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Geology of the Metionga Lake Area

Districts of Thunder Bay and Kenora

By

DAVID P. ROGERS

Geological Report No. 24

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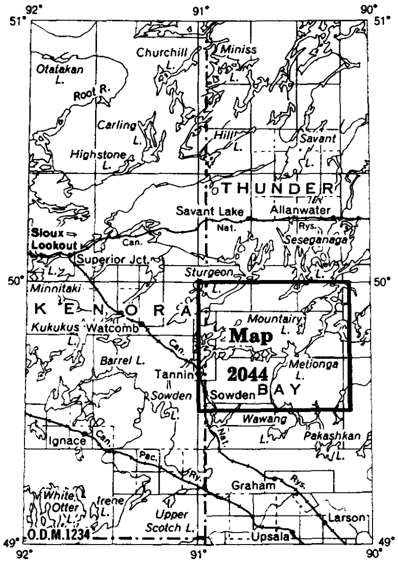
Abstract

In 1961 the author carried out, for the Ontario Department of Mines, a reconnaissance geological survey of the Metionga Lake area, comprising about 1,200 square miles, for publication at a scale of 1 inch to 1 mile.

The bedrock in the area is of Precambrian age and is classified into three groups: plutonic rocks (granitic and syenitic); sedimentary and volcanic rocks; early and late basic intrusive rocks.



Key map showing location of the Metionga Lake area. Scale, 1 inch to 50 miles.

The oldest rocks are the volcanic group, which comprises altered basic, intermediate, and acid types, pyroclastic rocks, and their metamorphic equivalents. Contemporaneous sedimentary bands occur with the volcanic group, both as large belts and narrow interbeds. The sedimentary rocks consist of greywacke, conglomerate, argillaceous rocks, staurolite schist, and biotite paragneiss, and their metamorphic equivalents. Banded magnetite iron formation occurs in the sedimentary series.

Early basic intrusive rocks intrude the volcanic and sedimentary rocks. The late basic intrusive rocks are porphyritic diabase. The plutonic rocks have been arbitrarily classified into several types.

The rocks of the area have been folded, but only a minor amount of faulting has been recognized. Occurrences of iron, sulphides, and an alkaline complex are described.

Geology of the Metionga Lake Area

BY

David P. Rogers[1]

Introduction

The Metionga Lake map-area is bounded by longitudes 90°07′–91°00′ W., and latitudes 49°30′–50°00′ N. and covers about 1,200 square miles. The centre of this area lies about 70 air miles southeast of Sioux Lookout and is in the districts of Thunder Bay and Kenora, and in the Patricia and Port Arthur mining divisions.

Evidence of prospecting, for gold and sulphides in the volcanic and sedimentary rocks of the Sturgeon Lake area, dates back to the early 1900's. Evidence of staking carried out during the past five to ten years was noted in the vicinity of Bell, Glitter, Quest, and Sassafras lakes. The most extensive exploration carried out to date has been on a belt of banded iron (magnetite) formation, which extends west and east of Sassafras Lake for a total distance of about 14 miles.

The present geological survey was made during the summer of 1961 and was largely reconnaissance in nature. Mapping was done at a scale of 1 inch to ¼ mile, using white prints of the basemaps derived from maps of the Forest Resources Inventory, Ontario Department of Lands and Forests. Air photographs at scales of 1 inch to 1 mile and 1 inch to ¼ mile were used in the field to find rock outcrops and water-routes, and to make topographic additions and geological interpretations where possible.

A preliminary report (O.D.M. 1961, pp. 8–10) on the field work in the Metionga area was published in 1961. In March 1962, two preliminary maps at a scale of 1 inch to ½ mile were issued; these are the Glitter Lake Area (O.D.M. Maps 1962, No. P. 148) and the Harmon-Mountairy Lakes Area (O.D.M. Maps 1962, No. P. 149).

Aeromagnetic maps at a scale of 1 inch to 1 mile, released jointly by the Ontario Department of Mines and the Geological Survey of Canada in October 1961, cover the map-area. Unfortunately, these maps were not available to the author at the time of the mapping. However, they were made available in time to incorporate their information in this report and accompanying geological map (No. 2044, back pocket).

[1]Geologist, temporary staff, 1961, Ontario Dept. Mines, Toronto.

ACKNOWLEDGMENTS

The author was ably assisted in the field by T. P. Armstrong, P. F. Hoffman, and A. S. Ruffman. Mr. Armstrong carried out independent mapping during the season.

The many courtesies and valuable assistance extended to the party by F. Atkinson, chief ranger, and his staff, of the Ontario Department of Lands and Forests, Sioux Lookout, especially during a bad fire season, are gratefully acknowledged.

Thanks are extended to H. C. Speight and G. E. Trussler, air pilots, of the Ontario Department of Lands and Forests, Sioux Lookout, for their efficient service in moving the party and maintaining its supplies throughout the season.

Thanks are also due to J. J. Dietiker and A. Groves, tourist outfitters, Sturgeon Lake, for providing information and use of their facilities in the area.

The author thanks J. Satterly, P. F. Karrow, and D. F. Hewitt, of the Ontario Department of Mines, who gave him many helpful suggestions during the preparation of the report and map.

MEANS OF ACCESS

The Canadian National Railways, Sioux Lookout–Port Arthur route, crosses the extreme southwestern part of the map-area.

A secondary gravel road has been completed from Ignace, on highway No. 17, northeast through Clarkdon on the C.N.R. line, to O'Briens Landing at the southwest end of Sturgeon Lake. A further section of this road is at present under construction along the northwest shore of Sturgeon Lake to the Sturgeon River, hence to Savant Lake on the northern C.N.R. transcontinental route.

Air service is available from Sioux Lookout, Ignace, and Fort William. It is the best means of transportation to any part of the map-area except Sturgeon Lake, which can be reached by road.

Canoe travel is practicable throughout much of the area. Portages are generally short and good, and are indicated on the accompanying geological map.

A. Groves operates a tugboat from O'Briens Landing, at the southwest tip of Sturgeon Lake.

PREVIOUS GEOLOGICAL WORK

The following summary of previous work includes some references to work done outside the Metionga Lake map-area. These are included because they describe the early work in the Sturgeon Lake area, part of which lies within the present map-area.

W. McInnes (1900, pp. 118–20), of the Geological Survey of Canada, seems to have been the first geologist to describe the Sturgeon Lake area. In 1902, A. P. Coleman (1902, p. 148) gave an account of some of the gold prospects on Sturgeon Lake. In 1902, W. G. Miller (1903, pp. 83–86, 104, 105) wrote a good account of many of the claims on Sturgeon Lake. W. H. Collins of the Geological Survey of Canada, in 1906, mapped the geology of the area between Lake Nipigon and Sturgeon Lake (Collins 1907 and map No. 993). E. T. Corkill, a former Inspector of Mines, wrote brief notes on the mines on Sturgeon Lake and vicinity in several reports of the Ontario Bureau of Mines (Corkill 1909, pp. 81, 82; 1910, p. 79). E. S. Moore (1911, pp. 133–57) reported on the geology and mines of the area. T. L. Gledhill (1925, pp. 19, 20) gave a fairly detailed description of the geology of the Sturgeon Lake area. A. R. Graham (1931, pp. 36–50) gave the most recent description of the geology of Sturgeon Lake.

In 1937, H. C. Horwood (1938, pp. 26–35) described the geology at the Darkwater mine in Beidelman Bay, southwest Sturgeon Lake, which is 4 miles west of the map-area.

W. F. Green (1924, pp. 1–8) first described the geology along Ross's Base Line (1922) extending from the boundary of the districts of Kenora and Thunder Bay, east through Shikag, Metionga, Brightsand, and Empire lakes.

TOPOGRAPHY AND DRAINAGE

The drainage in the area is mainly to the north, but locally it is northwest, northeast, or occasionally south.

The north half of the map-area is traversed by abundant lakes and connecting waterways; the central part of this section is characterized by a disorganized, patchy drainage system due to glacial dumping.

The south half of the map-area is more extensively covered by glacial debris. The English and Brightsand rivers are the main through-going water systems, and they flow to the north. The major creek system flows north-northeast but is often disrupted. Kettle lakes are common throughout.

There are many areas of swamp and bog; these are most abundant in the south half of the map-area, and have been noted on the accompanying geological map (No. 2044, back pocket).

The relief in the map-area reflects, in part, the nature of the underlying rocks. The areas of greatest relief are in the vicinity of Seseganaga, Harmon, Mountairy, Sparkling, and Empire lakes, which are mainly underlain by hybrid granitic rocks. In these areas, ridges and hills may rise to several hundred feet above the lake levels. One other area of relief is a broad zone, trending east-west, south of Metionga and Brightsand lakes. This relief area comprises glacial drift and appears to be due to a terminal moraine complex.

The belt of volcanic and sedimentary rocks stretching from Sturgeon Lake eastwards to the Mountairy Lake area is low lying and covered by abundant glacial debris (sandy boulder moraine). Similarly, the areas underlain by massive grey granite, Shikag, Metionga, and Brightsand lakes, are low lying with minor rock exposures and have an extensive glacial-drift cover.

Some elevations in the area are as follows:

ELEVATIONS[1]

	Feet
Sturgeon Lake	1,342
Bell Lake	1,389
Tannin (C.N.R. line)	1,470
Sowden (C.N.R. line)	1,464
Weaver Lake	1,541

[1]Elevations taken from the National Topographic Series Sheet No. 52G, Ignace Sheet, Ontario. Scale, 1 inch to 4 miles.

FORESTS

The area is mostly covered by second-growth mixed bush consisting of spruce, balsam, jackpine, poplar, birch, and alder.

In the 1950's, logging operations were carried out along the south shore of Sturgeon Lake south of Sturgeon Narrows, Barge Lake, and Post Lake. The only other past logging operation noted was in the vicinity of Tannin and in the southeastern part of Mattawa Lake. These were pulp operations. No logging companies were operating in the area at the time of writing this report. Evidence of old burned-over areas was observed; no large areas of recent burn were encountered during the present survey.

FISH AND GAME

Commercial fishing for pike, pickerel, whitefish, and lake trout is carried out on Sturgeon Lake by A. Groves. Fishing is also carried out to some extent on Bell, Shikag, Metionga, Globe, Empire, Sparkling, and Harmon lakes by inhabitants of the surrounding area.

Tourists have reached most of the larger lakes and rivers in the area, and fishing for pike, pickerel, and lake trout is generally good. Brook trout are not found in this area.

Moose are common and offer excellent hunting in the fall of the year. The author saw only one deer and occasional signs of others. Similarly, black bear are not plentiful. Some trapping is still carried out. Black duck, American merganser, teal, and ringneck duck were seen in the area. Ruffed grouse and spruce grouse were not abundant in 1961.

AGRICULTURE

Cultivation in the area is limited to the small gardens of the local residents. There are only small areas of cleared land in the old settlement areas and logging camps.

WATER POWER

Conditions in the map-area are not favourable for large-scale water-power projects.

INHABITANTS

The only settlement within the map-area is Sowden, which is situated on the Sioux Lookout–Port Arthur route of the Canadian National railway in the southwestern part of the area. The author passed this settlement while canoeing down the English River; it appeared to be an Indian village.

The only inhabitants of the area other than those at Sowden are seasonal —fishermen, hunters, trappers, and tourists. The Ontario Department of Lands and Forests maintains a fire tower, during the fire season, on the north shore of Sixmile Lake in the northwest corner of the map-area.

General Geology

The bedrock of the area is of Precambrian age. It is covered by glacial drift of varied nature, thickness, and extent.

The exposed Precambrian rocks fall into five major groups:

1. A volcanic sedimentary group, variously folded and metamorphosed.
2. Early basic intrusive rocks and their metamorphosed equivalents.
3. Granitic rocks comprising older varied granitic gneisses, gneissic granite, younger granite, pegmatite and porphyry intrusions.
4. Syenitic rocks comprising hornblende syenites and an alkaline syenite complex.
5. Late basic intrusive rocks.

No sedimentary rocks of later age were encountered. Diabase dikes and sills, so common in the Precambrian areas of central and eastern Ontario, are almost absent in this area.

The generalized geological history appears to be as follows. The oldest rocks consist of a series of basic and acid volcanic rocks, accompanied in the later stages of formation by contemporaneous sedimentation in favourable basins. The end result is an intercalated group, of dominantly volcanic rocks with lesser amounts of sedimentary rocks to the northwest, and a dominantly sedimentary group with lesser amounts of volcanic rocks to the east. There followed a period of intrusion of minor amounts of basic rocks, in the form of small stocks and dikes of diorite and gabbro. At a later period the large-scale regional emplacement of the granitic complex began. Early formation of the *lit par lit* injection gneisses along the contact zones progressed through migmatite and hybrid granite gneiss, and finally to the young "core-areas" of gneissic to massive, coarse-grained granite. Abundant granite pegmatite and fine-grained aplitic granite, in the form of small dikes that intrude the granitic gneiss terrain, appear to be the last intrusive event of this period of regional granite formation.

Folding, partial assimilation, and regional metamorphism accompanied this period of intrusion.

The syenitic rocks occur as satellitic, elliptically-shaped bodies; these are generally concordant with the regional foliation and apparently formed in the end stages of the main granitic period, or later. The contact effects of these bodies are quite local as compared to the effects of intrusion, folding, and metamorphism by the granitic rocks.

The latest period of rock formation is represented by the late basic intrusive rocks, of which only a few diabase dikes are evidence.

No regional system of faulting was recognized; only evidence of minor local faulting was observed, this being confined to the volcanic-sedimentary rocks.

Over the Precambrian rocks lie Pleistocene gravel and sand, and Recent alluvium and swamp deposits.

DISCUSSION OF CLASSICAL AGE CORRELATION

The classical time-rock units have not been used in this report or in the accompanying geological maps.

The early workers in the Sturgeon Lake area, especially Graham (1931),

TABLE OF FORMATIONS

CENOZOIC

RECENT: Peat, muck.

PLEISTOCENE: Glacial drift: boulders, gravel, sand, till.

Great Unconformity

PRECAMBRIAN

LATE BASIC INTRUSIVE ROCKS

Porphyritic diabase (dikes).

PLUTONIC ROCKS

Syenitic Rocks:

Scapolite-augite syenite (Sturgeon Lake alkaline complex).
Pink, porphyritic biotite-hornblende-quartz syenite (Vista Lake).
Melanocratic hornblende syenite gneiss (Vista Lake).
Hornblende-pyroxene-biotite syenite (Bell Lake).

Pink Granitic Rocks:

Pink granite; quartz monzonite; gneissic pink granite; porphyritic pink granite; quartz diorite; granite pegmatite; quartz and quartz-feldspar porphyry, feldspar porphyry.

Grey Granitic Rocks:

Grey granite; granodiorite; gneissic grey granite; porphyritic grey granite; granite pegmatite.

Granitic Gneisses:

Migmatite; *lit par lit* gneiss; hybrid granite gneiss; amphibolite (massive or foliated).[1]

EARLY BASIC INTRUSIVE ROCKS

Gabbro; metagabbro; metadiorite; pyroxenite; lamprophyre.

SEDIMENTARY AND VOLCANIC ROCKS

Sedimentary Rocks:

Greywacke; conglomerate; argillite; siltstone; slate; phyllite; staurolite-biotite-feldspar schist; metasedimentary schists and gneisses; minor volcanic rocks(?), chlorite schist, tuff(?); biotite paragneiss; banded magnetite iron formation.

Volcanic Rocks:

Basic volcanic rocks; altered basic and intermediate volcanic rocks; coarse-grained basic flow rocks;[2] agglomerate, tuff; pillow lava; porphyritic basalt;[2] schists and gneisses; metasedimentary interbeds, tuff(?).

Acid volcanic rocks; rhyolite, porphyritic (quartz) rhyolite[3]; acid agglomerate, tuff, flow breccia; acid to intermediate volcanic rocks; quartz-sericite-carbonate schist.

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[1]Origin not known; may be older basic intrusive and(or) extrusive rocks.
[2]May include some basic intrusive rocks.
[3]May include some intrusive quartz porphyry.

have referred to the volcanic rocks as Keewatin, the sedimentary rocks as Timiskaming, the basic intrusive rocks as Pre-Algoman intrusives, and the granites and syenites as Algoman. Gledhill (1925) refers to some of the granitic gneisses (Wapikaimaski Lake) as of Laurentian type.

The author believes that in view of recent discussions on Precambrian nomenclature it is best to discard the type names previously used. He does, however, consider the volcanic and sedimentary rocks as early Precambrian and of a somewhat contemporaneous age, because they are intercalated. The map legend indicates the relationships of the plutonic rocks. The syenitic intrusions are younger, satellitic, and probably of middle or late Precambrian age. The younger diabase intrusive rocks are probably late Precambrian (Keweenawan-type).

SEDIMENTARY AND VOLCANIC ROCKS

The main sedimentary-volcanic group of rocks forms a large belt underlying most of the northwestern part of the map-area.

The Vista Lake quartz syenite and melanocratic syenite gneiss intrudes and borders the northern and eastern parts of the group. Varied granitic gneisses and grey granite intrude and border the south and extreme east boundaries. A quartz porphyry stock intrudes the southwestern part near Darkwater Lake; numerous quartz and quartz-feldspar porphyry dikes intrude throughout. Large granite pegmatite dike-sheets invade the eastern termination of the belt. Small metagabbro-diorite stocks and dikes intrude both the volcanic and sedimentary rocks.

Lit par lit injection gneiss and migmatite contact phases are common along the sedimentary-volcanic-granitic rock contacts.

Metamorphism is generally in the amphibolite facies in the contact zones with the granitic rocks. The eastern part of the belt has been largely altered to metasedimentary-metavolcanic schists and gneisses

Volcanic Rocks

Basic to intermediate, and acid volcanic rocks of a varied nature underlie most of the northwestern part of the map-area. Primary textures and structures are preserved in much of this area. However, shearing and metamorphism have obliterated these features in many places; this is especially true in the area east of Div Lake, and in the remnant bands in the granitic gneisses.

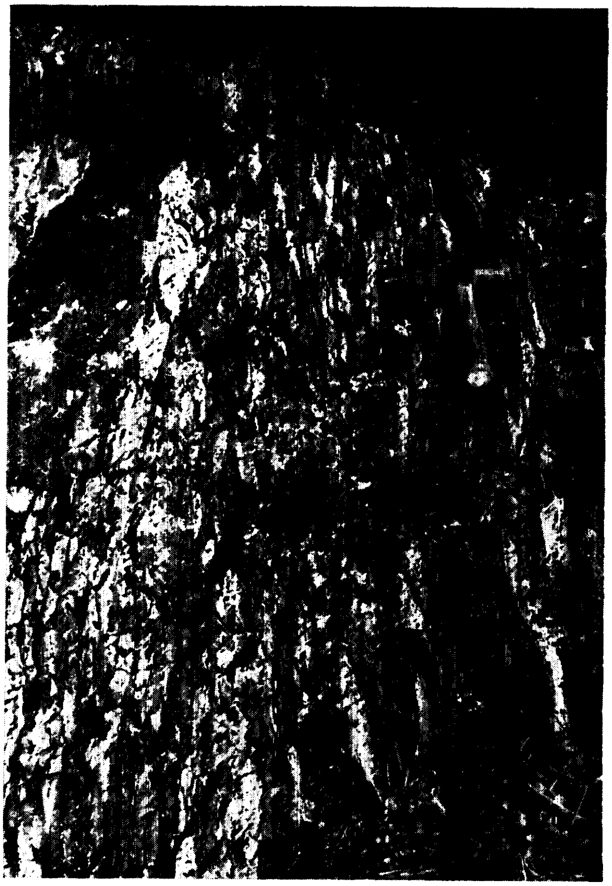
The acid volcanic rocks appear to be rather local and narrow in extent, and they occur at random within the volcanic group. They are most prominent: in the northern part of Sixmile Lake; on the northwest shore of Sturgeon Narrows; and along the south shore of Sturgeon Lake. Minor sedimentary beds are often intercalated with the intermediate to basic volcanic rocks.

BASIC VOLCANIC ROCKS

Altered Basic and Intermediate Volcanic Rocks (1a)

Included in this group are the fine- to medium-grained, massive to schistose, chloritic volcanic rocks. Primary features are not generally present or apparent, and the rock has a recrystallized metamorphic texture. Some amygdaloidal flows were observed in the Sturgeon Lake area. They are found in close association with pillowed lava, tuffs, and agglomerate.

Photo by P. F. Hoffman



Agglomerate band, 3—4 feet wide, in a sequence of pillowed lava, tuff, and massive flows. The fragments are acid and are enclosed in a chlorite-epidote matrix. From an island on north shore of Sturgeon Lake.

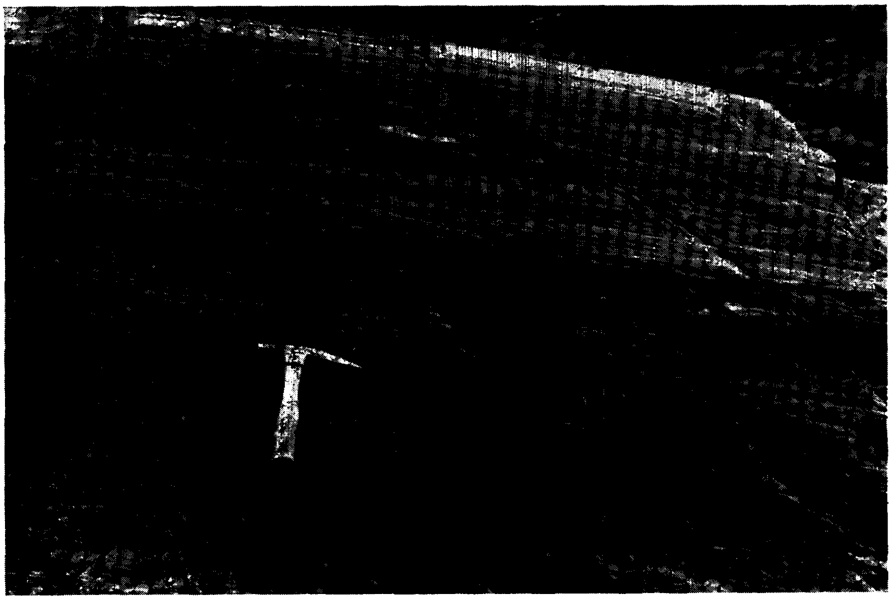
Coarse-Grained Basic Flow Rocks (1b)

The rocks included in this group are similar to those in (1a) except for a coarser grain; they have a metamorphic texture, and in many cases exhibit feldspar and(or) hornblende phenocrysts or porphyroblasts, up to ¼ inch across. It is possible that some rocks included in this group are altered basic intrusive rocks. This appears to be so in Cobb Bay of Sturgeon Lake, and at Sixmile Lake, but these occurrences were not closely examined. Some of the rocks included in (1a) and (1b) would perhaps be best described as medium- to coarse-grained amphibolites of probable volcanic origin.

Basic Agglomerate and Tuff (1c)

Basic agglomerate and coarse tuffs are well developed and preserved along the north shore and on the islands of Sturgeon Lake west of the Narrows. The photograph opposite shows typical basic agglomerate. The fragments are patchy to subrounded, fine- to medium-grained, basic to intermediate volcanic rocks. Occasional acid fragments are present. Narrow acid volcanic bands, now generally carbonatized quartz-sericite schists, commonly are closely associated. Small tuffaceous and agglomeratic bands are associated with massive and pillowed flow rocks throughout the area.

Photo by P. F. Hoffman



Pillowed lava; south shore of Sturgeon Lake. The pillow underlying the hammer indicates tops to the right; glacial striae parallels the hammer head.

Pillow Lava (1p)

Pillowed lava is not uncommon throughout most of the volcanic terrain. Top determinations were seldom possible owing to poor development of pillow structure, shearing, or limited exposure. Pillowed lava is most abundant to the north and south of the sedimentary band stretching from Sturgeon Lake southeast through Post and Add lakes. Strong shearing and carbonatization have altered these flows. From the few top determinations observed, the flows appear to face the sedimentary rocks on both the north and south.

Porphyritic Basalt (1d)

The rocks included in this category are medium-grained basic rocks, which have prominent rounded, altered feldspar phenocrysts. The few outcrops observed were in the areas of Cobb Bay, Sixmile Lake, and the north shore of Sturgeon Lake. Some of these may be porphyritic basic intrusive rocks.

Schists and Gneisses (1e)

The rocks included in this group are highly altered and metamorphosed volcanic rocks of diverse origin. The most common rock types are chloritic and hornblende-rich schists and gneisses modified by feldspar, quartz, biotite, and garnet. Often these schists and gneisses can be traced into the original (1a, 1b) type of volcanic rocks; for example in the Glitter Lake–Willet Lake area, and south of Sturgeon Narrows.

The foliation measured is secondary, but in general it appears to be parallel to the original flow contacts and primary structural planes.

Southeast of Sassafras Lake the distinction between metasedimentary and metavolcanic schists and gneisses is difficult. The chloritic and hornblende-rich schists and gneisses in this area are mostly grouped with the volcanic rocks. Similarly the chloritic and hornblende-rich bands in the granitic gneisses have been grouped with the volcanic rocks. The narrow belt through Redwing and Tokay lakes is largely metavolcanic schist and gneiss containing metasedimentary interbands.

ACID VOLCANIC ROCKS

Rhyolite, Porphyritic (Quartz) Rhyolite (1r)

The rhyolite and porphyritic (quartz) rhyolite is usually a sheared, fine-grained, greenish-coloured rock, containing prominent quartz eyes up to 2 millimetres in width. It commonly grades into acid agglomerate, flow breccia, and tuffaceous phases. Narrow rhyolite flow bands occasionally occur with the intermediate to basic volcanic rocks. In some places, outcrops mapped as rhyolite may in fact be intrusive quartz porphyry. Where these rocks are sheared and carbonatized, it is difficult to distinguish between them.

Acid Agglomerate, Tuff, Flow Breccia (1h)

Acid agglomerate, tuff, and flow breccia are the most abundant acid volcanic rocks in the area. They occur in close association with one another; the accompanying photographs show typical examples.

The fragments are of quartz and quartz-feldspar porphyry, and rhyolite, are angular to subrounded, and often grade into the finer-grained crystalline matrix. Feldspar and quartz grains occur both as fragments and phenocrysts in the matrix, which generally comprises about 5 percent of the rock. Occasional greenstone fragments are present in the agglomerate and coarse tuffs.

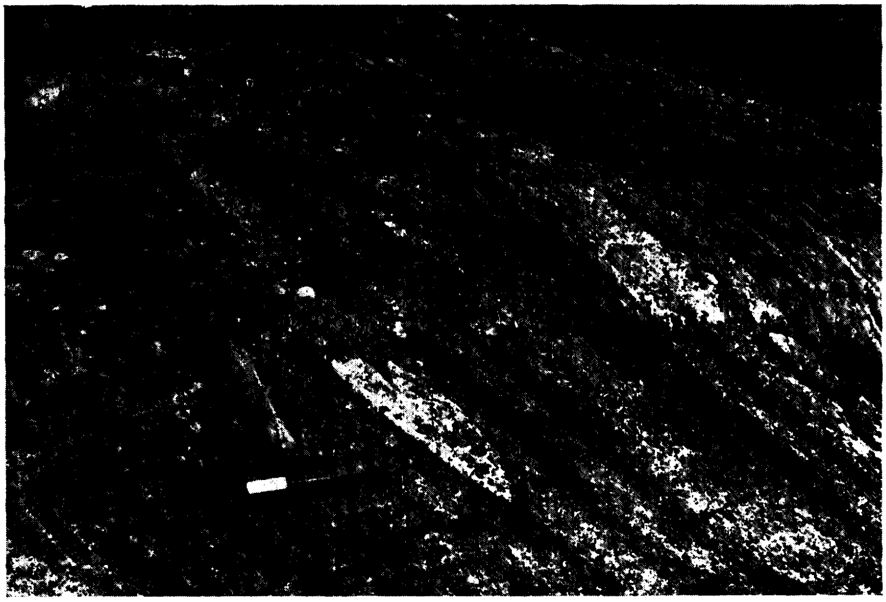
Shearing and carbonatization are common, giving rise to the quartz-sericite-carbonate schists (1g).

Sedimentary Rocks

The sedimentary rocks occur in two main belts: (1) Sturgeon Lake–Post Lake, an assemblage of conglomerate and greywacke-type sedimentary rocks, about 18 miles long and from ½ to ¾ mile wide; (2) Princess Lake–Quest Lake–

Photos by P. F. Hoffman

Acid agglomerate. Fragments are of porphyritic (quartz) rhyolite and are angular to subrounded. Both feldspar and quartz phenocrysts are present in the matrix. Photo taken from outcrop on south shore of Sturgeon Lake.



Bedded acid tuff containing patches of acid fragments. This rock type occurs as interbands and lenses with the acid agglomerate. Note glacial striae parallel to the hammer head. From south shore of Sturgeon Lake.

Div Lake, an assemblage of conglomerate, greywacke, and argillaceous rocks about 12 miles long, and 2½ miles wide on the north, thinning south of Quest Lake to about ½ mile wide.

Both of these belts contain sedimentary iron formation. They are separated by an assemblage of basic volcanic rocks on the west and north, but appear to join or interfinger south of Div Lake. The combined sedimentary belt continues for about 12 miles to the east, terminating east of Mountairy Lake. Lack of mapping detail in this area prevents the author from presenting a clearer relationship on the map.

The area between Quest and Empress lakes is unmapped. However, the structure and aeromagnetic data indicate that the sedimentary rocks continue to the northeast.

In many places along these sedimentary bands there appear to be rapid facies changes from conglomerate, greywacke, bedded argillaceous rocks, and iron formation, each of which is lens-like in nature. The conglomerates are most abundant to the north and west. That part from the Div Lake area eastward comprises mainly metasedimentary schists and gneisses derived from greywacke and argillaceous sedimentary rocks. Conglomeratic facies are minor. The sedimentary rocks are intimately intercalated with varied schistose volcanic and tuffaceous bands.

The east end of the main belt is much intruded by granitic gneiss and is folded into a northeast-plunging anticlinal structure. East of the anticlinal structure, small remnant bands of schist and gneiss mark the termination of the main sedimentary-volcanic belt.

A separate belt or sedimentary basin, consisting mainly of conglomerate and quartzitic greywacke, occurs in Sturgeon Narrows in Sturgeon Lake. It appears to be about 3 miles long and ⅓ mile wide and is lenticular in outline.

Narrow inclusion bands of metasedimentary schist were mapped on Vista and Rocker lakes.

A narrow belt, about 15 miles long and ½ mile wide, of metavolcanic rocks containing minor sedimentary interbands extends southwest from Longneck Lake, on the main belt. It is separated from the main group by the intrusion of granite and granitic gneisses.

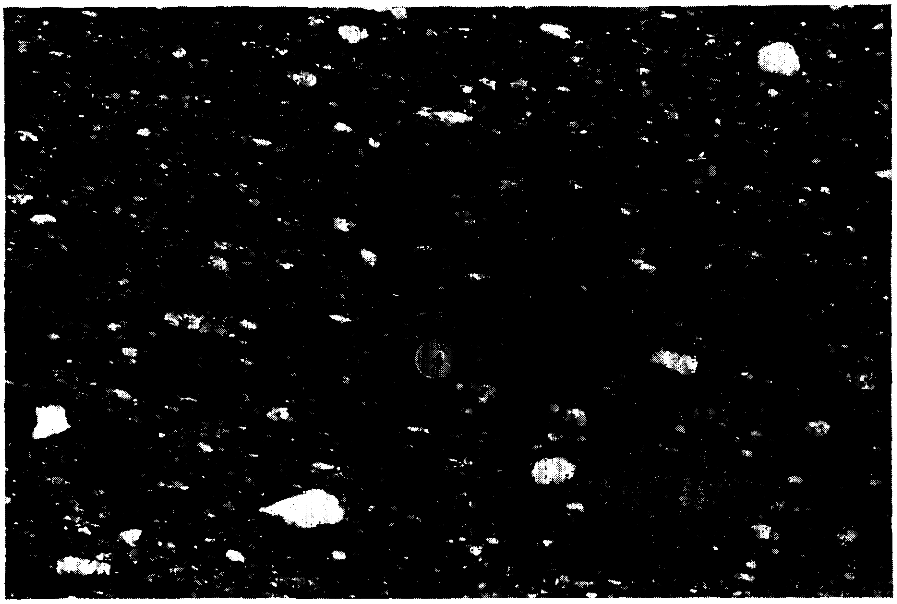
Lit par lit injection gneiss is commonly developed along the contacts between the sedimentary and granitic rocks.

Greywacke (3a)

The sedimentary rocks mapped as greywacke are, for the most part, coarsely banded to massive, arenaceous, grey-weathering rocks. They occur mainly in the vicinities of Willet and Add lakes, and in a belt lying east of Quest Lake, extending south between Quest and Vista lakes to Div Lake. The eastern extension of these bands has been altered to metasedimentary schist and gneiss (3d). Conglomeratic and argillaceous interbands and facies are common.

In thin section the greywackes are seen to be composed of angular quartz, with lesser amounts of feldspar and fine chloritic material containing traces of iron oxide, leucoxene, garnet, muscovite, and biotite. Biotite, garnet, and muscovite become more plentiful, with increase in metamorphic grade towards the granitic contacts, and in the schists and gneisses to the east.

Photos by P. F. Hoffman



Conglomerate; abundant pebbles of porphyritic (quartz) rhyolite, quartz, greenstone, argillite or tuff, and occasional granite pebbles in a greywacke matrix. From an island in Sturgeon Lake.

Banded sedimentary rocks; exhibits small dragfolds and boudin structures. The light-coloured bands are quartzitic (competent), and the dark bands are argillaceous (incompetent). From an island in Sturgeon Lake.

Conglomerate (3b)

The conglomerates are of a very varied nature, and the lithology varies with location and the type of adjacent volcanic rock. Both lateral and strike gradation with greywacke and argillaceous sedimentary rocks are common.

Two types of conglomerate occur on the islands in Sturgeon Lake. The major conglomerate has a greywacke matrix containing abundant lenticular pebbles and cobbles of porphyritic (quartz) rhyolite (*see* top photo, page 13). Minor amounts of greenschist, granite, and argillaceous pebbles are also present. The rhyolite pebbles are lithologically similar to the adjacent acid volcanic bands and are probably derived from them.

A narrow band of bedded, graphitic(?), argillaceous, slaty, and quartzitic sedimentary rocks (*see* bottom photo, page 13) separates a conglomerate band containing red jasper iron-formation pebbles and greenstone as well as minor rhyolite porphyry pebbles and cobbles. These variations appear to be due to sedimentary-source facies changes.

The conglomerate outcrops on Post and Willet lakes contain a greater proportion of granite cobbles.

The conglomerate in Sturgeon Narrows appears to be in a separate sedimentary basin or lobe. It is associated with a very quartzitic greywacke. The conglomerate tends to occur as lenses or pockets of pebbles of granite, chert, rhyolite, gabbro, and greenstone, and occasional red jasper pebbles. The northeast tip of Seaton Island in Sturgeon Lake is underlain by a very pink-grey, aplite-like, quartzitic greywacke in which a few small pockets of conglomerate were found. Shearing and carbonatization are common along the north shore of the Narrows, within both the conglomerate and the volcanic rocks.

The conglomerate in the northeastern sedimentary band underlies most of Princess Lake and the northern part of Quest Lake. It is lithologically different, containing abundant cobbles and boulders of diorite, gabbro and(or) greenstone, as well as lesser amounts of acid, angular to subrounded fragments, and minor granite pebbles. Outcrops of metagabbro-diorite were mapped within the interpretive boundaries of this conglomerate, but the contact relationships were not observed.

Bedded argillaceous and arenaceous sedimentary rocks occur both east and west of this conglomerate.

Sulphide mineralization was observed in the conglomerate at Princess Lake.

Argillaceous Rocks (3c)

Argillaceous beds are common throughout the sedimentary formations. Siltstone, slate, and phyllite were observed in close association with the argillaceous rocks. No particular horizon or continuous bands were mapped. Many of these rocks have been grouped with the metasedimentary schists and gneisses for mapping. Carbonaceous or graphitic material was seen in a thin-section specimen of argillaceous rocks from Sturgeon Lake.

Staurolite Schists (3s)

Staurolite-biotite-feldspar schist was observed at two localities on the east shore of the northeast bay of Quest Lake. It is bounded on the west by conglomerate and on the east by bedded greywacke. It represents an original compositional change in the sedimentary sequence.

Metasedimentary Schists and Gneisses (3d)

These schists and gneisses are found mainly in that part of the sedimentary-volcanic belt lying east of Div Lake. They are the metamorphic products of original greywacke and argillaceous rocks. In some places, original textures and sedimentary bedding can still be recognized. Detailed mapping would be required to satisfactorily separate these rocks into specific lithologic units. It was extremely difficult in the limited time available to separate the tuffaceous and fine-grained volcanic rocks, which have been rendered schistose, from the sedimentary rocks. In many places the interbanding of these two rock types is on a very small scale, and much arbitrary grouping was done. It was for this reason that the author used the grouping (3e) for minor volcanic rocks(?), chloritic schist, and tuff(?).

The main belt of banded magnetite iron formation occurs within the northern portion of these metasedimentary schists and gneisses.

The schists and gneisses contain varying amounts of garnet, biotite, chlorite, hornblende, feldspar, and quartz, plus accessory apatite and magnetite. As the author has not made a detailed thin-section study based on systematic mapping of these rocks, further description is not warranted. Changes in metamorphic facies were observed from north to south across the belt from Sassafras Lake to Dunne Lake and adjacent sections. Garnet amphibolite facies is recognized at, and near, the contacts with the granitic and syenitic rocks. A much lower metamorphic facies is present in the central part of this belt.

Biotite Paragneiss (3p)

The term biotite paragneiss is used here for fine-grained, quartzitic-greywacke-type rocks containing visible biotite. This is the major rock type found in the narrow metasedimentary bands on Vista and Rocker lakes and in narrow bands in the metavolcanics and granitic gneisses east of Mountairy Lake.

Iron Formation (2)

Iron formation is found in the two main sedimentary belts. It is indicated by anomalies on the aeromagnetic maps (O.D.M. Maps 1961).

The iron formation is of the lenticular, banded, magnetite-sedimentary schist type. It varies greatly in coarseness of banding, magnetite content, width (up to 300 feet), and is interbedded, interfingered, and grades out along strike into the enclosing sedimentary schists and gneisses. Dragfolding is not particularly well developed or abundant.

The longest belt, although it is locally discontinuous, stretches for a distance of about 14 miles, from west of Div Lake to Scruffy Lake in the east end of the volcanic-sedimentary belt. The reader is referred to the geological map (No. 2044, back pocket) and geophysical maps (O.D.M. Maps 1961) for the precise locations of the various bands of iron formation.

The iron formation appears to be present mainly in sedimentary rocks; however, tuffaceous bands may be present. The main belt is highly metamorphosed to garnet amphibolite facies and is variously cut by the Vista Lake quartz syenite, related intrusive rocks, and the Vista Lake melanocratic syenite gneiss.

The iron is in the form of very fine-grained magnetite. Minor sulphides, pyrite and pyrrhotite, were noted in scattered localities. Hematite is not present. Garnet-rich bands are common. A thin section of magnetite-rich iron formation showed: bands rich in magnetite-quartz; quartz-magnetite bands containing minor amphibole; quartz-rich bands of a granular mosaic of quartz and minor magnetite, amphibole, and biotite; hornblende-rich bands containing minor magnetite and quartz.

Only minor amounts of feldspar and biotite, and occasional carbonate grains, were observed. A thin section of a sample of hybrid iron formation cut by much syenitic material showed: feldspar (both plagioclase and microcline) and quartz, about 55 percent; hornblende, 40 percent; biotite, 10 percent; and magnetite, apatite, and pyrite, about 5 percent.

In some places the iron formation is intruded by much granitic-syenitic material giving rise to hybrid or "diluted" iron formation bands in the igneous gneisses. This is particularly true of the north border of the main iron formation belt.

Carbonatization

The volcanic rocks, both acid and basic, as well as some of the sedimentary rocks in the Sturgeon Lake area, commonly react to hydrochloric acid. This is especially true in shear and schist zones where the carbonate is recrystallized and has concentrated through migration, often in abundant stringers and blebs or pods in the shear. It is a rusty brown-weathering carbonate and is often pyritic. The carbonatization, where intense, has been indicated by "carb" on the accompanying geological map (No. 2044, in back pocket).

The Sturgeon Lake syenite contains some interstitial carbonate. In the breccia and mylonitic phases it has recrystallized and concentrated to various degrees. In places, small carbonate dikes or veins cut the borders of this syenite.

Small carbonate veins are associated with the quartz porphyry stock north of Bell Lake.

EARLY BASIC INTRUSIVE ROCKS (4)

This group includes many basic intrusive rock types, all of which appear to be older than the granite and younger than the volcanic-sedimentary rocks in age. It includes gabbro, metagabbro, metadiorite, pyroxenite, and lamprophyre.

The freshest basic rock is a black, medium-grained gabbro, which is exposed on Twining Lake and the lake immediately to the north. The border areas of the northern gabbro body have been recrystallized to a green, hornblende-rich metagabbro, which is cut by much coarse-grained granite pegmatite. The granite pegmatite dike borders are commonly chilled for 2–3 inches at the contacts with the gabbro. In thin section the fresh gabbro is seen to be composed of: clinopyroxene (augite), about 70 percent, and a lesser amount of orthopyroxene; amphibole (hornblende), 5–10 percent; plagioclase (approx. An_{60}), about 20 percent; and traces of biotite and apatite. These two occurrences of gabbro are reflected by two moderately magnetic anomalies shown on aeromagnetic map No. 1106G (O.D.M. Maps 1961).

A similar occurrence of fresh-looking, medium-grained, black gabbro was mapped about a mile northeast of Empire Lake. No contacts with the surrounding granitic rocks were observed here. Green (1924, p. 5) describes small masses of coarse-grained gabbro from this vicinity; he mentions one mass as being cut by a small granite dike, indicating that the gabbro is older than the surrounding granite.

Two small outcrops of heavy, black metagabbro, now mainly biotite, chloritized hornblende, and magnetite, were mapped on the northeast shore of Shikag Lake. The surrounding rocks are granitic; no contact relationships were observed. A moderately strong magnetic anomaly covers the area underlain by the outcrops, indicating a small basic intrusive body. A similar magnetic anomaly lies on the north flank of the previously mentioned anomaly and is interpreted as a smaller body of basic rock. No outcrops were found in this area; granitic rocks are exposed between the two anomalies, indicating that they are separate intrusions.

Various basic intrusive rocks are closely associated with the Bell Lake syenite stock. The basic rock that is exposed at or near the contact of the southwestern part of the stock is a heavy, black gabbroic or amphibolitic rock, in hand specimens. In thin section it is seen to be composed of: clinopyroxene (augite), somewhat altered to hornblende and chlorite, about 85 percent; orthopyroxene, about 10 percent; chloritic biotite, magnetite, apatite, 5–10 percent; and a trace of secondary carbonate. The term pyroxenite has been used for this rock. The relationship to the syenite and granitic rocks was not established.

The elongate body, lying immediately east of the Bell Lake syenite has also been called a pyroxenite, since it looks very similar in hand specimen to the rock described above. Both strongly gneissic phases of medium- and coarse-grained, massive varieties are present. Contact relationships with the volcanic rocks and granite are not clearly apparent. Some inclusions of similar rock were found in the adjacent granitic gneisses.

A rather peculiar basic, dike-like rock was mapped to the southeast of the Bell Lake syenite. This rock appears to be both included by, and intruded into, the granitic rocks. Numerous basic dikes, 1 foot wide, were observed in the vicinity. The main rock type is a purplish, porphyritic (amphibole or pyroxene) gabbro or pyroxenite. Medium- to coarse-grained, gabbroic and dioritic phases are also present.

A medium- to coarse-grained, greenish black, biotite-hornblende (chloritized) basic rock is commonly associated with the melanocratic border phases of the Bell Lake syenite. Along the northwest border area it occurs both as bands in coarsely gneissic phases and as separate outcrops. Very thin, white to pink, feldspathic veinlets occasionally cut the basic rock. Along the east border similar rocks occur as inclusions in the syenite.

In the Sturgeon Lake area, metadiorite bodies are found intruding both the sedimentary and volcanic rocks. The most common are medium-grained dike rocks exhibiting a metamorphic texture and comprising chloritized hornblende, strongly altered plagioclase, occasional remnant and highly altered pyroxene, minor quartz, leucoxene, magnetite, and secondary carbonate. Some dikes are distinctly porphyritic, the feldspars being highly altered, irregular phenocrysts. In the Cobb Bay area of Sturgeon Lake there are numerous recrystallized coarse-grained to porphyritic basic rocks. These rocks have been grouped with the volcanic rocks because time did not permit separation during mapping. In the area north of Barge and Post lakes a few outcrops of fine- to medium-grained metagabbro were observed. The basic intrusive rocks in this area appear to be more strongly magnetic, and some of the magnetic anomalies may be due to these rather than to lean magnetic iron formation. A few lamprophyric dikes containing granite pebbles were observed cutting the conglomerate on Sturgeon Lake.

Fine- to medium-grained metagabbro occurs in the belt of sedimentary rocks in the vicinity of Princess and Quest lakes. Lack of magnetic expression and paucity of outcrop information limit the interpretation. The outcrop of metagabbro at the north end of Princess Lake is cut by narrow, radioactive, pegmatite and syenite dikes, some of which contain small books of muscovite mica.

The presence of basic intrusive rocks was indicated in the eastern part of the sedimentary-volcanic belt. Due to lack of mapping detail, they have been grouped with the basic volcanic rocks.

PLUTONIC ROCKS

Granitic Rocks

GRANITIC GNEISSES (5)

The rock terminology used here has been defined by Shaw (1957, pp. 80, 81) as follows:

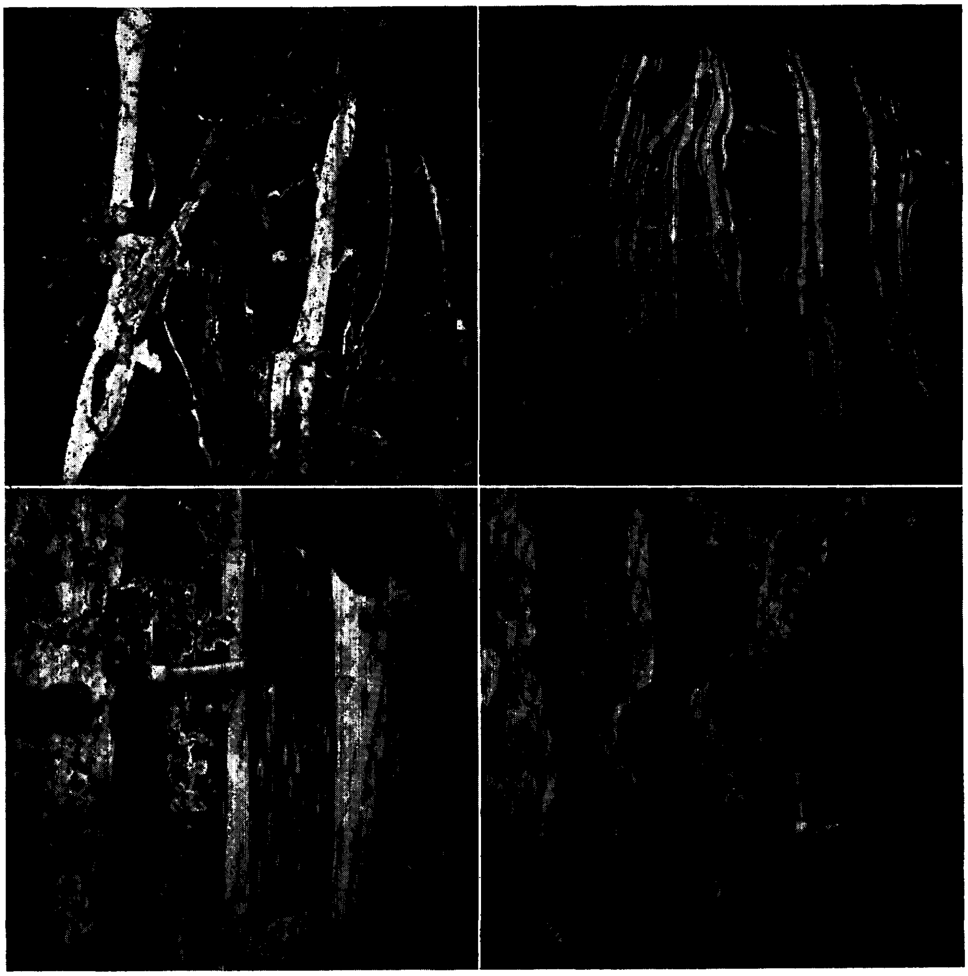
Hybrid gneiss. Any mixed gneiss consisting partly of older metamorphosed rock and partly of igneous, anatectic, or metasomatic material. The term may be applied either to granitic or non-granitic types; e.g., hybrid nepheline gneiss, hybrid granite gneiss.

***Lit par lit* gneiss.** A mixed gneiss with regular alternation of quartzo-feldspathic (granitic) and mafic layers; e.g., garnet-biotite *lit par lit* gneiss.

Migmatite. A mixed rock partly consisting of quartzo-feldspathic (granitic) material, together with older metamorphosed rock. Migmatites are commonly gneissic but not necessarily so; e.g., foliated hornblende migmatite, massive pyroxenic migmatite.

Hybrid granite gneiss, *lit par lit* gneiss, and migmatite have been grouped under the heading Granitic Gneisses. The term amphibolite has been included under this heading to cover the small irregular amphibolitic masses of unknown origin, which are sometimes closely associated with migmatite and *lit par lit* gneiss zones, but cannot be shown separately on the map.

The granitic gneisses are the most abundant rock group underlying the map-area, and they are discussed geographically. They are regionally similar in their gross characteristics; in detail they vary considerably in structure and association. Compositionally they range from granitic to intermediate quartzo-feldspathic rocks. The mineralogy is mainly quartz and feldspar (both soda and potash, with the soda feldspar predominating) and varying amounts of biotite and hornblende as the principal ferromagnesian minerals. In some places, garnet is also present.



Top left: Metavolcanic rock injected by varied granitic stringers and dikes. From Brightsand River, east of Rude Lake.

Top right: *Lit par lit* injection gneiss. Granitic veins and stringers injected parallel to foliation of metavolcanic band. Locally crosscutting. From outcrop on south shore of west bay of Harmon Lake leading to Hilltop Lake.

Bottom left: *Lit par lit* injection gneiss. Distinct granitic bands intruding parallel to the bedding of the metasediments. Note white blebs of granitic material in right mafic band. These are not fragments. From contact of the granitic gneisses with the metasediments southwest of Sassafras Lake and due west of Dunne Lake.

Bottom right: Faulted *lit par lit* injection gneiss, same location as photo, bottom left.

The foreign material comprising the inclusions and schlieren, and representing foundered portions of the original supra-crustal rocks, is now altered to biotite- and hornblende-rich schists and gneisses.

There is complete gradation between the three types of granitic gneisses, both across and along strike. All three types may occur in the same outcrop. The author found the sequence and association given below to be quite consistent and widespread throughout the map-area. This typical sequence of changes of rock type, across strike from a band of sedimentary or volcanic rocks into an area of massive granite, may occur within a single outcrop or over hundreds of feet:

1. An increase in metamorphic grade of the sedimentary or volcanic rocks.
2. Fine-grained, feldspathic to granitic, stringers and veinlets occurring parallel to the foliation of the metamorphosed country rock.
3. An increase in number of concordant granitic dikes.
4. Minor cross-fractures at right angles to the foliation along the contact are sometimes filled with feldspathic and granitic material.
5. Formation of a regular *lit par lit* injection zone cut by minor amounts of granite pegmatite.
6. Gradation into progressively thinner alternations of dark and light constituent bands, which are often wavy-banded, comprising the migmatite, and cut by many aplite and pegmatite dikes.
7. The migmatite grades imperceptibly into a hybrid granite gneiss having minor banding and schlieren. It is still cut by abundant dikes.
8. The hybrid gneiss passes into a foliated grey gneissic granite, with occasional inclusions, and cut by granitic dikes.
9. The grey gneissic granite may or may not become massive. Only occasional aplite and pegmatite dikes cut the granite.

The granitic material in the gneisses is the grey granite, which has been mapped as separate belts where possible; there is complete gradation. In many areas much of the grey biotite granite has been grouped as hybrid granite gneiss, largely because it could not be shown separately on the map. A greater variety of porphyritic textures is present in these grey granitic gneisses.

Locally, throughout the gneissic belts, the younger, fine-grained, aplitic, pink leucogranite either occurs as small mappable bodies, such as the one north of Sassafras Lake, or is abnormally abundant.

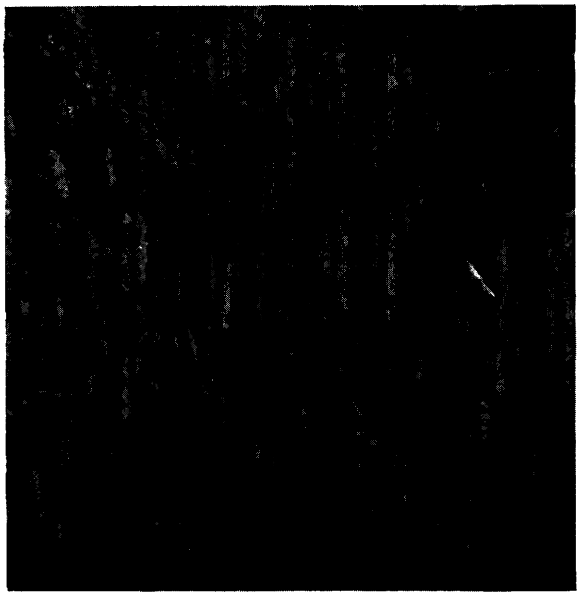
Northeastern Area

The Seseganaga Lake area is mainly underlain by a wavy-contorted migmatite containing abundant fragmental inclusions. A profusion of pegmatite and granite dikes intrudes the migmatite. Locally, regular *lit par lit* injection gneiss is abundant. A particularly complex migmatite (*see* photo opposite) occurs on the northeast shore of the lake. A similar type of migmatite was observed locally on the northeast shore of Harmon Lake.

The Allanwater–Gridiron–Twomile lakes area is underlain by much finely banded *lit par lit* gneiss, consisting of alternating bands rich in quartz-feldspar and biotite-hornblende respectively, grading into migmatite phases. All are cut by fine-grained aplite and pegmatite dikes.

In the Duggan Lake area the *lit par lit* gneiss consists of alternating pink, feldspar-quartz bands and bands rich in greenish biotite-hornblende-epidote.

Wapikaimaski Lake contains a series of linear bays whose long axes are parallel to the foliation of the underlying granitic gneisses. Migmatite gneiss is the most prevalent type. However, *lit par lit* and grey hybrid granite gneiss phases are also present. Only minor aplitic and pegmatite dikes cut the gneisses.



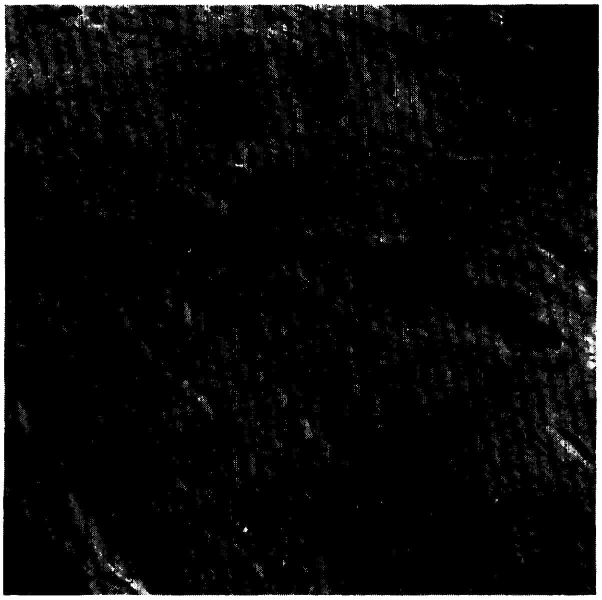
Migmatite. Biotite-quartz-feldspar hybrid granite gneiss (dark grey) exhibiting a swarm of lenticular pegmatite (quartz and feldspar) pods (light grey), all cut by younger pegmatite and aplite dikes (diagonal). From northeast shore of Seseganaga Lake.

The north end of Harmon Lake is underlain by a pink-grey, biotite-hornblende granitic gneiss containing minor inclusions and schlieren. It has been mapped as hybrid granite gneiss (5c). This grades southwards through varied migmatite with numerous *lit par lit* injection zones. Abundant pegmatite and aplitic granite cut the gneisses. Occasional bands of hornblende-rich schist were mapped separately on Harmon Lake. The large pegmatite dike-sheets become more prevalent towards the south end of the lake.

The area bounded by Hilltop, Stinson, Harmon, Little Sparkling, and Scruffy lakes is a complex of hornblende-rich schist and gneiss (metavolcanics?), *lit par lit*, migmatite, and large pegmatite dike-sheets. The generalized interpretation, as shown on the map, represents the larger part of the area underlain by migmatite and hybrid granite gneiss, with abundant *lit par lit* zones. The hornblende schist and gneiss bands are narrow, flat to steeply dipping, and are probably discontinuous along strike. The large pegmatite dike-sheets intrude all.

Southeastern Area

The area surrounding the junction of the Brightsand and Kashishibog rivers is dominantly medium-grained, grey, biotite, leucocratic hybrid granite gneiss (5c), with minor migmatite and *lit par lit* zones. To the west it appears to grade into coarse-grained, grey, biotite-hornblende gneissic leucogranite. To the southwest, through Hardog Lake and the northern area of Metionga Lake, the hybrid granitic gneiss belt grades into gneissic granite, having occasional migmatite and *lit par lit* zones. It terminates near the east end of Shikag Lake. To the east, along the Kashishibog River and Sparkling Lake, *lit par lit* gneiss and migmatite are predominant. In some places the biotite-hornblende schist and gneiss bands are up to 75 feet wide. South of Sparkling Lake there are indications of larger metavolcanic bands preserved in the gneisses.



Hybrid granite gneiss (grey biotite-quartz-feldspar gneiss) enclosing amphibolite inclusions. Fine-grained granite and pegmatite borders on the inclusions are quite pronounced. From a small island in Wapikaimaski Lake at the northeast edge of the map-area.

The northeastern part of Globe Lake and Empire Lake are underlain by varied wavy-banded migmatite, hybrid grey granite gneiss with inclusions, and minor *lit par lit* zones. Only minor pegmatite and pink granite dikes cut the gneisses.

Southern Area

Moberley Lake on the Brightsand River is mainly underlain by migmatite and grey hybrid granite gneiss. A large amount of massive, fine-grained, pink granite intrudes the gneisses near the south end of the lake. To the southeast, on Twining Lake, *lit par lit* injection gneiss and migmatite are more abundant. Much pink granite and pegmatite cut the gneisses.

This region of granitic gneisses has been extended westward to that of the Arabi and English rivers, largely on the basis of the aeromagnetic data. Migmatite and grey hybrid granite gneiss are dominant in this region, but locally *lit par lit* gneiss is abundant. The flat dips and paucity of outcrop in this region made observations difficult. The grey granitic gneiss is commonly porphyritic (plagioclase); gneissic banding ranges from fine to coarse. The rocks underlying the southern part of the English River are very similar to those on Harmon Lake and contain abundant pink granite and pegmatite dikes.

West-Central Area

The granitic gneisses in this area are mainly grey hybrid granite gneiss (locally porphyritic), with abundant migmatite and lesser amounts of *lit par lit* gneiss zones. The *lit par lit* zones are mainly found along the northwest shore of Shikag Lake and near the contact with the volcanic belt.

GREY GRANITIC ROCKS

The grey granitic rocks are divided as follows:

6a. Grey granite, granodiorite.
6b. Gneissic grey granite.
6c. Porphyritic grey granite.
6p. Granite pegmatite.

There are a number of areas underlain by grey leucocratic granite and granodiorite. These are generally massive in the "core areas," consisting of quartz and feldspar, less than 5 percent of biotite and(or) hornblende, and grade into gneissic and(or) porphyritic border phases. Inclusions of country rock are sometimes present. The gneissic border phases commonly grade imperceptibly into hybrid granite gneiss, migmatite, and *lit par lit* banded injection gneisses.

The mass of granite underlying the southern part of Bell Lake and parts of Willow Lake is essentially a massive, grey, leucocratic biotite granite, locally pinkish in colour, and having both gneissic and porphyritic phases.

A small mass of granite underlies the area between Hilltop and Harmon lakes, in the northeastern part of the map-area. It is a coarse-grained, biotite-hornblende, gneissic granite, containing a few inclusions and cut by minor fine-grained, pink granite and pegmatite dikes.

A large belt of coarse-grained, coarsely foliated, grey biotite granite underlies the central portion of the map-area. It extends from Shikag Lake through Gosling and Mountairy lakes; it has a northeasterly strike and dips 30°–65° N. It contains minor inclusions, migmatite phases, and is cut by pink-grey pegmatite dikes. This belt grades eastward to the Brightsand River area into grey hybrid granite gneiss and migmatite. The north boundary appears to grade into a predominance of pink leucogranite and very coarse-grained pegmatite dike-sheets, which intrude the southeast end of the sedimentary-volcanic belt. The south boundary grades into grey hybrid granite gneiss and migmatite with *lit par lit* injection zones.

The largest area of massive grey granite underlies Globe, Brightsand, Metionga, Little Metionga, Dasent, Ruxton, and Cottle lakes, and the east end of Shikag Lake. The north and east borders become progressively more strongly foliated, grading into hybrid granite gneiss with migmatite and *lit par lit* phases. A similar gradation marks the boundary to the south and east. To the west and southwest the massive grey granite exhibits a pinkish colour due to an increase in the potash feldspar content. A similar gradational sequence is postulated for this granite mass into the granitic gneisses, which underlie the southern and western parts of the map-area. The lack of outcrop observations in this area prevents the placing of an approximate line of contact on the map. However, aeromagnetic data have aided in extending the interpretation; colour boundaries only have been used.

PINK GRANITIC ROCKS

The pink granitic rocks are differentiated on the map as follows:

7a Pink granite, quartz monzonite.
7b Gneissic pink granite.
7c Porphyritic pink granite (may be gneissic).
7e Quartz diorite.
7p Granite pegmatite.
7d Quartz porphyry, quartz-feldspar porphyry, feldspar porphyry.

The pink granite is a fine- to medium-grained, leucocratic, quartz-feldspar rock in which the ferromagnesian mineral is biotite (less than 5 percent). It occurs as small dikes, from less than one to several hundred feet in width, cutting older grey granite and granitic gneisses. These dikes are generally closely associated with the granite pegmatite dikes, dike-sheets, and irregularly shaped intrusions, which also cut the older grey granites and granitic gneisses. These dikes commonly comprise both pegmatite and fine-grained granite, having all gradations, both laterally and along their length. The pink colour predominates; however, grey phases are also present.

Two areas of massive, fine- to medium-grained, pink granite or quartz monzonite were mapped separately. An oval-shaped area, about 3 miles by 1½ miles, underlies the area around Pipio Lake. It appears to grade into grey granite to the south, as well as contain inclusions of a grey hornblende granite.

A quartz stockwork striking northwest, 25–30 feet wide, was found in the central part of the intrusion (*see* map No. 2044). A thin section of the pink granite showed microcline, myrmekite, altered plagioclase (albite-oligoclase), chloritized biotite, secondary muscovite and epidote, and accessory apatite, sphene, allanite, magnetite, and leucoxene.

A similar pink, medium-grained granite or quartz monzonite was found underlying Goodman and King lakes on the northwest border of the Vista Lake syenite. Phases of this granite contain scattered phenocrysts of pink microcline feldspar. Outcrops are scarce in this area, so observations were limited. However, the author believes that this granite, especially the porphyritic phases, is related to the Vista Lake syenite as a younger differentiate. Fine-grained, pink granite and granite pegmatite dikes commonly cut the Vista Lake mass and are quite common along the south border with the sedimentary rocks.

Other areas of fine- to medium-grained, pink leucogranite, large enough to be shown separately on the map, occur about ½ mile north of Sassafras Lake and, closely associated with pink granite pegmatite, at the north end of Gosling Lake.

A pink porphyritic granite gneiss (7c) underlies the northern part of Harmon Lake and part of Wapikaimaski Lake. Phenocrysts of pink microcline feldspar up to 2 inches long occur in a groundmass of smaller potash feldspar grains, biotite, quartz, and minor hornblende. The border phases are markedly gneissic. This gneiss intrudes the bordering *lit par lit* injection gneiss and migmatite in a *lit par lit* fashion. Minor pink pegmatite and granite dikes cut all other rocks in the area.

A medium- to coarse-grained, melanocratic, hornblende-feldspar rock (mapped as quartz diorite, 7e) appears to grade into the pink, porphyritic gneiss along both its north and south contacts. The intrusion appears to lens out to the west and widens towards the east boundary of the map-area. To the east, quartz becomes more abundant and occurs as large irregular phenocrysts with the feldspar. The foliation of the body is northeast to east-west, with varied dips of 50°–80° S.

A pink, biotite-hornblende, leucocratic granite gneiss underlies the northern part of Sparkling Lake. It strikes northeast to east-west and widens to the east. Numerous, coarse-grained, pink granite pegmatite dikes and dike-sheets intrude both the granite gneiss and the surrounding grey hybrid and *lit par lit* granitic gneisses. The east end is very coarse-grained to porphyritic; containing abundant quartz, pink feldspar, minor biotite, and hornblende. The granite gneiss thins to the southwest and becomes melanocratic (biotite and hornblende) and syenitic (minor visible quartz). West of the Brightsand River, the paucity of outcrop data does not allow further interpretation.

Granite Pegmatite

The granite pegmatite falls into two main groups: (1) the large granite pegmatite dike-sheets; (2) the smaller dikes and irregular pegmatite masses cutting the granitic gneisses.

The large granite pegmatite dike-sheets are intruded over a large area in the northeastern part of the map-area in the vicinity of Gosling, Mountairy, Hilltop, Scruffy, Rude, Robert, and Stinson lakes, and the south half of Harmon Lake. Similar pegmatites occur along the pink granite gneiss belt on Little Sparkling Lake and the upper half of Sparkling Lake.

These pegmatites have been intruded generally parallel to the foliation of the country rocks; in the vicinity of Mountairy Lake they dip flatly north-northeast. They appear to range from 20 to several hundred feet in width, and up to 1,000–1,500 feet in length. The result is that much of the outcrop exposure in this area is pegmatite capping, and it is difficult to trace the underlying rock formation. The pegmatite is commonly a pink colour due to the potash feldspar, with lesser amounts of white feldspar (albite?) and quartz. Accessory minerals noted in some dikes were tiny red garnets in fine-grained aplitic zones in the pegmatite, and occasional books of muscovite. Inclusions of the country rocks are not uncommon. The pegmatites exhibit both lateral and strike gradation into fine-grained aplitic phases. Individual feldspar crystals up to 6 inches across were noted. Grey granite and grey granite pegmatite were also noted in this area; the grey colour is due to a predominance of white-grey feldspar over the pink potash variety. On the map, an attempt has been made to separate the two types (i.e., 7p and 6p); however, in many instances the grey pegmatites have been grouped with the pink pegmatites.

In the region around Harmon Lake the coarse granite pegmatite dikes are generally concordant but steeper in dip, pink, and contain trace amounts of biotite and occasional inclusions of hornblende-biotite schist. Aplitic phases are common.

The second type of pegmatite comprises the smaller granite pegmatite dikes and irregular pods that intrude the varied granitic gneiss terrain. Generally they range from less than one to several feet in width and are of moderate length. They are intruded both concordantly and discordantly. Only an occasional pegmatite dike was seen cutting the areas of gneissic and massive granite. Mineralogically they are of a simple quartz-feldspar nature; the feldspar is both a pink potash and a grey-white soda feldspar. Trace amounts of biotite and magnetite are present. Fine-grained aplitic granite is commonly found in gradation with this pegmatite.

Quartz Porphyry, Quartz-Feldspar Porphyry (7d)

A large stock of quartz porphyry intrudes the volcanic rocks between Darkwater and Bell lakes. It is the east end of a long narrow belt of "younger granite" mapped by Graham. He describes it as follows (Graham 1931, p. 43):

> The granite salient south of Biedelman bay is the most acidic of these later intrusives. It is a pink quartzose granite, which in thin section is seen to consist largely of quartz with minor amounts of altered feldspar and small biotite shreds, some of which may be changed to chlorite. Along its north contact the granite becomes more basic and changes in colour from pink to light-green. . . .
>
> . . . This granite mass has undergone metamorphism, due to the action of late pneumatolytic emanations accompanying its own intrusion. Small black tourmaline veins are numerous throughout the mass.

In the Metionga Lake area this "granite" is in fact a quartz porphyry. Minor phases are coarse-grained and have a granitic texture. Near the contacts with the volcanic rocks the quartz porphyry is generally strongly sheared and altered. Small quartz veins were observed both in the volcanic rocks and in the porphyry along the contacts. Narrow carbonate dikes and(or) veinlets were observed cutting the quartz porphyry on the Bell River. In hand specimen, milky to bluish quartz eyes are quite prominent. The eastern extension is not known owing to the paucity of outcrop.

Horwood (1938, p. 27) describes the quartz porphyry in the vicinity of the Darkwater mine, 4 miles west of the boundary of the map-area, as follows:

> Algoman granodiorite forms an east-west band about 1 mile wide across the central part of the property. The quartz-tourmaline veins occur in fractures and shear zones in this rock and in general have a strike of from N.45°E. to N.55°E. The granodiorite is a grey or grey-pink, medium- to coarse-grained rock made up of quartz and highly altered feldspar and hornblende . . . Close to the volcanic rocks the granodiorite is dark in colour, whereas at some distance it is lighter and in places has opalescent quartz grains.

Quartz porphyry and quartz-feldspar porphyry dikes are quite common in the vicinity of Cobb Bay and Sixmile Lake. They range in width from less than 1 foot to about 100 feet. In this area they appear to have a preferred orientation of nearly east-west. The milky to opalescent quartz eyes are diagnostic. Small white feldspar phenocrysts are not uncommon; in thin section they consist of altered plagioclase, quartz, chlorite, epidote, apatite, traces of leucoxene, and iron oxide. A few small quartz porphyry dikes were observed cutting the sedimentary rocks on Quest Lake.

Syenitic Rocks

Photo by P. F. Hoffman

Scapolite-augite syenite (Sturgeon Lake alkaline complex). Note the prominent potash feldspar phenocrysts arranged in a trachytic texture. Scapolite, calcite, and the ferromagnesian minerals occur interstitially. Photo taken on south shore of southwest end of Sturgeon Narrows.

STURGEON LAKE ALKALINE COMPLEX

Scapolite-Augite Syenite (8a)

An elliptical body of scapolite-augite syenite is exposed with good relief on the south shore and islands of Sturgeon Narrows in Sturgeon Lake. Its long axis trends northeast. The body is about 9 miles long, ranging in width from $\frac{3}{4}$ mile on the southwest to about $2\frac{1}{2}$ miles on the north.

The syenite intrudes the surrounding volcanic and sedimentary rocks as indicated by decrease in grain size and porphyritization of the intrusion, and a notable alteration of the contact rocks. Foliation or zonal structure was not apparent from the author's brief examination; however, various phases were recognized.

The main mass is a very coarse-grained to porphyritic, grey, leucocratic rock. The feldspar phenocrysts weather high and often exhibit a trachytic texture (*see* accompanying photo). The interstitial material, scapolite, carbonate, and mafic minerals, generally weather low. In thin section the feldspar is seen to be microcline, plagioclase, and microperthite, commonly altered. Altered hornblende, pyroxene, and biotite are the ferromagnesian minerals. Accessory scapolite, apatite, magnetite, sphene, and carbonate make up the remainder of the rock. Gledhill (1925) reported the presence of accessory fluorite and pyrite.

The rock along the borders of the syenite intrusive mass is a pink, highly altered, microcline feldspar porphyry. The best exposures of this rock type are along the northwest shore of Seaton Island. A thin section showed outlines of highly altered feldspar, abundant carbonate, and unidentified fine-grained alteration material, with accessory pyrite and iron oxide. It is difficult to separate the pink porphyritic border syenite from the altered and "porphyritized" metasediment on Seaton Island.

The large island northeast of Seaton Island, which shows the contact between the syenite and the metasediments, is a good example of the "porphyritization" and alteration along the contact. The red or pink colour is not as prominent here. Thin sections of the porphyry from this location showed: highly altered plagioclase phenocrysts; some potash feldspar; a micaceous alteration matrix; minor biotite (chloritic) and highly altered, unidentified, ferromagnesian mineral(s); varied amounts of carbonate; and accessory magnetite, apatite, leucoxene, and iron oxide. A thin section of the relatively unaltered metasediment contained mostly clastic grains of quartz, feldspar, and lesser amounts of carbonate, chlorite, and leucoxene.

It is in these areas of highly altered pink porphyritic syenite that the higher radioactive zones, discussed in the section on radioactivity (*see* page 42), occur. These zones are found along the northwest shore of Seaton Island, in the previously mentioned island to the northeast, and on the south tip of Coveney Island just north of the map-area. Careful search along the line of contact will undoubtedly uncover more of these zones.

Specimens from the contact zone on the south shore of Sturgeon Narrows, southeast of Seaton Island, were examined in thin section. The medium-grained grey syenite at the contact is composed of highly altered phenocrysts of both plagioclase and microperthite, brown biotite containing numerous inclusions, chloritic alteration, and apatite (1 percent). A section of a radioactive breccia band showed highly altered plagioclase laths, potash feldspar(?), and abundant carbonate as rounded aggregates and stringers, in an altered, fine-grained micaceous aggregate, including chlorite, pyrite, and iron oxide. The basic volcanic rocks close to this contact are strongly sheared and carbonatized. Pyrite mineralization is abundant.

A brecciated zone, exposed over about 50 feet, comprising rounded and subrounded fragments of the syenite in a granulated matrix, located on the south shore of Sturgeon Narrows (*see* map No. 2044, back pocket), registered about twice background radioactivity. A narrow, 2-foot-wide, radioactive gneiss phase of the syenite is located on the shoreline about 4 chains northeast of the breccia.

Tiny, short, black stringers are present in the gneissic phase. A basic dike (lamprophyre?) cuts the syenite adjacent to the gneiss phase. Continuing northeast along the shoreline for about 25 chains, numerous narrow shear zones and mylonitized coarse-grained syenite were observed. These are commonly radioactive, slightly pyritic, and show varying degrees of red alteration or rusty weathering. Occasional narrow carbonate veins were noted in this vicinity.

A light-coloured phase, of medium-grained to porphyritic to pegmatitic texture, is exposed in the west-central part of the syenite mass, and on the small island in the northern part of the Sturgeon Narrows. The outcrop on this island is of medium-grained, white to light grey, differentially weathered, scapolite-augite syenite. The small pyroxenes are sparsely scattered through it. A thin section of this rock shows altered phenocrysts of microline and microperthite, to about 60 percent; phenocrysts, aggregates, and interstitial scapolite, to about 30 percent; with traces of strongly pleochroic green pyroxene. Gledhill (1925) reported veins of calcite, 10 inches wide, frozen to the nephelite syenite, containing diopside, and titanite crystals. The author did not see these veins in this area.

A thin section of a coarse-grained pegmatitic phase of the scapolite syenite from the south shore of the Narrows, south of the island mentioned above, showed: feldspar phenocrysts of plagioclase and microcline perthite, about 90 percent; small granular aggregates of scapolite, about 5 percent; pyroxene, granular carbonate, apatite, and biotite, less than 5 percent. A medium-grained specimen from about ½ mile west of the pegmatite showed large phenocrysts of microcline and microperthite, lesser intersititial plagioclase, equigranular interstitial scapolite, brown-green biotite, and altered pyroxene (about 5 percent).

A specimen of medium-grained syenite from the northeast shore of the Narrows contains: tabular crystals of strongly altered microcline and microperthite, about 60 percent; interstitial scapolite, about 30 percent; altered pleochroic green pyroxene, less than 5 percent; carbonate, magnetite, pyrite, and apatite, less than 5 percent.

It is in this west-central area of the intrusion that Gledhill (1925, pp. 35, 36) reports the presence of nephelite:

> The nephelite syenite is a light-coloured, medium to coarse-grained rock with small dark green pyroxenes very sparsely scattered through it. The feldspars are euhedral for the most part and have an interstitial filling of nephelite and accessory minerals, which are calcite, fluorite, sodalite, titanite, apatite, and zircon; they are predominantly microperthite with smaller amounts of anorthoclase and microcline. The feldspar appears to be replaced by nephelite; this was deduced from the results of etching and staining a polished surface.
>
> . . . .
>
> A mineral, yielding tests for a scapolite with a carbonate radical, appears in all the thin sections of the syenite examined, whether the rock was a normal type or the nephelite type. This mineral was observed replacing the feldspars. Few of the nephelite crystals were of the limpid type, but contained hair-like, regularly oriented inclusions, probably augite. The nephelite had the veined structures seen in microperthite and did not extinguish in all parts of the crystal at the same time when rotated under crossed nicols.

In the few thin sections from this area studied by the author, no nepheline was recognized. Staining tests were carried out like those described by Keith (1939), on the sawed hand specimens, from which the thin sections were cut, to detect the presence of nepheline. The stain worked on some of the samples, but in each case it formed on scapolite grains. Apparently the method is applicable to scapolite as well as nepheline. D. F. Hewitt of the Ontario Department of Mines kindly examined the author's thin sections and hand specimens but was unable to detect the presence of nepheline in these specimens. It is entirely possible that the author did not sample the specific nepheline-bearing syenite. A more detailed examination of this area would be required to delineate the nepheline-bearing phases, if any exist.

A number of samples of the radioactive contact rocks were tested for beta-ray activity and gave values ranging from 0.001 to 0.06 percent U_3O_8 equivalent. Qualitative spectrographic analyses, by the Laboratory Branch, Ontario Department of Mines, were made of the same samples for the following:

Niobium	n.d.(1) to about 0.05 percent
Thorium	n.d. to detectable amounts
Cerium	n.d. to about 0.10 percent
Lanthanum	n.d. to about 0.10 percent
Beryllium	trace to less than 0.005 percent

(1)n.d. = not detected.

These analyses and values are fully described in the section Radioactivity (*see* page 42). The magnetic response of the syenite body is discussed in the section Discussion of Aeromagnetic Data (*see* page 40).

Rock analyses were made of three samples of the Sturgeon Lake syenite mass. Results are as follows:

ANALYSES OF ROCK SAMPLES

(Analyses by Laboratory Branch, Ontario Dept. Mines)

	Augite syenite(1)	Scapolite-rich augite syenite(2)	Augite syenite(3)
	percent	percent	percent
SiO_2	54.15	53.53	53.77
Al_2O_3	21.4	22.6	22.0
Fe_2O_3	4.95	2.50	4.30
MgO	1.40	0.15	0.49
CaO	2.70	2.85	1.52
K_2O	6.30	6.50	6.75
Na_2O	7.23	8.55	7.59
TiO_2	0.45	0.09	0.39
MnO	0.10	0.06	0.09
H_2O+	1.61	1.19	1.27
H_2O-	0.24	0.09	0.19
CO_2	0.69	2.23	0.61
P_2O_5	0.15	0.01	0.07
Cl	0.15	0.08	0.16
Total	101.5	100.4	99.2

(1) Sample R-3-B, from the southwest end of the Sturgeon Lake syenite, south of Seaton Island, Sturgeon Narrows

(2) Sample R-165-A, from the most northerly island in Sturgeon Narrows. This sample represents the mass described as nephelite syenite by Gledhill (1925) in the analyses given below.

(3) Sample R-167, from the northeast shore of Sturgeon Narrows.

Analyses made by T. L. Gledhill (1925, p. 36) are as follows:

	Augite syenite, Sturgeon Lake(1)	Nephelite syenite, Sturgeon Lake(2)
	percent	percent
SiO_2	52.42	51.47
Al_2O_3	25.04	21.67
TiO_2	trace	0.32
MgO	1.02	0.15
CaO	2.24	3.78
FeO	0.64	0.24
Fe_2O_3	1.54	2.08
K_2O	8.76	6.70
Na_2O	6.00	8.18
CO_2	1.52	3.17
H_2O	0.85	2.07
Total	100.03	99.83

(1) This rock corresponds to the author's augite syenite.
(2) This rock corresponds to the author's scapolite-rich augite syenite.

VISTA LAKE SYENITE

Porphyritic Biotite-Hornblende-Quartz Syenite (8b)

Melanocratic Hornblende Syenite Gneiss (8c)

The Vista Lake quartz syenite is the largest syenitic body in the map-area. It is a crescent-shaped intrusion about 3½ miles wide at the centre, thinning gradually to the northeast and southeast. It intrudes hybrid granite gneiss and migmatite on the east and sedimentary rocks including iron formation, to the west and south. Large included bands of metasediments and dikes or sills of syenite in the sedimentary rocks are common along the border areas. Locally it is in *lit par lit* or arteritic association with the sedimentary rocks.

The syenite is locally cut by minor small granite pegmatite and fine-grained pink granite dikes. In hand specimen it is seen to be a pink porphyritic, biotite-hornblende-quartz leucosyenite. It is commonly gneissic, and the phenocrysts are of pink microcline feldspar up to ½ inch in length. In thin section the syenite contains: microcline and some microperthite, 55–65 percent; plagioclase (strongly altered), 15–25 percent; quartz, from less than 5 to 15 percent; chloritized hornblende and biotite, 1–10 percent; accessory sphene, apatite, leucoxene, magnetite, and pyrite, from a trace to 5 percent; and minor secondary epidote and carbonate.

The Vista Lake quartz syenite borders on a body of medium-grained, pink quartz monzonite, which underlies most of Goodman, King, and Empress lakes. This quartz monzonite locally contains scattered microcline phenocrysts and looks much like the Vista Lake syenite. A gradation between the two bodies of rock is indicated. It is quite probable that the quartz monzonite is the source of the granite pegmatite and fine-grained granite dikes that cut the Vista Lake syenite.

In the vicinity of Sassafras Lake and east of Div Lake, there are many melanocratic phases. These include dioritic and amphibolitic rocks intersected in the diamond-drillholes. Frequently the darker colour and increased ferromagnesian content is due to assimilation and recrystallization of included country rocks. These rocks, and a well defined melanocratic hornblende-rich syenite gneiss, have been grouped together on the map as (8c).

In thin section these melanocratic rocks are composed of: varied amounts of microcline and plagioclase; abundant green hornblende; altered pyroxene and brown biotite; minor quartz; accessory apatite, sphene, fluorite; and traces of secondary carbonate and epidote.

Outcrops of melanocratic gneiss are scarce along the eastern extension of the Vista Lake syenite. However, the author has extended the interpretation between Sassafras and Hilltop lakes. This rock may be more intercalated with the sedimentary rocks than is indicated on the map. This was shown to be so in the diamond-drill cores obtained west of Sassafras Lake.

The melanocratic gneiss contains more abundant pink feldspar phenocrysts in the outcrops between Hilltop Lake and the northeastern part of Mountairy Lake. The character of this gneiss again changes between the northeastern part of Mountairy Lake and the south end of Scruffy Lake. Abundant granite pegmatite dike-sheets, dipping flatly to the north, are present in this area; only small exposures of the gneiss can be found, and they underlie the pegmatite. Here the gneiss is a grey, medium-grained to porphyritic (altered feldspar), biotite-hornblende melanocratic rock containing numerous lenses or inclusions of recrystallized material (biotite and hornblende).

This belt of gneiss may continue and grade into the melanocratic, hornblende, syenitic to granitic gneiss, immediately to the east, through Brightsand River into Little Sparkling Lake.

BELL LAKE SYENITE

Hornblende-Pyroxene-Biotite Syenite (8d)

An elliptical stock, about 3 by 5 miles in size, underlies the northern part of Bell Lake. It is a differentiated intrusion of syenitic composition, which intrudes the surrounding hybrid granitic gneisses and migmatite. Occasional inclusions of the granitic rocks are found along the northern border of the stock. The only actual contact observed is in the southeastern part of the stock, where it is found chilled against the intruded country rock.

The borders are commonly fine- to medium-grained, purplish grey, melanocratic hornblende-augite-biotite syenite. Coarse-grained to porphyritic pink phases are not uncommon.

Two thin sections of the border phase showed: patchy to string-braid, perthitic microcline, 50–80 percent; plagioclase, 10–15 percent; biotite, hornblende, and augite, 10–25 percent; and accessory sphene, magnetite, leucoxene, apatite, and carbonate, about 5 percent.

The main mass is a coarse-grained to porphyritic, leucocratic hornblende-augite-biotite syenite composed of: perthitic microcline, about 60–70 percent; plagioclase, up to 10 percent; hornblende, augite, and biotite, 5–15 percent; and accessory sphene, apatite, magnetite, and carbonate, up to 5 percent.

A medium-grained to porphyritic, pink leucosyenite is exposed on some of the islands near the centre of this stock. It is composed of: perthitic microcline, 85 percent; plagioclase, 5 percent; chloritized hornblende and biotite, 5 percent; quartz, less than 5 percent; and accessory sphene, apatite, magnetite, and carbonate, less than 5 percent.

A few pegmatite dikes composed of acid feldspar and hornblende were observed on one of the islands.

On the southwest border of the syenite there is a heavy, black pyroxenite composed of: clinopyroxene, 80 percent; orthopyroxene and chloritic biotite, 10 percent; and magnetite, apatite, and carbonate, 5–10 percent. This is found in close association with the syenite. Other occurrences along the border areas have been mapped as lamprophyre and metagabbro, and these are noted on the map.

Along the northeast edge of the stock, four small exposures on the islands consist of a rock type of slightly different appearance. An elongate, negative magnetic anomaly appears to reflect this zone. In outcrop it is a medium-grained to porphyritic, purplish-coloured rock, containing varied amounts of streaky clots of biotite and hornblende, which are up to a few inches in length. In thin section it is composed of: acid plagioclase, 60 percent; microcline and perthite, 15 percent; fresh green hornblende and brown-green biotite, 5–10 percent; quartz, less than 5 percent; and accessory sphene, apatite, and garnet, about 1 percent.

As shown by aeromagnetic maps Nos. 1127G and 1117G (O.D.M. Maps 1961), the stock is perfectly reflected by the magnetic contours, and to the west a satellitic structure is indicated adjoining the Bell Lake stock. The underlying rock type in this structure is not known to the author. The magnetic data indicates the stock to be plunging steeply to the south-southwest.

LATE BASIC INTRUSIVE ROCKS (9)

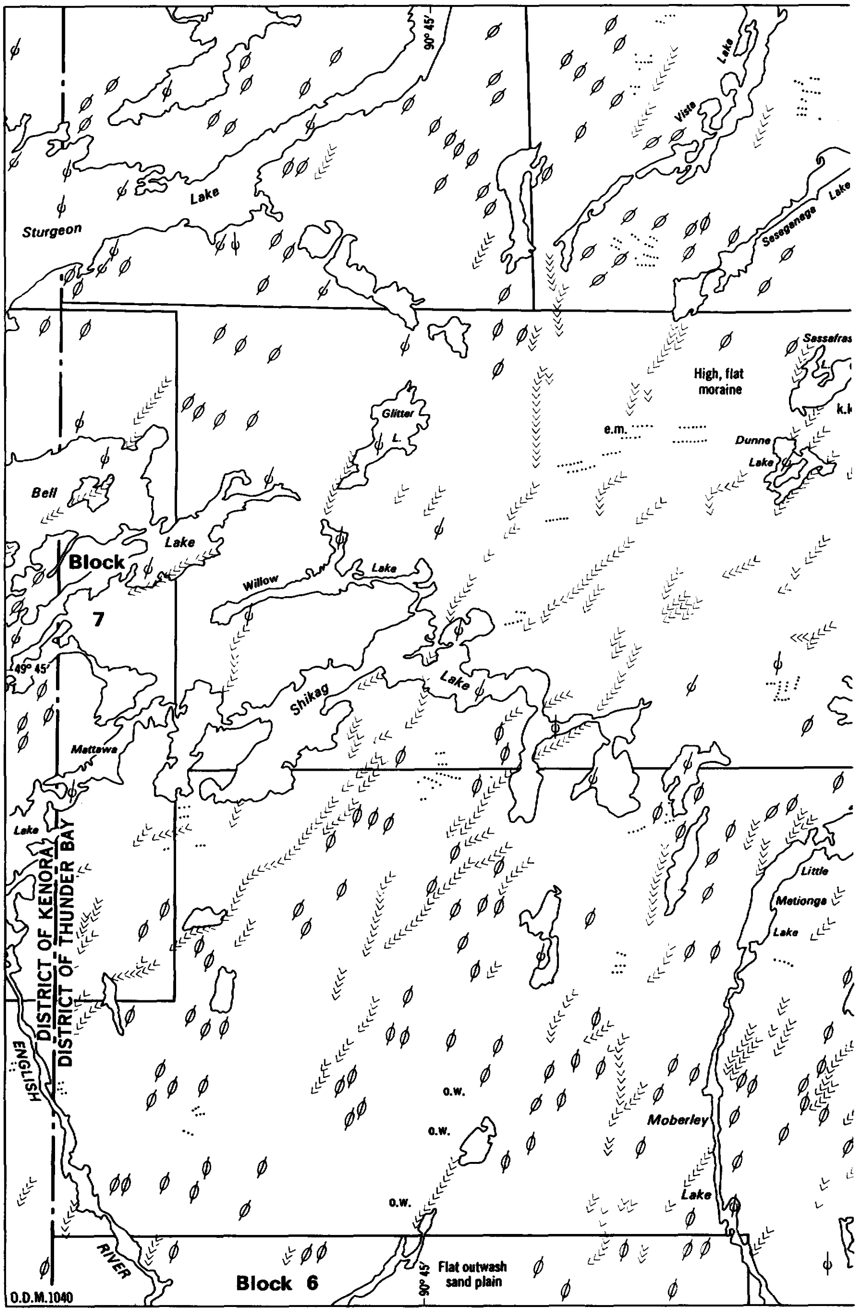
Only one occurrence of so-called late basic intrusive rock was mapped in the area. This outcrop is located on the west-central shore of Moberley Lake. It is a medium-grained, brown-weathering, diabase dike apparently less than 100 feet in width, which appears to strike north-northeast. Rounded and saussuritized phenocrysts of plagioclase feldspar are scattered throughout.

The author did not find the contact with the surrounding granite; however, the type and relative age assigned is interpreted from its resemblance to late basic intrusions in other Precambrian areas. Undoubtedly, there are other late basic dikes in the map-area, but no others were found during the survey.

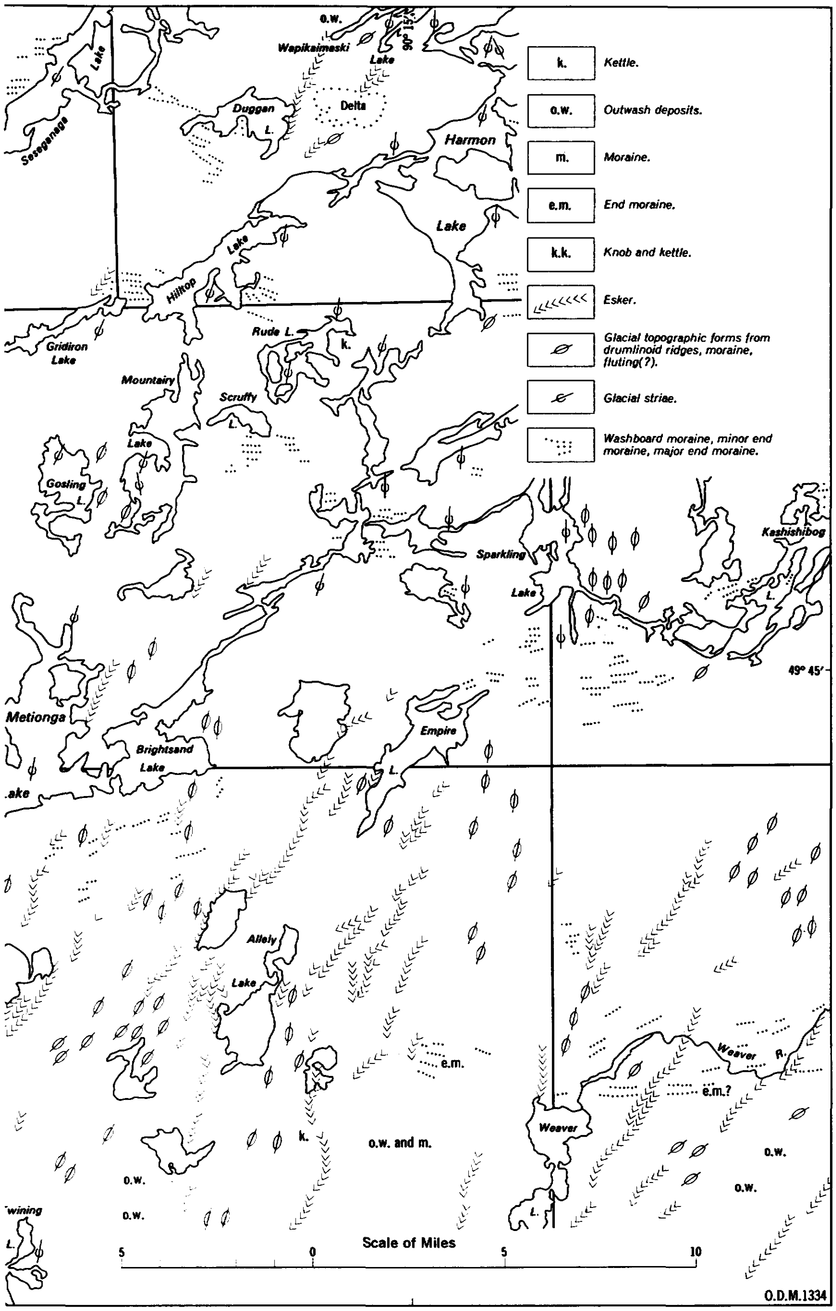
It is possible that the large tadpole-shaped, strong magnetic anomaly, shown on aeromagnetic map No. 1106G southeast of Empire Lake, reflects a late basic intrusion or diabase sill of the Lake Nipigon type. However, Green (1924) describes a black, coarse-grained gabbro cut by a small granite dike from this vicinity, and from his description it appears to be a gabbro similar in nature to that mapped by the author at Twining Lake.

PLEISTOCENE

The Pleistocene deposits of the area are of glacial origin, modified by post-glacial reworking and weathering. A map showing the Pleistocene geology is on pages 34 and 35.



Pleistocene geology of the Metiong



:e Area, District of Thunder Bay.

The major terrain types are: sandy boulder moraine, sand plain, and swamp and muskeg areas. The major physiographic features are: major moraines, washboard moraines, esker-outwash-kame complexes, and areas of drumlinoid ridges. These features are readily observed on the 1 inch to 1 mile air photographs, from which much of the Pleistocene map in this report has been compiled.

The areas of predominant rock outcrop, mixed outcrop and drift, and areas of little outcrop, are readily distinguished on the bedrock and Pleistocene maps.

Eskers

Eskers and esker-outwash-kame complexes are abundant in various parts of the area. They are sinuous ridges of sand, gravel, and boulders, up to 100 feet in height. The longest continuous esker is about 6 miles, but discontinuous series of complex eskers occur for a length of up to 24 miles. These esker series mark the subglacial river systems, which flowed in a southwesterly direction, more or less paralleling the latest direction of ice movement.

Washboard Moraines

The washboard moraines (Mawdsley 1936) are topographic forms occurring in low, flat areas from less than 1 mile to 6 miles across, scattered throughout the map-area. They are prominent features on the air photographs. The moraines commonly occur as short, straight, undulating to arcuate ridges up to 30 feet in height, generally at right-angles to the direction of ice flow. In detail they show many variations in height, direction, and continuity; minor branches, secondary parallel and right-angle ridges are not uncommon. They are markedly narrow compared to the inter-ridge distances. The south-facing slopes are generally steep, in some cases nearly vertical, but have gradual slopes to the north in the inter-ridge areas. However, some ridges noted in the vicinity of Hilltop Lake slope evenly north and south.

The ridges are composed of poorly-sorted, sandy, boulder-bearing morainic material, and boulders up to 6 feet in diameter were observed intermixed with sand pebbles and cobbles. In some places large boulders are "perched" (wave-washed?) along the crests of the ridges. The inter-ridge areas are gently-rolling mixed drift or sand, covered by scattered boulders and(or) muskeg.

The areas surrounding Duggan, Hilltop, and Scruffy lakes are excellent locations for more detailed studies of these deposits. The ridges can be traced into the existing lakes and commonly occur as elongated islands and shoals. These of course have been modified by lake ice and wave action. Undoubtedly more extensive postglacial lakes once covered these areas. Sand plains are often associated with the washboard moraine areas, but no clay deposits were observed.

It has been suggested that these ridges are annual recessional moraines, or some system of ice-front fracture fillings. Certainly, they must have formed just before the final disappearance of the ice, because any later movement or re-advance of the ice would have destroyed them.

Drumlinoid Ridges

Drumlins and drumlinoid ridges composed of sandy boulder morainic material are prominent in many parts of the map-area. They occur singly, or in groups, with the component ridges up to 1–2 miles in length and of varied widths. In some places minor eskers and washboard moraines are also present. Often their azimuths closely parallel those of the glacial striae found in the immediate vicinity. The linears plotted on the accompanying map (*see* pp. 34, 35), may in some cases, actually represent glacial fluting.

High Moraine Areas

An east-west-trending area of high sandy, boulder moraine occurs about 4 miles east of Glitter Lake. It continues to the east-northeast, south of Sassafras and Gridiron lakes. Hummocky, knob-and-kettle topography with relief up to about 150 feet characterizes much of this belt.

Another area of higher moraine, striking approximately east-west, extends east from Allely Lake through Weaver Lake, hence northeast along the Weaver River, east of the map-area.

South of Metionga and Brightsand lakes the topography is quite hilly and comprises varied sandy boulder morainic deposits and drumlinoid ridges. In many places, younger esker complexes overlie these deposits.

Kettle lakes and depressions are not uncommon in the outwash plains, areas of higher moraine, and the undulating till-moraine drift-covered parts of the area.

Outwash Deposits

Outwash deposits are most prominent in the south half of the map-area. They comprise flat sand-plain areas, swamp and muskeg, deltaic-like structures, and alluvial fans. These often bear stream-cut channels and exhibit fan structures, indicating drainage to the south-southwest. The drainage at present is completely reversed, flowing north-northeast.

A large outwash delta, about 2 miles in width, is located 1 mile east of Duggan Lake.

Glacial Striae

Glacial striae are most abundant in the areas underlain by the volcanic and sedimentary rocks and granitic gneisses. The coarse-grained granitic rocks seldom exhibit striae. Two ages of striae were observed at numerous locations along the south shore of Sturgeon Lake. Other locations having more than one age of striae are at Harmon and Mountairy lakes. The determinations made by the author at Sturgeon and Mountairy lakes indicated that the striae to the southeast were older. This situation appears ambiguous with respect to the northeast-striking striae, which parallel the major existing drumlinoid ridges, the general esker direction, and are close to right-angles to the washboard moraines, which were the last glacial structures to form.

REGIONAL STRIAE DIRECTIONS

Sturgeon Lake:	
older (?)	S.20°-33°W.
younger (?)	S.5°E.-S.18°W.
Seseganaga Lake	S.25°W.
Hilltop Lake	S.8°-14°W.
Wapikaimaski Lake	S.15°E.
Harmon Lake:	
set No. 1	S.30°E.
set No. 2	S.
set No. 3	S.10°-17°W.
Bell Lake	S.12°-22°W.
Glitter Lake:	
set No. 1	S.5°W.
set No. 2	S.18°-23°W.
Dunne Lake	S.30°W.
Gosling Lake	S.25°W.
Mountairy Lake:	
older (?)	S.15°W.
younger (?)	S.10°E.
Rude Lake	S.11°W.
Sparkling Lake:	
set No. 1	S.0°-18°W.
set No. 2	S.5°-15°E.
Shikag Lake:	
set No. 1	S.
set No. 2 (east end)	S.20°W.
Metionga Lake	S.10°W.
Mattawa Lake	S.8°W.

RECENT DEPOSITS

Recent deposits are mainly sand beaches, bars, reworked lag gravels, and boulder accumulations along the present drainage system. Bog and swamp deposits of organic mud and peat are common throughout the area, but are most abundant in the south half of the map-area. Recent ice and wave action is evidenced by perched boulders along the shores and, on clear sunny days, ice-pushed boulder trails, generally at right angles to the shoreline and up to 100 feet long, can be seen in the shallow water near the shorelines of most lakes. Numerous small lakes, with few or no outlets, exhibit all stages of filling-in by organic mud and the formation of new swamp and muskeg.

Purple garnet sand occurs on parts of the beaches of Sassafras, Gridiron, Hilltop, Mountairy, Brightsand, and Metionga lakes. It occurs generally in lenses fron less than one to several inches thick, a few feet wide, and up to 200–300 feet long. These garnet-rich sands overlie black magnetite, hornblende, biotite-rich lenses of similar extent, which in turn overlie the common white to light-brown, quartz- and feldspar-rich beach sands. It is interesting to note that the purple and black sand is located up to 12 miles, and perhaps farther, south of the garnet-magnetite-bearing part of the Precambrian sedimentary and volcanic schists and gneisses. This again indicates drainage to the south during Pleistocene glacial time. The Recent drainage is northwest, north, and northeast.

Structural Geology

GENERAL

The regional foliation of the Precambrian rocks is in an east-west direction (with north and south variations). The plunge of various lineations is commonly in an easterly direction, although systematic observations of the lineations were not recorded.

The foliation of the intruded rocks, and that of the enclosing and intruding granitic rocks, are regionally concordant; locally they are discordant.

Some primary structures and textures are preserved as pillows, amygdaloidal structures, and sedimentary bedding, in the northwestern part of the area. Elsewhere, shearing and metamorphism have destroyed these features or rendered them unusable for top determinations.

FOLDING

The folding appears to have been largely syntectonic with the emplacement of the granitic rocks, as indicated by the regionally concordant foliations. The younger syenitic intrusions and the pink granite bodies are also regionally concordant. The interpretation suggested is that folding was continuous throughout the major period of intrusion.

The major regional fold structure in the area is the W-shaped harmonious configuration of the volcanic-sedimentary belt enclosed by the granitic rocks. The centre of this W-shaped pattern, Mountairy Lake, is a folded anticlinal structure plunging north-northeast. Intense dragfolding locally accompanies the regional fold. The northwest limb of this fold may be overturned to the north. The volcanic rocks and sedimentary rocks, comprising the anticlinal structure, thin out and disappear to the southeast. However, the folded configuration is continued eastward, as is seen by the foliation of the enclosing granitic gneisses.

The belts of greywacke and conglomerate found in the area were formerly considered to be of Timiskaming type and age (Graham 1931). Insufficient data is available to determine whether they are folded synclinal belts or contemporaneously intercalated sedimentary deposits. The author considers them to be late-contemporaneous sediments deposited with the volcanic rocks.

The geometric configuration of the main volcanic-sedimentary rock belt indicates that there is a good possibility that regional crossfolding (on north-northeast axes) has been superimposed on east-west fold axes.

The areas of granitic gneisses show regionally continuous and discontinuous fold patterns. In detail they are often strongly contorted into small, pitching anticlinal and synclinal structures, or occur as vertical to shallow-dipping, layered gneisses.

FAULTING

Extensive faulting was not found in the area. Regional lineament patterns are not especially noticeable.

Only one fault has been shown on the accompanying geological map (No. 2044, in back pocket). This fault, located on Sturgeon Lake, just west of the

Narrows, is indicated by apparent left-hand displacement of strata and shearing. It strikes north-northeast, cutting the volcanic-sedimentary contact at a high angle.

A few narrow shears, 6 inches wide, striking north-northwest, were observed in the sedimentary rocks along the contact zone in the vicinity of Dunne Lake.

A prominent linear feature through Blackbird Lake, southeast along the Shikag River, transects a belt of volcanic rocks and minor sedimentary rocks enclosed by granitic gneisses. However, no displacement is apparent.

SHEARING

No large zones of shearing were noted during mapping. However, smaller shear zones, often carbonatized, are common in the volcanic and sedimentary rocks on Sturgeon Lake and in the vicinity. Schistosity is more strongly developed in the volcanic and sedimentary rocks along the eastern extension of this belt; in the smaller isolated belts east of Hilltop and Mountairy lakes; and in the belt through Tokay and Redwing lakes.

Discussion of Aeromagnetic Data

The Metionga Lake area was flown magnetically in 1961, and the map-sheets covering this area have been released jointly by the Ontario Department of Mines and the Geological Survey of Canada (O.D.M. Maps 1961). These are:

Bell Lake, Map No. 1117G.
Harmon Lake, Map No. 1107G.
Cottle Lake, Map No. 1116G.
Weaver Lake, Map No. 1106G.

Adjoining aeromagnetic map-sheets, which are also referred to in this report, are: Watcomb (Map No. 1127G) and Sturgeon Lake (Map No. 1118G).

The aeromagnetic data were not available until after the mapping was completed. However, the author has found a good correlation between the mapped geology and the aeromagnetic information. Comparison of the accompanying geological map (No. 2044, in back pocket) with the aeromagnetic sheets shows that:

1. The generalized magnetic trend follows the regional structure very closely.
2. The volcanic-sedimentary belts are regionally outlined with respect to the enclosing granitic rocks.
3. The regional strike of foliation of the granitic gneisses is closely matched by the magnetic contouring.
4. The belts of magnetic iron formation are well reflected.
5. Circular structures on Bell Lake and Sturgeon Narrows, and on Squaw Lake (north of this map-area), are well defined.
6. Small basic intrusive bodies are not so well defined and are often masked, or not apparent.
7. The actual contacts or contact zones between the sedimentary, volcanic, and granitic rocks are not always well defined by the magnetic contouring. This is due to masking by iron formation and to the lack of appreciable differences, at some places, in magnetic susceptibility between the various rock types.

MAGNETIC RESPONSE OF THE VARIOUS ROCK TYPES

The magnetite iron formation registers the highest magnetic intensity. The strongest magnetic anomaly is located 1½ miles west of Sassafras Lake. This anomaly has been drilled by N. A. Timmins (Ontario) Limited and is described under Economic Geology in this report. Other anomalies due to magnetite iron formation are:

1. The continuation of the Sassafras Lake belt to the northeast, south of Gridiron and Hilltop lakes, thence southeast, and terminating on the north shore of Scruffy Lake.
2. A concentration of iron formation west of Div Lake.
3. A narrow zone of iron formation lying between Post and Willet lakes.
4. A small zone of iron formation indicated on the north shore of Barge Lake.
5. A linear anomaly located in Sturgeon Lake just west of the map-area (*see* aeromagnetic map No. 1127G), which indicates the western extension of the iron formation.
6. Two smaller magnetic anomalies located ½ mile south and 1 mile west of Goodman Lake. These are probably due to iron formation.
7. A linear anomaly due to iron formation located between Empress and Vista lakes. It extends north of the map-area for about 1 mile, where it becomes a circular-shaped anomaly.

The sedimentary rocks are generally indicated by linear magnetic "highs" where they encompass the iron formation, and by magnetic "lows" where there is no iron formation (e.g., Quest Lake).

There is no apparent magnetic distinction between the acid and basic volcanic rocks. They are indicated by broad zones of mixed anomalies. In areas where the volcanic rocks have been altered to schists and gneisses, they often give a series of magnetic "lows" (i.e., through St. Mary, Redwing, and Tokay lakes). The volcanic assemblage in the area around Cobb Bay, Sixmile Lake, and north of the map-area, has no particular magnetic expression. The southern contact of the volcanic belt with the granitic rocks, extending from Darkwater and Bell lakes through to Glitter Lake, is not well indicated magnetically. However, there is a broad magnetic "low" along this contact, which indicates the strike.

The early basic intrusive rocks and their metamorphosed equivalents are indicated by magnetic anomalies of intermediate intensity, both positive and negative. The two positive anomalies on the north-central part of Shikag Lake are apparently due to older metagabbro bodies. One outcrop was observed within the southern anomaly; it is metagabbro and contains abundant magnetite. Similar metagabbro and pyroxenite noted in the vicinity of Bell Lake do not show a magnetic response. They may be too small, or masked by the Bell Lake stock.

An anomaly of intermediate character overlies a small outcrop area of metadiorite a mile southeast of Rude Lake.

A pair of anomalies occur on the northwestern part of Twining Lake. The southern one is smaller, positive, and underlain by a black, fresh-looking gabbro. The northern anomaly is broader and negative, and the western part of it is underlain by metagabbro cut by granite pegmatite.

The large tadpole-shaped anomaly located southeast of Empire Lake is interpreted as due either to a diabase sill or a large mass of older gabbro. This was not mapped by the author, but Green (1924) reported the existence of older gabbro and diabase in the area southeast of Empire Lake.

The Bell Lake syenite has been mapped as a differentiated syenitic stock. Its elliptical structure is clearly evident, both geologically and from the aeromagnetic data. The melanocratic borders are indicated by a broad elliptical magnetic "high"; the pink leucosyenite core is indicated by a magnetic "low". Correlation between the mapped geological contacts and the magnetic contours indicates the elliptical stock plunges steeply south-southwest.

The Sturgeon Lake alkaline complex is fairly well outlined by the magnetic contours covering the northeast half. Arcuate magnetic "highs" occur along the borders and contact areas, and a magnetic "low" overlies the central part. The southwestern part is indicated by linear magnetic "highs"; however, definition with regard to the contacts is not apparent.

The Squaw Lake stock, although lying outside the map-area, is noted here because of its circular structure. It was reported by Graham (1931) to be a coarse-grained, grey mica syenite. It is characterized by higher magnetic border zones and a magnetic "low" over the central part.

The granitic gneisses are characterized by long arcuate, fairly closely contoured regional magnetic trends. Numerous small, rounded and elongate magnetic "lows" are closely associated. In many instances these depressions are underlain in the field by biotite-hornblende schist inclusions and *lit par lit* gneiss. They represent foundered remnants of original supracrustal rocks.

The massive granite, which underlies the southern part of the map-area (e.g., Cottle, Dasent, Ruxton, Metionga, Brightsand, Globe, Gosling, and part of Mountairy lakes) are characterized by a broad, magnetically smooth area, containing low-value, rounded contours in the 60,700–60,800 gamma range. As can be readily seen, there is complete gradation magnetically to more regional magnetic trends between areas underlain by the massive granite and the granitic gneisses. This magnetic feature corresponds closely with the geology as mapped in the field.

Radioactivity

Low radioactivity is associated with both the Sturgeon Lake alkaline syenite complex and the Vista Lake syenite. The Bell Lake syenite stock and associated contact rocks were not checked during the present survey because a systematic check of all the rock types in the area for radioactivity was not carried out. However, spot checks were made where possible, and no other areas of abnormal radioactivity were noted. Details of radioactivity in particular areas are given below.

STURGEON LAKE ALKALINE SYENITE COMPLEX

In general, the main body of the Sturgeon Lake syenite registers 2–3 times the background radioactivity of the surrounding volcanic and sedimentary rocks. The outcrop areas of scapolite-rich syenite in the central part of the intrusion also register above background radioactivity. Areas of higher radioactivity, 3–6 times background, are described on page 43.

The contact zone between the volcanic country rocks and the syenite, located on the mainland due south of Seaton Island, is a complex of highly altered, carbonatized and brecciated country rocks, bounded on the north by medium-grained, carbonatized melanocratic syenite. Disseminated sulphide (mainly pyrite) mineralization is present in the carbonatized country rocks. Grab samples taken by the author from the various phases along this contact zone were tested for niobium (columbium) and uranium and gave results as follows:

Rock Type	Niobium	U_3O_8 equivalent
		percent
1. Fine-grained volcanic rock	n.d.	0.001
2. Brecciated and sheared country rock	n.d.	0.007
3. Fine-grained, highly altered country rock	n.d.	0.001
4. Sheared and brecciated siliceous country rock	n.d.	0.009
5. Medium-grained border phase of the syenite	n.d.	0.001

n.d.—not determined. Analyses by Laboratory Branch, Ontario Dept. Mines.

Radioactivity, measured in the field, of the various rock types listed above, registered from two to about five times above the background of the volcanic rocks away from the contact. The total exposed width of outcrop from which the above samples were obtained is about 25 feet. The zones of higher radioactivity ranged from a few inches to several feet in width. The lengths of the zones are unknown owing to extensive drift cover.

A radioactive vein, 2 inches wide, was found in a shear zone, 1–3 feet wide, on the south shore of Sturgeon Narrows, about 14 chains northwest of the contact described above. The vein contains: clusters and vuggy structures of a hard, white-grey, platy mineral tentatively identified as cleavelandite; carbonate; traces of hematite; and greenish black chloritic material. A grab sample of the vein material gave 0.001 percent U_3O_8 equivalent.

The brecciated and mylonitized shear zones in the Sturgeon Lake syenite (*see* pages 27–31) are commonly above background radioactivity. They are slightly pyritic and show varying degrees of red alteration or rusty weathering.

Two zones of higher radioactivity were observed on the northeast shore of the largest island in Sturgeon Narrows, northeast of Seaton Island. The zones are about 2–3 feet wide and are of unknown length. They consist of red, highly altered rock containing abundant carbonate, some hematite, surface staining, and minor amounts of tiny unidentified greenish-black, elongate ferromagnesian mineral(s). A grab sample taken by the author from one of these zones gave on analysis about 0.01 percent Nb and 0.01 percent U_3O_8 equivalent.[1]

Along the northwest shore of Seaton Island, Sturgeon Narrows, there are many pink to red, altered, syenitic contact rock phases. A number of small zones, up to a few feet wide and of unknown length, were observed. These commonly contain minor disseminated sulphides, small stringers of purple fluorite, are rusty weathering, and register higher radioactivity. Qualitative spectrographic analysis of grab samples from two of these zones gave:

[1]Analyses by Laboratory Branch, Ontario Dept. Mines.

Sample No.	Th	Ce	La	Nb	U_3O_8 Equivalent
		percent	percent		percent
1.	n.d.	n.d.	n.d.	n.d.	0.004
2.	n.d.	about 0.10	about 0.10	n.d.	0.004

n.d.—not determined.
Qualitative spectrographic analysis by Laboratory Branch, Ontario Dept. Mines. Radioactive determination (beta-ray activity) uranium oxide U_3O_8 equivalent.

A small exposure of a pinkish carbonate-feldspar rock is located on the north shore, between the altered volcanic rocks and the conglomerate, about 30 chains north-northeast of the large island in Sturgeon Narrows. Qualitative spectrographic analysis of a grab sample from this outcrop, taken by the author, gave 0.002 U_3O_8 equivalent, but no cerium, lanthanum, thorium, or niobium were detected.

Qualitative spectrographic analysis of a sample, taken by the author, of siliceous, brecciated contact rock from an outcrop area about 25 chains south of Anderson Lake, gave 0.006 percent U_3O_8 equivalent, but thorium, cerium, lanthanum, and niobium were not detected.

Another occurrence of higher radioactivity was located on the southwest tip of Coveney Island, Sturgeon Lake, which lies immediately north of the north boundary of the map-area. It is included here because it occurs on the contact zone between the Sturgeon Lake syenite and the altered volcanic country rock. A small pit, 4–5 feet across and about 6 feet deep, has been sunk on a radioactive, highly altered, red-coloured contact phase of the syenite. This is a red feldspar rock containing purple fluorite, minor magnetite, traces of sulphides and an unidentified black mineral. Abundant secondary carbonate occurs in both the volcanic rocks and the syenite. Qualitative spectrographic analysis of a grab sample taken by the author from this pit gave: about 0.05 percent niobium; detectable amounts of thorium, cerium, and lanthanum; and 0.06 percent U_3O_8 equivalent.

The eastern border of the Sturgeon Lake syenite, in the vicinity of the small lake immediately north of Princess Lake, registers 2–3 times the background radioactivity of the volcanic and sedimentary rocks. The narrow pegmatite and syenite dikes cutting the country rocks are of higher radioactivity (3–6 times background). One outcrop of syenite, on the southeast shore of this small lake and adjacent to the contact with the conglomerate, contains a few highly radioactive veinlets (1/8 inch by 1 foot) of black, pitchy-looking material. The conglomerate and much of the syenite in the vicinity are not especially radioactive.

VISTA LAKE SYENITE

The Vista Lake syenite registers 1–3 times background radioactivity, where the outcrops were checked along the northwest shoreline of Vista Lake. The eastern part, and the eastern extension from Sassafras Lake through to Scruffy Lake, were not checked for radioactivity. No zones of higher radioactivity were observed within or related to the Vista Lake syenite.

Economic Geology

IRON

Magnetic iron formation occurs in two main sedimentary belts in the area. The deposits consist of magnetite iron formation. The largest deposit indicated by the aeromagnetic data lies immediately southwest of Sassafras Lake. This is the only deposit on which exploration work has been carried out to date; it is described elsewhere in the report (*see* page 47). The next largest magnetically-indicated iron deposit is located immediately northeast of Empress Lake; the main part of this lies beyond the north boundary of the map-area. The magnetic anomalies over the remaining iron deposits indicate narrow and probably lower-grade deposits, which would not seem to warrant further exploration unless the two main magnetic bodies proved economic.

Dilution of grade due to varied proportions of intrusive syenitic rocks and barren schist phases, the lenticular nature of the deposits, and also the limited over-all tonnage possibilities are important factors in an economic appraisal of these iron deposits.

GOLD

No new gold prospects have been located recently within the map-area. The quartz porphyry stock, north of Bell Lake, offers possibilities for gold prospecting. The old Darkwater mine is located 4 miles west of the map-area, near the north contact of this porphyry body, and is described by Horwood (1938).

The author took a grab sample from a quartz-tourmaline-carbonate vein, about 15 feet wide, striking N.80°E., and located on the east shore of a large island at the mouth of Cobb Bay, Sturgeon Lake; it assayed only a trace of gold. No old trenching was observed on this vein.

SULPHIDES

Sulphide mineralization was noted in the following locations:

Pyrite mineralization in close association with abundant carbonatization is common in the volcanic and sedimentary rocks in Sturgeon Lake Narrows and in the contact zones with the Sturgeon Lake syenite. Pyrite mineralization with disseminations of chalcopyrite was reported, by a field assistant, in the volcanic rocks southeast of Seaton Island in Sturgeon Lake, and south of Anderson Lake.

Minor pyrite mineralization was noted in the conglomerate on the islands and east shore of Princess Lake. These conglomerates probably grade into greywacke and argillaceous sedimentary rocks to the east and are intruded by minor amounts of metagabbro-diorite.

Rusty-weathering, carbonatized, tuffaceous bands were noted along the west shore of Quest Lake.

The long, narrow metasedimentary band included in the syenite on the north-west shore of Vista Lake contains scattered sulphide mineralization, mainly pyrite and pyrrhotite. At one locality near the middle of this band, traces of molybdenite, as tiny disseminated flakes, were noted in the schist.

Massive and disseminated pyrrhotite and pyrite were encountered in the bottom section of drillhole No. 5 (*see* figure facing p. 47) intermixed with garnetiferous magnetite-bearing schist, west of Sassafras Lake.

Minor sulphide mineralization was observed in close association with the banded magnetic iron formation in the anticlinal fold area, northeast of Mountairy Lake.

Minor sulphide and rusty gossans were noted in some of the outcrops along the shores of Glitter and Claw lakes.

One outcrop of sheared pyritic, slatey sedimentary rock, in close association with the volcanic rocks, was mapped on the southwest shore of Post Lake.

The metavolcanic schist band along the north shore of Bell Lake is locally sheared, carbonatized, and pyritic.

The acid volcanic rocks—rhyolite, rhyolite agglomerate, and tuff—found on Sturgeon Lake, Cobb Bay, and Sixmile Lake, are commonly sheared and carbonatized in part. Although sulphide mineralization was not specifically observed, the author considers these bands worthy of prospecting.

QUARTZ VEINS

Quartz veins are fairly common in the volcanic rocks. They are generally very small and barren-looking, and no attempt has been made to show them on the geological map. In the vicinity of the quartz porphyry stock north of Bell Lake, some quartz-tourmaline-carbonate veins were observed, along the contact in both the volcanic rocks and the porphyry.

Two fairly large zones of quartz stockwork were observed in the pink granite on Pipio Lake. They strike northwest, are about 25–30 feet wide, and of unknown length. Nothing of economic interest was recognized in them, and no samples were taken for assay.

URANIUM AND NIOBIUM

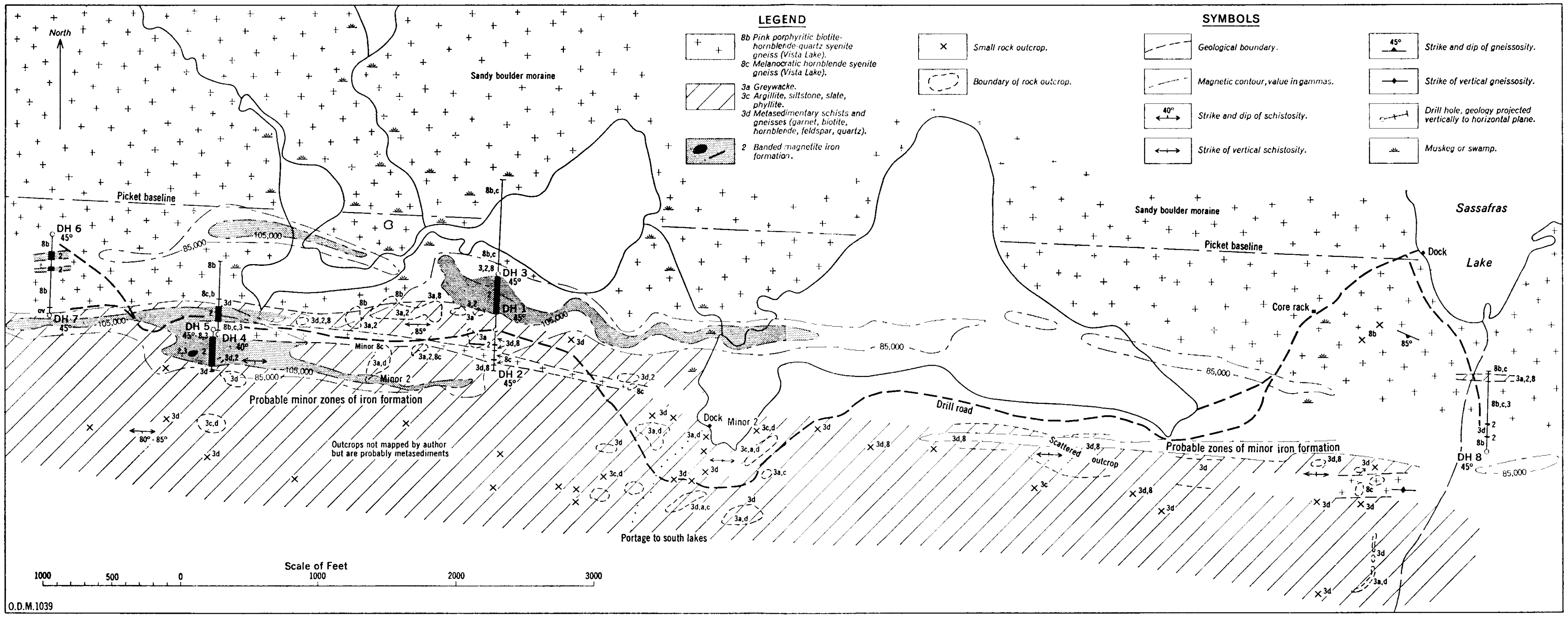
No occurrences containing economic amounts of uranium were located. Samples from highly altered, radioactive contact rocks from the Sturgeon Lake syenite gave on analysis a U_3O_8 equivalent of 0.001–0.06 percent. Some of these samples of the radioactive contact rocks contain detectable amounts of thorium, cerium, and lanthanum.

Two of the samples containing 0.01 and 0.06 percent U_3O_8 equivalent also contain about 0.01 and 0.05 percent niobium, respectively. Although these values are low, the author believes they are significant enough to warrant detailed prospecting along the contacts of the Sturgeon Lake syenite.

All the samples of the Sturgeon Lake syenite and associated contact rocks were also tested by qualitative spectrographic analysis for the presence of beryllium. Only trace amounts (less than 0.005 percent) were found.

NEPHELINE

Nepheline syenite was first reported by Gledhill (1925) as an occurrence covering several acres on the west-central border of the Sturgeon Lake augite



Geological plan of the Sassafras Lake MagnetiteIron Deposits, District of Thunder Bay.
(Courtesy of C. H. Hopper, P.Eng.)

syenite. The author's samples, from what appeared to be the mass described by Gledhill, failed to show the presence of nepheline. There is a lack of good outcrop in this area, and closer examination may be warranted to determine whether the nepheline-bearing zone(s), if present, were overlooked by the author.

PEGMATITE

Although nothing of economic importance was recognized in the huge pegmatite dikes (quartz, feldspar, traces of muscovite, garnet, and magnetite) in the area bounded by Gosling, Hilltop, Harmon, and Mountairy lakes and the Brightsand River, they may warrant closer examination, especially in the vicinity of the metavolcanic and sedimentary rocks. In general the dikes did not receive close examination by the author.

SAND AND GRAVEL

Sand plain areas are common and are readily located by the air photographs. Good gravel deposits are not plentiful; rather stony boulder morainic deposits predominate. Esker complexes are abundant and would provide good base for road construction.

Description of Property

SASSAFRAS LAKE MAGNETITE CLAIMS

In preparing the following account the author has made use of material from the assessment work file of N. A. Timmins Explorations (Ontario) Limited (O.D.M. File 63.907); and written information from C. H. Hopper, P.Eng. (published with his permission), which includes work done by Steep Rock Iron Mines Limited.

Claims and Ownership

The property consists of 19 claims, including 2 claims north-south and 9 claims east-west along strike of the main magnetic anomaly, and 1 claim to the east. The recorded owner of these claims, in December 1961, was N. A. Timmins (Ontario) Limited. Ten of the claims have been surveyed.

Location

The claim group is located directly on the southwest of Sassafras Lake, which lies 12 miles southeast of Sturgeon Lake Narrows, and about 25 miles northeast of Tannin, a station on the Port Arthur–Sioux Lookout branch of the C.N.R.

History of the Property

During the field season of 1956, two prospectors, W. C. Shepherd and M. Lambert, employed by N. A. Timmins Explorations (Ontario) Limited under engineer L. G. Smith, noticed great variation of the compass on a portage west of Sassafras Lake. This led to the discovery of a strongly magnetic belt and the staking of the Sassafras Lake Magnetite Claims.

In 1957 the magnetic belt was traced by ground magnetometer, dip-needle surveys, and an aeromagnetic survey. This work was followed by a diamond-drilling program consisting of 8 holes, which totalled 4,366 feet over a strike length of 10,400 feet. No further work was done on the property until August 1960, when a geological survey and review was made by C. H. Hopper, who was granted an option on the property by N. A. Timmins (Ontario) Limited.

During January and February 1961, Steep Rock Iron Mines Limited re-logged the iron formation-bearing sections of the drill core and carried out further assays and concentrating tests. In March 1961 they made a detailed ground magnetometer survey over a magnetic band west of Div Lake, which lies about 4 miles west of Sassafras Lake, and a detailed magnetometer survey over the main iron-bearing zones immediately west of Sassafras Lake and also west of Div Lake.

The author spent five days in June 1961, during reconnaissance mapping of the area, inspecting the core and studying the geology of Sassafras Lake Magnetite Claims. A geological map of the property at a scale of 1 inch to 400 feet was made (*see* figure, facing p.47). The original grid system was used for mapping purposes. Only the outcrop areas indicated on the map were checked and mapped. The remainder of the area received only reconnaissance mapping.

General Geology

Outcrop is not abundant in the claim group. Diamond-drilling and the regional geology indicate that the north half of the property is underlain by an intrusive body of quartz syenite, the Vista Lake syenite. This syenite (*see* page 31) is cut by younger pink granite, aplite, and pegmatite dikes. The gneissic structure is generally in an east-west direction and dips from vertical to 85°S.

The syenite has intruded and metamorphosed a sequence of greywacke and argillaceous-type sedimentary rocks containing minor greenstone and(or) tuffaceous rocks, which underlie the south half of the claim group. This sequence is foliated (generally parallel to the original bedding) in an east-west direction and dips variously from vertical to 80°S. They now comprise a complex of undifferentiated fine- to medium-grained schists and gneisses composed mainly of quartz, feldspar, hornblende, biotite, chlorite, and garnet. Along the contact zone, syenite gneiss, granite pegmatite, and aplite are found as bands and stringers, from 1 inch to more than 10 feet in width, in a *lit par lit* to veined association with the metasediments.

The iron formation is of sedimentary origin and has been highly recrystallized and metamorphosed by the intrusion of the Vista Lake quartz syenite. It occurs as lenticular bands both in the metasediments and the syenite gneiss. The iron(magnetite)-rich bands are often crumpled, locally dragfolded (vertical plunge), lenticular, and of limited length. These magnetite-rich bands are interbedded with magnetite-poor metasedimentary schists. The relative proportion of the magnetite bands and the schists, as well as the magnetite content, varies greatly throughout the property. Minor sulphides (pyrite and pyrrhotite) are present in some of the lower grade iron formation (e.g., the bottom of drillhole No. 5). No hematite was observed.

The iron formation of the best quality consists of fine-grained bands rich in quartz, biotite, and magnetite, with minor intrusive bands of "syenitic gneiss." The lean iron formation consists of medium-grained bands poor in quartz, biotite, hornblende, and magnetite, with abundant intrusive bands of syenite and granite, plus barren schist bands. There are all gradations between these two types.

Summary

Assay and mill-test results show that an acceptable concentrate can be made from most of the material encountered in the diamond-drilling.

Widths greater than 200 feet and up to 500 feet have been used in making estimates of possible open-pit ore to a depth of 300 feet. These estimates range from a more selective 22,300,000 tons of crude ore, capable of producing 7,400,000 tons of concentrate of a type grading 69 percent Fe and 3–4 percent SiO_2, to 44,000,000 tons, grading 23–24 percent magnetic iron, capable of producing 15,000,000 tons of concentrates of about 66 percent Fe and 5 percent SiO_2. Wet cobbing tests at minus ¼ inch suggested recoveries of 95 percent of the iron while rejecting 20 percent or more of the feed as a tailing.

These tonnage and grade estimates are preliminary in nature since they are based on only one cross-section across each of the two main bodies extended by geophysical interpretation.

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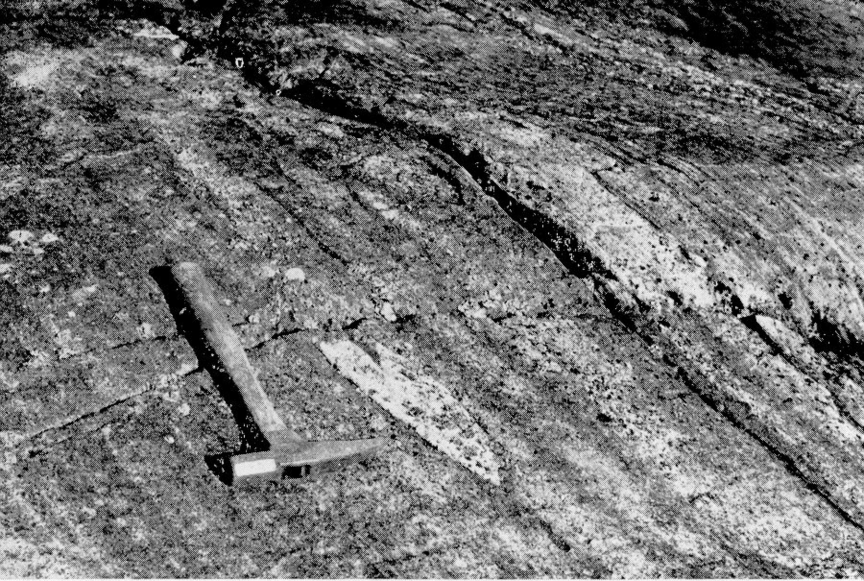

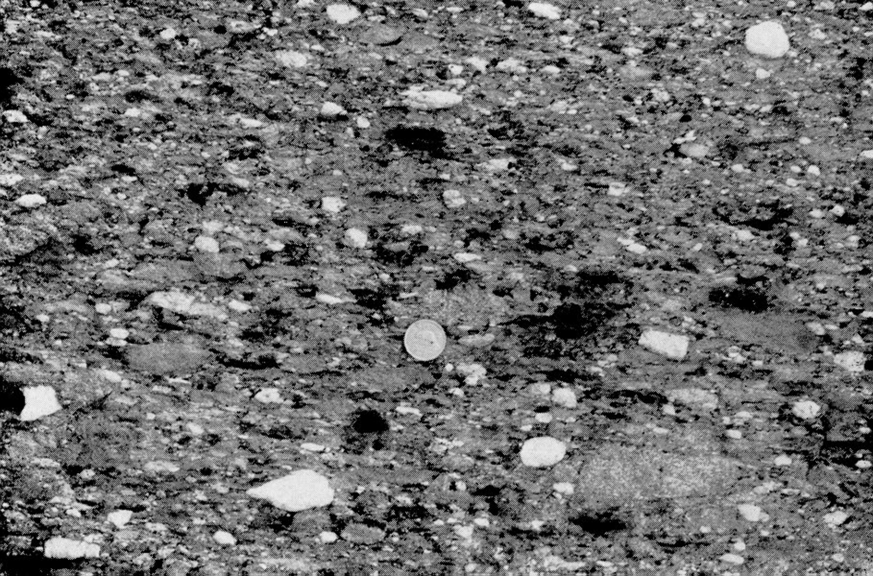

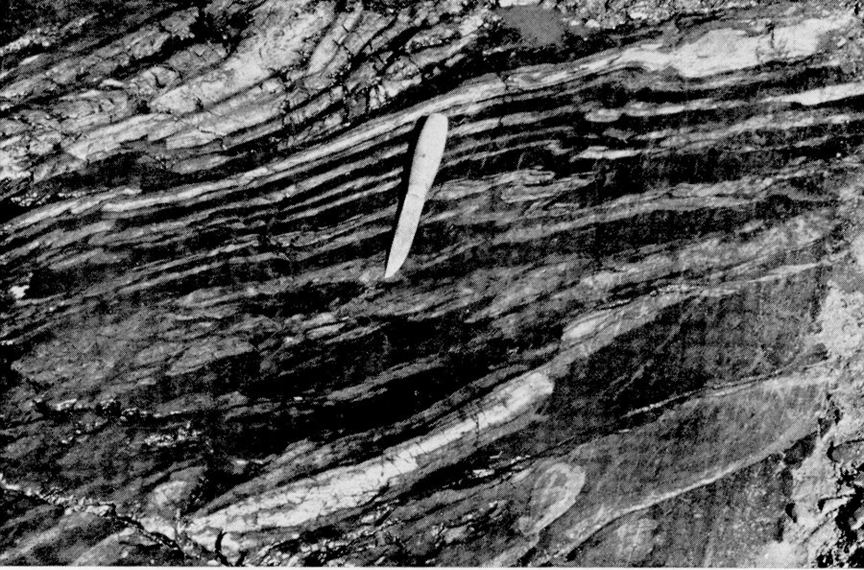

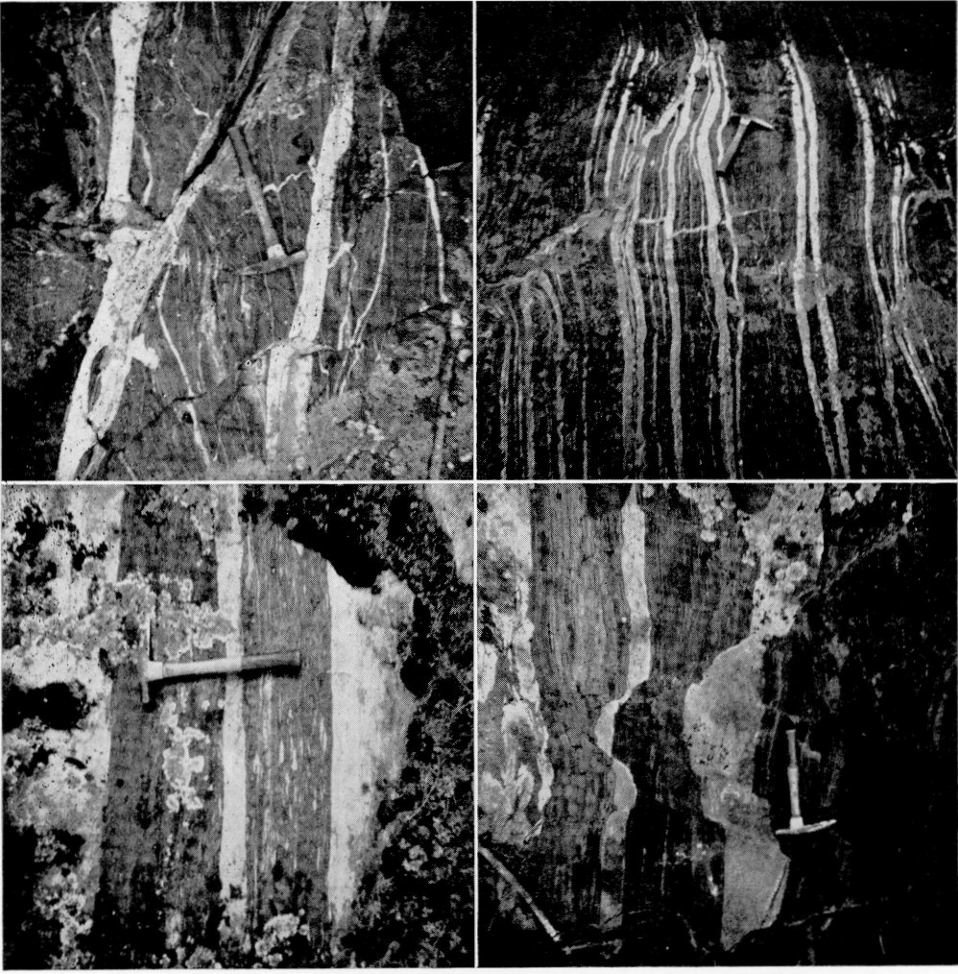

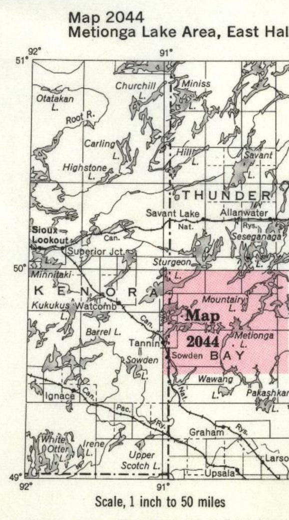

ONTARIO
DEPARTMENT OF MINES

HON. G. C. WARDROPE, *Minister of Mines*
D. P. Douglass, *Deputy Minister* M. E. Hurst, *Director, Geological Branch*

Map 2044

METIONGA LAKE AREA

THUNDER BAY AND KENORA DISTRICTS

Scale 1 : 63,360 or 1 Inch to 1 Mile

Chains 80 40 0 1 2 3 4 5 Miles
Feet 10,000 0 10,000 20,000 Feet
Metres 1000 0 1 2 3 4 5 6 Kilometres

LEGEND

CENOZOIC*

RECENT AND PLEISTOCENE

Peat, muck.
Glacial drift: boulders, gravel, sand, till.

GREAT UNCONFORMITY

PRECAMBRIAN**

LATE BASIC INTRUSIVE ROCKS

9 *Porphyritic diabase.*

PLUTONIC ROCKS

SYENITIC ROCKS

8a *Scapolite-augite syenite, (Sturgeon Lake alkaline complex).*
8b *Pink porphyritic biotite-hornblende-quartz syenite gneiss (Vista Lake).*
8c *Melanocratic hornblende syenite gneiss (Vista Lake).*
8d *Hornblende-pyroxene-biotite syenite (Bell Lake).*

GRANITIC ROCKS

Pink Granitic Rocks

7a *Pink granite, quartz monzonite.*
7b *Gneissic pink granite.*
7c *Porphyritic pink granite (may be gneissic).*
7e *Quartz diorite.*
7p *Granite pegmatite.*
7d *Quartz porphyry, quartz-feldspar porphyry, feldspar porphyry.*

Grey Granitic Rocks

6a *Grey granite, granodiorite.*
6b *Gneissic grey granite.*
6c *Porphyritic grey granite.*
6p *Granite pegmatite.*

Granitic Gneisses

5a *Migmatite.*
5b *Lit-par-lit gneiss.*
5c *Hybrid granite gneiss.*
5d *Amphibolite (massive or foliated).****

EARLY BASIC INTRUSIVE ROCKS

4a *Gabbro.*
4b *Metagabbro, metadiorite.*
4c *Pyroxenite, lamprophyre.*

SEDIMENTARY AND VOLCANIC ROCKS

SEDIMENTARY ROCKS

3a *Greywacke.*
3b *Conglomerate.*
3c *Argillite, siltstone, slate, phyllite.*
3s *Staurolite-biotite-feldspar schist.*
3d *Metasedimentary schists and gneisses (garnet, biotite, hornblende, feldspar, quartz).*
3e *Minor volcanic rocks (?), chlorite schist, tuff (?).*
3p *Biotite paragneiss.*

2 *Banded magnetite iron formation (I.F.).*

VOLCANIC ROCKS

Basic Volcanic Rocks

1a *Altered basic and intermediate volcanic rocks.*
1b *Coarse-grained basic flow rocks.*****
1c *Agglomerate, tuff.*
1p *Pillow lava.*
1d *Porphyritic basalt.*****
1e *Schist and gneiss (garnet, feldspar, biotite, chlorite, hornblende).*
1s *Metasedimentary interbeds, tuff (?).*

Acid Volcanic Rocks

1r *Rhyolite, porphyritic (quartz) rhyolite.******
1h *Acid agglomerate, tuff, flow breccia.*
1t *Acid to intermediate volcanic rocks.*
1g *Quartz-sericite-carbonate schist.*

Breccia.

carb *Carbonatized rock.*

**Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured and uncoloured parts of the map.*

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

****Origin not known. May be older basic intrusive and/or extrusive rocks.*

*****May include some basic intrusive rocks.*

******May include some intrusive quartz porphyry.*

SYMBOLS

- *Glacial striae.*
- *Drift features.*
- *Small rock outcrop.*
- *Boundary of rock outcrop.*
- *Geological boundary, defined.*
- *Geological boundary, approximate.*
- *Geological boundary, assumed.*
- *Geological boundary as indicated by geophysical data.*
- 65° *Strike and dip; direction of top unknown.*
- *Strike and vertical dip; direction of top unknown.*
- *Direction in which lava flows face as indicated by shape of pillows.*
- 55° *Strike and dip of schistosity.*
- *Strike of vertical schistosity.*
- *Strike of schistosity, dip unknown.*
- 75° *Strike and dip of gneissosity.*
- *Strike of vertical gneissosity.*
- *Horizontal gneissosity.*
- *Drag-folds.*
- *Fault, indicated or assumed.*
- qv 15′ *Quartz veins.*
- S *Sulphide mineralization.*
- Mo *Molybdenum.*
- ra *Radioactive mineral.*
- MA *Magnetic attraction.*
- *Muskeg or swamp.*
- R. F. *River, creek, stream, R = rapids; F = falls.*
- *Railway.*
- *Trail, portage, winter road.*
- *Building.*
- *District boundary. Approximate position.*
- *Surveyed line. Block boundary. Approximate position.*
- *Picket line.*

SOURCES OF INFORMATION

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Cartography by R. B. Robinson and P. E. Sorrell, Ontario Department of Mines, 1963.

Base map compiled from maps of the Forest Resources Inventory, Ontario Department of Lands and Forests, with additional information by D. P. Rogers, 1961.

The geology is not tied to surveyed lines.

Magnetic declination was approximately 1° E., 1961.

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Map 2044
Metionga Lake Area, West Half.

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