Ontario Geological Survey

Report 178

Geology of the

Endikai Lake Area

District of Algoma

By

K.M. Siemiatkowska

1978

Ontario

Ministry of Natural Resources

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Map Unit Public Service Centre, Queen's Park, Toronto,
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Siemiatkowska, K.M.
1978: Geology of the Endikai Lake Area, District of Algoma; Ontario Geological Survey Report 178, 79p. Accompanied by Geological Map 2399, scale 1:31 680 or 1 inch to ½ mile, and 1 Chart.

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(back pocket)

Map 2399 (coloured)–Endikai Lake, District of Algoma.

Scale 1:31 680 or 1 inch to ½ mile.

CHART

(back pocket)

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ABSTRACT

The Endikai Lake Area in the District of Algoma, consisting of Albanel and Varley Townships, and the northern parts of Kamichisitit and Nouvel Townships, is situated 58 km (36 miles) north of Blind River. The map-area, located at the contact between the Superior and Southern Provinces of the Canadian Shield, is underlain by Early Precambrian migmatitic rocks, metavolcanics and metasediments, mafic intrusive rocks, and also by sedimentary rocks of the Middle Precambrian Huronian Supergroup.

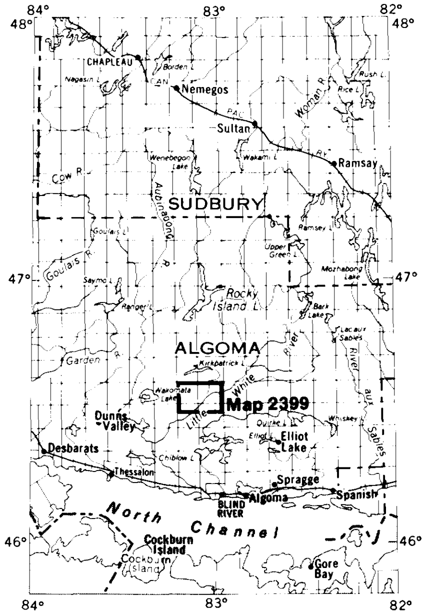

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Figure 1–Key map showing location of the Endikai Lake Area. Scale 1:3 168 000 or 1 inch to 50 miles.

The Early Precambrian rocks of the Superior Province consist of the following: older mafic to felsic flows and pyroclastic rocks strongly metamorphosed in places to amphibolite facies grade; metasediments; migmatitic and gneissic rocks. The younger felsic intrusive rocks range from trondhjemite to granodiorite, and contain xenoliths of metavolcanics, orthogneiss, and paragneiss.

The sedimentary rocks of the Huronian Supergroup unconformably overly the Early Precambrian basement rocks. These sedimentary rocks consist of the following: feldspathic sandstone of the Mississagi Formation; conglomerate and sandstone of the Bruce Formation; limestone, dolomite, siltstone, and calcareous sandstone of the Espanola Formation; sandstone of the Serpent Formation; conglomerate, sandstone, silstone, and mudstone of the Gowganda Formation; sandstone, conglomerate, and orthoquartzite of the Lorrain Formation; siltstone, cherty siltstone, greywacke, and sandstone of the Gordon Lake Formation; and orthoquartzite of the Bar River Formation. These rocks are predominantly non-marine deposits formed on the margin of a depositional basin to the south. The predominantly sandstone-bearing formations were formed in fluvial to deltaic depositional environments that were interrupted by periodic debris flows represented by the Bruce and Lower Gow-

ganda Formations. The limestone and siltstone of the Espanola Formation, and the purple siltstone of the Gowganda Formation, represent the only sedimentary rocks deposited in a shallow marine basin. Cherty siltstone and siltstone of the Gordon Lake Formation occurred in a tidal-flat environment which was subjected to periodic subaerial exposure.

Mafic intrusive rocks were emplaced at four separate intervals in the map-area. Two occur only in the Early Precambrian basement: these are the fine-grained amphibolitic and porphyritic dikes. The most abundant mafic rocks, the Nipissing Diabase, form the third interval, and minor post-Nipissing and olivine diabase dikes of the Sudbury Swarm represent the last of the mafic intrusive rocks.

The Huronian rocks are not much deformed or metamorphosed. The dominant structures in the map-area are: a set of faults belonging to the Flack Lake Fault System; the Quirke Syncline; and the Wakomata Lake Syncline. Movement along these faults resulted in the formation of a series of fault-bounded rotated blocks. Since the Quirke Syncline has a variably-plunging fold axis, it may continue to the west as the Wakomata Lake Syncline.

Mineralization in the form of chalcopyrite, chalcocite, and in one place, galena, with specularite-magnetite-bearing quartz veins, occurs in fault zones associated with Nipissing Diabase. Copper mineralization also occurs in the limestone of the Espanola Formation. The sandstone of the Mississagi Formation has slight radioactivity.

Geology

of the

Endikai Lake Area

District of Algoma

by

K.M. Siemiatkowska[1]

INTRODUCTION

The Endikai Lake Area comprises Albanel Township (formerly Township 169), Varley Township (formerly Township 176), the northern parts of Kamichisitit Township (formerly Township 168), and Nouvel Township (formerly Township 175). The map-area situated approximately 46.4 km (29 miles) northeast of Iron Bridge along Highway 546, 56.0 km (35 miles) northwest of Elliot Lake, and 58 km (36 miles) north of Blind River, can be reached via Highways 108, 639, and 546. The area covers about 260 km^2 (100 square miles) and is bounded by Latitudes 46°30′ to 46°37.5′ and Longitudes 83°12′ to 82°58.5′.

Access into the area is provided by the following: Highway 546; boat from Endikai Lake; float-equipped aircraft to Burns, East Caribou, Waterhole, and Big Lakes; also numerous old lumber roads provide access to some other parts of the area. These roads can be used in the later part of the summer with a four-wheel drive vehicle. An old road which extends north from Highway 546 can provide access to Waterhole and Burns Lakes only in late summer. The Little White River can be forded during periods of low water level; there is no bridge over the river. Midway Lumber Company was to construct a private road from Kynoch Lake through Grassett Lake to Castra Lake during the summer of 1974.

Mapping was carried out during the summer of 1974. Traverses, using a pace and compass method, were made at irregular intervals in order to provide maximum coverage of outcrops. In this way, two geologists and three assistants gathered data which were plotted directly in the field on to acetate overlays on aerial photographs at a scale of 1:15 840 (1 inch to ¼ mile). The information was then transferred by using a sketchmaster to base maps of the same scale prepared by the Cartography Section, Surveys and Mapping Branch, Divisions of Lands, On-

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tario Ministry of Natural Resources, from Forest Resources Inventory maps. Preliminary geological maps of the Endikai Lake (Eastern half), P.1002, and Endikai Lake (Western Half), P.1001, were published by the Division of Mines in 1975 (Siemiatkowska *et al.* 1975a and b).

Physiography

The area is rugged with elevations ranging from approximately 270 m (900 feet) to 530 m (1,750 feet) above mean sea level. The topography is controlled by rock formations in the area. The granitic terrane consists of rounded hills, and shows a moderate amount of bedrock exposure.

The east-central part of the area consists of rugged cliffs formed by differential erosion of the rocks by the Little White River. In the southern part of the area, this river meanders over flat sand plains that contrast with the high cliffs surrounding them. Bedrock exposure is generally very good in the map-area, except for the northeastern and southern parts which are heavily wooded, and where bedrock is covered with Pleistocene till. Numerous faults and lineaments are delineated by vertical cliffs.

Resources and Development

The map-area was explored in the past for copper and in the late 1960s for uranium. Numerous copper occurrences were found in the area, and minor radioactivity was found in the eastern part of Albanel Township. Two tourist camps are located on Highway 546. Private cottages are located on Endikai, Waterhole, Big, and East Caribou Lakes. Lumbering has been carried out in the region since the turn of the century, and the western part of the area has been recently logged. Tree species present include poplar, birch, maple, pine, and in swampy areas, spruce, balsam, and cedar. Hunting and fishing are popular activities in the area. Game species present include; grouse, moose, deer, black bear, and snowshoe rabbit. The lakes are well stocked with speckled trout, rainbow trout, lake trout, pickerel, northern pike, bass, and perch. The Little White River valley is one of the more scenic areas.

Previous Work

The map-area has never been mapped entirely before. Emmons in 1927 (R.C. Emmons 1927) mapped parts of the area. Numerous mining companies have detailed maps of their properties. The area is included on a regional Preliminary Map P.304 (Robertson *et al.* 1971) and Compilation Series Map 2108 (Giblin and Leahy 1967). The area to the west was mapped by the author in 1973 (Siemiatkowska 1977), that to the east by Robertson (1963; 1969), that to the south by Frarey (In Press), and that to the north in 1975 (Siemiatkowska and

Guthrie 1976; Siemiatkowska, Guthrie, and Gent 1976).

The magnetic characteristics of the area are shown on Aeromagnetic Maps 2227G and 2241G published by the Ontario Department of Mines and the Geological Survey of Canada (ODM-GSC 1963a,b). The Assessment Files Research Office in Toronto, and the Regional Geologist's Office, Ontario Ministry of Natural Resources, in Sault Ste. Marie have record of work performed by the mining industry in the map-area.

Acknowledgments

The author was assisted in the field by E.C. Grunsky, B.R. Berger, C.A. Robertson, and J.W. Pelltier. Messrs. Grunsky and Berger were responsible for part of the geological mapping.

The author would like to thank the following individuals for numerous services provided in the field: Mr. and Mrs. H. Frey, owners of the Little White River Lodge; Mr. Keuhn for allowing the party to camp on his property; Mr. and Mrs. Sandy Post; Mr. and Mrs. R. Makela, and L. Pilon of Lauzon Aviation; Midway Lumber Company for use of their road; Mr. R. Rupert, consultant geologist; fellow staff member, Dr. K.D. Card for helpful discussions about the geology in the area; Mr. W. Hicks, Mineral Research Branch for X-ray diffraction analyses of the Lorrain samples; Ms. E. Hillary for thin section analyses; and special thanks to Mr. A.E. Guthrie for preparation of diagrams, figures, and artistic interpretations of the geology of the area.

GENERAL GEOLOGY

The map-area, located at the contact between the Superior and Southern Provinces of the Canadian Shield (Card *et al.* 1972) can be subdivided into six major geological units (Table 1).

The felsic intrusive rocks, gneisses, and metavolcanics of the Superior Province constitute the basement on which the Huronian supracrustal rocks of the Southern Province were deposited. A Rb-Sr whole rock radiometric age of 2,500 m.y. was obtained for the granitic rocks (Van Schmus 1965). This age is possibly a minimum age because the granitic rocks surround remnants of older metavolcanic belts, and are cut by porphyritic diabase dikes having a similar appearance and strike to the Matachewan Diabase in the Matachewan area dated at 2,690±93 m.y. (Gates and Hurley 1973). The Huronian sedimentary rocks were deposited later than 2,500 m.y. ago, the minimum Rb-Sr radiometric age of the Early Precambrian basement rocks, and earlier than 2,150 m.y. ago, the radiometric age of the Nipissing Diabase (Gates and Hurley 1973) that intrudes the Huronian rocks. The Southern Province rocks were deformed and metamorphosed, albeit mildly in the map-area, during the Penokean Orogeny some 1,900 to 1,600 m.y. ago (Goldich 1968).

The youngest rock unit known in the area is a northwest-trending diabase dike of the Sudbury Swarm. Numerous ages have been proposed for this swarm.

TABLE 1 | TABLE OF LITHOLOGIC UNITS FOR THE ENDIKAI LAKE AREA.

PHANEROZOIC
CENOZOIC
QUATERNARY
PLEISTOCENE AND RECENT
Glacial, glaciofluvial, glaciolacustrine, swamp, lake and stream deposits

Unconformity

PRECAMBRIAN
LATE PRECAMBRIAN
MAFIC INTRUSIVE ROCKS
Olivine diabase

Intrusive Contact

MIDDLE PRECAMBRIAN
MAFIC INTRUSIVE ROCKS
NIPISSING DIABASE
Diabase, gabbro, diorite, metadiabase, metagabbro, amphibolite, granophyre, pegmatite, quartz metagabbro

Intrusive Contact

HURONIAN SUPERGROUP
COBALT GROUP
BAR RIVER FORMATION
Orthoquartzite
GORDON LAKE FORMATION
Sandstone, siltstone, greywacke, cherty siltstone
LORRAIN FORMATION
Orthoquartzite, pebbly sandstone, sandstone, conglomerate, feldspathic sandstone
GOWGANDA FORMATION
Conglomerate, arkose, sandstone, greywacke, feldspathic sandstone, siltstone, mudstone

Unconformity - Disconformity

QUIRKE LAKE GROUP
SERPENT FORMATION
Calcareous sandstone, siltstone, arkose feldspathic sandstone, conglomerate
ESPANOLA FORMATION
Calcareous sandstone, sandstone, siltstone, limestone, dolomite
BRUCE FORMATION
Conglomerate, sandstone, greywacke, protoquartzite
HOUGH LAKE GROUP
MISSISSAGI FORMATION
Feldspathic sandstone
BASAL SEDIMENTARY UNIT
Sandstone, conglomerate, regolith

Nonconformity

EARLY PRECAMBRIAN (ARCHEAN)

MAFIC IINTRUSIVE ROCKS

Porphyritic metadiabase, amphibolite, ultramafic dikes

Intrusive Contact

FELSIC INTRUSIVE AND METAMORPHIC ROCKS

GRANITIC INTRUSIVE ROCKS

Trondhjemite, granodiorite, quartz monzonite, porphyritic quartz monzonite, aplite, pegmatite

Intrusive Contact

GNEISSIC INTRUSIVE AND MIGMATITIC ROCKS

Orthogneiss, migmatite, amphibolite

Intrusive Contact

METAVOLCANICS AND METASEDIMENTS

Mafic, intermediate, and felsic flows pyroclastic rocks, metasediments

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The two most widely used are the Rb-Sr whole rock age of 1,460 ± 130 m.y. by Gates and Hurley (1973), and the revised age of 1,250 ± 50 m.y. (Van Schmus 1975).

Precambrian rocks are partly covered by a thin to heavy discontinuous mantle of sandy till, the deposits of continental glaciation formed during the Pleistocene Epoch. Two sets of glacial striae are present, indicating ice movement from the north and northeast. Thick deposits of gravel and sand can be found on the outwash plains beside the Little White River.

Precambrian

EARLY PRECAMBRIAN (ARCHEAN)

Metavolcanics and Metasediments

The Early Precambrian metavolcanics and metasediments form as irregular areas and xenoliths in the granitic basement rocks, and represent remnants of older "greenstone" belts. The best exposures of these rocks are located 1370 m (4,500 feet) southeast of Endikai Lake, just east of the northern tip of Endikai Lake, and north and northwest of West Twin Lake. These rocks have a variable composition. Southeast of Endikai Lake, two types of metavolcanics were observed as follows:

1) South of the Little White River, the rocks are strongly foliated, dark green, and very fine grained, altered mafic metavolcanics. Locally, the metavolcanics are highly magnetic because of their strong foliation, and can be confused with sheared argillite. However, these rocks are cut by Early Precambrian granitic rocks. These metavolcanics probably represent basaltic flows, minor felsic flows, and pyroclastic rocks; alteration caused by metamorphism and shearing related to the proximity of a fault obliterated all the primary structures. The presence of chloritic bands interlayered with light gray-green fine-grained felsic material is probably metamorphic, and not primary.
In thin section, the metavolcanics are revealed to be medium grained, and strongly altered to chlorite and carbonate. Plagioclase crystals appear either as very fine grained laths, or as phenocrysts up to 2 mm in length. The degree of alteration varies from extreme to minimal. Perthitic phenocrysts of plagioclase are also abundant. The fine-grained groundmass consists predominantly of chlorite with minor carbonate, sphene, and opaque minerals.

2) North of the Little White River, and east of the northern end of Endikai Lake, the metavolcanics are metamorphosed to amphibolite facies, and show a well-developed metamorphic layering of amphibole and plagioclase. The rock is dark green to black, fine to medium grained, and is foliated. Medium-grained, gray, granitic to aplitic dikes are injected along the planes of layering, or along fractures cross-cutting the layering (Photo 1). Late-stage quartz-carbonate-epidote-bearing veinlets crisscross the rock.

Thin section examination reveals the concentration of amphibole and feldspar in layers. Cummingtonite occurs as fresh stubby crystals aligned parallel to the layering, and is associated with biotite and quartz. The accessory minerals like sphene and opaque minerals also are concentrated in bands. Plagioclase is altered to epidote. A modal analysis of a felsic layer is given in Table 2.

The metasediments occur northwest of West Twin Lake (Map 2399, back pocket). These rocks are fine-grained, strongly foliated metagreywacke to argillite (mapped as "Metasediments", Map 2399, back pocket) with relic bedding, partly obscured crossbedding, and cross-laminations. Locally, minor slump structures can also be detected. Grain gradation was observed in some beds, but might be caused by metamorphic recrystallization. The metasediments are associated with fine- to medium-grained amphibolite gneiss, and are cut by numerous aplitic and granitic bands. Thin section examination reveals that the metasediment is a poorly sorted greywacke with angular to subangular grains of quartz, plagioclase, and rock fragments set in a fine-grained dark grey matrix.

ODM9802

Photo 1–Early Precambrian metavolcanic showing well-developed segregations of felsic and mafic minerals, and injections by aplitic dikelets.

Felsic Intrusive and Metamorphic Rocks

GNEISSIC INTRUSIVE AND MIGMATITIC ROCKS

Some attempt has been made to separate the more gneissic and migmatitic plutonic rock areas from the areas of more homogeneous granitic rocks. These boundaries are placed arbitrarily on the map (Map 2399, back pocket), and the gneissic rocks include orthogneissic or highly xenolithic granitic rocks. Most granitic rock forms veins, dikes, or irregular masses, and are present within these migmatitic terranes. The migmatite consists of fine- to coarse-grained amphibolite bands that are 7.0 to 15.0 cm thick (2.7 to 5.9 inches), strongly foliated, and are injected parallel to the foliation by quartz-rich felsic phases up to 30.0 cm (11.8 inches) thick. These phases are grey to pink, foliated, and coarse grained with up to 15 percent hornblende. These phases are faulted, show typical pinch and swell structures, and are infilled with carbonate at their centres. The folia-

TABLE 2 | MODAL ANALYSES OF EARLY PRECAMBRIAN (ARCHEAN) ROCKS.

Rock Type	Trondhjemite (3a)	Quartz Monzonite (3b)	Trondhjemite (3a)	Granodiorite (3b)	Felsic layer in metamorphosed metavolcanics (1c)
Sample Number	S9-74-61	S9-74-91	G9-74-30	S6-74-201	S9-74-130
Quartz	22.9	26.3	19.9	26.2	22.4
Plagioclase	67.2	42.2	58.1	55.8	63.2
Orthoclase Microcline	4.2	28.7	5.1	11.9	
Biotite	0.4	2.7	3.4	2.0	4.8
Chlorite	3.8			3.8	—
Muscovite	—	—	—	—	—
Epidote	—	—	2.5	—	1.0
Carbonate	—	—	—	—	—
Heavy Minerals	1.2	0.1	0.1	0.3	—
Amphibole	—	—	10.7	—	8.6
Apatite	0.2	—	0.1	—	—
Sphene	0.1	—	0.1	—	—
No. of Points	1000	1000	1000	1000	

Sample Locations

59-74-61	East of north end of Endikai Lake.
59-74-91	North of Endikai Lake, near Albanel Township boundary.
G9-30	Southeast of Wilson Lake.
G9-74-201	North shore of Castra Lake.
S9-74-130	North of Little White River, east of the south end of Endikai Lake.

Abbrevations

3a - Rock code, see legend on Map 2399 in back pocket

tion is less pronounced in the granitic rocks than in the metavolcanics. Aplite dikes 90 cm (35 inches) thick, and pegmatitic dikes 1.2 cm (0.5 inch) thick, cross-cut the banding and foliation. The gneissic rocks are rich in epidote which forms pods and bands associated with the numerous quartz veins.

The migmatites are composed of laminated amphibole-feldspar and amphibole-rich rocks. The rock consists of lath-shaped amphibole in a matrix of quartz and plagioclase with accessory chlorite, apatite, and muscovite. Secondary calcite veins are present.

North of Endikai Lake, a small area comprises a rock consisting of coarse-grained euhedral crystals of amphibole (5 mm across) enclosed in minor euhedral crystals of plagioclase. Minor alteration of the amphibole to biotite, chlorite, and sphene has taken place, and the rock is injected by numerous dikes and veins of pink to grey granite. The author does not propose to make an interpretation of the rock at this time. However, the rock was sufficiently different from the other rocks to warrant a separate description.

GRANITIC INTRUSIVE ROCKS

Granitic intrusive rocks are largely bounded by faults of the Flack Lake Fault System. The terrain underlain by these rocks has a fairly subdued relief south of the Flack Lake Fault compared to the terrain north of the Endikai Lake Fault, where, north of Endikai Lake, there is a significant rise in elevation and increase in the ruggedness of the hills. Bedrock exposures range from poor in the north, to fair in the south. Three types of granitic rocks predominate: (1) a pink foliated hornblende-bearing fine- to coarse-grained granodiorite to quartz monzonite with mafic xenoliths, and a predominant foliation trend of N10°E; (2) a light grey, coarse-grained biotite trondhjemite with a few gneissic to migmatitic xenoliths rich in amphibole; and (3) fine-grained aplitic dikes and coarse-grained pegmatitic veins. The xenoliths constitute 1 to 20 percent of the rock, and comprise amphibolite, gneissic, migmatitic, metavolcanic, and metasedimentary rock fragments ranging in maximum dimensions from 30 cm (1 foot) to 3 m (10 feet).

Between Wilson and Endikai Lakes, the predominant granitic rock is an amphibole-bearing pink to grey granodiorite containing up to 30 percent amphibole. Foliation in the granodiorite has a consistent strike of N10°E. Leucocratic varieties of pink quartz monzonite and trondhjemite commonly contain biotite. A few small areas have dioritic phases associated with the other granitic rocks. These are probably hybrid phases where mafic xenoliths have been digested by the surrounding granitic rocks.

Porphyritic pink monzonite occurs east of Endikai Lake and contains either euhedral crystals of potassic feldspar about 1.0 cm (2.5 inches) across or mottled phenocrysts of potassic feldspar intergrown with quartz and set in a grey granitic matrix. Pegmatitic patches of hornblende are associated with the phenocrysts.

Late-stage aplitic and pegmatitic dikes ranging from 1.5 cm (0.6 inch) to 60 cm (23 inches) in width cut the metavolcanic and granitic rocks. The dikes seem to be concentrated at margins of granitic terranes, and consist of variable amounts of quartz, microcline, and plagioclase.

The granitic rocks vary from predominantly trondhjemite to granodiorite and quartz monzonite. These rocks are equigranular to porphyritic, and are leucocratic containing about 5 percent biotite and chlorite, although in places a hornblende-rich variety exists. Thin section examination reveals that crystal size ranges from 1 mm to 7 mm. Plagioclase exhibits zoning, and chlorite and biotite form at the expense of primary hornblende; epidote, sphene, apatite, and opaque minerals are the accessory minerals. Near faults, the granitic rocks are characteristically deformed with granulation and deformation of crystals, and strong alteration to epidote and chlorite.

The porphyritic trondhjemite contains phenocrysts of microcline in a quartz-plagioclase matrix. The phenocrysts are fairly fresh, and exhibit a poikilitic texture. Modal analyses of several granitic rocks are given in Table 2.

Mafic Intrusive Rocks

Rocks in the map-area are intruded by many thin diabase dikes and metagabbro bodies. These rocks range in age from Early to Late Precambrian, and exhibit many similarities to each other. These dikes can be classified into groups based upon attitude, lithology, and the limited evidence of intrusive relationships. The majority of dikes in these groups can be generally assigned an Early, Middle, or Late Precambrian age, but some dikes within each group may be improperly classified. Two types of Early Precambrian dikes are: 1) a northwest- to north-trending set of porphyritic metadiabase dikes, and 2) a predominantly northwest-trending but anastomosing set of fine-grained amphibolitic diabase dikes which intrudes only the Early Precambrian basement rock. Two other types of dike, the Nipissing Diabase and olivine diabase dikes of the Sudbury Swarm (Card *et al.* 1972) are described in a later section.

Porphyritic Dikes

The porphyritic metadiabase dikes resemble the dikes of the Matachewan type (R.J. Rupert, personal communication, 1974). The four dikes of this composition mapped occur only in the Early Precambrian basement, and were not observed cutting the Huronian sedimentary rocks. The dikes are steeply dipping, and have an average thickness of about 30 m (100 feet). Two types of contacts with the country rocks were observed: a fine-grained chilled margin 76 cm (2½ feet) thick with a 60 cm (2 feet) thick alteration zone on each side of the dike in the host granitic rock; and a coarse-grained sharp contact with the plagioclase phenocrysts aligned and flattened parallel to the margins of the dike. The dikes comprise greenish, cream, or red-coloured euhedral to anhedral, fresh to altered plagioclase phenocrysts up to 5.0 cm (2 inches) in diameter set in a groundmass of dark green, fine- to medium-grained amphibolite. The percentage of phenocrysts in the rock ranges from 0 to 70 percent. The larger phenocrysts, as well as some of the smaller phenocrysts, are generally euhedral, and show zoning well, but most of the small phenocrysts are anhedral and show diffuse grain boundaries. The distribution of the phenocrysts in some of the dikes is irregular; parts of these dikes contain phenocrysts whereas the remainder are equigranular, medium grained, and resemble the amphibolitic dikes. In areas where outcrop is sparse, these intrusions were difficult to map consistently.

In thin section, the plagioclase phenocrysts average between 3 and 4 mm in diameter. These phenocrysts are completely saussuritized. The surrounding matrix looks like an altered Nipissing Diabase, and consists of saussuritized plagioclase laths, chlorite, uralitized amphibole, minor interstitial quartz, and zoned skeletal leucoxene.

Amphibolitic Diabase Dikes

The amphibolitic diabase dikes and altered Nipissing Diabase dikes are very difficult to distinguish in the field. Because the amphibolitic diabase dikes are Early Precambrian in age, and cut only the granitic basement rocks, some attempt was made to separate them from the altered Nipissing Diabase dikes.

However, more detailed mapping is required to accomplish this. Compared to the Nipissing Diabase, the amphibolitic dikes are finer grained, more mafic, commonly weather brownish, and in a few places display foliation at their contacts. These criteria though, were not always reliable, and many dikes classified in the amphibolitic group might be the Nipissing type and vice versa. The dikes averaging approximately 60 m (200 feet) in width, trend predominantly northwest and east, and dip as steeply as the Nipissing Diabase.

The amphibolitic dikes contain disseminated pyrite and pyrrhotite, some are highly magnetic and contain xenoliths of the country rocks 1.5 m (5 feet) across. Some have metasomatically altered the country rocks which they intrude. Much of the alteration in the country rocks along chilled contacts has resulted in the formation of albite: iron oxide alteration produced a deep red colour in the country rock. A few, fine-grained, massive, rusty weathering, black on the fresh surface, jointed dikes were observed ranging in width from 30 cm (1 foot) to 30 m (100 feet). These might be a different generation of dikes. One such dike contained stretched out phenocrysts of biotite.

Ultramafic Dikes

East of the north end of Endikai Lake, a green porphyritic diabase dike cuts the granitic rocks. The dike has an irregular contact with the host rock, and is fine grained with green euhedral phenocrysts and is rich in pyrite. The phenocrysts consist of serpentine, an alteration product after olivine, and are set in a fine-grained altered groundmass. Uralitized pyroxenes are also present. This is an ultramafic dike, or possibly a lamprophyric dike, and is the only one recognized by the author in the map-area.

MIDDLE PRECAMBRIAN

Huronian Supergroup

BASAL SEDIMENTARY UNIT

A nonconformity between the Early Precambrian granitic basement rocks and the Huronian sedimentary rocks was observed in several places throughout the area. The nonconformity is well exposed forming an undulating weathered surface developed upon the Early Precambrian basement rocks. Numerous depressions are filled with conglomeratic rocks and a "regolithic" sediment is preserved on the adjacent highs. Maximum dip of strata was observed at 40 degrees. The Basal Sedimentary Unit is present at the base of three formations; namely the Espanola, Bruce, and Mississagi Formations, where they come in contact with granitic basement rocks.

The Basal Sedimentary Unit consists of three parts: 1) arkose, or sandstone; 2) polymictic to oligomictic conglomerate; and 3) "regolithic" sediment derived *in situ* from the underlying rock. The following description of these rocks is divided into areas, because the basal rocks of this unit are different from the overlying rocks, no correlation was attempted with any of the formations.

Between Narrow Lake and the Twin Lakes Fault, a basal conglomerate is present between the Early Precambrian rocks and the limestone of the Espanola Formation. This conglomerate is significantly different from the conglomerate of the Bruce Formation, therefore no correlation is made between the two, even though they may be contemporaneous. The conglomerate consists of approximately 5 to 30 percent unsorted, angular to subrounded, grey granitic clasts ranging in size from 1 mm to 1.2 m (0.4 feet) and averaging 70 cm (28 inches) across in a mudstone to greywacke matrix. The clasts are concentrated near the contact with the basement, the degree of roundness of clasts increases upward from the contact. Minor sandy and muddy interbeds occur throughout the Basal Sedimentary Unit.

North of Varley Lake, and at the eastern end of Castra Lake, the gently undulating nature of the old paleosurface is demonstrated by the distribution of basement between the basal sedimentary rocks. The conglomerate in this area consists of 50 percent clasts in a coarse-grained dirty sandstone matrix. The clasts are angular to subrounded, range in size from 1 cm (0.4 inch) to 60 cm (24 inches), and consist of white and pink granitic rocks with minor pegmatite and minor sandstone clasts. The clast-supported conglomerate becomes interbedded with sandstone and mudstone lenses, and shows swirly textures indicating minor slumpage. These sedimentary rocks are very locally derived because their lithology reflects the lithology of the underlying rocks. The sandstone clasts probably represent the first deposition of a sedimentary rock which has been disturbed by later depositional events.

Thin section examination reveals that the basal conglomerate consists mainly of granitic clasts with minor metavolcanic, sandstone, pegmatite, and carbonate clasts in a black, poorly sorted matrix of chlorite, muscovite, and very fine grained silt with minor pyrite. The clasts that range from 1 mm to 6 mm in size show size gradation and some are coated with silty material. Sorting is poor in the conglomeratic parts to fair in the sandy lenses. Fragments of disintegrated granitic clasts can still be distinguished from a concentration of microcline and quartz clasts.

Between West Twin Lake and Varley Lake, a basal conglomerate unit is developed at the base of the Mississagi Formation. This unit consists of conglomerate, sandstone, and regolith. The conglomerate appears to fill depressions in the paleosurface, but the sandstone and regolith are found on the adjacent highs. The regolith and sandstone are closely related to one another, having gradational contacts. Where signs of transport appear, then the sedimentary rock was classified as sandstone.

The regolith which has a minimum thickness of 0.6 m (2 feet) consists of large pink clasts of potassic feldspar in a granitic-looking sericite-rich matrix. The underlying granitic rocks are deformed and cut by pink to red, thin 1 cm (2.5 inches) wide potassic feldspar veinlets. The overlying sandstone is green, sericite-rich pink arkose, with potassic feldspar clasts and minor lenses of mudstone. In many places, the granitic-looking matrix of the regolith gives the illusion that granite is interbedded with sedimentary rocks.

The conglomeratic rocks consist of white quartz pebbles set in a green, sericite-rich matrix with minor granitic, pegmatitic, potassic feldspar, and sandstone

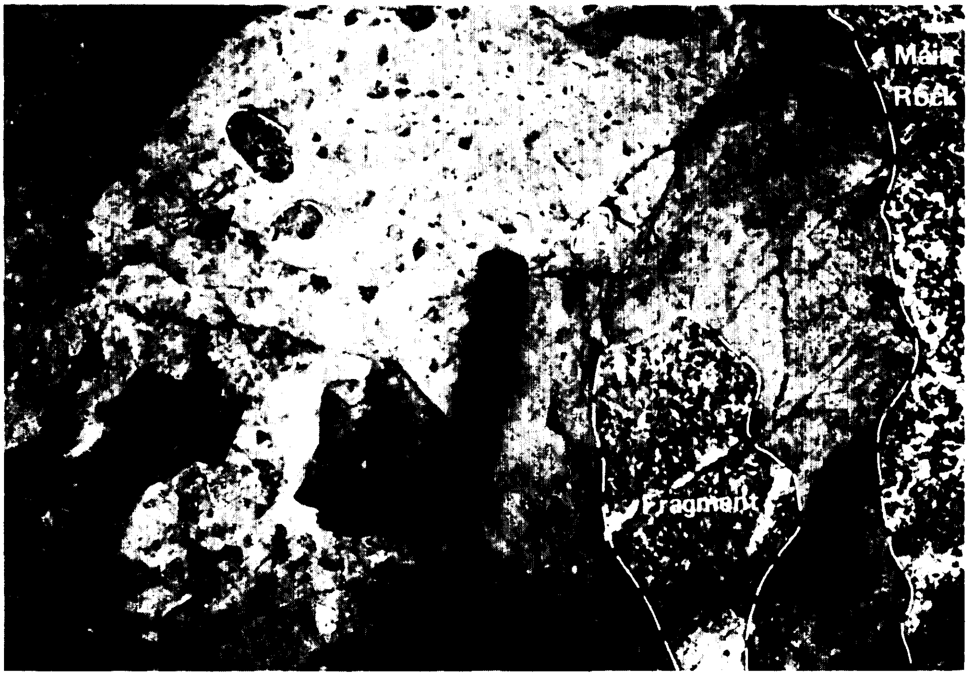

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Photo 2–Basal sedimentary unit from the unconformity at Castra Lake. Fragments of granitic rocks are surrounded by muddy sand with smaller granitic clasts.

clasts. Away from the paleosurface, the pebble content decreases, the matrix becomes more muddy with sandy lenses, and finally grades into green arkose of the Mississagi Formation.

At the western end of Castra Lake, the Basal Sedimentary Unit consists of granitic-looking patches surrounded by mudstone matrix. This rock grades into very immature, poorly sorted coarse-grained green arkose containing white quartz pebbles about 7.4 cm (2.9 inches) in diameter, potassic feldspar clasts, and minor granitic pebbles.

Thin section examination reveals that the green sericitic sandstone consists of angular grains of quartz, plagioclase, and microcline set in a very fine grained matrix of sericite, quartz, and feldspar. The sandstone is very poorly sorted and immature, and has an average grain size of 1 mm. Away from the contact with granitic rocks, plagioclase disappears, and sericite increases in amount in the matrix. Microcline exhibits fractures that are filled by sericite. This sedimentary rock is locally derived, and the effects of paleoweathering are obvious because all the grains are fractured and infilled with sericite and coated with iron.

On the north shore of Castra Lake, towards its western end, the basal rubble, derived directly from the underlying rock, is the best exposed regolithic material in the whole area (Photo 2). A spotted hornblende-rich granitic fragment cut by aplite dikes is separated from its parent rock by a conglomeratic mudstone containing 10 percent clasts of pink and grey granite, quartz, and hornblende-rich granite of the same lithology as the adjacent basement rocks. The clasts range in size from 1 cm (0.4 inch) to 15 cm (5.9 inches). The sedimentary rocks show no sign of transportation, but rather the rocks have developed *in situ*. The basal rubble then grades into the immature green arkose of the Mississagi Formation discussed above.

HOUGH LAKE GROUP

The Hough Lake Group overlies the Elliot Lake Group, which is not exposed in the map-area, and consists of three formations: namely the Ramsay Lake, Pecors, and Mississagi Formations. In the area studied, the Mississagi Formation unconformably overlies the Early Precambrian basement; the other two formations are not present.

Mississagi Formation

The Mississagi Formation, comprises a coarse, immature, feldspar-rich sandstone with abundant crossbedding, and has been interpreted as a fluvial or fluvial-deltaic deposit (Card *et al.* 1972). Palonen (1973) proposed a deltaic-marine depositional environment on the basis of polymodal paleocurrent patterns and upward coarsening cycles.

The Mississagi Formation unconformably overlies the granitic rocks of the Early Precambrian basement. The unconformity is well exposed at the western end of Castra Lake and north of Bridge Lake and has been discussed in an earlier part of this report in the subsection "Basal Sedimentary Unit". The sandstone lies directly on the Precambrian basement forming a narrow east-trending wedge. The lithology of the sandstone reflects the lithology of the underlying granitic rocks. The basal Mississagi sandstone is poorly sorted, contains angular clasts of pink feldspar, granite, and white quartz averaging 7.5 cm (3 inches) in diameter set in a green sericite-rich matrix. The overlying sandstone is finer grained, and is pinkish green. Bedding ranging from 0.6 to 1.2 m (2 to 4 feet), is laminated with laminae 2 to 5 cm (0.8 inch to 2 inches) thick, and contains greenish fine sandy siltstone interbeds approximately 30 cm (1 foot) thick. Away from the unconformity, the sandstone becomes coarser grained with less pronounced laminations. Minor pyrite occurs throughout the whole sequence. The sandstone of the Mississagi Formation also occurs in the core of the Little White River Anticline, and is conformably overlain by the Bruce Formation, and where the Bruce Formation is absent, by the Espanola Formation. The base of the Mississagi Formation is not exposed at the location under discussion and varies considerably from the sandstones associated with the unconformity. The sandstone is a predominantly green, coarse-grained, immature feldspathic sandstone with fresh pink feldspar clasts. Bedding is hard to observe as beds tend to be massive ranging in thickness from 1 m to 3 m (3 to 10 feet). Steep cliffs pre-

TABLE 3 MODAL ANALYSES OF ROCKS OF THE MISSISSAGI, SERPENT, LORRAIN, AND BAR RIVER FORMATIONS.

Formation	Mississagi	Serpent		Lorrain	Bar River
Sample No.	S9-74-7	S9-74-14	S6-74-207	S6-74-233	G9-74-69
Quartz	65.4	42.7	54.8	73.1	100.0
Plagioclase	12.0	22.4	10.3	10.0[3]	—
Orthoclase	—		20.7		—
Microcline	5.0	18.4	—	—	—
Biotite	—	—	—	—	—
Muscovite	—	—	—	—	—
Chlorite	—	tr M	— M	tr	—
Sericite	— M	—	—	— M	—
Kaolinite	—	—	—	—	—
Carbonate	—	—	— M	—	—
Matrix	17.6	14.6	11.8	15.6	—
Chert	—	1.9	0.6	—	—
Rock Fragments	—	—	—	—	—
Heavy Minerals	tr[2]	tr	1.8	1.3	—
Clay	—	—	—	—	—
	Feldspathic sandstone (6a)	Arkose (9b)	Calcareous sandstone (9a)	Sandstone (11b)	Orthoquartzite (13a)

Sample Locations

S9-7 Southeast of Speckle Lake on Highway 546.
S9-14 East of Endikai Lake on Highway 546.
S6-207 East of East Twin Lake.
S6-233 Northeast of Grasett Lake.
G9-69 Northeast of Speckle Lake.

Note:
Rock components listed as percentages.
[1] M—component exists as part of matrix
[2] tr—trace (< 1%)
[3] —These are pseudomorphs after feldspar.
(6a) Rock code, see Map 2399, back pocket

vented close examination. The only structures observed were graded bedding and planar crossbeds having grading in individual foresets. Minor, discontinuous gritty lenses with small, well rounded white quartz pebbles can be seen in the lower sandstone sequences. The pebbles tend to be elongated parallel to bedding. Towards the top, the sandstone becomes finer grained and pinkish.

Thin section examination reveals that the sandstone is poorly sorted with angular to subangular grains in the basal parts and the grains become more rounded towards the top of the exposed sequence. Grains range from 1 to 5 mm with bimodal distribution in some beds. The matrix consists of 40 percent sericite that gives rise to the distinct green colour of some of the sandstone. Hematite staining along grain boundaries produces the pink colour in the other sandstone. Proximity of faults produces deformation of grains, granulation along grain boundaries, and replacement of feldspar grains by calcite. A modal analysis is given in Table 3.

The Mississagi sandstone is radioactive directly north of Highway 546 and the Little White River. Selected areas were walked over with a scintillometer. Sporadic readings above background were noted in places, but they were not very encouraging.

QUIRKE LAKE GROUP

The Quirke Lake Group consists of the Bruce, Espanola, and Serpent Formations. The sequence of conglomerate, siltstone, and sandstone of the Hough Lake Group which comprises the Ramsay Lake, Pecors, and Mississagi Formations, is repeated in the Quirke Lake Group.

Bruce Formation

The Bruce Formation, considered by Young and Chandler (1968) to be of possible glacial origin, is a massive, polymictic, matrix-supported conglomerate consisting of scattered coarse clasts of igneous rock in a muddy feldspathic sandstone matrix. On a regional scale, local interbeds of sandstone and siltstone, ripples, and crossbedding are the only structures found. "Drop stones" were observed in some areas (Card *et al.* 1972).

In the map-area, the Bruce Formation conformably overlies the Mississagi Formation in the Little White River Anticline and between Bridge and West Twin Lakes. North of Bridge Lake, a thin, east-trending wedge of Bruce Formation unconformably overlies the Early Precambrian Basement.

At the contact with the Mississagi Formation, the Bruce Formation consists of interbedded sandstone and conglomerate which is 1.5 m (5 feet) thickness. The Bruce Formation varies from 0 to 6 m (0 to 20 feet) in thickness in the Little White River Anticline to a thickness of 150 m (500 feet) at West Twin Lake. In places where the Mississagi Formation does not occur, the Bruce Formation is difficult to distinguish from the Gowganda Formation. The predominant rock type is a polymictic, matrix- to clast-supported conglomerate containing 10 to 25 percent predominantly white plutonic clasts in a pyrite-bearing greywacke to mudstone matrix. The clasts, ranging in size from 1 mm to 46 cm (18 inches), are angular to subrounded, and consist of 85 percent white granite, and 15 percent of the following: smokey quartz, metavolcanics, metasandstone, metasiltstone, chert, and occasional pink granitic rock.

North of Bridge Lake, and in the vicinity of West Twin Lake, interbeds of clast-supported conglomerate with 60 percent white to pink granitic clasts set in a sandy matrix are common. Prominant scour channels, ripple marks, and slump balls of sand are associated with these conglomerates. The clasts range from boulder to pebble size with an average size of 60 cm (24 inches). Towards the top of the formation, the conglomerate becomes stratified and interbedded with sandstone that in places is calcareous. The sandy interbeds range in thickness from 30 cm (1 foot) to 60 cm (2 feet) and in turn are interbedded with minor argillaceous interbeds.

No good stratigraphic subdivisions can be mapped in the Bruce Formation in the report area, although, facies changes were observed from place to place. A general sequence noted by the author and is from the base to the top:

1) A lower unit of massive polymictic, matrix-supported, conglomerate with interbedded sandstone of the Mississagi Formation.
2) A massive, unstratified, polymictic, matrix-supported conglomerate.
3) A local greywacke to protoquartzite with no clasts, overlain by a conglomerate with less than 10 percent granitic clasts.
4) Sandstone, calcareous to non-calcareous, and interbedded with clast-supported conglomerate.

Thin section examination indicates that the matrix of the conglomerates is fairly well sorted with subangular to subrounded grains of quartz, feldspar, chlorite, sericite, pyrite, and other opaque minerals. Plagioclase is the predominant feldspar. The clasts are subrounded consisting of volcanic, granitic, and sandstone fragments. A modal analysis of a representative conglomerate is given in Table 4.

Espanola Formation

The Espanola Formation consists of calcareous siltstone and sandstone, limestone, and dolomite. It is the only formation in the map-area that has a limestone member, and therefore is very useful as a marker horizon. Ripples, desiccation cracks, flame structures, ball and pillow structures, intraformational breccias, slump balls, and clastic dikes have been interpreted as indicative of deposition in an unstable, shallow water, possibly tidal mud flat environment (Card *et al.* 1972).

In the map-area, three stratigraphic units were observed in the Espanola Formation. From the base these units are; 1) laminated to massive limestone and dolomite; 2) laminated to massive siltstone; and 3) calcareous sandstone with siltstone interbeds.

These stratigraphic units are described below as follows:

Laminated to Massive Limestone and Dolomite

This unit consists of laminae of siltstone ranging from 1 mm to 15 cm (6 inches) in thickness. Deformation is accentuated in this member by the more competent siltstone layers that are stretched and boundinaged (Photo 3); some of the boudins are separated and rotated through distances of as much as 15 cm (6 inches). The deformation is not as evident in the less competent limestone which underwent plastic deformation rather than fracturing. Tight folding produces spectacular disharmonic isoclinal similar folds (Photo 4) that approach, in places, chevron-type folds. Tension cracks, some filled with flourite, occur in the

TABLE 4 | MODAL ANALYSES OF REPRESENTATIVE ROCKS OF TI

Formation	BRUCE			
Rock Description	Matrix supported Conglomerate (7a)	Arkose (10a)	Clast supported Conglomerate (10a)	Feldspathic greywacke (10i)
Sample No.	S9-74-121	G6-74-15	G6-74-25	G6-74-207
Quartz	32.8	30.8	26.0	59.8
Plagioclase Orthoclase	16.8	53.5	34.2	11.2
Microcline	tr	5.4	6.0	2.8
Biotite	—	—	—	—
Muscovite	—	—	—	—
Chlorite	— M[1]	— M	— M	—
Sericite	— M	—	— M	— M
Kaolinite	—	—	—	— M
Carbonate	—	—	tr	—
Matrix	46.6	8.5	13.4	25.0
Chert	tr[2]	—	—	1.2
Rock Fragments	20 v.[3] 1.8 g.[4]	—	13.4 g. 1.2c.[5] 4.6 v.	—
Heavy Minerals	tr M	1.8 M	1.2	—
Clay	—	—	—	—

S9-74-121	South of Little White River
G6-74-15	East of Highway 546, north of southern map boundary
G6-74-25	South of Little White River north of northern map boundary
G6-74-207	Cuesta west of Little White River north of southern map boundary
G6-74-208	Cuesta west of Little White River north of southern map boundary
G8-74-128	East of Big Lake
G8-74-130	East of Big Lake
S9-74-167	Southwest of Lillibet Lake
S9-74-169	Southwest of Lillibet Lake
S6-74-222	South of Skunk Lake

;UCE AND GOWGANDA FORMATIONS.

	GOWGANDA					
	Feldspathic sandstone (10i)	Arkose (10b)	Matrix supported Conglomerate (10b)	Arkose (10g)	Arkose (10f)	Clast supported Conglomerate (10a)
	G6-74-208	G8-74-128	G8-74-130	S9-74-167	S9-74-169	S6-74-222
	69.2	37.2	19.4	52.9	35.0	8.0
	13.6	40.8	27.6	29.0	61.0	7.8
	1.1	0.8	0.5	8.3	4.0	6.6
	—	—	—	—	—	—
	—	—	—	—	—	—
	—	— M	— M	—	—	— M
	— M	— M	—	—	— M	—
	—	—	—	—	—	—
	—	—	—	—	—	—
	12.8	21.2	45.8	9.8	tr	11.4
						20.2 g.
	1.5	—	—	—	—	12.6 fel.[6]
						23.4 maf.[7]
	—	—	6.0	—	—	6.4 sed.[8]
						3.6 cong.[9]
	1.8	tr	0.7 M	tr	tr	tr
	—	—	—	—	—	— M

Note: Rock components listed as percentages
[1] M—component exists as part of matrix
[2] tr—trace (< 1%)
[3] v—volcanic fragments
[4] g—granitoid fragments
[5] c—carbonate fragments
[6] fel—felsic fragments
[7] maf—mafic fragments
[8] sed—sedimentary (fine-grained) fragments
[9] cong—conglomeratic fragments

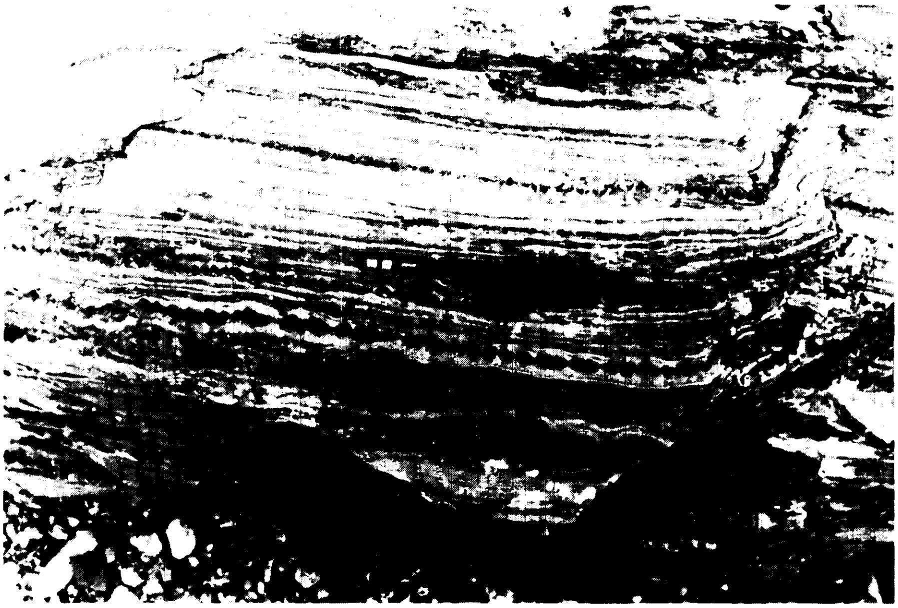

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Photo 3–Laminated limestone with boudinaged siltstone lenses of the Espanola Formation.

ODM9805

Photo 4–Isoclinal folding in the limestone of the Espanola Formation.

more massive silty lenses. South of Little White River, balls of silt with quartz and calcite centres from 15 cm (6 inches) to 60 cm (2 feet) in diameter occur in one horizon. These might be boundinaged silt layers.

In the Narrow Lake area, the limestone overlies a basal conglomerate, which is possibly the Bruce Formation. The contact of the Espanola Formation with the granitic rocks was not observed, although two small outliers occur north of the Twin Lakes. One peculiar outcrop, near the unconformity north of East Twin Lake, is highly metamorphosed containing concentrations of euhedral garnet crystals, the crystals are about 7 mm across, and occur in clay-rich layers about 2 cm (0.8 inch) thick. The clay-rich layers are interbedded with black 5 mm thick silt lenses and a few 2 cm (0.8 inch) thick, rippled sandy silt layers. This sequence is on the average 15 cm (6 inches) thick and repeats itself vertically about twenty times throughout the outcrop studied.

The limestone, where it occurs near faults, is usually recrystallized to a coarse-grained crystalline calcite-bearing rock, as for example south of Castra Lake. At the western end of East Caribou Lake, a small isolated outcrop of deformed and recrystallized limestone occurs between the Lorrain Formation and a conglomerate which is either part of the Bruce or Gowganda Formations. This limestone is probably part of the Espanola Formation, but because it is bounded on both sides by faults of the Flack Lake Fault System, no definite correlation can be made.

Laminated to Massive Siltstone

This unit is in sharp contact with the underlying limestone. The base of this member consists of finely, almost rhythmically, laminated lenses of black to dark green silt which average 0.5 cm in thickness and brown silty clay lenses about 1 cm thick. Sedimentary cycles 60 cm (2 feet) thick are apparent as sand increases in amount towards the top: the rocks consist of finely laminated 30 cm (1 foot) thick silty beds interbedded with more sandy beds about 30 to 46 cm (12 to 18 inches) thick. Ripples and flame structures are well preserved in these silt-sand cycles. Orange to pale brown chert is common in this unit of the Espanola Formation, and occurs as interbeds about 2.5 cm (1 inch) to 8 cm (3 inches) thick or as broken up fragments. Locally derived intraformational breccias are composed of very angular chert fragments from 1 mm to 5 cm (2 inches) across. Slump units with ball and pillow structures are associated with these breccias.

Deformation in the form of tight folds produced another type of breccia observed north of Le Scarbo Lake and East Twin Lake. The siltstone unit is competent, and where folding and squeezing took place, the rock has shattered producing blocks of laminated siltstone rafted at random oreintations. Overturned isoclinal folds are commonly associated with the margins of these breccia zones.

Calcareous to Non-Calcareous Sandstone with Siltstone Interbeds

This unit occurs only east of East Twin Lake. A gradational contact with the underlying siltstone member occurs, grading from a siltstone with minor sandstone interbeds to a sandstone with minor siltstone interbeds. The sandstone beds that are about 90 cm (3 feet) thick are either calcareous with rusty weathering spots, which are probably concentrations of calcareous material, or are non-calcareous sandstone, very fine grained, dark grey to pink sandstone with specks of pyrite. The siltstone interbeds, varying in thickness from 60 cm (2 feet) to 90 cm (3 feet) show well preserved structures such as climbing and starved ripples (Pettijohn and Potter 1964), flame structures, and minor desiccation cracks. The rippled beds are commonly cut off by a bed containing parallel laminations. Graded bedding occurs in the more sandy beds, with coarse-grained sand at the base to fine-grained sand at the top, and is present throughout.

Petrography

Thin section examination showed that the limestone grains ranging in size from 1.5 to 5 mm, are recrystallized in places. Inclusions of quartz grains surrounded by calcite are common. Limestone bands, 2 cm thick, show flow laminations alternating with siltstone bands, 1 cm thick, and are fractured along slip planes. The fractures and tension cracks are filled with calcite. The silty bands consist of quartz, feldspar, clay-size fraction, and opaque minerals with pyrite predominant. The grain size varies from 0.1 mm to 1 mm.

The contact between a calcareous sandstone bed and the overlying siltstone bed is revealed to be gradational in thin section, although it appears sharp in hand specimen. The calcareous sandstone is poorly sorted containing subangular grains of quartz and feldspar 0.5 mm to 1 mm in size set in a calcareous matrix of calcite and muscovite. The siltstone bed, poorly sorted, contains subangular to subrounded fragments ranging in size from 0.3 mm to 1.5 mm composed of metavolcanics and granitic rocks, quartz, feldspar, and chert set in a fine-grained matrix of sericite, chlorite, calcite, and opaque minerals. The bigger grains tend to be more rounded. Feldspars, with plagioclase predominating over potassic feldspar, show different degrees of alteration.

The intraformational breccia consists of 5 to 10 percent cherty fragments, "rip-up" clasts, and lenses of silt in a carbonate matrix showing grading and ripple marks. The bigger clasts, averaging 1 cm in size, are rounded as compared to the smaller, more angular clasts (0.1 mm to 1 mm in size). Pyrite and other opaque minerals are associated for the most part with the coarser fraction of each bed.

The peculiar outcrop, near the unconformity north of East Twin Lake, consists of bands of euhedral, 3 mm diameter, porphyroblasts of garnet, possibly grossularite, set in a matrix of quartz, chlorite, plagioclase, and minor calcite and opaque minerals about 0.5 mm in size. The porphyroblastic band is topped by a fine-grained finely laminated greywacke layer 5 mm to 10 mm thick, the laminations of which in turn are cut off at the top at a 40° angle by another porphyroblastic band.

The upper unit in the Espanola Formation consists of fairly well sorted, fine-grained (0.4 to 0.7 mm) feldspathic sandstone in a patchy carbonate, sericite, chlorite matrix. Plagioclase predominates over potassic feldspar. Modal analyses of selected thin sections are given in Table 5.

TABLE 5 MODAL ANALYSES OF REPRESENTATIVE ROCKS OF THE GORDON LAKE AND ESPANOLA FORMATIONS.

Formation	GORDON LAKE			ESPANOLA		
	Feldspathic sandstone (12a)	Cherty siltstone (12b)	Siltstone (12a)	Calcareous Siltstone (8a)	Contact between limestone & siltstone (8a,b)	Siltstone (8b)
Sample No.	G9-74-36	S9-74-49	S9-74-182	G6-74-182	S9-74-124	S9-74-120
Quartz	81.9	8.1 M	29.8	31.0	44.7	43.8
Plagioclase Orthoclase	16.4	tr	17.6	4.5	23.9	24.2 —
Microcline	—	—	tr	2.1	3.5	3.5
Biotite	—	—	—	—	—	—
Muscovite	—	—	—	—	—	—
Chlorite	— M[1]	—	—	—	—	18.9 M
Sericite	— M	— M	— M	—	— M	—
Kaolinite	—	—	—	—	—	—
Carbonate	—	—	—	— M	15.2	—
Matrix	1.7	19.0	52.2	62.4	12.7	6.8
Chert	—	70.3	—	tr M	— M	tr
Rock Fragments	—	—	—	—	—	2.8
Heavy Minerals	tr[2]	2.6	0.4	tr	tr	tr
Clay	—	—	— M	— M	—	—

G9-74-36 West of Endikai Lake
S9-74-49 East of Endikai Lake
S9-74-182 Northeast of Regal Lake
G6-74-182 Espanola outlier north of West Twin Lake
S9-74-124 West of Scarbo Lake
S9-74-120 South of Bailey Bridge on Little White River

Note:
Rock components listed as percentages.
[1] M—component exists as part of matrix
[2] tr—trace ($< 1\%$)

Serpent Formation

The Serpent Formation, an uniform wedge of coarse, immature, feldspathic sandstone, is characterized by abundant crossbedding and parallel laminations. Like the Mississagi Formation, a fluviatile or fluvial-deltaic depositional environment has been proposed by many workers (Card *et al.* 1972). An erosional disconformity has been proposed to exist at the base of this formation, because the Serpent Formation is missing in many areas (Frarey In Press; see Map 2399, back pocket) and the Lower Gowganda Formation rests directly on the Espanola Formation.

The four occurrences of the Serpent Formation in the map-area differ considerably from one another. The author is confident that sandstone east of East Twin Lake belongs to the Serpent Formation. However, the three occurrences in the vicinity of Le Scarbo Lake were placed, with a certain amount of reservation, in the Serpent Formation on the basis of their proximity to the Espanola Formation.

At East Twin Lake, the Serpent Formation is in gradational contact with calcareous sandstone beds with silty interbeds of the underlying Espanola Formation. The rocks in the Serpent Formation consist of fine- to coarse-grained laminated feldspathic sandstone, which is pink to greenish grey with brown-weathering calcareous spots, and contains small green siltstone clasts. The laminations, about 1 mm thick, are rather faint and hard to detect in the more massive beds. Minor pyrite is associated with the spotted sandstone. Minor siltstone interbeds 8 cm (3 inches) thick are sporadically present at intervals of 60 cm (2 feet) to 3 m (10 feet). A typical bedding sequence might be as follows: a basal non-calcareous "spotted" sandstone overlain by slightly calcareous unspotted sandstone with siltstone on top containing 1 mm thick laminations. Sedimentary structures are rare except from structures caused by slumping and minor crossbedding. Small-scale folding can be seen in the lower part of the formation.

The outcrop of the Serpent Formation on Highway 546 consists of a very massive siliceous sandstone, which weathers white-grey with a green tint on fresh surface. No structures were observed; the rock is very fine grained, massive, with prominent quartz grains and blocky white feldspar grains giving the rock the appearance of a quartz-feldspar porphyry rather than a sandstone. In thin section, the subrounded to angular grains appear to be strained and deformed with the larger grains 2.5 mm across occurring in a finer grained (1 mm to 1.5 mm) matrix. The porphyritic-looking grains are quartz, plagioclase, perthite, and plutonic rock fragment clasts.

East of Le Scarbo Lake, the Serpent Formation consists of a pink, medium-grained feldspathic sandstone with rusty brown pyrite-bearing spots, and is interbedded with fine-grained grey coloured dirty sandstone with parallel laminations. Minor siltstone interbeds are present.

At Le Scarbo Lake, the Serpent Formation is different again; it consists of fine-grained laminated grey sandstone with sparse white, well rounded and sorted granitic clasts ranging in size from 5 cm to 15 cm (2 inches to 6 inches) across. The pebble bands are 15 cm (6 inches) thick, and occur at base the of the lower beds.

The feldspathic sandstone from the East Twin Lake area is fairly well sorted with subangular to subrounded grains ranging from 0.3 mm to 1 mm. Spots of carbonate and iron staining are abundant in a chlorite and amphibole-rich matrix comprising 20 percent of the rock. Chlorite tends to be concentrated into layers 1 mm apart producing the fine laminations observed in hand specimen. Modal analyses of selected rocks are given in Table 3.

COBALT GROUP

The Cobalt Group is the most extensive of all the groups in terms of aerial distribution, outcrop, and volume. The Cobalt Group has a maximum preserved thickness of about 3300 to 4000 m (11,000 to 13,000 feet) in the Cobalt and Elliot Lake-Sault Ste. Marie area, and about 5100 m (17,000 feet) in the Sudbury-Killarney area (Card *et al.* 1972). The group consists of four formations: the Gowganda, Lorrain, Gordon Lake, and Bar River Formations. The lowest, the Gowganda Formation, in the more northern regions, unconformably overlies older Huronian Formations, suggesting a period of uplift and erosion before the deposition of the Cobalt Group (Card *et al.* 1972).

Gowganda Formation

The Gowganda Formation is the basal formation of the Cobalt Group, the thickest and most widespread of the Huronian groups. The Gowganda Formation, 200 to 2700 m (700 to 9,000 feet) thick, is a heterogeneous assemblage of paraconglomerate, orthoconglomerate, greywacke, feldspathic sandstone, and laminated argillite exposed from Sault Ste. Marie to the Cobalt-Gowganda area (Frarey In Press; Card *et al.* 1972). In the south, and in some northern regions, the Gowganda Formation conformably overlies the older Huronian rocks. In the most northerly occurrences, the formation lies directly on the Early Precambrian Basement. In most areas, the formation can be subdivided into a lower polymictic cobble to boulder conglomerate, and an upper, well-stratified sequence of non-conglomeratic laminated argillite and sandstone (Frarey In Press; Thomson 1957; Wood 1973).

In the map-area, the Gowganda Formation was mapped on the basis of lithology, but one of the characteristics of the formation is rapid facies changes; thus lithology can differ from outcrop to outcrop. No definite correlation of sequences is possible at the time of writing because of the following: many of these facies changes occur over short distances; the dip of the strata is low; the deformation; and the author was unable to visit all the areas. General sequences are present, and were noted when observed, and need close detailed mapping for correlation purposes.

The Gowganda Formation is partly exposed in the Quirke Syncline in the southeastern part of the map-area, and in the Waterhole Lake area in central Varley Township. North of Little White River Lodge on Highway 546, a cliff face exposes a fault contact between the Gowganda and Espanola Formations. Beneath the fault, the underlying siltstone of the Espanola Formation is highly contorted, brecciated in places, and truncated by a massive polymictic clast-supported conglomeratic cap of the Gowganda Formation. South of Narrow Lake, and at Bridge Lake, the contact with either the Serpent Formation or the Espanola Formation, is unconformable, and prominent scouring can be observed. Around Bridge Lake, the clast-supported conglomerate has scoured into the Espanola siltstone, and could be part of the upper Serpent Formation, or just a local variation in the lithology of the Gowganda Formation. Because of numerous faults in this area, difficulty arises in distinguishing the conglomeratic rocks

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Photo 5–Prominent ridges formed by the weather-resistant caps of the clast-supported conglomerate of the Gowganda Formation.

of the Bruce, Gowganda, and the conglomeratic parts of the Serpent Formations.

Lower Gowganda Formation

The base of the Gowganda Formation consists of massive clast-supported to matrix-supported polymictic conglomerate in a predominantly sandy matrix. The conglomerate scouring into the underlying siltstone and sandstone of the Espanola Formation, is weather resistant, and forms prominent ridges that can be seen from afar, especially between Waterhole and Endikai Lakes (Photo 5). The lithology of the rocks changes from outcrop to outcrop, but the overall general sequences can be recognized, although not correlated over any distances. Detailed work is needed for any type of correlation. The clast-supported conglomerate, upward from the basal contact, grades into a pebbly mudstone which commonly is interbedded with beds of sandstone or argillite.

Conglomeratic Rocks

The clast-supported polymictic conglomerate is a massive unit ranging in thickness from a maximum of 4.5 m (15 feet) at the base, to lenses approxi-

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Photo 6–Polymictic clast-supported conglomerate of the Gowganda Formation showing a prominent scour surface at the base in contact with the siltstone of the Espanola Formation. Note: reverse grading in the conglomerate.

mately 30 cm (1 foot) thick interbedded with coarse-grained arkose beds averaging 60 cm (2 feet) in thickness. The conglomerate consists of 50 to 70 percent clasts with about 70 percent of the total clast content consisting of pink to red, and in some areas, white granitic rocks; 10 percent quartz; and up to 20 percent metavolcanic, metasedimentary, and gneissic rocks; sandstone; and argillite. The clasts range in size from pebble to boulder, 1 to 26 cm (0.4 to 10 inches). The largest boulder of pink granite seen was 1.8 m (6 feet) in diameter. In the thinner conglomeratic lenses the clasts on the average are fairly well sorted with the degree of roundness ranging from rounded to angular. The matrix in these lenses is predominantly arkosic, and well sorted. In the thicker conglomeratic units, the matrix is poorly sorted with angular grains and clasts reflecting the same features as in the thinner conglomeratic lenses. Scour and fill channels are abundant.

At Bridge Lake, a clast-supported polymictic conglomerate differs markedly from other conglomerates, because it contains 60 percent white granitic cobbles instead of pink cobbles set in a gritty matrix of quartz and feldspar. The clasts, averaging 15 cm (6 inches) in diameter, are well rounded with a few boulders up to 2.4 m (8 feet) in diameter. The conglomerate also shows indistinct reversed grading, and is interbedded with sandstone and argillite (Photo 6).

Conglomeratic sandstone and mudstone are interbedded with coarse-grained arkose occurring between the massive clast-supported conglomeratic units. These conglomeratic sandstone rocks are usually lenticular, about 30 cm to 90 cm (12 to 36 inches) thick consisting of clast-supported conglomeratic facies to matrix-supported facies with 5 percent clasts or less; 80 percent of the clasts consist of granite and quartz, in coarse to medium-grained laminated grit. The clasts are well rounded, well sorted, and approximately 10 cm (4 inches) in diameter. The matrix is a grit ranging from 2 to 10 mm in size with medium sorting and rounded to subrounded grains.

Selected thin sections indicate that the matrix of the clast-supported conglomerate is an arkose with about 40 percent feldspar, the amount of plagioclase present exceeds that of potassic feldspar. The grains are angular to subangular in a poorly to fairly well-sorted matrix of fine-grained clay, sericite, chlorite, and opaque minerals. The clasts are predominantly granitic with minor mafic and felsic metavolcanic, diabasic, sedimentary rocks, chert, and quartz fragments. The interbedded feldspathic sandstone is poorly sorted with angular grains in the 2 mm grain size. The 5 percent matrix consists mostly of very fine clay. Selected modal analyses are given in Table 4.

The matrix-supported conglomerate occurs as distinct units and always occurs interbedded with sandstone, greywacke, and lenses of clast-supported conglomerate. Cycles of different combinations of these lithologies were observed in the field. Conglomeratic beds are fairly massive up to 1.5 m (5 feet) thick, and are interbedded with sandstone beds about 30 cm (1 foot) thick which are lensoid locally. Small sand lenses, 2 cm by 6 cm (0.8 to 2 inches), consisting of pink feldspathic sandstone, are common in the more massive conglomeratic lenses.

The clast content can range anywhere from 1 percent to 30 percent. Granitic clasts predominate with lesser amounts of metavolcanics, metadiabasic rocks, siltstone, and quartz clasts with a few jasper and iron formation pebbles. The clasts are rounded to subrounded, are poorly sorted ranging from 0.5 cm (0.2 inch) to 1.2 m (4 feet) in diameter with a few boulders 1.5 m by 4.6 m (5 feet by 15 feet) in size.

The matrix is massive to laminated mudstone, and is poorly sorted with subangular grains of feldspar and quartz. Slumped sandy lenses are not uncommon. Scour channels are present at the base of the more massive beds containing fragments of the underlying rock into which the conglomerate has scoured. Locally, calcareous siltstone is interbedded with the conglomerate.

Non-Conglomeratic Rocks

The non-conglomeratic rocks of the Lower Gowganda Formation consist of sandstone, siltstone, and mudstone, and occur predominantly as interbeds in the conglomeratic rocks. In a few places these rocks form units thick enough to be mappable, but they are not traceable over any significant horizontal distances. The sandstone also occurs interbedded with the siltstone. Sandstone is massive to laminated, predominantly feldspathic to arkosic, medium to fine grained, and ranges in colour from pink to grey. Sand waves, ripple marks, graded beds, and planar to festoon crossbedding are some of the structures observed. Bedding av erages 30 cm (1 foot) with siltstone interbeds about 6 mm thick. Greywacke is usually laminated with small-scale ripples and ripple cross-laminations. Slumped units from 0.6 m to 3 m (2 to 10 feet) thick, are repeated several times throughout the whole sequence, and consist of balls and pillows of fine-grained pink sand in a matrix of fine-grained mudstone to greywacke.

Examination of thin sections reveals that the greywacke ranges in composition from being arkosic to having less than 5 percent feldspar. The rock is poorly sorted, fine grained, and is very rich in chlorite and opaque minerals. Grains are subangular to subrounded, and plagioclase predominates over potassic feldspar. Local spots of carbonate replacement are common. Selected modal analyses are given in Table 4.

Sequences

A number of depositional sequences were repeatedly observed in the lower Gowganda Formation. Although the author was unable to correlate these over any significant distances, a general pattern is typical to most of them. Three of the most typical sequences are reported here. Sequence (1) and sequence (2) are very similar, although the order of lithologies is different. Sequence (2) occurs higher in the Lower Gowganda Formation than sequence (1). Sequence (3) occurring towards the top of the Lower Gowganda Formation, was observed on a cliff face located southeast of Long Lake, and it was possible to make some rough thickness estimates.

Sequence (1) from top to base is as follows:

Massive mudstone.

Clast-supported conglomerate interbedded with pink feldspathic to arkosic sandstone.

Interbedded matrix-supported conglomerate with greywacke.

Interbedded arkose with clast-supported conglomerate and matrix-supported conglomerate

Massive matrix-supported conglomerate

Interbedded clast-supported conglomerate with arkose and matrix-supported conglomerate, well stratified with ripple marks in the arkosic beds.

Matrix-supported conglomerate in mudstone matrix.

Coarsening upward sequence of 30 cm (12 inches) thick beds of laminated at the top argillite grading into more massive greywacke beds.

Sequence (2), from top to base is as follows:

Coarse-grained graded and laminated arkose.

Clast-supported conglomerate in arkosic matrix with arkosic lenses.

Interbedded fine- to medium-grained massive, matrix-supported conglomerate with greywacke.

Slump bed of sandstone in siltstone matrix.

Interbedded matrix-supported conglomerate with greywacke.

Sequence (3), from top to base is as follows:

Clast-supported to matrix-supported conglomeratic cap with crude stratification, lenses of sandstone, and well-defined scour and fill channels at base.

Pink feldspathic sandstone interbedded with minor siltstone.
Pink feldspathic sandstone beds 60 cm (24 inches) thick, with 90 cm (35 inches) thick finely laminated siltstone units.
Massive sandstone beds 60 cm (24 inches) thick with load casts, small-scale sand waves, and ripple marks interbedded with minor siltstone beds containing a few granitic clasts.
Pink feldspathic sandstone beds 30 cm (12 inches) thick interbedded with 30 cm (12 inches) thick beds of laminated siltstone.
Sandstone beds 30 cm (12 inches) thick ranging up to a maximum thickness of 90 cm (35 inches) interbedded with 15 cm (6 inches) thick finely laminated siltstone. Minor granitic clasts 1 mm in size are present in a few places in the siltstone.
Laminated siltstone with a few small clasts and sandy lenses towards the top.
Sandstone interbeds up to 30 cm (12 inches) thick with 1.7 cm (0.7 inch) silty partings in the laminated sandstone.
Finely laminated (1 mm apart) siltstone with a few clasts and sandy lens around 1 cm (0.4 inch) thick.

Upper Gowganda Formation

The Upper Gowganda Formation in the Endikai Lake area differs slightly from the Gowganda Formation described in the Wakomata Lake area (Siemiatkowska 1977). In the Quirke Syncline part of this map-area, only part of the Upper Gowganda Formation is exposed, and in the Wakomata Lake Syncline area, only the top transition zone is exposed. Therefore, it is not possible to study the whole sequence.

In the Quirke Syncline, northeast of Big Lake, the Upper Gowganda Formation consists of the following units: (1) a slump unit, 2) interbedded pink feldspathic sandstone and siltstone unit; 3) medium- to coarse-grained pink to red arkose unit; and 4) a laminated purple siltstone unit.

The slump unit consists of laminated siltstone interbedded with sandstone lenses which in places occur as slump ball and pillow structures (Photo 7). Ripple marks and climbing ripples can be found near the top of the sandstone beds. Brown weathering pyrite and carbonate spots are very common throughout the sandstone, and the overlying feldspathic sandstone is well spotted.

The feldspathic sandstone is very fine grained, grey- to pink-weathered with parallel laminations. Beds in the order of 90 cm (36 inches) thick contain 22 cm (9 inches) thick interbeds of siltstone.

The coarse-grained red arkose has hematite-rich, 1.2 m (4 feet) thick, well-graded beds with festoon crossbedding and sand waves. Fragments of green silt are scattered throughout the beds.

A sharp contact occurs between the arkose and the purple siltstone. The laminated purple siltstone closely resembles the purple siltstone from the Wakomata Lake area (Siemiatkowska 1977) and other areas (Frarey In Press). The siltstone is laminated with purple hematite-rich layers 2.5 cm thick alternating with green to grey non-hematitic layers 2.5 cm thick. Ripple marks are the pre-

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Photo 7–Slump unit of the Gowganda Formation showing ball and pillow structure of sandstone in a siltstone matrix.

dominant structure. Towards the top of the unit with more admixture of fine sand material, 15 cm (6 inches) thick lenses of sandstone appear in the siltstone. The siltstone becomes more massive and loses its laminated appearance.

Arkose, in thin section, is revealed to have fair to good sorting with subangular to rounded grains set in a matrix of rock flour and sericite. Plagioclase, predominating over potassic feldspar can be either fresh or altered, and is more rounded than quartz which shows well-developed secondary overgrowths and pressure solution features along grain boundaries. Hematite is present either as a coating along grain boundaries, or in spots as detrital concentrations. Good grading can be observed in thin sections. Modal analyses are given in Table 4.

In the Wakomata Lake Syncline area in the south-central part of the map area west of Little White River, a prominent cuesta can be seen from afar along Highway 546. This cuesta is about 90 m (300 feet) high, and consists of pink feldspathic sandstone. This sandstone forms the transition zone between the Gowganda and Lorrain Formations. In the Wakomata Lake area, this sandstone unit is a minor feature, and less than 30 m (100 feet) thick. The sandstone is pink, greenish pink, dark red, and purple near the top, and fine to medium grained. Beds are between 1.2 and 1.8 m (3.9 to 5.9 feet) thick and contain 7.6 to 30 cm (3 to 12 inches) thick green, gritty siltstone interbeds rich in muscovite. The sandstone contains 10 to 15 percent pale to pink feldspar and is poorly sorted. Ripple marks, sand waves, festoon and planar crossbedding, grading and hematite-rich laminations, are some of the structures observed. Near the top, the sandstone becomes coarser grained, darker in colour, and the abundance of hematite laminations increase.

Thin section examination reveals that the sandstone of the transition zone contains approximately 15 percent feldspar with equal proportions of plagioclase and potassic feldspar in a matrix (10 to 25 percent) of sericite, muscovite, and kaolinite. Sorting is poor to fair, and grains are subrounded to subangular with hematite staining along grain boundaries.

Other Occurrences

Isolated outcrops of Gowganda-type rocks occur throughout the map-area. These occurrences are usually in fault-bounded blocks, and the interpretation that they belong to the Gowganda Formation is an assumption made by the author.

One sheared outcrop of a clast-supported polymictic conglomerate occurs in a fault zone of the Flack Lake Fault System just east of East Caribou Lake. The conglomerate consists of 60 to 70 percent pink rounded pebbles and cobbles in a sheared greywacke matrix. East of Narvik Lake, an outcrop of laminated siltstone to greywacke with a few granitic clasts occurs in a fault zone of the Flack Lake Fault System. On the north shore of Wilson Lake, several outcrops of laminated siltstone and fine-grained pink sandstone also occur in the fault zone of the Flack Lake Fault System, and are in contact with a Nipissing Diabase body. The rocks are brecciated, and highly sheared. All the above mentioned occurrences are more or less classified on the basis of their stratigraphic position.

Lorrain Formation

The Lorrain Formation, a 1500 to 2400 m (5,000 to 8,000 feet) thick sandstone unit, is widely exposed throughout the eastern part of the Southern Province on the North Shore of Lake Huron and in the Cobalt-Gowganda area (Card *et al.* 1972). Although the formation displays some lithological variations from one area to another, the general stratigraphic subdivision proposed by Young (1973) is generally applicable throughout the region. This comprises a lower unit of varicoloured feldspathic and sericitic planar and crossbedded argillite, siltstone, and sandstone; a middle unit of quartz and jasper granule and pebble conglomerate; and an upper unit of pure orthoquartzite with subordinate quartz pebble conglomerate. The boundary with the underlying Gowganda Formation is conformable in all areas (Young 1973).

During the mapping project, a definite contact between the Gowganda and Lorrain Formations could not be established as proposed by previous workers in other areas (Frarey In Press; Hadley 1968; Young 1973; and Wood 1975). The thin argillite unit, found in the Whitefish Falls area and used by Card (1976) and Chandler (1969) as the contact between the Gowganda and Lorrain Formations, is missing from the map-area. Instead, a complete gradation exists from siltstone upward through interbedded siltstone and sandstone to feldspathic sandstone of the Gowganda Formation and arkosic sandstone of the Lorrain Formation over a stratigraphic interval some 150 m (500 feet) thick. In the Wakomata Lake area to the west, the arkosic basal member of the Lorrain Formation is very thin and insignificant. In this map-area, the arkose is much thicker, and is as much as 30 m (100 feet) thick. The placing of the contact on the basis of the disappearance of feldspar as has been done by other workers in other areas in this map-area cannot be justified. Other criteria easily recognizable in the field, were looked for, and on the accompanying map (Map 2399, back pocket), the contact was drawn arbitrarily on the following observations: 1) increase in grain size; 2) green colour of the sandstone caused by increase of sericite in the matrix; and 3) change in colour of feldspar grains from pale pink in the finer grained feldspathic sandstone to a deep salmon pink colour in the coarse-grained arkose.

The Lorrain Formation can be subdivided into six conformable lithostratigraphic members on the basis of colour and pebble content. With some exceptions, these members are similar to those of other workers (Frarey In Press; Young 1973) in the region. The six members (see Map 2399, back pocket) are in ascending stratigraphic order:

(11a) *Basal Purple and Green Sandstone and Feldspathic Sandstone.*
(11b) *Pink Hematitic Pebbly Sandstone.*
(11c) *Quartz Jasper-Pebble Conglomerate (Puddingstone).*
(11d) *Fine-Grained Hematitic Sandstone.*
(11e) *Pink to Buff Pebbly Sandstone.*
(11f) *White Orthoquartzite.* Frarey (In Press) combined members (11a) and (11b), and members (11d) and (11e). In this study, Member 11d was established because it is distinct, it is fine grained, contains no pebbles, and shows the development of liesegang rings. This member was used as a marker horizon. Except for the description of Member 11a, the following descriptions are taken from the Wakomata Lake Area (Siemiatkowska 1977) report where detailed sections were measured. The reader is referred to this report for detailed modal and grain size analyses.

Member 11a: Basal Purple and Green Sandstone and Feldspathic Sandstone

This lowermost member of the Lorrain Formation consists of medium- to coarse-grained, green, pink to red, and purple arkose. Sorting is poor. Beds ranging in thickness from 30 cm (12 inches) at the base to 1.3 m (4 feet) near the top are graded, and almost pebbly in places. Planar crossbedding with graded foresets are abundant, as well as lenticular gritty siltstone interbeds up to 10 cm (4 inches) thick. At the base, the colour of the beds is usually related to the grain size; the coarse fraction is predominantly green, whereas the finer fraction is pink. Towards the top, the arkose becomes red to purple loosing the green colour. A general coarsening sequence occurs with the appearance of conglomeratic layers 15 cm (6 inches) thick consisting of 90 percent white quartz pebbles, 1 percent jasper and chert, and 5 to 10 percent feldspar clasts. Black laminations of detrital hematite make their first appearance in this member and persist throughout most of the Lorrain Formation. Floating pebbles ranging from 0.5 cm to 5 cm (0.2 inch to 2 inches) are scattered throughout the beds. Towards the

TABLE 6 ABUNDANCE OF FELDSPAR, SERICITE, AND KAOLINITE IN SANDSTONE OF THE LORRAIN FORMATION AS DETERMINED BY X-RAY DIFFRACTION ANALYSES.

SAMPLE NUMBER	FELDSPAR	SERICITE	KAOLINITE
S9-74-72	B	D	—
S6-74-227	ND	D	—
S6-74-228	C	D	ND
S6-74-229	ND	D	—
S6-74-230	ND	C	—
S6-74-231	ND	C	—
S6-74-234	ND	C	ND
S6-74-235	ND	D	D?
S6-74-236	C	D	ND
S6-74-237	ND	D	ND
S6-74-238	D	D	ND
S6-74-239	D	D	ND
S6-74-240	ND	C	C
S6-74-241	C	D	D
S6-74-242	C	C	C
S6-74-243	D	C	C
S6-74-244	D	B	C

Notes:
B — peak about ½ chart length
C — peak small, but distinct
D — peak barely discernible
ND — peak not detected

top, the arkose becomes better sorted, and the feldspar clasts about 1 cm (0.4 inch) in diameter become progressively more altered. The feldspars are still concentrated in the coarse-grained fraction of each bed. Near the contact with Member 11b, the beds alternate in their content of fresh versus altered feldspar or no feldspar at all (Table 6). Related to the disappearance of feldspar, is an increase in the detrital hematite content occurs. The disappearance of feldspar also coincides with the appearance of good pebble layers in the sandstone.

Member (11b): Pink Hematitic Pebbly Sandstone

This member consists off a medium- to coarse-grained pebbly sandstone which varies in colour from pink through shades of orange, pink to greyish white at the top. Bedding ranges in thickness from 61 cm to 122 cm (24 inches to 48 inches), with some beds near the top reaching 1.8 m (6.0 feet) in thickness. Some beds are graded; others show prominent trough and planar crossbedding. Ripple laminations, some of which are accentuated by detrital hematite concentrations, convolute laminations, and scour channels are present throughout this member.

Crossbeds are about 14 cm (5 inches) thick, and are best developed in the upper part of the member. Interbeds of medium- to fine-grained greenish to red, gritty, muscovitic sandstone are present in the lower half of the member. The thickness of these interbeds ranges from 15.2 cm to 30.5 cm (5.9 to 11.9 inches) and exhibit a sugary texture that reflects their relatively good sorting.

In the middle and upper parts of the member, pebbles occur about every vertical 30 cm (12 inches). Floating pebbles occurring in the sandstone are isolated from pebble layers. Pebbles in the layers are subrounded to subangular, and range from 0.5 cm to 6 cm (0.2 to 2 inches) in size, and average about 3 cm (1.2 inches). The pebbles of these layers consist of 90 percent white quartz, and up to 10 percent jasper, and minor pebbles of iron formation, black chert, sandstone, and argillite. The jasper pebble content increases from 1 percent at the bottom of the member to 10 percent at the top, averaging generally 5 percent. Chert pebbles are more rounded than quartz pebbles.

Member (11c): Quartz-Jasper Pebble Conglomerate (Puddingstone)

This member which contains abundant quartz-jasper pebble conglomerate is probably best known for its ornamental beauty, and has the local name of "Puddingstone".

The contact zone between Member 11b and Member 11c is gradational, and consists of interbedded sandstone and conglomerate, and is over 15 to 30 m (50 to 100 feet) in true thickness. The lower contact of Member 11c was arbitrarily placed at the base of the appearance of the first white sandstone bed. The sandstone of Member (11c) is predominantly white, but ranges from greenish pink to white to slightly pink. Sandstones of the lower 25 m (80 feet) are commonly pinkish white, those of the central part are greenish white to white, and those of the upper part are slightly pink. The unit is notably conglomeratic, although in the lower part of the member, the pebble content is rather low. The main conglomerate, about 17 m (56 feet thick), occurs in the upper half of the member. Pebbles in the lower part of the member, are arranged in isolated pebble layers from 1.3 cm to 2.5 cm (0.5 inch to 1 inch) thick. In the conglomeratic part the pebble layers range in thickness from 8.6 cm up to 0.9 m (3.4 inches to 2.9 feet). These layers consist of poorly sorted angular to subrounded pebbles range from 1.3 cm to 6.35 cm (0.5 to 2.5 inches) and average approximately 2.5 cm (1 inch) in maximum dimension. Where distinct, conglomeratic layers are absent, the pebbles either form a paraconglomerate comprising up to 5 to 10 percent of the bed, or if these pebbles make up 1 percent to 2 percent of the sandstone bed, they are considered to be "floating". Most of the pebbles are quartz, the jasper pebble content ranges from 1 percent to 10 percent. The conglomeratic layers though, contain from 10 percent to 40 percent angular to rounded jasper pebbles, 5 percent to 10 percent subrounded iron formation pebbles, 10 percent to 15 percent subrounded black and pink chert pebbles, and subrounded white quartz pebbles with minor pebbles of smoky quartz, agate, pink sandstone, and argillite. Some beds display size grading with larger pebbles at the bottom to smaller pebbles at the top.

Bedding thickness ranges from 30 cm to 1.8 m (12 inches to 5.9 feet) and averages approximately 1.2 m (3.9 feet). Bedding is lenticular and discontinuous.

Green gritty sandstone partings up to 2.5 cm (1 inches) thick occur irregularly in the lower part of this member. Sedimentary structures include crossbedding at the bottom and the top of the unit as well as some ripple marks and scour and fill channels. Graded beds are present throughout the sequence. Matrix to pebble ratios vary from 80:20 at the lower part of the member, to about 30:70 in the middle conglomeratic part, and back to 80:20 at the top. In the upper 13.7 m (44.9 feet) of the member, the sandstone is again better sorted and finer grained. Discrete conglomerate layers are present. The best are wedge shaped, and display coarse parallel laminations and crossbedding.

Member (11d): Fine-Grained Hematitic Sandstone

This member is characterized by the paucity of pebbles and is useful as a marker horizon. It consists of sandstone variously coloured in shades of pink, red, orange, creamy buff, and white. The sandstone, very fine grained to medium grained with a maximum of 10 percent matrix, has a sugary texture with moderate to well-sorted grains. The pink beds contain more matrix, and are poorly sorted as compared to the white. Minor coarser interbeds about 0.9 to 1.5 m (2.9 to 4.9 feet) thick grade into finer grained sandstone. Beds tend to be wedge-shaped and discontinuous. Some interbeds in the lower part of the member contain 1 percent floating jasper and quartz pebbles. The top of the member may contain 15 cm (5.9 inches) pebble bands with each pebble 0.5 cm (0.2 inch) in diameter. The sandstone is mostly massive, but in some beds, structures such as trough crossbedding, ripple laminations accentuated by hematite concentrations, scour and fill channels, convolute laminations, and liesgang rings are present. Hematite is abundant, and is concentrated in the coarser layers, or in purple patches, or as coatings on quartz grains. A few 2.5 cm (1 inch) thick gritty sandstone interbeds are present.

Member (11e): Pink to Buff Pebbly Sandstone

This member is a similar to Member 11b except that it is coarser grained, and has a lower jasper pebble content. The contact between Member 11e and Member 11d was placed at the base of the reappearance of the first pebble layer.

The sandstone is pink, buff, grey, cream, and white at the top. The unit is relatively coarse grained, except at the bottom where it is interbedded with pebble-free hematite-rich crossbedded sandstones. The base of the member consists mainly of sandstone with floating quartz granules about 1 cm (0.4 inch) in diameter overlain by pebble-free, very hematite-rich, fine-grained crossbedded sandstone. Crossbeds are 30 to 90 cm (12 to 36 inches) thick, and both festoon and planar type are present. The rest of this member consists of sandstones, some of which have pebble layers, black hematitic laminations, and floating quartz and jasper pebbles.

Bedding thickness ranges from 0.6 m to 1.8 m (2 feet to 5.9 feet), and averages about 1.2 m (3.9 feet). Trough crossbedding with graded foresets, festoon and planar crossbedding, and ripple laminations are some of the sedimentary structures observed in the field. Gritty sandstone interbeds 2.3 cm to 5.1 cm (0.9 inch to 2 inches) thick are present. The pebble layers range in thickness from 3 cm (1 inch) thick in the middle and upper parts of the member. Most pebbly layers are lensoid and discontinuous. Floating quartz and jasper pebbles are present throughout the sequence where no discrete pebble layers are present.

Rounded to subrounded pebbles are concentrated in the coarse-grained fraction of the beds, or are associated with black hematite laminations.

The overall pebble content averages about 30 percent, and the pebbles consist mainly (90 percent) of white quartz with up to 5 percent pink chert, rose quartz, and minor jasper. Jasper pebbles are present in amounts of 1 percent to 5 percent, and locally up to 10 percent in some areas. The pebbles range from 2.5 cm to 12.7 cm (1 inch to 5 inches) and average about 7.6 cm (3 inches) in diameter. Floating pebbles are a minimum of 4 mm in diameter and average about 1 cm (0.4 inch). Jasper disappears towards the top and only white quartz pebbles remain.

Member (11f): White Orthoquartzite

The white orthoquartzite member, the uppermost member of the Lorrain Formation, can be distinguished from Member 11e by its white to creamy white and greenish white colour, and minor (less than 1 percent) jasper pebble content. Local hematite staining may give rise to minor pink colouration in some of the beds. Three distinct units were noted in this member, a lower conglomeratic submember, a middle pebble-free submember, and an upper conglomeratic submember.

The middle pebble-free submember is fine to medium grained with a sugary texture. In some areas, beds are sheared and slickensides can be observed on bedding-plane surfaces. A greasy, dull, talc-like mineral coats these surfaces. X-ray diffraction identified this mineral as a mixture of pyrophyllite, kaolinite, and muscovite (Mineral Research Branch, Division of Mines). The only sedimentary structure visible in the white beds is planar crossbedding.

The upper conglomeratic submember consists of coarse gritty bands 5 cm (2 inches) thick and pebble layers ranging in thickness from approximately 8 cm to 30 cm (3 to 12 inches). These conglomeratic layers consist predominantly of rounded white quartz pebbles with less than 1 percent jasper pebbles and up to 5 percent cherty quartz pebbles. Iron formation pebbles are rarely observed. The pebble layers are graded, lensoid, discontinuous, and consist of 50 to 60 percent pebbles which are well sorted and rounded, and have a bimodal distribution ranging in diameter from 1 cm to 4 cm (0.4 inch to 1.6 inches) and averaging about 1.5 cm (0.6 inch). Some pebbles have weathered out centres. Bedding thickness averages 1 m (3 feet) with a maximum thickness of 3 m (10 feet). Where pebbles are absent, good crossbedding (festoon and planar) is present, and minor scattered or floating pebbles persist throughout. These beds are rather poorly sorted. Grain distribution ranges from unimodal to bimodal to polymodal. At the top of the Lorrain Formation, the sandstone becomes finer grained almost cherty, well sorted, and pebble free.

Petrography

In thin section, the sandstones of the Lorrain Formation show a progression in textural maturity from the base to the top. Sandstones of the lower members have an open framework. Sorting and rounding of the grains become better as matrix decreases from a maximum 56 percent in the basal unit to 7 percent in the top member (Siemiatkowska 1977, p.31, and p.33). Grain size varies from member to member, and distribution patterns range from unimodal to bimodal, and to multimodal. The sandstones are composed mostly of quartz grains displaying prominent overgrowths, except in the top member. Smaller grains with no overgrowths are more angular than the larger grains. Hematite is present throughout the sequence, either as detrital grains in the matrix, or as coating on individual quartz grains, and give the sandstones their characteristic red to pink colour. The matrix consists mainly of sericite, kaolinite, and quartz. Chlorite occurs only in the lowest member where individual foresets in crossbeds are graded, the coarser fraction contains more matrix than the fine part. The finer grained part shows a higher degree of sorting and rounding. Chert pebbles and grains are partly altered to kaolinite. A modal analysis is given in Table 3.

Pyrophyllite and diaspore, identified by the X-ray diffraction method, first appear at the bottom of Member 11d and disappear at the bottom of Member 11f. These aluminous minerals occur in interstitial patches between the quartz grains. Diaspore occurs as porphyroblasts partly altered to pyrophyllite, and in places rims quartz grains. Pyrophyllite, a low greenschist facies mineral, is a reaction of diaspore and kaolinite with quartz, and forms lath-shaped patches interstitial to quartz grains. Pyrophyllite can be associated with diaspore, kaolinite, or can occur by itself. The diaspore and kaolinite are probably authigenic as will be discussed in a later chapter. Chandler (1969), Young (1973), and Wood (1970) give a detailed discussion of these minerals.

A cliff on the western shore of Burns Lake was sampled in detail from the base of Member 11c to the base of Member 11e. Fifty four chip samples, each sample representing one bed, were collected and subjected to examination by the X-ray diffraction method for pyrophyllite, kaolinite, sericite, and diaspore. The results are tabulated in Tables 6, 7, and 8. The diaspore is more abundant than shown in Table 7, because it occurs in numerous thin sections. However, it is not concentrated in sufficient proportions for detection by the X-ray diffraction method. No new evidence has been found to further explain the origin of the aluminous minerals (Siemiatkowska 1977, p.44).

In Member 11a, sorting is very poor, grains are subrounded, and the matrix forms 5 percent to 20 percent of the rock. Feldspar constitutes up to 15 percent of the rock, is plagioclase and microcline, and shows different degrees of alteration. Some of the larger grains are broken, others are partly altered to sericite and kaolinite, and some are still fresh looking. Plagioclase grains about 5 mm in size, are more readily altered, and break down to quartz and kaolinite and/or sericite. Where no fresh feldspars exist, and only pseudomorphs after feldspar are evident, the matrix increases up to 20 percent, and the rock becomes better sorted with rounded quartz grains.

In the Grasett Lake area, 16 beds containing feldspar or pseudomorphs after feldspar, were sampled in stratigraphic sequence. X-ray diffraction analyses (Table 6) show that there is considerable variation in the feldspar content from bed to bed. Examination of thin sections showed that the feldspars are almost completely altered, although in hand-specimen they still look quite fresh.

TABLE 7 ABUNDANCE OF DIASPORE, KAOLINITE, PYROPHYLLITE, AND SERICITE IN THE SANDSTONE OF THE LORRAIN FORMATION AS DETERMINED BY X-RAY DIFFRACTION ANALYSES.

SAMPLE NUMBER	PYROPHYLLITE	KAOLINITE	SERICITE	DIASPORE	SAMPLE NUMBER	PYROPHYLLITE	KAOLINITE	SERICITE	DIASPORE
SL-01	B	—	—	—	SL-28	AB	—	D	C
SL-02	A	D	D	—	SL-29	A	D	D	—
SL-04	AB	D	—	—	SL-30	BC	—	—	—
SL-05	A	D	D	—	SL-31	AB	—	—	C
SL-06	A	C	D	—	SL-32	AB	C	C	—
SL-07	C	C	—	—	SL-33	B	C	—	—
SL-08	C	C	D	—	SL-34	A+	D	D	—
SL-09	BC	C	—	—	SL-35	AB	—	C	—
SL-10	AB	—	D	C	SL-36	AB	—	D	—
SL-11	B	C	—	—	SL-37	B	D	D	—
SL-12	AB	C	—	—	SL-38	AB	C	D	C
SL-13	AB	C	C	—	SL-39	AB	—	—	—
SL-14	C	BC	—	—	SL-40	AB	—	D	—
SL-15	AB	AB	C	—	SL-41	A	—	D	—
SL-16	C	C	C	—	SL-42	A	—	—	—
SL-17	AB	—	C	—	SL-43	A+	—	—	—
SL-18	A	C	D	—	SL-44	A+	—	D	—
SL-19	B	C	D	—	SL-45	A	D	—	—
SL-20	AB	C	—	—	SL-46	A	—	—	—
SL-21	AB	—	C	—	SL-47	A	—	C	—
SL-22A	A	D	C	—	SL-48	A	—	—	—
SL-22B	A	D	C	—	SL-49	A	D	—	—
SL-23	A	D	C	—	SL-50	A	D	D	—
SL-24	AB	C	C	—	SL-51	A	C	C	—
SL-25	A+	D	D	—	SL-52	A	D	D	—
SL-26	BC	BC	—	—	SL-53	A+	C	—	—
SL-27	A	—	—	—	SL-54	AB	—	C	—

Notes:
A — peak is full chart height
B — peak is ½ chart height
C — peak is small but distinct
D — peak is barely discernible

Samples were collected from the cliff west of Burns Lake.

TABLE 8 QUANTITATIVE VALUES OF THE ALUMINA CONTENT OF SELECTED SAMPLES OF THE LORRAIN FORMATION AS A MEASURE OF THE ACCESSORY MINERAL CONTENT.

Sample No.	Al_2O_3 %	DIFFRACTOMETER -200 Mesh Fraction Pyrophyllite/Kaolinite/Diaspore/Sericite				Whole Sample -Pyrophyllite Peak Height-Chart Units
		Pyrophyllite	Kaolinite	Diaspore	Sericite	
SL-9	7.5	BC	C	—	—	15
SL-14	3	C	BC	—	—	10
SL-31	8.7	AB	—	C	—	25
SL-34	19.2	A^+	D	—	D	95
SL-35	7.9	A	—	—	C	35

Samples were collected west of Burns Lake.

Gordon Lake Formation

The Gordon Lake Formation conformably overlies the Lorrain Formation. The distribution of this formation is restricted in area, compared to the area covered by other Huronian formations. The Gordon Lake Formation ranges in thickness from 270 to 750 m (900 to 2,500 feet) (Card *et al.* 1972). Typically, it is a fine-bedded green, buff, purple siltstone, and minor sandstone with abundant structures such as intraformational breccias, graded bedding, crossbedding, ripples, flame structures, and desiccation cracks. Wood (1975) reported the presence of chert, gypsum, anhydrite, and ferruginous ooliths. The depositional environment has been interpreted as a shallow water one with periodic influxes of fine terrigenous material that alternated with periods of chemical sedimentation (Card *et al.* 1972).

The Gordon Lake Formation has been divided by the author into three stratigraphic units. This subdivision agrees with that reported by Eisbacher and Bielenstein (1969) and Wood (1975). Three units of the formation are as follows: 1) fine-grained pink sandstone; 2) dark green cherty siltstone (and chert); 3) buff to red interbedded sandstone, siltstone, greywacke, and chert in a few places.

The exposure of the basal unit is rather poor. Scattered outcrops occur west of Endikai Lake where the Nipissing Diabase body has been eroded away to reveal them. East of Endikai Lake, the basal unit is also poorly exposed in scattered outcrops. The fine-grained pink sandstone comprising this unit has prominent parallel laminations and beds are 15 to 30 cm (6 to 12 inches) thick. Fine-grained interbeds of laminated mudstone are present throughout. Ball and pillow structure, crossbedding, and ripple marks were the most common structures observed. Weathered out pits are common in some areas. These might have contained anhydrite or gypsum as reported by Wood (1975).

In thin section, the sandstone is revealed to be feldspathic, and well sorted with only about 2 percent matrix. The grains are subrounded with sutured borders. The quartz grains show well-developed overgrowths. Hematite occurs as

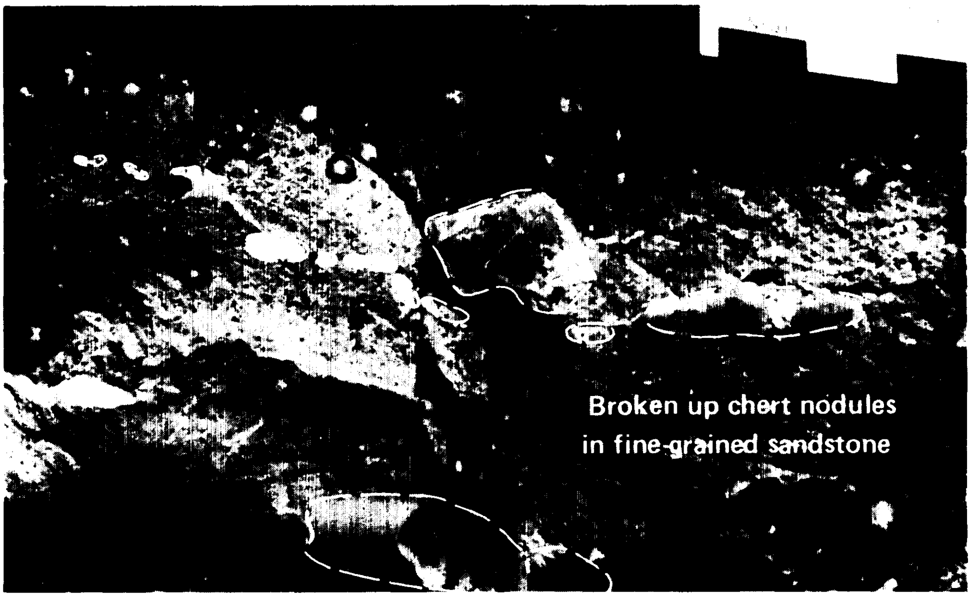
ODM9809

Photo 8–Unit of cherty siltstone of the Gordon Lake Formation showing a cross-section of desiccation cracks filled in with sandy material.

detrital concentrations, or as coatings along grain boundaries. The feldspar is predominantly plagioclase, and can be either fresh or altered. The siltstone interbeds are poorly sorted with 51 percent matrix and the grains are more angular than in the sandstone.

The middle unit is best exposed east of Endikai Lake in a prominent 60 m (200 feet) high cliff face. The predominant lithology of this unit is a dark to light green, brown, or reddish orange siltstone interbedded with green, pink to red, or cream to buff weathering chert and cherty siltstone. Although the contact with the underlying sandstone unit is not exposed, the base of this unit does have minor interbeds of purplish sandstone. Bedding ranges from 30 cm (12 inches) at the base to 2.5 cm (1 inch) in the middle. Prominent sedimentary structures are present throughout. They are symmetrical to asymmetrical ripple marks, desiccation cracks, flame structures, load casts, slump features, and intraformational breccias with or without imbrication of fragments.

A progressive upward sequence as observed on the cliff face may consist of a laminated cherty siltstone with 1 mm to 1 cm thick laminae, and desiccation cracks which have been infilled with sandy material. Photo 9 shows the top several metres shown in the photo consists of fragmental chert in a silt matrix. The



ODM9810

Photo 9–"Rip-up" clasts of cherty siltstone in fine-grained silty beds of the Gordon Lake Formation.

chert fragments are "rip-up" clasts and can be either aligned parallel to bedding, imbricated, or disorganized (Photo 9). Slump units with ball and pillow structures about 15 cm (6 inches) thick and lenses occur in many places in the sequence. A typical 10 cm (4 inches) thick bed consists of a lower 7 cm (23 inches) of rippled, cross-laminated and graded sandy to cherty siltstone and an upper 3 cm (1 inch) of thick cherty layers with fine black sand admixtures. These may be overlain by 10 cm (4 inches) of laminated chert with load casts and slump features, and are in turn overlain by 33 cm (13 inches) of fine massive sand. Towards the top of the unit, the rocks become more sandy losing their silty characteristics.

In thin section, the cherty siltstone is revealed to consist of layers of silt and chert. The silt layers contain angular grains of quartz, plagioclase, and hematite, and range in size from 0.1 mm to 1.5 mm. Graded bedding occurs in the majority of the siltstone beds. The grains occur in very irregular cycles with maximum concentration of 5 percent in a very fine grained clay matrix. The chert layers are mostly fragmental with a few feldspar and quartz grains. The long axes of the fragments are parallel to the layering or are imbricated. Typically, the fragments are all coated with opaque minerals. In places, the chert fragments are well rounded from 1 mm to 3 cm (2 inches) in diameter in a matrix of feldspathic fine-grained siltstone. These fragments have the appearance of fecal pellets found in limestones. Modal analyses of the fragments are given in Table 5.

The top unit consists of thinly bedded, medium- to coarse-grained, fairly well sorted, varicoloured sandstone. Bedding thickness ranges from 15 cm to 30 cm (6 to 12 inches). Well formed planar crossbeds cut off at the top by sandstone with parallel laminations can be seen in many places. The laminations are 2 to 4 mm apart, and are composed of quartz-rich and feldspar-rich layers. Ripple marks and rusty hematite spots are present throughout. The sandstone becomes very rich in hematite at the top of this unit, and interbeds of purple siltstone appear there.

Near the contact with the overlying Bar River Formation east of Endikai Lake, a bed was found containing ripple marks with the "worm burrow"-looking structures described by Hoffman (1967) from the Bar River Formation, north of Elliot Lake. The "worm burrows" are elongated features, averaging around 3 cm (1 inch) in length. They drape over one another in a disorientated criss-crossing pattern, and are concentrated in ripple troughs. In cross-section, the "worm burrows" are round, 7 mm in diameter, and are filled in with sand and surrounded by mud.

The sandstone in the upper part of the Gordon Lake Formation is fine grained (0.5 mm), and well sorted with sub-rounded grains in a cherty matrix. The feldspar, predominantly plagioclase, is fresh and comprises 5 to 8 percent of the sandstone. Minor opaque minerals and hematite staining produces the spotting observed in the field. A modal analysis of the rock is given in Table 5.

Bar River Formation

The Bar River Formation, the topmost formation of the Huronian Supergroup, consists of crossbedded and rippled orthoquartzite, ferruginous siltstone, and sandstone. It ranges in thickness from 300 m (1,000 feet) at its type locality east of Sault Ste. Marie to 1200 m (4,000 feet) in the Lake Panache Area (Wood 1975). A littoral depositional environment has been proposed for this sequence by many authors (Card *et al.* 1972) on the basis of variable paleocurrent directions.

In the map-area, the Bar River Formation occurs only east of Endikai Lake and north of the Flack Lake Fault. The Bar River Formation is weather resistant and forms impressive hills. The Bar River Formation was subdivided by the author into two units: 1) a lower massive orthoquartzite; and 2) an upper thinly bedded well-rippled orthoquartzite. The contact with the underlying Gordon Lake Formation is very sharp and abrupt. Massive orthoquartzite beds, approximately 3 m (10 feet) thick, overlie the red finely interbedded sandstone and siltstone. The colour of the orthoquartzite varies from red, purple, and white with pink hematite spots to pure white with brown laminations. The beds are massive, and planar crossbedding and minor laminations at tops of beds were the only structures observed. Some beds contain thin pebble bands at their base, and consist of 90 percent quartz and chert and up to 10 percent jasper pebbles. The pebbles are predominantly rounded to subrounded and average 1 cm (0.4 inch) in diameter. The grain size varies from coarse grained to fine grained to being almost cherty. Very fine grained greenish but gritty interbeds occur towards the transition with the overlying unit.

The top unit of the Bar River Formation exposed in the map-area is a very fine grained thinly bedded, pink to white cherty sandstone with prominent symmetrical ripples. Paleocurrent orientations interpreted by the author from these ripples are from all directions, and suggest rapid shifting of currents.

The orthoquartzite is well sorted, having a bimodal distribution of grains; 0.1 mm is the smaller fraction and 2.5 mm occurs in the larger fraction. Grains are rounded to subrounded with minor overgrowths. Hematite staining along grain boundaries gives the orthoquartzite its pink colour. A modal analysis (Table 3) shows only 1 percent cement to 99 percent quartz grains.

Mafic Intrusive Rocks

NIPISSING DIABASE

Nipissing Diabase occurs as dikes, irregular bodies, and sills. Nipissing Diabase is erosion resistant, and the larger bodies form prominent ridges. The bodies are irregular in outline, and average 1.6 km (1 mile) in diameter. All of the bodies are magnetically responsive, especially the intrusion around Rowe Lake which gives rise to a circular aeromagnetic anomaly shown on Map 2227G (ODM-GSC 1963a). The other two bodies west of Endikai Lake and south of Little White River are not as responsive. The dikes are generally fine grained, about 30 m (100 feet) thick, and can be traced for only short distances.

The dikes commonly have sharp contacts with the country rocks; most of the larger intrusions have chilled margins, and some have amphibolitic offshoots.

Nipissing Diabase is generally greenish, mottled grey, black, green, and greenish pink, fine to coarse grained in pegmatitic phases and equigranular. These rocks consist dominantly of quartz metagabbro, fresh two pyroxene-bearing gabbro, iron-rich granophyre, diabase, and amphibolite. The larger bodies display differentiation trends from two pyroxene (orthopyroxene and clinopyroxene) gabbro to one pyroxene (clinopyroxene) gabbro to granophyric gabbro and granophyre. The granophyric sections commonly occur as irregular zones from 0.6 to 0.9 m (2 to 3 feet) to 30 m (100 feet) thick throughout the bodies, and may be associated with pegmatitic phases.

The dikes do not usually show these compositional trends. Smaller dikes are usually altered and amphibolitized, and no fresh textures can be observed.

Some dikes are rich in sulphide minerals such as pyrite and pyrrhotite, and have vugs and veinlets 15 cm (6 inch) thick filled with quartz crystals, magnetite, specular hematite, carbonate, and epidote.

Layering was observed in the intrusive body east of Dobie Lake. This body varies from being a sill in the northern part to a dike in other areas. The sill part is underlain and overlain by sedimentary rocks of the Espanola Formation.

The amphibolitic parts of the larger bodies display the same texture and mineralogy as the diabase dikes. They are all altered gabbros with 0 to 15 percent quartz which appears as micrographic intergrowths with plagioclase in the more felsic parts, and as anhedral interstitial grains in the more mafic gabbros. Plagioclase as bladed crystals is commonly altered to epidote, sericite, and talc. Chlorite and amphibole are interstitial to the plagioclase crystals. The opaque minerals, ilmenite and magnetite, show skeletal textures. Accessory minerals include apatite, rutile, and sphene. In the fresh pyroxene-bearing gabbro, plagioclase (An_{50} to An_{60}) appears as fresh euhedral laths which are normally zoned. Some are slightly saussuritized. The pyroxenes present include orthopyroxene (enstatite) and clinopyroxene (augite and pigeonite), or only clinopyroxene. The orthopyroxene has exsolution lamellae of augite. The platy pyroxenes partly enclose plagioclase and form a subophitic texture. In places, the pyroxene is altered to chlorite and hornblende.

North of Little White River on the Albanel-Kamichisitit township boundary, a fine-grained, 30 cm (12 inches) thick, dikelet cuts the Nipissing Diabase dike. The dikelet consists of altered microlites in a fine-grained aphanitic groundmass rich in magnetite. Minor carbonate and chlorite forming pseudomorphs after amphibole or pyroxene are some of the other minerals identified in the groundmass. Similar, but larger dikes, 15 m (50 feet) thick cut the Lorrain and Gowganda Formations in many places. These dikes are probably post-Nipissing.

LATE PRECAMBRIAN

Mafic Intrusive Rocks

The youngest dike in the map-area is an olivine diabase dike of the Sudbury Swarm. The dike is approximately 60 m (200 feet) thick and trends northwest in the southwest part of the map (Map 2399, back pocket). It is fine to coarse grained, weathers a characteristic brown to rusty colour; and consists of olivine, clinopyroxene, orthopyroxene, and laths of plagioclase, and is rich in magnetite producing a high magnetic response on the aeromagnetic maps (ODM-GSC 1963a and b).

STRUCTURE AND METAMORPHISM

The Endikai Lake area lies partly within the Superior Structural Province, and partly within the Southern Structural Province of the Canadian Shield (Stockwell *et al.* 1970). The southern part of the Superior Province consists of Early Precambrian (Archean) granitic plutons, migmatites, and remnants of metavolcanic-metasedimentary "greenstone", belts which have been faulted, folded, and intruded by granitic rocks during the Kenoran Orogeny about 2,500 m.y. ago (Card *et al.* 1972; Stockwell *et al.* 1970). Rocks of the Superior Province are exposed in the northern part of the map-area, and are largely represented by massive to gneissic felsic intrusive rocks and by minor metavolcanics and metasediments. At the end of the Early Precambrian, or during the early part of the Middle Precambrian, some 2,300 m.y. or more ago, faulting and downwarping of the Superior Province craton initiated the Huronian depositional basin. This deformation was probably accompanied by emplacement of mafic dike swarms (Card *et al.* 1972).

The Southern Province consists of an early Middle Precambrian linear orogenic belt that developed along the southern boundary of the Superior Province (Card *et al.* 1972). The Southern Province can be subdivided into a number of subprovinces that include the Penokean Fold Belt, the Port Arthur Homocline, and the Lake Superior Basin (Stockwell *et al.* 1970). The eastern part of the Penokean Fold Belt is composed of supracrustal rocks of the Huronian Supergroup, a sequence of sedimentary and volcanic rocks which unconformably overlie the Early Precambrian basement (Stockwell *et al.* 1970).

The eastern part of the Penokean Fold Belt is further subdivided into three tectonic subdivisions: namely the Sault Ste. Marie-Elliot Lake, Espanola, and Sudbury Basin Subdivisions (Card *et al.* 1972). The Sault Ste. Marie-Elliot Lake zone comprises relatively thin, little deformed and metamorphosed Huronian rocks deposited upon a relatively stable cratonic basement. The tectonic structural pattern in the Southern Province has been attributed to deformational forces concentrated in the south actively thrusting a plate of supracrustal rocks northward against a relatively stable cratonic block now represented by the Superior Province (Card *et al.* 1972). The Huronian rocks of the Endikai Lake area form part of the Sault Ste. Marie-Elliot Lake Tectonic Subdivision, and are consequently little deformed and metamorphosed.

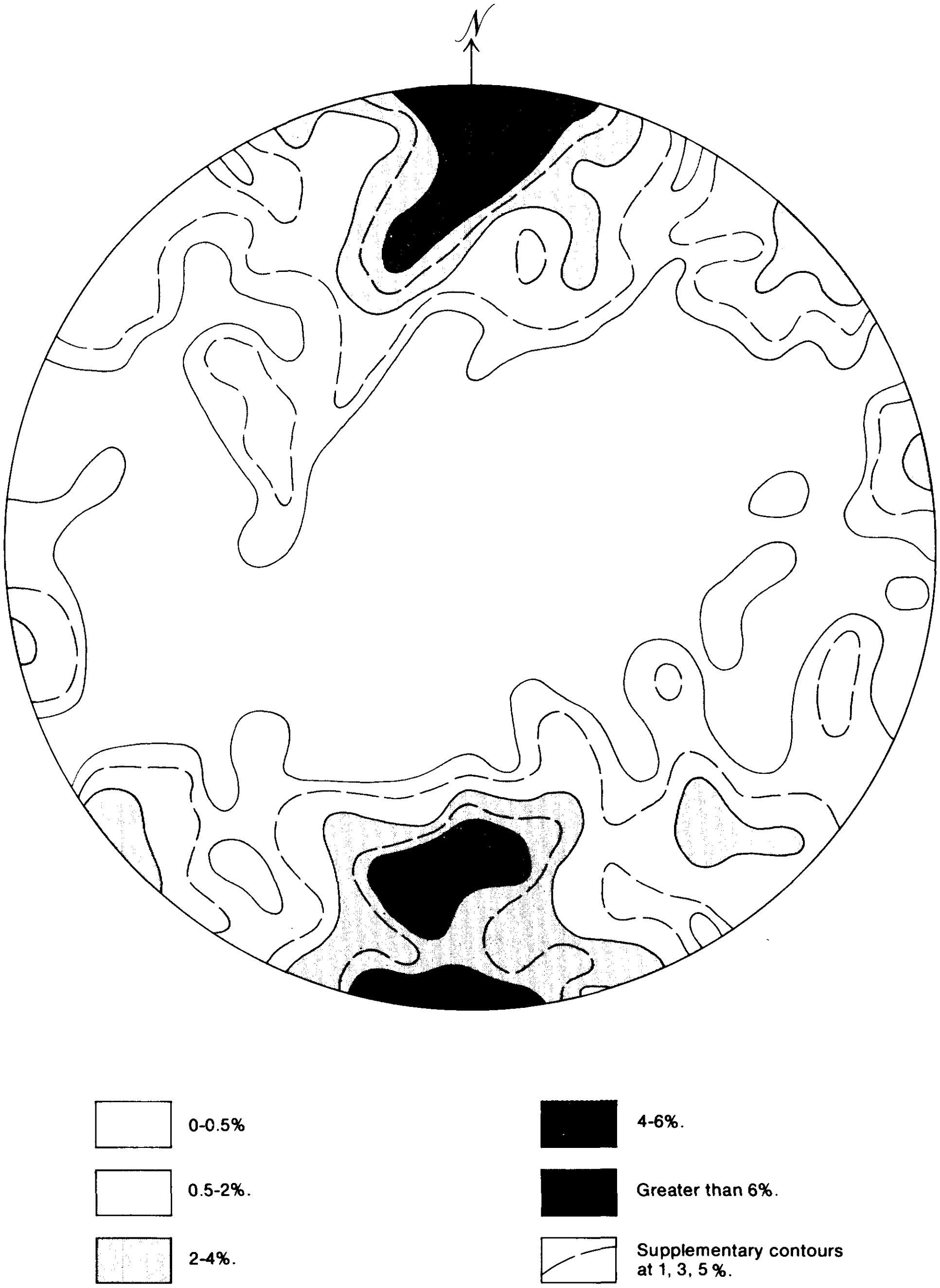
Faults

The dominant fault structure in the map-area is the Flack Lake Fault System consisting of the east-west-trending Flack Lake and Endikai Lake Faults and the northwest-trending Pearl Lake Fault. The faults delineate a prominent east- and northwest-trending fracture pattern accentuated by diabase dikes and quartz stringers. The foliation and shearing foliation in the Huronian rocks shows the same predominant easterly trend (Figures 2, 3, and 4) with a minor northwest trend (Figure 4). Movement along these faults, as well as numerous subsidiary faults, resulted in the formation of a series of fault bounded rotated blocks. Structurally the area can be divided into six parts as follows:

(1) Early Precambrian (Archean) basement north of the Endikai Lake Fault with minor exposure of Gowganda and Lorrain Formations in the east.

(2) A synclinal wedge of the Cobalt Group ranging from the Lorrain to the Bar River Formations bounded by the Endikai Lake Fault in the north and by the Flack Lake Fault on the south.

(3) A block of Early Precambrian (Archean) basement and Huronian sedimentary rocks ranging from the Mississagi to the Gowganda Formations bounded to the north by the Flack Lake Fault and to the south by the Pearl Lake Fault, west of the Little White River.



SMC 13894

Figure 2–Foliation and shearing in Huronian rocks of Albanel Township (formerly Township 169).

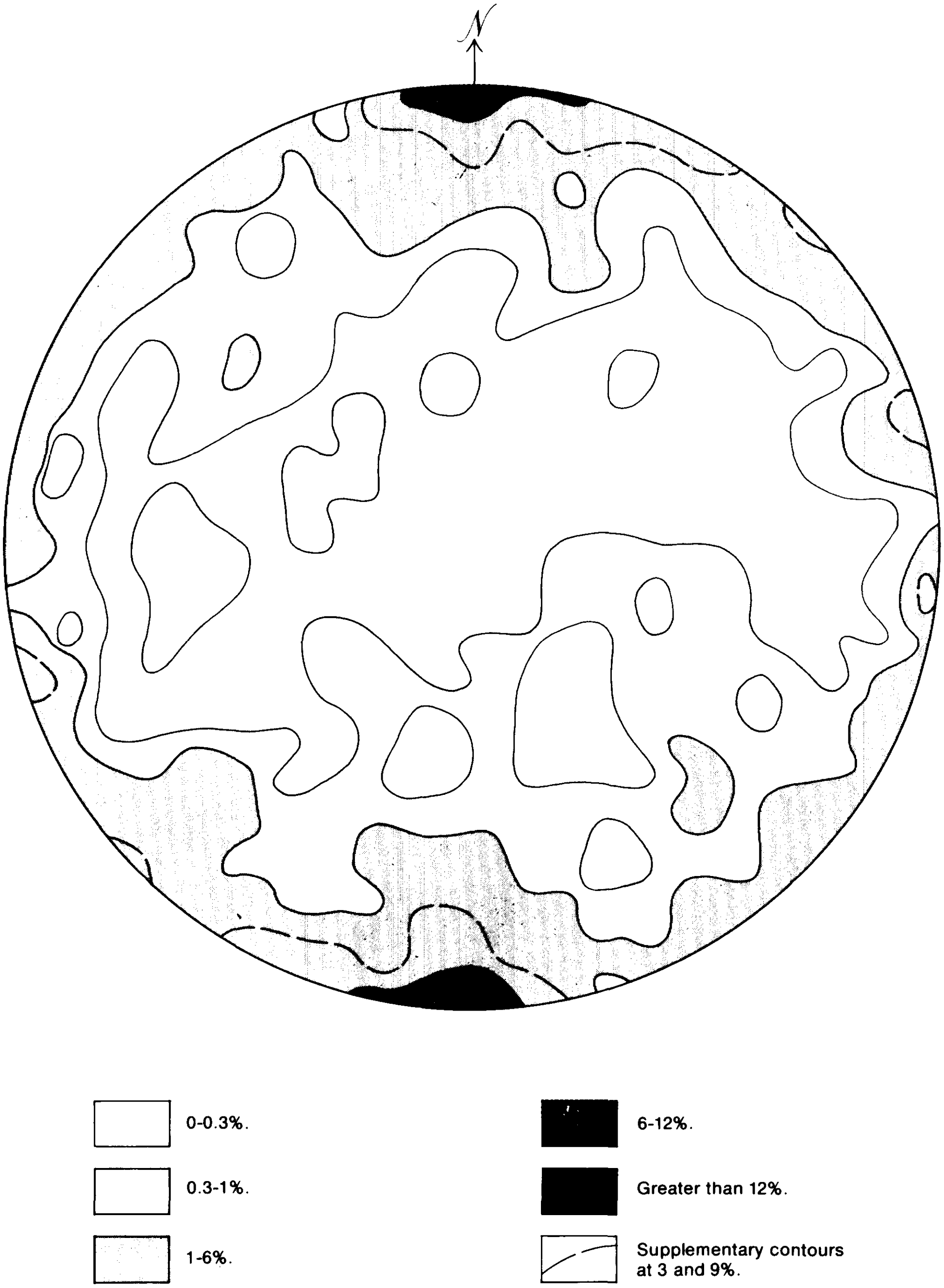


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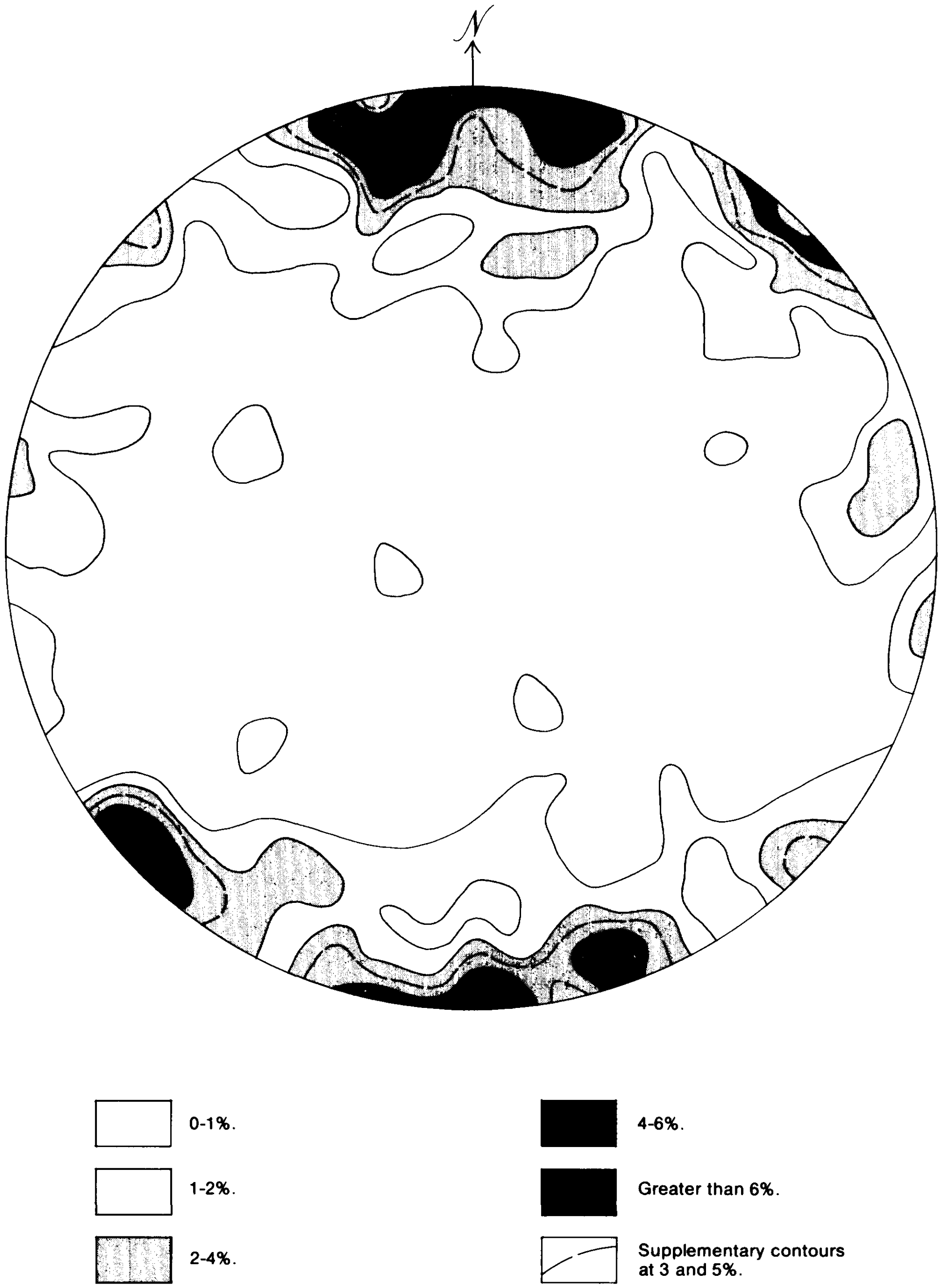
Figure 3–Foliation, shearing, and fracture cleavage in rocks of the Gowganda Formation.



SMC 13896

Figure 4–Foliation, shearing, and fracture cleavage in Huronian rocks other than the Gowganda Formation.

(4) The west-plunging Wakomata Lake Syncline southwest of the Pearl Lake Fault which is dislocated by the Skirl Lake Fault.

(5) The east-plunging Quirke Syncline southeast of Dobie Lake, and

(6) An area in east-central Albanel Township (formerly Township 169) north of Le Scarbo Lake consisting of an anticline and a series of small fault-bounded blocks of sedimentary rocks.

The Flack Lake Fault, the most important fault in the region, was described by Robertson (1963) as a system of faults, rather than a single fault forming an east-trending curvilinear structure extending for approximately 154 km (96 miles). In the Rawhide Lake area, Wood (1975) described the Flack Lake Structure as a reverse fault dipping 70° to the south with a downdrop to the north. In the map-area, the Flack Lake Fault consists of a zone of lenticular fault-bounded blocks in Varley Township (formerly Township 176), and a curvilinear structure in Albanel Township (formerly Township 169). Movement along the fault produced considerable shearing and deformation in the rocks. Carbonate and hematite-bearing quartz veins are associated with this shearing.

The Endikai Lake Fault separates the Huronian strata to the south from the Early Precambrian granitic basement to the north. This is a fault contact, because no unconformity-like surfaces are exposed, and the rocks are sheared in numerous places. It is not possible in this area to recognize whether or not there is a horizontal offset present. The only evidence for direction of movement as deduced from the rock formation is vertical.

The Pearl Lake Fault consists of two faults south of Castra Lake. These join to form a single structure farther south. The rocks within the fault zone are sheared, brecciated, and injected with carbonate specularite-bearing quartz veins. In the Wakomata Lake area (Siemiatkowska 1977), the fault was interpreted as having a dextral horizontal offset of approximately 2 km (1 mile). The Moon Lake Fault, a major fault to the south of the area crossing through Rackey Lake is most probably the same fault as the Pearl Lake Fault which has been offset by a northeast-trending subsidiary fault. The copper mineralization in quartz-carbonate veins on the north shore of Rackey Lake is associated with this fault.

The Skirl Lake Fault is a northwest-trending fault offsetting the axial trace of the Wakomata Lake Syncline. In the Wakomata Lake area (Siemiatkowska 1977, p.38) the movement was inferred from surface geology to be a strike-slip fault with a left-hand horizontal offset of 1.6 km (1 mile).

The east-west trending Le Scarbo Lake Fault separates the Gowganda Formation from the Espanola Formation along the Little White River. This is probably a reverse fault along which the south side moved up relative to the north side. Throughout the area there are numerous faults producing small fault-bounded blocks consisting of sheared and deformed rock which have been arbitrarily correlated by the author to various formations.

No good evidence was found for the presence of the Little White River Fault as it is shown on the Blind River-Elliot Lake compilation sheet (Robertson *et al.* 1971). It appears that a fault is present in Parkinson Township (Robertson *et al.* 1971) and east of Endikai Lake, but from surface geology in the map-area and further south (M.J. Frarey, Geologist, Geological Survey of Canada, personal communication, 1973) there does not appear to be a break in the strata to account for this fault. The conclusion made by the author is that the Little White River Fault is not a major fault in the area, but rather a series of small subsidiary faults, or a fault that has been active before the deposition of the Gowganda and Lorrain Formations causing the high between the Wakomata Lake and Quirke Synclines.

The Flack Lake Fault System in this region consists of five west-trending blocks. These blocks are bounded by four faults which moved relative to one another. The major movement was along the Flack Lake Fault and Blue Fault to the north (Siemiatkowska and Guthrie 1976) causing the two blocks south of these faults to be thrust upwards with a possible horizontal displacement (Figures 5, 6, and 7). Contrary to Wood's (1975) belief that the north side of the Flack Lake Fault had been downthrown, the author believes that the north side of both these two faults remained relatively stationary. A definite rotational component was associated with the movement along the Flack Lake Fault. The Flack Lake Fault System appears to have been active for long periods of time. Wood (1975) believed that early movements along these faults controlled sedimentation. The break in sedimentation between the Gowganda and the Espanola Formations, and the sporadic occurrence and thickness of the Serpent Formation may be attributable to these early fault movements. Fault movements took place also after sedimentation and intrusion of Nipissing Diabase, but the age relationship between Nipissing Diabase and faults is rather complicated. Movement probably took place pre- and post-Nipissing Diabase. The Nipissing Diabase appears to be offset in some areas, indicating post-Nipissing Diabase movement, or as in other cases, the dikes were injected along the faults, and the offsets thus produced might be apparent rather than real; the dikes follow fractures previously offset by the faults.

The other dominant structural elements in the Early Precambrian basement rocks are: 1) a set of northwest-trending fractures delineated by numerous diabase dikes, and 2) north-northeast-trending gneissosity of Pre-Huronian age (Figure 8).

Folds

The four prominent folds in the area are: 1) the Wakomata Lake Syncline, 2) the Quirke Syncline, 3) the Endikai Lake Syncline, and 4) the Little White River Anticline.

The Wakomata Lake Syncline is a doubly-plunging canoe-shaped open syncline with a shallow plunging, northwest-trending axis in the map-area. The dips on both sides are shallow (10° to 15°), and slickenside lineations on bedding surfaces in the fold limbs are "a" type lineations (Siemiatkowska 1977, p.36 and 37). The major part of the syncline is exposed in the Wakomata Lake area to the west (Siemiatkowska 1977, p.36). The Skirl Lake Fault offsets the trace of the axis of the syncline.

The Quirke Syncline is a major regional structure in the Sault Ste. Marie-Elliot Lake region. It is a variably-plunging fold with the north limb dipping approximately 40° to 45° south and a south limb dipping about 10° north (Robertson 1963; Robertson, Giblin, and Leahy 1971). The westward extension of the

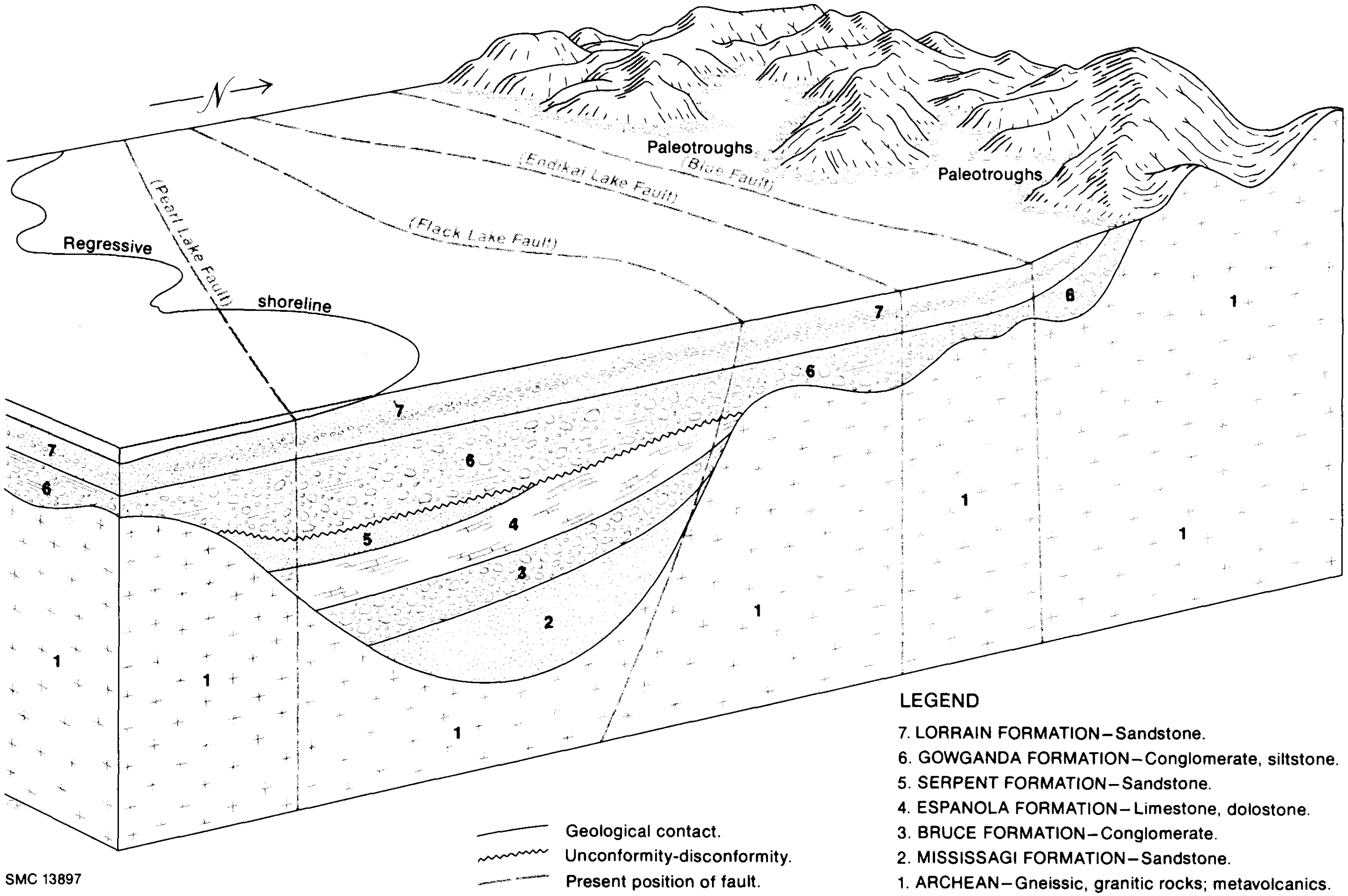


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Figure 5–Block diagram illustrating the interpretation of the pre-deformation, sedimentation, and stratigraphy in the Endikai Lake-Kirkpatrick Lake Area.

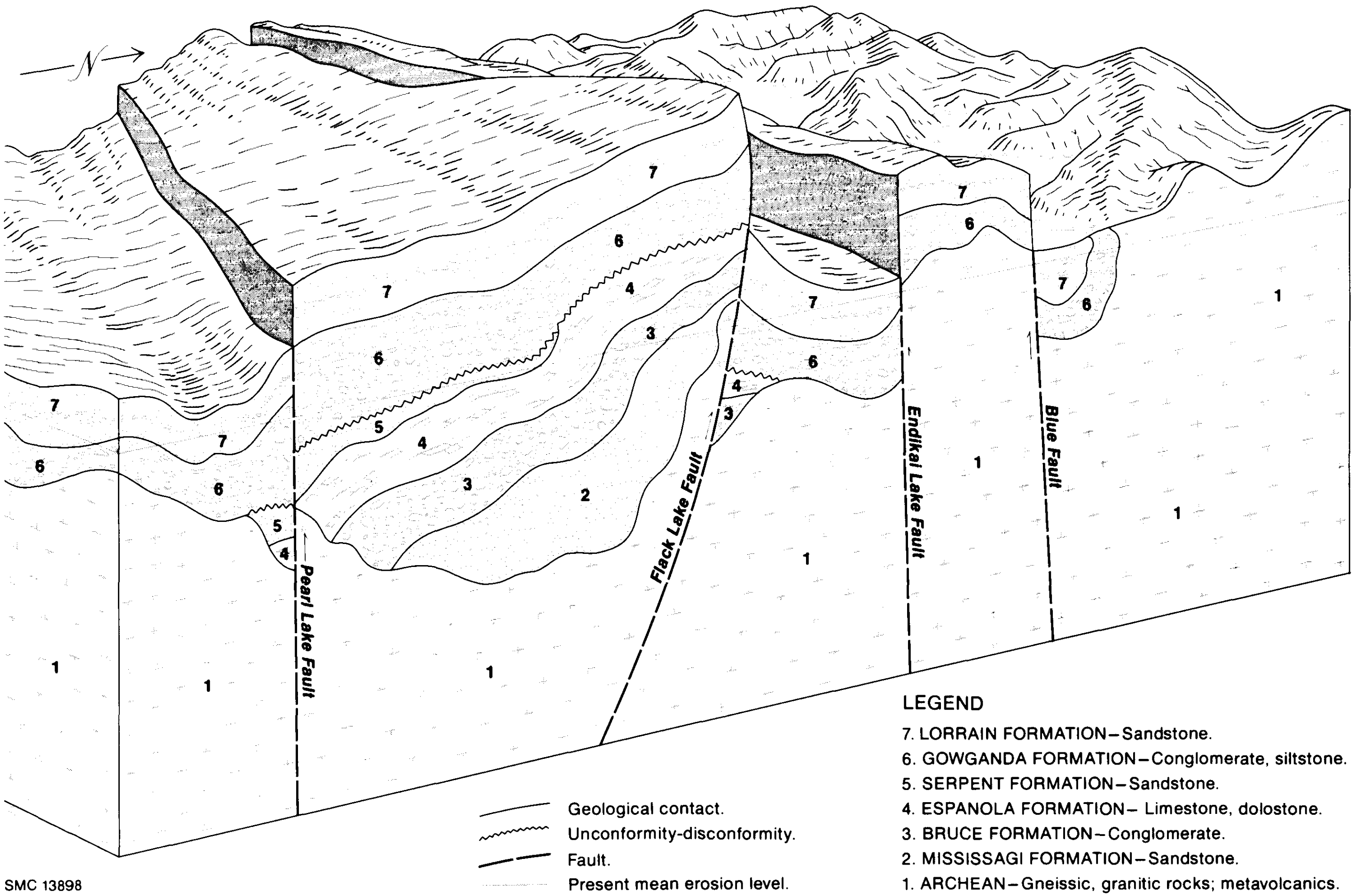

Figure 6–Schematic representation of relative fault-block movements.

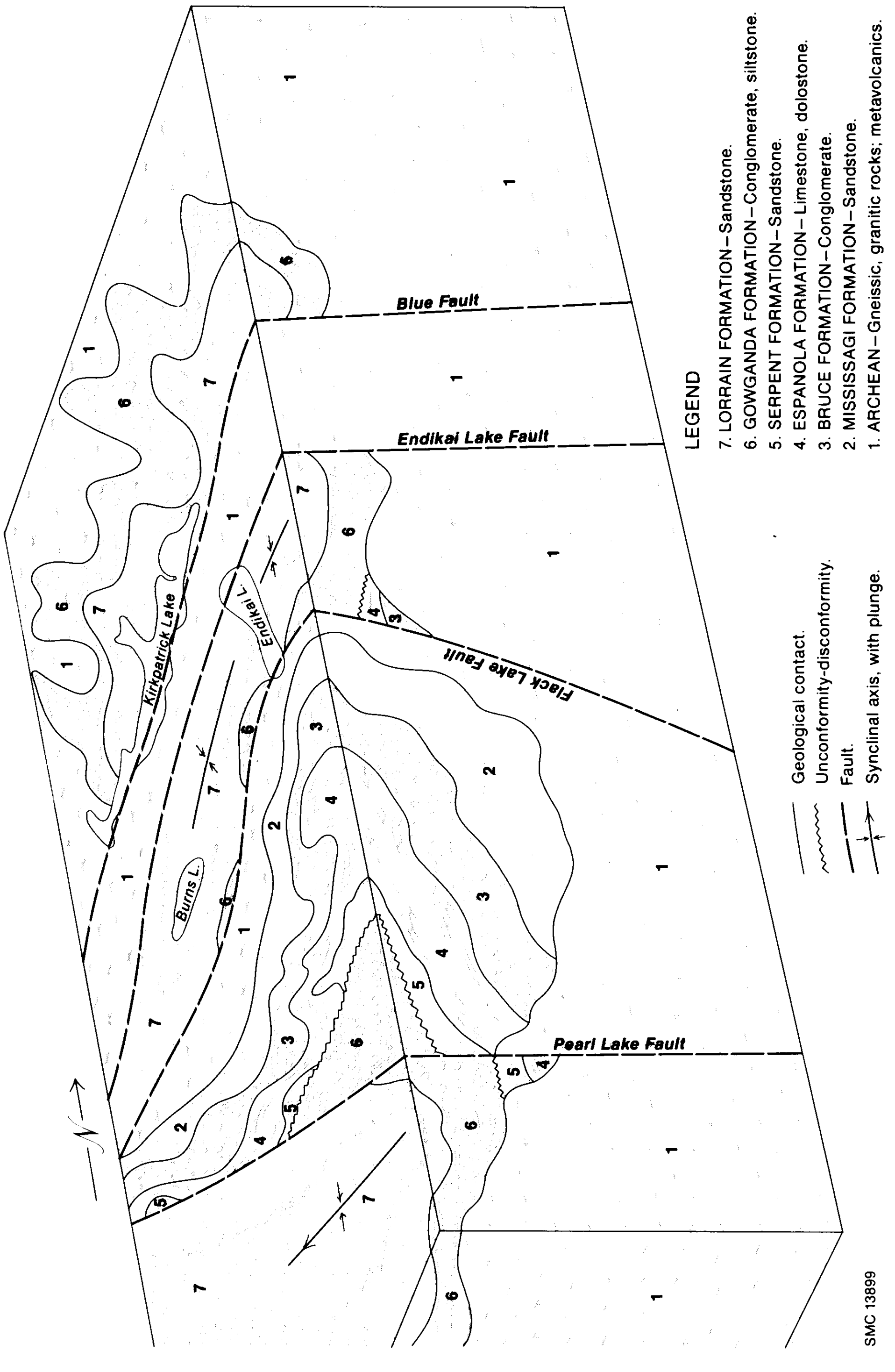

Figure 7–Generalized and simplified representation of post-deformational geology.

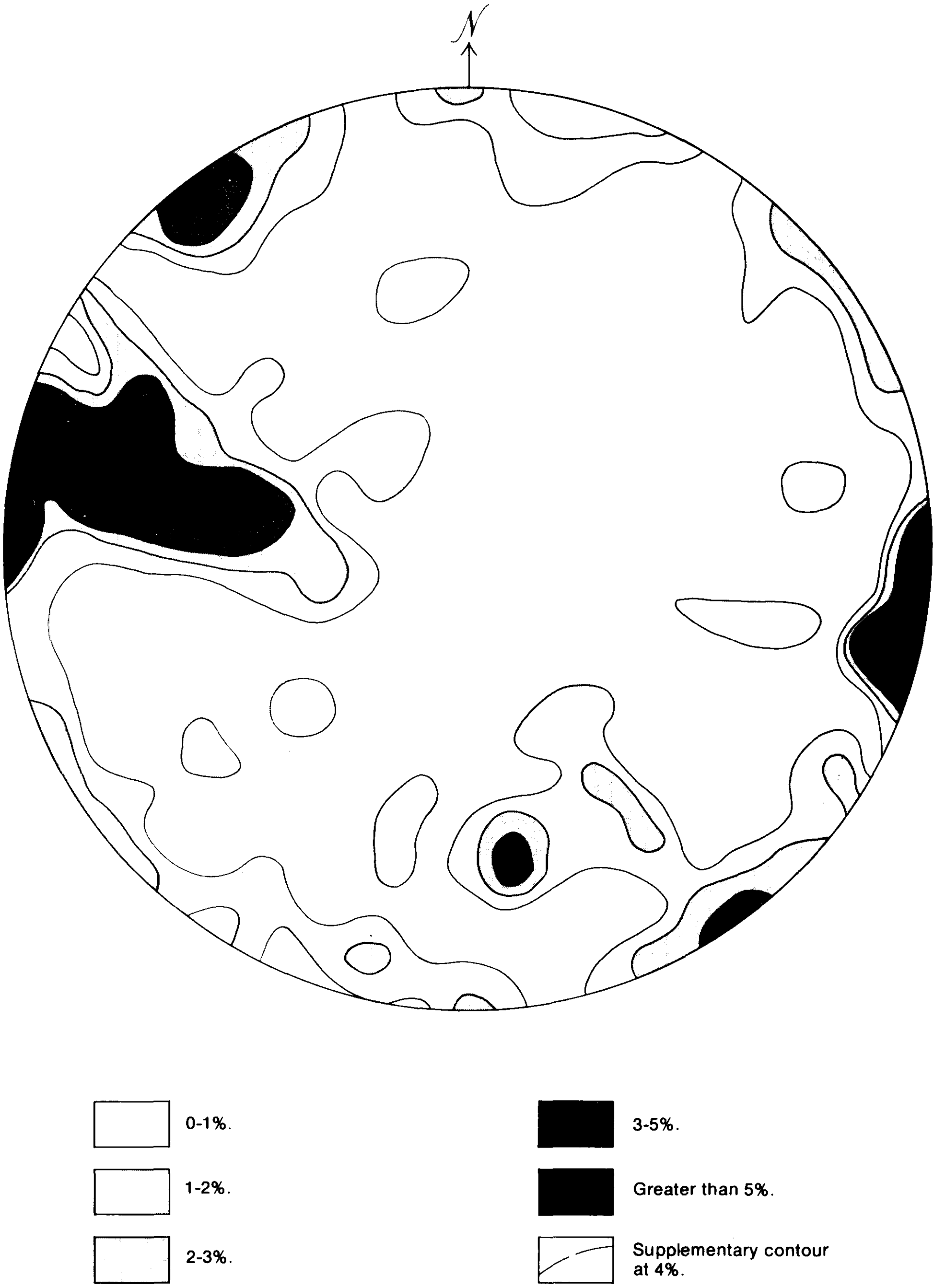

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Figure 8–Foliation and gneissosity in granitoid rocks.

trace of the fold axis cannot be accurately defined because of the lack of exposure, shearing, and lack of a distinctive marker unit in the Gowganda Formation. The Wakomata Lake Syncline may be the continuation of the Quirke Syncline.

The Endikai Lake Syncline, an easterly-plunging open syncline is truncated in the east by the Flack Lake Fault. West of Endikai Lake, the trace of the synclinal axis has been interpreted as extending through a Nipissing Diabase body where it is possibly offset southward and continues south of Burns Lake. The apparent break in the syncline axis south of the western end of Burns Lake is due to topography and not to structure.

The Little White River Anticline has an inverted canoe shape, and its axial trace has been buckled in a north-south direction. The deformation associated with the formation of this anticline is well preserved in the limestone member of the Espanola Formation which shows numerous drag folds, stretching, and boudinaging of the more competent layers.

The folds south of the Flack Lake Fault in the vicinity of West and East Twin Lakes are interrupted by numerous minor faults. In numerous places, folding and faulting produced minor tight folding and breccia zones where the rocks shattered rather than undergoing plastic deformation.

Metamorphism

The rocks of the Southern Province have been altered during Middle to Late Precambrian metamorphic events under conditions ranging from diagenesis to the amphibolite facies of regional metamorphism (Card *et al.* 1972). In the Sault Ste. Marie-Elliot Lake part of the Penokean Fold Belt, alteration ranges from diagenesis to the lower greenschist facies of regional metamorphism.

In the map-area, megascopic evidence for metamorphism is apparent in the Early Precambrian basement rocks. The metavolcanics and metasediments are metamorphosed to lower and upper amphibolite grade in gneissic terranes. The metagabbro dikes and bodies show the effects of metamorphism through alteration of original pyroxenes to chlorite, biotite, and amphibole, and of feldspar to sericite and epidote. The presence of muscovite in the Gowganda and Lorrain Formations indicates conditions existed pertaining to the lower greenschist facies of regional metamorphism. The Lorrain Formation contains aluminosilicate minerals such as kaolinite, sericite, diaspore, and pyrophyllite. Kaolinite and diaspore are products of diagenesis, whereas pyrophyllite and sericite formed from kaolinite and diaspore as a result of metamorphic reaction under lower greenschist facies conditions.

The carbonate rocks of the Espanola Formation with one exception show no evidence for metamorphism at grades higher than the lower greenschist facies. The exception is an outcrop of highly metamorphosed Espanola Formation north of East Twin Lake where euhedral crystals of garnet are well developed in the silt and clay layers.

DEPOSITIONAL ENVIRONMENTS

The Huronian Supergroup has been studied by many researchers, but considerable controversy continues over the depositional environment of these rocks. The greatest controversy is that between the advocates of glacial control theory as proposed by Young (1973), Casshyap (1969), and Lindsey (1971) versus the tectonic control theory advanced by Frarey (In Press). The Huronian Supergroup has been deposited in a continental environment (Pettijohn 1970) in a relatively shallow basin with periodic emergence of land. The author believes that a reconstruction of a depositional environment should be attempted only after a regional study has been completed. Some new ideas, which need further testing on a regional scale, will now be presented. Figures 9 to 13 represent schematic illustrations to help the reader visualize the processes taking place during the deposition of these rocks.

In the map-area, the discussion will be divided into two segments based on the natural break between the Gowganda and Serpent Formations. The Mississagi, Bruce, and Lower Espanola Formations all lie on a well-developed erosional unconformity on the Early Precambrian granitic basement. A transgressive onlapping situation with some subsidence of the basin prevailed during the deposition of these three formations (Figure 9).

The feldspathic sandstone of the Mississagi Formation consists of coarse grained, poorly sorted, immature arkose with numerous siltstone interbeds. These rocks were probably deposited in an upper flow regime such as can exist in a fluvial system (Figure 9).

The conformably overlying Bruce Formation is interbedded at its base with the sandstone of the Mississagi Formation. It is a lenticular deposit which pinches out in the Little White River Anticline, shows sedimentary structures such as scouring, slump balls, and ripple marks near the top, and displays numerous facies changes. It is interpreted by the writer as a debris flow deposit derived from the basement which formed mountainous highlands (Figure 9). If the Mississagi and Bruce Formations are continental deposits, then the advent of the deposition of the Espanola Formation represents a minor marine transgression, possibly controlled by tectonic activity. The period of transgression was minor because the upper two thirds of the Espanola Formation represent a regressive sequence. The lowest limestone unit was deposited in a marine environment in fairly shallow water. The limestone is deformed so that primary sedimentary structures are not well preserved. Nevertheless, the overlying siltstone unit shows ripple marks, desiccation cracks, chert fragments representing broken beds, and intraformational breccias which indicate that a very shallow water environment existed with periodic emergence which is typical of tidal-flat environments (Figure 10). The transition to the calcareous sandstone of the Espanola Formation and the immature arkose of the Serpent Formation may then represent a change from a tidal flat to a deltaic, and finally to a fluvial environment. The Serpent Formation shows a variation in thickness and lithology. The variation in thickness may be interpreted to be caused by erosion, or if taken together with the variations in lithology, then a depositional interpretation may be applied where the thicker part of the formation represents ancient channel mouth bar deposits (Figure 10).

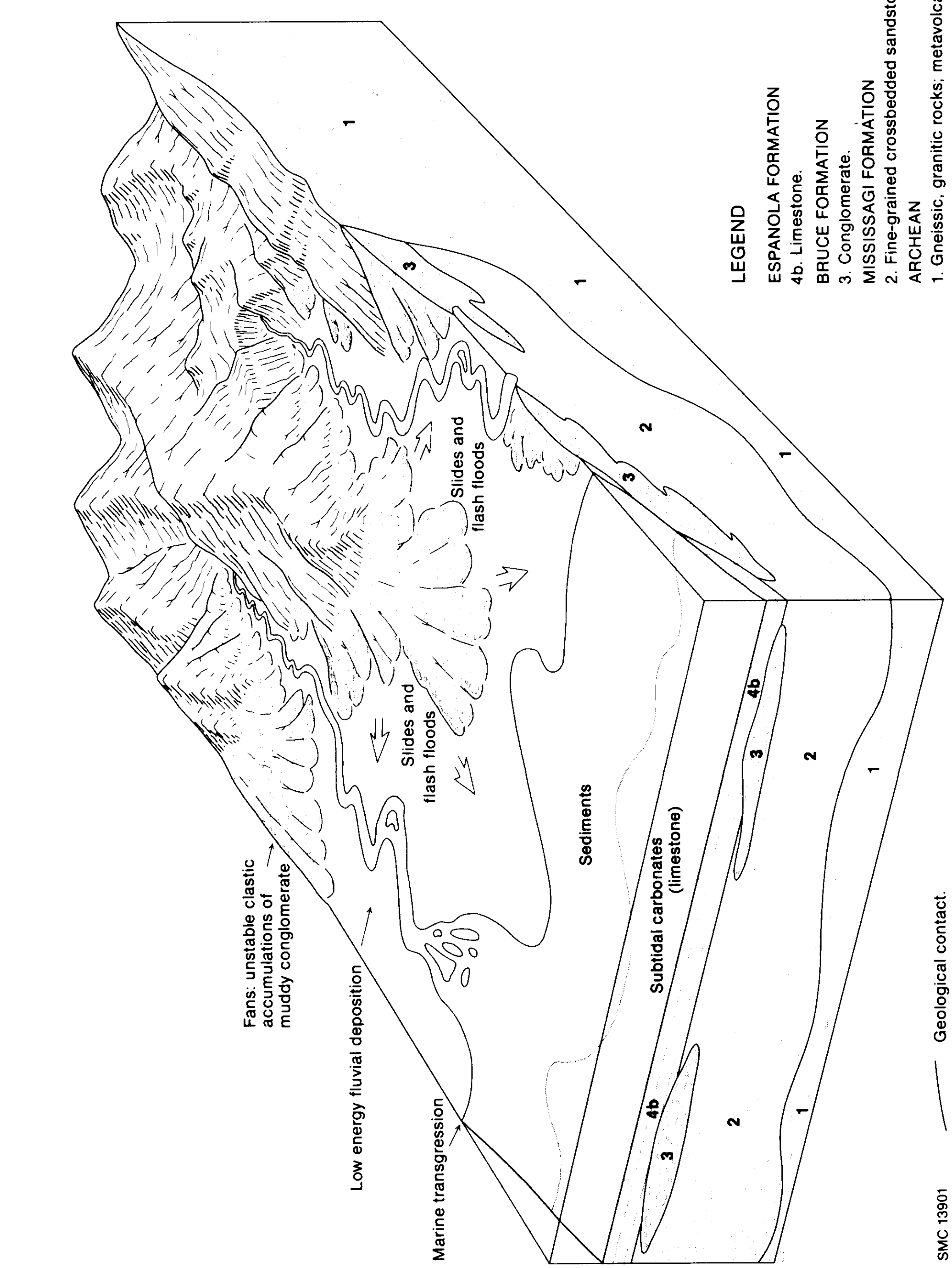

Figure 9–An interpretative illustration of the depositional environment of the Mississagi, Bruce, and lower Espanola Formations.

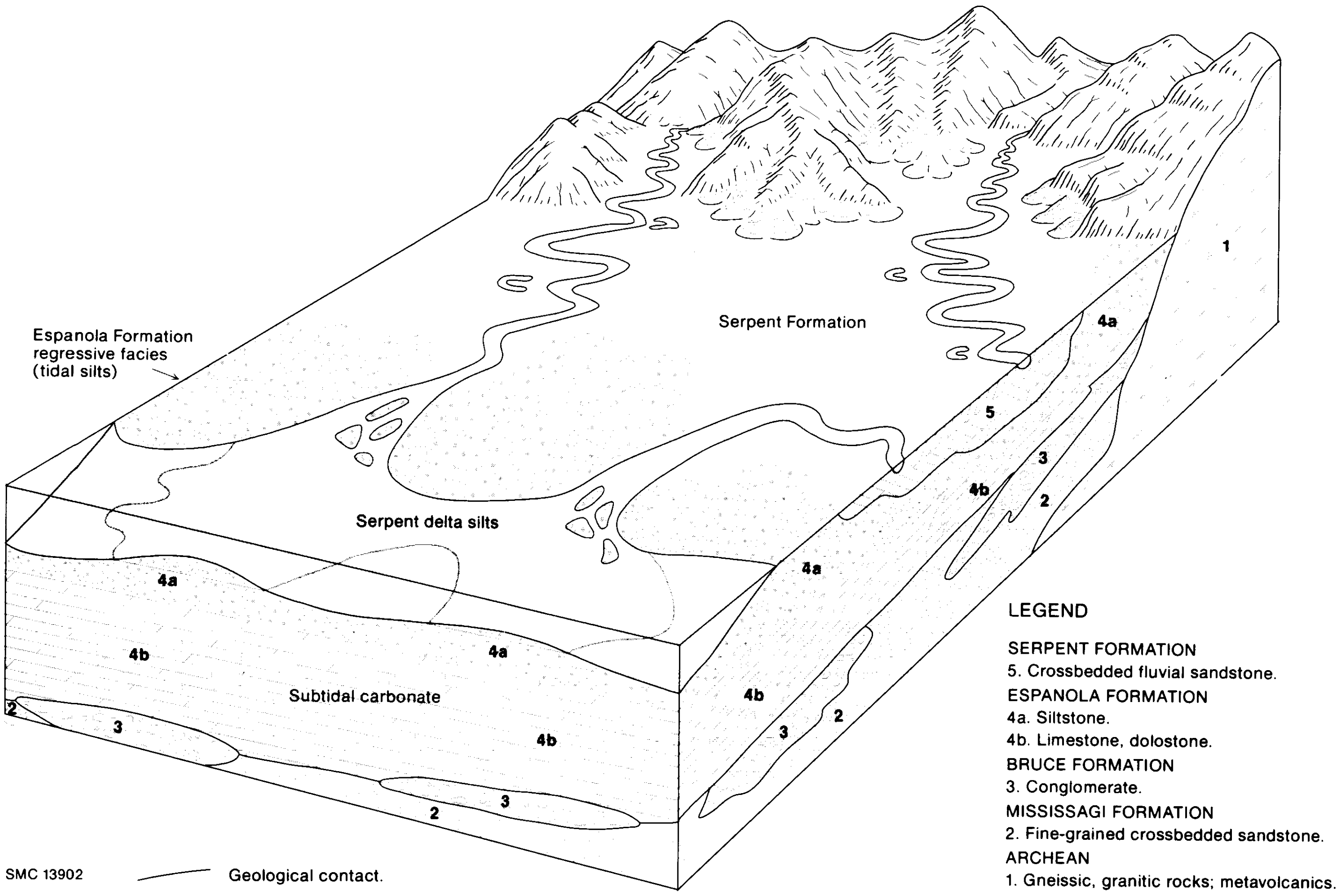

Figure 10–An interpretive illustration of the depositional environment of the upper Espanola and Serpent Formations.

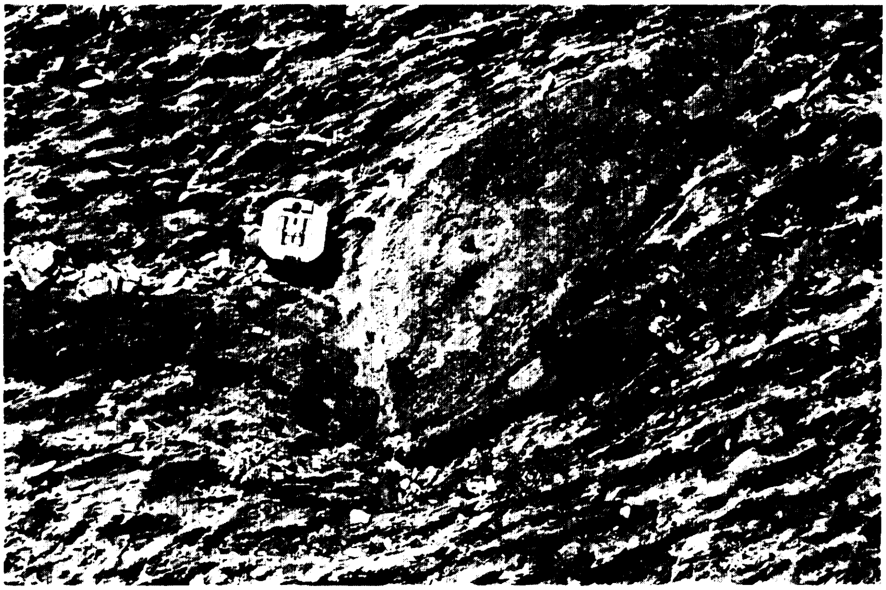

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Photo 10—"Dropstone" in siltstone with a sandstone interbed of the Gowganda Formation.

A definite unconformity exists at the base of the Gowganda Formation where it overlies the Serpent Formation, and locally, the Espanola Formation. This erosion surface may be the result of movement along a fault which produced erosion and uplift. The contact with the Serpent Formation is a scour surface upon which a thick unit of clast-supported conglomerate has been deposited. The conglomerate contains a variety of clasts ranging from pebbles to boulders with poor inverse grading typical of debris flows. The same lithology is apparent where the Gowganda Formation comes in contact with the Espanola Formation except on Highway 546 where a fault contact occurs. The rocks of the Lower Gowganda Formation are stratified throughout the map-area. The only evidence for glaciation is the presence of rare "dropstones" in nonconglomeratic parts (Photo 10). The Gowganda Formation has characteristics of an alluvial fan deposit to the north of the map-area (personal observation of the author, 1976). On the basis of these observations, the author has tentatively interpreted the Lower Gowganda Formation as a series of terrestrial debris flows with associated fluvial conglomerates and sandstones (Figure 11). Periodic minor transgressions, heavy precipitation, or possibly melting of glacial ice further to the north, could have been responsible for the deposition of the thicker argillite units, and for the "dropstones" transported and deposited by floating icebergs.

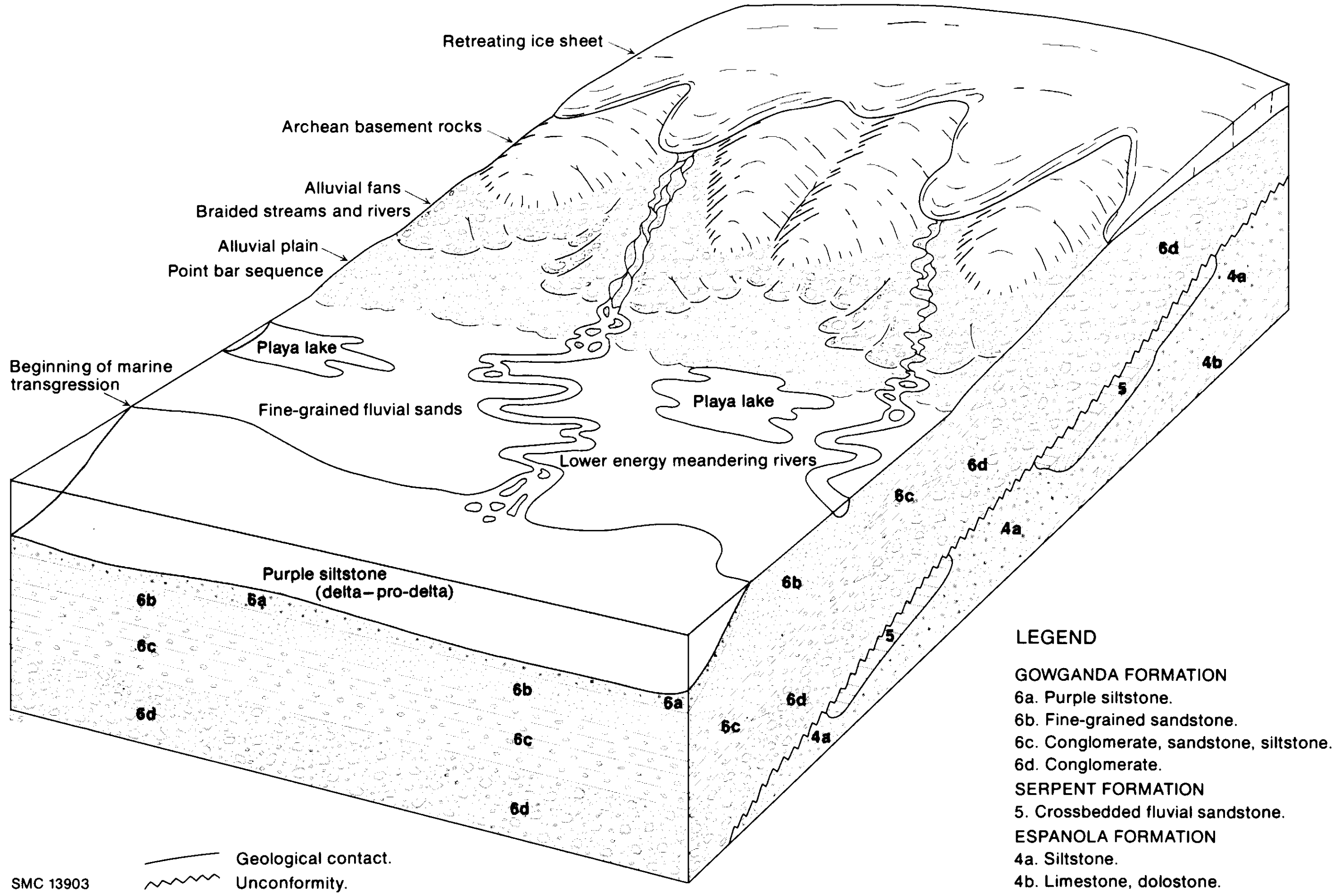

Figure 11–An interpretive illustration of the depositional environment of the Gowganda Formation.

A sharp break occurs between the lower and upper parts of the Gowganda Formation possibly indicating another period of transgression because the overlying purple siltstone and sandstone represent a regressive sequence. The reader is referred to the Wakomata Lake report (Siemiatkowska 1977, p.39 to 42) for further discussion of the Upper Gowganda Formation. A transition zone exists between the Gowganda and Lorrain Formations, and consists of a thick sequence of fine-grained feldspathic sandstone. This sandstone is about 120 m (400 feet) thick in the map-area as compared to a maximum of 30 m (100 feet) in the Wakomata Lake area (Siemiatkowska 1977), 30 m (100 feet) in the Kirkpatrick Lake area (Siemiatkowska and Guthrie 1976), and about 60 to 90 m (200 to 300 feet) thick in the Kynoch area to the south (author's personal observation, 1973). This fluctuation in thickness could be caused by the thick sandstone units being off-shore sand bars deposited at the mouth of the estuaries, and the thinner units being sands distributed along the shore by currents (Figure 12). The deposition of the Lorrain Formation indicates a change to a fluvial depositional environment for the middle sandstone units, and to marine a beach environment for the upper quartzites (see Siemiatkowska 1977, p.39 to 42; and Figure 13).

The abrupt change from the mature sands of the upper Lorrain Formation which were deposited on a marine beach to the dirty sands and silts having desiccation cracks and ripple marks of the Gordon Lake Formation indicates a transition from a marine beach to a tidal flat environment (Figure 13). The chert fragments probably indicate a period of aerial exposure with storm activity ripping up the cherty sediment and forming cherty fragments, which, with tidal flooding are rounded, imbricated, and aligned into layers. These storms must have occurred periodically for these "rip-up" chert clasts to occur throughout the middle unit. The overlying sandstone and thick massive sandstone beds of the Bar River Formation indicate a change to a non-marine environment with possible aeolian activity as indicated by bimodal sorting, the thickness of the beds, and sharp truncation of crossbeds (Wood 1975, p.37-41, and 46; and Figure 13). The presence of thin-bedded sandstone having symmetrical ripple marks of different orientations indicates that the variable current directions commonly found on beaches existed. The Bar River Formation is probably a marginal non-marine to marine deposit where an interaction between aeolian and beach environments took place (Figure 13).

ECONOMIC GEOLOGY

The area has been prospected for copper since the beginning of the twentieth century. Along the North Shore of Lake Huron, copper occurs in fault zones associated with Nipissing Diabase. In the map-area, copper contained in chalcopyrite, chalcocite, pyrrhotite, malachite, and azurite, occurs at several localities, and is associated with specularite-magnetite-bearing quartz-carbonate veins which are in turn associated with shear zones and Nipissing-Type Diabase Intrusions. The copper mineralization occurs in pods, which although commonly rich, are mainly small, and do not appear to have great economic potential.

Assessment work data is summarized in Table 9 (Chart A, back pocket) to which the reader is referred for more data. Only patented, and most recent prop-

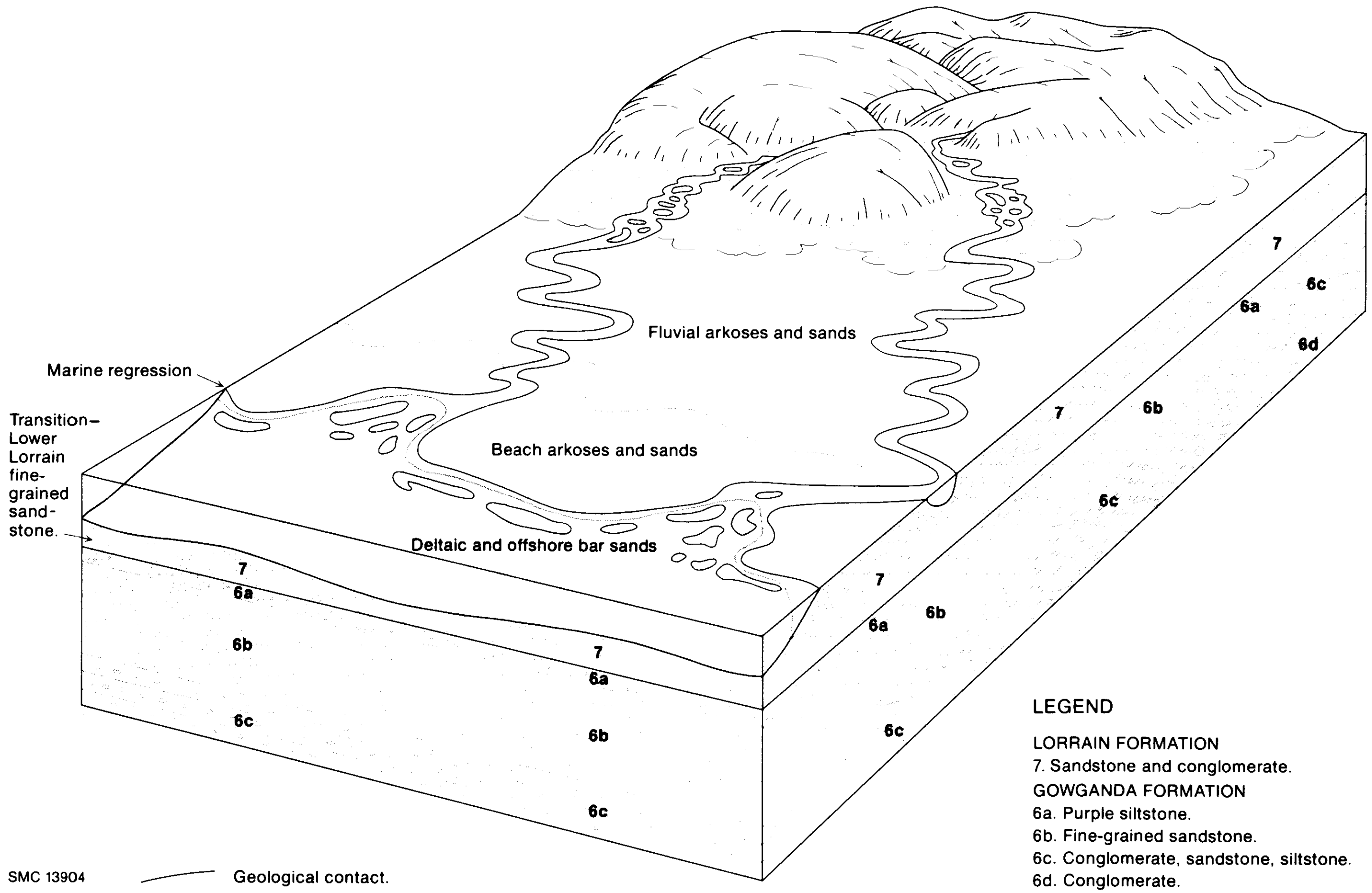

Figure 12–An interpretive illustration of the depositional environment of the Upper Gowganda and lower Lorrain Formations.

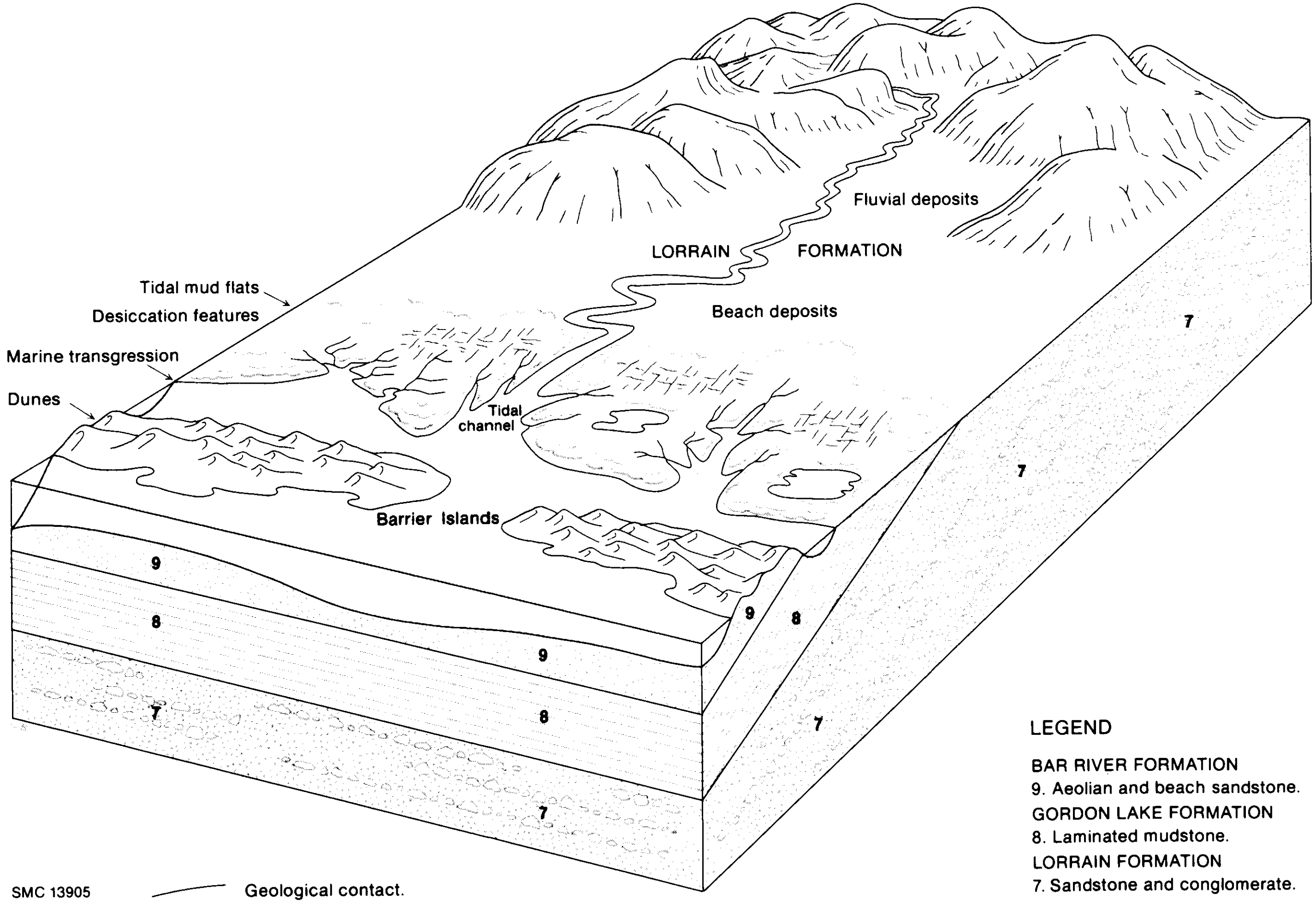

Figure 13–An interpretive illustration of the depositional environment of the upper Lorrain Formation, Gordon Lake, and Bar River Formations.

erties and showings where grab samples were analysed, are described at the author's discretion in the text.

Description of Properties

A.M. CLARK (2)[1]

The property consists of six claims located on the western shore of Endikai Lake, 0.8 km (0.5 mile) south of the northern end of the Lake. The property is a part of a block of claims held by US-CA-MEX Exploration Company Limited in 1970. The property dates back to 1952 when Teck Exploration Company Limited completed eight short diamond-drill holes for a total length of 221.4 m (726.5 feet). In 1955, four more diamond-drill holes were completed by Midrim Mining Company Limited for a total length of 501.4 m (1,645 feet). Analyses from the core and sludge samples range from 0 to 0.82 percent copper, the majority have less than 0.5 percent copper (Assessment Files Research Office, Division of Mines, Toronto). In 1970, US-CA-MEX Exploration Company Limited acquired the property, and performed geological prospecting and mapping, trenching, and stripping. Chip surface samples analyzed gave values of trace to 0.38 percent copper with assays ranging from 0 to 0.01 ounce silver per ton (Assessment Files Research Office, Division of Mines, Toronto).

The mineralization occurs in a stockwork of small quartz veins striking about N75°W to N70°W, with vertical to steep southerly dips in an alteration zone about 4.5 m (15 feet) wide at a contact of Nipissing Diabase and sandstone of the Gordon Lake Formation. Mineralization in the form of chalcocite, chalcopyrite, and hematite in quartz veins from 1 to 5 cm thick occur only in the Nipissing Diabase. Malachite and azurite staining is quite prominent, as well as banding of quartz and hematite. The mineralized zone has been traced by diamond-drilling for 900 m (3,000 feet), (Assessment Files Research Office, Division of Mines, Toronto). A grab sample taken during the mapping project yielded 0.15 ounce silver per ton and on analysis gave 0.92 percent copper (Mineral Research Branch, Division of Mines). Another specularite-bearing quartz vein 6 m (20 feet) wide and striking approximately N65°E with a vertical dip was located in the diabase 600 m (2,000 feet) to the northwest of this showing, north of the Endikai Lake Fault. No mineralization was observed.

A third occurrence of mineralization was located at the southeast corner of Regal Lake. This occurrence is part of the ground held by US-CA-MEX Exploration Company Limited in 1970. Since then, the claims have lapsed. A trench, 4.5 m (15 feet) away from the south-eastern shore of Regal Lake, exposes the contact between Lorrain sandstone and Nipissing Diabase. No mineralization was observed here, but north of the trench, another trench was located right on

[1]Number in parentheses refers to property number shown on Map 2399, back pocket.

the shore of Regal Lake. A shear zone about 3 m (10 feet) wide, striking N80°W, and dipping 55° to the south occurs in red granophyric Nipissing Diabase. Specularite, and pyrite with minor amounts of chalcopyrite and chalcocite are associated in the host rock with barite, quartz, and carbonate as accessory minerals.

COPPER PRINCE MINES LIMITED (3)

The property, located in the northwestern part of Kamichisitit Township (formerly Township 168) consists of eight patented claims (SSM6198, SSM6199, SSM6201 to SSM6205 inclusive, SSM6207, and SSM6208). The property consisting of 12 claims was staked in 1928 by S. Dillabough, eight of which were jointly owned by S. Dillabough and The Consolidated Mining and Smelting Company of Canada Limited (Cominco Limited). The other 4 claims were owned solely by The Consolidated Mining and Smelting Company of Canada Limited. During 1928, 260 m (860 feet) of trenching was carried out with 227 m (745 feet) concentrated on claims SSM6204 and SSM6207, and 35 m (115 feet) on claims SSM6198 and SSM6199. The discovery vein, from 2.5 to 6 m (8 to 20 feet) wide was traced for a length of 300 m (1,000 feet). From 1929 to 1930, 21 diamond-drill holes ranging in length from 62.5 m (205 feet) to 260 m (855 feet) and totalling 1998.7 m (6,557.5 feet) were drilled to investigate mineralization. The results of the holes are summarized below (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie):

Diamond-Drill Hole Number	Footages Feet	Core Length Feet	Copper Percentage
1	130.5 - 136.7	6.2	3.5
2	167.0 - 170.0	3.0	1.58
2	197.5 - 201.1	3.6	1.84
2	197.5 - 212.0	14.5	1.33
2	201.1 - 204.1	3.0	0.29
2	204.1 - 212.0	7.9	1.50
3	Not Known	17.4	0.355
3	Not Known	3.5	0.28
4	191.3 - 199.3	8.0	1.3
5	181.2 - 192.0	10.8	2.22
6	Not Known	5	0.25
8	270.0 - 272.5	2.5	1.0
8	447.4 - 457.5	10.1	1.2
9	337.0 - 340.0	3.0	4.87
10	370.0 - 372.0	2.0	1.9
	(Lost Core: Above 1.5 feet, Below 0.5 feet)		
13	111.0 - 117.0	6.0	1.7
17	166.0 - 172.0	6.0	1.025

No data is available for 3 diamond-drill holes out of the 21 drilled.
To convert footages to metres multiply by 0.3048.

The average analysis of the better diamond-drill holes under the main showing was 1.72 percent copper over a core length of 1.9 m (6.12 feet) and estimated true width of 1.5 m (4.9 feet) (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie).

Four surface shoots averaged the following: (1) 3 percent copper over a length of 94.5 m (310 feet) and a width of 1.9 m (6.3 feet); (2) 2.3 percent copper over a length of 13.5 m (45 feet) and a width of 2 m (6.6 feet); (3) 1.9 percent copper over a length of 18 m (60 feet) and a width of 2.9 m (9.7 feet); (4) 0.9 percent copper over a length of 33 m (110 feet), and a width of 2.9 m (9.6 feet); (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie).

The weighted average of trench samples taken from the zone 150 m (500 feet) west of Rackey Lake yielded 4.1 percent copper, and 0.03 ounce of gold per ton, over a length of 2 m (7.1 feet). The weighted average assays from four diamond-drill holes for the trenches yielded 2.7 percent copper, 0.03 ounce of gold per ton, over a length of 2.7 m (9.11 feet), (Shklanka 1969). The claims were patented in 1935, and four were allowed to lapse.

The mineralization is located 150 m (500 feet) west of the western end of Rackey Lake. A 15 m (50 feet) wide quartz vein striking N75°E for about 300 m (1,000 feet) with a vertical dip, cuts the arkose of the Gowganda Formation. The vein occurs in a chloritic shear zone and carries mineralization in the form of pyrite, chalcopyrite, chalcocite, and specularite. Two grab samples collected during the mapping project assayed trace and 0.02 ounce of gold per ton; trace and 0.44 ounce of silver per ton; and 1.86 percent and 13.2 percent copper respectively (Mineral Research Branch, Division of Mines).

FORT NORMAN EXPLORATIONS INCORPORATED (6)

In 1974, Fort Norman Explorations Incorporated owned a large block of 99 claims in the east-central part of Albanel Township (formerly Township 169). In order of importance these claims consist of:

1) A mineralized zone occurs about 1.6 km (1 mile) west of the Nicholas-Albanel township boundary and 150 m (500 feet) south of the Little White River. Chalcopyrite, pyrite, malachite, and azurite occur in a silicified shear zone striking around N65°E and dipping 65°S in the Espanola Formation some 90 m (300 feet) away from a Nipissing Diabase body. In the spring of 1974, four diamond-drill holes were drilled to test out the showing, no assessment work was submitted. During the following summer, airborne magnetometer, electromagnetic, radiometric, and resistivity surveys were carried out by Barringer Research for Fort Norman Exploration Incorporated. A further follow up by a ground electromagnetic survey over the property was performed as the author was mapping the area.

The shear zone striking approximately N65°E and dipping 65°S has been uncovered by numerous pits and trenches for about a length of 30 m (100 feet) and a width of 15 m (50 feet). The zone consists of silicified Espanola limestone rich in chlorite with minor brecciation. Associated with this showing, are beds of limestone rich in magnetite and chlorite about 3 m (1 foot) wide both to the north and south of the mineralized zone. Chalcopyrite occurs as a replacement along fractures, and as massive blebs associated with quartz carbonate and chlorite. Three grab samples taken by the author yielded trace assays of gold and silver, 0.68 percent copper, 1.29 percent copper, and 5.35 percent copper respectively; one sample contained 0.09 percent cobalt (Mineral Research Branch, Division of Mines).

2) In central Albanel Township (formerly Township 169), 1.6 km (1 mile) east of the south end of Endikai Lake and just west of the Little White River, a shear zone 30 m (100 feet) wide striking north and dipping 55°W consists of quartz and chlorite at a fault contact between the Early Precambrian mafic metavolcanics and the Gowganda Formation. Pyrite-rich veins and areas occur on both sides of the shear zone. At the east side, the pyrite-rich area is 4.5 m (15 feet) wide, but on the west side, pyrite occurs only as a 15 cm (6 inches) wide vein. A trench dug in a direction at N40°W exposes the mineralized zone as well as a 3 m (10 feet) wide quartz vein to the south. A grab sample taken by the writer from the quartz vein proved to be barren, but two grab samples taken from the shear zones collected by the author yielded nil and trace assays of gold, nil and 0.52 ounce of silver per ton; and 0.13 percent and 0.14 percent copper respectively (Mineral Research Branch, Division of Mines).

3) A shear and breccia zone occurs on the eastern boundary of Albanel Township (formerly Township 169) about 1.6 km (1 mile) south of the Little White River. A trench 9 m (30 feet) long exposes an east-trending quartz-carbonate vein about 3 m (10 feet) wide for a length of 150 m (500 feet). The shear zone and brecciated rocks hosting these veins are associated with an east-trending fault, and occur in sandstone with conglomerate lenses of the Gowganda Formation. The mineralization consists of disseminated chalcopyrite and pyrite in the quartz vein. A grab sample taken by the author yielded trace assays of silver and 2.6 percent copper (Mineral Research Branch, Division of Mines).

4) A shear zone is well exposed on a steep rock face overlooking the Little White River about 300 m (1,000 feet) west of the bailey bridge on the north side of the river. The massive chloritized shear zone strikes N40°E, has an almost horizontal dip, parallels the Flack Lake Fault, and occurs in the Nipissing Diabase. Associated with this zone are quartz carbonate, and potassic feldspar veins, and veinlets. The largest vein, about 0.3 m (1 foot) wide contains 1 mm to 1 cm wide fractures infilled with chalcopyrite. Specularite, malachite, pyrite, and epidote are some of the other minerals found in the veins. The mineralization was found by A.M. Clark, prospector in 1956 when a grab sample assayed 0.62 percent copper (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie).

5) Mineralization was located on the eastern boundary of Albanel Township (formerly Township 169) just north of Highway 546. A 3 m (10 feet) wide zone rich in chlorite and epidote contains stringers about 2.5 cm (1 inch) to 3.7 cm (1.5 inches) wide consisting of quartz with minor pyrite,

chalcopyrite, malachite, and azurite. The quartz stringers strike N75°E with a dip of 35°N and occur in the limestone of the Espanola Formation.

STANFORD MINES LIMITED (16)

The property consists of 20 unpatented mining claims, eight of which are located in Albanel Township. These claims are numbered SSM328867; SSM328868; SSM328875 to SSM328879 inclusive, SSM328885, and SSM328886, and are located on the eastern boundary of Albanel Township north of the Little White River. Limited work was done on the property in 1952 which uncovered two mineralized areas of limited extent. In 1954 S. Welsh optioned the property from a Mr. Paquette, and submitted samples for analysis which yielded 0.46 percent copper over a width of 88 cm (36 inches), 0.08 percent copper over 30 cm (12 inches), and 0.56 percent copper over 76 cm (30 inches), (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie). In 1965, air electromagnetic and magnetic surveys were carried out over the property, and a diamond-drill hole was drilled for a length of 138 m (453 feet). The location and party who performed the work are unknown. Minor copper mineralization was intersected over a width of 30 cm (1 foot). In 1971, Stanford Mines Limited aquired 20 unpatended claims known as the Hamilton Group. Blasting outlined a shear zone 1.2 to 1.8 m (4 to 6 feet) wide striking N20°E for 16.8 m (55 feet). In 1972, a diamond-drill hole was drilled for a length of 144.2 m (473 feet) on claim SSM328875. Grab samples yielded 7.45 percent copper, 1.6 percent copper, 0.15 ounce of silver per ton (Assessment Files Research Office, Division of Mines, Toronto).

The mineralized zone occurs in a shear zone striking N20°E in Lorrain sandstone which is cut by numerous diabase dikes. Quartz-carbonate-bearing veins striking north and N85°W carry chalcopyrite, malachite, azurite, and specularite. Chalcopyrite occurs as fracture fillings, or as disseminations in the shear zone.

Two grab samples taken by the author assayed nil and 0.02 ounce of gold per ton; nil and 0.36 ounce of silver per ton; and yielded 0.11 percent and 15.6 percent copper; nil and 0.24 percent zinc (Mineral Research Branch, Division of Mines).

SUMMIT DIVERSIFIED LIMITED (17)

The property located in the northwestern part of Kamichisitit Township (formerly Township 168), consists of 16 surveyed claims (SSM76664 to SSM76675 inclusive, and SSM76867 to SSM76870 inclusive). In 1965, North Summit Explorations Limited did trenching on the property, and uncovered a mineralized quartz vein. In the discovery vein, 300 m (1,000 feet) long on surface, four copper zones were found, as follows: (1) 94.5 m (310 feet) long, 2 m (6.3 feet) wide, averaging 3 percent copper; (2) 18 m (60 feet) long, 3 m (9.7 feet) wide, averaging 1.9 percent copper; (3) 14 m (45 feet) long, 2 m (6.6 feet) wide, averaging 2.3 percent copper; and (4) 34 m (110 feet) long, 3 m (9.6 feet) wide, averaging 0.9 percent copper. In 1966, ground electromagnetic, magnetometer, and self potential surveys indicated an anomaly on claim SSM76670, which was 430 m (1,400 feet) long and 137 m (450 feet) wide striking east. A follow up geochemical survey extended the anomaly to a width of 670 m (2,200 feet) which strikes east with a 55° dip to the south. That same year a diamond-drill hole was put down at an inclination of 45 degrees for a length of 126 m (412.5 feet), two samples yielded 1.85 percent copper for a length of 0.75 m (2.5 feet) and 2.4 percent copper for a length of 0.6 m (2 feet). In 1967, two more diamond-drill holes were drilled for a length of 394.7 m (1,295 feet) and 138.7 m (455 feet), at inclinations of 50° and 45° respectively. The longest hole yielded the following results: 1.37 percent copper for a length of 12 m (4 feet), at lengths of 336.8 to 338.3 m (1,105 to 1,110 feet), and 2.04 percent copper for a length of 0.9 m (3 feet) at length of 372.2 to 373.1 m (1,221 to 1,224 feet); (Assessment Files Research Office, Division of Mines, Toronto).

In 1971, Summit Explorations and Holdings Limited, did a scintillometer survey and drilled another diamond-drill hole for a length of 31.0 m (102 feet); no anomalies were discovered (Assessment Files Research Office, Division of Mines, Toronto).

Although no mineralization was observed by the field crew during the mapping project, a 4.6 to 6 m (15 to 20 feet) wide network of quartz-carbonate veins was observed 460 m (1,500 feet) northeast of Rackey Lake. The veins trending N80°W have vertical dips, and occur in a highly fractured and sheared zone in the conglomerate of the Gowganda Formation.

VENTURES CLAIMS LIMITED (18)

The property, consisting of five patented claims (SSM5521, SSM5522, SSM5523, SSM5595, and SSM5597) is located 4.4 km (2.75 miles) east of the southern end of Endikai Lake and about 300 m (1,000 feet) east of Le Scarbo Lake. This is an old property dating back to 1928 and 1929 when Sudbury Basin Mines Limited carried out surface work as well as making an adit 53.3 m (175 feet) long and doing 107.9 m (354 feet) of cross-cutting (Shklanka 1969, and Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie). A quartz-carbonate vein about 1.5 m (5 feet) wide mineralized with pyrrhotite, chalcopyrite, and galena, is exposed in a trench about 3 by 9 m (10 by 30 feet) trending N40°W. The vein was reported to have been traced on the surface for 150 m (500 feet), and a shoot in an adit (now collapsed) 24 m (80 feet) and 2 m (7 feet) wide averaged 7.6 percent lead, 1.0 percent copper, and 2.3 ounce of silver per ton (Shklanka 1969, and Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie). During the field season, the quartz vein and numerous other quartz-carbonate veins were located in the host Nipissing Diabase, as well as numerous pits and trenches and the collapsed adit. Chalcopyrite, pyrite, and galena were the main econcomic minerals observed. A sample rich in pyrrhotite was found at the site of the old dump. Five selected grab samples collected by the author yielded the following (Mineral Research Branch, Division of Mines):

(i) 0.10 ounce of gold per ton, 3.46 ounces of silver per ton, 1.56 percent copper, 0.63 percent lead, 0.26 percent zinc, 0.1 percent cobalt, and 0.05 percent bismuth.

(ii) 0.45 percent copper, 0.5 percent lead.

(iii) 0.62 ounce of silver per ton, 0.28 percent copper, 0.67 percent lead, 0.53 percent zinc, 0.13 percent cobalt.

(iv) 5.35 ounces of silver per ton, 1.077 percent copper, 36.6 percent lead, 0.05 percent bismuth.

(v) Trace of gold, 1.02 ounces of silver per ton, 0.59 percent copper, 0.14 percent lead, 0.10 percent cobalt.

Two other shear zones with no visible mineralization were located in the map-area. One occurs west of Bridge Lake where a quartz-carbonate vein about 4.5 m (15 feet) wide strikes N65°W, and was traced for approximately 300 m (1,000 feet).

Brown-weathering, sheared limestone with quartz-carbonate-chlorite veins occurs about 300 m (1,000 feet) west of Mistaken Lake. The shear zone strikes west along a ridge, and is 6 m (20 feet) wide.

SAND AND GRAVEL

The map-area has good potential as a source of sand and gravel. The Little White River meanders through broad sand plains consisting of Pleistocene melt water channel deposits. Numerous localities have heavy drift covered areas which conceal the bedrock, these areas are mainly concentrated in the northern part of the area, and consist of glacial boulder terranes which are locally derived.

RECOMMENDATIONS TO PROSPECTORS

The map-area has numerous small, but high-grade copper showings associated with shear zones in bedrock and Nipissing Diabase. A new copper showing was recently discovered in Espanola Limestone in the vicinity of the Nipissing Diabase. The Espanola Formation is a favourable host for copper, lead, and zinc deposits, and should be given more attention in the future.

The map-area is situated on the northern limb of the Quirke Syncline; to the east the uranium deposits are found. The map-area should be prospected for uranium mainly by diamond drilling to determine the extent of the uranium-bearing Matinenda Formation at the base of the Quirke Syncline.

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Geological Map

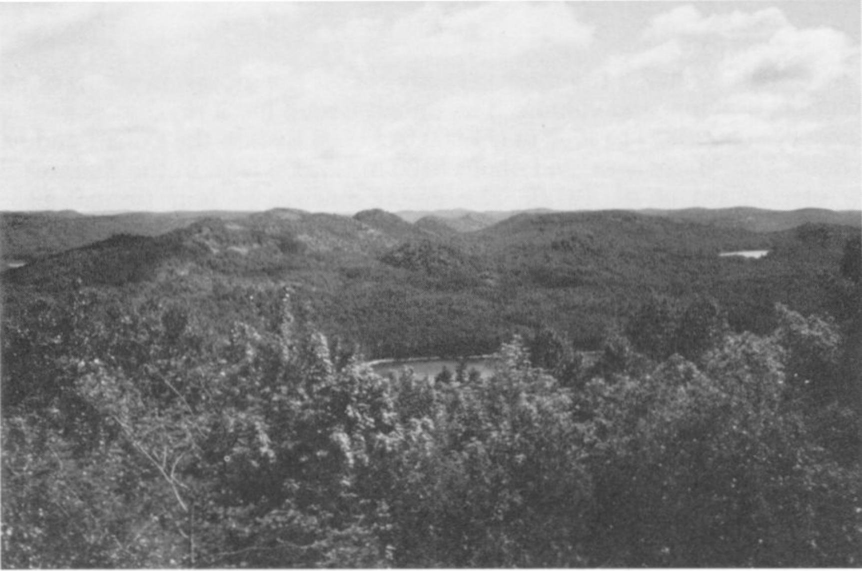
Map 2399 (coloured)–Endikai Lake, Algoma District.

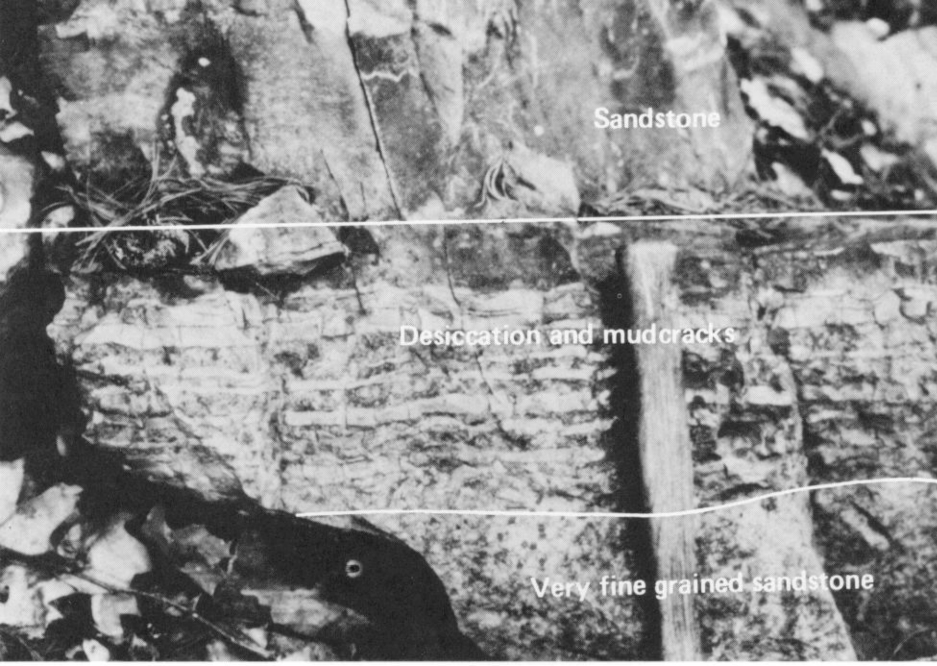
Scale 1:31 680 or 1 inch to ½ mile.

Chart

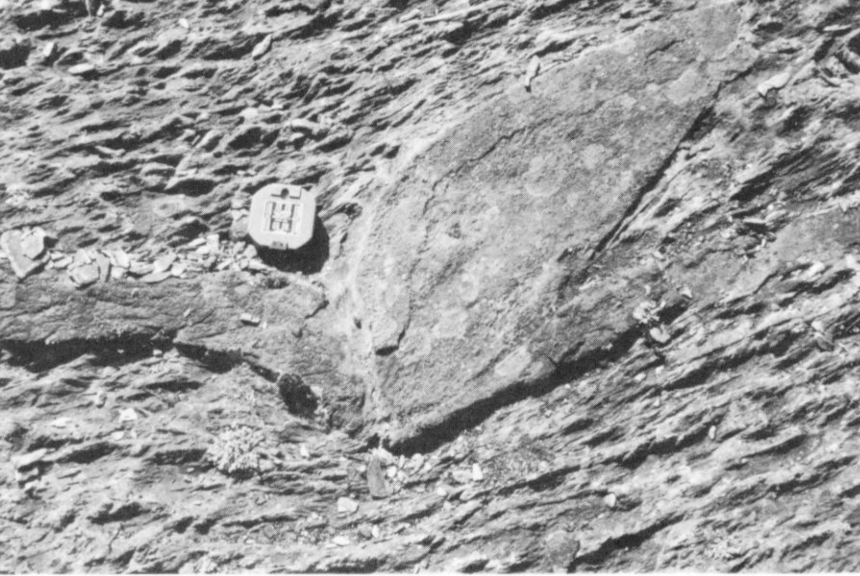
Chart A–Table 9


Matrix
Main
Rock
Fragment
Fragment




Sandstone
Desiccation and mudcracks
Very fine grained sandstone


Broken up chert nodules
in fine-grained sandstone



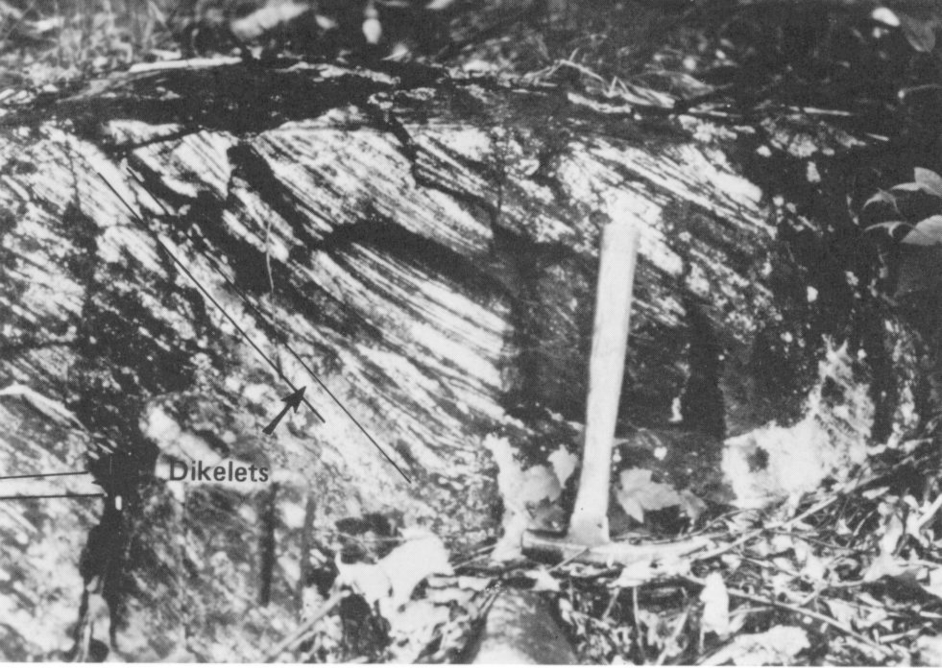

Dikelets

TABLE 9 | ASSESSMENT WORK ON FILE FOR ENDIKAI LAKE AREA[1].

Township	Property Number	Name of Property, Property Holder and/or parties performing Assessment Work	No. of Claims[2] held most recently (pre-1975)	Year Work Done	Type of Work Done; directed at detection of base metals unless otherwise specified.	Drilling[3]	Toronto File No.	Sault Ste. Marie File No.	Location by Geographical Landmarks and Surveyed Reference Points, (Property extent approximate; work areas specified).
Albanel Township[4]	2	Clarke, A.H.	6	(to 1974)					(Property) Northwest shore of Endikai Lake
	2	US-CA-Mex Explorations Ltd.	27	1970	GL-map; tr		63.2910		(Property) From Regal Lake (western Tp. boundary) to northwest shore of Endikai Lake; (Trenching) east end of Regal Lake
	2	Midrim Mining Co.Ltd.	part of 27 group	1955	GL	4-1645(501.4)	Albanel Tp.[4] Rept.13		(Property) From 1 mile (1.6 km) west of Endikai Lake to northeast shore of Endikai L.
	2	Teck Corporation Ltd	25	1952	GL-map	8-726.5(221.4)	Albanel Tp.[4] Rept.10		(Property) From east end of Regal Lake to northwest shore of Endikai Lake
	4	Cybulski, J.	1	(to 1974)					(Property) approx. ½ mile (0.8 km) west of Hwy.546 and ¾ mile (1.2 km) north of Cashen Lake
	4	Canamiska Copper Mines Ltd. (G.N. Milner Claim Group)	part of 42 group	1966	GL	1-467(142.3)		SSM 634	(Property 1966) from Hwy.546 and Cashen L. east to Elbow Lake and to the northeast of Dry Fly Lake
	4	Canamiska Copper Mines Ltd.	36	1965	GC-soil		63.1535		
	4	Canamiska Copper Mines Ltd.	part of 36 group	1965	GL-map; GP-G,EM,Mag		63.1800		(Drilling & ground work) ½ mile (0.8 km) west of Hwy.546, ¾ mile (1.2 km) north of Cashen Lake
	5	Desmarais, Guy Andre	12	(to 1974)	GL-tr				(Property) - Just east of the eastern tip of Narrow Lake to the Little White River south of Endikai Lake
	5	Falconbridge Nickel Mines Ltd.	31	1966	GL	2-2288(697.4)	Albanel Tp.[4] Rept.15		(Property) Southwest corner of the Tp. extending to Hwy.546; (Drilling) - ½ mile (0.8 km) east of Mistaken L. (S.W. of Prop.5)
	6a	Fort Norman Explorations Inc.	part of 44 group	1974	GL-tr; GP-G,EM	4-(no record of depth)	2.1575		(Property & air survey) From east Tp. boundary to EQ 45; (Drilling & ground work) ½ mile (0.8 km) south of Speckle Lake, 1 mile (1.6 km) west of eastern Tp. boundary
			44	1974	GP-A,EM,Mag,Rad,Res		2.1575		
	6a	Bruce-Presto Mines Ltd.	26	1965	GC-soil; GL-tr			SSM 620	(Property) South of Little White River from eastern Tp. boundary to EQ 46 & patented claim block; (Ground work) southeastern boundary of property
	6a	Bruce-Presto Mines Ltd.	26	1964	GP-G, IP Res			SSM 620	
	6a	Picton Uranium Mines Ltd. (- by Atlantic Richfield Co.)	8	1968	GL- [hole Arco P-4 an extension of DDH-4 drilled by Picton in 1955 - for Uranium	1-2175(662.9)		SSM 1357	(Property) from eastern Tp. boundary to EQ 46, EQ 45 & north to ½ mile (0.8 km) north of Speckle Lake (Drilling; Arco P-4) South shore of pond north of Speckle Lake
	6a	Picton Uranium Mines Ltd.	36	1955	GL - for Uranium	4-1631(497.1)	Albanel Tp.[4] Rept.12		(Property) same as above - (Drilling) same location as Arco P-4 and 3 additional holes along an east-west line just north of Hwy. 546, east of Speckle Lake
	6b	Fort Norman Explorations Inc.	1	(to 1974)	GL-tr; GP-A,EM,Mag,Rad,Res		2.1575		(Property) ¼ mile (0.4 km) southeast of EQ 45 on west side of Little White River; (Trenching) near banks of Little White River
	6b	David S. Robertson and Associates Ltd.	18	1970	GP-A,EM,Mag		63.2800		(Property & Air Survey) - from Little White River south of Endikai Lake, including Hwy. 546 to southeast corner of EQ 45
	6c	Fort Norman Explorations Inc.	part of 44 group	1974	GL-tr; GP-A,EM,Mag,Rad,Res		2.1575		(Property & Air Survey) same as stated for Property 6a (Trenching) Southern extension of the property near eastern Tp. boundary
	6c	Bruce-Presto Mines Ltd.	26	1965	GC-soil; GL-tr			SSM 620	(Property) same as stated for property 6a (Ground work) at eastern Tp. boundary in southeast corner of property
	6c	Bruce-Presto Mines Ltd.	26	1964	GP-G,IP,Res			SSM 620	
	6d	Fort Norman Explorations Inc.	6 & 3 parts-surveyed claims now EQ 45.	1974	GP-A,EM,Mag,Rad,Res		2.1575		(Property & Air Survey) is now surveyed block labelled EQ 45
		Clark, A.H. (not a property holder)		1956	(Inspection; grab sample for assay)			SSM 697	(Property) as above, samples taken in centre of EQ 45
	6e	Fort Norman Explorations Inc.	part of 44 group	1974	GL-tr; GP-A,EM,Mag,Rad,Res		2.1575		(Property & Air Survey) as stated for property 6a; (Trenching) eastern Tp. boundary just to the north of Hwy.546
	6e	Parson, G.E., and Baker, R.W.	9	1969	GP-G,Mag (on behalf of Hanna Mining Co.Ltd.)		63.2461		(Property & Ground Work) from EQ 45 to eastern Tp. boundary; north of Hwy. 546 to Speckle Lake
			9	1968	GL-map		63A.534		
	6e	Picton Uranium Mines Ltd.	36	1955	GL - for Uranium	4-1631(497.1)	Albanel Tp.[4] Rept.12		(Property & Drilling) same as stated for Prop.6a
	6f	Fort Norman Explorations Inc.	2	1974	GP-A,EM,Mag,Rad,Res		2.1575		(Property & Air Survey) ½ mile (0.8 km) north of Dry Fly Lake
	6f	Canamiska Copper Mines Ltd. (G.N. Milner Claim Group)	part of 36 group	1965	GC-soil		63.1535		(Property, 1965) From ¼ mile (0.4 km) east of Hwy.546 and west end of Cashen Lake, to Elbow Lake and to the northwest of Dry Fly L.
	6f	Canamiska Copper Mines Ltd.	part of 36 group	1965	GL-map; GP-G,EM,Mag		63.1800		
	6f	Canamiska Copper Mines Ltd.	part of 36 group	1965	GL-tr	15-2623(697.4)		SSM 634	(Ground work) Dry Fly Lake vicinity (Drilling & Trenching) just south of Dry Fly Lake - (work done is ½ mile (0.8 km) south of prop.6a marker number)
	9	Johnson, David	2	(to 1974)					(Property) ½ mile (0.8 km) east of Mistaken Lake - at Little White River
	9	Falconbridge Nickel Mines Ltd.	31	1966	GL	2-2288(799.5)	Albanel Tp.[4] Rept.15		(Property & Drilling) same as stated for Prop.5- but drilling was in immediate vicinity of prop.9 marker number
	10	Jorex Ltd.	2	(to 1974)					(Property) just west of Dry Fly Lake, ¼ mile (0.4 km) south of Hwy 546
	10	Canamiska Copper Mines Ltd. (G.N. Milner Claim Group)	part of 36 group	1965	GC-soil		63.1535		(Property, 1965) same as stated for prop.6f (Ground work & Drilling) same as stated for prop.6f; (work location generally to the southeast of prop. 10 marker number)
		Canamiska Copper Mines Ltd.	36	1965	GL-map, GP-G,EM,Mag		63.1800		
		Canamiska Copper Mines Ltd.	part of 36 group	1965	GL-tr	15-2623(799.5)		SSM 634	
	12	Levesque, Roland	5	(to 1974)					(Property) surrounding Dry Fly Lake to nearly ½ mile (0.8 km) south of Hwy. 546
	12	Canamiska Copper Mines Ltd. (G.N. Milner Claim Group)	part of 36 group	1965	GC-soil		63.1535		(Property 1965) same as stated for prop.6f (Ground work & Drilling) same as stated for prop.6f; (work location is in immediate vicinity of prop. 12 marker number)
	12	Canamiska Copper Mines Ltd.	36	1965	GL-map, GP-G,EM,Mag		63.1800		
	12	Canamiska Copper Mines Ltd.	part of 36 group	1965	GL-tr	15-2623(505.4)		SSM 634	
	13	McAllister, Richard	5	(to 1974)					(Property) from west end of Dobie Lake to approx. ¾ mile (1.2 km) west of Hwy. 546
	13	Canamiska Copper Mines Ltd. (G.N. Milner Claim Group)	part of 46 group	1965-66	GL	7-1658(505)		SSM 634	(Property 1966) same as stated for prop.4 - 1965 property extent was expanded by 10 claim "L-shaped" group on western corner (Ground work & Drilling) in immediate vicinity of west end of Dobie Lake and to the southwest
	13	Canamiska Copper Mines Ltd.	part of 46 group	1965	GC-soil		63.1535		
	13	Canamiska Copper Mines Ltd.	46	1965	GL-map; GP-G,EM,Mag		63.1800		
	15	Stanford Mines Ltd. (Hamilton Claim Group)	8	1972-74	GL	1-473(144.2)	Albanel Tp.[4] Rept.18 63.2907		(Property) northeast portion of Tp. ½ mile (0.8 km) north of Hwy. 546 (extends into adjoining Tp. to east);(Drilling) on eastern Tp. boundary 1 mile (1.6 km)
	15	Welsh, S. (Pauquette Claim Group)	3	1954	Assays on three samples			SSM 446	(Property) same location but smaller extent as Stanford Mines Ltd. property (above) - sampling done in same vicinity as Stanford Mines' drilling
	18	Ventures Claims Ltd. (White River Lead Prospect) - performed by,	5 patented						(Property) cross-shaped property on eastern side of Scarbo Lake adjoins southeast portion of EQ 46; (Ground work) ¼ mile (0.4 km) east of Scarbo Lake in central patented claim (SSM 5522)
	18	"Sudbury Basin Mines" — (later a subsidiary of Falconbridge Nickel Mines		1928-29	GL-adit(175 ft. or 53 m); tr (354 ft. or 108 m. in total)				
	19	Wilson, William	1	(to 1974)					(Property) central portion and along north shore of Dobie Lake
	19	Canamiska Copper Mines Ltd.	part of 36 group	1965	GC-soil		63.1535		(Property) same as stated for prop. 6f (Ground work) vicinity of North shore of Dobie Lake to Dry Fly Lake; (Drilling) near northwest shore of Dobie Lake
	19	Canamiska Copper Mines Ltd.	36	1965	GL-map; GP-G,EM,Mag		63.1800		
	19	Canamiska Copper Mines Ltd.	part of 36 group	1965	GL	2-650(198.1)		SSM 634	

Township	Property Number	Name of Property, Property Holder and/or parties performing Assessment Work	No. of Claims[2] held most recently (pre-1975)	Year Work Done	Type of Work Done; directed at detection of base metals unless otherwise specified.	Drilling[3]	Toronto File No.	Sault Ste. Marie File No.	Location by Geographical Landmarks and Surveyed Reference Points, (Property extent approximate; work areas specified).
	Miscellaneous	Gowganda Silver Mines Limited	12	1971			63.2942		(Property) ½ mile (0.8 km) north of EQ 45, 1 mile (1.6 km) east of Endikai Lake
		The Hanna Mining Co.	1	1969	GL (for uranium)	1-3002(915.0)	Albanel Tp.[4] Rept.17		(Property & Drilling) - straddles Hwy. 546 ¾ mile (1.2 km) east of eastern Tp. boundary
		Atlantic Richfield Co.	71 + 5 parts	1968	GP-A,EM,Mag,Rad		63.2825		(Property & Air Surveys) (Block 1) southwest corner of Tp. corners formed by Mistaken Lake Cashen and Dobie Lakes to Hwy.546, (Block 2) SE corner of Tp. + part at Elbow Lake
		Parsons, G.E.	2	1968	GL-map		63A.536		(Property) - adjoins northeast portion of EQ 46 - ¼ mile (0.4 km) south of Hwy.546
		Triller Explorations Ltd. (-by Atlantic Richfield Co.)	part of 18 group	1968	GL	1-4587(1398.1)	Albanel Tp.[4] Rept.16		(Property) adjoins Ventures Claims Ltd. prop. and extends east to ¼ mile (0.4 km) from the eastern Tp. boundary (Drilling & Ground work) central and eastern portions of property
		Triller Explorations Ltd.	part of 18 group	1967	GL	1-1543(470.3)		SSM 1077	
		Triller Explorations Ltd.	part of 18 group	1967	GL-map; GP-G,Mag		63.2213		
		Beaucoeur Yellowknife Mines Ltd.	16 (of 36 group)	1955	GL-map	1-952(290.2)	Albanel Tp.[4] Rept. 14 and 63A.305		(Property) west central portion of Tp. - east of Wilson Lake (Drilling) east of Wilson Lake
		Rosen, A.E.	5	1955	GL	1-400(121.9)	Albanel Tp.[4] Rept.11		(Property) eastern Tp. boundary ¼ mile (0.4 km) south of Hwy.546; (Drilling) -
	3	Copper Prince Mines Ltd. (formerly Property of Consolidated Mining and Smelting Co. & S. Dillabough)	8 patented	1947	GL-map			SSM 451	(Property and mapping) From western tip of Rackey Lake to 1¼ miles (2.0 km) east of western Tp. boundary; (Drilling & trenching) vicinity of west end of Rackey Lake and further west in central portion of property
			8 patented	1929-30	GL	18-6557(1998.6) (3 additional-no file record)		SSM 451	
			8 patented	1928	GL-tr (23 or more)			SSM 451	
	7	Garrelts, James E.	3 (9 originally)	(to 1974)	GL-3 tr				(Property & Ground work) ¾ mile (1.2 km) west of Rackey Lake
	7	Subeo Ltd.	39 + 5 parts	1968	GP-A,EM,Mag,scint.		63.2447		(Property & Air Survey) - northwest corner of Tp. - adjoining western portions of the surveyed Copper Prince Mines Ltd. Property
Kamichisitit Township[5]	7	Pathfinder Copper Mines Ltd.	11 of 31 group	1966	GP-G,IP		63.1912		(Property) - from western Tp. boundary to western portion of Copper Prince Mines Ltd. Property - extending ½ mile (0.8 km) to the south; (Ground work & drilling) - north central portion of property in vicinity and west of property 7 marker number
	7	Pathfinder Copper Mines Ltd.	11 of 31 group	1965	GC-soil; GP-G,EM,Mag,SP		63.1778		
	7	Pathfinder Copper Mines Ltd.	11 of 31 group	1965	GL	8-2282(695.6)	Kamichisitit Tp.[5] Rept.27		
	8	Happy, Denis James	3	(to 1974)					(Property) western Tp. boundary - ¼ mile (0.4 km) south of Hwy. 546
	8	Subeo Ltd.	39 + 5 parts	1968	GP-A,EM,Mag,scint		63.2447		(Property and Air Survey) same as stated above for property 7
	8	Pathfinder Copper Mines Ltd.	11 of 31 group	1966	GP-G,IP		63.1912		(Property) same as stated above for prop.7 (Ground work) extended from central to northwestern portions of property (drilling not done in immediate vicinity of property 8)
				1965	GC-soil; GP-G,EM,Mag,SP		63.1778		
	14	Solomon, Eugene D.	6 - (2 groups of 3 claims each)	(to 1974)					(Property, west) - on Western Tp. boundary ¾ mile (1.2 km) south of Hwy.546 (Property east) ¾ mile (1.2 km) southeast of Rackey L.
	14	Subeo Ltd.	part of 39 + 5 parts group	1970	GL	1-5941(1810.8)	Kamichisitit Tp.[5] Rept.25	SSM 1567	(Drilling) ¾ mile (1.2 km) southeast of Rackey Lake, ¼ mile (0.4 km) south of boundary for Copper Prince Mines Ltd. Property. (Property) same as stated above for property 7.
	14	Subeo Ltd.	39 + 5 parts	1968	GP-A,EM,Mag,scint.		63.2447		
	14	Pathfinder Copper Mines Ltd.	11 of 31 group	1966	GP-G,IP		63.1912		(Property & Ground work & drilling) same as stated above for property 7 and 8
	14	Pathfinder Copper Mines Ltd.	11 of 31 group	1965	GC-soil; GP-G,EM,Mag,SP		63.1778		
	14	Pathfinder Copper Mines Ltd.	11 of 31 group	1965	GL	8-2282(695.6)	Kamichisitit Tp.[5] Rept.27		
	16	Summit Diversified Limited (Summit Explorations and Holdings Ltd & North Summit Explorations Ltd.)	part of 16 surveyed group	1971	GL-map; GP-G,scint.	1-102(31.1)	2.492		(Property) From south central portion of Rackey Lake north to a lake (southeast of Cashen Lake) - roughly 2/3 mile (1.0 km) south of Tp. boundary; (Ground work & Drilling) in vicinity of the property 16 marker numbers; (a) on northeast shore of Rackey L. and; (b) central part of northern portion of the property
			part of 16 surveyed group	1966-67	GC-soil		63.2925	SSM 747	
			part of 16 surveyed group	1966-67	GL ; GP-G,EM,Mag,SP	3-2162(659.0)	63.1883		
	Miscellaneous	Raylloyd Mines & Explorations Ltd.	3	1973	GP-A,Mag		2.1249		(Property and Air Survey) eastern Tp. boundary covering parts of Keeler Lake and parts of its north and eastern shoreline
		Fidelity Mining & Investments Ltd. (-by Cominco)	part of 18 group	1969-70	GL	1-5721(1743.8)	Kamichisitit Tp.[5] Rept.20	SSM 1486	(Drilling) on centre of property 1 mile (1.6 km) east of central part of shoreline of Rackey Lake
		Fidelity Mining & Investments Ltd.	18	1968	GP-A,EM,Mag		63.2318		(Property & Air Survey) 1¼ miles (2.0 km) south of Tp. boundary. East of Rackey Lake
		Atlantic Richfield Co.	58 + 5 parts	1968	GP-A,EM,Mag,Rad		63.2825		(Property & Air Survey) northwest corner of Tp. also block extending from north central portion to northeast corner of Tp. including most of Big Lake
		Latcham Enterprises Ltd.	9	1965	GC-soil; GP-G,Mag		63.1723		(Property & Ground work) Hwy.546, east to boundary of Summit Diversified Property
	1	Charbonneau, Henry	20	(to 1974)					(Property) - northeast corner of Tp. - including part of Little White River
	1	Subeo Ltd.	30 + 5 parts	1968	GP-A,EM,Mag,scint.		63.2447		(Property & Air Survey) - northeast portion of Tp.; straddles Little White River - extends 1½ miles (2.4 km) west of eastern Tp. boundary
Nouvel Township[6]	11	Kakish, Joseph	originally 6 (map) 3	(to 1974)					(Property) from northern Tp. boundary to ¾ miles (1.2 km) to the south, 1¼ miles (2.0 km) west of eastern Tp. boundary
	11	Falconbridge Nickel Mines Ltd.	10	1970	GL	1-1285(391.7)	Nouvel Tp.[6] Rept.13		(Property) same as stated above for Kakish prop. - except extension further to west is another ½ mile (0.8 km) (Drilling) eastern part of property
	Miscellaneous	Pacific Petroleums Ltd. (H.C. Kerr, Claim Group)	part of 245 group 169 claims in Nouvel Tp.	1968	GP-A,EM,Mag		63.2303		(Property & Air Survey) within map-area; west of Little White River to western Tp. boundary - ¾ miles (1.2 km) south of Tp. boundary
		Radex Syndicate (D.J. Happy, Claim Group)	32 (marginal to map-area)	1968	GP-A,EM,Mag		63.2394		(Property & Air survey) coincides approx. with south limit of map-area boundary in west central portion of Tp.
		Sheba Mines Ltd. (interest controlled by Cove Uranium Mines)	1 of 20 surveyed group	1959	GL-map, tr; GP-G, scint. (for uranium)	1-1262(384.7)	Nouvel Tp.[6] Rept.11	SSM 464	(Property) along Hwy.546 & to south (beyond map-area)-(work done outside map-area)
		Cove Uranium Mines Ltd.	3 of 20 surveyed group	1957	GL (for uranium)	9-1718(523.7)	Nouvel Tp.[6] Rept. 11		(Property) same as above (work done on eastern portion of property)
Varley Township	17	Vanlith, George	33	(to 1974)					(Property) southeastern corner of Tp. south of EQ 37
		Falconbridge Nickel Mines Ltd.	1 of 19 group (remnants of 190 group)	1966	GL	1-2321(707.4)	Varley Tp.[7] Rept.10		(Property; 19 claims) - Bridge Lake to Bull L. (Drilling) south of Bridge Lake
Miscellaneous		First National Uranium Mines Ltd.	18	1969	GL-map (for uranium)		63.2463		(Property & work) southwest corner of Tp. to Hoover Lake
		Radex Syndicate (D.J. Happy Claim Group)	177	1968	GP-A,EM,Mag,spec		63.2394		(Property & Air Survey) central portions from east to west sides of Tp. Castra Lake - Bridge, East Twin, West Twin - Mistaken Lakes
		Falconbridge Nickel Mines Ltd.	1 of 19 group (remnants of 190 group)	1967	GL-(drilling performed outside)	1-2351(716.6)	Varley Tp.[7] Rept.11.		(Drilling) just southwest of west end of Waterhole Lake
		Beaucoeur Yellowknife Mines Ltd.	20 (of 36 group)	1955	GL-map		63A.305		(Property & work) west of eastern Tp. boundary, including Wilson Lake area

Notes:
[1] Assessment Files Research Office, Division of Mines, Toronto.
[2] Number of claims held at date work done (original size of group may be specified separately); number of claims of a larger claim block which fall within specified township only.
[3] Number at diamond-drill holes; total footage (metres) i.e. 4-1645 (501.4) reads 4 holes 1645 feet total, 501.4 m total
[4] Formerly Township 169
[5] Formerly Township 168
[6] Formerly Township 175
[7] Formerly Township 176

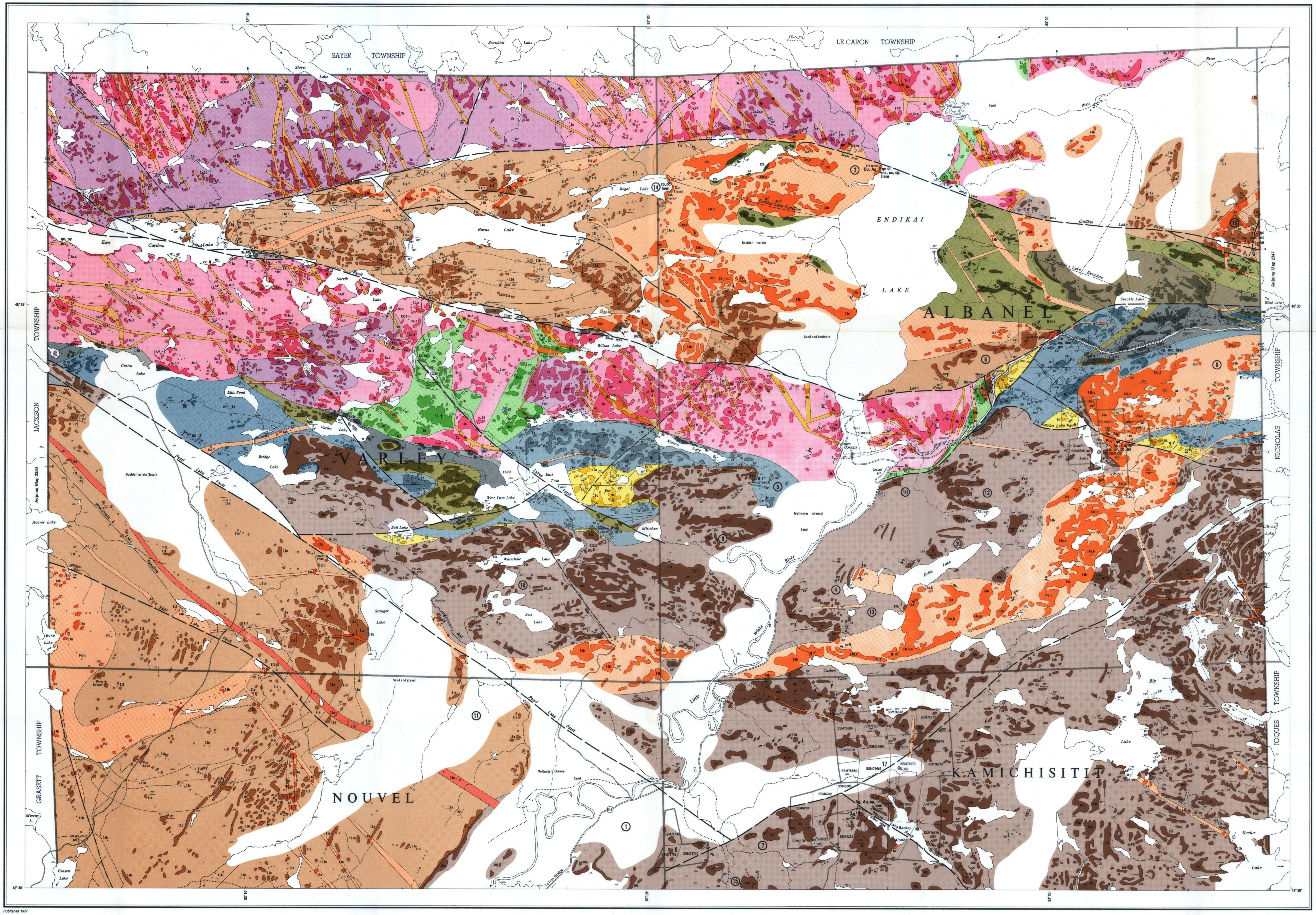
Abbreviations:
A — Airborne
DDH-Diamond-drill hole
EM — Electromagnetic
G — Ground
GC — Geochemical
GL — Geological
GP — Geophysical
IP — Induced polarization
Mag — Magnetic
Rad — Radiometric
Res — Resistivity
scint — scintillometer
soil — soil samples
SP — Self potential
spec — spectrometer
tr — trenching

Ministry of Natural Resources
Ontario

Hon. Frank S. Miller
Minister

Dr. J. K. Reynolds
Deputy Minister

Ontario Geological Survey
Map 2399
Endikai Lake



Scale: 1 inch to 50 miles

N.T.S. Reference: 41J/10, 41J/11

LEGEND

PHANEROZOIC

CENOZOIC[a]

QUATERNARY

PLEISTOCENE AND RECENT

Glacial, glaciofluvial, glaciolacustrine, swamp, lake, and stream deposits.

UNCONFORMITY

PRECAMBRIAN[b]

LATE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

15 — *15a Olivine diabase.*

INTRUSIVE CONTACT

MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

NIPISSING DIABASE

14
- *14a Diabase, gabbro, diorite.*
- *14b Metadiabase, metagabbro, amphibolite, quartz metagabbro.*
- *14c Granophyre.*
- *14d Pegmatitic metagabbro.*
- *14e Fine-grained diabase dikes.*[c]

INTRUSIVE CONTACT

HURONIAN SUPERGROUP

COBALT GROUP

BAR RIVER FORMATION[d]

13
- *13b Thinly bedded orthoquartzite.*
- *13a Massive white orthoquartzite.*

GORDON LAKE FORMATION[d]

12
- *12c Buff to red interbedded sandstone and siltstone, greywacke.*
- *12b Green cherty siltstone.*
- *12a Fine-grained pink sandstone.*

LORRAIN FORMATION[d]

11
- *11f White orthoquartzite.*
- *11e Pink to buff pebbly sandstone.*
- *11d Fine-grained hematitic sandstone.*
- *11c Quartz jasper-pebble conglomerate. (Puddingstone).*
- *11b Pink hematitic pebbly sandstone.*
- *11a Basal purple and green sandstone and feldspathic sandstone.*

GOWGANDA FORMATION[e]

Upper Gowganda Formation[d]

10
- *10j Feldspathic sandstone of the Transition Zone.*
- *10h Laminated purple siltstone.*
- *10g Red arkose.*
- *10f Feldspathic sandstone, arkose, siltstone.*
- *10e Slumped sandstone in siltstone.*[f]

Lower Gowganda Formation[g]

10
- *10a Polymictic clast supported conglomerate with arkose interbeds.*
- *10b Polymictic matrix supported conglomerate with feldspathic sandstone, arkose, conglomeratic sandstone, mudstone, greywacke, and clast supported conglomerate interbeds.*
- *10c Massive polymictic matrix supported conglomerate.*
- *10d Laminated to massive siltstone and mudstone with or without occasional pebbles.*
- *10e Slumped sandstone in siltstone.*[f]

UNCONFORMITY-DISCONFORMITY

QUIRKE LAKE GROUP

SERPENT FORMATION[h]

9
- *9a Calcareous sandstone with minor siltstone interbeds.*
- *9b Feldspathic sandstone, arkose.*
- *9c Sandstone with conglomeratic interbeds.*

ESPANOLA FORMATION[d]

8
- *8c Calcareous to non-calcareous sandstone with siltstone interbeds.*
- *8b Laminated to massive siltstone.*
- *8a Laminated to massive limestone and dolomite.*

BRUCE FORMATION[h]

7
- *7a Polymictic matrix supported conglomerate with sandstone interbeds.*
- *7b Polymictic matrix supported conglomerate in greywacke to protoquartzite matrix.*
- *7c Polymictic clast supported conglomerate.*

HOUGH LAKE GROUP

MISSISSAGI FORMATION

6 — *6a Feldspathic sandstone.*

BASAL SEDIMENTARY UNIT[i]

5
- *5a Sandstone.*
- *5b Polymictic to oligomictic conglomerate.*
- *5c Regolith.*

NONCONFORMITY

EARLY PRECAMBRIAN (ARCHEAN)

MAFIC INTRUSIVE ROCKS[j]

4
- *4a Porphyritic metadiabase.*
- *4b Amphibolite.*
- *4c Ultramafic dikes.*

INTRUSIVE CONTACT

FELSIC INTRUSIVE AND METAMORPHIC ROCKS

GRANITIC INTRUSIVE ROCKS

3
- *3a Grey biotite trondhjemite.*
- *3b Pink hornblende granodiorite, quartz monzonite.*
- *3c Porphyritic pink monzonite.*
- *3d Late pink aplitic, pegmatitic intrusions.*

INTRUSIVE CONTACT

GNEISSIC INTRUSIVE AND MIGMATITIC ROCKS

2
- *2a Mafic to leucocratic orthogneiss and migmatite.*
- *2b Coarse-grained amphibolite.*

INTRUSIVE CONTACT

METAVOLCANICS AND METASEDIMENTS

1
- *1a Mafic, intermediate, and felsic flows and pyroclastics.*
- *1b Layered and foliated metavolcanics and metasediments.*[k]
- *1c Strongly metamorphosed mafic metavolcanics.*

Breccia.

Ag	*Silver.*
Au	*Gold.*
Bi	*Bismuth.*
cc	*Chalcocite.*
Co	*Cobalt.*
cp	*Chalcopyrite.*
Cu	*Copper.*
Fe	*Iron.*
gn	*Galena.*
hem	*Hematite.*
mag	*Magnetite.*
mc	*Malachite.*
Pb	*Lead.*
po	*Pyrrotite.*
py	*Pyrite.*
q	*Quartz.*
qc	*Quartz-carbonate.*
Zn	*Zinc.*

SYMBOLS

- *Glacial striae.*
- *Small bedrock outcrop.*
- *Area of bedrock outcrop.*
- *Bedding, horizontal.*
- *Bedding, top unknown; (inclined, vertical).*
- *Bedding, top indicated by arrow; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).*
- *Gneissosity, (horizontal, inclined, vertical).*
- *Foliation; (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.*
- *Lineament.*
- SZ — *Shear zone.*
- *Jointing; (horizontal, inclined, vertical).*
- *Drag folds with plunge.*
- *Anticline, syncline, with plunge.*
- DH — *Drill hole; (vertical, inclined).*
- 10′ — *Vein, width in inches, feet.*
- RA — *Radioactivity.*
- *Swamp.*
- 546 — *Motor road; provincial highway number encircled where applicable.*
- *Other road.*
- *Trail, portage, winter road.*
- IV — *Township boundary, with milepost, approximate position only.*
- 17 — *Mining property, surveyed, approximate position only.*
- 18 — *Mineral deposit; mining property, unsurveyed.*
- *Surveyed line, approximate position only.*

Published 1977

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

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

[c] *Some diabase dikes may be of younger age than Nipissing Intrusions.*

[d] *These formations are subdivided on the basis of stratigraphic order.*

[e] *The Gowganda Formation is divided into two parts: the Upper non-conglomeratic formation and the Lower conglomeratic formation.*

[f] *This unit repeats itself throughout the Gowganda Formation.*

[g] *The Lower Gowganda Formation is subdivided on the basis of lithology and sedimentary sequences.*

[h] *These formations are subdivided on the basis of lithology and the lithologic units are not in stratigraphic order.*

[i] *The Basal sedimentary unit is part of the unconformity and grades into the overlying unit.*

[j] *Diabase intrusions in the Early Precambrian (Archean) basement are difficult to distinguish and may include dikes of the Nipissing type metadiabase.*

[k] *The metasediments and metavolcanics are foliated and injected with granitic bands. In places primary textures can still be observed.*

Ontario Geological Survey
Map 2399

ENDIKAI LAKE

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

SOURCES OF INFORMATION

Geology by K. M. Siemiatkowska and assistants, Geological Branch, 1974.
Geology is not tied to surveyed lines.

Unpublished maps, plans, and drill logs of mining companies.

Aeromagnetic maps 2227G, 2241G, ODM-GSC.

Ministry of Natural Resources map S465, Surficial geology of Algoma, Sudbury, Timiskaming, and Nipissing Districts, 1965.

Preliminary maps (ODM) P. 304, Blind River—Elliot Lake Sheet, Scale 1 inch to 2 miles, issued 1971, P. 1001 and P. 1002, Endikai Lake Area (west and east parts), scale 1 inch to ¼ mile, issued 1975.

Cartography by P. A. Wisbey and assistants, Surveys and Mapping Branch, 1977.

Base maps derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch, with additional information by K. M. Siemiatkowska.

Magnetic declination in the area was approximately 5°30′ West in 1974.

PROPERTIES, MINERAL DEPOSITS

1. *Charbonneau, H.*
2. *Clark, A. H.*
3. *Copper Prince Mines Ltd.*
4. *Cybulski, J.*
5. *Desmarais, G. A.*
6. *Fort Norman Explorations Inc.*
7. *Garrelts, J. E.*
8. *Happy, D. J.*
9. *Johnson, D.*
10. *Jorex Ltd.*
11. *Kakish, J.*
12. *Levesque, R.*
13. *McAllister, R.*
14. *Regal Lake occurrence.*
15. *Solomon, E. D.*
16. *Stanford Mines Ltd.*
17. *Summit Diversified Ltd.*
18. *Vanlith, G.*
19. *Venture Claims Ltd.*
20. *Wilson, W.*

Information current to December 31st 1974.

For further information see report.