MARGINAL NOTES

Mapping of the Paleozoic rocks on Manitoulin Island formed part of the Manitoulin Island Limestone-Dolostone Assessment Project. This project was funded by the Ontario Ministry of Northern Affairs through Ontario Geological Survey (NOGS) program. The principle objective of this project was to produce maps showing the distribution of the limestones and dolostones on the island according to their quality and usefulness as construction and metallurgical processing materials. In collecting data for this purpose, new information on the Paleozoic stratigraphy of the island became available, thus allowing production of new geological maps. These new maps constitute revisions to earlier maps prepared by Dr. B.A. Liberty and published in 1972, based on field work made during the period 1954 to 1957 (Liberty 1972a, 1972b, 1972c, 1972d, 1972e, and 1972f).

The Little Current map area displays considerable topographic relief (146 m) due to a series of north and east facing escarpments. Between the escarpments the topography is flatlying or moderately rolling. The escarpments were formed by differential erosion of the Paleozoic bedrock and are mainly coincident with the Georgian Bay Formation which forms the 52 m scarp at Ten Mile Point (U.T.M. 433750E-5080800N) and the Manitoulin Formation which forms the scarp south of Columbus Mountain (U.T.M. 424500E-5086650N). West of Sheguiandah Bay are several ridges and knolls of Precambrian basement material, protruding into or through the Paleozoic strata. These Proterozoic remnants have a pronounced east-west trend and continue to the northeast across the North Channel as a series of islands (map in Card 1978).

Glacial drift cover is thicker in this map area than in the adjacent sheets to the south (Manitowaning P.2672) and west (Kagawong P.2669), this being indicated by the decreased bedrock exposure. Topographically high plateaus in the map area have very thin or no glacial cover due to scouring.

Land areas east of Manitowaning Bay comprise the northern half of the Wikwemikong Unceded Indian Reserve (I.R. 26). Mapping was permitted on the reserve during 1979. Mapping of the Sheguiandah Indian Reserve (I.R. 24) west of Manitowaning Bay was permitted during 1980.

PRECAMBRIAN/PALEOZOIC CONTACT

The only exposed Precambrian/Paleozoic contacts on Manitoulin Island are found at Sheguiandah Village where Proterozoic quartzite knolls project through the Paleozoic strata. These quartzites represent the Bar River and Lorrain Formations of the Cobalt Group (Card 1978) and are in unconformable contact with shales of the Blue Mountain Formation or carbonates probably equivalent to the Lindsay Formation. The contact at Sheguiandah is sharp, with the Proterozoic surface often showing smoothing produced by Paleozoic water action. Where the Proterozoic rocks are found in contact with limestones, the latter are rich in reworked quartzite pebbles, crinoid debris and have frequent green glauconitic sandy partings (e.g. U.T.M. 426400E-5082400N). Shales that directly overlie the quartzite display very high bedding dip angles (e.g. U.T.M. 424050E-5081600N).

PALEOZOIC STRATIGRAPHY

ORDOVICIAN

Verulam Formation

The oldest Paleozoic unit exposed on Manitoulin Island, and in this map area, is the Middle Ordovician Verulam Formation. This unit is composed of an alternation of bluish-grey, coarsely crystalline to sublithographic limestone, separated by thin partings of blue-grey shales and claystones. The unit is in part bioclastic and argillaceous with some fossils present and tends to coarsen (in crystallinity) upwards. The Verulam Formation, having a thickness of about 18 m, is well exposed on Goat Island, the first island north of Manitoulin Island. The only probable occurrence of the formation on Manitoulin Island is a mound or dome-shaped inlier at Mackays Point (U.T.M. 424200E-5092800N).

Lindsay Formation

The contact between this unit and the underlying Verulam Formation is not exposed on Manitoulin Island, although the outcrop adjacent to the swing bridge (U.T.M. 429180E-5091950N) at Little Current displays characteristics of both units. The Lindsay Formation has 2 members (as recently defined by Russell and Telford 1983); the Lower Member consists of 15.25 m of grey to grey-brown, finely crystalline to sublithographic limestone and dolostone. This member has moderate amounts of shale and has a characteristic "mottling" or nodular appearance. The Upper or Collingwood Member is a black, calcareous, petroliferous shale some 7.62 m thick. The contact between the members is not exposed on the island. Both members are fossiliferous, with the Collingwood Member being richly fossiliferous in graptolite, brachiopod, conulariid and trilobite remains. The Lower Member contains a brachiopod/bryozoan assemblage.

Good exposures of the Lower Member occur in the vicinity of Little Current, at Turner Cove (U.T.M. 423400E-5091950N), and adjacent to the road leading to Gibbon's Point (U.T.M. 429600E-5091950N). The Collingwood Member is well exposed in the road allowance of Highway 6 immediately south of Little Current. A good section through this member is also exposed at Sheguiandah Village (U.T.M. 428330E-5082300N).

Blue Mountain Formation

The overlying Blue Mountain Formation consists of about 40 m of soft blue-grey shale. The unit is poorly fossiliferous with graptolite, triloblite and brachiopod remains, and is not petroliferous. These strata have been formerly termed the Sheguiandah Member of the Whitby Formation, but are being renamed here in accordance with the nomenclature now in use in southern Ontario (Russell and Telford 1983).

The formation is recessive and only poorly exposed in the map area. Outcrops occur in the village of Sheguiandah where the shales directly overlie Proterozoic quartzites (e.g. U.T.M. 424210E-5081750N). The contact between the Blue Mountain and underlying Lindsay Formation is not exposed on the island although it has been reported elsewhere to be sharp (Russell and Telford 1983).

Georgian Bay Formation

The Georgian Bay Formation conformably overlies the Blue Mountain Formation. The contact between these units is not exposed on the island, but the base of the Georgian Bay is usually placed at the first appearance of carbonate hardbands in the dominantly shale sequence.

Liberty (1972d) divided the Georgian Bay Formation into 3 subunits: 1) a Lower Member (Wikwemikongsing), an alternating sequence of blue-grey shale with carbonate hardbands; 2) an Upper Member. Lower Submember (Meaford), a bluish-grey, fine grained, argillaceous limestone, with shaly partings; and 3) an Upper Member, Upper Submember (Kagawong), a brown and grey, finely crystalline limestone and dolostone. The total thickness of the Georgian Bay Formation is about 137 m with the lower member accounting for at least 46 m of the formation. Contacts between the subunits are poorly exposed on the island, making field identification of the units difficult. Due to these and other constraints, delineation of the subunits within the formation was not attempted and detailed consideration was given only to the upper and lower contacts.

The Georgian Bay Formation is quite fossiliferous throughout, particularly in its upper member in which several biostromes have been reported (Liberty 1968). Fauna common in this formation include brachiopods, bryozoans, pelecypods, gastropods and corals. As mentioned earlier, the Georgian Bay Formation predominantly outcrops in escarpments formed by differential erosion of the shales and limestones. One of the better and more accessible sections through the formation may be seen at High Falls (U.T.M. 433850E-5072000N).

SILURIAN

Manitoulin Formation

The Lower Silurian Manitoulin Formation disconformably overlies the Georgian Bay Formation. The only exposed contact in the map area between these units was found in a road-cut northeast of Perch Lake (U.T.M. 424600E-5086800N). The contact is marked by the change from the brown and grey finely crystalline limestones of the uppermost Georgian Bay Formation to blue-grey, buff weathering, finely crystalline dolostones of the Manitoulin Formation. The contact is devoid of scour, rill or other features indicative of extended periods of erosion, although a few centimetres of silty shale are found separating the 2 formations.

The Manitoulin Formation on Manitoulin Island contains both biohermal and interbiohermal deposits. The bioherms are found only in the eastern part of the island, and mostly in the more southerly outcrops of the formation (Fay and Cooper 1982). Interbiohermal parts of the formation are thinly bedded, flat lying and about 9 m thick. Thicknesses of up to 15 m are found in the biohermal parts of the formation. Drilling by the Ontario Geological Survey (Johnson and Telford 1981a, 1981b), suggests that the larger bioherms stand directly on the Silurian-Ordovician disconformity surface. The large area north of Lake Manitou is a complex of both biohermal and interbiohermal deposits.

The Manitoulin Formation is sparsely fossiliferous, bearing a brachiopod-coral assemblage. South of Perch Lake and north of Pike Lake, the formation is anomalously thick. However, these are probably only apparent thicknesses caused by draping of the Paleozoic strata over buried ridges of Precambrian rocks.

Cabot Head Formation

The overlying Cabot Head, Dyer Bay, Wingfield and St. Edmund Formations were previously designated as members of the Cabot Head Formation (Liberty and Bolton 1971; Liberty 1972). However, more recent O.G.S. mapping and drilling has shown these units to be discrete and mappable, thus they should be accorded full formational status. This nomenclature was used by Bolton (1957) and earlier workers. Further discussion related to definition of the St. Edmund Formation is included with the description of that unit.

Disconformably overlying the Manitoulin Formation, the Cabot Head Formation consists of red and green shales. The contact between the formations is not exposed on Manitoulin Island. The Cabot Head Formation does not outcrop within the map area and only subcrops beneath glacial deposits in the extreme southwest corner (adjacent to Lake Manitou). The unit is about 17 m thick in the subsurface (Johnson and Telford 1981a, 1981b) and contains several bands of evaporite minerals.

Dyer Bay Formation

This unit disconformably overlies the shales of the Cabot Head Formation. The contact is not exposed within the map area but, where exposed elsewhere on the island (Ice Lake Road-Cut, Kagawong map area, N.T.S. 41G/16, U.T.M. 390250E - 5083400N), the contact is sharp. The Dyer Bay Formation consists of about 6 m of medium brown, thinly bedded, highly fossiliferous, mediocrystalline dolostone. The formation is characterized by an abundance of the brachiopod *Virgiana* in the lower part; bryozoan are common in the upper part. The Dyer Bay Formation does not outcrop within the map area and only subcrops beneath glacial deposits on the west shore of Lake Manitou (U.T.M. 422950E 5067900N).

Wingfield Formation

Overlying the Dyer Bay Formation, the Wingfield Formation consists of 10.6 m of thinly bedded, brown dolostone interbedded with green shale. The contact between these formations is not exposed within the map area, although elsewhere on the island (Ice Lake Road-Cut, Kagawong map area, N.T.S. 41G/16, U.T.M. 390250E-5083400N) it is very sharp. The Wingfield Formation is poorly fossiliferous with only occasional ostracod-rich horizons. It often has shallow water depositional features such as ripple marks, dessication cracks and occasional rain pits. This unit only subcrops beneath glacial deposits on the west shore of Lake Manitou.

St. Edmund Formation

Field mapping and subsurface studies (Johnson and Telford 1981a, 1981b), carried out in this map area and elsewhere on Manitoulin Island, have shown that strata formerly separated into the St. Edmund Member (Cabot Head Formation) and the Mindemoya Formation (Liberty 1972) constitute a single rock unit. The name St. Edmund has priority (introduced by Williams 1919) and therefore is used here, with formational status, to define those strata lying stratigraphically between the Wingfield and Fossil Hill Formations. The St. Edmund Formation consists of thin and evenly bedded, pale grey, lithographic dolostone, alternating with thicker beds of brown, finely crystalline dolostone. The formation is very poorly fossiliferous except for the "oncolite bed", a bed of bulbous stromatoporoids, found near the top of the formation.

The St. Edmund Formation conformably overlies the Wingfield Formation. The contact between these units is not exposed on the island although subsurface data suggest it is gradational in some places. The St. Edmund Formation is the youngest Paleozoic rock unit in the map area, but it only subcrops beneath glacial deposits in the extreme southwest corner.

ECONOMIC GEOLOGY

Although no recent petroleum exploration has taken place on Manitoulin Island, some 35 recorded exploration wells have been drilled in the map area (Johnson and Telford 1981a). Records for most of these wells are poor, but existing data suggest that 12 were dry with the rest being shows or very small producers. Most of the petroleum exploration wells were drilled south of Pike Lake.

No limestone-dolostone quarries are located in the map area. Northeast of Sheguiandah Village (U.T.M. 429500E-5083500N) quartzite has been extracted from a small quarry in the Lorrain Formation (Proterozoic) for use as a metallurgical flux.

REFERENCES

Bolton, T.E.
1957: Silurian Stratigraphy and Paleontology of the Niagara Escarpment in Ontario; Geolgical Survey of Canada, Memoir 289, 145p., 13 plates.

Card, K.D.
1978: Geology of the Sudbury-Manitoulin Area, Districts of Sudbury and Manitoulin; Ontario Geological Survey Report 166, 236p. Accompanied by Map 2360, scale 1:125 720 or 1 inch to 2 miles, and 4 charts.

Fay, I. and Copper, P
1982: Early Silurian Bioherms in the Manitoulin Formation of Manitoulin Island; Proceedings, Third North American Paleontological Convention, Volume 1, p. 159-163.

Johnson, M.D. and Telford, P.G.
1981a: Preliminary Results of the 1978-1979 Drilling Programme, Manitoulin Island Limestone-Dolostone Assessment Project; Ontario Geological Survey, Open File Report 5360.

1981b: Preliminary Results of 1980 Drilling Programme, Manitoulin Island Limestone-Dolostone Assessment Project; Ontario Geological Survey, Open File Report 5364.

Liberty, B.A.
1968: Ordovician and Silurian Stratigraphy of Manitoulin Island, Ontario, p.14-37 *in* Michigan Basin Geological Society, Guidebook for 1968 Annual Field Conference.

1972a: Meldrum Bay Area, Manitoulin District; Ontario Division of Mines, Map 2244, scale 1:63 360.

1972b: Silver Water Area, Manitoulin District; Ontario Division of Mines, Map 2245, scale 1:63 360.

1972c: Kagawong Area, Manitoulin District; Ontario Division of Mines, Map 2246, scale 1:63 360.

1972d: Little Current Area, Manitoulin District; Ontario Division of Mines, Map 2247, scale 1:63 360.

1972e: Providence Bay Area, Manitoulin District; Ontario Division of Mines, Map 2248, scale 1:63 360.

1972f: Manitowaning Area, Manitoulin District; Ontario Division of Mines, Map 2249, scale 1:63 360.

Liberty, B.A. and Bolton, T.E.
1971: Paleozoic Geology of the Bruce Peninsula Area; Geological Survey of Canada, Memoir 360, 163p.

Russell, D.J. and Telford, P.G.
1983: Revision to the Stratigraphy of the Upper Ordovician Collingwood Beds of Ontario - A Potential Oil Shale, Canadian Journal of Earth Sciences, Volume 20, Number 12, p.1780-1790.

Williams, M.Y.
1919: The Silurian Geology and Faunas of Ontario Peninsula, and Manitoulin and Adjacent Islands; Geological Survey of Canada, Memoir 111, 195 p.

SYMBOLS

- Bedrock outcrop from which a sample was taken and field data collected.(N.B. All outcrops present on the island are not shown on the map.)
- Quarry
- Geological Boundary
- Geological Boundary, approximate
- Geological Boundary, interpreted
- DDH1 O.G.S. Drillhole
- Location of bioherm, Manitoulin Formation

SOURCES OF INFORMATON

Topography from map 41H/13 of the National Topographic Series.

Additional geological information from 29 drill cores taken on Manitoulin between 1978 and 1980. (Johnson and Telford 1981a, 1981b).

Locations of Manitoulin Formation bioherms provided by P. Copper (Laurentian University).

CREDITS

Geology by M.D. Johnson, P.G. Telford and assistants, 1979-1981.

Every possible effort has been made to ensure the accuracy of the information presented on this map; however, the Ontario Ministry of Natural Resources does not assume any liability for errors that may occur. Users may wish to verify critical information; sources include both the references listed here, and information on file at the Resident or Regional Geologist's office and the Mining Recorder's office nearest the map area.

This project was funded by the Ontario Ministry of Northern Affairs through the Northern Ontario Geological Survey (NOGS) program.

Issued 1985

Information from this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

Johnson, M.D. and Telford, P.G.
1985: Paleozoic Geology of the Little Current Area, District of Manitoulin; Ontario Geological Survey, Geological Series-Preliminary Map P.2670, scale 1:50 000. Geology 1979 to 1981.

Ministry of Natural Resources
Hon. Michael Harris, Minister
Mary Mogford, Deputy Minister

Ministry of Northern Affairs
Hon. Leo Bernier, Minister
David Hobbs, Deputy Minister

Ontario Geological Survey

MAP P.2670

Geological Series - Preliminary Map

PALEOZOIC GEOLOGY

LITTLE CURRENT AREA

DISTRICT OF MANITOULIN

Scale 1:50 000

Metres 1000 0 1 Kilometre

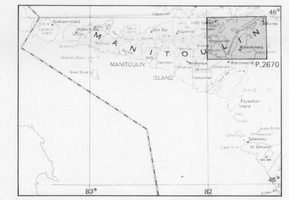
Mile 1 0 1 Mile

NTS Reference: 41 H/13

ODM-GSC Aeromagnetic Map: 2270G

OGS Geological Compilation Map: 2441

This map is published with the permission of V.G. Milne, Director, Ontario Geological Survey.



LOCATION MAP

Scale : 1 : 1 548 000 or 1 inch to 25 miles

LEGEND

PHANEROZOIC
PALEOZOIC
MIDDLE SILURIAN

- 17* Amabel Formation (Facies IV): Dolostone, granular, soft, white, massive
- 16* Amabel Formation (Facies III): Dolostone, medium to finely crystalline, blue–grey, massive to thickly bedded
  - 16c* Facies III, abundant crinoid debris
  - 16p* Facies III, abundant pentamerid brachiopods
- 15* Amabel Formation (Facies II): Dolostone, medium to finely crystalline, blue–grey to buff, massive, minor thinly bedded, lenticular bodies forming hummocky topography
  - 15c* Facies II, abundant crinoid debris
- 14* Amabel Formation (Facies I): Dolostone, finely crystalline, brown, thinly bedded
  - 14b* Facies I, richly fossiliferous
  - 14ch* Facies I, abundant nodular chert
- 13* Fossil Hill Formation: Dolostone, fine to coarsely crystalline, fossiliferous, buff-brown, thinly bedded, chert-rich in upper part
- 12 St. Edmund Formation: Dolostone, very fine to fine crystalline, pale grey to buff-brown, thin to medium bedded
- 11 Wingfield Formation: Interbedded dolostone and shale
- 10 Dyer Bay Formation: Dolostone, fine to medium crystalline, buff to grey-brown, thinly bedded, fossiliferous

LOWER SILURIAN

- 9 Cabot Head Formation: Shales, red and green
- 8 Manitoulin Formation: Dolostone, fine to medium crystalline, thinly bedded, locally massive (biohermal)

DISCONFORMITY

UPPER ORDOVICIAN

- 7 Georgian Bay Formation: Interbedded limestone, dolostone, and shale; shale increasing to base
- 6 Blue Mountain Formation: Soft, blue-grey, argillaceous shale

MIDDLE-UPPER ORDOVICIAN

- 5 Lindsay Formation: Limestone, finely crystalline to sublithographic, partly argillaceous, minor dolostones, thinly bedded, fossiliferous; overlain by black petroliferous shale

MIDDLE ORDOVICIAN

- 4 Verulam Formation: Limestone and shale interbedded, limestone is blue-grey, coarsely crystalline to sublithographic, partly bioclastic and argillaceous, fossiliferous
- 3* Bobcaygeon Formation: Limestone, sublithographic and very finely crystalline, thinly bedded, moderately fossiliferous
- 2* Gull River Formation: Limestone, dark grey, finely crystalline to granular, grading into lithographic, pale grey, fossiliferous
- 1* Basal Beds: Shales and sandstones, red and green

UNCONFORMITY

PRECAMBRIAN
PROTEROZOIC

- PC* Bar River and Lorrain Formation: (Huronian Supergroup, Cobalt Group) quartzite and orthoquartzites

* Not present in this map area