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Geology of the
Cutler Area
District of Algoma

By
J. A. Robertson

1977

Ministry of Natural Resources

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ABSTRACT

This report describes the stratigraphy, structure, and economic geology of the following areas: Proctor, Lewis, Deagle, and Shedden Townships; parts of I.R.5 and I.R.7; and islands in Lake Huron lying south of Lewis and Shedden Townships.

SMC 13486

Figure 1–Key map showing location of Cutler report-area. Scale 1 inch to 50 miles (1:31,680).

The Murray Fault divides the area into two distinct geological areas. Much of the area north of the Murray Fault is underlain by Algoman granitic rocks. Also, the oldest rocks, the Keewatin-type metavolcanics and metasediments are exposed in northern Deagle and Proctor Townships, and form the continuation of a "greenstone" belt underlying the eastern end of the Quirke Syncline. The area south of the Murray Fault is dominated by Huronian metasediments.

The following groups of the Huronian Supergroup are present in the report-area; the Elliot Lake, Hough Lake, Quirke Lake and Cobalt Groups.

Nipissing Diabase (radiometric age 2,100 million years) intrudes the Keewatin-type, Algoman and Huronian rocks. South of the Murray Fault this diabase was folded and metamorphosed during the Hudsonian-Penokean Orogeny.

The Cutler Granite (radiometric age 1,750 million years) was emplaced south of the Murray Fault as a Late Hudsonian-Penokean orogenic event. The two-mica Cutler Granite is quartz-rich and characterized by an abundance of pegmatite.

Northwest-trending olivine diabase dikes of probable Keweenawan age (1,170 million years) cut all the Precambrian rocks in the report-area.

The area has been extensively examined for radioactive materials, base metals, iron-formation, industrial minerals (such as quartz and "trap-rock") and sand and gravel. A copper showing at

Black Lake, Shedden Township has been examined several times by prospectors. Diamond drilling on the showing was undertaken in 1966. Exploration for uranium was reactivated during the years 1967 and 1968. The Huronian rocks north of the Murray Fault are influenced by a basement high and appear to be unfavourable for uranium exploration. South of the Murray Fault diamond drilling was in progress (July 1968) to test for a repetition of an horizon known to be favourable to uranium mineralization.

Geology

of the

Cutler Area[1]

District of Algoma

by

James A. Robertson[2]

INTRODUCTION

During the 1964 and 1965 field seasons, geological field parties of the Ontario Division of Mines[3] carried out geological mapping in the Cutler area under the author's supervision. This mapping was part of a long-term program designed to correlate the rocks of the "Original Huronian" of the Bruce Mines-Elliot Lake area with the rocks of the Sudbury-Espanola area. In 1964 Lewis and Proctor Townships were mapped, and in 1965 Deagle and Shedden Townhips, the eastern half of I.R.7 (Serpent River Indian Reserve), the western part of I.R.5 (Spanish River Indian Reserve), and the adjacent islands in the North Channel of Lake Huron, were mapped. Preliminary maps were made available to the public at a scale of 1 inch to 1,320 feet (1:15,840), (Robertson and Fraser 1964a,b; Robertson and Johnson 1965; Robertson 1965a, b, c).

The report-area lies 80 miles (130 km) west of Sudbury and 106 miles (169.6 km) east of Sault Ste. Marie. It is served by the Canadian Pacific Railway (Sault Ste. Marie spur line) and by Highway 17 (the Trans Canada Highway). Elliot Lake is connected to Highway 17 by Highway 108 near the southwestern corner of Lewis Township. Highway 108 runs in a northerly direction close to the western margin of the report-area. Aircraft use the Elliot Lake airstrip which is located north of Depot Lake.

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[1]Manuscript written in 1968; approved for publication by the Chief Geologist 14 January 1969, and revised in 1974.

[2]Chief, Mineral Deposits Section, formerly field geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Toronto.

[3]The Ontario Division of Mines was created when the Ontario Government was reorganized into various large ministries on 1 April, 1972.

The principal communities are Serpent River in southwestern Lewis Township, Cutler at the head of Aird Bay on I.R.7, and the town of Spanish in southeastern Shedden Township.

Industry in the report-area is restricted to small-scale farming and lumbering and a seasonal tourist industry. An acid plant, formerly operated by Noranda Mines Limited at Cutler, is dismantled. In the early twentieth century lumbering was a major industry and lumber mills were located at Buswell Bay, Cutler, Spanish, and on John and Aird Islands. Two hundred men used to sort logs at the mouth of the Spanish River.

Prospecting has been undertaken along the North Shore of Lake Huron since the discovery of copper at Bruce Mines in 1846. Following the discovery of the Pronto Uranium deposit in 1953, the southern parts of Shedden and Lewis Townships were staked and examined for uranium: John and Aird Islands and the adjacent islands in the Whalesback Channel were also examined for uranium.

In 1964 prospecting activity centred on low-grade iron formation in northwest Proctor Township and on quartz-chalcopyrite veins in Lewis and Shedden Townships. Further prospecting, including stripping and trenching, was carried out on the latter localities in 1966. In 1966-1967 some diamond drilling was carried out on the Black Lake copper showing in Shedden Township by Gradore Mines Limited. In 1967 and 1968 exploration and prospecting for uranium was resumed in the map-area.

A sufficient amount of sand and gravel exists in the area to allow maintenance of gravel roads. In 1960 Albert Hopkins of Toronto investigated trap rock from the peninsula at the west side of Shoepack Bay on I.R.5 for road metal. The investigation was abandoned because cheaper sources of trap rock exist elsewhere.

Field parties used standard methods to map the geology. In Proctor and Deagle Townships and the northern parts of Lewis and Shedden Townships traverses were run at intervals of between ¼- and ½-mile (0.4 and 0.8 km). In southern Lewis and Shedden Townships and on the Indian Reservations traverses spaced about ¼-mile (0.4 km) intervals were controlled by geological structure. The shoreline of the North Channel and the islands in Lake Huron were mapped in detail. The field data were plotted, at an approximate scale of 1 inch to 1,320 feet (1:15,840), on transparent acetate sheets attached to aerial photographs (flown in 1957 for the western part of the report-area, and in 1959 for the remaining part of the report-area). Control was provided by readily identifiable points.

A sketch master was used to transfer the original data from the acetate sheets to scale-corrected cronaflex base maps prepared by the Cartographic Section, Division of Lands, Ontario Ministry of Natural Resources.

The following preliminary maps, at a scale of one inch to 1,320 feet (1:15,840) are available to the public: P.245, Proctor Township; P.246, Lewis Township; P.317, Deagle Township; P.318, Shedden Township; P.319, I.R.7 (east half) and Off-shore Islands; P.320, I.R.5 (west part), and Off-shore Islands.

The entire report-area is covered by Map P.304, Blind River-Elliot Lake Sheet of the Geological Compilation Series, a preliminary map at scale of 1 inch to 2 miles 1:126,720) which was superseded in 1967 by Map 2108 Sault Ste. Marie-Elliot Lake Sheet of the Geological Compilation Series (Giblin and Leahy 1967), a coloured map at a scale of 1 inch to 4 miles (1:253,440). Another map, compiled by J. A. Robertson in 1971, is the 1971 revision of Preliminary Map P.304 (see Robertson, Giblin and Leahy 1971).

Acknowledgments

The following persons took part in the field work as indicated:

1964; Proctor and Lewis Townships: J. A. Robertson, M. B. Fraser, P. Kingston, B. St. John, and M. White. Mr. Fraser was responsible for the mapping of Proctor Township; Messrs. Fraser and Kingston were responsible for the mapping of most of Lewis Township. Robertson mapped the southern part of Lewis Township and compiled the maps. Kingston undertook the drafting of the maps.

1965; Deagle and Shedden Townships, I.R.7 (east half), I.R.5 (west part), and the Off-shore Islands: J. A. Robertson, J. M. Johnson, J. Wood, R. Thompson, B. Ashford, and S. Martin. The mapping of Deagle Township was done by J. M. Johnson; the mapping of the northern half of Shedden Township, by Messrs. Johnson and Wood. Wood mapped the southern part of Shedden Township and the author the rest of the report-area. The author compiled the maps and the drafting was performed by Messrs. Ashford and Martin.

During the winter of 1966-1967 examination of thin sections from the Cutler area was carried out by J. Wood.

Local residents, business men, tourists, and representatives of mining and exploration companies freely provided services, information, and hospitality. Living quarters and office facilities were rented from Rio Algom Mines Limited (Pronto Division). Thanks are expressed to the manager, Mr. Paul Young, and to the security officer, Mr. W. Spark.

During the 1965 and 1966 field seasons the author benefited from discussions and field trips with W. Cannon, a graduate student at Syracuse University, New York State. W. Cannon was carrying out detailed mapping of the Cutler Batholith and adjacent rocks (see Cannon 1967 and 1970). Useful discussions were held with Colin Knight, previously a geologist at the Pater Mine and with the staff and graduate students of the geology department of the University of Western Ontario. M. J. Frarey and S. M. Roscoe of the Geological Survey of Canada, and K. D. Card of the Ontario Division of Mines have experience of adjacent areas, and were of great assistance.

Means of Access

Highways 17 and 108, and the Sudbury to Sault Ste. Marie CPR spurline cross the report-area. The major drainage consists of the Serpent and Little Serpent Rivers and their tributary streams. The rivers join several lakes and provide access routes for canoes or light boats.

Gravel roads connect Cutler to the Serpent River at Camp Lake, and the town of Spanish to Walford, Crab, and Denvic Lakes (see Maps 2314 and 2315, back pocket). A portage connects Dollar Bay at the east end of McCarthy Lake to the western end of Bellows Lake. Portages and trails connect most of the major lakes and in some areas shortcut the large easterly swings in the rivers.

A gravel road runs southwesterly across I.R.7 from Cutler to Bartlett Point, near the Whalesback Channel. Lumbering trails extend west from this road, and provide some access to I.R.7. However, the best access in this area is either from Lake Huron or from the Canadian Pacific Railway right-of-way. A gravel road that runs from Spanish to the abandoned acid plant at Cutler provides access to the area between these communities, and between the Canadian Pacific Railway line and Lake Huron. The islands in Lake Huron are reached by powered canoes or motor boats from Spanish and Bartlett Point.

Most of the lakes can be used by float-equipped plane; care must be taken on some of the shallow lakes.

In 1968 a gravel air-strip some 3,000 feet (900 m) long was under construction in northwestern Proctor Township, west of Highway 108.

The report-area is thus readily accessible by using some combination of automobile, float-equipped plane, canoe, boat, and foot travel. Float-equipped plane service is available from Lauzon Lake, near Blind River or from Elliot Lake.

Previous Work

The North Shore of Lake Huron was the scene of much geological activity after copper was discovered at Bruce Mines in 1846 (Murray 1850). From 1847 until 1858 Logan and Murray mapped the Huronian between Sault Ste. Marie and Blind River. Prospecting intensified in the Sudbury area and at the eastern end of the North Shore of Lake Huron after the 1884 discovery of nickel at Sudbury. By the early twentieth century several copper showings had been found in the vicinity of Massey, which is 12 miles (19 km) east of the Cutler report-area (Robertson 1976). Attempts have been made to develop or mine several of these. Other copper showings, and a small gold showing were found in the Whiskey Lake area some 20 miles (32 km) northwest of Massey. The discovery of these showings led to considerable prospecting in the report-area. An 80-foot (24 m) shaft on a quartz-chalcopyrite vein near Black Lake, east of Shedden Lake, may date back to this time. A quartz vein on Passage Island at the east end of the Whalesback Channel was also worked in the early 1900s, probably for smelter flux.

By 1913 the need for geological work and correlation between the "Original Huronian" of Bruce Mines and the rocks of the Sudbury-Cobalt area was needed. In 1913, A. P. Coleman undertook an investigation of Massey and adjacent areas for the Ontario Bureau of Mines (Coleman 1913). In 1913, the Bureau published reports by Coleman on the copper prospects in the vicinity of Massey and Whiskey Lake (Coleman 1913). In 1914 the Bureau published a further report by Coleman on "The Pre-Cambrian Rocks North of Lake Huron". Coleman's Table of Formations, as it applies to the Cutler area is given in Robertson, Card, and Frarey (1969); Robertson, Frarey, and Card (1969); and in Table 1 (Chart B, back pocket). In a preface to Coleman's 1914 report, W. G. Miller introduced the term Algoman, defined in 1913 by A. C. Lawson in the Rainy Lake area, for most granitic rocks of the North Shore of Lake Huron (Lawson 1929). Coleman contended that those rocks which he called Sudbury Series were Archean metasediments intruded by the Algoman granites, and that both were overlain unconformably by the Huronian.

In 1914, W. H. Collins of the Geological Survey of Canada began systematic mapping along the North Shore of Lake Huron. He was assisted by T. T. Quirke in 1917 and later, by P. Eskola (Collins 1925). Certain areas were selected for attention and correlated with each other on the basis of lithostratigraphy, and structure. The Cutler report-area was included in Collins' mapping and forms the southeast corner of GSC Map No. 1970, Blind River, which accompanies Memoir 143, North Shore of Lake Huron (Collins 1925). The off-shore islands were mapped by Eskola (Collins 1925). Collins' Table of Formations is given in Table 1 (Chart B, back pocket). Collins was able to give formal names to several formations which could be correlated with those of Logan and Murray.

A major fault, first recognized by Murray at Bruce Mines, was traced eastwards through the Cutler report-area to Sudbury by Collins who named it the Murray Fault (Collins 1925). To the north of the Murray Fault in southern Lewis and central Shedden Townships, Collins recognized a thin belt of Huronian sedimentary rocks lying unconformably on the granitic (Algoman) basement. Between the Murray Fault and the Whalesback Channel and eastwards to the north of the Spanish River lay the McKim metagreywacke and schist of Coleman's Sudbury Series.

Along the Spanish River and eastwards to Sudbury the McKim greywacke was overlain by the Ramsay Lake conglomerate that Collins and Coleman identified as the basal member of the Mississagi Formation (Coleman 1914; Collins 1925). The Mississagi quartzite was recognised on the islands south of the Whalesback Channel. Several of the overlying formations were identified by Collins and Eskola on the south side of Aird Island and adjacent islands in the North Channel of Lake Huron (Collins 1925).

On I.R.7 and eastwards to the north of Spanish the rocks of the Sudbury Series were intruded by granite and granite pegmatite of the Cutler Batholith. Eskola showed that the Huronian in the North Channel of Lake Huron was strongly metamorphosed close to the Cutler Granite (Collins 1925, p.39). Collins (1925, p.85-90) showed that bodies of post-Huronian diabase were also metamorphosed and found as inclusions in or cut by the Cutler Granite; it was therefore concluded that the Cutler Granite was post-Huronian in age.

The nomenclature used by Collins, Quirke, Eskola, and Coleman for the area south of the Murray Fault between Cutler and Sudbury is shown in Table 1. Eastwards from the present report-area along the Spanish River, Collins (1925) and Quirke (1917) maintained that both Huronian and pre-Huronian sedimentary rocks occurred south of the Murray Fault. However, Collins and Quirke admitted difficulty in identifying the unconformity at the base of the Ramsay Lake conglomerate. Nevertheless, in 1936 (Collins 1936), Collins thought that the evidence then available required such an unconformity, and that the Sudbury Series should be placed in the Archean (Early Precambrian in this report). The dissenting view that there was perhaps no unconformity at the base of the Ramsay Lake conglomerate and that the Sudbury Series was in fact part of the Huronian sequence was expressed by Eskola (in Collins 1925, p.26), Fairbairn (1941) and Cooke (1941; 1946). A. C. Lawson (1929) claimed that field relationships between Algoma Mills and Spragge, west of the Cutler Batholith, showed that rocks mapped by Collins were Upper Huronian, rather than in the Sudbury Series. Rice (1940) showed that Lawson's local correlation was correct, and that the position of the Murray Fault needed to be reinterpreted. This was confirmed by Robertson (1970a).

Following the Second World War the Ontario Department of Mines decided that the questions of regional correlation of structure, stratigraphy, and ore deposits could only be settled by detailed systematic mapping in the North Shore region of Lake Huron. Jas. E. Thomson initiated a detailed mapping program at Baldwin Township (Thomson 1952). E. M. Abraham started mapping at Iron Bridge near the eastern limit of the "Original Huronian" (Abraham 1953; 1956; 1957; Robertson 1963; Thomson 1952). The discovery of the Blind River-Elliot Lake uranium deposits in 1953 caused an increase in geological activity by industry and government in the area. This activity has been summarized in recent papers by Robertson (1967a, 1971b, 1973); Robertson *et al.* (1968); Robertson, Card, and Frarey (1969); Robertson, Frarey, and Card (1969); and Roscoe (1969, 1973). Figure 2 (this report) shows the areas where map coverage is available either from the Geological Survey of Canada or from the Ontario Division of Mines. Thomson issued a preliminary compilation map covering the country between Sudbury and Spanish (Thomson 1961). Thomson was unable to show an unconformity at the base of the Ramsay Lake conglomerate. Because of the relatively high-grade metamorphism in the lower part of the sequence, and the local presence of volcanic rock, Thomson (1962) suggested that perhaps all the rocks to the south of the Murray Fault were Archean in age.

S. M. Roscoe of the Geological Survey of Canada suggested (1957) that the Espanola-Spanish sequence should be correlated with the lower part of the Huronian sequence at Elliot Lake. Roscoe also introduced a new nomenclature (see Table 1) for the Huronian sequence of the Blind River-Elliot Lake area. Roscoe's terminology and suggested correlation were accepted by Ginn (1960) and incorporated by Ginn in reports on townships adjacent to Baldwin Township (Ginn 1961, 1965). Card took over the work between Sudbury and Espanola initiated by Thomson and Ginn. Card's mapping has been done on a lithological basis. His marginal notes and summaries of field work (Card 1967a and b) indicated a belief that the rocks in the vicinity of Espanola are Huronian and can be correlated with those of Elliot Lake.

The author, who had worked with Abraham, took over the Blind River-Elliot Lake projects from him in 1957, and has continued work in the area, mainly extending the detailed mapping eastwards to Massey. The author originally (Robertson 1965a) used a modified form of Collin's nomenclature (see Table 1). At an early stage in the work (Robertson 1960) the writer accepted the Archean status of the Sudbury Series, but suggested that there was no proof of the post-Huronian age of the Cutler Batholith, which might be a block of Algoman Granite upthrust on the south side of the Murray Fault. As field work progressed, and as radiometric age determinations on both the Cutler Granite and the post-Huronian mafic intrusions became available, it became clear that the Cutler Granite was post-Huronian in age (Van Schmus 1965; Wetherill *et al.* 1960). The mapping of the Cutler and Massey areas showed that the rocks on I.R.5 and on Aird and adjacent islands were similar in lithostratigraphy to the Huronian rocks on the north side of the Murray Fault (Robertson 1964; 1965a,b,c; 1969a). The writer could find no evidence of an unconformity along the Spanish River, and concluded that the sequence was conformable. It was also shown that locally, the Ramsay Lake conglomerate and the overlying rocks were metamorphosed to the garnet-staurolite grade, and that low to intermediate grade metamorphism is prevalent in the southern part of I.R.5. Polyphase folding and metamorphism has occurred, and was most intense before the intrusion of the Cutler Batholith. The Cutler Batholith may be a late post-tectonic granite; later than the intrusion of the post-Huronian mafic intrusions (Van Schmus

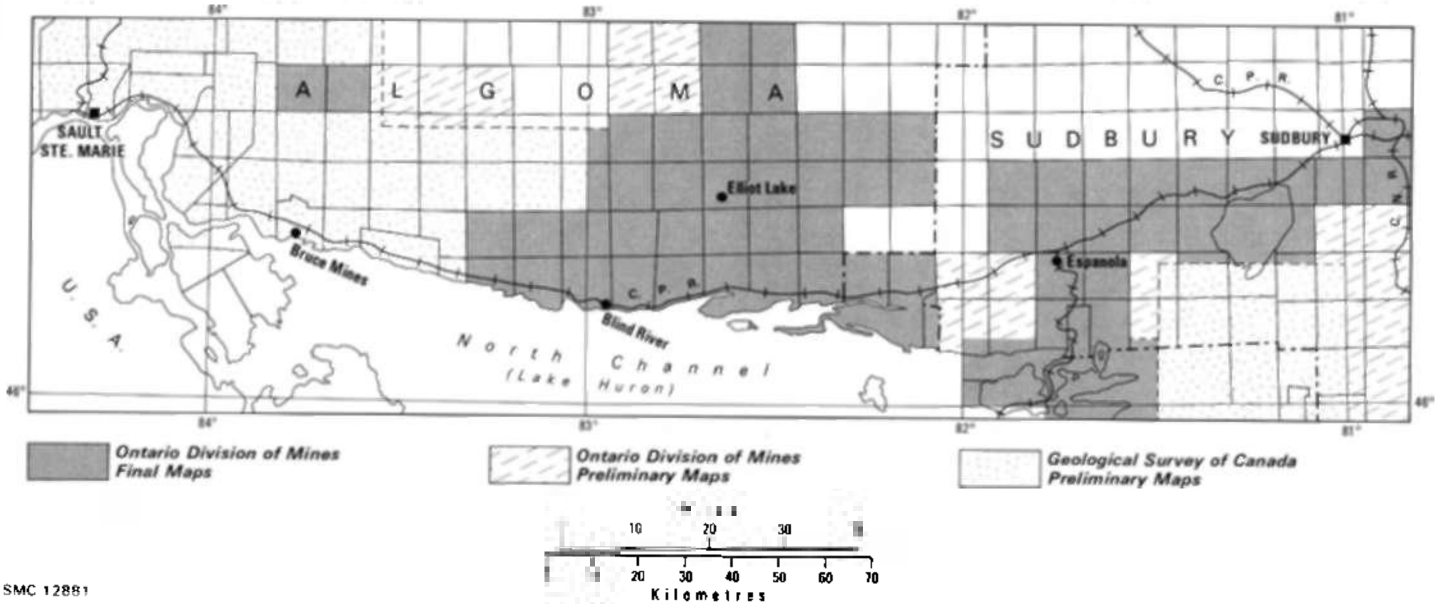

Figure 2—Key to recent geological maps, North Shore of Lake Huron. Note that Final Maps have been published to replace all the preliminary maps of the Geological Survey of Canada west of Elliot Lake.

1965; Van Schmus *et al.* 1963; Wetherill *et al.* 1960; Cannon 1967, 1970; Robertson 1965 *et seq.*).

The Huronian rocks south of the Murray Fault were shown to be similar in lithostratigraphy to those on the north side of the fault; (see Robertson 1961, 1962, 1963, 1965a,b and c, 1966a,b and c; Robertson and Fraser 1964a and b; Robertson and Johnson 1965; Robertson and McCrindle 1967; Robertson *et al.* 1968; Robertson, Card, and Frarey 1969; Robertson, Frarey and Card 1969).

No evidence for an unconformity exists along the Spanish River (Robertson 1967). Locally the Ramsay Lake conglomerate and overlying rocks are metamorphosed to the garnet-staurolite grade. Low to intermediate grade metamorphism occurred well to the south of the Murray Fault in I.R.5.

The folding and metamorphism is polyphase, and peaked before the intrusion of the Cutler Batholith (a syntectonic granite, later than the intrusion of the post-Huronian mafic intrusions).

In 1966 a Federal Provincial Committee consisting of J. A. Robertson, M. J. Frarey, and K. D. Card was instructed to review problems of Huronian Stratigraphy and recommend a standard Huronian nomenclature; to measure, describe, and mark reference sections; and make suggestions for further work. Results of the Federal Provincial Committee's work have been published by Robertson *et al.* (1968), Robertson, Card, and Frarey (1969). Recommendations of the Federal Provincial Committee (Robertson, Card, and Frarey 1969) are implemented in this report. The results of other work pertinent to this report are summarized by Card and Church *et al.* (1972); Robertson and Card (1972) and Robertson *et al.* (1968); Robertson, Card, and Frarey (1969); and Robertson, Frarey, and Card (1969).

Topography

The report-area shows a lack of major relief which is contrasted with local rugged detail. The general uniformity of the skyline is caused by the peneplanation of the Precambrian Shield. The surface rises from 600 feet (180 m) near Lake Huron to 1,100 feet (330 m) near the northern boundary of the map-area. Maximum local relief is generally less than 150 feet (46 m): greater relief than this is found where Mississagi quartzite is exposed in southern Lewis and Shedden Townships, and on John and Aird Islands; the granitic terrane of the Cutler Batholith; and ridges of epidiorite in the area between the Murray Fault and the North Shore of Lake Huron. Maximum relief in the report-area is at Mount Victoria in Shedden Township near the Lewis-Shedden township boundary; the bench mark on Mount Victoria is 1,083 feet (330.1 m) whereas Serpent Lake to the south is rather less than 700 feet (200 m) above sea level.

The topography in the southern part of the area shows a marked geological control. A prominent valley has developed over the trace of the Murray Fault, and other faults are defined by linear valleys or depressions. Low ground has also formed over more readily eroded members of the Huronian Supergroup north of the Murray Fault, and those in the metamorphosed sequence south of the Murray Fault. Ridges have formed over hard members of the Huronian, some of the post-Huronian diabase intrusions, and over the epidiorite (metadiabase) in the metamorphic terrane south of the Murray Fault. The Cutler Batholith forms high ground which is broken by valleys following faults, strike of gneissosity, and inclusion zones. Such valleys give the area an extremely broken terrain. Aird and John Islands are formed of near-vertical Mississagi quartzite and have a local relief of just over 200 feet (60 m). The other islands are smaller, and less rugged, but add to the scenic attraction of the Whalesback and North Channels.

Apart from low lying ground in the vicinity of Spanish there is little land suitable tor agriculture.

Drainage

The area is drained by sluggish streams which flow southeast, west, or southwest. The marked directional control of drainage is a reflection of geological structures such as joints, faults, and dikes, particularly in the Early Precambrian basement. In the rest of the area, drainage follows the strike of faults and more easily eroded Precambrian metasediments.

Natural Resources

Heavy lumbering was once carried out in the area and a number of white pine mills were operated (Kauffmann 1970). Pulp wood is cut for shipment to the Kalamazoo Vegetable Products Limited mill at Espanola[1]. Firewood is cut to meet local needs.

The only agricultural land in the area is in the vicinity of Spanish where some mixed farming is carried out.

Commercial fishing in the Spanish Estuary and adjacent parts of Lake Huron was important, but in recent years has been much reduced because of over-fishing in the Great Lakes and the ravages of lamprey eels.

The North Channel and the Whalesback Channel are used by cabin cruisers and sailboats. Docking facilities are available at Spanish. A number of tourist camps at Spanish cater to fishermen.

Wild life such as bear, beaver, deer, fox, mink and moose is common. Beaver and mink are trapped. Several varieties of duck and partridge are hunted.

Tourist camps are located in Spanish, one operates on Camp Lake. The Ontario Ministry of Natural Resources maintains a picnic ground on Highway 108 at the east end of Depot Lake in Proctor Township. A church group operates a children's summer camp on Aird Island. The Sudbury YMCA has a summer camp ground at the east end of John Island.

[1]The Espanola mill was acquired by Brown Forest Industries Limited in 1967; and was owned and operated by Eddy Forest Products Limited in 1972.

GENERAL GEOLOGY

The oldest rocks in the report-area consist of Keewatin-type metavolcanics and metasediments (Table 2) with some lean iron formation, and form a thin strip along the northern boundary of Deagle and Proctor Townships. However, the bulk of the area is underlain by Algoman granitic rocks that form the core of the Chiblow Anticline.

The southern part of Lewis Township and a mile-wide (1.6 km) strip running east-west across central Shedden Township is underlain by Huronian metasediments. These rocks form the eastern continuation of the south limb of the Chiblow Anticline. The Huronian rocks consist of the following units and rock types that are listed in the order in which they occur from north to south: Matinenda arkose (commonly absent because of basement highs) McKim argillite (absent because of a basement high in western Lewis Township), Ramsay Lake conglomerate (only present in eastern Shedden Township), Pecors argillite, Mississagi quartzite, Bruce conglomerate, Espanola limestone, Serpent quartzite and the Gowganda conglomerate. These rocks strike east, and dip south with tops facing south.

A series of schists and schistose quartzites (metamorphosed McKim Formation) are exposed south of the Murray Fault in the Spanish Estuary and the Whalesback Channel. These rocks are interdigitated with Nipissing Diabase and the Cutler Batholith. South of the Spanish River on I.R.5 and on some of the islands north of Aird Island the McKim schists are overlain by the western extension of the Ramsay Lake conglomerate. In the vicinity of Aird Island the Ramsay Lake conglomerate is overlain by units mapped as the Pecors, Mississagi, Bruce, Espanola, and Serpent Formations.

Metamorphic grade exhibits a decrease southward from the Murray Fault. On the north side of John Island, schist and schistose quartzite (Pecors Formation) fall rapidly from the staurolite-garnet grade to the muscovite-biotite grade in a sequence passing upwards into Collin's Mississagi Formation.

The Nipissing Diabase Intrusions south of the Spanish River and the Whalesback Channel generally retain diabasic texture; the pyroxenes are mostly altered to amphibole (actinolite or more usually hornblende).

Mafic rocks, (shown as Nipissing Intrusive Rocks on Map 2315, back pocket), exposed on the south side of the Murray Fault in Shedden Township, were thought by Knight to be metavolcanics similar to those exposed at the Pater Mine in Spragge Township (Knight 1965, 1967; Robertson 1965a, 1969a, 1970a). Cannon (1967; 1970) has questioned the volcanic origin for these rocks and suggested that they are formed from the low grade metamorphism of mafic intrusive rocks. Hence, these rocks, formerly called the "Victoria Greenstone" are placed in the Nipissing Intrusive Rocks in this report (see also Robertson 1976).

Problems with correlation of Huronian rocks north and south of the Murray Fault are reviewed in the section on previous work and are summarized in Table 1. A more detailed account is given by Robertson *et al.* (1968) and Robertson, Card, and Frarey (1969). Their recommendations concerning nomenclatures are implemented in this report, and incorporated in the Table of Formations (see Table 2).

The Huronian on the south and north sides of the Murray Fault is different in thickness and facies from that exposed at Quirke Lake and Elliot Lake, see Figures 3 and 4 (this report) and Robertson (1965a, b and c; 1966a, b and c; 1967).

This difference reflects the following: 1) a more distal depositional area; 2) proximity of a major basement high; and 3) early activity along the Murray Fault which acted as a hinge zone during sedimentation.

After the Huronian was deposited, the Penokean-Hudsonian Orogeny affected the Precambrian rocks. Dikes and irregular sill-like bodies of Nipissing Diabase were also intruded into the Precambrian rocks. The main Penokean-Hudsonian Orogeny then took place; deformation and metamorphism were polyphase (Card 1964; Blackburn 1967; Card and Church *et al.* 1972; Card and Robertson *et al.* 1972). The Cutler Batholith was intruded during the later phase of the orogeny, and was also deformed (Robertson 1965a; 1970b; Cannon 1967; 1970).

Northwest-striking dikes of olivine diabase are the youngest rocks exposed in the report-area. These dikes do not cut the Murray Fault in the report-area. Van Schmus (1965) has dated an olivine diabase dike cutting the Cutler Batholith at 1,255 million years, and has correlated it with Keweenawan (Late Precambrian) igneous activity.

Precambrian

EARLY PRECAMBRIAN (ARCHEAN)

The early Precambrian consists of: a) Keewatin-type metavolcanics interbedded with metasediments and minor lean iron formation; and b) Algoman granitic rocks. The Keewatin-type rocks are generally mafic and metamorphosed to the lower greenschist facies, though locally, amphibolite may be present. The Algoman granitic rocks consist of variable grey to pink, massive to gneissic, granodiorite to granite, and possibly younger red, massive, equigranular to porphyritic, quartz monzonite. Within the report-area, aplite and pegmatite dikes which are too small to map individually, may be related to the later phase of the Algoman granite.

Within the Cutler report-area, Keewatin-type rocks form a strip about 1 mile (1.6 km) wide along the northern boundary of Proctor and Deagle Townships. This strip forms the southeastern limit of a metavolcanic-metasedimentary belt underlying the east end of the Quirke Syncline. This metavolcanic-metasedimentary belt may have exerted a profound influence on the localization of the uranium ore deposits found in the Elliot Lake area (Robertson 1966a; 1970b). Elsewhere, the Keewatin-type rocks are represented by mafic inclusions, or by relict gneissic material in areas of Algoman granitic rocks close to the margin of the metavolcanic-metasedimentary belt, and near the southern limit of the Early Precambrian outcrop in Lewis and Shedden Townships.

Keewatin(?)

The rocks within the Keewatin(?) metavolcanic-metasedimentary belt in northern Proctor and Deagle Townships are similar to, and continuous with, similar

Table 2 | TABLE OF FORMATIONS FOR THE CUTLER AREA

PHANEROZOIC

CENOZOIC

QUATERNARY

RECENT[1]

Swamp, lake, and stream deposits

PLEISTOCENE[1]

Gravel, clay, till, sand

Unconformity

PRECAMBRIAN

LATE PRECAMBRIAN (PROTEROZOIC)

LATE MAFIC INTRUSIVE ROCKS[2]

16 Olivine diabase

Intrusive Contact

MIDDLE PRECAMBRIAN (PROTEROZOIC)

CUTLER GRANITE

15a Muscovite-biotite granite
15b Pegmatite

Intrusive Contact

NIPISSING DIABASE (Nipissing Intrusive Rocks)[3]

14a Diabase, gabbro and diorite cut by felsic and mafic dikelets.
14b Metadiabase, epidiorite, amphibolite, amphibolite gneiss, hornblende schist

Intrusive Contact

HURONIAN SUPERGROUP

COBALT GROUP

Gowganda Formation

13a Polymictic paraconglomerate
13b Feldspathic quartzite, quartzite
13c Greywacke

Unconformity

QUIRKE LAKE GROUP

Serpent Formation

12 Calcareous and non-calcareous feldspathic quartzite, quartzite; minor siltstone, argillite, polymictic paraconglomerate.

Espanola Formation

11a Interbedded limestone, dolomitic limestone, calcareous argillite, greywacke, argillite, quartzite, intraformational breccia.
11b As above with scapolite porphyroblasts in carbonate-bearing rocks.
11c Quartzite, feldspathic quartzite.

Bruce Formation

10 Polymictic paraconglomerate, lenses of quartzite, siltstone.

Unconformity-Local Disconformity

HOUGH LAKE GROUP

Mississagi Formation

9a Feldspathic quartzite, quartzite, arkose
9b Argillaceous quartzite

9c Polymictic conglomerate
9d Intraformational breccia

Pecors Formation
8 Interbedded argillaceous quartzite, argillite, greywacke, quartzite, minor siltstone.

Ramsay Lake Formation
7 Polymictic paraconglomerate with conglomeratic quartzite lenses.

Unconformity

ELLIOT LAKE GROUP

McKim Formation
6a Interbedded argillaceous quartzite, argillite, feldspathic quartzite.
6b Metamorphic equivalent of 6a with chlorite, biotite.
6c Metamorphic equivalent of 6a with garnet, staurolite, cordierite.

Matinenda Formation
5a Arkose, feldspathic quartzite, minor argillite.
5b Intraformational breccia.

Great Unconformity

EARLY PRECAMBRIAN (ARCHEAN)
4 Regolith[4]

MAFIC INTRUSIVE ROCKS[3]
3 Unsubdivided
3a Porphyritic diabase
3b Diabase

Intrusive Contact

FELSIC INTRUSIVE ROCKS (Algoman)
2a Granite, granodiorite and related rocks.
2b Porphyritic granite
2c Granitic rocks with abundant aplite dikelets
2d Granite, granite gneiss and related rocks

Intrusive Contact

METAVOLCANICS AND METASEDIMENTS (Keewatin?)[5]
1 Unsubdivided metavolcanics and metasediments
1a Rhyolite
1b Massive to porphyritic andesite and basalt flows.
1c Amygdaloidal mafic lava
1d Pillowed mafic lava
1e Unsubdivided metasediments
1g Conglomerate
1h Metagreywacke
1j Chert

Footnotes

[1]The Recent and Pleistocene deposits are not differentiated.

[2]All post-Huronian mafic intrusions in the Blind River-Elliot Lake area were formerly classified as Keweenawan, but age-determinations indicate that the bulk of these are older.

[3]The numerous diabase dikes cutting Early Precambrian rocks include both Pre- and Post-Huronian varieties which could not be distinguished during field mapping.

[4]Granite regolith takes the colour of the underlying parent rock.

[5]Iron Formation is intercalated with the metasediments.

rocks found in the southern parts of Joubin and Gaiashk Townships (Townships 143 and 137), (Robertson 1961; 1962).

In the King's Lake-Depot Lake sector of Proctor Township, the Keewatin-type metasediments and metavolcanics strike northwest and dip northeast at 38 to 60 degrees; the dip averages 50 degrees. In the Kings Lake-Serpent River-Deagle Lake region, the strike is slightly south of east, and the dip is 40 to 75 degrees north, and averages 60 degrees. Tops, determined from graded bedding in greywacke and relict pillows in lava-flows, are to the north and indicate that the sequence is "right way up".

The metasediments comprise greywacke (both mafic and quartzose), local lean iron formation, conglomerate, and possible pyroclastic rocks; and form the greater part of the sequence as exposed in Proctor Township. They are also found intercalated in the dominantly volcanic sequence exposed in Deagle Township.

Near Highway 108, where the Elliot Lake air-strip is now located, the high ground north of Depot Lake is composed of greywacke and lean iron formation (Photo 1) intercalated with mafic lava flows. When traced to the northwest, these rocks form the buried ridge separating the Nordic and Pardee channels in the Pre-Huronian surface (see Robertson 1966a, Figure 5). The greywacke is thinly bedded, and consists of quartz, feldspar, and variable amounts of hornblende, biotite, and chlorite. A cleavage parallel to the bedding is visible in the ferromagnesian-rich layers. Graded bedding is locally preserved in the greywacke. The iron formation consists of thinly banded quartz and magnetite-chert with or without a pale green amphibolitic mineral. Rusty weathered surfaces are characteristic of this rock. Pyrite, pyrrhotite, chalcopyrite, and sphalerite form irregular, sooty partly pitted surfaces.

To the west of Highway 108, the greywacke is more femic, and intercalated flows are more common in the greywacke. Cleavage and, locally, gneissosity are present in the rock. The sedimentary rocks are altered to schist and phyllite, and the mafic volcanic rocks to schistose-gneissic amphibolite and diorite. Hornblende is more common than chlorite and biotite. In one greywacke bed, garnets, ¼ inch (6 mm) in diameter, are numerous.

Near Depot Lake and the Esten-Proctor township boundary, dikes and sills of granitic material are found in the metasediments and metavolcanics. These are too small to map individually, but the pattern is visible on the aerial photographs.

In the Kings Lake-Serpent River region, metasediments are characterised by the development of mafic minerals and cleavage parallel or subparallel to the bedding. In the more siliceous greywacke, graded bedding is locally preserved. The mafic flows are represented by massive porphyritic, and diabasic amphibolite. These rocks are believed by the author to have been massive to porphyritic andesites to basalts. The diabasic rocks, as previously noted by Robertson (1962, p.13-14) and by Collins (1925, p.20) are easily mistaken for the younger diabase dikes. The two units may be distinguished on the basis of their intrusive relationships.

A number of beds of leucocratic feldspathic rocks are exposed near Kings Lake. These are probably felsic flows or pyroclastic rocks. Some of these show flow-banding which may be obscured by cleavage. Plagioclase is well developed as generally subidiomorphic crystals in a quartz-orthoclase groundmass. Epidote and biotite are generally present. Rhyolite has been identified in the Keewatin rocks of the Elliot Lake area (Collins 1925, p.20; Robertson 1968a, p.11).

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Photo 1–Keewatin (?) Iron Formation: Light bands–quartz, dark bands–magnetite–chert; *note* folding and fracturing, former Highway 612, NW Proctor Township.

In northeastern Proctor and northwestern Deagle Townships massive mafic volcanic rocks form the dominant part of the sequence. Relict diabase texture in the more basaltic flows is common, and locally, the flows pass into pillowed, amygdaloidal, or porphyritic types (Table 3). In this area, as in the southern part of Gaiashk Township (Township 137), (Robertson 1962, p.13-14) it is clear that much "diabasic" rock represents the massive structureless parts of basaltic flows. The amygdaloidal and porphyritic rocks are grey to light green, rather than green to black, and were probably andesite.

Along the shores of Deagle Lake are outcrops of siliceous polymictic conglomerate. This rock contains well-rounded to subangular quartz, granite, and "greenstone" pebbles in a dark gritty quartzose matrix carrying minor sulphide mineralization. The conglomerate is as much as 450 feet (137 m) thick, and has been traced intermittently for at least 9,000 feet (2,700 m). The contacts appear to be conformable.

No iron formation was observed in Deagle Township. However, a series of magnetic anomalies adjacent to the Deagle-Gaiashk (137) township boundary are shown on ODM-GSC Aeromagnetic Map 2256G (ODM-GSC 1963c). A magnetic disturbance of the compass needle was noted by field parties about ¼-mile (0.4 km) west of the northeastern corner of Deagle Township. Iron formation, traced from Pecors Lake and across southern Gaiashk Township (formerly Township 137), (Robertson 1962, p.14) outside the report-area, may cause the above-mentioned anomalies and magnetic disturbance.

N. Massie, a local prospector, reported to the author (1958) that he had seen an outcrop of iron-formation near the Gaiashk (137)-Deagle township boundary.

Provided there has been no repetition by faulting or unrecognized folding, the Keewatin rocks exposed in Proctor and Deagle Townships represent some 9,000 feet (2,700 m) of interbedded mafic volcanic rocks and sedimentary rocks which have been metamorphosed to at least the greenschist facies (Turner and Verhoogen 1960). Iron formation forms a useful marker in northwest Proctor Township and possibly near the Gaiashk (137)-Deagle township boundary. Sulphide minerals are not conspicuous, but pyrite and chalcopyrite and traces of pyrrhotite are normally present in these rocks.

Algoman

Granitic rocks of Algoman age underlie most of the map-area north of the Murray Fault.

The rocks are generally medium to coarse grained, equigranular to porphyritic, and range from grey to red. Red, equigranular, quartz monzonite is found in central Proctor Township north of the west end of McCarthy Lake. Red granitic segregations, aplite, and pegmatite are more common towards the southern limit of the Algoman outcrop area.

The granitic rocks are locally contaminated by mafic or gneissic material which is probably derived from the older Keewatin-type rocks. Such contaminated zones occur in northwestern Deagle Township near the contact of the Algoman granite and the Keewatin volcanic belt. Areas containing 30 to 60 percent chloritized or amphibolitized mafic inclusions are small and scattered throughout the outcrop areas of Algoman granitic rocks in the map-area. A more extensive zone of mafic material mixed with granitic rock occurs along the northern side of the Murray Fault in southern Lewis Township and less extensively in Shedden Township. Numerous shear zones also are in this area, and post-granite diabase dikes lose their continuity in it; there are also zones of "Sudbury-type breccia".

Doubt exists as to how much of the mafic material is derived from Pre-Algoman rocks. However, in southern Spragge Township, (see Robertson 1970) in the vicinity of Highway 108, and in Shedden Township (particularly the Shedden Lake area), the granitic rocks are markedly gneissic, indicating a possible derivation from the anatexis of sedimentary rocks. Most of the mafic inclusions in the above-mentioned areas are probably derived from the pre-granitic rocks.

The essential minerals of the granitic rocks are: quartz, plagioclase (oligoclase or albite), microcline, and chlorite interleaved with biotite. Hornblende is only found where there are amphibolite inclusions. Muscovite is only found in the sericitic or saussuritic alteration products of the plagioclase. The rock-type is a function of the minerals present and of the composition of the plagioclase. The colour of the rock is caused by hematite dust, particularly in feldspar. The principal accessory minerals are apatite, magnetite, monazite, sphene, and zircon. Both sphene and zircon have been seen in hand specimens. Traces of sulphide minerals, pyrite, chalcopyrite, and rarely pyrrhotite, and, very rarely, molybdenite have been observed; it is possible that these are hydrothermal in origin. The aplite and pegmatite dikes consist of quartz, microcline, minor plagioclase, and muscovite.

Photo 2–Early Precambrian (Archean) (?) porphyritic diabase, Kecil Lake, Shedden Township, partially absorbed phenocrysts are altered sodic plagioclase.

The petrography and chemistry of the granitic rocks of the Blind River-Elliot Lake district have been discussed in detail in earlier reports by the author (Robertson 1960, Chapter 6; Robertson 1961 *et seq.*).

Age determinations indicate a minimum age of 2,500 million years for the Algoman granites of the North Shore of Lake Huron (Fairbairn *et al.* 1960, 1965; Lowdon 1963; Wetherill *et al.* 1960; Van Schmus 1965). However progressively younger ages, caused by isotopic readjustments, are obtained as the Hudsonian-Penokean Orogenic Belt in the southern part of the area is approached (Van Schmus 1965, p.770 and Figure 9 his report).

Mafic Intrusive Rocks

Mafic intrusive rocks younger than the Algoman granites but older than the Huronian sedimentary rocks may exist in the map-area. A distinctive porphyritic diabase has been observed cutting only Early Precambrian rocks. Such diabase has been coded "3a" on Map 2314 (back pocket).

This porphyritic diabase is also found in the Massey report-area (Robertson 1970b, 1976). It is characterized by yellow-green corroded and altered crystals of plagioclase that are as much as 2 inches (5 cm) across set in a fine-grained dark green matrix (Photo 2). The cores of the largest phenocrysts may be slightly pink. Altera-

Table 3 | CHEMICAL ANALYSES OF EARLY PRECAMBRIAN PORPHYRITIC DIABASE, SHEDDEN LAKE; CHEMICAL ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES

Matrix: Major Oxides (Percent)			Matrix: Trace Elements (Parts per Million)		Matrix: Detection Limits	Phenocrysts: Major Oxides (Percent)			Phenocrysts: Trace Elements (Parts per Million)		Phenocrysts: Detection Limits
SiO_2	49.00	X	Ag	2		SiO_2	44.20	X	Ag	1	
Al_2O_3	15.40	X	As	—		Al_2O_3	28.40	X	As	—	3
Fe_2O_3	3.00	X	Ba	200		Fe_2O_3	4.98	X	Ba	1000	
FeO	9.35	C	Be	-	3	FeO	0.94	C	Be	-	3
MgO	6.00	X	Co	30		MgO	2.00	X	Co	-	10
CaO	8.70	X	Cr	50		CaO	15.50	X	Cr	-	10
Na_2O	2.08	C	Cu	300		Na_2O	1.35	C	Cu	10	
K_2O	0.66	C	Ga	40		K_2O	1.87	C	Ga	40	
H_2O^+	2.29	C	Li	40		H_2O^+	0.68	C	Li	40	
H_2O^-	0.16	C	Mn	1500		H_2O^-	0.02	C	Mn	500	
CO_2	0.10	C	Mo	-	5	CO_2	0.10	C	Mo	-	5
TiO_2	1.13	X	Ni	40		TiO_2	0.10	X	Ni	-	5
P_2O_5	0.12	C	Pb	10		P_2O_5	0.01	C	Pb	10	
S	0.04	C	Sb	—		S	0.01	C	Sb	—	
MnO	0.21	X	Sc	30		MnO	0.10	X	Sc	-	20
			Sn	-	5				Sn	-	5
			Sr	300					Sr	1000	
			Ti	—					Ti	200	
			V	300					V	10	
			Y	30					Y	-	20
			Zn	100					Zn	100	
			Zr	80					Zr	-	10
Total	98.20					Total	100.30				

Abbreviations
- None present or below limits detection.
Method: C – chemical, X – X-ray.
Analyst: D. Moddle, Ontario Provincial Laboratory.

tion, particularly of the feldspar, is so complete that its original mineralogy cannot be determined.

Table 3 lists chemical analyses of matrix and phenocryst material from a typical porphyritic dike on Shedden Lake.

On Shedden Lake a number of multiple dikes were noted. These consist of porphyritic (3a) and non-porphyritic (3b) phases. The non-porphyritic phases are epidote-rich.

Eparchean Interval

Throughout the Blind River-Elliot Lake-Spanish area the Huronian sedimentary rocks rest on the Early Precambrian rocks with marked unconformity (Robertson 1966a; 1967). In the Cutler report-area the unconformity may be traced across southern Lewis and central Shedden Townships. The Precambrian basement is largely granitic in character with varying amounts of assimilated mafic sedimentary material. The texture of the granitic rocks within a few feet of the contact is partly or totally destroyed. Where pegmatitic segregations or dikes occur, they remain fresh, although the texture of the adjacent granitic rock may be destroyed. This altered rock has been regarded as a regolith or fossil soil (Robertson 1968a, p.16 and Figure 2). The regolith is not well developed in the Cutler report-area. Some yellowing of the uppermost granite surface was observed along the northerly Ontario Hydro-Electric Power Commission transmission line in southwestern Lewis Township, and on the northern shore of Denvic Lake near the Shedden-Victoria township boundary. Diamond-drill core from this area shows a few feet of "transition zone".

Between the Spragge-Lewis township boundary and the small unnamed lake north of Grassy Lake, arkose of the Mississagi Formation rests unconformably on the weathered Algoman granite. However, eastwards as far as the eastern end of Tube Lake in Victoria Township (Robertson 1976) the granite is overlain by the Matinenda arkose. The Matinenda arkose, in the Cutler report-area, is not more than a few hundred feet thick.

The southwestern part of Lewis Township is a basement "high" and the area between Grassy Lake and Tube Lake, although somewhat lower, is an embayment in the basement "high". There is no indication that this embayment was developed well enough to have permitted the deposition of uranium-bearing conglomerate in the Matinenda Formation.

MIDDLE PRECAMBRIAN (PROTEROZOIC)

Huronian Supergroup

The Huronian Supergroup forms a belt over 200 miles (320 km) long along the North Shore of Lake Huron, and is as much as 35,000 feet (10,700 m) thick. Rocks of the Huronian Supergroup are mainly medium- to coarse-grained sedimentary rocks deposited under shallow water conditions some 2,160 to 2,500 million years ago (Robertson and Card 1972; Card and Church *et al.* 1972; Young 1973c).

In the report-area, sedimentary rocks of unquestioned Huronian age are exposed north of the Murray Fault in southern Lewis Township and central Shedden Township. However there was doubt that metasediments of Huronian age were present south of the Murray Fault (see section on "Previous Work", Table 1; and Robertson *et al.* 1968; Robertson, Card, and Frarey 1969). The thesis that the metasediments south of the Murray Fault are Huronian in age has been accepted partly on the basis of lithological and structural observations in the Cutler and Massey report areas, by the Federal-Provincial Committee on Huronian Stratigraphy; their recommendations are implemented in this report (see Robertson, Card, and Frarey 1969; and Robertson, Frarey, and Card 1969).

The formations of each group of the Huronian Supergroup are described in two parts (where appropriate), one for the area north of the Murray Fault, the other for the area south of the Murray Fault. Variations in thickness between the formations are shown in Figure 3. A regional correlation of Huronian rocks is shown in Figure 4 (Chart A, back pocket).

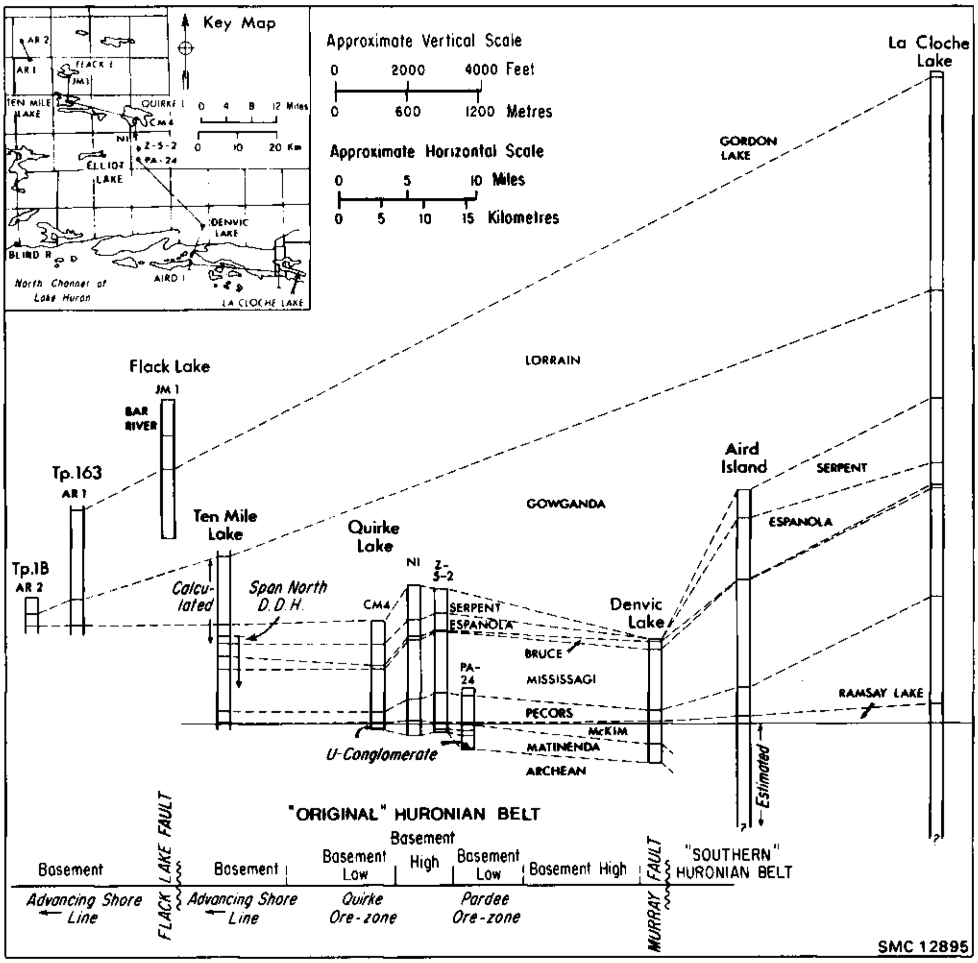

Figure 3–Lateral thickness variation of the Huronian Supergroup, Flack Lake-La Cloche Lake areas (after Robertson 1971, Figure 6; reprinted as Robertson 1973, Figure 6).

Huronian argillaceous metasediments are highly metamorphosed in a zone of variable width south of the Murray Fault. Elsewhere in the Cutler report-area the Huronian is less metamorphosed.

ELLIOT LAKE GROUP

The oldest Huronian Group, the Elliot Lake Group, consists, within the report-area, of arkose, feldspathic quartzite and minor argillite (the Matinenda Formation), and argillaceous metasediments (the McKim Formation).

The Matinenda Formation is only exposed north of the Murray Fault; and varies in thickness considerably because of depressions on the pre-Huronian surface. South of the Murray Fault the amount of downthrow is significant and the only formation in the Elliot Lake Group exposed is the McKim Formation.

Lateral stratigraphic variations are great in the group and are partly the result of bedrock "highs". Matinenda arkose and quartzite are overlain by the more extensive McKim argillite. The group is thicker south of the Murray Fault than north of it, as is shown in Figure 3. The fault trace approximates the locus of a regional hinge zone that was active during sedimentation (Card and Church *et al.* 1972; Card and Robertson *et al.* 1972).

Matinenda and McKim Formations

North of the Murray Fault

The Elliot Lake Group is exposed in a narrow zone that strikes eastward from southeastern Lewis Township, along the northern flank of Mount Victoria, and across central Shedden Township to Denvic Lake (Robertson 1970b, 1976). In Lewis and Shedden Townships the group consists of Matinenda arkose that passes upward into feldspathic quartzite which is overlain by interbedded argillite and quartzite. No quartz pebble (oligomictic) conglomerate occurs in the report-area. The sequence is best developed along the Serpent River and in the Mink Lake-Denvic Lake area; elsewhere it is a condensed sequence. Because of a regional basement high (the "Haughton-Lewis High") the group is not present in southwestern Lewis Township, eastern Lewis Township, and Shedden Township.

Slight radioactivity (two to three times background) was recorded from arkose near the contact with Early Precambrian rocks and along the Serpent River by companies in the Preston East Dome Group (see Table 5 for assessment files). Nevertheless, these companies did not find quartz-pebble conglomerate of Blind River type on surface or in core from diamond-drill holes put down by them. On the ABE claim group of Panel Consolidated Uranium Mines Limited in Lewis Township, and on ground held by Plum Uranium and Metal Mining Limited along the Serpent River south of Camp Lake are exposures of "conglomerate". This "conglomerate" is an intraformational breccia composed of fragments of arkosic quartzite with scattered pebbles and boulders of quartz and granite. The intraformational breccia is probably the result of rapidly moving currents washing material off the basement high, and disrupting the already deposited arkosic material (see Table 5 for assessment data). At two localities, one north of Grassy Lake and the other on the Serpent River, radioactivity of as much as 10 times background was obtained. Elsewhere, radioactivity was 2 times background. Diamond drilling undertaken at these localities (see Table 5 for assessment work data) failed to reveal anything of interest, and the cores were not significantly radioactive.

The Matinenda arkose is coarse to medium grained, well bedded, up to 3 feet (1 m) thick, and generally show crossbedding (either festoon or concave) and a crude graded bedding. The current structures indicate deposition in shallow water from fast-moving currents derived from the northwest. The rock is typically green to yellow when fresh, and green to yellow-brown when weathered, and contains 20 to 35 percent microcline grains and feldspathic debris. The uppermost parts of the beds or the partings between the beds consist of medium-grained, yellow-green weathering feldspathic debris.

On the group of claims controlled by Preston Mines Limited in Lewis Township and on ground along the Serpent River just south of Camp Lake in Lewis Township there are exposures of conglomerate. This conglomerate is really an intraformational breccia composed of arkosic quartzite with scattered pebbles and boulders of quartz and granite; the intraformational breccia is probably the result of rapidly moving currents washing material off the basement high and disrupting the already deposited arkosic material (see Table 5 for assessment work data).

Moving up the sequence in the Matinenda Formation from the arkosic member, the feldspar content drops to about 10 percent, the cementing material is silica rather than feldspathic debris, and the feldspathic quartzite is pale green, pink, or white in colour. Crossbedding is planar to concave, but still indicates that the sedimentary rocks were derived from a source area to the northwest. The partings are rusty weathering siltstone. The arkosic member ranges in thickness from a few feet (about 1 m) in central Shedden Township to about 100 feet (30 m) at Denvic Lake and the quartzite member ranges from 200 to 600 feet (60 to 180 m). The feldspathic quartzite member passes upwards into the interbedded argillaceous quartzite, argillite, and feldspathic quartzite of the McKim Formation. Within the argillitic sequence the laminations may be graded or rhythmic or just streaks in more quartzitic beds.

Sedimentary structures such as micro crossbedding, ripple marks, ripple crossbedding, convolute bedding, slumpage balls and pillows, and flame structures are common. These structures are well exposed in Section 23 of Shedden Township where the township road crosses the Little Serpent River. The thicker argillite beds are as much as 75 feet (23 m) thick but are generally less than 20 feet (6 m) thick.

The argillaceous quartzite is a few inches to 2 feet (4 to 6 cm to 0.6 m) thick. The rock may be massive with subconchoidal fracture or exhibit laminations and graded bedding. The quartzite beds are similar to those of the underlying quartzite member (of the Matinenda Formation), grey to white when fresh, white to brown when weathered, and massive to strongly crossbedded, and derived from a provenance area to the northwest. A few beds however, were characterized by a gritty texture with large well-rounded quartz grains scattered throughout a disrupted quartzite framework.

No volcanic rocks are associated with the Matinenda Formation exposed within the Cutler report-area, but such rocks are believed to occur at this horizon in the Massey report-area to the east (Robertson 1966b,c; and 1976).

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Photo 3–McKim Formation: Interbedded metaquartzite and mica-(garnet)-quartz-feldspar schist; *note* (1) rhythmic bedding, (2) graded bedding, — tops to left, and (3) quartz veins in quartzite bed; I.R.7 adjacent to Cutler Acid Plant housing-site.

South of the Murray Fault

The McKim Formation is exposed between the Murray Fault and the northern shore of the Whalesback Channel and the Spanish Estuary. It consists of interbanded schist and schistose quartzite (generally of staurolite-garnet metamorphic grade) associated with metamorphosed mafic intrusive rocks, and has been folded and intruded by the Cutler Granite during the Hudsonian-Penokean Orogeny. Immediately south of the Murray Fault in east-central Shedden Township are a series of mafic rocks, believed by Knight (1967) to be equivalent to the metavolcanic sequence at Spragge described by Knight (1965; 1967) and Robertson (1970a) but regarded by the author (Robertson 1970b) and Cannon (1970) as Nipissing Diabase.

The metasediments consist of interbanded schist and quartzite and form layers ranging from less than 1 inch (2.5 cm) to several feet (about 1 to 2 m) in thickness. Both rhythmic bedding and graded bedding are common, but the bedding relationships are obscured by the schistosity (Photo 3).

Tops from graded bedding and the tracing of epidiorite around fold structures in the Cutler and Massey report-areas revealed the structural pattern (Robertson 1976). The outcrop width of the McKim Formation is mainly caused by repetition of beds by folding, and dilation by diabase and granite intrusives, rather than to original thickness of sedimentary rocks with a uniform south dip. It is estimated that at least 2,500 feet (760 m) of pelitic and semi-pelitic rocks are present within the report-area. The post-depositional structures of these rocks are discussed in the section "Structural Geology".

The uppermost beds of the McKim Formation are poorly exposed on some of the islands in the Whalesback Channel or the Spanish Estuary; generally across a few feet (m) near the water line at the base of diabase cliffs or underlying the Ramsay Lake Formation. Where exposed, argillaceous quartzite is the dominant rock, and, argillaceous rocks if present, are not strongly metamorphosed. Intraformational breccia in semi-pelitic rock showing incipient metamorphism was observed at the southeastern corner of Shanly Island and on the western shore of Shoepack Bay, but other primary sedimentary structures were not observed in the McKim Formation in the Cutler report-area. Diamond drilling in 1968 (Resident Geologist's Files, Ontario Ministry of Natural Resources, Sudbury and Files of the Assessment Files Research Office, Ontario Division of Mines, Toronto) on Villiers Island confirmed the relatively low grade of metamorphism in rocks adjacent to the island increasing to biotite grade some 1,200 feet (360 m) to the north.

HOUGH LAKE GROUP

The Hough Lake Group overlies the Elliot Lake Group and consists of sedimentary rocks representative of a wider basin of deposition than that in which the Elliot Lake Group was deposited. The metasediments comprise a single cycle of a lower conglomeratic unit (the Ramsay Lake Conglomerate), a middle pelitic unit (the Pecors Formation) and an upper sandstone unit (the Mississagi Formation).

The Ramsay Lake Conglomerate is probably a tillite formed as a result of the advance of an Early Proterozoic ice sheet into or close to the report-area (Young 1973b). Climatic conditions ameliorated during the deposition of the Pecors Formation which represents a deep water facies deposited as the ice sheet retreated northward. Palonen (1973) recognized that the Mississagi Formation comprises a regressive shallow water marine shelf type arenaceous deposit in the Elliot Lake area. Palonen (1973) interpreted the Mississagi Formation as a marine shelf deposit to the south of the Murray Fault and as a tidal flat deposit in the Elliot Lake area. Furthermore, Pecors argillite, probably characteristic of deep water sedimentation grades upward into marine shelf type arenaceous deposits of the Mississagi Formation, the coarse upper part of which may complete a marine regressive cycle (Palonen 1973).

Ramsay Lake Formation

The Ramsay Lake paraconglomerate, where present, is normally between 20 and 30 feet (6-9 m) thick, but can be as much as 100 feet (30 m) thick. The conglomerate consists of subangular to rounded, ½ inch-2 inches (1.2-5 cm) diameter pebbles of quartz, granite and "greenstone" in a medium-grained, moderately well-sorted, grey- to white-weathering, grey, gritty to argillaceous quartzite matrix. Sulphide minerals are not common; a few crystals of pyrite are present and oxidation has caused rusty patches on the weathered surface. Anomalously high radioactivity has not been reported from this conglomerate.

North of the Murray Fault

The Ramsay Lake Formation forms a narrow easterly striking belt that crosses east-central Shedden Township in the Mink Lake-Denvic Lake area. The Ramsay Lake paraconglomerate has not been found west of Mink Lake. It is not known if the Pecors Formation is present in the argillaceous zone traced by the writer in southeastern Lewis Township and west-central Shedden Township, or if the zone is composed entirely of the McKim Formation. Between the Serpent River and the east end of Clear Lake, particularly on Mount Victoria, and intermittently between Clear Lake and Denvic Lake, the basal beds of the Mississagi Formation are conglomeratic. The author suggests that because this area was located on the flank of a basement high, the Ramsay Lake and Pecors Formations were eroded from it, and then reworked and incorporated into the basal members of the Mississagi Formation. The Matinenda, Salmay Lake, McKim, Ramsay Lake and Pecors Formations were not deposited over the basement high in southwestern Lewis Township.

South of the Murray Fault

The Ramsay Lake Formation, mainly a polymictic paraconglomerate has been traced along the Spanish River (Collins 1925, 1936; Thomson 1961, 1962) and is exposed on various islands in the Spanish Estuary, at Shoepack Bay, and along the south margin of the Whalesback Channel.

The Ramsay Lake conglomerate is exposed along the west boundary of the report-area. The western part of the Whalesback Channel has not been diamond drilled, so the presence there of the conglomerate cannot be verified. Polymictic paraconglomerate occurs on an islet in Aird Bay; this may be an infolded outlier of the Ramsay Lake conglomerate.

The Ramsay Lake conglomerate, a gritty quartzite that weathers light grey to pale pink, has numerous scattered grains up to ½ inch (1.2 cm) long of grey quartz and a few ½ to 1 inch (1.2 to 2.5 cm) pebbles of quartz, granite, and rarely 'greenstone'. The conglomerate exposed along the Spanish River (see Massey report, Robertson 1976) and the Spanish Estuary has a distinct cleavage; incipient sericite is found in the matrix; and grains and pebbles show distinct elongation. At Shoepack Bay and Whalesback Channel, these signs of metamorphism are less distinct.

Pecors Formation

The argillaceous Pecors Formation which overlies the Ramsay Lake conglomerate is poorly exposed in the Cutler map-area, usually being under water.

North of the Murray Fault

The Pecors argillite is similar to that of the McKim Formation. The unit is best exposed at Mink Lake (Photo 4), on the western shore of Denvic Lake and eastwards


ODM9340

Photo 4–Pecors Formation: Interbedded quartzite and argillite — *note* fine lamination, graded-bedding — top of bedding to left, Mink Lake, Shedden Township.

in the Denvic Lake-Tube Lake area of Victoria Township (Robertson 1966b; 1970b; 1976). The argillite and streaky to laminated argillaceous quartzite show numerous structures characteristic of shallow water, current action, compaction, and gravitational slumpage. Current structures in the quartzite beds indicate a derivation dominantly from the northwest. Spotty radioactivity was reported from argillite in the Denvic Lake area of Victoria Township (J. Humpage, personal communication).

At Denvic Lake (see Figure 3) the Pecors argillite member attains a thickness of some 300 feet (90 m). The marked decrease in thickness from the Elliot Lake area is partly caused by the regional facies change and the location on the flank of a basement high.

South of the Murray Fault

In the Spanish River-Shoepack Bay area pelitic and semi-pelitic rocks transitional to the Mississagi quartzite show the slumpage breccia, convolute bedding, and flame structures characteristic of soft rock compaction. Between Shoepack Bay and Jackson Island argillaceous sedimentary rocks are largely under water. Further west, the uppermost beds are exposed on the northern shore of John Island where they consist of interbedded, crossbedded feldspathic quartzite and grey micaceous schist of low metamorphic grade, which are cut in a few places by stringers of Cutler pegmatite and Cutler granite.

The Pecors and Mississagi Formations may form a normal regressive marine sequence (Palonen 1973).

Mississagi Formation

The Mississagi Formation was deposited south of the Murray Fault in a marine shelf environment (Palonen 1973). To the north of the Murray Fault the corresponding unit is indicative of a tidal flat depositional environment (Palonen 1973).

North of the Murray Fault

The Mississagi Formation, which is composed of feldspathic quartzite, quartzite, conglomerate, and minor argillaceous quartzite, is moderately to well exposed as an easterly trending ridge in southern Lewis Township and central Shedden Township. It has been traced continuously throughout the Elliot Lake-Blind River-Massey region (Robertson 1960 *et seq.*; Robertson *et al.* 1971).

At the western end of Lewis Township the middle member of the Mississagi Formation is represented by greenish arkose (similar to that of the arkosic basal member of the Matinenda Formation) lying on the local basement high and cut off to the south by the Murray Fault (Robertson 1969a; 1976).

In central Lewis Township well-bedded grey to white feldspathic quartzite and quartzite overlies the argillaceous rocks of the McKim Formation and possibly the Pecors Formation. These rocks are truncated to the south by the Murray Fault, adjacent to which they are strongly fractured and slickensided. Locally, for example north of Grassy Lake, there are numerous easterly trending quartz veinlets. Crossbedding is conspicuous; trough crossbedding is more common towards the west, and concave-planar crossbedding more common towards the east. The depositional currents were derived primarily from the northwest. Similar rock is the dominant component of the Mississagi Formation in southeastern Lewis Township and in west-central Shedden Township, but in these areas conglomerate is also present.

Conglomeratic gritty quartzite is exposed at the east end of Grassy Lake, from the Serpent River road to the east end of Clear Lake, on Mount Victoria, and intermittently from Clear Lake to the southern bay of Denvic Lake (George Westner, geologist to Broulan Reef Mines Limited, personal communication 1968). This conglomerate contains small, rounded pebbles of quartz and granite and, very rarely, metabasalt that are widely scattered in a grey to greenish grey weathering, grey, gritty quartzite matrix which contains scattered large grains of quartz and fresh feldspar. Elongated grains and pebbles and colour variation in the matrix give a crude indication of bedding.

Between the Serpent River road and the eastern end of Clear Lake the massive conglomeratic quartzite is normally between 100 and 200 feet (30-60 m) thick (as shown on maps compiled for Peach Uranium and Metal Mining Limited, see Table 5). Nevertheless on Mount Victoria there is at least 500 feet (150 m) of unbroken exposure and a further 300 feet (90 m) probably reflecting duplication by a thrust fault. This conglomeratic quartzite probably contains material derived from the

Ramsay Lake Formation which is exposed and eroded from the flank of the local basement "high".

On the high ground west of Denvic Lake and eastwards in Victoria Township (Robertson 1966; 1970b; 1976; Roscoe 1969; 1973) an unusual conglomeratic intraformational breccia forms a conspicuous marker horizon. This breccia consists of fragments, 1 inch to several feet (2.5 cm to m) long, of a yellow-green siltstone with large grains of quartz and feldspar, and small pebbles of partly weathered granite. The matrix is a medium- to coarse-grained white-weathering feldspathic quartzite. Pebbles and boulders of quartz or granite may be found in the matrix in a few places. Where the matrix is conglomeratic, rusty coloured staining is generally present, and in these areas prospectors have recorded spotty radioactivity. The siltstone fragments are contorted indicating that the material was partly consolidated when deposited.

Jasper and chert fragments, materials not normally found in the Mississagi Formation of this area, are found in the matrix of the intraformational breccia and in some of the adjacent beds. The beds between the breccia and the overlying Bruce Formation are normal quartzite and feldspathic quartzite derived from the northwest.

South of Clear Lake and in the Denvic Lake area the Mississagi Formation is 1,600 to 1,800 feet (490 to 550 m) thick. However, between Clear Lake and Mink Lake it is only 200 feet (60 m) thick just west of the Little Serpent River. This is probably caused by partial non-deposition and erosion in the lee of the Lewis Township basement "high".

South of the Murray Fault

The Mississagi Formation normally comprises well-bedded, greenish grey to white weathering feldspathic quartzite and quartzite which locally grade into argillaceous quartzite. It is exposed in the western part of the Spanish River Indian Reserve (I.R.5), and on the chain of islands separating the Whalesback and North Channels of Lake Huron.

The contact with the underlying Pecors Formation is exposed in the eastern part of the report-area and west of the report-area on the northern shore of John Island. In both localities the contact is gradational.

In the Spanish River area cleavage and micas are found in the argillaceous beds; the quartzites are only partly recrystallized. Elsewhere, in the report-area the feldspathic quartzite and quartzite closely resemble quartzite of the Mississagi Formation of Lewis Township. Locally, as for example on islands in the Spanish Estuary and on Rainboth, Klotz, and Aikens Islands, the uppermost beds comprise argillaceous quartzite; biotite porphyroblasts and stringers of Cutler-type pegmatite are found in the Mississagi Formation on the southern shore of Klotz Island. The argillaceous medium- to fine-grained quartzite is dark grey when fresh and grey to pink when weathered. Graded bedding and crossbedding are poorly developed in the argillaceous rocks, but are characteristic of the coarser grained feldspathic quartzite and quartzite. This crossbedding is dominantly planar-concave and shows derivation from the northwest (McDowell 1963, Plate I).

No quartz-pebble conglomerate has been observed in the Mississagi Formation as exposed in the Cutler report-area, but quartz pebbles are sparsely distributed in the quartzite.

Cannon (personal communication, 1965) has reported localized pebble bands but was unable to detect radioactivity. Scintillometer surveys (ODM 1954 b, c) show radioactivity anomalies on the Klotz-Aird island chain. These anomalously high readings are caused by mass effect and may reflect the potassium content of the rocks (Robertson 1967).

Dense polymictic conglomerate is exposed on Boyd Island which lies to the south of McBean Channel near the southeast corner of the report-area. It was not found on Crooks or Hawkins Islands to the east nor on Aird Island to the west.

QUIRKE LAKE GROUP

The Quirke Lake Group comprises the following formations and their main rock types, the Bruce Formation (polymictic paraconglomerate), the Espanola Formation (limestone, dolomitic limestone, siltstone) and the Serpent Formation (quartzite). Young and Chandler (1968), Lindsey (1966, 1967, 1969), Casshyap (1971), Robertson (1971, 1973), and Young (1973b) suggested that the Bruce Formation is glacial in origin. The Espanola Formation is unique in the Huronian for its carbonate content and depositional and post-depositional structures (Young 1973a). The Espanola Formation has been attributed to the interglacial period which followed the Bruce glaciation (Casshyap 1971). Possibly, the Serpent Formation was deposited in an environment which at first fluctuated between a beach and deltaic-fluvial one, and later became a fluviatile-deltaic one (Wood 1973).

Bruce Formation

North of the Murray Fault

The Bruce Formation, comprising a polymictic paraconglomerate with a matrix of siliceous greywacke, is exposed in central Shedden Township as a low east-striking ridge between the east end of Serpent Lake and the south bay of Denvic Lake. The contact between the Bruce Formation and the underlying Mississagi Formation is not exposed in Shedden Township. To the east in Victoria Township (Massey report-area) the contact is sharp, but apparently conformable (see Robertson 1966b, 1970b, 1976). In Shedden and Victoria Townships the Bruce conglomerate consists of a moderately sorted aggregate of subangular to subrounded cobbles and boulders of granite, gneiss, diabase, greenstone, quartz, feldspar, and rarely chert and jasper; as well as angular to rounded pebbles and fragments of the same materials set in a gritty dark grey to black matrix of siliceous greywacke and quartzite. The matrix is characterized by well-rounded grains, approximately 1/10 inch (2.5 mm) in diameter, of smoky quartz, rather smaller grains of pale sky blue quartz, and by disseminated pyrite and pyrrhotite. On the weathered surface, oxidation of the sulphide minerals gives rise to irregular rusty patches. Otherwise the outer ¼ inch (6 mm) of the rock is light grey in colour.

A moderately sparse distribution of pebbles is common in the Bruce Formation. The granitic and gneissic clasts are similar to the Early Precambrian granitic rocks; white to pale pink varieties predominate. Because the matrix is normally harder than the clasts, the latter weather quickly giving the rock a pitted surface. Where the matrix is less siliceous, or where the outcrop surface has been protected this differential erosion is not observed. Some markedly striated boulders and pebbles are found at a number of localities between Blind River (Rice 1940) and Massey (Robertson 1966b; 1976). These striated boulders and pebbles show that the conglomerate was probably initially transported in mass, either by ice or perhaps by a mud flow, was deposited in water, and then was subjected to some sorting and winnowing (Robertson 1971a).

Lenses of quartzite may be present in a few places as, for example, near Serpent Lake. The quartzite is well washed, white, feldspathic, and has a white to rusty weathered surface. These quartzite lenses are only a few inches thick and cannot be traced for more than a few feet.

In that part of the report-area north of the Murray Fault the Bruce Formation is generally between 200 and 250 feet (60 to 76 m) thick; somewhat thicker than in the Quirke Lake-Elliot Lake area (see Figure 3).

South of the Murray Fault

The Bruce Formation is exposed on small islands east of the YMCA camp at the east end of John Island and mainly consists of a polymictic paraconglomerate. At the east end of Aird Island a few inches to a few feet of gritty quartzite is exposed with small granitic pebbles (Photo 5). On the shore of Aird Island north of Conmee Island, the Espanola Formation overlies the Mississagi Formation. This indicates that non-deposition or erosion of the Bruce Formation occurred here. At the west end of Aird Island and on the small islands to the east of John Island at least 400 feet (120 m) of dense to moderately dense boulder conglomerate lies in an erosion channel which cuts the Mississagi Formation. The contact with the underlying Mississagi Formation as exposed on Aird Island is unconformable.

On Aird Island the Bruce conglomerate contains cobbles and boulders (predominantly of white granitic rocks) set in a dark grey, gritty siliceous greywacke to greywacke-type matrix with grains of smoky quartz and disseminated pyrite.

Dark grey gritty quartzite with scattered rock fragments and disseminated pyrite is poorly exposed on I.R.5, near the eastern limit of the report-area. These rocks have been tentatively correlated with the Bruce Formation (Robertson 1970b; 1976).

The Bruce Formation is poorly exposed in the southern part of the report-area. The lithology suggests deposition from ice or from a mudflow. Adjacent rocks indicate that shallow water conditions prevailed; probably the formation was either not deposited or was eroded in the central part of Aird Island.

ODM9341

Photo 5–Bruce Formation: Sparse polymictic conglomerate; note differential weathering between some clasts and gritty matrix; east end of Aird Island.

Espanola Formation

The Espanola Formation comprises interbedded calcareous and dolomitic limestone, siltstone, argillite, greywacke, protoquartzite, feldspathic quartzite, quartzite, and interformational breccia. A three-fold division of the formation was made by Collins (1925) into a lower limestone unit, the Bruce Limestone; a middle argillite and greywacke unit, the Espanola Greywacke; and an upper unit with a marked development of ferruginous dolomite, the Espanola Limestone. Young (1973a, p.136) has also made a three-fold division of the formation. However, the author could not make a three-fold division in the Cutler report-area.

North of the Murray Fault

The Espanola Formation is poorly exposed in a zone extending from Serpent Lake south of Denvic Lake in east-central Shedden Township into central Victoria Township (Robertson 1965a, 1969a, 1976). The Espanola Formation consists of thinly bedded siltstone and white limestone, protoquartzite, and rusty weathering carbonate-bearing beds. In some beds cross-laminations and other primary sedimentary structures are defined by bands of argillaceous material or quartz grains. The rusty weathering beds are normally several inches thick and may be laminated limestone, calcareous siltstone, or steel grey dolomitic siltstone. The latter are weathered to a depth of ¼-½ inch (0.5-1.2 cm).

The white limestone bands are more common at the base of the formation, and may be regarded as the Bruce Limestone member of Collins (1925). The Gowganda Formation unconformably overlies the Espanola Formation.

Because the dolomitic beds are not common at the top of the Espanola Formation, the three-fold subdivision was not practical. The Espanola Formation exposed northeast of Walford Lake is 150-200 feet (46-60 m) thick, and remains constant in thickness in Shedden Township. Therefore, a small amount of the Espanola Formation was eroded before the deposition of the Gowganda Formation. The relatively thin sequence at Denvic Lake (see Figure 3) is caused by non-deposition in the lee of the Lewis Township basement "high".

South of the Murray Fault

The Espanola Formation is well exposed on the southern part of Aird Island and on the adjacent islands between Dennis and Hoskin Islands. Depositional, compactional, and tectonic structures are shown in Photos 6, 7, and 13 (see subsection "Folds").

The Espanola Formation consists of between 1,500 and 1,800 feet (460 to 550 m) of feldspathic quartzite, quartzite, siltstone, calcareous and dolomictic siltstone; the latter has a rusty brown pitted surface formed by solution weathering. Although calcareous rocks are slightly more common towards the base of the Espanola Formation a three-fold subdivision is not practical.

The rocks are slightly metamorphosed being recrystallized and have porphyroblasts of scapolite in the carbonate-rich layers, and are moderately to severely contorted and fractured. Bedding is typically measured in inches. Internal laminations within the beds are common (see Photo 12).

Feldspathic quartzite and quartzite are best-developed on central Aird Island and the adjacent small islands. These are medium to coarse grained, off-white to grey when fresh, and variegated in shades of white, grey, brown, or pink when weathered. Argillaceous material and(or) heavy minerals outline laminae and internal structures. Planar to concave, festoon, and ripple crossbedding are all found (Photo 6). Scour and fill structures are common. These features indicate strong current action with rapidly varying intensity and direction deposited these rocks. Because the Bruce Formation is missing, the arenaceous beds of the Espanola Formation in the Aird Island area were probably partly derived from the Mississagi Formation.

In the thinly bedded pelitic and semi-pelitic rocks differential weathering has produced etched and pitted surfaces. Where the outcrop surfaces have been protected or recently subjected to water-polishing, current and compaction structures such as crossbedding, ripple marks, graded bedding, convolute bedding, load casts, flame structures, slumpage balls and pillows, and intraformational breccias are well displayed. Some of these features are illustrated in Photos 6, 7, and 13. Biotite, locally found in some argillaceous beds, indicates low to moderate regional metamorphism.

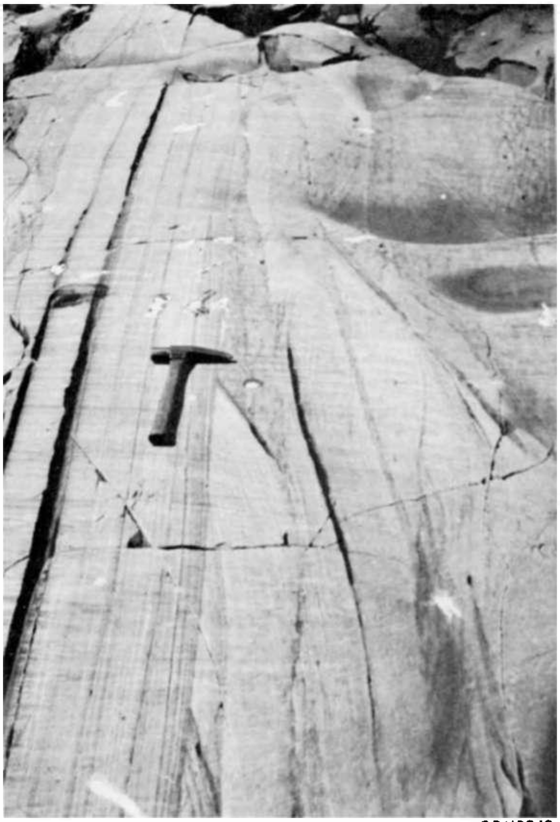

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Photo 6–Espanola Formation: Feldspathic quartzite on small island southeast of Aird Island and north of Ferguson Islands. Note: lamination planar-concave crossbedding (centre); scour- and fill-structures and festoon crossbedding at left; ripple crossbedding at top right. Hammer head points west.

The carbonate bands are conspicuous because of brown weathering, and differential and solution erosion. The beds are white or cream where calcareous, and blue-grey where dolomitic. Internal laminations in many places reveal microcurrent structures that are defined by quartz grains. The carbonate-bearing beds may show ripple marks, mudcracks, and pass laterally into intraformational breccias. Some of the carbonate bands are recrystallized. Idiomorphic scapolite crystals as much as ½ inch (1.2 mm) long (identified by the Mineral Research Branch, Ontario Division of Mines as dipyre) were found in recrystallized dolomitic siltstone exposed on a small island south of Klotz Island. Irregular white spots found elsewhere in the Espanola Formation may also be scapolite.

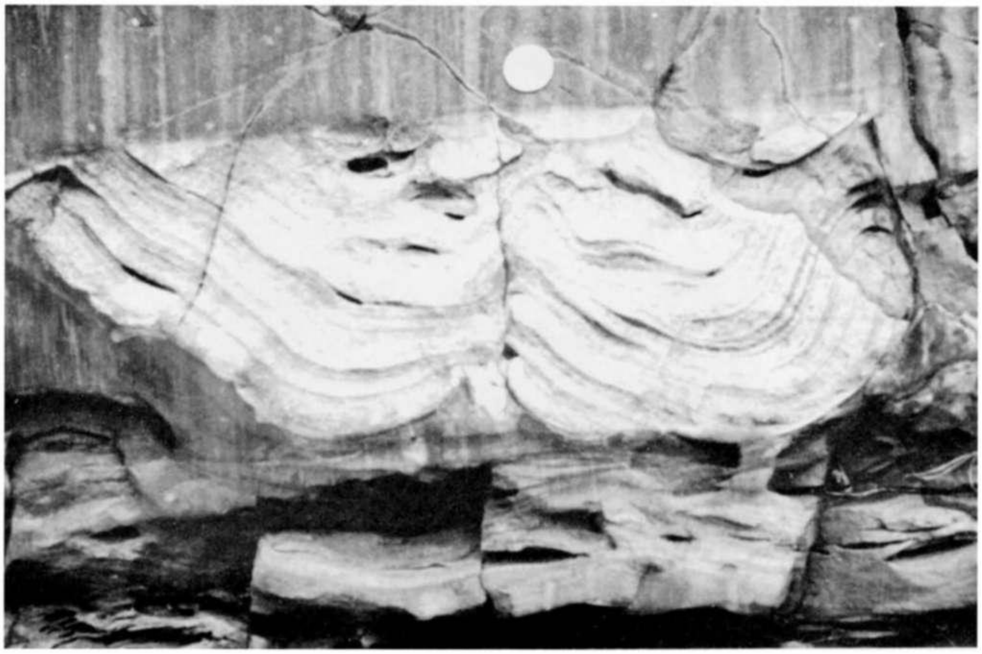

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Photo 7–Espanola Formation: Convolute bedding; laminated calcareous protoquartzite slumped into and overlain by siltstone, small island south of east end of Aird Island (coin is 25 cent piece). Note glacial striae and polish on siltstone.

The abundance of current structures, ripple marks, and mudcracks indicate that the Espanola Formation accumulated under very shallow water conditions. It is interpreted that the formation is a product of diachronous deposition by migration of different facies (Young 1973a).

The rocks were subjected to low and moderate regional metamorphism in some parts of the report-area, primary structures were not destroyed.

Serpent Formation

North of the Murray Fault

The Serpent Formation overlies the Espanola Formation apparently conformably, and consists of calcareous and non-calcareous feldspathic quartzite and quartzite. The formation is only exposed in Shedden Township northeast of Walford Lake; elsewhere it is cut out by the unconformity at the base of the Gowganda Formation.

The Shedden Township outcrops show a maximum development of 120 feet (37 m) of white, well-bedded, fine- to medium-grained, thinly laminated to massive, calcareous feldspathic quartzite. Some laminae, more calcareous than others, are

Photo 8–Serpent Formation: Well-bedded crossbedded quartzite; *note*: (1) variable direction of lamination (hammer head points west), (2) etching of calcareous laminae, (3) spotting caused by carbonate and sulphide weathering, (4) at right, differential erosion of schistose conglomeratic bed. Small island southeast of Aird Island (northeasternmost island of the Ferguson Islands).

etched on the weathered surface. In some beds, the laminae are parallel to the bedding, and in others the laminae define crossbedding, indicating derivation of material generally from the northwest.

South of the Murray Fault

The Serpent Formation is well exposed on the headlands on the southern shore of Aird Island and on the islands to the south of Aird Island between Mouse Island to the west and the Ferguson Islands to the east.

The Serpent Formation consists of well-bedded slightly calcareous to non-calcareous quartzite to feldspathic quartzite weathering white to pale pink. The bedding is usually several feet in thickness and internally massive to cross-laminated (Photo 8). Graded bedding is a common feature in the formation. Calcareous beds and laminae are more common towards the base of the formation. The laminae may be faintly etched, but the calcareous strata are more deeply etched than the adjacent massive quartzite. At one locality the crossbedded units are themselves several feet thick. Near the top of the exposed formation on Conmee Island, white

Photo 9–Serpent Formation: Large-scale and normal mudcracks in siltstone near base of formation, headland west side of Galbraith Point; Aird Island.

to pale pink granite pebbles are scattered in massive feldspathic quartzite. Similar pebbles and cobbles may be numerous in some interbeds, the matrix of which may contain some argillaceous material. These conglomerate interbeds are differentially eroded to a depth of 2 to 3 feet (0.6 to 0.9 m), (Photo 8).

Siltstone, or argillite may also form beds between clean quartzite. Such interbeds are commonly ripple marked or in some places mud cracked. An exceptional exposure of mudcracks occurs in siltstone beds outcropping on a headland on the west side of Galbraith Point of Aird Island (see Photo 9). The two beds, which are 5 feet (1.5 m) thick, consist of thinly laminated siltstone. The laminae are mud cracked and ripple marked. Large scale mudcracks are up to an inch (2.5 cm) across and form polygons up to 9 inches (23 cm) across. The individual siltstone polygons are further broken by normal small-scale mudcracks. The dominant orientation of crossbedding and ripple marks suggests derivation of material from the northwest.

The complete Serpent Formation is not exposed in the Cutler report-area. Because the Serpent Formation forms good scarps, the width of outcrop is a guide to the true thickness of the formation.

The Serpent Formation is not exposed south of the Murray Fault west of the Cutler report-area. West of Mouse Island, the Serpent Formation was either not deposited or was eroded prior to the deposition of the succeeding formation. To the east along the McBean Channel the Serpent Formation is locally absent because of an unconformity (Robertson 1965b; 1970b, and 1976).

COBALT GROUP

The Cobalt Group is represented in the report-area only by the Gowganda Formation which is exposed only north of the Murray Fault. The Gowganda Formation consists predominantly of polymictic paraconglomerate.

Lindsey implied that the Gowganda Formation was deposited in a continental glacial environment (Lindsey 1969, p.1,685-1,701) which was probably marine, but close to an ice front.

Gowganda Formation

The Gowganda Formation is exposed from the eastern end of Serpent Lake to south of Denvic Lake in east-central Shedden Township. To the south, the Gowganda Formation is truncated by the Murray Fault. To the east it continues into Victoria Township (Robertson 1966b). The Gowganda Formation, where exposed, comprises up to 900 feet (270 m) of polymictic paraconglomerate, impure quartzite, greywacke, and argillite. The basal contact is not exposed in Shedden Township but regional mapping (Collins 1925; Robertson 1960 *et seq.*) indicates that it is an unconformity.

In the report-area the outcrop of the Gowganda Formation is broken by cross-faults and by a transgressive sill-like mafic intrusive body. Adjacent to the Murray Fault the rocks are strongly fractured; the more argillaceous rocks are cleaved, and the quartzites, normally pink, are bleached, and recrystallized. Hematite has been redeposited in the fractures.

The conglomerate consists of pebbles, cobbles, and boulders of granitic rocks (red and pink varieties predominate over white), diabase, metabasalt, and quartz that are sparsely distributed in a fine- to medium-grained chloritic greywacke matrix. The clasts are sub-angular to sub-rounded and are in diameter as much as 1 foot (0.3 m) but are generally 2 to 4 inches (5.1 to 10.2 cm). Minor amounts of pyrite may be disseminated in the matrix. Towards the top of the exposed sequence some conglomerate beds have been winnowed and matrix material has been removed leaving a more densely packed conglomerate. Laminated greywacke conglomerate has not been identified in Shedden Township, but has been found to the east in Victoria Township (Robertson 1966b; 1976). The sparse conglomerates were transported in mass either by ice or by mud flow. The presence of argillites and varvites, the well-developed bedding, and sorting in conglomerate beds, indicate deposition in water.

The quartzite is normally a dirty grey to pink, the feldspathic quartzite weathers pink. The beds are a few inches to 2 feet (cm-0.6 m) in thickness and form as ribs between the paraconglomerate or argillite. Crude graded bedding, crossbedding, and load casting have been observed in the quartzite.

Close to the Murray Fault the ferruginous material has been leached by solutions, and in some instances redeposited as hematite veinlets; quartz has also been remobilized and redeposited by percolating solutions.

A few beds of well-laminated argillite were noted. Similar beds have been used as marker horizons in the Gowganda Formation exposed in Victoria Township (Robertson 1976). Either graded bedding or rhythmic banding is found in the argillites exposed in Shedden Township; rafted pebbles are found in some beds in Victoria Township (Robertson 1966b).

The Gowganda Formation probably accumulated under sub-glacial conditions and, in the present report-area, in a marine rather than a continental environment.

Post-Huronian Intrusions

The post-Huronian igneous rocks are: (1) the Post-Huronian mafic intrusions including principally the Nipissing Diabase; (2) the Cutler Granite; and (3) olivine diabase of Upper Precambrian age.

The Nipissing Diabase is found as sills and irregular bodies particularly in the Huronian metasediments north and south of the Murray Fault.

Numerous diabase dikes cut the Algoman granitic rocks. The precise relationship of these dikes to the Nipissing sills is not known, and several periods of intrusion may be represented. All post-Huronian igneous events were considered by the earlier workers (eg. Collins 1925) to be phases of the Keweenawan igneous cycle, but recent age determinations (Van Schmus 1965) demonstrate that these events were widely separated in time.

Closely related to post-Huronian igneous events are the post-Huronian tectonic events. Breccias of Sudbury-type rock are found to the north of the Murray Fault in the Early Precambrian rocks and are in turn intruded by diabase dikes. Differentiation of Nipissing Diabase in sill-like intrusions in the Huronian rocks on the north side of the Murray Fault suggest that the sill-like intrusions were folded subsequent to consolidation.

NIPISSING INTRUSIVE ROCKS

The rocks that are correlated with the Nipissing Diabase occur as sill-like bodies in the Huronian metasediments, or as dikes largely confined to the Early Precambrian rocks and are characterized by west-northwesterly or northwesterly strikes. The irregular bodies and sills consist of gabbro differentiated to diorite. Where unmetamorphosed, these bodies and sills are lithologically and petrographically identical to Nipissing Diabase (Card and Pattison 1973), and where metamorphosed consist of massive to schistose or gneissic amphibolite. The dikes are especially numerous in the core of the Chiblow Anticline. Within the report-area the relationship of the dikes to the sill-like bodies is not clear. Elsewhere in the Blind River area, there is some indication that northwest-trending dikes cut sill-like intrusions. It is possible that such dikes may represent a phase of igneous activity younger than the sills. As noted in the section on "Early Precambrian Mafic Intrusive Rocks" the possibility of older dikes existing that are not related to the Nipissing intrusions has not been excluded.

In the report-area, irregular bodies of gabbro-diorite are located as follows:

1) Along the northern boundary of Proctor Township north and northwest of Kings Lake, in the Whiskey Lake area (Robertson 1962, p.45). This body intruded the Huronian as a sill, but within the report-area, it cut across the Keewatin structures (see Robertson 1968a, Photo 4).

2) As an east-northeasterly trending transgressive sill in the Huronian rocks exposed in Sections 21 to 24 of Shedden Township (Robertson 1965a). In Victoria Township this body shows differentiation indicating the top faced south, but in the present area, it cut across a gentle fold in the Huronian strata.

Between the Murray Fault, and the Whalesback Channel, metadiabase occurs in generally concordant bodies varying in thickness from a few inches to 750 feet (230 m). The larger bodies are normally continuous but may show boundinage; the smaller bodies are commonly boudinaged. Sill-like bodies of metadiabase are well exposed on the islands in the Spanish Estuary and the eastern part of the Whalesback Channel and also to the west and north of Shoepack Bay. A transgressive sill of metadiabase-metadiorite is exposed in the northwest part of I.R.5.

In the area south of the Murray Fault, these metadiabase bodies form the most easily traced markers, and where not unduly transgressive, outline the isoclinal folding. A large body outlines the Spanish Anticline north of Highway 17 in I.R.7, Shedden and Victoria Townships, and this body probably controlled the intrusion of the Cutler Granite. To the southwest of Cutler village, the epidiorite (metadiabase) on the south limb of the anticline is folded into a syncline and a more southerly anticline; the epidiorite can then be traced as inclusions near the southern margin of the Cutler Batholith (Robertson 1970b; Cannon 1967, 1970).

The dikes are vertical or near-vertical and are typically 20 to 150 feet (6 to 45 m) in width, some are wider than 150 feet (45 m). At map-scale they are rectilinear in pattern, and a number have been traced for several miles. A marked concentration of dikes occurs in the granitic core of the Chiblow Anticline, a feature thought to be caused by the high competency of granite that only yields to applied forces by fracturing. The dikes, as in the Blind River-Elliot Lake district (Robertson 1960 *et seq.*), show a marked concentration along west-northwest and northwest trends. North- and northeast-trending dikes occur, but are rare except in west central Lewis Township. Relationships between dikes of different trend are rarely observed.

Except for porphyritic diabase that only intrude Early Precambrian rocks (see section "Mafic Intrusive Rocks") there is little direct evidence of other Pre-Huronian dikes; although a few can be shown to cross the Early Precambrian-Huronian boundary.

South of the Murray Fault dikes are extremely rare. Those observed trend northwest but are normally too narrow to show on the map. On the shore south of the former Cutler station such northwest-trending dikes post-date the intrusion of sill-like diabase (epidiorite) (Church and Young 1972). Also, on a small island between the Otter Islands and Villiers Island on the south side of the Whalesback Channel a northwest-trending diabase dike shows a chilled contact against the sill-like diabase body forming the east-trending chain of islands (see Map 2315, back pocket).

The diabase and gabbro as exposed north of the Murray Fault consist of calcic labradorite, diallagic augite with minor pigeonite, and minor amount of quartz. The accessory minerals may include chlorite, red-brown biotite, zircon, apatite, and magnetite. Pyrite, pyrrhotite, and chalcopyrite may be disseminated through the rock. The pyroxenes may be fresh, particularly in the basal parts of the sill-like rocks, but are normally moderately to strongly uralitized. Plagioclase, particularly the more calcic cores are partly altered to saussurite. These effects are more pronounced in the dike rocks in the southern parts of Lewis and Shedden Townships than elsewhere.

The gabbroic rocks exhibit a gradual transition to diorite and granophyric diorite upward in the intrusions. The uralitized pyroxene is replaced by blue-green pleochroic hornblende. Chlorite and red-brown biotite become characteristic accessory minerals. There is an increase in the free quartz and micropegmatite present. The plagioclase is less calcic but more strongly zoned. In some patches the diorite is characterized by 1 inch (2.5 cm) long crystals of euhedral hornblende. These patches may be vuggy with quartz, and rarely is calcite present in them, and they are generally lighter in colour than the adjacent rocks. Sphene and epidote are characteristic accessory minerals of the dioritic phase. The red-brown biotite may show intergrowths of skeletal titaniferous magnetite.

No granophyre or "red rock", the normal end-stage of differentiation of the Nipissing Diabase, has been identified within the report-area.

To the south of the Murray Fault, the sill-like diabase has been metamorphosed to amphibolite or epidiorite, and consists of hornblende and intermediate to sodic plagioclase with varying amounts of epidote, quartz, sphene, magnetite, chlorite, biotite, zircon, apatite, and sulphide minerals. In areas of higher grade metamorphism finer grained rocks are represented by hornblende schist, and the coarser grained rocks by gneissic epidiorite; the amphibole and plagioclase grains are segregated into layers one or two grains thick. In these areas garnet may be developed in the marginal phases of the larger sill-like bodies. Garnets up to 1 inch (2.5 cm) across are characteristic of the margins of the sill-like diabase at Cutler Post Office and near the Imperial Oil Company's storage plant at Cutler. South of the Spanish Estuary, and in the islands in the Whalesback Channel the diabase retains a diabasic texture, but the pyroxene is replaced by amphibole.

Pyrite, and to a lesser extent, pyrrhotite and chalcopyrite are associated with the marginal phases of the dikes and sills. Some pitting has been carried out on a sulphide-bearing dike in Lewis Township. This dike is one of a few in the district associated with a magnetic anomaly shown on the following maps; ODM Provincial Aeromagnetic and Radioactive Survey Maps 51 and 52, ODM Provincial Aeromagnetic Map 7068G (ODM 1954b, c; ODM-GSC 1963a, b, c). Minor amounts of sulphide minerals were noted associated in dikes within the Huronian metasediments on the islands in the North Channel of Lake Huron; the sulphide level was normal for such rocks, and there is no indication of economic quantities.

On the ridge north of Highway 17 at the Shedden-Victoria township boundary quartz segregations in epidiorite carry blades and plates of ilmenite up to 2 inches (5 cm) in length. At Passage Island in Whalesback Channel a vein of milky to translucent white to pink quartz cuts diabase.

The northwest-striking dikes are found in a few places in the Aird Bay area, and these dikes are chloritized particularly at their margins, and along joints, and form small gulleys. The cores of the joint blocks remain amphibolitic and may show foliation (Church and Young 1972).

North of the Murray Fault the country rock adjacent to the dikes and sills may, over a width of a few inches or feet have a pink colouration caused by the introduction of albite and hematite. This effect was not noted south of the Murray Fault.

The mafic rocks (the "Victoria Greenstone") adjacent to the Murray Fault near Walford Lake consist of fine- to medium-grained chloritic amphibolite, are generally massive, and are cut by irregular more schistose zones. Definite primary volcanic structures were not observed, although spotting suggestive of the amygdules observed at the Pater Mine (Robertson 1970a) occurs in more schistose zones. The spotting was possibly caused by metamorphic segregation. Some bands of metasediment are enveloped by the amphibolite, but these may be inclusions or may be interlayered with the amphibolite. Minor amounts of sulphide mineralization are disseminated in the amphibolite and the metasediments.

Knight (1967) found during a study of the Rb-Sr ratios in volcanic rocks near Lake Huron, that samples from the "Victoria Greenstone" lay on the isochron obtained from the Pater Volcanic rocks and suggested that both units were Archean volcanic rocks trapped against the Murray Fault. Cannon (1967; 1970) has questioned the volcanic origin for these rocks in both areas, and has indicated a preference for considering relatively low grade metamorphism of mafic intrusive rocks. Support for this view is found in Victoria Township where outcrops at the east end of the fault zone are massive and show ophitic texture, and where metadiabase traced on the south limb and crest of the Spanish Anticline cannot be traced along the north limb (Robertson 1966b; 1976).

Emplacement of Nipissing Diabase is the earliest phase of Post-Huronian igneous activity. Nipissing Diabase is largely sill-like when intruded into the Huronian rocks but forms vertical or near-vertical dikes in the Algoman granite and Keewatin-type metasediments.

CUTLER GRANITE

The Cutler Batholith forms the rugged ground lying between the Serpent River and the Whalesback Channel of Lake Huron, between the mouth of the Serpent River and Aird Bay, and also forms a tongue extending eastwards along the core of the Spanish Anticline. About one third of the Cutler Batholith lies in the Cutler map-area. Age-dating and recent mapping (Van Schmus 1965; Van Schmus *et al.* 1963; Wetherill *et al.* 1960; Cannon 1967, 1970; Robertson 1965a, b, c; 1966b, c; 1967; 1968a) show that the granite is post-Huronian in age.

There are numerous inclusions of metasediments and mafic igneous rocks in the Cutler Batholith that have generally uniform strike and dips and show little sign of disturbance. Where sedimentary inclusions are particularly abundant in the granite, valleys have developed on the ground.

Epidiorite inclusions outline pre-granite structures. Tops measured from reversed graded bedding in the metasediments adjacent to the Cutler Batholith confirm this interpretation. These features were used at the western end of the Cutler Batholith by Robertson (1970a) to delineate pre-granite structures and were most effective in the Aird Bay area. The structure of the area has been further studied by Cannon (1967, 1970).

The granite is foliated, and the micas are generally aligned parallel to the inclusions. Thin sections of such rocks show cataclasis has occurred, and that the structures are metamorphic.

Pegmatite is characteristic of the Cutler Batholith, particularly of the marginal phases that are exposed within the report-area. The pegmatite is normally flesh-coloured and consists of quartz, microcline, and muscovite, but plagioclase, garnet, pyrite, and rarely traces of molybdenite have been observed. A second variety of pegmatite consisting of quartz, white plagioclase, microcline, muscovite, and minor apatite has been observed along the shore of Aird Bay. Some pegmatite bodies have no sharp boundaries with the country rock and large feldspar porphyroblasts (*dents du cheval*) are found in adjacent rocks. Others have sharp contacts and are obviously intrusive (Photo 10). Zoned pegmatites are common: feldspar, feldspar-muscovite (or chrome-muscovite), and quartz form the sequence from margin to core. The micas form either plates or books oriented normal to the walls of a pegmatite body, or plumose aggregates. Patches of radial fracturing, discolouration, and reddening along the fractures that surround small fragments of slightly radioactive mineral matter are observed in a few places. Many of the pink pegmatite bodies exhibit a dominant foliation parallel to that measured in the granitic rocks. Foliated pegmatites exhibit foliations of differing age (Photo 10). Other bodies of pink pegmatite show no marked foliation. The white plagioclase pegmatites are strongly foliated, and may be folded or boudinaged.

The granitic rocks are largely grey to pink two mica granites, but at a distance, look white. Grey granite predominates over pink. Porphyritic to sub-porphyritic varieties of granite are rare.

Samples selected from the Cutler Batholith have fairly uniform mineral composition consisting of 30-40 percent quartz, 5-30 percent potassic feldspar, 30-50 percent sodic plagioclase, 4-9 percent biotite, and 2-8 percent muscovite (Robertson 1960; Cannon 1967, 1970). In thin section the following accessory minerals have been identified: zircon, apatite, magnetite, hematite, allanite, monazite, and sulphide minerals. In hand specimen, mineral composition, texture and colour distinguish the Cutler Granite from the Algoman Granite of the North Shore of Lake Huron and the granitic bodies in the Espanola-Sudbury region that are postulated to be post-Huronian in age (Card and Church *et al.* 1972; Robertson 1972).

Evidence such as the high quartz content, two micas, the abundance of simple pegmatite and the localization of granitic rocks parallel to the bedding and foliation planes show that anatexis of metasediments formed the Cutler Granite. The presence of garnet and, rarely, staurolite in the granitic rocks is thus explained. In many areas away from water-worn surfaces it is difficult to tell strongly altered sedimentary material from granite, and contact relationships may be blurred suggesting extensive metasomatism. These field observations of the writer, Robertson (1965a, b, and c; 1966b, and c), and Robertson and Fraser (1964 a and b), were confirmed and supported by the extensive chemical, petrographic, and petrofabric studies of Cannon (1967; 1970).

Thin section studies indicate that there is little variation in the Cutler Granite; the pinker phases tend to be higher in hematite and biotite content. The quartz grains are elongate, strongly strained, and have interlocking boundaries with adjacent grains and exhibit biaxial interference figures. Inclusions of biotite, plagioclase, microcline, and the accessory minerals are common in quartz. Trains of fluid and dust inclusions are present in quartz grains, but the fine hematitic dust characteristic of Algoman red-phase granites is absent. Quartz exhibits embayed grain boundaries with adjacent microcline and plagioclase grains. Microcline and microcline-perthite grains are anhedral to subhedral, and have inclusions of subhedral to euhedral plagioclase and blebs of quartz. Perthite with intergrowths of albite in microcline are common. Oligoclase shows normal zoning and oscillatory zoning. The cores are altered to sericite and minor clinozoisite. Myrmekite is present in

ODM9346

Photo 10–Cutler pegmatite, massive, cutting epidiorite to garnetiferous hornblende schist, north side of Highway 17 at former Cutler Acid Plant, I.R.7.

small quantities in most thin sections, and was probably derived by metamorphism of incorporated metasedimentary material.

Biotite is the dominant ferromagnesian mineral. Zircon and allanite(?) with pleochroic haloes are common inclusions in biotite. Muscovite may be interleaved with biotite. Alteration of muscovite to penninite is seen only at the margins of muscovite grains or along some cleavages. Muscovite occurs as large plates or as an alteration product in feldspar. Flakes of chlorite and grains of epidote are also found in feldspar in a few places.

Quartz, microcline, and plagioclase grains show undulose extinction, and bent twin planes; mica flakes may be contorted. These features are indicative of cataclastic deformation.

A zircon concentrate from a sample of typical Cutler Granite was made for comparison with zircon from other granitic rocks of the district (Robertson 1960; 1968b). The zircons were identified (on the basis of refractive index and birefringence) as slightly metamict malacon of simple habit but high elongation. In these properties the zircons from the Cutler Granite showed significant differences from those zircons found in the Algoman granites. Length-breadth ratios indicate that the zircons were self-nucleated and magmatic in origin; and also that the growth trend was different from that of zircons from other granite bodies (Robertson 1960; 1968b).

Table 4 shows the available chemical analyses from the Cutler Batholith. Limited trace element analyses have also been made (Robertson 1960). The analyses do

Table 4 CHEMICAL ANALYSES OF GRANITIC ROCKS OF CUTLER BATHOLITH

Major Oxides	Derived from Cannon (1967) 47 samples Maximum	Minimum	Average	Robertson 1960 Bartlett Point	North of Spanish
SiO_2	79.00	65.20	74.26	71.00	74.11
Al_2O_3	18.90	13.30	15.00	15.05	14.38
Fe_2O_3	not given	—	—	0.59	1.12
FeO	not given	—	—	1.76	1.30
total Fe as FeO	3.63	0.00	1.91	—	—
CaO	2.67	0.30	1.40	1.47	1.90
MgO	0.24	0.00	0.06	0.74	0.38
Na_2O	4.24	0.01	2.78	3.50	3.12
K_2O	9.56	1.64	4.27	4.07	4.00
H_2O^+	not given	—	—	0.88	0.42
H_2O^-	not given	—	—	0.05	0.02
CO_2	not given	—	—	0.20	0.13
TiO_2	0.54	0.00	0.24	0.20	0.23
MnO	0.14	0.00	0.06	0.02	0.04
Total	N.D.	N.D.	99.98	99.40	101.15

Abbreviations
— Not detected.
N.D. Not determined.

not confirm a primary magmatic origin for these rocks, but do indicate the possibility of a metamorphic origin. Isotopic studies and age-determinations may reveal whether the granite has a magmatic, metasomatic, or an origin due to remelting of the Early Precambrian basement. The batholith is clearly intrusive at the level now exposed and was formed not later than 1,750 million years ago (Wetherill *et al.* 1960).

LATE PRECAMBRIAN (PROTEROZOIC)

Late Mafic Intrusive Rocks

OLIVINE DIABASE

Age-determinations (Van Schmus 1965) and regional mapping indicate the term Keweenawan should be restricted to olivine diabase dikes which clearly cut all other Precambrian rocks.

A northwest-striking swarm of olivine diabase dikes occurs in the vicinity of Sudbury (Fahrig *et al.* 1965, p.278). The number of these dikes diminishes westwards. There are few in the Blind River area; only four have been recognised in the Cutler report-area. One of them strikes east-southeast from the Amyot Rocks on the southern side of the Whalesback Channel across Rainboth and Klotz Islands to Conmee Island on the North Channel of Lake Huron. The dike is indicated by a marked magnetic anomaly on ODM-GSC Aeromagnetic Maps 2240G, 2255G, 7068G (ODM-GSC 1963a, b, c). To the west (Robertson 1970a), this dike swings northwest cutting across the Cutler Batholith and is displaced by the Murray Fault (Robertson 1970a and b). To the east, the dike is not exposed, but the magnetic anomaly cuts that of the Croker Island Complex (Card 1965; Card and Church *et al.* 1972; Card and Robertson *et al.* 1972; Robertson 1970b; Robertson 1976) and continues southeastward indicating continuance of the dike under the Paleozoic rocks.

A second northwest-trending dike cuts the epidiorite ridge north of Highway 17 at the Shedden-Victoria township boundary and has been traced to the Ontario Hydro-Electric Power Commission line southeast of Walford Lake. The dike is too small to give a well-defined magnetic anomaly.

A third northwest-striking olivine diabase dike is found in the granitic rocks of central Shedden Township. The fourth dike lies in east-central Lewis Township to the northwest of Camp Lake.

The weathered surface of the olivine diabase is normally reddish brown, but the fresh surface is black. Deeply weathered joints and spheroidal weathering are typical of olivine diabase. The chief minerals are labradorite, titaniferous augite, and magnesium-rich olivine partly altered to serpentine. The chief accessory minerals are red-brown biotite, magnetite, apatite, and zircon.

Van Schmus (1965, p.768) obtained a Rb-Sr age date of 1,225 ± 25 million years for the large dike that cuts the Cutler Batholith west of the map-area. Fahrig *et al.* (1965) have carried out paleomagnetic studies on the Sudbury swarm and give further data on age-determinations (using a K-Ar age of 1,285 million years) and average chemistry; the latter corresponds to a typical alkalic basalt (Fahrig *et al.* 1965, p.295-296).

Summary of Post Huronian Activity

The following is the sequence of events: (1) orogeny (Hudsonian/Penokean); (2) opening of joint and fault structures permitting the intrusion of Nipissing Diabase mainly as sill-like bodies; (3) orogeny (Hudsonian/Penokean) metamorphism to staurolite-garnet grade decreasing southwards to biotite grade; (4) renewed folding about axes trending approximately east (5) intrusion of the Cutler Granite; (6) further east-west foliation; (7) intrusion of Croker Island Complex; (8) orogeny (Grenvillian) faulting; (9) intrusion of olivine diabase and; (10) right-hand displacement on the Murray Fault (see Card and Church *et al.* 1972; Card and Robertson *et al.* 1972; Church and Young 1972).

All post-Huronian igneous and tectonic events have been regarded as the expression of one polyphase orogeny, the Penokean or Hudsonian Orogeny. However, the time gap between the Nipissing Diabase (2,155 million years) and the olivine diabase (1,225 million years) is great. Young and Church (1966) have suggested that the first deformation and the first regional metamorphism represent the Penokean Orogeny and that this preceded the intrusion of the Nipissing Diabase and that a second deformation and regional metamorphism, the intrusion of the Cutler Granite and subsequent foliation, represent the Hudsonian Orogeny with an approximate date of 1,750 ± 50 million years (Wetherill *et al.* 1960). Within the Cutler and Massey report-areas (Robertson 1976) the post-Nipissing tectonic and metamorphic events dominate the geology and evidence of a prior orogeny is somewhat lacking. Evidence of thermal activity or a period of later metamorphism at 1,300 million years for the Cutler Granite is given by biotites which give concordant Rb-Sr and K-Ar ages averaging 1,300 million years (Van Schmus 1965, p.764).

POST-PRECAMBRIAN GEOLOGY

After the end of Proterozoic time, the area was eroded to form a peneplain. Lower Paleozoic shelf-sea deposits probably extended over the report-area. The northward limit of Paleozoic rocks is not far south of John and Aird Islands. Slabs of flaggy fossiliferous Paleozoic limestone, are found in a few places on southward-facing beaches on the islands to the north of the North Channel; these were probably ice-rafted from the south.

During the Pleistocene, the area was glaciated and soil was removed. Striae and chatter marks indicate the regional ice flow was S15°W. On the retreat of the ice, till, glaciofluvial sands, clays, gravels and a few large erratics were deposited. This material occupies the low ground between the outcrops. Sand and gravel form some beaches on the islands in Lake Huron. Arable land, poorly developed, is found adjacent to Aird Bay and north of the Spanish Estuary. Silt and sand banks lie in the mouth of the Spanish River. The regional glacial geology has been discussed by Boissonneau (1968).

Along the present shores of the North Channel of Lake Huron and of the Whalesback Channel, raised beaches, filled in lagoons, and progressive bars characteristic of an emergent shoreline can be identified.

STRUCTURAL GEOLOGY

The most significant structural feature of the report-area is the Murray Fault which divides it into two terranes that differ markedly in metamorphism and structural features (see Card and Church *et al.* 1972; Card and Robertson *et al.* 1972).

FOLDS

The area north of the Murray Fault is largely occupied by the core of the Chiblow Anticline. South of the Murray Fault the folding is isoclinal near the

Murray Fault becoming slightly more open towards the southern limit of the report-area.

The principal folds are; the Spanish Anticline, folds along the northwestern side of Aird Bay, the La Cloche Syncline, and the McGregor Bay Anticline.

The Spanish Anticline trends easterly across the report-area just south of the Murray Fault and plunges gently east. The axial zone is best-exposed in cuts on Highway 17 south of Grassy Lake, but can be traced across Shedden Township, using top determinations, axial-plane cleavage, and attitudes of congruent drag-folds. Subsidiary folds are superimposed on the limbs of the main fold. The configuration of the Cutler Batholith is largely controlled by the Spanish Anticline and by a prominent folded sill-like body of epidiorite (see also Cannon 1967; 1970).

Between Cutler and Bartlett Point, a northeasterly trending anticline and a northeasterly trending syncline are exposed. These folds plunge northeast, but could not be traced east or northeast of the Cutler acid plant. These folds predate the intrusion of the Cutler Batholith, and were partly mapped on the basis of attitudes and top determinations from inclusions in the granite.

In I.R.5 to the east of the present report-area the dominant structure is the La Cloche Syncline (Robertson 1976; Robertson and McCrindle 1967). This normally trends east-west with a gentle easterly plunge, but near the eastern boundary of the Cutler report-area the axial trace swings northwesterly and is displaced by faults, resuming a more westerly trend along the Whalesback Channel. The La Cloche Syncline cannot be recognized west of Aird Bay, and is probably replaced by the *en echelon* fold structures observed to the northwest of the bay.

South of the La Cloche Syncline the core of the McGregor Bay Anticline is formed of the easily eroded argillaceous rocks of the McKim Formation. Near the boundary of the Cutler-Massey report areas, the McGregor Bay Anticline is defined by the sill-like diabase intrusions west of Shoepack Bay, and the chains of islands at the east end of the Whalesback Channel. Owing to lack of exposure, the fold cannot be traced west of Laurier Island; like the La Cloche Syncline, the anticline may die out in the vicinity of Aird Bay.

FAULTS

Faults were mapped largely on the basis of air-photo lineaments and field evidence such as apparent displacement of units, shearing and shattering of the adjacent rocks. The similarity of the rock types on opposite sides of a suspected fault may preclude determination of net slip or the sense of the movement.

Faults are easily recognised in the southern part of the map-area where they cut Huronian rocks, the associated post-Huronian igneous rocks, and the Penokean (Hudsonian) folds. These faults, have northwest-, northeast-, and east-trends.

Murray Fault

The Murray Fault is defined by a sharp topographic low trending easterly across the report-area from the west along Highway 17 and the Serpent River - Little Serpent River system to a point approximately ½ mile (0.8 km) south of Denvic Lake. Low electromagnetic anomalies have been recognized along the fault-zone (see Table 5 for assessment data).

The fault-zone is not exposed in the report-area, but quartzitic rocks on the northern side of the fault are strongly fractured and bleached with a network of generally well-developed quartz veins. Dips in adjacent rocks suggest that the fault is near-vertical with locally a northerly dip.

The Murray Fault has a long and complex history (Robertson 1971b, 1973, 1976). Magnetic evidence in the Spragge area indicates that the post-Keweenawan olivine diabase movement is approximately 1 mile (1.6 km) north side east (Robertson 1970a). The stratigraphic displacement is of a similar amount south side up; the net slip is not known and may be several miles.

Whalesback Channel Fault

The linear nature of the Whalesback Channel may be caused by a fault or the easily eroded rocks of the Pecors Formation that may underlie the channel. Thomson (1961, 1962, p.84, Figure 2) suggested that the Espanola Fault continued westward along the Spanish River possibly entering the present map-area at Frenchman Bay. On preliminary maps the possible fault underlying the Whalesback Channel was correlated with the Espanola Fault (Robertson 1965b, c). However, subsequent mapping in the Massey Area (Robertson 1966b, c; 1970b; 1976; Robertson and McCrindle 1967) indicated that there was no major fault in the vicinity of the Spanish River west of Massey. It is concluded that the Espanola Fault does not continue as far west as Massey. ODM-GSC Aeromagnetic Maps (ODM-GSC 1963a, b, and c), show a deviation in the anomaly accompanying the Spragge olivine diabase dike where it crosses the channel. An ice-borne magnetic survey (R. Benner consultant geologist, Aggressive Mining Limited, personal communication, 1966) originally carried out by F. Joubin has indicated that the anomaly is broken (with left-hand strike-separation) and not bent, confirming the presence of a later strike-slip fault herein called the Whalesback Channel Fault.

Northwest-Striking Faults

Faults striking northwest to west-northwest are common particularly in: (1) Huronian rocks exposed north of the Murray Fault; (2) on the western part of Aird Island and; (3) in that part of the Cutler Batholith northwest of Aird Bay. These faults are traceable for short distances and generally have right-hand displacements. A prominent fault is the Spanish Fault which has been traced from Serpent Lake in west-central Shedden Township southeast along Highway 17, through Spanish to the Spanish Estuary, and east of the report-area (Robertson 1970b; 1976).

The Spanish Fault has a right-hand strike displacement of approximately 1 mile (1.6 km) measured on the diabase sill along the southern limb of the Spanish Anticline in the Cutler map-area (see Map 2315, back pocket). The Spanish Fault postdates the major folding and metamorphism of the area and the intrusion of the Cutler Granite. It apparently terminates at the Murray Fault.

Northeast-Striking Faults

Faults trending north-northeast to northeast are most common between Aird Bay and Spanish and in the McBean Channel-Spanish Estuary area. Age relationships between the northwest- and northeast-trending faults when observed, conflict with one another.

The faults of the two trends suggest a conjugate system formed by a north-south compressive force. However, the displacements on the northeast-trending faults are not uniformly sinistral. The more north-northeasterly faults are normal to the local fold-axes and may, therefore, represent local extension fractures rather than regional shear fractures.

SUDBURY BRECCIA

Card (1968, p.43-44) discussed the age and origin of the Sudbury breccia as follows:

> There are probably several ages of Sudbury-type breccias. Most of the breccia bodies are pre-nickel irruptive but some may be post-nickel irruptive. Also, it is possible that there are both pre- and post-regional metamorphism breccias. Breccias may have been formed over a long period of time in this area.
>
> The origin of the breccias is not known. Thomson [1956] suggests that they are the product of diatreme activity connected with the intrusion of the gabbros. The evidence of movement indicates that gas streaming and phreatic explosions could have played a part in their formation. Fairbairn and Robson [1941] conclude that the breccias are of tectonic origin and were saturated with fluids. Speers [1957] compares the breccias to the Onaping tuffs inside the Sudbury Basin and postulates a common origin for both. Speers [1957] envisions a rather complex sequence of doming and collapse, intrusion, explosive volcanism and opening and closing of fractures.
>
> Recently, Dietz [1964] has postulated that the nickel irruptive and other associated phenomena such as the breccia are of meteorite impact origin. He cites the shatter cones found in the area, and the breccias themselves, as evidence for this hypothesis. However, the evidence of long continued brecciation, and the fact that most of the breccias are regionally metamorphosed would seem to negate his hypothesis.
>
> The spatial relation of the breccias to the nickel irruptive and the manner in which breccia zones radiate out from the irruptive implies a definite genetic link between the breccias, the irruptive, and the Sudbury Basin. It is probable that explosive activity at depth was in some way connected with the production of the breccias.

It may be noted that shatter cones have not been described as far west as the Massey-Cutler areas.

ODM9347

Photo 11–Sudbury Breccia (?): Fragments of quartz, granite and greenstone or diabase in schistose chloritized groundmass, east end of Camp Lake, Shedden Township.

MINOR STRUCTURES

Small-scale Folds

There are numerous small-scale folds within the report-area. These are of three types, the first is congruent with the primary large-scale fold structures, the second is shear-folding related to the east-west-trending foliation and the third is drag-folding in sedimentary rocks or metasediments adjacent to faults. Typical small-

ODM9348

Photo 12–McKim Formation: Interbedded metaquartzite and mica schist. North limb of Spanish Anticline (hammer head points up and west handle parallel to second generation-crenulation cleavage in schist). Note difference in folding style between quartzite and schist with development of second generation cleavage and foliation in latter; Hydro line, southeast Shedden Township.

scale folds, shown in Photo 12, illustrate the different fold styles developed in quartzite and schist, and the axial plane cleavage crenulating the primary schistosity of the schist bands.

Small-Scale Faults

Small-scale faults are common and are best seen in the finely bedded rocks of the Mississagi, Espanola, and Gowganda Formations north of the Murray Fault and in the Espanola Formation along the North Channel of Lake Huron. Many small-scale faults may also be observed on suitable outcrop surfaces. These faults have the same strike and sense of diplacements as the large faults observed throughout the report-area.

An interesting example of small-scale faults was found on one of the small islands south of Aird Island (Photo 13). The Espanola Formation consists of 5-foot (1.5 m) thick beds of finely laminated, slightly calcareous, medium- to fine-grained protoquartzite separated by sequences, 5-10 feet (1.5 m-3.0 m) thick, of siltstone, calcareous and dolomitic siltstone, and a rib of quartzite in a few places. Each of the quartzite beds is faulted into rectangular blocks up to 7 feet (2.1 m) long by

ODM9349

Photo 13–Espanola Formation: Interbedded laminated quartzite showing faulting, and carbonate-bearing siltstone siltstone, and minor quartzite showing flowage. Note also characteristic weathered surfaces. Small northwestern island off Sampson Island, southeast of Aird Island (hammer head points west).

northeasterly striking faults with sinistral displacements of 1 to 2 feet (0.3 to 0.6 m). The relatively incompetent carbonate-siltstone sequence is not faulted, and maintains an east-west strike and steep southerly dip, except adjacent to the corners of the quartzite block where some flowage has taken place.

JOINTS

No special study of joints was made during the field work for the Cutler report-area. Joints are parallel to the other structures of the area and are parallel and perpendicular to bedding lithologic contacts. Jointing has exercised a marked control over the distribution of the post-Huronian diabase intrusions, the Cutler Granite and pegmatite (see Photo 10), and, possibly, the Keweenawan (Late Mafic Intrusive Rocks) olivine diabase.

FOLIATION

Gneissosity and Schistosity

In the Cutler report-area the gneissosity in the Early Precambrian granitic rocks trends generally eastwards. The normal trend of the gneissosity in the granitic rocks reflects the regional structure of the Keewatin(?) volcanic belt. Within the Cutler map-area there are two departures from this pattern. The first is in the west-central part of Lewis Township where northerly trending gneissosity was observed. This is one of the few areas where the post-Algoman diabase dikes have a pronounced northerly trend. The second is in the area north of the Murray Fault where the gneissosity parallels to the fault, this reflects movement on fault surfaces.

Post-Huronian gneissosity is only found in the most metamorphosed phases of the Nipissing Diabase, and in the border zone of the Cutler Batholith. The gneissosity is nearly vertical and the trend is similar to the other structural trends; it is slightly north of east to the northwest of Aird Bay and east-west elsewhere.

Schistosity is characteristic of the Huronian between the Murray Fault and the Spanish River. The schistosity is essentially parallel to the bedding, but is readily confused with, and commonly obscured by later foliation. The Ramsay Lake conglomerate has grains and pebbles that show a marked elongation in the plane of schistosity.

Cleavage

Cleavages have been superimposed on bedding, schistosity, and gneissosity.

Argillaceous rocks of the Pecors Formation lying to the south of the Ramsay Lake conglomerate and locally interbedded in the Mississagi Formation show a moderate to poorly developed cleavage. Argillaceous Huronian rocks to the north of the Murray Fault have slaty cleavage which strikes parallel to the bedding and has a steep south to vertical dip.

In the vicinity of the Cutler Granite and certain diabase dikes at Aird Bay several foliations intersect to form several cleavages. Away from the Cutler Granite or the noses of fold structures it is normally impossible to separate the foliations as their trends are almost identical (Church and Young 1972, p.42-43). The later foliations consist of irregularly spaced cleavages and schistosity. This has given rise to crenulation of the micas and to numerous minor shear folds where axial-plane cleavage exists. The structures are visible from the microscopic to the map scale (see Photo 12).

"Kink bands" have been observed at a number of localities and trend either northwest or northeast and cut and displace the east-west trending structures.

Between the Murray Fault an Whalesback Channel many of the more competent quartzite beds and the sill-like mafic intrusive rocks have a well-marked boudinage structure. In the same area the quartzite beds developed *en-echelon* tension fractures which are filled with quartz; these fractures are up to 1 inch (2.5 cm) wide with strike some 30 degrees less than that of the bedding (see Photo 3).

LINEATION

There are several types and ages of lineation in the area, particularly in that part lying between the Murray Fault and the Spanish River. These lineations include bedding and joint-plane slickensides mainly in the less metamorphosed section, mineral lineations, minor and drag fold axes, intersection of foliation planes with each other or with bedding or joint planes.

Card (1964, 1968, p.54) has divided the lineations into 3 main ages. These are: 1) an early set of mineral and intersection lineations formed during the major period of metamorphism and folding; 2) a second set of intersection lineations and crenulation cleavage associated with the later east-west trending foliation or foliations and; 3) lineations associated with the relatively late northwest- and northeast-trending kink bands. Each set of minor structures is at least partly overprinted by the subsequent structures.

In the Cutler and adjacent Massey areas (Robertson 1976) the lineations south of the Murray Fault trend east-northeast to the northwest of Aird Bay and easterly elsewhere. The plunge of the lineations is horizontal to gently east; but locally moderate to steep easterly plunges have been recorded. West-plunging linear structures have also been observed but are rare.

The relationship of linear and planar structures in the rocks adjacent to the Cutler Batholith, in the inclusions in the Cutler Batholith, and within the granitic rocks have been studied by Cannon (1967; 1970).

ECONOMIC GEOLOGY

The Cutler report-area, lying to the west of the Massey copper area, has a long history of prospecting activity. In 1908, the Ontario Government drilled diamond-drill holes (83 feet and 36 feet; 25.3 and 10.9 m) for copper in Shedden Township 7 miles (11 km) from the Cutler railway station (Gibson 1909, p.50-52). Prospecting was intensified during the Blind River uranium boom (1953-1956). After the uranium boom there was small-scale prospecting for radioactive materials, sulphide minerals, iron formation, and industrial minerals.

RADIOACTIVE MATERIALS

Uranium and thorium, minor amounts of yttrium and rare earths are concentrated in the matrix of oligomictic (quartz pebble) conglomerate beds lying at or near the base of the Matinenda Formation. The distribution of the conglomerate beds is controlled by basement topography, sedimentation direction, and relationship to a favourable source area in the Early Precambrian basement.

The Huronian rocks exposed in the Cutler report-area to the north of the Murray Fault lie on the flank of a regional basement high (The "Haughton-Lewis High"). Because of this the most favourable horizons for uranium mineralization in the Matinenda Formation were either not deposited, or are only poorly developed.

During the Blind River uranium boom (1953-1956) companies of the Hirshhorn-Preston East Dome Group (predecessors to the Rio Tinto Group of companies) held and explored those parts of Lewis and Shedden Township underlain by Huronian sedimentary rocks (Table 5) that consisted of arkose near the basement contact (Early Precambrian rocks) and along the Serpent River. The exploration consisted of geological mapping, geophysical exploration, and 10,000 feet (3,000 m) of diamond drilling. The locations of diamond-drill holes are shown on the Maps 2314 and 2315 (back pocket), and the appropriate assessment files are listed in Table 5. No oligomictic conglomerate and only minor scattered radioactivity (2-3 times background) was found during this exploration. The work also failed to reveal significant sulphide or gold mineralization.

Minor radioactivity is associated with the argillite of the McKim and Pecors Formations, but the amounts found to date are insufficient to warrant exploration to depth (see Table 5 assessment work files for ABE claim group of Panel Consolidated Uranium Mines Limited, and Peach Uranium and Mining Limited, now Preston Mines Limited). Conglomeratic intraformational breccia in the Huronian Formations may be locally radioactive, but what has been reported is insufficient to encourage further exploration at present.

Airborne scintillometer surveys (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault St. Marie, File SSM 176); ODM (1954a and b); Robertson (1967, p.18-20), Brownell and Schaller (1954) indicated anomalies associated with the Mississagi Formation in Lewis and Shedden Townships. These anomalies represent a mass-effect from high outcrops or arkosic quartzite; the relative contributions of uranium, thorium, and potassium are not known. Similar anomalies are associated with the feldspathic quartzites of the Mississagi Formation that are exposed on the large islands to the south of the Whalesback Channel (ODM 1954b; Robertson 1967, p.18-20 and Figure 8; Darnley *et al.* 1972). In July 1968 diamond drilling was being carried out by Aggressive Mining Limited, on Villiers Island in the Whalesback Channel, to obtain a section of the rocks underlying the axis of the McGregor Bay Anticline and to determine whether an assemblage of arkose and possibly oligomictic conglomerate is present at depth (Northern Miner 1968).

SULPHIDE MINERALIZATION

Sulphide minerals, particularly pyrite, pyrrhotite, and chalcopyrite are found throughout the report-area. The most favourable association is with the mafic rocks of the "greenstone belt" exposed in Proctor and Deagle Townships, with the larger bodies of diabase-diorite in the area north of the Murray Fault, with the epidiorite, and metadiabase in the area to the south of the Murray Fault.

Because of the similarity in geology and structure of those parts of Lewis and Shedden Townships lying south of the Murray Fault to the Spragge area (Robertson 1970a) where the Pronto Division of Rio Algom Mines Limited has operated the Pater Mine on what was originally believed to be a copper-cobalt prospect, companies of the Hirshhorn-Preston East Dome Group undertook magnetic and electromagnetic surveys followed by limited trenching and diamond drilling (listed in Table 5), but no significant mineralization was found during these surveys.

Sulphide-bearing quartz veins have been noted at a number of localities in Lewis and Shedden Townships and these are probably genetically related to the mafic intrusive rocks.

Exploration of these showings has been restricted to stripping, and only pitting or diamond drilling has been undertaken in only a few places.

Table 5 SUMMARY OF DATA FILED FOR ASSESSMENT CREDIT, CUTLER MAP-AREA

Company Name	Location	Size of Property	Metal[4]	Year	Type of Work	Filed Sudbury	Filed Toronto	Notes
Algom Uranium Mines Limited	N.W. Proctor Township	S 86916 (1 claim)	(Cu)	1955	1 diamond drill log, 400 feet (120 m)	—	5-1-558	Buckles Property
Ameranium Mines Limited	Kings Lake, Proctor Township	18 claims	(U)	1955	Magnetometer	SSM 623	63-583	A RA survey not filed.
Brown, Robert	Camp Lake, Lewis Township	S 68979 (1 claim)	(Cu)	1955	11 diamond-drill logs, 1,081.7 feet (329.4 m)	SSM 553	5-27-234	
Buckles Algoma Uranium Mines Limited	N. W. Proctor Township	S 86916 (1 claim) + 3 fractions	(Cu)	1953–1955	Geology, Magnetic	SSM 336	63A-296	Main property in Township 149 (Gunterman Township) and Esten Township.
Consolidated Orlac Mines Limited	Lillie Lake-Forrestry Lake, Lewis Township	16 claims	—	1955	Magnetometer	SSM 78	63-570	Outlined diabase.
Estes, J. R.	Lewis Township	S 97156 (1 claim)	(Cu)	1957	Diamond-drill log	SSM 562		
Gradore Mines Limited	Black Lake, Shedden[3] Township	18 claims	(Cu)	1966	9 diamond-drill logs, 3,154 feet (961.3 m)	SSM 1061		Assays given, see also text p. 106-107.
Harico Mining and Development Limited	Black Lake, Shedden[3] Township	15 claims	(Cu)	1956	Prospectus	SSM 71		
Jamaica International Exploration Limited	Forrestry Lake–Camp Lake Lewis Township	18 claims	(U)	1954	Geology radioactivity	SSM 79	63-484	Granite RA 2XBg., one area 4 X Bg.
Linton, Sam	Black Lake, Shedden[3] Township	17 claims	(Cu)	1956	4 diamond-drill holes, 209 feet (63.7 m)	SSM 527	63A-322 5-4.342	Submitted by W. P. Murdoch
Maybrun Mines Limited	Lots 7–12, Concession III, Lewis Township	16 claims	(U)	1955	Magnetometer, Scintillometer	SSM 80	63-648	

Panel Consolidated Uranium Mines Limited[5]	Lewis Township	23 claims (ABE group)	(U)	1953–1955	Geology 6 diamond drill logs 2,220 feet (677 m)	SSM 565		
	Central Shedden Township	65 claims + 2½ patented lots	(Cu-Co)	1955	Magnetometer Electromagnetic	SSM 165	63-645	Part of property south of Murray Fault, SSM 165, includes geology reports on Plum and Peach properties.
Park, Paul	North Shore, Shedden Lake, Shedden Township	4 claims	(Cu)	1965	pitting	SSM 738		Location and size of trenches only.
Peach Uranium and Metal Mining Limited[1], [5]	Shedden Township	118 claims + 8¼ sections	(U, Cu-Co)	1953–1956	Geology, 18 diamond-drill logs, 6,492 feet (1,978.8 m) trenching	SSM 166		For Toronto files see below. Slight RA in argillite.
		132 claims + 8 patented lots		1954	Geology		63A-179	
		(Hirshhorn Claims)	(Cu-Co)	1955	2 diamond-drill logs, 609 feet (185 m)		5-2-324	Included in, SSM 165, Panel.
			(U)	1954	Diamond-drill logs PH-1, PH-2.			
			(Cu-Co)	1955	Trenching on S67046		5-4-332	
			(U)	1955, 1957	diamond-drill log PH-3			
			(U)	1955	Diamond-drill log PH-4 }			
			(U)	1954	Diamond-drill log PH-5 }		5-2-335	
Plum Uranium and Metal Mining Limited[2],[5]	Lewis Township	14 claims	(U)	1953–55	Geology map 8 diamond-drill logs, 1,665 feet (507.5 m)	SSM 529	5-1-235B	For geology report see Panel SSM 165
Preston East Dome Mines Limited[5]	Lewis Township	Bourk claims 8 claims + optional patented ground	(Cu-Co)	1955	Electromagnetic		63-694	Some indication of Murray Fault

Table 5 (continued)

Table 5 (concluded)

Company Name	Location	Size of Property	Metal[4]	Year	Type of Work	Filed Sudbury	Filed Toronto	Notes
	Lewis Township	17 claims (includes above)	(U)	1955	Airborne RA Magnetometer Diamond-drill logs, Geology	SSM 81	63-425	
Technical Mine Consultants Limited[5]	Parts of Deagle Parts of Lewis and Shedden Townships				Airborne magnetometer & scintillometer	SSM 176	63-419	Ground adjacent to Pecors Lake (Township 144-137) (Buckles and Gaiashk Townships) adjacent to and including ground held by Panel, Peach and Plum Uranium Mines Limited.
			(U)	1954	Diamond-drill logs PH-6, PH-7, PH-8		5-6-338	
			(U)	1955	Diamond-drill log PH-13			
			(U)	1954	Diamond-drill logs PH-9, PH-10, PH-11, PH-12		5-4-340	
			(U)	1955	Diamond-drill log PH-4			Deepened to basement.
			(Cu-Co)		Trenching S66728 (Deepened to basement)		5-1-333	
			(Cu-Co)	1956	Diamond-drill log P-15			Submitted by Panel.
			(U)	1954	Diamond-drill log PH-3		5-1-336	Submitted by Panel.
			(Cu-Co)	1956	P-16			
			(Cu-Co)	1956	Diamond-drill P-17		5-1-339	Submitted by Panel.
			(Cu-Co)		Diamond-drill P-19		5-1-341	Submitted by Panel, 40 feet (12 m) silt, no bedrock.

Teck Exploration Company Limited	137-Deagle Township	(9 claims only in Deagle)	(Fe)	1951–52	Geology report and map	SSM 362	63A-146

Notes: [1]Assets transferred to Pronto Uranium Mines Limited in 1958.
[2]Merged 1957 into Consolidated Frederick Mines Limited.
[3]These files all cover the Black Lake or Shedden copper showing, only Gradore files include assays.
[4]Cu: copper; Cu-Co: copper-cobalt *cf.* Pater Mine Spragge Township; Fe: iron; U: uranium; little of no significant mineralization found.
[5]These companies were in the Hirshhorn-Preston East Dome Group, predecessors to the Rio Tinto Group of companies, exploration was managed by Technical Mine Consultants. Exploration by Panel Consolidated Uranium Mines Limited was for Cu-Co of Pater type and included holes P-14 to P-18 (P-19 abandoned) total 2,625 feet (800.1 m). Testing slight EM anomalies near Murray Fault.

Abbreviations: Bg – Background.
RA – Radioactivity.
For metals, see Note 4 above.

A number of pits were found in segregations of quartz containing ilmenite (confirmed as such by the Mineral Research Branch, Ontario Division of Mines) in the epidiorite ridge lying to the north of Highway 17 to the west of the Victoria-Shedden township boundary. It is not known by whom or when the work was carried out.

Molybdenite has been reported from late fractures in the uranium mines of Elliot Lake (Robertson 1968, p.76) and a number of occurrences are known north of Massey (Giblin and Leahy 1967; Johnston 1968, p.19). Molybdenite flakes were found twice during the mapping of the Cutler area.

Black Lake Occurrence, Shedden Township (2)

The best known copper showing in the report-area is in the southeastern half of the northern half of lot 9, concession IV, Shedden Township near Black Lake. Chalcopyrite is found in quartz veins and disseminated in diabase. A shaft, reportedly 80 feet (24 m) deep, was sunk on this showing, but there is apparently no published record of the workings or of any production. In 1966 (the year after completion of the field work for this report Gradore Mines Limited, acquired a block of 18 claims and put down nine diamond-drill holes totalling 3,154 feet (961.3 m). Assays were made for copper and in several samples for gold and silver.

The best intersections were 1.47 percent copper over 5.0 feet (1.5 m) in hole No. 1, and 0.7 percent copper over 10 feet (3 m) in hole No. 2. Individual assays generally run less than 0.4 percent copper. Gold was present in trace amounts only, and silver was normally absent (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie, File SSM 1061). For other assessment files on the Black Lake showing, see Table 5.

P. Park (3)

Quartz-chalcopyrite zones were also reported by Paul Park (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie, File SSM 738) on the northern shore of Shedden Lake. The late Floyd May[1] (personal oral communication to the author, 1966) noted mineralized zones in the vicinity of the creek east of Hope Lake in west-central Lewis Township.

IRON FORMATION

M. Keba (1) and Rio Algom Mines Limited

Buckles Property (2) Proctor Township

Low-grade banded iron formation occurs in the vicinity of Highway 108 and former Highway 612 to the north of Depot Lake in northwest Proctor Township (see Photo 1). Individual zones (see Map 2314, back pocket) have been traced for

[1]The zone located by the late Floyd May is at a different location from that of P. Park (3).

as much as 1,000 feet (300 m) and may be up to 200 feet (60 m) wide but are usually smaller than this. The iron formation consists of banded quartz and chert-magnetite with traces of pyrite, chalcopyrite, and pyrrhotite. Three grab samples taken by M. Keba of Elliot Lake, contained 29.3 percent total iron, 30.6 percent total iron, and 25.3 percent total iron. Trace amounts of Co, Cu, Mn, Ni, and Ti, were also reported (personal communication from Mr. Keba). The iron formation in Proctor Township is the continuation of a zone in Joubin and Gunterman Townships (Township 143 and 149) (Robertson 1961, p.9; 1968a, p.13). The zone is marked by a moderate aeromagnetic anomaly (Robertson and Fraser 1964a, and b; ODM-GSC 1963a, b, and c).

Similar iron formation observed in the Pecors Lake area of Joubin and Gaiashk Townships (Township 143 and 137) (Robertson 1961, p.10, 46; Robertson 1962, p.14) can be intermittently traced on surface outcrop and by a magnetic anomaly that trends east-southeasterly in the vicinity of Gaiashk (Township 137) and Deagle township boundary (see Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie, Files SSM 362, SSM 176, and 63.419).

A ground magnetic survey was carried out by the Algoma Ore Properties Division of the Algoma Steel Corporation (J. Huddert, personal communication, 1966) on part of the Keba property in Proctor Township. Teck Exploration Company Limited examined sulphide-bearing iron formation in the vicinity of Pecors Lake (in Joubin Township, Township 143) in the early 1950s (Robertson 1961, p.46; Robertson 1962, p.16, 62). The individual beds are too narrow and discontinuous to be potential iron ore. Their chief economic significance is in the presence of sulphide minerals, and in their use as structure markers in the "greenstone" belt where buried beneath drift or the Huronian rocks; in the latter case they tend to form buried ridges separating buried valley structures which may contain fossil uranium placer deposits (Robertson 1966a, Figure 5).

INDUSTRIAL MINERALS

Industrial minerals occurring in the Cutler report-area are quartz, trap rock, and gravel.

A quartz vein in metadiabase on Passage Island in the Whalesback Channel was quarried, reportedly in the early part of the twentieth century, for smelter flux (personal oral communication from Mr. Vance Sr. of Spanish). At the northeast end of Passage Island the vein is up to 30 feet (9 m) wide and strikes slightly south of west gradually swinging westwards across the centre of the island to the west shore where it is only a few feet (about a metre) wide. The quartz is white to pale pink and is generally sub-opaque to translucent and is suitable for lapidary work. Locally the vein is vuggy with small quartz crystals but is normally massive.

A large quartz vein striking northwest-southeast lies to the south of McCarthy Lake in Proctor Township. The maximum width is approximately 400 feet (120 m) and the vein has been traced for some 14,000 feet (4,300 m). However, the western 2,000 feet (600 m) of the vein is poorly exposed and over the easternmost 7,000 feet (2,000 m) the width ranges from 20 to 200 feet (6 to 60 m). Locally, the vein is sheeted, being interlayered with chloritic material, probably altered diabase. Parts of the McCarthy Lake quartz vein (and that on Passage Island) might be suitable for crushing and incorporation in ornamental pre-cast concrete panels ("exposed aggregate").

The metadiabase and diabase exposed in the vicinity of Shoepack Bay at the west end of I.R.5 and on various islands in the Whalesback Channel is generally suitable for use as road metal or "trap rock" (Northern Miner 1962). Deep water suitable for medium-sized freighters persists to the shoreline in many places and loading facilities could be readily constructed. Albert Hopkins, geologist (1966?), investigated the diabase body bounded by Shoepack Bay, Little Detroit Passage, and the Whalesback Channel. Hopkins found that the physical characteristics of the rock, the reserves, and the location were suitable and proposed that a quarry (the Gibraltar Quarry) be established. However, sufficient markets were not developed and the project is dormant.

No extensive deposits of sand and gravel are found in the report-area. A number of small pits have been opened adjacent to Highway 17 and are used to service local roads. Larger quarries were opened adjacent to Highway 108, in northwestern Proctor Township during the construction of Elliot Lake and of Highway 108. In 1968, during construction of the Elliot Lake airstrip located in northwest Proctor Township north of Depot Lake, fill was obtained from the quarry on the western side of the road.

ASSESSMENT WORK

Table 5 is a summary of the data available in files of the Assessment Files Research Office, Ontario Division of Mines, Toronto or in the Regional Geologists's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie (the latter bear the prefix SSM). All assessment files kept by the Resident Geologist in Sault Ste. Marie have been incorporated with the Resident Geologist's Files, Ontario Ministry of Natural Resources, Sudbury.

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INDEX

Cutler Area Report
Chart A
Figure 4

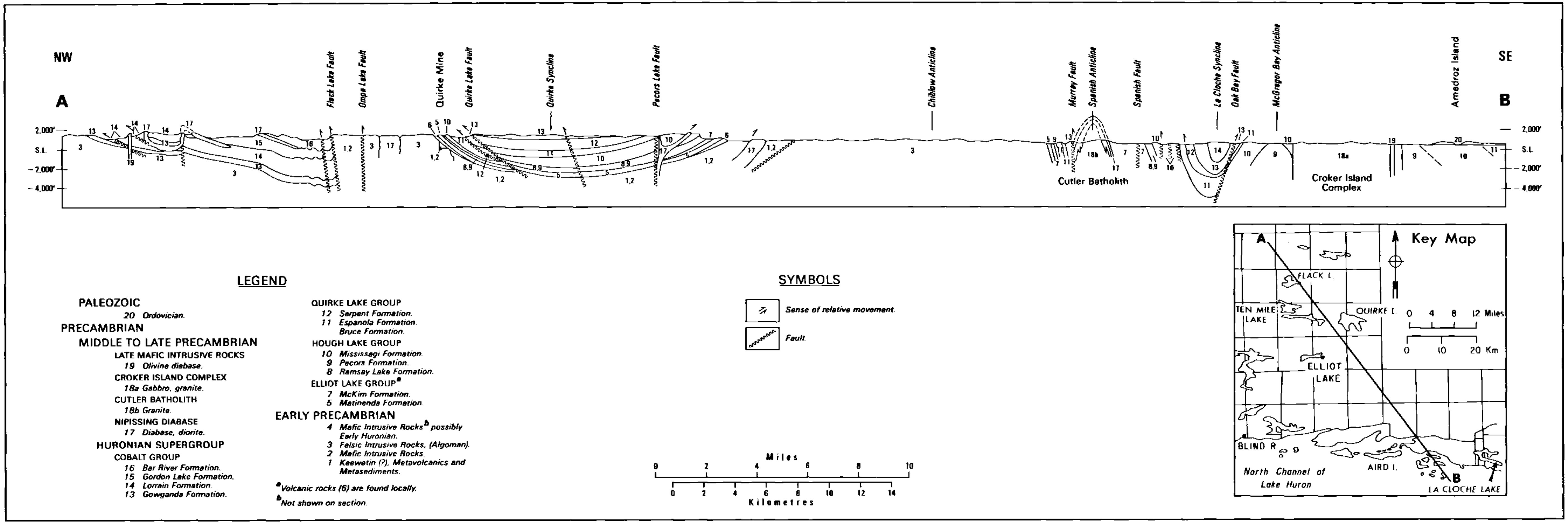

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Figure 4 — Schematic Cross-Section, Quirke Lake to Amedroz Island. (After Robertson 1971 Figure 7; reprinted as Robertson 1973 Figure 5.)

Cutler Report Area (GR 147)
Chart B
Table 1

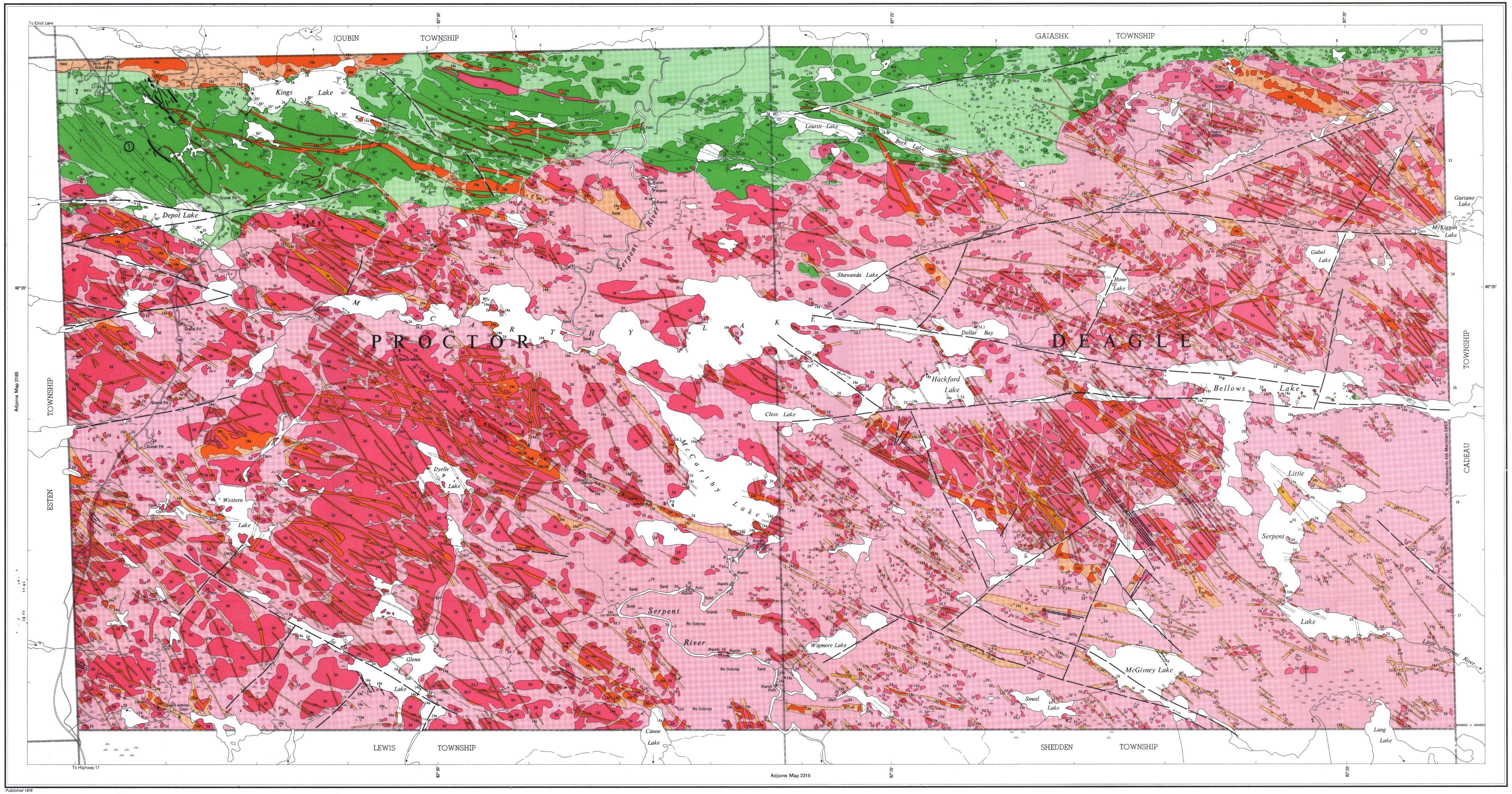
Table 1 | COMPARISON OF STRATIGRAPHIC NOMENCLATURE USED FOR NORTH SHORE OF LAKE HURON MODIFIED FROM J. A. ROBERTSON (1967).

Logan and Murray as in Logan 1863	Coleman 1914	Collins 1925		Abraham 1953; 1956; and 1957.		Roscoe 1957 as in Pienaar 1963; and Roscoe 1960.		J. A. Robertson 1965a North of Murray Fault.		J. A. Robertson 1965a South of Murray Fault		Coleman 1914 and Collins 1925 South of Murray Fault		This report J. A. Robertson et al. 1968; 1969a, b				Rock Types
Greenstone intrusions	Intrusions	Keweenawan	Olivine diabase	Keweenawan	Olivine diabase	Keweenawan	Olivine diabase		Keweenawan		Keweenawan	Keweenawan	Olivine diabase	Late PЄ			Late Mafic Intrusions	Olivine diabase
																	Lamprophyre	Lamprophyre
			Granite		Granite		Granite				Cutler Granite		Granite				Croker Island Complex	Diorite, granite, gabbro
																	Cutler Granite	Granite, pegmatite
			Diabase including Thessalon Greenstone		Diabase		Diabase		Nipissing		Nipissing		Diabase	Middle Precambrian (Middle PЄ)			Nipissing	Gabbro, diabase, granophyre
Upper formations	Upper Huronian	Cobalt Series	Upper formations	Cobalt Series	Lorrain	Cobalt Group	Upper formations	Cobalt Group	Upper formations	Cobalt Group	Not present in area mapped	Cobalt Series	Upper formations		Huronian Supergroup	Cobalt Group	Gordon Lake	Quartzite, siltstone
																	Lorrain	Quartzite, arkose
Upper slate conglomerate			Gowganda		Gowganda		Gowganda		Gowganda				Gowganda				Gowganda	Paraconglomerate, greywacke, quartzite
Limestone	Lower Huronian	Bruce Series	Serpent	Bruce Series	Serpent	Quirke Group	Serpent	Bruce Group	Serpent	Bruce Group	Serpent	Bruce Series	Serpent			Quirke Lake Group	Serpent	Quartzite
			Espanola		Espanola		Espanola		Espanola		Espanola		Espanola				Espanola	Calcareous and dolomitic siltstone, quartzite
Lower slate conglomerate			Bruce		Bruce		Bruce		Bruce		Bruce		Bruce				Bruce	Conglomerate
White quartzite			Mississagi		Upper Mississagi	Hough Group	Mississagi		Upper Mississagi		Upper Mississagi		Mississagi			Hough Lake Group	Mississagi	Quartzite
					Middle Mississagi		Pecors		Middle Mississagi	Sprague Group	Middle Mississagi						Pecors	Argillite ±quartzite → schist
							Whiskey						Ramsay Lake				Ramsay Lake	Conglomerate → schist
						Elliot Group	Nordic		Lower Mississagi		Lower Mississagi	Sudbury Series	McKim			Elliot Lake Group	McKim	Argillite ±quartzite → schist
Chloritic slates					Lower Mississagi		Matinenda (Upper)				Pater Volcanics		Wanapitei				Matinenda	Quartzite, arkose, oligomictic conglomerate
Grey quartzite							Matinenda (Lower)										Salmay Lake	Mafic volcanic rocks, arkose
																	Gabbro Anorthosite	Gabbro Anorthosite
Laurentian Granite	Laurentian Granite		Algoman Granite		Algoman Granite		Algoman Granite		Algoman Granite		?		Schist Complex (Keewatin)	Early PЄ			Mafic Intrusions	Diabase
																	Algoman Granite	Granite, etc.
	Sudbury Series		Sudbury Series		Keewatin		Greenstone		Keewatin								Keewatin – type metavolcanics and metasediments	Sedimentary rocks
	Granites and Keewatin		Schist Complex															Volcanic rocks

Map 2314
Proctor and Deagle Townships

ONTARIO
DIVISION OF MINES

HONOURABLE LEO BERNIER, *Minister of Natural Resources*
DR. J. K. REYNOLDS, *Deputy Minister of Natural Resources*
G. A. Jewett, *Executive Director, Division of Mines* E. G. Pye, *Director, Geological Branch*



Published 1976

Scale 1 inch to 50 miles
N.T.S. reference 41J/7, 41J/8

SYMBOLS

- *Glacial striae.*
- *Small bedrock outcrop.*
- *Area of bedrock outcrop.*
- *Bedding, top unknown, (inclined, vertical).*
- *Bedding, top indicated by arrow; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from relationship of cleavage and bedding; (inclined, overturned).*
- *Schistosity; (horizontal, inclined, vertical).*
- *Gneissosity, (horizontal, inclined, vertical).*
- *Lineation with plunge.*
- *Geological boundary, observed.*
- *Geological boundary, position interpreted.*
- *Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.*
- *Jointing; (horizontal, inclined, vertical).*
- *Drag folds with plunge.*
- *Anticline, syncline, with plunge.*
- *Drill hole; (vertical, inclined).*
- *Drill hole; (projected vertically, projected up dip).*
- *Drill hole which intersected little or no uraniferous quartz-pebble conglomerate.*
- *Drill hole not completed to Pre-Huronian basement rock.*
- *Vein.*
- MA *Magnetic attraction.*
- RA *Radioactivity.*
- *Swamp.*
- *Motor road. Provincial highway number encircled where applicable.*
- *Other road.*
- *Trail, portage, winter road.*
- *Building.*
- *Township boundary or meridian line, with mileposts, approximate position only.*
- *Mining property, surveyed. Boundary approximate position only.*
- *Mineral deposit; mining property, unsurveyed. Approximate position only.*
- *Surveyed line, approximate position only.*

PROPERTIES, MINERAL DEPOSITS

PROCTOR TOWNSHIP

1. *Keba, M.*
2. *Rio Algom Mines Ltd. (Buckles Property).*

Information current to December 31st 1966. Only current and defunct properties for which geological or related information is available are listed and located on the map face. For further information see report.

Map No. 2314

PROCTOR AND DEAGLE TOWNSHIPS

ALGOMA DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

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

LEGEND

CENOZOIC[a]

QUATERNARY

RECENT

Swamp, lake, stream deposits.

PLEISTOCENE

Gravel, clay, till, sand.

UNCONFORMITY

PRECAMBRIAN[b]

LATE PRECAMBRIAN (PROTEROZOIC)

LATE MAFIC INTRUSIVE ROCKS†

16 *Olivine diabase.*

INTRUSIVE CONTACT

MIDDLE PRECAMBRIAN (PROTEROZOIC)

CUTLER GRANITE†

15a *Muscovite, biotite granite.*
15b *Pegmatite.*

INTRUSIVE CONTACT

NIPISSING INTRUSIVE ROCKS[c]

14a *Diabase, gabbro, diorite cut by felsic and mafic dikelets.*
14b *Metadiabase, epidiorite, amphibolite, amphibolite gneiss, hornblende schist.†*

INTRUSIVE CONTACT

HURONIAN SUPERGROUP

COBALT GROUP

GOWGANDA FORMATION†

13a *Polymictic paraconglomerate.*
13b *Feldspathic quartzite, quartzite.*
13c *Greywacke.*

UNCONFORMITY

QUIRKE LAKE GROUP

SERPENT FORMATION†

12 *Calcareous and non-calcareous feldspathic quartzite, quartzite, minor siltstone, argillite, polymictic conglomerate.*

ESPANOLA FORMATION†

11a *Interbedded limestone, dolomitic limestone, calcareous argillite, greywacke, argillite, quartzite, intraformational breccia.*
11b *As above with scapolite porphyroblasts in carbonate-bearing rocks.*
11c *Quartzite, feldspathic quartzite.*

BRUCE FORMATION†

10 *Polymictic paraconglomerate, lenses of quartzite, siltstone.*

UNCONFORMITY—LOCAL DISCONFORMITY

HOUGH LAKE GROUP

MISSISSAGI FORMATION†

9a *Feldspathic quartzite, quartzite, arkose.*
9b *Argillaceous quartzite.*
9c *Polymictic conglomerate.*
9d *Intraformational breccia.*

PECORS FORMATION†

8 *Interbedded argillaceous quartzite, argillite, greywacke, quartzite, minor siltstone.*

RAMSAY LAKE FORMATION†

7 *Polymictic paraconglomerate with conglomeratic quartzite lenses.*

UNCONFORMITY

ELLIOT LAKE GROUP

MCKIM FORMATION†

6a *Interbedded argillaceous quartzite, argillite, feldspathic quartzite.*
6b *Metamorphic equivalent of 6a with chlorite, biotite.*
6c *Metamorphic equivalent of 6a with garnet, staurolite, cordierite.*

MATINENDA FORMATION†

5a *Arkose, feldspathic quartzite, minor argillite.*
5b *Intraformational breccia.*

GREAT UNCONFORMITY

EARLY PRECAMBRIAN (ARCHEAN)

4 *Regolith[d]†*

MAFIC INTRUSIVE ROCKS[c]

3 *Unsubdivided.*
3a *Porphyritic diabase.*
3b *Diabase.*

INTRUSIVE CONTACT

FELSIC INTRUSIVE ROCKS (ALGOMAN)

2a *Granite, granodiorite and related rocks.*
2b *Porphyritic granite.*
2c *Granitic rocks with abundant aplite dikelets.†*
2d *Granite, granite gneiss and related rocks.*

INTRUSIVE CONTACT

METAVOLCANICS AND METASEDIMENTS (KEEWATIN?)

1 *Unsubdivided metavolcanics and metasediments.*
1a *Rhyolite.†*
1b *Massive to porphyritic andesite and basalt flows.*
1c *Amygdaloidal mafic lava.*
1d *Pillowed mafic lava.*
1e *Unsubdivided metasediments.*
1g *Conglomerate.*
1h *Metagreywacke.*
1j *Chert.*

IF *Iron formation.*

Sudbury breccia

Breccia†

q *Quartz.*
S *Sulphide mineralization.*

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

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

[c] *The numerous diabase dikes cutting Early Precambrian rocks include both Pre- and Post-Huronian varieties which could not be distinguished during field mapping.*

[d] *Granite regolith takes the colour of the underlying parent rock.*

† *Appears on accompanying Map 2315, Cutler Area report.*

SOURCES OF INFORMATION

Geology by J. A. Robertson and assistants, Geological Branch, 1964, 1965.
Geology is not tied to surveyed lines.

Geological plans of mining companies.

Aeromagnetic maps 2256G, 3237G, O.D.M.—G.S.C.

Assessment files, Ministry of Natural Resources, Sault Ste. Marie office.

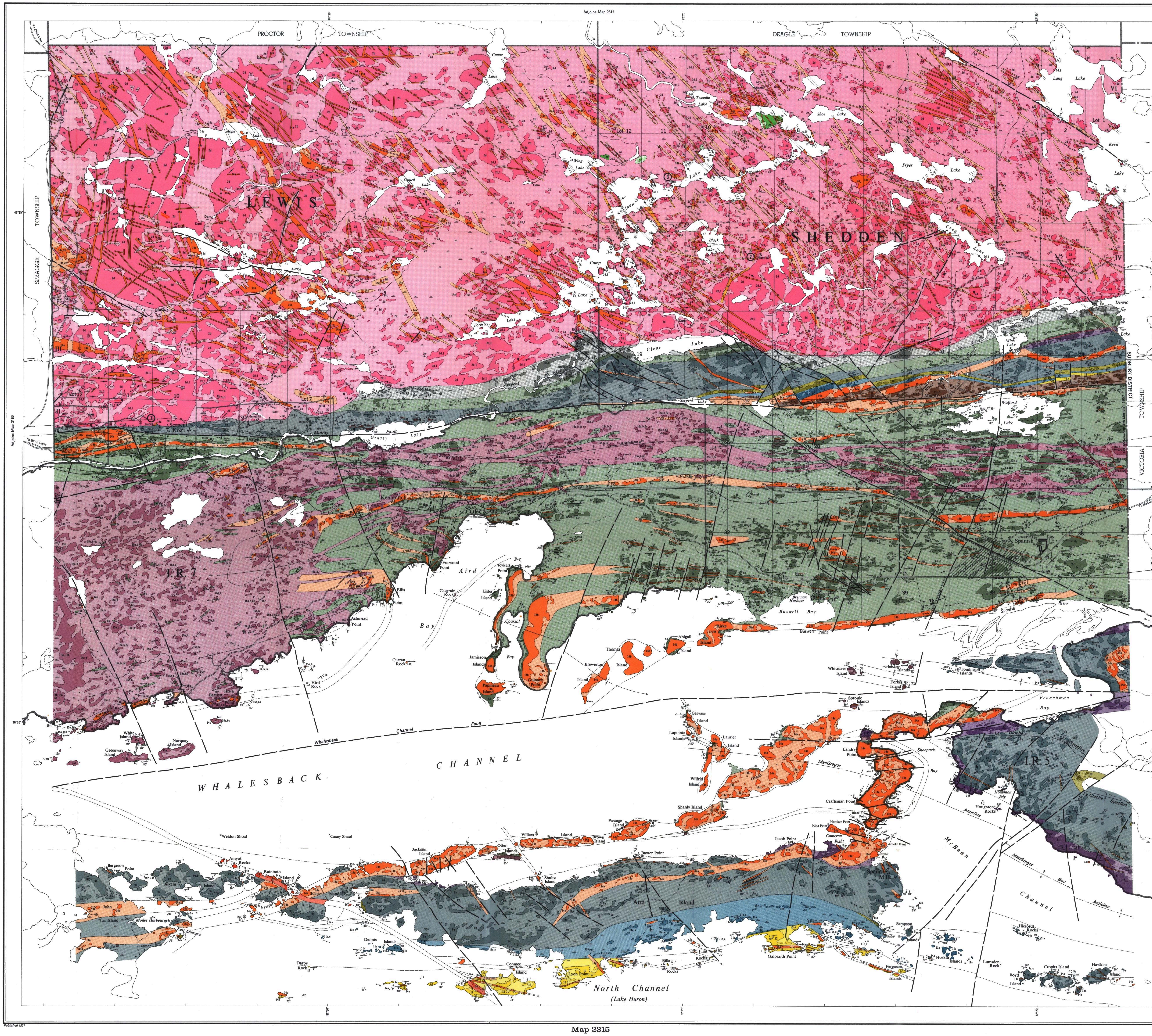
ODM Preliminary maps, P.245, Proctor Township; P.317, Deagle Township, Scale 1 inch to ¼ mile, issued 1964, 1965.

Cartography by M. G. Sefton and assistants, Surveys and Mapping Branch, 1974.

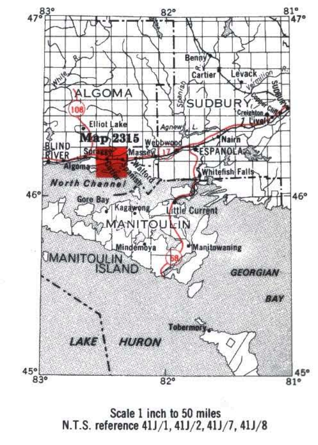
Base map derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch, with additional information by J. A. Robertson.

Magnetic declination in the area was approximately 6° West, 1964.

ONTARIO
DIVISION OF MINES
HONOURABLE LEO BERNIER, *Minister of Natural Resources*
DR. J. K. REYNOLDS, *Deputy Minister of Natural Resources*
G. A. Jewett, *Executive Director, Division of Mines* E. G. Pye, *Director, Geological Branch*



Published 1977



Scale 1 inch to 50 miles
N.T.S. reference 41J/1, 41J/2, 41J/7, 41J/8

SYMBOLS

- Glacial striae.
- Small bedrock outcrop.
- Area of bedrock outcrop.
- Bedding, top unknown, (inclined, vertical).
- Bedding, top indicated by arrow; (inclined, vertical, overturned).
- Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).
- Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).
- Bedding, top (arrow) from relationship of cleavage and bedding; (inclined, overturned).
- Schistosity; (horizontal, inclined, vertical).
- Gneissosity, (horizontal, inclined, vertical).
- Lineation with plunge.
- Geological boundary, observed.
- Geological boundary, position interpreted.
- Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
- Jointing; (horizontal, inclined, vertical).
- Drag folds with plunge.
- Anticline, syncline, with plunge.
- Drill hole; (vertical, inclined).
- Drill hole; (projected vertically, projected up dip).
- Drill hole which intersected little or no uraniferous quartz-pebble conglomerate.
- Drill hole not completed to Pre-Huronian basement rock.
- 18" Vein. Width in inches.
- MA Magnetic attraction.
- RA Radioactivity.
- Swamp.
- 68 Motor road. Provincial highway number encircled where applicable.
- Other road.
- Trail, portage, winter road.
- Building.
- 23 Township boundary or meridian line, with mileposts, approximate position only.
- 2 Mining property, surveyed. Boundary approximate position only.
- 3 Mineral deposit; mining property, unsurveyed. Approximate position only.
- District boundary, approximate position only.
- Surveyed line, approximate position only.

SOURCES OF INFORMATION

Geology by J. A. Robertson and assistants, Geological Branch, 1964, 1965.
Geology is not tied to surveyed lines.

Geological plans of mining companies.

Aeromagnetic maps 2240G, 2255G, 2256G, 3237G, O.D.M.— G.S.C.

Assessment files, Ministry of Natural Resources, Sault Ste. Marie office.

Preliminary maps P.246, Lewis Township; P.318, Shedden Township and part of I.R. No. 7; P.319, I.R. 7 East and offshore Islands; P.320, I.R. 5 West and offshore Island, Scale 1 inch to ¼ mile, issued 1964, 1965.

Cartography by M. G. Sefton and assistants, Surveys and Mapping Branch, 1974.

Base map derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch, with additional information by J. A. Robertson.

Magnetic declination in the area was approximately 6° West, 1964.

PROPERTIES, MINERAL DEPOSITS

LEWIS TOWNSHIP

1. Preston Mines Ltd.

SHEDDEN TOWNSHIP

2. Black Lake occurrence.
3. Park, P.

Information current to December 31st 1966. Only current and defunct properties for which geological or related information is available are listed and located on the map face. For further information see report.

LEGEND

CENOZOIC[a]

QUATERNARY

RECENT

Swamp, lake, stream deposits.

PLEISTOCENE

Gravel, clay, till, sand.

UNCONFORMITY

PRECAMBRIAN[b]

LATE PRECAMBRIAN (PROTEROZOIC)

LATE MAFIC INTRUSIVE ROCKS

16 *Olivine diabase.*

INTRUSIVE CONTACT

MIDDLE PRECAMBRIAN (PROTEROZOIC)

CUTLER GRANITE

15a *Muscovite, biotite granite.*
15b *Pegmatite.*

INTRUSIVE CONTACT

NIPISSING INTRUSIVE ROCKS[c]

14a *Diabase, gabbro, diorite cut by felsic and mafic dikelets.*
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HURONIAN SUPERGROUP

COBALT GROUP

GOWGANDA FORMATION

13a *Polymictic paraconglomerate.*
13b *Feldspathic quartzite, quartzite.*
13c *Greywacke.*

UNCONFORMITY

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ESPANOLA FORMATION

11a *Interbedded limestone, dolomitic limestone, calcareous argillite, greywacke, argillite, quartzite, intraformational breccia.*
11b *As above with scapolite porphyroblasts in carbonate-bearing rocks.*
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BRUCE FORMATION

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UNCONFORMITY—LOCAL DISCONFORMITY

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8 *Interbedded argillaceous quartzite, argillite, greywacke, quartzite, minor siltstone.*

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7 *Polymictic paraconglomerate with conglomeratic quartzite lenses.*

UNCONFORMITY

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EARLY PRECAMBRIAN (ARCHEAN)

4 *Regolith*[d]

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3b *Diabase.*

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2c *Granitic rocks with abundant aplite dikelets.*
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METAVOLCANICS AND METASEDIMENTS (KEEWATIN?)

1 *Unsubdivided metavolcanics and metasediments.*
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1c *Amygdaloidal mafic lava.*†
1d *Pillowed mafic lava.*†
1e *Unsubdivided metasediments.*†
1g *Conglomerate.*†
1h *Metagreywacke.*
1j *Chert.*†

IF *Iron formation.*†

Sudbury breccia

Breccia

q *Quartz.*
s *Sulphide mineralization.*

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

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

[c] *The numerous diabase dikes cutting Early Precambrian rocks include both Pre- and Post-Huronian varieties which could not be distinguished during field mapping.*

[d] *Granite regolith takes the colour of the underlying parent rock.*

† *Appears on accompanying Map 2314, Cutler Area report.*

Map 2315

LEWIS AND SHEDDEN TOWNSHIPS AND PARTS OF INDIAN RESERVES No. 5 AND No. 7

ALGOMA DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

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