# The North Shore of Lake Superior

ONTARIO
DEPARTMENT OF MINES

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Cover: *The shore of Lake Superior from Old Woman Bay in Lake Superior Provincial Park. The high cliff marks the trace of the Red Rock River fault and is known as a fault scarp. An Ontario Department of Tourism and Information photograph.*

# GEOLOGY AND SCENERY

## NORTH SHORE OF LAKE SUPERIOR

*by E. G. Pye.*

Geological Guide Book No. 2

ONTARIO DEPARTMENT OF MINES

*Designed and produced by the staff of the Ontario Department of Mines/ Author: Dr. E. G. Pye./Photographs not otherwise credited: Dr. E. G. Pye, Dr. L. D. Ayres, L. C. Brown./Editing, layout, typography, general production: J. A. Haddon./Illustrations: C. Cashin./Maps: P. Wisbey./ Set in Baskerville with Optima headings and Goudy italic captions./ Lithographed in Ontario on Georgian offset.*

# PREFACE

In 1960, the last link of the Lake Superior section of the Trans-Canada Highway, between Marathon and Wawa, was completed. It became possible, for the first time, to drive by automobile completely around the largest of the Great Lakes. Because the north shore scenery is perhaps unrivalled in eastern Canada, the official opening of the highway by the Hon. Leslie M. Frost, Premier of the Province of Ontario, in Wawa on 17 September, 1960, heralded an unprecedented increase in the tourist industry of northwestern Ontario. Indirectly as a result of the increased tourism, there arose a demand for information on the region. This guide book was prepared to fill this need. Its first edition, classified as Geological Circular No. 10, proved so successful that it led to the introduction of guidebooks of other areas, issued in colour in a more convenient format.

The Ontario Department of Mines has undertaken the publication of these geological guidebooks in recognition of the interest of hobbyists and amateur geologists from all parts of Canada and the United States in rock and mineral collection. There is increasing awareness of our scenic attractions and the part geology has played in the development of the landscape. Many people, recognizing the great impact of the mineral industry on our national economy, have requested geological information to help them understand better the nature of our mineral resources. These guidebooks are intended to satisfy the needs of amateur geologists and to stimulate similar interests among the public generally.

The second edition, now classified as Geological Guidebook No. 2, has been expanded, revised and produced in the new format. It is divided into three parts. The first part of the guidebook is a resumé of the general geology of the region and is intended to provide general information concerning the relationships between the principal groups of rocks, and to give the reader a simplified account of the geological history. While written primarily for the novice, it is nevertheless presumed that the reader has some knowledge of rocks and minerals. In case of difficulty, however, there are many excellent textbooks on elementary geology and mineralogy available in most libraries and book stores.

The second part of the guidebook lists various points of geological interest along or close to the principal highways in the region. The locations and means of access are indicated, and descriptions and explanations of the salient features are given. Although only easily-reached sites with safe parking facilities nearby have been included, the reader is advised to use every precaution against possible traffic hazards.

The third part is for the attention of amateur mineralogists, lapidaries, and collectors, giving them information on localities where specimens may be obtained, lapidary clubs and shops, and public displays of rocks, minerals and ores; there is a brief and simplified glossary of the technical terms used in this book and a list of references to some of the extensive geological literature and maps of the area.


## ACKNOWLEDGEMENTS

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**PART 1**

# General Geology of the Lake Superior Region

*Through the study of rocks, their structures, their mutual relationships, and their contained fossils, geologists have succeeded in working out a reasonably complete and accurate history of the Earth, from the time the first rocks were formed until the present. They have divided the Earth's chronology into several eras, from the youngest to the oldest:*

*Cenozoic—the era of recent life, when mammals inherited the Earth and man made his appearance;*

*Mesozoic—the era of middle life, when the reptiles reached the zenith of their development;*

*Paleozoic—the era of old life, when invertebrate creatures dominated the scene, primitive fishes were evolved, and amphibians emerged from the sea;*

*Precambrian—the era of primitive life, which preceded the Cambrian, the oldest subdivision of the Paleozoic.*

*The rocks and unconsolidated rock materials found along the north shore of Lake Superior vary greatly in age and represent every major division of the Earth's history except the Mesozoic. The oldest rocks, and by far the most abundant, were formed in Precambrian time. Overlying the oldest rocks, in places along the east shore of Lake Superior, are small patches of sediments deposited by Paleozoic seas. Intermittently, throughout the whole region, the consolidated rocks are covered by gravels, sands, and clays laid down in the Cenozoic era, in the so-called Pleistocene epoch, when continental glaciers spread across the country.*

## TABLE OF PRECAMBRIAN FORMATIONS

| | |
|---|---|
| | Lipalean Erosion Interval |
| **PROTEROZOIC** | |
| KEWEENAWAN: | |
| INTRUSIVE IGNEOUS ROCKS: | *Diabase, quartz porphyry, syenite and related rocks* |
| OSLER GROUP: | *Basic lavas, volcanic tuff, conglomerate, sandstone* |
| SIBLEY GROUP: | *Conglomerate, sandstone, shale, carbonate rocks, volcanic tuff.* |
| ANIMIKIE: | |
| ROVE FORMATION: | *Shale, greywacke.* |
| GUNFLINT FORMATION: | *Shale, carbonate rocks, chert-carbonate rocks, chert, taconite, volcanic tuff.* |
| KAKABEKA FORMATION: | *Conglomerate.* |
| | Eparchean Erosion Interval |
| **ARCHEAN** | |
| ALGOMAN: | *Granite, syenite, diorite, quartz diorite, quartz and feldspar porphyries, pegmatite, and related rocks.* |
| PRE-ALGOMAN: | *Gabbro* |
| WINDIGOKAN OR TIMISKAMING | *Slate, greywacke, mica schist and gneiss, conglomerate, iron formation.* |
| LAURENTIAN: | *Granite and related rocks.* |
| KEEWATIN: | *Acid and basic lavas, volcanic tuff, volcanic breccia, iron formation, slate, greywacke.* |

# Precambrian Rocks

## AGE RELATIONSHIPS

The Lake Superior region lies within the Canadian Shield, an extremely large area underlain by ancient sedimentary, igneous, and metamorphic rocks formed in Precambrian time. The centre of this shield is Hudson Bay, and from here it stretches westward to the plains of Alberta, eastward to Greenland, and southward to, and in places beyond, the Great Lakes. It has an exposed area of about 2,000,000 square miles. Because, along much of its outer boundary, its surface slopes gently to form a platform on which all younger formations rest, it constitutes the nucleus or basement of the North American continent.

The Precambrian era was immensely long, and represents more than three-quarters of the length of the history of the Earth. It began with the formation of the oldest recognizable rocks; it ended, some 600,000,000 years ago, with the deposition of the earliest Paleozoic formations. Because of the scarcity of fossils in Precambrian rocks, because of their generally disturbed and metamorphosed condition, and because of lack of continuity of exposure, great difficulty has been experienced in classifying Precambrian rocks according to relative age. Indeed, it seems that the more detailed the geological work, the more complex the relationships become. Nevertheless, through a great deal of effort, a reasonably satisfactory classification has been accomplished; the Precambrian rocks found along the north shore of Lake Superior can be assigned readily to the several subdivisions indicated in the table opposite. In this table the youngest formations are represented at the top, and the oldest at the bottom, in the customary manner.

## ARCHEAN ROCKS

### THE PRE-ALGOMAN BASEMENT COMPLEX

The oldest formations found in the Canadian Shield are those of the Pre-Algoman basement complex. Along or close to the Lake Superior shoreline, this complex is made up largely of volcanic and sedimentary rocks. The volcanic rocks, the first to be considered, are chiefly lava flows. Two principal types occur, acid lavas and basic lavas.

#### *Volcanic Rocks*

Acid lavas, or rhyolites as they are called, are rich in silica and are similar to granite in composition, They are hard, fine-grained, greenish grey rocks. They are not very abundant along the north shore, or near the shoreline. Far more widespread are the basic lavas, which, in contra-distinction, are relatively poor in silica. These generally have been highly altered; because of the development of new minerals, such as green chlorite and amphibole, at

Photo 1. *An outcrop of greenstone showing well developed pillow structure, 1.7 miles west of the Steel River on highway No. 17 near Jackfish.*

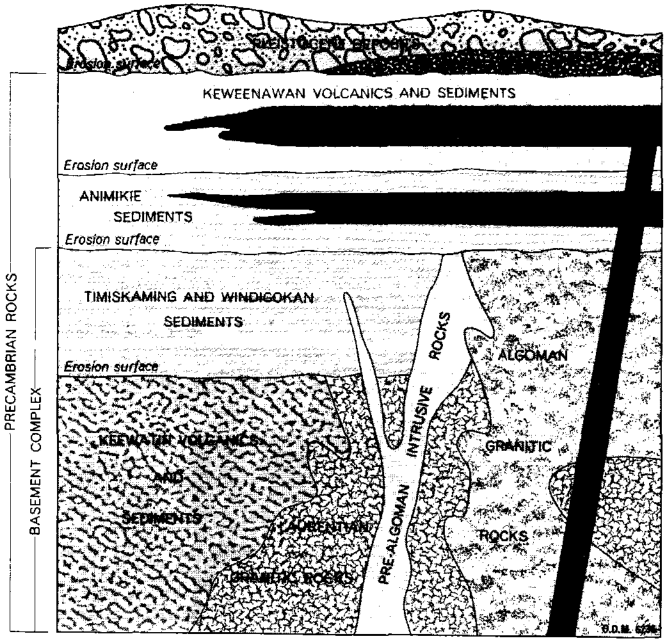



Figure 1. *A diagrammatic summary of Precambrian rock classification in the Lake Superior region.*

the expense of original constituents, they are dark greenish in appearance and are called greenstones in the field. Typical greenstones are found along highway No. 17 in several localities: north of Kakabeka Falls; in the vicinity of Schreiber; between Jackfish and Middleton; and between Kabenung Lake, 30 miles north of Wawa, and the Baldhead River, 31 miles south of Wawa.

It is of considerable interest that, despite the changes these rocks have undergone, original or primary structures are often found to have been preserved. Some greenstones are pillowed (photo 1) and are made up of piles of flattened, balloon-like, and irregular-shaped masses that are thought to have formed in lavas under water; other greenstones, for example, are amygdaloidal or spotted (photo 2), owing to the filling, by late-formed minerals, of tiny cavities resulting from the escape of contained gases when the lava was poured out on the surface. It is generally believed that the greenstones issued quietly from below, through fissures, and spread outward to form a thick, layered deposit, perhaps not unlike that of the Columbia Plateau in Oregon and Washington. The fissure eruptions, however, were punctuated at intervals by

Photo 2. *Details of one of the pillows in the greenstone illustrated in Photo 1. Note the amygdaloidal or spotted structure due to the filling of gas cavities by later forming minerals. The pocket knife is three inches long.*

explosive volcanism, when considerable quantities of ash and other ejectamenta accumulated on the pre-existing lava surface. As a result, it is common to find, interbanded with the greenstones, layers of consolidated volcanic dust called tuff, and layers of coarse, fragmental material called volcanic breccia. These rocks are particularly abundant near Wawa, where, in places, they form accumulations having thicknesses of hundreds of feet.

### *Sedimentary Rocks*

The principal sedimentary rocks of the basement complex are slate and greywacke. Slate, the metamorphic equivalent of an indurated mud or shale, is quite familiar. Greywacke is a variety of sandstone. It is characterized by an abundance of tiny angular fragments of rock and rock minerals and resulted from the sudden deposition of materials derived through the rapid erosion of pre-existing formations. Both rocks, the slate and greywacke, are usually intimately associated in large deposits, some of which rival the volcanics in thickness and prominence. They are exposed along highway No. 17 east of the Steel River in the Jackfish-Middleton area and again east of Marathon, between Hemlo and highway No. 614. Like the volcanics, they too have been altered or metamorphosed. Indeed, if it were not for their banded appearance, due to the original bedding or stratification, they would be difficult to distinguish from some of the other rocks in the field.

Associated with the slate and greywacke, in a few places, is conglomerate. Conglomerate is the hard, compacted equivalent of a gravel. It is not a particularly abundant rock. But because of the presence of pebbles, cobbles, and boulders, it is distinctive and easily recognized by the novice. The pebbles, cobbles, and boulders of much of the Pre-Algoman conglomerate consist of lava, tuff, slate, and greywacke, as might be anticipated. In the youngest conglomerate beds, however, they also consist of granite and related igneous rocks. Igneous rocks are those that have resulted from the crystallization of a hot natural melt or magma, generated at high temperatures deep within the Earth and subsequently thrust upward into overlying cover rocks. Because of this, and because the youngest sedimentary deposits are sometimes found to be inclined at an angle to the older basement formations, it is evident that the basement rocks must have been tilted, intruded by granite magma, and deeply eroded, before the new sediments were laid down. The granitic rocks formed at this time are known locally as Laurentian, (Figure 2). The youngest sedimentary rocks are accordingly distinguished and classified as Windigokan or Timiskaming; the old basement volcanic rocks and sedimentary rocks are classified as Keewatin. An example of Windigokan or Timiskaming conglomerate, with pebbles and cobbles of granitic rocks, can be seen along the south side of highway No. 17 at a point 2.4 miles east of the Marathon turnoff. Locally both the Keewatin and Timiskaming formations are intruded by small bodies of a basic igneous rock called gabbro. These Pre-Algoman gabbro bodies are difficult to distinguish from some coarse grained basic lavas.

One of the most conspicuous and important rocks found in Pre-Algoman sequences is iron formation. This rock consists largely of very fine-grained quartz or chert. Some of this quartz or chert contains little other material and is pale grey or even white. Much of it, however, may be coloured, owing to the presence of variable amounts of one or more of red or black hematite, black magnetite, and pale brown or grey siderite. All of these are iron-bearing minerals. Because they tend to be mutually exclusive and to be arranged in different layers, the iron formation is strikingly banded in appearance. Exposures of typical iron formation, with well defined layers of red chert (jasper), are found along both Brulé Creek and the Canadian National railway near Mokomon, about 6 miles north of Kakabeka Falls. As a general rule the rock is of too low-grade to be of any value. At Wawa, however, there are large masses of siderite associated with banded, silica-rich iron formation. Because siderite can be roasted or sintered to yield a product suitable for use in the blast furnace, these masses constitute workable orebodies, of great economic significance to this part of Ontario.

## ALGOMAN ROCKS

The term Algoman has been applied to a system of igneous rocks that intrude the basement volcanic rocks and sedimentary rocks. The igneous rocks are of considerable variety. They include: syenite, found at Rainbow Falls Provincial Park; diorite, exposed between Fungus and Kabenung lakes south of White River; feldspar porphyry found at Rossport Provincial Camp Grounds and at Sand River; and quartz porphyry, which is exposed at Michipicoten Falls near Wawa. The most abundant and widespread igneous rocks, however, are granites. Granites can be observed along highway No. 17 at several convenient places: the Red Rock cuesta; the Cavers Hill scenic lookout, 11 miles west of Rossport; White River, Marion Lake, and Hammer Lake parks in the White River region; the Agawa Bay scenic lookout; and Hiawatha Park near Sault Ste. Marie. Like granites found elsewhere, these are typically pale pink or greyish rocks made up principally of the minerals quartz, feldspar, and mica or hornblende. In some localities, they are quite massive in appearance; in others they are gneissic due to the parallel alignment of the dark minerals present. Some granites are free of other materials; others contain abundant inclusions of highly altered pre-existing rocks. The variety of granites is indeed surprising. Much more impressive is the extent of the areas throughout which they are exposed; the conclusion that they make up extremely large masses or batholiths is inescapable. The volcanic and sedimentary rocks originally bordering the granites were formed with horizontal or near-horizontal attitudes. In rockcuts along the highway they are standing vertically or are inclined at very steep angles. It is at once apparent that the development of the great granite batholiths was accompanied by intense compression in the Earth's crust that resulted in large-scale folding, creating mountainous ridges, perhaps as high as any found today in western North America. This period of extensive development of granite batholiths and of great crustal disturbance is spoken of as the Algoman or Kenoran revolution, (Figure 3).

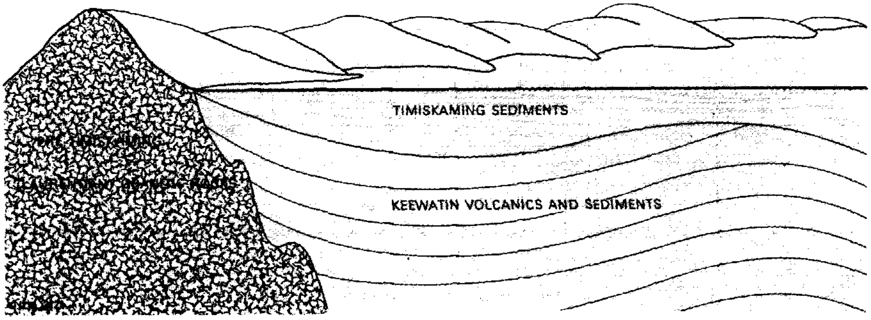
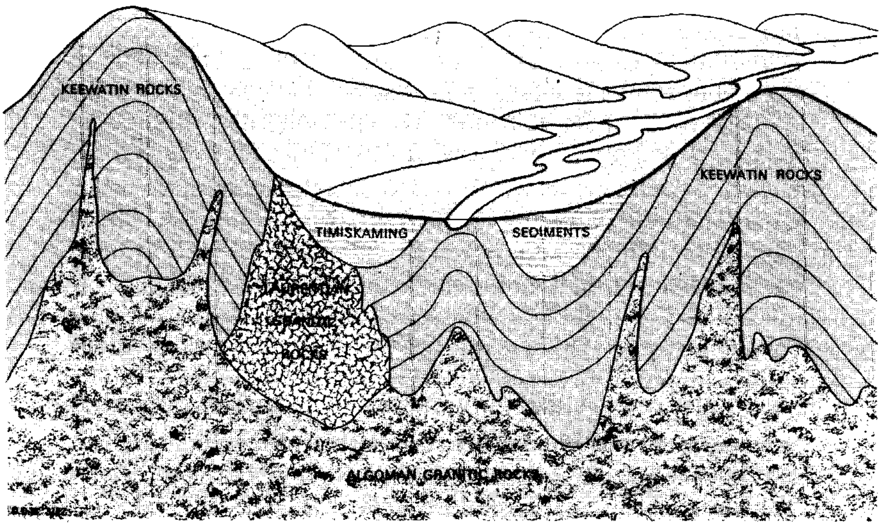



Figure 2. *A diagram illustrating the supposed relationships between the Keewatin rocks and the overlying younger Timiskaming or Windigokan sediments.*

Figure 3. *A diagram illustrating the supposed relationships between the various Archean rock groups at the close of the Kenoran revolution.*



## THE KENORAN REVOLUTION

The Kenoran revolution was of great importance to the Lake Superior region, for at this time in the long history of the Canadian Shield a large number of mineral deposits were formed. Genetically related to the granitic rocks, but usually found in basement volcanic rocks or sedimentary rocks, are large orebodies containing significant amounts of one or more of copper, zinc, and lead, often with a little silver. Examples include the mines at Manitouwadge (at the north end of highway No. 614, which branches from highway No. 17 at a point 27 miles east of Marathon); and a copper mine near Kashabowie (on highway No. 11 about 68 miles west of the Lakehead described in Geological Guidebook No. 1). Also found are pegmatite deposits. Pegmatite is an igneous rock similar to granite in composition, but is very coarse-textured, with crystals commonly several inches, often a foot or more, across. It is a host for certain valuable substances. In places in the region there are small, crudely tabular-shaped bodies of pegmatite containing ore minerals of beryllium, molybdenum, or lithium. Important lithium-bearing pegmatites are found north of Nipigon, particularly in the area east of highway No. 11. In addition to the base metal and pegmatite deposits, gold-quartz veins are also found. Valuable gold-quartz veins were first discovered in the Lake Superior region in 1897, near Jackfish east of Terrace Bay and at Wawa. Numerous "finds" have been made since then, and important mines have been brought into production in the vicinity of Schreiber, in the area between Beardmore and Geraldton along and close to highway No. 11, in the Michipicoten area, and in other localities. From 1897 to the end of 1967, the mines of the Algoma and Thunder Bay districts bordering Lake Superior have yielded 4,161,031 ounces of gold, and 502,913 ounces of silver recovered as a byproduct, having a gross value of $151,514,735. The locations of all major mines and mineral occurrences in Ontario with much statistical data on its mineral industry are shown on the Ontario Mineral Map, available from Ontario Department of Mines offices.

In recent years, great use has been made of radioactive dating techniques in establishing the ages of rocks. The results of the work done in northwestern Ontario, and the adjoining state of Minnesota, indicate that the period, during which the basement volcanic rocks and sedimentary rocks were folded and the granitic and related igneous rocks were developed, may have been about 200,000,000 years, and occurred roughly 2,500,000,000 years ago.

## THE EPARCHEAN INTERVAL

After their formation, the Algoman mountains were subjected to weathering and rapid erosion. Over an immense span of time, called the Eparchean interval, they were gradually worn down, and the countryside became a vast plain similar, perhaps, to that found inland from Lake Superior at the present time, as along highway No. 17, between Marathon and Wawa, (Figure 4). We have learned that the Algoman granite batholiths were formed at considerable depths below the surface. Because of the removal of a great thickness of ancient cover-rocks, these batholiths, once at the roots of the Algoman mountains, were exposed to view. Most of the rocks that are exposed in the Lake Superior region are granitic; the older basement volcanic rocks and sedimentary rocks occur merely as small, irregular-shaped, and widely separated remnants, resembling islands in a vast granitic sea.

The Eparchean interval of erosion has been estimated to have had a duration of about 200,000,000 years, or even more. It separates two major divisions of Precambrian time: the Archean, when the Algoman and the older basement rocks were formed; and the Proterozic, when the Huronian, Animikie and Keweenawan rocks were formed, (Figure 5).

There is substantial evidence that after the Eparchean interval the vast area north of the Great Lakes was inundated by the sea and some parts were subjected to glacial action, with the result that various types of sedimentary rocks were laid down, some in very great thicknesses.

These post Archean sediments were first recognized a century ago north of Lake Huron and were named Huronian. The sediments north of Lake Superior have some characteristics of the typical Huronian rocks and in fact most of them at some time have been classified as Huronian. However, the area north of the Great Lakes is so large that it is difficult to credit that sediments of similar characteristics laid down five hundred miles apart were necessarily deposited at the same point in time. Events would have had to have coincided on a gigantic regional scale. In point of fact, it is generally believed from evidence found in the United States that the rocks found along the north shore of Lake Superior are younger than the typical Huronian rocks found east of Sault Ste. Marie. Geologists generally now classify the Lake Superior sedimentary rocks as Animikie. This guidebook deals mostly with the Animikie.

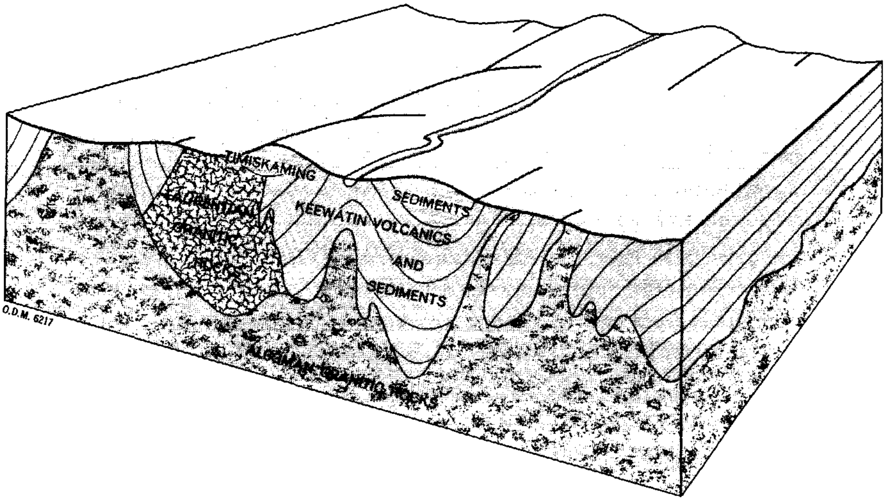
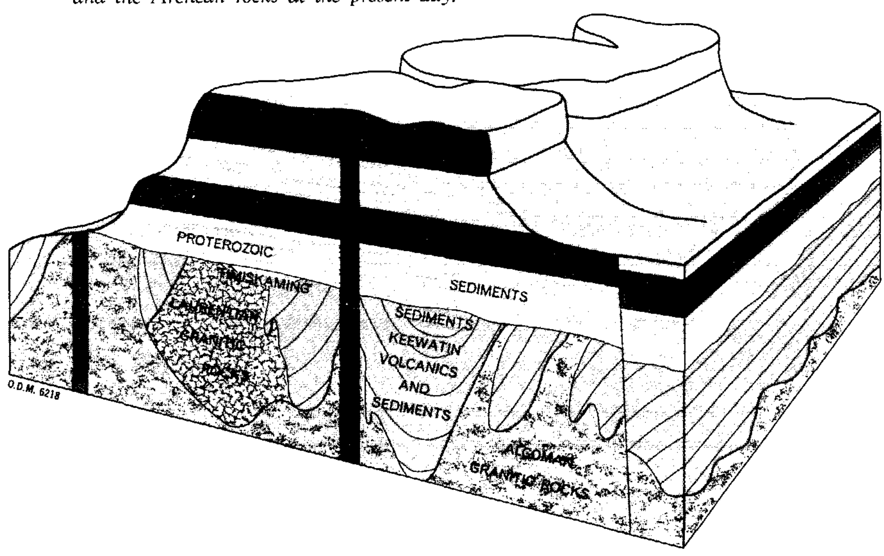



Figure 4. *A diagram showing the peneplaned surface of the Archean rocks at the close of the Eparchean interval.*

Figure 5. *A diagram illustrating the relationships between the Proterozoic rocks and the Archean rocks at the present day.*



# PROTEROZOIC ROCKS

## ANIMIKIE ROCKS

After the planation of the Algoman mountains, an inland sea spread across the Lake Superior region, and a considerable thickness of sediments, classified as Animikie, were laid down on the eroded granitic and basement rocks. These sedimentary rocks have been divided into three parts, which, from oldest to youngest are referred to by the names Kakabeka, Gunflint, and Rove.

### *Kakabeka Formation*

Kakabeka Formation is a conglomerate. This is the hard compacted equivalent of a gravel and consists of small pebbles of quartz, chert, jasper, granite, and greenstone, usually in a coarse sandy matrix. Its thickness ranges from a few inches to 4 feet. It is horizontal or nearly so, and rests directly on granite or greenstone. Typical exposures may be observed: at the bottom, and near the south end, of the outcrop located at the junction of highways No. 17-11 and No. 590 at Kakabeka Falls; and in the bed of the Whitefish River, near the bridge, along highway No. 588, about 1.8 miles west of Nolalu.

Photo 3. *A thin erosional remnant of chert at the north end of Boulevard Lake, Port Arthur. The circular markings have been attributed to the action of algae in Proterozoic time.*

### *Gunflint Formation*

The Gunflint sedimentary rocks, which overlie the Kakabeka conglomerate, are exposed in various localities near Port Arthur and extend from there north-eastward for about 25 miles to Loon Lake, and southwestward across the international boundary into Minnesota. A large number of these rocks are fairly rich in iron. In Canada they have not been found to be sufficiently high-grade to justify mining, and the iron does not occur in an economically concentratable form; but in Minnesota they form the rich ore-bodies of the famous Mesabi Range.

The Gunflint sedimentary rocks that are exposed at and near the Lakehead are of considerable variety, and include shale, tuff, carbonate rocks, chert-carbonates, and taconite. Black, thin-bedded shale is exposed in the gorge of the Kaministikwia River below Kakabeka Falls and here attains a thickness of 125 feet or more. Consolidated volcanic debris, or tuff, resulting from explosive volcanism, is interbedded with these shales near the bottom of the gorge, and one prominent bed is found upstream beneath the highway bridge. The carbonate rocks are layered sediments in which the beds consist of such carbonate minerals as calcite, dolomite, and siderite. Siderite is an iron-bearing substance. On exposure to the atmosphere, it weathers to form a hydrous iron oxide, a brown mineral called limonite; where it is present, the surface of the rock is distinctly rusty. Typical carbonate rocks are exposed in Port Arthur at Hillcrest Park and at Boulevard Lake

Photo 4. *Bedded chert-carbonate rock at Trowbridge Falls Park, Port Arthur. The carbonate layers are light and the chert layers are dark.*

Photo 5. *The Current River below Black Bay Bridge, Boulevard Lake Park. (Courtesy Ont. Dept. Tourism & Information).*

Park. At Boulevard Lake Park they contain lenses and occasional thin layers of chert. In places, such chert layers are numerous and closely spaced, and the carbonate rocks become strongly banded in appearance, forming chert-carbonates (photo 4). Chert-carbonates are found at: Kakabeka Falls, where they lie upon the shales; Trowbridge Falls Park; and Blende Creek. Taconite occurs along the bed of the McIntyre River in Port Arthur, and at Boulevard Lake Park. It is a peculiar sedimentary rock made up, not of sand grains, but rather, of tiny rounded bodies or granules of iron-bearing minerals and some chert. Because of its high iron content, it is the most important member of the Gunflint formation, and provides an economic source of iron in Minnesota.

Associated with the taconite in places are lenses and layers of oolitic and algal cherts. Both are found in Boulevard Lake Park, and particularly fine exposures can be examined in the bed of the Whitefish River 1.8 miles west of Nolalu. Oolitic cherts contain small, rounded bodies called oolites. Oolites are much like the granules of the taconite, but are characterized by radial or concentric structures or both. They are generally less than ⅛ inch in diameter, and collectively resemble the roe of fish. Algal cherts are cherts made up of cabbage-like, biscuit-like, and irregular bodies having peculiar concentric markings (photo 3). They are thought, by most geologists who have studied them, to have been formed through the action of primitive plants in Proterozoic time.

Photo 6. *Gently dipping Rove shales in the gorge of the Pigeon River along the Canadian-United States border.*

### *Rove Formation*

The Rove Formation overlies the Gunflint and, in one place, is known to exceed 1,200 feet in thickness. It is found in a number of localities between Pigeon River and Loon Lake, along or close to highways No. 61 and No. 17-11; it can be studied most conveniently at Middle Falls, High Falls, and Riverdale Road quarry, Mount McKay, and on Sibley Peninsula. The Rove sedimentary rocks are largely shales; they are thin-bedded, dark-coloured, and fissile rocks indistinguishable from the shales in the older Gunflint Formation. Associated with them are relatively thick massive layers of siltstone and greywacke; in the Riverdale Road quarry and at the north end of Sibley Peninsula, they contain large concretions (photo 17). Like the rocks of the Gunflint Formation, they are flat-lying or slope gently to the southeast (photo 6).

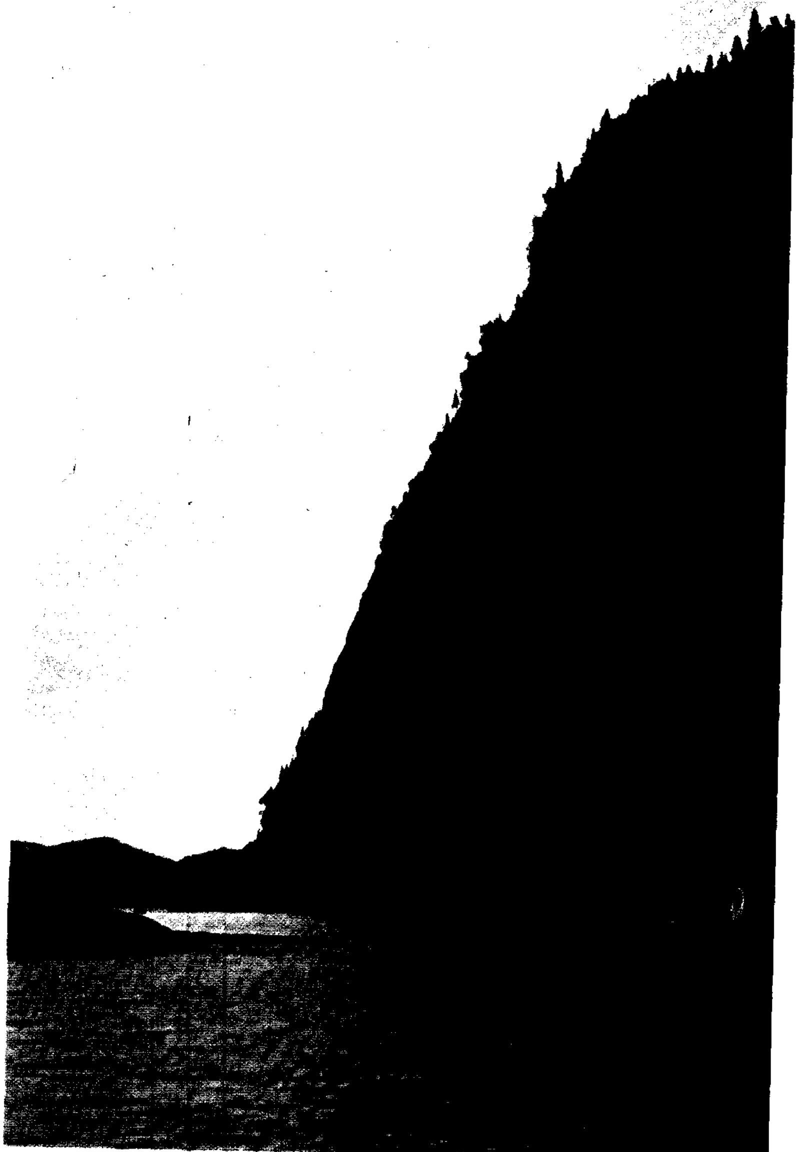


Photo 7. *In Lake Superior Provincial Park, south of Michipicoten.* (*Courtesy Ont. Dept. Tourism & Information*).

## KEWEENAWAN ROCKS

Rocks classified as Keweenawan are found intermittently throughout the whole of the Lake Superior region. They are of three principal types: sedimentary rocks, which have been called Sibley from their prominence on the peninsula of that name; volcanic rocks, called either Osler, from an occurrence at Osler Bay on the west side of Edward Island, or Mamainse from exposures about Mamainse Point; and intrusive igneous rocks.

### *Sedimentary Rocks*

The Sibley sedimentary rocks, like the older Animikie strata, are flat-lying or gently sloping. The Animikie rocks, however, must have suffered considerable erosion before sedimentation was renewed in Sibley time, for the Sibley rocks in various places are found in contact with the Rove Formation, with different members of the Gunflint Formation, and even with Algoman granitic rocks. The Sibley sedimentary rocks are several hundred feet thick. At the bottom of the deposit there is conglomerate. This is reddish coloured and consists of pebbles and boulders of Animikie, Algoman, and older rocks, in a sandy matrix. Typical exposures occur along the West Loon road about 1 mile west of Loon Lake station on the Canadian Pacific railway. Overlying the conglomerate is about 100 feet of white quartz sandstone, and this is succeeded upward by reddish shales and shaly impure carbonate

Photo 8. *Escarpment formed by thick bedded light coloured quartz sandstone along the north shore of Pass Lake, Sibley Peninsula.*

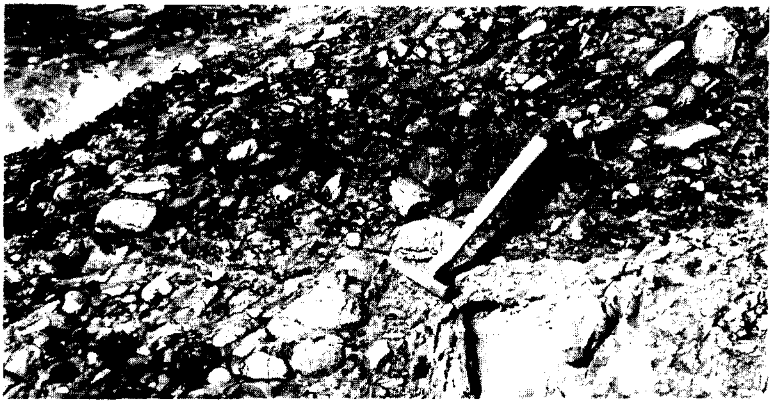


Photo 9. *Conglomerate near the old Mamainse mine along the shore of Lake Superior, north of Sault Ste. Marie.*

rocks (dolomites and dolomitic limestones). Prominent cliffs of quartz sandstone occur on Sibley Peninsula, (photo 8) at Pass Lake, and along the east shore of Thunder Bay; the carbonate rocks, with layers of sandstone, are most accessible in the Red Rock cuesta and along highway No. 17 at Mozakama Bay. It is probable that the quartz sandstones were deposited in shallow waters along the margins of an inland sea. The red colour of the carbonate rocks, however, is due to the presence of earthy or ocherous hematite, which is thought to have formed from hydrous iron oxides by exposure to the atmosphere and the drying action of the sun. Indeed, typical red beds have been found to exhibit preserved mud or dessication cracks. It would thus appear likely that the red shales and impure carbonate rocks originally were laid down by streams as flood-plain detritus under conditions of seasonal rainfall.

### *Volcanic Rocks and the Origin of the L. Superior Basin*

The Keweenawan volcanic rocks, together with some interbanded conglomerate (photo 9) and sandstone, are found in several localities in the Lake Superior region. They are exposed: on the large peninsula separating Black and Nipigon bays and on the islands between this peninsula and Schreiber; on Michipicoten Island; at intervals along the shoreline near Sault Ste. Marie and northward for 65 miles to Mica Bay; and in the states of Michigan and Minnesota in the United States. They can be examined most conveniently at the Mamainse mine.

They are principally lava flows, of basic or basaltic composition, and many, perhaps most, of them are amygdaloidal. These amygdaloidal lavas are of considerable interest to mineralogists; filling the vesicles or gas cavities are such minerals as agate, calcite, chlorite, datolite, epidote, prehnite, thomsonite, and zeolites. Also found in these rocks, and in the associated sedimentary rocks, is native copper; in Michigan, on Keweenaw Peninsula, there are deposits which, since mining was started in 1847, have supported 100 mining companies that have paid dividends approaching $350,000,000.

The Keweenawan volcanic rocks and associated sedimentary rocks, exposed on Lake Superior islands, have been estimated to have an aggregate thickness of 6,000–10,000 feet; those at Mamainse Point, about 12,000 feet; those in Michigan, about 20,000 feet; and those in Minnesota, between Duluth and Tofte, about 25,000 feet. The immense volume of lava represented by these deposits generally has been assumed to have originated at great depth beneath the area now occupied by Lake Superior. In this regard it is significant that the volcanic rocks, almost without exception, slope or dip from the shore inward under the lake. They thus form a large structural basin or trough, and the suggestion has been advanced that the development of this basin was the result of foundering, upon the withdrawal of the magma that poured out at the surface as basic lava flows.

### *Intrusive Igneous Rocks*

At the time of, and later than, the extrusion of the Keweenawan lava flows and the development of the Lake Superior basin, the crustal rocks were intruded by large bodies of basic magma, which crystallized to form the dark igneous rock called diabase. Two principal types of diabase bodies were formed: dikes, and sills. Both are tabular-shaped. The dikes cut obliquely or transversely across the older rocks, and in general stand vertically or at steep angles; the sills were injected parallel to the older rocks, and in most places are flat or slope gently. Diabase dikes, up to about 650 feet thick, form high northeast-trending ridges in the area crossed by highway No. 61, north of the Pigeon River. They are also conspicuous where, in the vicinity of White River, they cut sharply through Algoman granitic rocks, and where, at and near Montreal River Harbour they have been gouged out by erosion to form deep, steep-walled canyons.

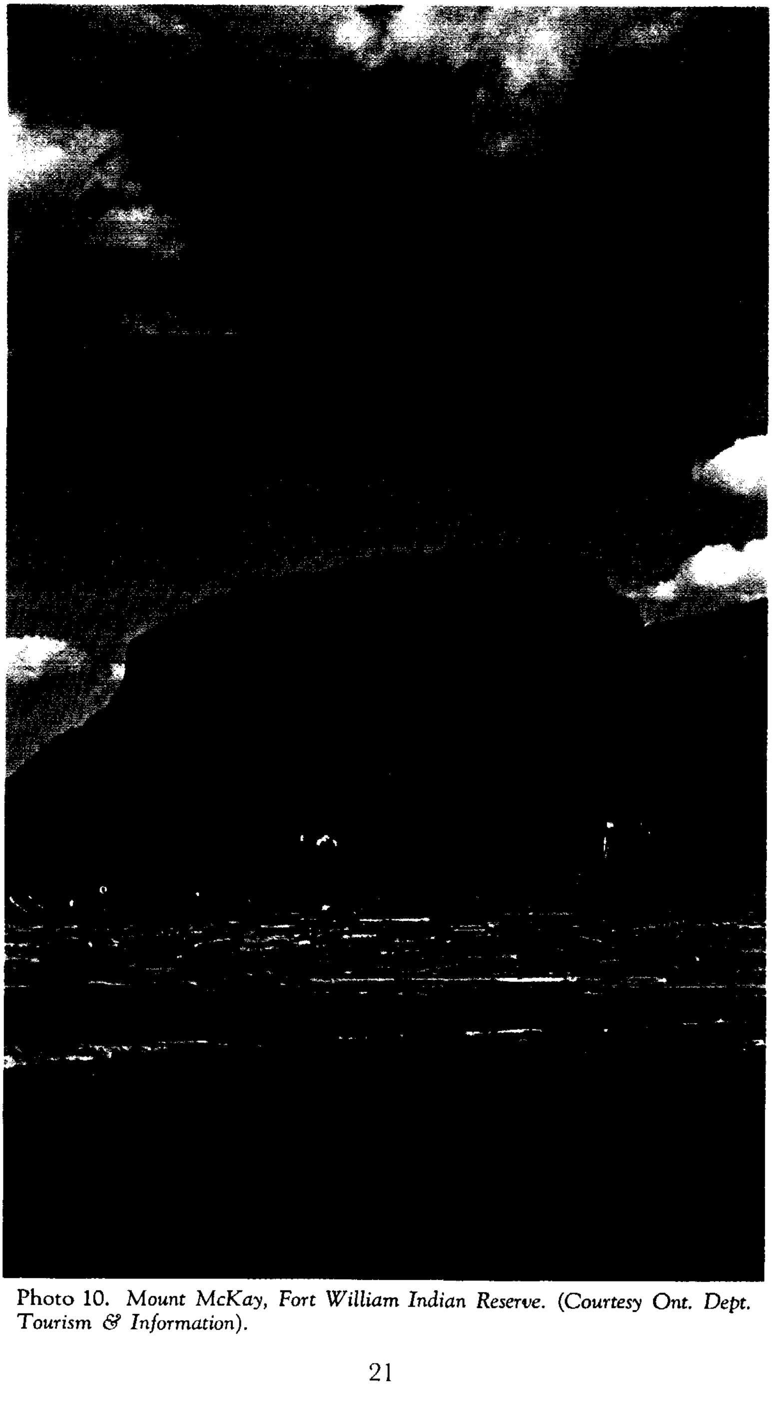
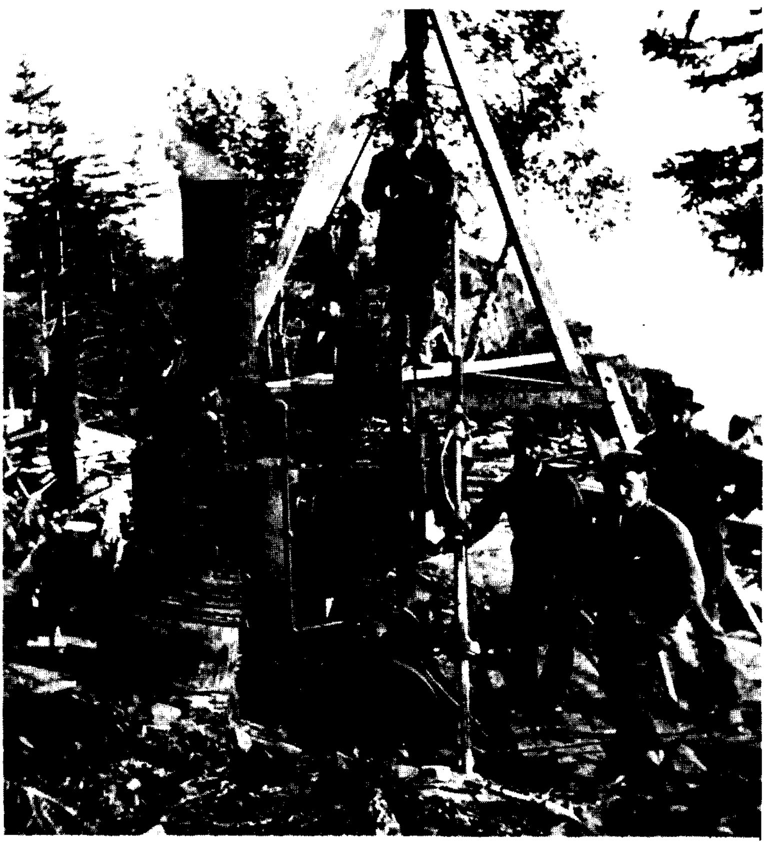


Photo 10. *Mount McKay, Fort William Indian Reserve.* (*Courtesy Ont. Dept. Tourism & Information*).

The diabase sills, called Logan sills after Sir William Logan who first described them, are even more prominent. They were formed by the injection of basic magma, perhaps laterally outward from feeder dikes, along the bedding of the Animikie and Sibley strata. Unlike the sedimentary rocks, they are highly resistant to erosion, and they form the dark rocks capping many of the high hills in the western part of the Lake Superior region. A 200-foot-thick sill forms the uppermost parts of Mount McKay (photo 10), Pie Island, and the Sleeping Giant; others occur at Red Rock, and Mozakama Bay; a huge sill, about 600 feet thick, is found north of Nipigon. Most of the sills are broken by vertical cracks or joints and, as a result, their outcrops are commonly

Photo 11. *A drilling rig and crew at Silver Islet a hundred years ago. Silver Islet became Ontario's first major producing mine.*



bounded by sheer cliffs, thus providing northwestern Ontario with some of its most magnificent scenery. Possibly related to the diabase sills, and occurring in the vicinity of Coldwell, is a large mass of igneous rocks called syenites. Age determinations made on the contained minerals indicate that the rocks were formed about 1,100,000,000 years ago.

### *Mineral Deposits*

As in the Algoman period of igneous activity, numerous mineral deposits were formed in Ontario in Keweenawan time. Copper deposits of Keweenawan age have been found near Mamainse Point; uranium deposits have been found near Montreal River Harbour; lead-zinc deposits occur north of the Lakehead in Dorion and McTavish townships; a large barite deposit occurs on McKellar Island; important silver orebodies have been mined at Silver Islet (photo 11) and in the general vicinity of the Lakehead. The total production of the silver mines, from 1869 to 1922, had a gross value of $4,780,000.

## THE LIPALEAN INTERVAL

After the development of the Lake Superior basin, and the large-scale intrusion of the crust by diabase and related igneous rocks, the Keweenawan period came to an end. Then began a long interval of erosion, called the Lipalean interval. Like the Eparchean interval that preceded it at the close of the Algoman period, the Lipalean interval lasted for hundreds of millions of years. It marked the close of the Precambrian era of geological history.

# Paleozoic Rocks

The Lipalean interval was terminated by the deposition of the oldest rocks of the Paleozoic era—the era of old life, when invertibrate creatures dominated the scene, primitive fishes evolved and amphibians emerged from the sea. In this region there are large areas where there are no Paleozoic rocks, possibly because the land stood high and dry above the Paleozoic seas. In such areas it may be assumed that the long period of erosion continued until the continental glaciation of the Pleistocene epoch deposited its tills and clays about 1,000,000 years ago. This period of erosion may well have lasted a billion years.

However, at Mica Bay and at intervals along the Lake Superior shoreline from Mica Bay to Sault Ste. Marie, there are exposures of a flat to gently folded formation that rests on weathered Algoman granitic rocks and on the eroded, upturned edges of tilted Keweenawan lava flows. This formation forms part of what is commonly called the Lake Superior Sandstone (photo 12).

## CAMBRIAN ROCKS

### *Lake Superior Sandstone*

At the base of the Lake Superior Sandstone usually there is found a thin deposit of conglomerate with large angular boulders of the underlying granite and, in places, fragments of basic lava and other rocks that formed in Late Precambrian or Proterozoic time. This is overlain by grey and reddish sandstones and shales. These locally exhibit preserved structures such as ripple marks and cross-lamination (photo 79) made by current action, and are, doubtlessly, water-laid deposits. Lake Superior Sandstone has been correlated with Potsdam Sandstone that is exposed in Michigan. Potsdam Sandstone is considered to have been formed in the Cambrian period, the oldest subdivision of the Paleozoic era. Age determinations of rocks classified as Cambrian indicate this period of Earth history occurred 500,000,000—600,000,000 years ago.

Photo 12. *Lake Superior Sandstone at Mica Bay, north of Sault Ste. Marie.*

# Pleistocene Deposits

## GLACIAL ACTION

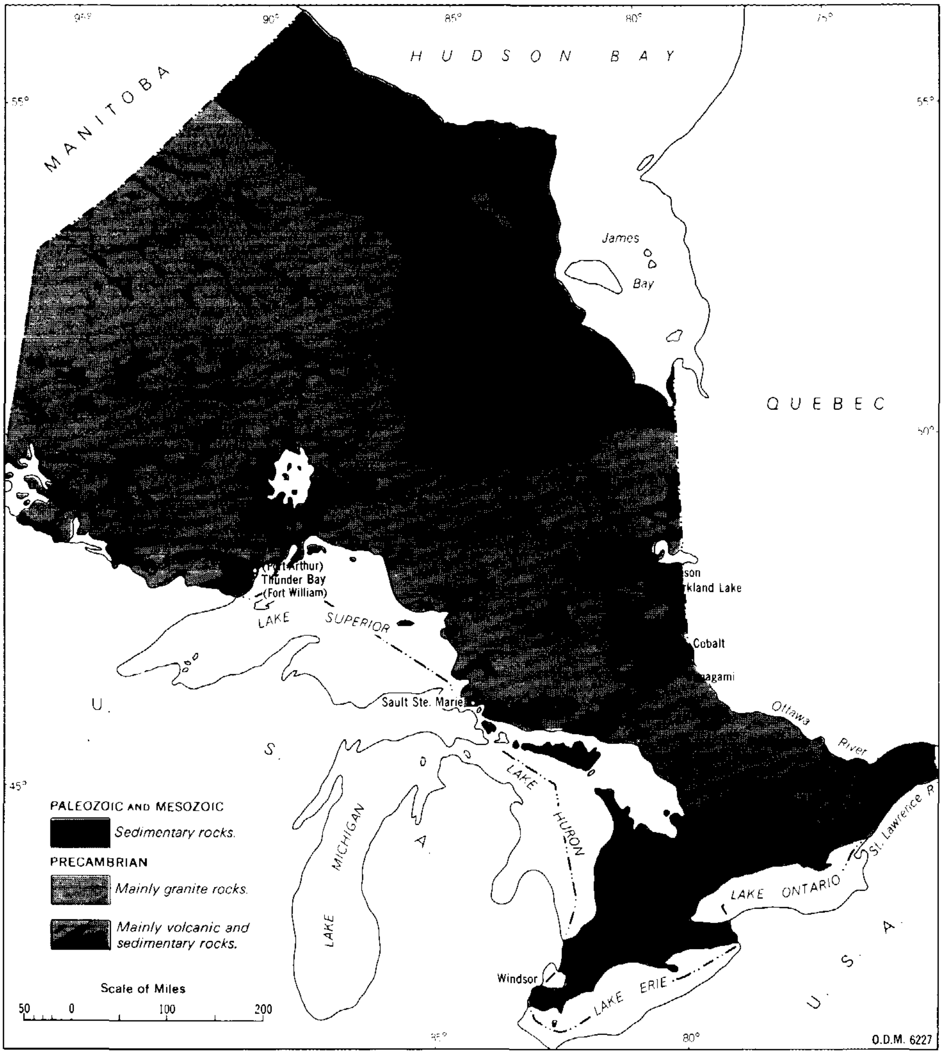
About 1,000,000 years ago, at the start of the so-called Pleistocene epoch, large parts of the Earth became colder and continental glaciers were formed. One of these gigantic glaciers, perhaps several thousands of feet thick, spread across the Lake Superior region. It advanced in a general southwesterly direction and, in doing so, it profoundly modified the existing topography. The bedrock was stripped of a weathered mantle that had been accumulating on the surface since Precambrian time. The surface was grooved and scratched (photo 48) and in other places was smoothed and polished. Elevated areas in general were severely abraded. At the same time, old river valleys that happened to be parallel to the direction of ice movement were gouged and deepened.

Eventually, towards the close of Pleistocene time when the climate warmed, and the ice wasted away by melting, the loose debris or moraine, largely a mixture of boulders, sand, and clay, which had been picked up by the advancing ice sheet, was dumped helter-skelter as glacial till. Complete disorganization of the pre-existing drainage system was effected; an intricate pattern of innumerable lakes; either large with indented shorelines, or long and narrow connected by short rapid rivers and spillways, characterized the new landscape.

During the northward retreat of the ice sheet, the glacial meltwaters were ponded in the Superior basin, forming a succession of lakes. The first of these lakes was much larger and deeper than the present lake, and was drained by an outlet through the valley of the present St. Croix River separating parts of Minnesota and Wisconsin. The lake water was held in by glacial ice.

As the ice melted away, and the glacial front receded, the land surface was exposed and, at the same time new drainage patterns were developed. Water-levels in the Lake Superior basin were changed accordingly. With the lowering of water levels, old shorelines became abandoned, more recent lake deposits became exposed progressively to view, and new shorelines were established. This produced a succession of terraces and abandoned beaches, separated from one another by rather abrupt escarpments or shore cliffs due to wave erosion. Flat terraces, made up of such lake deposits as gravel, sand, and clay, are found at numerous localities around the present Lake Superior shoreline. They are particularly prominent at the Lakehead (photo 13), Nipigon, Terrace Bay, Marathon, Wawa, and Sault Ste. Marie. Aside from detritus being laid down by rivers and streams, and beds of peat being formed by decaying vegetation in swamps, they constitute the youngest deposits in the region.

Photo 13. *An abandoned beach at Current River Park, Port Arthur. The steep embankment separating the playground from the upper terrace marks the position of a former shore line when the waters in the Lake Superior basin stood higher.*




Map A. *The generalised geology of Ontario.*

**PART 2**

# Points of Interest

# Pigeon River to the Canadian Lakehead

## PIGEON RIVER (CUSTOMS OFFICE)

At this locality where highway No. 16 crosses the Pigeon River, the topography is relatively flat and the river has cut a meandering channel in silt, sand and gravel deposits of glacial lake origin. The deposits were probably laid down at the mouth of the Pigeon River when thousands of years ago the level of Lake Superior stood much higher. No bedrock is exposed here but half a mile upstream the river emerges from a gorge in the dark-grey, thin-bedded, fissile shales of the Rove Formation. They are soft and easily eroded, and the Pigeon River, flowing rapidly to Lake Superior, has cut deeply into them to form a prominent gorge.

The Pigeon River drops about 300 feet in its last ten miles before entering Lake Superior. Rapids are numerous, and there are three waterfalls. The most westerly falls, Horne Falls, lies about 4 miles west of the bridge; the most easterly, High Falls, ½ mile west. The third occurs roughly midway between the others, and has been appropriately named Middle Falls although on many maps it is shown as Little Falls. At its site the Ontario Department of Lands and Forests has developed a beautiful park with facilities for picnicking, camping, and swimming.

## HIGHWAY NO. 61: HIGH FALLS

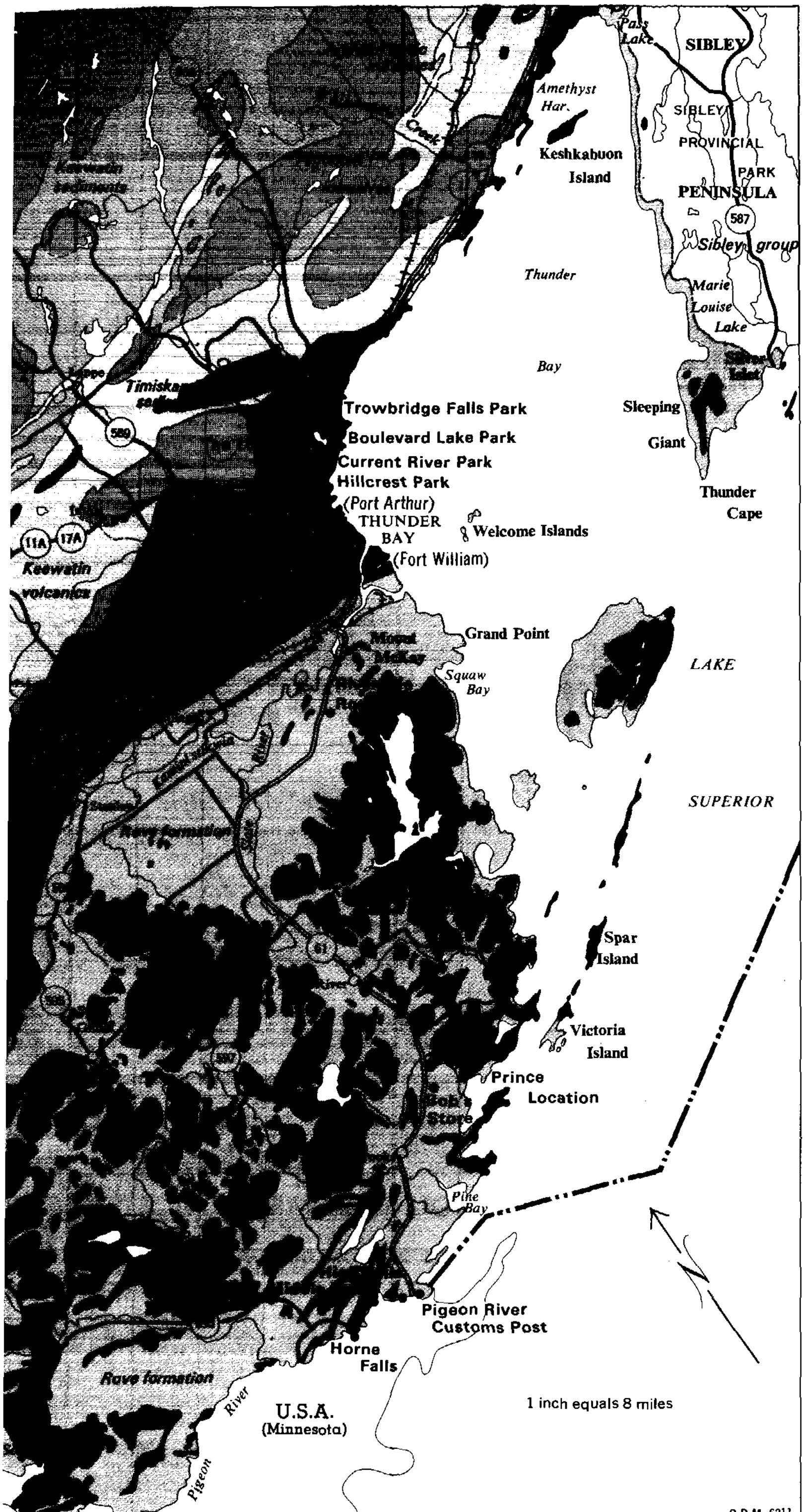
High Falls, or Pigeon Falls as it is sometimes called, lies about five eighths of a mile upstream from the Pigeon River Customs Office. Access to the falls is by the first dirt road north of the river running west from highway No. 61. High Falls (photo 14) is one of the most impressive physiographic features in the Pigeon River region, and the tourist is well advised to include it on his itinerary.

Photo 14. *High Falls occurs where the Pigeon River flows over a resistant vertical diabase dike. The river has cut into the relatively soft Rove sedimentary rocks, forming a narrow steep-walled gorge downstream from the falls. The diabase dike forms the cliff face.* (Courtesy Ont. *Dept. Tourism & Information*).

Below the falls, the Pigeon River flows through a narrow, steep-walled gorge, that has been cut into gently sloping sedimentary rocks (shales and greywackes) of the Rove Formation. It has already been emphasized that these rocks are easily eroded, and one would naturally expect the gorge to persist upstream for a considerable distance. This is not the case, however, for the sedimentary rocks are cut by a prominent diabase dike. This dike trends northeast. It is perpendicular and, having resisted erosion, stands up as a 90-foot cliff, abruptly terminating the gorge upstream. This cliff forms the face of High Falls.

## MIDDLE FALLS PARK

Access to Middle Falls Park is by turning west on highway No. 593. Highway 593 meets Highway 61 some two miles north of the bridge. At the Middle Falls Park there are two features of geological interest: the rock outcrop along the highway, towering above the entrance to the park, and the falls themselves. The outcrop along the highway is made up largely of flat-lying, dark-coloured Rove shales.




Map B. *The International Boundary at Pigeon River to the Canadian Lakehead.*

At its top, this assemblage of sedimentary rocks is capped by a sheet or sill of diabase, made conspicuous by its rusty-weathered surface. A second diabase sill, not more than 4 feet thick, lies below and is separated from the first by about 20 feet of shales. The shales and the two diabase sills have been dislocated by faults. These slope or dip steeply north, and they are normal faults along which the upper sides have moved downward. Cutting across both the shales and the diabase sills are three diabase dikes that extend northwest across the region. They are vertical, or nearly so, in attitude and, being more resistant to erosion than the enclosing shales, they form promontories extending outward from the cliff face, one about midway along the outcrop, and one at each end. The diabase dike at the south end of the outcrop can be traced across the highway to the river. It is a hard, resistant rock, and it stands up as a vertical escarpment over which the waters of the river tumble to form the beautiful Middle Falls (photo 15).

Photo 15. *Middle Falls, like High Falls, also occurs where the Pigeon River flows over a resistant vertical diabase dike cutting Rove sedimentary rocks. (Courtesy Ont. Dept. Tourism & Information).*

## MIDDLE FALLS TO BOB'S STORE

In the region crossed by highway No. 61, from High Falls northeast for 11½ miles to Bob's Store, the terrain is characterized by high ridges separated by deep linear valleys. The valleys are largely filled with unconsolidated deposits of till, sand, silt, and clay; except in the few places where quarry operations have exposed Rove sedimentary rocks, bedrock outcrops are scarce. The ridges, some of which rise almost 300 feet above the highway, are the topographic expressions of northeast-trending, perpendicular diabase dikes. The highway extends 3½ miles northeast of the park along the side of one of these dikes, runs north for about 2½ miles, crossing at least four dikes, and follows another dike to Bob's Store. Parallel diabase ridges, separated by deep intermontane valleys, are conspicuous from Memory Lodge on Pine Bay, one of the most picturesque bays along this portion of the Lake Superior shoreline. Their prominence, as a topographic feature of the region, is evident in air photographs (photo 16).

## BOB'S STORE TO THE CANADIAN LAKEHEAD

Between Bob's Store and the Canadian Lakehead the terrain is again characterized by high hills and deep, broad valleys. The hills, however, are not linear ridges, but rather cuestas and mesas. Cuestas occur where the bedrock is inclined; they slope gently upward from the lowlands and terminate abruptly in vertical escarpments. Mesas occur where the bedrock is horizontal; they have flat upper surfaces and are bounded on one or more sides by precipitous slopes. Both cuestas and mesas are found at intervals along the highway for many miles, and are particularly prominent within 10 miles of the Lakehead, attaining their maximum development in Mount McKay at Fort William. They are made up of shales and greywackes overlain and protected by hard cappings of diabase. The diabase cappings are thought to represent sills that were intruded into the Rove sedimentary rocks in Keweenawan time, and were once continuous across the whole region. They were fractured and faulted, and erosion by streams and atmospheric agencies resulted in the development of isolated hills, in which only small remnants of the sills remain.

As the Lakehead is approached, the heights of the cuestas and mesas become accentuated by the flatness of the lowland through which the highway passes. This flatness reflects the occurrence of a large deposit, 60–90 feet thick, of stratified blue clay. The clay

Photo 16. *The Pigeon River where it enters Lake Superior. This vertical air photograph shows the prominent north east trending ridges reflecting the occurrence of hard diabase dikes cutting relatively soft Rove sedimentary rocks. The best impression of relief is obtained when the photograph is lighted from the lower edge. Scale about 1½ miles to the inch. (Photograph A 13504-88 courtesy National Air Photo Library).*

is believed to have been deposited by a huge lake of glacial meltwaters that occupied the Lake Superior basin after the retreat of the Pleistocene ice sheet, thousands of years ago. This lake stood at a much higher elevation than Lake Superior, and it extended along the intermontane valleys, many miles inland from the present shoreline.

## PRINCE LOCATION
*(The earliest mine)*

Along highway No. 61, 19 miles northeast of Pigeon River and 22 miles southwest of Fort William, a historic marker has been erected in memory of Colonel John Prince (1796-1870). Colonel Prince was responsible for the first mining operation undertaken on the Canadian shores of Lake Superior. At a location on Prince Bay, about 6 miles east of the historic marker, a vein, carrying significant amounts of copper and silver, was discovered. This vein was tested by underground work in 1846 or 1847. A little silver is known to have been recovered. No records or production are available, however, and there is some doubt that the venture was successful. Nevertheless, the Prince mine is of special significance in that it represents the beginning of one of northwestern Ontario's most important industries.

## RIVERDALE ROAD QUARRY

An excellent exposure of the Rove Formation of the Animikie Series is found in the quarry along the Riverdale Road. This quarry is located about ½ mile west of the intersection along highway No. 61, at a point midway between the Neebing Hotel and Uncle Frank's Tavern, approximately 3 miles southwest of Fort William.

The rock that is exposed in the quarry is a flat-lying, thin-bedded, dark, fissile shale. Its chief claim to geological prominence is the fact that it contains numerous large well-developed concretions. A fine example of one of these bodies is illustrated in photo 17.

The concretions are much like curling stones in shape; they are oblate spheroids, having diameters up to about 6 feet, and thicknesses up to 1.5 feet. They are harder and more massive (less fissile) than the enclosing rock, and contain abundant finely crystalline calcite and thus differ somewhat in composition. They have a distinctly layered structure; when viewed from above, as in the floor of the quarry, the boundaries of the layers appear as concentric circles. In the quarry face, where the concretions can be examined in section, their internal layered structure is found to be coincident with, and their long dimensions parallel to, the bedding or stratification of the shales. Significantly, the layers thicken slightly from the margins of the concretions inward, and the shale strata immediately above and below the concretions are distinctly bulged, upward and downward, respectively. These features, the continuity of the bedding of the shale through the concretions, and the distortion of the enclosing strata, indicate that the concretions are not simply inclusions of foreign material in the enclosing rock. On the contrary, they must have been formed in-place, and in their development they must have partly incorporated, and partly displaced, original rock material. Although the mechanism of the process has not been satisfactorily explained, it is generally conceded that concretions, like those found at this locality, are the result of a spontaneous migration of a minor rock constituent (calcite) toward, and a precipitation and accumulation of this constituent near and around, some nucleus such as might be provided by a pebble or a grain of sand.

Photo 17. *A concretion resembling a large curling stone in flat shales. This specimen is about 3 feet across.*

Photo 18. *Pie Island, off shore in Thunder Bay Note the diabase sill.*

# Canadian Lakehead and Vicinity

## THUNDER BAY

Fort William, Port Arthur and the surrounding municipalities have been incorporated for administrative purposes into the City of Thunder Bay. To avoid confusion with the actual water feature of Thunder Bay which is mentioned many times in this guidebook, sparing use is made of the new city title; unless clearly described to the contrary, Thunder Bay is used for the magnificent water feature on whose western shores the Canadian Lakehead lies. The former cities, Port Arthur and Fort William, are used as convenient localities for description and will be identified readily by the visitor, (map B).

## KAMINISTIKWIA DELTA

Where a river laden with sediment flows into a body of standing water, such as a lake, the rate of flow is checked, and the materials being transported are rapidly dropped from suspension. The debris settles near the river's mouth, forming a triangular-shaped piece of land called a delta because of its resemblance to the Greek letter Δ.

One of the most noticeable features of Fort William is the extreme evenness of the land upon which it has been built; Fort William, and part of Port Arthur, are on the forefront of a huge delta. This delta occupies the lowlands drained by the Kaministikwia River and its tributaries. It extends inland, to and beyond the village of Stanley, a distance of over 16 miles; it is the largest and most impressive delta found along the north shore of Lake Superior (photo 19).

The delta deposits are chiefly sand, silt, and clay. They are believed to have been laid down at the mouth of the ancestral Kaministikwia River when, thousands of years ago, the level of Lake Superior was much higher. With the lake lowered to its present level, the Kaministikwia River now cuts deeply into these old deposits, forming an entrenched channel that is contributing material to help build up a new delta (Island 1 and Island 2) on the Fort William waterfront.

## MOUNT McKAY

South of Fort William, on the reserve of the Ojibway Indians, and towering above the Kaministikwia delta, is Mount McKay (photo 10). Mount McKay rises to a height of 1,600 feet above sea-level, which is 1,000 feet above Lake Superior. It is a large mesa, made up of shales and greywackes of the Rove Formation, overlain by a hard, protective capping, about 200 feet thick, of diabase.

The diabase capping is the erosional remnant of a flat sheet or sill that once extended without interruption across the entire area. A second sill, about 15 feet thick, also an erosional remnant, is found in the Rove sedimentary rocks about 200 feet below the first and about 400 feet below the top of the hill. Like the upper sill, it is also very hard, much more so than the enclosing shales and greywackes; it forms the base of a wide and prominent terrace to which the tourist may drive his automobile for a magnificent view of the city of Thunder Bay.

Photo 19. *The Kaministikwia delta with Mount McKay in the distance. The delta flatlands were laid down by an earlier Kaministikwia River when the level of Lake Superior was higher.*

## HILLCREST PARK

Hillcrest Park along the Scenic Drive in Port Arthur stands about 160 feet above the level of Lake Superior; because, as its name implies, it is at the top of a steep embankment, it affords a splendid panoramic view of Thunder Bay and the harbours of the new City of Thunder Bay.

Along the escarpment at Hillcrest Park, at the flagpole, and in the mound 250 feet south of the flagpole, are outcrops of limestone. This limestone is a peculiar fragmental rock; it is made up of numerous, small, rounded to angular pieces of chert in a matrix of coarsely crystalline iron-bearing carbonate. Interrupting it at close intervals are thin layers of chert. These layers, in places, separate and join in an irregular manner, enclosing lenticular masses of the limestone. When traced for any distance, however, they are found to be persistent and crudely parallel bands, and it is quite possible that they represent an original sedimentary stratification. The fragmental character of the limestone and the irregular chert layers are best observed at the base of the escarpment, in the lane near the stairway 150 feet south of the flagpole.

Because the limestone is exposed along the escarpment, it might be assumed that it controls the nature and height of the latter. This, however, is not the case. The limestone trends northeast at a small angle to the escarpment and dips about 20° southeast, opposite to the direction one might anticipate. The most notable feature of the escarpment is that it separates two terraces. The upper terrace is of water-laid sand; the lower terrace is an old beach. They are thought to have been formed when, after the melting of the glaciers that once covered the area, the waters of the Lake Superior basin stood higher than they do now. The escarpment is a cliff formed largely by wave action along an old shoreline after the lake level had dropped to the elevation of the lower terrace.

### *The Welcome Islands and the Sleeping Giant*

Directly in front of the park lookout, and 3 miles offshore, are the Welcome Islands. To the left of the Welcome Islands, commanding the entrance to the bay, is the Sleeping Giant, so-named because of a superficial resemblance to a reclining human figure; to the right, some 12 miles away, is Pie Island, with a roughly circular, pie-like hill at its west end (photo 18); and on the extreme right, at the south end of Fort William, is Mount McKay and the range of hills stretching toward Pigeon River and the International Boundary.

The Welcome Islands are made up of Rove sedimentary rocks. These slope gently to the southeast and form cuesta ridges that attain elevations of almost 100 feet above the lake. Similar rocks are found in the Sleeping Giant, Pie Island and, as we have already noted, Mount McKay. In these localities, however, they are overlain and protected by flat diabase cappings. They occur as large mountainous hills, rising hundreds of feet above the lake. Of particular interest is the Sleeping Giant (photo 20) in which can be seen four flat-topped mesas known, from north to south, as the Head, Adam's Apple, Breast, and Triangle. A fifth mesa, Thunder Mountain, lies east of the Breast and the Triangle, but is not visible from the park. On the west side of the Giant, facing the Lakehead, is a sheer cliff 800 feet high. This cliff is the highest in Ontario.

Photo 20. *View of the Sleeping Giant from Mount McKay. The Sleeping Giant is made up of Proterozoic sedimentary rocks capped by erosional remnants of a thick diabase sill. Four mesas give the profile of the giant; the Head, Adam's Apple, Breast and Triangle.*

## CURRENT RIVER PARK

Current River Park is located along Cumberland Street; (highway No. 17) where the road crosses the Current River near the north end of Port Arthur. In this park are two features of geological interest; the southeast-facing embankment behind the nursery and the playground; and the falls in the river below the dam.

The southeast-facing embankment is an old shore cliff, similar to that at Hillcrest Park. There are, in fact, several such shore cliffs in the city of Thunder Bay; and these separate old abandoned beaches, the highest of which has an elevation of about 235 feet above the present lake-level. The shore cliff in Current River Park (photo 13) is perhaps the most prominent. It separates terraces having elevations of 85 and 60 feet, and it can be traced across Port Arthur from the Canadian Pacific railway on Strathcona Avenue (highway No. 17) southwest to the Oliver Road (highway No. 130), a distance of more than 5 miles.

Below the dam, the Current River drops about 40 feet in a horizontal distance of 600 feet. Here the bedrock is diabase. The diabase is interrupted by a large number of cracks or joints, which cause the rock to break into rectangular-shaped blocks. The most prominent joints are vertical; others are flat-lying. Because of these joints, the surface of the bedrock is step-like rather than of uniform slope, and the river water tumbles over a series of flat ledges, forming a rather beautiful cascade (photo 21).

## BOULEVARD LAKE PARK

### *Black Bay Bridge*

Exposures of Gunflint Formation are found along the east bank of Current River, below and near the Black Bay bridge at the upper end of Boulevard Lake. The sedimentary rocks here slope gently south at the south end of the outcrop, and slope north at the north end near the bridge. Downstream, towards Boulevard Lake, the river cuts deeper and deeper into them, so that rocks occurring progressively lower in the stratigraphic section (geological column) can be seen. At the bottom of the section is dark green, thick-bedded taconite; it is found along the river bank below the low falls that terminate the rapids about 500 feet south of the bridge. Taconite makes up a very large part of the Gunflint Formation. Its principal distinguishing feature is that it possesses a granular texture, best seen when the rock is examined through

Photo 21. *At Current River Park, Port Arthur, the river flows over a body of diabase. Because the diabase is broken by flat and vertical joints, the falls are step-like in character.*

a hand lens. This granular texture is due to the presence of innumerable tiny rounded bodies or granules made up largely of iron-bearing minerals, chiefly greenalite.

Overlying the taconite are about 20 feet of limestone beds, covered in turn by about 5 feet of dark coloured shales. The limestone also is iron-bearing; on exposure to the atmosphere, it breaks down to form hydrous iron oxide in the form of the brown-coloured mineral, limonite; it has characteristic rusty weathered surfaces that are in sharp contrast to the grey freshly-broken rock. One notable feature of this limestone is the interruption, at close intervals, particularly in its lower portions, by small lenses and thin layers of taconite and chert. These stand up in relief on exposed surfaces and occur as conspicuous irregular-shaped patches (photo 22). More notable, however, is the contact between the limestone and the overlying shales. The upper surface of the limestone, where it can be seen on the north side of the bridge, is hummocky, and the shales resting upon it tend to

Photo 22. *Below Black Bay Bridge in Boulevard Lake Park, rusty weathering limestone beds contain layers and lenses of cherty rocks. The cherty rocks are resistant to erosion and stand up in relief as irregular shaped patches on the limestone.*

conform to the irregularities and, as a consequence, to be gently undulating. The hummocky surface is called a surface of unconformity. It represents an interruption in the development of the sedimentary rocks in this locality and indicates uplift and a period of erosion after the formation of the limestone but prior to the time the mud, which ultimately gave rise to the shales, was deposited.

## *The Lookout*

North of the Black Bay bridge, across the river, is a vertical cliff rising about 90 feet out of the valley. This cliff, when examined closely, is found to be made up of shales overlain and protected by a 25-foot thick capping of diabase. The diabase is flat-lying, and it forms a prominent ledge from which the tourist can obtain a superb view of Boulevard Lake and Thunder Bay to the east. The Lookout provides Port Arthur with one of its many scenic attractions (photo 24).

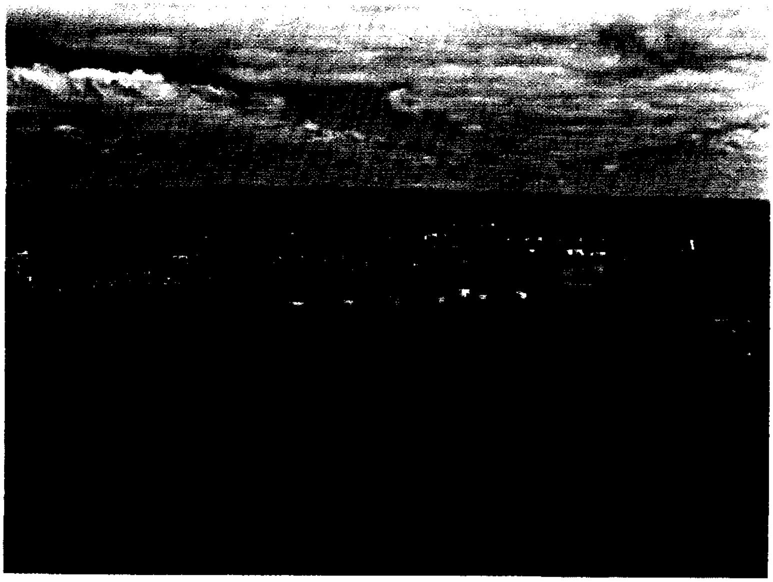


Photo 23. *The City of Thunder Bay from Mount McKay.*

Photo 24. *Black Bay Bridge and Boulevard Lake, looking south along the Current River from the Lookout, Boulevard Lake Park. (Courtesy Ont. Dept. Tourism & Information).*

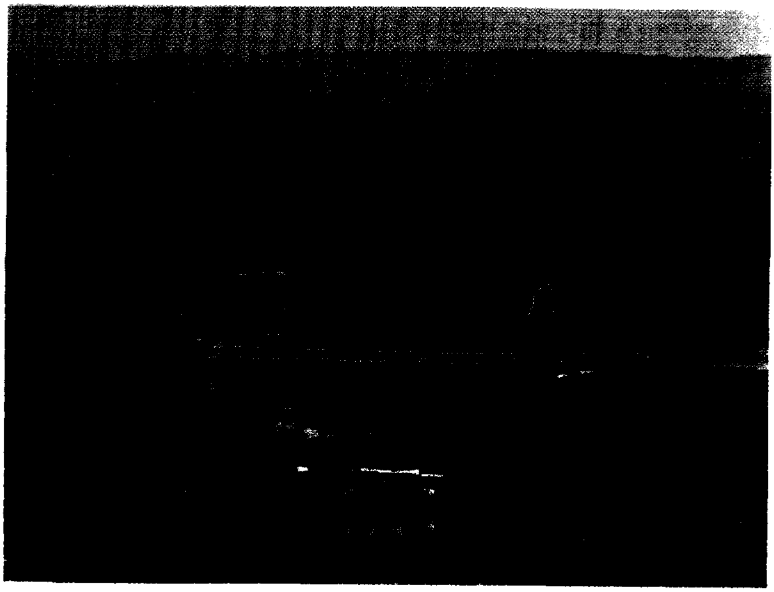


Photo 25. *The lower falls of Trowbridge Falls Park, Port Arthur, showing a step-like cascade due to the presence of vertical joints interrupting flat-lying sediments of the Gunflint Formation.*

## TROWBRIDGE FALLS PARK

Two small but scenic waterfalls occur along the Current River, about 2 miles upstream from Boulevard Lake, at Trowbridge Falls Park. This park was established in 1957 by the Kinsmen Club of Port Arthur as a community recreational site. It is readily accessible by motor road; the entrance is found on Hodder Avenue, 1.3 miles north of Arundel Street where highway No. 17 turns east to skirt the Strathcona Golf Links.

At Trowbridge Falls Park the bedrock is mainly gently dipping shale of the Gunflint formation. The shale is typical of the area; it is dark coloured, fine-grained, and thin-bedded. In it, at widely spaced and irregular intervals, are thin beds of iron-bearing carbonate. Upstream, these carbonate beds increase in number and thickness so that, at the lower falls, they make up about one third of the rock exposed. They are rusty-weathering, and because their brown surfaces contrast sharply with the dark shales, they are easily recognized in outcrops. The rusty carbonate beds can be traced upstream about 1,000 feet to the upper falls. Here, however, they do not alternate with thin layers of shale, but rather with thin layers of chert; accordingly, they mark a transition between the shales and the overlying chert-carbonate member of the formation.

At each of the two falls, the Current River does not tumble over one escarpment but, rather drops over the ends of a number of flat ledges, from 2 to 5 feet in height (photo 25). Unlike most waterfalls, they are not due to the protection of soft, easily eroded rocks by overlying, more-resistant ones. Some ledges are capped by thin layers of carbonate, and others are capped by beds of shale or chert; however, the bedrock splits easily along the flat bedding, and it is interupted in places by vertical cracks or joints that extend across the outcrop. The river water readily works itself into these cracks and widens them, and blocks of rock are removed from the stream bed. As the blocks are removed, a vertical cliff is developed, and a low falls is initiated. In the step-like cascade produced, the treads of the individual steps are due to the flat-layered structure of the rocks formation, and the risers are the cracks or joints.

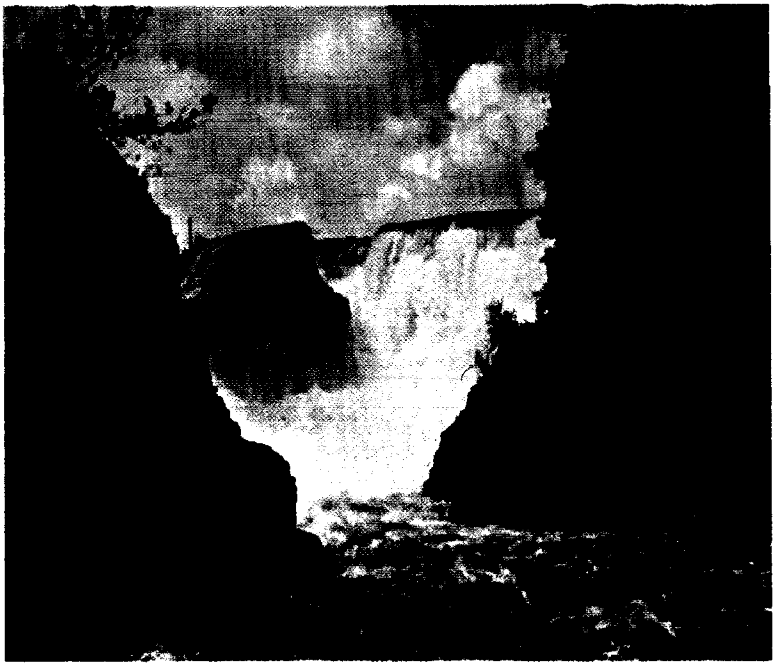
Photo 26. *An anticline formed by a 3-foot thick bed of volcanic tuff in shales, below the highway bridge at Kakabeka Falls Provincial Park.*

## KAKABEKA FALLS PROVINCIAL PARK

A park with facilities for camping, picknicking, and swimming has been established by the Ontario Department of Lands and Forests at Kakabeka Falls, where the Kaministikwia River is crossed by the highway No. 17-11, about 18 miles west of Fort William. In this park are two points of geological interest: an outcrop in the river bed below the highway bridge; and the falls themselves.

The rocks exposed under the highway bridge are dark shales overlain by a 3 foot thick bed of tuff. Tuff is the compacted and consolidated equivalent of ash (fine-grained debris) resulting from explosive volcanic discharge. In this locality, after its formation, it was compressed and folded, so that it forms a low structural ridge, one limb of which slopes gently upstream, the other gently downstream (photo 26). It forms a gentle upwarp called an anticline.

Photo 27. *Kakabeka Falls, the Niagara of the North. The falls have developed where a capping of hard resistant chert-carbonate overlies soft black shale. The Kaministikwia River, 200 feet wide at the crest drops vertically 128 feet and has carved out a deep gorge downstream. (Courtesy Ont. Dept. Tourism & Information).*



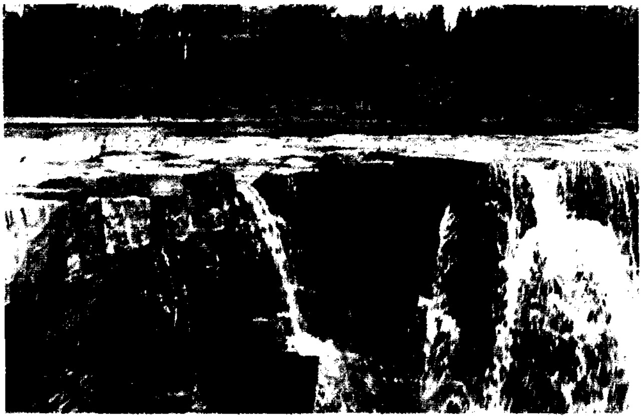


Photo 28. *Hard chert-carbonate rock capping black shales, Kakabeka Falls.*

## *Kakabeka Falls*

Having a crest-width of over 200 feet, and a near-vertical drop of 128 feet, there is no doubt that Kakabeka Falls, aptly termed the Niagara of the North, is the most spectacular physiographic feature in northwestern Ontario (photo 27). It is a typical example of a waterfall that has developed where, along a river's course, easily eroded rocks are overlain by a capping of hard, resistant material. Here, the rocks are flat-lying sediments; a thick sequence of soft, black shale is protected by a 2-foot-thick layer of Gunflint chert-carbonate (photo 28). Had the shales been the only rock present, any original waterfalls would have been destroyed early in the river's history, for the running water would eventually have scoured out the river bottom to produce a bed sloping gradually towards Lake Superior. The chert-carbonate above the shales, however, has prevented the scouring. Because the underlying shales wear away at a faster rate than the chert-carbonate, the latter tends to be preserved as a projecting lip, thereby maintaining the sheerness of the escarpment. This escarpment was originally much closer to Lake Superior, but, through the gradual erosion of the shales and the attendant undercutting and piecemeal collapse and foundering of the cap-rock, it receded slowly upstream, leaving a deep gorge downstream to mark the watercourse. Of special interest in this regard is that, when the site of the falls was somewhere to the southeast, the river was wider. It slowly wore down the iron formation above the receding falls. This reduced the cap-rock's thickness and formed the lower terrace in the park, between the present site of the falls and Greenmantle's Tower.

# Canadian Lakehead to Nipigon

## KESHKABUON ISLAND

One of the prettiest and most striking islands in Lake Superior is Keshkabuon (Caribou) Island near the north end of Thunder Bay (photo 29). The best view of the island is from Perry Point bounding Amethyst Harbour on the east. Perry Point is accessible from the east branch of the Amethyst Harbour road, which intersects highway No. 17-11 about 14 miles north of Thunder Bay city limits and 6 miles south of highway No. 587 (road to Pass Lake and Silver Islet Landing). The island lies about a mile south and southeast of the Point. It is composed principally of the igneous rock diabase. The diabase is the erosional remnant of a large flat-lying sheet, which, like that found in Mount McKay, rests directly upon gently sloping shales of the Rove Formation. Its principal characteristic is that it exhibits numerous cracks or joints, which stand upright and bound thin columns of rock. These joints are contraction cracks. They are thought to have been the result of shrinkage of the diabase upon the solidification and cooling of its magma. Because they formed at right angles to the boundaries of the sheet, and since at the west end of the island they change in attitude, it is apparent that here the diabase has cut obliquely across the strata of the Rove shales. This is a strictly local phenomenon. It does not detract from the fact that in general the diabase sheets in the region were formed in positions parallel to the stratification of the older rocks, and thus occur as sills.

Photo 29. *Keshkabuon Island, near the north end of Thunder Bay.*

## BLENDE CREEK

A fine exposure of typical chert-carbonate rock of the Gunflint Formation is found along Blende Creek, 400 feet west of highway No. 17-11, about 3,000 feet south of the latter's junction with highway No. 587. There is no public parking and for safety reasons cars should be left near the intersection of the highways. It is well-stratified, consisting of layers of grey chert, not more than about 1 inch thick, alternating with equally thin layers made up of rusty weathering, finely crystalline, relatively soft carbonate minerals. A very interesting feature is the fracturing and cementing of chert. In places, the chert layers have been fractured, in large part transversely, and the chert fragments, some of which are oriented at oblique angles to the original bedding of the rock, have been cemented by the material making up the adjoining carbonate layers (photo 30). The chert-carbonate was subjected to lateral compression, under which the two materials behaved differently; the hard, brittle chert simply fractured, whereas the carbonate must have "flowed" so as to fill the cracks in the broken and distorted chert layers. This "flowage" may have occurred in part by movement along minute fractures and crystal glide planes and in part by recrystallization, a process of partial dissolution and reformation of crystals under pressure.

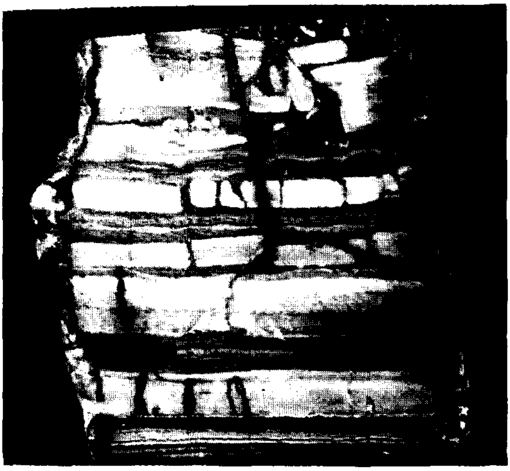


Photo 30. *Bedded chert-carbonate of the Gunflint Formation at Blende Creek. The fractured chert layers have been cemented by flowage of material making up the dark carbonate layers.*

At closely spaced intervals, the chert-carbonate rock is interrupted by thin strata, not more than a few inches wide, of highly fissile, crumbly shales; at the level of the top of the pile of talus, or loose material, around the bottom of the outcrop, there is a 2-foot-thick bed of pale grey, rather massive greywacke. The greywacke, like the chert-carbonate, is of special interest because of its internal structure. It is not fragmental as are parts of the chert-carbonate. Near its top it exhibits distinct and remarkably well-developed cross-laminations; these are primary depositional features, due to the shifting of sediment by water currents when the materials making up the rock were laid down. Each cross-lamination represents an addition of sediment to the deposit and, as expected, slopes steeply in the direction of the current from which it was deposited.

## SIBLEY PENINSULA

Sibley Peninsula, projecting into Lake Superior from the north shore, is a large land mass, 32 miles long and 6 miles wide, separating Thunder Bay on the west from Black Bay on the east (map C). Except for numerous disbase dikes, and for the large diabase sill forming the upper part of the Sleeping Giant near its tip, the peninsula is underlain entirely by stratified sedimentary rocks. These rocks strike northeast and dip gently, usually at angles of 5° or less, to the southeast. They form a huge cuesta, the west margin of which is a vertical escarpment rising in places to as

Photo 31. *The Sea Lion, west of Silver Islet Landing, is a narrow vertical diabase dike pierced by wave action to form a natural bridge.*

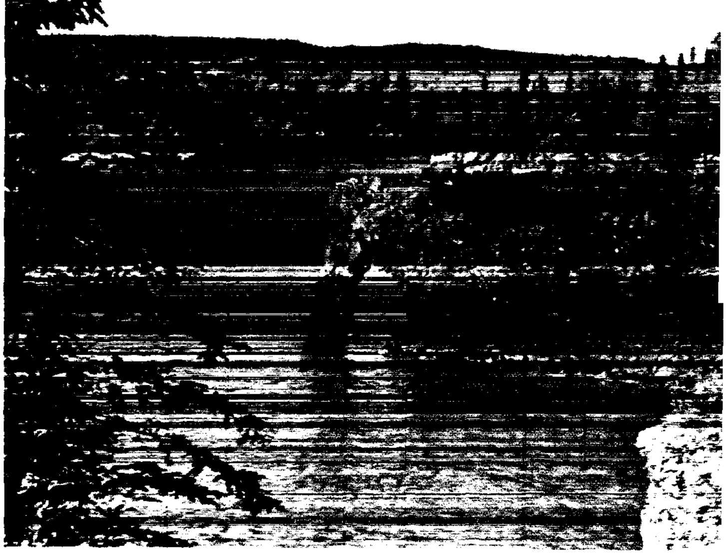
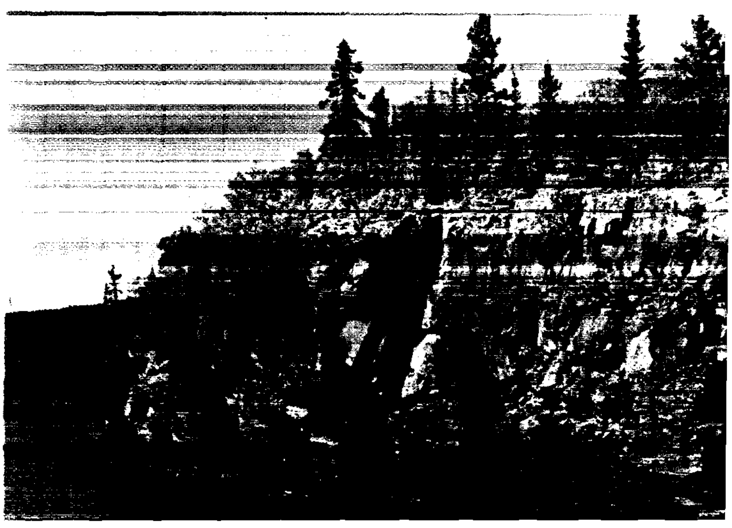


Photo 32. *Silver Islet, on the horizon, from Silver Islet Landing. This rock speck produced $3,250,000 in silver during the 1870's.*

Photo 33. *Cliffs formed by the wave erosion of Rove sedimentary rocks near Silver Islet Landing, Sibley Peninsula.*



much as 450 feet above Lake Superior. This cuesta is the topographic expression of a homocline, a structural feature where the rocks, over a wide area, slope almost uniformly in one direction. It is made up of two groups of Precambrian formations, the Animikie, and the younger overlying Sibley.

The Animikie at the bottom of the stratigraphic section is represented by the Rove Formation, the bedded rocks of which are exposed continuously in the escarpment extending along the west side of the peninsula. They can be examined most conveniently at two readily accessible localities: the quarry along highway No. 587, 2.2 miles east of the intersection with highway No. 17-11; and along the shore of Lake Superior at Silver Islet Landing. In the quarry, the Rove sediments are thinly laminated, highly fissile, black (carbonaceous) shales, which, at irregular intervals, are interrupted by large concretions, similar in many respects to those found in the Riverdale Road Quarry near Fort William (*see* p. 36). At Silver Islet Landing they are somewhat harder slaty rocks interbedded with relatively thick strata of massive greywacke.

The principal exposures of the Sibley Series are found along highway No. 587 at the north end of Pass Lake (photo 8), and at Moffat Point (photo 34) about 8 miles southwest where a scenic lookout overlooking Thunder Bay from the top of the 450-foot high escarpment has been established. In both places the rocks are massive, thickly bedded, white quartz sandstones. Other outcrops, of red, impure dolomites and dolomitic limestones, are found in the middle of the peninsula, between Pass Lake and Rita Lake. Red shaly sediments occur about Fisherman's Cove at the northeast end of Silver Islet Landing.

### *Sibley Provincial Park*

The Ontario Department of Lands and Forests has developed a large part of the peninsula as a wilderness and recreational park with full facilities for camping and picnicking centred on Marie Louise Lake which is on highway No. 587 about 27 miles south from highway No. 17.

### *The Sea Lion*

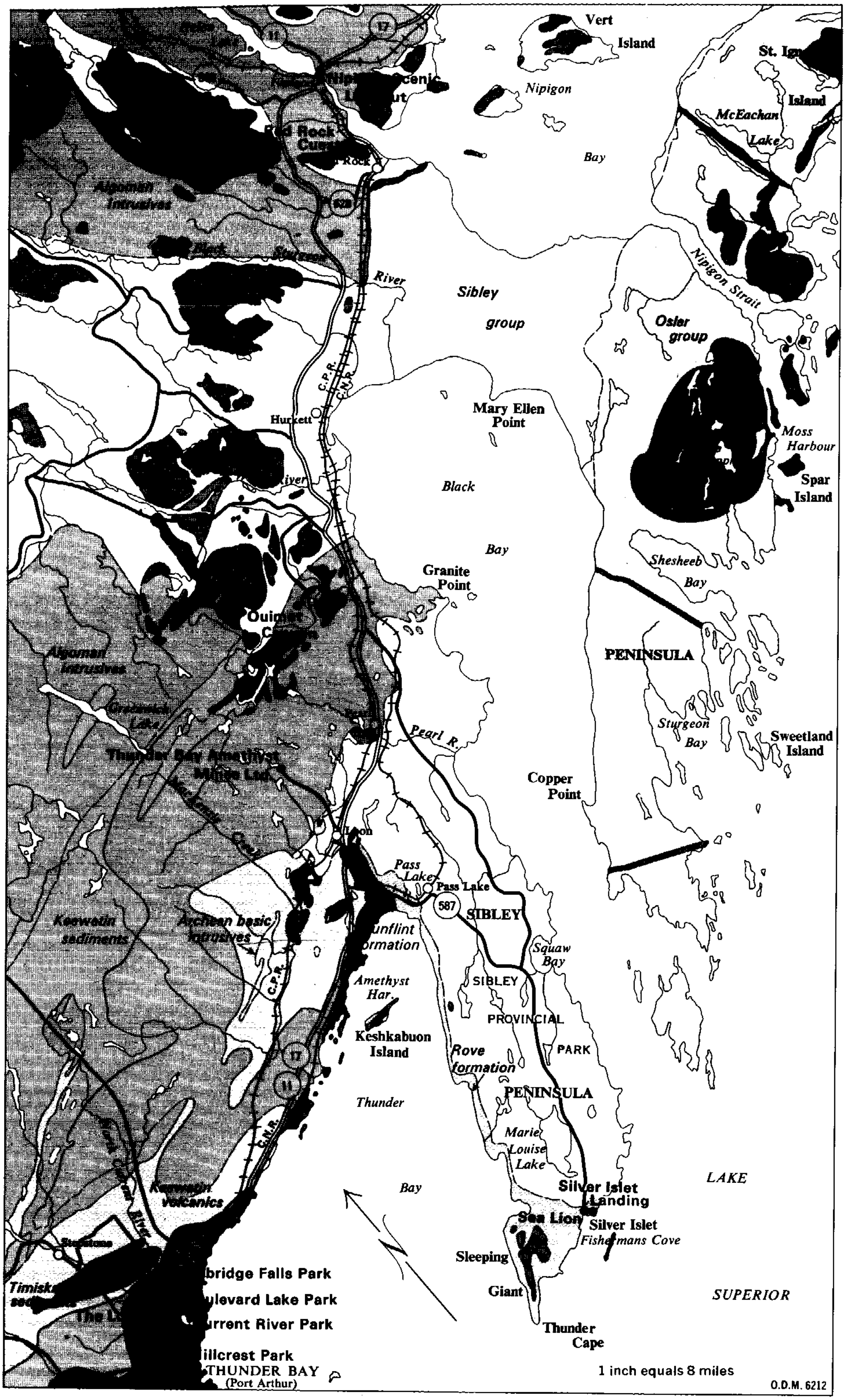
The most interesting physiographic feature to be found on Sibley Peninsula is the Sea Lion, a small promontory through which a tunnel has been cut by wave action (photo 31). Waves have great erosive power: as they pound against a shoreline, rock fragments are quarried out and hurled back and forth by the moving water.

Photo 34. *View across the mouth of Thunder Bay from Moffat Point on Sibley Peninsula toward Pie Island. The rock is thick bedded quartz sandstone of the Sibley Series. (Courtesy Ont. Dept. Tourism & Information).*

The bedrock is gradually worn away, and as the shoreline retreats landward, steep wave-cut cliffs are formed. Such wave-cut cliffs, in places 30 feet or more in height, are found along the coast west of Silver Islet Landing (photo 33). They are made up of gently dipping sedimentary rocks of the Rove Formation. Significantly, these rocks are interrupted in places by vertical, east and northeast trending dikes of diabase. The dikes are harder and much more resistant to erosion and, as the sediments were worn back, these dikes were left to project into the lake as thin, wall-like headlands. The most conspicuous of these headlands is the Sea Lion, a tabular mass of rock, not more than 5 feet thick, that stands 25 feet high and extends about 50 feet into the lake. It is found along the shore about ¼ mile west of the public beach at the south end of Surprise Lake. It is readily accessible by a good trail that leads past the first cottage encountered along the road at Silver Islet Landing.

### *Silver Islet*

Silver Islet, a small rock island not more than 80 feet wide, is situated ¾ mile southeast of the dock at Silver Islet Landing; it is the site of one of the most interesting stories in the history of Canadian mining. (photos 11 and 32).




Map C. *The Canadian Lakehead to Nipigon.*

The island was taken up as a mining location by Joseph Woods in 1846, but aside from an examination by W. E. Logan in the following year, this location was largely neglected for 22 years. It was not until silver had been found at, and west of, the Canadian Lakehead in 1868 that interest was aroused, and the island was acquired by the Montreal Mining Company. This company proceeded to make a systematic examination. Thomas Macfarlane was put in charge of the field party, and shortly after his arrival in the area, in the latter part of June, silver was discovered on the island. Macfarlane's party returned with silver-bearing specimens valued at $1,200.

Mining was initiated in 1869, and by 1870 ore valued at about $25,000 had been shipped to Montreal. At this stage, the Montreal Mining Company sold its interests to New York and Detroit capitalists, and W. B. Frue was placed in charge of the mine. The island was immediately cribbed for protection against the lake. Except for interruptions caused by storm damage, or brought on at times by the necessity of underground exploration for additional ore as reserves ran low, mining continued until early in 1884, when work had to be suspended because of the non-arrival of a cargo of coal required for the operation of the pumps. From the start of operations in 1869 to the suspension of work in 1884, the mine yielded silver worth $3,250,000.

Because of the forced suspension of work at the mine, rumours persisted for many years that considerable ore remained. These rumours, however, were finally dispelled. In 1920, a Duluth company took an option on the property. The mine was pumped out and, during 1920 and 1921, considerable exploratory work was carried out at great difficulty because of flooding, without finding any additional ore. The mine was finally closed and allowed to fill with water on 15 August 1922.

The ore at the Silver Islet mine consisted of native silver and argentite in quartz-carbonate veins. These veins were found along a northwest-trending fault at a point where the fault cuts through and displaces a diabase dike. This fault appears to extend through Burnt Island, which lies opposite the dock at Silver Islet Landing, and to persist for a considerable distance inland on Sibley Peninsula. One cannot discount the possibility that, where it crosses one of the many other diabase dikes in the area, there may be rich pockets of ore awaiting discovery.

## THUNDER BAY AMETHYST MINE

The mine lies north of highway No. 17-11 and is reached by a gravel road, a distance of 4½ miles from the intersection of highway No. 17-11 and the East Loon road.

The rock in the vicinity of the mine site consists of pink granite of Early Precambrian (Archean) age, rounded and smoothed by glaciers that once passed over the area. During a period of earthquake activity the granite shattered. Fault zones were formed and later became filled with hot liquids from which white and purple quartz crystallized. Amethyst is a variety of quartz, mauve to purple in color. The coloration, and its intensity, is due to the presence of variable trace amounts of the element iron, incorporated into the crystal structure during crystallization.

The deposit at the Thunder Bay Amethyst Mine consists of an inter-connecting system of amethyst veins, contained within a fault zone in granite and enclosing angular fragments of the host rock. The amethyst veins vary in width from one-quarter inch to four feet and include numerous cavities, or vugs, lined with mauve to purple crystals. The vugs attain lateral and vertical lengths up to 10 feet and widths up to 4 feet. Well-formed pyramid-shaped crystals (points) bounded by six faces, line the cavities; they vary from one-quarter inch in diameter to large crystals that measure nine inches in length and 6 inches in diameter. One of the largest crystals mined during operations measured fifteen inches in length, ten inches in diameter and weighed thirty-five pounds.

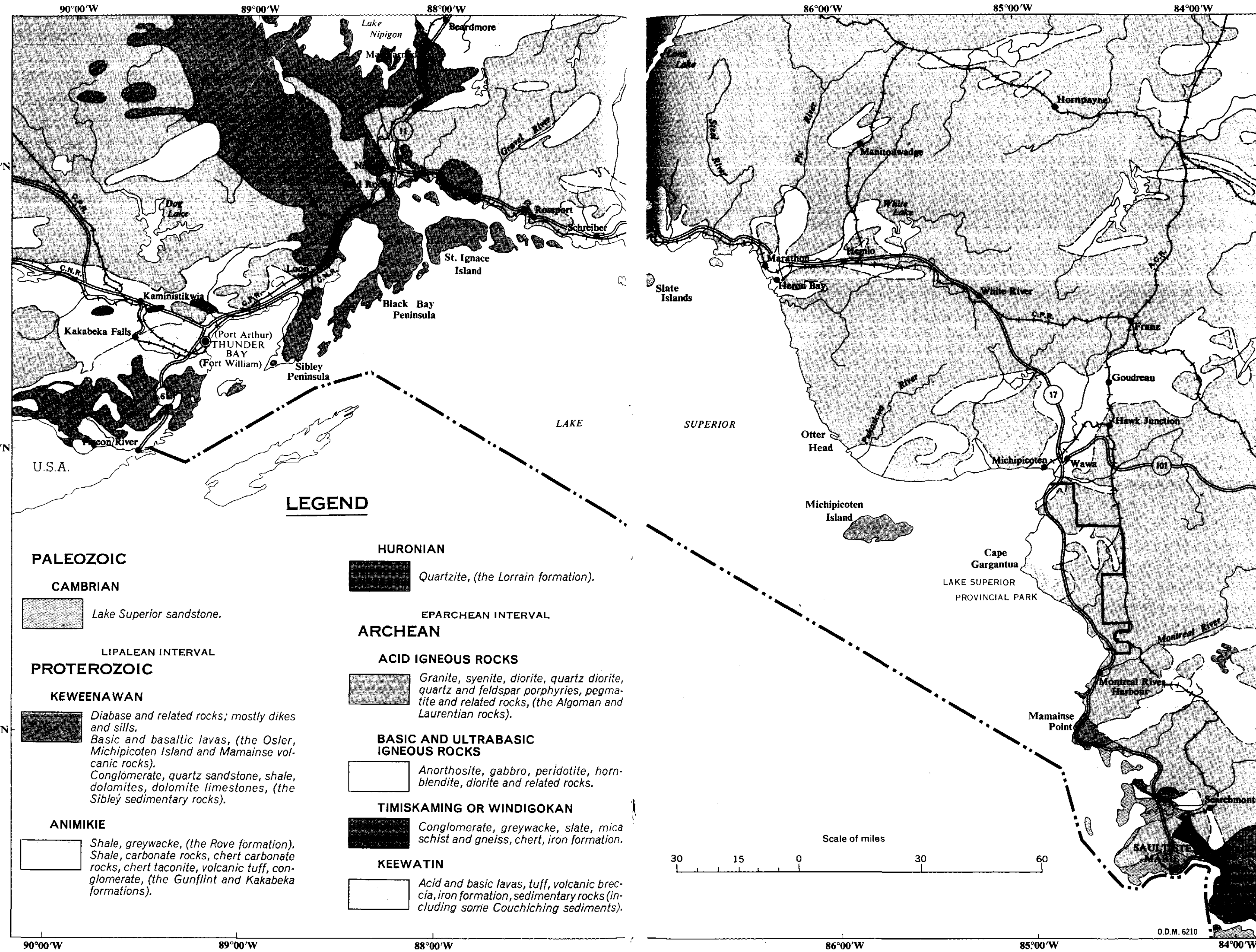
Mining operations continue throughout the summer months, and consist of gently blasting the amethyst-bearing rock, sorting crystal groups by hand and stock-piling amethyst-bearing granite material. The hand-sorted crystal clusters are cleaned and sold to visitors driving to the mine site; or they are shipped in barrels to a continually expanding world market. The bulk of the rough material is used by the construction industry as decorative facing-stone.

## OUIMET CANYON

Ouimet Canyon can be reached by following a well marked motor road extending 6 miles westerly from Ouimet, 39 miles north of Port Arthur and 28 miles south of Nipigon on highway No. 17-11. Ouimet is marked as Quiment on some maps of the area. Reported to be 500 feet wide and over 400 feet deep, it is one of the most impressive topographic features in the region (photo 35.)

It is said to reflect the occurrence of a great fault in the earth's crust. This, however, is not necessarily the case. The rock exposed in the canyon is diabase. Because here, as elsewhere in the district, the diabase occurs as a thick flat sheet, and because the two walls of the canyon have the same elevation, there is little to indicate that any displacement of rock masses has occurred. It seems quite possible that the canyon is simply a deep erosional depression, carved out of the diabase along a large crack or joint by the action of glacial ice and running water.

Photo 35. *Ouimet Canyon, 500 feet wide and nearly as deep, lies west of Ouimet. It is probably a deep erosional depression carved out of a flat diabase sill by glacial ice and running water acting along a large crack or joint.*




Map D. *The generalized geology of the north shore of Lake Superior.*

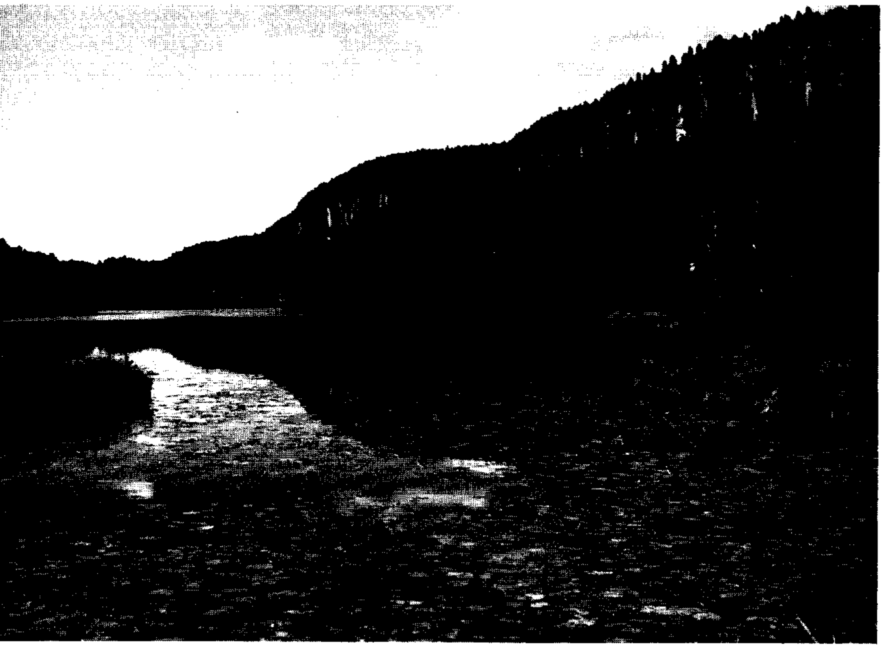


Photo 36. *The cliff face is an erosional remnant of a flat-lying diabase sheet, showing well developed columnar jointing. Good Morning Lake, Dorion Township, near Ouimet.* (*Courtesy Ont. Dept. Lands and Forests*).

## RED ROCK CUESTA

A very prominent landmark along highway No. 17 is the large cuesta located about 7 miles south of Nipigon. This hill rises several hundred feet above the surrounding country, and can be seen for miles. It is most conveniently studied from the Main Hotel, at the junction of highway No. 17 and the road to Red Rock, and from the Beaver Valley Trailer Court and Campgrounds on highway No. 17, 2.2 miles north of the hotel. At these localities it is noted that, at the base of the hill there are outcrops of granitic rocks that occur as low rounded knolls almost 50 feet high. Overlying the granitic rocks are 200—300 feet of flat-lying sediments of the Sibley Series; these in turn are covered by an erosional remnant, 100 feet or more in thickness, of a flat sheet of diabase (photo 37).

There are three features of interest: the contact between the granitic rocks and the sedimentary rocks; the colour of the sedimentary rocks; and the jointing in the diabase.

The granitic rocks at the base of the hill reflect the occurrence of a batholith of granite. A batholith is a very large body of igneous rock, usually of irregular shape, that resulted from the crystallization of hot molten material, or magma, deep within the earth. It becomes accessible to human observation only as a result of exposure by erosion. The batholith that is exposed at the base of the Red Rock cuesta did not form at, or even near, the surface; it became visible only after prolonged erosion had removed a great thickness of old cover-rocks. This great period of erosion, lasting for millions of years, between the time the granitic rocks were formed and the time they became exposed and then were buried by the flat-lying strata of the Sibley Series, is known as the Eparchean interval.

The Sibley sedimentary rocks overlying the granitic rocks are shales and impure shaly dolomites and dolomitic limestones with interbedded sandstones. They are typically bright red in colour, (photo 38) and they stand out in marked contrast to the other rocks, particularly to the dark grey diabase at the top of the hill. The red colour is due to the presence of small amounts of the iron-bearing mineral hematite. The fact that the hematite was formed from other original iron minerals by dehydration (loss of water) indicates that the red beds may have been exposed to the atmosphere at or about the time of deposition. It is thought that the Sibley sediments were laid down partly in the shallow waters of a lake or inland sea of fluctuating level, and partly by rivers as flood-plain detritus.

The diabase here is characterized by prominent vertical cracks or joints. These joints form the outlines of long prisms or columns of rock and give the appearance of a pronounced columnar structure. They are tension cracks, formed immediately after solidification of the parent magma, at right angles to the lower surface of the flat sheet as a result of contraction or shrinkage of the diabase on cooling.

## NIPIGON SCENIC LOOKOUT

A scenic lookout has been established jointly by the Ontario Department of Highways and the Canadian Government along highway No. 17-11, at a point one mile west of the junction with highway No. 11 (photo 39). This lookout is on a high ridge of sand and gravel overlooking the town of Nipigon. Because it is 175 feet above Lake Superior, it provides an excellent view of the

Photo 37. *Red Rock Cuesta from highway No. 17-11 south of Nipigon. Here flat red beds of the Sibley Series rest on granitic rocks, and themselves are overlain by a flat sheet of diabase.*

Photo 38. *The red colour of the Sibley sediments, here dolomitic limestone, is due to small amounts of iron as hematite in the rocks. (Courtesy Ont. Dept. Tourism & Information).*

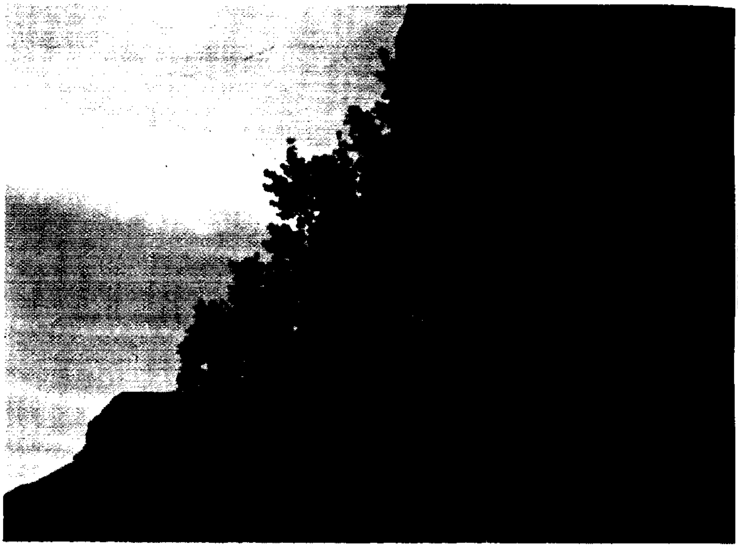


Photo 39. *View over Nipigon and the Nipigon River from the Nipigon Scenic Lookout on highway No. 17-11. The lookout is on a high sand and gravel ridge.*

Nipigon River; on a clear day the paper mill at Red Rock, at the river's mouth 5 miles distant, is plainly visible.

The mouth of the Nipigon River and the bay into which the river discharges are girdled by ranges of high, imposing, rocky hills. These hills rise several hundred feet above the lake, and one, near Red Rock, has an elevation of more than 800 feet. They are made up of erosional remnants of a thick sheet or sill of diabase, which overlies and rests upon either flat-lying sedimentary rocks of the Sibley Series, or, in places, Algoman granitic rocks. One of the members of the Sibley Series is a marble. When cut and polished, this rock provides a decorative stone comparable in quality to many imported marbles; prior to 1919, at a location on the east side of the river's mouth, it was quarried commercially.

## NIPIGON

The town of Nipigon has been built on flat terraces of stratified sand and gravel. These terraces are lake deposits formed when the waters in the Superior basin were higher and extended farther up the valley of the Nipigon River. Three terraces are recognizable. One is found along the river bank at the north end of the town; one is occupied by the business section and provides a level base for the Canadian Pacific Railway line; the third lies just below the lookout and has been reserved largely as a residential area. The terraces are separated by steep-walled embankments. The lowering of the lake to its present level was intermittent, and these embankments mark old shorelines, abandoned successively with each drop in water level.

# Nipigon to Marathon

## PALISADES OF THE PIJITAWABIK

The Palisades of the Pijitawabik, named after the bay in Lake Nipigon where they are most prominent, are found along highway No. 11. Vantage points for viewing them are Gorge Creek, Reflection Lake (photo 40), Orient Bay, and Macdiarmid, at points 23, 25, 29, and 35 miles, respectively, north of the intersection of highway No. 11 and highway No. 17 near Nipigon. At these localities, ancient sedimentary rocks are overlain by huge erosional remnants of a great diabase sheet that, in places, exceeds 500 feet in thickness. These remnants are separated by deep narrow valleys. They form large, flat-topped hills, which, because of vertical jointing, are bounded by abrupt, towering escarpments that provide northwestern Ontario with some of its most magnificent scenery.

The diabase sheet was once thought to be a thick lava flow, largely because of the general lack of any overlying rock. Near Pine Portage on the Nipigon River, however, diamond-drilling and mapping have shown that the sheet dips below the surface and cuts through Archean sedimentary rocks. This indicates that the diabase is intrusive; it was originally formed below the surface and was exposed to view only after the removal by erosion of once extensive cover-rocks.

## MOZAKAMA BAY

Three scenic lookouts have been established along the east shore of Mozakama Bay, shown on most maps as Kama Bay at points 13, 13½, and 16 miles from the intersection of highways No. 17 and No. 11 near Nipigon (9½, 9, and 6½ miles, respectively, from Gurney). Located on the flanks, and in the case of the southernmost, at the top of high hills that rise to elevations of over 700 feet above Lake Superior, they provide excellent views of the shoreline and the off-shore islands (photo 44).

From the lookouts, the geological character of the whole region, made up of diabase-capped mesas and cuestas rising abruptly, like sentinels, out of the Superior basin and the adjoining lowlands, is quite apparent. The hills along the highway at the lookouts are typical mesas, with erosional remnants of a diabase sheet overlying and resting upon a thick sequence of flat-lying Sibley sedimentary rocks. The diabase can be examined most conveniently at the southernmost lookout, and the underlying Sibley sedimentary rocks at the middle lookout. The diabase is a massive, rather coarse-grained rock. It consists largely of the minerals pyroxene and feldspar, the latter occurring as small, randomly oriented, lath-shaped crystals. As in other localities, it is broken by numerous vertical cracks or joints; because these facilitated erosion, outcrop boundaries are sheer cliffs, 300 feet or more in height. The Sibley sedimentary rocks below the diabase are similar to those in the Red Rock cuesta. They form a sequence of flat-lying, pale sandstone beds alternating with thin strata of brick-red, impure dolomites and dolomitic limestones.

The Sibley sedimentary rocks are interrupted at close intervals by dark coloured, fine-grained diabase sills, much like the sill at the tops of the mesas but having thicknesses ranging from a few inches to 15 feet. Although these sills can be followed along the highway for considerable distances and thus appear to be rather persistent, in a few places they have been found to pinch out abruptly. Of considerable interest is that where this pinching occurs, the sedimentary rocks have been severely distorted (photo 42). This distortion evidently reflects a wedging apart of the sediments, caused by the forcible injection of the magma from which the diabase crystallized.

## ROSSPORT PROVINCIAL CAMP GROUNDS

The Rossport Provincial Camp Grounds are along the shore of Lake Superior about 3 miles east of Rossport (9.5 miles west of Schreiber). They offer complete facilities for tent and trailer camping. Here, forming prominent headlands projecting into the lake, are excellent exposures of granite. These exposures have been worn smooth by wave action, and the texture of the rock is remarkably well displayed. Close observation indicates that the rock is made up of large rectangular-shaped crystals of pink feldspar in a relatively fine-grained groundmass of feldspar, quartz,

Photo 40. *The Palisades of the Pijitawabik from Reflection Lake on highway No. 11.*

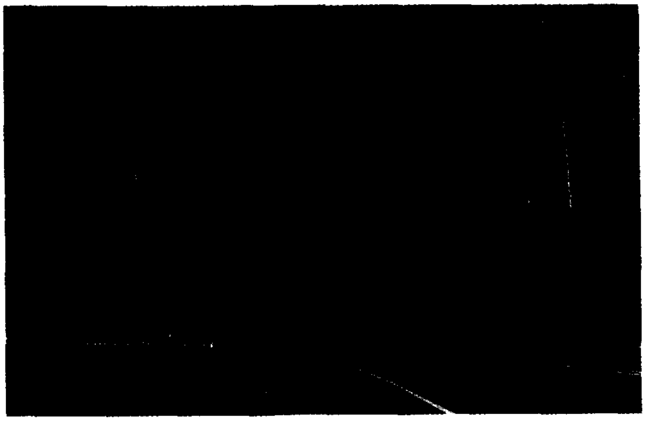


Photo 41. *Sibley red beds capped by black diabase. North Kama Hill on highway No. 17, east of Nipigon.*

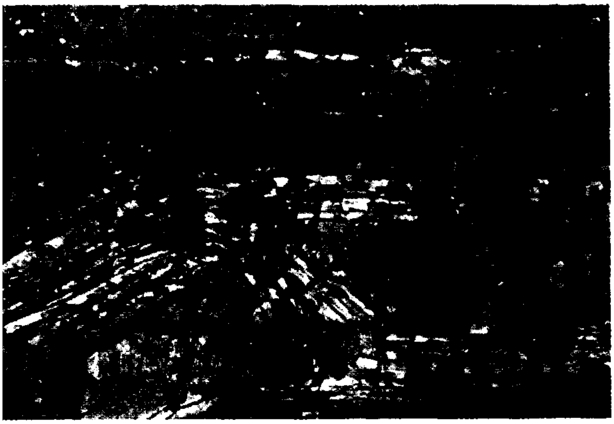


Photo 42. *Diabase sills in distorted Sibley sedimentary rocks near the northernmost lookout, Mozakama Bay.*

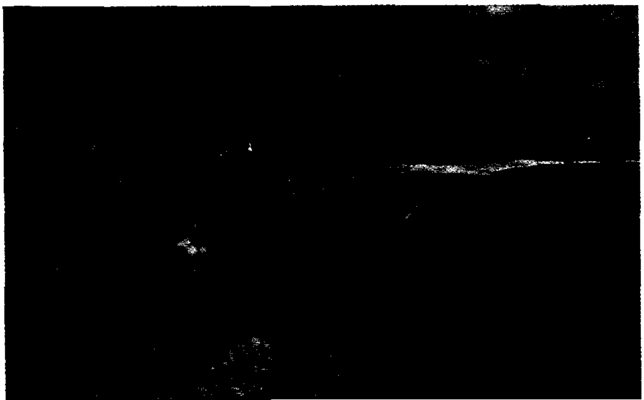


Photo 43. *The gravel beach at Rossport Provincial Park.*

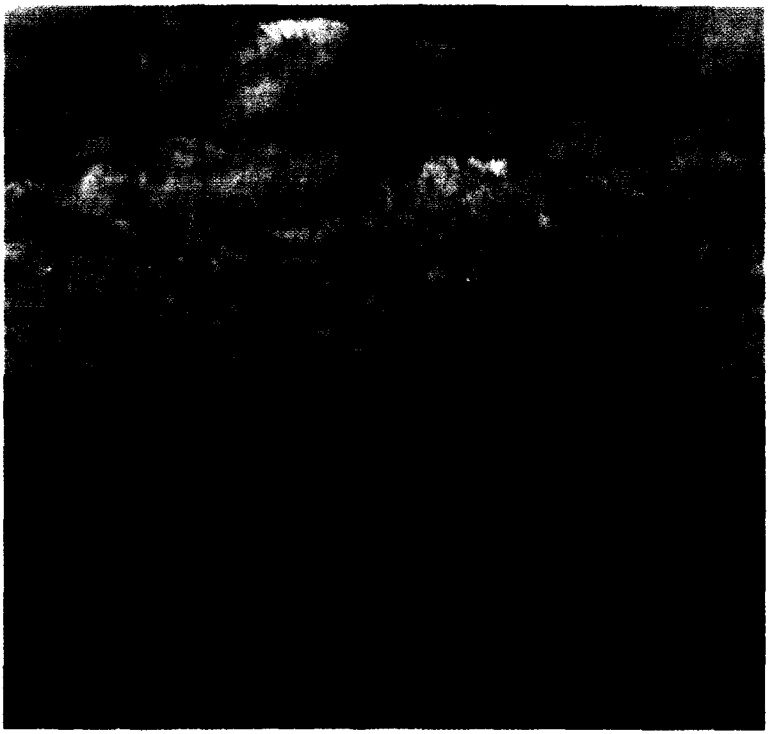


Photo 44. *View across Nipigon Bay, Lake Superior from the southernmost lookout at Mozakama Bay. The bedrock exposed at the lookout is diabase but the islands offshore are largely Sibley red beds overlain by erosional remnants of a diabase sill. (Courtesy Ont. Dept. Tourism & Information).*

and black mica (photo 45). The texture is said to be porphyritic and, because of this, the rock is called a porphyritic granite.

The porphyritic granite is an igneous rock that crystallized from a natural melt, or magma. It is well known that, when a melt is slowly cooled, very few crystal nuclei are formed, and these develop into a small number of large crystals. On the other hand, when a melt is rapidly chilled, many crystal nuclei are formed, and these develop into a large number of small crystals. Because of this we can infer that the porphyritic granite crystallized in two stages. The large feldspar individuals resulted from slow cooling of the magma at depth, where the temperature was high; the small groundmass crystals resulted from rapid chilling after the magma had worked its way upward into a cooler environment closer to the Earth's surface.

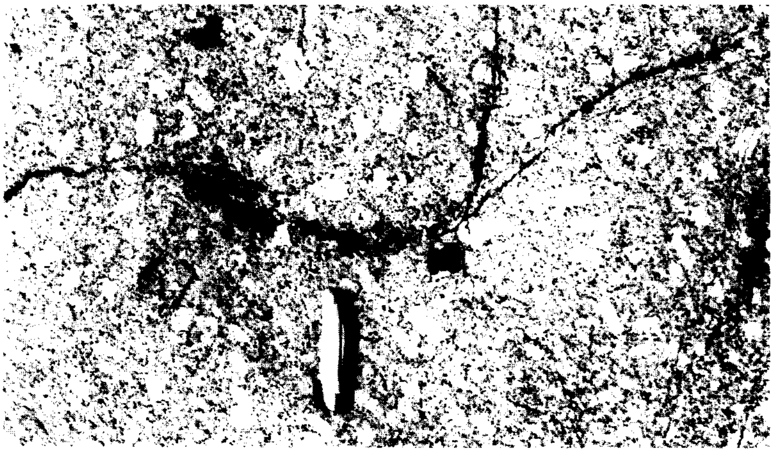


Photo 45. *Porphyritic granite, Rossport Provincial Camp Grounds. The large rectangular shaped light coloured crystals are feldspar phenocrysts which formed slowly at depth. The groundmass probably crystalised more rapidly when the magma approached the Earth's surface.*

## HEWITSON RIVER SCENIC LOOKOUT

A magnificent view of the Lake Superior shoreline and nearby islands is afforded by a scenic lookout along highway No. 17 near the Hewitson River, 4.5 miles east of the east turn-off to Rossport (8 miles west of Schreiber). The rocks exposed along the shoreline are mainly granites of Archean age; those found on the islands are of late Precambrian (Keweenawan) age. The late Precambrian rocks represent two series, the Sibley, and the Osler. The Sibley Series is the older. As at Mozakama Bay, it is made up chiefly of sandstone interbedded with red impure dolomites and dolomitic limestones. The Osler Series, which overlies the Sibley, also contains sedimentary rocks. Indeed, at its base it is represented by conglomerate, sandstone, and red mudstone not much different in composition and structure from their Sibley counterparts. The principal members of the series, however, are basic lava flows, and these with some interflow sediments, attain an aggregate thickness of several thousands of feet. The Sibley and Osler sedimentary rocks and the Osler volcanic rocks in this region trend east—west and dip at low angles to the south. This attitude is reflected in the physiography. The islands are cuestas, with abrupt escarpments along their north sides but with gentle slopes toward the open lake to the south (photo 46).

## RAINBOW FALLS PROVINCIAL PARK

While not the most spectacular scenic attraction between Nipigon and Wawa, there is little doubt that Rainbow Falls is one of the prettiest. As in other localities near Lake Superior, the falls does not occur where a river flows over a single vertical cliff. It is a cascade, in which the flowing water tumbles from ledge to ledge in a rapid descent to Lake Superior. It occurs where the Hewitson River drains Selim Lake, in the park established by the Ontario Department of Lands and Forests along highway No. 17, about 5½ miles east of Rossport (7 miles west of Schreiber).

The bedrock at the falls is a pink syenite, a massive igneous rock made up chiefly of black hornblende and reddish-coloured feldspar. It is a well jointed rock, and careful observations disclose that the attitudes and dispositions of the joints or cracks have controlled the course of the river and the positions of the individual escarpments of the cascade. The course of the river is a zig-zag one; it follows vertical or nearly vertical joints, some of which trend northwest, others southwest. The escarpments, as one might anticipate, are most prominent at those places where the joints intersect and the river's direction changes abruptly.

Photo 46. *Rossport on highway No. 17 and the Lake Superior islands. The Proterozoic rocks slope to the south giving rise to cuesta topography. The boats are taking part in the annual fish derby.* (*Courtesy Ont. Dept. Tourism & Information*).

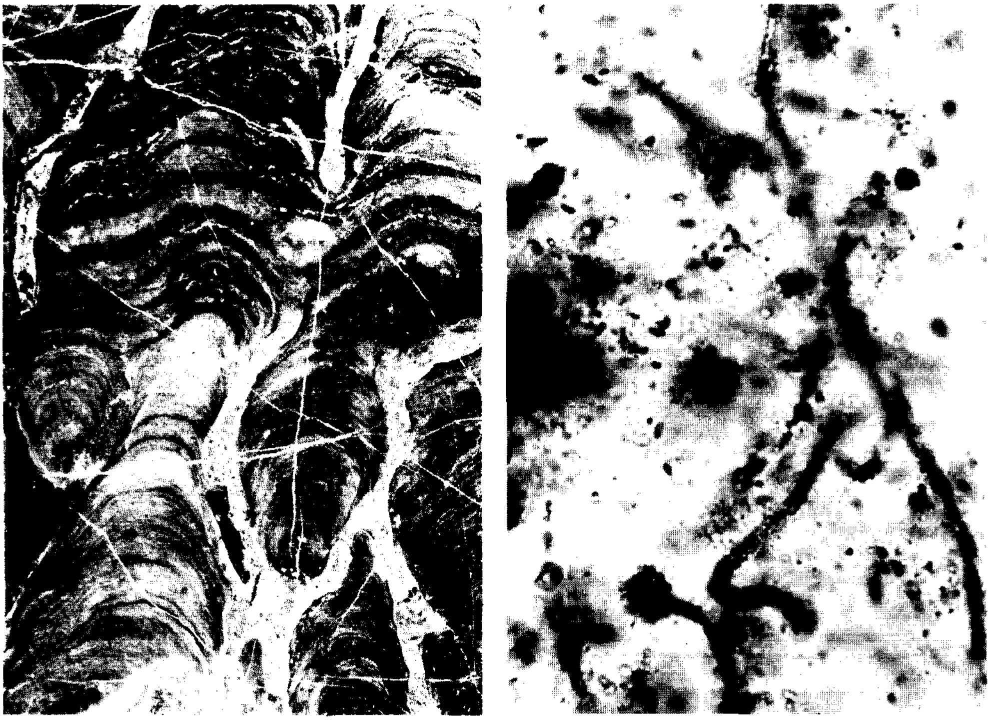
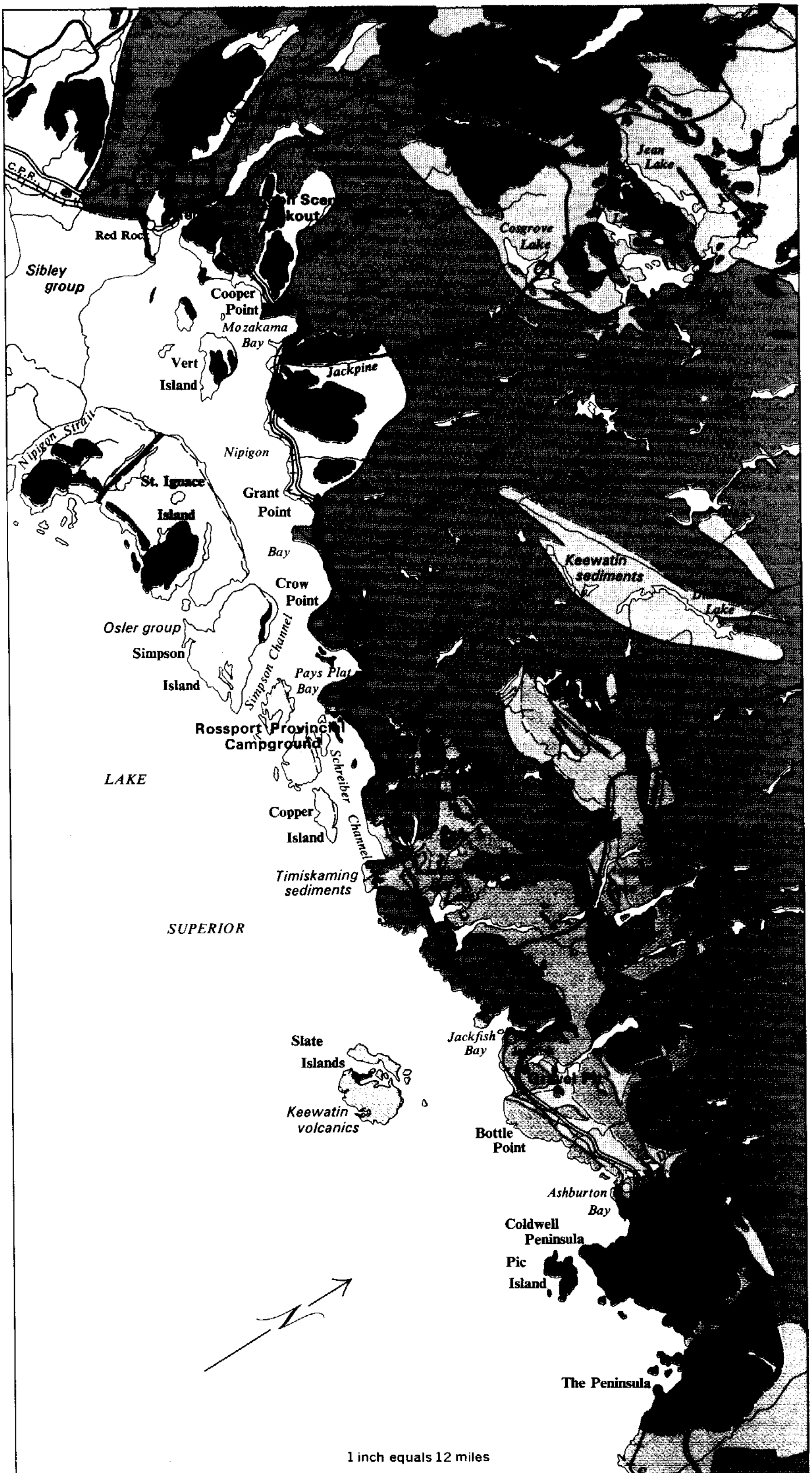


Photo 47. *The stromatolitic structures traced in the left hand photo by the wavy parallel banding were built up by algae whose fossil filaments are shown in the right hand photograph, enlarged 1000 times. These stromatolites and micro fossils in the Gunflint chert at Winston Point are thought to represent the earliest known forms of life. Photos courtesy the Geological Survey of Canada (left), and W. W. Moorhouse and A. E. Edhorn (right).*

## WINSTON POINT

South of the Rainbow Falls Provincial Park at or near Winston Point along the Lake Superior shore, outcrops of chert of the lower part of the Gunflint Formation have been studied by geologists and found to contain algal structures or stromatolites and the micro-fossil remains of other organisms. These are thought by most geologists who have studied them to represent some of the earliest forms of life discovered on earth to the present day (photo 47). Certain pseudo-fossils have also been recorded. Pyrite grains propelled through solid rock by the force of crystallization have left a trace of their path in worm-like quartz or carbonate trails. The deposition of the formation, based on radioactive age determinations, is believed to have occured 1,600—1,900 million years ago.




Map E. *Nipigon and Macdiarmid to Marathon.*

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## TERRACE BAY

Bedrock is not exposed at Terrace Bay. The principal feature here is the succession of flat terraces, which are deposits of sand and gravel, upon which the town has been built. These terraces, as at the Lakehead and Nipigon, reflect the changes in water levels in the Superior basin after the retreat of the Pleistocene glaciers from the north shore region. They are particularly prominent at this locality (the uppermost extends along the highway for several miles), and they rightly have provided the town with a most appropriate name.

## JACKFISH-MIDDLETON AREA

Ancient (Archean) volcanic rocks with interbanded sedimentary rocks are exposed intermittently along highway No. 17, between points 13 miles and 29 miles east of Terrace Bay (23 miles and 39 miles, respectively, west of the Marathon turn-off). They trend easterly, roughly parallel to the highway. Because they dip steeply north, at angles of 75° or more, and because they formed originally with horizontal or nearly horizontal attitudes, it is apparent that they have been steeply tilted. It is believed that in the Algoman period they were tightly compressed into great folds; mountainous ridges, now largely eroded away, may have alternated with deep, linear depressions.

Because of the compression and folding, the volcanic and sedimentary rocks were rendered schistose; they became foliated, somewhat like the pages of a book, so as to split readily along roughly parallel, irregular, undulating, very closely spaced planes. At the same time, original minerals were made over into new ones, so that the rocks suffered changes, not only in structure but also in mineralogical composition and appearance. The rocks were, in effect, highly metamorphosed. Basic lavas, perhaps not unlike those found on the Lake Superior islands, at the Mamainse mine, and elsewhere along the north shore, were converted to greenstones; rocks rich in the green, micaceous mineral chlorite. Contemporaneously, original sediments became chloritic slaty rocks. They can be examined most conveniently in three localities, where small parks with roadside tables have been established by the Ontario Department of Highways. These localities are: the Steel River, where, at the east end of the bridge, are typical slaty sediments; Black Fox Lake, where the outcrop is a chlorite-rich, highly schistose lava; and Dead Horse Creek, where typical greenstone is exposed. The Steel River, Black Fox Lake, and Dead Horse Creek are found 17, 19, and 27 miles, respectively, east of Terrace Bay.

A particularly interesting outcrop is found about 16 miles east of Terrace Bay and 500 feet east of a gravel pit on the north side of the highway. The gravel pit which provides safe parking lies a mile east of the turn-off to Jackfish. Parking is not safe at the outcrop, which is made up of basic lava, now metamorphosed to greenstone. It is similar to the greenstone found elsewhere in the area, its principal distinguishing feature being a well-developed pillow structure (photo 1). Pillow structure is fairly common in Archean volcanic rocks. Most geologists consider it to have been formed, at least in part, under water. The exact mechanism of development is not quite understood. Presumably, as the lava erupted at the surface and flowed into the sea, it was chilled and became viscous; it formed itself into irregular balls or pillows, which accumulated, one on top of the other, as we see here. The individual pillows at this locality are distinctly spotted, particularly in their upper parts (photos 1 and 2).

Photo 48. *Exposure of greenstone showing a surface that is polished and scratched by glacial ice. The scratches, glacial striae, indicate the ice moved south-south westerly. See also photos 1 and 2. Near the Steel River east of Jackfish.*

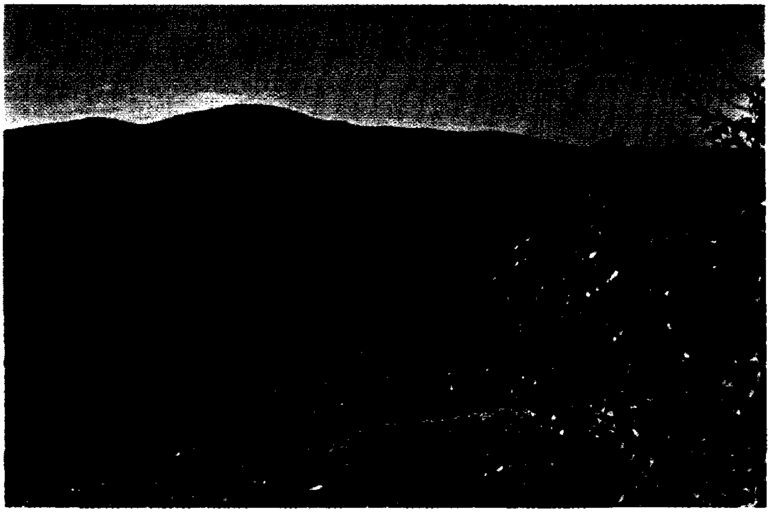


Photo 49. *View over Lake Superior towards the Coldwell Peninsula, from the Neys Park scenic lookout. The rock exposed at the lookout is a breccia.*

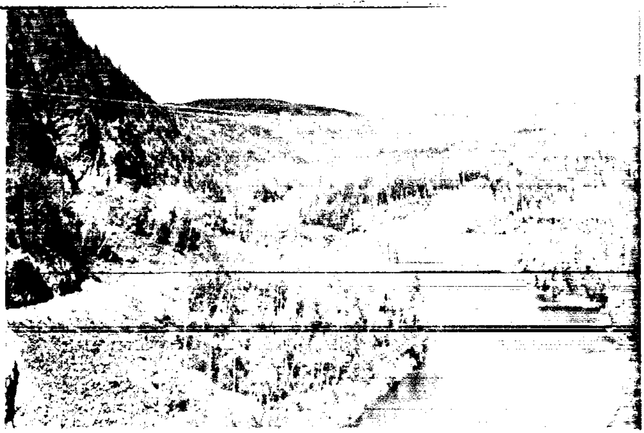
The spots represent cavities, or vesicles, that were formed by the escape of contained gases as the lava cooled, and that were subsequently filled by minerals that crystallized late in the evolution of the rock.

In Pleistocene time, when the continental glaciers advanced across Ontario, the grinding action of debris, carried along by the ice, wore down the greenstone bedrock, leaving the surface crudely polished and scratched; in places, where subsequent weathering has been negligible, these surfaces are preserved. The scratches, called glacial striae (photo 48), are roughly parallel. They indicate that, thousands of years ago, the glaciers moved south-southwesterly over this particular region.

## COLDWELL SYENITE COMPLEX

The Coldwell syenite complex extends along highway No. 17 for 22 miles, from a point 1.8 miles west of the Little Pic River near Middleton to a point 2.3 miles east of Marathon. It is so named because in this region about Coldwell is a great complex mass of igneous rocks called syenites. These rocks are rather like granites in overall appearance, and, except for the absence of quartz, also in composition. For the most part they slope, or dip gently, to the east near the Little Pic River, to the west near Marathon, and

Photo 50. *The valley of the Little Pic River, thought to follow the alignment of a prominent north-south fault.*



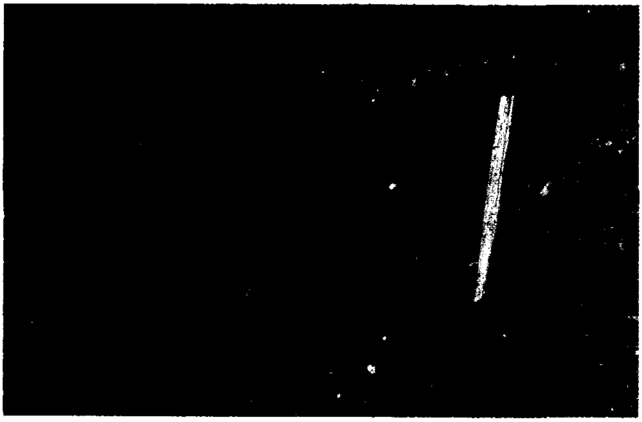


Photo 51. *Igneous breccia exposed at Neys Park scenic lookout.*

Photo 52. *Angler Creek near Marathon.*

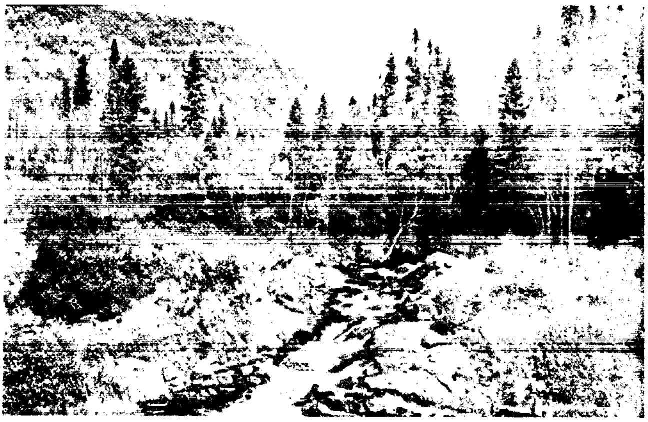


Photo 53. *The Marathon area. Man-made mountains of pulp logs compete for domination with hills of laurvikite.* (*Courtesy Ont. Dept. Tourism & Information*).

to the south at Bamoose Lake a few miles north of the highway. The syenites thus form a huge saucer-shaped or funnel-shaped body, and the different rocks are exposed as discontinuous and crudely semicircular bands, roughly concentric about a point near the body's geometric centre.

Syenites are named after the principal minerals, other than feldspar, that are present. Thus, an augite syenite contains the mineral augite; hornblende syenite, the mineral hornblende; and nepheline syenite the mineral nepheline. The outer band or ring is made up largely of a variety of rock called gabbro. This is succeeded upward and inward by augite syenite, and this in turn by red hornblende syenite with, in places, nepheline syenite. Gabbro is exposed in roadcuts east of the Marathon turn-off; augite syenite, at the roadside table 2.6 miles west of the turn-off and 1.3 miles east of Angler Creek; red syenite at the roadside table 10 miles west of the turn-off on the bank of Mink Creek; and nepheline syenite at Coldwell. The Coldwell syenites contain deposits of copper, columbium, and iron; although none of these appears to be mineable at this time, they indicate the area to have potential economic significance.

The rocks themselves are of considerable interest. The dark augite syenite and the red hornblende syenite are massive, coarse-textured rocks of pleasing appearance, particularly when cut and polished. They have all the necessary qualities of good building and ornamental stones. Indeed, in the late twenties and early thirties, both rocks were quarried at Marathon for these purposes, and were sold as "black granite" and "red granite" respectively. They have been used in the construction of several buildings in Toronto, Ontario, and in Chicago, Detroit, and other midwestern cities in the U.S.A.

The mineral nepheline, an important constituent of the syenite at Coldwell, has wide application in ceramic manufactures. It is not obtained commercially from the Coldwell syenite. A similar rock, however, is currently being mined for its nepheline content near Peterborough in southern Ontario.

## NEYS PARK SCENIC LOOKOUT

A scenic lookout has been established along the south side of highway No. 17 at a point 0.8 miles east of the Little Pic River near Middleton (photo 49). It provides an excellent view of the Lake Superior shore, and of the river valley, which extends northward for several miles as a deep, narrow, linear depression (photo 50). This linear depression is thought to reflect the occurrence of a zone of fractured and sheared rock, developed by movements along a prominent north—south fault through the Coldwell syenite complex at this locality. In this regard it is interesting that the rock exposed at the lookout, and in the road cut at the entrance to the lookout, is a breccia. As illustrated in photo 51, it is made up of angular fragments of broken, dark volcanic and other rocks, veined and cemented by reddish syenite. From this, and the fact the syenites themselves have been displaced, one might infer that at least two dislocations occurred, one before, one after the formation of the Coldwell complex.

Neys Provincial Park entrance lies east of the Little Pic River. The park camp grounds are located on a sandy beach in the Little Pic River estuary about 2 miles by gravel road from the main highway. There are secluded campsites, good swimming and full camping facilities in this scenic park.

## MARATHON

Marathon is sheltered in a deep water bay behind a high rounded promontory known as The Peninsula. The road into the town from highway No. 17 drops down over a series of sandy terraces which mark former glacial lake beach levels. Approximately the first 0.5 miles of the road lies on the highest of these beach levels, over 400 feet above the present lake level. Marathon is dominated by the high rounded hill of the Peninsula, which is composed essentially of laurvikite of the Coldwell Complex, and by the conical, man made hills of pulp logs stored on the shores of the bay (photo 53). Black laurvikite is exposed on highway No. 17 0.25 miles east and 2.5 miles west of Marathon and the rare mineral parisite has been reported from a road cut 1 mile east of Marathon.

# Marathon to Michipicoton

Highway No. 17 east of Marathon departs from the shore line of Lake Superior and arcs inland for about 120 miles, regaining the lake near Michipicoton. It leaves the syenite complex about two miles east of the Marathon turn-off and enters a region characterized by a great terrain of granite covered in part by long ribbon-like belts of ancient volcanic and sedimentary rocks. The highway follows one of these belts almost to the intersection with highway 614 except that there is an area of granitic rocks near Rous Lake, two miles west of the Hemlo road.

The gorge of the Pic River is crossed about two miles beyond the Marathon turn off and the Black River is reached in a further two miles. The valleys of both rivers were inundated by glacial lake Algonquin during the Pleistocene period leaving swamps and sand plains. About four miles beyond the Hemlo road, the highway passes near an old gold prospect. The whole area has seen considerable prospecting activity in the past eighty years, and although nothing of economic importance has yet been discovered, one cannot help but be impressed by the area's possibilities, in view of the occurrence of similar rocks at Manitouwadge nearby.

## MANITOUWADGE

Manitouwadge lies 35 miles north on highway No. 614 from its junction with highway No. 17 about 25 miles east of the Marathon cut-off. This attractive little town came into being in the mid-1950's following the discovery of zinc-copper-lead-silver ore bodies north of Manitouwadge Lake. Four mines have operated in the area and these are the Geco, Willroy, Willecho and Big Nama Mines. Annual metal production from these mines totals in the neighbourhood of 45,000 tons zinc, 28,000 tons copper, 1200 tons lead, over 2 million ounces silver and 5,000 ounces of gold.

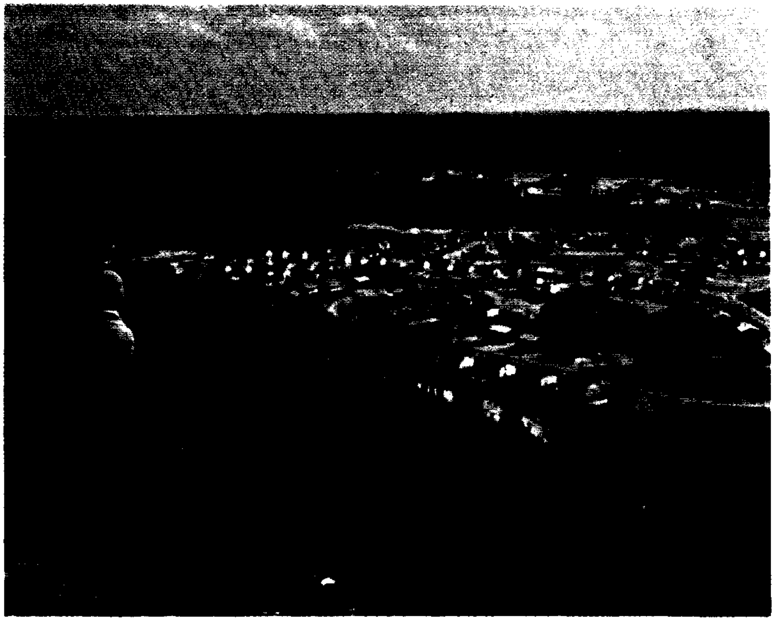


Photo 54. *View of Manitouwadge from a ridge composed of highly altered basic lavas. Manitouwadge Lake, left background, lies east of the town.*

A high east-west trending ridge of metamorphosed or highly altered basic lavas extends along the north side of Manitouwadge Lake and the town is situated at the west end of the lake on gently sloping ground at the base of this ridge. All the mines are located north of the ridge and are not visible from the town (photo 54).

The Archean volcanic and sedimentary rocks at Manitouwadge are folded into a large east trending trough or syncline, the core of which is intruded by a large mass of Algoman granitic rock. The sedimentary rocks overlie the volcanics, occurring towards the interior of the syncline, and the ore bodies are located in the upper part of the sedimentary section near the contact with the granitic core. The ore bodies are composed essentially of pyrite, sphalerite, pyrrhotite and chalcopyrite with minor galena. In form, they are roughly lens-shaped, and all plunge eastwards parallel to the regional syncline. Proterozoic diabase dikes intrude the volcanic, sedimentary and granitic rocks, and the ore bodies. Numerous faults cut the rocks and some of the ore bodies. The roads to both the Geco Mine, northeast of the town, and the

Willroy Mine, north of the town, utilize valleys eroded along such faults. At the Geco Mine an impressive pit some 400 feet deep lies on the west side of Fox Creek, west of the road. This marks the location of the original surface outcrop of the Geco Mine orebody. The ore has now been mined out of this section and the pit has formed by caving of the old mine workings.

## WHITE LAKE PROVINCIAL PARK

About 36 miles east of the Marathon cut off and eleven miles beyond the junction of highway No. 614, an access road on the south side of highway No. 17 leads to a recreation park of some six square miles on the shore of White Lake. There are many campsites in a forest of jackpine, white birch and poplar. Across the lake from the park is the Hudson Bay Company Trading Post, around which much of the Indian life is centred.

This area is the ancestral homeland of the Ojibway and the Cree Indians and there are many legends about the battles fought for its hunting grounds.

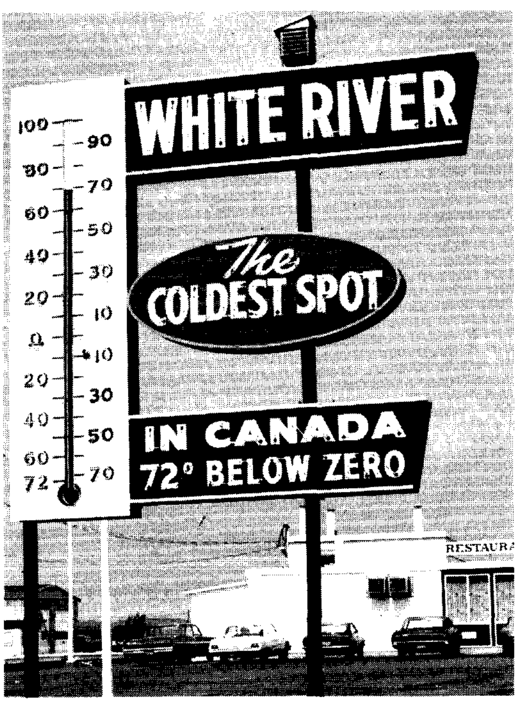



Photo 55. *White River has the frequent distinction of reporting Canada's lowest winter temperature. The town competes in friendly rivalry with a select group of northern Ontario communities for the title of Canada's coldspot. (Courtesy Ont. Dept. Tourism & Information).*

The contact between granitic rocks and one of the sedimentary and volcanic belts has been mapped as running across the park on an east west alignment through the group camping area. The granite lies to the south of the contact. There are also geophysical indications of a majòr diabase dike running northwest-southeast through the camp area.

## WHITE RIVER AND VICINITY

The town of White River lies 42 miles east of Marathon on highway No. 17 and is located within a deeply eroded section of the Canadian Shield. It lies within a large batholith of granitic rocks that are exposed intermittently along highway No. 17 for 34 miles west, and for 29 miles south of the town. Some of the rocks making up the batholiths are granites in the true sense of the terminology; they are pink massive rocks made up of quartz, feldspar, and some black mica. Most, however, are migmatites; these are composed of highly altered remnants of pre-existing volcanic and sedimentary rocks mixed thoroughly with variable amounts of granite. There are two varieties of migmatites: breccias, in which fragments of the older rocks are cemented by

Photo 56. *Outcrop of migmatite, South White River Park, showing lit-par-lit structure; alternating thin layers of granite and dark metamorphosed Archean rocks.*

dikes and veins of granite; and banded rocks, in which layers of the older materials alternate with layers of granite (photo 56). In the banded type, the migmatite is said to have a lit-par-lit structure. Particularly good examples of migmatite can be studied in exposures at South White River Park (photo 56), Marion Lake Park, and Hammer Lake Park, 13.0, 15.5, and 19.0 miles respectively, south of the White River turn-off. These are roadside parks established by the Ontario Department of Highways.

The White River granite batholith is believed to have formed deep within the Earth in Algoman time. Later, in the Keweenawan period, toward the close of the Precambrian era, it was fractured and intruded by magma that crystallized to form dikes of diabase. The diabase, like that near Nipigon and the Lakehead, is a black rock. It thus contrasts sharply with the pink granitic rocks and, where it is present along the highway, it is quite conspicuous. Prominent diabase dikes occur 1.5 miles west and 0.5 miles east of Wabikoka Creek, which is 1.8 miles south of Hammer Lake Park. There is no parking at these localities.

## OBATANGA PROVINCIAL PARK

This beautiful natural park of 53 square miles lies about 23 miles south east of White River and 34 miles north of Wawa and is currently being developed for camping at Burnfield Lake on the north side of highway No. 17. The campsites will be in an area of small lakes where more than the usual number of shore birds may be seen.

South and east of this park where the highway crosses Desolation Lake, the granitic rocks of the batholith give way to ancient volcanics and sediments and the highway enters an iron mining region. Near here the iron formation is represented topographically by steep hills of irregular outline separated by deep valleys where erosion has cut and attacked relatively soft rock materials. There are old iron mines in the area.

## WAWA

The town of Wawa, at the west end of Wawa Lake, is the business and community centre of the Michipicoten iron mining district. Its most interesting feature geologically is the flat sand plain on which it has been built; the plain lies between high hills composed of ancient volcanic rocks on the north and southeast. This sand plain is one of several terraces found between the town and Michipicoten Harbour on Lake Superior about 6 miles to the

Photo 57. *The Wawa Goose. (Courtesy Ont. Dept. Tourism & Information).*

southwest. The terraces are lake deposits formed when, after the retreat of the Pleistocene glaciers, the waters in the Superior basin stood higher. They occur at different elevations, the highest being about 360 feet above Lake Superior, and represent successive drops in the water level. Excellent vantage points for viewing these terraces exist at the parking area at the monument of the Wawa Goose along the turn-off road to Wawa, and along highway No. 17 north of the Wawa turn-off road and south of the bridge over the Algoma Central railway line (photo 59).

Photo 58. *The Helen Mine and the Wawa countryside. (Courtesy Ont. Dept. Tourism & Information).*

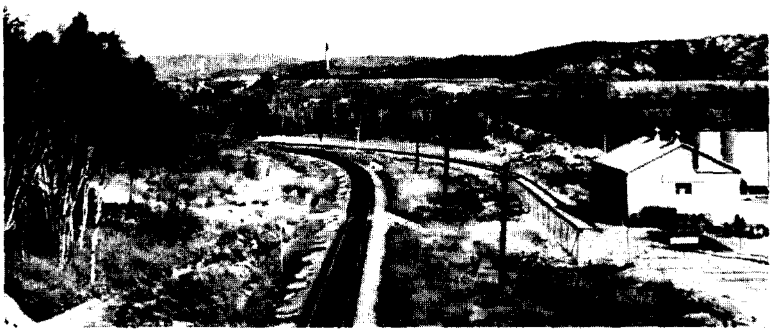


Photo 59. *Volcanic hills contrast with abandoned lake terraces in this view of the Wawa countryside from the rail overpass at highway No. 17.*

## ALGOMA STEEL CORPORATION LIMITED

Iron ore used in the manufacture of steel at mills in the United States, and at the Sault Ste. Marie mill of the Algoma Steel Corporation Limited is currently being obtained in the Michipicoten district from mines operated by the Corporation. The George W. MacLeod mine and some open pit operations produce about 3,000,000 tons of ore each year. The ore is made up mainly of the mineral siderite, which occurs as large, steeply-dipping, tabular bodies. The siderite is an iron-bearing carbonate. It does not contain sufficient iron for direct use in the blast furnace and, for this reason, it must be upgraded, or beneficiated. This is done by sintering, a process whereby the siderite is heated to drive off the carbon dioxide it contains. This yields a highly desirable product (iron oxide sinter) containing about 50 percent iron.

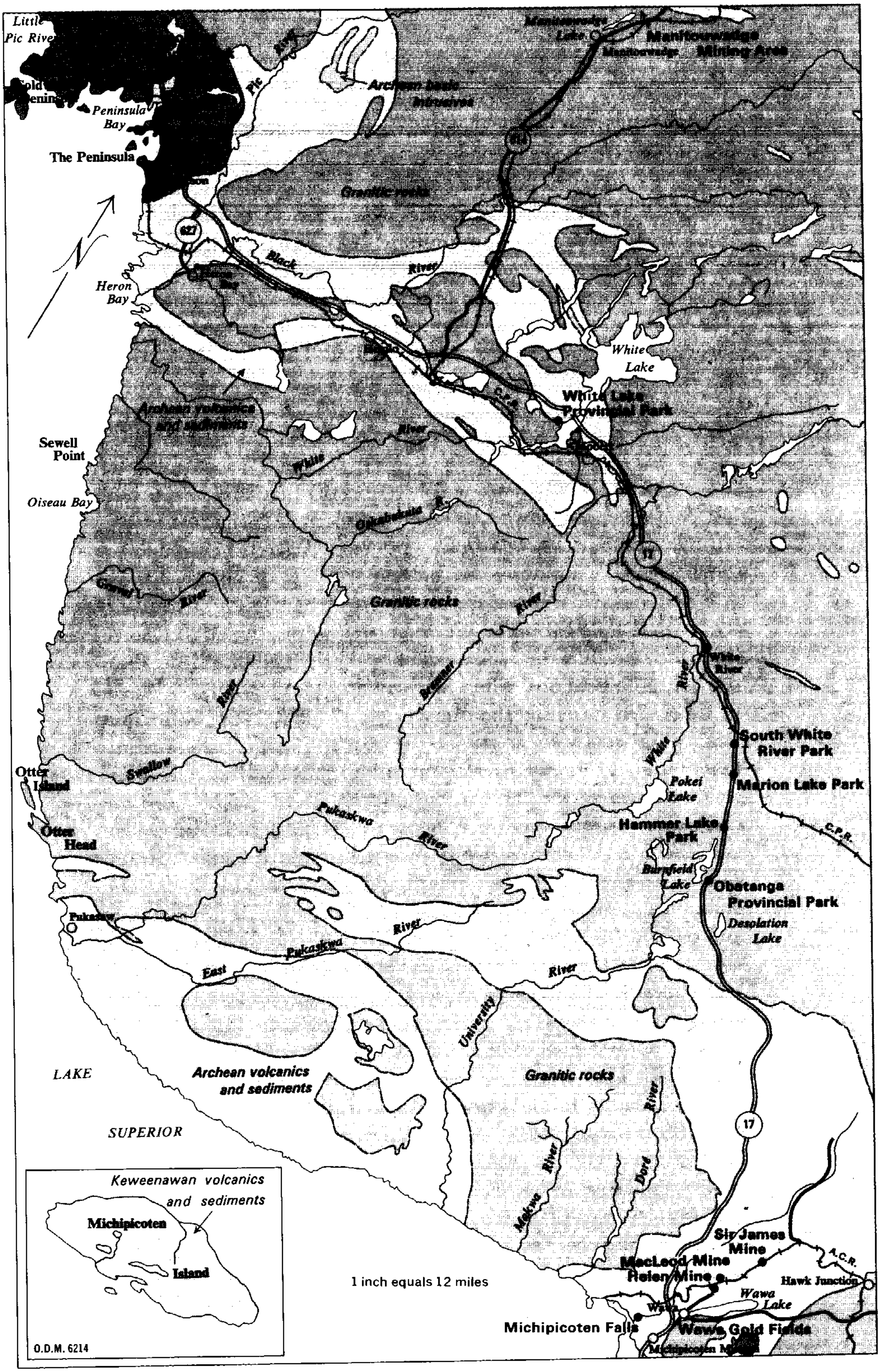
The first discovery of iron ore in the district was made at the site of the Helen mine in 1898 (photo 58). Mining began in 1900 and continued until 1918, when operations were suspended owing to the exhaustion of the known ore. At that time, only high-grade ore, consisting largely of the mineral goethite, a hydrous iron oxide, was recognized, and this was found to terminate at a depth of about 650 feet. Years later, when it became known that the goethite was merely a surface deposit resulting from the weathering of a large mass of underlying siderite, mining was revived. Soon afterward, other siderite orebodies were discovered, and the camp since has enjoyed continuous mining and sinter production from 1939 to the present.

Because of the interest demonstrated by tourists in its operations, Algoma Steel Corporation Limited arranges for conducted tours through the mines and sintering plant. These are held twice weekly, without charge.

## MICHIPICOTEN GOLD MINES

Long before the Michipicoten area became famous for its iron ore bodies, it was known for its gold deposits. Gold was first discovered on Mackey Point along the south shore of Wawa Lake in 1897. It is said that one day a Mission Indian, William Teddy, and his wife paddled across the lake to Mackey Point to camp for lunch. While Mrs. Teddy was getting water, she noticed some bright material in the rock at the lakeshore. The bright material proved to be gold and when her husband took samples to Wawa he succeeded in selling the discovery for $1,200. News of the find was published by the Associated Press. A staking rush was initiated, and it was not long before other gold-bearing veins were located south of the lake. Some of these were explored by the sinking of prospect shafts; subsequently, two mines, the Grace, and the Manxman (Norwalk), were brought into production. There is no record of how much gold was actually mined. The orebodies, however, were found to be either small or lowgrade and, after a few years, mining activity gradually ceased.

Interest in the gold deposits was renewed in the 1920's doubtlessly because of successful exploratory results in areas of similar geological conditions elsewhere in the province, particularly in the Porcupine and Kirkland Lake areas. Several new veins were discovered. The Grace mine was re-opened in 1926, and by 1931 three mines, the Jubilee, the Minto, and the Parkhill, had begun production. From 1930, when milling was started at the Grace mine, until 1939, when the Jubilee was shut down, the area yielded gold and some silver having a gross value of $3,329,369. Interest was revived in recent years and a recently opened gold mine, the Surluga lies along highway No. 101 south of Wawa Lake.




Map F. *Marathon to Wawa and Michipicoten.*

The sites of three of the old abandoned gold mines, the Mackey Point, the Wawa Gold Fields, and the Stanley, are along highway No. 101, 1.8 miles, 2.8 miles, and 4.0 miles respectively, east of Broadway Avenue in Wawa. There is little remaining at these mine sites. Except for the old dumps and, in the case of one, an adit (tunnel) into a hillside, they would be difficult to locate.

## MICHIPICOTEN FALLS, MAGPIE RIVER

The Michipicoten Falls on the Magpie River, shown on some maps as Magpie Falls, and sometimes referred to locally as High Falls is easily accessible by motor car. However, the route through a heavily timbered area is poorly marked, and doubtless some tourists have been deterred from visiting the site. This is regrettable. Having a height of 70 feet, and a width of 150 to

Photo 60. *Michipicoten Falls on the Magpie River. The abrupt change in the course of the river below the falls is controlled by fracturing and jointing in the granitic rocks. (Courtesy Ont. Dept. Tourism & Information).*

200 feet, the Michipicoten Falls is the most spectacular physiographic feature in the vicinity of the town of Wawa. It is reached by following highway No. 17 for one mile south of the Wawa turn-off; turning right to advance along a two-lane gravel road for 0.2 miles, and proceeding once more to the right or westward along a single-lane road across a sand plain for 1.7 miles. The falls lies in the river valley, 750 feet by trail downhill from the parking area at the road's terminus.

Most waterfalls occur at the boundaries between rocks having different degrees of hardness, particularly where, as at Kakabeka, a resistant rock overlies and protects relatively soft, easily eroded ones. At the Michipicoten Falls however, only a single rock type, a variety of granite, is evident. This being the case, one wonders why the falls does not occur downstream, where the hard granitic rock is known to come into contact with comparatively soft volcanic rocks. Close examination of the granitic rock at the falls shows that it is closely jointed or fractured. Some joints or fractures, 6 inches or more apart, trend easterly and slope steeply north. Other more numerous and more prominent fractures trend northeast roughly parallel to the face of the falls, and slope 65°-75° northwest. These fractures are spaced at intervals of one to two inches. Because they have greatly facilitated erosion of the bedrock at this locality, they control the location and attitude of the escarpment and, in addition, the downstream course of the river, which curves abruptly at the base of the falls and flows southwest almost at a right angle to its previous course (photo 60).

The reddish granite at the falls is porphyritic; it is made up of large crystals of phenocrysts of quartz in a comparatively fine-grained matrix. Known locally as "tapioca rock", it forms a part of an irregular body, about ½ mile across, enclosed by ancient volcanic rocks. It may be an upward-projecting tongue of a much larger mass or batholith of granite at depth. The granitic rocks in the Michipicoten area are very complex and are thought to span a great period of time. Very detailed mapping of the area will be required before it is safe to assign an age to this rock.

## MICHIPICOTEN ISLAND

The road to Michipicoten Harbour, Michipicoten Beach and Michipicoten Mission intersects highway No. 17 about 3 miles south of the Wawa turn off. Michipicoten Mission, a former Hudson Bay trading post and Indian mission known officially and on most maps as Michipicoten River, is a small community where boats can be rented for the 40 mile lake trip to Michipicoten Island, a noted centre for the collection of agate. Jasper, chalcedony, amethyst and several varieties of zeolite can be found on the island. The trip is recommended for experienced collectors only and visitors should seek advice locally about the availability of accommodation on the island before leaving the mainland.

## MISSION FALLS, MAGPIE RIVER

The road to Michipicoten Harbour branches from Mission Road 0.7 miles west of the intersection with highway No. 17. Where it crosses the Magpie River west of Michipicoten Mission, there are three small but picturesque waterfalls, referred to collectively as Mission Falls. The middle falls, (photo 62) with a drop of 15–20 feet, is about 500 feet north of the bridge over the river and can be seen from the road. The upper falls, 20–25 feet high, is a short distance farther upstream, and it can be reached by a good trail extending north along the west bank of the river.The lower falls, of about the same height, occurs 100 feet south of the bridge, and is best viewed from vantage points along a trail extending south along the east bank of the river.

Photo 61. *An acid dike cutting acid lava on the Mission River below Lower Mission Falls.*

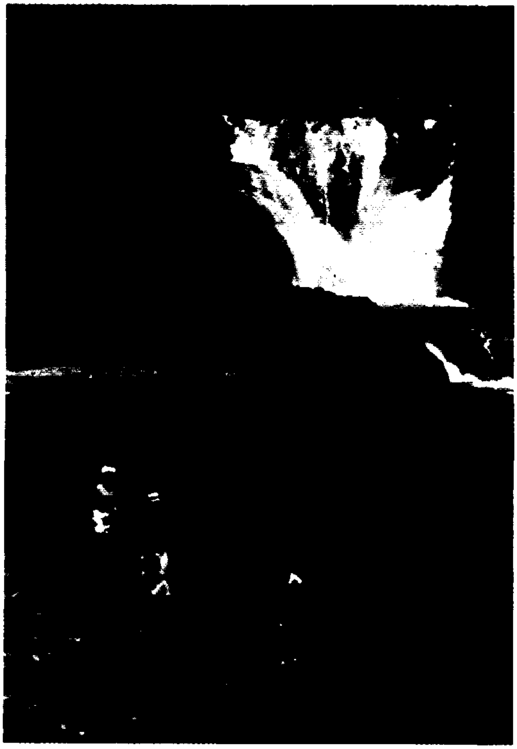


Photo 62. *Middle Mission Falls, one of three picturesque falls on the Magpie River near Michipicoten Mission. The rock exposed is a hard fine grained gray-green lava and the sites of the falls are probably controlled by jointing in the rock. (Courtesy Ont. Dept. Tourism & Information).*

The rock exposed at the three falls is a hard fine-grained greyish-green lava. It is highly fractured throughout, and probably has been eroded at a much more rapid rate than its hardness would indicate. As at both High Falls on the Michipicoten River, and again at Michipicoten Falls farther upstream on the Magpie River, there is no change in rock composition at the sites of the individual escarpments. Once more, one is inclined to suspect that the falls are localized where the bedrock is cut by prominent joints; in this regard it is perhaps significant that, in outcroppings south of the bridge at Mission Falls, the rock exhibits a well developed system of closely spaced, vertical joints trending east-northeast, roughly parallel to the face of the lower falls. High Falls lies about seven miles upstream from the bridge where highway No. 17 crosses the Michipicoten River and may be reached by a road running east from Michipicoten Mission. There is a power dam at the site.

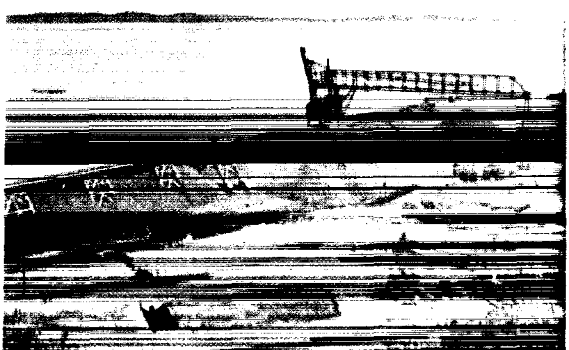
In the river bed below the lower falls, the lava at one locality is cut by a narrow vertical dike of material that is similar to the lava in both appearance and composition (photo 61). This dike, 30 inches wide, trends east-southeast. It likely represents an injection of magma from the same source as that which at an earlier date had erupted at the surface to form the lava flow itself.

## MICHIPICOTEN BEACH

The Michipicoten Beach lies along the northeast shore of Michipicoten Bay on Lake Superior, 3 miles by road northwest of Michipicoten Mission. About a half-mile long, the beach lies between two rocky headlands, where hard ancient volcanic rocks project into the bay. It is several hundred feet wide, and is made of clean, granular quartz sand. It rises rather gently from the shore. About 100 feet inland, however, it becomes strikingly hummocky, with knolls and curving ridges rising as much as 30 feet above lake level. These knolls and curving ridges are sand dunes (photo 63), formed by the action of strong south-westerly winds, which have picked up the sand near the shore and spread it irregularly landward. They are similar in every way to sand dunes found in desert regions, and they attest to the force with which the winds, blowing without obstruction across the waters of Lake Superior, sometimes strike this portion of the shoreline.

Photo 63. *Sand dune at Michipicoten Beach. Granular quartz sand is blown from the beach by strong winds across Lake Superior.*

Photo 64. *Algoma Steel Corporation ore loading docks at Michipicoten Harbour. Note the stockpile of sinter ready for shipment.*



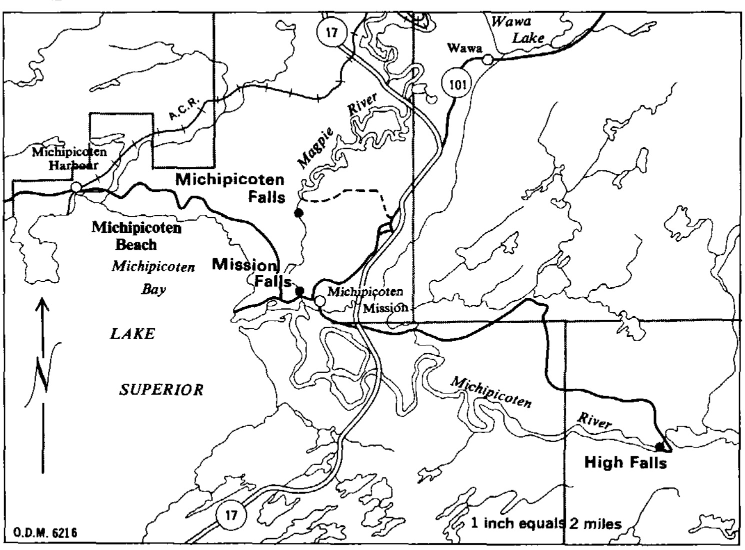
## MICHIPICOTEN HARBOUR

About three miles further west along the road from Michipicoten Beach is Michipicoten Harbour where the ore loading docks of Algoma Steel Corporation Limited are located (photo 64). The sinter or beneficiated iron ore from the mines near Wawa is here loaded onto lake boats for transportation to steel mills on the lower Great Lakes.

An interesting outcrop of boulder conglomerate can be observed by climbing the wooded hill north of the ore loading docks. The conglomerate is part of the Early Precambrian Dore Formation and contains pebbles, cobbles, and boulders of granite, porphyry, iron formation, and several types of volcanic rocks. The origin of the conglomerate has been the subject of considerable controversy, but it was probably deposited near the shore of an ancient island immediately south of Michipicoten Harbour. This island disappeared about 2,700,000,000 years ago.

The same conglomerate formation is also exposed in road cuts along Highway 17 about five miles north of the Wawa turn-off, but the pebbles here are much smaller. The change in pebble size is one method of determining the location of the ancient source area or island. As the pebbles are moved away from the source area they become smaller because of abrasion.

Map G. *The Michipicoten area.*



# Michipicoten to Sault Ste. Marie

## LAKE SUPERIOR PROVINCIAL PARK

### *The Park*

About 4.5 miles south of the Michipicoten River, highway No. 17 enters Lake Superior Provincial Park which is administered by the Ontario Department of Lands and Forests. For the next 52 miles the highway is within the park, which covers an area of five hundred and twenty square miles of rugged terrain, wooded with pine, spruce, birch and maple, and the motorist is presented with magnificent views of Lake Superior shoreline scenery. There are more than a thousand lakes in the park and many rivers. Picnic and swimming areas are well distributed. There are three fully developed camp grounds; Rabbit Blanket Lake, five miles south of Old Woman Bay; Agawa Bay on Lake Superior; and Crescent Lake, near the south boundary. Many interesting geological features can be observed near the highway. However, it has many curves and hills and when stopping at outcrops, visitors should take special precautions to park well off to the side of the road.

The moose population within the park is high, and moose can often be seen feeding in small lakes and swamps. Drivers should be on the look out for moose crossing the highway, especially in spring.

### *The North Park Boundary*

Near the north boundary of the park several iron formation outcrops composed of alternating layers of black magnetite and white chert occur on the west side of the road (photo 65). The iron formation can be identified by its layered appearance.

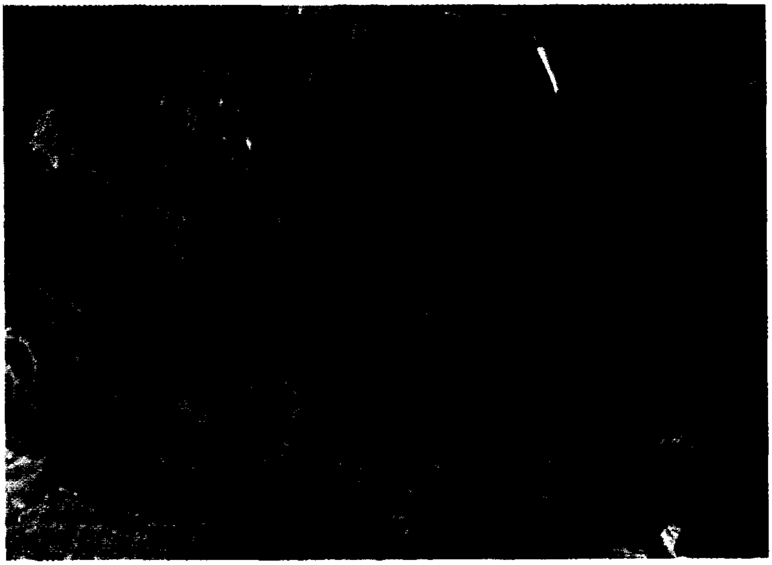


Photo 65. *Contorted iron formation on the west side of highway No. 17 near the north boundary of Lake Superior Park. The dark layers are magnetite and the light layers are chert.*

## *Old Woman Bay*

Eleven miles south of the Michipicoten River highway No. 17 descends to Lake Superior at Old Woman Bay where the North Information Centre is located. A picnic site has been established at a long sand beach at the head of the bay. From the beach there is an excellent view southward along a prominent cliff or scarp, 400 to 500 feet high, marking the location of the Red Rock River fault (Photo 66). This fault has a northerly trend and rocks on the west side of the fault have moved about 4.5 miles south and several thousand feet downward relative to rocks on the east side. Movement along the fault took place over a long period of time and the last movement was very many millions of years ago.

The northern continuation of the fault can be seen in the valley through which the highway descends toward Old Woman Bay. Granitic rocks on both sides of the road are highly fractured by movement along the fault and are stained deep red by hematite that was deposited from hot solutions moving along the fault.

## Red Rock Lake

The Park headquarters of the Ontario Department of Lands and Forests are at the south end of Red Rock Lake about seven miles south of Old Woman Bay. It is worth walking half a mile along the highway north of the headquarters to examine the ancient volcanic rocks displayed in the road cuts.

On the east side, high road cuts expose light-coloured ash-flow tuff, a variety of acid lava known as porphyritic rhyolite that forms when rhyolite magma containing a high volume of gas is erupted. A high gas content makes the lava very fluid and it travels a long distance from the vent and forms a blanket-like deposit whereas normal rhyolite lava moves only a short distance from the vent and forms a steep-sided dome or spine.

Photo 66. *The east shore of Lake Superior from Old Woman Bay in Lake Superior Provincial Park. The high cliff marks the trace of the Red Rock River fault and is known as a fault scarp. (Courtesy Ont. Dept. Tourism & Information).*

The ash-flow tuff at Red Rock Lake contains large crystals or phenocrysts of quartz and plagioclase and the rock resembles some types of granitic intrusions. Geologists recognize it as ash-flow tuff rather than granite because of the non-uniform distribution of the phenocrysts, and the presence of dark-coloured inclusions.

Northward along the road cut, layers of ash-flow tuff alternate with dark-green basalt lava flows and near the north end of the road cut, a 10-foot thick layer of iron formation occurs between two basalt flows. The iron formation is best exposed on top of the outcrop and is composed of alternating layers of white chert and grey to black magnetite.

Another iron formation unit is exposed about 75 feet west of the highway directly opposite the northwest corner of Red Rock Lake. (When travelling south on the highway this corner of the lake is the point where the highway first comes close to the lake.) The iron formation is about 60 feet thick but cannot be seen from the highway. It is composed mainly of alternating white chert and black magnetite layers but between many of the magnetite and chert layers are thin green layers composed mainly of the iron silicate mineral grunerite.

A porphyritic diabase dike is well exposed in the high road cut about 500 feet south of the iron formation outcrop. The vertically dipping, black dike is about 120 feet wide and is in sharp contact with white, rhyolitic ash-flow tuff on the south and with ash-flow tuff and dark green basalt lava flows on the north. The contacts and many of the other features of the dike are best seen on top of the outcrop.

The diabase was intruded as a fluid magma into a vertical crack or joint in the older volcanic rocks during Keweenawan time. When crystals form in rocks, slower cooling permits them to grow larger. The magma was much hotter than the adjacent volcanic rocks and the edges of the dike were chilled and quickly solidified into very fine-grained diabase. The centre of the dike cooled more slowly, because of the insulating effect of the crystallized chilled margins, and larger crystals were able to form at the centre. This variation in grain size is characteristic of all diabase dikes and is well exposed in this road cut.

The diabase contains small phenocrysts of plagioclase feldspar that are concentrated near the edges of the dike. In the centre of the dike are white, irregularly-shaped inclusions of ash-flow tuff, and the diabase immediately adjacent to the inclusions is lighter coloured and contains more plagioclase feldspar and quartz than normal diabase. This lighter-coloured rim represents a reaction between the solid acid inclusions and the basic diabase magma. The concentration of phenocrysts near the margins and of inclusions in the centre of the dike resulted from flowage of the fluid magma along the dike.

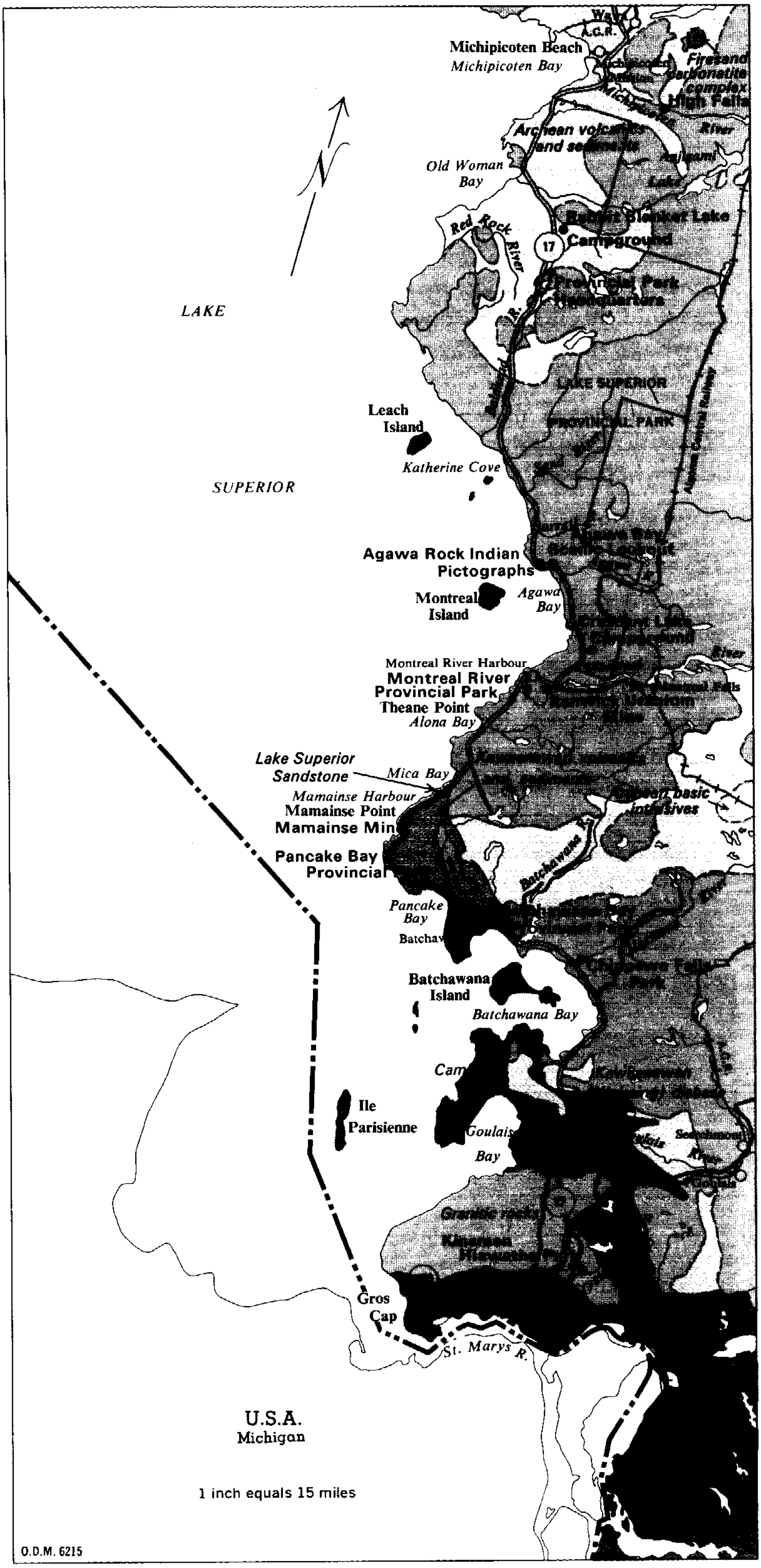
About 150 feet south of the dike a 10-foot thick, dark-green basalt flow at the side of the road contains oval amygdules of quartz about ¼ inch long.

South of the park headquarters the highway follows a sand-filled valley that marks the trace of the Red Rock Lake fault.

### *Baldhead River*

Seven miles south of Red Rock Lake (about 1000 feet south of the bridge over the north branch of the Baldhead River) an outcrop on the east side of the highway exposes basic rock called gabbro, here showing complex relationships often found in igneous intrusions. At least four different types of intrusive rocks are found. The older rocks occur as inclusions in the younger rocks (photo 67) and it can be seen that some of the inclusions themselves contain inclusions of still older rocks. In general the darker coloured rocks are the older ones.

Photo 67. *An outcrop on the east side of highway No. 17 showing the complex relationships found in igneous intrusions in the area. Four different intrusive rocks in various shades of grey are shown in the photograph. The black spots are basalt.*




Map H. *Michipicoten to Sault Ste. Marie and Desbarats.*

About 0.9 and 1.2 miles south of the north branch of the Baldhead River, unusual brick-red syenite dikes occur on the east side of the highway. These two dikes are 50 to 100 feet wide and are composed of red plagioclase and orthoclase feldspars and a rare black amphibole mineral known as kataphorite. Tabular, white feldspar phenocrysts occur in, and generally parallel the edges of, the dikes; this parallelism resulted from flowage of magma along the dikes. The dikes were intruded during Keweenawan time and have the same variation in grain size as diabase dikes — the margins were rapidly chilled and are very fine-grained but the centres cooled more slowly and are coarser-grained.

At the top of a hill on the east side of the highway about 500 feet south of the southern syenite dike are several peculiar spotted outcrops (photo 69). The spots are about three inches in diameter. Upon close examination it is found that the spots are aggregates of large plagioclase feldspar crystals near the bottom of 50-foot thick dark green basaltic lava flows. Such aggregates are known as glomerocrysts and the rock is called glomeroporphyritic basalt. The aggregates formed when a basalt flow containing large plagioclase felspar phenocrysts was extruded. The phenocrysts were heavier than the magma and sank towards the bottom of the flow where they collected in aggregates. The plagioclase feldspar in the aggregates is a calcic variety known as bytownite.

Photo 68. *Looking south along highway No. 17 near the Baldhead River. Note the rugged nature of the topography in this beautiful park.*

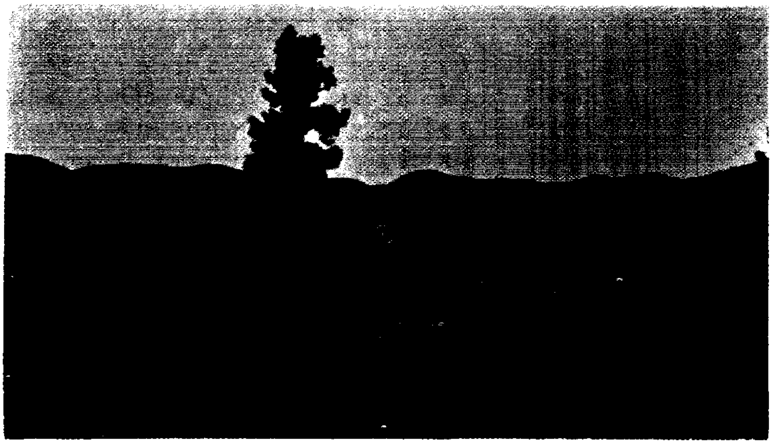


Photo 69. *A spotted basalt outcrop on the east side of highway No. 17 about a mile and a quarter south of the Baldhead River, north branch. The spots are glomerocrysts, aggregates of bytownite feldspar grains.*

## Sand River

The Sand River is crossed by highway No. 17 at a point about a mile south of Katherine Cove and fifteen miles north of the park's southern entry point. It is noted mainly for the fact that, near Lake Superior, it tumbles quickly in its descent over well jointed granitic rock to form a beautiful succession of low falls and rapids. A picnic area gives good parking and there are scenic trails to the falls. One can hardly refrain from being attracted by the appearance of the bedrock; it has large crystals of reddish feldspar, some as long as 6 inches, and exhibits a distinct porphyritic texture. Also of considerable interest are the prominent sand dunes along the beach at this locality, created by wind action, and similar to those at the Michipicoten Beach near Wawa. In the author's opinion, however, the outstanding feature is the conspicuous sand bar that has developed across the river's mouth (photo 70).

The sand bar was created by the action of longshore currents sweeping along the margin of the lake. Longshore currents are usually set up by waves that strike the shore at an oblique angle. They remove the sand from beaches about exposed headlands, and distribute it along the more protected places, such as are provided by embayments in the shoreline. Where the currents pass a particularly deep indentation, such as the mouth of a river, the sand is deposited as a ridge, and this ridge grows until, finally, it extends across the indentation as a long narrow bar.

## *Agawa Rock Indian Pictographs*

About two and a half miles south of the Barrett River and ten miles north of the south boundary of the park, a short access road on the west side of highway No. 17 leads to a parking lot and picnic area, from which a short, rugged and picturesque trail (photo 72) leads to Agawa Rock.

Agawa Rock rises sheer a hundred feet about Lake Superior. Scattered along its base are 35 Indian rock paintings (photo 73) which are said to illustrate the story of an Indian war party which left a village on the south shore of Lake Superior, came ashore at this point in five canoes after a three day lake crossing and destroyed an enemy village near Agawa. The story is well documented in park literature. The first trace of these pictographs came from Henry Schoolcraft, a United States Indian agent early in the nineteenth century. Longfellow used Schoolcraft's collection of Ojibway folklore in the theme of his epic poem "Hiawatha".

Photo 70. *Sandbar across the mouth of the Sand River, Lake Superior Provincial Park.*

A vertical gash splits Agawa Rock. Present day geologists have interpreted it as resulting from the erosion of a narrow dike or joint, but Indian lore ascribes it to the path of descent of Manabozko, "the Devil".

### *Agawa Bay Scenic Lookout*

The Agawa Bay Scenic Lookout, at a point along the highway four miles south of the Barrett River and two miles north of the Agawa River, provides a magnificent view of the Lake Superior shoreline and the surrounding country. This area, with its high hills rising hundreds of feet above the lake, is one of the most rugged and most beautiful in Ontario. It is underlain almost entirely by granitic rocks, such as those exposed at the lookout itself. The granitic rocks are of igneous origin and form a part of a large batholithic mass formed in the Algoman period of Precambrian time.

Most rocks contain radioactive elements such as uranium, potassium, or rubidum that break down into other elements at a steady rate. By measuring the amount of radioactive element and of its breakdown products in a rock, the age of the rock can be determined if the rate of breakdown is known. This has been done by the Geological Survey of Canada for granite at Agawa Bay Lookout using potassium in mica. The age thus determined is 2,340,000,000 years.

Photo 71. *Agawa Rock and Agawa Islands looking southeast toward Agawa Bay. (Courtesy Ont. Dept Tourism & Information).*

Photo 72. *The trail to Agawa Rock. The photographs on this page are courtesy Ontario Department of Tourism and Information.*

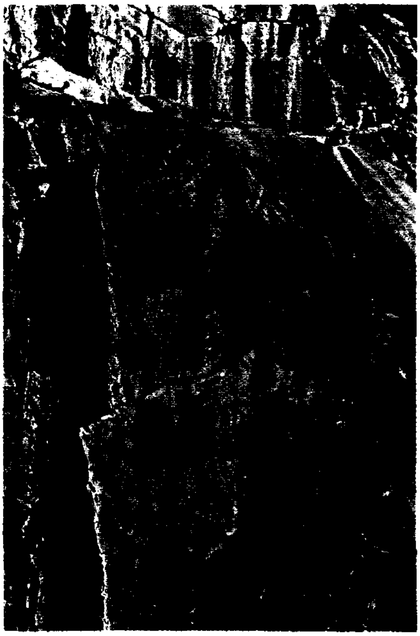


Photo 73. *One of 35 ancient Indian rock paintings at Agawa Rock. The horse and rider are thought to represent Ojibway Chief Myeengun.*

Photo 74. *Agawa Bay. The area is mostly underlain by granitic rocks; those at the Lookout have been dated at 2,340,000,000 years old.*

Photo 75. *Visitors underground at Ranwick Uranium Mine, south of Lake Superior Park.*

## RANWICK URANIUM MINE

The Ranwick Uranium mine (photo 75) is situated along the highway 2.7 miles east of Montreal River Harbour and 4.0 miles south of the south boundary of the Lake Superior Provincial Park. When uranium was discovered at Theano Point by Robert Campbell in 1948, a staking rush was precipitated in the Montreal River area. In November 1948, while working north of the original find and back from the lakeshore, R. R. Ranson discovered pitchblende in a northwest-trending diabase dike, similar to that on Theano Point. Strong radioactivity was noted along this dike at intervals for about a mile, In January 1950, an adit was driven along its southwest side for 1,050 feet and, from this, several openings (crosscuts) were extended across the dike. A number of occurrences, in which pitchblende was found in veins associated with calcite and hematite, were found; these averaged a little better than 0.6 pounds of uranium oxide per ton.

Throughout the summer months tours of the underground workings of the Ranwick Uranium mine are conducted for tourists, and demonstrations are given in the use of the geiger counter for uranium prospecting. A mineral collection is also displayed, and samples are available for collectors.

## MONTREAL RIVER

Where it is crossed by highway No. 17, the Montreal River flows through a steep-walled canyon (photo 76). Although this canyon is no more than about 100 feet deep, it is unusually narrow; the tourist is prone to conclude all too quickly that it represents a deep crack in the earth opened by some violent earthquake. Like most theories based on insufficient evidence, however, this idea is far from being an acceptable explanation of the phenomenon. Close examination of the bedrock shows that the walls of the canyon consist of hard granite, whereas, in the river bed, one finds a tabular-shaped body of black diabase. This diabase is in the form of a dike that extends along the river bed below the bridge and dips, or slopes, steeply to the north at the same angle as the canyon walls. There is little doubt that the canyon resulted merely from more rapid erosion by the river of the diabase dike than of the enclosing granite.

The differential erosion of the diabase dike may be due to the fact that the diabase is highly cracked or jointed, whereas the

Photo 76. *Canyon of the Montreal River caused by the differential erosion of a diabase dike cutting Algoman granitic rocks. (Courtesy Ont. Dept. Lands and Forests).*

granite is quite massive in character. The joints or cracks are of two types. Some joints, which may be described as longitudinal, have the same attitude as the dike itself. Other joints, much more numerous and closely spaced, extend transversely across the dike and cause the rock to break into thin polygonal prisms or columns, 1–6 inches in diameter. The columnar jointing is remarkably well developed in this dike and is one of the most outstanding examples of columnar jointing to be found along the north shore of Lake Superior. The diabase crystallized from a hot magma, and the columnar jointing is thought to have resulted from contraction due to cooling, from the walls of the dike inward, of the solidified rock.

## MONTREAL RIVER PROVINCIAL PARK

### *The Abandoned Cobble Beaches*

Across highway No. 17 from Tony's Northgate Restaurant, 1.5 miles south of the Montreal River bridge (5.7 miles north of Alona Bay), there is a natural clearing in the forest, underlain almost entirely by pebbles and cobbles of granitic and other rocks. This unconsolidated material is an old abandoned beach, similar, except for its composition, to other abandoned beaches found along the highway at such places as Port Arthur, Nipigon, Terrace Bay, Marathon, Wawa, and Sault Ste. Marie. A beach of this type, containing little or no sand, is usually found along unprotected sections of a shoreline, where undertow and shore currents remove all fine material, but leave any original pebbles and cobbles. Similar beaches are being formed about Lake Superior at the present time, good examples being found north of Grand Marais in Minnesota.

The abandoned beach is interesting, not only because of its make-up, but also because of its structure. Walking over it, one notes that the loose materials form several parallel and gently curving ridges, the crests of which lie roughly 50 feet apart (photo 77). Each of the ridges is thought to have been caused by the accumulation of pebbles and boulders tossed up on the beach by violent wave action, but it has also been suggested that they formed as off shore bars. Eastward, the crestlines of the ridges tend to occur at successively lower elevations, a phenomenon best observed at the side of the clearing farthest from the highway.

Ontario has set aside the beach area as a nature reserve provincial park to preserve it for the enjoyment of future generations.

Photo 77. *An abandoned cobble beach near Montreal River Harbour, showing the curved ridges, thought to result from violent wave action.*

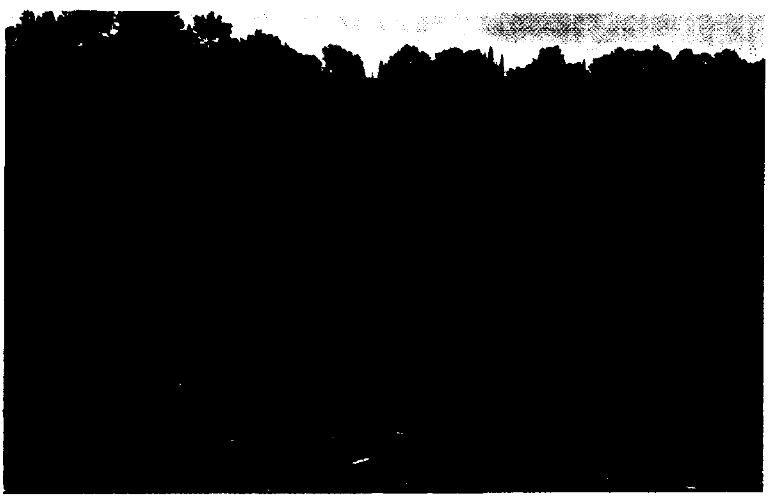


Photo 78. *Theano Point from across Alona Bay. Theano Point is the site of what was probably Canada's first uranium discovery in 1847, rediscovered a century later.*

## ALONA BAY

A roadside park at Alona Bay, 7 miles south of Montreal River and 12 miles north of Mamainse Harbour, affords an excellent view of the Lake Superior shoreline. The prominent rocky headland guarding the bay on the north is Theano Point (photo 78).

### *First Discovery of Uranium*

Theano Point may be the site of the first uranium discovery in Canada. In 1847, in a paper published in the American Journal of Science, J. L. Le Conte refers to a sample of a uranium-bearing mineral collected by B. A. Stanard and said to have been taken from the lakeshore about 70 miles north of Sault Ste. Marie, at a place where the geology is not unlike that of Theano Point. Several attempts were made by the Ontario Department of Mines and the Geological Survey of Canada to relocate this occurrence. These efforts were unsuccessful, and it was not until 1948 that a uranium-bearing deposit finally was found here by prospector Robert Campbell.

Robert Campbell's curiosity in the region about Theano Point was prompted by the sudden interest in uranium arising out of the atomic bomb. Learning of the original discovery, he obtained a geiger counter and set out to prospect the Lake Superior shoreline. On 8 September 1948, he was caught in a storm on the lake. His boat was wrecked, and he was forced to take shelter in a small cove on the west side of Theano Point. Undaunted by his supposed ill-fortune, he proceeded to check the rocks in the cove with his geiger counter; and near the water's edge, in the granite face forming the south wall of the cove, he found short veins of a highly radioactive black mineral, which ultimately proved to be pitchblende, the chief ore mineral of uranium. Additional veins were evident deeper in the cove; Mr. Campbell proceeded to stake out his find, and his claims, recorded on 16 October 1948, were transferred ultimately to Camray Mines Limited.

The rock exposed on Theano Point is principally granite. The granite is interrupted in several places by diabase dikes. Indeed, the discovery cove, a narrow canyon similar to that at Montreal River Harbour (*see* p. 106), was formed by the differential erosion of a dike, 35–40 feet wide. This particular dike trends west-northwest and dips 70°N. Along the dike's south boundary, both the diabase and the granite country rock had been highly fractured, and these fractures are mineralized with pink calcite, chlorite, hematite, and pitchblende in varying proportions.

In 1949, a shaft was sunk on the deposit, and some underground work was carried out. However, the results of this work were disappointing, and operations at the property were soon suspended.

## MICA BAY

At Mica Bay, 12 miles south of Montreal River Harbour and 7.5 miles north of Mamainse Harbour, there is a small sand terrace at an elevation of about 15 feet above a 1,000-foot long gravel beach between two prominent granite headlands. Behind the beach, at the base of the cliff formed by the terrace, and extending north about 100 feet from the south headland, is an exposure of sedimentary rocks of the Lake Superior Formation (photo 12). This formation is the youngest exposed in the region. Most geologists who have studied it do not believe it to be of Precambrian age as are other rock formations nearby, but rather of Paleozoic age. The contact with the underlying rocks is a surface of unconformity, representing a long period of erosion, during which a great thickness of rocks was removed to expose the granite, before the Lake Superior Formation was deposited.

Photo 79. *Lake Superior Sandstone at Mica Bay, showing a well developed cross laminated structure resulting from current action.*

At the bottom of the formation, and resting directly on the granite at the end of the beach, is a small patch of conglomerate. This rock is similar in many respects to that found near the Mamainse mine; it is the indurated, compacted equivalent of a coarse gravel containing pebbles, cobbles, and boulders of material not unlike the granite on which it lies. Above it, in the cliff, are several feet of grey, rather soft, well stratified shales and sandstones. These rocks are particularly interesting because, in places, they are distinctly cross-laminated (photo 79). This structure is a primary one and was caused by water currents at the time of sedimentation. Where currents sweep sand or silt along the bottom, the deposit develops parallel ridges, much like the ripples formed on the surface when a object is thrown into water. These ridges form roughly at right angles to the current. They are asymmetric, with gentle slopes facing upstream and relatively steep slopes downstream. Once formed, they provide loci for further deposition and, as the currents continue to flow, material is dropped over their crests to accumulate on their lee sides. In this way new crests are formed, and the ridges migrate downstream. As the material accumulates, and the deposit gets thicker, a wavy bedding is formed at a considerable angle to the main stratification.

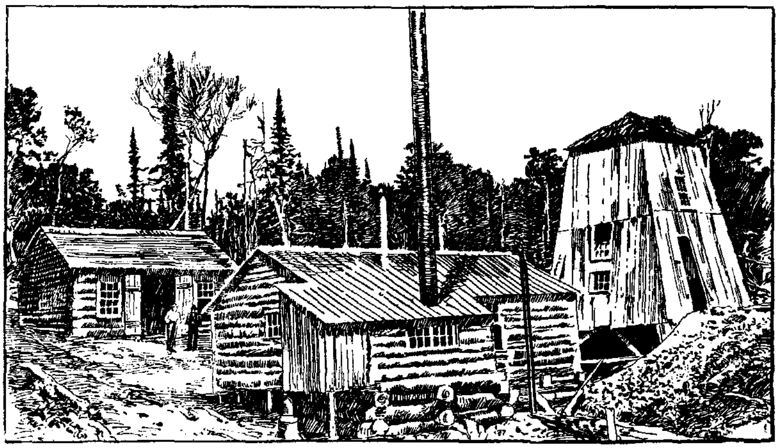
In addition to being cross-laminated, the sediments of the Lake Superior Formation have been distorted because of lateral compression. At the south end of the outcrop, they dip or slope about 15 degrees to the north. At the north end of the outcrop, they dip about 10 degrees to the south. Near the centre of the exposure, they curve abruptly and stand nearly vertical. This change in dip is conspicuous. It reflects the occurrence of a small monocline, defined as the type of fold characterized by a local and abrupt steepening in the attitude of otherwise gently sloping strata.

## MAMAINSE MINE

The existence of copper at Mamainse Point was known in early times from its utilization by the local Indians; later, when the geology was observed to be similar to that of the great Michigan copper district on the Keweenaw Peninsula, the region was thoroughly investigated by prospectors. Indeed, several copper deposits were discovered, and between 1842 and 1894 a number of attempts were made by different mining companies to develop profitable operations. These activities, however, met with little success. Although at least three mines, the Copper Creek (photo 80), the Silver Creek, and the Mamainse, were opened, and a mill was constructed at the Mamainse mine, there is no record that any significant amount of copper was produced until recent years when two mines, the Coppercorp and the Tribag came into production in the general Batchewana Bay area.

The Mamainse mine is located near the south end of a small

Photo 80. *A pen and ink sketch of the Copper Creek Mine on Sand Bay location, in the 1880's. From Ontario Department of Mines records.*



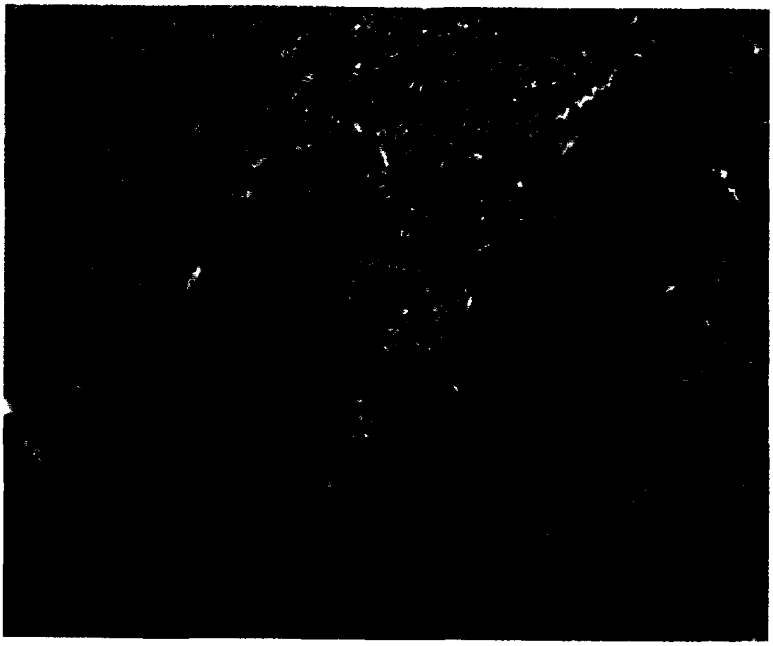


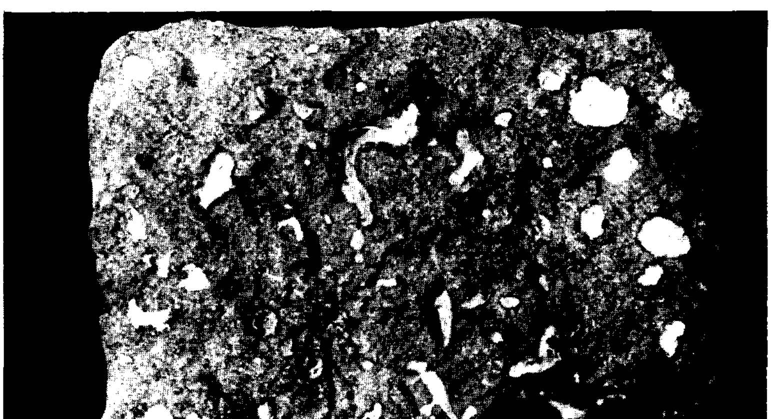
Photo 81. *An aerial photograph of the Mamainse area, showing the fingerlike headlands projecting into the lake. The top of the photograph is slightly west of north. The deep gorge running across the headland is probably a fault which was eroded by wave action when the lake stood higher.* (*Courtesy* Ont. *Dept. Tourism & Information*).

park along the highway, 2.0 miles north of Mamainse Harbour and 5.2 miles south of Mica Bay. The rocks here are of Late Precambrian (Keweenawan) age. They are of two markedly contrasting types. Along the highway, about 250 feet north of the park entrance, is a conglomerate. This rock consists of pebbles, cobbles, and boulders of granite and other rocks in a matrix of red sandstone; the rock is simply the hard, compacted or consolidated equivalent of a coarse textured gravel (photo 9). In the park itself, both along the lakeshore and at the mine site, the bedrock is made up of a number of thin, dark lava flows. These flows are all basalts; their tops are characteristically spotted or amygdaloidal (photo 83), owing to the fact that small cavities, formed by the escape of gases when the molten lava poured out over the surface, have been filled by such minerals as agate, calcite, chlorite, and epidote. The conglomerate bed and the amygdaloidal lava flows trend north and dip about 30 degrees

Photo 82. *Fingerlike headlands, Mamainse mine area. The headlands are parallel to the strike of the rocks (lava flows). They have gentle dip slopes facing the lake and have steep slopes or escarpments inland.*

to the west. Significantly, this structure is reflected in the physiography of the shore line. The individual lava flows form a series of low ridges. These ridges project northward, along the line of strike, into the lake as finger-like headlands (photos 81 and 82); when viewed lengthwise, they are commonly found to be asymmetrical, with gentle dip-slopes to the west and abrupt escarpments facing the east.

Photo 83. *Amygdaloidal lava, showing vesicles or gas cavities filled by late formed minerals.*



The mineral deposit at the old Mamainse mine is exposed at the lakeshore, where a little native copper occurs in an 8-foot wide, well-defined zone of highly fractured and mineralized lava. This zone strikes north-northwest, obliquely to the trend of the lava flows, and dips easterly at 50 degrees. It has been traced for a distance of ¼ mile. Three shafts were sunk on it, and the material mined can be seen on the dumps about the old openings. There is little evidence that, despite the large amount of work done, any valuable ore was found in the workings.

## PANCAKE BAY AND BATCHEWANA BAY

### *Provincial Parks*

Provincial Parks with camping facilities have been established on sandy beaches ten miles and sixteen miles south east of Mamainse Point (photos 85 and 86). Pancake Bay was a stopping point on the famous fur trade canoe route which ran from Quebec to the North West Territories. Here is one of the longest and widest sand beaches found along the entire north shore of Lake Superior.

## CHIPPEWA FALLS PARK

Chippewa Falls Park is located on the Harmony River known locally as the Chippewa, which flows south-westerly into Harmony Bay on Lake Superior, at a point 38 miles north of Sault Ste. Marie and about 6 miles east of Batchawana. Here are two scenic waterfalls, about 150 feet apart, facing the southwest. They have been found to be attractive to tourists, and a park with facilities for picnicking has been established at the site by the Ontario Department of Highways (photo 84).

The upper falls can be reached conveniently by following a good trail from the park for about 800 feet along the southeast bank of the river. It occurs where the principal rock formation, a well jointed but otherwise massive pink granite, is cut by a dike of diabase. This dike is a vertical, or nearly vertical, tabular-shaped body about 65 feet thick. It trends northwest and stands up as a highly resistant wall, over which the river tumbles 20–25 feet in its descent toward Lake Superior. Standing on the dike and looking northwesterly along it, one will see that it terminates abruptly; this is because it has been faulted. It has been displaced to the right, and is found on the opposite side of the river about 30 feet farther upstream (northeast) than would normally be anticipated.

Photo 84. *The lower Chippewa Falls, Harmony River. Granitic rocks are overlain by Keweenawan lavas sloping gently towards Lake Superior. (Courtesy Ont. Dept. Lands and Forests).*

The lower falls also drops 20–25 feet. Here, however, there is no resistant dike to provide an escarpment. On the contrary, the falls occurs where the granite is capped by a thin erosional remnant of a Keweenawan lava flow. This remnant lies athwart the river bed. It slopes or dips about 30 degrees to the southwest near the top of the falls (photo 89), but flattens so that, at the base of the falls, it slopes at angles of 10 degrees or less. Like the diabase dike at the upper falls, this remnant of lava, too, has been faulted and, as a result, its exposures along the northwest bank of the river lie farther upstream than those in the river bed and along the southeast bank.

The patch of lava is most interesting, not only because its controls the site of the falls, but also because of the features it exhibits, and because of its relationship with the underlying granite. The lava flow is dark in colour and is basic, or basaltic, in composition. It crystallized from a liquid magma, which, before eruption, contained abundant water vapour and other gases. When this magma poured out over the surface, these gases escaped rapidly and, in

Photo 85. *Pancake Bay, a stopping point on the once famous fur trade route and a new provincial park, has one of the longest sand beaches on the north shore of Lake Superior.*

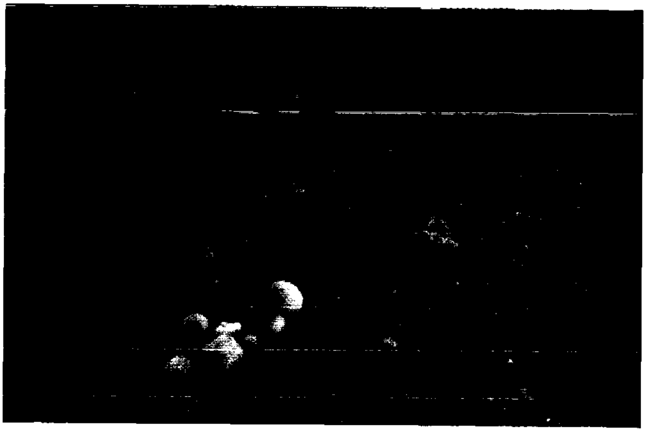


Photo 86. *Rock outcrop at Batchewana Bay. This area is also a provincial park.* (Courtesy *Ont. Dept. Tourism & Information*).

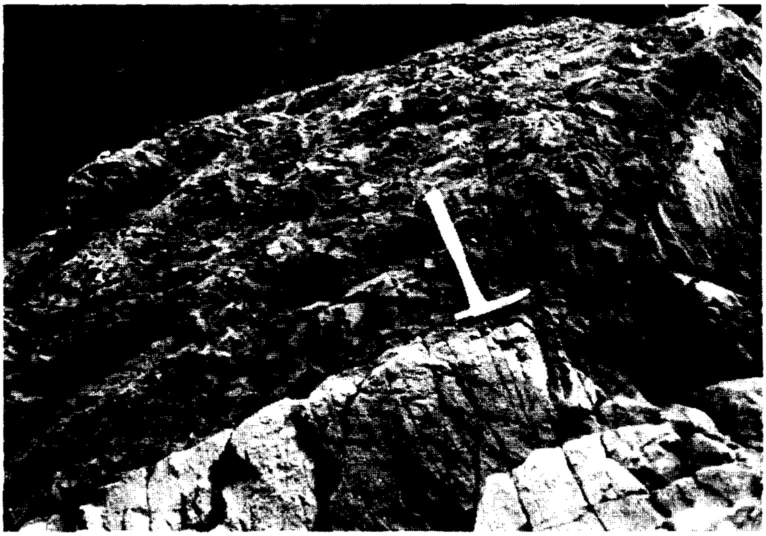
Photo 87. *Harmony Bay, a picnic spot on highway No. 17 east of the Harmony River.* (Courtesy *Ont. Dept. Tourism & Information*).

Photo 88. *A pothole in basic lava, Chippewa Falls Park.*

doing so, left the lava riddled with rounded bubble-holes or vesicles. Subsequently, those vesicles became filled with secondary minerals, such as dark green chlorite and pale green epidote, and the resulting rock became crudely spotted in appearance, and amygdaloidal. In addition, it is very closely jointed, and its surface is exceedingly rough and jagged in appearance. It is also broken by irregular but persistent fractures. Along some of these, the rock has taken on a reddish colour, due to the presence of the mineral hematite. Some fractures are filled with pale green epidote; along others are found narrow veins of white calcite. Where the basic lava is in contact with, and rests upon, the granite, it is very fine-grained, no doubt because here the lava was rapidly chilled. In a general way the boundary between the two rocks is fairly even In detail, however, the contact is highly irregular; thin tongues of lava project downward and outward from the flow for several inches, extending along fractures, and in places completely enclosing small blocks of the older granite (photo 90).

Where the water in a rapidly flowing river is given a rotary motion by eddying currents, as might be the case below a waterfalls, it tends to grind out round depressions in the bedrock. Such round depressions, or potholes as they are called, are found in the basic lava and, to a lesser extent, in exposures of the granite near

Photo 89. *A basic lava flow resting on granite and sloping southwest, Chippewa Falls Park, Harmony River.*



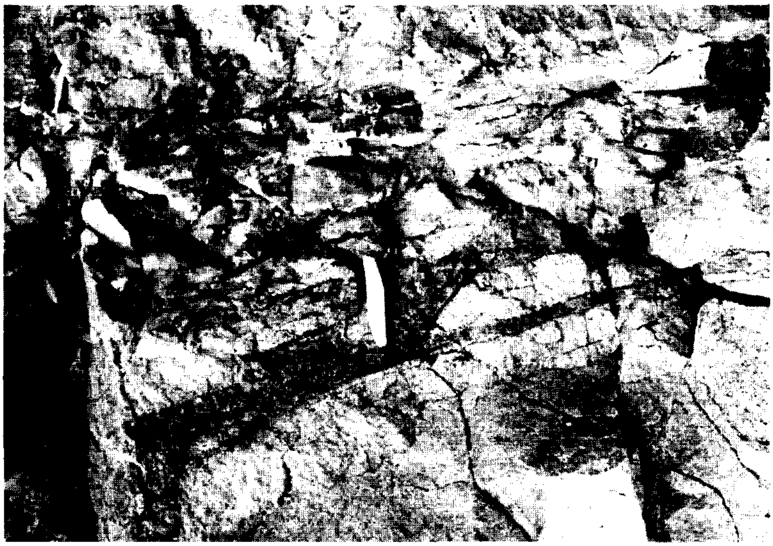


Photo 90. *Detail of the irregular contact between the granite and overlying basic lava, Chippewa Falls Park.*

the base of the lower escarpment (photo 88). They are numerous, and attain large sizes, with diameters as much as 5 feet and depths as great as 3 feet. Nowhere along the north shore of Lake Superior has the author noted more outstanding examples of this geological phenomenon. Because of these large, well developed potholes, the geological conditions controlling the sites of the two waterfalls, the structures displayed by the bedrock formations, and the scenic attractiveness, there is little doubt that Chippewa Falls Park is one of the most interesting locations along the north shore highway.

# Sault Ste. Marie and Vicinity

## ST. MARYS RIVER LOWLANDS

The city of Sault Ste. Marie is on the north bank of the St. Marys River connecting Lake Superior with Lake Huron. It has been built on deposits of clay, sand, and gravel. These deposits form a number of flat or gently sloping terraces. Like similar deposits at other localities in the region, they are deposits formed when the lake waters, after the retreat of the Pleistocene glaciers, stood higher. They vary greatly in elevation, and three are prominent. The highest stands about 420 feet above the present lake level; the second prominent terrace has an elevation of about 100 feet; the third an elevation of about 50 feet.

## THE GROS CAP BATHOLITH

The most prominent geological feature in the vicinity of Sault Ste. Marie is a rugged highland, with elevations of 400–600 feet above Lake Superior, separating the St. Marys River and Goulais River lowlands. Its southern boundary is a prominent and somewhat irregular escarpment that stretches from Gros Cap, on the shore of Lake Superior, eastward to the Garden River Indian Reserve, a distance of about 20 miles. It is several miles wide, and is crossed by highway No. 17, from 8 to about 15 miles north of downtown Sault Ste. Marie. It is the topographic expression of a large mass or batholith of Algoman granite.

As pointed out previously, a batholith is formed deep within the earth, and is exposed to view only after a prolonged period of erosion. In this regard, it is of considerable interest that most batholiths are associated with intensely folded volcanic and sedimentary rocks in mountain ranges; thus, it is tempting to specu-

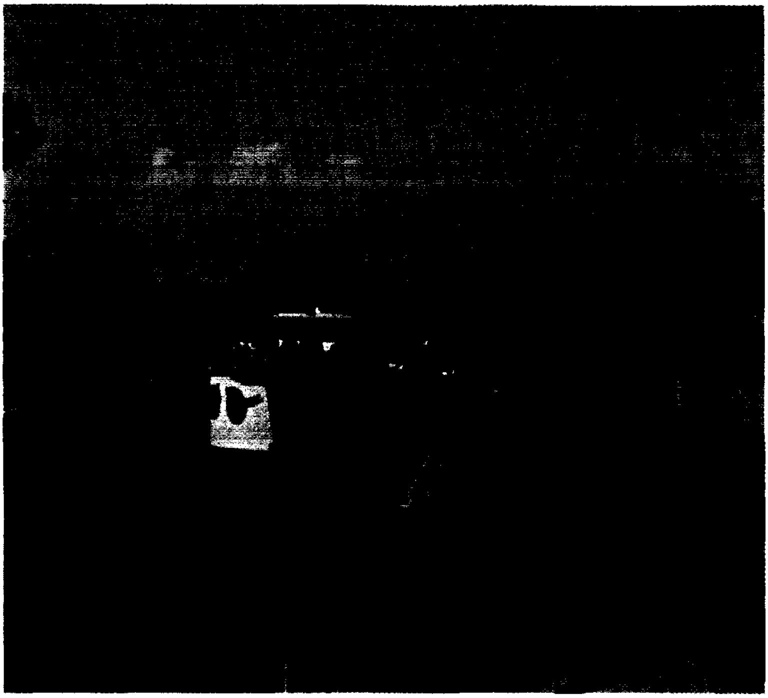


Photo 91. *The locks at Sault Ste. Marie. (Courtesy Ont. Dept. Tourism & Information).*

late that, in Precambrian time, the Gros Cap batholith was one of many such masses formed in a mountainous region, perhaps not unlike that found today along the western margin of the North American continent.

## KINSMEN HIAWATHA PARK

Hiawatha Park has been established as a community recreational site by the Kinsmen Club. It lies along Crystal Creek and is on the Tarentorus Township 5th Line Road, about 2.5 miles east of the intersection with highway No. 17, 5.6 miles north of downtown Sault Ste. Marie. Crystal Creek flows southwesterly across the Gros Cap granitic highlands. The south boundary of the highlands is a high, step-like escarpment; where Crystal Creek flows over this escarpment, it forms a series of beautiful waterfalls. At Crystal Falls (photo 92), at the north end of Hiawatha Park, the creek drops about 100 feet; at Minnie Ha-Ha Falls, about ¼ mile

Photo 92. *Crystal Falls, where Crystal Creek falls over the south-facing escarpment of the Gros Cap batholith in Hiawatha Park near Sault Ste. Marie.*

to the south, it drops over two closely spaced ledges, one about 10 feet high, the other about 20 feet. The locations of both these falls were controlled, doubtlessly, by prominent joints in the pink granite bedrock.

Below Crystal Falls, the creek flows through a narrow valley, about 100 feet deep, cut into a flat sand terrace. This terrace is a lake deposit that was formed along the south side of the Gros Cap highlands when the latter, upon the retreat of the Pleistocene glaciers, formed the shoreline of one of the ancestral Great Lakes.

## DESBARATS

### *The Ripple Rocks*

Along highway No. 17 east, 1.5 miles west of Desbarats and about 3 miles east of the road leading to St. Joseph Island, is a large rockcut through an outcrop of thin-bedded quartzite, a metamorphosed form of sandstone. The Ontario Department of Highways has made parking available just west of this noted geological

Photo 93. *Wave-made ripple marks in Huronian quartzite, near Desbarats east of Sault Ste. Marie.*

site which is mentioned in standard North American geological texts. Sample collecting is not permitted, to preserve the site intact.

The rock was laid down in late Huronian times as part of the Lorrain formation. It strikes west-northwest and dips or slopes at about 60° to the south. It was originally laid down in a horizontal, or near-horizontal, position in a standing body of water, and obviously has been tilted to its present attitude as the result of folding due to compression in the earth's crust. Aside from the fact the sandstone slopes at a steep angle, its principal characteristic is the presence of ripple marks. Where the rock has broken along its bedding planes, the ripple marks are very prominently displayed (photo 93).

The ripple marks lie from 3 to 6 inches apart, and they occur as symmetrical ridges that rise as much as an inch above the troughs between them. There is little doubt that the ripple marks were formed by the action of waves close to an old shoreline. In this regard, it is of great interest that, in some beds, the ripple marks are oriented almost at right angles to those in other beds. One must conclude, therefore, that as the sand, which gave rise to the ripple-marked rock, was being deposited, there were abrupt changes in the direction of the shoreline of the ancient lake or ocean.

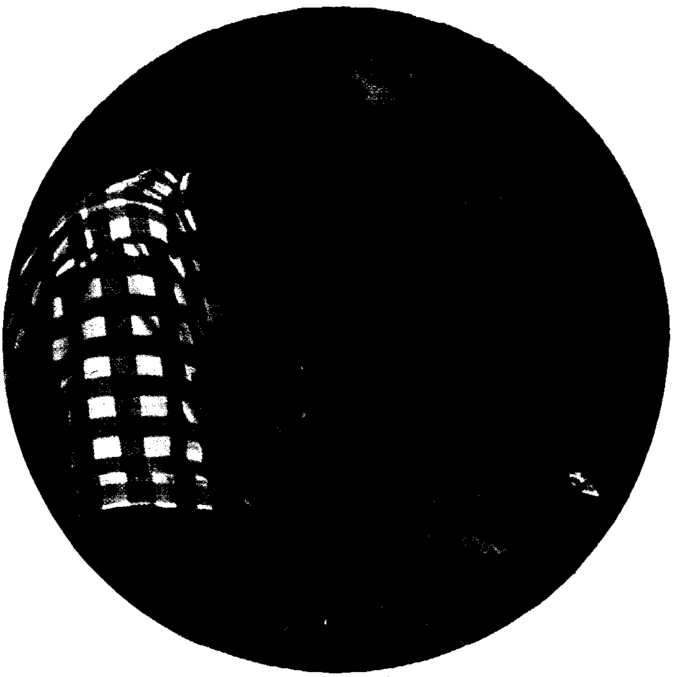


Photo 94. *The rockhound. Photograph courtesy Ontario Department of Tourism & Information.*

**PART 3**

# Rock Collecting, Glossary, References

# LOCALITIES FOR COLLECTORS

A large number of minerals and rocks, some of them suitable for lapidary work (cutting and polishing) are obtainable along or close to highways No. 61, No. 17-11, and No. 17, about the north shore of Lake Superior. Names and descriptions are on the pages following.

### *Agates*

Agates, with beautiful concentric circular markings, are found filling cavities in basic lavas exposed on the islands in Lake Superior east of Sibley Peninsula and south of Rossport. Many of these have weathered loose from the bedrock. Because of this they commonly are found as pebbles in the gravel beaches along the south sides of the islands. Michipicoten Island and Cape Gargantua, noted sites for agates, can only be reached by boat.

### *Amethyst*

Amethyst is a variety of quartz having a distinct purple colour. It occurs in veins and, where these have open cavities or vugs, it commonly forms beautiful clusters of pyramidal crystals. Samples of amethyst can be found: on old mine dumps in the region about the Lakehead; in veins exposed at the mouth of the McKenzie River about 10 miles northeast of Port Arthur; and in narrow veinlets cutting shales in the bed of the Current River in Port Arthur, between Boulevard Lake and Trowbridge Falls Park. The Thunder Bay Amethyst Mine is described on page 58.

### *Anthraxolite*

Anthraxolite, a mineral substance resembling anthracite, occurs in narrow veins in rocks of the Gunflint Formation. Samples have been found at several localities in and near Port Arthur. Generally, the veins are so narrow and so erratically distributed that individual occurrences have not been recorded.

### *Apophyllite*

Apophyllite crystals up to ½ inch in diameter occur in narrow, quartz-calcite veins in diabase, 0.8 miles south of the south branch, Baldhead River, Lake Superior Park.

### *Argentite*

Argentite was a common, but valuable, mineral in the silver ores mined in the region about Port Arthur prior to 1913. Samples, in which it is associated with calcite, are obtainable in the old mine dumps on and about the diabase-capped mesas along highway No. 588 about 4 miles southwest of the village of Stanley. The quality of the material, however, is poor.

### *Arsenic*

Native arsenic was found in a 35-foot shaft sunk on a silver-bearing vein at the south end of Edward Island in 1884. Edward Island is at the entrance to Black Bay, Lake Superior, east of Sibley Peninsula, and can be reached by seaworthy boats from Silver Islet Landing.

### *Augite*

Specimens of augite, ½ to 1 inch across, can be obtained from a very coarse-textured augite syenite exposed in a rockcut 200 feet east of the Roadside Table on highway No. 17 at a point 2.5 miles west of the Marathon turn-off.

### *Barite*

Good samples of barite can be found in the dumps at the Beaver Junior mine, and in the North Bluff vein on which this mine was developed. The mine site is along highway No. 588, 4 miles southwest of Stanley, at the west end of the diabase-capped mesa at this locality. Barite occurs as veins in granitic rocks about ½ mile north of Ozone, on Ozone Creek, 11 miles east of the junction of highways No. 11 and No. 17.

### *Bytownite*

Bytownite, a calcic variety of plagioclase is found in glomeroporphyritic basalt, 1.3 miles south of the north branch, Baldhead River, Lake Superior Park. It is generally equant and ½ inch to 1 inch in diameter.

### *Calcite*

Calcite occurs in most mineral veins found in the vicinity of the Canadian Lakehead. Particularly good samples can be obtained from the dump at the Shuniah mine in Port Arthur. This mine is reached from the Scenic Lookout at Boulevard Lake Park, by taking the single-lane road for ½ mile to the radio tower. The calcite here is fluorescent. Delicately zoned crystals of calcite are found locally in quartz-calcite veins in diabase 0.8 miles south of the south branch, Baldhead River, Lake Superior Park. Good crystals are found in open veins on Cape Gargantua but can only be reached by boat.

## *Chalcocite*

Small amounts of chalcocite occur in fractures in basic lavas along the Lake Superior shoreline between Mica Bay and Mamainse Harbour. It also occurs in a vein at the north end of a wagon road that branches from highway No. 17 at a point 1.1 miles south of Mamainse Harbour. The distance from the highway to the occurrence is about 3,000 feet.

## *Chalcopyrite*

Chalcopyrite occurs at the Enterprise mine, where it is associated with amethyst, quartz, calcite, and other minerals. The Enterprise mine lies 9.2 miles south of Dorion and 0.7 miles north of Pearl Lake. It is easily reached from highway No. 17-11 by following road No. 69-13 east for 0.7 miles to the Canadian National railway line and then by proceeding northeast (left) alongside the railway line for 0.2 miles. Chalcopyrite is also found in a copper deposit near Middleton, along a wagon road that extends a half-mile south from highway No. 17, at a point 1.3 miles west of the bridge over the Little Pic River.

## *Chert*

Three varieties of chert occur in the city of Port Arthur. One

Photo 95. *A picnic site overlooking Lake Superior, Ontario. (Courtesy Ont. Dept. Tourism & Information).*


Photo 96. *A rockcut on highway No. 17 north of Lake Superior.*

variety is a dark grey, thinly laminated (banded) type occurring as layers in sedimentary rocks. In structure, it resembles some varieties of onyx. Samples may be obtained from outcrops along Banning Street, in the lane below Hillcrest Park and at Trowbridge Falls Park. The second type of chert is oolitic; it is made up largely of oölites, tiny rounded bodies having concentric or radial structures or both, and resembling the roe of fish. Good samples, suitable for lapidary work, are found below the Black Bay bridge at the north end of Boulevard Lake. The third, and prettiest, type of chert is algal chert. This material, when cut and polished, presents beautiful colour and textural patterns. It, too, can be obtained along the Current River north of Boulevard Lake. Exceptionally fine specimens are obtainable also from outcrops in the bed of the Whitefish River, near the bridge along highway No. 588, about 1.8 miles west of Nolalu.

### *Chlorite*

Dark green to black chlorite can be picked up: in an old mine dump along the road to Silver Islet Landing on Sibley Peninsula, about 300 feet north of the Silver Islet store; and at Black Fox Lake along highway No. 17, 19 miles east of Terrace Bay and 33 miles west of Marathon.

### *Concretions*

Small concretions, suitable for collectors, are found in shale quarries along the Oliver Road (highway No. 130) about 4 miles west of the junction with Memorial Avenue (highway No. 17-11) in Port Arthur.

### *Conglomerate (Puddingstone)*

Conglomerate, with pebbles small enough to make the rock suitable for collections, can be obtained in the lower part, and at the south end of, the large outcrop at the junction of highways No. 17 and No. 590 at Kakabeka Falls Park Plaza. Leave vehicles in the park and walk to the outcrop.

A coarse conglomerate, the basal member of the Sibley Series, is exposed along the West Loon Road 1.1 miles west of Loon Lake railway station on the Canadian Pacific railway line. The station is 0.6 miles north of the intersection with highway No. 17-11, at a point 21 miles northeast of the Port Arthur city limits.

### *Copper*

Native copper occurs as cavity-fillings in amygdaloidal lavas, and specimens have been collected from exposures of this rock on Edward and Porphyry islands at the mouth of Black Bay on Lake Superior, and in the islands along the north shore near Rossport. Copper-bearing amygdaloidal lavas have also been observed southwest of the Lakehead, in Blake township (lot 8, concession VI), Crooks township (lot 4, concession II), and Oliver township (lot 12, concession III). Samples have been found along the Lake Superior shoreline between Mamainse Harbour and the old Mamainse mine. During the construction of highway No. 17 in 1936, a specimen of native copper, weighing 147 pounds, was found in a rockcut at mileage 55 north of Sault Ste. Marie.

### *Dolomite*

The mineral dolomite was found in the Silver Islet mine, and samples can be found on the dump on the island.

### *Epidote*

Green epidote coats joint surfaces in a hornblende diorite along highway No. 17 between Fungus and Kabenung lakes, 29 and 31 miles south of White River (32 and 30 miles north of Wawa), respectively. Parking is available at Kabenung Lake. Epidote is associated with fluorite and quartz in veins in granite along highway No. 17, from 7 to 8 miles west of Rossport. Excellent specimens of green-coloured epidote-feldspar pebbles are obtainable along the Lake Superior shoreline at Montreal Harbour.

### *Feldspar*

Good specimens of feldspar, some with cleavage faces having a chatoyant lustre (moonstone) occur along highway No. 17 in a rockcut 1.2 miles west of the bridge over the Little Pic River; the bridge is 17.5 miles west of Marathon.

An interesting deposit of feldspar is exposed near Shack Lake in the northwest corner of Pic Township, two miles north of Marathon on the property of C. Downey. The feldspar occurs in an augite syenite, or laurvekite, that underlies this area. The augite syenite is part of the Port Coldwell alkali complex. The feldspar deposit is tabular and consists of coarse crystals of perthite feldspar exhibiting a chatoyant lustre. A beautiful play of colours in merging patches of blue, purple and gold is to be seen on certain crystal faces. The crystals vary in largest dimensions from ½ inch to 6 inches.

### *Fluorite*

Excellent specimens of fluorite, occurring as small cubic crystals, either coating fracture surfaces in granite or associated with quartz and epidote in veins, have been obtained from a rockcut along highway No. 17 about 7 miles west of Rossport and 2.4 miles west of the Pays Plat River.

### *Fossils*

Limestone samples, rich in marine fossils, are obtainable from a rock quarry on St. Joseph Island. This island is 30 miles east of Sault Ste. Marie, and is accessible by a ferry operated as a public service by the Ontario Department of Highways. The quarry lies along the island road (highway No. 548) 1.1 miles from the ferry dock.

### *Galena*

Good specimens of galena, as perfect cubic crystals, can be obtained from the dump at the Enterprise mine. Galena occurs in a 12-inch-thick vein exposed on the west side of a peninsula near the west end of Silver Lake in McTavish township. The east end of Silver Lake is accessible by a 1.3-mile long motor road that branches from highway No. 17-11 at a point 25 miles northeast of the Port Arthur city limits (3.8 miles north of the West Loon Road; 3.0 miles south of Pearl Lake). The mineral is also found near Ozone, where it is associated with barite.

Photo 97.
*White River*

Photo 98.
*High Falls.*

### *Garnet*

Small but well formed crystals of red garnet occur in rock cuts on highway No. 17 about 0.9 miles south of the north branch, Baldhead River, Lake Superior Park. Syenite dikes in this outcrop also locally contain garnet.

### *Graphite*

Graphite was encountered in the Silver Islet mine, and samples are obtainable on the dump. A small amount has been observed in the limestone along the bank of the Current River at the north end of Boulevard Lake in Port Arthur. The mineral is also reported to occur in an outcrop at the south end of the beach extending southward along the Lake Superior shore from the mouth of the Steel River. The Steel River is bridged by highway No. 17 about 17 miles east of Terrace Bay and 31 miles west of Marathon.

### *Grunerite*

Small grains of grunerite form the green layers in iron formation near Red Rock Lake on highway No. 17, Lake Superior Park.

### *Hematite*

Good samples of hematite are available along the Canadian Pacific railway line 2 miles west of Loon Lake station about 21 miles northwest of the Port Arthur city limits. Botryoidal hematite occurs with manganite in a calcite vein in rhyolite on Devil's Warehouse Island on the east shore of Lake Superior. This locality is only accessible by boat.

### *Hornblende*

Hornblende crystals, with cleavage faces several inches long, occur in a rockcut along highway No. 17 about 14 miles west of the town of White River. The outcrop is 1.0 mile east of the river known as the West White River. There are no parking facilities at this outcrop, and collectors are warned to take the necessary precautions to prevent traffic accidents.

### *Jasper*

Oölitic jasper occurs in lenses in taconite along the bed of the McIntyre River in Port Arthur. Ordinary red jasper can be obtained in the creek bed behind Mokomon station on the Canadian National railway line, and at a point along the track about 1 mile north of the station. Mokomon station can be reached by a motor road that branches from highway No. 17-11 about 6 miles north of Kakabeka Falls.

### *Laumontite*

Laumontite, a variety of zeolite, is found in quartz-calcite veins in diabase 0.8 miles south of the south branch, Baldhead River, Lake Superior Park. The grains are very small and form aggregates in the vein.

### *Limonite*

Good specimens of limonite, resulting from the weathering of pyrite, are available in the rockcut at the junction of highways No. 17-11 and No. 590 at Kakabeka Falls Park. Samples, inferior in quality, are also obtainable from a large deposit, along highway No. 17, midway between Schreiber and Walker Lake about 1 mile west.

### *Magnetite*

Magnetite (titaniferous) is found in the roadcut 1.2 miles west of the bridge over the Little Pic River. It weathers to a coarse, dark-rusty, granular material, and is easily recognized in the outcrop. Fine grained magnetite can be collected from exposures of iron formation in Lake Superior Park.

### *Manganite*

Botryoidal manganite occurs with hematite on Devil's Warehouse Island. See hematite.

### *Molybdenite*

Molybdenite occurs in a quartz vein exposed in the southern part of lot B, concession III, Conmee township. It lies along a motor road, 0.8 miles east of the intersection with highway No. 17-11. This intersection is found about 3 miles north of the entrance to Kakabeka Falls Park.

### *Pectolite*

Excellent specimens of pectolite, in the form of sheaf-like aggregates of acicular crystals, have been found in the quarry of McNamara Construction Company Limited, about 1 mile northeast of the Port Arthur city limits. Permission to search the quarry for pectolite would have to be obtained from the company.

### *Pitchblende*

Pitchblende occurs in narrow veins along the contact of a diabase dike in granite on Theano Point at Alona Bay. A 2-mile long road, not passable to motor traffic, leads to the occurrence from its intersection with highway No. 17, about 5 miles south of Montreal River.

### *Prehnite*

Excellent specimens of prehnite have been found along the beaches of the islands in Lake Superior near Rossport. Prehnite has also been found with pectolite in veins in the diabase at the quarry of McNamara Construction Company Limited.

### *Pyrite*

Samples of pyrite are obtainable from the outcrop at the intersection of highways No. 17-11 and No. 590 at Kakabeka Falls Park, and from the rusty exposure along highway No. 17 midway between Schreiber and Walker Lake.

### *Quartz*

Small prismatic crystals, with pyramidal terminations, of the mineral quartz have been obtained from narrow veins in granite in the exposure at the intersection of highways No. 17-11 and No. 590 at Kakabeka Falls Park. Usually, pyramidal crystals of transparent quartz are found associated with amethyst, and can be found in veins along the Current River north of Boulevard Lake, and at and near the mouth of the McKenzie River about 10 miles northeast of the Port Arthur city limits. Small quartz crystals are common in open veins in basalt on islands near Cape Gargantua but this locality can only be reached by boat.

### *Siderite*

The iron ore currently being mined near Wawa by Algoma Steel Corporation Limited is siderite. During 1961, tourists participating in the conducted tours of the company's operations were given small but representative samples of this mineral.

### *Silver*

Samples of vein material containing native silver have been found on the dump at the Silver Islet mine.

### *Sphalerite*

Sphalerite, associated with galena, is found in barite and quartz-barite veins located about ½ mile north of Ozone (*see* Barite).

### *Spodumene*

Prismatic crystals of spodumene can be obtained from a pegmatite dike that is found along the Gorge Creek road, 9 miles east of highway No. 11. The Gorge Creek road intersects highway No. 11 at a point 23 miles north of the junction with highway No. 17 near Nipigon.

### *Staurolite*

Well-formed crystals of staurolite occur in mica schists that are exposed in the same locality as the spodumene-bearing pegmatite mentioned overleaf.

### *Zeolites*

Zeolites occur as amygdules in basic lavas exposed on the Lake Superior islands near Rossport. They occur on Michipicoten Island and Cape Gargantua but are accessible only by boat.

## LAPIDARY CLUBS AND SHOPS

Nani Bijou Curio Shop
Cumberland Street,
Port Arthur

Rehabilitation Industries (Lakehead) Inc.
899 Fort William Rd.,
Port Arthur.

Superior Gems and Gifts
172 S. Algoma Street,
Port Arthur.

The Rock Shop
Highway 17,
(10 miles north of S. S. Marie)

Thunder Bay Lapidary Club
Mrs. A. Gilby, Secretary,
264 Ray Court,
Port Arthur.

## ROCK, MINERAL, AND ORE DISPLAYS

Historical Museum
Thunder Bay Historical Society,
Fort William Public Library,
216 Brodie Street South,
Fort William.

Ontario Department of Mines
Geological Branch (2nd floor),
179 S. Algoma Street
Port Arthur.

Ranwick Uranium Mine
Montreal River.

## GLOSSARY

**Acid Rock.** An igneous rock containing 66 percent or more silica.

**Agglomerate.** Coarse fragmental debris resulting from explosive volcanic activity.

**Amphiboles.** Rock-forming minerals, of complex composition. Hydrous silicates, usually with aluminium, calcium, iron, and magnesium.

**Amygdaloidal Lava.** A lava with numerous tiny gas cavities filled with late-formed minerals.

**Anticline.** A fold structure, or arch, in which the rocks slope in opposite directions away from a common ridge.

**Ash-Flow Tuff.** A variety of rhyolite that had a very high gas content at the time of eruption. The lava is very fluid and forms large blanket-like deposits.

**Basalt.** A lava, made up chiefly of the minerals pyroxene and feldspar, with or without olivine, of basic composition and dark colour.

**Basic Rock.** An igneous rock with a low content of silica, generally less than 55 percent.

**Batholith.** A very large mass of igneous rock (e.g. granite), formed deep within the Earth.

**Bedding.** A layered structure in sedimentary rocks.

**Botryoidal Mineral.** Any mineral having an external form like a bunch of grapes.

**Breccia.** A fragmental material, the pieces of which are of angular shape.

**Calcite.** A vein mineral and rock-forming mineral having the composition of calcium carbonate.

**Carbonate.** A chemical compound which, on being heated, yields the gas carbon dioxide (e.g. calcite, dolomite, siderite).

**Carbonate Rock.** A rock made up largely of carbonate minerals.

**Carbonatite.** An igneous rock composed almost entirely of carbonate minerals.

**Chert.** An extremely fine-grained form of silica.

**Chert-Carbonate.** A sedimentary rock in which layers of carbonate minerals alternate with layers of chert.

**Chlorite.** A rock-forming mineral, usually greenish in colour and platy, like mica. A hydrous silicate of aluminium, iron, and magnesium.

**Columnar Jointing.** A variety of jointing that divides the rock into columns.

**Concretion.** A rounded or nodular mass of seemingly foreign material in a sedimentary rock, resulting from the concentration of one or more rock constituents about a central nucleus.

**Conglomerate.** (Sometimes called Puddingstone.) The hard, compacted equivalent of a sedimentary deposit, made up of pebbles and boulders in a matrix of sand, silt, or clay.

**Cross-Lamination.** (Commonly referred to as cross-bedding). A feature of a sedimentary rock, in which individual layers have a distinct laminated structure inclined to the principal bedding.

**Cuesta.** A ridge with a gentle slope on one side, and a precipitous escarpment on the other.

**Diabase.** A special type of gabbro occurring only in dikes and sills.

**Dike.** A tabular mass of igneous rock that extends obliquely or transversely across older rocks.

**Diorite.** An igneous rock, usually made up of the minerals feldspar and hornblende, and having a composition intermediate between that of syenite and that of gabbro.

**Dolomite.** A vein mineral and rock-forming mineral having the composition of calcium magnesium carbonate. Also a sedimentary rock made up largely of the mineral dolomite.

**Dolomitic Limestone.** A sedimentary rock made up largely of variable proportions of the two carbonate minerals, dolomite and calcite.

**Epidote.** A green rock mineral. A hydrous silicate of aluminium, calcium, and iron.

**Epoch.** A subdivision of a Period of geological time.

**Era.** A division of geological time of the highest order.

**Fault.** A fracture, or zone of fractures, along which there has been movement of the wall rocks. A normal fault is one where those rocks that lie above a sloping fracture zone have apparently moved or dropped downward.

**Feldspars.** Common rock-forming minerals; (e.g. orthoclase, microcline, plagioclase). (See standard mineralogy texts for detailed information.) Aluminium silicates of one or more of calcium, sodium, and potassium.

**Fissile Rock.** A rock that is easily split, along closely-spaced parallel or near-parallel planes.

**Foliated Rock.** (Also referred to as Schistose Rock.) A fissile rock in which platy minerals are arranged in thin, irregular, and generally undulating, crudely parallel sheets.

**Gabbro.** A coarse-textured igneous rock, having the same composition as basalt but occurring as dikes and sills.

**Glomerocrysts.** Aggregates of phenocrysts in a rock.

**Goethite.** An ore mineral of iron. A hydrous iron oxide.

**Gneissic.** Like a gneiss; the type of rock in which bands rich in granular minerals alternate with bands rich in platy or micaceous minerals.

**Granite.** A coarse-textured igneous rock, made up of quartz, feldspar, and one or both of mica and hornblende, and usually found in batholiths. It is an acid rock, with a high content of silica.

**Greenstone.** An altered or metamorphosed basic igneous rock, usually basalt, rich in greenish minerals such as chlorite and some amphiboles.

**Greywacke.** A variety of sandstone, with tiny fragments of rock and rock minerals (quartz and feldspar), resulting from rapid erosion and sedimentation.

**Hematite.** An ore mineral of iron. An iron oxide containing 70 percent iron by weight.

**Homocline.** The structure where bedded rocks slope uniformly over a wide area.

**Hornblende.** A variety of amphibole, dark green or black in colour.

**Igneous Rock.** A rock formed by the crystallization of molten, or partially molten, matter of magma.

**Intrusion.** A body of igneous rock that invades older rocks.

**Iron Formation.** A sedimentary rock having an unusually high iron content.

**Jasper.** A variety of chert usually coloured red due to the presence of small amounts of the mineral hematite.

**Joint.** A fracture that interrupts the physical continuity of a rock.

**Lava.** Magma erupted on the surface of the earth.

**Limestone.** A sedimentary rock made up largely of the carbonate mineral calcite.

**Lit-par-lit Structure.** A layered structure due to the alternation of layers of foliated or gneissic rock with layers of an igneous rock like granite.

**Magma.** A hot mass of molten, or partially molten, rock constituents, formed at high temperatures within the Earth.

**Magnetite.** An ore mineral of iron. A magnetic oxide of iron containing 72 percent iron by weight.

**Marble.** A limestone or dolomite hardened by recrystallization.

**Mesa.** A flat-topped hill bounded on one or more sides by steep cliffs.

**Mica.** A rock-forming mineral that splits into flat sheets.

**Migmatite.** A mixed rock made up of layers or abundant fragments of foliated or gneissic rock cemented by granite.

**Monocline.** A local steepening in otherwise gently sloping or flat-lying layered rocks.

**Oölite.** A tiny spherical or ellipsoidal body having a radial or concentric structure or both.

**Pegmatite.** A very coarse-grained igneous rock, usually of granitic composition, and occurring in such small bodies as dikes and sills.

**Period.** A fundamental unit of geological time, but smaller than an era.

**Phenocryst.** A large crystal in a porphyry.

**Pillow Lava.** A lava made up of an agglomeration of rounded masses resembling pillows.

**Porphyry.** An igneous rock in which large crystals (phenocrysts) of early-formed minerals are embedded in a relatively fine-grained groundmass. A feldspar porphyry has phenocrysts of feldspar; a quartz porphyry, phenocrysts of quartz.

**Pothole.** A deep, round hole worn into bedrock at falls and rapids by sand and gravel spun around by water currents.

**Pyroxenes.** Rock-forming minerals. Complex silicates, usually with aluminium, calcium, iron, and magnesium (e.g. augite).

**Quartz.** A vein mineral and rock-forming mineral having the composition silica.

**Ripple Marks.** Low, closely-spaced parallel ridges created in sand by the action of waves or currents.

**Rhyolite.** A lava, having a composition similar to that of granite, usually light-coloured.

**Sandstone.** A compacted sediment made up largely of grains of quartz.

**Schistose.** *See* Foliated Rock.

**Siderite.** An iron-bearing carbonate mineral.

**Shale.** A laminated sedimentary rock composed of compacted or cemented mud.

**Sill.** A tabular mass of igneous rock that occurs within, and parallels, older rocks.

**Siltstone.** A sedimentary rock, not a shale, made up of very fine-grained mineral particles.

**Slate.** A very fine-grained metamorphosed sedimentary rock having a well-developed fissility that may or may not parallel the original bedding.

**Stratification.** *See* Bedding.

**Striae.** Minute, closely-spaced, parallel grooves or scratches on bedrock surfaces, usually resulting from glaciation.

**Syenite.** An igneous rock that, except for the absence of the mineral quartz, is similar to granite in both appearance and composition.

**Syncline.** A fold in which the rocks slope inward, in opposite directions, to form a trough-like structure.

**Taconite.** A variety of iron formation made up largely of tiny rounded bodies or granules of iron-bearing minerals and chert in a groundmass of chert or carbonate.

**Tuff.** A rock made up of dust and fine rock fragments from explosive volcanic activity.

**Unconformity.** A surface of erosion separating younger strata from older rocks.

**Vein.** An aggregate of minerals filling a fracture in a rock. The minerals were deposited from hot solutions and not from a magma.

**Vesicle.** A small cavity formed in a lava consequent upon the escape of gas upon extrusion at the surface.

## REFERENCES

In the preparation of the guidebook, considerable use was made of the extensive literature available on the geology of the Lake Superior region. For those who wish to pursue their studies beyond the scope of this compilation, the reports considered to be most comprehensive and pertinent are included in the following list of references. Many of these reports contain coloured maps.

Publications of the Geological Survey of Canada are available through the Office of the Queen's Printer, Ottawa, Ontario.

Publications of the Ontario Department of Mines are available through the Publications Office, Department of Mines, Queen's Park, Toronto 2, Ontario.

In the following list, the six publications marked with an asterisk (*) are out of print. These would be available only in libraries.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*1931: Goudreau and Michipicoten gold area, District of Algoma; Ontario Dept. Mines, Vol. XL, pt. 4, pp. 1-54.
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*1932: Geology of the Heron Bay-White Lake area; Ontario Dept. Mines, Vol. XLI, pt. 6, pp. 34-47.
1953: Geology of the Mamainse Point copper area: Ontario Dept. Mines, Vol. LXII, pt. 4.

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## MAPS WITHOUT REPORTS
*(by the Ontario Dept. of Mines)*

**Coloured geological maps.** Scale 1 inch to 4 miles.

Map 2065 Atikokan—Lakehead.
Map 2108 Sault Ste. Marie—Elliot Lake.
Map 2137 Nipigon—Schreiber.

Scale 1 inch to 25 miles.

Map 2148 Ontario Mineral Map.

**Preliminary geological maps, uncoloured.** Scale 1 inch to 2 miles.

P 184 Michipicoten.
P 476 Hornepayne.
P 494 Manitouwadge.
P 541 Pukuskwa.

## GUIDEBOOKS OF THIS SERIES
*(by the Ontario Dept. of Mines)*

Geological Guidebook No. 1. Geology and Scenery; Rainy Lake and east to Lake Superior.

Geological Guidebook No. 2. Geology and Scenery; North Shore of Lake Superior.

Geological Guidebook No. 3. Geology and Scenery; Peterborough, Bancroft and Madoc area.

Other guidebooks are planned. The Publications Office, Department of Mines, Queen's Park, Toronto, will be pleased to put you on their notification list.

# NOTES

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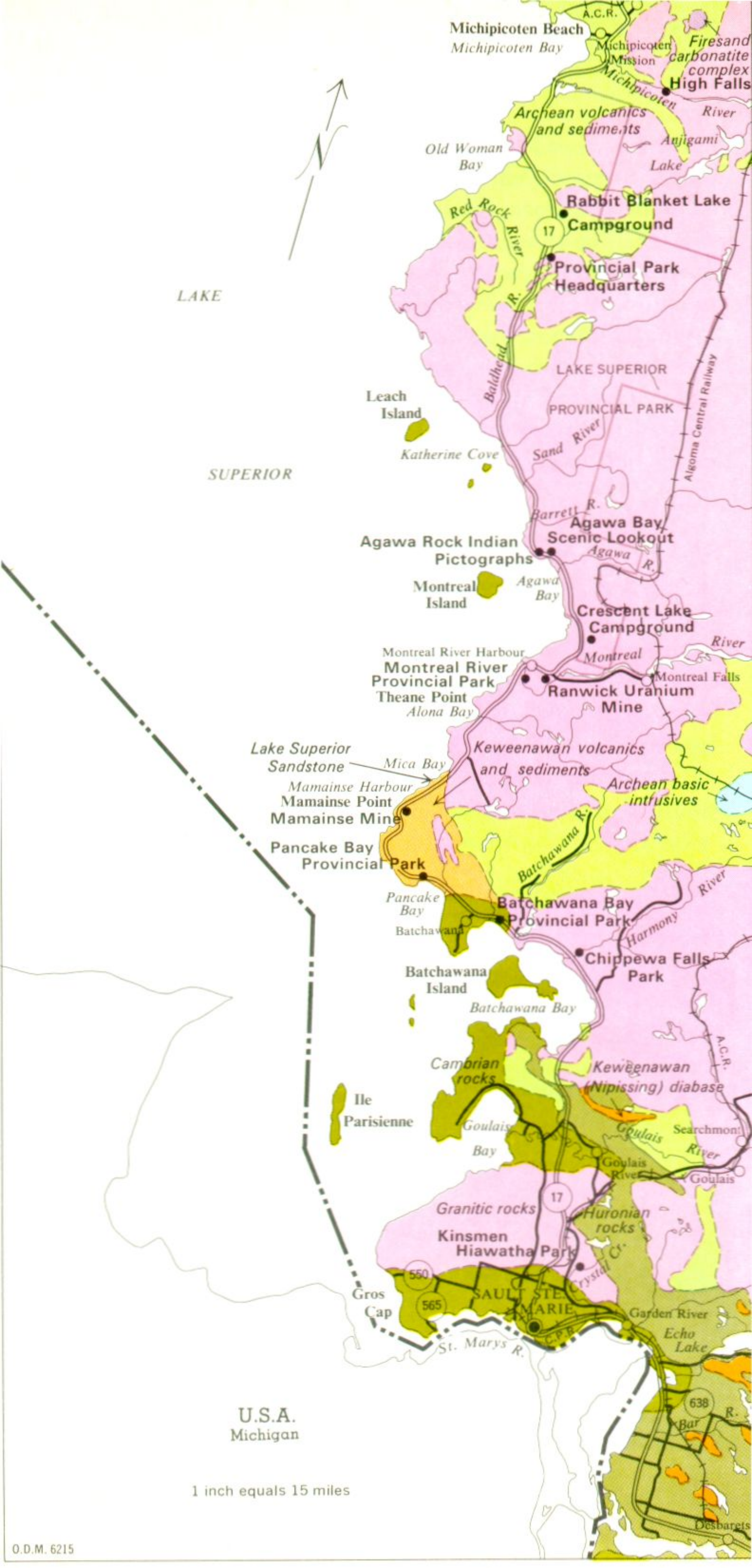
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Michipicoten Bay
Michipicoten Mission
Firesand carbonatite complex
High Falls
Michipicoten River
Archean volcanics and sediments
Anjigami Lake
Old Woman Bay
Rabbit Blanket Lake Campground
Red Rock River
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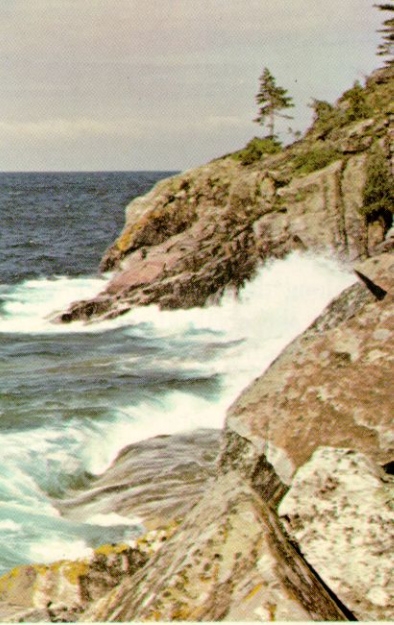
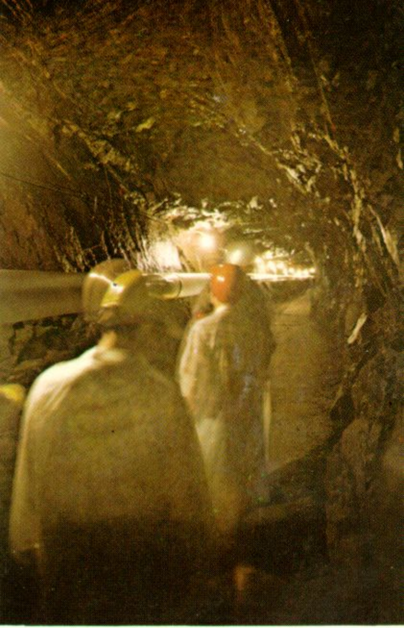
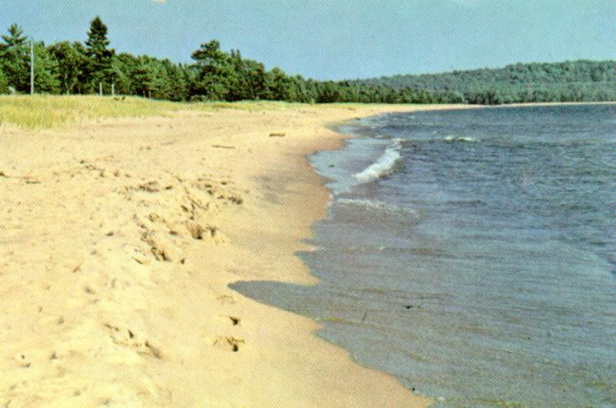
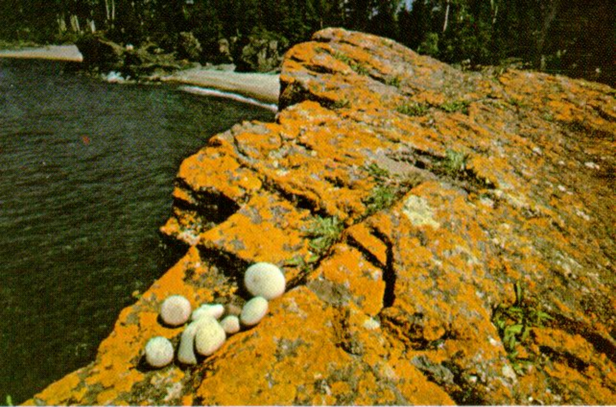
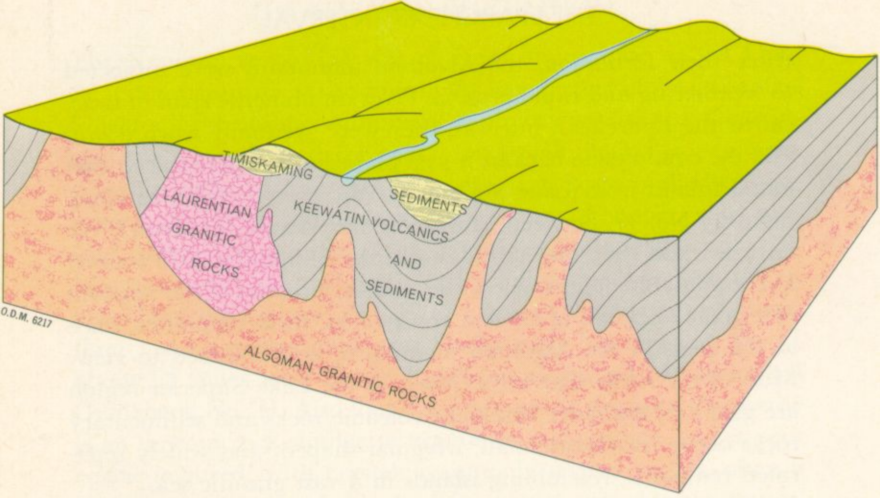
Provincial Park Headquarters
LAKE
Baldhead R.
LAKE SUPERIOR PROVINCIAL PARK
Algoma Central Railway
Leach Island
Sand River
Katherine Cove
SUPERIOR
Barrett R.
Agawa Bay Scenic Lookout
Agawa Rock Indian Pictographs
Agawa R.
Montreal Island
Agawa Bay
Crescent Lake Campground
Montreal River
Montreal River Harbour
Montreal River Provincial Park
Montreal Falls
Ranwick Uranium Mine
Theane Point
Alona Bay
Lake Superior Sandstone
Mica Bay
Keweenawan volcanics and sediments
Archean basic intrusives
Mamainse Harbour
Mamainse Point
Mamainse Mine
Batchawana R.
Pancake Bay Provincial Park
Pancake Bay
Batchawana Bay Provincial Park
Harmony River
Batchawana
Chippewa Falls Park
Batchawana Island
Batchawana Bay
A.C.R.
Cambrian rocks
Keweenawan (Nipissing) diabase
Ile Parisienne
Goulais Bay
Goulais River
Searchmont
Goulais River
Goulais
17
Granitic rocks
Huronian rocks
Kinsmen Hiawatha Park
Crystal Cr.
550
565
Gros Cap
SAULT STE. MARIE
C.P.R.
Garden River
Echo Lake
St. Marys R.
638
Bar R.
U.S.A.
Michigan
1 inch equals 15 miles
Desbarats
O.D.M. 6215







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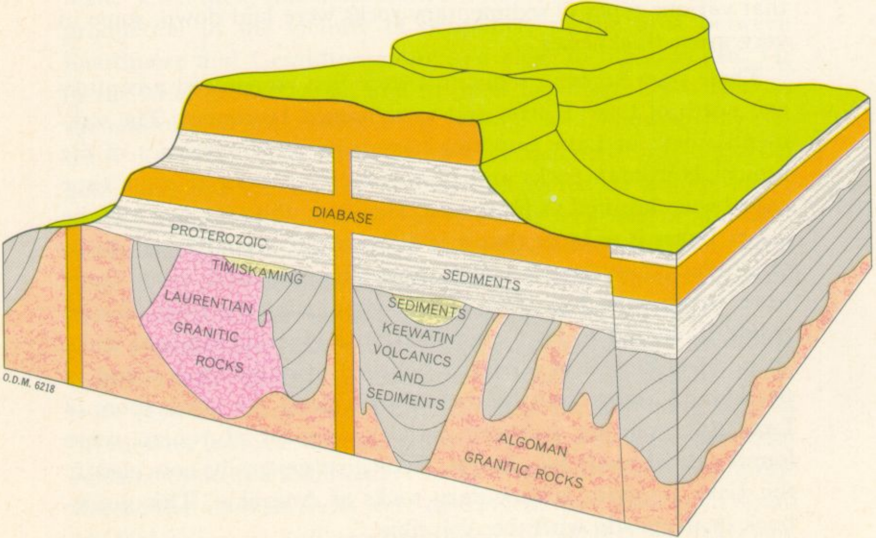
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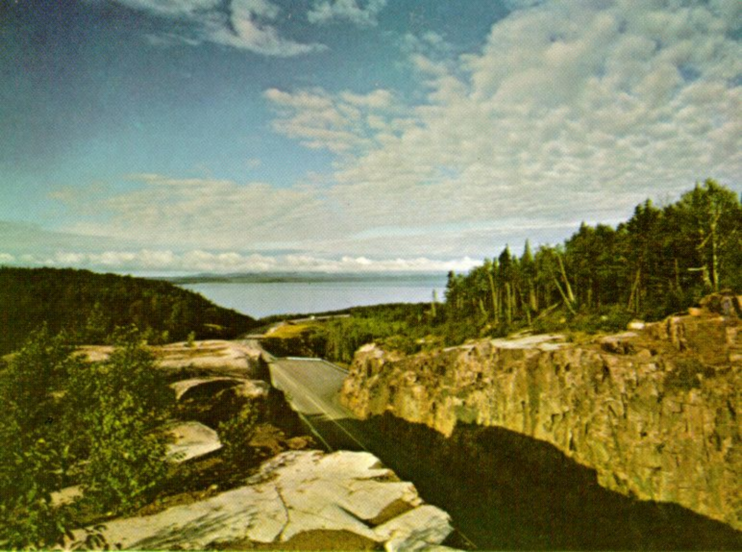
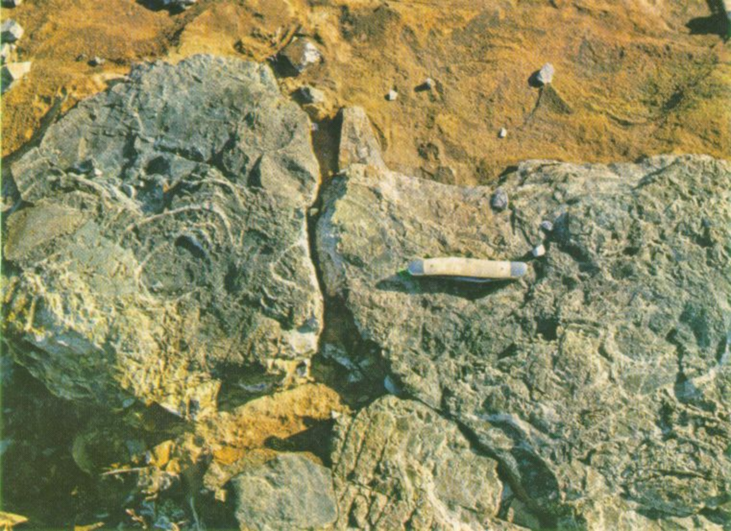
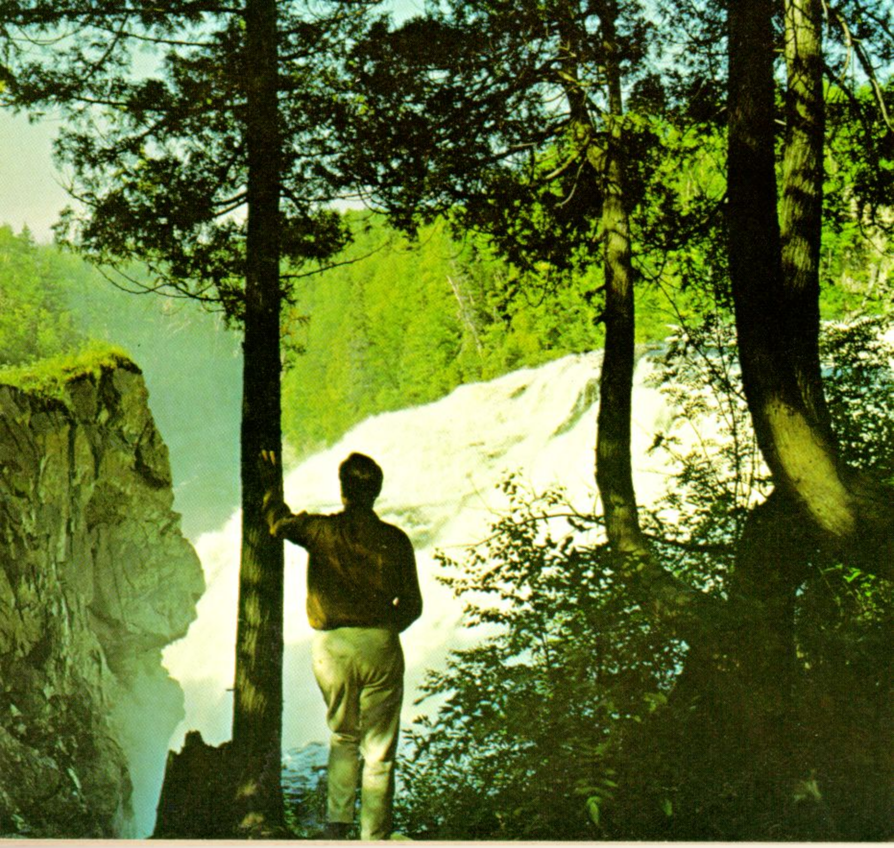
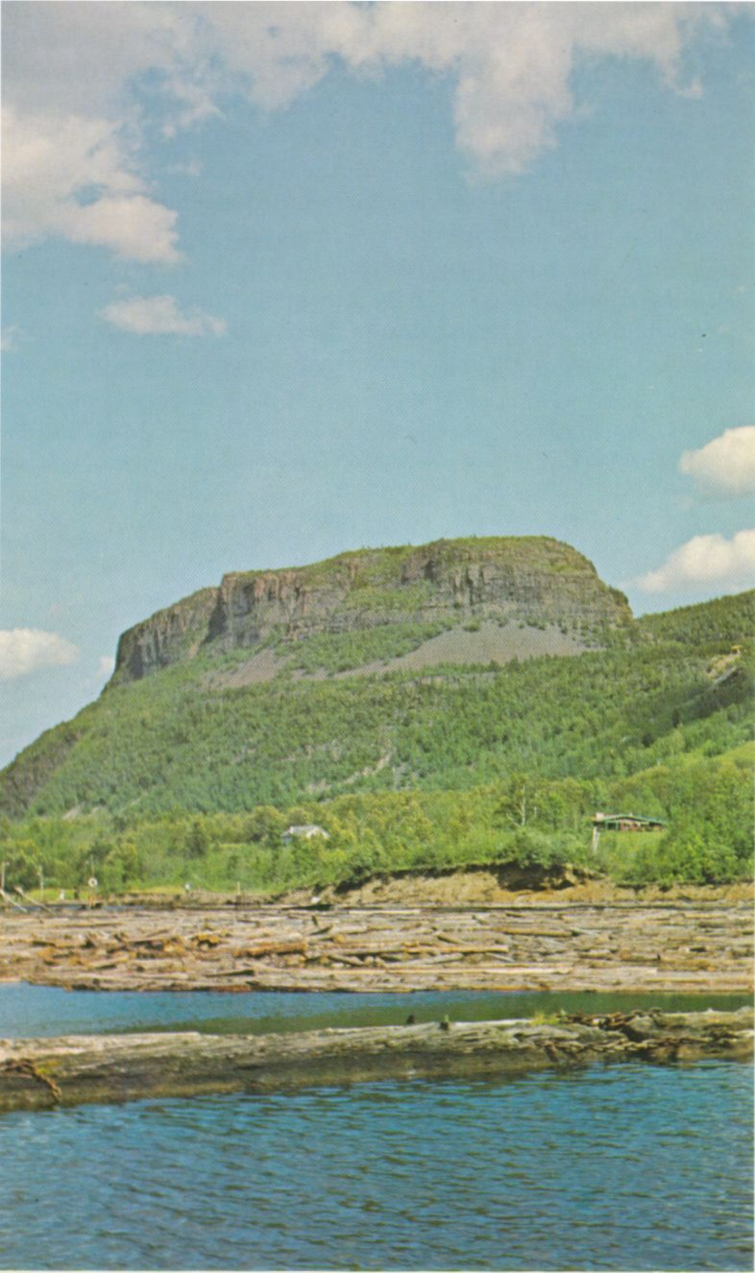
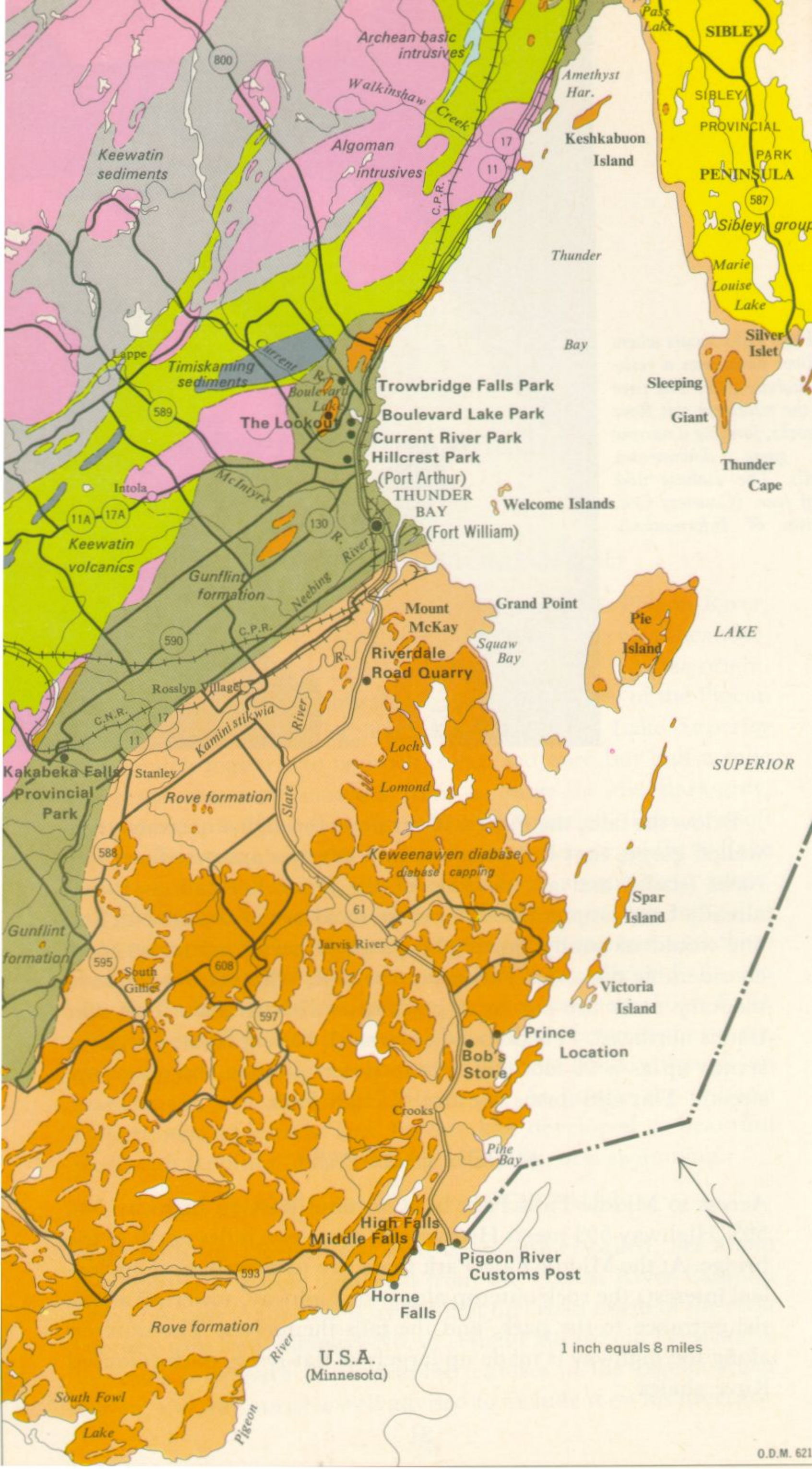




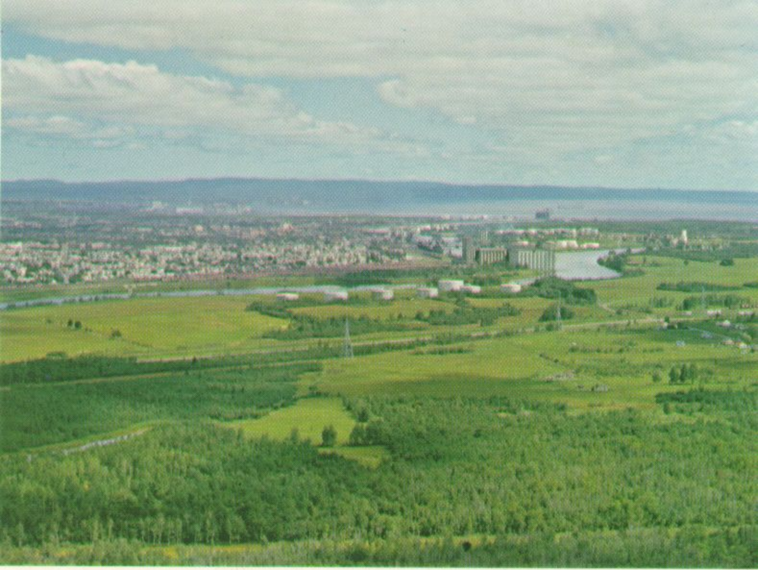


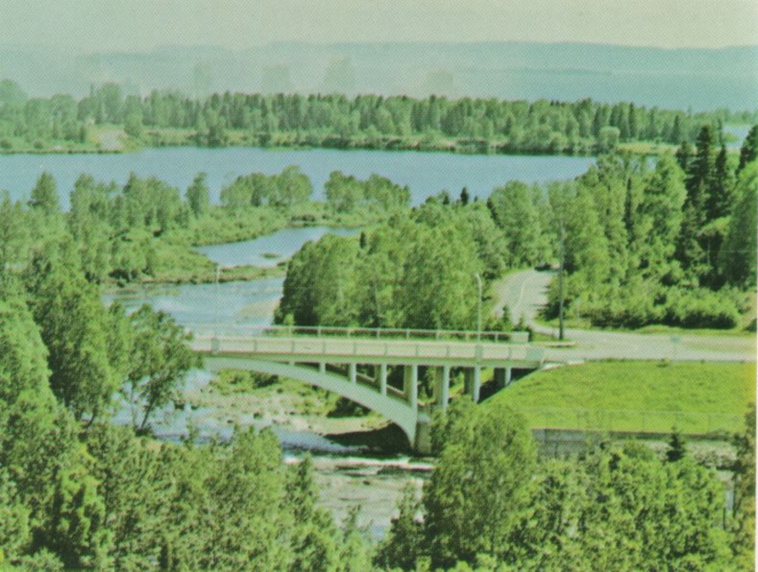


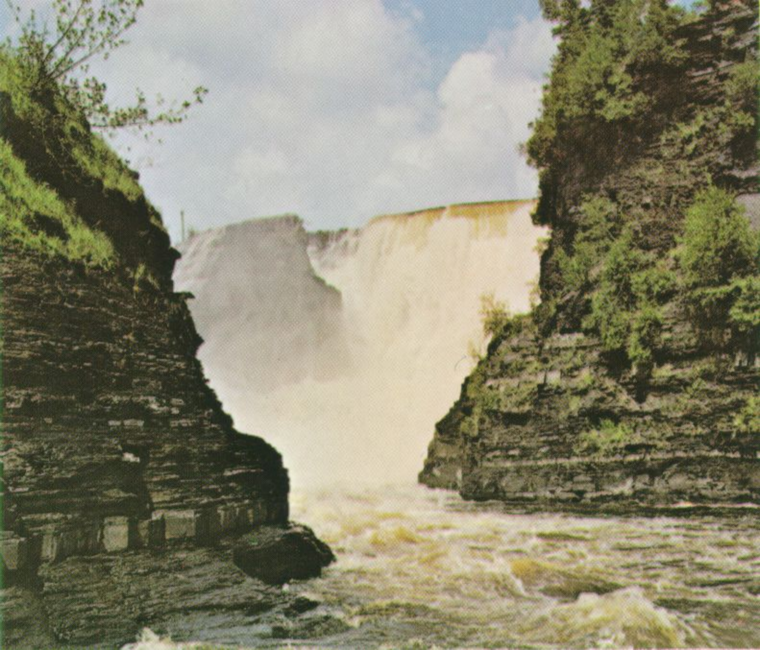
HUDSON BAY
MANITOBA
QUEBEC
James Bay
Severn River
Winisk River
Attawapiskat River
Albany River
Moose R.
Missinaibi R.
Abitibi R.
Ottawa River
St. Lawrence R.
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
U.S.A.
Red Lake
Pickle Crow
Kenora
Geraldton
Steep Rock
Nipigon
Kashabowie
Manitouwadge
(Port Arthur)
Thunder Bay
(Fort William)
Moosonee
Timmins
Matheson
Kirkland Lake
Wawa
Chapleau
Cobalt
Timagami
Sault Ste. Marie
Elliot Lake
Sudbury
North Bay
Pembroke
Ottawa
Bancroft
Madoc
Kingston
Peterborough
Toronto
Goderich
Hamilton
London
Windsor
PALEOZOIC AND MESOZOIC
Sedimentary rocks.
PRECAMBRIAN
Mainly granite rocks.
Mainly volcanic and sedimentary rocks.
Scale of Miles
50 0 100 200
95° 90° 85° 80° 75°
55°
50°
45°
O.D.M. 6227

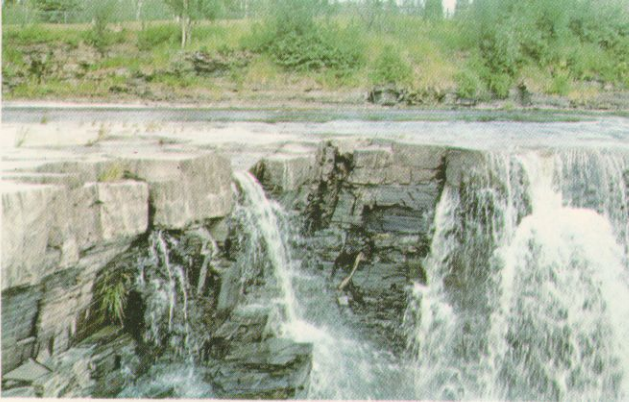


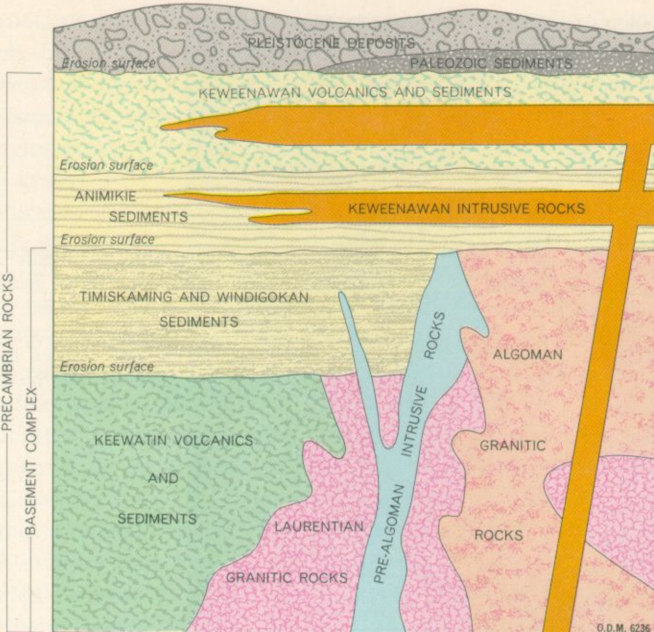
Archean basic intrusives
Walkinshaw Creek
Keewatin sediments
Algoman intrusives
Amethyst Har.
Keshkabuon Island
SIBLEY PENINSULA
SIBLEY PROVINCIAL PARK
Sibley group
Pass Lake
Marie Louise Lake
Silver Islet
Sleeping Giant
Thunder Cape
Thunder Bay
C.P.R.
Lappe
Timiskaming sediments
Current R.
Boulevard Lake
The Lookout
Trowbridge Falls Park
Boulevard Lake Park
Current River Park
Hillcrest Park
(Port Arthur)
THUNDER BAY
(Fort William)
Welcome Islands
McIntyre R.
Intola
Keewatin volcanics
Gunflint formation
Neebing River
Mount McKay
Grand Point
Squaw Bay
Pie Island
LAKE SUPERIOR
Riverdale Road Quarry
Rosslyn Village
C.N.R.
Kaministikwia River
Slate River
Loch Lomond
Kakabeka Falls Provincial Park
Stanley
Rove formation
Keweenawen diabase
diabase capping
Spar Island
Jarvis River
South Gillies
Victoria Island
Prince Location
Bob's Store
Crooks
Pine Bay
High Falls
Middle Falls
Pigeon River Customs Post
Horne Falls
U.S.A. (Minnesota)
Pigeon River
South Fowl Lake
1 inch equals 8 miles
800
17
11
589
11A
17A
130
590
588
595
608
597
61
593
587
O.D.M. 621

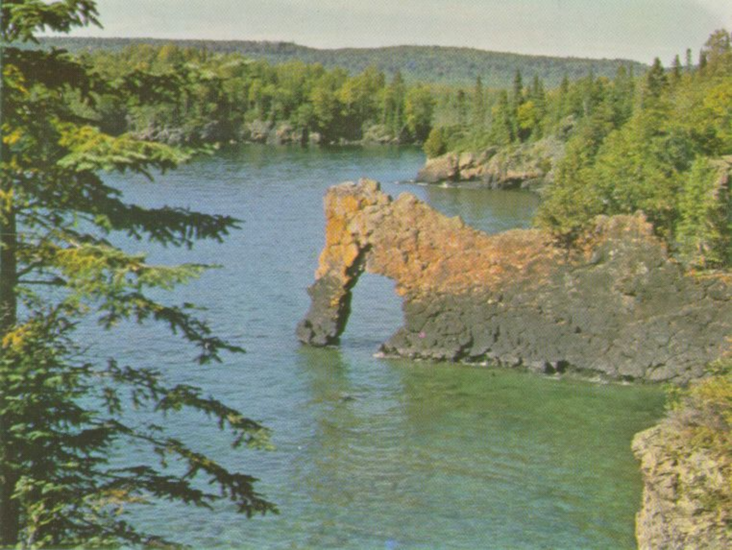


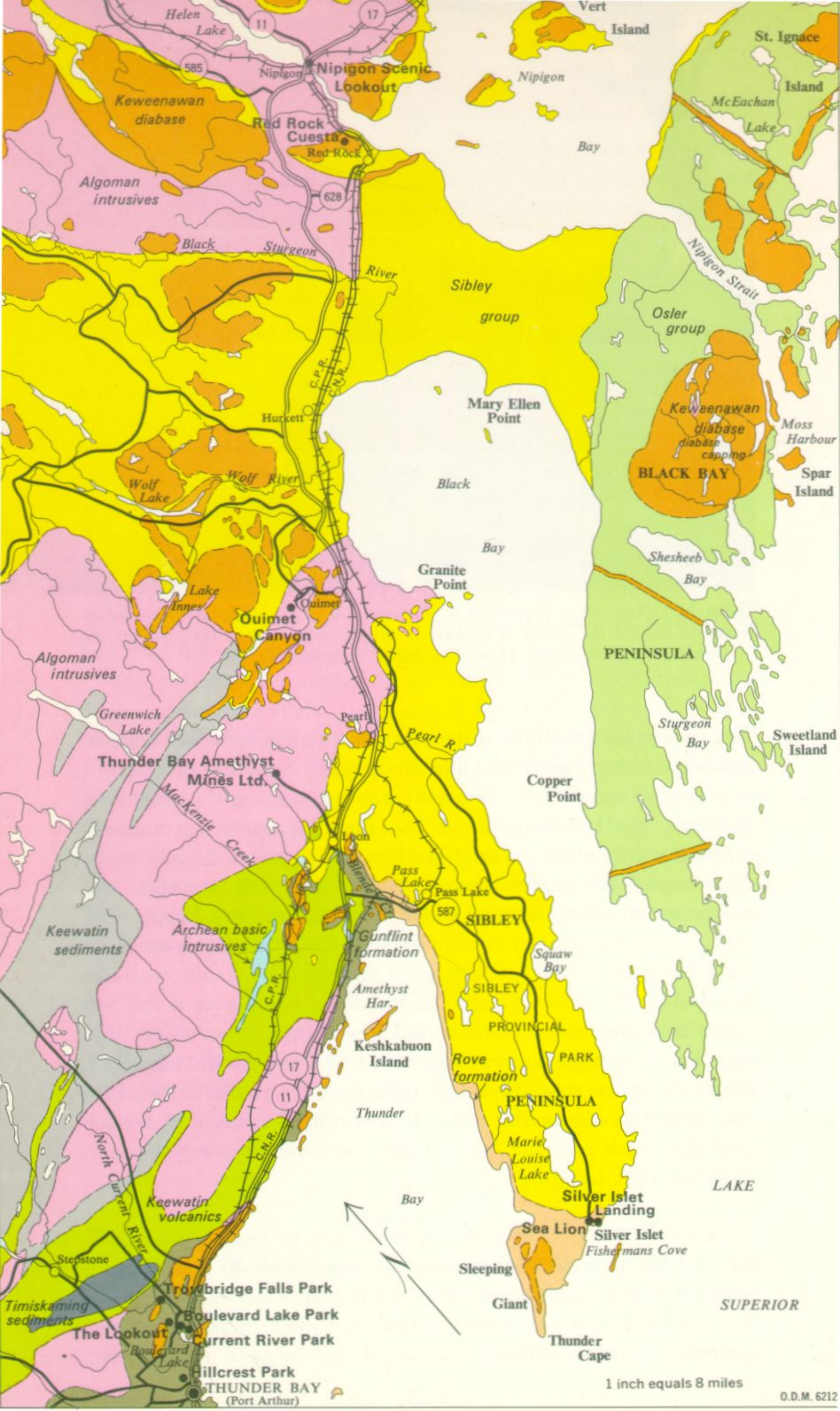




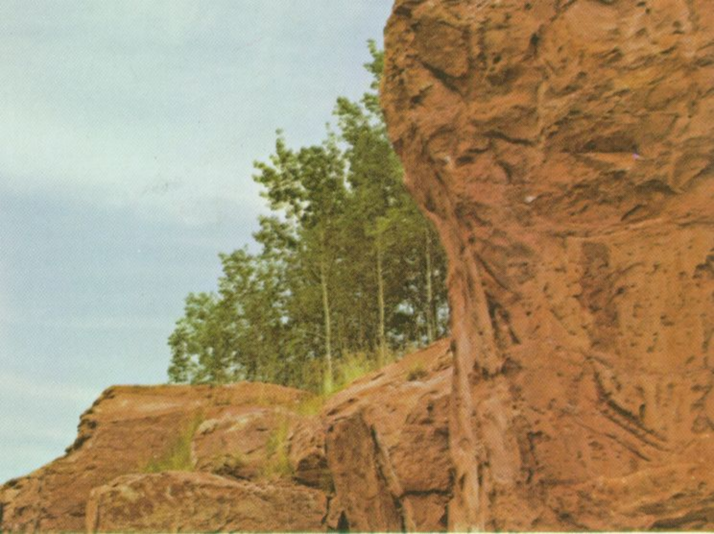


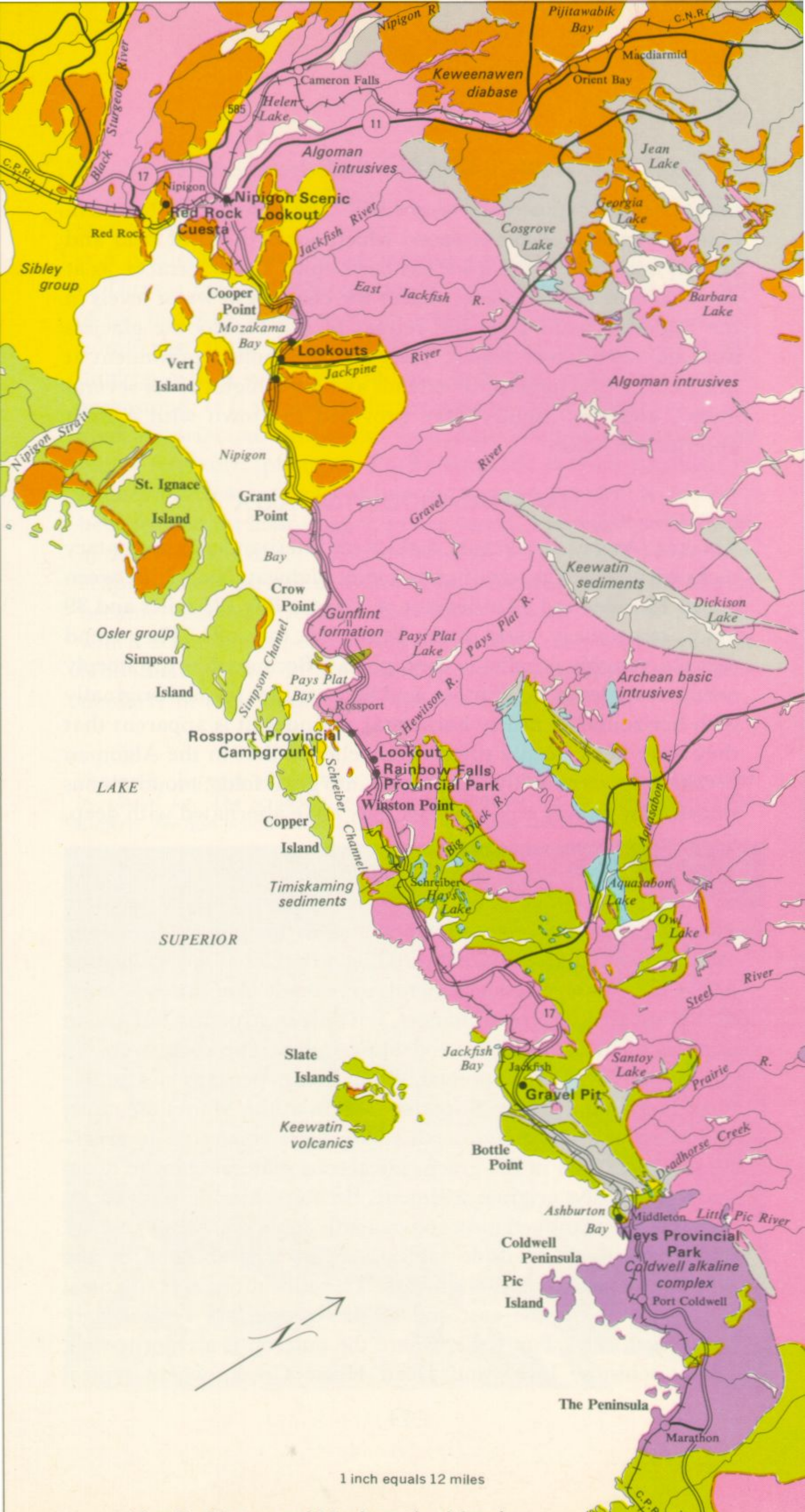

PLEISTOCENE DEPOSITS
Erosion surface
PALEOZOIC SEDIMENTS
KEWEENAWAN VOLCANICS AND SEDIMENTS
Erosion surface
ANIMIKIE
SEDIMENTS
KEWEENAWAN INTRUSIVE ROCKS
Erosion surface
TIMISKAMING AND WINDIGOKAN
SEDIMENTS
Erosion surface
PRECAMBRIAN ROCKS
BASEMENT COMPLEX
KEEWATIN VOLCANICS
AND
SEDIMENTS
LAURENTIAN
GRANITIC ROCKS
PRE-ALGOMAN
INTRUSIVE
ROCKS
ALGOMAN
GRANITIC
ROCKS
O.D.M. 6236





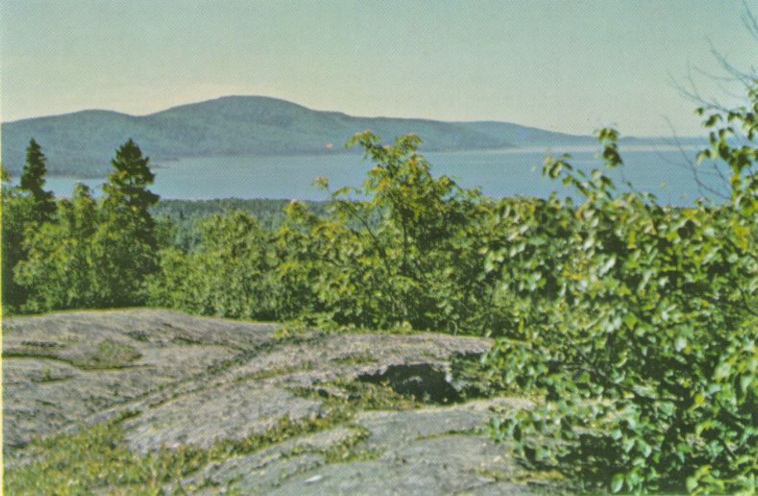
Helen Lake
Nipigon
Nipigon Scenic Lookout
Keweenawan diabase
Red Rock Cuesta
Red Rock
Algoman intrusives
Black Sturgeon River
Vert Island
Nipigon Bay
St. Ignace Island
McEachan Lake
Nipigon Strait
Sibley group
Osler group
Mary Ellen Point
Hurkett
C.P.R.
C.N.R.
Wolf River
Wolf Lake
Black Bay
Keweenawan diabase
diabase capping
BLACK BAY
Moss Harbour
Spar Island
Granite Point
Lake Innes
Ouimet
Ouimet Canyon
Shesheeb Bay
PENINSULA
Algoman intrusives
Greenwich Lake
Pearl
Pearl R.
Sturgeon Bay
Sweetland Island
Thunder Bay Amethyst Mines Ltd.
MacKenzie Creek
Copper Point
Loon
Pass Lake
Pass Lake
SIBLEY
Keewatin sediments
Archean basic intrusives
Gunflint formation
Squaw Bay
Amethyst Har.
SIBLEY PROVINCIAL PARK
Keshkabuon Island
Rove formation
PENINSULA
Thunder Bay
Marie Louise Lake
North Current River
Keewatin volcanics
LAKE SUPERIOR
Silver Islet Landing
Sea Lion
Silver Islet
Fishermans Cove
Stepstone
Sleeping Giant
Trowbridge Falls Park
Timiskaming sediments
Boulevard Lake Park
The Lookout
Current River Park
Boulevard Lake
Thunder Cape
Hillcrest Park
THUNDER BAY
(Port Arthur)
1 inch equals 8 miles
O.D.M. 6212

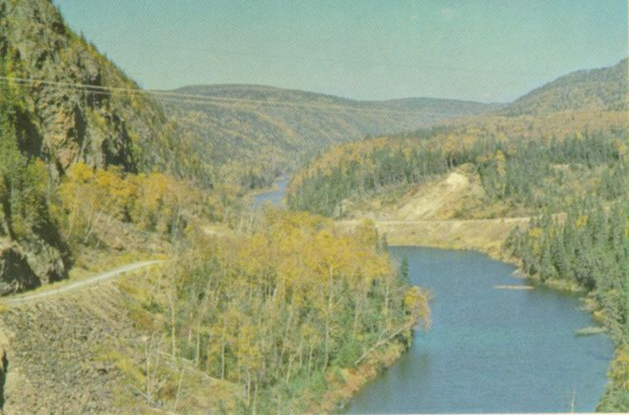


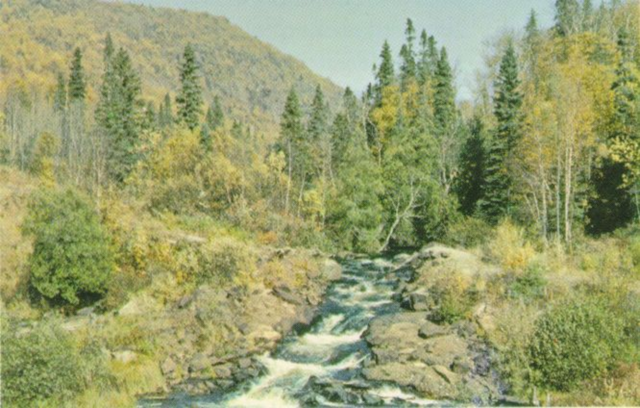


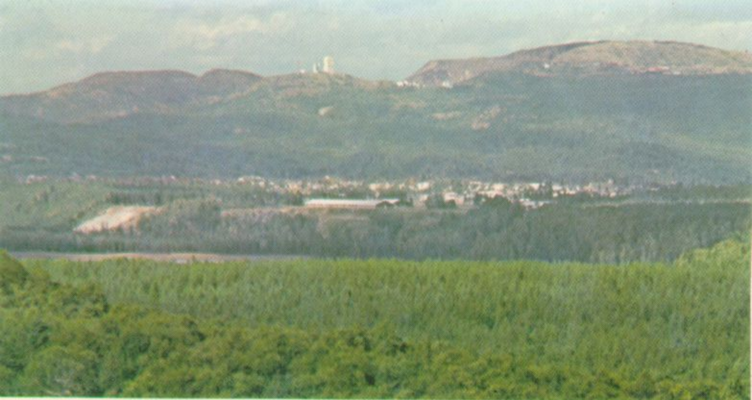

Map E. *Nipigon and Macdiarmid to Marathon.*

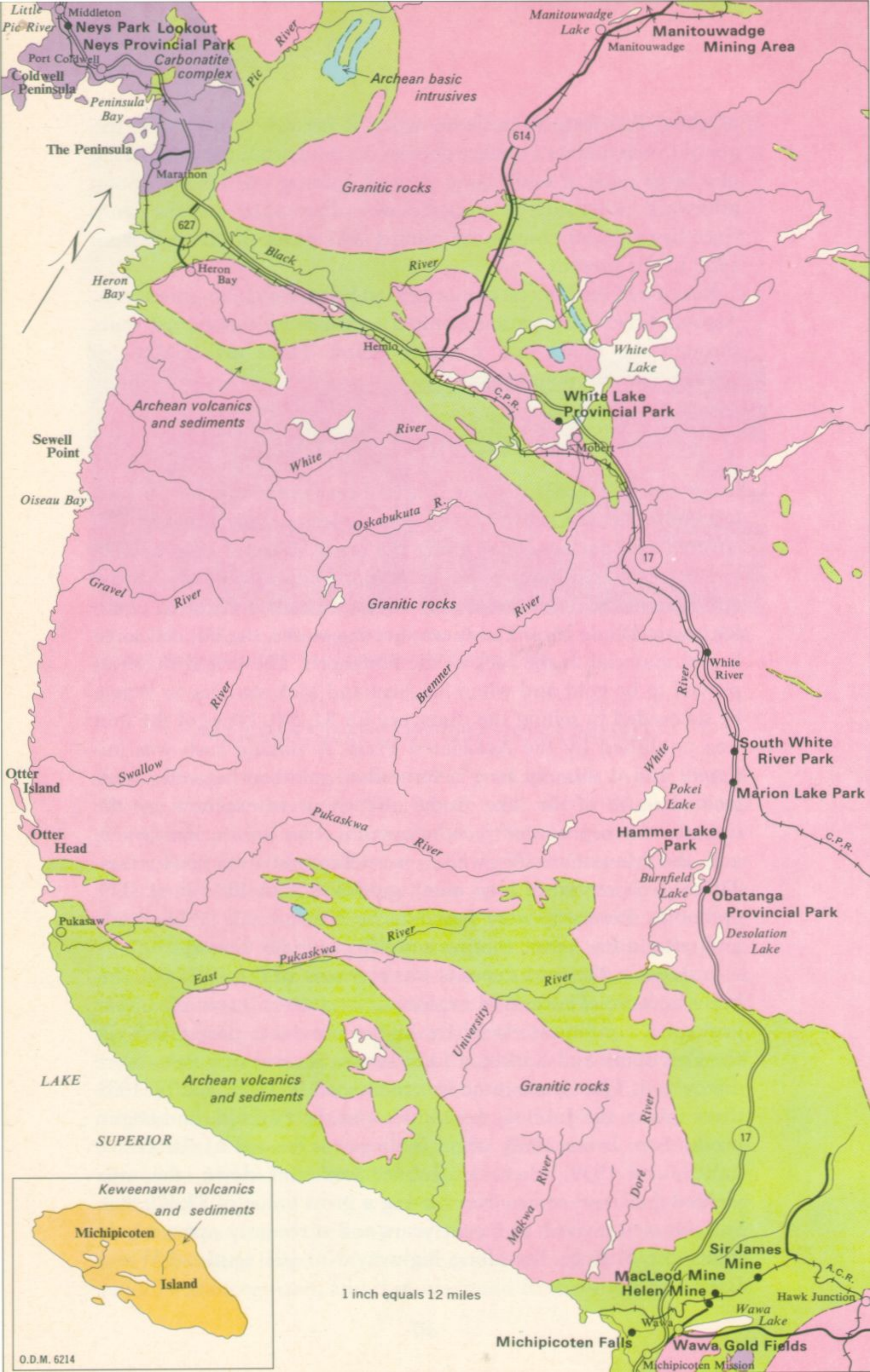
O.D.M. 6213



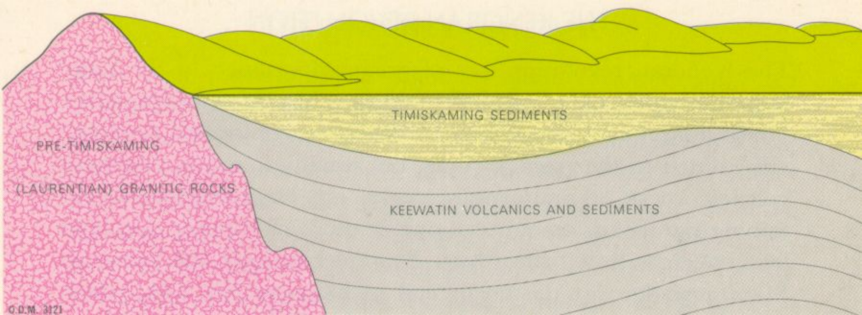


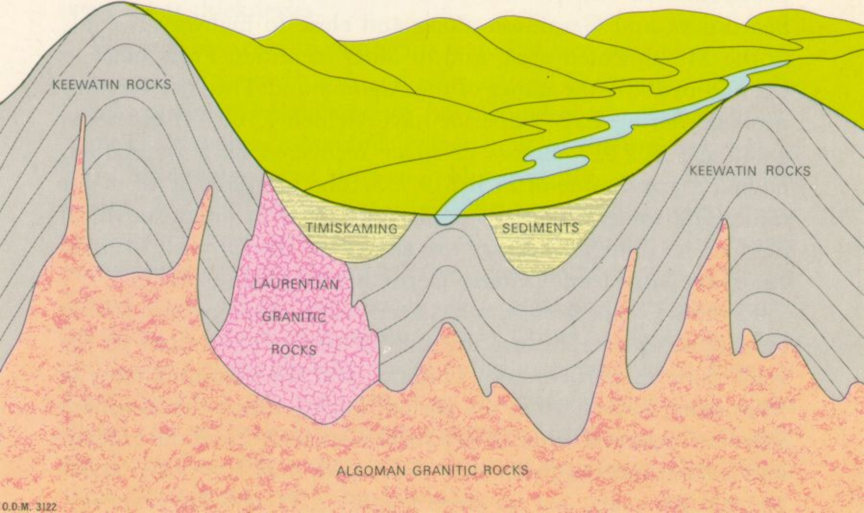


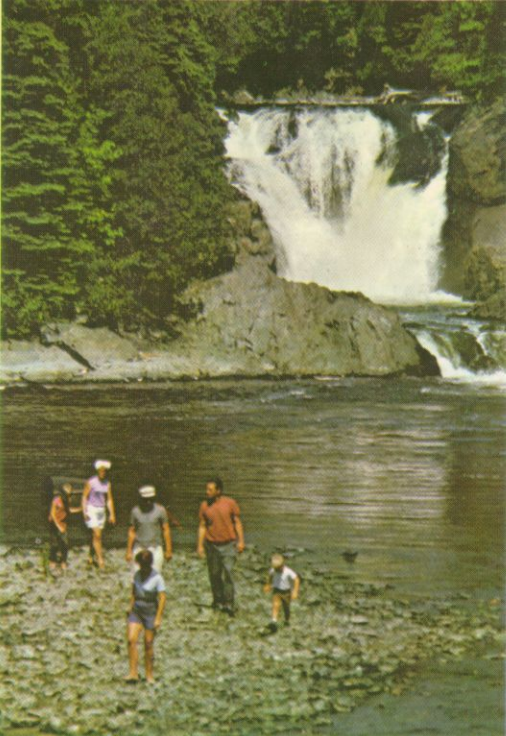


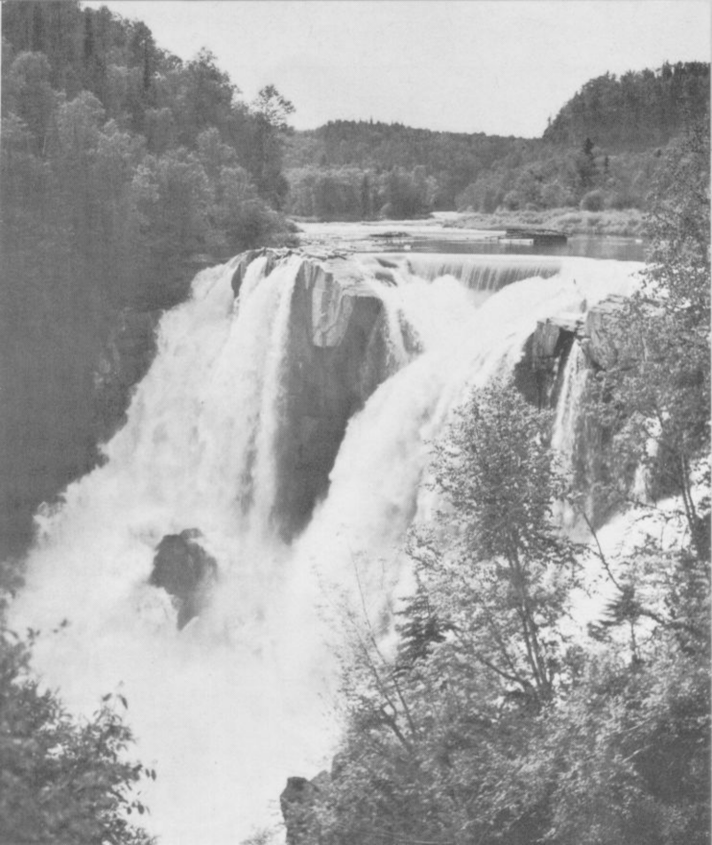


Little Pic River
Middleton
Neys Park Lookout
Neys Provincial Park
Port Coldwell
Carbonatite complex
Coldwell Peninsula
Peninsula Bay
The Peninsula
Marathon
Pic River
Archean basic intrusives
Manitouwadge Lake
Manitouwadge
Manitouwadge Mining Area
614
Granitic rocks
627
Black River
Heron Bay
Heron Bay
Hemlo
C.P.R.
White Lake
White Lake Provincial Park
Mobert
Archean volcanics and sediments
Sewell Point
White River
Oiseau Bay
Oskabukuta R.
17
Gravel River
Granitic rocks
River
Bremner
River
White River
River
Swallow
White
South White River Park
Otter Island
Pokei Lake
Marion Lake Park
Otter Head
Pukaskwa River
Hammer Lake Park
C.P.R.
Burnfield Lake
Obatanga Provincial Park
Pukasaw
River
Desolation Lake
East Pukaskwa
River
University
LAKE
Archean volcanics and sediments
Granitic rocks
River
SUPERIOR
17
Keweenawan volcanics and sediments
Michipicoten
Island
Makwa River
Doré
Sir James Mine
MacLeod Mine
Helen Mine
A.C.R.
1 inch equals 12 miles
Hawk Junction
Wawa
Wawa Lake
Michipicoten Falls
Wawa Gold Fields
Michipicoten Mission
O.D.M. 6214

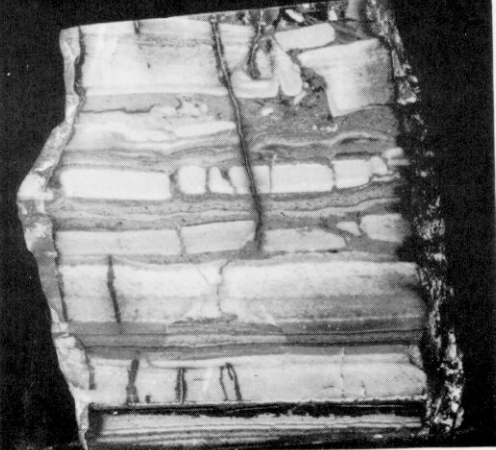

TIMISKAMING SEDIMENTS
PRE-TIMISKAMING
(LAURENTIAN) GRANITIC ROCKS
KEEWATIN VOLCANICS AND SEDIMENTS
O.D.M. 3121

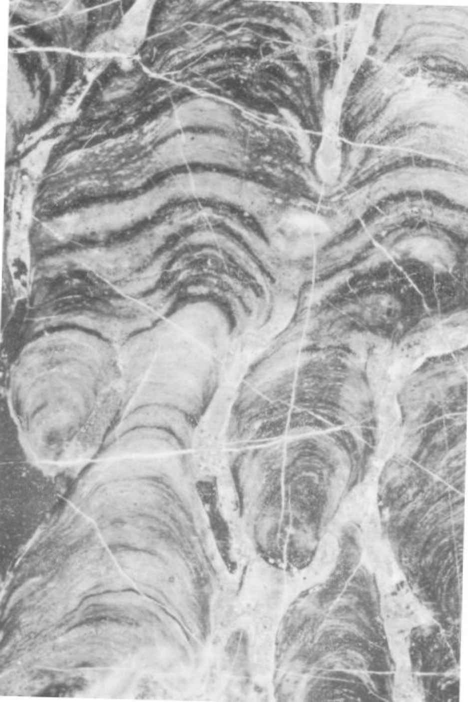

KEEWATIN ROCKS
KEEWATIN ROCKS
TIMISKAMING
SEDIMENTS
LAURENTIAN
GRANITIC
ROCKS
ALGOMAN GRANITIC ROCKS
O.D.M. 3122

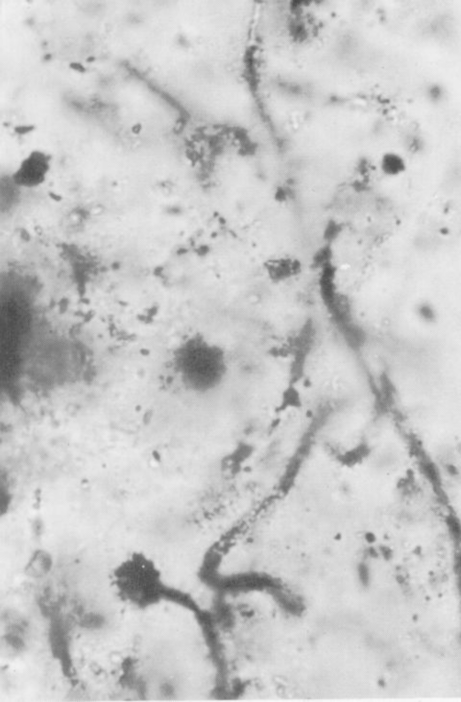





HIGHWAY 61
PINE BAY
MIDDLE FALLS
HIGH FALLS








WHITE RIVER
The COLDEST SPOT
IN CANADA
72° BELOW ZERO
RESTAUR