and basic feldspar in semi-ophitic to equigranular texture; locally they grade into anorthosite. Magnetite, nickeliferous pyrrhotite, chalcopyrite, and pyrite are characteristic accessories. Similar rocks have been observed to the east by Moore and Armstrong (1945, pp. 9, 10) and to the west by the author (Robertson 1961, p. 9).

A porphyritic phase is fairly common, with plates of chlorite or amphibole crystals up to  $\frac{1}{4}$  inch across giving the rock a mottled appearance.

Both the tuff beds and the agglomerate beds display on the weathered surface much the same appearance as do the chloritized lava flows. Here also the ferromagnesian minerals that made up the bulk of the original rock have been converted to chlorite. The agglomerates have in them occasional fragments of chloritized rocks and rare cobbles of extraneous material such as granite and quartzite; no cobbles larger than 3 inches were observed, and the majority of the fragments were less than  $\frac{1}{2}$  inch. It was not found possible to trace these rock types either from one outcrop to another along strike or down dip; hence they are considered to be thin lenses trapped between individual flows. On the east shore of Whiskey Lake, opposite Campbell Island, and in the northeastern part of Deagle township the predominant rock type is a fine- to medium-grained, dark-grey greywacke, which like the other Keewatin(?) rocks is chloritized, and the weathered surface of which bears the same dark-green appearance. Occasionally this passes into a thinly-bedded, calcareous mudstone. A bed of this mudstone, at least 20 feet thick, can be traced in the northern part of Deagle township.

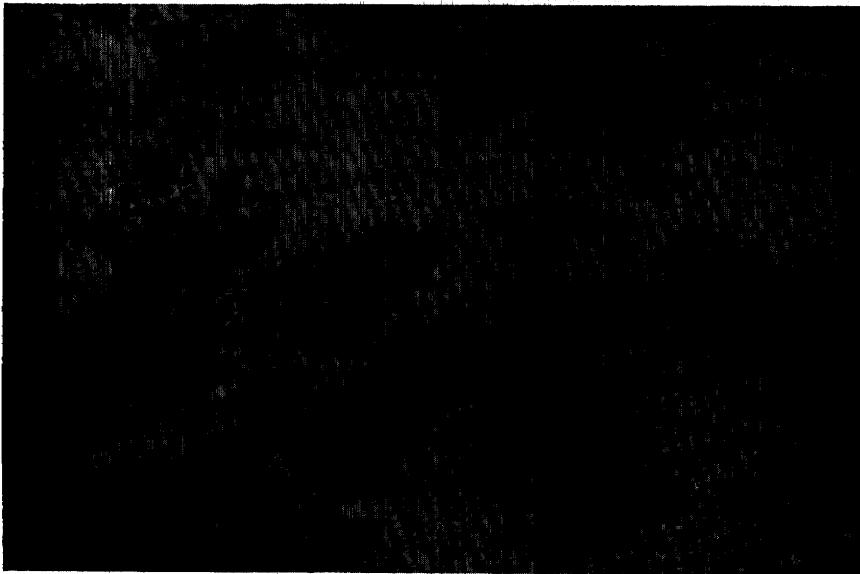
In thin section, the mudstone is seen to consist of fine-grained lenses of quartz and feldspar and an aggregate of dusty materials surrounded by cleavage planes with lineated chlorite and epidote and dusty materials.

Slightly south of the mudstone a siliceous conglomerate can be followed for a strike distance of 2 miles in the vicinity of Wild Lake in Deagle township. This conglomerate, which is about 100 feet thick, consists of pebbles and boulders of a fine-grained, pink, equigranular granite with little or no ferromagnesian content, and fragments of vein-type quartz set in a dark-grey, gritty, quartzite matrix. Sorting and rounding of the boulders is poor.

Iron formation was found some  $\frac{3}{4}$  mile northeast of the southwest corner of Township 137. The iron formation consists of interbanded layers of magnetite partially oxidized to hematite, and recrystallized quartzite. Each layer is about



**Angular basic inclusions in granite; Wiggly Lake, Township 138.**

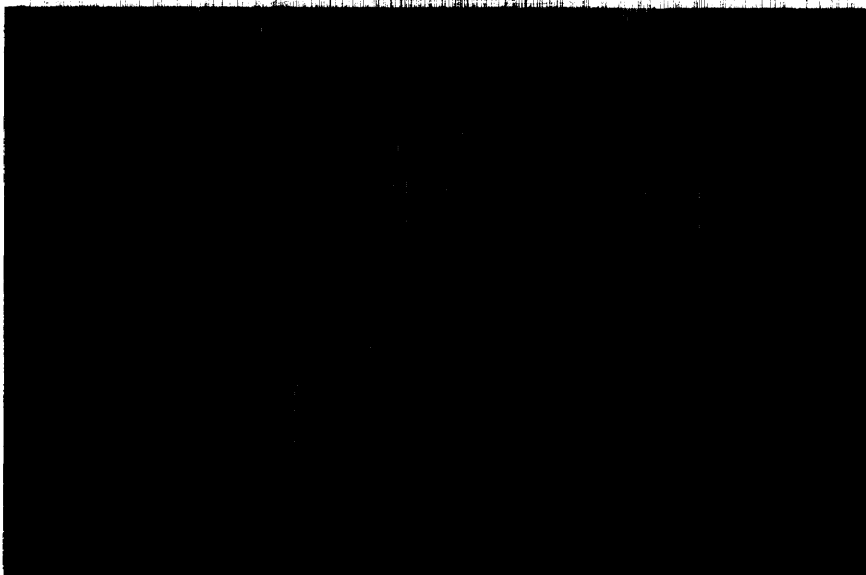


**Assimilated basic inclusions in granite; Wiggly Lake, Township 138.**

## Geology of Townships 137 and 138

$\frac{1}{4}$  inch thick with occasional layers up to 6 inches. The iron formation units are about 50–100 feet thick, and intermittent outcrops are found between the above-mentioned locality and the southeast corner of the township. Although the outcrops are both few and poor, it was frequently noticed that the compass needle was deviated, indicating the presence of iron formation at no great depth beneath the overburden. The belt of iron-formation-bearing sediments is about  $\frac{3}{4}$  mile wide and is the eastward extension of the belt of iron formation mapped to the south of Pecors Lake in Township 143. (Robertson 1961, p. 10.)

Teck Exploration Company Limited<sup>1</sup> carried out mapping on the iron formation in 1951 and discovered that the iron formation carried minor amounts of pyrite and pyrrhotite. The latter contained traces of nickel.



Granitized greenstone cut by aplitic dikes; northeastern Township 138.

In thin section, the iron formation is seen to consist of bands of very fine-grained magnetite with minor quartz, alternating with bands of fine-grained interlocking quartz with minor magnetite. The cement in both types is silica, and both are cut by quartz veinlets. In the coarse bands minor amounts occur of an amphibole-like mineral, probably stilpnomelane. Apatite needles are also found.

In the southwestern part of the iron-formation area, near the discovery locality, there are a number of outcrops of a sugary-textured, white to pale-green, siliceous rock that weathers a pale yellow-green; it is believed to represent a metamorphosed rhyolite.

Similar rocks showing flow banding were observed in association with iron formation near Ryan Lake in Township 143 (Collins 1925, p. 20; Robertson 1961, p. 9). No rocks with pronounced flow banding similar to that of the undoubted rhyolites at the northwest end of Quirke Lake (Township 150) were found (Abraham 1956).

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<sup>1</sup>Teck Exploration Co. Ltd.; company reports.

Both north and south of the greenstone belt proper, the granite contains numerous basic inclusions. These may occasionally retain original structures such as pillows, amygdules, and bedding, but normally they are made over to an aggregate of hornblende (or chlorite) and feldspars. Close to the greenstone outcrop, the majority of the inclusions are angular, have sharp outlines, and show little sign of feldspathization (*see* photo, p. 15, top). Farther away from the main outcrop the inclusions become less numerous, lose their angularity and their sharp outlines, and show the development of feldspars (*see* photo, p. 15, bottom). North of Whiskey Lake in the vicinity of Wiggly Lake and West River aux Sables the basement rock is a granodiorite rather than a granite with included material (*see* photo, page 16). Occasionally the Keewatin(?) inclusions have survived, and the gneissic structure of the area and the development of feldspar eyes in them suggest that here the original rocks were sediments.

## ALGOMAN

### Granites

Granitic rocks form the greater part of the rocks of Township 138. These granitic rocks may be divided into two broad groups: (1) medium- to coarse-grained gneissic granodiorite, generally grey to pink in colour with abundant inclusions and remnants of basic volcanic rock and more rarely sediments derived from the Keewatin(?); and (2) massive, coarse-grained, equigranular to porphyritic, red quartz monzonite.

The grey granites are best exposed in the eastern part of Township 138 where they are foliated in an east-west direction with dips close to vertical.

Under the microscope the granites of this area are seen to have the following average mineralogical composition: quartz, 25 percent; microcline, 15 percent; plagioclase, 50 percent; green or brown biotite, 7 percent; and accessories, 3 percent. The characteristic accessories are sphene, apatite, zircon (hyacinth), allanite, monazite, magnetite, and sulphides. The microcline is normally fresh and may show exsolution of albite (parallel to (001) ), the plagioclase (oligoclase-albite) is altered to an aggregate of clay minerals, sericite, and in the more calcic members and cores, to clinozoisite. The biotite is largely altered to the chlorite penninite.

These rocks contain inclusions derived from the Keewatin(?); they may be angular (*see* photo p. 15, top) or may have been largely transformed so that only ghosts of their original form remain (*see* photo, p. 15, bottom). Locally, the amount of basic material assimilated is so great that a diorite results.

In addition to the dominant grey variety, there is a fine-grained, equigranular, pink granite, which has few inclusions of ferromagnesian material.

The granites and the basic inclusions are cut by dikes and dikelets of aplite. These have no preferred orientation but appear to be more numerous close to the margins of the red granite. Where these veins cut the readily weathered granitized greenstone, they stand up as ridges about an inch high. Pegmatite dikelets consisting of quartz, microcline, and minor biotite are only rarely found. Quartz veins, up to a foot wide, frequently with a northeast strike, are common, but in general it is not possible to distinguish between pre-Huronian and post-Huronian quartz veins in the basement.

The granites exposed in the northeastern part of Deagle township, although not markedly gneissic in character, belong to the first group. The granite forms dikes and stringers in the brecciated fringe of the greenstone mass; it is pale-

## Geology of Townships 137 and 138

pink to red in colour, weathering red, and consists of albite, quartz, microcline, and minor amounts of biotite, with zircon, apatite, magnetite, and sulphides.

The second group of granites consists of massive potash granites exposed in the west half of Township 138. On the west and northwest they are continuous with massive granites, generally porphyritic, in Townships 145 and 144 (Harding 1941: Robertson 1961, p. 11). Typically this rock consists of phenocrysts of perthitic microcline up to 1½ inches long, set in a groundmass of andesine-oligoclase and ferromagnesian minerals. The average composition is: quartz, 15 percent; potash feldspar (microcline—slightly perthitic microcline), 40 percent; plagioclase, 30 percent; ferromagnesian, 10 percent; accessories, 5 percent. The oligoclase is more strongly altered than the microcline and takes on a characteristic yellow-green colour due to the development of sericite and, to a lesser extent, clinozoisite. Biotite is the normal ferromagnesian mineral but is more or less altered to penninite; hornblende is present close to the contacts with the greenstone, and augite was recovered in heavy-mineral concentrates from one sample. Accessory minerals include zircon (malacon and minor hyacinth), monazite, titaniferous magnetite, and apatite. The sulphides—pyrite, chalcopyrite, and pyrrhotite—are sparsely distributed and are generally anhedral, though small euhedral crystals are not uncommon. When weathered, the rock takes on a dark-red coloration due to the oxidation of iron-bearing inclusions in the feldspars. This porphyry grades into equigranular rocks containing the same minerals but less of ferromagnesian minerals and calcic oligoclase. In this phase the quartz grains are frequently faintly blue.

Within the outcrop of the red granite there are a number of aplite dikes and pegmatitic segregations, but neither of these have any preferred orientation. The aplites are less common than in the adjacent gneissic rocks. Quartz veins trending northeast are again common.

The outcrop of the red porphyritic quartz monzonite extends into central Township 138, where its contact with the gneissic rocks is largely obscured by a diabase mass. However, about half-way between the west end of Wiggly Lake and the west boundary of Township 138, and also on a large island in Wiggly Lake, porphyritic potash granite has sharp chilled contacts against small equidimensional bodies of a fine-grained, equigranular, pink granite.

Chemically the granites are distinguished by their alkali and ferromagnesian constituents (*see* Table II).

TABLE II—COMPARISON OF AVERAGE CONTENTS OF ALKALI AND FERROMAGNESIAN CONSTITUENTS OF THE RED AND GREY PHASES OF THE ALGOMAN GRANITES  
(After Robertson 1960, p. 61)

Type	K <sub>2</sub> O	Na <sub>2</sub> O	$\frac{K_2O}{Na_2O}$	CaO	FeO	MgO	$\frac{MgO}{FeO}$	MnO
	percent	percent		percent	percent	percent		percent
Grey.....	2.66	5.29	0.51	1.91	1.66	1.22	0.62	0.038
Mean deviation..	0.70	0.64	0.14	0.80	0.58	0.57	0.25	0.017
Red.....	4.70	3.68	1.29	1.06	0.88	0.52	0.60	0.016
Mean deviation..	0.78	0.44	0.26	0.62	0.42	0.37	0.22	0.008

The red phase is thus characterized by high potash, a high potash-soda ratio and low calcium and ferromagnesian constituents, and by a less marked variation in these constituents.

Where the red granite is contaminated by greenstone, the resultant hybrid rock is enriched in ferrous iron, magnesium, calcium, titanium, and strontium.

Of the trace constituents, Rb follows K, and Sr follows Ca, and Mn follows Fe plus Mg; zirconium is twice as abundant in the red phase as in the grey, and chromium is characteristically absent although typically present in the grey. (Robertson 1960, Table 17 and Chap. VI).

Although the heavy-mineral assemblages derived from both types are similar (Robertson 1960, Table 14), the dominant species from the grey phase are biotite, hornblende, sphene, titaniferous magnetite, and apatite, whereas from the red they are biotite, zircon, and epidote. The zircon in the grey phase is hyacinth, whereas in the red it is dominantly malacon with minor hyacinth (Robertson 1960, Table 16 and Fig. 18).

When the area of outcrop of the various granitic types is compared with the distribution of radioactivity anomalies (aeromagnetic maps, O.D.M. 1954), it is revealed that, with very few exceptions, the anomalies in the basement are restricted to the potash granites. The granite north of Quirke Lake is markedly radioactive. The radioactivity is not shown quantitatively on the published maps, but W. N. Millar of Toronto has reported readings of three to four times background on a Ferris scintillometer at a height of 200 feet above mean land surface.<sup>1</sup>

Thus the granitic rocks of Township 138 and the northeast corner of Township 137 may be broken into two groups: the first is grey, gneissic, sodic, with inclusions, non-radioactive, and with a diagnostic heavy-mineral assemblage; the second is massive, red, potassic, with few inclusions except where in close contact with greenstone, typically radioactive, and also with characteristic heavy minerals. The gneissic types surround the massive types and this, plus the distribution of the aplitic dikes and veins, suggests that the red phase is younger than the grey.

It may be pointed out that the presence of potassic granites in masses of batholithic dimensions, generally red in colour, has been known for some time, and there has been a tendency to regard such granite as Killarnean i.e., post-Huronian in age (Harding 1950: Moore and Armstrong 1945, p. 12).

However, it has been shown, particularly by drilling, in the Quirke Lake area, that the basal members of the Huronian rest with pronounced unconformity on both red and grey granites alike. (Robertson 1961, pp. 11, 12.) Jas. E. Thomson has observed a similar relationship between the Huronian and the Birch Lake granite near Geneva Lake northwest of the Sudbury Basin (Thomson 1961, p. 6). This granite has long been considered as post-Huronian in age. On the Lake Huron sheet (G.S.C. 1933) just southeast of the present map-area, no definite boundary between the Birch Lake granite (post-Huronian) and the Algoman granite (pre-Huronian) was shown. Research on the chemistry and the heavy minerals of the granites of the Sudbury area and of those of the Blind River area indicated that in all essentials the granites of the two areas are similar (Ginn 1958: Robertson 1960).

## **POST-ALGOMAN INTERVAL**

### **Pre-Huronian Soils**

The Huronian rests with marked unconformity on the Algoman granites and the Keewatin(?) greenstones. The boundary surface, although irregular, is approximately parallel to the bedding of the Huronian. (Roscoe 1957, Fig. 3: Robertson 1961, Charts A-D).

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<sup>1</sup>Personal communication.

## Geology of Townships 137 and 138

However, within the present map-area the contact between the Huronian and the pre-Huronian is nowhere visible. Along the north shore of Quirke Lake (in Township 144), and in drill core, a transition zone between the granites and the basal Mississagi beds can be observed. (Roscoe 1957, pp. 4, 5; Collins 1925, pp. 30, 31.)

The plagioclase feldspars of the granite become yellow owing to the development of sericite, and the ferromagnesian minerals disappear. Rock retaining a granitic texture passes upward into a yellow-green, unsorted, quartz and microcline aggregate set in a sericitic matrix with scattered fragments of vein quartz and partially altered granite. Chemically, this material is enriched in potash, alumina, and water, and reduced in soda, lime, magnesia, and iron, relative to the underlying granite. Such would be the characteristic of a soil developed from the granite during the prolonged period of subaerial denudation required to reduce the pre-Huronian land surface to a peneplane. This soil is overlain by the basal members of the Huronian; the division between the two is marked by the appearance of sorting and of structures such as bedding and crossbedding, showing that the material has been subjected to transportation. Frequently the actual contact is defined by a layer of quartz pebbles. When this pebble band is absent it is difficult to observe the contact in core. This transition zone, depending on the extent of later sorting, ranges up to 50 feet in thickness but is generally less than 20 feet. The regolithic material is formed from both the red and the grey granites.

Core sections show the development of a crumbly chloritic earth between the greenstones and the Lower Mississagi. Within the area mapped, this earth is normally about one foot thick but may attain 4-5 feet.

Since the greenstones were more susceptible to weathering, they were eroded to a greater depth than the adjacent granites. Thus, in pre-Huronian time, a scarp developed along the granitic side and a valley along the greenstone side of the contact zone of the two rock types. During the earlier stages of Huronian sedimentation this scarp persisted along the Ten Mile Lake-Quirke Lake-Whiskey Lake linear, and there is thus a northward overlap of the lower Huronian against the granite. Erosion since the end of the Precambrian has resurrected this scarp, which now forms a prominent linear feature running from the northwest end of Ten Mile Lake in Township 156, along the Serpent River from the west end of Quirke Lake in Township 150, to the northeast corner of Township 137.

Within the greenstone belt itself, differential erosion over the softer and more readily attacked members of the greenstone series caused the development of minor hollows and valleys trending parallel to the strike of the greenstone members. In this connection it is significant that the uraniferous conglomerates of the Quirke Lake syncline are concentrated in channels formed above the granite-greenstone contact area and striking parallel to the strike of the basement structures.

### **Proterozoic**

#### **HURONIAN**

The whole area west of Whiskey Lake, i.e., that part of the map-area bounded by the Serpent River system, and a strip  $\frac{1}{4}$ - $\frac{1}{2}$  mile wide south of the river in Township 137, is underlain by sedimentary rocks of Huronian age folded into a syncline, the axis of which strikes slightly north of west and pitches  $20^{\circ}$ - $35^{\circ}$ W. These rocks consist of conglomerate, quartzite, arkose, siltstone, greywacke,

and limestone. The rocks are normally only slightly metamorphosed, and original structures such as individual grains, crossbedding, graded bedding, ripple marking, and mud cracks are perfectly preserved.

The Huronian has been subdivided as indicated in the Table of Formations (page 11), and Table I correlates the various stratigraphic nomenclatures that have been used in the Blind River area.

### **Bruce Group**

The lowermost group, the Bruce Group, consisting of the Lower, Middle, and Upper Mississagi Quartzite, the Bruce Conglomerate, the Espanola Formation, and the Serpent Quartzite, is well exposed within the map-area.

#### **MISSISSAGI FORMATION**

This is the oldest member of the Huronian exposed within the Blind River area and, as the basal members contain the uranium-bearing conglomerates, is the one that has aroused most interest in recent years. The formation as originally defined by Winchell (1887, pp. 145-71) and understood by Collins (1925, pp. 30-45) can be further broken down into three subdivisions on the basis of lithology (Roscoe 1957, Fig 2; McDowell 1957, p. 3). The Lower Mississagi consists of coarse arkosic quartzites with intermittent, oligomictic conglomerate beds overlain by a series of grey feldspathic quartzites. In the Pecors Lake sector of Township 137 the upper part of the Lower Mississagi is represented by a sequence of greywackes and argillites (the Nordic formation of Roscoe's classification). In the same area scattered lenses of polymictic conglomerate are also found. The Lower Mississagi is overlain, possibly disconformably, by a polymictic boulder conglomerate, which shows considerable lateral variation in thickness and lithology. The conglomerate is overlain by an argillite-greywacke series. The conglomerate and argillite are grouped as the Middle Mississagi (the Whiskey formation of Roscoe). The Middle Mississagi is followed conformably by a series of well-sorted quartzites and feldspathic quartzites.

#### **Lower Mississagi**

Apart from one small outcrop at the northwest end of Whiskey Lake, the Lower Mississagi is only exposed, in Township 137, on the south limb of the syncline. The lower part of the sequence is well exposed to the south of the Serpent River east of Pecors Lake and to the south and east of Whiskey Lake, where beds form a prominent south-facing scarp (*see* photo on page 22).

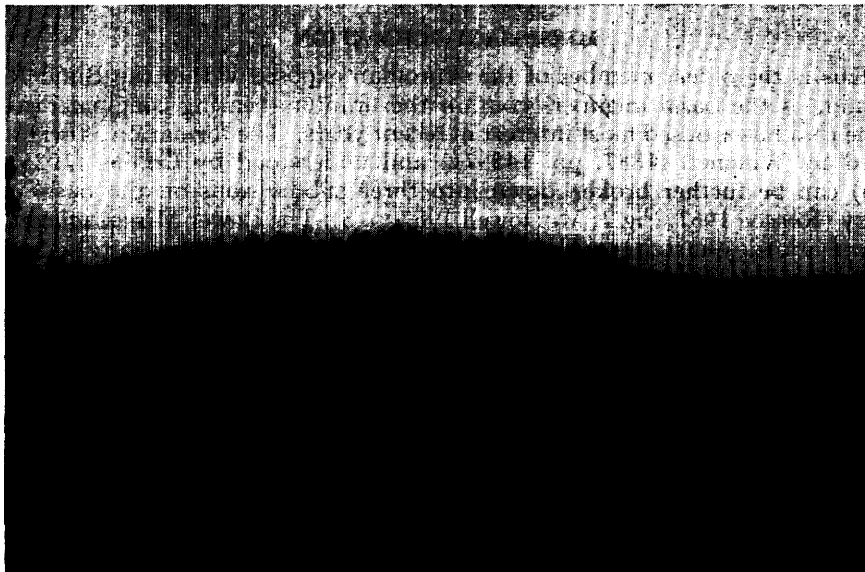
Between those two localities the upper part of the Lower Mississagi rests directly on the greenstone basement or on the basal greywacke conglomerate.

Diamond-drilling indicates that this ridge of the basement, flanked by two channels in which the lower members of the formation were deposited, strikes northwest passing to the north of Pecors Lake (*see* figure on page 24).

In the more westerly (or Pecors) channel, the lowermost bed exposed is a boulder conglomerate (*see* photo on page 23). This conglomerate consists of an unsorted assemblage of rounded to subangular blocks, up to 1 foot across, of granite, diorite, and greenstone, angular to subangular pebbles and fragments of vein quartz, and numerous irregularly shaped pieces of greenstone and argillaceous material. The more massive blocks of greenstone show pillow structure, and some have vesicular or amygdaloidal rims; the shape of others suggests that they were volcanic bombs. The contorted shapes of the more argillaceous fragments suggest that they were only partly consolidated at the time of formation of the

## Geology of Townships 137 and 138

conglomerate. Packing is normally tight, and the sorting very poor. The matrix consists of a gritty greywacke that contains pyrite. Oxidation of the pyrite gives the weathered surface a characteristic red appearance. The longer axes of the pebbles and boulders have a marked southeasterly lineation. In outcrop the relation of the conglomerate to the greenstone is not seen, but drillholes show that it probably forms an intermittent basal bed of the Mississagi within the Pecors channel and on part of the ridge separating the Pecors and Whiskey channels, rather than a bed within the greenstone assemblage. The maximum thickness attained by this conglomerate within the channel is 85 feet. Such conglomerate is not developed in the Whiskey (or easterly) channel.



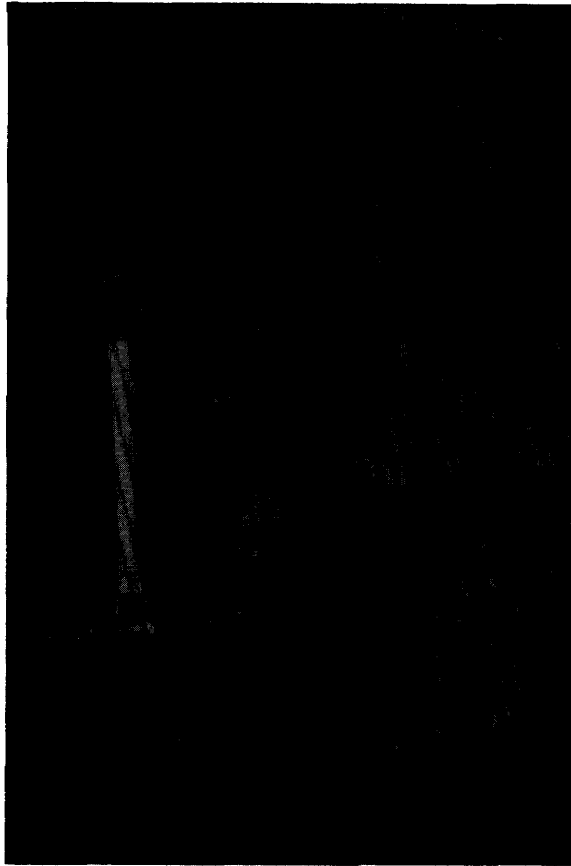
Southward-facing scarp of the Lower Mississagi Quartzite; east of Pecors Lake, Township 137.

The conglomerate is followed by a series of well-bedded, coarse-grained arkoses with interbedded quartz conglomerate. The lower part contains much sericitic material presumably derived from the pre-Huronian paleosol, and on weathering, the rock takes on a greenish colour. The upper parts of the beds grade into finer-grained arkoses, which contain a greater proportion of this sericite and weather a pale yellow-green.

In thin section the arkosic quartzites of the Lower Mississagi are seen to be an aggregate of coarse-grained, angular to subrounded, poorly sorted grains of quartz (from both igneous and metamorphic sources), altered potash feldspar (non-perthitic and perthitic microcline), and, rarely, fresh plagioclase set in a pale yellow-green, sericitic matrix. Titaniferous magnetite, zircon, and pyrite are present in minor amounts.

The beds are 3-6 feet thick, and the finer-grained bands 2-4 inches. Oligomictic pebble bands are scattered throughout the Lower Mississagi but are more common towards the base (*see* figure, p.24). These consist of well-rounded and sorted quartz pebbles with occasional chert and jasper set in a coarse-grained arkosic matrix. These conglomerate beds are generally 6 inches to 2 feet thick, and the pebbles are  $\frac{1}{2}$ -2 inches in diameter. The matrix contains minor amounts

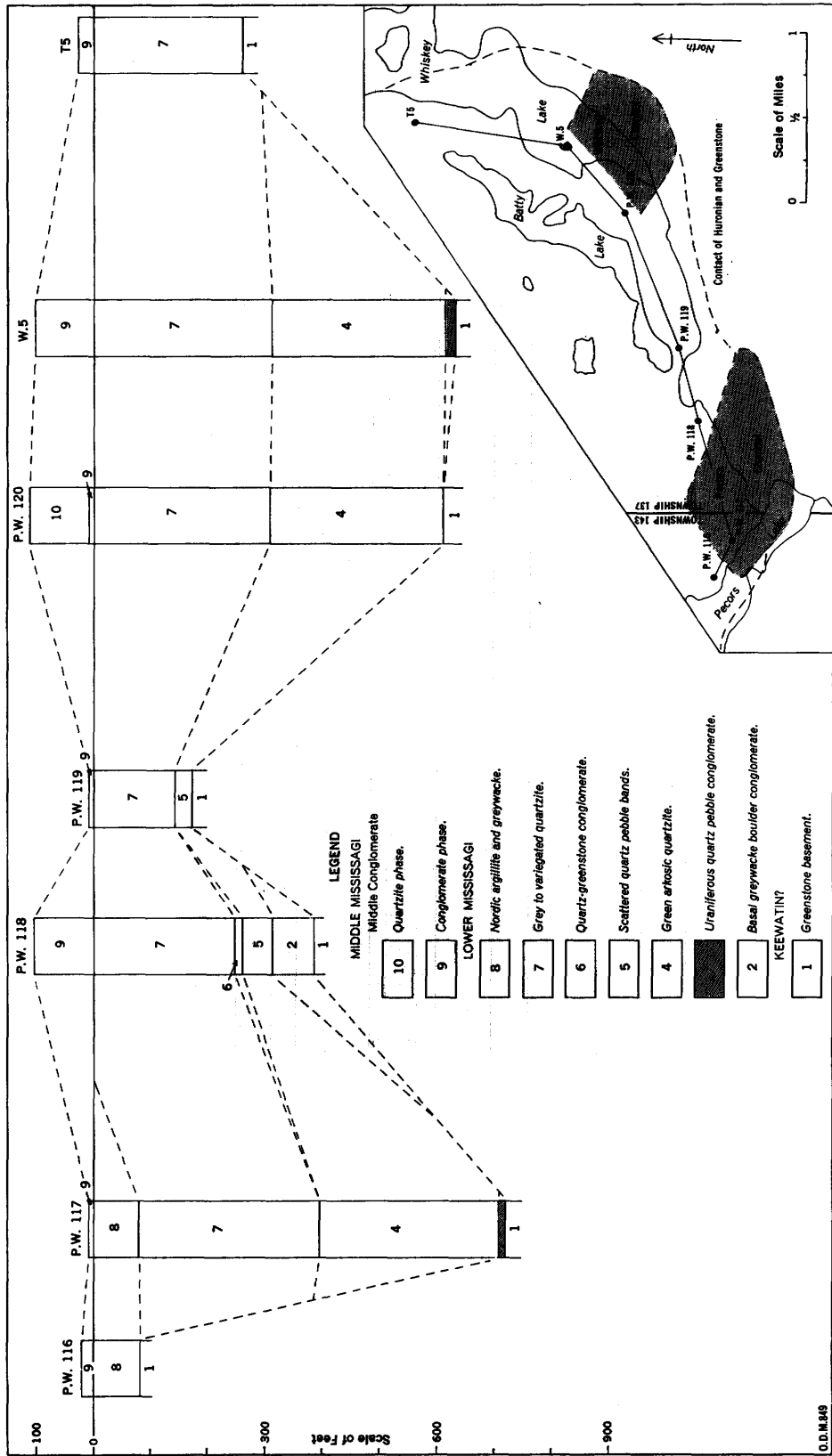
of pyrite, pyrrhotite, and chalcopyrite. In surface outcrops on the Pecors (East) property of Algom Uranium Mines Limited, south of the Serpent River and in the northeast corner of the block staked by J. A. Pousette, pyritiferous oligomictic conglomerates are exposed. These have been oxidized; the matrix of the rock has developed a cellular texture, and the surface is coated with finely divided secondary iron and uranium minerals, probably hematite, limonite, and uranophane. These outcrops, together with slight regional radioactivity, indicated the presence of uranium in the conglomerates, and in 1954-55 diamond-drilling was carried



Boulder conglomerate at base of the Lower Mississagi; east of Pecors Lake, Township 137.

out down dip and along strike from them. This drilling showed that the beds in question did form low-grade uranium ore. The lowermost conglomerate beds, which were thicker, coarser, and with more pebbles and greater pyrite content, were shown to contain up to 0.1 percent  $U_3O_8$  but generally to average 0.03-0.05 percent  $U_3O_8$ . However, the grade, the thickness of the favourable beds, and their lateral extent were insufficient to warrant further exploration or development.

The greenish-weathering, coarse-grained, poorly sorted arkoses pass upwards into medium- to coarse-grained, brownish-weathering arkoses, which have slightly better sorting and more silica in the matrix than the lowermost arkoses.



Lateral variation in the Lower Mississagi Quartzite between Pecora and Whiskey lakes. Townships 143 and 137.

The coarse-grained arkosic sequence is followed by grey and pink quartzites and feldspathic quartzites. These are medium- to coarse-grained, contain up to 12 percent feldspar, and are partially rounded and better sorted than in the earlier beds. The matrix is essentially silica with minor sericite.

In thin section it is seen that the feldspars are microcline or microcline-perthite. Crossbedding is defined by dark bands one or two grains thick containing the heavy minerals, zircon, magnetite, and iron oxide.

Near the Serpent River, between Pecors and Whiskey lakes, drilling shows that there are scattered lenses of quartz, greenstone, and conglomerate. Fragments of quartz, pink and grey granite, and greenstone up to 2 inches across are randomly scattered in an impure, dark-grey, quartzite matrix. South and west of the southwest end of Batty Lake the conglomeratic phase of the upper members of the Lower Mississagi rests on the boulder conglomerate formed on top of the greenstone ridge developed in the area. Throughout the rest of the map-area the Lower Mississagi is made up of grey quartzites, typically well-sorted, crossbedded (both planar and trough), and composed of quartz and feldspar grains set in a siliceous matrix. Pyrite is often visible as interstitial blebs, along crossbedding, and in irregular fractures. The upper grey quartzites may carry scattered quartz, chert, and jasper fragments up to  $\frac{1}{2}$  inch in diameter.

In thin section the rock is seen to consist of well-sorted, medium-grained, rounded to subangular grains of quartz (from an igneous source) and, more rarely, perthitic and non-perthitic microcline.

Well-bedded, grey to slightly pink quartzites are exposed on the island near Shelter Point in central Whiskey Lake. Well-bedded but fractured, grey- to brown-weathering quartzites are intermittently exposed along the southeast shore of Batty Lake, half-way between the north end of Batty Lake and the southeast arm of Kindle Lake, and at the east end of Kindle Lake. In all these localities the rocks in question are close to both diabase and faulting, and the quartzites are shattered and have been subjected to albitic alteration. At the bottom of the cliff running west from the northwest arm of Whiskey Lake at least 15 feet of coarse-grained, grey, feldspathic quartzites are exposed. On the east side of the adjacent bay into which the Serpent River flows from Kindle Lake a drillhole shows Middle Mississagi conglomerate resting on greenstone paleosol.

The Bracemac drillhole on the south shore of Rangers Lake near the west end of the lake intersects 120 feet of feldspathic quartzite, of which the lower 100 feet consists of a fine-grained, sugary-textured, white, feldspathic quartzite, and the upper 20 feet of coarse-grained, greenish arkose with scattered quartz pebbles and minor pyrite. It may be noted that to the west of Elliot Lake, diamond-drilling has intersected similar white sugary quartzite resting on the basement in areas where little or no uranium was proven.

On the south limb of the syncline the grey quartzite and conglomerate sequence is followed by argillites and subgreywackes (the Nordic formation of Roscoe's classification). In Algom Uranium Mines' drillhole P.W. 117 (*see* figure, p. 24) on the northeast shore of Pecors Lake,  $\frac{1}{4}$  mile west of the Townships 143-137 boundary, the assemblage is 70 feet thick. However, in drillhole P.W. 118 on the north bank of the Serpent River, 1 mile to the east of the Townships 143-137 boundary, this unit is missing. There are no drillhole sections of this unit in the area, and the few outcrops near the township boundary are poor. In Township 143 drilling indicates that the argillites die out northward, probably within a mile. (Robertson 1961, p. 14.) It is not known whether they represent a deeper-water facies of the upper members of the Lower Mississagi as suggested

## Geology of Townships 137 and 138

by Roscoe (1957, p. 8), or whether they represent a younger formation partially removed by erosion prior to the deposition of the Middle Mississagi Conglomerate.

Crossbedding determinations indicate that the rocks were laid down by currents from the northwest. The dip of the foreset beds, where planar-type crossbedding is developed, is close to 35 degrees, the angle of rest for coarse sand in water. More often the crossbedding is of the trough or festoon variety. (McDowell 1957, pp. 13-18, and photos: McKee 1948, p. 1378.) In this case the direction of sedimentation is derived from the plunge of the troughs. This also indicates a northwesterly source.

Crossbedding was measured at six localities. The average value obtained from twenty determinations was S.74°E, which closely resembles the strike of the greenstones south and east of Whiskey Lake. In addition to the predominant southeasterly trend it was noticed that there was a minor southwesterly trend, indicating that some of the sediment must have been brought in or disturbed by currents flowing perpendicular to the channels controlling the sedimentation. The dip of the foreset beds is generally just below that of the angle of rest for wet sand, i.e. 35 degrees. Both beds and crossbedding laminae show graded bedding. (McDowell 1957, p. 21, Fig. 8.)

As in Townships 143 and 144, where more extensive drilling allows more accurate observation, there is a gradual southerly increase in the thickness of the Lower Mississagi. However, this increase tends to be obscured by the pronounced variation in thickness caused by the channels of deeper sedimentation.

Thus the Lower Mississagi is missing on Kindle Lake and generally missing along the northwest arm of Whiskey Lake; at the north end of Batty Lake it is 360 feet thick; at the island off Shelter Point in south-central Whiskey Lake it is 400 feet; between the southwest end of Batty Lake and Whiskey Lake, 400-600 feet; west of the southwest end of Batty Lake, 130 feet; near the Serpent River between Whiskey and Pecors Lakes, 375 feet; and at the east end of Pecors Lake, 670 feet (with an additional 70 feet for the Nordic argillites).

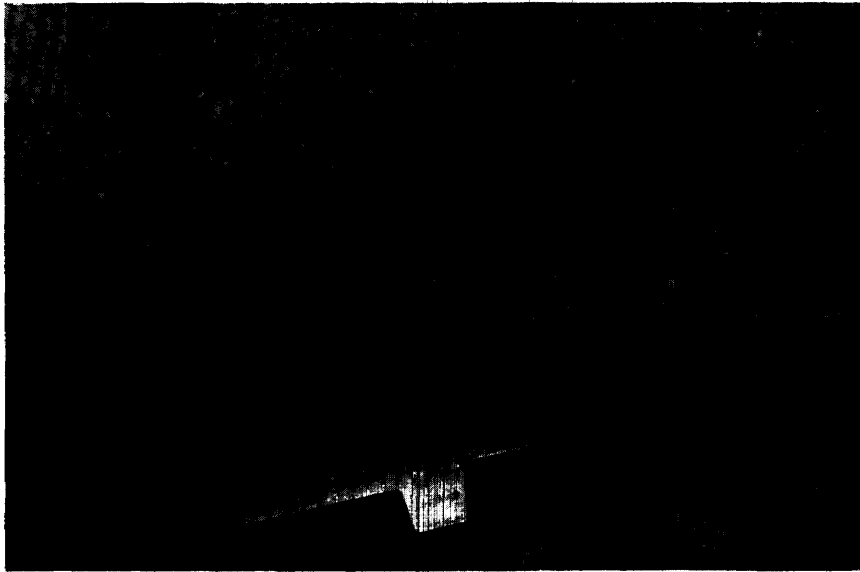
Thus the Lower Mississagi was laid down by rapidly moving water probably at shallow depth. The predominance of trough crossbedding shows that the beds were continuously exposed during the period of deposition. Sedimentation, particularly of the uraniferous conglomerates and the coarse-grained sericitic arkoses of the lower part of the sequence, was controlled by ridges of relatively hard rock in the basement left standing above the general level of the pre-Huronian peneplane. During the earlier stages of sedimentation these ridges probably formed off-shore islands. The overlapping of the Lower Mississagi on to the granitic basement along Whiskey and Kindle lakes indicates that at no time was the area far from the shoreline.

### **Middle Mississagi**

The Middle Mississagi consists of a basal conglomerate, which, within the map-area, shows considerable lateral variation, and an upper member consisting of argillite and subgreywacke. The Middle Mississagi Conglomerate is exposed on the west shore of the central part of Whiskey Lake and is repeated by faulting in an arc extending from the east end of Kindle Lake to the southern part of Batty Lake. Drilling at the northwest end of Whiskey Lake shows that there the conglomerate lies on the paleosol; in the Bracemac drillhole (on the south shore of Rangers Lake) it lies on Lower Mississagi Quartzite; in the Batty Lake-Whiskey Lake area, on the upper quartzites of the Lower Mississagi; and at the east end of Pecors Lake, on the Nordic argillite. In the central Whiskey Lake area, except on the island off Shelter Point where there is a sharp contact (*see* accompanying

photo), the relationship between the Middle Mississagi Conglomerate and the Lower Mississagi is not seen owing to lack of exposure. (Both Collins (1925, pp. 38-42) and Douglas (1926, p. 41) considered that conglomerate exposed on the north shore of Quirke Lake (in Township 144) and in the vicinity of Whiskey Lake was the earliest member of the Huronian System.) The conglomerate thus bevels across the structure of the Lower Mississagi at a small angle and is probably a "time-rock unit." Roscoe (1957, p. 9) recognized the importance of this conglomerate and, regarding it as the most useful horizon marker in the Lower Huronian, used it as the basis of this reclassification of the Mississagi.

At the east end of Kindle Lake and the northwest end of Whiskey Lake the Middle Mississagi Conglomerate rests on the basement. The lower 15 feet is composed of scattered angular to subrounded boulders of granite and greenstone,



Contact of Middle Mississagi Conglomerate and Lower Mississagi Quartzite; island off Shelter Point, Whiskey Lake, Township 137.

plus pebbles and fragments of granite, greenstone, and quartz in a dark-grey to yellow-grey, gritty, feldspathic matrix. The matrix has only minor sulphide mineralization, which on oxidation gives the weathered surface a rusty colour. This grades upward into feldspathic quartzite, pale yellow-grey in colour, and finally into a well-washed, fine-grained, white to light-grey, quartzite, which is in turn overlain by the argillites. The granite boulders are grey to white. The over-all hardness of the matrix and the pebbles is similar, so that there is little tendency to differential weathering. This quartzite between the conglomerate and the argillite was observed only in the area of Kindle Lake and the northern part of Batty Lake.

In the Bracemac drillhole the conglomerate is composed of subrounded cobbles of white granite and greenstone, with pebbles of granite, greenstone, and quartz, and angular fragments of quartz and white feldspar in a matrix of dark-grey, siliceous greywacke to quartzite. The matrix is characterized by the presence of numerous round grains of smoky quartz and minor pyrite. Normally the pebbles and cobbles of granitic rocks predominate over those of greenstone.

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On the island off Shelter Point, in Whiskey Lake, the contact between the conglomerate and the Lower Mississagi Quartzite is exposed and is seen to be non-gradational in character (*see* photo, page 27). The basal gritty bed passes up into typical Middle Mississagi conglomerate. On the weathered surface the greenstone blocks are seen to be vesicular and amygdaloidal in character. The shape of some of them suggests that they were individual pillows or possibly volcanic bombs probably derived from the Keewatin(?). A number of blocks of quartzite up to 5 feet across, resembling that in the Lower Mississagi, were also found. There are occasional lenses of greywacke and argillaceous quartzite, oriented parallel to the bedding. Within these lenses cross-stratification and slumpage are well developed.

On the other islands and on the west shore of the central part of Whiskey Lake crossbedding is visible in the matrix of the upper part of the conglomerate, which is locally calcareous. Differential weathering of the calcareous beds makes this crossbedding readily visible.

Drillholes in Township 137 west of Whiskey Lake and north of the Serpent River show that, on the south limb of the syncline, the conglomerate bed is represented by only a few feet of dark-grey quartzite or greywacke with a few scattered pebbles and fragments of quartz, white granite, and greenstone.

At the east end of Kindle Lake and the northwest end of Whiskey Lake the conglomerate is 13-30 feet thick (if the quartzite member is included as part of the conglomerate); in the Bracemac drillhole and at the northeast end of Batty Lake it is about 30 feet; in central Whiskey Lake, 150-200 feet (the maximum thickness attained in the syncline) (Roscoe 1957, p. 9); and on the south limb, up to 5 feet. Thus the Middle Mississagi Conglomerate shows marked lateral variation in thickness and also to a lesser extent in lithology. The variation in lithology is due partly to the overlap against the basement and partly to the conditions in the channel of greater deposition in the Whiskey Lake area. It may be that the filling in of this channel is responsible for the lack of deposition on the south limb. In Townships 144 and 143, where data is more complete, the Middle Mississagi Conglomerate shows a gradual southerly increase in thickness.

The nature of this conglomerate suggests that it was deposited very rapidly. Both glacial and mud-flow deposition have been suggested (McDowell 1957, p. 31). Possibly it represents a basal conglomerate formed after a short break in the sedimentation sequence.

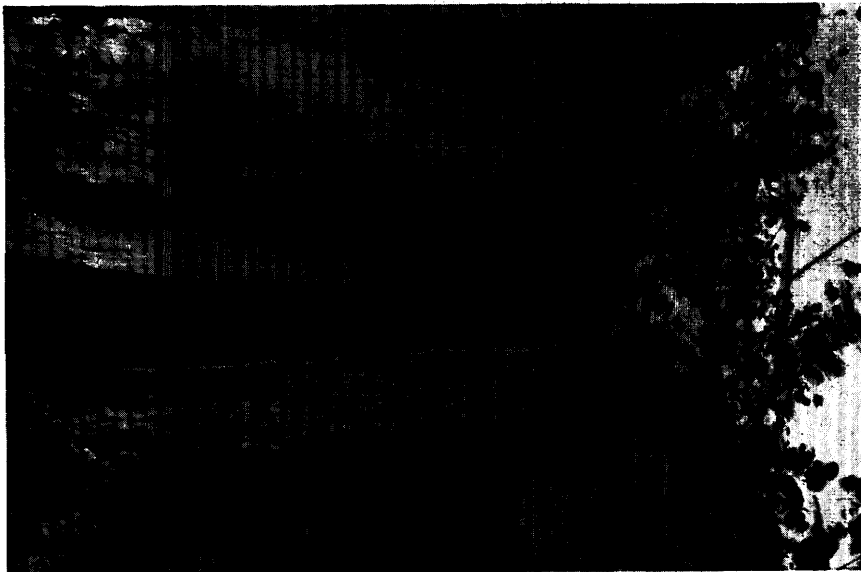
The conglomerate normally passes upwards, by diminution in the number of pebbles and increase of argillaceous material, into argillite. In the Kindle Lake-Batty Lake area, however, where the upper part of the conglomerate is represented by quartzite, the argillite lies on the quartzite. The argillite is a finely laminated, dark-grey, fine-grained rock. Wherever exposed the argillite has a cleavage generally parallel to the bedding or at a small angle to it. The original bedding is revealed by slight alterations in colour. The individual bands are up to  $\frac{1}{4}$  inch but are generally less than  $\frac{1}{10}$  inch. In hand specimen these bands are seen to grade upwards from medium-grain to fine-grain.

In thin section the argillite is seen to be composed of finely-divided, sub-angular quartz grains and minor plagioclase, in a fibrous chloritic groundmass; black iron oxide, probably magnetite, is the principal accessory. The cleavage, as revealed by the lineation of the chlorite, is oblique to the bedding, defined by variation in the number and packing of the quartz grains.

The presence of graded bedding suggests seasonal deposition possibly under glacial or subglacial conditions. Where the cleavage is best developed, especially on the north limb of the fold, the rock may be regarded as a slate

rather than an argillite. The physical and chemical nature of the rock is such that it has little resistance to weathering; consequently it is eroded rapidly, and the area of outcrop is marked by a deep valley. The rock is only exposed in cliff faces, where it is capped either by the quartzites of the Upper Mississagi or by diabase sills.

The upper part of the sequence on the west shore of Whiskey Lake and on the south limb passes through a series of argillites and greywacke, with local development of intraformational breccia, into greywacke interbedded with quartzite and then into the Upper Mississagi quartzite. Drilling in the Quirke Lake–Elliot Lake area shows that the contact of the Middle and Upper Mississagi is probably interbedded, and in consequence Roscoe (1957, pp. 8, 9) has placed the contact where the quartzitic members exceed the argillaceous. The argillite-



Middle Mississagi Argillite with ripple marks; southwest shore of Batty Lake, Township 137.

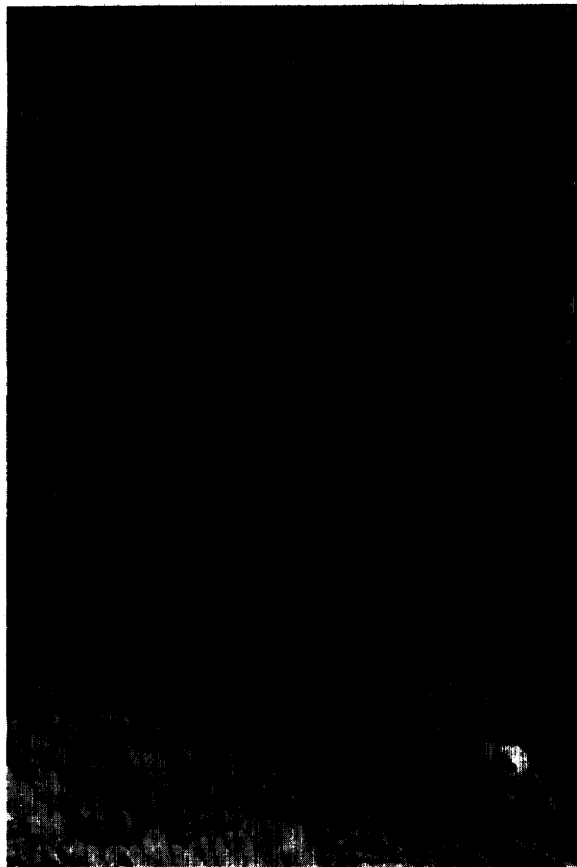
greywacke members at the top of the Middle Mississagi are characterized by the abundance of ripple marks on the bedding planes (*see* accompanying photo). Asymmetric and symmetric ripples are both found; where measured these indicated that the shoreline lay to the west-northwest.

The argillite is some 200 feet thick at the northwest end of Whiskey Lake; 300 feet at the north end of Batty Lake; 400 feet near the west end of Rangers Lake; 200–300 feet on central Whiskey Lake; and up to 650 feet thick between Whiskey and Fecors lakes. This corresponds to a southerly increase of 450 feet in about 5 miles, or 90 feet per mile; in Townships 143 and 144 a similar rate of increase of thickness was observed (Roscoe 1957, p. 10; Robertson 1961, p. 16). There is little evidence of a variation in thickness in an east-west direction. The southward increase in thickness is apparent in the total sequence and in both the lower argillite and the upper argillite-greywacke members.

The argillites were thus laid down in an east-striking zone, which, within the confines of the Quirke syncline, increased in depth from north to south. During the earlier part of the sequence fine-grained, graded-bedded sediments were laid down, possibly under subglacial or glacial conditions. In time, the sediments

## Geology of Townships 137 and 138

became coarser, and the presence of ripple marks shows that this deposition took place in shallow water. On the north shore of Quirke Lake the Middle Mississagi conglomerate is characterized by pockets of claystone filling hollows on the bedding planes. These claystones are mudcracked showing that the conglomerate accumulated in shallow water (Robertson 1961, p. 16). Thus both the conglomerate and the upper part of the argillite sequence were laid down in shallow water. It is therefore probable that the fine-grained nature of the argillite is due to a lack of coarse sediment rather than to deep-water deposition.



Contact of Middle Mississagi Argillite and Upper Mississagi Quartzite; west of Batty Lake, Township 137.

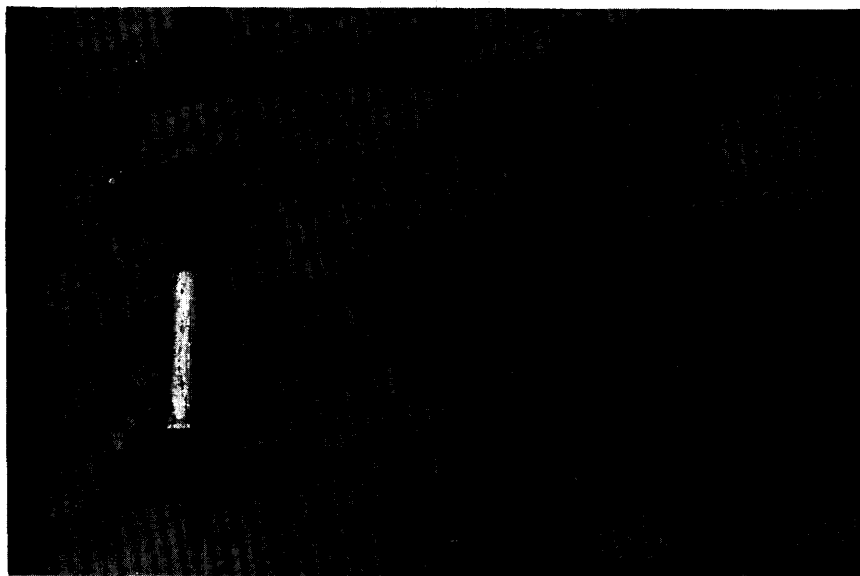
### **Upper Mississagi**

The Upper Mississagi Formation consisting of well-washed quartzites and feldspathic quartzites is exposed in an arc up to  $\frac{3}{4}$  a mile wide extending from Kindle Lake, passing to the east of Batty Lake and to the north of the Serpent River, reaching Pecors Lake  $1\frac{1}{2}$  miles west of the boundary between Townships 137 and 143. The greater part of the Upper Mississagi is repeated by thrust-faulting between Batty and Whiskey lakes, and the lower part is again repeated along the south shore of the northwest arm of Whiskey Lake. The quartzite, being well-bedded and resistant to both mechanical and chemical attack, forms well-developed scarps. These scarps frequently preserve the argillites of the

Middle Mississagi. The basal members are usually fine-grained, slightly argillaceous quartzites with argillite partings (*see* photo opposite). The argillite partings die out, and the quartzites become medium-grained, well-sorted, and consist of quartz grains with relatively minor feldspar in a silica cement.

In thin section the rock is seen to consist dominantly of recrystallized quartz grains many of which have interlocking boundaries. Some 8 percent of fresh microcline and minor amounts of sericitized plagioclase are also present. The cement is silica with scattered clay-minerals and sericite; chlorite shreds, pyrite, and iron oxide are present in small amounts.

However, in the area between the east end of Kindle Lake and the north end of Batty Lake the basal members consist of medium- to coarse-grained, grey to brownish-grey, feldspathic quartzites with green arkosic seams similar to those



Crossbedding in Upper Mississagi quartzite; northwest end of Whiskey Lake, Township 138.

of the typical Lower Mississagi. The quartzite beds are 3–5 feet thick, and the green bands up to 4 inches. These grade up into medium-grained, white to grey quartzites. The quartzites and arkoses are frequently crossbedded; the crossbedding is of the planar type (*see* photo above) rather than of the trough or festoon type, which is characteristic of the Lower Mississagi. Ripple marking can be occasionally observed on bedding planes. Another characteristic feature of the Upper Mississagi is the presence of well-rounded pebbles, up to 1 inch in diameter, of milky quartz, chert, banded chert, and more rarely, jasper. These pebbles may be scattered irregularly through the quartzite or concentrated into lenses or pebble bands—the latter being not more than two or three pebbles thick.

Within the present area, crossbedding determinations show that the currents that deposited the Upper Mississagi flowed primarily from the northwest. However, in the south limb the current direction is more variable than in the north, the average directions being only slightly south of east. In addition to the typical southeasterly trend there is also a marked northwesterly trend. Crossbedding from both the southeast and the northwest can be observed in the same bed. These observations confirm those made in a regional study by McDowell

## Geology of Townships 137 and 138

(1957, Fig. 6, p. 14.) From his studies on the crossbedding, thickness of bedding, and on regional variation in the size of the chert pebbles, McDowell (1957, p. 28) concluded that the source of sedimentation lay 137–150 miles west-northwest of Thessalon.

On the north limb of the syncline, as exposed in Townships 137–138, the average direction of sedimentation was S.35°E. and on the south limb, N.85°E., with an average over the area mapped of S.65°E. McDowell gives S.71°E. as the regional direction of sedimentation.

The Upper Mississagi Quartzite is about 1,000 feet thick along the north limb, 1,200 feet at the southeast end of Kindle Lake, and 1,600 feet between the southeast end of Batty Lake and Pecors Lake; a southerly increase of 600 feet

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.	.....
Gowganda:		
Township 150.....	SE.	Westner <sup>(1)</sup>
Serpent:		
Quirke Lake.....	S.50°E.	Simony (1958)
Townships 137 and 138.....	S.10°E.	Robertson
Quirke syncline.....	S.37°E.	Robertson
Upper Mississagi:		
Regional.....	S.71°E.	McDowell (1957)
North limb, Township 138.....	S.35°E.	Robertson
South limb, Township 137.....	S.85°W.	Robertson
Average, Townships 137 and 138.....	S.65°E.	Robertson
Mississagi:		
Bruce Mines.....	S.70°E.	Pettijohn (1957)
Middle Mississagi:		
Townships 137 and 138.....	S.35°E.	Robertson
Lower Mississagi:		
Regional.....	S.22°E.	McDowell (1957)
Township 137.....	S.74°E.	Robertson

<sup>(1)</sup>Personal communication.

in about 4 miles, i.e., 125 feet per mile. This is similar to the rate observed in Townships 143 and 144 and about half that observed by Roscoe (1957, p. 10: Robertson 1961, p. 16) in the Quirke Lake–Elliot Lake area.

The Upper Mississagi was thus laid down in a basin with gradual increase in depth from north to south and possibly from west to east. The abundance of crossbedding, the presence of ripple marks, and the scattered pebbles throughout the member indicate that it accumulated in shallow to very shallow water.

Conglomerate dikes similar to those observed in Township 143 and 144 (Robertson 1961, p. 17) were not observed, but narrow pebble and sandstone dikes were seen on Batty Lake. These point to minor earthquake activity during Mississagi time.

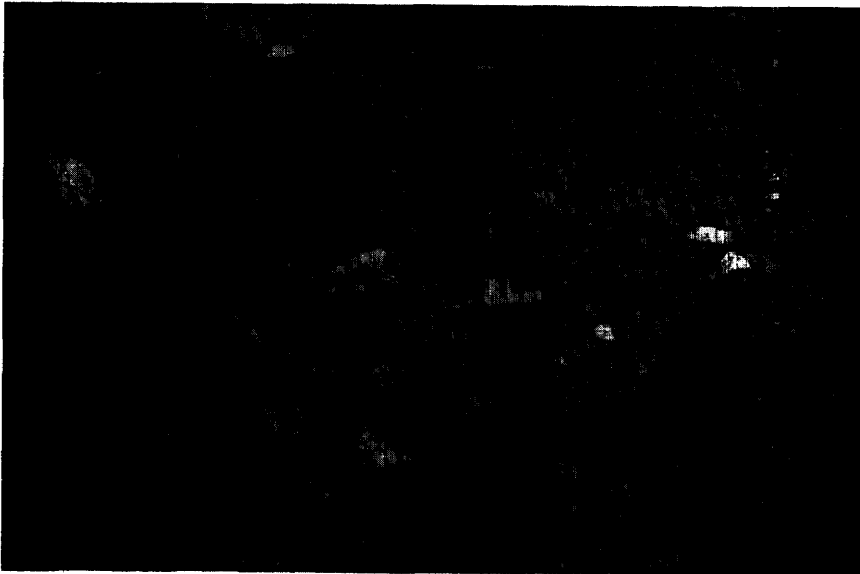
### BRUCE FORMATION

#### Bruce Conglomerate

The Upper Mississagi Quartzite is followed disconformably by a polymictic conglomerate, probably corresponding to the Lower Slate Conglomerate of Logan's and Murray's classical Bruce Mines succession (Logan 1863). This was renamed the Bruce conglomerate by Collins. Within the present map-area the Bruce

Conglomerate is exposed: on the south bank of the Serpent River between Nook Lake and Kindle Lake; on the southwest shore of Kindle Lake; and as an arc about 100 yards wide extending from the east end of McCool Lake, by Deresti Lake, to the west boundary of Township 137, some  $1\frac{3}{4}$  miles north of Pecors Lake. In the north limb of the syncline the conglomerate is about 70 feet thick and forms a slight scarp. However, in the central area and on the south limb the conglomerate is no more than 30 feet thick, and the scarp is less pronounced.

Within the area mapped, the contact with the underlying quartzite is sharp, and occasionally, on both the north and south limbs, angular boulders of Mississagi-type quartzite have been found (*cf.* Collins 1925, p. 47), indicating that probably there was a slight break in sedimentation between the two formations.



Bruce Conglomerate; Kindle Lake, near portage to Rangers Lake, Township 138.

Characteristically the Bruce Conglomerate (*see* accompanying photo) consists of scattered cobbles and fragments of granite and greenstone in a dark-grey to black, grey- to rusty-weathering, medium-grained, siliceous greywacke to quartzite matrix. The derived pebbles are  $\frac{1}{2}$ -3 inches in diameter and may be rarely as large as 10 inches. The granite is the most common type and is normally a medium-grained, equigranular, massive, biotite-bearing, grey variety, but pale-pink and gneissic types are also found. The quartz fragments are usually subangular and are of white quartz and less frequently of chert or jasper. Angular fragments of white feldspar are also common. The matrix is characterized by many rounded grains of black glassy quartz; these are responsible for the very dark colour of the rock when fresh. Another characteristic, which helps to distinguish the rock from the rather similar Middle Mississagi Conglomerate, is the universal presence of interstitial pyrite in the matrix; on weathering this gives rise to irregular rusty patches on the surface of the rock. On the fresh surface and in core the pyrite can be seen to surround pebbles or quartz fragments and, in some cases, to replace the quartz.

## Geology of Townships 137 and 138

Sorting is very poor but becomes somewhat better towards the top of the bed. The upper part of the conglomerate is represented by normal to slightly calcareous siliceous greywacke with very few pebbles and fragments. This grades upwards into the overlying Bruce Limestone.

The highly siliceous nature of the matrix makes it resistant to weathering, and in consequence the pebbles of granite and diabase or greenstone weather more rapidly giving the rock a characteristic pitted surface. The general hardness of the rock is also responsible for the tendency to form a scarp.

The thickness of the conglomerate is similar to that observed in Townships 143 and 144 but is rather less than that recorded by Roscoe for the Quirke Lake-Elliot Lake area. The conglomerate was thus laid down as a fairly uniform sheet after a slight pause in the sedimentation following the Upper Mississagi. Conditions of sedimentation and the source of the material were probably similar to those for the Middle Mississagi Conglomerate, which it closely resembles. It may also be noted that these conglomerates are like the Ramsay Lake Conglomerate of the Sudbury area. The repetition of this lithologic type points to periodic rejuvenation of the source area. Lateral variations in thickness are not sufficiently pronounced to define the direction of transportation, other than indicating that land lay to the north.

### **ESPANOLA FORMATION**

Overlying the Bruce Conglomerate conformably is a series of limestones, mudstones, and dolomites. In the Quirke syncline it is possible to distinguish three units: a lower, characterized by limestone—the Bruce Limestone; a middle, dominantly siltstone—the Espanola Greywacke; and an upper, with a development of dolomite—the Espanola Limestone. However, elsewhere in the North Shore District, Collins (1925, p. 54) found that it was not possible to make the above distinction and, therefore, grouped the three units as the Espanola Formation.

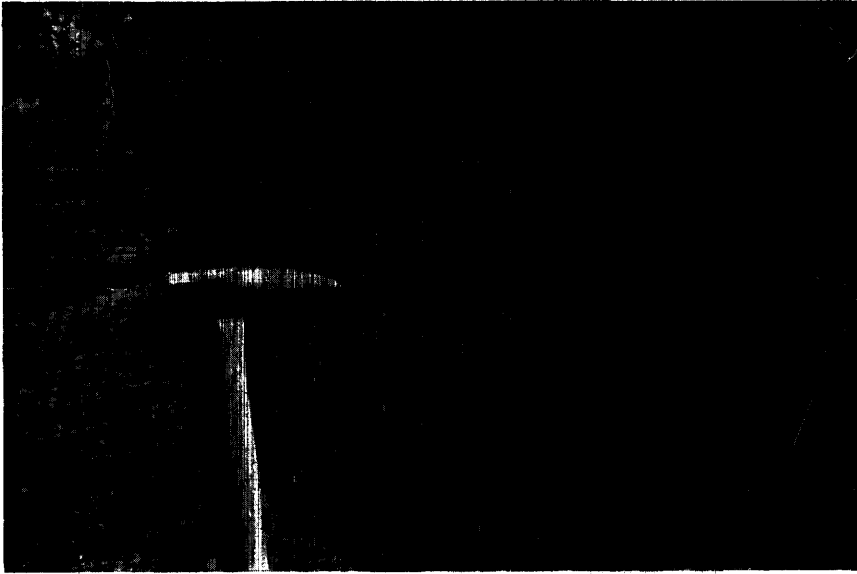
#### **Bruce Limestone**

The Bruce Limestone is exposed along the southwest shore of Kindle Lake and in an arc running south from the east end of Kindle Lake to the east of Rangers Lake and McCool Lake, to the west of Deresti Lake, and westwards from Deresti Lake to the township boundary  $1\frac{1}{2}$  miles north of Pecors Lake. The outcrop is repeated by faulting on the high ground to the west of the northwest arm of Whiskey Lake. Since the limestone is chemically unstable and mechanically soft, it is easily eroded. The outcrop area is generally marked by a prominent valley, and the rock is only exposed at the base of cliffs, where it is capped either by Espanola greywacke or by diabase.

The contact between the Bruce Conglomerate and the Bruce Limestone is not exposed in Townships 137 and 138, and only one drillhole, the Bracemac hole near the west end of Rangers Lake, penetrates the upper part of the Bruce Group. In this hole the Bruce Conglomerate passes upwards by diminution in size and number of pebbles into a medium-grained siliceous greywacke, thence into a calcareous siliceous greywacke, and finally into a finely laminated limestone siltstone sequence. Similar relations are seen north of Elliot Lake near the Stanleigh mine (Robertson 1961, p. 18).

The lower part of the Bruce Limestone consists of a thinly bedded series of limestones and siltstones. The limestone bands range in thickness up to 3-4 inches. Generally they are composed of fine- to medium-grained, recrystallized calcite showing decussate structure. Minor amounts of pale-green biotite,

chlorite, angular quartz grains, feldspar, and rare grains of magnetite and zircon are also present. Pyrite is found as disseminated cubes or irregular blebs. The siltstone bands alternate with the limestone but are generally thinner. In thin section these bands are seen to consist of pale-green biotite and chlorite oriented parallel to the band set in a calcite cement, which also contains rather more detrital quartz and feldspar grains than the limestone. Other bands less well developed than the other two consist of aggregate of detrital quartz grains in a calcite cement. These bands of differing composition have markedly different susceptibilities to weathering, and therefore on the weathered surface of the rock the siltstone and siliceous bands stand out (*see* accompanying photo).



Bruce limestone, west of Deresti Lake, Township 137.

On the north limb, in the Kindle Lake area, the limestone members in the lower 30 feet are slightly dolomitic. On the fresh surface these are pale bluish-grey, and on the weathered surface are pale-brown, probably due to oxidation of iron-bearing impurities.

In the upper half of the formation the limestone beds become more massive and purer. When weathered they are pale cream, but if fresh or in drill core they are white. The upper part of the Bruce Limestone is again characterized by finely-bedded alternations of cream-weathering, white limestone, calcareous siltstone, and siliceous limestone.

The Bruce Limestone is characterized by flowage folds; these indicate that the limestone has flowed away from the axis of the syncline (*see* accompanying photo).

On the limbs of the syncline the apparent stratigraphic thickness is 100-120 feet, but in the area west of Batty Lake it is reduced to 50-70 feet. This variation in thickness is probably due to flowage away from the compressed axial part of the syncline rather than to any variation in the original thickness of the deposit.

The grade of metamorphism is such that it is not possible to distinguish whether the bands are graded or what their bedding relationships are to each

## Geology of Townships 137 and 138

other. Elsewhere in the Quirke syncline ripple marks have been found on bedding planes, and graded bedding has been observed. It is probable that the Bruce Limestone formed by chemical precipitation in shallow water.



Intraformational conglomerate in Espanola Greywacke; Kindle Lake, at portage to Rangers Lake, Township 138.

### **Espanola Greywacke**

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

The Espanola Greywacke forms the ridge separating Kindle and Rangers lakes and is exposed in the lower part of a prominent scarp extending southwards from the east end of McCool Lake. In this scarp the greywacke is capped by a thick quartz diabase sill, but it is unlikely that this sill has replaced part of the greywacke sequence. From Deresti Lake to the west boundary of Township 137 the greywacke forms a scarp striking west. Throughout the area the Espanola Greywacke has a uniform thickness of about 250 feet. The lowermost 100 feet is made up of thinly-laminated siltstone and subgreywacke. Frequently these beds

were dislocated during or slightly after consolidation, so that intraformational breccias are common (Roscoe 1957, p. 11; Robertson 1961, p. 20). One such breccia exposed on the portage and on the creek between Rangers and Kindle lakes has, in addition to randomly oriented fragments of the greywacke, small cobbles and pebbles of white granite, chert, and quartz and thus may be regarded as a conglomerate rather than as an intraformational breccia (*see* photo opposite). No conglomerate dikes or quartzite attributed to earthquakes, as found in the other parts of the Quirke syncline, were observed (Collins 1925, pp. 53, 54. Robertson 1961, p. 20). The lower part of the sequence has only minor and sporadic calcite. Pyrite is scattered throughout.

The upper part of the sequence is rather more massive in character, the beds being subgreywacke rather than siltstone. Intraformational breccias are not



Mud cracks on bedding plane in Espanola Greywacke; north shore of Rangers Lake, Township 138.

common, but the bedding planes are occasionally seen to be ripple marked or mudcracked (*see* photo above), indicating that the rock is still of very shallow-water deposition.

In thin section the rock is seen to consist of a fine-grained aggregate of angular quartz and feldspar grains set in a matrix of chlorite and biotite with occasional flakes of muscovite. Scattered fragments of magnetite and zircon are also visible. Pyrite and secondary calcite are sporadic. In the intraformational breccias the fragments contain only a few detrital grains, which are small, whereas the matrix is coarser-grained and contains about 40 percent of detrital grains. Bedding in fragments can be seen, but there is no sign of this in the matrix, which under the microscope shows no structure. Plagioclase feldspar grains are absolutely fresh, indicating accumulation under conditions where chemical attack was at a minimum.

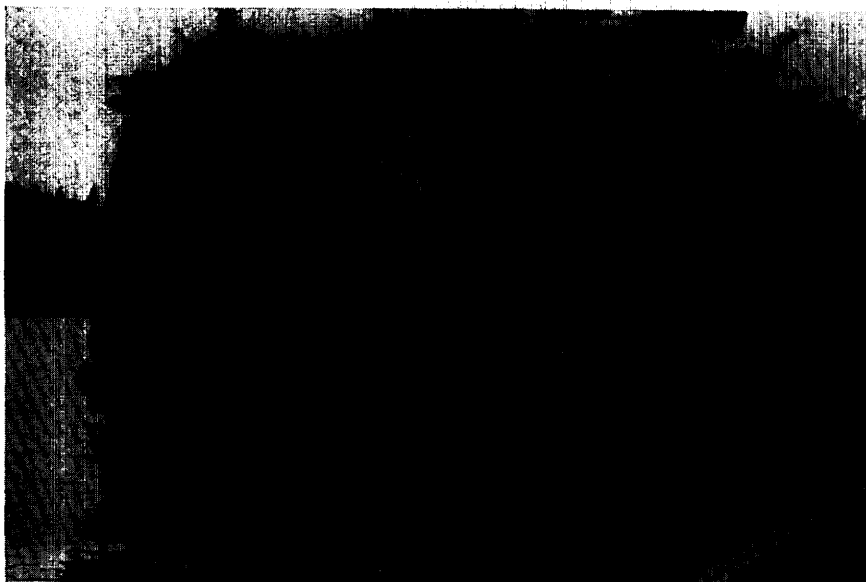
Thus the Espanola Greywacke accumulated in shallow water under conditions that were similar to those for the underlying Bruce Limestone, except that there was no longer a source of carbonate.

## Geology of Townships 137 and 138

### **Espanola Limestone**

The uppermost member of the Espanola Formation, the Espanola Limestone, is intermittently exposed: on the northeast shore and the islands of Rangers Lake; in a cliff extending from the east end of Rangers Lake to the east end of McCool Lake; and in an arc from the southeast bay of McCool Lake to the west boundary of Township 137, some 2 miles north of Pecors Lake. Throughout the area the Espanola Limestone is about 200 feet thick; in the area south of McCool Lake it is rather less, but this may be due to partial assimilation by a diabase sill rather than to variation in the original thickness of the unit.

The Espanola Limestone is characterized by the presence of beds up to 2 feet thick of fine-grained, rusty-weathering, ferruginous dolomite interbedded with siltstone, calcareous siltstone, and occasional thin bands of limestone. The



Espanola limestone (dark bands are ferruginous dolomite); larger island in central Rangers Lake, Township 138.

unit can only be distinguished from the underlying Espanola Greywacke by the presence of these brown bands. At the base they may be only  $\frac{1}{2}$  inch thick, and consequently where outcrop is poor it is difficult to place the contact of the two units. On the south limb of the syncline about 1 mile east of the Townships 143-137 boundary, Collins shows the Serpent Quartzite cutting out the Espanola Limestone and from that point to the southeast bay of McCool Lake lying directly on the Espanola Greywacke. Collins probably failed to recognize the thin dolomitic bands on poorly exposed outcrops. In weathered drill core it is possible to recognize the dolomitic bands by an olive-green colour that develops, but in fresh core it is difficult to distinguish them. As these bands of differing composition react differently during weathering, the rock develops an etched surface, the dolomitic bands being recessed. (See accompanying photo). On the weathered surface individual clastic grains stand out, and where thin layers rich in such grains occur, minor ridges develop.

In thin section the rock is seen to consist of small angular grains of quartz, microcline, plagioclase, minor shreds and flakes of green biotite and muscovite, and occasional grains of magnetite, zircon, and possibly apatite, in a very fine-grained, equigranular, brownish carbonate groundmass. As the rock shows very little action to acid, the carbonate is probably ferruginous dolomite. The feldspars are fresh, indicating no chemical attack. Pyrite is also present but not to any greater extent than in the adjacent greywacke. Collins suggested that the brown weathering was partially due to the oxidation of pyrite, which he claimed was more common in the limestones than in the greywackes. However this brown weathering is uniform in the bands and is more probably derived from the dolomitic base.

Locally the brown bands are disrupted and pass into breccias consisting of angular blocks up to 9 inches across set in a siltstone matrix. Elsewhere in the Quirke syncline, mud cracks and dessication breccias have been recognized, showing that the unit was deposited in very shallow water.

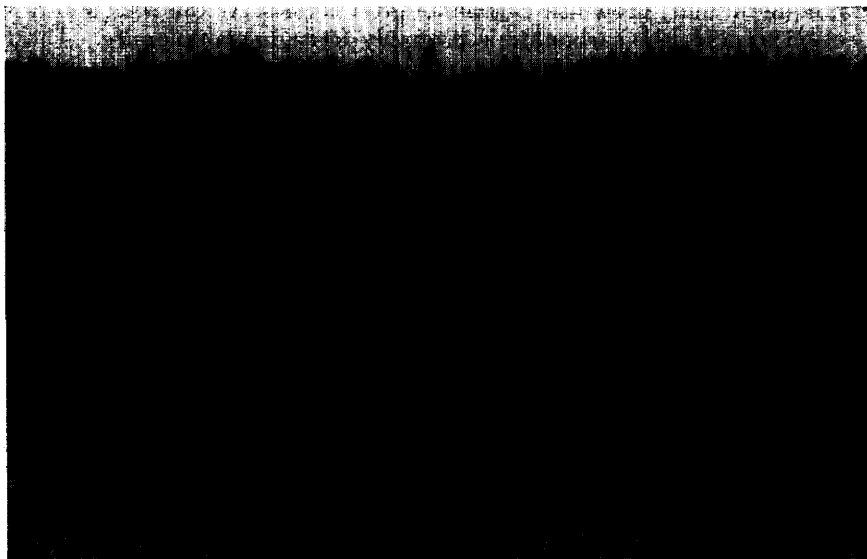
### **SERPENT FORMATION**

#### **Serpent Quartzite**

The Espanola Limestone is followed by a series of massive white quartzites and feldspathic quartzites; these were first described by Collins from the Quirke Lake area and were named the Serpent Quartzite (Collins 1925, p. 55.) The Serpent Quartzite, particularly the upper part of the formation, is a good scarp former (*see* photo, page 40, top). The Serpent Quartzite is exposed: at the west end, along the southwest shore, and at the east end of Rangers Lake; around McCool Lake; and in an arc from the southeast bay of McCool Lake to the Townships 137-143 boundary, 2 miles north of Pecors Lake. Near Rangers Lake the Serpent Formation is about 700 feet thick, to the south of McCool about 800 feet, but towards the township line it is reduced to 450 feet. It is believed that this variation in thickness, especially along the south limb, is due to folding and erosion prior to the deposition of the Gowganda Formation of the Cobalt Group (Robertson 1961, p. 24).

The Espanola Limestone passes upwards in a few feet through calcareous siltstone and impure quartzite into a well-bedded, cross-laminated, quartz greywacke. Alternate laminae are characterized by coarser grain and calcareous cement respectively. The coarser laminae are thinner than the finer grained, more calcareous bands. The calcite cement dissolves on weathering, giving the rock a characteristic surface. (*See* photo, page 40, bottom.) The grains consist of quartz, microcline, perthite, plagioclase, occasional titaniferous magnetite, zircon, monazite, muscovite, chloritized biotite, and hematite, set in a matrix of clay-minerals, chlorite, and calcite. In general, the quartz is only slightly strained, but some larger grains show the mosaic structure characteristic of quartz derived from metamorphic rocks. Simony (1958, pp. 54, 55), from a study of the elongation quotient of quartz grains from the Serpent Quartzite in the Quirke Lake area, has suggested that the grains were derived from a granitic rather than from a gneissic rock. The feldspar grains are normally fresh, but the plagioclase grains may be slightly altered. The plagioclases range in composition from albite to oligoclase. Occasionally the feldspar grains have the twin lamellae bent, or the grains have been fractured and recemented. Plagioclase is more abundant than the potash feldspars; of the latter, microcline exceeds perthite and orthoclase. The feldspars and the heavy mineral assemblage are similar to those of the grey phases of the Algoman complex. Pyrite is scattered throughout and is also found in irregular fractures and replacing quartz grains and is thus secondary.

## Geology of Townships 137 and 138



Serpent Quartzite (white) unconformably overlain by Gowganda Formation (dark-grey, top left only); west end of Rangers Lake, Township 138. Note anticlinal roll in the bedding.



Laminated calcareous lower Serpent quartzite; east end of Rangers Lake, Township 138.

In Townships 143 and 144 the laminated lower Serpent is followed by a gritty arkosic band which, in that area, could be used as a marker horizon (Robertson 1961, p. 22). At the west end of Rangers Lake (Township 138) the gritty arkosic quartzite is poorly defined, and it was not found on the south limb.

The upper part of the Serpent Formation consists essentially of massive quartzite and feldspathic quartzite. Normally both varieties are white, grey-weathering, medium-grained, well-sorted, and with a silica cement. Locally, however, there are bands of a dirty-grey, green-weathering siltstone up to 2 feet thick. These silty bands may be either massive or brecciated. Pink-weathering, grey, silty quartzite with hematite is found near the top of the sequence. Laminated quartzites similar to those of the lower Serpent are not entirely absent.

The typical upper Serpent quartzite is seen in thin section to be made up of an aggregate of fine- to medium-grained, well-sorted, subangular, subrounded quartz and angular, subangular, altered plagioclase in a dusty siliceous cement. The quartz is predominantly of igneous origin though a few grains are of metamorphic origin. The grains are characterized by silica overgrowths, and the boundaries are defined by dusty inclusions. Iron oxides form the most important accessories.

The presence of small-amplitude ripple marks, mud cracks, and the cross-lamination (*see* photo, page 40, bottom) points to deposition in shallow water. The persistence of acid plagioclase indicates a cold climate, and the abundance suggests a probable derivation from the grey phase of the Algoman complex. Crossbedding determinations indicate a principal direction of sedimentation of approximately S.5°E. The dips of the foreset beds range 10°–25° and are thus rather less than those of the Mississagi Quartzite.

The Serpent Quartzite can be distinguished from those of the Mississagi Formation by the presence of appreciable plagioclase, by the green brecciated siltstone bands, by planar shallow-angled crossbedding, shallow-amplitude ripples and mud cracks, and by a lack of scattered quartz and chert pebbles.

### **Cobalt Group**

The Bruce Group is followed unconformably by the Cobalt Group. This consists of a basal heterogeneous assemblage of conglomerates, greywackes, siltstones, and quartzites—the Gowganda Formation—followed by white quartzites characterized by quartz jasper pebble bands—the Lorrain Quartzite—followed by a Banded Cherty Quartzite, and finally by an Upper White Quartzite and Cherty Quartzite. In Townships 137 and 138 only the Gowganda Formation is exposed, although boulders derived from the Lorrain are common in the drift deposits.

### **GOWGANDA FORMATION**

Within the Blind River area the Gowganda Formation is seen to rest on all formations in the Bruce Group, from the Bruce Conglomerate to the Serpent Quartzite. Generally the contact is sharp, and the basal members are seen to truncate the bedding of the Bruce Group and occasionally to contain material derived from them; but in the Quirke syncline there are places, notably in Township 150 and in the central parts of Townships 143 and 144, where the basal part of the Gowganda Formation and the upper part of the Serpent Quartzite are lithologically very similar, making it difficult to place the contact precisely. However, within Townships 137 and 138 the contact is sharp, and there is no doubt of the unconformable relationship (Collins 1925, p. 72; Robertson 1961, p. 27).

## Geology of Townships 137 and 138

Considerable variation in the thickness of the Serpent Formation in the above-mentioned areas and changes in dip suggest that there was a period of gentle folding and erosion between the deposition of the Serpent Formation and that of the Gowganda Formation.

The Gowganda Formation is exposed south of Rangers Lake, in southwest Township 138, and in the vicinity of Corner, McCool, Clayton, and Grimard lakes in northwest Township 137. Since much of the Gowganda Formation has been removed by erosion, the total thickness of the formation within the map-area cannot be determined; the maximum thickness obtained is about 1,000 feet in the vicinity of Corner Lake. Within the area mapped, the Gowganda Formation is made up of boulder greywacke conglomerate with lenses of pink quartzite; the latter are discontinuous, and there are no reliable marker horizons present.



Gowganda conglomerate; near Ouellette Lake, Township 144. (This photo first appeared in Ontario Department of Mines Geological Report No. 4, 1961.)

The conglomerates are variable, but typically they consist of boulders and cobbles of red granite, gneiss, diabase, and greenstone; pebbles of the same materials plus quartz, chert, jasper, and siltstone; and fragments of quartz and red feldspar scattered through a fine- to medium-grained, dark-green to black, greywacke matrix with disseminated pyrite (*see* accompanying photo). The granite boulders, which are the most numerous type, have the same petrological and chemical features as the red granite (quartz monzonite) phase of the Algonian basement, from which they were probably derived. These boulders range in size from a few inches to 3-4 feet. Generally the sorting is very poor, but occasional beds of gravel conglomerate, particularly near the base of the formation, show both good sorting and rounding of the pebbles. These gravel beds are not more than 5 feet thick.

The matrix consists of poorly-sorted, angular to subangular grains of quartz, plagioclase, and microcline, in a groundmass of silica, chlorite shreds, magnetite, and iron oxide. The feldspars are slightly altered to clay-minerals. The matrix may show some slight lamination; where the rock has a cleavage the intersection

of the cleavage and the lamination allow the rock to disintegrate into triangular "pencils."

The greywacke matrix of the conglomerate has weathered more rapidly than the siliceous pebbles, which thus stand out above the general surface of the rock. The matrix may be delicately banded, each band showing a vertical gradation from medium to fine grain. These bands are seen to be cut or depressed by the pebbles and to be attenuated over the pebbles; this indicates that the pebbles were dropped into the sediments before consolidation had taken place. It is probable that such pebbles had been ice-rafted. Elsewhere this lamination is very indistinct or is lacking. The massive unsorted and unlaminated beds may represent tillite; Collins (1925, p. 73) and Coleman believed that only glacial deposition could account for the unsorted character of much of the Gowganda Formation. They also believed that the presence of striated, faceted, or soled pebbles and boulders was an indication of glacial origin. However, recently it has been suggested that such criteria are not diagnostic and could also be indicative of mud flows or turbidity currents.

In the lower part of the sequence there are a few lenses of pink-weathering, grey, fine- to medium-grained, impure, feldspathic quartzite. These lenses or beds are less than 2 feet thick and cannot be traced laterally for more than a few yards.

In thin section the quartzite is seen to be composed of recrystallized quartz with up to 30 percent of acid plagioclase (altered albite-oligoclase) and microcline. The matrix consists of silica and iron oxide. Accessory minerals are magnetite, hematite, muscovite, and zircon. The hematite in the feldspar and the matrix is responsible for the pink-weathering of the rock.

In the upper part of the Gowganda Formation such quartzite beds become thicker, more persistent, and more numerous. (Collins 1925, p. 67; Robertson 1961, p. 26). No cross-stratification was recorded in them, and no other information is available on the direction of sedimentation of the Cobalt Group in the Blind River area. However, it was probably derived from the area to the north and west, and the character of the boulders suggests that they were transported only a short distance. The whole formation accumulated under glacial or sub-glacial conditions.

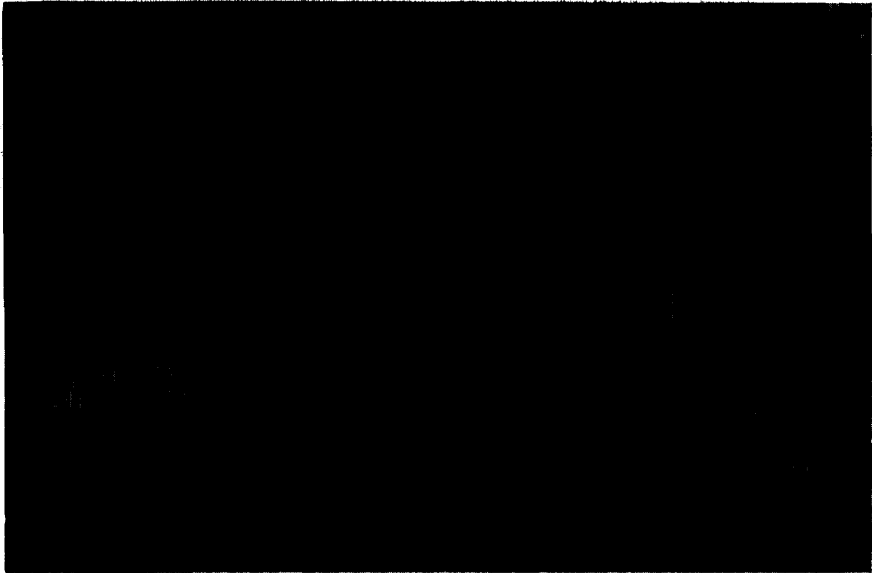
### KEWEENAWAN

The youngest rocks exposed in the area are intrusions of quartz diabase, quartz gabbro, diorite, gabbro, and lamprophyre, all of which are correlated with the Keweenawan or Nipissing diabase. No olivine diabase intrusions, the last stage of Keweenawan igneous activity in the North Shore of Lake Huron area (Collins 1925, pp. 82-86; Moore and Armstrong 1945, p. 13), were identified in the field, although in thin section pseudomorphs of serpentine after olivine have been recognized.

The diabase is found either as near-vertical dikes (*see* photo on page 44, top) or as flat-lying, sill-like bodies striking parallel to the bedding of the sediments and with a dip either parallel to that of the sediments or only slightly greater. The sill-like bodies are differentiated and show considerable variation in lithology and in the alteration effects on the country rock, whereas the dike rocks show little variation and have little effect on the adjacent rock.

The dikes range in thickness from a few feet to 150 feet and trend predominantly northwest-southeast, east-west and, in the northern part of Township 138, north-south. These are the same directions as characterize Townships 143

Geology of Townships 137 and 138



**Diabase dike cutting granite; 1 mile west of the northeast corner of Township 138.**



**Diabase dike filling fracture in diabase sill; west of Batty Lake, Township 137.**

and 144 and the Blind River area as a whole (Robertson 1961, p. 28; 1960, pp. 175-78). There is no apparent lithological distinction between dikes of the different directions, and in a number of localities, particularly in Township 138, dikes were observed to swing from one trend to another or to bifurcate—the two branches following different trends. Occasionally one dike may be seen to cut another, but in these conditions there is no consistent set of cutting relationships. Thus the dikes were probably intruded at more or less the same time and from the same magma.

The relationship of the sills to the dikes has not been fully established. Formerly it was considered that the sills were intruded at the same time as the dikes, which may have acted as feeders for the sills (Robertson 1961, p. 28). In the central Whiskey—south Batty lakes area of Township 137, a number of lineaments known to represent dikes are seen, on the air photographs, to continue uninterrupted through the outcrop of the sills, but in the region of the sills themselves it was not possible to prove the existence of later dikes. On structural grounds there is some evidence that the intrusion of the sill-like bodies took place either prior to or during the formation of the syncline, and that the dikes were formed later than the main folding. Moreover, later dikes and dikelets have been observed in sills east of Whiskey and McCool lakes (*see* photo on page 44, bottom). It has therefore been tentatively concluded that the intrusions of diabase took place in several stages, and that the earlier stages were characterized by sills and the later stages by dikes.

The dikes have chilled margins often chloritized and characterized by secondary calcite and quartz. The contact areas are sometimes sheared, indicating that some faulting took place after the intrusion and consolidation of the diabase. Characteristically the central parts of the dikes consist of pale-brown augite plus pigeonite, and labradorite showing ophitic texture. The labradorite crystals are normally zoned, the composition of the cores being  $An_{70}$  and that of the margins about  $An_{20}$ . The pyroxene may show coronas of clinoenstatite. Accessory minerals are magnetite, apatite, red-brown biotite, pale-green interstitial chlorite, pyrite, pyrrhotite, and chalcopyrite. Quartz and granophyric intergrowth of quartz with sodic plagioclase may be present. In one dike, exposed on the shore of Whiskey Lake west of the island off Shelter Point, pseudomorphs of yellow-green serpentine after olivine were found.

A number of differentiated diabase sills are exposed. The most important of these are:

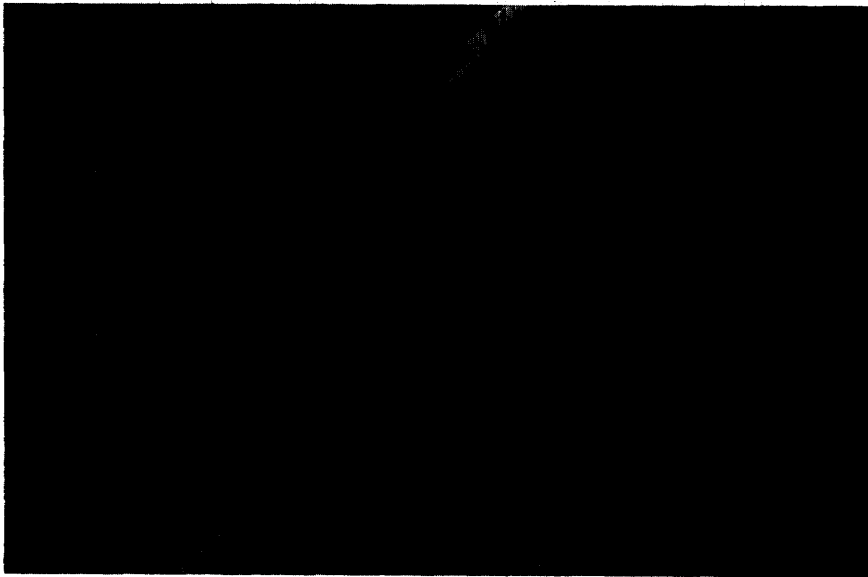
- 1) From the southeast end of McCool Lake, extending in an arc to the east of Clayton Lake and along the north edge of the Picton Uranium Mines' property in Township 137.
- 2) From the north end of Corner Lake to the east end of Rangers Lake, across the narrows at the east end of Kindle Lake to the northwest end of Batty Lake and probably continued on the southeast shore of the lake, swinging westwards and splitting near the west end of the lake. The main part of the sill, called the Lake Nordic diabase, has been traced across Township 143 (Robertson 1961, p. 28) and Township 149 (Abraham 1956).
- 3) From the south shore of Nook Lake to the west end of Kindle Lake, between Kindle and Whiskey lakes, along the south shore of the northwest arm of Whiskey Lake and also in the islands and on the southeast shore of the lake, swinging westwards to the west shore and thence along the valley of the Serpent River to the east end of Pecors Lake, whence it has been traced along the south boundary of Townships 143 and 149 (Robertson 1961, p. 28; Collins 1925, map).

## Geology of Townships 137 and 138

- 4) From the northeast corner of Township 138, striking southeast along the southwest shore of Wiggly Lake to the east shore of Trap Lake and probably dying out about  $1\frac{1}{2}$  miles southeast of Trap Lake.

It may be noted that the regional distribution of sill-like diabase masses is generally concordant with the lower members of the Huronian near the axis of the syncline and is higher in the sequence near the axis of the southerly anticline (Collins 1925, map).

In the field it can be seen that these masses have certain features in common. They are massive and resistant and form well-defined scarps. The contacts are fine-grained and frequently chloritized, and less frequently albitized. The lower parts are black and weather slightly rusty. They consist of brown augite and labradorite showing ophitic texture. The central parts and much of the upper



Coarse-grained diabase (quartz diabase phase); northwest arm of Whiskey Lake, Township 138. Note dioritic segregations characterized by acicular hornblende crystals.

part consist of quartz-hornblende diorite, the principal constituents of which are hornblende and intermediate plagioclase, with quartz and sulphides also visible in hand specimen. The upper parts may again contain much pyroxene. In thin section there is little difference between the lower pyroxene phase of the sills and the dike rocks already referred to. Sections from drillholes west of the north end of Batty Lake show serpentine, pseudomorphs after a magnesium-rich olivine. In addition to augite, which is the principal ferromagnesian mineral, pigeonite and chlorite may also be present. Alteration to, and reaction rims of, clinostastite and tremolite are visible, particularly in the transition zone between the pyroxene and the amphibole phases. The feldspars become more sodic and are strongly zoned from bytownite to oligoclase. Interstitial quartz and a myrmekitic intergrowth of quartz and sodic plagioclase are present. Flakes of red-brown mica, possibly phlogopite, skeletal magnetite, and apatite are the characteristic accessories. Secondary calcite and chlorite may or may not be present. Pyrite and chalcopryrite are scattered throughout and locally are sufficiently important to be

regarded as principal constituents of the rock. The upper pyroxene phase is considerably altered, and the upper contact area is strongly chloritized and permeated with calcite.

No granophyre ("red rock"), the normal end stage of Keweenawan differentiation (Collins 1913, p. 95; 1925, pp. 77-82; Bowen 1910, pp. 658-74) was observed within Townships 137 and 138, although it has been observed elsewhere in the Blind River Area (Robertson 1961, p. 29; 1956, p. 55).

The sills and some of the adjacent rocks are cut by medium-grained dikes of biotite-rich lamprophyre and by albitic stringers, or have been albitized. The lamprophyres are best seen in core, because on surface they yield readily to weathering and become obscured. Comparatively little is known of their actual distribution, but it seems that they are more common close to the axis of the syncline and are best developed either within the sills themselves or in argillite where that rock is in juxtaposition with the diabase.

Under the microscope the lamprophyre is seen to consist of reddish to colourless mica, probably phlogopite, set in a groundmass of mica, calcite, melilite, minor plagioclase, and traces of apatite, magnetite, and other unidentified iron oxides.

Pink albite stringers, both with or without epidote, are also found. The quartzite above the sill in the southeastern part of Whiskey Lake, e.g., on the island off Shelter Point, shows zones of strong pink discoloration, and in core it is seen that these are more numerous and better developed close to the contact with the sill. On the Vite Uranium Mines' property north and west of the north end of Batty Lake, quartzite and argillite above a diabase sill have been recrystallized and strongly albitized or adinolized. At first sight the product resembles an igneous rock, but closer examination reveals the original sedimentary structures such as bedding and crossbedding. In the same area the upper part of the sill has been altered to albitic feldspar and chlorite. The feldspars have corroded boundaries, and only the distribution of the chlorite reveals the original ophitic texture.

There is also considerable development of sulphides, chiefly pyrite and chalcopyrite. These are present both disseminated and filling fractures in the diabase and the sediments. The other copper showings of the Whiskey Lake and McCool Lake areas are also characterized by close association with diabase and by the abundance of secondary quartz. Thus the end-stage fluids were rich in sulphides and albite, and these migrated through the diabase itself and through the country rock, probably becoming more siliceous in character. The quartz-gold vein on the Peyton Prospect west of Whiskey Lake, and the numerous quartz veins developed in the argillite on the west shore of central Whiskey Lake, were attributed by Douglas (1926, p. 44) to the migrating fluids derived from the diabase intrusions. On Campbell Island a galena-chalcopyrite-quartz-calcite vein in diabase may also have resulted from hydrothermal solutions derived from the diabase. There is no evidence within the area of the effect of the hydrothermal fluids on uranium-bearing conglomerate.

The complete lack of uranium mineralization associated with the albitization and the quartz-sulphide deposits indicates that hydrothermal solutions derived from post-Huronian diabase were not the source of the uranium mineralization.

The albitization and the deposition of sulphides are most marked close to the axis of the syncline. It is suggested that the sodic solutions and the ferromagnesian-rich lamprophyric magmas represented diaschistic magmas formed from the residual diabasic magma, and that their distribution close to the axis of the

syncline indicates that the intrusion and the consolidation of the diabase had taken place largely prior to the folding or during an early stage of it; it is further suggested that the folding opened fissures and channelways into which the differentiated end-stage fluids could permeate and consolidate.

### STRUCTURAL GEOLOGY

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

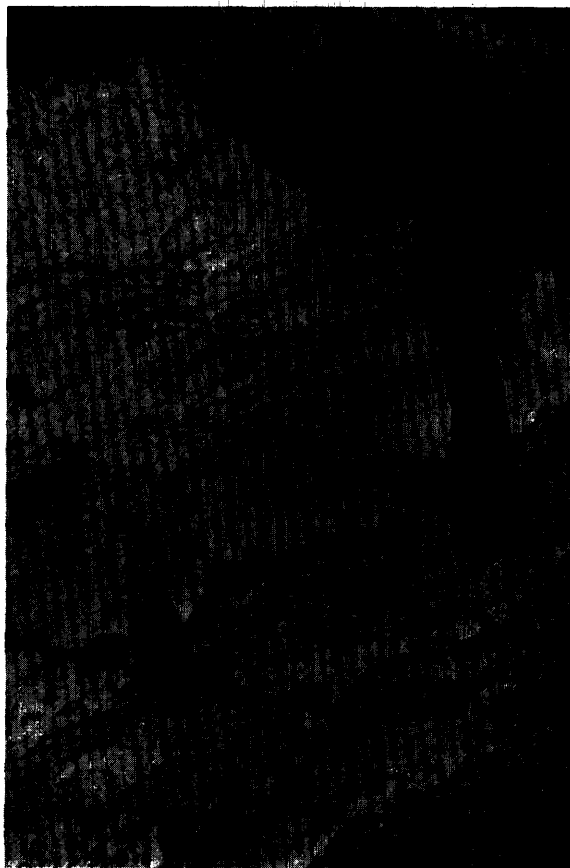
- 1) The major fold—The Quirke syncline.
- 2) Minor folds.
- 3) Joints.
- 4) Faults—thrust faults cutting the bedding at low angles.  
—vertical or near-vertical faults.
- 5) Diabase dikes.
- 6) Diabase sills.

#### 1. Quirke Syncline

The major structural feature of the area is the Quirke syncline, the nose of which is well exposed in the central parts of Townships 137 and 138. The axis of the syncline strikes at N.80°W. across Township 137, from the south end of Corner Lake in the northwestern part of the township through north-central Batty Lake, and Anticline Point on the west shore of Whiskey Lake.

The Huronian strata exposed within the syncline strike parallel to the Serpent River drainage system. The dips on the north limb in the Kindle Lake-Rangers Lake area are 20°–55°S. with a characteristic value of 30°–35°S. On the south limb west of Whiskey and Batty lakes the dips are 15°–45°N. with the typical values close to 20°N. The fold is thus slightly asymmetrical. Where the beds strike normal to the strike of the axial plane of the folds, the dip of the beds is also the plunge of the fold. Thus at Whiskey Lake the axis plunges 28°W.; at the west side of Batty Lake, 25°; at a small lake 1 mile to the west, 18°; and at Corner Lake, 15°. Therefore the fold is an asymmetric syncline plunging westwards at a rapidly decreasing angle. Immediately west of Corner Lake the axis is deflected northward, and near Halfmoon Lake in Township 144 there is a local roll in the axis, and to the west of that lake the axis resumes its strike at N.80°W. and plunges at about 1½°W. It may be noted that in the Batty Lake and Whiskey Lake areas there is duplication of the Middle Mississagi by thrust-faults on the westward side of sill-like diabase intrusions. It may be that the steepening in the plunge of the axis is partly due to the thrusting against the diabase. These figures are in general agreement with those of previous authors. Collins describes the structure as a “. . . shallow syncline which widens and pitches westward at an angle of 2 to 5 degrees. The nose on Whiskey Lake is tilted up more steeply. This fold . . . is slightly asymmetrical. Its northern limb dips 25 to 40 degrees, and the southern one 15 to 30 degrees.” (Collins 1925, p. 101.) Hart *et al.* (1955, p. 262) give 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°E; Pecors Lake, 25°N; Algom Nordic mine, 18°N. They state: “Thus the apparent synclinal axis is a curving east-west line lying closer to the north limb than to the south limb. The synclinal axis appears to plunge west at about 5°.” These figures are also in agreement with those determined in Townships 144 and 143 and predictions made therefrom. (Robertson 1961, pp. 29, 30.)

At a number of localities on both limbs, lineations striking normal to the axis of the syncline have been observed on bedding planes. At one locality on Kindle Lake a bedding plane in Mississagi quartzite is coated with secondary quartz, which shows this lineation (*a*-lineation) and also a crenulation parallel to the axis of the syncline (*b*-crenulation) (*see* accompanying photo). The crenulations have the form of small-scale dragfolds "climbing out" of the syncline. The



Quartz-coated bedding-plane on Upper Mississagi quartzite; north shore of Kindle Lake, Township 138. Note *a*-lineation and *b*-crenulation.

presence of these lineations indicates that the fold formed as the result of north-south compression, and that the upper beds moved upwards and outwards over the lower. This type of folding is termed "pack of cards" folding.

## 2. Minor Folds

Minor folds are common within the area. These are of two general classes: those that affect several stratigraphical units, and those that are confined to a single stratigraphical unit, which is more incompetent than its neighbours.

In the northern and central parts of Township 137 there are a number of gentle anticlines and synclines with an amplitude of up to 200 feet, which strike

## Geology of Townships 137 and 138

parallel or subparallel to the major synclinal axis and which plunge westward at similar angles (*see* Quirke Syncline structure map, in map case). These minor folds represent gentle corrugations within the axial area of the syncline and are probably congruent to the main fold. The sulphide-gold-quartz veins of the area are emplaced along bedding planes and fractures in the axial areas of these folds.



Cleaved and sheared Middle Mississagi argillite, with secondary quartz on limbs and crests of dragfolds; Whiskey Lake, Township 137.

The argillite-greywacke sequence of the Middle Mississagi in the general axial-plane area of the syncline shows a development of dragfolds and of small-scale symmetrical anticlines and synclines in addition to the rather larger features already mentioned. The dragfolds (*see* accompanying photo) plunge parallel to the axis of the syncline and are frequently filled with secondary quartz. The symmetrical folds also plunge parallel to the major axis.

The Bruce Limestone is characterized by the presence of small-scale dragfolds (*see* photo p. 35). These folds are characterized by the following features: the general strike is parallel to that of the bed as a whole; the plunge is parallel to that of the synclinal axis; the upper limb has moved upwards and outwards from the synclinal axis; the limbs are attenuated and the crests swollen; and an axial-

plane cleavage may be present. These folds are evidently dragfolds caused by differential movement parallel to the bedding during the formation of the syncline.

The Espanola Limestone, wherever exposed, is buckled into folds of small amplitude and relatively long wavelength, and the principal axial planes of these folds strike parallel to the plane of the regional bedding, and dip perpendicular to it. The folds in the Espanola Limestone are more open and less conspicuous than those observed in Townships 143 and 144 (Robertson 1961, pp. 31, 32).

Once again these folds are caused by the dragging action of more competent beds on well-bedded, relatively incompetent beds.

Thus the small-scale and minor folds are apparently congruent with the major fold, and point to a north-south compression as the formative force.

### **3. Joints**

Attitudes of joints and small-scale faults were recorded at a number of localities in Township 138 and in the areas of better exposure in Township 137.

The following generalizations can be made concerning these joints and minor fault fractures:

- 1) In the sedimentary rocks, particularly in the quartzites and conglomerates, the joints are perpendicular to and parallel to the bedding.
- 2) In diabase dikes and sills the best-developed joints are perpendicular to and parallel to the contacts with the country rock.
- 3) Jointing is well-developed, particularly in the more siliceous rocks close to faults and diabase intrusives.
- 4) Drainage is very largely controlled by the joint pattern.
- 5) The whole area is characterized by vertical or near-vertical joints, which strike north, northeast, east, and southeast. Small-scale faults with a displacement of up to a few inches indicate that the northeast and southeast faults and joints are shear directions probably related to a north-south compressive force. In the granites of Township 138 there are quartz veins of uncertain age in both northeast and east directions.
- 6) Joints with the above-mentioned strike and character can be seen in the diabase sills and possibly in some of the dikes.

There are thus two general joint systems in the area, one being a normal and bedding-plane system and the other a vertical system indicative of a north-south compressive force, which is at least partially post-diabase in age.

### **4. Faults**

A number of faults enter or are contained entirely within the area. These are less numerous than those in the areas to the west but are of the same pattern. The faults may be divided into two types:

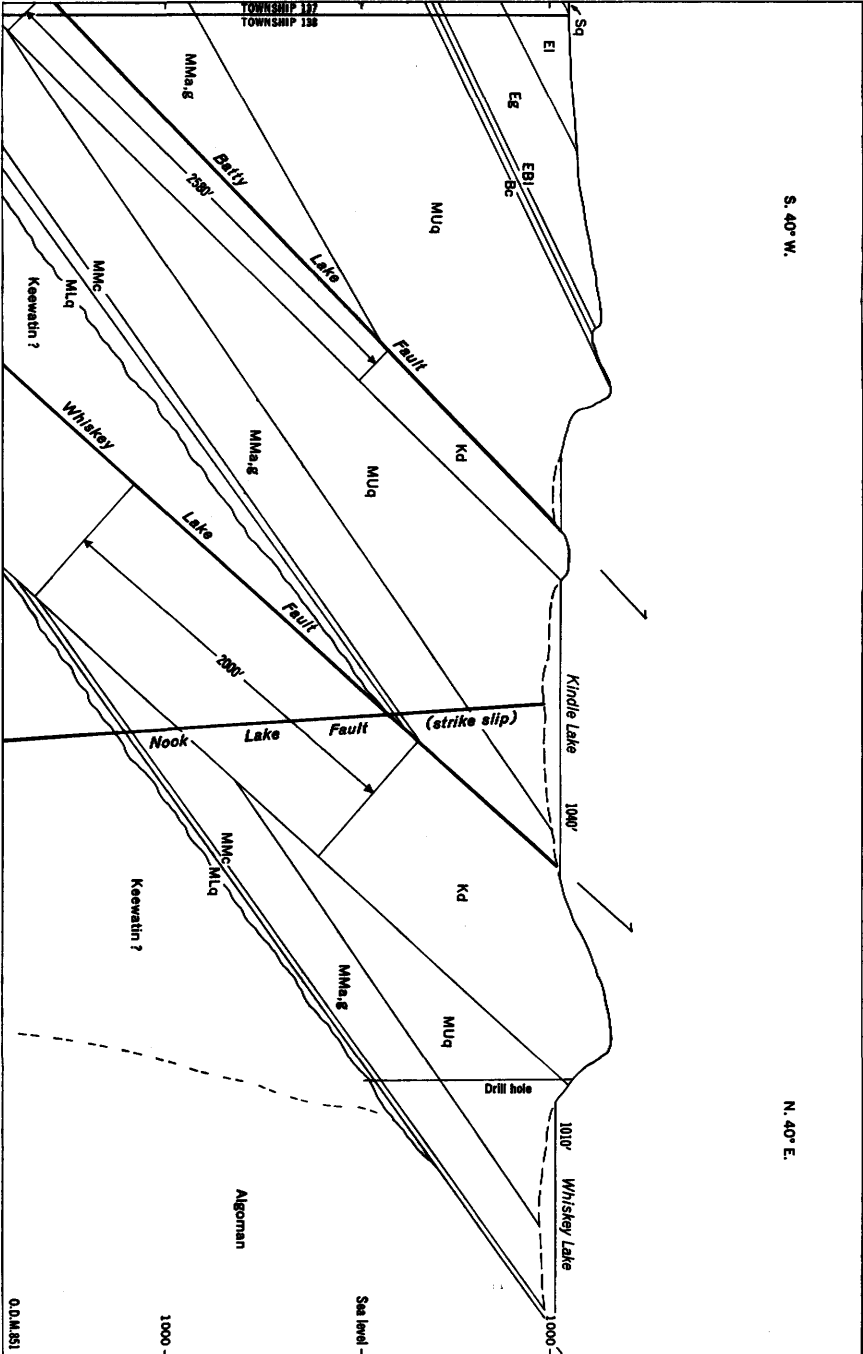
- 1) Thrust faults closely associated spatially with the diabase sills.
- 2) Vertical or near-vertical faults.

#### **Thrust Faults**

The Middle Mississagi conglomerate and argillite sequence is repeated on the south side of the diabase sill to the south of the northwest arm of Whiskey Lake; this repetition, measured along the upper surface of the diabase, is 2,000 feet more than that which would be caused by dilations corresponding to the

**LEGEND**

- Kd Keweenaw diabase and diorite intrusives.
- Sq Serpent quartzite.
- E1 Espanola limestone.
- Eg Espanola greywacke.
- EBI Bruce limestone.
- Bc Bruce conglomerate.
- MUq Upper Missisquoi quartzite.
- MMA,g Middle Missisquoi argillite and greywacke.
- MMC Middle Missisquoi conglomerate.
- MLq Lower Missisquoi quartzite.
- Algonan Algonan granitic rocks
- Keewatin? Basic pillow lavas with pyroclastics and sediments.



Vertical geological section from near the east end of McCool Lake to the northwest end of Whiskey Lake.

750-foot thickness of the sill (*see* section, opposite page). In the central Whiskey Lake area, although there is shearing and shattering in drill core, the lack of a suitable marker horizon in the Lower Mississagi Quartzite makes it impossible to define the extent of the movement. On the south limb drilling indicates movement of some 300 feet at drillhole P.W. 120; 600 feet at P.W. 119; and about 1,100 feet at P.W. 118. On both limbs the westward continuation of this fault is not clear. On the north limb this thrust is possibly equivalent to the Quirke thrust, which occupies a similar position in the structure. However, drilling in Township 144, between Conecho Point on Quirke Lake and the boundary between Townships 144 and 138, failed to indicate any faulting of this type (Robertson 1961, p. 33).

The Middle Mississagi is again repeated in an arc extending from the south-east end of Kindle Lake to the south end of Batty Lake. The net movement is about 2,750 feet and is on the dip slope of a sill-like diabase intrusion. On the east shore of Batty Lake, near the portage between Batty and Whiskey lakes, the fault is represented by at least two faults rather than by one single fault. On the north limb the sill swings westward across the southeast end of Rangers Lake and passes to the north of Corner Lake. The displacement on the associated fault apparently decreases westwards, and at the township boundary is probably very small. On the south limb the sill has been traced across Townships 143 and 149, and some movement above it has been postulated as far west as Flying Goose Lake on the west side of Township 143. (*See* Robertson 1961, maps and sections).

Both these faults conform to the trends of the syncline and are apparently cut by both vertical faults and by diabase dikes. It is considered that they formed during the continued folding of the syncline after the intrusion and consolidation of the diabase sills, the upper surface of which being slightly discordant provided a plane of weakness along which movement could take place.

### **Vertical Faults**

In Townships 137 and 138 vertical faults follow two trends, slightly south of east and southeast. 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 shattering or small-scale faulting in the adjacent beds.

### **East-Striking Faults**

Four faults were mapped in the area with a strike parallel or subparallel to that of the syncline. In addition, east-striking shear zones were observed in Keewatin(?) rocks on the east shore of Whiskey Lake. It was not possible to deduce the actual movement on these faults, though slickensiding on adjacent structures indicated that the final movement at least was horizontal with the north side east. However, elsewhere in the Quirke Lake area, east-west faults were mostly steeply dipping reversed faults with the south side up (Robertson 1961, pp. 37, 38; Roscoe 1957, p. 15). For faults north of the synclinal axis the two types of movement would result in the same configuration of the beds. Since the fault lineaments cross the more steeply dipping diabase sills without displacing their outcrop, it is probable that the main movement was vertical rather than horizontal.

The most important of these faults runs from the southeast bay of McCool Lake, across the head of Batty Lake, to Whiskey Lake a few chains north of the stream and portage from Batty Lake. The maximum throw appears to be about 250 feet between McCool and Batty lakes, but on the west shore of Whiskey Lake

## Geology of Townships 137 and 138

it is reduced to a few feet, and the lineament dies out in the greenstone on the east side of the lake. A second fault has been traced from Corner Lake along the north side of McCool Lake and runs slightly north of east to the southeast arm of Kindle Lake. The displacement on this fault is in the same sense as that on the first but is probably only about 50 feet.

A third fault was detected in the granitic basement about  $1\frac{3}{4}$  miles north of the southeast post of Township 138. Slickensides indicated that the north side had moved east but, as there are no reliable markers in the basement, it is not possible to determine the slip. A fourth fault strikes eastward from the southeast end of Pecors Lake, but again owing to the lack of satisfactory markers it was not possible to determine the movement. As this fault can only be traced for a short distance the slip is probably small.

In 1955 a prominent strike-slip fault (the Lake of the Mountains fault) was traced northeast from the Mississagi River where it crosses the Thompson-Cobden township boundary, through Lake of the Mountains to the northeast end of Lake Magog (Robertson 1956, p. 62: *also* maps P.68-73, 1960). An examination of aeromagnetic maps and air photographs indicates that this fault continues northeast to McGiverin Lake and then swings eastward to Trout Lake, thence slightly south of east forming the valley containing McCarthy and Bellows lakes in Deagle township (O.D.M. 1957, inset G). In the field, apart from topographic evidence, little indication of faulting was obtained, probably because the rocks on both sides of the valley are similar.

### **Southeast-Striking Faults**

Only two faults with this strike were observed within the area; one on the north limb and one on the south.

On the north limb the Nook Lake fault, recognized in the northeastern part of Township 144 (Robertson 1961, p. 36), has been traced along Kindle Lake, where it apparently defines the orientation of the lake, to the east end where it dies out. The fault is a strike-slip fault with right-hand displacement. The fault is vertical, and since it displaces diabase as well as Huronian sediments it is post-diabase in age.

A second fault with this strike was mapped in a lineament some  $\frac{3}{4}$  mile to the northeast of the east end of Pecors Lake. Vertical cleavage was observed in Lower Mississagi quartzite and basal greywacke conglomerate adjacent to this lineament, but it was not possible to determine the sense of the movement. Diamond-drilling in the vicinity indicates that there is little appreciable vertical separation of the strata on either side of the fault. It may be noted here that the southward deflection of the contact of the Lower Mississagi and the greenstone basement to the east of Pecors Lake is a reflection of a channel of deeper sedimentation during Mississagi time rather than a result of fault movement. The faulting in this area probably represents adjustment of the sediments to the basement topography during the folding. The relation of this fault to diabase is uncertain owing to the lack of satisfactory exposures. Other faults with this trend in the Quirke syncline tend to be post-diabase in age (Robertson 1961, p. 40).

### **Northeast-Striking Faults**

No northeast-striking faults have been identified within the Huronian sequence exposed in Townships 137 and 138, west of the Serpent River system, but four faults with this strike have been mapped in the Pre-Huronian basement

in Township 138: three to the east of the syncline in Township 137, three in the southwest corner of Township 137, and one in the basement complex of Deagle township.

A northeast-striking fault is exposed in the granite on Cognac Point on Whiskey Lake. Here the granite is strongly sheared and mylonitized over a width of 150 feet. The shearing dips at 50°SE., and the southeast side has moved northwest. The extent of the movement is not known, but it is believed to be pre-Huronian in age. The northwesterly extension of the fault beyond the east-striking fault in the area was not found.

A second fault with this strike was mapped to the northeast of the northeast corner of Trap Lake running to the east of a small pond on Wiggly Creek just east of the falls from Wiggly Lake. In this area there is considerable shattering of the country rock with introduction of secondary quartz. It was not possible to define the movement on this postulated fault. Linear valleys running northeast from the northeast bay of Kindle Lake and the northwest bay of Whiskey Lake may also represent faults.

In the southeastern part of Township 138 and at the east end of Kindle Lake there is evidence from small-scale vertical faults and joints that the northeast direction is one of left-hand strike-slip but that the system is not well developed. Southeast of Whiskey Lake there are three faults with this strike and apparent vertical dip. The movement is such that the northwest side is displaced upwards and southwards relative to the southeast. These faults strike parallel to the adjacent diabase and may indicate that some thrusting movement has taken place along the lower contact as well as the upper.

Teck Exploration Company Limited have also reported small-scale northeasterly-striking faults in the Keewatin(?) to the southeast of Pecors Lake.<sup>1</sup> These cut volcanics and iron formation, later Keewatin(?) diabase, and probably Keweenawan diabase. The apparent strike-slip is right-hand on one fault, left-hand on a second, and on the third has not been defined.

Thus the vertical faults have the same general characteristics as the faults recognized elsewhere in the Quirke syncline. They belong to three main trends: a northeasterly, left-hand, strike-slip set; an easterly set parallel to the axial plane of the syncline and probably representing an axial-plane cleavage with the south side up; and a southeasterly, right-hand, strike-slip set. These faults are post-diabase in age and were formed as the result of a north-south compression.

In Deagle township, a post-diabase, left-hand, strike-slip, northeasterly fault was traced for about a mile from the north shore of McCarthy Lake just east of the Deagle-Proctor township line. This movement is the same as that on the Lake of the Mountains fault, which here strikes slightly south of east. This fault is probably a second-order shear associated with the major fault (McKinstry 1953, pp. 401-14).

## 5. Diabase Dikes

The general nature of the diabase dikes has been described on pages 43-45. The diabase dikes are fairly uniform in thickness and are characterized by their rectilinearity, some of them being traced for as much as 5 miles. The dikes are concentrated into three groups, all of which are essentially vertical. These groups strike:

1. Slightly east of north.
2. Slightly south of east.
3. Southeast.

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<sup>1</sup>Unpublished company reports.

## Geology of Townships 137 and 138

Of these, the east and the southeast groups are the most important; the north group is rather better developed than in the adjacent townships, and there is some slight development of dikes with a northeast strike, but this is less well developed than elsewhere in the district. It may be noted that some dikes swing from one trend to another and that a dike may split, the two parts following different trends. More rarely, dikes may be observed to crosscut each other, but in these cases the evidence as to age relationships is conflicting. As indicated on page 45 there is some evidence that at least some of the diabase dikes are rather younger than the sills.

The dikes are best developed in the granitic basement of Township 138 and within the more siliceous (and thus more competent) members of the Huronian sequence. Normally, dikes in the greenstone basement of Township 137 were either not found, or not recognized owing to their similarity to the greenstone. In the hybrid and granitic rocks of Deagle township, diabase dikes, particularly those with a northwesterly trend, were mapped.

Thus it is concluded that the diabase dikes were intruded at essentially one period of time, and that they are generally later than the diabase sills. Since there is no evidence of replacement, they were intruded along sets of pre-existing joints and fractures.

### **6. Diabase Sills**

The distribution and petrology of the Keweenawan diabase sills has already been discussed (*see* pp. 45-48). As noted, there is some evidence that these sills are older than the dikes. The sills strike parallel to the sediments but in general have a slightly greater dip. They are differentiated and in the vicinity of the axis of the syncline are broken by faults. In the same area there are lamprophyres filling fractures in the diabase and in the adjacent sediments, particularly the argillites and greywackes of the Middle Mississagi. Near the contacts of the diabase, particularly the upper contacts, there is evidence of the passage of soda-rich hydrothermal solutions and of the mobilization of silica, which was deposited as quartz in the joints and fractures associated with faults and small-scale folds close to the axis of the syncline. These veins contain the known sulphide deposits and the only gold prospect in the area. It is believed that the diabase sills formed early in the folding, and that their distribution close to the base of the syncline was controlled by the development of dilational areas during the early stages of the folding. During the later stages, and after the consolidation of the greater part of the diabase magma, the residual magma was split and squeezed out, forming the lamprophyres and the acid hydrothermal solutions.

### **Summary of Structural History**

The history of the area may be summarized as follows and as shown on the idealized serial sections on pages 58, 59. The oldest exposed rocks are Keewatin(?) interbedded basic volcanics, pyroclastics, and sediments. These were mountain built and were caught up in large bodies of granites, which formed in the area. These granites consist of cores of relatively potash-rich massive red quartz monzonite, with few inclusions, surrounded by grey granodiorite gneiss with high soda content and abundant inclusions. The mountain area was subjected to subaerial denudation and reduced to a peneplane, on the surface of which residual soils were intermittently preserved. A valley formed over the greenstone belt as a whole, and deeper hollows formed over the less resistant members in particular. During the earlier Huronian, the region became one of deposition. Rivers flowing from the northwest deposited conglomerates and arkoses in the valleys

while the intervening ridges remained as land. Along with the siliceous material a suite of heavy minerals derived from the weathered basement complex were concentrated and deposited. These included thorium- and uranium-bearing minerals, derived both from the main body of the granite and from the pegmatites that formed above the granite intrusions but which were largely destroyed by erosion prior to the Huronian. The Huronian was a period of shallow-water accumulation, intermittently interrupted so that there was a series of cycles of sedimentation each grading from a relatively coarse basal to a fine-grained upper member. It is probable that much of the sedimentation took place under subglacial conditions.

A period of more prolonged interruption of sedimentation separates the Lower Huronian or Bruce Group from the Upper Huronian or Cobalt Group. Some folding and erosion took place during this interval. During the Upper Huronian, a sequence of conglomerates, greywackes, and thin quartzites accumulated, probably under glacial or subglacial conditions. Younger formations of quartzites and conglomerates found in adjacent areas may also have been deposited and later removed by erosion.

The district was then subjected to a north-south compression, and folding began about axes striking slightly south of east. Quartz diabase and diabase were intruded as sills and possibly dikes into the dilational areas of the folds. These differentiated and consolidated while compression continued. The end-stage fluids consisted of lamprophyres and soda-rich solutions possibly containing sulphides. These were intruded along and permeated outwards from fractures within the diabase itself and the adjacent rocks, particularly where there were small-scale folds developing congruently with the major fold. The diabase sills, when consolidated, became the locus of thrusting. On release of the compressive forces, the jointing and small-scale fault fractures that had developed during the compression (particularly in the more competent rocks) became the locus of intrusion of normal and quartz diabase dikes. Renewed compression in a north-south direction developed a series of faults with the same attitudes as the diabase dikes. There is no evidence within the area, or the adjacent areas, of Late Precambrian intrusive, potash-rich granite, as has been postulated by some earlier authors (Moore and Armstrong 1945; Harding 1950).

During the period of folding, the rocks became slightly metamorphosed, rising to the chlorite grade.

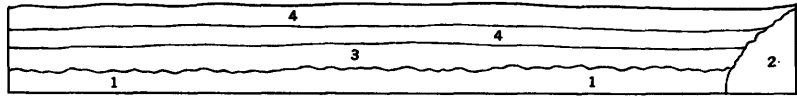
It may be noted here that, as uranium is relatively unstable in the presence of fluids, the uranium minerals could be reconstituted, both during diagenesis and during the metamorphism of the strata, and that the final product from this reconstitution would resemble that which would have been found had the uranium been introduced by externally derived hydrothermal solutions.

## **ECONOMIC GEOLOGY**

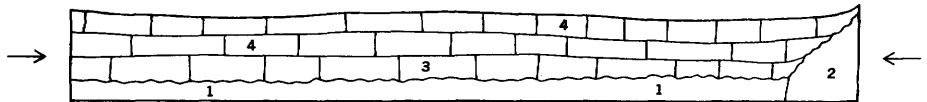
Although there are no mineral deposits being worked within the area, occurrences of copper, lead, gold, iron, and more recently uranium, have intermittently aroused interest among prospectors.

### **Uranium**

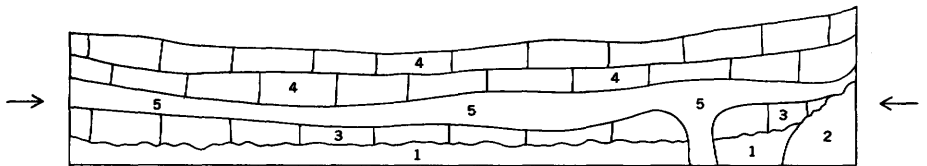
The map-area lies some 8 miles east of the main uranium-bearing reefs of the Elliot Lake mining camp. During the early development of that camp much of the ground in Townships 137 and 138 was staked, and exploratory and development work was carried out.



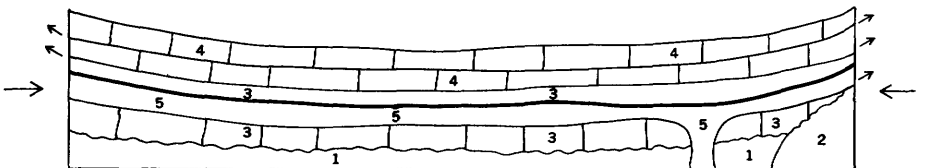
Deposition of horizontally-bedded sediments on a peneplaned surface of granite and greenstone, showing slight relief due to differential erosion. Uraniferous conglomerates laid down in valleys.



Beginning of north-south compression causing gentle folding, development of joints, bedding-plane slip, and over-riding of bedding against granite buttress.



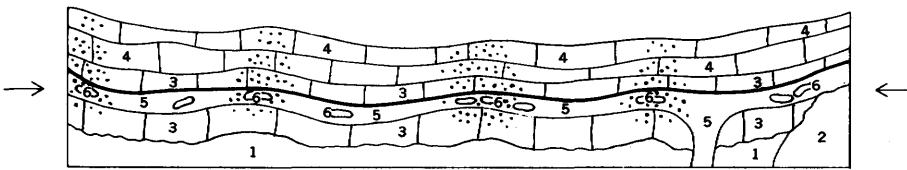
Intrusion of quartz diabase sills (with feeding dikes) in 'tensional' areas of fold.



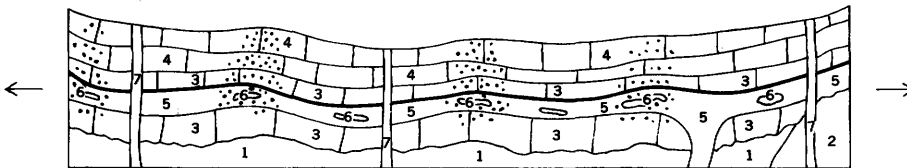
Compression continues; bedding-plane slip and over-riding become more pronounced, development of thrust faults on down-dip side of the sill-like diabase bodies.

O.D.M.870

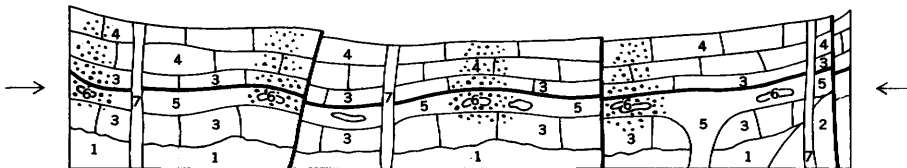
**HYPOTHETICAL STAGES IN THE**



Compression continues; development of small-scale folds, particularly near the axial plane of the syncline. End-stage fluids of diabase are differentiated: volatiles carrying soda, sulphides and minor gold migrate upwards especially on minor anticlines, and lamprophyres form, generally in fractures in the diabase.



Release of compressional forces, allowing intrusion of diabase dikes along pre-existing vertical fractures—either joints or faults.



Renewed compression in a north-south direction. Development of faulting.

LEGEND

- 7 Diabase.
- 6 Lamprophyre.
- Migratory volatiles.
- 5 Diabase.
- 4 Upper Mississagi.
- 3 Middle and Lower Mississagi.
- 2 Algoman granite.
- 1 Keewatin (?) sediments and volcanics
- Fault.
- ~ Unconformity.

O.D.M.871

EVOLUTION OF THE QUIRKE SYNCLINE

## Geology of Townships 137 and 138

Uraniferous conglomerates in the lower part of the Lower Mississagi are exposed east of Pecors Lake and southeast of Whiskey Lake. The surface outcrops are leached, so that individual samples are non-radioactive, and there is a development of both secondary uranium minerals (dominantly uranophane) and limonite. Drilling down dip and along strike from those occurrences showed that uraniferous conglomerates did occur within the area, but that they were confined to channels of thicker sedimentation developed in valleys in the pre-Huronian greenstone complex. These valleys (*see* figure, p. 24, and Quirke Syncline structure map, in map case) strike slightly north of west and are parallel to the strike of the greenstones. Assays performed for companies of the Rio Tinto group showed that in the Whiskey channel the  $U_3O_8$  content is 0.01–0.03 percent, and in the Pecors channel up to 0.05 percent.<sup>1</sup>

Little or no detailed work has been done on the character of the uraniferous horizons in the area, and the published data on the Blind River deposits are based largely on examination of material taken from the main orebodies.

The following notes summarize the general character of the ores. Uranium is found in moderately well-sorted oligomictic conglomerates developed in north-westerly-striking channels overlying either the contact areas of the granite and the greenstone or over less resistant members of the greenstone. These conglomerates are found near, but not necessarily at, the base of the Lower Mississagi.

Ore grade is best where the conglomerates are closely packed and contain a relatively high proportion of pyrite. Under these conditions the quartz pebbles show darkening due to radioactive bombardment. Grade is also normally highest at the base of any given bed, decreasing upwards.

Uranium is found as brannerite (a complex uranium rare-earth titanate) and uraninite-pitchblende. At some of the mines, thucholite, a uranium hydrocarbon, and some non-radioactive hydrocarbons have been found both in fractures and disseminated through the lower part of the ore beds. The following heavy minerals have been identified: anatase, apatite, cassiterite, chromite, gold, fluorite, hematite, ilmenite, magnetite, monazite, rutile, scheelite, sphene, and zircon.

This suite is similar to that obtained from the pre-Huronian granite complex (*see* pp. 17, 18). Also found in the ore beds, but not confined to them, are sulphides and arsenides, up to 25 percent, dominantly pyrite, also appreciable chalcopyrite and pyrrhotite with traces of galena, molybdenite, sphalerite, and possibly cubanite, cobaltite, and pentlandite. (Abraham 1953: Arnold 1954: Davidson 1957: Holmes 1957, pp. 324–39: Joubin and James 1956, p. 85: Traill 1954: Roscoe 1957: C.I.M.M. 1957).

Although the type of mineralization is relatively constant throughout the Blind River area and possibly throughout the basal Mississagi of the North Shore of Lake Huron, there are local variations in the proportions of the minerals present. Thus there is no consistency in the uranium-thorium ratio, which may range from 3:1 in the orebodies (Roscoe 1957, p. 17) to 1:1 in the Moon Lake area, Township 161 (Barnes 1955), and 1:13 in the Matinenda Lake area, Mack township (Friedman 1958, pp. 889, 890) some 10 miles west of Elliot Lake. Within the orebodies themselves it is known that the ratio varies considerably, though precise values have not been published. Although the abundance of pyrite in the ore zone is a general guide to the uranium concentration, there are

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<sup>1</sup>Rio Tinto Management Services Limited; company reports.

localities where the uranium content is maintained though there is little or no pyrite.<sup>1</sup> Locally, pyrite may be seen to fill fractures in non-radioactive rocks adjacent to the ores. The distribution of gold and other trace elements present, such as copper, cobalt, and nickel, is patchy and not fully determined. Recently it has been shown that the ore beds have been altered by the passage of hydrothermal solutions close to diabase dikes or sills (Airth and Olson 1958, pp. 666-77). Albitic and chloritic material has been introduced, and the quartz pebbles have been replaced. In the areas of alteration it is not yet clear whether uranium values are, on the average, increased or decreased, both types of variation having been observed. There is some indication that the ratio of uraninite to brannerite varies throughout the area, being greater in the bodies on the south limb of the syncline than in those on the north limb (Derry 1958, p. 918; Roscoe 1957, p. 17; Barnes 1955; Friedman 1958, pp. 889, 890).

As with the similar Rand deposits in South Africa, there has been much controversy over the formation of the ores. Bateman (1955, p. 371), Joubin and James (1957), and Davidson (1957, p. 668) have cited the supposedly uniformly high uranium-to-thorium ratios, high titanium-to-iron ratio, and the association of Ti, Co, Ni, Th, and U in a deposit containing gold, brannerite, and pyrite as the characteristic minerals, as evidence of a hydrothermal origin. Joubin (1954, pp. 431-37) has suggested that the Keweenaw diabase was the probable source of the mineralizing fluids, and Davidson has suggested the (supposedly) post-Huronian granite lying to the south and east. Abraham (1953) and McDowell (1957, p. 31) regard the ores as syngenetic.

Holmes (1956, p. 116) has suggested syngenetic deposition modified by later hydrothermal activity, and this view was also given in the guide to the area compiled by the mine geologists for the Sixth Commonwealth Mining and Metallurgical Congress Tour (C.I.M.M. 1957).

Derry (1958, p. 918) has suggested the possibility of biogenic precipitation during or shortly after the deposition of the sediments and has also pointed out that the age-determination data available indicates that the mineralization is older than the post-Huronian granite. Roscoe (1957, p. 20) indicates that the maximum uranium-to-thorium ratio attained is similar to that found in pegmatite minerals.

It may be noted that the other Huronian conglomerates in the district, the basal greywacke conglomerate, the quartz-greenstone conglomerate in the Lower Mississagi, the Bruce Conglomerate, and the Gowganda Conglomerate do not carry marked concentrations of uranium, though all carry pyrite.

The sericitic matrix of the uraniferous oligomictic conglomerate is similar to that of the adjacent Lower Mississagi quartzites and to the material forming the bulk of the pre-Huronian regolith. The sericite was probably derived from the weathering products of the granitic rocks, and there is no reason to suppose that it was produced by the passage of hydrothermal solutions. Within the present map-area there is no indication of uranium mineralization with the proven post-Huronian sulphides, associated with the Keweenaw diabase.

There is also no indication, within the map-area or the adjacent districts, of a post-Huronian granite that could have provided mineralizing solutions.

At present the modified placer theory of origin is the most logical explanation of the known facts; the modification is due to migration of solutions during diagenesis, and metamorphism during burial and folding of the area.

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<sup>1</sup>S. W. Holmes, personal communication.

### **Sulphides**

It may be noted that, in addition to the sulphides found in the uranium ores, no rock in the district is free of minor amounts of disseminated sulphides, particularly pyrite, chalcopyrite, and pyrrhotite. Nickeliferous pyrrhotite, pyrite, and chalcopyrite are characteristic of the diabases and gabbros developed in the Keewatin(?) basement. Shear surfaces in the greenstones (observed in drill core) are coated with pyrite, pyrrhotite, chalcopyrite, calcite, and chlorite. Although some prospecting has been carried out for nickel, only trace amounts have been found<sup>1</sup> (Moore and Armstrong 1945, p. 14).

Quartz, pyrite, and chalcopyrite veins and disseminated chalcopyrite in diabase, at or near the contacts of diabase masses, are found in the following localities: on the island off Shelter Point in Whiskey Lake; on the Peyton Prospect on the west shore of Whiskey Lake near the portage to Batty Lake; on Campbell Island; on the Reynolds Prospect at the northwest end of Whiskey Lake; on the Batty and Whitefish prospects west of the north end of Batty Lake; and on the north shore of the west arm of McCool Lake. A number of veins on the Peyton Prospect have been proven to contain minor amounts of visible gold, arsenopyrite, and cobalt-bearing minerals. The Campbell Island vein contains galena and has yielded gold and silver assays.

### **Iron**

The occurrence of iron formation in the Keewatin(?) has been mentioned on pages 14-16. This consists of low-grade, finely banded, quartz and magnetite interbanded with quartzites. The individual formations are 50-80 feet thick. Exposures are poor and intermittent. Where not exposed, the beds can be traced by magnetic anomalies detectable with a Brunton compass. The weathered surface of the beds is rusty owing to the oxidation of pyrite and development of hematite and limonite. Assays of samples of iron formation taken for Teck Exploration Company Limited<sup>2</sup> also indicated the presence of zinc.

## **Description of Properties**

### **ALGOM URANIUM MINES LIMITED**

This company holds 99 claims in Township 137 in the Pecors Lake-southwest Whiskey Lake area. These claims are continuous with the company's Pecors west group in Township 143 (Robertson 1961, pp. 47, 48) and may be reached by using the road from the Algom-Nordic mine in Township 149 to the west end of Pecors Lake in Township 143, then crossing the lake by boat and following a tractor road that connects Pecors and Whiskey lakes. The group may also be reached by way of the Massey tote road and Whiskey Lake.

The rocks exposed on the property belong to the Keewatin(?), the Lower, Middle, and Upper Mississagi Formation, and Keweenawan diabase dikes and sills. Thrust faulting on the sills has been recognized both from surface mapping and from drilling (*see* page 53). Faults with east and southeast trends also occur but are probably minor (*see* pages 54, 55).

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<sup>1</sup>Teck Exploration Co. Ltd.; unpublished company reports.

<sup>2</sup>Teck Exploration Co. Ltd.; company reports.

R. T. Pountney has reported:<sup>1</sup>

The portion of Algom's Pecors Lake property included in Township 137 totals 99 claims. All claims have been surveyed, and all assessment work requirements have been met.

Prospecting and early geological mapping, both reconnaissance and detail, was carried out during the 1953 field season on the claims lying south of the Serpent River; and two surface exposures of radioactive quartz pebble conglomerate were found on claims S.67641 [due east of the east end of Pecors Lake] and on claims S.64478-79 [northeast of the east end of Pecors Lake]. Geological mapping on scale 1 inch to 400 feet of the entire property was done during 1956-57.

Shallow exploration and assessment drilling was carried out during the latter half of 1953 on the surface showings and along strike therefrom. This drilling delineated a very low-grade, narrow conglomerate zone, which averaged 4.5 feet in thickness, with a strike length of about thirteen hundred feet, and having an average grade of 1.0 lbs U<sub>3</sub>O<sub>8</sub> [per ton]. Further deep drilling was done in 1955 and 1957 with negative results. [The figure on page 24 of this report is derived from the results of the deep drilling.] Diamond drilling to date on claims in Township 137 totals fifteen thousand, eight hundred and seventy-three feet on forty-four holes. There is no work in progress on this ground.

The figure on page 24 showing the variation in sedimentation in the Lower Mississagi in the Pecors Lake-Whiskey Lake area was derived from the deep drillholes referred to below.

Following are logs of deep drillholes drilled on the Pecors East Property. The locations of the holes are shown on the figure (page 24), and the logs are summarized from company logs submitted for assessment credit.

HOLE P.W.118  
Elevation: 132.4 feet above Pecors Lake.  
Plunge: vertical at collar.

Footage	Description
0-9 .....	Casing
9-60 .....	Conglomerate (Middle Mississagi?)
60-352 .....	Lower Mississagi Quartzite.
352-366 .....	Lower Mississagi polymictic conglomerate.
366-423 .....	Lower Mississagi Quartzite (thin oligomictic conglomerate bands, little pyrite or radioactivity).
423-506 .....	Lower Mississagi basal greywacke conglomerate.
510-1,666 .....	Keewatin(?) interbedded lavas and sediments.
1,666 .....	End of hole.

HOLE P.W.119  
Elevation: 122.6 feet above Pecors Lake.  
Plunge: at collar ..... vertical  
at 400 feet ..... 71°  
at 800 feet ..... 67°  
at 1,200 feet ..... 79°

Footage	Description
0-27 .....	Casing.
27-396.5 .....	Middle Mississagi Argillite.
396.5-400.5 .....	Middle Mississagi Conglomerate.
400.5-458 .....	Lower Mississagi Quartzite.
458-460 .....	Lower Mississagi polymictic conglomerate.
460-545 .....	Lower Mississagi Quartzite (scattered quartz pebbles, little pyrite or radioactivity).
545-553 .....	Transition zone.
553-1,446 .....	Keewatin(?) interbedded lavas and sediments.
1,446 .....	End of hole.

<sup>1</sup>R. T. Pountney, personal communication, 1958.

## Geology of Townships 137 and 138

### HOLE P.W.120

Elevation: 70 feet above Whiskey Lake.

Plunge: at collar.....vertical  
 at 400 feet.....77½°  
 at 800 feet.....77½°  
 at 1,200 feet.....72°  
 at 1,600 feet.....70°

Footage	Description
0-10.....	Casing.
10-350.....	Middle Mississagi Argillite.
350-445.....	Middle Mississagi conglomeratic quartzite.
445-545.....	Lower Mississagi conglomeratic quartzite.
545-622.....	Lower Mississagi Quartzite.
622-1,157.5.....	Diabase.
1,157.5-1,425.8.....	Lower Mississagi Quartzite (thin pyrite seams and pebble bands).
1,425.8-1,444.2.....	Diabase.
1,444.2-1,624.3.....	Lower Mississagi Quartzite (rare, thin pyrite seams and pebbles).
1,624.3-1,625.5.....	Transition zone.
1,625.5-1,648.....	Keewatin(?) greenstone.
1,648.....	End of hole.

### HOLE W.5

Elevation: 22 feet above Whiskey Lake.

Plunge: at collar.....vertical  
 at 400 feet.....vertical  
 at 800 feet.....87°  
 at 1,200 feet.....84°

Footage	Description
0-5.....	Casing
5-40.0.....	Middle Mississagi Conglomerate
40.0-348.4.....	Lower Mississagi Quartzite
348.4-783.5.....	Diabase
783.5-1,142.8.....	Lower Mississagi Quartzite (Pebbly sections from 1,119 ft.)
1,142.8-1,542.....	Keewatin(?) basic lavas.
1,542.....	End of hole

The following assays were obtained from the above hole (W.5):

Footage	Width	Assay U <sub>3</sub> O <sub>8</sub> per ton
1,128.5-1,133.5.....	feet 5.0	pounds 0.20
1,133.5-1,137.5.....	4.0	0.20

At the north end of the island off Shelter Point in Whiskey Lake, members of the party discovered a quartz vein striking in width from 2 inches to 1 foot, striking N.50°E. and dipping 75°SE. This vein contains massive chalcopyrite, forming up to 25 percent of its volume, and minor pyrite. Azurite is also present, and in polished section is seen to have the colloform structure characteristic of supergene deposition.

**BRACEMAC MINES LIMITED**

This company's holding consists of 18 unsurveyed claims in the Rangers Lake area of Township 138. The group may be reached either by portaging or walking from Quirke Lake in Township 144, or from Whiskey Lake.

Strata exposed are the normal Huronian sequence from the Upper Mississagi to the Gowganda Formation. One thin diabase dike crosses the area and was intersected in the drillhole. The northwesterly extension of the Batty Lake sill lies close to the south margin of the property.

Exploration consists of a vertical diamond-drill hole located on the south shore of Rangers Lake about 1/2 mile east of the Townships 144-138 boundary. A summary log taken from that submitted for assessment work credit is given below. No results of interest were obtained from this hole, and no work has been done on the property since 1956.

Elevation: 10 feet above Rangers Lake.  
 Dip: at collar . . . . . 90°  
 at 500 feet . . . . . 90°  
 at 1,000 feet . . . . . 89°  
 at 1,800 feet . . . . . 85°  
 at 2,800 feet . . . . . 79°

Footage	Description
0-23 . . . . .	Casing.
23-93.7 . . . . .	Serpent Quartzite.
93.7-130.5 . . . . .	Espanola Limestone.
130.5-394.0 . . . . .	Espanola Greywacke.
394.0-1,043.0 . . . . .	Bruce Limestone.
1,043.0-1,088 . . . . .	Bruce Conglomerate.
1,088-1,210.8 . . . . .	Upper Mississagi Quartzite.
1,210.8-1,353.5 . . . . .	Diabase.
1,353.5-2,491.0 . . . . .	Upper Mississagi Quartzite.
(1,876.5-1,894.0 . . . . .)	sheared, carbonatized zone)
2,491.0-2,993.0 . . . . .	Middle Mississagi Argillite.
2,993.0-3,031.0 . . . . .	Middle Mississagi Conglomerate.
3,031.0-3,079.0 . . . . .	Lower Mississagi Quartzite.
3,079.0-3,091.5 . . . . .	Lamprophyre.
3,091.5-3,175.0 . . . . .	Lower Mississagi Quartzite plus transition zone.
3,175.0-3,216.0 . . . . .	Greenstone.
3,216.0 . . . . .	End of hole.

Weakly radioactive mineralized conglomerate bands at: 3,031.0-3,034.0  
 3,035.4-3,035.8  
 3,066.0-3,069.0

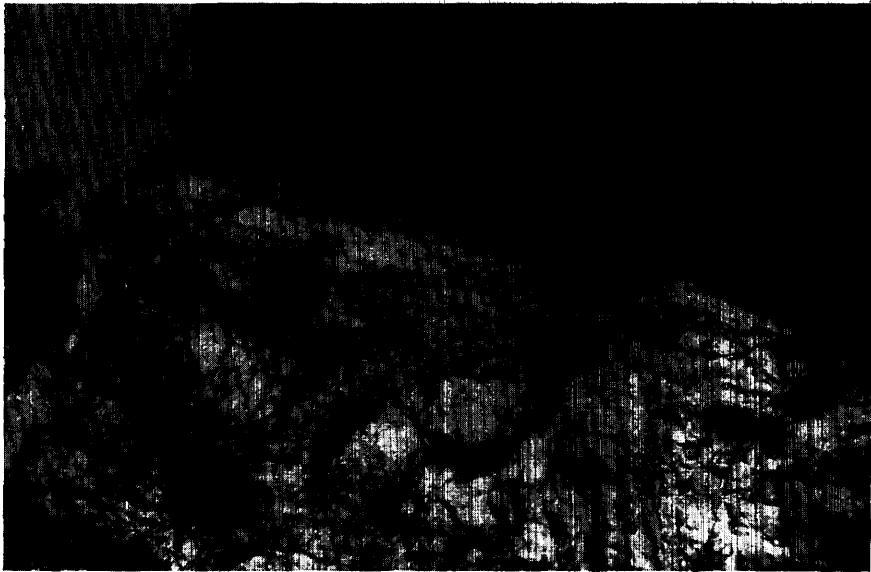
**CAMPBELL ISLAND**

Campbell Island, in the centre of Whiskey Lake, consists of dioritic diabase, probably an offshoot from the Whiskey Lake sill, cutting Algoman granite. A quartz vein, about 6 feet thick (*see* photo on page 66) and containing galena and chalcopyrite, is visible on the face of a bluff on the south side of the island. In 1905, Carter (1905, p. 64) reported:

Campbell's Island has an area of about 160 acres and rises very steeply to a height of 185 feet above the lake. It consists of a mass of diorite, and through the face of a bluff of this on the south side, at 125 feet above the lake, the quartz vein outcrops, striking about N.W.-S.E., with a dip of thirty degrees N.E. The vein can be traced for about 225 feet in all, having a width of four or five feet for 75 feet N.W. of the one opening, but pinching out to narrow stringers in the remaining 150 feet in the opposite direction. [Assays are reported to have shown only a trace of gold and from \$1.00-\$3.00 (1905) per ton of silver depending on the content of galena.]

## Geology of Townships 137 and 138

On visiting the locality it was noted that the vein contained quartz, calcite, galena, pyrite, and chalcopyrite. The calcite, galena, and chalcopyrite were separated into masses up to 2 inches across close to the margin of the vein, and calcite and chalcopyrite were more common towards the east end of the showing.



Quartz-calcite-galena-chalcopyrite vein in diabase; Campbell Island, Whiskey Lake, Township 137.

### **CARIBOU LOCATION Y.401**

This location is situated on the south shore of Rangers (formerly Caribou) Lake slightly west of the portage to McCool Lake. The westward extension of the Batty Lake diabase cuts the Serpent Quartzite, which is folded here into a small-scale syncline plunging at 20°W. On this location talus blocks of Serpent quartzite were found containing "splashes of chalcopyrite as much as 2 feet long and 3 or 4 inches wide. A careful inspection of the face exposed—40 square feet—indicates an average copper content of slightly over 2 percent." (Collins 1917, p. 9E.)

According to Collins, ore hand-picked in 1916 yielded 7.25 percent copper. Boulders were traced for 500 yards along the face of the hill. Further exploration failed to reveal the deposit from which the boulders were derived, and no further work has been done on the location.

### **MAGOMA MINES LIMITED**

This company held a group of 16 unsurveyed claims northwest of the southwestern part of Batty Lake and north of Algom Uranium Mines' Pecors Lake property. The group is most easily reached by way of Batty Lake.

The greater part of the property is underlain by quartzite and arkose of the Upper Mississagi Formation cut by northwest-trending Keweenawan diabase dikes. The argillites and greywackes forming the upper beds of the Middle Mississagi are exposed on the west shore of Batty Lake near the east end of the

group. The Bruce Conglomerate and the lowermost members of the Espanola Formation are exposed in the northwest corner of the property.

Between December 1954 and February 1955, a hole located in the southeast corner of the property was drilled to basement. A summary log, derived from a company log submitted for assessment credit is given below:

HOLE M.8  
Southwest Batty Lake.  
(Vertical at collar)

Footage	Description
0-7	Casing.
7-279	Upper Mississagi Quartzite.
279-724	Middle Mississagi Greywacke and Argillite.
724-734	Middle Mississagi Conglomerate.
734-1,232	Diabase.
1,232-1,930	Lower Mississagi Quartzite (6-inch conglomerate bands at 1,865 and 1,869 feet).
1,930-1,950	Lower Mississagi Conglomerate, with basement material.
1,950-2,023	Basement volcanics.
2,023	End of hole.

### MARCH MINERALS LIMITED

This company formerly held 35 unsurveyed claims in Township 137 to the east of Whiskey Lake. A further 19 claims were held in the adjacent part of Township 130.

The area is underlain by Keewatin(?) volcanics and sediments, cut by north-west- and east-striking Keweenawan diabase dikes. In the southwestern part of the property the lowermost part of the Whiskey Lake gabbro sill may be seen lying on Lower Mississagi arkose.

A ground magnetic and scintillometer survey was carried out on cut lines running north-south at approximately 400-foot intervals. The magnetic survey indicated that the grain of the country trends slightly south of east. However, in Township 137, only one anomaly was considered worthy of exploration. This lay along the south shore of the west end of a lake east of Whiskey Lake on latitude 46° 25' N.

Two holes (No. 3 for 125 feet and No. 4 for 573 feet) were drilled in 1956 on this anomaly; these intersected alternating gabbroic diabase and andesite<sup>1</sup> probably representing the massive central portions and the marginal phases of lava flows. Little or no sulphide was observed. At the northeast end of the same lake two inclined holes were drilled northeast to intersect a zone on strike with an anomaly observed in Township 130. These holes (No. 1 for 510 feet and No. 2 for 501 feet) also intersected gabbroic diabase and andesite with little or no sulphides. Finely disseminated magnetite was noted in gabbroic diabase near the base of hole No. 2.

No further work was carried out, and the property was allowed to lapse.

### NORTHSPAN URANIUM MINES LIMITED

Northspan Uranium Mines Limited, through a wholly owned subsidiary, Spannorth Mining Claims Limited, held a total of 93 claims in Townships 137 and 138. The original holdings formed two groups:

<sup>1</sup> Company drill logs.

## Geology of Townships 137 and 138

- 1) Kindle Lake Group: consisting of 21 unsurveyed claims in the Kindle Lake-Rangers Lake area of Township 138.
- 2) Whiskey Lake Group: consisting of 72 claims in Township 137 to the southeast, east, and northeast of the Algom group.

### 1. Kindle Lake Group

This ground was originally held by Plympton Uranium and Metal Mines Limited, and Teasdale Uranium Mines Limited.

Algoman quartz monzonite is exposed on the north shore of Kindle Lake. Upper Mississagi quartzite is found in the prominent headland in Kindle Lake near the east end of the group. The south shore of Kindle Lake shows the Bruce Conglomerate and the Espanola Formation lying on top of the Upper Mississagi Quartzite. Sill-like bodies of gabbroic diabase are visible on the headland in Kindle Lake, and again at the west end of the lake. The chief structural feature of the area is the Nook Lake fault, a near-vertical, northwest-striking, right-hand, strike-slip fault running the length of Kindle Lake.

In 1954, British Columbia Explorers (1953) Limited drilled three holes at the west end of Kindle Lake and one on the headland on the north shore of the lake.

**HOLE CH.1**  
Northeast corner of Kindle Lake.  
Vertical.

Footage	Description
0-12.....	Casing.
12-21.....	Coarse quartzitic conglomerate.
21-46.....	Transition zone. (Brecciated at 25-27 and 46-47 feet.)
47-60.....	Granite.
60.....	End of Hole.

**HOLE CH.2**  
Headland,  $\frac{1}{2}$  mile south of Serpent River inlet.  
Bearing, N.10°E.; dip, 60°.

Footage	Description
0-10.....	Casing.
10-814.....	Upper Mississagi Quartzite.
814-961.....	Diabase.
961-980.....	Lower Mississagi Quartzite.
980-985.....	Transition zone.
985-987.....	Granite.
987.....	End of hole.

**HOLE CH.3**  
West end of Kindle Lake, south of Serpent River inlet.  
Bearing, N.10°E.; dip, 60°.

Footage	Description
0-12.....	Casing.
12-189.....	Upper Mississagi Quartzite, strongly fractured, with quartz veins.
189-192.....	Upper Mississagi Quartzite.
192.....	End of hole.

**HOLE CH.4**  
 Northwest side of headland, north shore of Kindle Lake.  
 Bearing, N.; dip, 80°.

Footage	Description
0-4.....	Casing.
4-316.....	Upper Mississagi Quartzite.
316-318.....	Fault zone.
318-350.....	Granite.
350.....	End of hole.

No further development was undertaken.

**2. Whiskey Lake Group**

The second group, consisting of 72 unsurveyed claims, was located in the vicinity of Whiskey Lake, in Township 137. The group is most easily reached by way of Whiskey Lake; the southwestern part may be reached by the tractor road connecting Pecors and Whiskey lakes. Thirty claims, south and southeast of the Algom property, were held originally by Grand Chibougamau Mines Limited; ten, in the vicinity of Campbell Island, by Teasdale Uranium Mines Limited; and the rest were staked by Aurora Mines Limited and British Columbia Explorers (1953) Limited (the latter also holding the Peyton Prospect).

The group straddles the axial area of the nose of the Quirke syncline. From east to west the rock units are: Keewatin(?) lavas and sediments (granite on Campbell Island); the Lower and Middle Mississagi Formation; the Whiskey Lake sill (thrust); Middle Mississagi conglomerate and argillite; and the Upper Mississagi Quartzite. The area is crossed by northwest-trending and east-trending diabase dikes. Minor folds trend roughly parallel to the main fold. Faults and fractures later filled with quartz veins are associated with these folds.

Extensive diamond-drilling (details of which are given below) was carried out partly under the auspices of the various companies listed above and partly under the auspices of Panel Consolidated Uranium Mines Limited, one of three companies that merged to form Northspan Uranium Mines Limited.

Drilling results are given as closely as possible in order from north to south in the northern part of the property and from east to west in the southern part.

**TEASDALE OPTION (CAMPBELL ISLAND)**

**HOLE TD.1**  
 Bearing, N.70°W.; dip, 40°.

Footage	Description
0-212.....	Diabase.

**HOLE TD.2**

Footage	Description
0-67.....	Diabase.

**HOLE TD.3**

Footage	Description
0-65.....	Diabase.

## Geology of Townships 137 and 138

HOLE TD.4  
Bearing, S.30°W.; dip, 45°.

Footage	Description
0-50 .....	Casing.
50-92 .....	Diabase.
92-141 .....	Granite.
141-169 .....	Chlorite-amphibole schist.
169-181 .....	Granite.
181-236 .....	Chlorite-amphibole schist.
236-238 .....	Granite.

The logs given above are taken from the files of E. M. Abraham.<sup>1</sup>

The holes are collared on the high ground in the centre of the island, to the north of the Campbell Island lead showing, but there is no record in Abraham's files regarding sulphide mineralization.

### WEST SHORE OF WHISKEY LAKE (BRANDY POINT TO ANTICLINE POINT) British Columbia Explorers (1953) Limited

HOLE No. 1  
Brandy Point (January 1954).  
Bearing, N.100°E.; dip, 45°

Footage	Description
0-18 .....	Casing.
18-373 .....	Grey granite cut by thin diabase dikelets.
373 .....	End of hole.

### Panel Consolidated Uranium Mines Limited

In March 1956, Panel drilled 7 short vertical holes near the mouth of the stream on the south side of Brandy Point.

Hole No.	Footage	Description
56/1 .....	0-14	Casing (hole lost).
56/2 .....	0-2 2-78	Casing. Diabase.
56/3 .....	0-2 2-48	Casing. Lower Mississagi Quartzite.
56/4 .....	0-2 2-41	Casing. Lower Mississagi Quartzite.
56/5 .....	0-2 2-41	Casing. Lower Mississagi Quartzite.
56/6 .....	0-2 2-72	Casing. Diabase.
56/7 .....	0-2 2-30	Casing. Lower Mississagi Quartzite.

<sup>1</sup>Formerly geologist, Ontario Dept. Mines.

**Aurora Uranium Mines Limited**

In 1954, Aurora Uranium Mines Limited drilled a hole (AW.1) to the south of the creek connecting the lake west of Brandy Point with Whiskey Lake.

HOLE AW.1  
Bearing, N.60°E.; dip, 47°.

Footage	Description
0-13.....	Casing.
13-61.2.....	Middle Mississagi Argillite.
61.2-105.2.....	Middle Mississagi Conglomerate.
105.2-204.0.....	Lower Mississagi Quartzite.
204.0.....	End of hole.

**Teasdale Uranium Mines Limited**

Teasdale Uranium Mines Limited's hole TD.5 was located about ¼ mile south of hole AW.1 and 800 feet from the west shore of Whiskey Lake.

HOLE TD. 5  
Bearing, N.50°E., dip, 60°.

Footage	Description
0-45.....	Middle Mississagi Conglomerate.
45-276.....	Lower Mississagi Quartzite with narrow conglomerate beds.
276-277.....	Conglomerate (negligible radio- activity).
277-350.....	Granite.
350.....	End of hole.

**British Columbia Explorers (1953) Limited**

In 1953-54, British Columbia Explorers (1953) Limited drilled a series of holes as follows:

- No. 1—discussed above (page 70).
- No. 2—west shore of Whiskey Lake opposite Ale Point.
- No. 3—in small bay south of hole No. 2.
- No. 4—south end of small island opposite Ale Point.
- No. 5—west shore of Whiskey Lake opposite Beer Point.
- No. 6—Anticline Point. (In some files this hole is designated TD.6.)

In 1956, Panel Consolidated Uranium Mines Limited deepened hole No. 6 and drilled a new hole (No. 7) 1,000 feet from the shore of Whiskey Lake near holes Nos. 2 and 3.

HOLE No. 2  
Bearing, due east; dip, 60°.

Footage	Description
0-5.....	Casing.
5-212.....	Lower Mississagi Quartzite, with pebbly sections.
212-220.....	Transition zone.
220-235.....	Greenstone.
235.....	End of hole.

Assay	Footage	U <sub>3</sub> O <sub>8</sub>	Gold
	feet	percent	oz. per ton
1.....	37.0-40.0	0.008	trace
2.....	96.5-97.5	0.008	trace
3.....	140.0-140.5	0.004	trace
4.....	187.5-188.5	0.006	0.02

## Geology of Townships 137 and 138

HOLE No. 3  
Vertical.

Footage	Description
0-3.....	Casing.
3-125.....	Middle Mississagi Argillite.
125.....	End of hole.

HOLE No. 4  
Vertical.

Footage	Description
0-10.....	Casing.
10-197.....	Middle Mississagi Conglomerate.
197-226.....	Lower Mississagi Quartzite, scattered pebbles, only slight radioactivity.
226.....	End of hole.

HOLE No. 5  
Vertical.

Footage	Description
0-21.....	Casing.
21-160.....	Middle Mississagi Conglomerate.
160-540.....	Lower Mississagi Quartzite; pebbly sections (only slightly radioactive) at 370-425 and 507-520 feet, shattered core at 218-221 feet, quartz stringers at 345-350 feet.
540-550.....	Transition zone.
560-574.....	Greenstone.

Assays at 105.6-106.7 feet were 0.01 percent  $U_3O_8$  per ton.

HOLE No. 6 (also designated TD. 6)  
S.65°E.; dip, 45°.

Footage	Drilled by
0-180.....	British Columbia Explorers (1953) Ltd., Feb. 1954.
180-305.....	Teasdale Option, June 1954 (as hole TD. 6).
305-480.....	Panel Consolidated Uranium Mines Ltd., June 1956 (as hole No. 6).

Footage	Description
0-7.....	Casing.
7-49.....	Diabase.
49-180.....	Middle Mississagi Argillite.
180-189.....	Middle Mississagi Conglomerate.
189-428.6.....	Lower Mississagi Quartzite.
428.6-431.0.....	Lost core.
431.0-480.0.....	Andesite (rare specks of chalcopyrite).

## Geological Report No. 10

HOLE No. 7  
Bearing, north; dip, 85°.

Footage	Description
0-25.....	Casing.
25-313.5.....	Middle Mississagi Argillite.
313.5-331.5.....	Middle Mississagi Conglomerate.
331.5-619.5.....	Lower Mississagi Quartzite.
619.5-622.5.....	Transition zone.
622.5-639.5.....	Granite.
639.5-647.0.....	Diabase.
647.0-660.0.....	Granite.
660.0.....	End of hole.

In 1953-54 three drillholes were collared southeast of Whiskey Lake to the south of Rum Point by British Columbia Explorers (1953) Limited. These were: BW.2, at the southeast corner of the bay south of Rum Point; CF.1, on the Chubb-Featherstone option some 1,000 feet southwest of BW.2; and BW.1, 2,000 feet south of CF.1. Summary logs are given below:

HOLE BW. 2  
Vertical.

Footage	Description
0-180.....	Lower Mississagi Arkose.
180.....	End of hole.

HOLE CF. 1  
Vertical.

Footage	Description
0-6.....	Casing.
6-85.....	Diabase.
85.....	End of hole.

HOLE BW. 1  
Bearing, south; dip, 65°.

Footage	Description
0-152.....	Lower Mississagi Quartzite, with pebble sections.
152-180.....	Greenstone.
180.....	End of hole.

HOLE BW. 1—ASSAYS

Footage	U <sub>3</sub> O <sub>8</sub>
	percent
64-64.5.....	0.01
129-138.....	0.01
138.3-138.8.....	0.09

## Geology of Townships 137 and 138

### Grand Chibougamau Mines Limited

That part of the property lying to the south and southwest of Whiskey Lake was originally held by Grand Chibougamau Mines Limited. The following holes were drilled:

- No. 1—1,000 feet south of the Serpent River outlet from Whiskey Lake.
- No. 2—1,500 feet southwest of hole No. 1.
- No. 3—1,300 feet southwest of hole BW.1. (Drilled by British Columbia Explorers (1953) Ltd.)
- G.C. 4—2,000 feet southwest of the first "lake" on the Serpent River west of Whiskey Lake.
- G.C. 5—400 feet northeast of hole G.C.4.

### Panel Consolidated Uranium Mines Limited

The following holes were drilled in 1955 by Panel Consolidated Uranium Mines Limited:

- G.C. 6, 6A—west of small lake on Serpent River.
- G.C. 7, 7A—north of Serpent River, 1,700 feet east of the boundary of the Algom property.
- G.C. 8—400 feet north of hole No. 2.
- G.C. 9—southeast of Whiskey Lake, north of fork in the creek and slightly west of holes CF.1 and BW.1.

The following hole was drilled by Panel Consolidated Uranium Mines Limited in 1956:

- G.C. 10—south bank of Serpent River north of hole No. 6.

HOLE No. 1  
Bearing, south; dip, 45°.

Footage	Description
0-7.....	Casing.
7-286.....	Lower Mississagi Quartzite (2-foot conglomerate at 230.8 feet).
286-362.....	Greenstone.
362.....	End of hole.

HOLE No. 2  
Bearing, south; dip, 45°.

Footage	Description
0-3.....	Casing.
3-88.5.....	Lower Mississagi Quartzite. (7.5-foot conglomerate bed at 81 feet.)
88.5-137.....	Greenstone.
137.....	End of hole.

HOLE No. 3  
Bearing, S.30°E.; dip, 60°.

Footage	Description
0-12.....	Casing.
12-89.5.....	Lower Mississagi Quartzite. (Conglomerate sections at 63.8-66.3 feet and 72.5-78.5 feet, and 78.8-89.5 feet.)
89.5-133.5.....	Greenstone.
133.5.....	End of hole.

## Geological Report No. 10

HOLE G.C.4  
Bearing, south; dip, 45°.

Footage	Description
0-80 .....	Casing.
80-150 .....	Lower Mississagi Quartzite.
150-153 .....	Greenstone.
153 .....	End of hole.

HOLE G.C.5  
Bearing, south; dip, 45°.

Footage	Description
0-118 .....	Casing.
118-222.3 .....	Lower Mississagi Quartzite and Argillite.
222.3-231.0 .....	Basal Mississagi Conglomerate.
231.0 .....	End of hole.

HOLE G.C.6  
Vertical.

Footage	Description
0-174 .....	Overburden; hole lost.
174 .....	Hole abandoned.

HOLE G.C. 6A  
Vertical.

Footage	Description
0-107 .....	Casing.
107-222 .....	Middle Mississagi Argillite.
222-475.5 .....	Lower Mississagi Quartzite.
475.5-477 .....	Transition zone.
477-520.0 .....	Greenstone.
520.0 .....	End of hole.

HOLE G.C. 7  
Vertical.

Footage	Description
0-51 .....	Casing.
51 (casing hole) .....	Hole abandoned.

HOLE G.C. 7A  
Vertical.

Footage	Description
0-54 .....	Casing.
54-555 .....	Middle Mississagi Argillite.
555-615.5 .....	Lower Mississagi Quartzite.
615.5-689.0 .....	Greenstone.
689.0 .....	End of hole.

## Geology of Townships 137 and 138

HOLE G.C. 8  
Vertical.

Footage	Description
0-25.....	Casing.
25-218.5.....	Lower Mississagi Quartzite. (1.1 feet conglomerate at 162.9 feet.)
218.5-257.5.....	Greenstone.
257.5.....	End of hole.

Thin lamprophyre dikes were observed in both the Lower Mississagi and the Keewatin(?) greenstone.

HOLE G.C. 9  
Vertical.

Footage	Description
0-75.....	Casing.
75-461.9.....	Lower Mississagi Quartzite. (Conglomeratic sections at: 267.0-267.4 272.0-272.3 294.1-294.4 305.0-306.7 310.7-312.2 326.2-336.6 417.1-418.2 449.7-461.9)
461.9-467.5.....	Transition zone.
467.5-553.0.....	Greenstone.
553.0.....	End of hole.

HOLE G.C. 10  
Bearing, S.25°W.: dip, 85° (at collar)  
84° (at 400 ft.)  
83° (at 800 ft.)

Footage	Description
0-193.....	Casing.
193-266.4.....	Middle Mississagi Argillite.
266.4-749.0.....	Lower Mississagi Quartzite.
749.0-831.0.....	Greenstone.
831.0.....	End of hole.

On the results of this drilling, all but eight claims of the Northspan group were allowed to lapse in 1957. The eight claims retained were those adjacent to the Algom property at the west end of the original Grand Chibougamau holdings. Subsequently, two claims to the southeast of Whiskey Lake were restaked by J. Burns, and a further four in the same area by J. A. Pousette.

### PEYTON PROSPECT W.R.94

This group is located on the west shore of Whiskey Lake, southwest of Campbell Island. The stream from Batty Lake to Whiskey Lake and an old portage connecting the two lakes, pass through the property. Exposed rocks are gently folded Middle and Upper Mississagi cut by Keweenawan diabase and by quartz-gold-sulphide veins.

The date of the earlier work is not known, but in 1913, Coleman (1913, pp. 153-54) stated: "about fifteen years ago a small shaft was sunk close to the shore by Mr. Teasdale, on a little deposit of copper pyrites in quartzite."

In 1904-6 the vein had been traced for 100 feet (mostly under the lake) on a strike of N.30°W., and vertical dip. A 25-foot shaft had been dug, and a drift driven for 24 feet under the lake. The ore exposed in the original pit "ran high in copper content," but in the shaft "the quartz body breaks up into a few smaller stringers with less copper." (Carter 1905, p. 65.)

In 1912, J. S. Wilson discovered gold on the prospect, and in 1913, Coleman reported (1913, p. 154):

The recent work . . . has been more extensive, including a large amount of stripping and trenching, with a few quite large test pits. The ore disclosed is rusty quartz containing . . . pyrite, pyrrhotite and a little copper pyrites and galena. Free gold could be seen at a number of places, . . .

Exploration inland revealed the presence of further veins. On one of these a 40-foot trench was dug, which in 1925 was further sampled by J. S. Wilson and by G. V. Douglas (1926, pp. 34-49).

**TABLE V—GOLD ASSAYS FROM PEYTON PROSPECT,  
WHISKEY LAKE  
(After G. V. Douglas)**

Distance from Mouth of Trench	Width	Value of Gold per Ton	
		Douglas 1924	Wilson 1924
feet	inches		
55 .....	54	\$ nil	\$ 0.40
61 .....	46	0.80	0.80
67 .....	20	0.80	nil
73 .....	22	nil	2.40
79 .....	5	121.20	108.40
20 (from head of trench) .....	32		14.80
59 (from mouth of trench) .....			
Upper vein in shaft .....		0.80	
Lower vein in shaft .....		nil	

At the same time a 30-foot shaft was dug on an adjacent vein, possibly a faulted or bent continuation of the first, and free gold was again found. (Douglas 1926, p. 45).

The assays (*see* Table V) were extremely erratic, being appreciable only at the narrow part of the vein. No further work was done on the property, and the buildings and the shaft timbering have now disintegrated.

During the 1958 season, members of the party visited the locality. A number of samples of visible gold were obtained from the dump and from the vein in the trench. The flakes of gold did not exceed  $\frac{1}{16}$  inch in length. In addition to native gold, the vein was found to contain pyrite, arsenopyrite, and chalcopyrite. In the trench where the gold was found it was noted that the sulphide content reached a maximum and the width of the vein a minimum.

The Peyton Prospect is situated on the axis of one of the subsidiary anticlinal folds paralleling the main synclinal fold. Douglas (1926, p. 44) suggested that fissures in the anticline controlled the passage of mineral-bearing solutions derived originally from the intruding diabase. The author agrees with this suggestion.

**PICTON URANIUM MINES LIMITED**

This group is made up of 34 unsurveyed claims between Deresti Lake and the Townships 137-143 boundary, and a further 20 claims are held in Township 143 immediately to the west (Robertson 1961). The group is best reached by tractor road from the northwest end of Pecors Lake.

## Geology of Townships 137 and 138

Within the area the following formations are exposed striking slightly north of east and dipping 25°–40°N.: Upper Mississagi, Bruce Conglomerate, Bruce Limestone, Espanola Greywacke, Espanola Limestone, Serpent Quartzite, and the Gowganda Formation. The sedimentary formations are cut by dikes of Keweenaw diabase, and the McCool Lake sill is exposed on the north margin of the group. Near the intersection of the south boundary of the group and the township boundary, a steeply dipping normal fault striking at N.80°W., with a throw of about 60 feet, repeats the outcrop of the Bruce Conglomerate and the Bruce Limestone.

No development has been carried out within Township 137, but a diamond-drill hole west of the township boundary was abandoned at 2,350 feet in diabase, having passed through the Upper Mississagi Quartzite and 452 feet of the Middle Mississagi Argillite.<sup>1</sup>

### J. A. POUSETTE

This holding comprises four unsurveyed claims southeast of Whiskey Lake. The exposed rocks consist of Lower Mississagi arkosic quartzite with thin beds and lenses of oligomictic conglomerate resting on lavas and intercalated sediments of the Keewatin(?). On the shore of Whiskey Lake in the northwest corner of the group the quartzite is capped by the Whiskey Lake diabase sill. In the northeast corner of the block a band of oligomictic conglomerate is exposed with up to 5 percent pyrite in the matrix. The matrix of this conglomerate has been leached, and the weathered surface has a yellow, earthy appearance. The secondary minerals present are dominantly uranophane and limonite. One drillhole sunk by Grand Chibougamau Mines Limited gave an intersection of 0.03 percent U<sub>3</sub>O<sub>8</sub> over a width of 10 feet.<sup>2</sup>

### REYNOLDS LOCATION W.R.92

The Reynolds Location lies at the northwest end of Whiskey Lake between that lake and Kindle Lake and includes the high ground immediately west of the Serpent River and the portage connecting the two lakes.

Early work (Carter 1905, p. 67) showed the presence of a quartz-chalcopyrite vein striking N.80°E with vertical dip and up to 20 feet width over a strike length of 300 feet.

In 1910, Major Leckie, who then held the ground, had a 50-foot shaft dug and further surface exploration carried out. At this time limestone was recognized as being one of the members of the sequence.

In 1917, Collins (1917, pp. 8E, 9E) described the property thus:

... a large mass of diabase abuts against the older conglomerate, argillite, and impure limestone of the Bruce series. The contact is nearly vertical and the argillite close to it is greatly contorted, somewhat schistose, and so fractured that it breaks readily into small, wedge-shaped fragments. For about 100 feet away from the diabase the deformed argillite is also silicified, traversed by a plexus of veinlets and irregular patches of quartz, and impregnated irregularly with pyrite, chalcopyrite, and a few specks of galena.

This mineralized contact zone extending north 30 degrees west, is exposed at two places 500 feet apart between which lies a soil filled ravine. The larger and more richly mineralized of the two outcrops, situated on the eastern edge of the ravine, is about 80 feet wide and 200 to 300 feet long. [Here the deposit appears to have a vertical dip.] Sulphides are not entirely lacking in any part of this outcrop, but are chiefly concentrated in a number of patches and belts that altogether make up 15 to 20 per cent of the whole outcrop.

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<sup>1</sup>Picton Uranium Mines Ltd., personal communication from the manager.

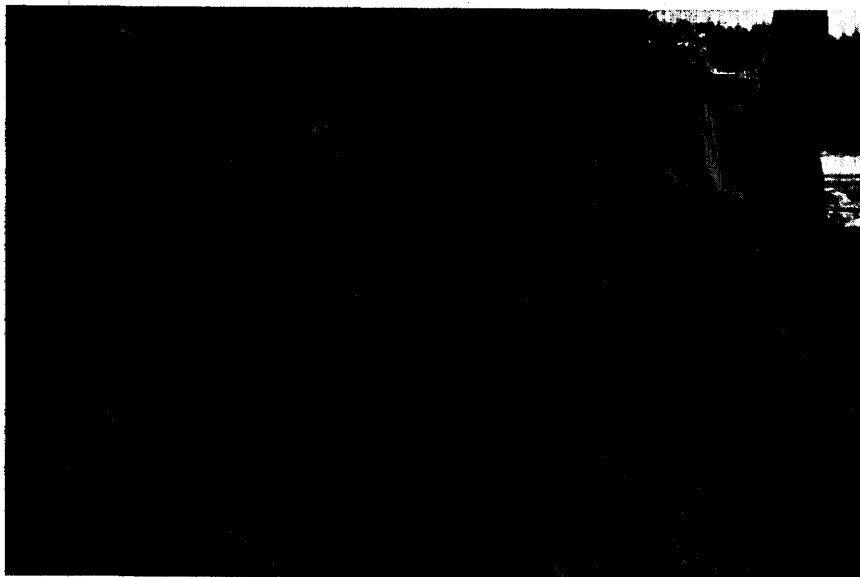
<sup>2</sup>J. A. Pousette, written personal communication.

## Geological Report No. 10

[The ore is composed of quartz and country rock through which chalcopyrite is disseminated in considerable proportions chiefly in a fine state.] Richer portions are of mineable size, but so distributed that a large amount of rock will have to be removed with them, if they prove to be rich enough in copper. . .

A sample fairly representative of the richer body . . . [by R. A. Teasdale of Sudbury] was found upon assay to contain 4.57 percent copper.

It is also reported that at one place a width of 30 feet gave 5 percent copper. The shaft, which is 50 feet deep, ends in schists, the orebody dipping away from it.



Sheared diabase with secondary quartz; east bank of Serpent River, between Kindle and Whiskey lakes, Township 138.

In 1951, Teck Exploration Company Limited held an option on the property, and two vertical X-ray holes were drilled. Descriptions and assays of these holes are contained in the accompanying table.

TABLE VI—DIAMOND-DRILLING RESULTS—REYNOLDS LOCATION W.R.92

Hole No.	Footage	Description		Assay	
		Lithology	Mineralization	Footage	Value of Copper <sup>(1)</sup>
1	0-45.5	Diabase	Chalcopyrite, minor bornite, and pyrite	20-35 35-45.5	per ton \$2.90 1.82
	45.5-59.5	"Greenstone schist"	Chalcopyrite	45.5-56.5	0.16
	59.5-72.0	Argillite	None	—	—
2	0-35	Diabase	Chalcopyrite, minor bornite, pyrite, azurite	3-20 20-26.5	\$0.88 2.44

<sup>(1)</sup>The price for copper in 1951 ranged from 25.60 to 29.55 cents per pound (Canadian funds), averaging 27.66 cents (f.o.b. Montreal).

## Geology of Townships 137 and 138

The option was not exercised, and the property has since remained idle.

In the same area the upper part of the diabase as exposed on the banks of the Serpent River is strongly sheared, and there are numerous quartz veins dipping 40°W. (See photo on page 79).

On the east side of the river a vein 2-8 feet wide with an east strike and a vertical dip has been traced for 400 feet. When assayed in 1905 (Carter 1905, p. 65) this vein gave traces of gold and silver.

Also on the east side of the river a wide quartz vein striking slightly west of north was traced for 600 feet. (Douglas 1926, pp. 34-49 and map.)

In 1906, Corkill (1906, p. 70) states:

Northeast of Bear Lake [the former name of Kindle Lake] is a very wide quartz vein containing bunches of calcite, also small bunches of argentiferous galena, the pure galena running from 100 to 160 ounces per ton in silver, and from a trace to an ounce per ton in gold. The vein is about 20 feet wide and occurs in a diabase dike near the quartzite contact. The dikes dip at high angles from the vertical, and in them the galena is always associated with chlorite schist.

As the precise locality is not given it can be assumed that this vein is one of those already mentioned.

### SAND RIVER GOLD MINING COMPANY LIMITED

The property of this company consists of 24 unsurveyed claims lying along the Serpent River in the vicinity of Nook Lake in Townships 144 and 138 (Robertson 1961, p. 57). The seven easternmost claims lie in Township 138 north of Rangers Lake and west of Kindle Lake. The area may be reached either from Quirke Lake in Township 144 or from Whiskey Lake in Township 138.

From north to south the following formations are exposed striking east and dipping 25°S.:

- Algoman quartz monzonite.
- Middle Mississagi conglomerate and argillite.
- Upper Mississagi Quartzite.
- Bruce Conglomerate.
- Bruce Limestone.
- Espanola Greywacke.

The central part is crossed by a thick Keweenawan gabbroic sill.

The Nook Lake fault, a northwest-striking, right-hand, strike-slip fault, crosses the northern part of the property.

In 1954 diamond-drilling was carried out on the property; one deep hole and one shallow hole were located in Township 144 (Robertson 1961, p. 57), and two holes were drilled at the east end of Nook Lake in Township 137. Summary logs are given below:

HOLE N-2  
 Bearing, N.10°E.; dip, 45° (at collar)  
                                   45° (at 200 feet)  
                                   45° (at 400 feet)

Footage	Description
0-16 .....	Casing.
16-324 .....	Upper Mississagi Quartzite.
324-387 .....	Diabase.
387-400 .....	Middle Mississagi Argillite (from 338 feet—schisting, much lost core). Probable fault.
440-459 .....	Granite.
459 .....	End of hole.

HOLE N-3  
 Bearing, north; dip, 88° (collar)  
 88° (at 400 feet)

Footage	Description
0-36.....	Casing.
36-37.5.....	Diabase.
37.5-300.....	Upper Mississagi Quartzite.
300-731.....	Middle Mississagi Argillite.
731-748.....	Middle Mississagi Conglomerate.
748-817.....	Granite.
817.....	End of hole.

**SUDBURY CONTACT MINES LIMITED**

This company formerly held 28 unsurveyed claims surrounding the northwest end of Whiskey Lake in Township 138 and extending into Township 137 to the southeast of Bonamico Lake. Geological mapping and diamond-drilling were undertaken in 1954.

By 1958 one claim (on the south shore of Whiskey Lake east of the Serpent River inlet) had been transferred to Vite Uranium Mines Limited, and six others had been dropped, reducing the property to 21 unsurveyed claims. Two of these lie at the east end of the northeast bay of Kindle Lake, the remainder near the west end of the northwest arm of Whiskey Lake. The property is best reached by way of the Massey tote road and Whiskey Lake.

The claims on and south of Whiskey Lake are underlain (from north to south) by: Algomian granite and Keewatin(?) greenstone cut by Keweenawan diabase; (Whiskey Lake) Middle Mississagi Argillite; the Whiskey diabase sill and thrust fault; Middle Mississagi Conglomerate; Middle Mississagi Argillite; and Upper Mississagi Quartzite. (See cross-sections, page 52). A similar sequence up to the Whiskey diabase sill is exposed on the Kindle Lake claims, though there are exposures of Middle Mississagi conglomerate and of up to 20 feet of Lower Mississagi quartzite. Minor copper mineralization—chalcopyrite and secondary malachite and azurite—was noted in narrow quartz veins in diabase on the small island in Kindle Lake at the southwest corner of the group.

In 1954 seven drillholes were located as follows:

- W.1—1,000 feet southeast of Paddy Point.
- W.2—Paddy Point.
- W.3—800 feet west of Paddy Point.
- W.4, 5—on the south shore of Whiskey Lake, 2,000 feet east of the Serpent River Inlet.
- W.6—between Whiskey and Kindle lakes.
- W.7—500 feet northwest of hole W.3.

## Geology of Townships 137 and 138

Summary drill logs, derived from company logs submitted for assessment credit, are given below:

### HOLE W.1

Whiskey Lake level plus 45 feet.  
Bearing, N.18°E.; dip, 45° (at collar)  
42° (at 300 feet)  
40° (at 560 feet)

Footage	Description
0-8.....	Casing.
8-106.....	Upper Mississagi Quartzite.
106-481.....	Middle Mississagi Argillite (conglomerate at base).
481-484.5.....	Quartz-pebble conglomerate.
484.5-508.....	Greenstone.
508-545.....	Granite.
545-549.....	Greenstone.
549-560.....	Granite.
560.....	End of hole.

Thin diabase intrusives were recorded in the first 160 feet.

### HOLE W.2

Whiskey Lake level.  
Bearing, N.10°W., dip, 50°.

Footage	Description
0-112.....	Casing.
112.....	Hole abandoned.

### HOLE W.3

Whiskey Lake level plus 55 feet.  
Bearing, north; dip, 50° (at collar)  
46° (at 300 feet)  
41° (at 600 feet)

Footage	Description
0-7.....	Casing.
7-149.5.....	Upper Mississagi Quartzite.
149.5-853.0.....	Middle Mississagi Argillite
	181.0-199..... diabase
	379.0-384.0..... diabase
	411-430..... diabase
	694-784..... diabase
	815-820..... diabase
	831.5-853..... diabase
853.0.....	End of hole.

### HOLE W.4

Whiskey Lake level plus 33 feet.  
Bearing, N.20°E.; dip, 50° (at collar)  
41° (at 300 feet)  
39.5° (at 600 feet)

Footage	Description
0-12.....	Casing.
12-15.....	Upper Mississagi Quartzite.
15-574.....	Middle Mississagi Argillite, with thin diabase intrusions.
574-583.0.....	Middle Mississagi Conglomerate.
583.0-599.5.....	Lower Mississagi Quartzite.
599.5-645.....	Greenstone.
645-658.....	Granite.
658.....	End of hole.



## Geology of Townships 137 and 138

The greater part of the property is underlain by Keewatin(?) basic metalavas, pyroclastics, and metasediments, which strike slightly south of east and dip steeply north; these are cut by late Keewatin(?) and Keweenawan diabase intrusions.

Portions of the lavas show pillows and amygdules, which indicate that the tops face north. Other portions are massive and have a diabasic texture making it difficult to distinguish them from the later Keewatin(?), and possibly Keweenawan, diabase intrusions.

In addition to these rocks the company geologists traced a band of iron formation from the southeast corner of Township 137 into the adjacent parts of Deagle township. Further bands were picked up during the 1958 mapping. An aeromagnetic survey carried out in the district under the auspices of Technical Mine Consultants Limited and Algom Uranium Mines Limited<sup>1</sup> indicate that the zone of anomalies observed to the southwest of Pecors Lake in Township 143 (O.D.M. 1954) continues to the southeast into Township 137 then swings east following the Township 137-Deagle township boundary. Neil Massie<sup>2</sup> of Sault Ste. Marie has reported lean iron formation in Keewatin(?) sediments near the Township 137-Deagle township boundary south of Jules Lake.

The iron formation comprises low-grade magnetite and chert and quartzite in zones up to 100 feet wide. Where fractured, particularly close to contacts with diabase, the rocks are oxidized, and pyrite, pyrrhotite, and chalcopyrite are found in the fractures. Grab samples taken by company employees assayed: less than 1 percent copper, less than 1 percent nickel, and up to 4.5 percent zinc.<sup>3</sup>

Fault structures were mapped on lineaments striking either northeast or parallel to the strike of the Keewatin(?) rocks, and a post-Keweenawan age was suggested but not proven for these.

It was considered that the area did not warrant further exploration, and the ground was allowed to lapse.

### URANIUM KING CORPORATION

This company formerly held 12 unsurveyed claims in Township 138 lying north of Whiskey Lake between Cider and Sandy points.

During 1954 the company carried out a geological and geophysical exploration of the holding. The results were filed for assessment credit and are summarized below.

The central and southeastern parts of the property are largely drift covered. The west-central part is underlain by a Keweenawan basic intrusion. The rest of the property is underlain by a mixture of Keewatin(?) andesite and Algoman granitic rocks cut by Keweenawan diabase dikes, which follow a northerly direction.

Gneissic granite was only observed in the northeast corner of the property, where the vertical foliation has an easterly strike. The rest of the granite is described as a red and pink, hornblende and chlorite granite, but is cut by aplite, syenite, and quartz-porphyry dikes. Left-hand, strike-slip, easterly-striking, post-Keweenawan diabase faults were observed in the northeastern part of the property.

Sulphide mineralization was noted associated with the diabasic intrusions, but in quantities too small to be of economic significance.

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<sup>1</sup>Assessment File No. 63.419, Ont. Dept. Mines.

<sup>2</sup>Written personal communication.

<sup>3</sup>Geological report submitted by company officials for assessment credit, File No. 63A.146 Ont. Dept. Mines.

Geiger readings, indicative of possible anomalies, were recorded near the more northerly of the three faults mentioned above, and also at places where the creek flowing southwards through the property cuts through sand and gravel.

A spontaneous polarization survey was carried out in October 1954 with the hope of outlining areas possibly carrying sulphides. However, no significant anomalies were found.

No further development was undertaken, and the claims were allowed to lapse.

### **VITE URANIUM MINES LIMITED**

This company holds a total of 59 claims, originally held by Teck Exploration Company Limited, in Townships 137 and 138. These are located as follows:

Group 1—Township 137; northwest of McCool Lake; unsurveyed claims (Teck Exploration Group 51-2 and part of Group 51-3).

Group 2—Township 138; southeast of Rangers Lake and southeast of Kindle Lake; 27 surveyed claims and 1 unsurveyed claim. (Teck Exploration Groups 51-4, 51-5, 51-6.)

Group 3—Township 137; west of the north end of Batty Lake, surrounding the Whitefish Location Y.352; 20 unsurveyed claims. (Teck Exploration Batty Lake group.)

Copper-bearing sulphide showings have been known on these properties since the turn of the century (Carter 1905, pp. 62-67).

In 1951 the ground was taken up by Teck Exploration during an intensive search for copper within the area. Diamond-drilling proved disappointing, and ground was transferred to Vite Uranium Mines Limited in March 1955.

#### **Group 1—Northwest Corner of McCool and Rangers Lakes**

This group can be reached by portaging from Quirke Lake via Ouellette Lake, from May Lake in Township 144, or by using the lake system in Township 138.

The dominant rock types exposed in the area are conglomerate and intermittent, fine-grained, feldspathic quartzite of the Gowganda Formation. On the shore of McCool Lake, and in the northeast corner of the group, Serpent quartzite is also present. The westward extension of the Batty Lake diabase runs along the north boundary of the area. A second diabase, dipping steeply south and probably representing the northwestward continuation of the McCool sill, crosses the southwest corner of the area. A fracture zone filled with quartz carrying chalcopyrite is located on the north contact of the diabase. At the beginning of the century, H. E. Long discovered this vein and traced it for 6 miles from the west shore of Corner Lake, along the north shore of McCool Lake to just north of the island. (Carter 1905, p. 67.)

In 1913, Coleman (Collins 1917, p. 10E) reported that the most interesting section occurred over a length of 1 mile at the west end of McCool Lake:

Samples taken at intervals of 25 to 50 feet along the vein for several hundred feet yielded average values of  $1\frac{1}{2}$  per cent copper and from 0.02 to 0.04 ounce of gold and silver per ton.

In 1951-54, Teck Exploration Company Limited carried out trenching and diamond-drilling. The table on page 86 summarizes the data submitted for assessment credit. Ground held on the eastward extension of the vein was allowed to lapse, and the rest of the group was transferred to Vite Uranium Mines Limited in March 1955; since then no work has been done on the property.

DIAMOND-DRILLING DATA—NORTHWEST CORNER MCCOOL AND RANGERS LAKES

Hole No.	Location from Mouth of Creek	Attitude		Length	Assay		
		Azimuth	Plunge		Footage	Grade (percent)	Width (feet)
T.E.19.....	feet 270 W., 105 N.	150°	-45°	161	—	$\frac{0.13 \text{ Cu}}{20}$ (no Au, Ag)	
T.E.20.....	185 W., 185 N.	150°	-50°	185	—	$\frac{0.55 \text{ Cu}}{9}$	
T.21.....	95 W., 260 N.	155°	-55° (collar) -46° (206 ft.) -47°	206	—	$\frac{0.46 \text{ Cu}}{4.9}$	
T.22.....	20 E., 310 N.	155°	-47° (collar)	—	—	$\frac{0.93 \text{ Cu}}{7.0}$	
51-2-05.....	1,250 E., 615 N.	158°	-45°	559	—	} (only thin quartz)	
51-2-06.....	1,290 E., 525 N.	158°	-45°	300	—		
T.E.23.....	2,050 E., 755 N.	345°	-40°	2,472	—	$\frac{2.29 \text{ Cu}}{6.1}$	
T.E.24.....	2,050 E., 755 N.	345°	-82°	—	315	$\frac{0.77 \text{ Cu}}{2.5}$	
					410	$\frac{0.72 \text{ Cu}}{15.9}$	
51-3-04.....	2,052 E., 825 N.	345°	-45°	300	63.6	$\frac{10 \text{ Cu}}{5}$	
51-3-03.....	2,055 E., 745 N.	—	-90°	554	—	—	

### **Group 2—Rangers Lake-Kindle Lake**

This group is best reached by way of the Massey tote road and the lake-river system in Township 138. In the northeast corner the property is crossed by the Whiskey Lake diabase and in the centre by the dike-like northwesterly extension of the Batty Lake diabase. The property is also crossed by the southwesterly extension of the Nook Lake strike-slip fault. As there are thrust faults repeating the outcrop of the Middle Mississagi Conglomerate and Argillite on top of each of the diabase masses, the area is one of considerable tectonic disturbance.

Diamond-drilling has been carried out along the contacts of the sill-like diabase intrusions (*see figure, facing p. 85*), with negative results. An additional hole, located on the unsurveyed claim belonging originally to Sudbury Contact Mines Limited north of, and structurally below, the diabase, was completed to basement. This drilling showed that the Middle Mississagi Conglomerate rested on the basement.

Minor copper mineralization was found in fractures in the Batty Lake diabase just west of the narrows in Kindle Lake.

### **Group 3—Batty Lake**

This property is reached by trail from the north end of Batty Lake but can also be entered from the southeast end of Kindle Lake.

This group, and the Whitefish Location (*see below*) which it surrounds, straddles the outcrop of the Batty Lake diabase sill for a strike distance of  $1\frac{1}{2}$  miles. Both the east and west thirds of the property lie on Upper Mississagi quartzite, and the central part consists of the diabase with a strip of Middle Mississagi argillite repeated by thrusting along the upper contact of the diabase sill on the west flank.

The presence of copper on the Whitefish Location had been known since early in the century (Carter 1905, pp. 62-67), but during their exploration of the area, Teck-Hughes Gold Mines Limited discovered further showings about  $\frac{1}{2}$  mile west of the north end of Batty Lake.<sup>1</sup>

Here Lower Mississagi quartzite, and Middle Mississagi conglomerate and argillite are repeated above the diabase. The diabase has been impregnated with albite and disseminated sulphides. The quartzite has been albitized so that at first sight it resembles an albitite, the conglomerate is sericitized taking on a yellow-green colour, and the argillite albitized and partially replaced by pyrite along the bedding planes.

The area was mapped in 1951, and the mineralization was traced in a belt 12 feet wide for a strike length of 300 feet. Drilling was carried out in 1952.

The drilling indicated the presence of copper grading up to 3 percent in zones in the diabase and altered argillite as indicated on the figure facing this page. (Reproduced by permission of Teck Exploration Co. Ltd.)

These zones have a general strike of N.10°W., which is parallel to the axis of the syncline. There is some evidence that an anticlinal roll with this strike passes through the area.

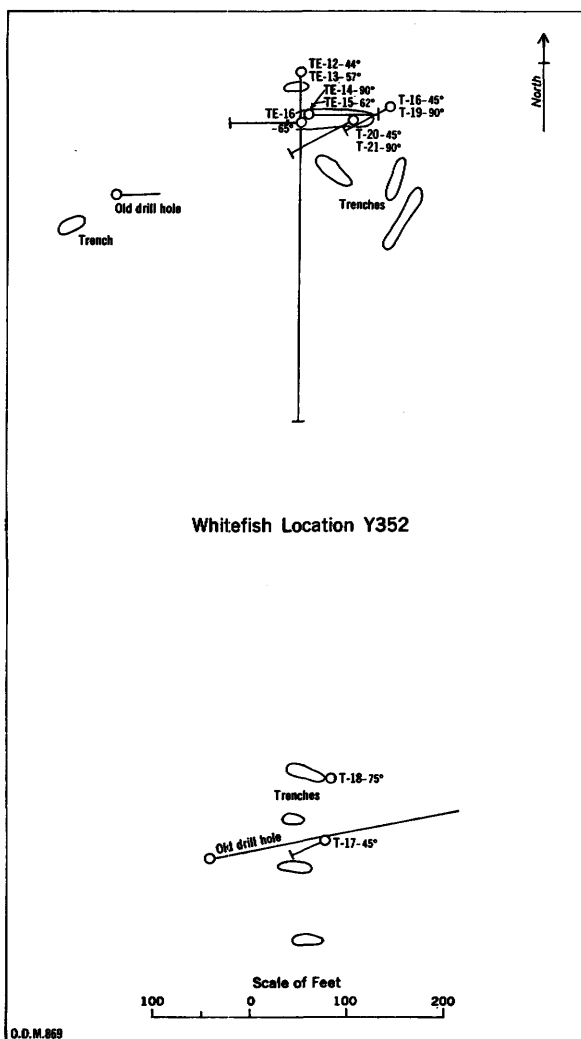
### **WHITEFISH LOCATION Y.352**

As indicated above, this group lies on the Batty sill. The copper showings discovered in 1905 by J. A. Montague lie some  $\frac{3}{4}$  mile south of the Batty showing, on the westward slope of a high ridge of quartzite capped by diabase forming the west shore of south Batty Lake.

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<sup>1</sup>Teck Exploration Co. Ltd., company reports.

## Geology of Townships 137 and 138



Development work on Whitefish Location Y.352, west of Batty Lake. (From information from Teck Exploration Co. Ltd.) Hole T-17 (southernmost showing) is located about 2,100 feet on a bearing of N.42°E. from the south end of the Batty Lake-Kindle Lake portage system. In addition to the collar No. the dip of the collar is given.

Development including pitting, stripping, and drilling was carried out in 1905-6.

In 1917, Collins (1917, pp. 9E, 10E) reported:

The copper deposits on this claim are situated near the top of the southwest slope of a diabase ridge, 200 feet high, that extends along the southwest side of Whitefish lake [former name for Batty Lake]. They form a series of lenticular mineralized fractures in the diabase. Each fracture strikes about 100 degrees and is offset about 25 feet south from its neighbour to the west, so that a line passing through the middle of each runs at 160 degrees. They dip 45 to 50 degrees southwest, being only 10 to 15 degrees steeper than the side of the diabase ridge. Three lenses have been uncovered, 35 feet apart, each of which has been test-pitted for 1 to 4 feet deep and can be traced along the surface for a few yards. The largest shows ore for a maximum width of 8 feet and a length of 25 feet. They are filled with angular fragments of diabase cemented together by a

mixture of quartz, ankerite, chalcopyrite, and pyrite deposited in the order in which they are named. This ore carries about 2 per cent copper but can be concentrated by hand-sorting to about 10 per cent. A general sample taken from the largest of the three lenses and assayed by Thos. Heys and Son, Toronto, yielded 0.16 ounce gold per ton, in addition to the copper.

No further work was done until Teck Exploration investigated the area in 1951-52.

Considerable development, including mapping, trenching, and drilling, was carried out.

Full details of the drilling are not available, but the following information on mineralized intersections was obtained. (*For locations of holes see figure, p. 88*).

**COPPER ASSAYS—WHITEFISH COPPER PROSPECT**  
(Information from files of Teck Exploration Co. Ltd.)

Hole	Width of Intersection		Grade (copper)	
	feet		percent	
TE-15.....	70		1.01	(locally up to 4.85)
TE-16.....	190		0.3	
T-19.....	no mineralization			
T-20.....	85		0.606	
T-21.....	35		0.35	

Even with the high price of copper during the Korean war, it was not considered feasible to work the deposit.

In 1954 a series of short holes were collared on the company's claims (Group 51-9) on the east shore of Batty Lake, in the vicinity of the entry to the south portage leading to Whiskey Lake and of the headlands immediately to the south. These holes were collared in gritty to pebbly quartzite. Core showed only slight radioactivity, and no samples were assayed.

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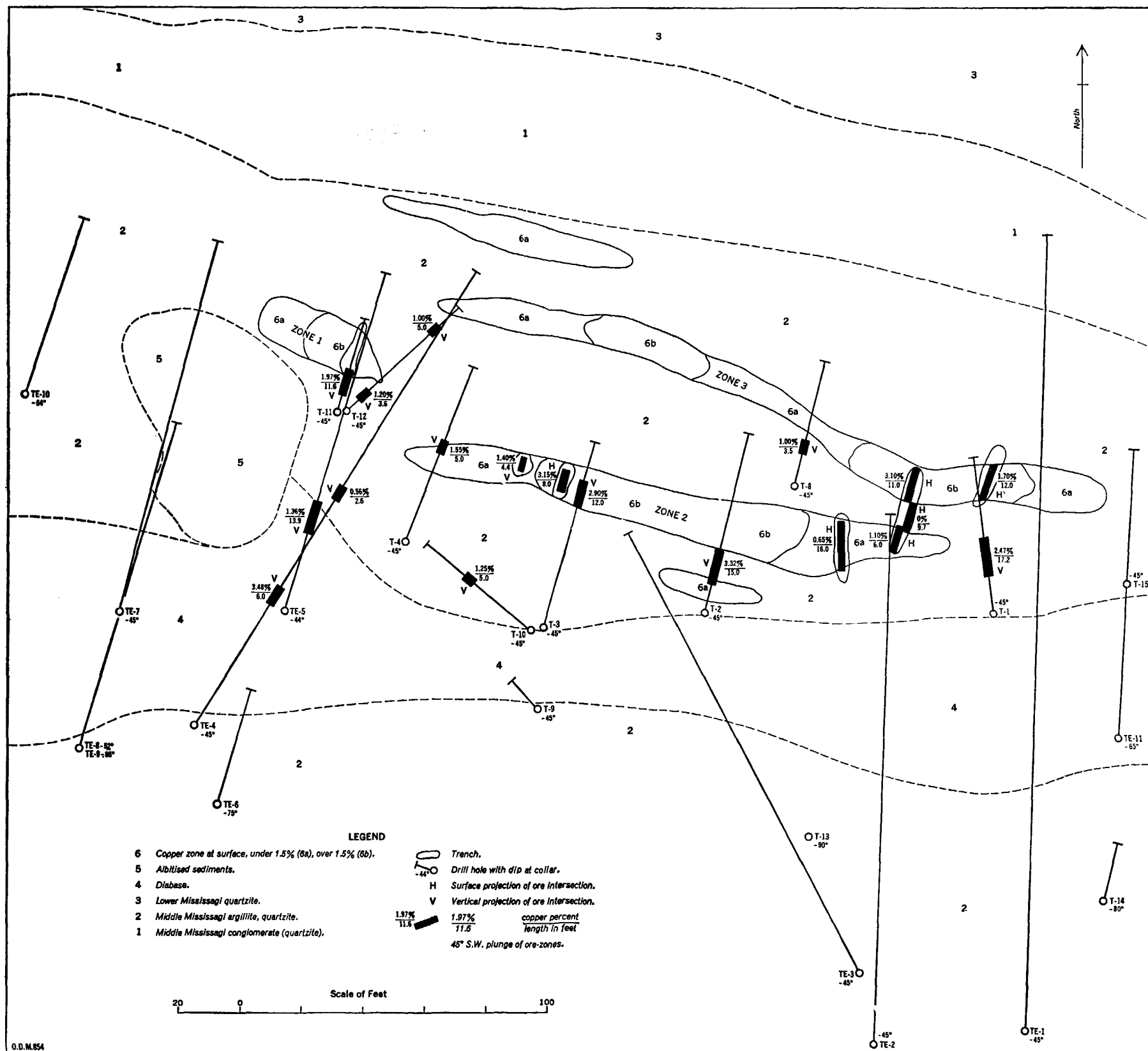
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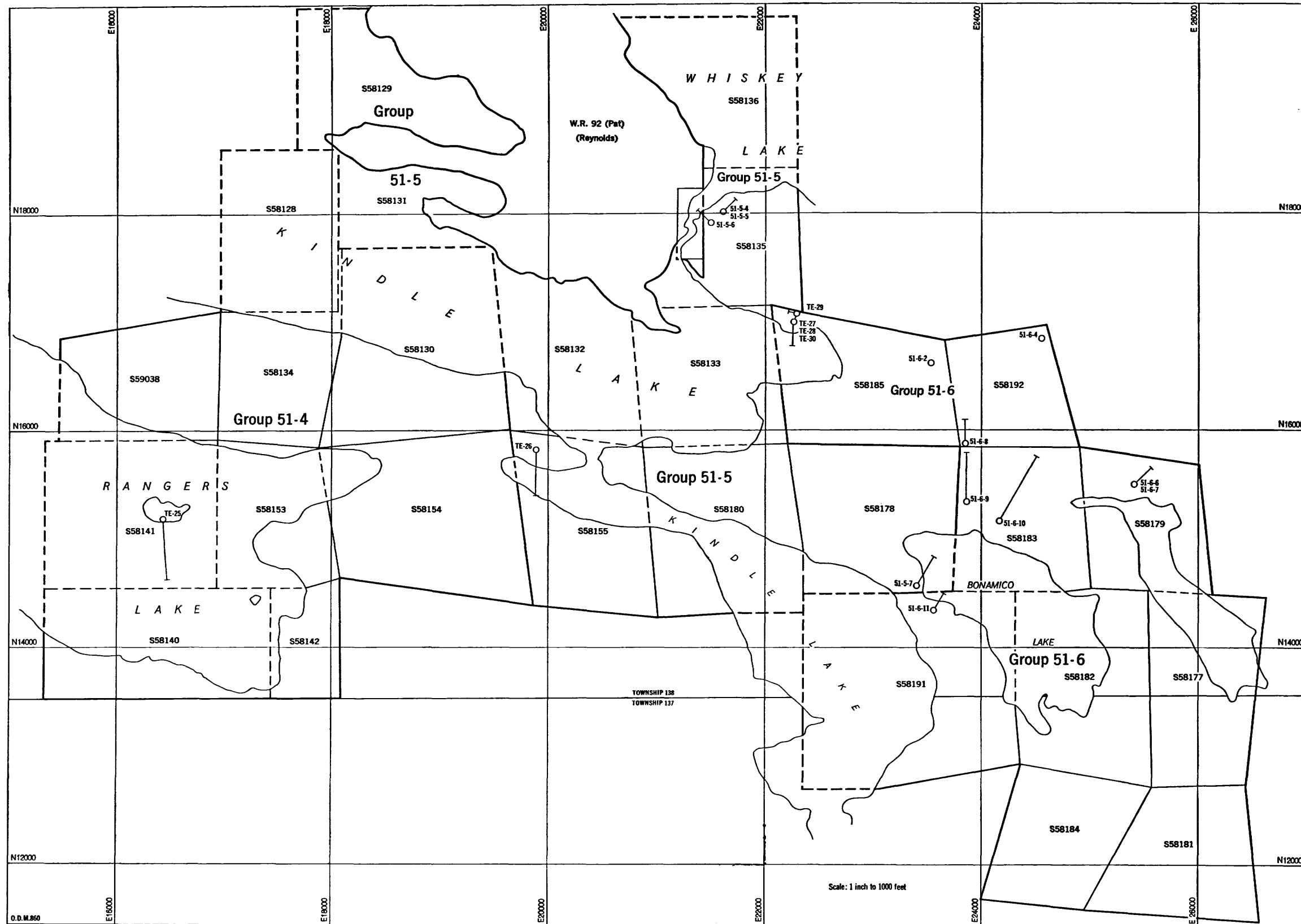
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Vite Uranium Mines Limited, Batty Lake Copper Property  
(From Teck Exploration Co. Ltd.)

The trench north of hole T-1 is located about 1,900 feet on a bearing of N.21°W.  
from the mouth of the creek at the north end of Batty Lake.

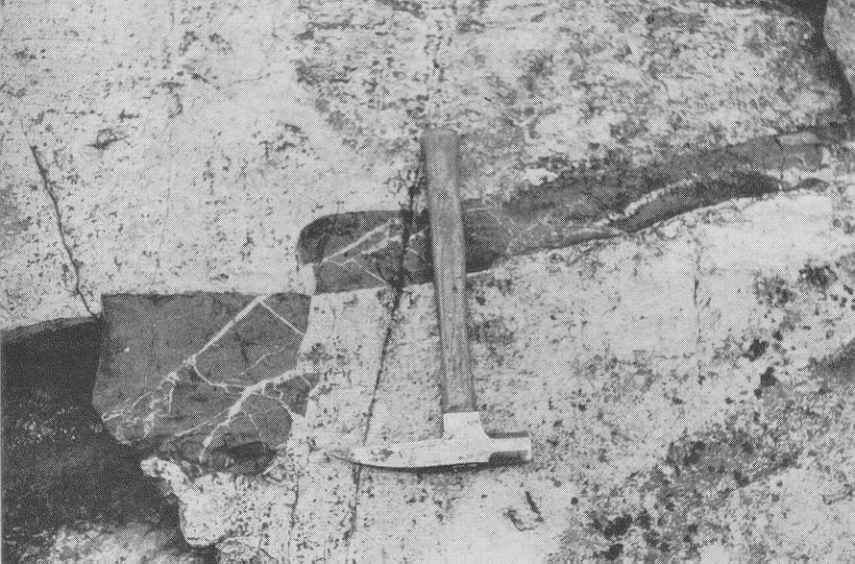
DRILLHOLE DATA AND LOCATIONS—TECK EXPLORATION COMPANY LIMITED—RANGERS LAKE—KINDLE LAKE



Hole No.	Elevation at Collar above Whiskey Lake	Dip		Total Length	Notes
		At Depth	Inclination		
GROUP 51-4: TE-25	feet	feet	degrees	742.0	0-100 feet fractured diabase with blebs of chalcopyrite.
	—	collar	45		
		250	45		
		500	43		
		735	36		
GROUP 51-5: 51-5-4	5	—	90	403	Considerable lost core.
51-5-5	5	collar 200	55 58	303	No significant mineralization.
51-5-6	95	collar 200	60 53	200	At 35 feet, 5-foot zone: Au.....nil Ag.....nil Cu.....0.36 percent Ni.....nil
51-5-7	103	collar 380	45 37	402	Slightly radioactive pebble bands. At 60.5 feet, 5-foot quartz vein up to 5 percent chalcopyrite.
TE-26	—	collar 500 740	50 50 50	740	At 209.8 feet, minor chalcopyrite in quartz vein.
GROUP 51-6: 51-6-2	301	—	90	704	Diabase with thin lamprophyre and barren quartz veins.
51-6-4	96	—	90	700	Granite basement at 658 feet.
51-6-6	215	—	90	400	No quartz veins.
51-6-7	215	collar 275	45 44	305	No quartz veins.
51-6-8	169	collar 300	45 37	300.8	Minor disseminated chalcopyrite.
51-6-9	95	collar 300 525	45 39 37	607	Disseminated, pyrite, pyrrhotite, and chalcopyrite in argillite.
51-6-10	93	collar 300 600 800	45 40 35 31	800	Minor disseminated sulphide in diabase at 11-220.3 feet; in argillite and quartzite down to 600 feet.
51-6-11	109	collar 150	45 46	241	Minor disseminated sulphide and radioactivity in MUq.
TE-26	—	collar 500 740	50 50 50	740	Minor chalcopyrite in 0.5-foot quartz vein at 209.8 feet.
TE-27	—	collar	45	114.0	At 70.9-75 feet, quartz vein with galena, chalcopyrite; disseminated chalcopyrite in diabase.
TE-28	—	collar	75	204	No quartz veins.
TE-29	—	collar	45	88	At 31.0-34.7 feet, quartz vein; galena in fractures.
TE-30	—	collar	50	340	At 236.1-237.0 feet, quartz-calcite vein; minor chalcopyrite.











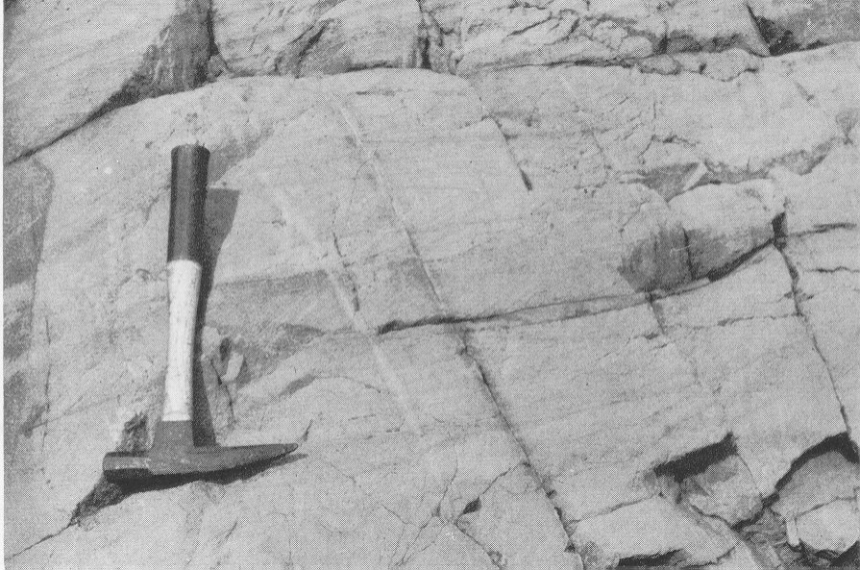










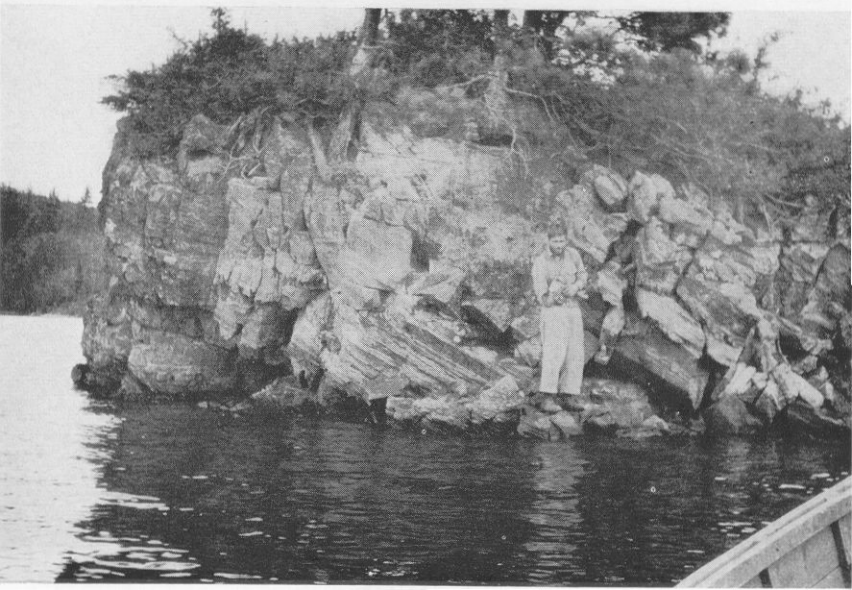




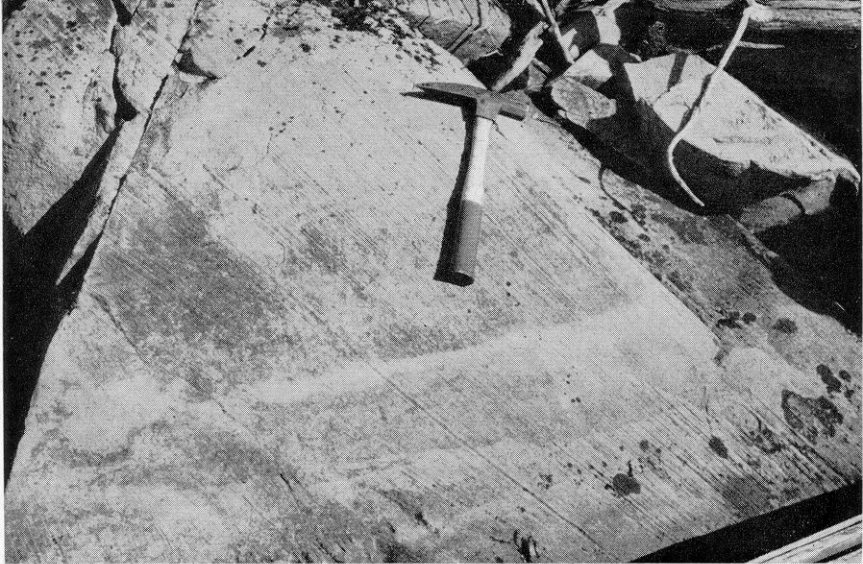




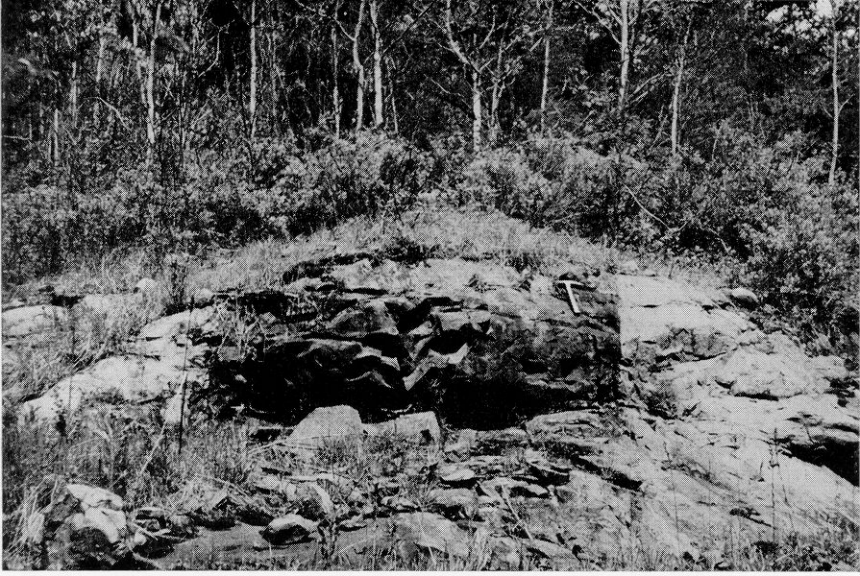






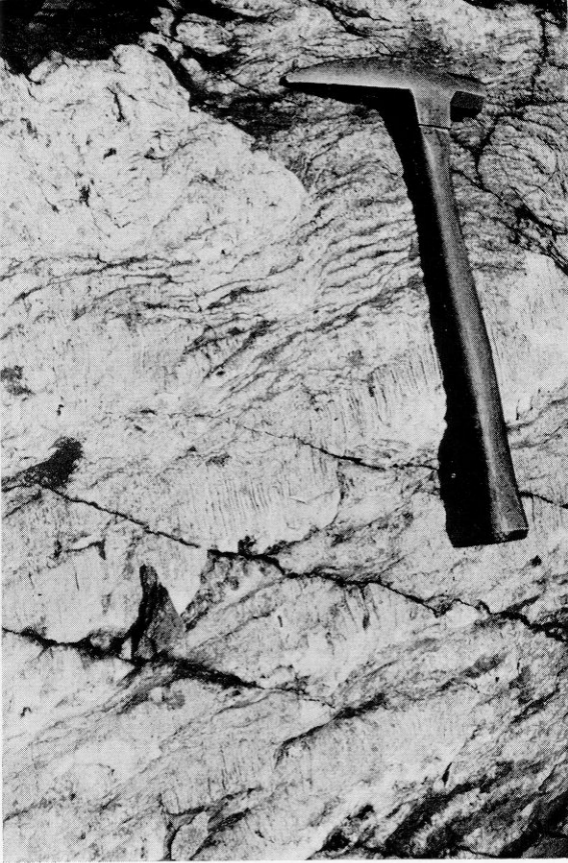










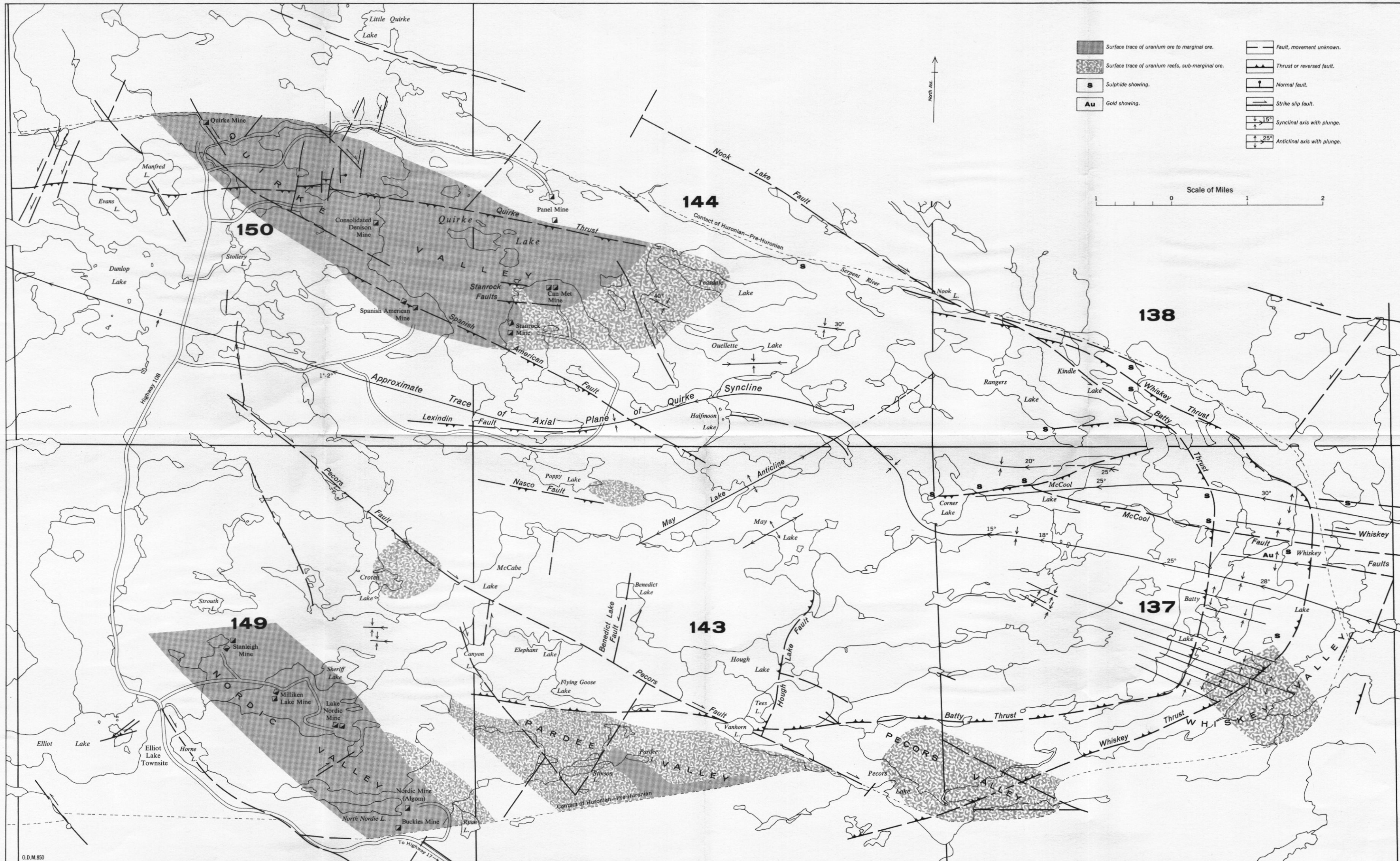




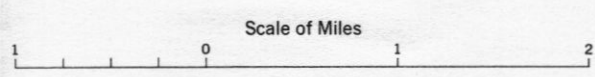








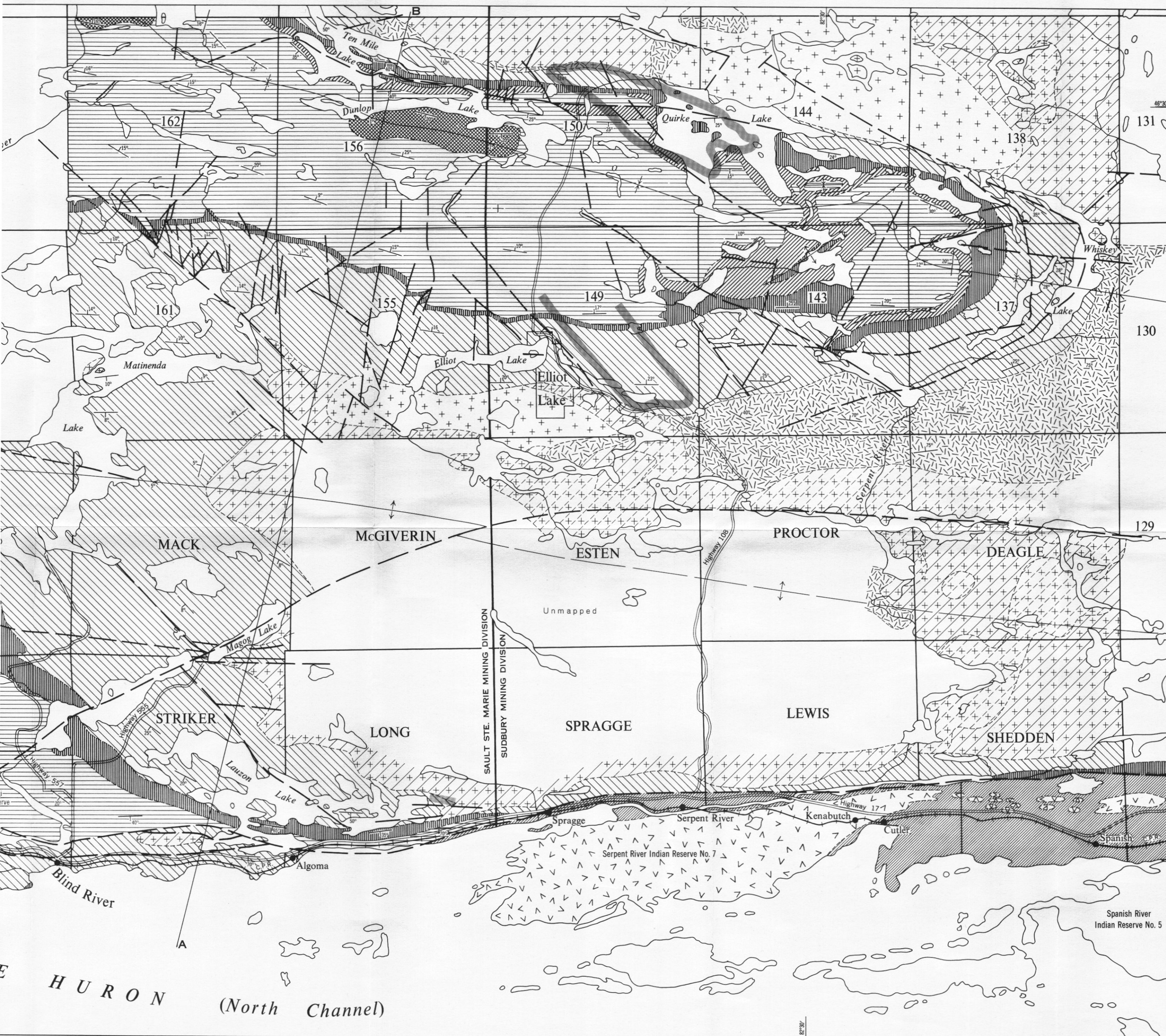
	Surface trace of uranium ore to marginal ore.		Fault, movement unknown.
	Surface trace of uranium reefs, sub-marginal ore.		Thrust or reversed fault.
	Sulphide showing.		Normal fault.
	Gold showing.		Strike slip fault.
			Synclinal axis with plunge.
			Anticlinal axis with plunge.



Structure and Mineral Deposits of the Quirke Syncline

O.D.M.850

**BLIND RIVER AREA  
Geological Sketch Map**



**LEGEND**

- PRECAMBRIAN**
- PROTEROZOIC**
- Huronian
- Cobalt Group
    - Lorrain Formation.
    - Gowganda Formation.
  - Bruce Group
    - Serpent Formation.
    - Bruce-Espanola Formations.
    - Mississagi Formation.
- ARCHEAN**
- Cutler granite.
  - Massive granite.
  - Gneissic granite.
  - Granite with inclusions.
  - Sudbury Group
    - Sediments and volcanics.
  - Keewatin Group
    - Volcanics and sediments.

**SYMBOLS**

- Geological boundary.
- Horizontal bedding.
- Strike and dip of bedding.
- Synclinal axis.
- Anticlinal axis.
- Direction of plunge of fold axis.
- Fault.
- Approximate ore assay boundary of uraniferous pebble conglomerate.

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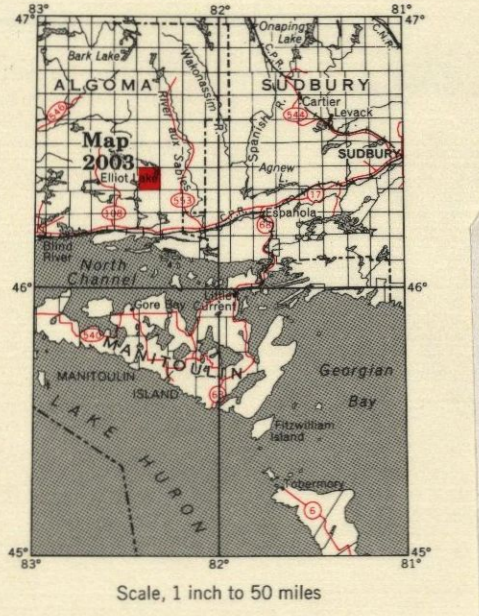
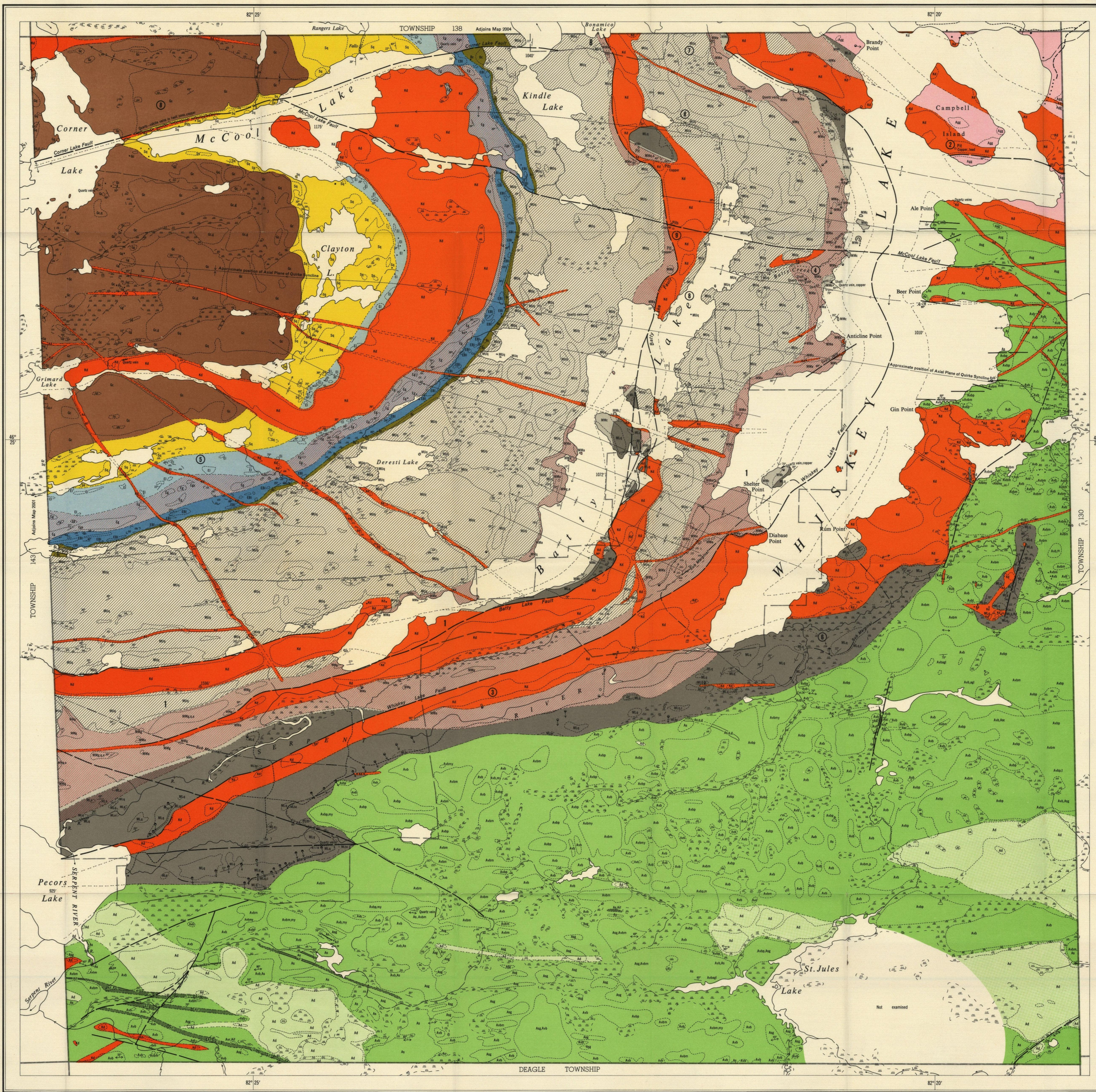
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Sketch Map showing the Geology of the Blind River Area, District of Algoma, Ontario



- LEGEND**
- CENOZOIC**
- RECENT\***  
Sediment and stream deposits.
- PLEISTOCENE\***  
Sand, gravel and clay.
- GREAT UNCONFORMITY**
- PRECAMBRIAN**
- PROTEROZOIC**
- KEEWATIN**
- Ke: Diabase, gabbro and diorite, cut by later acidic and basic dikes.
- INTRUSIVE CONTACT**
- HURONIAN**
- COBALT GROUP**
- SONWANDA FORMATION**
- Sc: Pyroclastic conglomerates with or without interbedded quartzite, gneissic, argill. or siliceous quartzite, or without interbedded conglomerates, gneissic, or gneissic, siliceous, argill. with or without some conglomerates and quartzite.
- UNCONFORMITY**
- BRUCE GROUP**
- SERPENT FORMATION**
- Sr: Amphibolite, quartzite, subvolcanic.
- CONFORMABLE CONTACT**
- ESPANOLA FORMATION**
- Es: Diabase, gabbro and interbedded sil. argill. or siliceous quartzite.
  - Es: Diabase, gabbro and interbedded sil. argill. or siliceous quartzite.
  - Es: Diabase, gabbro and interbedded sil. argill. or siliceous quartzite.
- CONFORMABLE CONTACT**
- BRUCE FORMATION**
- Bf: Polymictic conglomerates.
- CONFORMABLE CONTACT**
- MISSISSAUG FORMATION**
- Ms: Limestone with some interbedded sil. argill. or siliceous quartzite.
- CONFORMABLE CONTACT**
- UPPER MISSISSAUG**
- Mu: Pelitic quartzite, gill and argill.
- MIDDLE MISSISSAUG**
- Md: Gneissic quartzite with minor argill. and sil. argill.
  - Md: Quartzite with minor gneissic and argill.
  - Md: Argillite, siltstone, with minor gneissic.
  - Md: Pelitic conglomerates.
- LOWER MISSISSAUG**
- ML: Argillite, siltstone, gneissic.
  - ML: Pelitic quartzite, argill. or siliceous quartzite, with minor argill. and sil. argill.
  - ML: Diagenetic (quartz-poor) conglomerates.
  - ML: Interbedded basal gneissic conglomerates and argill.
- GREAT UNCONFORMITY**
- ARCHAIC**
- Ar: Granitic gneiss, etc.
- ALGOMAN**
- Ag: Massive granite, granodiorite, and other rock types with or without basic intrusions.
  - Ag: Massive granitic porphyry.
- INTRUSIVE CONTACT**
- Ag: Variable massive to granitic, granodiorite, and other rock types, with or without basic intrusions, cut by later acidic and basic dikes.
- INTRUSIVE CONTACT**
- KEEWATIN ?**
- K: Gabbro, amphibolite, diabase.
- INTRUSIVE CONTACT**
- Sediments\*\*\*\***
- As: Undifferentiated sediments.
  - As: Conglomerate.
  - As: Gneissic quartzite.
  - As: Quartzite.
- Volcanics\*\*\*\***
- Av: Rhyolite.
  - Av: Andesite.
  - Av: Undifferentiated basic volcanics.
  - Av: Basalt.
  - Av: Massive basalt.
  - Av: Basaltic breccia.
  - Av: Basaltic tuff.
  - Av: Basaltic sandstone.
  - Av: Basaltic siltstone.
  - Av: Basaltic shale.
  - Av: Basaltic sandstone.
  - Av: Basaltic siltstone.
  - Av: Basaltic shale.
- Iron Formations\*\*\*\***
- IF: Lean iron formation.

- SYMBOLS**
- Triangulation station.
  - Approximate altitude in feet above mean sea level.
  - Musking or swamp with boundary.
  - River, creek, stream, R-rapid.
  - Motor road.
  - Wagon road.
  - Trail, path, winter road.
  - Local mine.
  - Small rock outcrop.
  - Boundary of rock outcrop.
  - Geological boundary, defined.
  - Geological boundary, assumed.
  - Strike and dip.
  - Strike and vertical dip.
  - Direction in which flow flows as indicated by shape of pillow.
  - Synclinal axis; plunge in direction of arrow.
  - Anticlinal axis; plunge in direction of arrow.
  - Strike and dip of schistosity.
  - Strike of schistosity, dip unknown.
  - Fault, defined, with dip.
  - Fault, indicated or assumed.
  - Fault, defined; arrows indicate horizontal movement.
  - Building.
  - Shaft, vertical.
  - Test pit.
  - Drill hole, inclined and vertical, which intersects unconsolidated quartz pebbles conglomerate of marginal to sub-marginal grade.
  - Drill hole, inclined and vertical, which intersects siliceous quartz pebbles conglomerate.
  - Drill hole, inclined and vertical, not completed to pre-Huronian basement rock.
  - Assumed boundary of unconsolidated quartz pebbles conglomerate of marginal to sub-marginal grade.
  - Township boundary, approximate location.
  - Mining property boundary, approximate location. Some properties are not outlined.
  - Location of mining property, surveyed. See list of properties.
  - Location of mining property, unsurveyed. See list of properties.

- LIST OF PROPERTIES**
1. Algoma Uranium Mines Ltd.
  2. Campbell Island.
  3. Northway Uranium Mines Ltd.
  4. Pagan Project.
  5. Pagan Uranium Mines Ltd.
  6. J.A. Paganite.
  7. Sudbury Contact Mines Ltd.
  8. Site Uranium Mines Ltd.
  9. Whitson Location.

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

\*\*Basalt developed during EPOCHAN interval.

\*\*\*\*Unbedded outcrops of basic rocks may be either late Keweenaw intrusions (K) or massive basic lava (L).

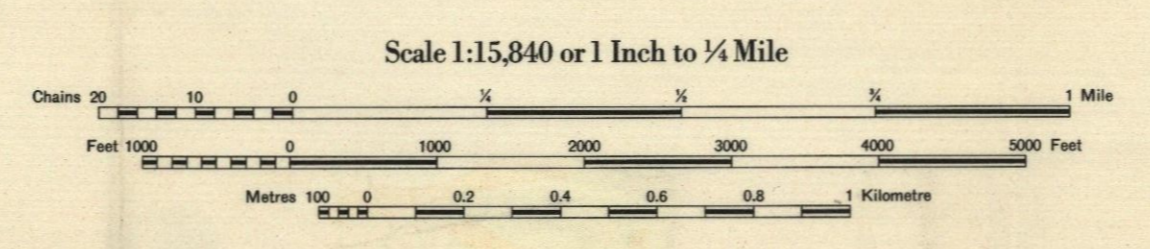
\*\*\*\*\*Unbedded rocks.

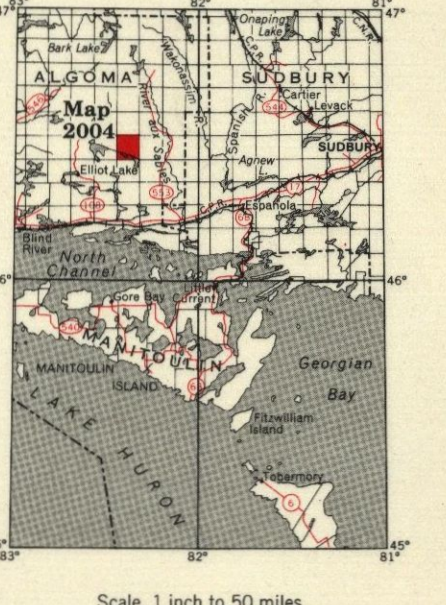
†††††These rocks are not mapped on the sheet area.

**SOURCES OF INFORMATION**

Geology by J. A. Robertson and assistants, 1955.  
 Cartography by M. S. Cox and R. B. Robinson, Ontario Department of Mines, 1965.  
 Base map derived from maps of the Forest Resources Inventory, Ontario Department of Lands and Forests, with amendments by J. A. Robertson.  
 The magnetic declination in this area was approximately 6° W. 1955.

**Map 2003**  
**TOWNSHIP 137**  
 DISTRICT OF ALGOMA, ONTARIO





Scale: 1 inch to 50 miles

**LEGEND**

- CENOZOIC**
- RECENT\***  
Swamp and stream deposits.
- PLEISTOCENE\***  
Sand, gravel and clay.
- GREAT UNCONFORMITY**
- PRECAMBRIAN**
- PROTEROZOIC**
- KEEWENAW**  
Kd Diabase, gabbro and diorite, cut by later acidic and basic dikes.
- INTRUSIVE CONTACT**
- HURONIAN**
- COBALT GROUP**  
COBALT FORMATION  
Cg Polymorphic conglomerates with or without interbedded quartzite, greywacke, argill. sh. (includes units with or without interbedded conglomerate, greywacke, argill. sh. with some conglomerate and quartzite).
- BRUCE GROUP**  
SERPENT FORMATION  
Ss Helvetic quartzite, subgreywacke.
- CONFORMABLE CONTACT**
- ESPANGULA FORMATION**  
Espangula Limestone  
E1 Diabasic siltstone and interbedded silt. sh.  
E2 Diabasic siltstone shales.  
Espangula Greywacke  
E3 Carbonaceous argillite, siltstone, greywacke.  
E4 Carbonaceous argillite, siltstone, greywacke.  
E5 Polymorphic conglomerate shales.
- BRUCE LIMESTONE**  
B1 Limestone with some interbedded silt. sh.
- CONFORMABLE CONTACT**
- BRUCE FORMATION**  
B2 Polymorphic conglomerate.
- CONFORMABLE CONTACT**
- MESSISSAG FORMATION**  
Upper Messissag  
M1c Helvetic quartzite, gill and argill.  
Middle Messissag  
M1a Greywacke with minor argillite and silt. sh.  
M1b Quartzite with minor greywacke and argill. sh.  
M1d Argillite, siltstone, with minor greywacke.  
M1e Polymorphic conglomerate.
- Lower Messissag**  
M2a Argillite, siltstone, greywacke.  
M2b Helvetic quartzite, argillite, including some lenses of polymorphic conglomerate.  
M2c Chloritic (quartz-poor) conglomerate.  
M2d Interbedded basic greywacke conglomerate (thin siltstone).
- GREAT UNCONFORMITY**
- ARCHAIC**  
A1c Granite gneiss\*\*
- ALGOMAN**  
A1 Massive granitic, granodioritic, and allied rock types with or without basic intrusions.  
A2 Massive granitic gneiss.
- INTRUSIVE CONTACT †**  
A3 Variable masses of granitic gneiss, granodiorite, and allied rock types with or without basic intrusions, cut by acidic dikes.
- INTRUSIVE CONTACT**
- KEEWATIN †**  
K1 Gabbro, amphibolite, diabase,\*\*\*
- INTRUSIVE CONTACT**
- Sediments\*\*\*\***  
S1 Unconsolidated sediments.  
S2 Consolidated argill. sh.  
S3 Quartzite.
- Volcanics\*\*\*\***  
V1 Rhyolite.  
V2 Undifferentiated basic volcanics.  
V3 Basic gneiss (V1, V2, V3).  
V4 Amphibolite (V1, V2, V3).  
V5 Iron Formation\*\*\*\*
- Iron Formation\*\*\*\***  
I1 Lean iron formation.

- SYMBOLS**
- 1040' Approximate altitude in feet above mean sea level.
  - Musking or swamp with boundary.
  - River, creek, stream, F-rills.
  - Motor road.
  - Highway road.
  - Trail, portage, winter road.
  - Glacial striae.
  - Small rock outcrop.
  - Boundary of rock outcrop.
  - Geological boundary, defined.
  - Geological boundary, assumed.
  - Strike and dip.
  - Strike and vertical dip.
  - Strike and dip of schistosity.
  - Strike and vertical schistosity.
  - Strike and dip of gneissosity.
  - Fault, defined, with dip.
  - Fault, indicated or assumed.
  - Building.
  - Shaft, vertical.
  - Drill hole, inclined and vertical, which intersects sites for no unambiguous quartz-poor conglomerate.
  - Drill hole, inclined and vertical, not completed to pre-Huronian basement rock.
  - Network of quartz veins.
  - Township boundary, approximate location.
  - Mining property boundary, approximate location. Some properties are not outlined.
  - Location of mining property, surveyed. See list of properties.
  - Location of mining property, unsurveyed. See list of properties.

- LIST OF PROPERTIES**
1. Brantley Mines Ltd.
  2. Carleton Location.
  3. Reynolds Location.
  4. Sudbury Contract Mines Ltd.
  5. Vile Uranium Mines Ltd.

\*The Recent and Pleistocene deposits are not differentiated on this map. They occur in areas not mapped as outcrop.  
\*\*Based on developed during Gneissic interval.  
\*\*\*Included outcrops of basic rocks may be other than Keweenaw intrusions (K1) or massive basic lava (K2).  
\*\*\*\*Unconsolidated rocks.  
†These rocks are not mapped on the sheet area.

**SOURCES OF INFORMATION**  
Geology by J. A. Robertson and associates, 1988.  
Cartography by G. Curtis, Ontario Department of Mines, 1980.  
Base map derived from maps of the Forest Resources Inventory, Ontario Department of Lands and Forests, with amendments by J. A. Robertson.  
The magnetic declination in this area was approximately 4° W. 1988.

Map 2004  
**TOWNSHIP 138**  
 DISTRICT OF ALGOMA, ONTARIO

