

Twenty Seventh Annual Meeting

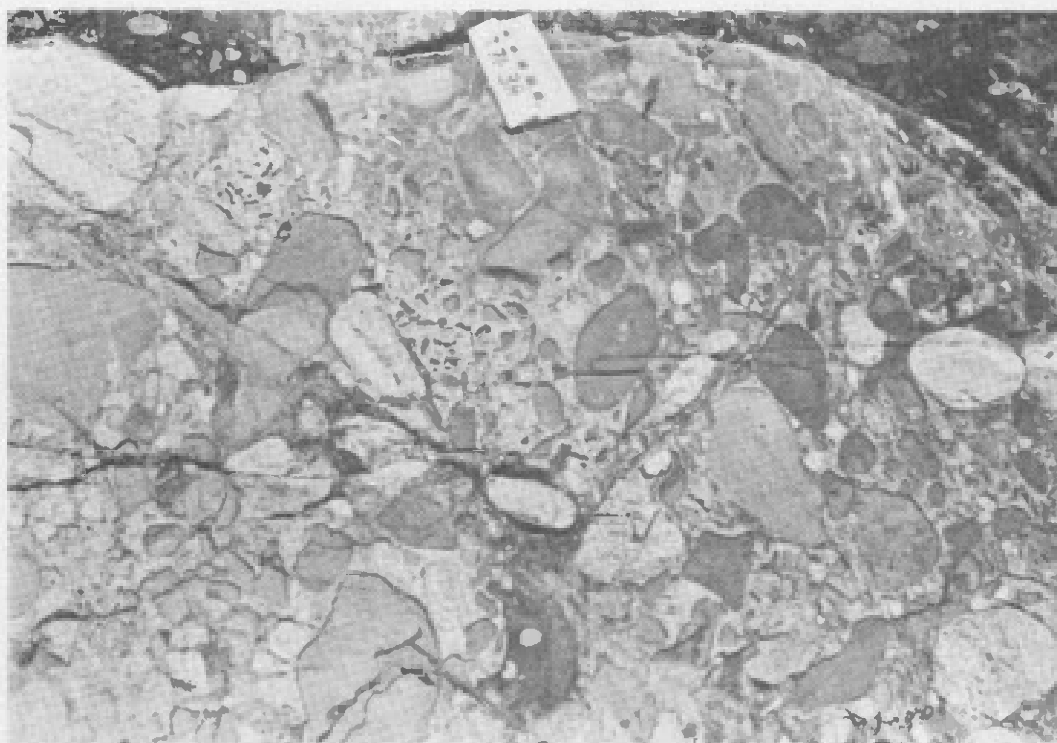
Lansing, Michigan

Institute on Lake



Superior Geology

May 11-12, 1981



The Huronian Between Sault Ste. Marie and Thessalon

THE HURONIAN ROCKS BETWEEN SAULT STE. MARIE
AND THESSALON
DISTRICT OF ALGOMA
ONTARIO

MAY 11-12, 1981

FIELD EXCURSION GUIDE

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THE HURONIAN SUPERGROUP OF THE SAULT STE. MARIE
AND THESSALON AREAS, ONTARIO

Introduction:

Previous Work:

The Huronian Supergroup is probably the most studied sequence of rocks in Canada with published observations going back to 1821.

Knight (1915) investigated part of the areas and recognized volcanic rocks in the Thessalon area.

Collins (1925) memoir included the first accurate geological map of the North Shore of Lake Huron and his stratigraphic subdivision of the Huronian has only recently been supplanted. McConnell (1927) described the rocks of the Sault Ste. Marie area and placed the Huronian rocks in their correct stratigraphic position. Chandler (1973, 1976) did detailed mapping for the Ontario Division of Mines in the area west of Wakomata Lake.

Frarey (1977) culminated several seasons of mapping for the Geological Survey of Canada with the publication of a memoir on the geology between Sault Ste. Marie and Blind River. Frarey revised the stratigraphic scheme for the Sault Ste. Marie area and recognized additional Huronian volcanic rocks in the Aberdeen Lake area.

The writer carried out $\frac{1}{4}$ mile to the inch mapping for the Ontario Geological Survey between Sault Ste. Marie and the Aberdeen Lake area between 1974 and 1977. A study of the stratigraphic relationships of the Huronian volcanic rocks was begun in 1978 (Bennett in preparation).

In addition to the above studies there are many studies of specific problems relating to the Huronian geology. Most of the significant theses and publications are given in the references accompanying this field guide.

General Geology:

The Lower Proterozoic (Aphebian) Huronian Supergroup forms part of the Southern Province of the Canadian Shield. These predominantly clastic sedimentary rocks form an east-west trending belt about 35 miles (56 km) wide extending along the north shore of Lake Huron as far east as the Quebec border, a distance of approximately 200 miles (320 km). The total stratigraphic thickness of Huronian rocks is about 40,000 feet (12,000 m).

An absolute age for the Huronian rocks has not yet been firmly established. The basal Huronian rocks lie unconformably upon Archean granitic rocks of the Superior Province which give K-Ar ages of 2,500 m.y. Nipissing diabase which intrudes the Huronian sequence has been dated by Sr-Rb methods at 2,150 m.y. (Van Schmus, 1965).

The Huronian rocks along the north shore of Lake Huron are part of the Penokean Fold Belt and have undergone varying degrees of deformation and metamorphism. Radio-metric dating of metamorphic rocks generally gives ages between 1,600 and 1,800 m.y.

In the area between Sault Ste. Marie and the east end of Quirke Lake Syncline Huronian rocks are metamorphosed to lower greenschist facies and strata are deformed into open folds or a south to southwest dipping homocline. Normal fault sets strike northeast and northwest. Most movement occurred along northwest trending thrust faults (Frarey, 1977).

East of the Quirke Lake Syncline the metamorphism and deformation is more intense. In the Sudbury-Espanola area dips are generally steep, folds are locally tight and the metamorphic grade is almandine-amphibolite facies (Card et al 1972).

Elliot Lake Group:

In the Sault Ste. Marie and Thessalon areas the Elliot Lake Group is represented by the Livingstone Creek, Thessalon, and Matinenda Formations. The McKim Formation, a very thick sequence of mudstones, siltstone and turbidites present in the eastern half of the Huronian belt has not been recognized in the area between Sault Ste. Marie and Thessalon (Frarey, 1977).

The Livingstone Creek Formation:

The Livingstone Creek Formation is a clastic sedimentary sequence which overlies the Archean basement rocks and which is, in turn, overlain by the Thessalon Formation volcanics. In the Quirke Lake Syncline the Livingstone Creek Formation is missing and the Thessalon volcanics lie directly on the basement.

In the Sault Ste. Marie area the Livingstone Creek Formation can be subdivided into a conglomerate member, a sandstone member, and a quartz-arenite member. The conglomerate member of variable thickness is locally present at the base of the formation, although in Morin Township, about 25 miles (40 km) north of the Thessalon area, the conglomerate member occurs at least one hundred feet (33 m) above the base.

TABLE OF FORMATIONS FOR THE SAULT STE. MARIE AND THESSALON AREAS

PHANEROZOIC

CENOZOIC

(max. thickness in feet)

Pleistocene and Recent

Gravel, sand, silt, clay and organic deposits

Unconformity

Paleozoic

Ordovician

Limestone, shale, sandstone

Unconformity

PRECAMBRIAN

LATE PRECAMBRIAN (PROTEROZOIC)

Jacobsville Formation (+ 700)

Sandstone, shale, conglomerate

Unconformity

KEWEENAWAN GROUP

Mamainse Point Formation

Basalt, rhyolite, conglomerate, diabase,
felsite dikes

Unconformity

Olivine diabase dikes, lamprophyre dikes

Intrusive Contact

MIDDLE PRECAMBRIAN (PROTEROZOIC)

Nipissing Diabase

Gabbro, diabase, granophyre

HURONIAN SUPERGROUP

COBALT GROUP

Bar River Formation (1000)

Quartz arenite

Gordon Lake Formation (1000)

Siltstone, chert

Lorrain Formation (8000)

Arkose, quartz arenite, pebble conglomerate,
siltstone, mudstone

Gowganda Formation (3500)

Matrix supported and clast supported conglomerates,
siltstone, mudstone, wacke, arkose

Disconformity

QUIRKE LAKE GROUP

Serpent Formation (800)

Subarkose, conglomerate

Espanola Formation (650)

Grey limestone, siltstone, dolomite

Bruce Formation (300)

Matrix supported conglomerate

Local Disconformity

HOUGH LAKE GROUP

Mississagi Formation (5000?)

Subarkose, pebble conglomerate, arkose

Aweres Formation

Subarkose, arkose, clast and matrix supported
conglomerate, siltstone

Pecors Formation (Not recognized in Sault Ste. Marie area)

Mudstone

Ramsay Lake Formation

Matrix supported conglomerate

Local Disconformity

ELLIOT LAKE GROUP

McKim Formation (Not recognized in Sault Ste. Marie area)

Mudstone, siltstone, wacke

Matinenda Formation

Arkose, subarkose, quartz wacke, uraniferous
quartz pebble conglomerate

Disconformity

Thessalon Formation (3500)

Basalt, andesite, rhyolite, basaltic andesite,
minor arkose, pebble conglomerate

Disconformity

Livingstone Creek Formation (+ 1000)

Subarkose, clast supported conglomerate,
quartz arenite

Unconformity

EARLY PRECAMBRIAN (ARCHEAN)

Late Intrusive Rocks

Diabase, gabbro dikes

Intrusive Contact

Plutonic Rocks

Porphyritic quartz monzonite, granitic gneiss,
migmatite

Intrusive Contact

Metavolcanic-metasedimentary belts

Mafic to felsic metavolcanics, metasediments,
gabbro and porphyry intrusions

Sources of Information:

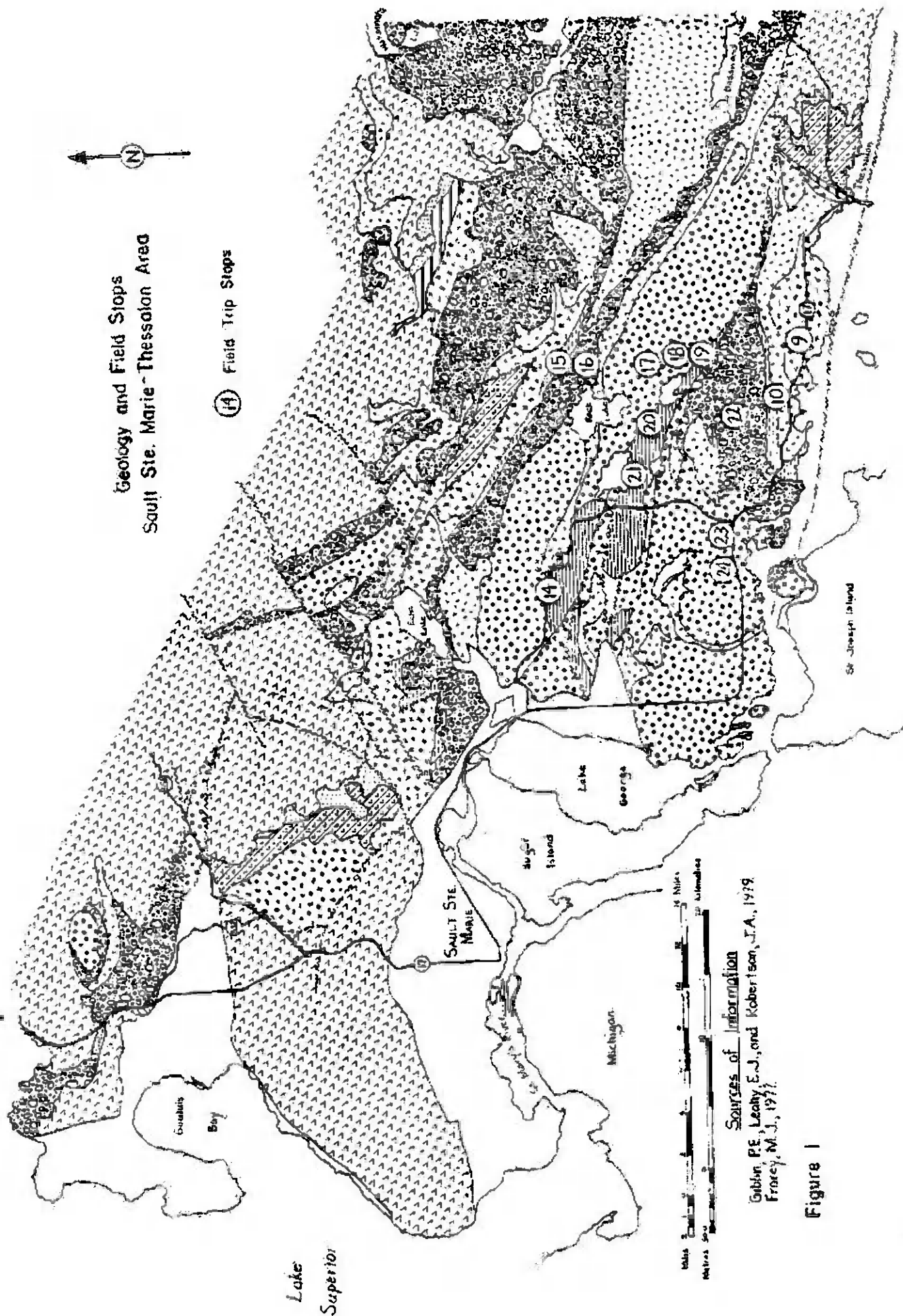
Frarey, 1977.

Robertson et al, 1969.

Bennett et al, 1975.

LEGEND FOR FIGURE 1

	LATE PRECAMBRIAN AND PALEOZOIC	
	NIPissing DIABASE	
	COBALT GROUP Gordon Lake and Bar River Formations	
	Lorrain Formation	
	Gowganda Formation	
	QUIRKE LAKE GROUP	
	HOUGH LAKE GROUP	
	ELLIOT LAKE GROUP Matinenda Formation	
	Thessalon Formation	
	Livingstone Creek Formation	
	EARLY PRECAMBRIAN BASEMENT	
		Symbols
		 Fault
		 Thrust fault (Hanging wall)
		 Highway with number



Sources of Information
 Giblin, P.E., Leachy, E.J., and Robertson, J.A., 1979.
 Francy, M.J., 1977.

Figure 1

The conglomerate member consists of clast supported granite cobble to boulder conglomerate with coarse sandstone interbeds. The granitic megaclasts are typically pale grey in contrast to the pink to reddish granitic rocks which make up much of the basement. Clasts of diorite, gabbro, quartz and mafic volcanics are subordinate to the granitic component.

The sandstone member forms the bulk of the Livingstone Creek Formation. This unit consists predominantly of fine to medium-grained, grey subarkose and arkose displaying planar and trough cross-beds. Interbeds of siltstone, mudstone or pebble conglomerate are rare within the sandstone member. The member is locally calcareous.

An upper quartzarenite member of the Livingstone Creek Formation, up to 10 meters (30 feet) thick, has been recognized only in the Sault Ste. Marie area where it directly underlies the Thessalon flows. It is a pale grey to white, or yellowish grey, fine-grained, silicious subarkose and quartzarenite. The quartzarenite member is generally well sorted and finer grained than the subarkose member.

The Livingstone Creek Formation is up to at least 1,200 feet (350 m) thick in the Sault Ste. Marie area. Frarey (1977) gives the thickness of the Livingstone Creek Formation in the Thessalon area as up to 300 feet (100 m).

The Thessalon Formation:

The Thessalon Formation (Frarey, 1967) is a predominantly volcanic sequence near or at the base of the Huronian Supergroup west of the nose of the Quirke Lake Syncline. The distribution of the Thessalon Formation is shown in Figure 2.

The Thessalon Formation is underlain by the Livingstone Creek Formation as far east as the Crazy Lake area. In the Dollyberry Lake and Pecors Lake areas the Thessalon Formation lies directly on the Early Precambrian basement. Drill logs indicate that the Livingstone Creek Formation is missing throughout the Quirke Lake Syncline.

In the Sault Ste. Marie and Aberdeen Townships areas the Thessalon Formation is up to at least 3,500 feet (1000 m) thick. In the Thessalon area the Huronian volcanics are about 1,500 feet (450 m) thick, but may be thicker under Lake Huron. In the Quirke Lake Syncline drill hole data indicates thickness from 0 to about 500 feet (150 m) of Thessalon Formation is present.

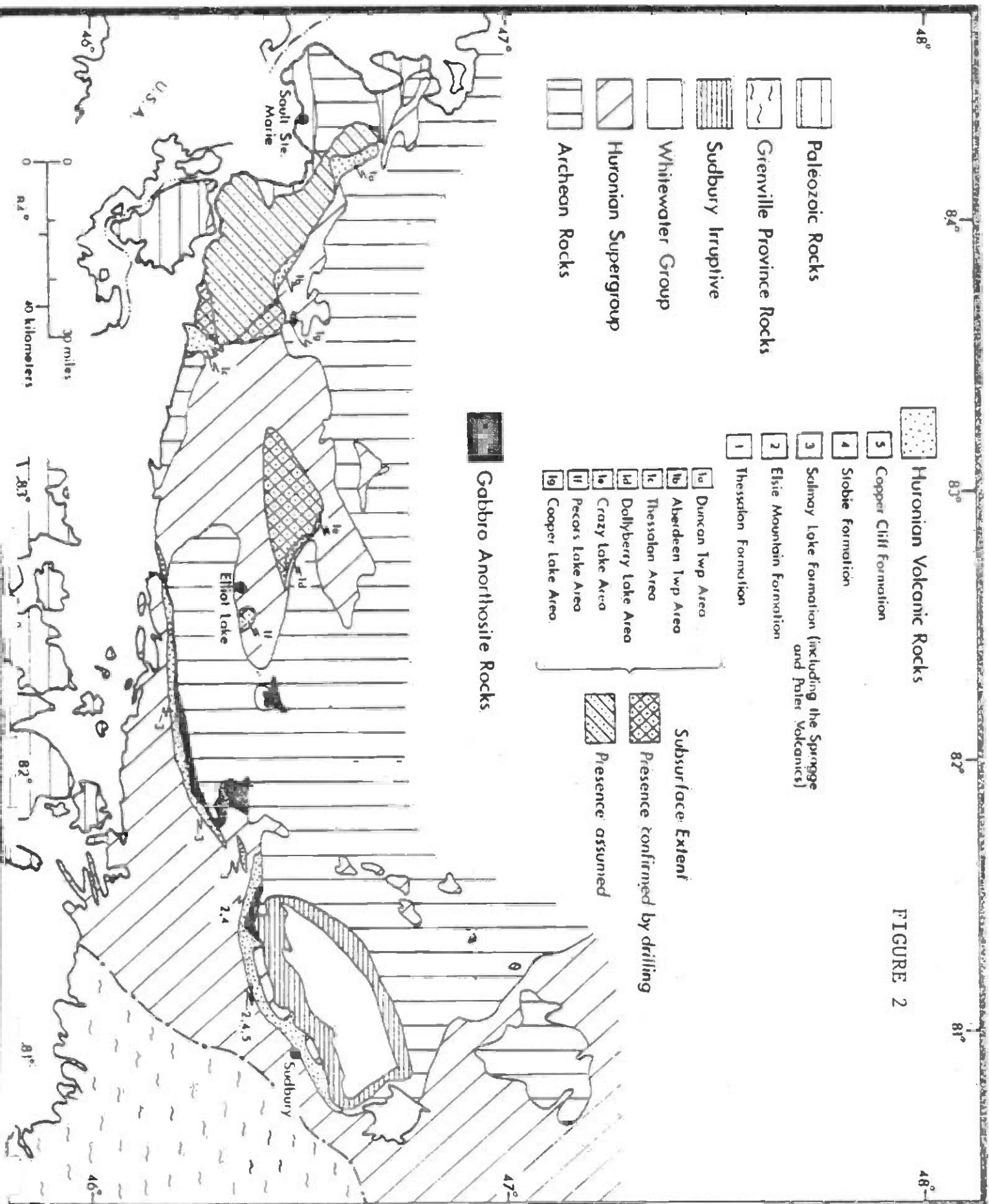


FIGURE 2

Thin lenses of coarse, poorly-sorted arkose and quartz pebble conglomerate are locally present at the base, or intercalated with the lowermost few flows, of the Thessalon Formation. These clastic units are in places pyritic and radioactive. These radioactive quartz pebble conglomerates are not correlated with the uranium bearing Matinenda Formation of the Elliot Lake area because thin clastic units, lithologically identical to these at the base of the Thessalon Formation in the Sault Ste. Marie-Thessalon area, occur at the base of the Thessalon Formation in the Dollyberry Lake and Crazy Lake areas (Figure 2). At the latter location the Matinenda Formation overlies the volcanic rocks and there is evidence of disconformity between them.

The available whole rocks chemical analyses suggest that the volcanic rocks of the Thessalon Formation can be subdivided into two groups or members, an (upper) tholeiitic basalt member, and a (lower) mixed member. There is some interfingering of these members, and in the Sault Ste. Marie area the mixed member is locally missing or very thin so that the basaltic member rests on the Livingstone Creek Formation.

The mixed member varies in content from area to area. In the Sault Ste. Marie and Aberdeen Lake areas the mixed member is predominantly basaltic andesite with minor hawaiite. In the Thessalon area icelandite, rhyolite, tholeiitic andesite, high-magnesium tholeiitic basalt and mugearite are present. In the Dollyberry Lake area mugearite, hawaiite rhyolite, volcanic breccia and high-magnesium tholeiitic basalt, tholeiitic basalt and andesite have been identified.

The (upper) tholeiitic basalt member is prominent in the Sault Ste. Marie and Aberdeen Lake areas where it is about 1,500 feet (500 meters) thick. The basalt member is thinner in much of the Thessalon area and apparently missing in the Dollyberry Lake and Pecors Lake areas of the Quirke Lake Syncline.

The Thessalon Formation typically exhibits a greenschist mineralogy. The basalts are made up of albite, clinozoisite epidote, actinolite, chlorite and oxides. Primary clinopyroxene is locally preserved in basalts of the Sault Ste. Marie area.

The icelandites and basaltic andesites generally contain biotite and stilpnomelane in addition to albite, chlorite actinolite epidote and quartz.

Many, if not all of the volcanic rocks of the Thessalon Formation have undergone varying degrees of metasomatic alteration involving mainly addition of Na_2O , gain or loss of K_2O , and loss of calcium. Spilitization is especially pronounced in some parts of the Sault Ste. Marie area where metabasalts have soda contents of over 5 percent.

Explanation of Table 2:

1. Average analysis of tholeiitic basalt, Thessalon Formation, Thessalon area.
2. Average analysis of icelandite. Lower mixed member, Thessalon Formation, Thessalon area.
3. Average analysis of high magnesium basalt. Mixed member, Thessalon Formation, Thessalon area.
4. Average analysis of basaltic andesite. Mixed member, Thessalon Formation, Duncan Township area.
5. Average Hawaiite-mugearite. Mixed member, Thessalon Formation, Dollyberry Lake area.
6. Rhyolite. Mixed member, Thessalon Formation, Dollyberry Lake area.

CHEMICAL ANALYSES OF HURONIAN VOLCANIC ROCKS TABLE 2

Major Components in Weight Percent
Trace Elements in Parts per Million

Analysis No.	1	2	3	4	5	6
SiO ₂	50.65	59.03	50.46	51.8	51.69	70.5
Al ₂ O ₃	14.26	14.04	9.89	14.3	15.3	14.5
Fe ₂ O ₃	2.43	2.47	1.94	2.69	4.15	1.08
FeO	10.32	7.41	10.41	9.64	9.51	2.23
MgO	6.01	1.92	9.38	4.21	2.73	0.62
CaO	7.78	3.61	9.99	5.54	4.65	0.94
Na ₂ O	3.31	4.07	2.28	4.71	5.90	3.66
K ₂ O	0.58	3.01	0.78	1.27	0.95	4.07
TiO ₂	1.02	1.31	1.304	1.99	2.27	0.75
P ₂ O ₅	0.13	0.28	0.174	0.38	0.42	0.23
S	0.023	0.02	0.021	0.06	0.07	0.03
MnO	0.21	0.14	0.19	0.19	0.17	0.04
CO ₂	0.20	0.78	0.38	0.62	0.19	0.09
H ₂ O+	2.12	0.89	1.606	2.16	1.80	0.51
H ₂ O-	0.28	0.28	0.44	0.43	0.41	0.38
Total	99.32	99.23	99.28	99.99	100.21	99.8
n	12	12	5	11	9	1
Cr	103	5	885	22	43	8
Ni	81	5	341	42	51	5

Rock names assigned using the Irvine and Baragar (1969) procedure were scrutinized by examination of immobile elements such as Ti, P, Al, Cr, Ni. A triangular diagram of $TiO/P_2O_5/Al_2O_3$ proved useful in grouping the volcanic rocks. The Jensen cation plot (Jensen, 1976) aided the classification of subalkaline rocks.

The Matinenda Formation:

The Matinenda Formation is the host of the major uranium deposits of the Elliot Lake area, and is by far the most commercially significant formation of the Huronian Supergroup. The Elliot Lake deposits and enclosing rocks are described by Robertson (1968, 1976), Roscoe (1969), Piennar (1963), Theis (1973), and others.

In the Quirke Lake Syncline the Matinenda Formation overlies the volcanic rocks of the Thessalon Formation or, where the Thessalon Formation is absent, it lies on the Early Precambrian basement (Bennett, 1979a). The writer knows of no specific locality, either in outcrop, in mine workings, (personal communication with mine geologists) or from diamond drilling (Leahy, 1973) where rocks of the Matinenda Formation interfinger with the Thessalon volcanics. In at least two localities a regolith is preserved at the top of the Thessalon Formation in the Quirke Lake Syncline.

It is the conclusion of the writer that a significant disconformity exists between the Thessalon and overlying Matinenda Formation. This is in contrast to the view held by Bottrill (1971) that the Matinenda Formation and the Huronian volcanics are essentially coeval.

A unit of pale grey to yellowish subarkose overlying the Thessalon Formation in the Thessalon area and at one locality in the Sault Ste. Marie area is assigned to the Matinenda Formation by the writer (Bennett, 1977a, 1977b). In these areas the nature of the contact with the Thessalon Formation could not be determined.

The Aweres Formation:

A thick sequence of conglomerates and sandstones which overlie the Thessalon Formation in the Sault Ste. Marie area was termed the Aweres Formation by McConnell (1926).

The lowermost member of the Aweres Formation is a discontinuous unit of clast-supported, metabasalt conglomerate up to 300 feet (100 meters) thick. Megaclasts

in the metabasalt conglomerate are more than 80% mafic metavolcanics of the Thessalon Formation with scattered megaclasts of grey sandstone from the underlying Livingstone Creek Formation.

With increasing stratigraphic height the granitic clasts become more abundant in the conglomerates and the proportion of arkose matrix generally increases. This polymictic conglomerate member passes upward into a mixed conglomerate-sandstone member and finally into a member comprised mainly of arkose, subarkose with some wacke and siltstone as well as subordinate matrix-supported and clast-supported conglomerates.

The total thickness of the Aweres Formation may be as much as 6,000 feet (2,000 meters), but this may be an exaggeration since there may have been a considerable primary dip.

The correlation of the Aweres Formation has been a problem for some time. McConnell (1927) placed the Aweres Formation at the top of his "Soo Series" which included the Duncan (Thessalon Formation) and the Driving Creek (Livingstone Creek) Formation. The Soo Series was placed by McConnell directly below the Bruce Group (the present Bruce Formation). Hay (1964) considered the Aweres Formation equivalent to the Serpent Formation; and Roscoe (1967) correlated the Aweres Formation in the Mississagi Formation of the Hough Lake Group, and noted the presence of conglomerates resembling the Ramsay Lake Formation.

Frarey (1977) tentatively correlated the lower, conglomeratic part of the Aweres Formation with the Ramsay Lake Formation and the sandstone-rich upper part with the Mississagi Formation.

In 1977 the writer found, in the Sault Ste. Marie area, conglomerate resembling those of the Aweres Formation overlying yellowish, sericitic sandstone which he correlated with the Matinenda Formation (Bennett, 1976, 1977b).

The writer favours correlating the Aweres Formation with the Mississagi Formation and the Ramsay Lake Formation. The Aweres Formation appears to represent an alluvial fan complex formed as a clastic wedge at the base of a prominent fault scarp. The coarse, proximal deposits of the Aweres Formation may pass laterally and vertically into the Mississagi Formation.

The Hough Lake, Quirke Lake, and Cobalt Groups:

Each of these groups contains a repeated lithological assemblage which begins with matrix-supported conglomerate followed by mudstone, siltstone or limestone, and completed with the deposition of a thick sandstone sequence (Table 1) (Roscoe, 1967).

The conglomeratic sequences (Ramsay Lake, Bruce, and parts of the Gowganda Formation) contain much matrix-supported conglomerate generally held to be glaciogenic. The only limestone in the Huronian is found in the Espanola Formation which is probably of shallow marine origin (Young, 1973) and represents the earliest record of platform sedimentation (Frarey and Roscoe, 1970).

The thick cross-bedded arenite sequences (the Mississagi, Serpent and Lorrain Formations) had sources areas on the Archean craton to the north, northwest, and west (McDowell, 1957, Long, 1978, Hadley, 1968). For the most part these formations are fluvial (braided stream) deposits laid down on a great outwash plain (Frarey and Roscoe, 1970, Long, 1978).

A shallow marine or beach environment of deposition has been advocated for parts of the Lorrain Formation (Hadley, 1968, Pettijohn, 1970).

It has been pointed out (Piennar, 1963; Roscoe, 1968; Frarey and Roscoe, 1970) that regoliths developed below the Matinenda Formation are depleted in iron, in contrast to more recent soils. Also, rocks of the lower three groups of the Huronian are drab coloured while those of the Cobalt Group, in particular the Lorrain and Gordon Lake Formations, contain reddish and maroon coloured hematite-bearing beds. Pyrite, apparently of detrital origin, is abundant in parts of the Matinenda Formation and is common in the Mississagi Formation but generally lacking in rocks of the Cobalt Group. These features have been interpreted as evidence for a change from essentially reducing atmosphere to an atmosphere containing free oxygen (Frarey and Roscoe, 1970).

The large uranium deposits of the Elliot Lake area are considered by most recent workers to be of a placer or modified placer origin. The transportation of uraninite by surface streams is believed to be possible only under reducing atmospheric conditions (Roscoe, 1968).

A RIFT MODEL FOR HURONIAN SEDIMENTATION

By

G. Bennett and D. G. Innes

The concept of a rift through Lake Huron is not entirely new. Kumarapeli and Saul (1966) postulated a westward extension of the St. Lawrence Valley rift passing along the north shore of Lake Huron to join the Lake Superior rift. Innes (1977) completed a detailed study of the Huronian volcanics in the Sudbury area and proposed that the volcanics were fissure eruptions associated with cratonic rifting. He noted the significance of the alkalic volcanics in the Dollyberry Lake area.

The following is a scenario in an attempt to interpret the features of the Elliot Lake Group in an intracratonic rift environment.

- a. Early Rifting Stage: The Livingstone Creek Formation is interpreted as being deposited in a graben or graben complex with a conglomeratic sequence along fault scarps and a more distal sandstone facies. A period of relative crustal stability permitted the weathering and reworking of the Livingstone Creek sands to produce an upper quartzarenite member.
- b. Tectonic uplift, somewhere east of the present Elliot Lake area, bevelled the Livingstone Creek Formation. The upper quartz arenite member was removed east of the Sault Ste. Marie area and the entire sequence was eroded away in the Quirke Lake Syncline.
- c. Main Rifting Stage: Volcanism begins initially from central vents to provide the icelandite, rhyolite, tholeiitic and mildly alkalic rocks of the lower part of the Thessalon Formation.
- d. Rifting and volcanism continues with voluminous eruption of subaerial tholeiitic basalt which forms the upper member of the Thessalon Formation.
- e. A return of uplift east of the present Elliot Lake area causes a bevelling of the Thessalon Formation. The upper tholeiitic volcanic sequence is removed in the Quirke Lake Syncline and the entire formation is eroded further east.

f. Thermotectonic subsidence following the cessation of Thessalon volcanic activity results in an influx of sands and quartz and pyrite-rich gravels of the Matinenda Formation in the Elliot Lake area.

g. In the Massey-Sudbury area volcanism is renewed with the extrusion of thick sequences of tholeiitic basalts of the Elsie Mountain and Stobie Formations, and finally the eruption of rhyolites of the Copper Cliff Formation.

The gabbro-anorthosite complex (Agnew Lake Formation) between Massey and Sudbury were probably emplaced during one of the volcanic episodes. An earlier statement that the intrusive complex was equivalent to the Thessalon Formation and unconformably overlain by the volcanics of the Sudbury area (Bennett and Innes, 1979) did not stand up under further field investigations (our own) (Bennett, 1979).

h. Late Rifting Stage: The end of Huronian volcanic activity is followed by a period of thermotectonic collapse. Some of the subsidence took place along one of the rift boundary faults which was later reactivated as the Murray Fault. The slowly subsiding basin is filled by fine clastic detritus of the McKim Formation.

i. This elongate zone of subsidence and structurally weakened crust provides the initial trough for sedimentation from the craton. The basin expands laterally under the continuing load of Huronian sediments now represented by the Hough Lake, Quirke Lake, and Cobalt Groups.

Perhaps other equally detailed scenarios may be constructed to account for the observed features of the Huronian Supergroup. However, the writers feel that any scheme to explain the origin of the Huronian basin must place emphasis on the rocks of the Elliot Lake Group, since these are the oldest preserved Huronian rocks.

The Elliot Lake Group is atypical of Huronian sequences, since the former contains the only volcanic rocks of the Huronian succession. The volcanic suite contains tholeiitic and alkalic rocks typical of rift environments and large gabbro-anorthosite intrusions (or intrusion) with a stratigraphic position similar to that of the Duluth Complex of the Lake Superior Rift System.

The Elliot Lake Group does not contain the conglomerate-mudstone-arenite cycle of the overlying groups. There is evidence of significant erosion intervals within the Elliot

Lake Group, and formations of the oldest Huronian group tend to be discontinuous or more variable in lithology and thickness along strike than formations of the overlying groups.

Given a Huronian rifting event it is tempting to look upon the Penokean tectonism and magmatic events as the closing stage of a Wilson Cycle. Unfortunately the area south of the Huronian belt is covered by Phanerozoic rocks and it is not possible to choose between an intracratonic and continental marine environment for the bulk of the Huronian Supergroup.

LEGEND FOR FIGURE 3

MIDDLE PRECAMBRIAN

 Nipissing Diabase
Gabbro, diabase, granophyre

HURONIAN SUPERGROUP

Hough Lake Group

 Mississagi Formation
Subarkose, arkose, pebble conglomerate

Elliot Lake Group

 Matinenda Formation
Subarkose, grit, conglomerate

Thessalon Formation

 Mafic to intermediate metavolcanics

 Felsic Metavolcanics

Livingstone Creek Formation

 Subarkose, granite-cobble conglomerate

EARLY PRECAMBRIAN

 Felsic plutonic rocks

Symbols

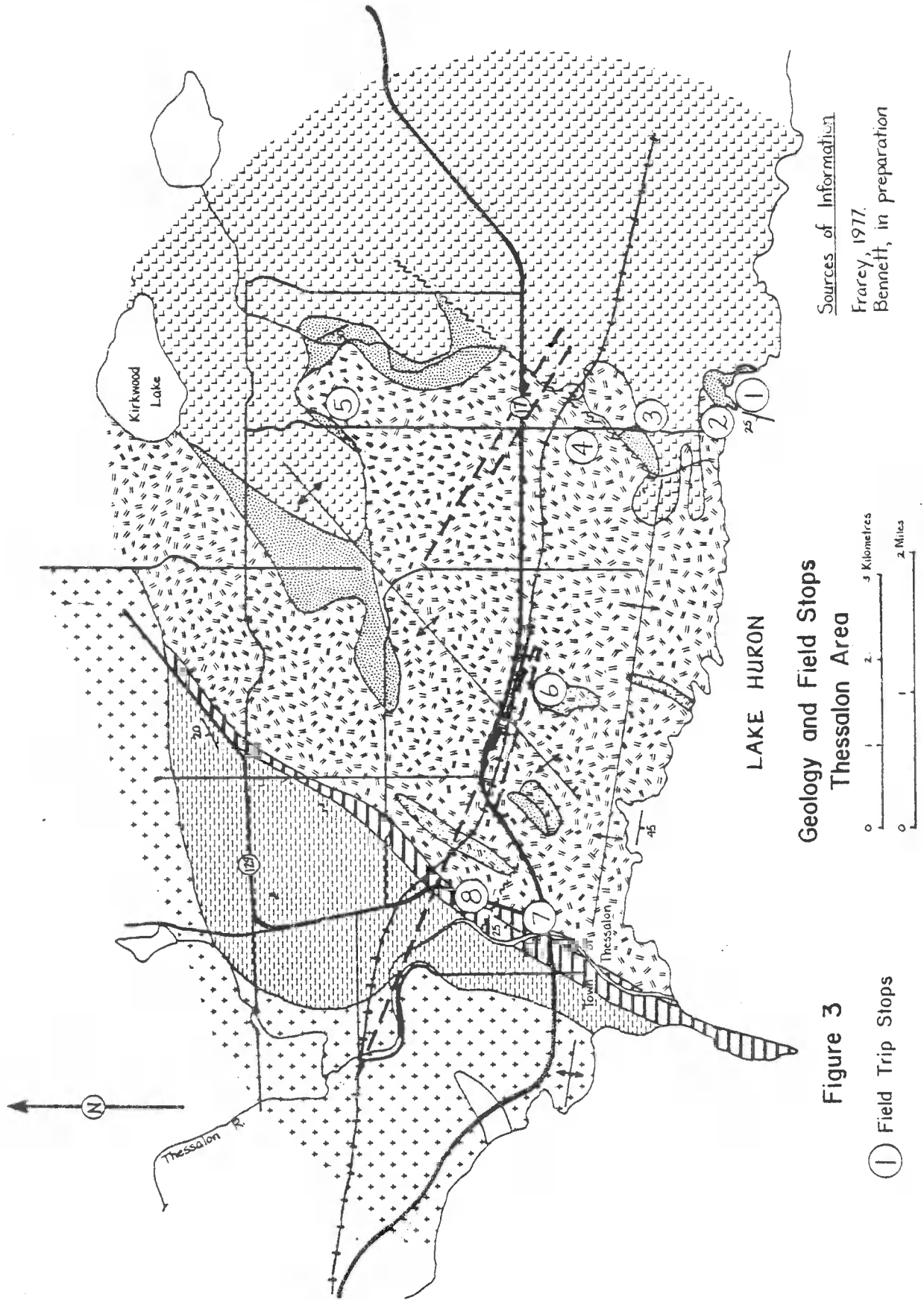
 Fault (inferred)

 Strike and dip of bed or flow

 Anticlinal axis

 Highway with number

 Secondary road



Description of Stops and Roadlog for the Huronian
Supergroup in the Sault Ste. Marie and Thessalon Areas

Time constraints are uncertain. To allow for flexibility some optional stops have been included. Also included are some locations and very brief descriptions for those following the guide at their leisure.

DAY 1: HURONIAN STRATIGRAPHY IN THE THESSALON AREA (Figure 3)

The mileage count begins at the intersection of Highway 17 and Highway 129 at the town of Thessalon about 80 km (50 miles) east of Sault Ste. Marie.

KM MILES

- | | | |
|-----|-----|--|
| 00 | 00 | Intersection of Highway 129 and Highway 17 at Thessalon. Continue east on Highway 17. Count begins at 0 km. |
| 6.0 | 3.7 | Pine Ridge Road and Highway 17 east. Turn right (south) on to Pine Ridge Road. |
| 8.5 | 1.6 | At Lake Huron. Cross causeway on foot to small, rocky island with boat house. This is private property. You should contact Guaranty Trust Realtor, Sault Ste. Marie, Ontario, for permission to enter. Stop 1 - Livingstone Creek Formation. |

STOP 1 LIVINGSTONE CREEK FORMATION CONGLOMERATE

The clast-supported conglomerate is pale-grey to white weathering with megaclasts mainly of grey equigranular and porphyritic granitic rocks and subordinate mafic rocks. The maximum clast size is about 70 cm with most in the 5-25 cm range. The sparse matrix is poorly sorted grey arkose. A few arkose lenses are crudely cross-bedded.

The gradational contact with the basement Early Precambrian granitic rocks is exposed on one of the small islands about 250 m (800 feet) east of here. At that location massive granite gives way to angular blocks of grey granite separated by sandstone. Over a few meters this regolith zone grades into clast-supported conglomerate. (See Robertson and Card, 1972, p.10).

Return to vehicle at northwest end of causeway.

KM	MILES	
00	00	Outcrop west of road - Stop 2.
STOP 2		LOWER (MIXED MEMBER) OF THESSALON FORMATION
		South end of Pine Ridge Road - Rocks here are dark grey-green, fine-grained tholeiitic andesite with areas of epidote alteration up to a meter across. A chemical analysis from near the shore of Lake Huron, about 100 m (300 feet) west of here, indicates the volcanics are tholeiitic andesite with a low TiO_2 content (0.77%). Similar volcanics have been found near the base of the volcanic sequence in the Dollyberry Lake area.
		Proceed north on Pine Ridge Road.
.8	.5	Pink to red granite along the road. Note contrast with colour of conglomerate clasts at Stop 1.
1.1	.7	Partly lichen covered outcrop east of road - Stop 3.
STOP 3		REGOLITH BELOW LIVINGSTONE CREEK FORMATION
		The regolith here is a breccia comprised of blocks of grey granite and gneiss separated by fine-grained grey sandstone. The breccia probably formed as sand sifting down through a coarse rubble or talus. The blocks represent bleached equivalent of red and pink granite and gneiss found nearby.
		The bleaching is generally considered to be due to reduction of ferric iron under the influence of a reducing atmosphere.
1.7	1.1	Low outcrops along road - Stop 4.
STOP 4		THESSALON ARKOSE
		Along east side of road are low outcrops of grey, coarse, poorly sorted arkose of the Thessalon Formation. Similar sandstones are found in the Sault Ste. Marie, Aberdeen Lake, and Dollyberry Lake areas. The Thessalon sandstones are found as thin discontinuous units between the Livingstone Creek Formation and the volcanics, or intercalated with the lowermost flows.

KM	MILES	
		The fine-grained volcanics in the area are icelandite in composition. They can usually be recognized by their very dark colour and faint bluish to purplish tint as a result of abundant, very fine biotite.
2.3	1.4	Highway 17 East. Continue north on Pine Ridge Road.
00	00	
2.3	1.4	Weir's Farm. Private land. Inquire at farmhouse before continuing - Stop 5. Continue on foot through farm yard to long outcrop ridges in field to the east. Note: if access to farm is not possible the high magnesium tholeiite described below can be seen on the east side of the road about 300 m (1000 feet) south of farm gate.
STOP 5		HIGH MAGNESIUM THOLEIITE OF THE THESSALON FM. An average analysis of this flow is given in Table 2. The high magnesium tholeiite is a relatively pale green colour in spite of its basic composition. The mineralogy is predominantly actinolite with subordinate albite. The normative composition suggests it was originally a clinopyroxene-rich basalt. The high magnesium tholeiite contains many irregular coarse-grained areas (pegmatoid patches). A chemical analysis of one of these patches indicates composition similar to a tholeiitic basalt. High magnesium tholeiite (with pegmatoid patches) have been identified in the Dollyberry Lake and Pecors Lake areas; providing evidence for stratigraphic equivalence with the Thessalon Formation (Bennett, in preparation). Continuing eastward to the furthest outcrop ridge. These are icelandites near the base of the Thessalon Formation. See Table 2 for composition. These flows are similar to those of Stop 4. Continuing southeast along farmers trail.

KM MILES

Low outcrops of Livingstone Creek subarkose. The fine-grained, grey, cross-bedded subarkose is typical of the bulk of the Livingstone Creek Formation.

South of the stockyard near Thessalon Station the upper part of the Livingstone Creek sandstone is very pale-grey and yellowish grey. Chemical analysis reveals a composition typical of a Huronian regolith (Bennett in preparation).

Return to Pine Ridge Road.

Outcrop of radioactive Thessalon Formation pyritic conglomerate in a field west of Pine Ridge Road. Private land; obtain permission at house.

Here pale-pink and rusty, pyritiferous quartz-feldspar grit and conglomerate is exposed in a low outcrop. This unit is at or near the base of the Thessalon Formation. Note fresh appearance of pink feldspar "phenocrysts" as clasts in grit and conglomerate. Assay indicates the radioactivity is due mainly to thorium (50 ppm, 0.1 lb./ton). Very similar radioactive conglomerate occurs at the base of the Thessalon Formation in the Crazy Lake area.

Return to Highway 17 via Pine Ridge Road. Proceed west on Highway 17.

00 00 Highway 17 and Pine Ridge Road.

3.19 2.0 Turn off on to road to south. Field with old barn due south of turn-off. This is private property. Permission to enter may be obtained from owner who resides on north side of road just east of turn-off. Low outcrops in field near barn are rhyolite. Stop 6.

STOP 6 RHYOLITE OF THESSALON FORMATION

This is pink to grey, fine-grained rhyolite with large flattened amygdules filled with quartz and biotite or stilpnomelane. Dark staining is due to local concentration of pyrite. The rhyolite consists mainly of a fine-grained mosaic of albite, k-feldspar and quartz with very minor green pleochroic biotite.

KM MILES

Since this area is located near the crest of an anticlinal structure we are near the base of the Thessalon Formation. A felsic volcanic center was located in this area or perhaps under Lake Huron to the south.

00 00 Return to Highway 17. Proceed west.

2.6 1.6 Intersection of Highway 129 and Highway 17. Outcrops of tholeiitic basalt are located just north of Highway 17 on Highway 129. Stop 7.

STOP 7 THOLEIITIC BASALT OF THESSALON FORMATION

The dark green amygdaloidal metabasalt consists mainly of fine albite, chlorite, epidote-clinozoisite, leucoxene, and minor quartz and oxides. The larger amygdules are generally concentrically zoned with quartz-calcite-epidote being a common sequence. Small amygdules are chlorite, quartz, calcite or epidote. This outcrop is located near the top of the Thessalon Formation.

00 00 Continue north on Highway 129.

.5 .3 Low outcrop of very pale sandstone on east side of Highway 129 is Matinenda Formation. Stop 8.

STOP 8 MATINENDA FORMATION SANDSTONE

Fine-grained, pale pink to pale yellowish sandstone displays well developed trough cross-bedding and yellow (sericitic) partings between beds. The trough cross-beds and sericite are typical of the Matinenda Formation but the fine-grain size is not. This rock type occurs as a unit up to a few hundred feet thick directly overlying the volcanics. The contact between the two was not observed in this area.

Return to junction of Highway 129 and Highway 17.

00 00 Proceed west (turn right) on Highway 17. Outcrops found along the highway for the next five kilometers, with few exceptions, are Nipissing gabbro and part of a large sill which extends as far west as Bruce Mines.

KM MILES

15.6 9.7 Waltonen Road. Continue on Highway 17.
Outcrops of Mississagi Formation on both
sides of highway. Stop 9.

STOP 9 MISSISSAGI FORMATION

This is grey to pinkish-grey cross-bedded subarkose of the Mississagi Formation. Pebbly layers are mainly quartz, black chert and very sparse jasper. Very fine pyrite is concentrated in thin, continuous layers along fore-set beds and in the narrow pebble conglomerate layers. With a hand lens it can be seen that the pyrite is largely crystalline in outline while the distribution strongly suggests a detrital origin. Recently Innes and Colvine (1979) have suggested that the Huronian Supergroup is a potential host of base metal and gold deposits of sedimentary origin.

Continue west on Highway 17.

Town of Bruce Mines.

20 11.4 Junction of Route 561 and Highway 17. Town of Bruce Mines. Bruce Mines is the location of the first known copper deposits in the north shore region. Development work began on the veins in 1846 and production took place intermittently until 1921. Production statistics are incomplete but the grade appears to have been between 3 and 4% copper over five feet. Some orebodies were continuous for a length of over 1800 feet (550 m).

The deposits are fissure veins of quartz, carbonate, chalcopyrite and bornite in Nipissing diabase and related granophyre (Frarey, 1977, Knight, 1915).

Mineralized quartz vein in diabase outcrop on north side of Highway in Bruce Mines. Stop 10.

STOP 10 MINERALIZED QUARTZ VEIN

The vein is about 2 m (6 feet) wide but appears to pinch toward the northwest. It may be divided into three zones which are, from east to west, disseminated bornite and chalcopyrite in quartz, chalcopyrite, bornite, chalcocite and quartz: quartz-diabase breccia. The host

rock is Nipissing gabbro and granophyre.
Some of the old workings can be seen just
north of the highway.

Thanks to the efficiency of the Cornish miners
who first worked these veins, there is very
little high-grade material left at the surface.
YOU ARE THEREFORE ASKED NOT TO TAKE SAMPLES
OF THIS VEIN.

This is the last stop of Day 1 - Continue
west on Highway 17 to Sault Ste. Marie.

LEGEND FOR FIGURE 4

LATE PRECAMBRIAN

 Jacobsville Formation
Sandstone, siltstone, conglomerate

MIDDLE PRECAMBRIAN

 Nipissing Diabase
Gabbro, diabase, granophyre

HURONIAN SUPERGROUP

COBALT GROUP

 Lorrain Formation
Quartzarenite, quartz-pebble conglomerate, arkose

 Gowganda Formation
Paraconglomerate, siltstone, mudstone, arkose

HOUGH LAKE GROUP

 Aweres Formation
Arkose, subarkose, paraconglomerate, basalt
cobble conglomerate, orthoconglomerate

ELLIOT LAKE GROUP

 Thessalon Formation
Tholeiitic basalt, basaltic andesite, spilite, arkose

 Livingstone Creek Formation
Subarkose, granite cobble conglomerate, quartzarenite

EARLY PRECAMBRIAN

 Felsic Plutonic Rocks
Quartz monzonite, gneissic granite, migmatite

 Metavolcanic Rocks
Mafic metavolcanics, amphibolite

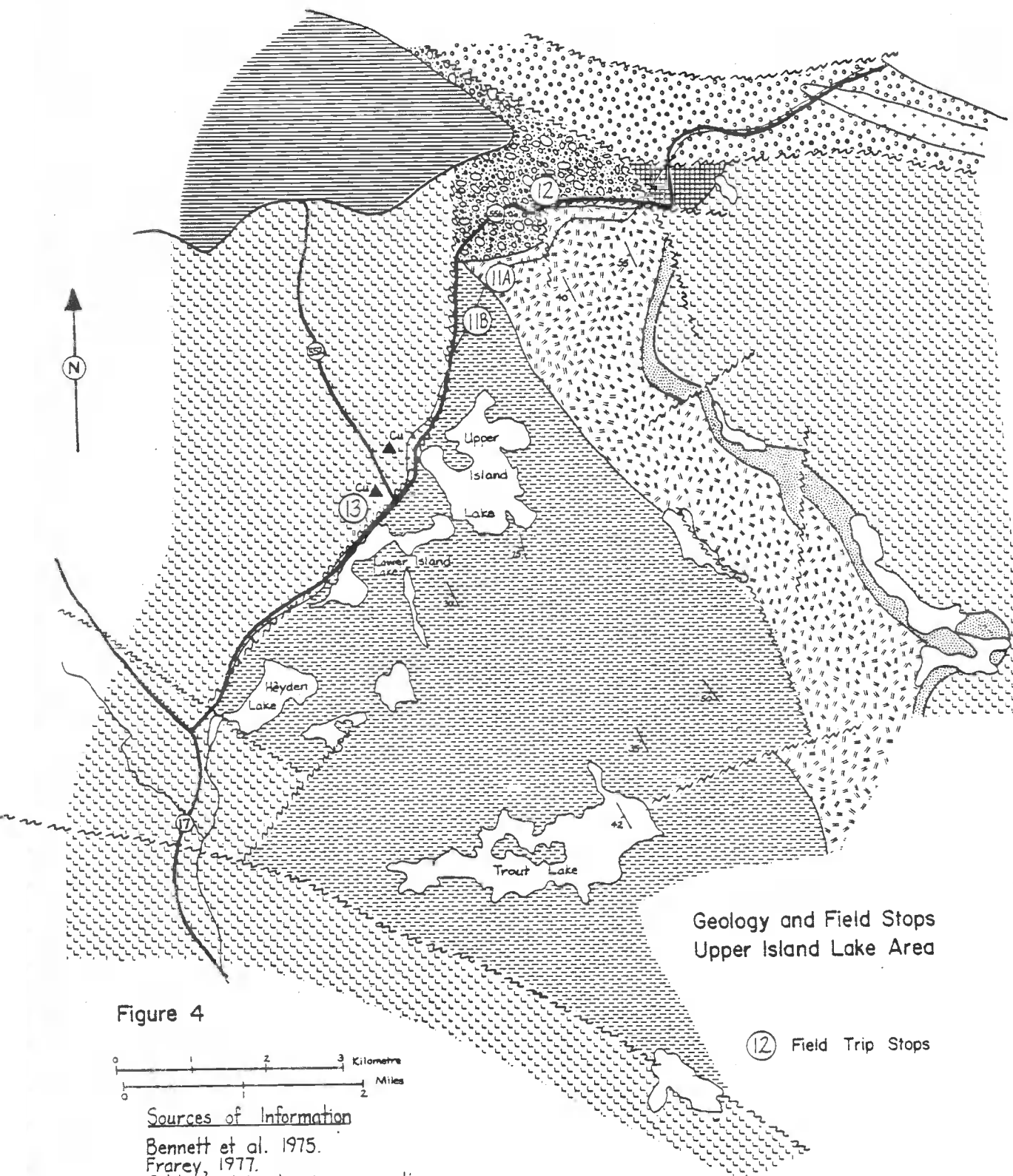
SYMBOLS

 Fault (inferred)

 Strike and dip of bed or flow

 Highway with number

 Algoma Central Railway



DAY 2: ISLAND LAKE AREA (FIGURE 4)

The mileage log begins at the junction of Highway 556 and Highway 17 in the village of Heyden, about 15 km (10 miles) north of Sault Ste. Marie on Highway 17.

KM	MILES	
----	-------	--

00	00	Turn right (east) on Highway 556.
----	----	-----------------------------------

7.4	4.6	Abandoned section of Highway 556 branches off to the right. Turn off onto abandoned highway and park. The abandoned section is washed out about 100 m (100 yards) ahead. Vehicles with very low ground clearance may park a few hundred feet ahead on the right side of the road. Walk north along old highway to washout and from there walk about 500 feet (200 m) through the bush in an easterly to east-southeasterly direction as far as the Algoma Central Railway track.
-----	-----	--

Proceed northeast along the track to outcrops of dark green metabasalts of the Thessalon Formation. Stop 11A.

STOP 11A

SPILITES OF THE THESSALON FORMATION

Dark green, massive and amygdaloidal spilite of the tholeiitic basalt member is exposed along both sides of the track. Amygdules up to 3 cm across contain quartz, epidote, pink albite, and calcite. Black chlorite amygdules a few millimeters across are characteristic of the mafic rocks of the Thessalon Formation. Amygdaloidal flow tops and flow breccia are found near the southwest end of the outcrop. Thin seams of chalcopyrite occur along fractures and veins of epidote, pink albite, and calcite are common.

Primary clinopyroxene are generally presented in the basalts of this area. The soda content is from 3 to over 5 percent.

Proceed southwest on the track across a gully which marks a fault between the volcanics and the overlying Aweres Formation. Stop 11B.

STOP 11B

AWERES FORMATION

Clast-supported and matrix-supported conglomerates of the Aweres Formation are exposed in rock-cuts and outcrops along the tracks. The predominant megaclasts are mafic volcanics and granitic rocks with minor subarkose and dark chert in a matrix of coarse, poorly sorted subarkose and subwacke. Bedding planes are poorly defined.

Continuing up-section the matrix becomes more abundant and contains many angular, shard-shaped fragments a few centimeters or less in size.

A few pyrite nodules up to 12 cm across occur in the upper part of this section.

The coarse arkose which makes up much of the upper part of the Aweres Formation is not exposed along the railway track section. A few kilometers south of here in Jarvis and Aweres Townships the conglomerates are found intercalated with coarse, poorly sorted arkose. The writer believes that the Aweres Formation represents a thick clastic wedge deposited along prominent fault scarps.

KM MILES

Return to Highway 556 either by continuing along the track or proceeding to the right through the bush for a few hundred feet (100 m).

Continue east on Highway 556.

9.6 6.0

Rock-cut on the right. Stop 12.

STOP 12

GOWGANDA MIXITE AND THESSALON SPILITE

This is a good example of matrix-supported conglomerate (mixite) of the Gowganda Formation in fault contact with glomeroporphyritic spilite of the (upper) tholeiite basalt member of the Thessalon Formation. The conglomerate consists of clasts of pink granitic rocks, dark green volcanics and some quartz pebbles in an abundant dark green wacke matrix. This type of conglomerate is generally considered a tillite.

Using Irvine and Baragar's (1971) procedure, the glomerophyritic volcanic would be classified as hawaiite, as would many of the upper tholeiitic basalts. The low TiO_2 (0.7%), low P_2O_5 content (0.07%), and chromium content (110 ppm) shows that it is not. It is a spilite with over 4.8% total alkalis. The mineralogy is clinopyroxene, albite, chlorite, actinolite, epidote, and leucoxene.

Turn round and proceed west for about 5 km (3 miles) on Highway 556 to the junction with Highway 552. Park near railway track on Highway 552 and locate a bush road on west side of Highway 552 near railway track. Continue on the bush road or trail which continues west and then turns north, up the hill for about 500 m (1500 feet). A few outcrops of brecciated granitic rocks and a small, low outcrop of fine-grained, red Keweenawan felsite dike is exposed on the trail. One of the mineralized exploration trenches of the Nystedt copper prospect is found near the trail near the crest of the hill. Stop 13.

STOP 13

NYSTEDT COPPER PROSPECT

Chalcopyrite occurs as seams, disseminated grains and massive patches in pink quartz syenite and breccia. Veinlets and disseminated grains of specular hematite are common in the surrounding rocks. This is one of four known major surface showings in the immediate area; a fifth occurs just east of Highway 552.

Kennco Explorations (Canada) Ltd. optioned the property in 1965-66, and carried out a diamond drilling program. Assays from one diamond drill hole returned 0.78% copper over 95.3 feet.

The copper deposits are set in pink syenite and chloritic granite-breccia consisting of fragments of gneissic and massive granite in a matrix of quartz, chlorite and feldspar. The granite breccia extends to the east of Highway 552 and there is well exposed in rock-cuts along the highway.

Return to Sault Ste. Marie.

DAY 2 HURONIAN STRATIGRAPHY EAST OF SAULT STE. MARIE

(Figure 1)

Proceed east from Sault Ste. Marie on Highway 17 to the town of Echo Bay, a distance of about 25 km (15 miles). Turn left on Highway 638 in Echo Bay.

- | | | |
|------|-----|---|
| 00 | 00 | Town of Echo Bay. |
| 1.1 | 1.3 | Highway 638 East to Leeburn - turn left. |
| 6.5 | 4.2 | Outcrop on south side of highway. One to two-foot (.5 m) quartz-specular hematite vein in white, pale yellow medium-grained quartzarenite of the Lorrain Formation. |
| 10.9 | 6.8 | McCarroll Lake Road - Continue on Highway 638. |
| 11.8 | 7.4 | High rock-cut along both sides of road. Stop 14. |

STOP 14 GORDON LAKE FORMATION

The rocks here are from the transition zone between the Gordon Lake Formation and the underlying Lorrain Formation.

Rocks are pink to white fine-grained, well sorted silicious subarkose to quartzarenite with well developed cross-beds. Ripple marks and slickensides are found on some partings. Sandstone sequence contains a narrow unit of laminated ferruginous siltstone with green (sericitic) partings.

An east-west trending, 1 to 2-foot wide (30-60 cm) hematitic shear zone with wide flanking bleached zones is located near the east end of outcrop.

- | | | |
|------|------|--|
| 7.2 | 10.7 | Gordon Lake Road - Continue on 638, left turn. |
| 23.6 | 14.7 | Bass Lake Road - Continue on 638. |
| 24.4 | 15.1 | Village of Leeburn. |
| 49.7 | 30.9 | Center Line Road - Continue on 638, turn left. |
| 31.8 | 19.8 | Poplar Dale Road - turn right on 638. |
| 32.4 | 20.1 | Route 638 - Continue on 638, turn left. |
- MacKay Road - turn left onto MacKay Road.

KM MILES

34.3 21.3

Proceed about 100 yards (100 m) north on MacKay Road to abandoned farm house on the Harnden farm. This is private property. Obtain permission to enter from resident of house east of Harnden farm. Proceed northwest on foot to pale grey outcrops on hill west of farm house. The outcrops on the north slope of the hill are outcrops of Mississagi Formation. Stop 15.

STOP 15

MISSISSAGI, BRUCE, ESPANOLA, AND SERPENT FORMATIONS

Pale grey subarkose of the Mississagi Formation display well developed cross-bedding with cosets about a meter thick. These exposures are typical of the upper half of the Mississagi Formation. The lower half of the formation is generally finer-grained, darker grey and approaches a subwacke in composition.

A few hundred feet (less than 100 m) to the south is grey weathering, matrix-supported conglomerate of the Bruce Formation. The predominant clasts are granite, mafic meta-volcanics, and quartz in an abundant, dark, quartz wacke matrix. This is the second of the extensive mixite units in the Huronian and like the Ramsay Lake and Gowganda mixites is generally considered to be a tillite.

Further to the southwest the Espanola Formation is exposed. The Espanola Formation consists of three members: The Bruce limestone, the Espanola siltstone member, and the Espanola dolomite member. Only the Bruce limestone member is exposed here. The Bruce limestone member consists of alternating thin layers of pale grey, white or pink limestone and dark grey argillite and siltstone. The Bruce limestone is generally highly deformed. Some discussion has arisen over whether or not the tight folding is tectonic or syndepositional (Young, 1973a, Frarey, 1977).

The distinctive appearance and composition of the Espanola Formation along with its widespread distribution makes the Espanola Formation the most useful stratigraphic marker in the Huronian Supergroup.

The Espanola Formation is overlain by the Serpent Formation, the lowermost part of which is exposed on a south-facing steep slope just

KM MILES

south of the Espanola Formation outcrops. In this area the lowermost part of the Serpent Formation consists of a thin unit of tightly packed polymictic conglomerate with well rounded cobbles of granite, mafic igneous rocks and small fragments of Bruce limestone (Frarey, 1977).

Continuing to the south one comes upon exposures of pale pink, medium-grained, well sorted, massive subarkose, which makes up most of the Serpent Formation. Frarey (1977) gives the composition of the subarkose at this location as quartz (80%), plagioclase (20%) with traces of chlorite, zircon, tourmaline or hornblende and opaques.

000 000 Return to intersection of Highway 638 and 561.
Turn left (south) on 561.

1.1 0.7 Polymictic matrix-supported conglomerate of the
Gowganda Formation is exposed on both sides of
road.

2.0 1.2 Large outcrop ridge west of road. Stop 16.

STOP 16 GOWGANDA FORMATION

Near the road thin beds of fine-grained, pink weathering sandstone are interbedded with dark green mudstone and siltstone. The sandstone beds have undergone considerable deformation and disruption which appears to have been the result of syndepositional slumping.

A mixite unit striking about 150° and dipping about 45° south overlies the mudstone. The mixite consists of rounded to angular clasts of granitic rocks up to over a meter (3 feet) long in an abundant dark green, wacke matrix.

Just above the mixite unit, mudstone and siltstone contains large, well rounded balls of pink weathering sandstone producing an "intraformational mixite".

A 10-meter (30 feet) wide Nipissing type diabase strikes 140° near the crest of the outcrop.

The features and relationships displayed in this exposure are typical of much of the middle part of the Gowganda Formation in the Sault Ste. Marie area.

KM MILES

Continue south on Highway 561.

7.4 4.6

The rocky, hill $\frac{1}{2}$ to 1 mile to the west of the road reveal four of the six members of the Lorrain Formation. The most distant hill consists of the upper white quartzite member, the pinkish summit of the nearest hill is part of the upper red quartzite member; this is underlain by the jasper conglomerate member (white from a distance) which is in turn underlain by the, mostly tree covered, lower red quartzite member. The remaining purple siltstone and basal arkose members are further to the north but cannot be distinguished from this point.

Mount Zion Road - Continue on Route 561.

8.1 5.0

Outcrops of jasper conglomerate. Stop 17.

STOP 17

JASPER CONGLOMERATE OF THE LORRAIN FORMATION

The jasper conglomerate (known locally as "puddingstone") is probably the most distinctive and attractive rock in the north shore area. It consists of rounded to angular pebbles up to 7 cm (3 inches) of quartz and abundant varicoloured Jasper. The jasper conglomerate and intercalated white quartzarenite units make up the jasper conglomerate member of the Lorrain Formation. This member is up to 200 m (600 feet) thick (Frarey, 1977).

8.5 5.3

Large, high outcrop area to the right (west) of the road. Upper red quartzite. Stop 18.

STOP 18

UPPER RED QUARTZITE OF THE LORRAIN FORMATION

The outcrop consists mainly of well cross-bedded, poorly sorted, reddish quartzarenite, with thin pebble conglomerate interbeds. The red colouring is due to fine hematite. Thin seams of detrital grey hematite can be seen along fore-set beds and within continuous layers of quartz and jasper pebble conglomerate. The upper red quartzite member varies from 260 m (850 feet) to as much as 20 m (1700 feet) (Frarey, 1977).

Continue south on Highway 561.

9.5 5.9

Ledyit Line Road. Outcrop of white quartzite on west side of road. Stop 19.

KM MILES

STOP 19 UPPER WHITE QUARTZITE MEMBER OF LORRAIN FORMATION

The outcrop consists mainly of white, to pink, medium-to-coarse-grained quartzarenite with scattered pebble layers. This is the uppermost and thickest member of the Lorrain Formation. It is the thickest member, about 740 m (2400 feet) (Frarey, 1977).

12.8 7.8 Village of Rydal Bank.

00 00 Highway 561 turns left. Plummer road straight ahead. Proceed on Plummer Road.

3.8 2.4 Plummer Road and West Road. Outcrops of Gordon Lake Formation on west side of West Road about 100 m (100 yards) north of junction. Stop 20.

STOP 20 GORDON LAKE FORMATION

Thinly bedded and laminated, fine-grained sandstone, siltstone, mudstone and chert are exposed here. Frarey (1977) suggests that some chert may be the result of the diagenetic replacement of siltstone. Curving, and branching mud cracks in mudstone beds are filled with fine sandstone.

The Gordon Lake Formation contains sedimentary structures indicative of a stable, low energy environment, probably nearshore marine to littoral or in part lagoonal (Frarey, 1977). See Wood (1973) for a discussion of the depositional environment of the Gordon Lake Formation.

Proceed northwest on Plummer Road.

7.2 4.5 Center Line Road. Continue on Plummer Road.

8.3 5.2 Outcrops of white quartzite to the right (north). Continue to top of hill and park. Stop 21.

STOP 21 BAR RIVER FORMATION

Almost all of the Bar River Formation consists of thick bedded, white quartzarenite similar in most aspects to the upper white quartzite of the Lorrain Formation. The rocks here are white to pale yellow quartzarenite with little visible structure.

00 00 Return to Center Line Road via Plummer Road. Turn right (south on Center Line Road).

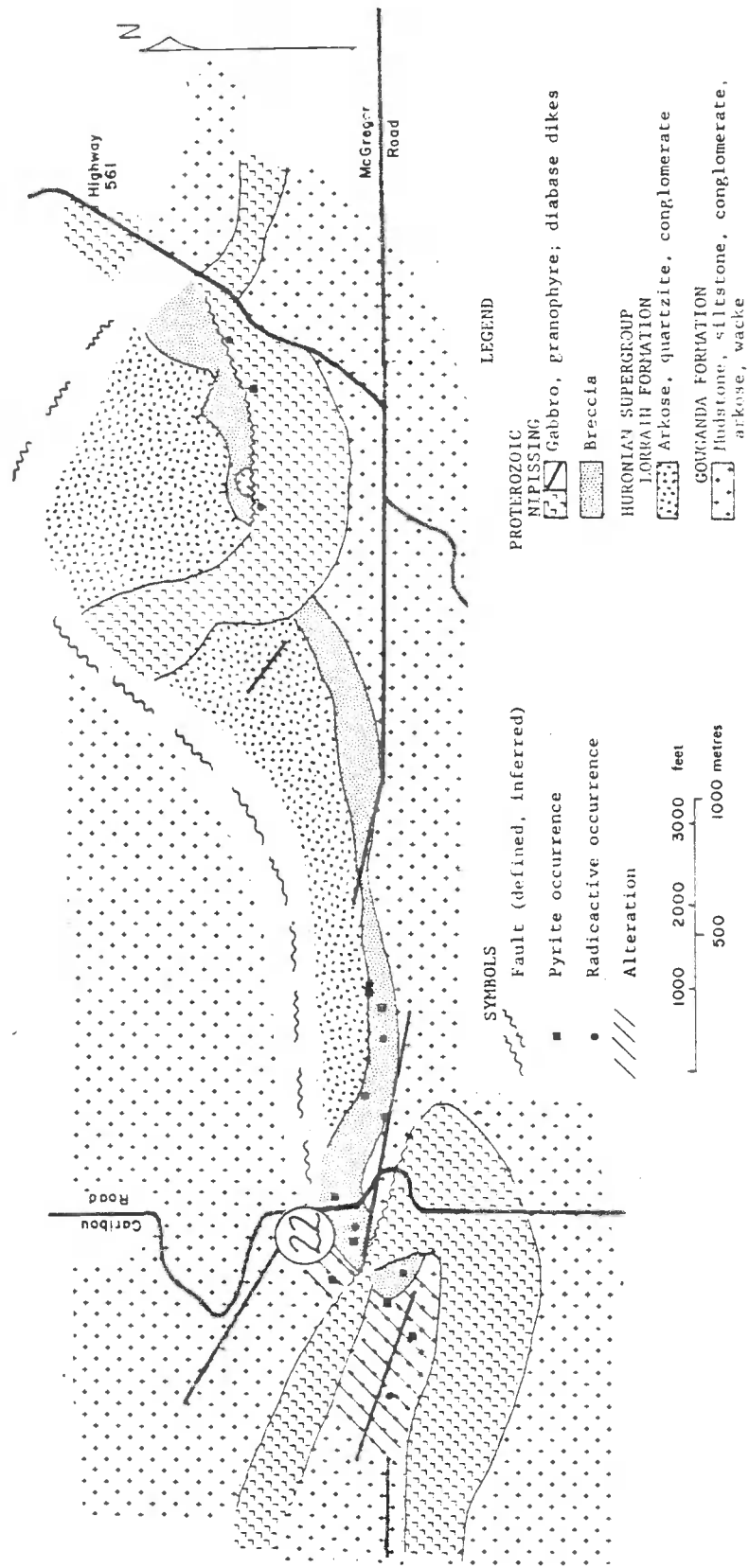


FIGURE 5

—Geological Sketch Map of the McGregor Road Breccia Zone.

KM	MILES	
5.4 00	3.4 00	Government Road. Turn left (east) on Government Road.
1.7 00	1.1 00	Caribou Road. Turn right (south) on Caribou Road.
3.7	2.3	Outcrop on left (east side of road is sulfide stained outcrop of McGregor Road breccia. Fragments of Lorrain Formation arkose and quartzarenite are set in a quartz and pyrite matrix. Sulfide-rich samples gave values of 0.20 and 0.34 ounces of silver /ton).
3.8	2.4	Tractor road to the right (west). This is private land. Inquire at farmhouse directly east of here for permission to enter. Outcrop area is located about 100 m (100 yards) west of Caribou Road. (Stop 22, McGregor Road Breccia).

STOP 22

McGREGOR ROAD BRECCIA

The McGregor Road breccia (Figure 5) is emplaced along the south side of a down-dropped fault block of basal arkose of the Lorrain Formation. The surrounding rocks are part of the Gowganda Formation. The breccia consists mainly of angular to rounded fragments of Gowganda siltstone and mudstone, and arkose, quartzarenite and jasper conglomerate of overlying members of the Lorrain Formation. Fragments of jasper conglomerate are about 1000 m (3000 feet) below their stratigraphic position. Although in places the breccia is polymictic, there are localities where the predominant clast lithology varies (from south to north) in a manner corresponding to their original position in the Huronian stratigraphy.

Near the west end of the breccia fractured Gowganda argillite is altered to a locally pyritic, hard, pink rock approaching pure albite in composition. Small radioactive occurrences (up to 10 times background) occur in the breccia.

The breccia may be a fissure diatreme formed as a result of explosive degassing of magma along a fault. Alternatively, the breccia may be the result of fracturing and spalling along a dilatant zone formed along the down dropped fault block.

KM MILES

Just north of the tractor road a Nipissing type diabase dike intrudes breccia consisting of arkose and quartzarenite of the Lorrain Formation along with brown weathering, dark green fragments of diabase. Continuing north the breccia is comprised mainly of fragments, blocks and fractured slabs of Lorrain quartzite.

Continuing for about 200-300 m (yards) north and west are outcrops of pink, locally pyritic albitized, laminated mudstone of the Gowganda Formation.

Continue south on Caribou Road to the Town of Bruce Mines.

00 00 Bruce Mines. Turn right (west) on Highway 17.

12.3 7.6 Village of Desbarats - Large pink outcrops of basal arkose of the Lorrain Formation just east of the village. Stop 23.

STOP 23 BASAL ARKOSE MEMBER OF THE LORRAIN FORMATION

The basal arkose member is up to 500 m (1700) feet thick (Frarey, 1977). In Desbarats well sorted pink arkose of this member are exposed in rock-cuts along Highway 17. The dark spots commonly found in this member are due to fine hematite.

Disseminated chalcopyrite and pyrite mineralization occurs in this member about 3 km (2 miles) north-west of Desbarats. The mineralization may be syngenetic but Pearson (1979) suggests a diagenetic origin.

13.3 8.6 Dark red to maroon outcrops of the purple siltstone member of the Lorrain Formation are exposed along the highway. Stop 24.

STOP 24 PURPLE SILTSTONE MEMBER OF THE LORRAIN FORMATION

This unit is a thick bedded, massive, fine-grained arkose and siltstone with a hematitic matrix. It appears to be a relatively local, true red bed, and is evidence for an oxygen bearing atmosphere during its deposition. (The unit is about 30 m (100 feet) thick (Frarey, 1977)).

KM MILES

15.3 9.5 "Ripple Rock". Thinly bedded arkosic sandstone of the Lorrain Formation displays excellent examples of asymmetrical ripple marks. This outcrop is a designated historical site and should not be defaced.

End of Field Trip - Return to Sault Ste. Marie.

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