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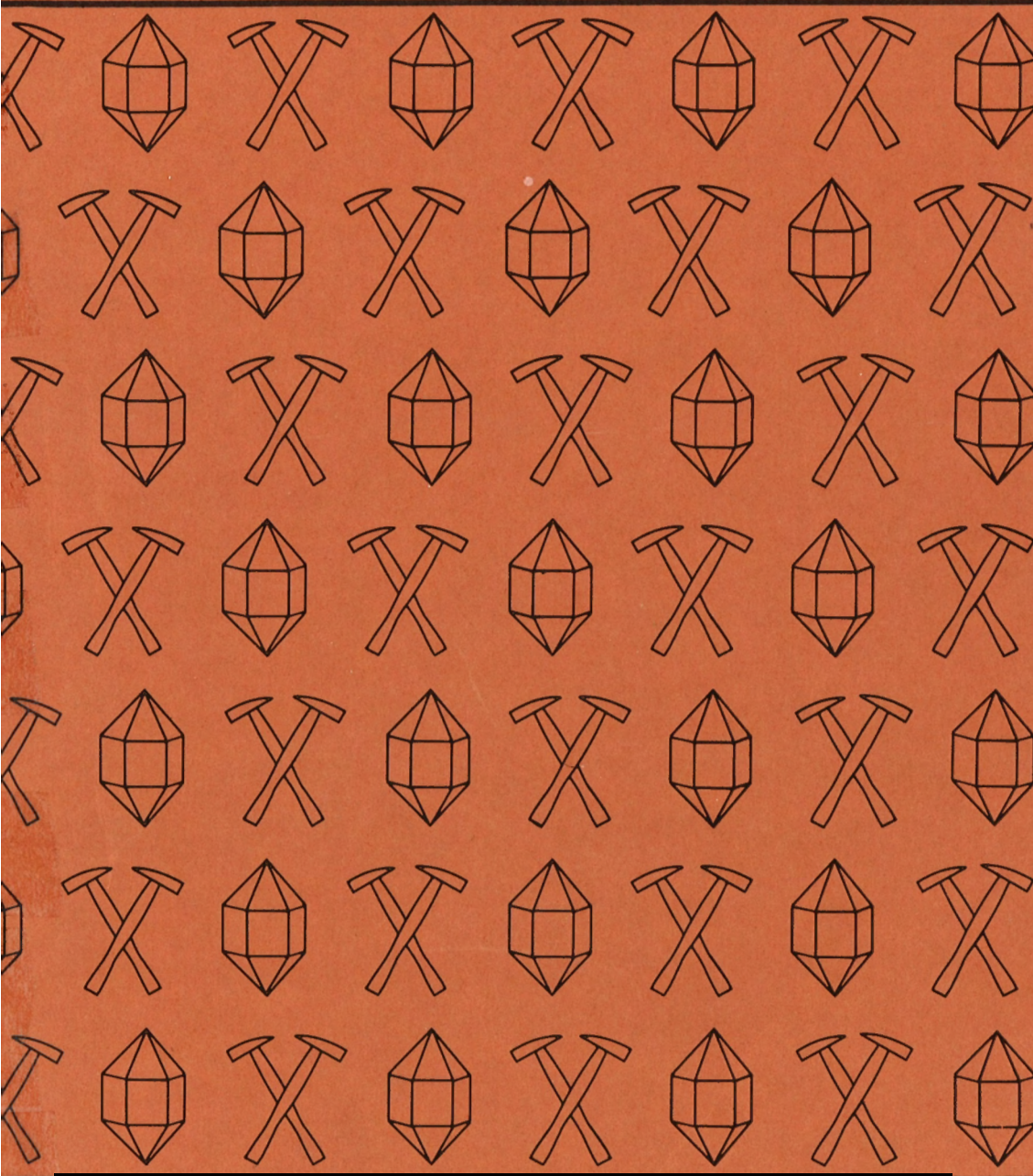
ROCKS AND MINERALS FOR THE COLLECTOR

The Magdalen Islands, Quebec, and the Island of Newfoundland

Ann P. Sabina



DEPARTMENT OF ENERGY, MINES AND RESOURCES

GEOLOGICAL SURVEY

OF CANADA

PAPER 75-36

ROCKS AND MINERALS FOR THE COLLECTOR: THE MAGDALEN ISLANDS, QUEBEC, AND THE ISLAND OF NEWFOUNDLAND

Ann. P. Sabina

DEPARTMENT OF ENERGY, MINES AND RESOURCES

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CONTENTS

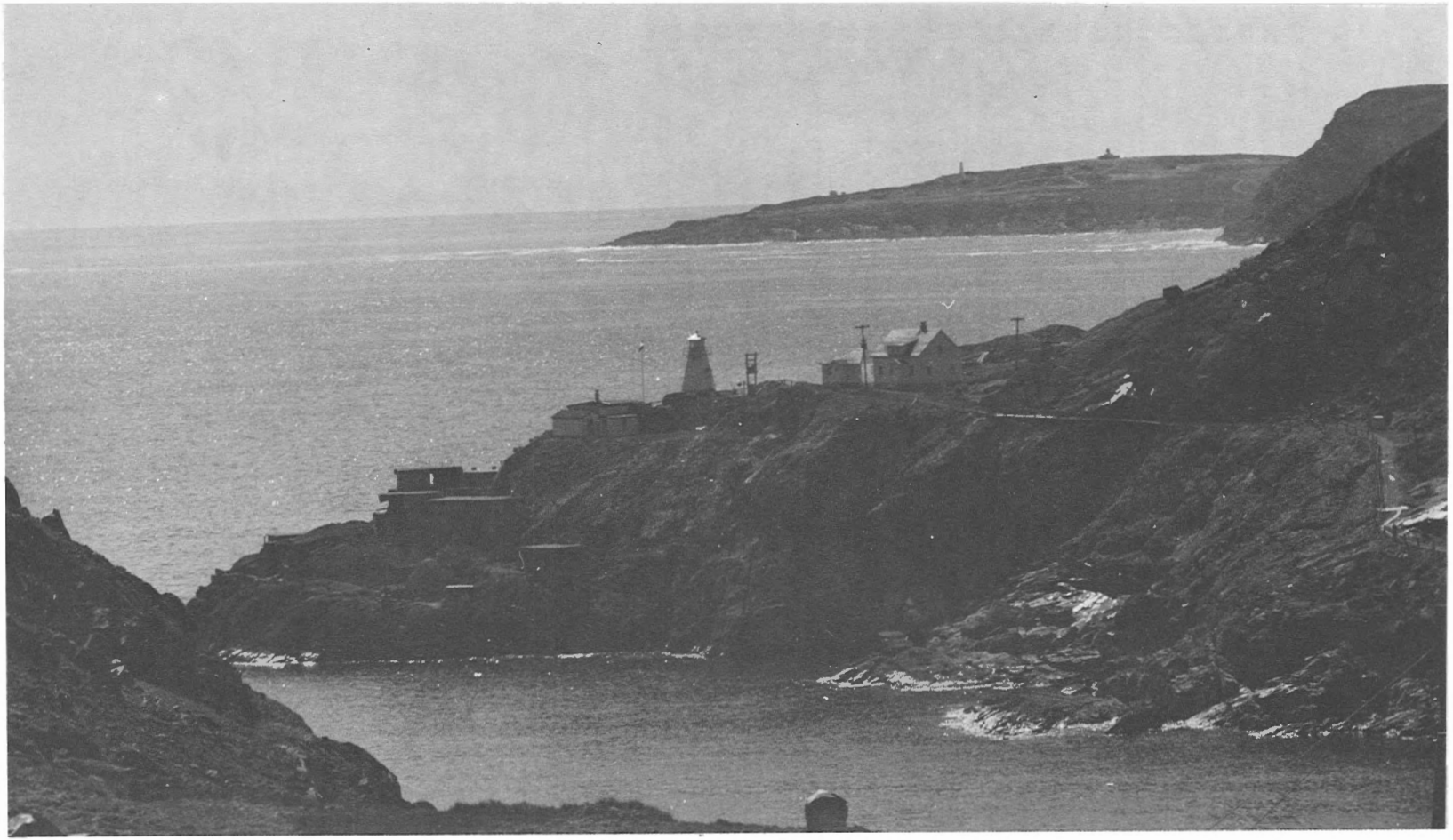
Contents (cont.)

Contents (cont.)

Contents (cont.)

Illustrations

Contents (cont.)



Frontispiece: Cape Spear on the Avalon Peninsula's rocky sea-coast is the most easterly point of land on the North American continent. Its lighthouse, built in the 1830's, is the oldest on the continent. (Nfld. Dep. Tourism 2469).

Abstract

This booklet describes mineral and rock collecting localities in the Magdalen Islands (Quebec) and in the Island of Newfoundland. It is one of a series of guide-books covering various accessible areas in Canada and completes the coverage in the maritime regions. In these islands a variety of mineral, rock and fossil collecting sites await the tourist, the amateur and professional mineralogist, and the hobbyist.

The Magdalen Islands — a cluster of islands strung together by seemingly endless sands that also fringe their sea-sculptured shores — are famed for their sweeping seaside beaches but are relatively unknown for the minerals they furnish. Along their craggy, cliffed shorelines volcanic and sedimentary rocks provide the collector with several varieties of gypsum, with crystals of calcite and quartz, and with other minerals including specularite, pyrite, epidote, magnetite, dolomite and manganese minerals. Fossils of late Paleozoic age are found in some localities. There has been no commercial production from the mineral deposits although some exploration was conducted in the past for gypsum and manganese. Recent exploration resulted in the discovery of natural gas and of salt deposits.

Mining activity in the Island of Newfoundland began two centuries ago, the greatest boom being late in the 19th century when the copper mines came into production. In 1974 the Island contributed about 18 per cent to the total value of mineral production from the Province which ranked sixth in the nation. The Island is Canada's sole producer of pyrophyllite and fluorite. Other mines currently in operation yield gypsum, asbestos, base metals, limestone and silica. Mining in the past produced copper, gold, lead, iron, antimony, arsenic, barite and coal. Both the inactive and active mines provide mineral collecting sites; there are also other occurrences including celestite, quartz crystals, beryl, scheelite, prehnite and manganese minerals. For the gem-cutter or sculptor, there is amethyst, xonotlite, labradorite, and jasper, and a variety of ornamental rocks including pyrophyllite, chrome-mica rock (virginite), marble, granite and volcanic rocks. Rock-cuts along highways and shoreline exposures contain cavities lined with tiny crystals of quartz, pyrite and other minerals suitable for micro-mounting.

Most localities are readily accessible. Those in the Magdalen Islands and many in the Island of Newfoundland require only a short shoreline walk. Others can be reached by automobile and a short hike and, less commonly, by boat.

Résumé

Ce rapport décrit les endroits des Iles-de-la-Madeleine et de l'île de Terre-Neuve les plus intéressants pour les collectionneurs de minéraux et de roches. Ce guide fait partie d'une série traitant de diverses régions, faciles d'accès, du Canada et qui couvre toute la région des Maritimes. Ces îles offrent aux touristes, aux minéralogistes amateurs et professionnels et aux collectionneurs, une variété de sites riches en minéraux, roches et fossiles.

Les Iles-de-la-Madeleine, grappe d'îles reliées entre elles par des bancs de sable qui s'étendent à perte de vue, sont célèbres pour les immenses plages qui bordent leurs côtes érodées par la mer, mais relativement peu connues pour les minéraux qu'on y trouve. Le long du littoral, rocailleux et escarpé, le collectionneur trouvera, dans les roches volcaniques et sédimentaires, plusieurs variétés de gypse, des cristaux de calcite de quartz, ainsi que d'autres minéraux comme l'oligiste, la pyrite, l'épidote, la magnétite, la dolomie et les minéraux manganésiens. On trouve en certains endroits des fossiles de la période paléozoïque supérieure. Ces

gites de minéraux n'ont jamais été exploités commercialement bien qu'on ait fait, à un certain moment de la prospection pour trouver du gypse et du manganèse. Des campagnes de prospection récentes ont permis de découvrir du gaz naturel et des gisements de sel.

Les débuts de l'exploitation minière à Terre-Neuve remontent à deux siècles; l'époque la plus active a été vers la fin du 19e siècle, lorsque commença l'exploitation des mines de cuivre. En 1974, l'île a fourni 18 pour cent de la valeur globale de la production minérale de la province qui occupait la sixième place parmi les producteurs canadiens. L'île est le seul producteur canadien de pyrophyllite et de fluorine. D'autres mines et carrières, actuellement en exploitation, fournissent du gypse, de l'amiante, des métaux communs, du calcaire et de la silice. Dans le passé, les mines ont produit du cuivre, de l'or, du plomb, du fer, de l'antimoine, de l'arsenic, de la barytine et du charbon. Les mines, en exploitation ou non, sont des sites idéaux pour le collectionneur de minéraux; il existe également d'autres gites où l'on peut trouver des minéraux comme la célestine, le quartz en cristaux, le béryl, la scheelite, la prehnite et les minéraux manganésiens. Pour le lapidaire ou le sculpteur, il y a l'améthyste, la xonotlite, la labradorite et le jaspe ainsi qu'une variété de pierres ornementales: pyrophillite, fuchsite, marbre, granite et roches volcaniques. Les coupes le long des routes en tranchée, et les affleurements le long de la rive contiennent des cavités tapissées de menus cristaux de quartz, de pyrite et d'autres minéraux, qui se prêtent merveilleusement à l'examen au microscope.

La plupart des sites intéressants sont facilement accessibles. Ceux des Iles-de-la-Madeleine et de nombreux sites de l'île de Terre-Neuve peuvent être atteints après une courte marche le long de la rivé. D'autres sont accessibles en voiture et après une courte escalade, ou plus rarement, par bateau.

ROCKS AND MINERALS FOR THE COLLECTOR

THE MAGDALEN ISLANDS, QUEBEC
THE ISLAND OF NEWFOUNDLAND

INTRODUCTION

This booklet describes mineral, rock and fossil occurrences in the Magdalen Islands, Quebec and in the Island of Newfoundland. The occurrences in the adjacent Maritime Provinces and in the Gaspé region are described in Geological Survey of Canada Papers 64-10, 65-10 and 66-51 (*see* page 167).

Most of the collecting localities are accessible by automobile from main roads and from secondary roads branching from them; in some cases, a boat or a short hike is required. Directions to reach each of the occurrences are given in the text, and are designed for use with official provincial road maps. Locality maps are included for deposits that may be difficult to find. Additional detailed information can be obtained from the appropriate topographic and geological maps listed for each locality. These maps are available from the agencies listed on page 166.

Many of the inactive mines have not been operated for several years and entering shafts, tunnels, and other workings is dangerous. Collecting in operating mines is generally not permitted; their descriptions are included only as a point of interest to the collector. Some of the occurrences are on private property and are held by claims; their listing in this booklet does not imply permission to visit them. Please respect the rights of property owners at all times.

The localities were investigated in the summer of 1973 by the author ably assisted by Margaret M. Burgess. The field investigation was facilitated by information received from J. H. McKillop, Newfoundland Department of Mines and Energy, V. S. Papezik, Memorial University of Newfoundland, and H. J. Warren, all of St. John's; from Joseph Hayes of Curling, Newfoundland; and from J. J. Brummer, Canadian Occidental Petroleum Limited, Toronto. The laboratory identification of minerals was performed by G. J. Pringle, Geological Survey of Canada. This assistance is gratefully acknowledged.

COLLECTING ALONG THE ISLANDS

The collecting route in the Magdalen Islands is shown in Figure 2; in the Island of Newfoundland it is shown in Figure 3. Numerous side trips lead from the main routes: Highway 199 in the Magdalen Islands and the Trans-Canada Highway in Newfoundland. Information on each locality is systematically listed as follows: mileage along the main route; name of mine or occurrence; minerals or rocks found in deposit (shown in capital letters); mode of occurrence; brief notes on the locality with special features of interest to the collector; location and access; references to other publications indicated by a number and listed at the end of the booklet; references to maps of the National Topographic System (T), and to geological maps (G) of the Geological Survey of Canada, the Newfoundland Department of Mines and Energy, and the Québec Department of Natural Resources.

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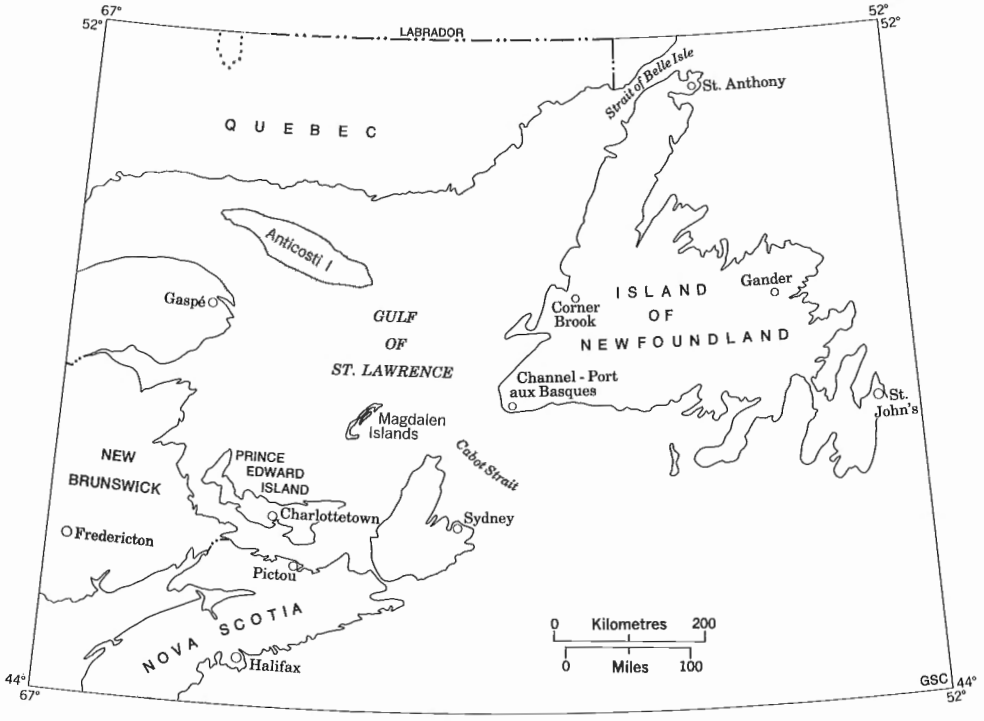


Figure 1. Map showing geographic location of the Magdalen Islands and the Island of Newfoundland.

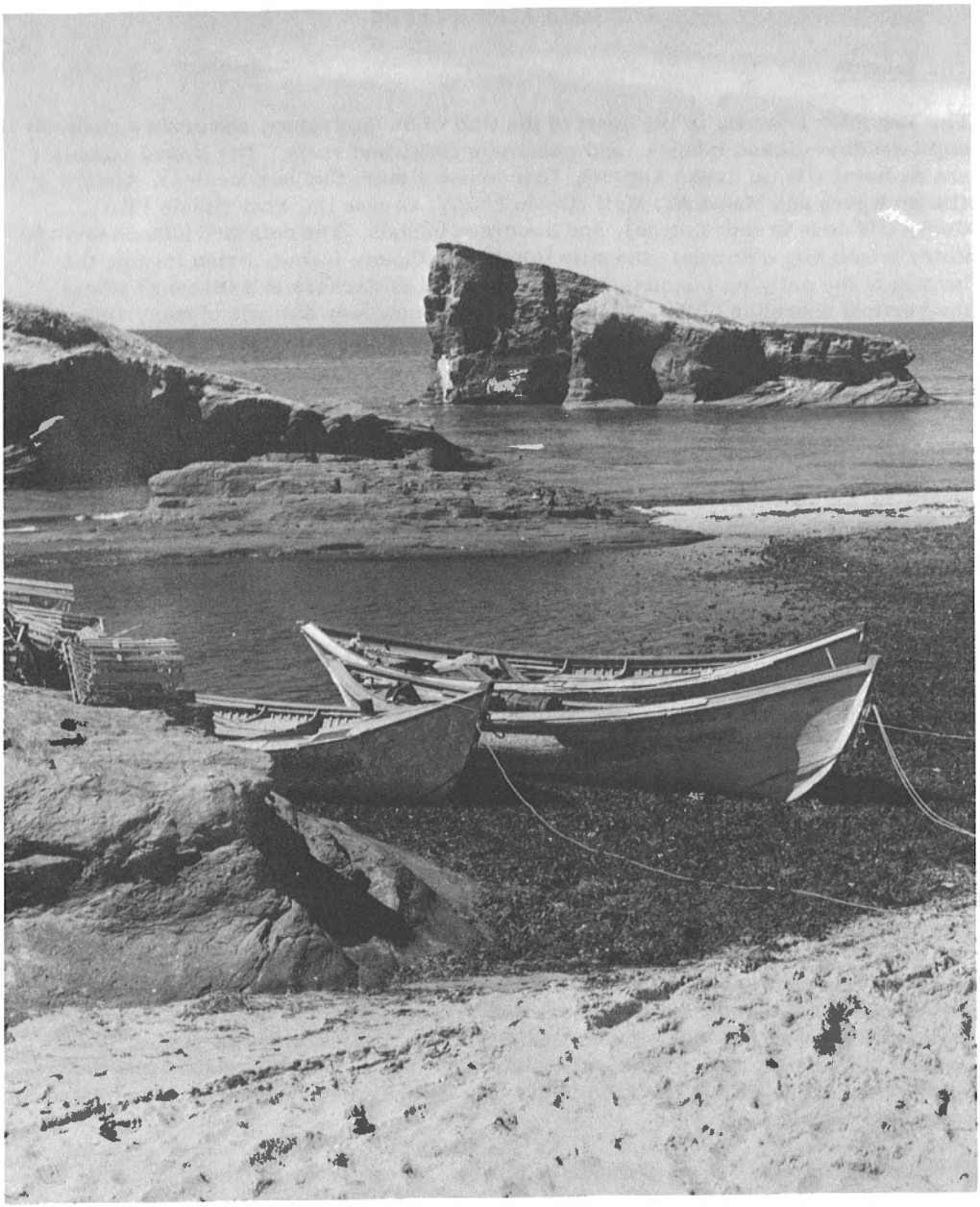


Plate I. Anse à la Cabane, Amherst Island. Sea-sculptured shorelines, offshore islets and sandy beaches are typical coastal features of the Magdalen Islands. (Canadian Government Photo Centre 63507)

THE MAGDALEN ISLANDS

The Islands

The Magdalen Islands, in the heart of the Gulf of St. Lawrence, comprise a chain of eight sandbar-linked islands, and numerous rocks and reefs. The linked islands are Amherst (Ile du Havre Aubert), Grindstone (Ile du Cap aux Meules), Alright (Ile du Havre aux Maisons), Wolf (Ile du Loup), Grosse Ile, East (Ile de l'Est), Coffin (Ile de la Grande Entrée), and Boudreau islands. The detached islands include Entry Island (Ile d'Entrée), the only inhabited offshore island; Brion Island, the largest of the outlying islands; the Bird Rocks (Les Rochers aux Oiseaux) where the vertical shoreline cliffs provide a haven for hundreds of birds of many species; and Deadman (Ile du Mort), Shag, and Gull (Ile aux Goélands) islands - all of them rocky and barren as are the many islets scattered in the lagoons.

This cluster of islands represents the protruding highlands and summits rising from the otherwise featureless and flat floor of the Gulf of St. Lawrence. The waters along the shorelines are shallow so that lowering the sea level to the 10-fathom line would result in the emergence of one large island encompassing all the islands of the Magdalens except Deadman Island. Along these shallow shorelines, shoals, reefs and rocky points provide navigational hazards to all but the smaller boats.

Their surface

Physiographically, the Magdalen Islands are a part of the Maritime Plain, a lowland within the Appalachian Region, that includes Prince Edward Island and adjacent low-lying areas of New Brunswick and Nova Scotia. Their surface is slightly rolling with elevations varying from 10 to 150 feet above the sea. Conical domes and steep-sided ridges rise from this surface to maximum elevations of 559 feet on Entry Island, 543 feet on Grindstone Island, and 477 feet on Amherst Island. Streams flow radially from the hills to the sea. At the base of the hills, solution of the underlying gypsum-bearing rock has resulted in oval, funnel-shaped depressions or sinkholes 10 to 100 feet deep, some of them now occupied by lakes or ponds.

The sands

The main islands are strung together by double lines of long sandbars or tombolos that enclose shallow salt-water lagoons and several lakes and ponds. These sandbars are a few feet to 8500 feet wide and are up to 25 miles long. In places, the accumulating sands have formed sand spits that project from the islands into the open waters of the Gulf. These belts of sand comprise nearly a third of the total area of the island-group.

The lagoon-separated belts of duned sand were perceived by Cartier during his discovery voyage of 1534 to be great sandy beaches fringing a mainland. It was on the return part of his second voyage (1535-36) that he realized that these sands were the connecting links of a group of islands. He referred to the main island as Les Araines (The Sands), a name used for the archipelago on maps and charts for more than a century thereafter.

The sands feature an ever-changing topography brought about by shifting winds that whip the sand into ridges, mounds and hills ranging from 30 to 125 feet high.

Their shoreline too is constantly changing: as the sea waves lash away at the sandbanks, they remove some sand, carry it elsewhere along the shore, then pile it up again in a never-ending sequence of erosion and deposition. Gaps in the bars are sometimes opened wide and at other times closed almost completely by the action of the sea. The effects of the wind and the sea are curbed somewhat by bunches of grass, stunted trees and low-growing shrubs that are scattered on the surface and serve to anchor the sand.

The cliffs

Vertical cliffs, generally less than 100 feet high, outline nearly all the shorelines. Most are composed of friable red sandstone that is easily eroded by the sea and the wind. The ceaseless lashing by the sea waves has produced saw-toothed and pitted cliff-walls, crevices, caves and chasms in the cliffs, and pillars, archways and sea stacks detached from them. These sea-sculptures can be seen at several places along the Gulf shores including Red Cape, Cap au Trou and Étang du Cap.

Most of the higher cliffs - those that are 100 to 200 feet high - are composed of alternating layers of sedimentary and volcanic rocks. These resistant rocks are only slightly affected by erosional forces of the sea and the wind, and have not been carved by them into shoreline sculptures. These durable shoreline cliffs form the eastern shores of Entry and Alright islands, the high cliffs of Cap Noir, and the Demoiselle Hill shore.

Fringing the cliffs are beaches of ivory coloured sand composed almost entirely of quartz. This beach sand and the sand forming the sandbars and sand spits is derived from the loosely consolidated red sandstone that underlies most of the shoreline. The coating of red hematite on the grains composing the sandstone that give the rock its red colour is lost in the weathering process, leaving the loose sand white.

Their geological history

About three-quarters of the island mass is underlain by red sandstone of Pennsylvanian age, geologically the youngest rock formation found on the Magdalens. Being the last-formed rock, it covers all other rock formations except those comprising the hilly regions where erosion has claimed the friable sandstone cover. The low, almost flat-lying platform of rock lying between the hilly areas and the sea, is formed of this sandstone. This striking red cap of rock can be seen along coastal cliffs at several places including the Cap aux Meules headland that comes into view as the ferry from Prince Edward Island approaches the harbour. At this locality, it blankets grey sandstone deposited at an earlier time.

The oldest rocks are the volcanic and associated sedimentary rocks that form the hills and ridges on Grindstone, Alright, Amherst and Entry islands. They were formed in Mississippian time when the region was invaded by seas that laid down layers of limestone and gypsum. While these sediments were accumulating, intermittent volcanic outbursts spread volcanic ash, particles, and bombs over them resulting in the formation of alternating layers of volcanic and sedimentary rocks. After the volcanic explosions ceased, sedimentation continued and the grey sandstone was deposited. All these rocks were subsequently subjected to earth movements that folded, faulted and fractured them. These contorted and overturned layers of rocks can be seen along coastal cliffs at Demoiselle Hill on Amherst Island, along the shore north of Cap aux Meules, on the south shore of Boudreau Island, and along the south and east shores of Entry Island.

TABLE I

AGE (millions of years)	ERA	PERIOD	ROCKS FORMED	WHERE TO SEE THEM
	Cenozoic	Quaternary Tertiary	Gravel, sand	Gravel pits; sand dunes; shorelines
65				
	Mesozoic		Not represented in area	
225		Permian		
	Paleozoic	Pennsylvanian	Red sandstone	Bird, Brion, Shag, Wolf, Coffin islands; Ile Rouge; Ile aux Cochons southern and western shores of Amherst Island; north half of Alright Island; west half of Entry Island; Cap Rouge, Pointe à Richard and western shore of Grindstone Island
			Grey sandstone	Cap aux Meules, Pointe Basse, Cap du Sud-Ouest, Les Demoiselles shore, Shea Point, Cap au Dauphin, Pointe Rockhill, Pointe de la Grosse Ile, Brion Island, Bird Island
		Mississippian	Gypsum, argillite, shale, limestone, sandstone, volcanic rocks	Eastern shore of Entry Island; shoreline at Les Demoiselles, north of Cap aux Meules, Butte Ronde, Buttes Pelées, Cap au Taureau, Anse à Damase, Ile Boudreau, Cap Noir, Anse à la Cabane
			Limestone conglomerate	Eastern shore of Entry Island
			Limestone, volcanic rocks	Magdalen Manganese Mine
			Volcanic rocks	Chemin des Buttes quarry; Deadman Island
		Devonian Silurian Ordovician Cambrian	Not represented in area	
570	Precambrian			

Valleys and hills were carved out of the existing rocks following the period of crustal disturbance. It was after this that the sands gathered around the hills and covered the low-lying areas to form the red sandstone that is visible on nearly every shore. This rock is generally flat lying and undisturbed except in a few localities where local rock deformation tilted the otherwise horizonal beds. An example of this dislocated rock can be seen along the cliffs north of Cape Alright and along Anse à Damase on Alright Island, and on the south shore of Entry Island.

During Pleistocene time, the Magdalen Islands and eastern North America, to which they were then attached, were depressed due to the weight of glacial ice. With the retreat of the glaciers, the region was uplifted, but the islands failed to reach their former level remaining as islands separated from the continent as they are today.

The geological history with examples of rocks formed is summarized in Table I.

Their mineral deposits

Although there are deposits of gypsum and manganese minerals on Amherst, Alright and Grindstone islands, there has been no commercial production. Natural gas was found on Amherst Island in 1959 when a test-hole was drilled in preparation for the construction of a wharf; the gas flowed from the hole intermittently for almost two months. On the same island, a salt (halite) deposit was discovered by SOQUEM (Société Québecoise d'Exploration Minière) in 1972 in Mississippian rocks at a depth of about 450 feet. Subsequent drilling programs have revealed additional salt deposits at Havre aux Maisons and at Grosse Ile; potassium chloride is associated with the halite.

Collecting on the islands

There are numerous accessible localities on the Magdalen Islands where mineral specimens and fossils may be collected. These localities and other points of interest are described in the text. Their exact locations are given in two road logs, one leading north from Cap-aux-Meules, the other leading south. The place-names used in the text correspond with those appearing on topographic maps; geographic names used on official road maps are also given.

Access to the islands is by boat or by air. An automobile ferry connects Souris, Prince Edward Island to Cap-aux-Meules. The airport serving the Magdalen Islands is on Alright Island. Entry Island is the only offshore island connected to the main islands by a ferry service. The other islands can be reached by small boats.

Refs:

2 - p. 623-645
31 - p. 5-7
34 - p. 333-335
43 - p. 275-278, 323-324
85 - p. 1-2
116 - p. 468-469
117 - p. 711
120 - p. 1-10
127 - p. 16-49, 53
179 - p. 55
182 - p. 1

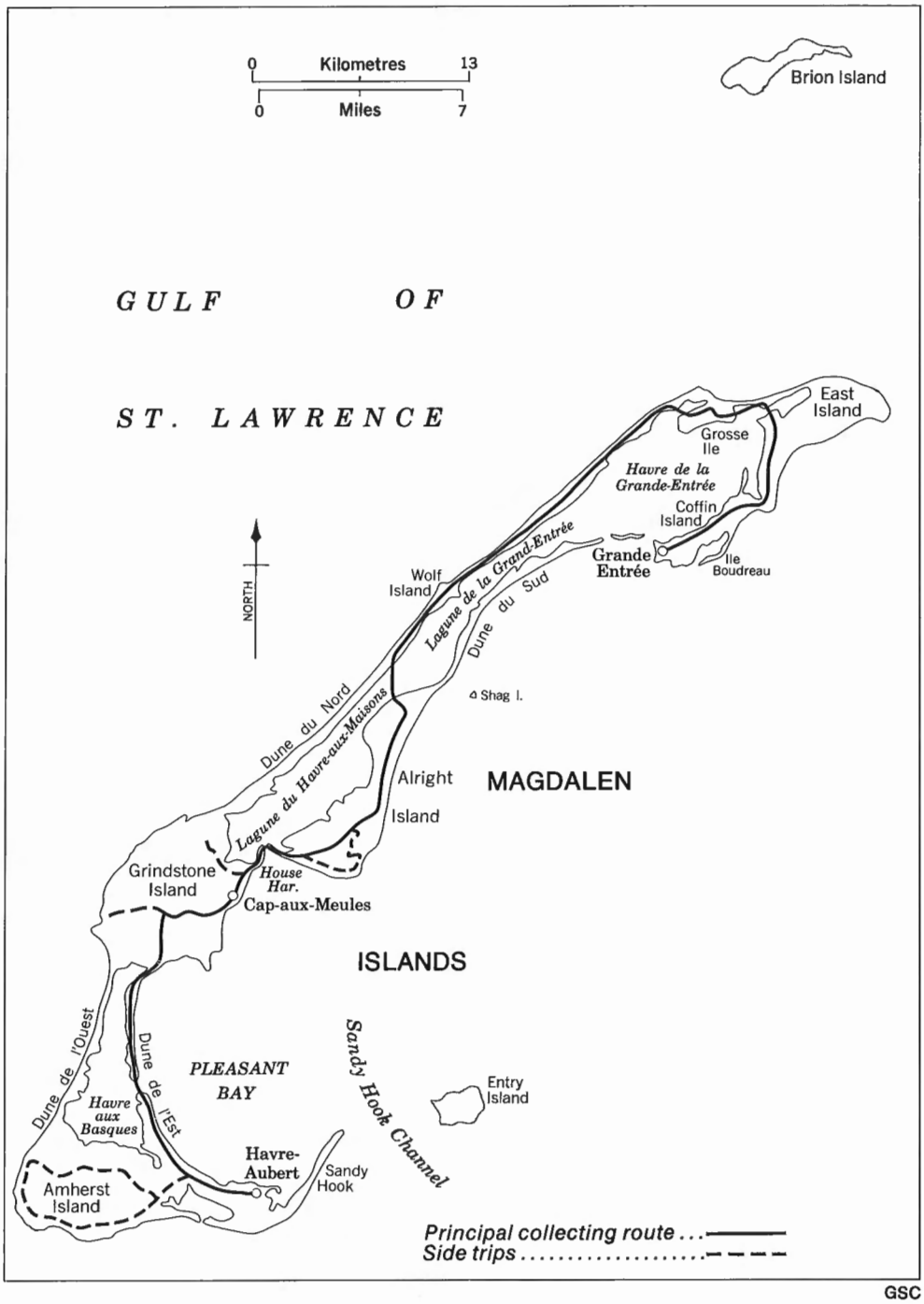


Figure 2. The Magdalen Islands: map showing collecting route.

Maps (T): 11 N Magdalen Islands
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

ROCK AND MINERAL COLLECTING ON THE ISLANDS

CAP-AUX-MEULES TO GRANDE-ENTRÉE

Mile 0 Cap-aux-Meules, at junction Highway 199 (Route Principale) and the road leading to the Cap-aux-Meules pier.

Grindstone Island (Ile du Cap aux Meules)

This, the largest of the Magdalen Islands, is the commercial centre of the islands. A double line of sand bars extending from its north and south ends connects it to the adjoining islands. The shoreline, cliffed on nearly all sides, borders a gently rolling lowland underlain by sandstone. Rising from this plain is an interior core of resistant volcanic and sedimentary rocks that form cone-shaped hills 450 to nearly 550 feet above the sea. Streams radiating from the hills feed lakes and ponds near the shore, or flow directly into the sea. Off the southeast point and off the west coast of the island, numerous cliffed islets and rocky points protrude from the shallow waters; the largest is Gull Island (Ile aux Goélands) at the southwest end.

The island contains occurrences of gypsum and of manganese minerals. A quarry near Fatima is operated for sandstone.

Maps (T): 11N/5 Grindstone Island
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Cap aux Meules Headland

CALCITE CRYSTALS

In grey sandstone

Crystals of colourless to white calcite (dog-tooth spar) occupy cavities and veins measuring 3 to 4 inches wide in the sandstone. The crystals average about $\frac{1}{4}$ inch in diameter. A black manganese mineral occurs as a coating on the sandstone.

The sandstone containing the calcite crystals is exposed along the sea-cliffs south of the Cap-aux-Meules pier. At the head of the cape, the sandstone forms a hill, 100 feet high, with steep cliffs on its east and south sides dipping into the sea. Many years ago the rock was quarried for use in making grindstones and through the years, the island became known as Grindstone Island. The grey sandstone is capped by red sandstone that also forms the cliffs at Leslie Cove.

1. Fatima sandstone quarry.
2. Magdalen Manganese Mine.
3. Baie du Sud manganese occurrence.
4. Gypsum occurrences.
5. Cap aux Meules Headland calcite occurrences.

Map 1. Grindstone Island

The occurrence is readily accessible from the Cap-aux-Meules pier, 0.2 miles east of Highway 199.

Refs: 2 p. 640-641; 127 p. 37

Maps: See maps for Grindstone Island (page 9)

Cap aux Meules Gypsum Occurrence

GYPSUM, DOLOMITE, QUARTZ CRYSTALS, SPECULARITE, CALCITE, PYRITE

In argillite and volcanic rocks

Colourful and attractive specimens of gypsum can be collected from the shoreline cliffs north of Cap-aux-Meules. Both fibrous and massive varieties occur. The fibrous gypsum is white, grey or pink; the massive is white, orange, or white banded with grey. Tiny, light yellow to colourless dolomite crystals are associated with the fibrous variety. The gypsum occurs in layers and in veins in sedimentary rock (argillite) that is interbedded with volcanic rock.

Some of the volcanic rock (basalt) is amygdaloidal and contains cavities lined with "micro" crystals of colourless quartz, pink and white dolomite and colourless to white calcite, and with tiny plates of specularite. Small nodules of pyrite occupy some of the cavities. A bluish grey clayey material known as "terre grasse" is associated with the gypsum and with the volcanic rock. It can readily be removed by swirling the gypsum specimens in water.

This is one of several gypsum deposits occurring on the Magdalen Islands. Although small shipments of gypsum were made by returning supply boats to Quebec City sometime before 1880, the deposits remain undeveloped. They differ from those of New Brunswick, Nova Scotia and Newfoundland in that they lack anhydrite, a mineral commonly associated with gypsum deposits and regarded as an impurity.

The gypsum-bearing rocks at this occurrence outcrop along the shoreline cliffs 500 yards north of Cap-aux-Meules. The outcrop area extends northward for about 250 feet. Specimens can be collected from the cliffs and, more readily, from broken blocks of rock along the shore. They are also found on the beach where they are commonly water-worn and sculptured into a variety of unusual and attractive forms.

Access to the occurrence is by a road, 0.25 mile long, leading from Highway 199 just north of its junction with the Cap-aux-Meules pier road. It leads to the beach at the south end of the gypsum-bearing cliffs.

Refs.: 2 p. 638, 648; 76 p. 100; 120 p. 9; 141 p. 4-6, 14

Maps: See maps for Grindstone Island (page 9)

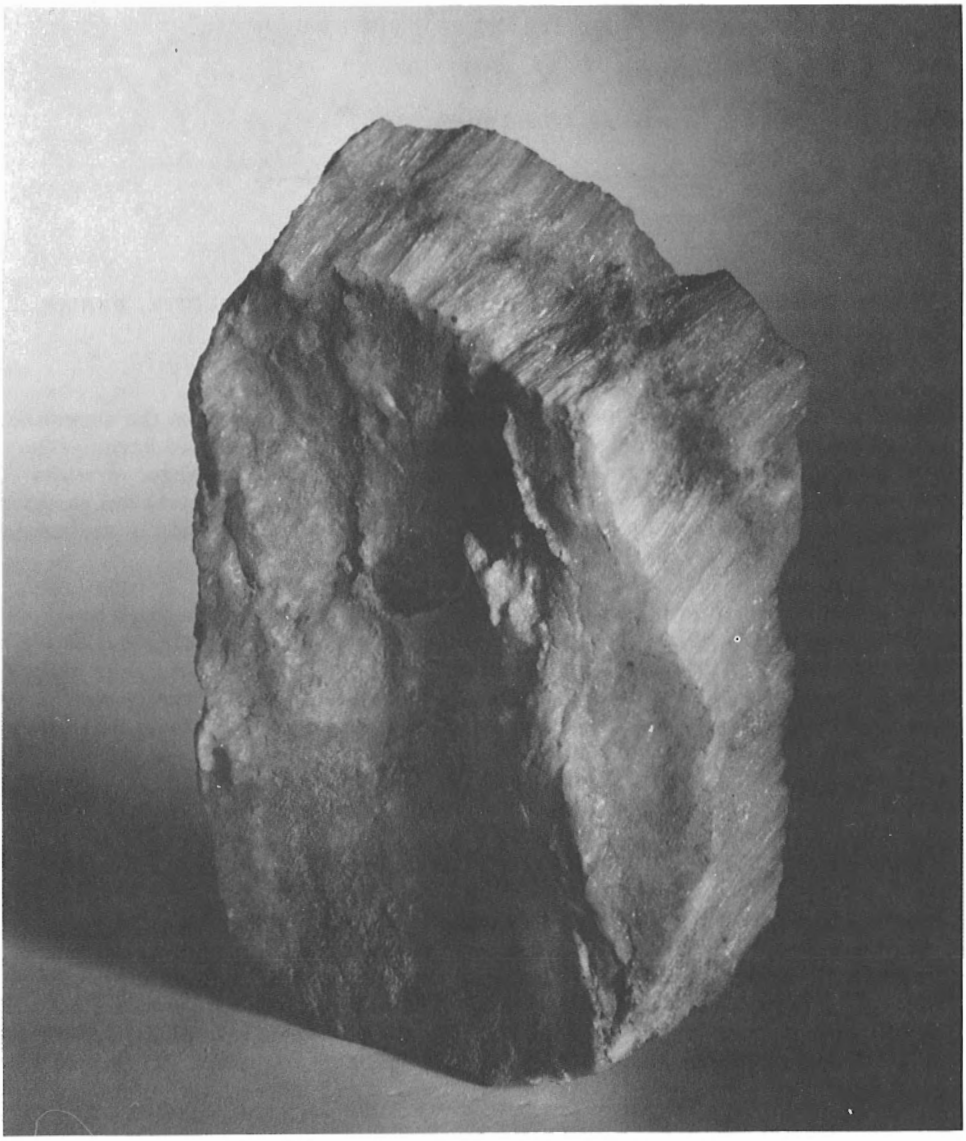


Plate II. Fibrous gypsum specimen collected from shoreline north of Cap-aux-Meules pier, Grindstone Island. (GSC 202820)

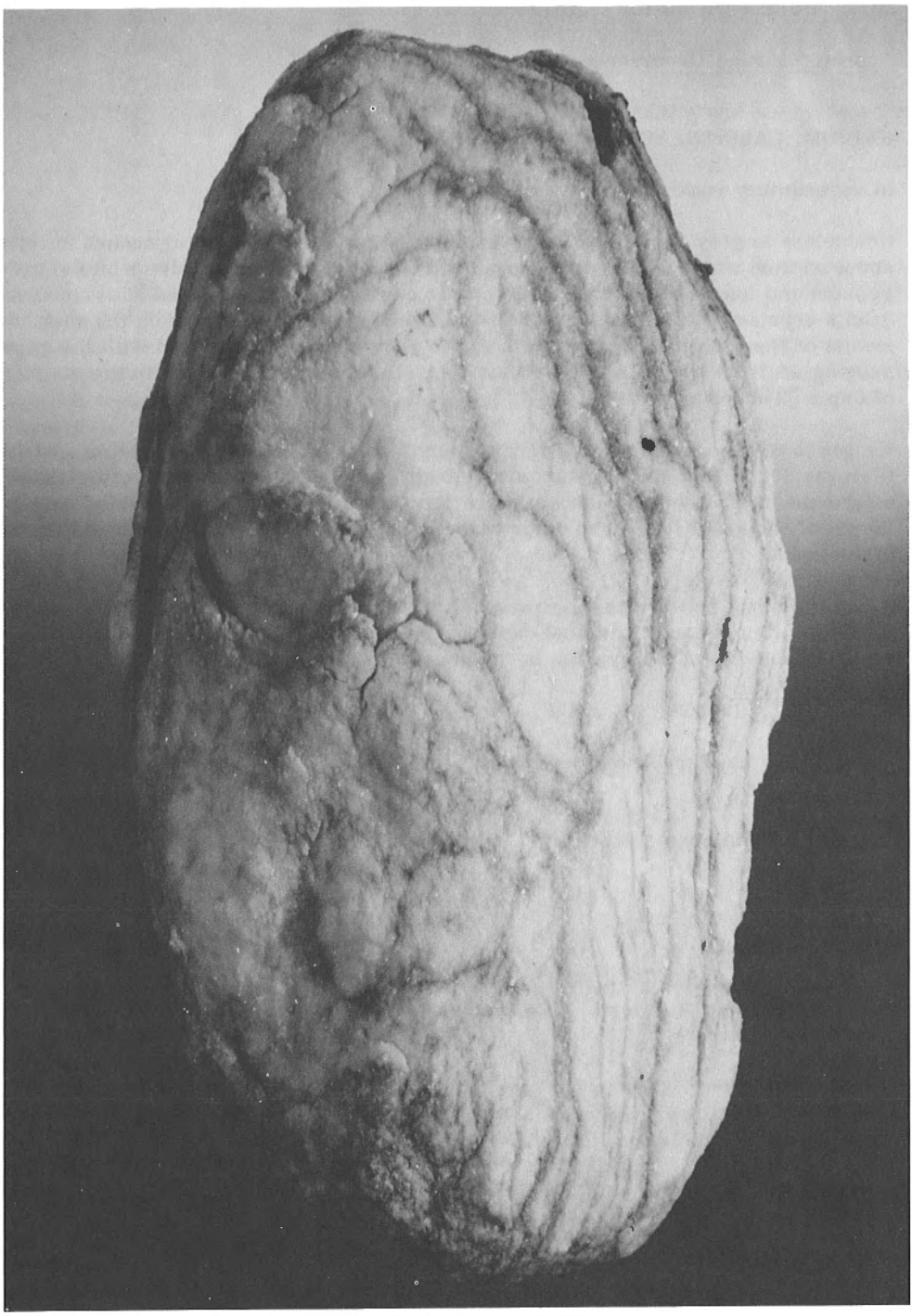


Plate III. Water-worn specimen of banded gypsum from shoreline north of Cap-aux-Meules pier, Grindstone Island. (GSC 202820-B)

Mile 0.8 Turn-off (on right) to Cap au Taureau.

Cap au Taureau Occurrences

GYPSUM, CALCITE, FOSSILS

In sedimentary rocks

Colourless to grey transparent fibrous and platy gypsum (selenite) occurs in layers about an inch wide in grey argillite. The rock also contains massive white to grey gypsum and lenses of massive white calcite containing cavities lined with colourless calcite crystals. Tiny black nodules of a manganese mineral occur on the rock. Shell fossils of Mississippian age occur in red to grey siltstone associated with the gypsum-bearing argillite and with the volcanic rocks that form the sea cliffs in the vicinity of Cap au Taureau.

Access to the shore at Cap au Taureau is by a road, 0.2 mile long, leading east from Highway 199 at Mile 0.8. One exposure begins about 100 yards south of the point where the road meets the shore; here the gypsum-bearing rocks extend over a length of about 400 feet. The other occurrence is about 200 yards north of the end of the road.

Along the slope between the highway and the shore, the topography is marked by numerous funnels or cylindrical depressions several feet in diameter; they are the result of solution of the gypsum in the underlying rocks.

Refs.: 127 p. 20, 26; 141 p. 14

Maps: See maps for Grindstone Island (page 9)

Mile 0.9 Junction road on left: Chemin des Caps

Fatima Quarry

SANDSTONE

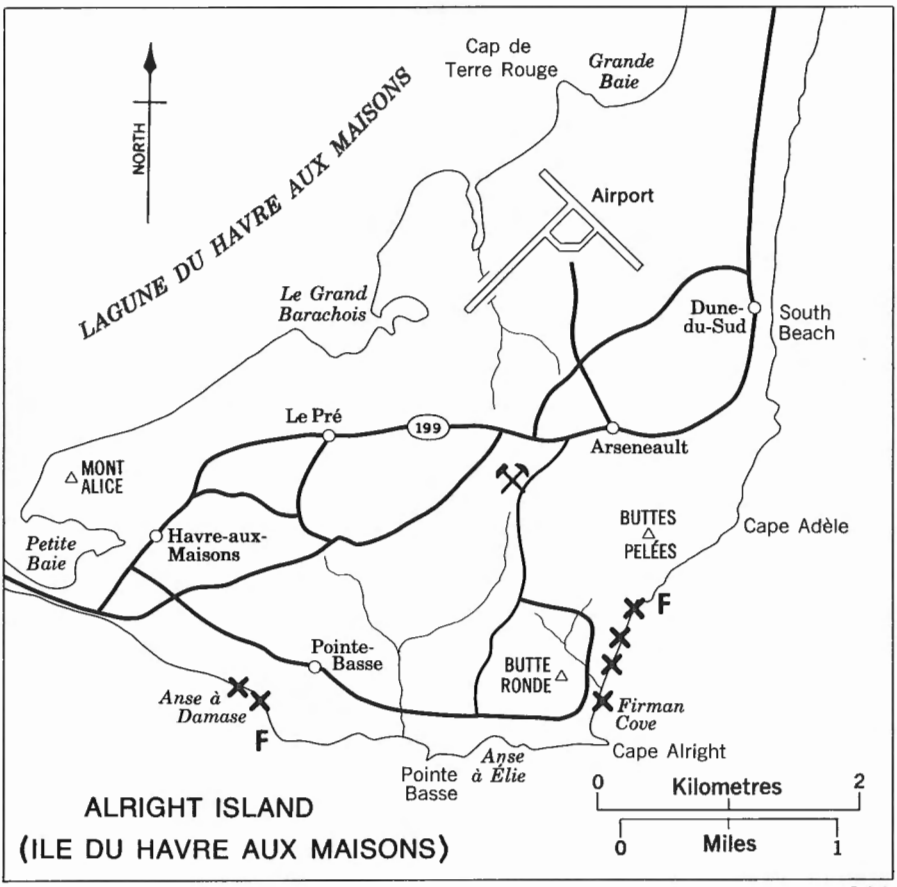
Grey sandstone is being quarried on the southeast side of a 150-foot hill between Fatima and Grand-Ruisseau. The sandstone contains shaly beds and cavities lined with calcite crystals.

This hill rises from a low-lying area that, like the hill itself, is underlain by red sandstone. This red rock forms all the shoreline cliffs on Grindstone Island except those on the northeastern side which are composed of volcanic and sedimentary rocks.

Access to the quarry is via Chemin des Caps; it is 1.6 miles from Highway 199 and is visible from it.

Ref.: 127 p. 43

Maps: See maps for Grindstone Island (page 9)



⚒, Chemin des Buttes quarry. **F**, Fossil occurrences. ×, Gypsum occurrences.

Map 2. Alright Island.

Mile 1.3 Baie du Sud on left; a trail leads from the highway to and along part of the shore of this bay.

Baie du Sud Occurrence

BIRNESSITE, MAGNETITE, CALCITE, DOLOMITE; GYPSUM

In carbonate rock; in argillite

These minerals occur in the low cliffs along the shore of Baie du Sud. An altered friable rock composed of carbonates is exposed along the cliffs nearest the highway. It contains a manganese mineral and vugs lined with tiny crystals of dolomite and of calcite. The manganese mineral birnessite occurs as a greasy black coating or film associated with dull black small irregular masses of magnetite. Beyond these cliffs, at a distance of 300 to 400 yards from the highway, exposures of argillite containing gypsum occur along the shore. They outcrop again along the headland that forms the west side of Baie du Sud, ½ mile west of Highway 199.

These occurrences can be reached by walking along the shore west of Mile 1.3 on Highway 199.

Ref.: 141 p. 14

Maps: See maps for Grindstone Island (page 9)

Mile 2.1 Bridge at House Harbour (Havre aux Maisons).

This bridge connects the slender belts of duned sand that project from Grindstone Island and Alright Island. The Havre aux Maisons Lagoon - the Great Lagoon — on the left side of the bridge, contains the rocky islets known as Ile Rouge, to the northwest of the bridge, and Ile aux Cochons (locally known as Ile aux Porcs) to the northeast. These islets are composed of red sandstone.

Mile 3.3 Church, at bend in highway.

Alright Island (Ile du Havre aux Maisons)

At Mile 3.3, the highway turns away from the Gulf shore and begins its traverse through the hilly part of Alright Island, an area that comprises all but the island's northwestern part which is flat and only a few feet above the level of Havre aux Maisons Lagoon. Red sandstone underlies this low-lying area which is the site of the airfield serving the Islands. The hills, locally known as buttes, rise to form rounded summits that reach their maximum elevations toward the eastern shore of the island where they end abruptly in steep coastal cliffs 200 feet high. All but two of the hills are composed of interbedded sedimentary and volcanic rocks. The exceptions are Mont Alice at the island's extreme west end, and a 250-foot hill on the west side of Highway 199 at Mile 5.4; they are formed of grey sandstone. This resistant sandstone also forms two headlands, one at Pointe Basse and the other immediately west of it. Their steep grey cliffs contrast strikingly with the low, friable red sandstone cliffs bordering the bays on either side.

Maps (T): 11N/5 Grindstone Island
(G): 1482 Magdalen Islands, Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Mile 3.6 Junction road on right: Chemin Pointe Basse.

Anse à Damase Occurrence

GYPSUM, PYRITE, FOSSILS

In sedimentary rocks

The sea-cliffs at Anse à Damase are composed of sedimentary rocks — argillite, shale, siltstone, sandstone — and some volcanic rocks. Gypsum occurs in argillite and limestone. The varieties include: colourless, transparent platy gypsum (selenite); colourless, white and pink fibrous gypsum (satin spar); pink granular massive gypsum; and white and grey finely banded massive gypsum. Nodules of pyrite are found in brown sandstone, and Mississippian shell fossils occur in shale.

The rocks containing the gypsum and fossils are exposed along the shoreline cliffs at Anse à Damase, on the south shore of Alright Island.

Road log from Highway 199 at Mile 3.6:

Mile 0 Proceed onto the Pointe Basse road.
0.9 Junction; turn right.
1.3 End of road at shore.
The occurrence is in the cliffs near the road.

Refs.: 127 p. 29, 43; 141 p. 11, 12

Maps: See maps for Alright Island (page 17)

Butte Ronde Occurrence

GYPSUM, FOSSILS; CALCITE, QUARTZ, SPECULARITE, EPIDOTE

In sedimentary rocks; in volcanic rocks

Gypsum occurs in argillite and limestone exposures along the sea-cliffs at the foot of Butte Ronde, north of Cape Alright. The gypsum is grey to almost black, massive, and is cut by veins of white gypsum.

The gypsum-bearing rocks here and at other localities on the Magdalen Islands are highly contorted due to deformation that took place following volcanic activity in Mississippian time. Rocks produced by the volcanic eruptions occur with the sedimentary rocks in the sea-cliffs and form Butte Ronde, Buttes Pelées and adjacent hills. Some shell fossils of Mississippian age occur in the limestone and siltstone associated with the gypsum-bearing rocks. These shoreline occurrences are accessible from the Pointe Basse road.

Along this road at the foot of Butte Ronde (Mile 2. 0) the pebbles in the gravels and broken rock fragments provide the following specimens: white fibrous and massive gypsum in sedimentary rocks; amygdaloidal basalt with cavities (measuring less than 1 inch across) containing platy aggregates of specularite and "micro" crystals of calcite, quartz and epidote; and crystalline layers of epidote in basalt.

Road log from Highway 199 at Mile 3. 6:

Mile 0 Proceed onto the Pointe Basse road.

0. 9 Junction road to Anse à Damase; continue straight ahead.

1. 6 Junction. The hill on the south side of the road opposite this junction forms the cliffed headland known as Pointe Basse. It is composed of grey sandstone, a rock more resistant to erosion than the red sandstone which underlies the surrounding low-lying region.

The road log continues straight ahead.

2. 0 Butte Ronde on left. This 300-foot hill is typical of the beehive-shaped hills or buttes that rise abruptly from the slightly undulating plains on this island and on Grindstone and Amherst islands. They are composed of volcanic rocks; the plains below them are younger, easily eroded, sedimentary rocks. Cape Alright, south of the road, is formed of flat-lying red sandstone. Erosion of its cliffs by sea-waves has produced eerie caves, graceful arches and statuesque pillars that are visible from the road at this point.

Along the shore, the faulted contact of the red sandstone with the underlying volcanic rocks can be seen at a point 550 feet north of the Cape Alright lighthouse. The deformation of the sandstone and of the older volcanic rocks on which it had accumulated is the result of earth movements that affected this locality in late Paleozoic or early Mesozoic time. This is one of the few localities on the Magdalen Islands where the red sandstone strata has been disturbed; elsewhere, as seen along the shoreline cliffs, it is remarkable for its undeformed, flat-lying character. Because of its friable nature, this sandstone, unlike the more resistant grey sandstone, is readily attacked by the sea resulting in marine erosional features such as sea-arches and sea-caves, pierced holes and pillars.

2. 1 Junction access road to shore at foot of Butte Ronde. The gypsum-bearing rocks outcrop along the sea-cliffs to the north and south of the road. They extend 500 feet southward from the road. The exposures north of the road stretch for 1500 feet northward from a point 500 feet from the road. The fossils occur near the northern end of these exposures.

Refs.: 2 p. 638, 642, 644; 127 p. 21, 25, 43; 141 p. 7, 9, 12

Maps: See maps for Alright Island (page 17)

Plate IV. Buttes along Chemin des Buttes, Alright Island. Dome-like and conical shaped hills are characteristic of the topography of the islands. (GSC 202765)

Mile 5.4 Red sandstone is exposed by a low outcrop along the highway, and the hill beyond (on the left side of the highway) is composed of grey sandstone.

5.75 Junction road on right: Chemin des Buttes.

Chemin des Buttes Quarry

CALCITE CRYSTALS, HEMATITE

In volcanic rock

This quarry was opened on the side of a hill in volcanic rock that was used for road-building. The rock contains irregualr masses of hematite and aggregates of white calcite crystals (dogtooth spar) with individual crystals averaging $\frac{1}{4}$ inch in diameter. The calcite fluoresces pink when exposed to ultraviolet light. Patches of a greenish grey clay occur as an alteration of the volcanic rock.

This rock is brecciated and has undergone deep surface alteration; it is disintegrated to such an extent that its extraction for use in road building was feasible using only power shovels. Crushing was not required. Similar quarries were opened on the slopes of other volcanic buttes on the islands; the rock was found to be weathered to depths of up to 100 feet from the surface.

Plate V. Sea-eroded cliffs of red sandstone, Cape Alright, Alright Island. Entry Island is in the distant haze. (GSC 202766)

The quarry is on the west side of the des Buttes road 0.3 mile south of its junction with Highway 199.

Ref.: 127 p. 18-19

Maps: See maps for Alright Island (page 17)

Buttes Pelées

Buttes Pelées are a series of hills or buttes that form a ridge extending eastward from the des Buttes road to the Gulf shore. They reach uniform maximum elevations of over 300 feet above the sea. The ridge is steep-sided at its western end, along the road, where it reaches its maximum elevation of 362 feet. It terminates in 100- to 200-foot coastal cliffs that form a series of headlands including Cape Adèle. The hills are composed predominantly of volcanic rocks of Mississippian age interbedded with some sedimentary rocks.

At the south end of Buttes Pelées, a bed of grey limestone particularly rich in Mississippian shell fossils is exposed near the shore at an elevation of 50 feet. This limestone weathers black and is associated with argillite and gypsum; volcanic rocks are interbedded with these rocks. The fossil occurrence is about 800 yards north of the access road leading to the shore from Butte Ronde. (See page 18)

The des Buttes road parallels the western edge of the Buttes Pelées for 0.8 mile from its junction with Highway 199.

Refs.: 2 p. 638; 127 p. 21, 25

Maps: See maps for Alright Island (page 17)

Mile 6.0 Junction road to the airport.

7.05 Turn-off (right) to shoreline.

South Beach

Along this sandy beach, south of the access road, the low shoreline cliffs of red sandstone display the sea-eroded sculptures characteristic of much of the seacoast of these islands. Broad arches and lone pillars of this striking red rock, at one time part of the shoreline cliffs, have been carved out by the lashing sea-waves leaving them isolated. The attacks by the sea producing caves and crevices, tunnels and tilting ledges, and other erosional features in the poorly consolidated sandstone is a continuing geological process resulting in an ever-changing shoreline.

Mile 7.3 Junction road on left: Chemin des Sillons.

Dune du Sud

At about this point the highway begins its course along Dune du Sud - the 13-mile sandbar extending from Alright Island to the entrance of Grande Entrée Harbour. With Dune du Nord, it forms a double link enclosing a very shallow protected interior passage between Grande Entrée Harbour and Havre aux Maisons Lagoon. The highway leads north along the southern part of the sandbar. At this end it bulges out onto the lagoon and attains its maximum width of 1½ miles. As the dune passes Shag Island, it narrows abruptly forming a crescent that separates Grande Entrée Lagoon from the Gulf of St. Lawrence.

Mile 11.5 The highway leaves Dune du Sud and bridges the interior channel which at this point is one mile wide.

12.6 Dune du Nord

From this point to Mile 26.0, the highway route is along Dune du Nord, the immense 25-mile sandbar that connects Hospital Cape on Grindstone Island to Grosse Ile enclosing Wolf Island at about the mid-point. This is the longest of the sandbars linking the islands of the archipelago. Its width varies from half a mile to just slightly more than the width of the highway.

Mile 13.7 Le Buttereau du Nègre on right. This is a group of duned islets in Grande Entrée Lagoon.

15.8 Wolf Island

This irregularly shaped island, with a maximum elevation of only 50 feet above the sea, is formed of red sandstone and is less than a mile wide and almost 1½ miles long.

Plate VI. Sea arches produced by wave erosion along shore at South Beach. Entry Island is in the distance. (GSC 202764)

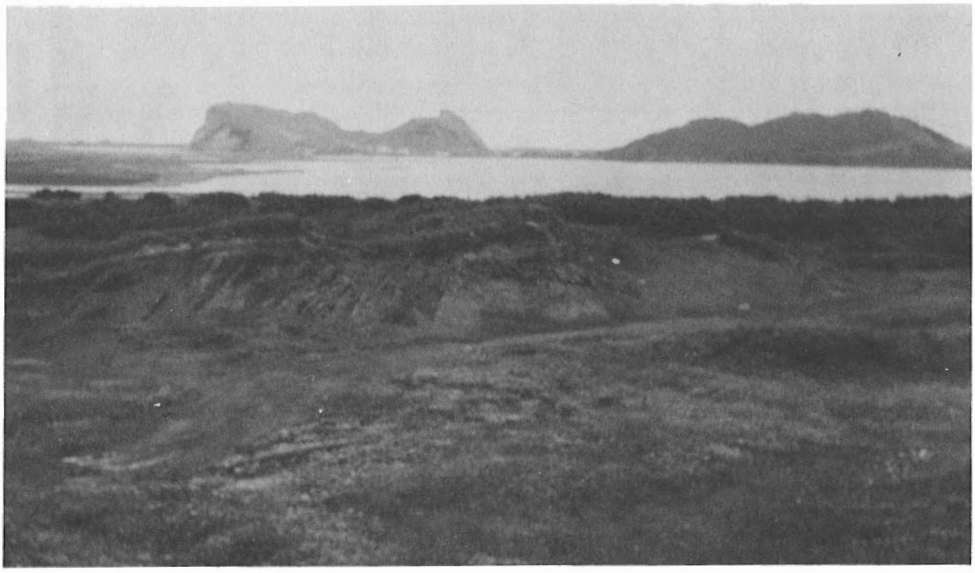


Plate VII. Grosse Ile viewed from south of Havre de la Grande Entrée. (GSC 202825)

Mile 20 From this point to Mile 22.5, Dune du Nord is dotted with numerous shallow pools of water separated by marshy areas. It reaches its maximum width of one half mile in this section.

25 Rochers au Dauphin

Rock points such as these on the north side of the highway occur at various places along the shores. They are erosional remnants projecting from a platform of rock covered by shallow waters.

Mile 26 Causeway and bridge connecting Dune du Nord to Grosse Ile. Grosse Ile Bay (on left) projects deeply into Grosse Ile nearly cutting it in two.

Grosse Ile

This island is composed of two parts joined by a narrow neck of land and duned sand that separates Grosse Ile Bay from the Gulf of St. Lawrence. The larger, southern part is made up of a series of hills with elevations from 250 to 300 feet. A single 150-foot hill, its northern side cut by 100-foot cliffs overlooking the Gulf, comprises the northern part. The 2-mile-long southern shore of the island is bordered by a continuous 50-foot cliff. Red sandstone underlies all of the island except Rockhill Point and Grosse Ile Point which are formed of the older grey sandstone.

Maps (T): 11N/12E Grosse Ile
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Plate VIII. Sea Cow Bay, Coffin Island. The constant lashing of sea waves resulted in a series of sea caves and sea arches along this shore. (GSC 202747)

Brion Island, Bird Rocks

These uninhabited islands lie north and northeast of Grosse Ile: Brion Island is 10 miles north, and Bird Rocks (Rochers aux Oiseaux) are 22 miles northeast. They are the most distant of the offshore islands. These islands were the first of the Magdalen Islands to be sighted by Jacques Cartier on his discovery voyage of June, 1534 - Bird Rocks was the first to come into view as he sailed into the Gulf from the Strait of Belle Isle. He then made a landing at Brion Island which he named for Philippe Chabot, Sieur de Brion, the Grand Admiral of France and patron of the expedition.

The islands are composed mostly of red sandstone with some grey sandstone. Brion Island, the largest of the isolated islands, is nearly five miles long with a maximum width of about a mile. Its rolling surface rises to an elevation of 250 feet in the central part. The island is bordered by vertical cliffs 50 to 200 feet high. Along much of the shoreline, cliffs form smooth sweeping curves unmarked by the jagged edges and sea-sculptured features formed in other islands. Elsewhere the coastline is intricately indented with countless coves and headlands.

The Bird Rocks consist of a rock-island — Great Bird — and a small cluster of rock-islets known as the North Bird rocks. Great Bird is a flat-topped, oval-shaped island only 350 yards long with cliffs about 120 feet high on all sides. Its stacked horizontal layers of sandstone rise like a fortress out of the sea. Differential erosion of these layered vertical walls has produced innumerable crumbly ledges where the many species of birds perch and nest. The North Bird rocks are jagged rock-islets and small towers of rock that project upward from the gulf floor about 1400 yards northwest of Great Bird.

Refs.: 2 p. 631; 43 p. 275; 127 p. 1, 5

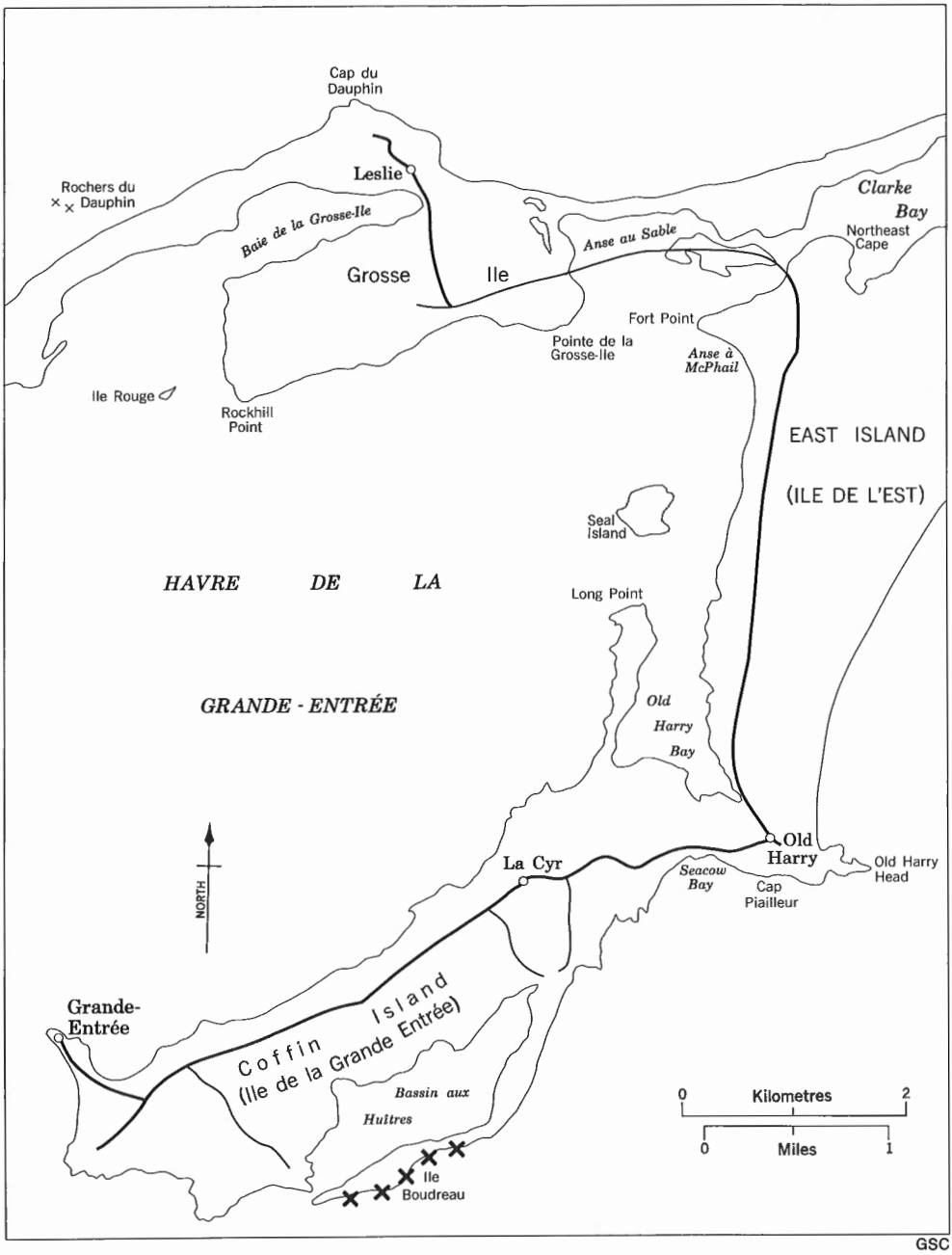
Maps (T): 11N/14W Brion Island
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Mile 29.5 Bridge at Clarke Bay. Northeast Cape is to the left of the bridge.

East Island (Ile de l'Est)

This island, at the northeastern tip of the linked chain of islands, consists of small rocky hills near the Clarke Bay bridge and a vast expanse of sand dune country containing a network of ponds and extensive marshy ground. The prominent hills at Northeast Cape that rise conspicuously from the flat surrounding area are formed of red and grey sandstone. They comprise the only rocky area in the island; the rest is duned sand - the broadest stretches of sand in the Magdalen Islands.

Maps (T): 11N/11W East Island
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)



Map 3. Ile Boudreau: Gypsum, fossil occurrences.

Mile 33.3 Junction road on left to Old Harry Head, Coffin Island.

Old Harry Head

A ½-mile access road leads east to the cliff-tops at Old Harry Head, a jagged headland composed of red sandstone. Its steep shoreline cliffs have been incised by the sea forming deeply penetrating crevices that can be viewed from the end of the access road. The rhythmic lashing of the sea waves has carved scalloped edges into the base of the shoreline cliffs and a series of sea-caves above them.

Coffin Island (Ile de la Grande-Entrée)

The rock exposures at Old Harry Head mark the end of the vast dune country of East Island and the beginning of Coffin Island.

This island is completely underlain by red sandstone. Its uniform skyline, unbroken by the dome-shaped hills that characterize the other islands of the archipelago, slopes gently from a central ridge that rises to a maximum elevation of 100 feet above the sea. It is bordered by sea-cliffs only on its southwestern and northeastern shores.

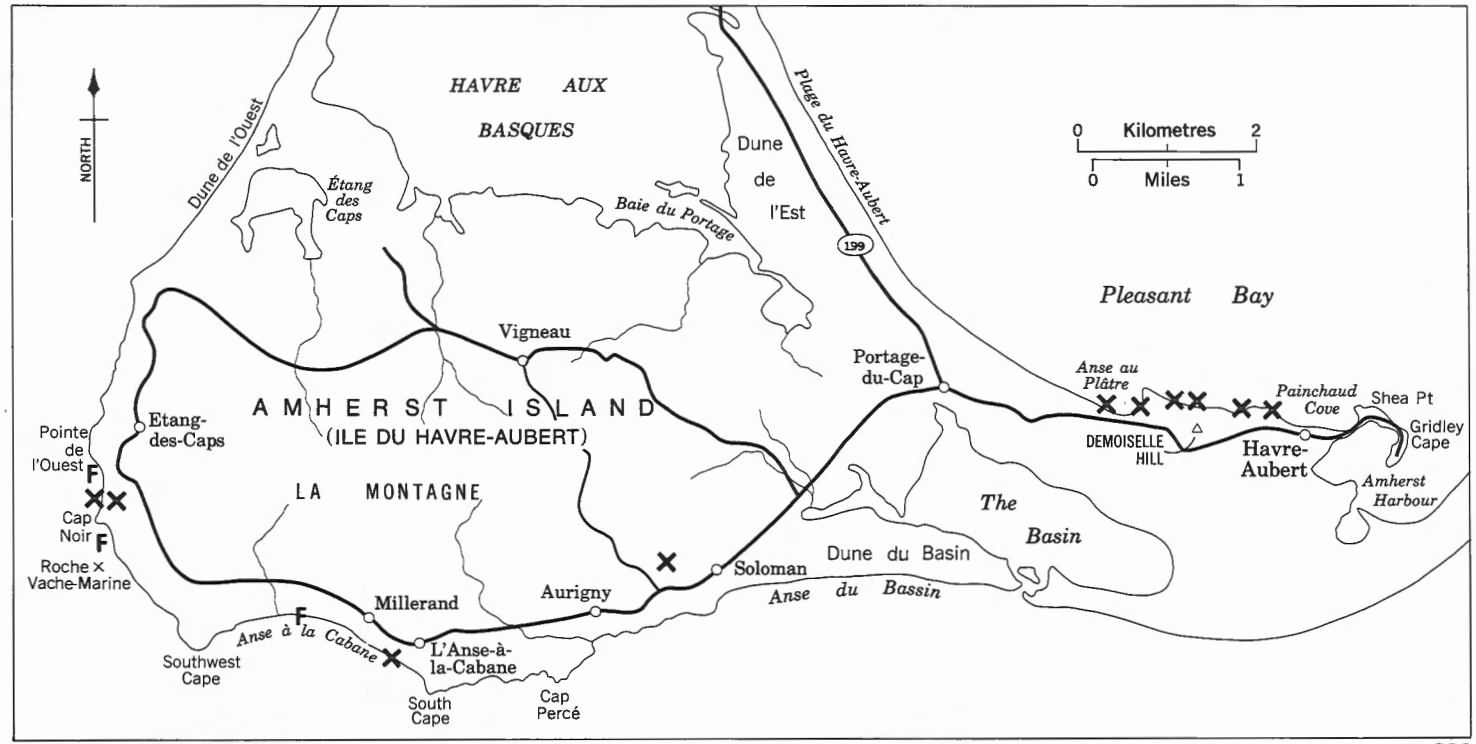
Jutting out from its north end is a long, flat peninsula — Long Point — and from its southern shores, a sandbar linking Ile Boudreau. This narrow island (Boudreau) with its sand-duned link encloses Oyster Bay (Bassin aux Huîtres). Its 50-foot sea-cliffs on the Gulf shore expose grey Mississippian sedimentary rocks containing veins and masses of gypsum and numerous shell fossils including brachiopods, ostracods, pelecypods, gastropods, trilobites, corals and cephalopods. This rock is capped in places by a conspicuous layer of red sandstone. These shoreline cliffs are accessible at low tide only.

Refs.: 2 p. 634, 636, 638, 641; 127 p. 31-37

Maps (T): 11N/11W East Island
11N/12E Grosse Ile
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Mile 33.4 Seacow Bay on left. The west shore of this bay is one of two locations on this island where its shore is bound by sea-cliffs. These low sandstone cliffs have been sculptured and etched by the sea producing the typical features of marine erosion.

Mile 34.6 From this point to about Mile 36, the highway parallels the northwest side of a morainal ridge consisting of unsorted sand and gravel, and pebbles and boulders that were deposited when glacial ice melted in Pleistocene time. This ridge, with an elevation of 50 to 100 feet above sea level, occupies the area between the highway and Oyster Bay. It is sparsely vegetated with shrubs and low-growing trees. (Refs.: 2 p. 634; 116 p. 467)



×, Gypsum occurrences. F, Fossil occurrences.

Map 4. Amherst Island.

Mile 35.0 Junction road on left: Chemin de l'Ile. This road, about a mile long, leads across the island and part way into the sandbar that connects Ile Boudreau to Coffin Island.

Ile Boudreau Occurrence

GYPSUM, FOSSILS

In sedimentary rocks

Massive white gypsum occurs in criss-crossing veins and in masses in argillite and siltstone that form part of a sedimentary sequence exposed by cliffs on Ile Boudreau. Shell fossils of Mississippian age are found in the grey calcareous shale; they include brachiopods, ostracods, gastropods, trilobites, corals and cephalopods. Limestone concretions have been reported to occur in the siltstone.

These rocks containing the gypsum and fossils are exposed along 50-foot cliffs on the Gulf shore of Ile Boudreau. In places they are capped by a conspicuous layer of red sandstone. The rocks have been deformed by earth movements that displaced and overturned the strata producing several faults and folds. The results of this rock-movement are evident in the tilted and crenulated beds exposed along the sea-cliffs.

The shoreline cliffs are accessible at low tide only. Access is by boat or by walking from the end of the road (Chemin de l'Ile) to the cliffs, a distance of about ¾ mile.

Refs.: 2 p. 636-638, 642; 127 p. 31-37

Maps (T): 11N/12E Grosse Ile
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Mile 37.2 Grande-Entrée village, at the entrance to Grande Entrée Harbour. A long sandbar extends across the entrance and nearly reaches Dune du Sud. This is the terminal point of Highway 199 through the northern part of the archipelago.

CAP-AUX-MEULES TO HAVRE-AUBERT

The collecting localities and points of interest along Highway 199 (Route Principale) south of Cap-aux-Meules are described in the following section.

Mile 0 Cap-aux-Meules, at junction Highway 199 and the road to Cap-aux-Meules pier. Proceed south along Highway 199.

0.8 Junction road on left to Red Cape: Chemin Gros Cap.

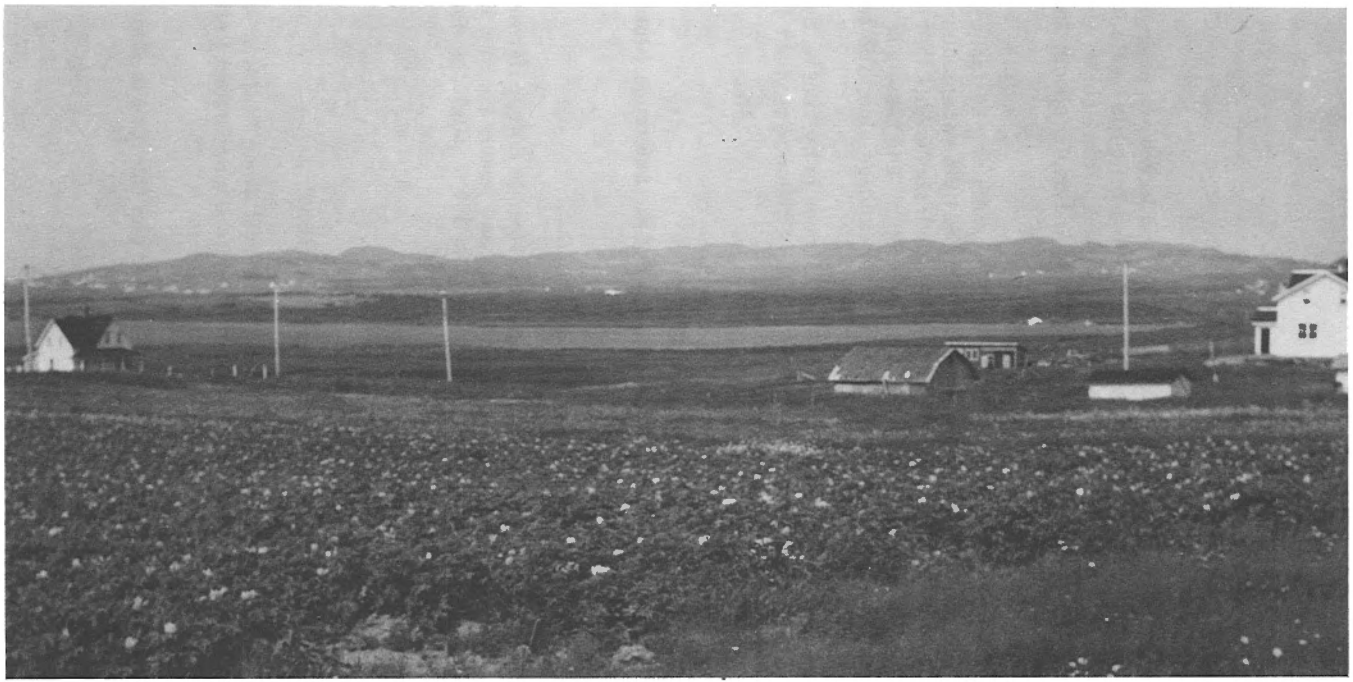


Plate IX. La Montagne, Amherst Island. This ridge, composed of erosion-resistant volcanic and sedimentary rocks, rises above the lowlands which are underlain by easily eroded red sandstone. (GSC 202759-A)

Mile 0.8 (cont.) Red Cape is a cliffed headland composed of red sandstone. It projects from the southeast corner of Grindstone Island into Pleasant Bay. The headland displays the etched, grooved, and sculptured features of marine erosion including several sea-arches and caves.

1.1 Junction road (on right) to Provincial Nursery and Magdalen Manganese Mine.

Magdalen Manganese Mine

PYROLUSITE, MANGANITE, PSILOMELANE, SPECULARITE, PYRITE, CALCITE, DOLOMITE

In limestone

The manganese minerals — pyrolusite, manganite and psilomelane — occur as nodules, irregular masses, and lenses in limestone. Nodules measuring up to 18 inches in diameter have been found in the deposit. Specular hematite and pyrite occur in volcanic rocks associated with the manganese ore. Cavities in the limestone are common; they are lined with tiny crystals of calcite and dolomite

The occurrence of manganese ore on Grindstone Island has been known for some 70 years. The mineralization was first found as nodules of manganese minerals and as blocks of manganese-bearing rock in the soil at the foot of the ridge that extends across the width of the island. Along this belt, the Mississippian volcanic and sedimentary rocks that form the hilly region are in contact with the younger red sandstone underlying the low-lying area below. Several tons of ore were shipped from the island in about 1900.

The world shortage of manganese at the onset of World War II brought a revival of interest in the deposit. In 1939, Magdalen Manganese Mines Limited acquired claims staked by J. W. Storer, and explored the deposit by a number of pits and several shallow shafts. A small tonnage of commercial ore was hoisted but the venture was unsuccessful. Later, in 1947, hand-cobbed ore was obtained from an open pit by Quebec Manganese Mines Limited. In the following year the company sank a 100-foot shaft from the bottom of the pit but the results were unfavourable and work was discontinued.

This mine, now abandoned, is ½-mile north of Highway 199 at Mile 1.1.

Refs.: 2 p. 645-648; 103 p. 69-73; 127 p. 49-50; 167 p. 15; 169 p. 187; 170 p. 329

Maps (T): 11N/5 Grindstone Island
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Mile 2.8 Junction road to Étang-du-Nord: Chemin de l'Étang.

Plate X. Crenulated gypsum-bearing rock exposed along the shore of Demoiselle Hill, Amherst Island. (GSC 202768)

Butte du Vent

The hill north of this junction is Butte du Vent; it rises to an elevation of 543 feet, the highest summit on Grindstone Island and the second highest in the Magdalen Islands. It is composed mostly of volcanic rocks.

L'Étang-du-Nord

The Étang road leads to the western shores of the island where a continuous line of sandstone sea-cliffs extends northward from L'Étang du Nord Bay to a point about a mile southwest of Hospital Cape. The cliffs have been notched in places allowing streams that drain the hilly central region to flow into the sea.

From the junction, the highway leads south through the south-central part of the island and through the sandbar-links to Amherst Island.

Mile 5.3 La Martinique bridge

Havre aux Basques Lagoon

The Martinique bridge connects Grindstone Island to Ile aux Oeufs, a 9-mile-long strip of duned sand. This is the first of two sandbar links connecting Amherst Island to the chain of islands forming the Magdalen Island group. Together with Dune de l'Est it forms a twin line of banked sand enclosing Havre aux Basques, a salt water lagoon.

At one time when the waters of the lagoon flooded the total area enclosed by the two islands and by the double set of sandbars, gaps in these bars provided open passages to the sea. These breaks in the bars were never permanent, being alternately filled then opened by the sweeping and drifting action of the sea and the wind. Following the building of the roads along the dunes, the gaps closed and now only those bridged by the highway remain. With the sealing off of these channels, the sand gradually crept into the lagoon so that now all but its southern part is dry. Islands of sand that once dotted the lagoon have been engulfed by the travelling sands and are now a part of the vast expanse of trapped sand.

As the highway continues its southward course, the haunting skeletons of ships, wrecked and partly buried in the sandy banks of Dune de l'Ouest, come into view. These are but a few of the several hundred ships and schooners that met their destruction when they were swept ashore by gales; or, lost in the fog, they crashed against the unlighted cliffs or were trapped in the treacherous sands. Since the present system of fog-signals and lights was installed, losses have been rare.

Mile 9.1 Bridge over passage separating Ile aux Oeufs from Dune de l'Est.

12.4 South end of Dune de l'Est. The highway begins its short journey through Amherst Island.

Amherst Island (Ile du Havre-Aubert)

This is the most southerly and the largest of the Magdalen Islands. Its topography is dominated by La Montagne, an east-west ridge of resistant volcanic and sedimentary rocks that forms the backbone of the island. The 477-foot summit near the east end of the ridge is the island's highest point, and the third highest on the Magdalen Islands.

The red sandstone sea-cliffs along the southern and western shores outline long gently curved bays and numerous more intricate indentations that form a succession of capes and coves. Elsewhere, except for the Demoiselle Hill region, the shoreline is flat and near the level of the surrounding waters.

The Basin (Le Bassin) at the southeastern end of the island, is a shallow lagoon where sea water is enclosed by a sandbar that is broken by a passage to the sea at its midpoint. From the east end of the island, a sand-spit-Sandy Hook — curves into Pleasant Bay; its submerged tip swings out eastward extending to within 2 miles of Entry Island.

Maps (T): 11N/4W Havre-Aubert
11N/5 Grindstone Island
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Mile 12.9 Junction at Portage-du-Cap.

The Basin, a salt water lagoon, is on the south side of this junction; it is 2 miles long and ½ mile wide, and occupies a low-lying flat marshy area underlain by sedimentary rocks. Visible beyond it are the duned banks of sand that enclose it and the open waters of the Gulf of St. Lawrence.

The road that leaves the main highway at this junction leads to the south and west sides of the island. Points of interest along this road are described on pages 37-40.

Mile 14.1 Anse au Plâtre (on left) is a small bay on the south side of Pleasant Bay. The cliffed headland on its east side is composed of grey sandstone. South from this headland and toward the road, the cliffs are formed of gypsum-bearing sedimentary rocks: masses of gypsum occur in argillite that in turn contains veins of gypsum.

Mile 14.3 The highway begins its climb up the west slope of Demoiselle Hill, circles its south slope, then proceeds eastward paralleling the south shore of Pleasant Bay as it approaches the end of its course.

Demoiselle Hill

Demoiselle Hill is a broad-based, conical-shaped hill rising conspicuously from the low-lying surrounding area to an elevation of 280 feet. Its seaward slope is sliced by a 150-foot cliff. The hill is composed of volcanic rocks. Near its summit is a memorial to Jacques Cartier, discoverer of the Magdalen Islands.

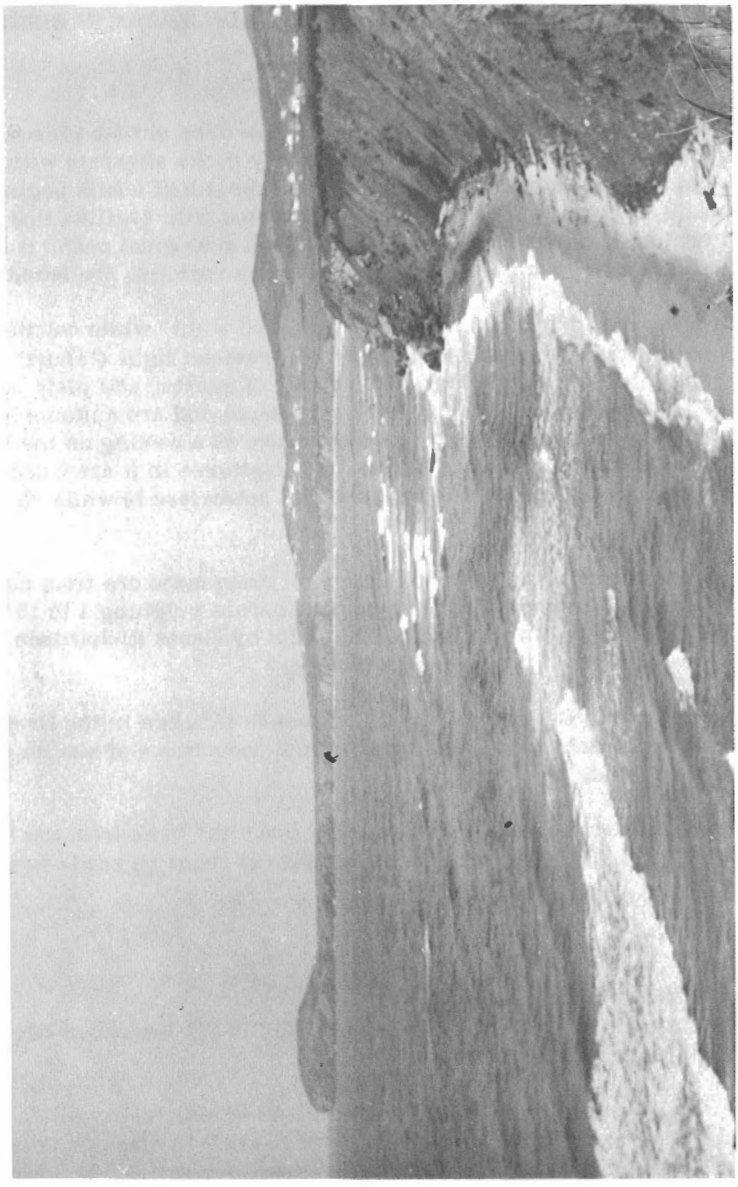


Plate XI. Southwest Cape at the western end of Anse à la Cabane, Amherst Island. (GSC 202759)

Mile 15.4 Painchaud Cove (on left) on east side of Demoiselle Hill.

Demoiselle Hill Occurrence

GYPSUM; CALCITE, SPECULARITE, QUARTZ CRYSTALS, EPIDOTE, BIRNESSITE

In argillite; in volcanic rocks

Gypsum occurs in a series of exposures along the shoreline cliffs on the north side of Demoiselle Hill. The gypsum-bearing sedimentary rocks alternate with volcanic rocks to form the cliffs. They extend westward for about half a mile beginning on the shore opposite Mile 15.4. The gypsum is associated with argillite that has been deformed and contorted due to earth movements in the geological past. It is white with a reddish tint; both granular massive and fibrous varieties are found.

The volcanic rocks have numerous small cavities lined with: white calcite crystals that fluoresce bright pink when illuminated with ultraviolet light ("short" rays are more effective than the "long"); colourless crystals of quartz; and platy aggregates of specularite. These crystals are generally very small and are suitable for micro-mounting. The manganese mineral birnessite, occurs as a coating on the rock. Some of the volcanic rock has been epidotized and fractures in it are filled with platy specularite, tiny prismatic crystals of epidote, and colourless to white cleavable masses of calcite.

It was from this locality that the first occurrence of manganese ore from the Madgalen Islands was reported. Fragments of manganese minerals weighing 1 to 15 pounds were found in the fallen rock at the base of the cliffs by James Richardson during his 1880 geological survey of the Magdalen Islands.

This investigation for the Geological Survey of Canada resulted in the first geological report of the islands. Richardson also reported the occurrence of similar ore in the soil on Grindstone Island.

These shoreline cliffs can be reached by walking down the bank from the highway (at Mile 15.4) to the shore. The first rock exposure is about 50 yards west of this point.

Refs.: 2 p. 639; 120 p. 10; 141 p. 20-21

Maps (T): 11N/4W Havre-Aubert
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Mile 16.0 Junction at end of Highway 199. The road on left leads to Shea Point, the one on right to Cape Gridley.

Sandy Hook

Opposite Cape Gridley, Sandy Hook, a 5-mile-long crescent-shaped sand spit — curves out from the south shore of Amherst Island toward the open waters of the Gulf. Its tip, for a distance of about a mile, is buried beneath the water.

The spit is built up of sand churned and swept up by the combined action of waves and shoreline currents that move northeastward toward and beyond the south shore of the island. A southeastward-moving current from Pleasant Bay prevents these sands from accumulating onward toward Entry Island, thus maintaining an open channel that would otherwise link this island to the chain of islands. The distance between Entry Island and the exposed tip of the sand spit fluctuates, depending upon the relative strengths of the two sets of currents. Records indicate that, since 1765 the maximum separation was 17 980 feet, the minimum 16 620 feet. In 1956, the distance was 17 420 feet, in 1959, 16 620 feet (Ref.: 127 p. 9). The ferry from Souris, Prince Edward Island to Cap-aux-Meules passes through this channel.

Side trip to central Amherst Island

This side trip is along the road that leaves Highway 199 at Portage-du-Cap (Mile 12.9) and forms a loop in the central part of the island. The road skirts the south and west coasts of the island, circles the mountainous central core, and completes the loop opposite an irregular bay projecting out from the Basin.

Mile 0 Junction Highway 199 and road to Bassin (Chemin Havre-Aubert); proceed toward Bassin.

1.3 Junction road on right: Chemin de la Montagne. This road leads along the north side of the hilly central region and constitutes the northern part of the loop-road.

The road log continues straight ahead toward the south shore of the island.

2.3 Bassin, at church.

Massive white gypsum outcrops at the side of a hill overlooking Bassin. The exposure is about 350 yards north of the road. In the vicinity of the deposit, the land surface is pitted with sinkholes. These depressions were formed when the easily soluble gypsum in the underlying rock was dissolved due to surface weathering. This topography is a common feature of regions underlain by gypsum-bearing rocks.

3.2 Junction road to the shore: Chemin du Moulin.

This road leads to the beaches that border the sea-cliffs on the south shore of the island. There is no access by road to the shore west of this point. Cap Percé is the headland southwest of the road. Its cliffs as well as those between South Cape and Dune du Bassin are composed of red sandstone. Near the tops of the cliffs there is a conspicuous thin white layer: this is sandstone that has been decoloured by organic acids seeping down from the mantle of vegetation above it.

4.2 The highest point on the island is north of the road at this point. It is the 477-foot summit at the east end of the series of hills forming an east-west ridge — La Montagne — that is paralleled on both sides by this road. The hilltops gradually decrease in elevation toward the west end where a maximum of 250 feet is reached. Because the ridge is composed mostly of resistant volcanic rocks, it has survived the erosion that levelled the surrounding rocks.

Mile 4.4 Junction road on left (Chemin du Phare) leading to the cliff-tops at the South Cape lighthouse.

Between South Cape and Southwest Cape (Cap du Sud-Ouest), Anse à la Cabane forms a broad gently curved arc nearly 2 miles long. Its cliffs expose red sandstone at either end and, between them, sedimentary and volcanic rocks capped by red sandstone. Gypsum occurs in the sedimentary rocks.

5.9 Southwest Cape is south of the road at this point.

6.1 A rock exposure on the right side of the road consists of volcanic rocks that contain massive white calcite and coatings of specular hematite. This type of rock is interbedded with sedimentary rocks to form the hilly region in the south-central part of the island.

Mile 6.7 Cap Noir is about 500 yards west of the road at this point.

Cap Noir

The steep 150-foot cliffs forming Cap Noir and the adjacent shoreline mark the western end of the ridge of resistant volcanic and sedimentary rocks that dominates the topography of the south-central part of the island. These are the highest cliffs bordering the south and west shores of the island. Massive and fibrous gypsum occurs in the sedimentary rocks on both sides of the Cap Noir headland. Inland, this gypsum-bearing rock outcrops along the slope between the shoreline and the pond that lies about 200 yards west of the road at Mile 6.7.

About 600 yards south of Cap Noir, La Roche Vache-Marine — an erosional rocky remnant — emerges from the shallow waters as an isolated offshore rock. There are several such detached rocks lying off the coastal parts of the Magdalen Islands.

Mile 7.1 Pointe de l'Ouest is about 400 yards west of this point.

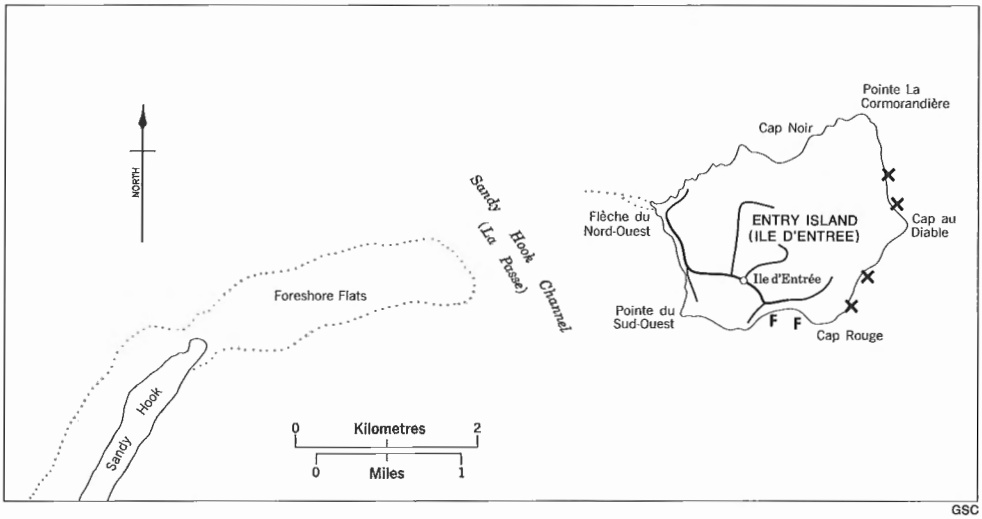
Pointe de l'Ouest

Red sandstone forms the headland at Pointe de l'Ouest and the sea-cliffs that continue northward to Dune de l'Ouest. The bay between this headland and Cap Noir is bordered by cliffs exposing grey and brown sedimentary rocks and some volcanic rocks. Shell fossils of Mississippian age occur in the sedimentary rocks (siltstone) on the southeast side of Pointe de l'Ouest.

Fragments of manganese ore weighing 15 to 20 pounds were found many years ago in an outcrop of volcanic rock near Pointe de l'Ouest.

Deadman Island (Ile du Mort)

This oblong island, only $\frac{1}{4}$ mile long, lies isolated in the Gulf of St. Lawrence 9 miles west of Pointe de l'Ouest. Viewed from the sea toward either end, it rises like a steeply sloping pyramid, 170 feet high. The view onto its length is irregular in outline which, to early explorers, resembled that of a body laid out for burial, a resemblance that gave rise to its name.



×, Gypsum occurrences. F, Fossil occurrences.

Map 5. Entry Island.

It is the most westerly of the Magdalen Islands and the waters between it and the main islands are deeper than the waters separating any of the other islands. This bare, rocky island is made up of Mississippian sedimentary and volcanic strata.

Mile 8.5 Junction road to Dune de l'Ouest.

At this junction the main road (Chemin de la Montagne) leaves the seacoast and heads eastward along the north side of the central ridge and into the interior of the island. In the first 3¼ miles of its scenic woodland course, it climbs from near sea level at the junction to an elevation of about 175 feet at Mile 12. Its 1½ mile descent brings it down to the low-lying meadowland on the west side of The Basin. The road parallels and cuts through thickly forested slopes furrowed by streams radiating from the upper regions. This is the only region in the sparsely-treed Magdalen Islands where a major road penetrates a wooded area.

Mile 13.6 End of loop road at junction of the road to Bassin.

Refs.: 2 p. 639; 43 p. 275-278; 103 p. 71; 120 p. 5; 127 p. 24, 28; 141 p. 17-20

Maps (T): 1N/4 Havre-Aubert
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Entry Island (Ile d'Entrée)

This is the only inhabited offshore island. It is connected by a regularly scheduled ferry service to Havre-Aubert, Amherst Island.

The island is 1 to 1½ miles wide and 2 miles long. Its rugged, hilly eastern half rises abruptly from the sea to peaks of over 500 feet above it, in striking contrast to the gently rolling, low-lying western part of the island. The 559-foot summit in the heart of the island is the highest elevation on the Magdalen Islands. As elsewhere on these islands, the hills are underlain by resistant volcanic and sedimentary rocks, the lowlands by red sandstone.

Gypsum occurs at intervals along the southern and eastern sea-cliffs between Pointe du Sud-Ouest and La Cormorandière at the northeastern tip of the island. Irregular masses of gypsum are associated with grey sandstone, argillite, limestone conglomerate, shale and fragmental volcanic rocks. These rocks, as seen along the cliffs, are highly deformed and contorted. Veins of massive and fibrous gypsum cut argillite. Some of the massive gypsum is almost black and is traversed by veins of white gypsum. Some Mississippian shell fossils occur in the sedimentary rocks along the cliffs east of the lighthouse.

The rock exposures along the shoreline near the lighthouse (east of Pointe du Sud-Ouest) may be reached by walking along the shore from the lighthouse. Those on the east side of the island are accessible only by boat since there are no roads on the eastern part of the island.

Refs.: 2 p. 639; 76 p. 99; 127 p. 20, 24, 28; 141 p. 20, 22

Maps (T): 11N/5 Grindstone Island
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (Que. Dep. Nat. Resour., 1 inch to 1 mile)

Plate XII. Gypsum cliffs, Romaines Brook on the Island of Newfoundland. Several varieties of gypsum are available for collecting from this locality and from others on the Island of Newfoundland. (GSC 202742)

THE ISLAND OF NEWFOUNDLAND

The Island

The Island of Newfoundland is a triangular-shaped island extending over a distance of about 320 miles along each side. Its landmass of 43 359 square miles places it sixteenth among islands of the world. It is the third largest island in Canada ranking behind Baffin and Ellesmere islands, the world's fourth and ninth largest respectively.

The island lies in the mouth of the Gulf of St. Lawrence with its northern tip only 11 miles from mainland Canada. Cape Breton Island is 65 miles away. A headland on the eastern coast - Cape Spear - is the most easterly point in continental North America.

Access for motor vehicles is by regularly scheduled ferry service connecting Sydney, Nova Scotia, to Channel-Port aux Basques and to Argentia.

Its surface

The Island of Newfoundland is a gently undulating southeastward tilted plateau with an average elevation of 2000 feet in its mountainous western side sloping gradually to an average of 700 feet in the Avalon Peninsula at the eastern end. Rising from this plateau are rounded peaks and flat-topped ridges of relatively low relief. The highest elevations are in the western coastal mountain ranges where summits reach maximums of over 2600 feet above sea level. Eastward the elevations of hills and ridges decrease steadily to a maximum of about 1000 feet in the Avalon Peninsula.

Carved into the surface are broad U-shaped river valleys, shallow lakes and ponds, and aimless streams. They were scooped out by glaciers that also denuded the rocky surface of its soil replacing it with a blanket of sand and gravel. Much of the surface is a poorly drained barren land with numerous boggy areas. About a third of the surface is occupied by lakes, rivers, ponds, and bogs. Woodland areas are confined to the major river valleys such as the Humber, the Exploits, and the Gander rivers.

Its shores

Most of Newfoundland is bordered by steep, rocky coastal cliffs that plunge into the sea from heights of up to 500 feet. It is a jagged 6000-mile-long shoreline intricately indented with countless slender inlets and deeply penetrating arms of the sea that are hemmed in by rugged headlands. Because of these numerous far-reaching indentations, no place inland is more than fifity miles from the sea. The embayments enclose deep sheltered harbours; many of them, notably those on the south shore, are fiord-like in character. Hundreds of rocky and barren offshore islands dot the bays and line the shores.

The irregular, steep and deeply indented shoreline with numerous offshore islands is characteristic of a drowned shoreline. These features indicate that in the geological past, dating back to preglacial times, the sea was at a lower level and the coastal area that is now beneath the sea was dry land that extended outward for several miles beyond the present shore. This dry region was carved by erosional forces into valleys, ridges and hills that were later modified by glaciers and subsequently

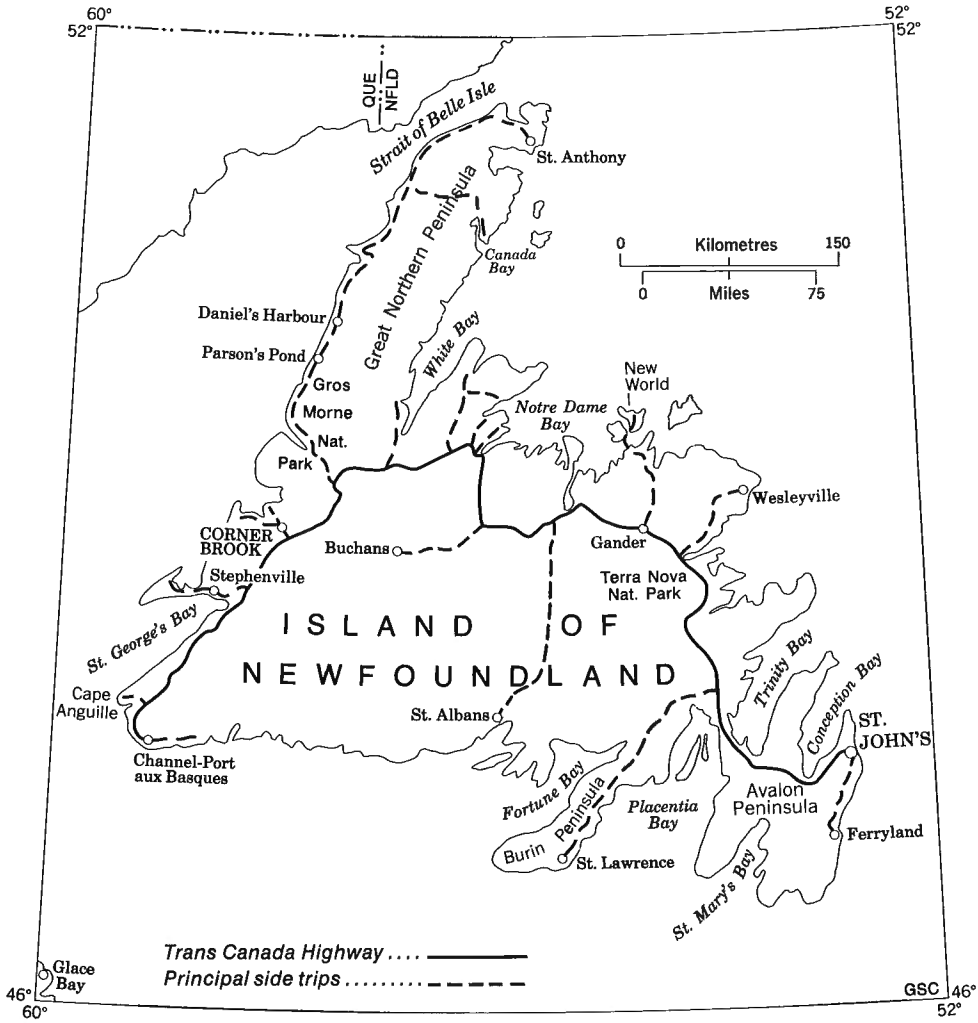


Figure 3. The Island of Newfoundland: map showing collecting route.

flooded by the sea. Today's coastal indentations are the inland sections of river valley systems that continue seaward for several miles beneath the waters. The offshore islands are the summits of hills and ridges rising from a submarine platform; they are the visible remnants of a former land surface. After the seacoast was inundated, the land was uplifted but did not regain its former level. This emergence of the land relative to the sea left wave-cut benches, elevated beaches, and raised deltas along the coastline.

A striking feature of coastal Newfoundland is the remarkable parallel alignment of the bays, inlets and peninsulas in a northeast-southwest direction. Inland, the lakes, streams, ridges and valleys are similarly aligned. This distinctive topography is the result of erosion by glaciers and other agents of erosion that have worn down zones of structural weakness in the underlying rock to produce valleys, inlets, and lake basins. The rock structure responsible for this differential erosion was produced during a major crustal disturbance that affected the whole island in the geological past.

Physiographic regions

Two physiographic regions are represented on the Island of Newfoundland: the Appalachian Region comprising almost the entire island, and the St. Lawrence Lowlands which consists of the narrow coastal strip of low-lying slightly deformed sedimentary rocks along the western shore. The Appalachian Region in Newfoundland forms the northeasterly tip of the Appalachian mountain system — a 2000-mile-long belt of strongly folded and faulted rock formations extending along coastal North America from Alabama to Newfoundland beyond which it continues beneath the Atlantic Ocean to the Continental Shelf.

The Appalachian Region consists of highlands, lowlands and uplands. The Newfoundland Highlands is a rugged, steeply sloped mountainous region formed of Paleozoic and Precambrian metamorphic and granitic rocks. This mountainous terrain includes the Long Range and Anguille mountains, the Topsail Hills, and other hills and ridges in the western part of the island. Eastward, the highland region slopes downward to the Newfoundland Central Lowland and the Atlantic Uplands of Newfoundland. The lowland consists of the northern tip of the Great Northern Peninsula and of a gently rolling basin of mostly Paleozoic rocks surrounding Notre Dame Bay and extending southward to central Newfoundland. The uplands constitute the remainder of the Island including the area east of Gander, the south shore, and the Avalon Peninsula. It is a region ranging from rugged to rolling terrain with elevations between 600 and 1000 feet.

Surrounding the Island are the Gulf of St. Lawrence and the Atlantic Continental Shelf. The Gulf floor is flat and featureless except for gentle ridges including one that surfaces as the Magdalen Islands Archipelago. The waters of the Gulf and of the Continental Shelf are relatively shallow, 100 to 200 metres deep. The Shelf slopes gradually from coastal Newfoundland to its outer edge - 150 to 200 miles from the Island — where it drops steeply into the depths of the Atlantic Ocean.

Geological history

The geological history of Newfoundland began with the formation of volcanic and sedimentary rocks in Precambrian time. During the same era, these rocks were intruded by a variety of igneous rocks and were subjected to some rock movement.

In the Paleozoic era, repeated cycles of sedimentation and volcanic eruptions produced a cover over the Precambrian rocks upon which the rocks thus formed remain today except in regions such as the Avalon and Burin peninsulas where subsequent erosion has removed them. During two periods — the Ordovician and the Devonian — the existing rocks underwent extensive deformation that folded and faulted them. At the same time they were intruded by masses of granitic rocks. The rock disturbances or orogenies caused some of the existing sedimentary and volcanic rocks to be metamorphosed into gneisses, schists, and quartzites. The northeasterly trending geological structures that gave rise to the parallel alignment of lakes and streams, valleys and ridges were produced during these upheavals. The crustal movements were most severe in the western part of the island resulting in highly deformed rock formations in that region contrasting with rocks that have been only slightly deformed elsewhere.

In western Newfoundland — in the Hare Bay-Canada Bay and Daniel's Harbour-Port au Port areas — there are rock masses composed of sedimentary rocks, lava, gabbro and ultrabasic rocks that lie upon rock formations of the same early Paleozoic age but of a different mode of formation. Since younger rocks generally rest upon older ones, geologists believe that these rock masses were transported to their present locations from elsewhere. Because of their similarity to rock formations 40 miles to the east in the White Bay area and north of it, it is thought that they were formed there and, over a long period of time, slid westward. This movement probably took place in Ordovician time, and the transported rock masses are known as klippen. Table Mountain and Blow Me Down Mountain in the Bonne Bay area and the White Hills near Pistolet Bay are slabs of ultrabasic rocks forming parts of the klippen.

The last rocks formed were the sedimentary rocks that were laid down during Mississippian and Pennsylvanian times. They constitute a broad belt extending from Cape Anguille to White Bay.

Several times during the Pleistocene Epoch, ice sheets covered the Island as they did continental North America. The last ice caps were centred at four locations: on the Great Northern Peninsula, near the head of St. Mary's Bay, and one near Grand Lake and another near Grand Falls. As each of them swept out toward the sea, they scraped, scoured and polished the underlying rock removing most of the soil cover built up through periods of erosion that followed the last rock-building event. In their wake they left a cover of gravel, sand, and till strewn with glacial erratics — large boulders of rock transported by glaciers.

The glaciers are largely responsible for the topography of the island. They scooped out the bedrock to form basins for lakes and ponds; they carved broad trough-like river valleys and fiord-like inlets; and they planed the hills and ridges into unsymmetrical forms featuring a gentle slope on one side and steep drop on the other. The uneven distribution of glacial drift resulted in poorly drained regions characterized by an abundance of marshland, ponds, and aimlessly wandering streams. With the immense weight of the ice removed, the land was gradually uplifted leaving raised beaches and wave-cut terraces along the seacoast.

The geological history with examples of rocks formed is summarized in Table II.

Mineral deposits

The Island of Newfoundland contains the only producing fluorite and pyrophyllite mines in Canada. Base metal mines are operated to produce copper, zinc, lead, gold, and silver, and a zinc deposit discovered in 1963 is a new producer. Relatively new producers are a gypsum mine and an asbestos mine. There are numerous formerly operated mines, some that began their operations in the 1860's. Among these are the Wabana iron mines, several copper mines, and some copper-zinc, pyrite, magnetite, antimony-arsenic, gold, barite, chromite, lead, and coal mines. Limestone, quartzite and sandstone are being quarried, and granite was formerly quarried.

In addition to these producers and former producers, scattered throughout the Island are numerous small deposits including some that have been explored by pits, adits, or shallow shafts. These occurrences include marble, barite and celestite, manganese minerals, scheelite, molybdenite, beryl, gypsum and anhydrite. Oil seepages have been reported.

Mining history

Mining was first attempted in Newfoundland in 1778 when a copper-bearing vein was unsuccessfully exploited at Shoal Bay, Avalon Peninsula. In 1857, the La Manche lead mine began its short period of operations, and in 1864 copper mining started in the Notre Dame Bay area with the opening of the Tilt Cove Mine. Within a few years, a number of other copper mines came into production and for the next 50 years the Notre Dame Bay area was transformed into an active mining district. Between 1870 and 1880, Newfoundland ranked fourteenth in world production of copper with the peak in 1879 when it ranked in sixth place.

In the early 1890's the Wabana iron mines on Bell Island began their 72 years of continuous operations, the longest sustained mining operation in the province. At about the turn of the century minor production was obtained from gold, barite, chromite, and antimony-arsenic mines. Two gold bars — one weighing 11 ounces, the other 37 ounces — were produced from a gold mine at Mings Bight, and 150 ounces of gold were extracted from a mine at Sop's Arm, White Bay. In 1905, the Buchans base metal deposit and the Gullbridge deposit were discovered, the first discoveries of orebodies in central Newfoundland.

Following World War I, there was a lull in mining activity until 1928 when the Buchans deposits were put into production. This was closely followed, in the 1930's, by the opening of the Burin Peninsula fluorite mines. New mines producing gypsum, asbestos and pyrophyllite were opened in the 1950's, a decade that also saw a revival of mining activity in some of the old copper mines. Four new copper mines came into production in the 1960's, and a zinc mine in 1975.

Current (1975) metal producers are Consolidated Rambler Mines Limited (East Mine), American Smelting and Refining Company (Buchans Mine), and Newfoundland Zinc Mines Limited at Daniel's Harbour. Industrial minerals and produced by Advocate Mines Limited (asbestos), Flintkote Mines Limited (gypsum), Newfoundland Fluorspar Limited (fluorite), Newfoundland Minerals Limited (pyrophyllite), and Newland Enterprises Limited (silica).

TABLE II

AGE (millions of years)	ERA	PERIOD	ROCKS FORMED	WHERE TO SEE THEM
	Cenozoic	Quaternary	Gravel, sand, till Peat	Gravel pits, stream beds Cochrane Pond, Gambo, Gander, Flat Bay, Barachois bogs
		Tertiary	Not represented in area	
65	Mesozoic			
225	Paleozoic	Permian		
		Pennsylvanian	Coal, shale, limestone Sandstone, limestone, shale	Robinsons River, Barachois Brook Shoreline between Black Point and Woody Cape
		Mississippian	Gypsum Limestone, shale, sandstone, gypsum Sandstone, siltstone Limestone	Flat Bay gypsum quarry; Romaines Brook gypsum occurrence Shoreline between Codroy and Woody Cape Road-cuts: Trans-Canada Highway Mile 511 to 520 Shoreline west of Aguathuna quarry
		Devonian	Granite Gabbro, diorite Peridotite	Road-cuts: Trans-Canada Highway near Square Pond and Highway 210 at Swift Current; Centreville-Wesleyville area; Petites; Bay D'Espoir Powder Horn Hills Advocate Mine; road-cuts: Highway 410 Mile 28.5 and at Flat Water Pond
		Silurian	Conglomerate Sandstone	Road-cuts: New World Island and Trans-Canada Highway near Halls Bay Road-cut: Trans-Canada Highway near Bishop's Falls

570	Paleozoic	Ordovician	Iron-formation, shale, limestone	Wabana mines, Bell Island
			Argillite	Road-cut: Trans-Canada Highway at Red Cliff over-pass
			Limestone	Aguathuna quarry
			Slate	Road-cuts: Trans-Canada Highway at Gander
			Dolomitic limestone	Newfoundland Zinc Mine
			Crystalline limestone (marble)	Doucers Brook; Canada Bay; Cobbs Arm, North Star, Dormston quarries
			Shale	Random Island shale quarry
			Volcanic rocks	Notre Dame Bay area copper mines; road-cuts: Highway 380; Harry's Harbour
			Pillow lava	Road-cuts: Little Bay road; shoreline: Snooks Arm, Little Bay, Betts Cove
			Serpentinite	North Arm, Winter House Brook xonotlite occurrences
			Gneiss, schist	Road-cuts: Highway 470; shoreline from Channel-Port aux Basques to Rose Blanche
		Cambrian	Shale, limestone, conglomerate	Manuels River at Highway 60 bridge
			Slate	Road-cuts: Trans-Canada Highway near junction Highway 202; Clarkes Beach quarry
			Crystalline limestone (marble)	Limestone Junction quarry
	Precambrian		Sandstone	Signal Hill; South Side, White Hills, Torbay quarries
			Conglomerate	Logy Bay, Signal Hill
			Slate, arkose, conglomerate, sandstone	East shore Avalon Peninsula from Middle Cove to Ferryland
			Sandstone, volcanic rocks, conglomerate, chlorite schist	Road-cuts: Trans-Canada Highway in Terra Nova National Park
			Quartzite	Villa Marie quarry
			Volcanic rocks	Road-cuts: Trans-Canada Highway between St. John's and Glovertown
			Granite	Road-cuts: Trans-Canada Highway between Highways 60 and 61
			Anorthosite	Indian Head
			Gneiss, schist	Long Range Mountains (Great Northern Peninsula), Steel Mountain

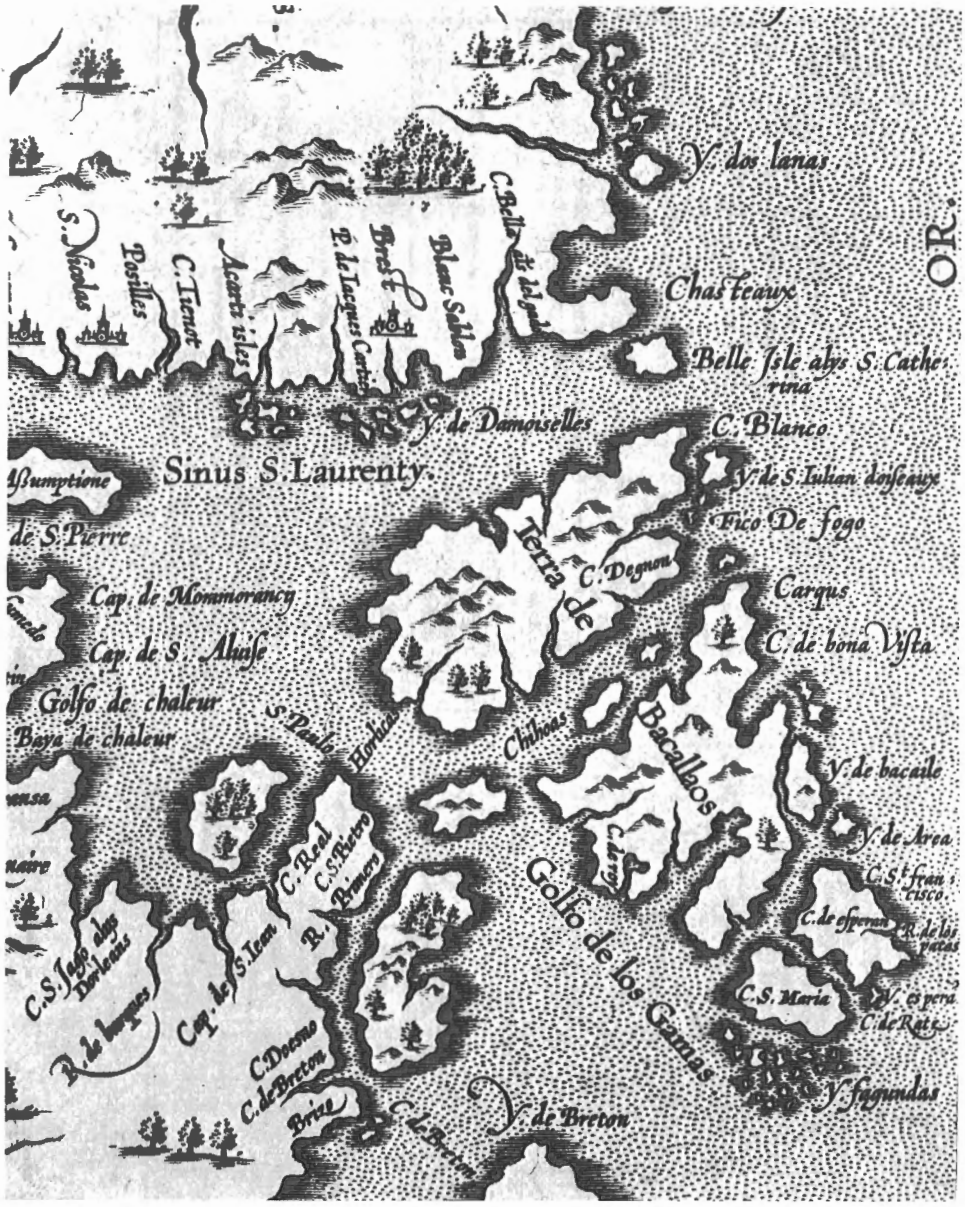


Figure 4. Terra de Bacallaos — Land of the Cod-fish — as Newfoundland, the greatest cod-fishing ground in the world, was known to Portugese explorers of the 16th century. Map is part of Cornelius Wytfliet's 'Nova Francia et Canada 1597' map published in Louvain. Most 16th century maps depict Newfoundland as an archipelago which it was thought to be by explorers of that time. The single island concept became accepted in the 17th century.
(Public Archives of Canada, National Map Collection G 75897).

Collecting on the Island

The collecting sites are varied and readily accessible. Active and abandoned mines and old prospects yield a variety of ore specimens. Road-cuts, shoreline exposures, gravel pits and beach gravels are additional sources of mineral and rock specimens. Some of the materials from these localities lend themselves to the lapidary arts. Pyrophyllite, the marbles, gypsum, and anhydrite are suitable for carving. Jasper, amethyst, rock crystal, labradorite and xonotlite are cut and polished for use in jewellery, and marble, chrome-mica rock (virginite), labradorite, granite and various volcanic rocks are suitable for other ornamental purposes.

Most of the collecting sites are easily accessible from the Trans-Canada Highway and branch roads. A short hike is required to reach some of the localities and a boat for a few shoreline occurrences.

Refs.: 4
13
17
40
52
94
98
114
135
138
165
168

Map (G): 1231A Island of Newfoundland (G. S. C., 1: 1 000 000)

ROCK AND MINERAL COLLECTING ON THE ISLAND

ST. JOHN'S — CHANNEL-PORT AUX BASQUES

Mile 0 St. John's, at junction of Trans-Canada Highway (Prince Philip Drive) and Portugal Cove Road (Highway 40).

The main road log is along the Trans-Canada Highway; side trips to the St. John's area, to Wabana, and to localities along the eastern shore of the Avalon Peninsula originate at Mile 0.

Road log to occurrences in St. John's and along the eastern shore of the Avalon Peninsula (descriptions of the occurrences follow the road log):

Mile 0 Junction Prince Philip Drive and Portugal Cove Road; proceed southeast along Portugal Cove Road.

0.3 Junction; continue straight ahead onto New Cove Road.

Mile 1.15 Intersection. Kenna's Hill (on left) leads to Logy Bay Road and to: White Hills quarry, Logy Bay amethyst occurrence, Middle Cove and Outer Cove occurrences. The road straight ahead (The Boulevard) leads to the Quidi Vidi Lake prehnite occurrence. To continue the road log, turn right onto King's Bridge Road.

1.65 Cavendish Square; turn right onto Duckworth Street. The road on left (Signal Hill Road) leads to the Signal Hill prehnite occurrence. Visible from Cavendish Square is the deep-sea harbour of St. John's with the steep-sided, flat-topped ridge — the South Side Hills — forming its south bank; the ridge, composed of resistant sandstone and conglomerate of Precambrian age, reaches heights of 700 to 800 feet above the sea. The fiord-like St. John's harbour and others like it along the rocky sea coast to the south including Bay Bulls, Witless Bay, Mobile Bay and Calvert Bay were carved out of former river valleys by glacial ice caps that spread eastward from the interior of the Avalon Peninsula in Pleistocene time. When the ice moved out, the land was uplifted, raising the beaches several feet above the present level of the sea and leaving marine terraces composed of silt, sand and gravel along the sheltered harbour walls. The shorelines of the numerous bays are lined with pebbles and boulders of a variety of rocks including some ornamental types; the accessible collecting localities are noted in this road log.

2.0 Turn left onto Prescott Street.

2.05 Turn right onto Water Street.

2.9 Water Street, at turn-off to Job's bridge over Waterford River. This is the turn-off to the South Side Hills quarry. Water Street parallels the Waterford River and the South Side Hills on the left and leads to Highway 10, the eastern shore route.

3.45 Turn-off (left) to Blackhead Road. This road climbs over the South Side Hills to Cape Spear, the easternmost point of land in North America and site of the oldest lighthouse on the continent; the light-house, constructed of granite from England and local timber, dates back to the 1830's.

10.5 Junction road to Petty Harbour. As this road approaches Petty Harbour (3.3 miles from Highway 10), it follows the base of a gorge that cuts through a ridge about 500 feet high. The steep walls of the gorge expose red conglomerate and red sandstone of Precambrian age, their colour due to hematite staining and to the colour of the constituents of the rocks. Pebbles and small boulders of rhyolite and rhyolite porphyry are common constituents of the conglomerate.

On the shoreline near Shoal Bay, about midway between Petty Harbour and Bay Bulls, the first attempt at mining in Newfoundland was made in 1778; copper was the metal sought and the ore consisted of chalcopyrite, chalcocite, bornite and tetrahedrite in quartz-calcite veins cutting sandstone. The venture proved to be unsuccessful as did another one in 1839 (Refs.: 33 p. 4; 123 p. 55). This part of the shoreline is accessible only by boat.

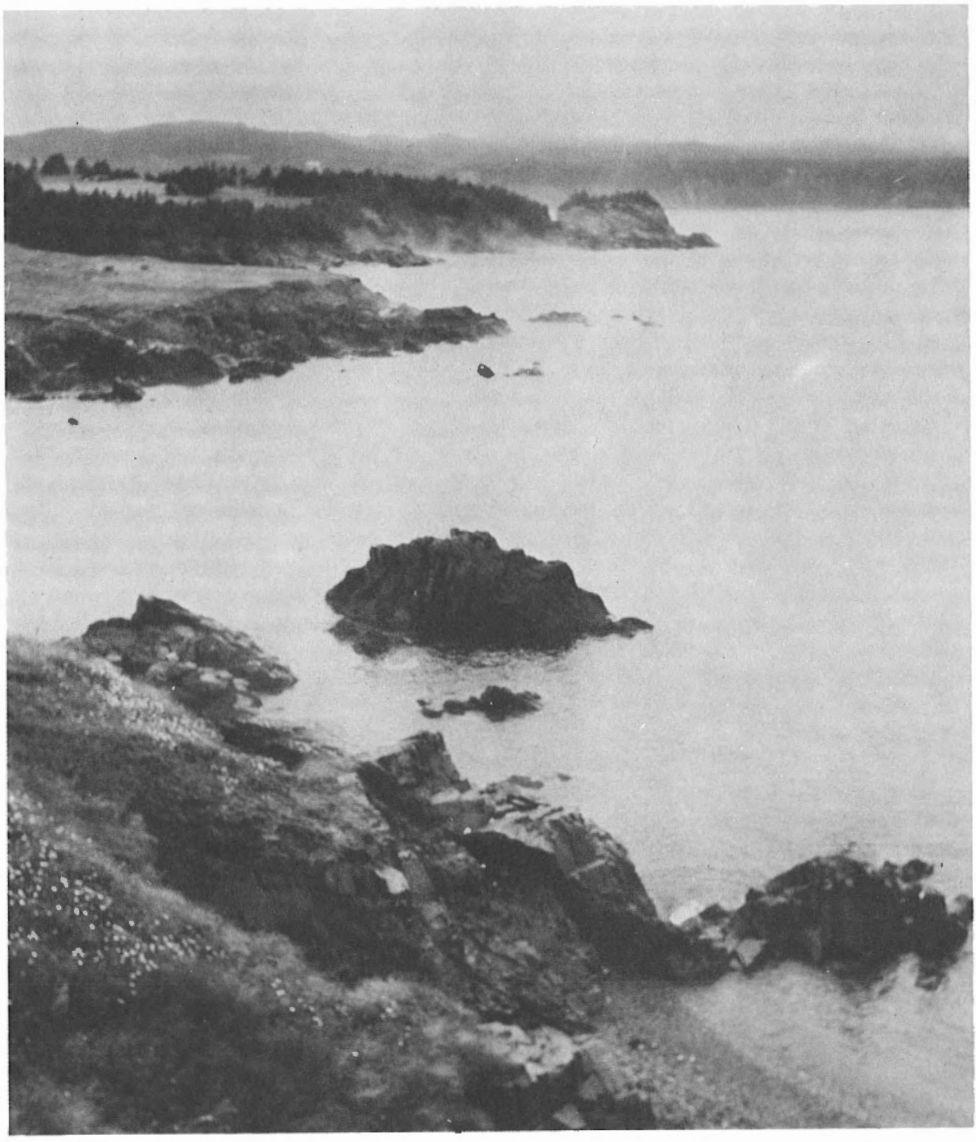
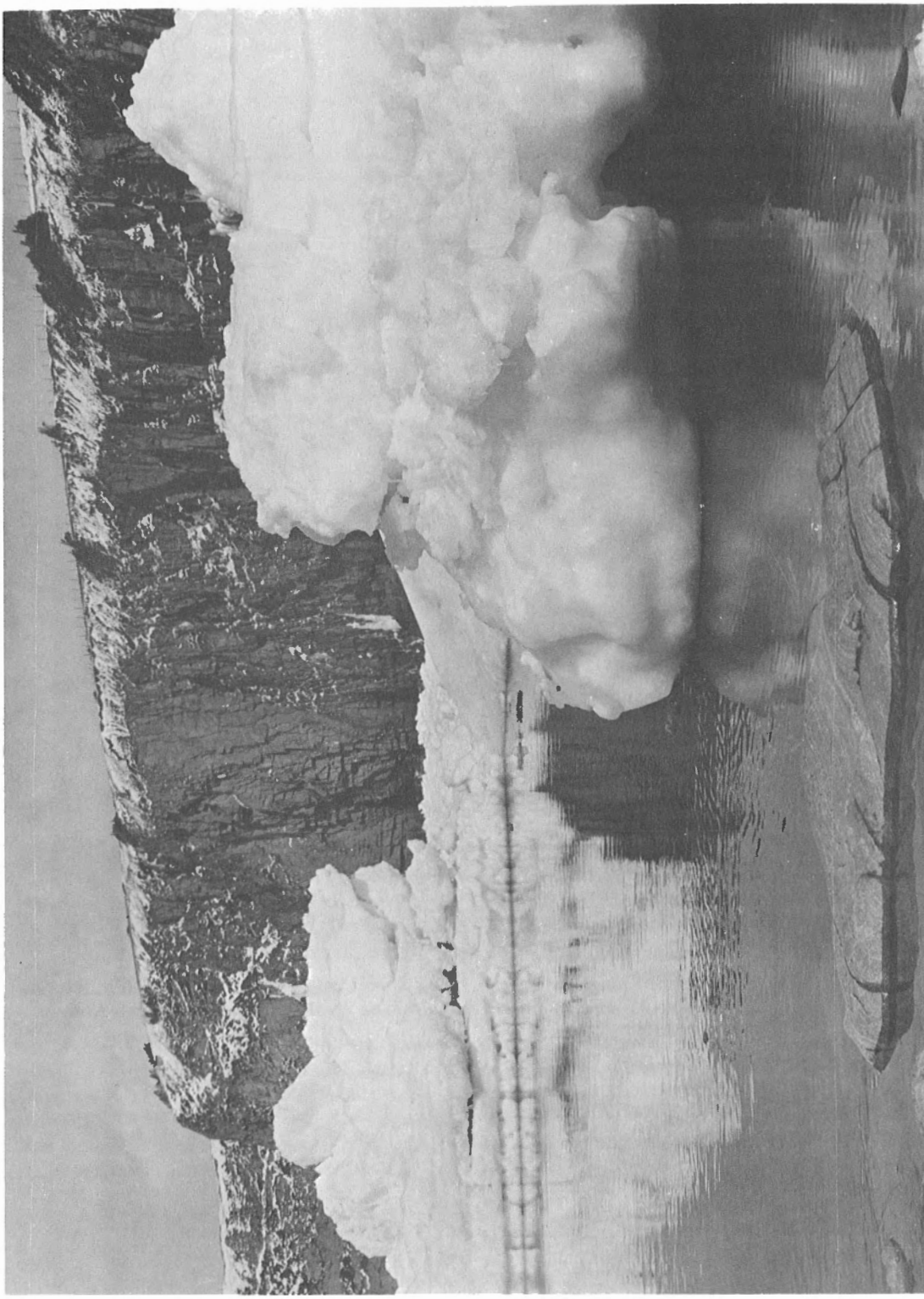


Plate XIII. Avalon shore near Ferryland. The steep, rugged shoreline with numerous offshore rocks and islets is typical of the Avalon Peninsula's eastern seacoast. (GSC 202770)



Mile 14.0 Bay Bulls Big Pond on right. This is one of the innumerable small bodies of water scooped out from bedrock in Pleistocene time by the movement of glacial ice that also modified stream valleys, left a mantle of gravel, sand, clay and till over bedrock, and produced marshes such as the one crossed by Highway 10 south of Witless Bay (Mile 25.0).

The highway continues southward along the eastern coast of Avalon Peninsula. The shoreline is fringed by an almost continuous glacier-scoured outcrop of folded, resistant Precambrian sandstone and conglomerate that drops precipitously from over 500 feet into the sea, and is indented by numerous picturesque bays and coves. The ridge paralleling the east side of the highway between Bay Bulls Big Pond and Bay Bulls is at a level of over 800 feet above the sea.

20.5 Junction road to Bay Bulls. Pebbles similar to those at Witless Bay occur along the shore of Bay Bulls (*see* page 61).

20.9 Gravel pit on right at side of Williams Hill. The gravel pits in the area furnish pebbles and boulders of a variety of rocks including volcanic and granitic rocks, chert and jasper, which also occur at Witless Bay and numerous other shorelines along the eastern and southern shores of the peninsula.

23.8 Witless Bay, at turn-off to shoreline.

25.0 Peat bog on left.

26.0 Mobile, at bridge over Mobile River.

35.4 Turn-off (left) to La Manche Valley Provincial Park.

36.0 Highway crosses a peat bog.

39.2 Junction road to Brigus South.

39.6 A series of road-cuts extending to Mile 40.8 exposes Precambrian sandstone, siltstone and slate; this rock formation comprises the cliffs that form the steep walls of Cape Broyle Harbour.

41.5 Cape Broyle Harbour.

49.2 Ferryland, at turn-off to the lighthouse at Ferryland Head, 1.5 miles from Highway 10.

60.7 Turn-off to Renews.

Maps (T): 1/N St. John's
(G): 1018A Torbay, Newfoundland (G.S.C., 1 inch to 4 miles)

Plate XIV (opposite)

Middle Cove, Avalon Peninsula. Crystals of pyrite and quartz occur in the Precambrian sedimentary rocks exposed along these shoreline cliffs. (Nfld. Dep. Tourism 1989)

White Hills Quarry

QUARTZ CRYSTALS, PREHNITE, CALCITE, CHERT

In sandstone

Colourless to white crystals of quartz measuring about ¼ inch in diameter occur in veins of white to greenish white massive quartz cutting greenish grey sandstone. Massive white calcite and narrow bands of chalk-white prehnite occur in the quartz; the prehnite, being nearly opaque, is readily distinguishable from the semitransparent to translucent quartz. Chert, in shades of green varying from yellow-green to olive-green and greyish green, and including banded varieties, is found in the quarry and can be used for lapidary purposes.

The quarry is operated by Lundrigan's Concrete East Limited; it is located on the western slope of a ridge known as the White Hills.

Road log from New Cove Road at Mile 1.15 (*see* page 51):

Mile	0	Proceed onto Kenna's Hill from its junction with New Cove Road.
	0.25	Junction; turn right onto Logy Bay Road.
	1.7	Turn right onto road to quarry.
	2.5	White Hills Quarry.

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G. S. C., 1 inch to 4 miles)

Logy Bay Amethyst Occurrence

AMETHYSTINE QUARTZ

In conglomerate

Transparent amethystine to colourless quartz crystals averaging ¼ inch in diameter line crevices in purplish red conglomerate. The crystals are stubby and, generally, only the terminal faces protrude from the rock surface. The crystals are too small for lapidary purposes but make attractive specimens.

The conglomerate containing the crystals is exposed along steep barren cliffs on the shore of Logy Bay. This rock extends along the coast southward to Petty Harbour.

Road log from junction New Cove Road and Kenna's Hill:

Mile	0	Proceed onto Kenna's Hill.
	0.25	Junction; turn right onto Logy Bay Road.

Mile 1.7 Turn-off to White Hills quarry; continue straight ahead.

2.7 Turn right onto road to Logy Bay.

4.1 Memorial University's Marine Science Research Laboratory. The conglomerate is exposed in the vicinity of the University buildings.

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G.S.C., 1 inch to 4 miles)

Middle Cove, Outer Cove Occurrences

QUARTZ CRYSTALS, PYRITE, CALCITE

In sandstone, argillite, slate

Quartz veins containing cavities lined with colourless to white quartz crystals occur in the Precambrian rocks exposed along shoreline cliffs at Outer Cove and at Middle Cove in Tor Bay; the crystals average about ¼ inch in diameter. Cubes of pyrite, about an inch across, have been reported from the two localities. Cleavable masses of white calcite occupy veins cutting the rocks; the calcite fluoresces bright pink under "short" ultraviolet rays, and reddish pink under "long" ultraviolet rays.

Quartz crystals are also found along Highway 21 near Bauline on the east shore of Conception Bay. / This occurrence is at the crest of the hill where the road begins its descent to the village.

Road log to Middle, Outer coves;

Mile 0 From the junction of New Cove Road and Kenna's Hill, follow the road log toward Logy Bay (*see* page 56).

2.7 Junction road to Logy Bay; continue straight ahead along road to Middle Cove.

5.5 Junction. The road on left leads 0.2 mile to an access road to the shoreline at Middle Cove.

To reach the shore at Outer Cove, proceed 0.8 mile along road on right; at a point 0.2 mile east of the junction, a viewpoint at the brow of the shoreline cliff affords a view of Tor Bay and the north-eastern shore of Avalon Peninsula.

A road-cut on the west side of this junction exposes Precambrian sedimentary rocks cut by quartz veins containing crystals of colourless to white quartz.

Refs.: 96 p. 12; 153 p. 190

Maps (T): 1 N/10 St. Johns
(G): 1018A Torbay, Newfoundland (G.S.C., 1 inch to 4 miles)

Torbay Quarry

QUARTZ CRYSTALS, CALCITE, CHERT

In sandstone

Tiny quartz crystals averaging 1/8 inch in diameter occur in massive quartz veins cutting green sandstone. White massive calcite that fluoresces pink when exposed to ultraviolet rays is associated with the quartz. Dull green chert is also found in the quarry.

The abandoned quarry is located south of Torbay.

Road log from the New Cove Road at junction Kenna's Hill:

Mile	0	Proceed onto Kenna's Hill.
	0.25	Turn left onto Torbay Road (Highway 20).
	6.1	Turn left onto single-lane road.
	7.0	Junction quarry road; turn right.
	7.3	Quarry.

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G.S.C., 1 inch to 4 miles)

Quidi Vidi Lake Occurrence

PREHNITE, QUARTZ CRYSTALS, CHLORITE, PYRITE

In sandstone

Light yellowish green to chalk white prehnite occurs as narrow bands, about ¼ inch wide, in massive white quartz veins that traverse greenish grey sandstone. The prehnite has a transverse columnar structure and it fluoresces weakly (yellowish white) under "long" ultraviolet rays. The quartz has a more vitreous appearance and is more transparent thereby distinguishing it from the prehnite. These minerals also occur as narrow streaks in the sandstone. Small crystals of quartz and patches of chlorite and pyrite occur in the quartz.

The sandstone bearing the prehnite-quartz veins is exposed along a cliff forming the south end of the White Hills at the eastern end of Quidi Vidi Lake. To reach it, follow The Boulevard for a distance of 1.3 miles from the intersection of New Cove Road, Kenna's Hill and The Boulevard at Mile 1.15 (*see* page 52). The locality is behind the oil tanks.

Ref.: 109 p. 1569

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G. S. C., 1 inch to 4 miles)

Signal Hill Occurrence

PREHNITE, QUARTZ CRYSTALS, PYRITE, CHLORITE

In quartz veins cutting sandstone

This occurrence is similar to the prehnite occurrence at Quidi Vidi Lake. The quartz-prehnite veins occur in the sandstone outcrops on Signal Hill near the entrance to Signal Hill National Historic Park. Both grey and red sandstone is exposed along the road in the park.

These outcrops have been striated, grooved and polished by the eastward movement of glacial ice during Pleistocene time. Glacial action and erosion have stripped the bedrock almost bare leaving numerous rock exposures and only a thin mantle of soil to support the sparse vegetation along the slopes of Signal Hill; its bald, rocky, treeless summit (500 feet above sea level) is crowned by the Cabot Tower built in 1897-1898 to commemorate John Cabot's discovery of Newfoundland four centuries earlier. The tower is constructed of local red and blue conglomerate and of light grey sandstone.

Access to Signal Hill is via the Signal Hill Road leading east from Cavendish Square.

Ref.: 109 p. 1569

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G. S. C., 1 inch to 4 miles)

South Side Hills Quarry

PREHNITE, QUARTZ CRYSTALS, CHLORITE, PYRITE, CALCITE

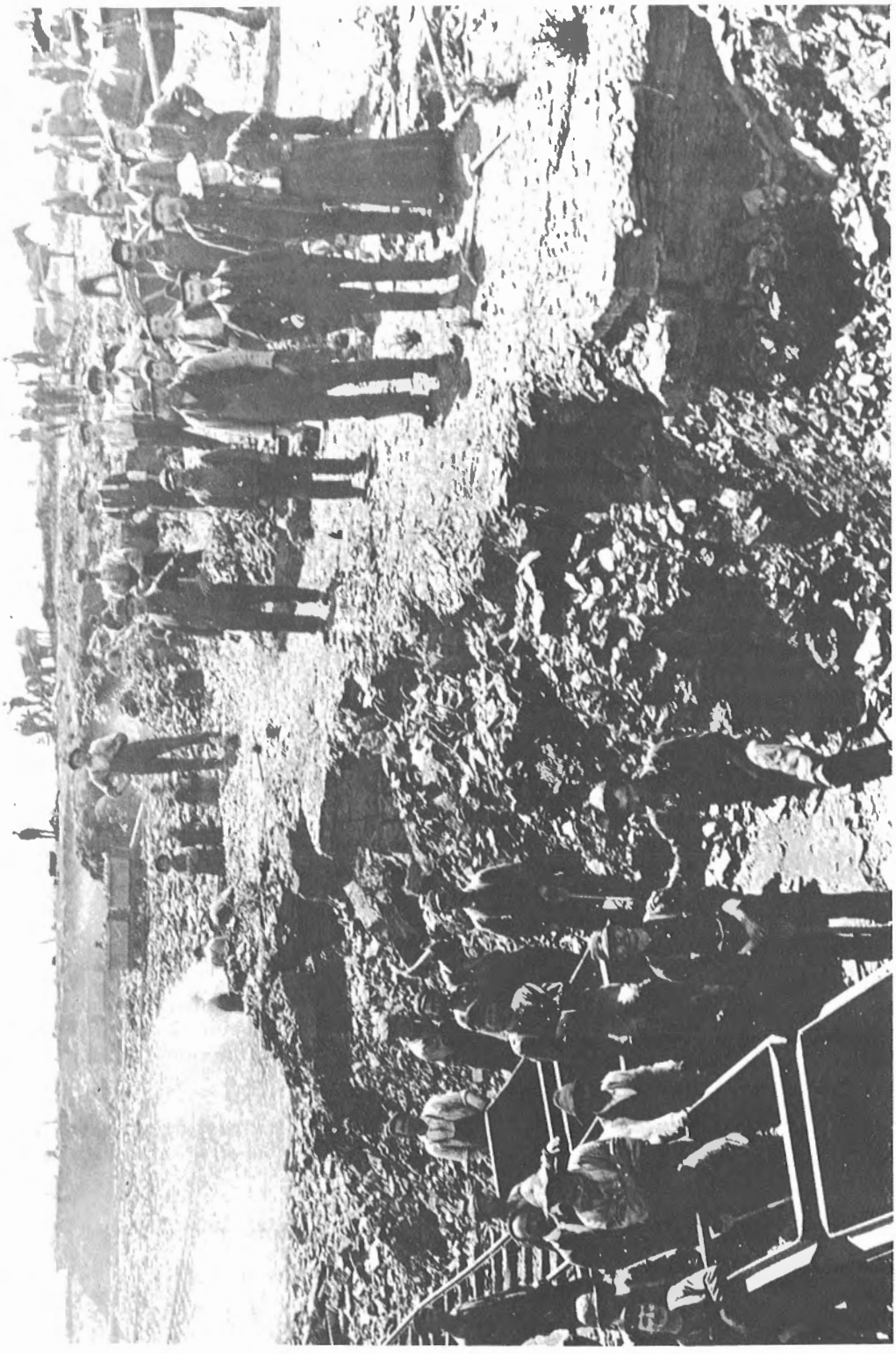
In quartz veins cutting sandstone

Light, slightly greenish yellow prehnite occurs in the quartz veins; the occurrence is similar to the Quidi Vidi Lake prehnite occurrence. The veins also contain patches of massive white calcite that fluoresces bright pink when exposed to "short" ultraviolet rays.

The quarry was formerly worked for sandstone for use as a building stone. Examples of the use of this greenish grey sandstone can be seen in the exterior of the Anglican Cathedral and St. Patrick's Church in St. John's.

The quarry is located at the foot of the South Side Hills in St. John's harbour.

Road log from Water Street at Mile 2.9 (*see* page 52):



Mile 0 Turn left onto access to Job's bridge.

0.2 Turn left onto Southside Road.

0.5 Quarry on right.

Refs.: 109 p. 1569; 123 p. 56

Map (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G.S.C., 1 inch to 4 miles)

Witless Bay Shoreline Occurrences

VOLCANIC ROCKS, EPIDOTE, JASPER, CHERT, GRANITE, CALCITE

In beach gravels along shoreline

A variety of attractively patterned, fine grained volcanic rocks occur as pebbles and boulders along the beaches in the Avalon Peninsula as well as in numerous beaches and gravel pits elsewhere in Newfoundland. These volcanic rocks are also referred to as felsites. The pebbles occur in shades of red, maroon, brown, purple and green; they are banded, mottled, streaked and speckled in contrasting tones that are enhanced when the surface is polished rendering them suitable as an ornamental stone. Epidote occurs as crystalline crusts, as streaks in some of the pebbles, and as crystalline aggregates filling amygdules in others. Pebbles of red jasper and green chert, both suitable for lapidary purposes, are found in the gravels of some beaches. Also present are pebbles of granite composed of pink feldspar and white quartz patterned with patches and stringers of green epidote; these are also attractive when cut and polished. At one locality — the beach at Ferryland — numerous water-worn pebbles of compact white vesicular calcite are found. They have been sculptured by the sea into unusual forms that are collectors' items in themselves.

The pebbles of these ornamental-type rocks can be collected from the accessible shorelines (noted in road log on page 55) along the eastern shore of the Avalon Peninsula; they include the beaches at Bay Bulls, Witless Bay, Mobile Bay, and Ferryland. There are innumerable other accessible beaches along Newfoundland's shores that yield a similar array of pebbles suitable for lapidary purposes.

Refs.: 96 p. 5-6; 153 p. 188, 190

Maps (T): 1 N/2 Ferryland
1 N/7 Bay Bulls
(G): 1018A Torbay, Newfoundland (G.S.C., 1 inch to 4 miles)

Plate XV (opposite)

Wabana Mine, Bell Island. Open-cut mining conducted by Nova Scotia Steel & Coal Company in about 1900. (Public Archives Canada PA 51491)

'Midnight Rock'

A rock exposure on a slope opposite the Roman Catholic Holy Apostles Church in Renews is known as the 'Midnight Rock' or the 'Mass Rock'. It is the site where Roman Catholics gathered in darkness to attend services conducted by priests disguised as fishermen at a time — about the mid-18th century — when the practice of Roman Catholicism was unlawful in Newfoundland. In 1927, a grotto was built on the site; it is constructed of flat boulders obtained locally, and is illuminated at night. This is one of the few known 'Midnight Rocks' on the Island. The area is underlain by Precambrian sedimentary rocks.

The Church is on the slope of Midnight Hill overlooking Renews Harbour. It is half a mile from Highway 10 at Mile 60.7.

Refs.: 131 p. 112; pers. comm.: Rev. J.S. Hanlon

Maps (T): 1 K/15 Renews
(G): 1231A Island of Newfoundland (G.S.C., 1:1 000 000)

Wabana Mine

HEMATITE, CHAMOSITE, SIDERITE, PYRITE, QUARTZ CRYSTALS, CALCITE, FOSSILS

In lenses in Ordovician sandstone and shale

This mine, a former iron producer, was worked continuously for 72 years. Its workings are no longer accessible but specimens may be collected from numerous dumps. The ore consisted of closely packed, elongated spherules (less than $\frac{1}{2}$ millimetre in diameter) composed of alternating concentric layers of hematite and chamosite and cemented by siderite. The general appearance of the hand ore specimen found in the dumps is of a reddish brown to black finely granular mass with a sub-metallic to greasy lustre on the freshly broken surface (dull red on the weathered surface); the spherules are visible only under magnification. Less commonly, hematite occurs as microscopic platy crystals. Pyrite was associated with some of the ore; it occurred as a massive aggregate of microscopic oolites or spherules (composed of concentric layers of pyrite) in a cherty matrix, and as a replacement in graptolites and brachiopods. Specimens of colourless transparent quartz crystals in calcite and in hematite ore may be found on the dumps; the crystals are stubby, terminated at one or both ends, and measure up to $\frac{3}{4}$ inch in diamter. The calcite is coarsely cleavable, colourless and transparent (Iceland Spar variety) or white, and it fluoresces deep pink under "long" ultraviolet rays. The fossils — graptolites, brachiopods and algae — associated with the orebody are characteristic of the marine life that occupied a shallow sea in the region during Ordovician time when the host rocks and the iron-formation were deposited.

This deposit was the largest of its type in Canada. The ore occurred in three beds — the Lower (Dominion) bed, the Middle (Scotia) bed, and the Upper bed — that were enclosed in a rock formation consisting of greenish grey sandstone and black shale. The rock and the ore beds outcropped along the shoreline cliffs and inland on the northwest side of Bell Island between South Head and Ochre Cove; they dipped gently

toward the northwest and passed beneath the water of Conception Bay. The iron-formation consisted of narrow hematite-rich lenses separated by sandy and shaly material, the ore lenses measuring up to a few feet thick and extending over a distance of several hundred to a few thousand feet. The iron-bearing rock broke characteristically in rectangular blocks.

The occurrence of the Wabana iron deposit — an 8-foot-wide band of bright red sandstone on the northwest shore of Bell Island — was first reported by J. B. Jukes after he conducted a geological survey of Newfoundland in 1842-1843. Although local residents had, for many years, noticed the blocks of reddish rock broken from the sea-cliffs and strewn along the beaches, and had used them as anchors and ballast and for building purposes, the rock's iron content was overlooked until about 1892 when an incident related by the Reverend M. Harvey led to its discovery: "A fisherman, who was going to St. John's chanced to observe that these rocks were much heavier than ordinary blocks, and it occurred to him that they would make good ballast. He piled a number of them into his little craft, and when leaving St. John's on his return trip, having obtained a cargo of goods, he left his ballast on one of the wharves. Someone with a sharper eye than his fellows was struck with the appearance and weight of the stones, and suspected that they were metalliferous. He sent a sample to England for analysis, and was speedily informed that it was a rich iron ore. An exploration of the island followed, and the red rock was traced under the soil for a considerable distance." (Ref.: 54 p. 94-95).

Mining began in 1895, two years after the Nova Scotia Steel and Coal Company Limited obtained the mining rights from the Butler brothers of Topsail. The first shipment of ore was made in December of the same year to the smelter in Ferrona, Nova Scotia; a few years later, the ore was shipped to the then-new (built in 1899) steel plant in Sydney Mines, Nova Scotia, and to Europe and the United States. In 1899, another company — Dominion Iron and Steel Company Limited — began mining adjoining claims. The deposit was operated separately by the two companies until 1922 when they were amalgamated to become British Empire Steel Corporation Limited which later became Dominion Steel and Coal Corporation Limited.

Both surface and underground mining methods were employed, with most of the production coming from the submarine workings beneath the floor of Conception Bay. These workings extend over an area of 6 square miles; the deepest is 1850 feet below sea level with 1500 feet of rock above it. There is a minimum of 200 feet of rock cover above the upper workings. The room-and-pillar method of underground mining was used, the pillars measuring 70 by 40 feet wide with roof spans of up to 27 feet. Access to the workings was via four slopes or shallow inclines, their portals on the island near its west-central shore. The maximum distance ore was hauled from the workings to the portal was nearly 4 miles. The ore was crushed underground, conveyed to the surface for treatment, stored at the docks on the eastern shore of the island, then shipped to steel plants in Nova Scotia and to points in Europe and the United States.

The mine was closed in 1966 due to ore exhaustion. In 72 years of production, it yielded 78 989 412 tons of iron ore; the peak was reached in 1960 when 2.81 million tons of ore were shipped.

The mine is near the town of Wabana, an Indian word meaning the place where daylight first appears. A regularly scheduled ferry connects Bell Island and Portugal Cove.

Road log from Trans-Canada Highway in St. John's:

Mile 0 Junction Portugal Cove Road and Prince Philip Drive (Trans-Canada Highway); proceed northwest along Portugal Cove Road (Highway 40).

7.9 Road-cuts expose chlorite schist containing finely disseminated pyrite and quartz-calcite veins. The calcite is white with coarse cleavage surfaces; it fluoresces pink under "long" ultraviolet rays.

8.3 Portugal Cove, at ferry landing; proceed onto ferry for the 3-mile journey to Bell Island in Conception Bay. This flat-topped, steep-walled island measures 6 miles by 2 miles with a maximum elevation of 400 feet above the sea; it is underlain by Ordovician sandstone and shale that contain fossils in a few localities and an iron-formation at its northwest side.

The ferry landing on the island is at The Beach where a 200-foot shoreline cliff exposes light grey sandstone and greyish brown shale of Ordovician age; the rocks contain brachiopods and fossil algae. The two piers used for loading the iron ore were 0.6 and 1.0 mile southwest of The Beach.

From the ferry landing, proceed onto the road to Wabana.

10.0 Wabana, at town square. A road leads 0.6 mile from this point to Gull Island South Head where a remnant of the Dominion bed is exposed along the shore on the west side of the ruins of a powder magazine. Turn left onto No. 2 Road. The area between this road and the shore, was mined by surface methods.

10.3 Dump on right. Ore specimens are found in this dump.

10.4 Junction Ten Commandment Road; it leads to No. 6 slope on right. There is a rock dump on the shore of Grebes Nest Point (east side), to the northeast.

10.5 Dump and remnants of treatment plant on left.

11.3 No. 4 slope is near the shore on right.

Refs.: 19 p. 1; 20 p. 274-298; 50 p. 123-125, 133; 51 p. 4-17; 55 p. 4-8, 24-28, 136; 93 p. 554-555; 123 p. 33-34, 44-45, 46-53; 129 p. 193, 200; 173 p. 112

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G.S.C., 1 inch to 4 miles)

This completes the description of collecting localities in the St. John's area; the occurrences along the Trans-Canada Highway between St. John's and Channel-Port aux Basques are described in the text that begins below.

Mile 0 St. John's at Prince Philip Drive (Trans-Canada Highway) and Portugal Cove Road; proceed onto Prince Philip Drive.

For the first 55 miles, the Trans-Canada Highway route is within the Avalon Peninsula — a gently rolling upland at the southeastern extremity of the Atlantic Uplands physiographic region which in turn is at the easternmost tip of the continent. The area is one of low relief with occasional monadnocks rising a few hundred feet above the level of the land. It is almost entirely underlain by Precambrian sedimentary and volcanic rocks including some of the oldest rocks comprising the Island of Newfoundland. Its surface is characterized by countless bogs, ponds and streams, and is mantled by a cover of glacial gravel and clay left by Pleistocene glaciers that radiated seaward from the peninsula and flowed down channels now occupied by Conception, Trinity, Placentia and St. Mary's bays.

7.0 Junction, Highway 60 at Donovans.

9.0 Quarry at right beyond road-cut exposes Precambrian siltstone and tuff.

The hilltop above the quarry (elevation of about 750 feet above sea level) provides a lookout for a panoramic view of the Avalon Peninsula; Bell Island in Conception Bay can be seen to the northwest, 850-foot Kenmount Hill to the northeast with the city of St. John's beyond it, and the rolling hills to the south.

11.7 Turn-off (left) to Cochrane Pond Provincial Park.

A peat bog, worked by Sundew Peat Moss, is located on the south side of the park at the west end of Cochrane Pond. The surface is covered with low-growing shrubs characteristic of bogs. As in other areas of the island, peat formed on the glacial mantle where drainage was poor.

13.9 Bridge over Manuels River.

14.4 Road-cuts expose altered volcanic rocks cut by veins containing quartz, epidote, pink feldspar, chlorite, calcite and pyrite. The epidote occurs as aggregates of microscopic prisms in quartz and as finely granular masses with chlorite forming bands in the rock. Tiny quartz crystals occur in cavities in massive quartz veins in a similar road-cut at Mile 15.7.

15.9 Road-cut on left exposes lower Precambrian purple, green and grey rhyolite, and a siliceous rhyolite porphyry with a purple matrix that encloses rounded and angular fragments of pink feldspar. The rock makes an attractive ornamental stone.

Plate XVI. Pyrophyllite carving. The pyrophyllite was obtained from the Foxtrap Mine and was carved by a Labrador Eskimo. (GSC 202820-G)

Mile 16.7 Pink to grey granite is exposed by road-cuts extending over a distance of 0.2 mile. Epidote occurs as finely crystalline aggregates forming coatings, veinlets and bands (about $\frac{1}{2}$ inch wide) in the granite. Dark green chlorite and brown titanite grains are also found in the rock. The granite is medium textured and is composed of quartz, white plagioclase and pink orthoclase, and biotite; it is the exposed portion of a large granitic mass known as the Holyrood batholith that intruded the existing volcanic rocks.

17.0 Junction road to Foxtrap (Highway 61).

Foxtrap Mine

PYROPHYLLITE, QUARTZ, DIASPORE, RUTILE, PYRITE; JASPER

In lenses and masses in quartz-pyrophyllite schist; in rhyolite

This is currently the only pyrophyllite producer in Canada. Pyrophyllite resembles talc in its physical properties and can be put to the same uses. The pyrophyllite in this deposit is generally cream white in colour but is commonly tinted in shades of yellow, green, pink, brown and reddish to purplish. It is compact, massive, and is generally admixed with quartz and sericite to form a pyrophyllite rock that is easily carved. Embedded in some of the pyrophyllite are grains of pyrite and rutile, and grains and nodules of quartz and light blue diaspore (rare) intergrown with barite. The diaspore-bearing pyrophyllite makes an attractive stone when slabbed and polished. Some of the silicified rhyolite in which the quartz-pyrophyllite schist occurs is attractively coloured and is suitable for use as an ornamental rock. Red jasper is present as fracture-fillings and veinlets in the rhyolite.

When this deposit first became known, the mineral was referred to as agalmatolite — a general term used to designate soft, carvable substances like talc and steatite — and specimens were included in an 1898 exhibit of Newfoundland minerals displayed in England. Pyrophyllite is currently fashioned by Eskimo artisans into appealing carved ornaments featuring wildlife subjects, and these are available from several outlets in Newfoundland.

The pyrophyllite deposit lies along a narrow belt extending south about six miles from Manuels; its host rock is sheared rhyolite and conglomerate. Development of the deposit began in 1903 with the opening of a quarry on Mine Hill just west of Johnnys Pond and about ¼ mile south of the currently operated quarry. The operator — North American Talc Company — constructed an aerial tramway to the railway and a loading wharf at Seal Cove, and in 1904-1905 shipped a total of approximately 7750 tons of hand-sorted pyrophyllite to its plant in Maine. Subsequently, the mine was inactive until 1938 when production was resumed by Industrial Minerals Company of Newfoundland. With the opening in 1942 of a new quarry north of Johnnys Pond, the Mine Hill quarry operation ceased. The ore was treated at a mill near Manuels and production was continuous until 1947. Operations were resumed in 1956 by the present operator, Newfoundland Minerals Limited, which constructed a new mill and a wharf at Long Pond on the shore of Conception Bay. The ore is shipped to the company's plant in Pennsylvania for use in the manufacture of ceramic tile.

Road log from the Trans-Canada Highway at Mile 17.0:

Mile	0	Proceed onto road to Foxtrap (Highway 61).
	0.8	Granite is exposed along the road.
	2.9	View of Conception Bay, the villages along its shore, and Bell Island in the distance.

Plate XVII. Foxtrap Mine, Open-pit operations. (GSC 202744)

Mile 4.9 Junction, Highway 60. Enquiries regarding visits to the mine should be directed to the company's office at Long Pond (at the wharf located ½ mile north of Highway 60 at a point 0.9 mile east of the junction at Mile 4.9). To reach the mine, turn right onto Highway 60.

6.1 Junction mine road at east end of bridge over Conway brook; turn right.

8.2 Foxtrap Mine

Plate XVIII. Manuels River, conglomerate exposure below Highway 60 bridge. Pebbles of jasper and rhyolite occur in the conglomerate. The Manuels River manganese occurrence is downstream from this bridge. (GSC 202740)

Refs.: 8 p. 203; 21 p. 113-121; 65 p. 546; 66 p. 570; 96 p. 6, 8; 110; 150 p. 1, 4-8, 13, 24-26; 153 p. 190; 178 p. 243-244

Maps (T): 1 N/7 Bay Bulls
1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G.S.C., 1 inch to 4 miles)
5A Manuels sheet (Nfld. Dep. Mines Energy, 1 inch to 100 feet)

Manuels River Occurrence

BIRNESSITE, RHODOCHROSITE, HEMATITE, BARITE, PYRITE, FOSSILS

In shale

Manganese-bearing red and green shale is exposed along the steep banks of the Manuels River downstream from the Highway 60 bridge at Manuels. The manganese mineralization is concentrated in disc-shaped nodules (averaging about ¾ inch in diameter), and as thin bands and lenses in the rock.

Birnessite is the chief manganese mineral; it is dark brown to black, massive with a dull to submetallic lustre. Irregular fragments of brownish red rhodochrosite are associated with the birnessite. Hematite, barite, and pyrite are present in small amounts with the manganese minerals and in the enclosing shale.

Trilobites occur in dark grey to black Cambrian shale that is exposed along the steep cliffs just beyond the sharp bend in the Manuels River, downstream from the manganese occurrence.

A floor of resistant conglomerate with numerous ledges over which the water falls is exposed in the bed of Manuels River at the highway bridge and downstream from it. The rock is composed of Precambrian-age pebbles, cobbles and boulders of chert and of the volcanic (mostly silicified rhyolite) and granitic rocks that existed as erosional fragments when the conglomerate was formed in Cambrian time. It overlies the Precambrian rocks and is part of a sequence of nearly flat-lying Cambrian sedimentary rocks including shale, slate and limestone that resisted the erosional forces affecting the Avalon Peninsula. This rock formation remains as a narrow fringe occupying a lowland along the shore of Conception Bay from Topsail to the head of Holyrood Bay. It has been dissected by U-shaped valleys carved by glaciers drifting toward Conception Bay during the Ice Age.

The occurrences may be reached by walking from the Highway 60 bridge over Manuels River; the manganese occurrence is about 400 yards downstream from the bridge, the fossil occurrence about 800 yards.

Road log from Trans-Canada Highway at Mile 17.0:

Mile	0	Proceed onto road to Foxtrap.
	4.9	Junction, Highway 60; turn right.
	6.1	Turn-off to Foxtrap Mine; continue straight ahead.
	7.8	Bridge over Manuels River. The occurrences may also be reached by descending the steep river-bank from the school yard on the east side of the river: continue east along Highway 60.
	8.0	Turn-off (left) to the school. The manganese occurrence is in the cliff behind the school.

Refs.: 18 p. 2-3; 28 p. 377-418; 123 p. 28-32, 53-55

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (G. S. C., 1 inch to 4 miles)

Mile 17.0 Trans-Canada Highway at junction Highway 60.

17.7 A series of road-cuts from here to Kelly's Pond (Mile 24.3) exposes pink to grey granite containing epidote as veinlets and bands and as coatings on its surfaces. Cavities in the rock are commonly lined with small, clear to white, crystals of quartz.

22.8 Soldiers Pond on left with northern extension of Hawke Hills in background. This series of hills extends southwestward for about 15 miles, their rounded summits reaching elevations of 800 feet above sea level at the north end and 1 100 feet in the south; these are among the highest elevations in the Avalon Peninsula. The hills have been scoured by glaciers and further eroded by weathering agents leaving only a thin veneer of soil to support their sparse vegetation. They are composed of Precambrian granitic, volcanic and sedimentary rocks. The Trans-Canada Highway parallels the Hawke Hills to Mile 29.0.

24.3 Kellys Pond on left.

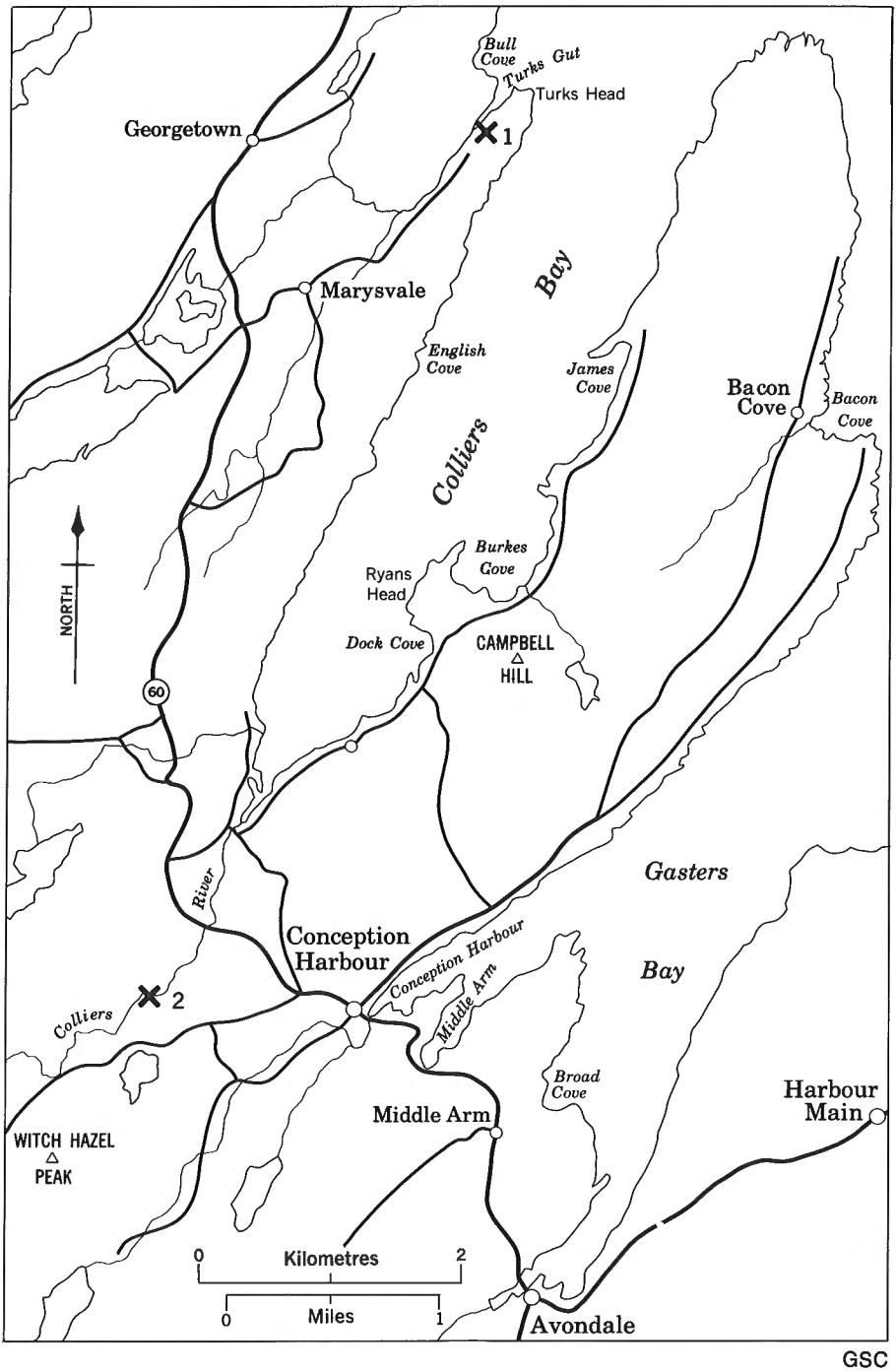
22.6 Road-cut on left exposes dark grey volcanic rock traversed by veins of epidote and quartz; tiny crystals of quartz occur in epidote fracture-fillings.

23.0 Turn-off to Butterpot Provincial Park.

Within the park are several ponds and wooded hills. Butter Pot, a steep-sided, oval-shaped hill at the western boundary of the park, is the highest in the area with an elevation of 1020 feet above sea level; it is capped by a layer of quartz gabbro overlying granite (Ref.: 92 p. 5, 27).

23.8 Road-cuts expose granite and a chloritized volcanic rock that contains clear to white crystalline calcite (fluoresces pink under "short" ultraviolet rays) and pink feldspar containing patches of epidote. Here the highway enters a region known as the "barrens", one of several areas in Newfoundland where glaciers have scoured the country rock leaving large bare exposures of rock. For some distance on either side of the highway, knobby outcrops of light coloured Precambrian granite are a conspicuous characteristic of the landscape; numerous large boulders of granite — glacial erratics — are perched atop the outcrops. These granite exposures mark the western extension of the Holyrood batholith.

Westward, the highway passes over an area underlain by a variety of Precambrian rocks including rhyolite, andesite, basalt, conglomerate, sandstone, greywacke and slate. Road-cuts along the way



1. Turks Gut copper occurrence. 2. Colliers River copper occurrence.

Map 6. Colliers Bay area.

Mile 23.8 (cont.) expose these rocks; minerals occur in veins or lenses in some of the exposures and these are noted in the text.

33.2 Junction, Highway 90.

39.1 Turn-off to Gushues Pond Provincial Park.

39.5 Junction road to Conception Harbour.

Colliers River Copper Occurrence

CHALCOPYRITE, CHALCOCITE, BORNITE, BROCHANTITE, POSNJAKITE

In andesite and basalt

Massive chalcopyrite, chalcocite and bornite occur as irregular patches in the volcanic rocks. The secondary copper minerals — green brochantite and blue posnjakite — form powdery and finely crystalline coatings on the ore-bearing rock.

The deposit is on the north side of a bend in the Colliers River, south of Highway 60. It was originally explored by a shallow shaft over a hundred years ago.

Road log from Trans-Canada Highway at Mile 39.5:

Mile 0 Proceed onto road to Conception Bay.

3.0 Witch Hazel Peak on right; it rises to a height of 300 feet above the surrounding countryside.

4.7 Junction, Highway 60; turn left.

5.3 Bridge over Colliers River.

5.4 Junction single-lane road on left leading 0.4 mile to a baseball diamond and municipal dump. The copper occurrence is about 75 yards to the left of the road and at the end of the dump.

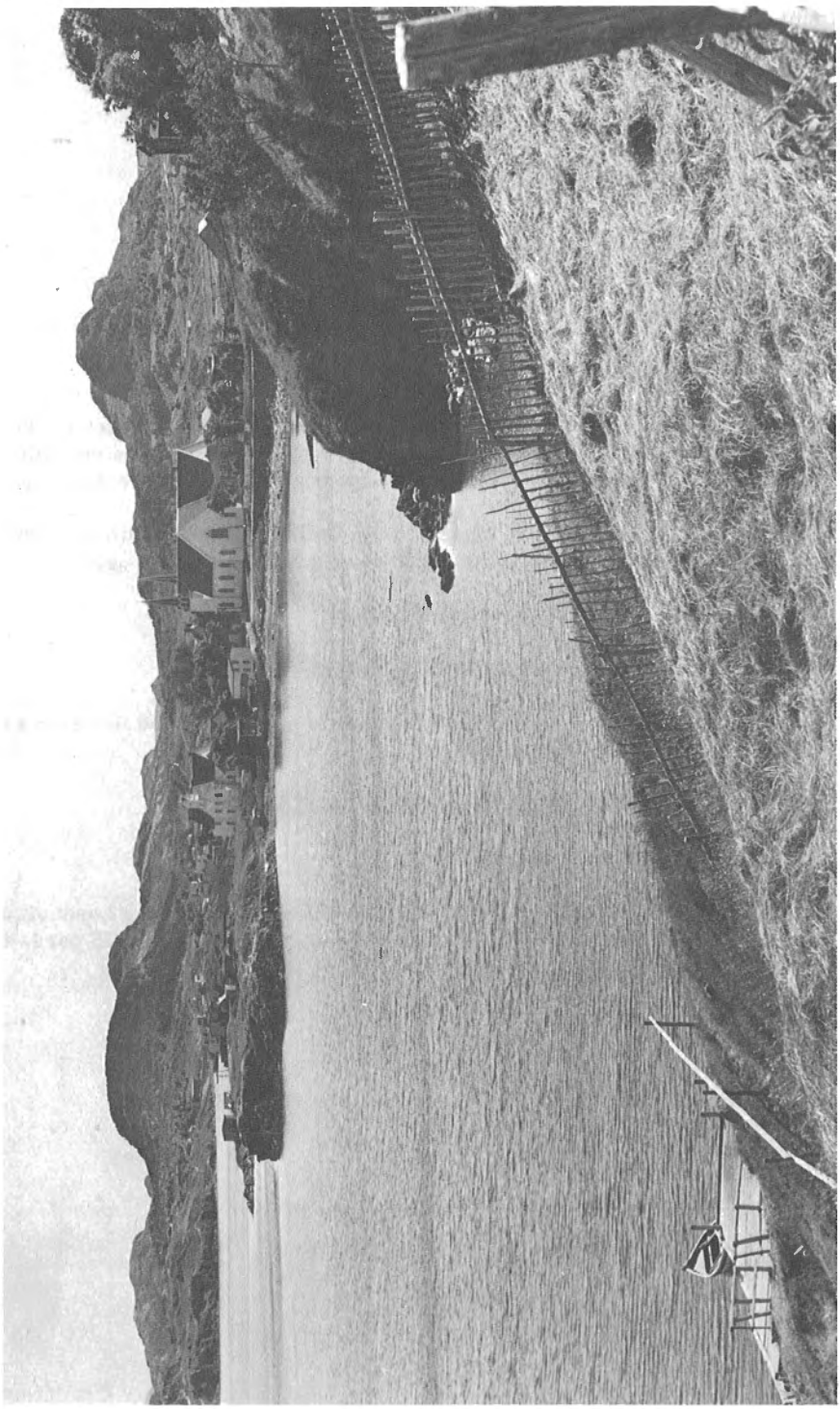
Ref.: 33 p. 145

Maps (T): 1 N/6 Holyrood
(G): 1168A Whitbourne (St. John's, west half) Newfoundland (G.S.C., 1 inch to 4 miles)
54-3 Holyrood, Newfoundland (G.S.C., 1 inch to 1 mile)

Turks Gut Copper Occurrence

CHALCOPYRITE, BORNITE

In amygdaloidal basalt



Massive chalcopyrite and bornite occur as fracture-fillings and in amygdules in basalt.

The deposit was explored by a shaft and an adit prior to 1868. It is located on the west slope of a ridge overlooking Turks Gut, an inlet on the west side of Colliers Bay.

Road log from Trans-Canada Highway at Mile 39.5:

Mile	0	Proceed onto road to Conception Bay, and follow road log to the Colliers River copper occurrence.
	5.3	Bridge over Colliers River. Continue along Highway 60.
	8.3	Junction; turn right onto road to Marysvale and proceed through the village toward the wharf at Turks Gut.
	9.9	Copper occurrence on slope on right. Specimens can be collected from the talus along the slope above the road.

Ref.: 33 p. 5, 145

Maps (T): 1 N/11 Harbour Grace
(G): 1035A Harbour Grace, Newfoundland (G.S.C., 1 inch to 1 mile)

Mile 40.8 Junction Highway 70.

Adams Cove Occurrence

QUARTZ CRYSTALS

In glacial drift

Colourless, transparent, terminated crystals of quartz occur in massive, white quartz blocks found in glacial drift. The crystals are well formed with smooth facies; they commonly measure 1 to 4 inches long and $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter. Some crystals measuring up to 7 inches long and $3\frac{1}{2}$ inches in diameter have been found.

The deposit has been exposed by shallow pits and trenches on a low ridge near Forked Pond, about 7 miles northwest of Adams Cove on the western shore of Conception Bay. Quartz crystals have been extracted from the deposit since 1946 by Clifford Baggs of Adams Cove. There are no facilities for collecting specimens from the deposit, but they may be purchased from Mr. Baggs.

Plate XIX (opposite)

Bald, asymmetrical, glacier-sculptured hills at Harbour Main, Conception Bay. Here, and elsewhere on the Island of Newfoundland, seaward-moving ice sheets rode slowly up the hills, scoured them, and dropped rapidly down producing hills with gentle slopes on one side and steep slopes on the opposite side. Spread Eagle Peak at Mile 56 on the Trans-Canada Highway is another example of this stoss-and-lee topography. (Nfld. Dep. Tourism 1511)

Road log from Trans-Canada Highway at Mile 40.8:

Mile 0 Proceed onto Highway 70. About 5 miles from this junction, the jagged, rocky southwestern shoreline of Conception Bay comes into view. The long, narrow, steep-sided ridges composed predominantly of resistant Precambrian sedimentary rocks jut out as peninsulas into the bay in marked contrast to the gently rolling, unindented southeastern shore that is underlain by Cambrian shale and slate.

8.9 Junction Highway 60; turn left.

10.8 Clarke's Beach.

12.2 Slate quarry on left. The slate (grey) contains lenses of greyish green chert and white massive quartz.

44.0 Adams Cove.

Refs.: 21 p. 122-123; 96 p. 13; 153 p. 190

Maps (T): 1 N/14 Heart's Content
(G): 1168A Whitbourne (St. John's, west half) Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 53.1 Junction, Highway 80.

Near this junction, the highway dips to a low point (elevation about 150 feet above sea level) in traversing a valley that extends from Trinity Bay to St. Mary's Bay. The valley represents a syncline — a downward fold in the Precambrian sedimentary rocks. Numerous ponds and streams, including Rocky River, occupy this depression.

53.8 Junction, Highway 100.

Silver Cliff Mine

GALENA, SPHALERITE, PYRITE, QUARTZ CRYSTLAS, CHALCOPYRITE, BARITE

In brecciated fault zone in volcanic and sedimentary rocks

Argentiferous galena, the ore mineral at this former silver mine, occurs as small crystals (less than $\frac{1}{4}$ inch in diameter) and as compact masses associated with amber to dark brown massive and, less commonly, coarsely crystalline sphalerite. These minerals, along with pyrite and some chalcopyrite, occur with quartz, a manganese-bearing carbonate and barite in the brecciated rock. The pyrite carries low values in gold; in the rock adjacent to the ore-bearing zone, crystals of pyrite have formed. Small vugs, 1 to 2 inches in diameter, are lined with "micro" crystals of colourless, transparent quartz that, in places, are studded with "micro" crystals of chalcopyrite pyrite and/or barite.

The occurrence of argentiferous galena in the vicinity of the Silver Cliff Mine was known as early as 1881 when a mineralized vein was discovered by John Burke. The Silver Cliff deposit was discovered about 10 years later and was worked by J. W. Foran until 1898; the workings included a shaft and some open-cuts. From 1922 to 1925, the Silver Cliff Mining Company Limited operated the mine and a 50-ton-per-day mill. About 2000 tons of ore were mined from 2 adits measuring about 400 feet long, and several hundred tons of concentrates were shipped.

The mine is in the canyon of Broad Cove Creek, about 1700 feet inland from Broad Cove on the east shore of Placentia Bay near Argentia.

Road log from Trans-Canada Highway at Mile 53. 8:

Mile 0 Proceed onto Highway 100 to Argentia.

27. 5 U. S. Naval Station at Argentia. Before proceeding to the mine, permission must be obtained from the military authorities. To continue to the mine, turn right onto the Sight Sam Road.

29. 2 Junction; turn left.

29. 8 End of road. From this point, follow the path leading about 500 yards to the shore of Broad Cove. Then proceed east along Broad Cove a few yards to the mouth of Broad Cove Creek. The mine is located on the west bank of this creek, about 1700 feet from the mouth. The adits are about 36 feet apart.

Refs.: 92 p. 119-121; 135 p. 81-84

Maps (T): 1 N/5 Argentia
(G): 1168A Whitbourne (St. John's, west half), Newfoundland (G. S. C., 1 inch to 4 miles)

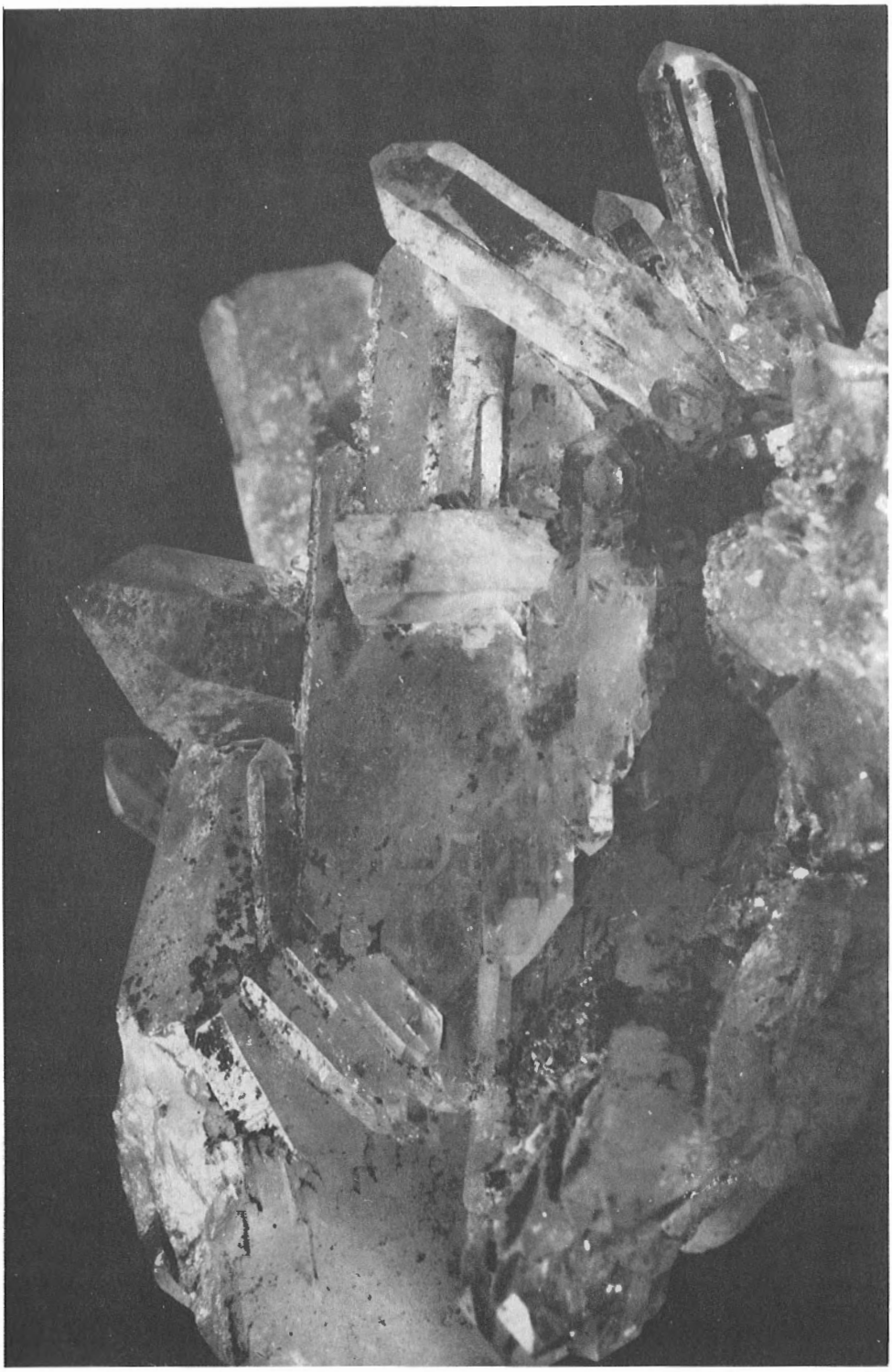
Cuslett Barite Occurrences

BARITE

In veins cutting Precambrian conglomerate

White to salmon-pink platy aggregates of barite occur in veins exposed along 60-foot shoreline cliffs on the east side of Placentia Bay between the villages of Cuslett and St. Bride's. The exposures are at the following localities: at Otterrub, half a mile north of Cuslett Cove; on the south side of Perch Cove which is 1½ miles south of Cuslett Cove; and at Cross Point, 2 miles south of Cuslett Cove. These distances are measured along the shoreline.

The village of Cuslett, on Highway 100, is 53. 5 miles from the Trans-Canada Highway at Mile 53. 8. A road, 0. 4 mile long, leads from the highway to Cuslett Cove.



Refs.: 21 p. 22; 135 p. 100-102

Maps (T): 1 L/16 St. Bride's
(G): 1231A Island of Newfoundland, Newfoundland (G.S.C., 1:1 000 000)

Mile 56.0 Road-cuts expose dark grey sedimentary rocks cut by veins of white massive quartz containing small cavities lined with tiny white quartz crystals.

Spread Eagle Peak (elevation 693 feet above sea level), an isolated steep hill on the south side of the highway with Peak Pond in the foreground, is composed of Cambrian gabbro that intruded slate of an earlier Cambrian age (Ref.: 92 p. 73-74).

58.2 A series of road-cuts from here to the junction of the Long Harbour Road (Highway 202) expose maroon, green and grey slate of Cambrian age. Surfaces of the rock are commonly coated with a thin film of a greasy black manganese mineral. Birnessite, a light grey metallic mineral, occurs in the grey slate exposure at Mile 60.3.

61.4 Junction Long Harbour Road (Highway 202).

Villa Marie Quarry

QUARTZITE

Light grey to white quartzite is being quarried from this deposit by Newland Enterprises Limited for use as flux in the phosphorus plant at Long Harbour. The quarry is near Villa Marie and has been in operation since 1968.

Road log from Trans-Canada Highway at Mile 61.4:

Mile 0 Proceed onto Long Harbour Road.

5.4 Junction; turn left onto road to Placentia, Argentia.

14.4 Junction; turn right onto quarry road.

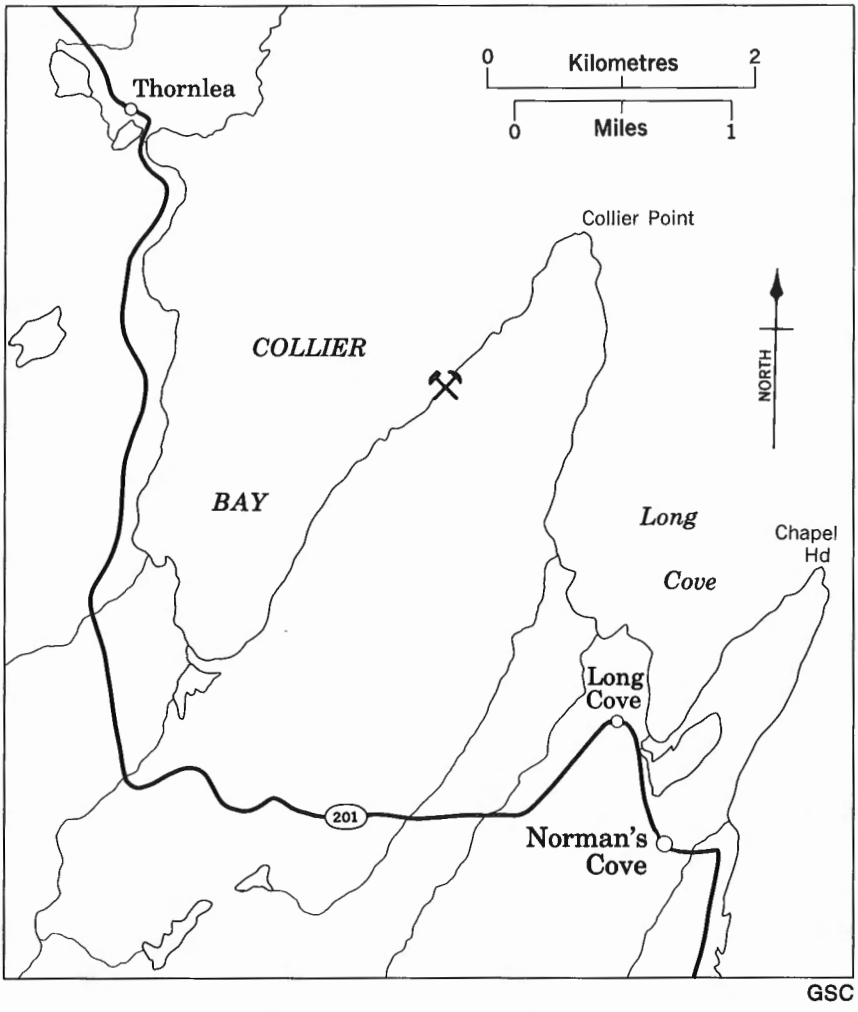
15.4 Quarry.

Ref.: 40 p. 35

Maps (T): 1 N/5 Argentia
(G): 1168A Whitbourne (St. John's, west half) Newfoundland (G.S.C., 1 inch to 4 miles)

Plate XX (opposite)

Cluster of quartz crystals collected from a Trans-Canada Highway road-cut at Mile 68.8. The clear crystals at top of the cluster measure 1/8 inch in diameter. (GSC 202514P)



Map 7. Collier Cove Mine.

Mile 61.4 Junction, Long Harbour Road.

From this point to Mile 95, the Trans-Canada Highway follows a narrow neck of land — the isthmus of Avalon — that joins Avalon Peninsula to the main part of the Island. It separates Trinity Bay from Placentia Bay.

63.3 Precambrian sedimentary rocks (siltstone and arkose) are exposed by a series of road-cuts from this point to the turn-off to Bellevue Beach at Mile 71.1. The rocks are cut by veins filled with calcite, chlorite, quartz, orange feldspar, and epidote. The calcite is white, massive and fluoresces pink when illuminated by ultraviolet light. In the road-cuts between Mile 68.8 and Mile 70.2, clusters of colourless, transparent, terminated crystals of quartz measuring up to $\frac{1}{4}$ inch in diameter occupy cavities in massive quartz; "micro" crystals of pink plagioclase are associated with the quartz crystals.

71.1 Junction road to Bellevue Beach Provincial Park.

Collier Cove Mine

BARITE

In vein cutting arkose

Barite occurs as aggregates of coarse tabular crystals with individual crystals measuring up to 2 inches long; most of the barite is white but a pink to red colour variation is also present.

The barite occurs in a vein that is reported to have averaged 20 feet over a distance of 300 feet. It was mined from the deposit by the Collier Cove Barite Company between 1902 and 1904 yielding a total of 6615 tons of ore. The openings, at tidewater, consist of an open cut, a 40-foot shaft and an adit; they are no longer accessible.

The mine is on the shore of a steep-walled peninsula that forms the east side of Collier Bay. It is about $1\frac{3}{4}$ miles southeast of Thornlea from which it is accessible by boat.

Road log from Trans-Canada Highway at Mile 71.1:

Mile 0 Proceed onto road to Bellevue Beach Provincial Park.

0.6 Junction. The road on left leads to the park. To reach the mine, turn right.

4.3 Junction; turn right.

5.8 Thornlea, at wharf.

Refs.: 21 p. 19-22; 92 p. 121-123; 134 p. 105

Plate XXI. Barite vein cutting volcanic rock, Trans-Canada Highway road-cut at Mile 74. Pink bladed aggregates of barite occur at this locality. (GSC 202762)

Maps (T): 1 N/12 Dildo
(G): 1168A Whitbourne (St. John's, west half) Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 72.3 Purple volcanic rocks are exposed on both sides of the highway. Finely crystalline epidote, "micro" crystals of pink plagioclase, and colourless to white tiny crystals of quartz occur in the rock. Patches of finely flaky hematite in quartz and some massive orange-pink feldspar were also noted. Epidote also occurs in the road-cut at Mile 73.2.

74.0 to 74.3 Road-cuts on both sides of the highway just beyond a bend and between two powerline crossings expose rusty coloured volcanic rocks cut by veins of pink to white bladed barite. Earthy yellow goethite coats the rock.

74.5 Road-cut on left exposes a dark red volcanic breccia consisting of variously-sized orange-red angular and rounded fragments of feldspar with quartz embedded in a dark brown to almost black siliceous matrix. The rock takes a high polish and makes a striking ornamental rock.

75.4 Junction road to Chance Cove.

76.4 Road-cut on right. The highway cuts through purplish grey rhyolite that contains small cavities lined with pink tabular crystals of barite and colourless "micro" prismatic crystals of quartz; kaolinite occurs as chalk-white powdery patches on the rock. Small pockets in the rock are filled with black covellite that has a tarnished blue metallic surface. Bluish green to emerald green finely granular chrysocolla and bright green fibrous malachite occur as crusts on the covellite and on the rock surfaces. A red siliceous rhyolite occurring in the rock-cut resembles jasper when cut and polished. The rocks are of Precambrian age. Barite also occurs in the rock-cuts at Mile 77.5 and 79.2.

76.9 Volcanic breccia is exposed in the road-cut on left. The rock is similar to the breccia at Mile 74.5 and is equally suitable for use as an ornamental stone.

78.3 Junction road to Little Harbour. Green slate cut by quartz veins is exposed in the road-cuts on both sides of this junction.

79.0 Cleavable masses of white calcite occur in dark green fine-textured conglomerate. The calcite fluoresces pink under ultraviolet rays. It contains small cubes of pyrite and patches of green glassy quartz.

82.9 Junction single-lane road on left.

La Manche Mine

GALENA, BARITE, CHALCOPYRITE, SPHALERITE, PYRITE, QUARTZ, CALCITE, FLUORITE, OPAL

In vein in grey and green siltstone and slate

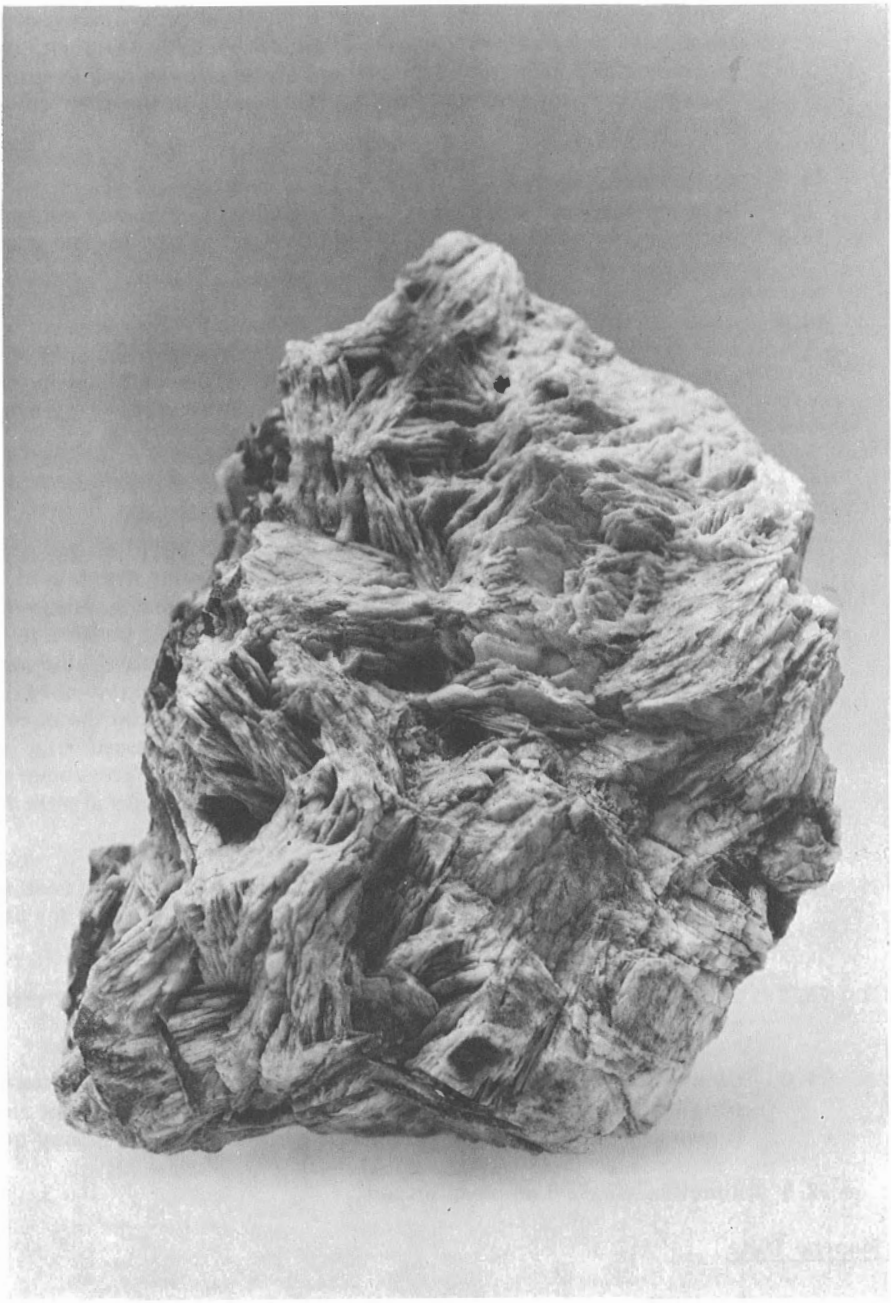


Plate XXII. Tabular barite crystals collected from Trans-Canada Highway road-cut at Mile 74. (GSC 202820-E)

This mine was formerly worked for galena which can now be found in the dumps adjacent to the workings. The galena occurs as coarsely crystalline aggregates with individual crystals measuring about ¼ inch along the edge. It is associated with pyrite and dark brown sphalerite in white, grey to mauve-coloured massive calcite that fluoresces pink when exposed to ultraviolet light. Vugs in the calcite are commonly lined with calcite crystals, pink tabular barite crystals, tiny chalcopyrite crystals, amethystine quartz crystals, and fluorite. One vug encountered during mining operations measured 40 feet long. Opal has been reported from the deposit. In its early days, large quantities of "prill ore" — blocks of galena weighing several pounds — were found in vugs and pockets in the mine.

The deposit was discovered in the 1840's and was mined intermittently between 1857 and 1924. The original companies involved in mining operations were the Ripley Company and the Placentia Bay Lead Company. Mining continued under the La Manche Mining Company from 1863 to 1873 after which there is no record of further production although other companies including La Manche Mining Syndicate Limited and Newfoundland Mining Corporation subsequently resumed development work. Production amounted to 18 762 tons of ore. The workings consist of an 1685-foot adit driven from the shore near high tide level, a 410-foot shaft located 1485 feet from the portal of the adit, and another shaft 2600 feet northeast of the portal.

The mine is located on the east side of La Manche Bay in Placentia Bay.

Road log from the Trans-Canada Highway at Mile 82.9:

Mile 0 Turn left (at highway sign indicating a bend in the road) onto a single-lane road.

2.5 Junction; turn right.

3.6 Mine at shore.

Refs.: 69 p. 233, 247; 92 p. 115-119; 134 p. 86-88

Maps (T): 1 N/12 Dildo
(G): 1168A Whitbourne (St. John's west half) Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 83.7 Junction road to Southern Harbour

83.8 Road-cut on the right side of the highway exposes grey slate cut by a vein of pink to white massive calcite containing patches of green serpentine, some chlorite, and small pyrite crystals. The calcite fluoresces pink under ultraviolet light.

85.1 Turn-off to Jack's Pond Provincial Park.

92.8 Turn-off (left) to Come by Chance oil refinery. The refinery, operated by Newfoundland Refining Company Limited, began refining oil in 1973. The crude oil originates from foreign sources.

92.9 Viewpoint on right.

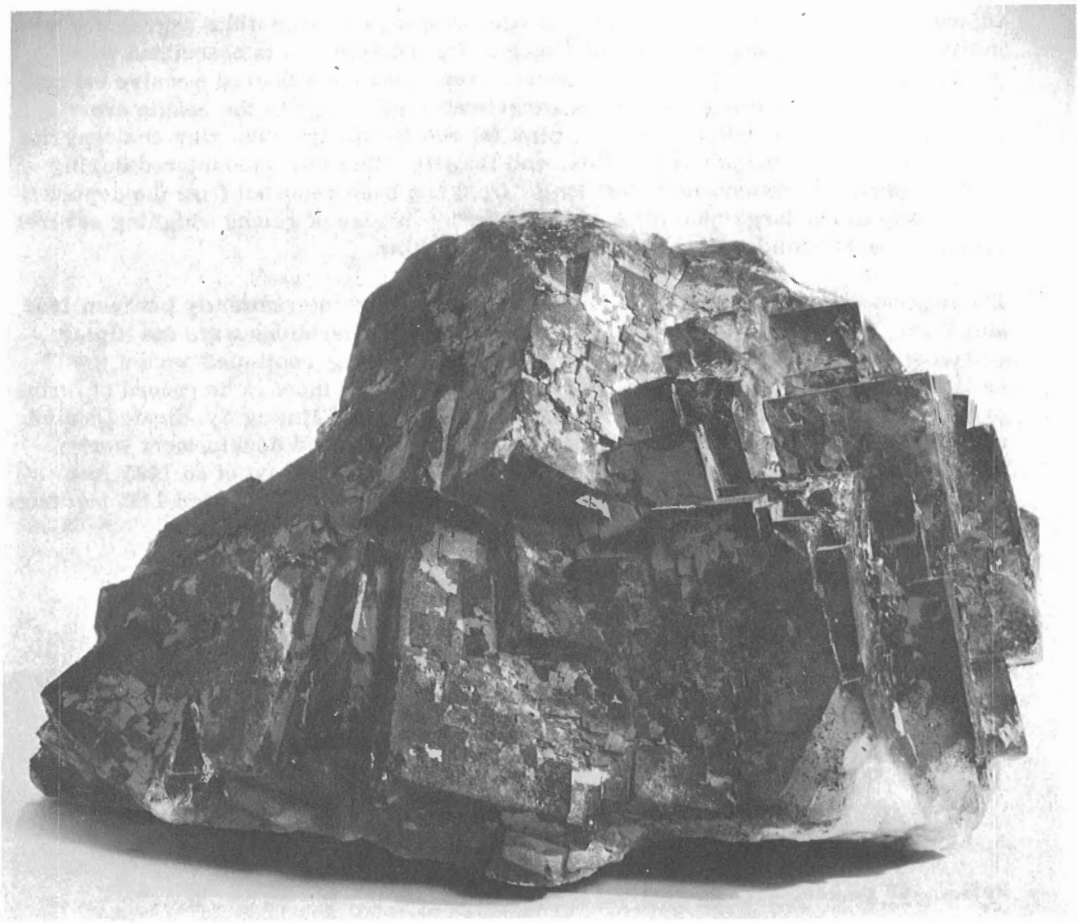


Plate XXIII. Fluorite crystals from St. Lawrence fluorite mines. Specimen measures 7 inches long. (GSC 202820-F)

From an elevation of 250 feet above sea level, the view to the east is of Trinity Bay with the village of Sunnyside in the foreground and to the west is Placentia Bay. The narrow strip of land — less than three miles wide — separating these bays is the isthmus of Avalon. It joins Avalon Peninsula to the main part of the Island of Newfoundland.

95.9 Centre Hill, in distance on right, is the highest point in the area. Its conical peak rises abruptly from a plateau averaging 400 feet above sea level to an elevation of 1133 feet. It is underlain by resistant Precambrian volcanic rocks. The rounded hills beyond the Come By Chance River on the west side of the highway are composed of Devonian gabbro and diorite. Their highest peak is Powder Horn Hill (elevation 1045 feet), due west of the Trans-Canada Highway at Mile 97.4.

99.6 Junction, Burin Peninsula Road (Highway 210).

St. Lawrence Fluorite Mines

FLUORITE, BARITE, CALCITE, QUARTZ CRYSTALS, PYRITE, GALENA, SPHALERITE, CHALCOPYRITE, CHALCOCITE, HEMATITE, PYROLUSITE, URANINITE, LIMONITE, MALACHITE, CHRYSOCOLLA, AZURITE

In veins in granite

The St. Lawrence district is the sole producer of fluorite in Canada. The fluorite occurs as finely granular to coarsely crystalline masses. Aggregates of crystals occur in vugs but are uncommon; the individual crystals measure about 2 inches along the edge. The cube is the most common form but the octahedron is also present. The crystals are commonly coated with a reddish brown mixture of goethite and clay. During earlier mining operations, crystals measuring 12 and 18 inches in diameter were encountered. Banded and nodular varieties are included in the ore. The former consists of alternating bands of different colours, textures and translucency, the latter of bands of variously coloured and textured fluorite or of fluorite and calcite around a nucleus of fluorite or of cemented fragments of granite. The fluorite (all varieties) ranges from colourless to white, yellow, grey, green, blue, pink, and violet. Under ultraviolet light, the green fluorite and the blue fluorite fluoresce in a bluish white colour and the yellow fluoresces pink. Associated with the fluorite in the vugs are crystals of calcite and quartz. Massive white to pink calcite fluoresces bright pink under "short" ultraviolet rays. Barite occurs as dense pink platy aggregates. Minerals present in minor amounts include: galena, pyrite, brownish red sphalerite, chalcopyrite, chalcocite, hematite, pyrolusite, uraninite, and limonite; the secondary copper minerals — malachite, chrysocolla and azurite — occupy pockets in the fluorite. An unusual occurrence is that of "blastonite" — a fine grained rock consisting of fragments of fluorite cemented by white silica. A dense, finely granular, chalk-white quartz resembling unglazed pottery fills spaces between fluorite crystals and occurs as a botryoidal crust on crystalline masses of fluorite.

About forty fluorite-bearing veins have been outlined in an area of 20 square miles in the St. Lawrence district. They generally occur as fissure-fillings in pink quartz-feldspar granite. The higher grade veins are less than five feet wide but the lower grade ones measure up to 35 feet wide; a vein formerly mined had a maximum width of 90 feet. Their length varies from a few hundred feet to 7000 feet. Mining is conducted by underground methods to a maximum depth of 900 feet (Iron Springs Mine). Although the occurrence of fluorite in the southern part of the Burin Peninsula was known as early as 1839, mining did not begin until 1932 when St. Lawrence Corporation of Newfoundland Limited commenced development of the Black Duck Mine. Production began in 1933 with the first shipment of fluorspar to Dominion Steel and Coal Corporation Limited at Sydney, Nova Scotia. Within a few years operations by the same company began at other mines including the Iron Springs, the Blue Beach, and the Lord and Lady mines. Mining operation by the St. Lawrence Corporation of Newfoundland terminated in 1957. The other operator in the district, Newfoundland Fluorspar Limited, undertook development of its Director Mine in 1940; this mine later became the world's largest single producer of fluorspar. It is currently (1975) in operation and has the longest history of continuous operation in the district. In 1968 the Tarefare Mine was brought into production by Newfoundland Fluorspar Works, Aluminum Company of Canada, currently the sole operator in the district. Production is also obtained from the Blue Beach Mine. The concentrates are shipped to the Alcan aluminum smelter in Arvida, Quebec.

Tours of the surface operations are conducted for visitors; arrangements should be made by contacting the company prior to the proposed visit.

Road log from Trans-Canada Highway at Mile 99.6:

Mile 0 Proceed onto the Burin Peninsula Road (Highway 210).

The Burin Peninsula is a narrow boot-shaped upland, about 20 miles wide, projecting into the Atlantic Ocean between Fortune Bay and Placentia Bay. Its subdued, gently undulating surface with an average elevation of 400-500 feet is pitted with hundreds of small ponds, grooved by wide-bottomed river valleys, and broken by broad, rounded monadnock hills having a relief of only a few hundred feet. It is underlain by folded Precambrian volcanic and sedimentary rocks that were intruded by Devonian (or older) granitic rocks and that are overlain in a few localities by erosional remnants of sedimentary rocks deposited in Cambrian time. Glacial drift mantles the bedrock. The peninsula is sparsely vegetated with extensive treeless areas and abundant glacier-grooved and -polished rock outcrops.

1.3 Road-cut exposes dark grey volcanic rock containing veins, lenses and bands of epidote. Similar rock is exposed by road-cuts at intervals to Mile 8.8.

7.9 Junction road to North Harbour.

9.7 Pink granite is exposed by intermittent road-cuts from here to just beyond the bridge over Pipers Hole River (Mile 18.7). There are small patches and thin veinlets of epidote in the granite. This rock represents the exposed part of a batholithic granite mass — Northern Bight granite — measuring over 30 miles long with a maximum width of nearly 10 miles. It extends southwestward from Clarenville beyond Pipers Hole River which cuts a broad valley across it.

14.8 Swift Current village. The highway follows the north shore of Swift Current, an arm of Placentia Bay; the shore is walled by steep-sided ridges of pink granite. On the south side of the arm, granite forms barren hills that reach elevations of over 1200 feet, among the highest in the Burin Peninsula. Tobys Lookout, an 1185-foot monadnock hill, is one of these hills.

18.7 Bridge over Pipers Hole River.

19.1 From this point to Marystown, the road passes over an area underlain by grey epidotized volcanic rocks interspersed with a few intervals of granite that also contains epidote.

33.7 Numerous boulders of granite can be seen perched on granite bedrock along the roadside — they were transported and left there by southward-moving glaciers in Pleistocene time.

41.2 Junction road to Grand LePierre.

Mile 69.4 Junction road to Rushoon. From this junction to Marystown, road-cuts expose dark grey and red epidotized volcanic rocks. In some exposures the epidote zones are several feet thick; these zones vary from a light greyish green to olive green colour. The epidote rock comprising these bands is composed of epidote, quartz and chlorite. It takes a good polish and the result is an attractive ornamental stone.

70.0 Bridge over Rushoon River.

70.7, 70.9 Silicified rhyolite is exposed by road-cuts on the left side of the road. The rock is light coloured with tints of green, yellow, pink, rust and light brown predominating. It is commonly banded and mottled and is suitable for use as an ornamental stone.

78.4 Junction road to Red Harbour.

82.9 The volcanic rock exposed by this road-cut contains conspicuous bands composed essentially of green epidote and orange-red feldspar.

90.0 Turn-off to Marystown.

90.2 Quarry on right. Lustrous black hematite occurs as a coating on a dark green chloritic rock.

91.1 Junction, turn left.

97.3 Junction, turn right.

105.4 Road-cut on right exposes dark purple volcanic rock containing lenses of white feldspar and quartz with patches of yellowish green finely crystalline epidote.

115.5 Road-cuts expose red granite. Fractures in the granite are filled with massive and crystalline fluorite including colourless, yellow, light blue and violet varieties. The cubes average about $\frac{1}{4}$ inch in diameter.

115.8 Turn-off (left) to St. Lawrence; continue straight ahead.

116.05 Junction; turn left.

116.8 Junction; turn right.

118.1 Newfoundland Fluorspar Works mine office.

Refs.: 21 p. 51-65; 40 p. 31; 70 p. 295-300; 140 p. 1-2; 149 p. 1, 4-7, 23-33; 162 p. 90-120; 163 p. 90-97; 178 p. 26

Maps (T): 1 L/14 St. Lawrence
(G): 23 St. Lawrence sheet, Burin district (Nfld. Dep. Mines Energy, 1 inch to 1 mile)
1231A Island of Newfoundland (G.S.C., 1:1 000 000)

Mile 99.6 Junction Burin Peninsula Road.

105.2 Junction road to Queen's Cove.

Between this junction and the junction of the road to Hillview, there are numerous road-cuts exposing Precambrian sedimentary rocks and volcanic and intrusive rocks commonly coated with epidote.

106.1 Turn-off to North West Brook.

Southwest Arm, Trinity Bay (on right) is typical of the numerous long slender inlets penetrating deeply inland from Trinity, Bonavista, Notre Dame and White bays and accounting for the jagged and intricate northeastern seacoast of Newfoundland. Their steep walls rise abruptly 200 to 300 feet above the sea. Their rugged headlands are rocky and barren of vegetation. These long arms of the sea are former river valleys that existed sometime in the past when the level of the sea was much lower. In more recent times, the sea invaded the land submerging these valley systems. The islands in the bays and inlets are the summits of ancient hills whose lower slopes have been drowned by the sea. Glacial action has rounded the topography leaving accumulations of boulders in the inlets and in the streams emptying into them. These features are visible from the Trans-Canada Highway and from other routes along the seacoast.

107.5 Junction, road to Hillview.

The ridge on the west side of the highway between this junction and the junction of the road to Adeytown is the eastern extension of the height-of-land that extends westward into the interior. This height-of-land is a drainage divide separating the streams and rivers flowing to the northern and northeastern coast from those emptying into the south coast. Near the highway its elevation is 600 feet above sea level but farther west its peaks reach elevations of 1000 to 1200 feet above sea level.

Mile 109.7 Junction, road to Adeytown.

111.7 Quarry (abandoned) on left. Epidotized volcanic rock containing lenses and bands of chert occurs in the quarry.

114.5 Viewpoint on right overlooks Random Island and Northwest Arm of Trinity Bay. The road-cut opposite the viewpoint exposes red granite, the northern tip of the Northern Bight batholith which extends into the Burin Peninsula.

116.2 Turn-off to Clarenville.

From here to Port Blandford, the highway cuts through an area of rounded hills, their broad summits reaching elevations of up to 1000 feet above sea level. The region is underlain predominantly by Precambrian sedimentary rocks.

Mile 130.9 Grey and dark red volcanic rocks containing epidote-quartz bands measuring up to 3 feet wide are exposed by road-cuts. Some of the epidote-quartz rock is an attractive green colour and is suitable for use as an ornamental rock.

136.2 Junction, road to Port Blandford.

141.5 Entrance to Terra Nova National Park.

Terra Nova National Park

The park comprises approximately 150 square miles of a gently rolling upland liberally dotted with lakes and ponds, carved by broad valleys, and marked by extensive boggy areas. The highest hill, with an elevation of 709 feet above sea level and relief of about 300 feet, is near the southwestern boundary. The sharply indented coastal area of the park extends into Bonavista Bay to encompass several rugged islands including Swale Island, the largest within the park. Mount Stamford, on the south shore of Newman Sound, is a conspicuous landmark rising abruptly from the water level to an elevation of 600 feet. The park is underlain by a variety of Precambrian sedimentary and volcanic rocks.

Maps (T): 2 C Bonavista; 2 D Gander
(G): 1129A Terra Nova (Gander Lake, east half), Newfoundland (G.S.C., 1 inch to 4 miles)
1130A Bonavista, Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 151.2 Intermittent road-cuts for the next 3 miles expose sheared, highly fragmented greenish grey sericite and chlorite schist cut by veinlets of massive quartz and calcite. Some grey volcanic rocks are also exposed. These rocks are of Precambrian age and are the oldest and most deformed rocks that occur within the park.

151.6 Junction road to Charlottetown.

155.9 Turn-off to Ochre Hill Lookout Tower which provides a panoramic view of Terra Nova National Park. The Lookout (a fire tower) is situated on Ochre Hill (elevation 750 feet above sea level), the highest point on a ridge known as the Bread Cove Hills that lies to the east of the highway and terminates with Mount Stamford on the south shore of Newman Sound. Precambrian conglomerates consisting of pebbles and boulders of volcanic rocks in a sandy matrix outcrop at the tower.

156.3 Junction road to Terra Nova.

162.7 Turn-off to Blue Hill Lookout tower.

The Lookout is situated on Blue Hill at an elevation of 750 feet above sea level. It provides a panoramic view of the coastal area of the park and of the many islands, channels and headlands in Bonavista Bay.

Mile 167.5 Northwest entrance to Terra Nova National Park.

183.5 Junction, Highway 320. This road provides access to the Wesleyville beryl occurrences, and to amethyst occurrences.

Wesleyville Beryl, Chrysoberyl Occurrences

BERYL, CHRYSOBERYL, TOURMALINE, FLUORITE, APATITE, GARNET, TITANITE, EPIDOTE, AMPHIBOLE, CHLORITE

In pegmatite and granite

Light green and greenish yellow beryl crystals measuring up to 5/8 inch in diameter and 2 to 3 inches long occur in a white pegmatite composed of feldspar, smoky quartz and muscovite. The crystals are opaque. Light yellow to greenish yellow chrysoberyl occurs sparingly in the rock. Other minerals associated with the beryl include: black tourmaline prisms, grains of purple fluorite and of light blue vitreous apatite, pink to peach-coloured garnet crystals, reddish brown titanite, yellowish green epidote, dark green chlorite, and amphibole (as black prisms and as light greenish blue radiating fibres).

The beryl-bearing granitic rocks are a part of a large batholithic mass, the Ackley batholith, emplaced in Devonian time that comprises an area measuring about 130 miles long from the south coast at Fortune Bay to the northeast coast north of Bonavista Bay, with a width varying from 3 to 40 miles. Beryl and the accessory minerals occur in outcrops along the Wesleyville Road (Highway 40) and in a road-side quarry.

Road log from the Trans-Canada Highway at mile 183.5:

Mile 0 Proceed onto Highway 320.

1.8 White granite is exposed by road-cuts at intervals for several miles. Porphyritic granite was noted at Mile 6.1.

2.0 Freshwater Bay on right. Boulders and cobbles of a variety of glacier-transported rocks line the bottom and sides of the bay. Thick deposits of glacial sand and gravel occur on the west side of the road between Dark Cove and Middle Brook.

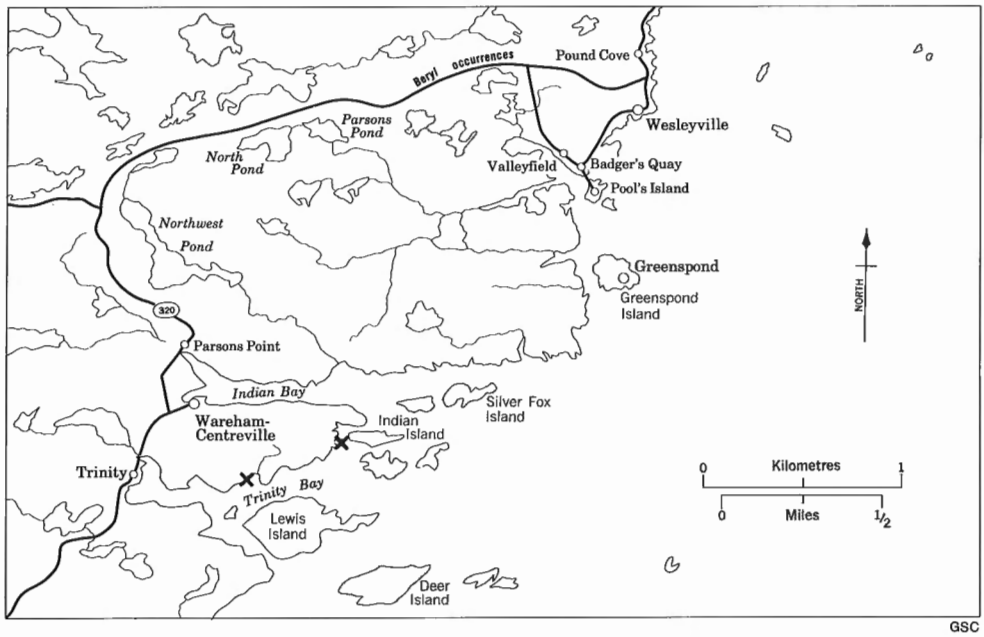
4.7 Turn-off to David Smallwood Memorial Provincial Park.

11.0 Bridge over Traverse Brook.

11.4 to 11.7 Road-cuts expose white pegmatitic granite containing zones of a greenish yellow clay mineral in quartz. Small grains of pink garnet and pyrite occur with black tourmaline in these zones.

27.8 Trinity, at wharf.

30.4 Centreville, at turn-off to Wareham.



Beryl occurrences. ×, Amethyst occurrences.

Map 8. Trinity-Wesleyville area.

Mile 32.4 Bridge over Indian Brook.

51.0 Outcrops of white granite are visible for several miles along and beyond both sides of the road.

51.4 The beryl-bearing granitic rock outcrops on both sides of the road in this area and in outcrops for the next 2 miles.

54.9 Junction road to Badger Quay; the road log continues to Wesleyville.

59.2 Junction; road on right leads to Wesleyville.

60.3 Wesleyville.

Ref.: 75 p. 90

Maps (T): 2 F/4 Wesleyville
(G): 1227A Wesleyville, Newfoundland (G.S.C., 1 inch to 4 miles)

Amethyst Occurrences

AMETHYST

In granite

Crystals of amethyst measuring about 2 inches in diameter occur in cavities and along fractures in white granitic rocks exposed along the north shore of Bonavista Bay in the Trinity area. The crystals are transparent and range in colour from light to medium-deep violet. They are used locally for jewellery and ornamental purposes. The amethyst occurs at a number of localities including the shoreline exposures at Diamond Head and Man Rock Cove (at low tide only) on the north shore of Trinity Bay (3½ miles and 6½ miles respectively from Trinity), and at Silver Fox Island. Colourless and amethystine quartz crystals are also found in granite boulders strewn in the fields southeast of Centreville.

Refs.: 47 p. 267; 96 p. 3-4

Maps (T): 2 C/13 St. Brendan's; 2 F/4 Wesleyville
(G): 1227A Wesleyville, Newfoundland (G.S.C., 1 inch to 4 miles)
1130A Bonavista, Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 184.6 Viewpoint on right and view of Freshwater Bay.

The gravel deposit exposed at the side of the hill opposite the viewpoint is part of a glacial sand and gravel deposit that extends from the east end of Gander Lake to Freshwater Bay. It was left by glacial meltwaters that flowed along this route into the Atlantic Ocean. The countless boulders strewn in the bed of Freshwater Bay were transported by glaciers from several miles inland and represent the various types of rocks of which the Island of Newfoundland is composed.

Mile 189.5 Road-cuts expose pink granitic rocks and chlorite schist. Black tourmaline occurs in the granite, and patches of light green massive talc are found in the schist. Veins of an attractive quartz-epidote-chlorite rock cut the chloritic rock.

189.9 Turn-off to Square Pond Provincial Park.

193.4 Pink granite is exposed by a road-cut on right. The granite is part of the Ackley batholith that extends from Fortune Bay to north of Bonavista Bay. The rock is composed of pink orthoclase feldspar with smaller proportions of plagioclase feldspar, quartz and biotite. The granite was quarried in the 1890's for use in building the railway bridge. This quarry is on the south side of the railway, about 1½ miles east of the Trans-Canada Highway (Ref.: 75 p. 144).

195.0 East end of Gander Lake. At about this point the Trans-Canada Highway completes its 195-mile course through the Atlantic Uplands of Newfoundland and enters the Newfoundland Central Lowland, a physiographic region that extends westward to include Red Indian Lake from which it extends north to Baie Verte and includes the northeastern tip of the Great Northern Peninsula. The route of the Trans-Canada Highway is within this region to about the junction of Highway 72 (Mile 340.8). It is a gently rolling lowland varying from sea level to an elevation of about 500 feet, with some prominent hills reaching elevations of almost 1900 feet above sea level. Its coastal area from Rocky Bay in Hamilton Sound to Baie Verte encompasses hundreds of islands and the most intricate shoreline in the northern part of the island. Inland, it is surrounded by the Atlantic Uplands to the south and east, and by the Newfoundland Highlands to the west. It is underlain mainly by Paleozoic rocks mantled by glacial drift.

196.3 Road-cuts expose granite at its contact with partly metamorphosed sedimentary rocks (greywacke and sandstone). Andalusite porphyroblasts are reported to occur in the metamorphosed rocks (Ref.: 75 p. 81).

196.9 View of Gander Lake, the third largest lake on the Island of Newfoundland after Grand Lake and Red Indian Lake. Gander Lake is 35 miles long, 1 to 2 miles wide with a maximum depth of 900 feet. It is bounded on the south by a series of flat-topped massive hills that drop steeply to the water from elevations of up to 700 feet, and on the north by cliff-like banks rising to a relatively flat lowland. The Trans-Canada Highway parallels the north shore and is about 300 feet above the water's level. Gander Lake is an important segment of the Gander River drainage system, the largest in the eastern part of the Island, draining an area of about 2500 square miles. The water level of the lake fluctuates 6 to 8 feet between the spring run-off and the dry season: the lake acts as a reservoir withholding large volumes of early spring waters, thus preventing widespread flooding of the lower Gander River. The waters of the drainage basin reach the Atlantic Ocean via the Gander River and Gander Bay in Hamilton Sound. It is believed that during or even before the Ice Age, Gander Lake emptied into Bonavista Bay via a valley to Freshwater Bay (Ref.: 75 p. 8-9).

Plate XXIV. Moreton's Harbour antimony mine on shore of Frost Cove. (GSC 202751)

Mile 207.5 Junction road to Gander airport. Road-cuts extending several miles east and west of this junction expose Ordovician slate containing pyrite crystals and pods and veinlets of quartz. The rock was quarried about 17 years ago for use in road-building of the Trans-Canada Highway and for maintenance of the airport facilities (Ref.: 75 p. 139-140).

210.0 Junction Highway 330. This road provides access to the Gander Bay scheelite occurrence, Moreton's Harbour antimony mine, Stewart Mine, Cobbs Arm quarry and to the New World Island jasper occurrences.

Gander Bay Scheelite Occurrence

SCHEELITE, TUNGSTITE

In quartz vein cutting quartzite, slate and granodiorite

Patches of massive yellowish white scheelite occur in colourless, white to grey massive quartz. Tungstite occurs as an alteration of the scheelite.

The scheelite-bearing vein is exposed along the shore of Charles Cove on the west side of Gander Bay, and it extends in a northerly direction for more than $\frac{3}{4}$ of a mile inland. It was discovered in 1952 by T. O. H. Patrick of the Geological Survey of Canada and has since been explored by trenches.

To reach the occurrence, proceed along the Rodgers Cove Road for 1.3 miles from Highway 331 (see road log to Moreton's Harbour antimony mine). The road ends at this point. Walk along the beach at low tide for about 1 mile to Charles Cove which is on the west side of the first prominent headland.

Ref.: 87 p. 201-202

Maps (T): 2 E/7 Comfort Cove; 2 E/8 Carmanville
(G): 60-1963 Botwood, Newfoundland (G. S. C., 1 inch to 4 miles)

Moreton's Harbour Antimony Mine

STIBNITE, ARSENOPYRITE, PYRITE, GALENA, SPHALERITE, CHALCOPYRITE, VALENTINITE, STIBICONITE, GOETHITE, KERMESITE, CERVANTITE

In veins at or near the contact of rhyolite and andesitic lava

Stibnite occurs as dark grey metallic bladed aggregates in quartz-calcite veins. Associated with it are arsenopyrite and pyrite with smaller amounts of galena, sphalerite and chalcopyrite. Secondary minerals include: valentinite, as white flat acicular crystals in small cavities; stibiconite, as yellow powdery coatings on stibnite and on quartz; goethite, as rusty-brown coatings on quartz and on the host rocks. Kermesite and cervantite have been reported from the deposit. The ore carries values in gold and silver.

The deposit was worked for antimony intermittently between 1889 and 1916. In 1890, ore valued at $1200 was shipped, and in 1906 a shipment of 81 tons of hand-sorted ore was made. The mine was re-opened in the early part of World War I after which it remained idle. Recent examination of the deposit was made by Newmont Mining Corporation Limited in 1953 and by Newfoundland and Labrador Corporation Limited in 1965.

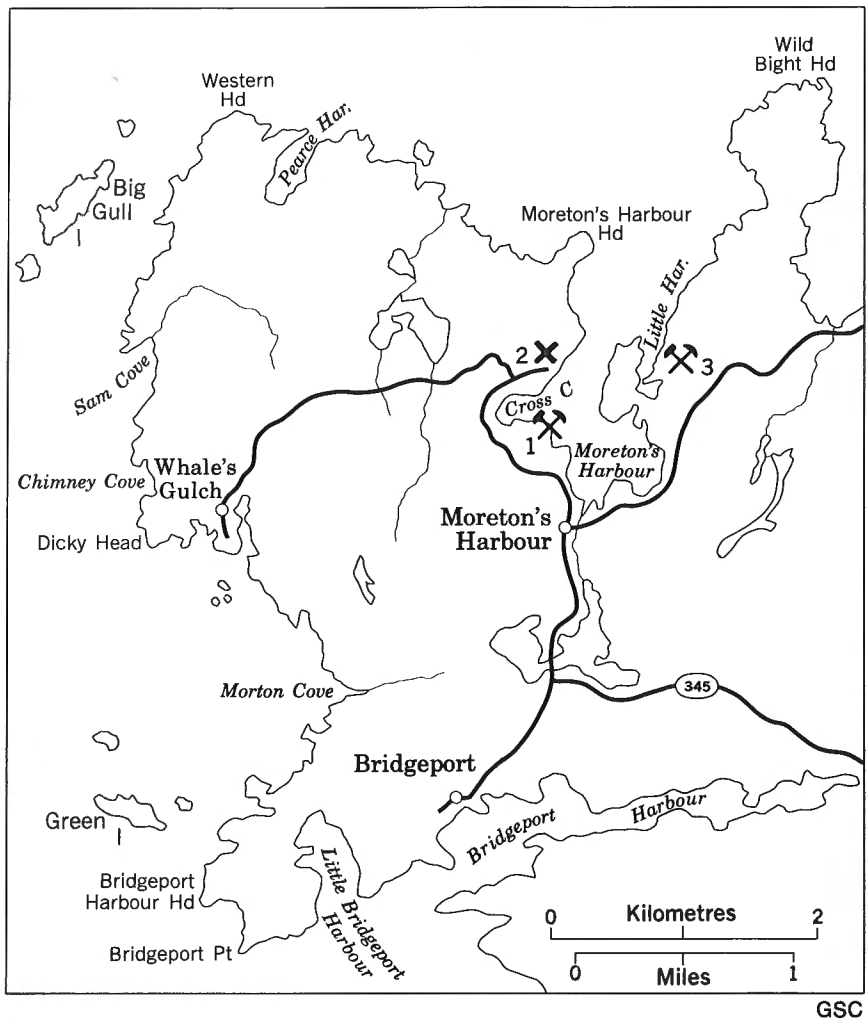
The mine is on the steep side of a hill at the south shore of Frost (Cross) Cove on the west side of Moreton's Harbour, New World Island in Notre Dame Bay. It consists of a 230-foot adit 10 feet above tidewater with a shaft to the surface at its inner end, and a shorter adit at a level of 55 feet. The rock dumps along the slope are partly overgrown.

Auriferous quartz veins containing arsenopyrite, sphalerite, chalcopyrite, pyrrhotite and pyrite in andesite have been exposed by prospect pits on the northwest side of Moreton's Harbour. The locality is known as Taylors Room. It is 400 feet from the shore and about 800 feet north of Frost Cove.

Access to both localities is by boat from the settlements of Frost Cove or Moreton's Harbour.

Road log from the Trans-Canada Highway at Mile 208.2:

Mile	0	Proceed onto Highway 330.
	9.7	Turn-off to Jonathan Pond Provincial Park. Road-cuts along the highway expose Ordovician argillite.
	17.0	Ultrabasic rocks containing serpentine are exposed along the Highway.
	25.6	South Gander at junction, Highway 331; turn left onto Highway 331.
	32.2	Junction, Rodgers Road leading to the Gander Bay scheelite occurrence. Continue along highway.
	42.8	Junction; turn right onto Highway 340.
	44.2	Boyd's Cove on the east shore of Notre Dame Bay. From this settlement the road passes over causeways and bridges in Notre Dame Bay linking several islands in its scenic course. As the road follows the shores of these islands, hundreds of smaller islands, remarkable for their even skyline and steep shorelines, come into view. The islands are composed of a variety of Paleozoic sedimentary, volcanic and granitic rocks.
	45.0	Causeway over The Reach, a channel separating Chapel Island from the main island.
	45.3	Chapel Island. This island is 7 miles long with a maximum width of $4\frac{1}{2}$ miles. The road traverses its northern end.
	49.6	Dildo Run, separating Chapel Island from New World Island. Its many islands are low lying with a noticeably subdued topography.
	50.9	Southern tip of New World Island.
	54.5	Junction at Virgin Arm village. To reach Moreton's Harbour, turn left onto Highway 345. (Highway 340 leads to Cobbs Arm quarry and to the New World Island jasper occurrences.)
	58.5	The hill to the left has an elevation of 398 feet above sea level, the highest elevation on New World Island.
	60.3	Junction; turn right.
	61.1	Junction at Moreton's Harbour. To reach Cross Cove village, turn left.



1. Moreton's Harbour antimony mine. 2. Taylors Room gold occurrence.

3. Stewart (Little Harbour) Mine.

Map 9. Moreton's Harbour area.

Mile 62.1 Cross Cove, at wharf. Moreton's Harbour antimony mine is about 400 yards by boat from the wharf.

Refs.: 63 p. 39-44, 49-50; 135 p. 68-69

Maps (T): 2 E/10 Twillingate
(G): 33-1963 Twillingate, Newfoundland (G.S.C., 1 inch to 1 mile)

Stewart (Little Harbour) Mine

ARSENOPYRITE, PYRITE, SPHALERITE, CHALCOPYRITE, STIBNITE, SCORODITE, REALGAR

In quartz-calcite vein in brecciated zone near margin of diabase dyke cutting volcanic rocks

Arsenopyrite, as crystals and in massive form, is the principal metallic mineral in the vein. Quartz crystals are associated with arsenopyrite crystals in massive calcite. Pyrite, sphalerite, chalcopyrite, and small amounts of stibnite are associated with the arsenopyrite. The secondary arsenic minerals — scorodite and realgar — occur in pockets in calcite. In addition to arsenic, the ore contains gold and silver values.

The mine was operated in the 1890's and a shipment of 125 tons of arsenopyrite was made in 1897. By 1900 a shaft was sunk to a depth of 110 feet but operations were discontinued a short time later. A trench 6 feet deep and about 100 feet long exposes the vein.

The mine is located in a clearing on the east side of the opening of Little Harbour, a small inlet on the east side of Moreton's Harbour. Access is by boat from Moreton's Harbour village or from Cross Cove, each being about a mile from the mine.

Refs.: 63 p. 46-49; 135 p. 69

Maps (T): 2 E/10 Twillingate
(G): 33-1963 Twillingate, Newfoundland (G.S.C., 1 inch to 1 mile)

Cobbs Arm Quarry

CALCITE, PYRITE

In crystalline limestone

Colourless, white and pink coarsely cleavable calcite occurs in veins in the limestone. Some of the calcite is transparent and of the Iceland spar variety. The white calcite fluoresces deep pink when exposed to "long" ultraviolet rays. Tiny cubes of pyrite occur in the calcite. The limestone is a medium grained, grey, high calcium crystalline limestone of Ordovician age.

The quarry, now inactive, was in operation for about 100 years. From 1912 until production ceased in 1967, the principal operator was the Newfoundland Lime Manufacturing Company Limited. The limestone was shipped from the nearby dock to St. John's where it was burned for agricultural purposes, to Grand Falls for use in the pulp and paper mill, and to Buchans for use in the mine's flotation mill. The quarry was opened into the north side of a limestone ridge paralleling the south shore of Cobbs Arm.

Road log from Trans-Canada Highway at Mile 208.2:

Mile 0 Proceed onto Highway 330 and follow the road log toward the Moreton's Harbour antimony mine (page 98).

54.5 Junction at Virgin Arm; turn right onto Highway 340. Beyond this junction, the waters of Virgin Arm and Dildo Run almost meet to divide New World Island in two: at about Mile 55.1 the strip of land joining the western and eastern parts of the island is but ½ mile wide. New World Island is characterized by a hummocky, wooded surface with an average relief of about 100 feet. It contains steep hills with elevations of 250 to 350 feet above sea level, except in the south-eastern part adjacent to Dildo Run where the terrain is almost flat, sloping gently to the sea. Here it is underlain by shale and sandstone, but in other parts of the island more resistant volcanic and granitic rocks form the bedrock. The island abounds in lakes, bogs, streams and valleys and is bordered by an extremely jagged shoreline with numerous bays and coves, and deeply recessed arms of the sea that in several places almost separate the peninsulas to form even more small islands in isle-studded Notre Dame Bay. Much of its shoreline is marked by steep sea-cliffs that plunge into deep coastal waters.

55.4 Turn-off to Dildo Run Provincial Park.

58.0 Road-cut on left exposes altered lava cut by veins of white quartz banded with green epidote. The quartz-epidote rock is an attractive ornamental rock. The veins are about 6 inches wide.

62.5 Junction. The road straight ahead (Highway 340) leads to Twillingate Island, the one on right (Highway 346) to Cobbs Arm; turn right.

67.3 Cobbs Arm; turn right toward ferry-landing.

67.5 Junction; turn right.

67.6 East end of Cobbs Arm quarry. It extends westward for nearly ½ mile.

Refs.: 21 p. 91-92; 53 p. 2, 30-31; 135 p. 27-28

Maps (T): 2 E/10 Twillingate
(G): 33-1963 Twillingate, Newfoundland (G.S.C., 1 inch to 1 mile)
1 Geology Cobbs Arm area, New World Island, Newfoundland (Nfld. Dep. Mines Energy, 1 inch to 400 feet)

New World Island Jasper Occurrences

JASPER, CALCITE

In conglomerate

Jasper pebbles and cobbles measuring up to several inches in diameter occur with pebbles of volcanic rocks and quartzite in red conglomerate; the colour of the rock is due to a hematite-rich matrix. The jasper pebbles are red to brown, black and dark green. Some are banded. There are also some pebbles of green quartz, the colour due to an admixture with epidote. These pebbles and the jasper pebbles are suitable for cutting and polishing. Veins of white massive calcite cut the conglomerate; the calcite fluoresces bright pink under ultraviolet rays.

The jasper conglomerate is exposed at several localities in the northeastern end of New World Island where it underlies a narrow area extending about 4 miles southwestward from Herring Head, along the south side of Goshen (Goldston) Arm to Indian Cove. The most accessible localities are: a road-cut on the Twillingate Road (Highway 340) opposite its junction with the road to Herring Neck which in turn is 0.7 mile north of the junction of the Cobbs Arm Road (mile 62.5 of road log to the Cobbs Arm Quarry); a quarry behind this road-cut (its entrance is at the north end of the road-cut); a road-cut on the Herring Neck Road at a point 0.1 mile from its junction with the Twillingate Road; along the shore at Herring Neck (near Pikes Arm village).

Refs.: 7 p. 11-12; 82 p. 3-7

Maps (T): 2 E/10 Twillingate
(G): 33-1963 Twillingate, Newfoundland (G.S.C., 1 inch to 1 mile)

The road log along the Trans-Canada Highway is resumed.

Mile 210.0 Junction Highway 330.

219.6 Turn-off to Glenwood Provincial Park.
Opposite the entrance to the park, Ordovician slate is exposed in a road-cut. Pyrite cubes averaging ½ inch along the edge occur in the slate. Quartz veins containing chlorite cut the rock. Similar rock was at one time quarried for use as railway ballast; the abandoned quarry is on the east bank of the Gander River about 1½ miles south of the bridge over the Gander River. Graptolites are reported to occur in the rock at the south end of the quarry (Ref.: 75 p. 140).

222.6 Bridge over Gander River.

236.8 Turn-off to Notre Dame Provincial Park.

237.5 Junction Highway 340, the Road to the Isles, leading north to Lewisport, then along the southeastern shore of Notre Dame Bay. At Boyd's Cove (17 miles from this junction) it meets Highway 34 leading to occurrences in New World Island.

Mile 245.5 Road-cut on left exposes diorite cut by white quartz-feldspar veins measuring up to 8 inches wide. Colourless to smoky quartz and white, greenish white and pink feldspar are the main constituents of the veins; dark green chlorite, colourless to white calcite (fluoresces pink when exposed to ultraviolet rays), and tan coloured clinozoisite (as sugary and microscopic bladed aggregates) occur in the quartz-feldspar rock.

249.0 Bridge over Rattling Brook.

255.3 Junction Highway 360 to Bay d'Espoir and the South Shore.

The Bay d'Espoir Road

The highway leading to Bay d'Espoir and to the north shore of Fortune Bay is the only road that traverses the central inland part of Newfoundland and links the Trans-Canada Highway and the north shore to the isolated south shore. The Bay d'Espoir Road begins its course at an elevation of 200 to 300 feet above sea level rising gradually to an elevation of 500 feet at Miguels Lake then to a maximum of 850 feet at about Mile 53 (22 miles south of the bridge over the Northwest Gander River). At this point, it crosses the height of land that extends eastward to Trinity Bay, then it begins a gradual descent to near sea level at Bay d'Espoir. The region of higher elevations is characterized by an interlacing network of ponds and streams, numerous bogs, island-dotted lakes, and barren, treeless areas. Along its southward course, the highway successively parallels Great Rattling Brook (Mile 5 to Mile 17, measured from the Trans-Canada Highway), Northwest Gander River (Mile 30 to Mile 34, crossing it at Mile 31), Little Gull River (Mile 38 to Mile 46), Conne River (Mile 58 to Mile 66), Twillick Brook (Mile 70 to Mile 74), and Conne River (Mile 74 to Mile 80). Their gently sloping, wooded valleys are bordered by flat-topped hills and ridges with a maximum relief of 300 feet. The hills are underlain by Ordovician sedimentary and volcanic rocks. The highest hills (at Mile 42 and Mile 71) reach an elevation of 900 feet above sea level. At about Mile 14, the highway leaves the Newfoundland Central Lowland physiographic region and enters, for the duration of its course, the Atlantic Uplands of Newfoundland. The latter comprises the entire southeastern part of the Island from Cape Freels, north of Bonavista Bay to Channel-Port aux Basques.

Thirty-mile-long Bay d'Espoir is the most deeply penetrating fiord dissecting the rugged southern seacoast. Branching from it are steep-walled fiords, long narrow bays and sheltered coves. Outcropping along the rocky shoreline are Paleozoic sedimentary, metamorphic and granitic rocks that form the walls of the bay and underlie the adjacent areas. The almost vertical cliffs that comprise the walls of North Bay and much of East Bay are composed of granitic rocks. The most spectacular cliff is the breathtaking 1000-foot overhanging cliff at the Devil's Dancing Table near Doting Cove in North Bay about 2 miles from its mouth. The less resistant sedimentary rocks comprising much of the shoreline have been eroded by the sea forming caves and arches, chasms and stacks.

The water of Bay d'Espoir is commonly 100 to 200 fathoms deep with a depth of 390 fathoms (2340 feet) near Goblin Head. The shoreline rises to 800 feet above the sea at its head at Northwest Brook and to over 1100 feet at its mouth at Pushthrough to an almost flat glaciated upland surface. The upland is characterized by innumerable lakes and streams. The inland part of the bay is wooded whereas the higher ground south of St. Alban's is moss-covered and barren of trees. Much of the region underlain by granite is bare.

Plate XXV. Pearson's Peak, a tower at Mile 279 on the Trans-Canada Highway commemorating the official opening of the Newfoundland section of the Trans-Canada Highway by Lester B. Pearson in 1966. The granite used to face the tower was obtained from the Gander area. (GSC 202752)

Ref.: 77 p. 1-6

Maps (T): 1 M Belleoram; 2 D Gander Lake; 2 E Botwood
(G): 1280A Burgeo (east half) Newfoundland (G. S. C., 1 inch to 4 miles)
13 Baie d'Espoir sheet, south coast (Nfld. Dep. Mines Energy, 1 inch to 1 mile)

Mile 256.1 Junction Highway 350 to Bay of Exploits, Notre Dame Bay.

256.8 Junction road to Bishop's Falls. The road-cuts along the Trans-Canada Highway in this vicinity expose red sandstone of Silurian age.

269.5 Grand Falls, at turn-off to Windsor. Grand Falls, on the Exploits River, is a major pulp and paper producing centre.

271.3 Turn-off to Beothuck Provincial Park. The park bears the name of the Red Indian tribe — the Beothucks who were early inhabitants of Newfoundland. They became extinct early in the 19th century.

274.9 Road-cuts, west side of Red Cliff overpass. Pyrite occurs abundantly as finely crystalline aggregates and as "micro" cubes in argillite. Goethite forms a rusty powdery coating on the rock.

275.6 Exploits River on left.

The Trans-Canada Highway parallels the north bank of the Exploits River from Bishop's Falls to Badger. The river flows through a meandering 71-mile course from Red Indian Lake to the Bay of Exploits where it enters Notre Dame Bay. The Exploits drainage basin with an area of 4600 square miles is the largest in Newfoundland. The Exploits River valley has been carved into a gently rolling surface of moderate relief underlain by a variety of Ordovician sedimentary and volcanic rocks. Its bed is characterized by numerous islands, rock outcrops, rapids, and sand and gravel bars. It broadens to a maximum of ¾ of a mile opposite Mile 277.5 on the Trans-Canada Highway. This waterway serves as a source of hydro-electric power, as a water route to the Atlantic, and as a transportation route for timber processed at the Grand Falls pulp and paper mill.

277.1 Bridge over Leech Brook.

277.5 Road-cuts expose pyrite in slate.

279.0 Turn-off to Pearson's Peak, a tower faced with pink granite fieldstone. It is at the mid-point in the Newfoundland section of the Trans-Canada Highway and commemorates its official opening on July 12, 1966 by Lester B. Pearson, then Prime Minister of Canada. The tower is on the east bank of Pynn's Brook at an elevation of 300 feet above sea level and overlooks the Exploits River, at this point less than 100 feet below. The prominent monadnock hill in the distance south of the river and topped by a fire-tower is 802 feet above sea level.

280.9 Turn-off to Aspen Brook Provincial Park.

287.2 Badger, at junction Highway 370.

Buchans Mine

SPHALERITE, GALENA, CHALCOPYRITE, PYRITE, TETRAHEDRITE, TENNANTITE, COVELLITE, HEMATITE, NATIVE SILVER, ARGENTITE, BORNITE, BARITE, CALCITE, QUARTZ, FLUORITE

In volcanic breccia, tuff and conglomerate

The Buchans Mine has been a producer of copper, lead and zinc since 1928. The ore consists of a massive, fine grained aggregate of the sulphides — sphalerite, galena, pyrite and chalcopyrite — with tetrahedrite, tennantite, covellite and hematite. Fractures in the ore contain native silver (including leaf silver), bornite and argentite. The gangue consists of massive white to grey barite with quartz and calcite. Small cubic crystals of pyrite measuring about $\frac{1}{4}$ inch across occur in the ore. Vugs in the gangue are lined with crystals of barite, calcite, or pyrite.

The orebodies occur along an undulating belt nearly 6 miles long. There are two types of orebodies: the Breccia Zone containing high-grade ore in volcanic breccia, conglomerate and dacitic tuff and agglomerate from which all the production has been mined; and the Footwall orebody, a lower-grade ore in which the sulphides are coarser grained and not intimately mixed as they are in the Breccia Zone ore. The average grade of ore obtained from the first four producing mines — the Lucky Strike, Oriental, Old Buchans and Rothermere mines — is 1.45 per cent copper, 7.85 per cent lead, 15.5 per cent zinc, and 0.05 ounce gold and 3.52 ounces of silver per ton.

The deposit was discovered in 1905 by Matty Mitchell, a Micmac Indian, who found one of the three small orebodies in the bed of Buchans River north of Red Indian Lake. The deposit was developed by underground methods by the Anglo-Newfoundland Development Company. Development was discontinued in 1911 due to metallurgical difficulties in processing the fine grained ore. A successful flotation process was later developed by the American Smelting and Refining Company which, in 1926, undertook a program of geophysical prospecting that resulted in the discovery of the high-grade orebodies a short distance to the east and west of the original Buchans River discovery. A concentrator and a townsite were built and production began in 1928. The original producers — the Lucky Strike, Oriental and Old Buchans mines — are now mined out. They were mined by underground methods and by an open pit. Production is currently obtained from the Rothermere Mine that is serviced by a 2513-foot shaft, and from the MacLean Mine, developed by a shaft to a depth of 3523 feet. The name of the producer was changed in 1975 to Asarco Inc.

The mine is located at Buchans, the townsite named in honour of Captain David Buchan of the Royal Navy who, in 1810, was involved in an attempt to establish friendly relations with the Beothuck aborigines. It is connected to the Trans-Canada Highway by a 45-mile road (Highway 370). Since this is an operating mine, visits are restricted; application should be made to the company in advance.

Refs.: 40 p. 23-27; 102 p. 406-413; 135 p. 15-18; 136 p. 349-352; 139 p. 618-626; 178 p. 28

Maps (T): 12 A/15W Buchans
(G): 1196A Red Indian Lake (east half), Newfoundland (G.S.C., 1 inch to 4 miles)

Plate XXVI. Site of Pilley's Island Mine, Pilleys Harbour. (GSC 202753)

Mile 293.2 Turn-off to Catamaran Provincial Park.

293.6 Road-cut, on left, exposes a fine grained grey diabase rock, its surfaces encrusted with aggregates of microscopic crystals of epidote, "micro" crystals of quartz, and tiny crystals of pyrite.

296.5 Road-cuts on both sides of the road expose pink granite cut by epidote-quartz bands measuring up to an inch wide. Small grains of brown titanite and flaky aggregates of chlorite occur in the rock.

307.2 Junction road to Gull Pond.

Gullbridge Mine

CHALCOPYRITE, PYRRHOTITE, PYRITE, GALENA, ILMENITE, SPHALERITE, MAGNETITE, CORDIERITE, ANTHOPHYLLITE, ANDALUSITE, TREMOLITE, ACTINOLITE, GARNET

In sheared volcanic rocks

The Gullbridge Mine is a former copper producer. The orebody consisted of chalcopyrite, pyrrhotite and pyrite with minor amounts of galena, ilmenite, sphalerite (brown), and magnetite. Chalcopyrite was the ore mineral. Gangue minerals included cordierite, andalusite, chlorite, tremolite, actinolite and garnet. This mineral assemblage occurred in a cordierite-andalusite-chlorite zone enclosed in cordierite-anthophyllite rock. Specimens are available from the rock dumps at the mine. The cordierite is found as greyish blue to almost black grains, pods and prisms partly altered to chlorite. It is associated with smoky blue radiating prismatic aggregates of andalusite, with black foliated chlorite, and with greyish fibrous and rosette-like aggregates of anthophyllite.

The deposit was discovered in 1905. Original underground development was done in 1918 by Great Gull Lake Copper Company Limited. Subsequent exploration was conducted intermittently by other companies until the property was acquired in 1950 by Gullbridge Mines Limited which brought it into production in 1967. Operations ceased at the end of 1971. The mine was serviced by a 4-compartment shaft sunk to a depth of 1050 feet and a mill with a capacity of 2000 tons per day. The mine produced a total of 41 664 122 pounds of copper from 2 395 228 tons of ore milled. The ore averaged about 1.1 per cent copper.

The mine is located at Mineral Point on the west side of Gull Lake. There are some small dumps furnishing ore specimens on the property. Access is by a road, 3.2 miles long, leading from the Trans-Canada Highway at Mile 307.2.

Refs.: 33 p. 36-43; 135 p. 46-47; 148 p. 1065-1068; 176 p. 129

Maps (T): 12 H/1E Gull Lake
(G): 54-4 Gull Pond, Newfoundland (G.S.C., 1 inch to 1 mile)

Mile 314.8 Hall Hill on right (elevation 1000 feet above sea level).

320.3 South Brook, at junction Highway 380. The hill on the east side of the junction is 855-foot Rowsell Hill; it is underlain by Ordovician volcanic rocks.

Pilleys Island Mine

PYRITE, CHALCOPYRITE, SPHALERITE, GALENA, SERICITE, CHLORITE, CALCITE, JAROSITE, BARITE

In rhyolite

The Pilleys Island Mine is a former pyrite producer. The ore consisted of massive pyrite intergrown with chalcopyrite, minor sphalerite, and traces of galena. Sericite and chlorite were associated with the sulphide minerals. Some ore specimens may still be found in the vicinity of the mine. The most common are finely disseminated crystals and grains of light yellow metallic pyrite in greyish white quartz. The specimens are generally coated with yellow powdery jarosite. White cleavable massive calcite occurring on the dumps fluoresces pink when exposed to ultraviolet rays. Colourless barite has been reported from the deposit.

The occurrence of this deposit as a pyrite-bearing rock outcrop on the west side of an inlet in Pilleys Island Harbour was known in 1875. Mining began in 1889. The mine was operated from 1891 to 1899 by Pyrites Company Limited which shipped 300 000 tons of ore before terminating operations due to mining difficulties. Between 1901 and 1908, a further shipment of 225 000 tons of ore was obtained by the Pilleys Island Pyrite Company. The ore was mined for its sulphur content. Original mining was by open-cuts into the side of a ridge; later, underground methods were employed.

The mine is at tidewater on the northeast side of Pilleys Island Harbour, south side of Pilleys Island in Notre Dame Bay.

Road log from the Trans-Canada Highway at Mile 320.3:

Mile 0 Proceed onto Highway 380. This highway was being re-routed in 1973 when the road log was compiled; there may be slight differences in the actual mileages from those given below.

1.9, 5.4 Road-cuts expose epidotized volcanic rocks.

5.8, 6.6, 7.1 Road-cuts expose volcanic rocks containing jasper. (The description is given on page 110).

13.0 Crescent Lake on right.

15.3 Crescent Lake Park on right. The sealed shafts and some mine dumps of the old Crescent Lake Mine are located in the park. The mine was worked for copper between 1878 and 1880. The ore consisted of chalcopyrite and pyrite with some pyrrhotite and sphalerite in quartz veins cutting chloritized volcanic rocks.

Mile 16.4 Junction at Rogers Arm; turn right.

16.5 Road-cut exposes epidote in volcanic rock.

16.9, 17.1 Road-cuts expose jasper in volcanic rocks.

20.1 Causeway across Flat Rock Tickle.

22.1 Pilley's Island village at junction road to Spencer's Dock; continue straight ahead.

22.8 Turn-off (left) to mine.

22.9 Pilleys Island Mine.

Refs.: 21 p. 144-146; 36 p. 31-41; 112 p. 173-174, 177-178; 135 p. 44-45, 117-118

Maps (T): 2 E/12 Little Bay Island
(G): 19-1962 Botwood (west half) Newfoundland (G.S.C., 1 inch to 4 miles)
3 A Pilleys Island mine area (Nfld. Dep. Mines Energy, 1 inch to 1000 feet)

Highway 380 Jasper Occurrences

JASPER, EPIDOTE

In volcanic rocks

Jasper occurs as veins and lenses in Ordovician volcanic rocks exposed by road-cuts along Highway 380, the Pilleys Island Road. Some of the jasper zones measure 2 to 3 feet wide, as at the road-cut at Mile 6.6. The colour ranges from orange red to maroon red and brownish red. In some of the localities the jasper is banded and mottled in various shades of red; in others it is cut by epidote-quartz or chlorite-quartz veinlets. Fracture-free specimens can readily be obtained from most of the localities and the jasper is suitable for use in jewellery. Green epidote-quartz bands also occur in the volcanic rocks but the colour is generally drab.

The jasper occurs in road-cuts at the following mile-points on Highway 380 (see road log to Pilleys Island Mine): 5.8, 6.6, 7.1, 16.9, and 17.1.

Maps (T): 2 E/5 Robert's Arm
(G): 19-1962 Botwood (west half) Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 322.0 Halls Bay on right.
Twenty-mile-long Halls Bay extends northeastward into Notre Dame Bay. Several streams including South Brook, Indian Brook, Barneys Brook and West Brook discharge into it draining the region to the south and southwest. Part of the drainage area is the barren, swampy region

Plate XXVII. Whalesback Mine. (GSC 202754)

Mile 322.0 (cont.) occupied by a multitude of lakes and ponds and by a series of granite hills — The Topsails — with elevations of 1400 to 1900 feet above sea level. The head of the bay near the Trans-Canada Highway is drift-covered and low lying; its sides rise abruptly 300 to 800 feet above the sea to form flat-topped ridges.

Westward along the head of Halls Bay, the highway reaches an elevation of 300 feet providing an excellent view of the bay and of South Brook village. It then completes its 145-mile course within the Newfoundland Central Lowland and approaches the Newfoundland Highlands physiographic region for the remainder of its route.

Mile 322.0 (cont.) The Highlands is a rugged area containing the highest hills (with elevations to nearly 2700 feet above sea level) and some of the most spectacular scenery in Newfoundland. It comprises the entire western part of the island except for a narrow strip along the west coast and the extreme northern tip of the Northern Peninsula. Its eastern boundary extends from Baie Verte to Channel-Port aux Basques. The region is underlain mainly by Precambrian and Paleozoic igneous and metamorphic rocks.

324.8 Road-cuts expose red conglomerate of Silurian age. The pebbles in the conglomerate consist of volcanic rocks, porphyry, and some red jasper.

328.3 Junction Highway 390. This road provides access to Whalesback Mine, to Little Bay Mine, and to Harry's Harbour jasper occurrences.

Whalesback Mine

CHALCOPYRITE, PYRITE, PYRRHOTITE, SPHALERITE, MACKINAWITE, PENTLANDITE, MAGNETITE, CUBANITE, GALENA, ILMENITE, MARCASITE, COVELLITE, GOETHITE, TITANITE, EPIDOTE, TREMOLITE, NATIVE ARSENIC

In chloritized shear zone in lava

The Whalesback Mine is a former copper producer. The ore consisted of irregular veins, pods and disseminations of chalcopyrite, and pyrite, with pyrrhotite, sphalerite, mackinawite, pentlandite, magnetite, cubanite, galena, ilmenite, marcasite, covellite and goethite. Massive aggregates of these minerals occurred in a gangue of quartz and calcite. Titanite, epidote, amphibole (tremolite), muscovite and calcite were accessory minerals. Native arsenic has been reported from the deposit.

The deposit, known since 1885, was originally explored by test-pits, trenches and shallow shafts about 50 years ago. In 1960 British Newfoundland Exploration Corporation Limited undertook a program of surface exploration that resulted in outlining an orebody 1200 feet long and up to 130 feet wide, the ore grading 1.75 per cent copper with some silver and gold. In 1963, a three-compartment shaft was completed to a depth of 1088 feet and production began in 1965. The mine was equipped with a 2000-ton mill. The concentrates were trucked seven miles to the dock at Little Bay for shipment to the Noranda smelter at Gaspé. Operations were terminated in 1972 due to ore depletion. A total of 4 405 000 tons of ore averaging less than 1 per cent copper was milled. In 1974, Green Bay Mining Company renewed mining activity on the property from an adit at a site about 500 yards from the Whalesback Mine. The first shipment of concentrates was made late in 1974.

The mine is located at Whales Back Pond, northeast of Springdale.

Road log from the Trans-Canada Highway at Mile 328.3:

Mile 0 Proceed onto Highway 390.

1.5 Junction, Highway 391; continue on Highway 390.

Mile 4.5 Junction; proceed straight ahead onto Highway 392.

10.4 Junction mine-road; turn left.

12.4 Junction; turn left.

13.2 Whalesback Mine.

Refs.: 48 p. 847-848; 81 p. 1387-1395; 90 p. 36; 108 p. 101-102; 111 p. 181-192; 112 p. 176-177; 178 p. 54

Maps (T): 12 H/9 E Kings Point
(G): 40-1962 Sandy Lake (east half) Newfoundland (G.S.C., 1 inch to 4 miles)
22 Little Bay sheet, Green Bay district (Nfld. Dep. Mines Energy, 1 inch to 1 mile)

Little Bay Mine

PYRITE, CHALCOPYRITE, WURTZITE, MARCASITE, PYRRHOTITE, MAGNETITE, COVELLITE, NATIVE ARSENIC, EPIDOTE, JAROSITE, GOETHITE

In chlorite schist

The Little Bay Mine, a former copper producer, is the oldest mine in the Halls Bay area. Mining began in 1878. The ore consisted of pyrite and chalcopyrite with minor amounts of wurtzite, pyrrhotite, magnetite and covellite. Native arsenic was found as small grains during early mining operations, and as a mass weighing over ten pounds in more recent (1966) operations. The gangue minerals were quartz, epidote, and calcite. The ore was massive and occurred as lenses, pods and disseminations. Ore specimens are available from the dumps; they are commonly coated with yellow powdery jarosite and rusty, earthy goethite.

The deposit, discovered in 1877, was mined continuously from 1878 to 1892 by the Betts Cove Company. Production amounted to about 200 000 tons of 2½ to 10 per cent copper ore. The workings consisted of seven shafts sunk to a maximum depth of 1420 feet. Some of the ore was smelted at the mine-site, the remainder was shipped untreated. Some additional ore was produced in 1898 by Newfoundland Copper Company. Several companies were subsequently involved in exploring the deposit, but it was not until 1961 that production was renewed. In that year, Atlantic Coast Copper Corporation Limited put its 1000-ton-per-day mill in operation. Ore was hoisted through a 2058-foot shaft opening 11 levels. Mining ceased in 1969 due to ore exhaustion. The nine-year operation yielded a total of 56 797 456 pounds of copper from 2 835 120 tons of ore milled.

The mine is ½ mile southeast of Little Bay village and on the south slope of a ridge on the peninsula between Little Bay and Little Bay Arm in Notre Dame Bay.

Road log from the Trans-Canada Highway at Mile 328.3:

Mile 0 Proceed onto Highway 390.

10.4 Turn-off to Whalesback Mine; continue straight ahead.

Mile 14.1 Junction mine-road; turn right.

14.6 Little Bay Mine.

Refs.: 21 p. 143-144; 40 p. 19; 90 p. 23-25; 108 p. 101-104; 112 p. 175-176; 135 p. 47-49; 156 p. 14-15; 178 p. 36

Maps (T): 2 E/12 Little Bay Island
(G): 60-1963 Botwood, Newfoundland (G.S.C., 1 inch to 4 miles)
22 Little Bay sheet, Green Bay district (Nfld. Dep. Mines Energy 1 inch to 1 mile)

Harry's Harbour Jasper Occurrences

JASPER, EPIDOTE, CHERT

In Ordovician volcanic rocks

Orange red to maroon red jasper suitable for lapidary purposes occurs in shoreline rock exposures at Harry's Harbour. Some contains darker red to black mottling due to inclusions of hematite. A banded variety consists of red jasper alternating with irregular bands of light green and greyish green jasper. Patches of green crystalline epidote with calcite and quartz occur in the jasper. Greyish green chert also occurs in the volcanic rocks.

The jasper-bearing rock is exposed along road-cuts, shorelines and in outcrops near Harry's Harbour, a village on the narrow irregular peninsula between Green Bay and Western Arm, Notre Dame Bay. Pebbles and boulders of jasper occur in the beach deposits along the adjacent shores.

Road log from the Trans-Canada Highway at Mile 328.3:

Mile 0 Proceed onto Highway 390.

1.5 Junction; turn left onto Highway 391.

8.5 King's Point, at junction; turn right and continue along Highway 391.

21.3 Silverdale, at junction; turn right.

21.9 Silverdale Mine on left.
Galena, pyrite, specularite, chalcopyrite and tetrahedrite occur with quartz and calcite in the small roadside dump of the abandoned Silverdale Mine. Cerussite and anglesite commonly coat the specimens. The deposit was explored many years ago by a 60-foot shaft. It is also known as the Bear Cove prospect.

22.8 Junction at Nick's Neck Cove; turn right.

24.6 Junction at Harry's Harbour; turn left.

Plate XXVIII. Shoreline at Harry's Harbour. Jasper occurs in the volcanic rocks exposed along this shore. (GSC 202755)

Mile 24.6 Junction at Harry's Harbour; turn left.

24.9 Jasper occurs in the road-cut on left and along the shore below.

25.0 Harry's Harbour wharf. Continue beyond wharf and along the single-lane shoreline road.

25.6, 26.3 Outcrops of volcanic rock containing jasper along sides of the road.

26.4 Salmon Cove shore. Jasper-bearing volcanic rock is exposed along the shoreline cliffs on the west side of the cove. Pebbles and boulders of jasper occur along the shore.

Refs.: 90 p. 35; 135 p. 78

Maps (T): 2 E/12 Little Bay Island
(G): 60-1963 Botwood, Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 328.3 Trans-Canada Highway at junction Highway 390.

For the next 22 miles, the highway parallels the broad valley of Indian Brook. Ridges bordering the south side of the highway reach elevations of up to 1500 feet above sea level, those on the north side to about 1000 feet. The valley's thick mantle of glacial sand, gravel and till can be seen on both sides of the highway.

329.3 Turn-off to Indian River Provincial Park.

340.8 Junction, Highway 410, the Baie Verte Road. This road provides access to: the Flatwater Pond chrome-mica rock occurrence, the Tilt Cove Mine, the Consolidated Rambler Mine, and the Advocate Mine.

Flatwater Pond Chrome-Mica Rock Occurrence

CHROME-MICA ROCK, MAGNESITE, MAGNETITE

In ultrabasic rock

An attractive emerald-green rock composed of aggregates of green chrome-mica in quartz occurs at this locality. It takes a good polish and is used as an ornamental stone for jewellery and other purposes; it locally is known as "virginite". Light orange to brownish yellow magnesite is found as coatings and massive patches in the rock, and small specks of magnetite occur in it. The rock weathers to a rusty yellow colour and is an alteration product of an ultrabasic rock.

The chrome-mica rock is exposed by two road-cuts on Highway 410 at Flatwater Pond, 27.7 miles and 28.1 miles from its junction with the Trans-Canada Highway.

Map (T): 12 H/16 W Baie Verte
(G): 40-1962 Sandy Lake (east half), Newfoundland
(G.S.C., 1 inch to 4 miles)

Plate XXIX. Flatwater Pond, opposite the road-cut exposing the chrome-mica rock (virginite) on the Baie Verte Road. (GSC 202757)

Advocate Mine

CHRYSOTILE, SERPENTINE, MAGNETITE

In peridotite

Cross-fibre chrysotile asbestos has been produced from this mine since 1963. The chrysotile is light to medium green. Fibres measuring up to 1¼ inches long occur in the deposit although the average length is much shorter. Ribbon-fibre asbestos is also present. Massive green serpentine (antigorite) and magnetite are associated with the chrysotile.

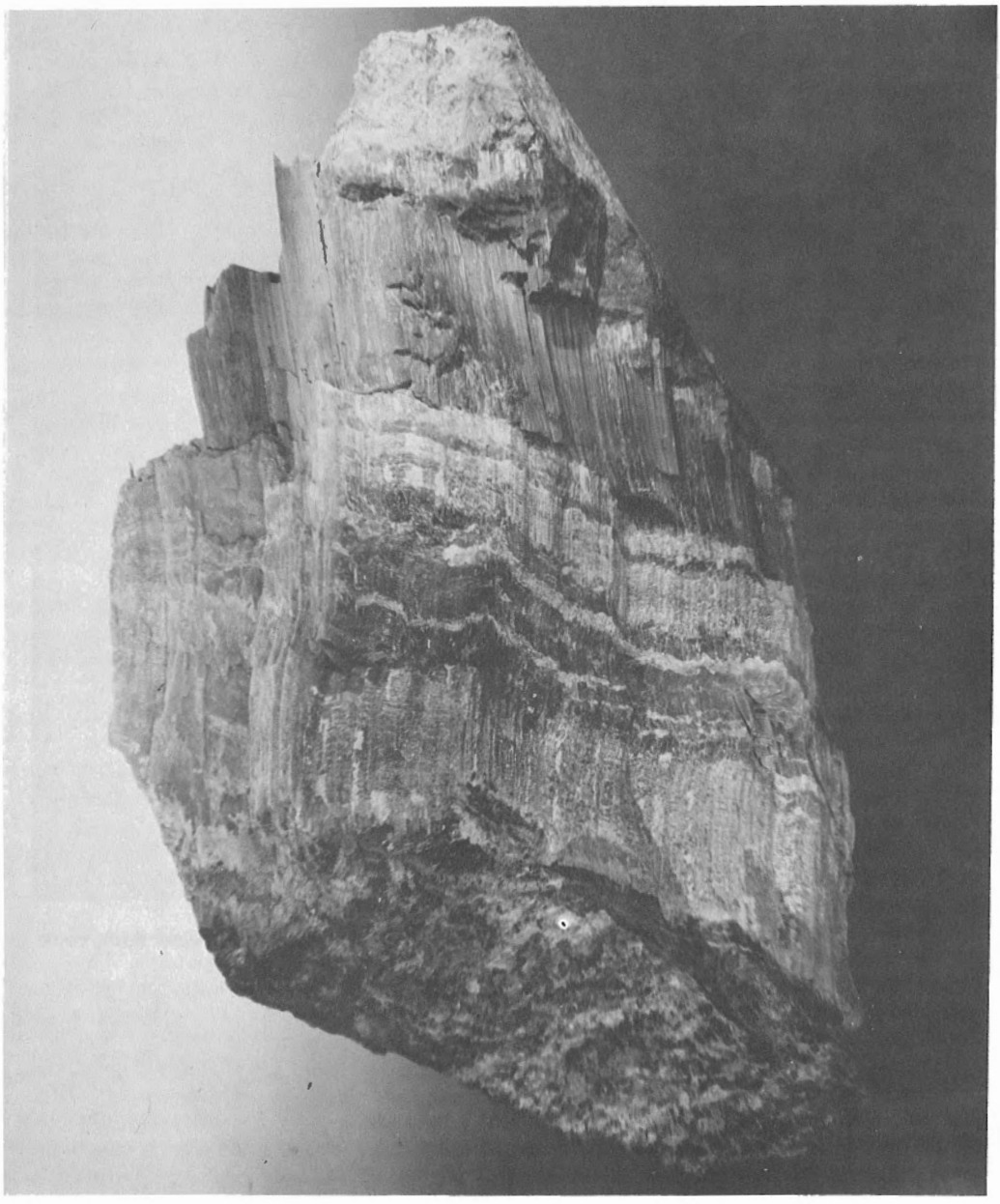


Plate XXX. Banded picrolite specimen collected from a rock exposure at Mile 28.5 on the Baie Verte Road. (GSC 202820-A)

The deposit was discovered in 1955 by prospectors, Norman Peters and George MacNaughton. Shortly after the discovery, Advocate Mines Limited undertook exploration of the deposit that resulted in outlining an orebody of commercial size and grade. This was followed by preparations for open-pit mining and the construction of a mill and storage facilities and dock at Upper Duck Island Cove, Baie Verte. Production began in June 1963. The mill has a capacity of 5000 tons per day. Total production to the end of 1974 amounted to 776 496 tons of fibre from 23 829 964 tons of ore milled.

The mine is north of Baie Verte village.

Road log from the Trans-Canada Highway at Mile 340. 8:

Mile 0 Proceed onto Highway 410.

25. 4 Turn-off to Flatwater Pond Provincial Park.

25. 7 Junction, road to Bear Cove (Highway 411).

27. 7, 28. 1 Road-cuts expose green chrome-mica rocks (see page 116). Flatwater Pond is on right.

28. 5 Three varieties of serpentine occur in peridotite rock exposed by stripping along the hillside on the left side of the highway. The massive serpentine (antigorite) is yellowish green to dark green, and contains some chrysotile cross-fibre asbestos. Picrolite occurs in colours ranging through all shades of green, and from amber to brown. Specimens of picrolite weathered from the outcrop present unusual, appealing sculptured forms. Small grains and crystals of magnetite and patches of yellowish white magnesite occur in the serpentine. The deposit was investigated by Advocate Mines Limited.

28. 6 Junction road to Burlington (Highway 413).

36. 2 Junction road to Tilt Cove (Highway 414). This road leads to the Consolidated Rambler mines and to the Tilt Cove Mine. The road log continues straight ahead.

37. 5 Junction road to Seal Cove. The site of the old Terra Nova Mine is opposite the junction. The mine was worked for copper intermittently from 1862 to 1915. The workings consist of several shafts and an adit. The ore consisted of pyrite, chalcopyrite, pyrrhotite, sphalerite and native copper in greenstone and slate. Some ore specimens coated with rozenite, siderotil, leonhardtite and goethite can be found in the dumps at the side of the road.

39. 7 Baie Verte village, at church. Continue straight ahead.

42. 6 Junction; turn right.

43. 6 Advocate Mine.

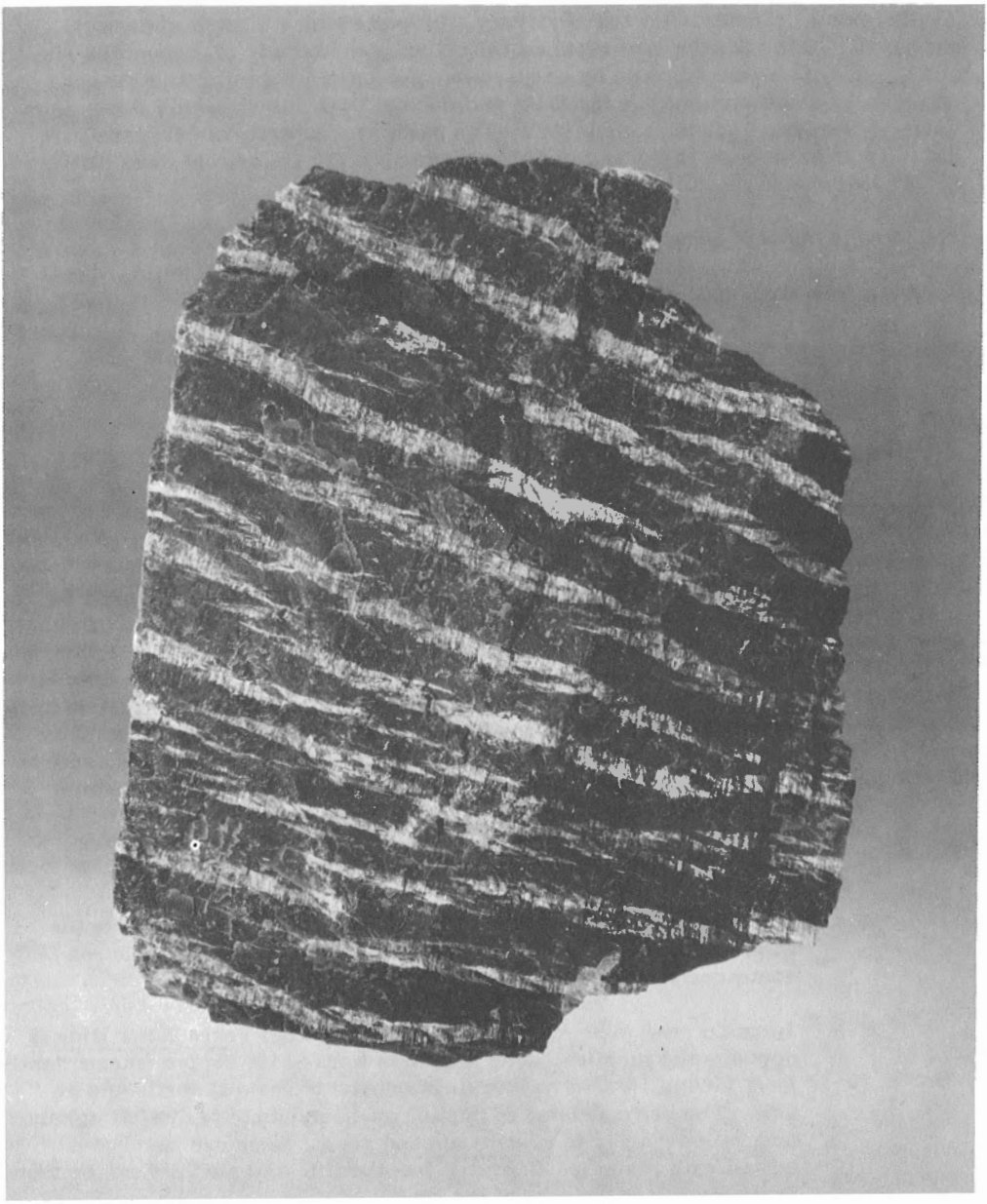


Plate XXXI. Ribbon-fibre asbestos specimen from the Advocate Mine. (GSC 202820-C)

Refs.: 72 p. 314-315; 100 p. 36; 135 p. 58; 154 p. 21-27; 181 p. 20; 184 p. 19

Maps (T): 12 H/16 E Baie Verte
(G): 40-1962 Sandy Lake (east half) Newfoundland (G. S. C., 1 inch to 4 miles)
10-1958 Baie Verte-White Bay and Green Bay districts, Newfoundland (G. S. C., 1 inch to 1 mile)
21 Baie Verte-Mings Bight sheet, White Bay district (Nfld. Dep. Mines Energy, 1 inch to 2500 feet)

Consolidated Rambler Mines

PYRITE, CHALCOPYRITE, PYRRHOTITE, GALENA, SPHALERITE, BORNITE, NATIVE COPPER

In quartz-sericite schist

The copper-gold-silver property of Consolidated Rambler Mines Limited comprises three mines; the Main, the East and the Ming mines. The ore consists of pyrite with chalcopyrite, pyrrhotite, galena and sphalerite (dark brown). Bornite and native copper have been reported from the deposit. The sulphide minerals occur as disseminations and as a massive intergrowth that contains cubic crystals of pyrite commonly measuring $\frac{1}{2}$ inch along an edge.

The original deposit, the England vein, was discovered in 1903 by Enos England, a trapper and prospector from Little Bay. It was found in a branch of South Brook and was claimed by England and Thomas E. Wells. A 65-foot shaft was sunk on the vein between 1905 and 1907 by Naylor and Company of New York, but the results did not warrant further development. In 1935, Enos England and his son William discovered the Rambler vein on a hill 600 feet north of the original shaft; this deposit carried values in gold and silver and later became the Main Mine. Investigation of the deposit between 1939 and 1945 by the Geological Survey of Newfoundland revealed the existence of a substantial orebody and, in 1945, Rambler Mines Limited was formed by a group of businessmen from St. John's to develop the deposit. Other mineralized veins were discovered in the immediate area and staked by Jawtam Key Gold Zones (Rambler) Limited and B. A. Norris. Reports indicate that gold was panned from the overburden above some of the veins.

From 1945 until 1960, the Rambler deposit was investigated by several companies including Siscoe Gold Mines Limited, Falconbridge Nickel Mines Limited, Rambridge Mines Limited and the Government of Newfoundland which expropriated the Rambler, Norris and Jawtam properties and subsequently leased them to the M. J. Boylen interests. Underground development began in 1960 and in the following year Consolidated Rambler Mines Limited was incorporated to continue development. The shaft that was being sunk in 1960 was destroyed by fire in 1961 and another one was started and sunk to a depth of 934 feet. The Main Mine came into production in 1964. When its operations were terminated in 1967, it had produced a total of 440 000 tons of ore grading 1. 30 per cent copper, 2. 16 per cent zinc and 0. 15 ounce of gold and 0. 85 ounce of silver per ton. Production began at the East Mine in 1966 and at the Ming Mine in 1972. The East Mine is serviced by a 1125-foot shaft with an underground decline, the Ming Mine by an 1100-foot decline. The mill has a capacity of 1500 tons per day.

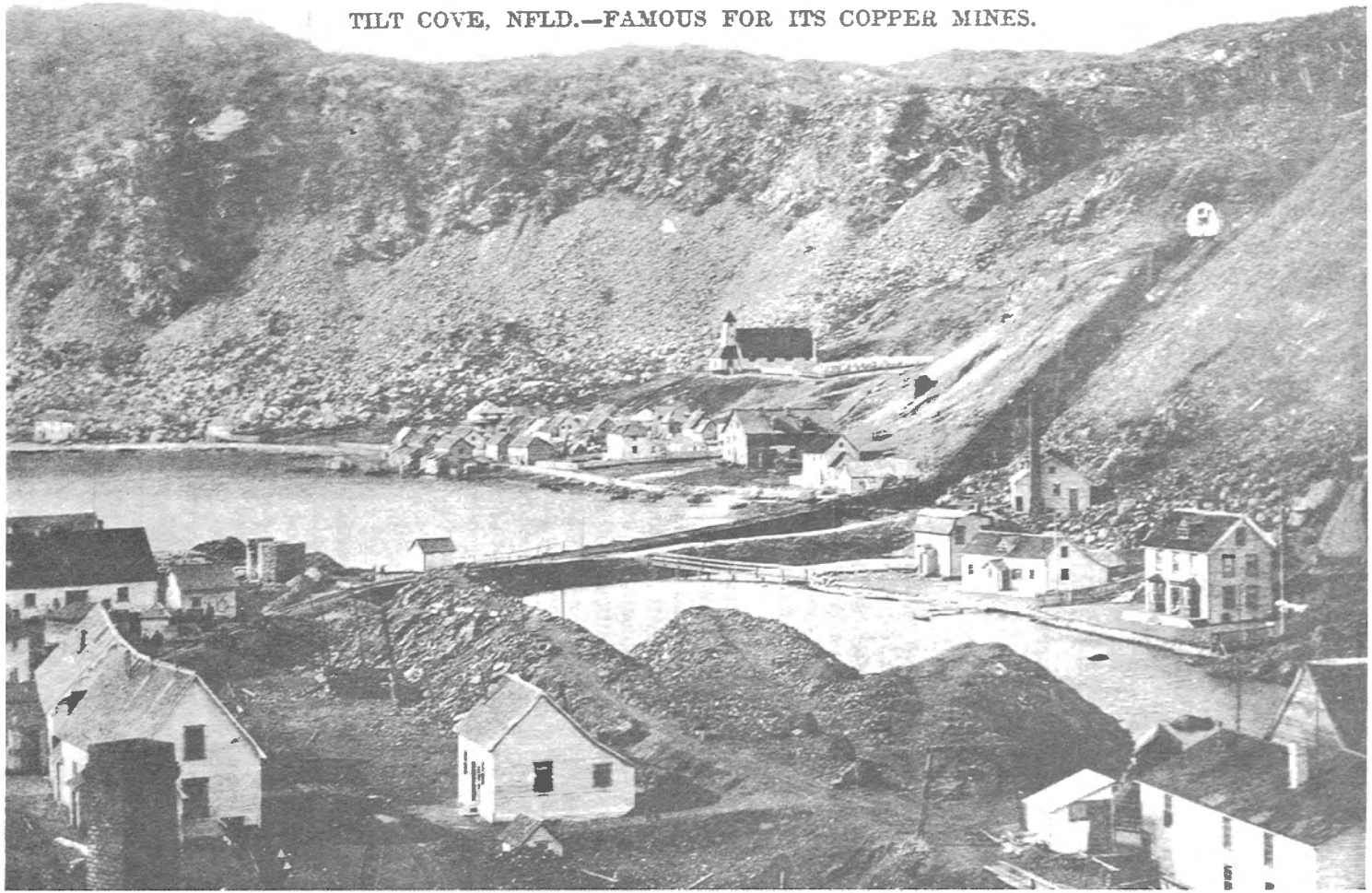


Plate XXXII. Early mining operations at Tilt Cove Mine. (Public Archives Canada C-74887)

To the end of 1974, the mines produced a total of 87 636 737 pounds of copper, 540 286 ounces of silver, 83 115 ounces of gold, 13 601 517 pounds of zinc and 45 455 pounds of cadmium from 3 158 864 tons of ore milled. The production is valued at $57 602 418.

The mines are located south of Ming's Bight. Access is via Highway 414, the Tilt Cove Road. The mine office and Main and East mines are reached by a 1.3-mile access road leading south from Highway 414 at a point 7.6 miles east of its junction with Highway 410; the Ming Mine is 0.3 mile north of this point.

Refs.: 33 p. 81-86; 58 p. 77-82; 100 p. 35-36; 118 p. 305-310; 135 p. 58; 154 p. 29-34; 181 p. 93; 184 p. 84

Maps (T): 12 H/16 E Baie Verte
(G): 40-1962 Sandy Lake (east half) Newfoundland (G.S.C., 1 inch to 4 miles)
10-1958 Baie Verte, White Bay and Green Bay districts, Newfoundland (G.S.C., 1 inch to 1 mile)
21 Baie Verte-Mings Bight sheet, White Bay District (Nfld. Dep. Mines Energy, 1 inch to 2500 feet)

Tilt Cove Mines

CHALCOPYRITE, PYRITE, MAGNETITE, PYRRHOTITE, HEMATITE, NATIVE COPPER, NATIVE SILVER, SPHALERITE, MAUCHERITE, NICKELINE, CHLOANTHITE, GERSDORFFITE, VIOLARITE, ARSENOPYRITE, MILLERITE, RAMMELSBERGITE, ANNABERGITE, ERYTHRITE

In sheared lava

The now inactive Tilt Cove mines were Newfoundland's oldest and largest copper producers. There were two mines: the West or Union Mine located on a hillslope immediately west of Tilt Cove, and the East Mine, in a plateau one-half mile east of the same cove. The copper orebody at the West Mine consisted of veinlets and disseminations of chalcopyrite and pyrite with minor amounts of pyrrhotite, magnetite, specular hematite, native silver, and native copper. They occurred with quartz and ankerite in chlorite schist. The deposit also contained nickel ore in a talc-carbonate zone; the mineralization consisted of an intimate intergrowth of maucherite, nickeline, chloanthite, gersdorffite, violarite, arsenopyrite, rammelsbergite, millerite, annabergite and erythrite. The ore at the East Mine was massive pyrite with chalcopyrite, magnetite, specular hematite and sphalerite.

This copper deposit is reported to have been discovered in 1857 by fishermen who noted the unusual heaviness of rocks they picked up in the cove for use as ballast for their boats. The property was acquired by two Newfoundland merchants, Smith McKay and C.F. Bennett, who began mining operations at the West Mine in 1864, the first copper mining venture in Newfoundland. It was worked by open-cuts, adits and a shaft. The hand-picked ore that was produced yielded about 12 per cent copper. A few years later, nickel ore was discovered and between 1869 and 1876 a total of 411 tons of high-grade nickel ore valued at $32 740 was shipped to England. In the late 1870's the price of copper fell, mining of the nearly depleted orebody was suspended, and the attention of miners was diverted to the newly discovered and promising Little Bay deposit.

In 1886, the copper-sulphur deposit that became the East Mine was discovered, bringing renewed vigour to the area's then-declining mining activities. This large orebody was estimated to contain 35 to 45 per cent sulphur and 3.2 to 3.5 per cent copper, and had the advantage of being cheaply mined by open-cut methods. In 1888, operations of the mines were taken over by the Tilt Cove Mining Company of London but ore treatment in furnaces installed at the mine became unprofitable and the property was subleased to the Cape Copper Company Limited. This company operated the mines until 1913. Most of the ore produced was shipped to Swansea, Wales for smelting, but small shipments were also made to New York. Some gold valued, at 10 000 pounds sterling, was recovered from the ore. From 1913 to 1917 mining operations were conducted by the Tilt Cove Mining Company which shipped the ore to the United States.

During part of the time between 1864 and 1917, the Tilt Cove mines were the largest mining operation in Newfoundland. Total shipments are reported to have been 1 491 136 tons of ore, 78 015 tons of matte, and 5416 tons of ingots. To 1912, the West Mine's output was estimated at 84 448 tons of hand-picked ore averaging 9.1 per cent copper, and from 1888 to 1910 the East Mine yielded over a million tons of ore averaging 4 per cent copper and 35 to 40 per cent sulphur.

After 1918, the mines were inactive until 1957 when production was renewed for a 10-year period by First Maritime Mining Corporation Limited. Mining was conducted from a 4-compartment 2750-foot shaft opening 14 levels. Ore was processed in a 2050-ton mill. Total production during this period was 183 597 125 pounds of copper and 42 425 ounces of gold from approximately 7 400 000 tons of ore milled.

The Tilt Cove Mines are located at Tilt Cove, a narrow embayment on the northeast shore of Notre Dame Bay. Access is via Highway 414. The distance from the junction of Highways 414 and 410 is 33 miles.

Refs.: 21 p. 146-149; 32 p. 54-56; 33 p. 104-130; 107 p. 27-30; 135 p. 51-54; 156 p. 14; 165 p. 91-92; 175 p. 144-145

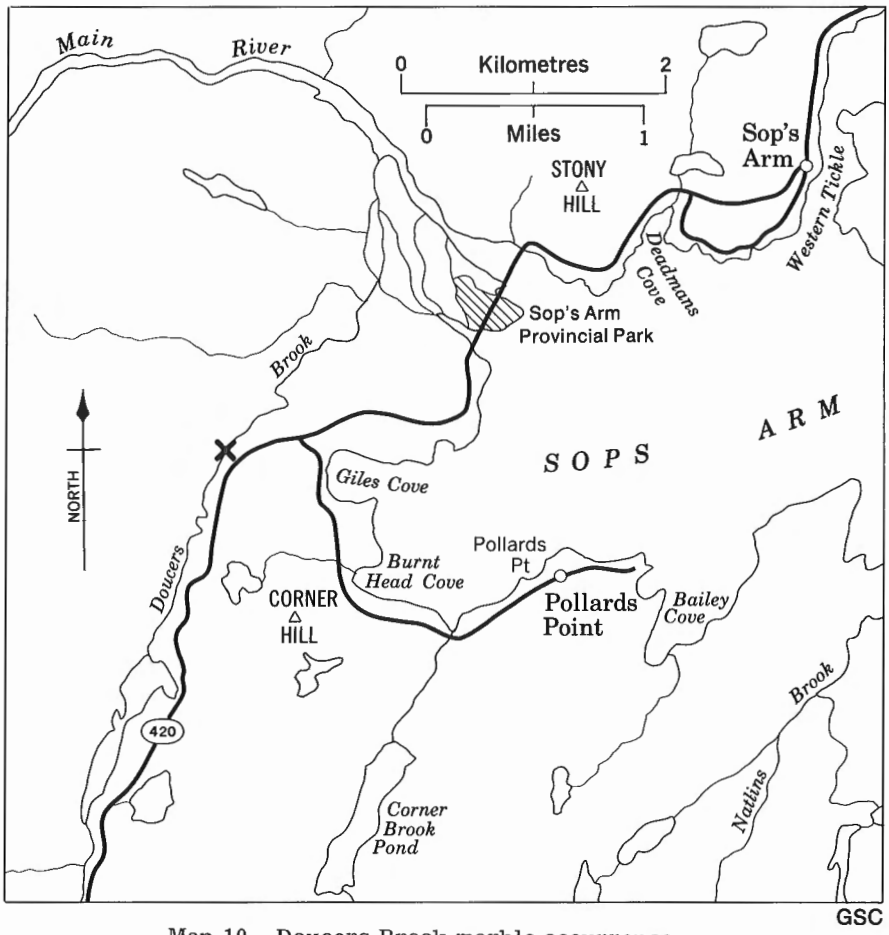
Maps (T): 2 E/13 Nippers Harbour
(G): 60-1963 Botwood, Newfoundland (G.S.C., 1 inch to 4 miles)
22-1958 Nippers Harbour, Newfoundland (G.S.C., 1 inch to 1 mile)

The road log along the Trans-Canada Highway is resumed.

Mile 340.8 Junction, Highway 410.

352.4 Birchy Lake on right.

This lake is 12 miles long with a maximum width of less than a mile. It occupies a northeast-striking fault that extends to Southwest Arm, Green Bay. The north side of the lake is underlain by Devonian granitic rocks, the south side by Silurian volcanic rocks. Hills along the ridge to the south of the lake reach elevations of over 1500 feet above sea level (about 1200 feet above the level of the lake), those on the north side are about 500 feet less.



Map 10. Doucers Brook marble occurrence.

Mile 355.7 Mount Sykes (elevation 1520 feet) is to the south of the highway.

364.2 Sandy Lake on left.

370.8 Road-cuts expose pink and grey Devonian granite.

372.8 Junction Highway 420, the Sop's Arm Road.

Doucers Brook Marble Occurrence

MARBLE

An attractive marble suitable for ornamental purposes occurs at Doucers Brook near Sops Arm, White Bay. The marble has a white to cream-white background with orange-red to brick-red narrow veinlets traversing it in a random geometric pattern. The rock is compact, very fine grained and resembles porcelain. It takes a high polish.

The marble (crystalline limestone) formation in which this white marble occurs is of Ordovician age and is white to blue grey in colour. The white marble is the ornamental variety. The formation forms a discontinuous narrow belt that outcrops along a valley between Taylors Pond and Jacksons Pond. Doucers Brook flows through part of this valley which occupies a major fault zone. The marble belt crosses Main River about 3000 feet upstream from its delta at Sops Arm. In places, the rock has been brecciated and recemented with iron-stained, rust-coloured carbonate. The white variety suitable for ornamental purposes is exposed conspicuously in a 150-foot cliff on the west bank of Doucers Brook at a point ½ mile west of the head of Giles Cove. Adjacent hills are also formed of the marble. Some marble was extracted from Doucers Brook several years ago.

Access to the Doucers Brook marble occurrence is by a trail leading west from Giles Cove, Sops Arm.

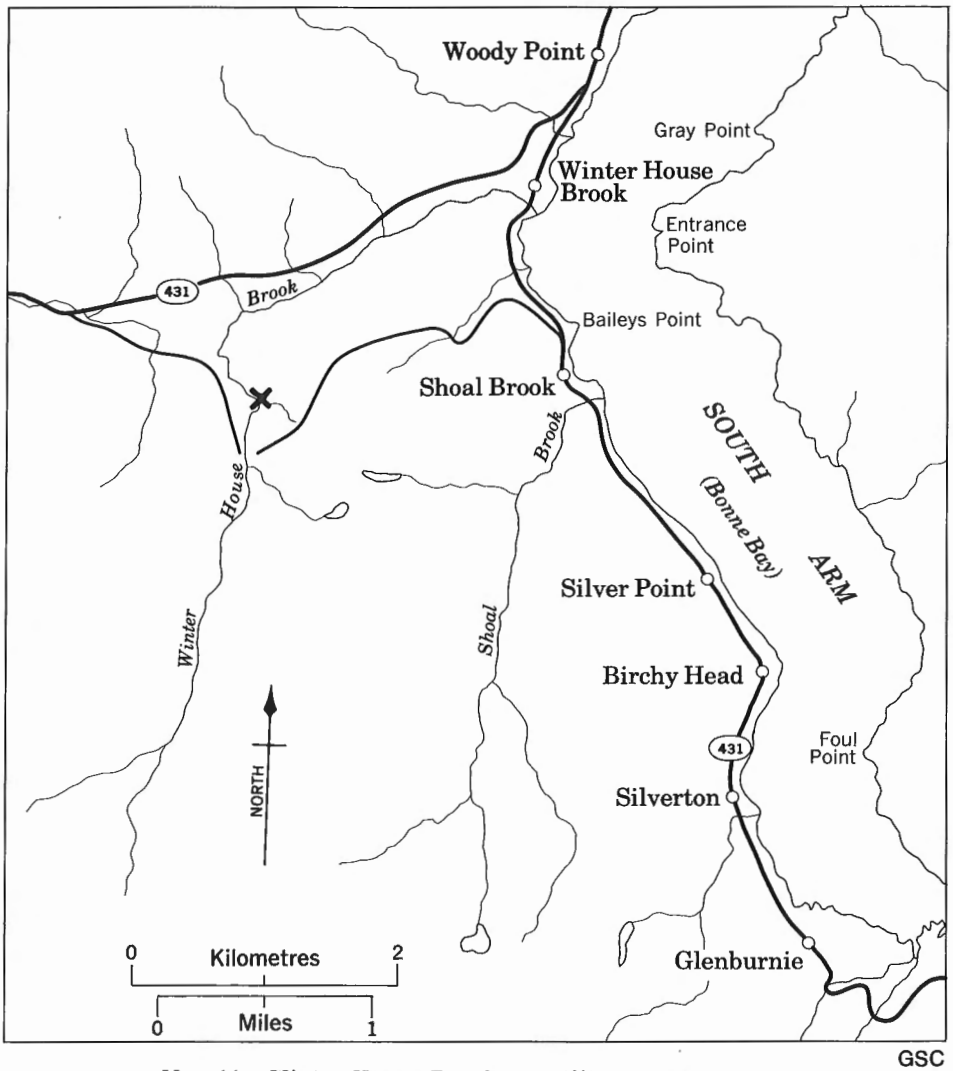
Road log from the Trans-Canada Highway at Mile 372.8:

Mile 0 Proceed onto Highway 420 toward Sops Arm.

0.3 Turn-off to Squires Memorial Park; continue along highway.

5.9 Junction; turn left. From this junction the road heads west for the next five miles crossing a ridge with an elevation of about 700 feet above sea level. It then parallels the steep west side of the ridge to a junction at Mile 19.8. To the west of the road and ridge, there is a lowland underlain by Mississippian sedimentary rocks into which the Upper Humber River has carved its broad, meandering course. The east side of the ridge is formed of Mississippian sedimentary rocks, the west side of Devonian granitic rocks. The Long Range Mountains are visible in the distance west of the lowland.

19.8 Junction; turn right.



Map 11. Winter House Brook xonotlite occurrence.

Plate XXXIII. Winter House Brook xonotlite occurrence. (GSC 152522)

Mile 25.0 Taylors Pond is on the left side of the road. For the next 10 miles, the road follows the valley occupied initially by Taylors Pond and for the last 6 miles, by Doucers Brook. Between this pond and the brook, there is a drainage divide: the waters south of the divide flow into the Humber River system which empties into the sea on the west coast about 60 miles away; and Doucers Brook, on the north side of the divide, flows north to Sops Arm reaching the sea in a distance of only six miles. This drainage divide is the result of damming by glacial drift.

Mile 35.1 Junction at Giles Cove in Sops Arm, White Bay; turn left.

Sops Arm is the largest indentation in the steep, rugged, remarkably even shoreline of White Bay. This V-shaped bay extends 55 miles from Hampden at its head to Partridge Point on the Atlantic Ocean. It is unusually deep with the 100-fathom line extending southward into the bay to within 3 miles from its bottom. The bay occupies the northern end of a major fault zone that extends southwestward to the South Shore. The average elevation is considerably higher on the west side of the bay than on the east side. Devils Room, a prominent 1254-foot granite hill immediately west of Sops Arm Provincial Park is the highest hill bordering White Bay.

36.3 Bridge over Doucers Brook.

36.5 Sops Arm Provincial Park (on left) between the outlets of Doucers Brook and Main River. The 1½-mile trail along Doucers Brook to the marble occurrence begins at the park. Numerous streams entering Doucers Brook between the park and the occurrence make it difficult to follow Doucers Brook; the services of a local guide would be helpful.

36.6 Bridge over Main River.

38.8 Sops Arm village, at wharf.

Refs.: 3 p. 15-19; 16 p. 2-3, 19-21; 21 p. 104-105; 64 p. 9-10; 96 p. 10; 100 p. 10-11; 135 p. 133

Maps (T): 12 H/15 Jackson's Arm; 12 H/10 Hampden
(G): 40-1962 Sandy Lake (east half), Newfoundland (G.S.C., 1 inch to 4 miles)
6 Sops Arm sheet, White Bay district (Nfld. Dep. Mines Energy, 1 inch to 1 mile)

Mile 372.8 Junction Highway 420.

Between this junction and Deer Lake, the highway passes through a lowland extending from White Bay to Grand Lake. It is one of two lowlands within the Newfoundland Highlands; the other one is in the Codroy area.

It is marshy with an elevation of 200-300 feet and is dissected by numerous streams and by one major river, the Upper Humber River. From this junction (Mile 372.8) to Mile 386, the highway parallels the east side of Birchy Ridge, a northeast-trending remnant of an upland surface within the lowland. The ridge has an elevation of about 800 feet and is underlain by Mississippian sandstone and conglomerate. This upland extends to White Bay.

400.8 Deer Lake, at junction Highway 430 to Bonne Bay and to the Great Northern Peninsula.

Winter House Brook Xonotlite Occurrence

XONOTLITE, GARNET, PECTOLITE, PLAGIOCLASE, CHLORITE, PUMPELLYITE, APATITE

In faulted contact between serpentinite and shale

Pink xonotlite occurs as massive granular aggregates and as fibrous or columnar masses in veins cutting altered shale. The veins measure up to three inches wide and several feet long. The xonotlite ranges from a delicate shade of pink to white and is semitransparent. It takes a high polish which brings out an attractive pink and white mottled effect. It is used locally for cabochon-cut jewellery. Associated with the xonotlite are: white massive pectolite, white plagioclase feldspar, grey to green chlorite, and small patches of light green pumpellyite, dark bluish green apatite, pink to peach-coloured garnet, and amber mica. The xonotlite alters to a chalky white, soft compact to powdery mass. The pectolite fluoresces yellowish white when illuminated by ultraviolet light.

At Winter House Brook, near its headwaters, the xonotlite occurs in a 4- to 5-foot layer of calcium-bearing rocks that marks the faulted contact between serpentinite and shale. The outcrop is on the east bank of the brook just north of the mouth of a stream flowing from the east.

Road log from the Trans-Canada Highway at Mile 400. 8:

Mile	0	Proceed onto Highway 430, the Great Northern Peninsula Road. This highway and its branch, Highway 431, cut through the Long Range Mountains that extend for about 300 miles from Channel — Port aux Basques almost to the northern tip of the Great Northern Peninsula. Peaks along this range reach a maximum elevation of over 2600 feet near Bonne Bay, tapering off to about 1600 feet at either end. Gros Morne, the second highest peak on the Island of Newfoundland, is on the north side of Bonne Bay; it has an elevation of 2644 feet. An excellent view of Gros Morne and of Bonne Bay can be had from the Winter House Brook xonotlite occurrence.
	20. 0	Junction; proceed onto Highway 431.
	23. 8	Bonne Bay Little Pond on left.
	28. 4	Turn-off to Lomond; continue straight ahead.
	32. 0	The road begins its 2-mile descent from an elevation of 900 feet to near sea level at the south end of South Arm, Bonne Bay. It then parallels the western shore of South Arm.
	39. 5	Shoal Brook village, at junction road (on left) to Table Mountain flats. This junction is 0. 8 mile south of the highway bridge over Winter House Brook and 1. 5 miles south of the junction of the Trout Brook Road and the Woody Point Road. Turn left onto the road to Table Mountain.

Mile 41.3 The road ends at Winter House Brook. From the end of the road, walk north 500 yards to the point where a stream flows westward into Winter House Brook. The xonotlite occurrence is in the gorge of the brook just north of the stream junction.

Table Mountain flats into which Winter House Brook cuts its gorge provides a panoramic view of scenic Bonne Bay with its fiord-like branching arms and of some of Newfoundland's highest hills that tower above it, including Gros Morne.

Refs.: 96 p. 14-15; 132 p. 531-532; 133 p. 48-50, 126

Maps (T): 12 H/5 Lomond
(G): 1057A Bay of Islands, Island of Newfoundland (G.S.C., 1 inch to 2 miles)

The Great Northern Peninsula and its points of interest are described in the following text; the Trans-Canada Highway road log continues on page 147.

The Great Northern Peninsula

The Great Northern Peninsula is a broad 175-mile-long strip of land extending from Bonne Bay to Cape Bauld, its northern end reaching to within 11 miles of Labrador, the shortest separation of the Island of Newfoundland from continental Canada. Its shoreline, shared by the Atlantic Ocean, the Strait of Belle Isle, and the Gulf of St. Lawrence, is fairly regular except for the jagged northern tip. The peninsula is a region of sharply contrasting topography comprising three physiographic regions: the Newfoundland Highlands consisting of the Long Range Mountains, the Newfoundland Coastal Lowland fringing its western shore, and the Newfoundland Central Lowland at its northern extremity. The lowlands are underlain by Cambrian and Ordovician sedimentary rocks, the highlands by Precambrian metamorphic (gneisses and schists) and granitic rocks.

To the traveller proceeding along the low-lying coastal highway, the most striking feature is the abrupt rise of the Long Range Mountains from the lowland to form a rugged, west-facing escarpment deeply incised by immense, steep-walled valleys of breathtaking beauty. This mountain range is a dissected upland — a remnant of an ancient peneplain — that forms the backbone of the peninsula dividing the streams flowing westward to the Gulf from those that drain eastward to the Atlantic.

Along the western front of the Long Range Mountains, barren, domed peaks rise above the plateau to a maximum elevation of 2644 feet near Bonne Bay, gradually decreasing in elevation to about 1000 feet at the northern end. Its indented, almost featureless eastern edge is marked by sheer 1000-foot cliffs dipping into the deep Atlantic. Numerous lakes, ponds and streams occupy depressions on the plateau, their basins and valleys scooped out and carved by Pleistocene ice sheets that moved toward both coasts.

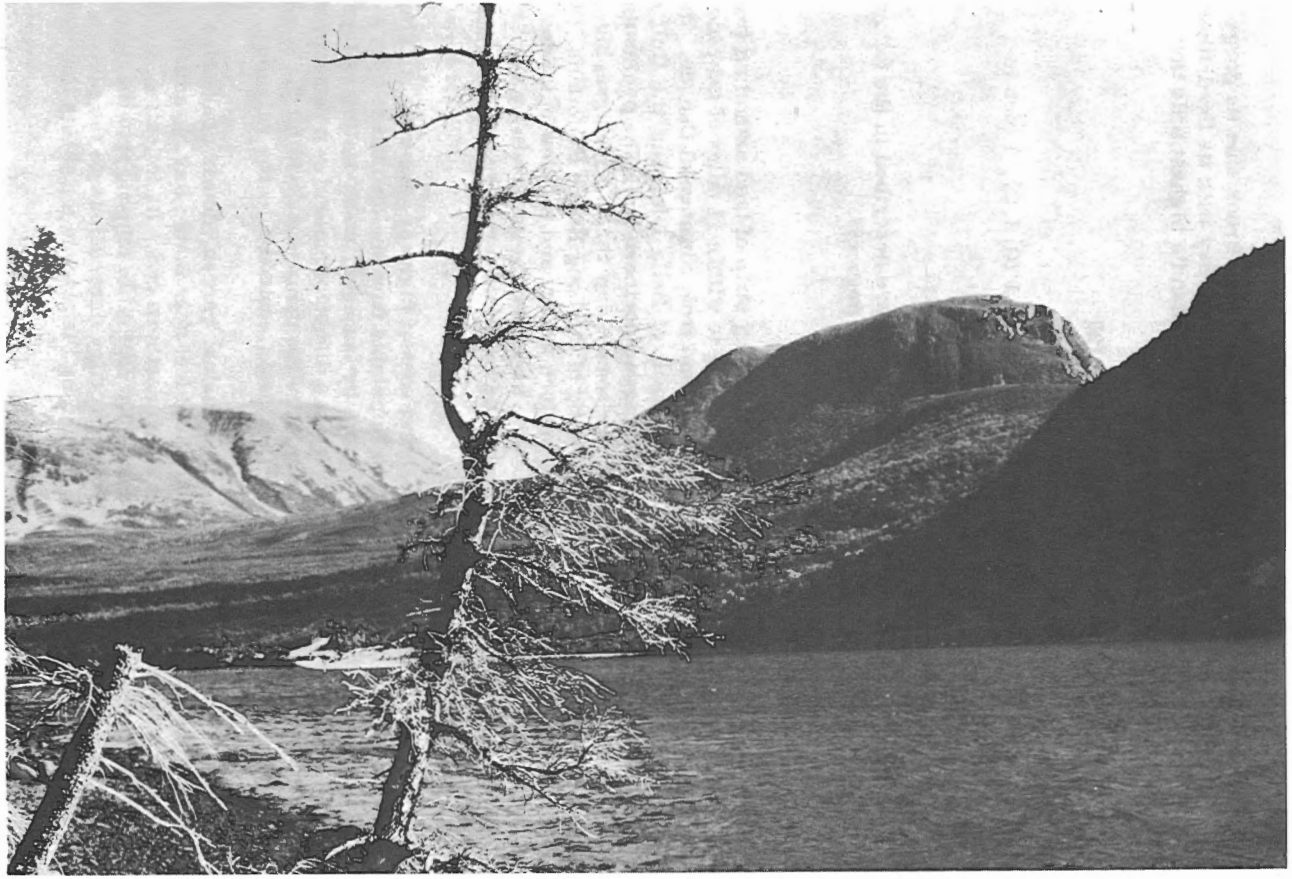


Plate XXXIV. Gros Morne, the 2644-foot barren peak (on left) is the second highest mountain on the Island of Newfoundland. Old Crow Mountain (2150 feet) on its right is formed of Precambrian gneiss. (GSC 201825-N)

Through most of its course, the Great Northern Peninsula Road parallels the shoreline of the Coastal and Central lowlands that separate the Long Range Mountains from the sea. The lowland regions are marshy areas of low relief dotted with hundreds of lakes and ponds. The Coastal Lowland is a belt 5 to 15 miles wide along the western shore. The Central Lowland comprises the eastern part of the peninsula from Canada Bay northward to the tip of the peninsula.

Points of Interest along the Great Northern Peninsula Road (Highway 430)

Mile 0 Junction Highway 430 and the Trans-Canada Highway at Deer Lake. Highway 430 begins its short journey to the Gulf of St. Lawrence shore by cutting across the Long Range Mountains. A ten-mile stretch of the highway beginning at Mile 28 is along the north shore of East Arm, Bonne Bay at the foot of the mountain range whose steep slopes rise abruptly to an elevation of 2000 feet above the road.

20.0 Junction Highway 431.

21.0 Gros Morne National Park

This proposed national park occupies a coastal area of 550 square miles including most of the shoreline from Trout River to Parsons Pond. Inland it extends into the Long Range Mountains with an irregular boundary 10 to 25 miles from the coast. Within this park are scenes of rugged and unrivalled beauty that include some of Newfoundland's highest peaks and most spectacular valley gorges. Highways 430 and 431 and branch roads provide access to the park.

38.0 The highway enters the Coastal Lowland. Gros Morne, the bald, flat-topped mountain visible to the northeast, is the highest peak (elevation 2644 feet) in the Long Range Mountains and the second highest on the island. It is formed of Cambrian carbonates capped by quartzite of the same age.

44.0 Rocky Harbour, at junction Norris Point road leading to the Norris Point-Woody Point ferry.

46.5 The highway begins its 200-mile-long shoreline journey paralleling, for over 100 miles, the wall-like front of the Long Range Mountains which rise abruptly from the coastal lowland.

49.5 Bakers Brook. The headwaters of Bakers Brook is in the Long Range Mountains about 15 miles east of the highway. There, at an elevation of 2000 feet, the drainage systems divide, the waters of Bakers Brook and of the Humber River system flowing in opposite directions.

51.5 Green Point. Erosion-resistant sedimentary rocks of early Paleozoic age form the prominent, low headland at Green Point. Graptolites occur in shale exposed along the north and west shores of the headland.

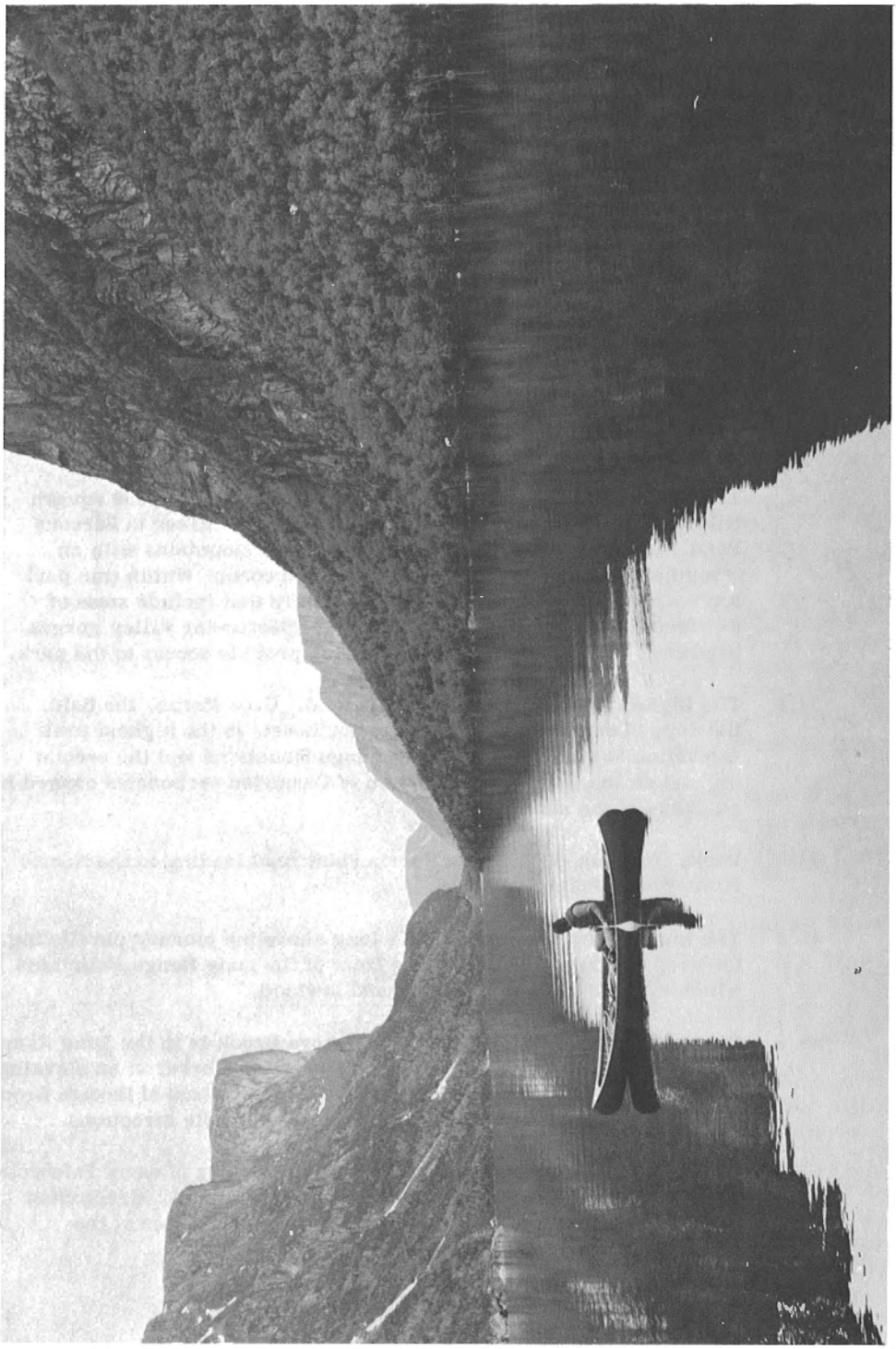


Plate XXXV. Western Brook Pond. (Nfld. Dep. Tourism 2553)

Mile 63.0 Bridge over Western Brook.

Western Brook Pond

Western Brook is a meandering stream which cuts across Gulls Marsh carrying the water from Western Brook Pond to the Gulf of St. Lawrence. Three miles to the southeast is Western Brook Pond which occupies a spectacular 8-mile-long fiord-like gorge with a magnificent cirque at its head. It is one of several U-shaped valleys that cuts a deep, broad, steep-walled trough into the western edge of the Long Range Mountains. The pond is bordered on either side by barren, flat-topped, 2400-foot hills whose summits slope gently toward their precipitous valley walls. It is the most spectacular of the canyon-like, lake-filled valleys that were gouged out of the edge of the mountain range by glaciers. Similarly striking valleys are those occupied by St. Pauls Inlet, Parsons Pond and Portland Creek Pond.

63.5 Turn-off to Broom Point. This headland is formed of tattered, sea-eroded, barren strips of rock jutting seaward. The rock formation consisting of limestone conglomerate and limestone is intensely folded and crumpled.

67.0 Bridge at St. Pauls.

St. Pauls Inlet

St. Pauls Inlet, on the east side of the bridge, is a salt water tidal lagoon extending 6 miles from the bridge to the mountain front. Unlike other coastal ponds, this and Parsons Pond are filled with salt water since their outlets are low enough to admit sea water. The steep-walled head of the inlet is a U-shaped glacial trough through which valley glaciers passed during the Ice Age on their way to the sea, leaving deposits of sand and gravel that now line the shores at the western end of the inlet. Graptolite-bearing shale is exposed along the shore just north of the bridge.

Exposed along the south shore and in points projecting into the inlet, is a limestone breccia composed of angular fragments and slightly rounded boulders of variously coloured limestone embedded in a sandy or dolomitic limestone. The fragments are generally flat and measure less than an inch to 3 feet long. Black, grey, and brown chert fragments occur in the exposures at the west end of the inlet. This limestone breccia, known as the Cow Head breccia, is exposed on the Cow Head Peninsula and at other localities along the west coast of the Island of Newfoundland.

Oil was found in wells drilled in the St. Pauls Inlet and Parsons Pond areas. At St. Pauls Inlet, on its west side, the first well was drilled in 1896. Further drilling was carried out in 1952-1953.

71.5 Turn-off to Cow Head Peninsula.

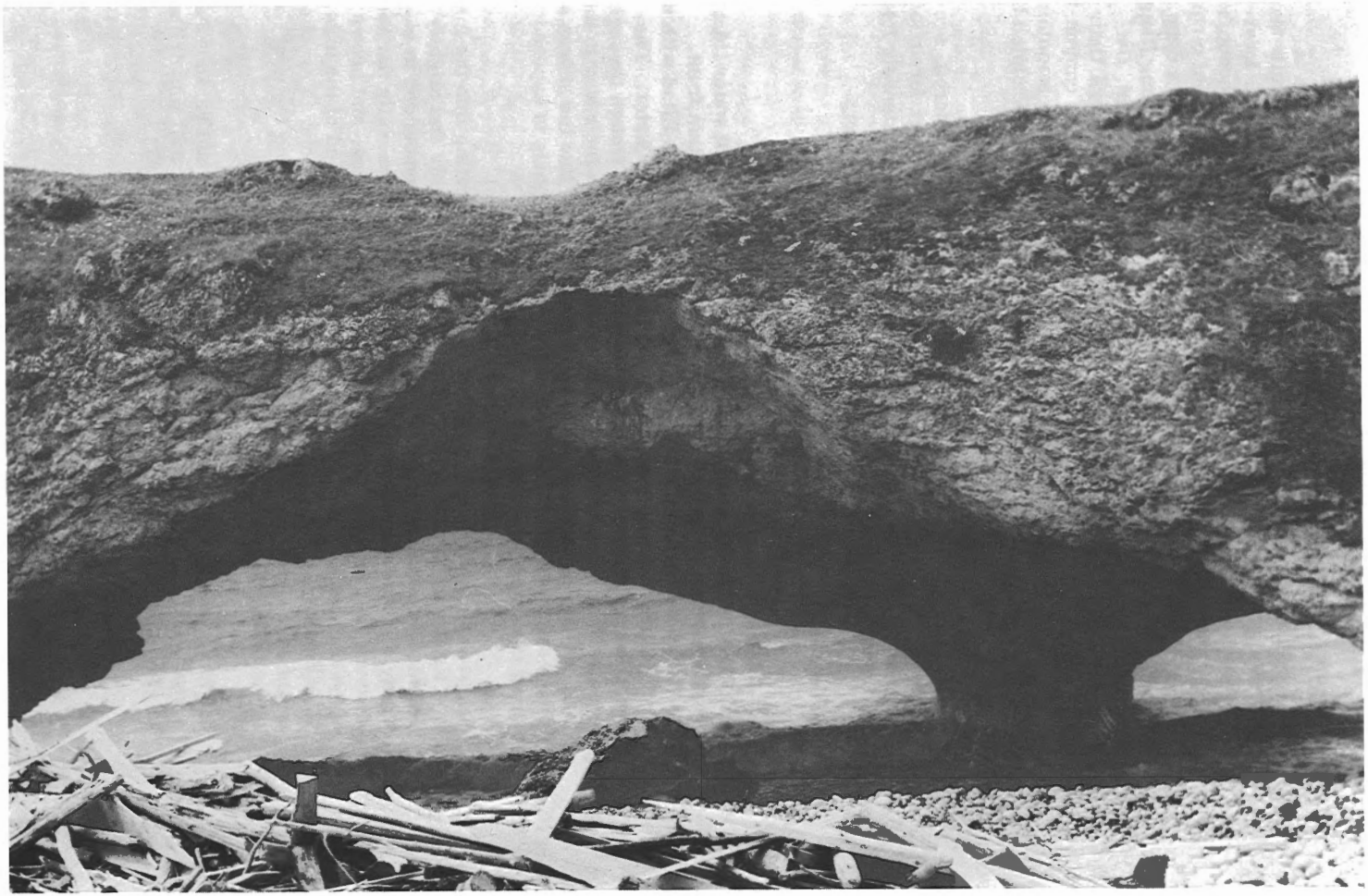


Plate XXXVI. Sea-arches, the result of sea-erosion along shoreline exposures near Portland Creek. (Nfld. Dep. Tourism 794)

Mile 71.5 (cont.) Cow Head

Cow Head, a peninsula extending into the Gulf of St. Lawrence, is the world famous geological locality where a limestone breccia is spectacularly developed. The breccia, known as the Cow Head breccia, consists of a densely packed chaotic jumble of variously sized limestone fragments embedded in a fine grained sandy or dolomitic limestone matrix. The fragments, in various shades of grey, range in size from flat angular chips ¼ inch to several inches long to enormous slabs, blocks, and slightly rounded boulders measuring up to several hundred feet long. An immense slab measuring 600 by 400 by 20 feet is the largest recorded. Some of the boulders contain fossils. Along seaside exposures — notably on the peninsula's northwest side — the rock displays a striking weather-beaten surface with boulders and fragments protruding out, the result of weathering by the sea, wind, and rain. This breccia is unusual in that it is extremely coarse and it contains well-preserved angular chips and plates of limestone within the chaotic assemblage. The rock is of Cambrian to Ordovician age. It is also exposed at St. Pauls Inlet, Parsons Pond, Broom Point (Mile 63.5), Martin Point (Mile 58), Lower Head (west of Mile 75.5) and at Green Point.

The Cow Head breccia is interbedded with limestone, shale and some sandstone. These rocks form a coastal belt extending from Port au Port Peninsula to Pistolet Bay, but the best exposures are between Green Point and Daniel's Harbour where they form erosion-resistant headlands and hills and ridges.

Cow Head Peninsula is slightly more than a mile long, a maximum of half a mile wide, and rises to form a hill 221 feet above the level of the shore. Graptolites occur in steeply dipping Ordovician shale beds exposed on the south shore. Cambrian fossils including brachiopods and trilobites occur in limestone exposed along the northwestern shore of the peninsula. Along the beaches of Cow Head Harbour, pebbles and boulders of green chert and of multi-patterned volcanic rocks are found. They are suitable for ornamental purposes.

72.0 Cow Head Harbour on left.

Stearing Island, White Rock Islets

Stearing Island, 2½ miles to the northwest, and the White Rock Islets, on the north side of the harbour, are visible from the harbour. They are composed of Cow Head breccia weathered to a white, knobby surface. The adjacent reefs are also formed of this rock. Stearing Island is half a mile long and 200 yards wide. At its southwestern end, black shale interbedded with dark grey limestone is conspicuously contrasted with the light coloured breccia. The White Rock Islets form a mile-long, crescent-shaped string of white islets and reefs; the breccia there is composed of fragments averaging 2 inches long.

78.0 Parsons Pond Hill (elevation 470 feet) on right.

Mile 81.0 Bridge over Parsons Pond River. Parsons Pond is another tidal lagoon where salt water extends as far as the Long Range Mountain front.

Parsons Pond

The presence of oil in the St. Pauls — Parsons Pond area was noted as early as 1812 when a Mr. Parsons obtained oil from seepages at Parsons Pond. He is believed to have used it in the treatment of rheumatism. There was no exploration until 1867 when a Halifax mill owner, Mr. Silver, drilled a well to a depth of 700 feet and struck oil. Between 1893 and 1906, Newfoundland Oil Company drilled several holes that yielded paying quantities of oil. The wells, drilled to a maximum depth of 2850 feet, yielded 1½ to 6½ barrels of oil per day. In 1907-1908, about 800 barrels of oil were shipped to the Gas Works at St. John's. Gas was also produced from the wells. In the early 1920's, Mr. Jack Henry drilled three wells and operated a small refinery on the site producing gasoline and kerosene. Intermittent drilling was continued until 1965 when the most recent well was bored by Newfoundland and Labrador Corporation. A total of 26 wells were drilled at Parsons Pond. The petroleum from these wells was a light amber, rich lubricating oil. Some of it was used to lubricate the engines used in the drilling operations. The oil occurs in a rock formation consisting of argillite and limestone of Ordovician age. The wells were drilled along the shore on both sides of Parsons Pond, east of the Inner Narrows. Graptolites occur in shale exposed along the north shore.

88.5 The Arches Beach

At this seaside locality, sea-arches have been carved out from shoreline exposures of dolomitic limestone. They were produced by wave erosion that pierced fractured zones in the rock. The beach along the arches is lined with granite cobbles transported by glaciers from the Long Range Mountains. Similar erosional features occur elsewhere along the seacoast.

90.5 Portland Hill (elevation 562 feet) on right.

93.5 Portland Creek bridge. Portland Creek drains Portland Creek Pond, a freshwater lagoon.

98.0 Daniel's Harbour. A new zinc mine, the Newfoundland Zinc Mine, is located 7 miles from this port.

Newfoundland Zinc Mine

SPHALERITE, GALENA, PYRITE, MARCASITE, DOLOMITE, CALCITE

In brecciated dolomitic limestone of Ordovician age

Sphalerite, the ore mineral, forms coarsely crystalline aggregates and, less commonly, colloform masses. Minor amounts of galena, pyrite and marcasite are associated with it. The gangue minerals are white dolomite and calcite.

The deposit, located 7 miles inland from Daniel's Harbour, was discovered as a result of a diamond drilling campaign conducted by Newfoundland Zinc Mines Limited between 1963 and 1967. The investigation was sparked by the discovery of zinc mineralization near Daniel's Harbour by prospectors M. Labchuk and J. T. Meagher. The ore reserves are estimated to contain 4 500 000 tons averaging 8. 8 per cent zinc. Development consists of a 5000-foot inclined adit and a 1500 ton mill expected to be in production in 1975. Concentrates will be trucked 35 miles to Hawkes Bay where they will be loaded onto 6000-ton ships. Future plans include an open pit operation to a depth of 80 feet in ore zones near and beneath Zinc Lake. This lake will be dammed and its north end drained to make way for mining operations.

Access to the mine is by a 7-mile road from Daniel's Harbour.

Refs.: 37 p. 20-24; 181 p. 238

Maps (T): 12 I/6 -12 I/5 Bellburns
(G): Portland Creek — Port Saunders, Newfoundland (Nfld. Dep. Mines Energy, 1 inch to 2 miles)

As the highway continues its northward course, the Coastal Lowland broadens and the distant, remarkably uniform Long Range Mountains decrease in elevation.

Mile 105. 0 Bellburns. On the shore, two miles north of Bellburns, Table Point forms a broad headland. From its south side to a cove 3 miles to the north, sea-cliffs expose fossiliferous Ordovician rocks. The rock formation consists of limestone and dolomitic limestone interbedded with shale. Fossils including trilobites, gastropods, corals, brachiopods, sponges, bryozoans, cephalopods and ostracods occur in the limestone. The dolomitic limestone exposures between Table Point and Bateau Cove (opposite Mile 108. 5 on Highway 430) contain cavities lined with crystals of dolomite.

108. 5 Bateau Cove on left.

109. 0 Blue Mountain (elevation 2128 feet) at the edge of the Long Range Mountains is southeast of this point. This mesa-like hill is an erosional remnant of Cambrian sedimentary rocks that cap the Precambrian granitic base. It is flanked by Western Blue Pond on its south side and Eastern Blue Pond on the north side.

115. 5 River of Ponds Provincial Park. This park occupies a gently sloping area on the west side of River of Ponds, including a one-mile stretch of the river bank. The river drains River of Ponds Lake and Eastern Blue Pond.

132. 5 Bridge over Torrent River; 8-mile-long Hawkes Bay is on the west side of the highway. Torrent River, the outlet of Western Brook Pond, flows from the Long Range Mountains; its headwaters are at an elevation of 1200 feet, 20 miles east of its mouth.

Mile 145.0 Turn-off to Port au Choix. This road leads to two peninsulas marking the southwestern end of St. John Bay: Pointe Riche Peninsula, and Port au Choix Peninsula, the smaller and more northerly of the two. They are separated from the mainland by Gargamelle Cove and Back Arm.

Port au Choix Archeological Sites

A large burial ground used by the Maritime Archaic Indian people, believed to be the first inhabitants of the peninsula, was revealed in excavations at Port au Choix in 1968. This culture is believed to date back to 2000-1200 B.C. A museum displaying tools and ornaments used by this ancient people was opened on the site in 1969. Near Port au Choix is another archeological site — the Dorset site where excavations revealed that the Dorset Eskimo people lived on the Great Northern Peninsula from about A.D. 100 to 700.

Port au Choix Shoreline Occurrences

Limestone and dolomitic limestone are exposed along the shore of St. John Bay from Pointe Riche Peninsula eastward to Bustard Cove, 6 miles from Gargamelle. The rocks contain cavities lined with crystals of calcite, dolomite or quartz. Ordovician fossils including gastropods, cephalopods, corals and trilobites occur in the limestones. These rocks are exposed at the following localities: the northwest side of Point Riche Peninsula, the north and west sides of Port au Choix Peninsula, the east shore of Back Arm (the inlet north of Gargamelle village), the west side of Gargamelle Cove (an inlet on the south side of Gargamelle village), and eastward along the shore from Gargamelle to Bustard Cove. Cavities lined with white, pink and red fluorite crystals have been reported from exposures near Bustard Cove.

155.0 Eddie's Cove West. The highway parallels the Highlands of St. John, a 20-mile-long, steeply sloped ridge lying between the Long Range Mountains and St. John Bay, Gulf of St. Lawrence. The ridge consists of several flat, barren summits (elevations of up to 2050 feet above sea level) that tower above the adjacent Long Range Mountains and are separated from them by the valley of the East River which is bridged by Highway 430 at Mile 135. Cambrian sedimentary rocks overlie a basement of Precambrian rocks to form this ridge. Low-lying, marshy St. John Island in St. John Bay is underlain by Ordovician limestone, shale and dolomitic limestone.

180.0 Junction Highway 432 to Canada Bay. This highway leads eastward along the southern edge of the lowlands that occupy the northern tip of the peninsula north of the Long Range Mountains. Mount St. Margaret, a prominent 915-foot hill, is at the northwestern end of the mountain range and a few miles southeast of the junction of the highways at Mile 180. A marble deposit occurring at Canada Bay is described on page 146.

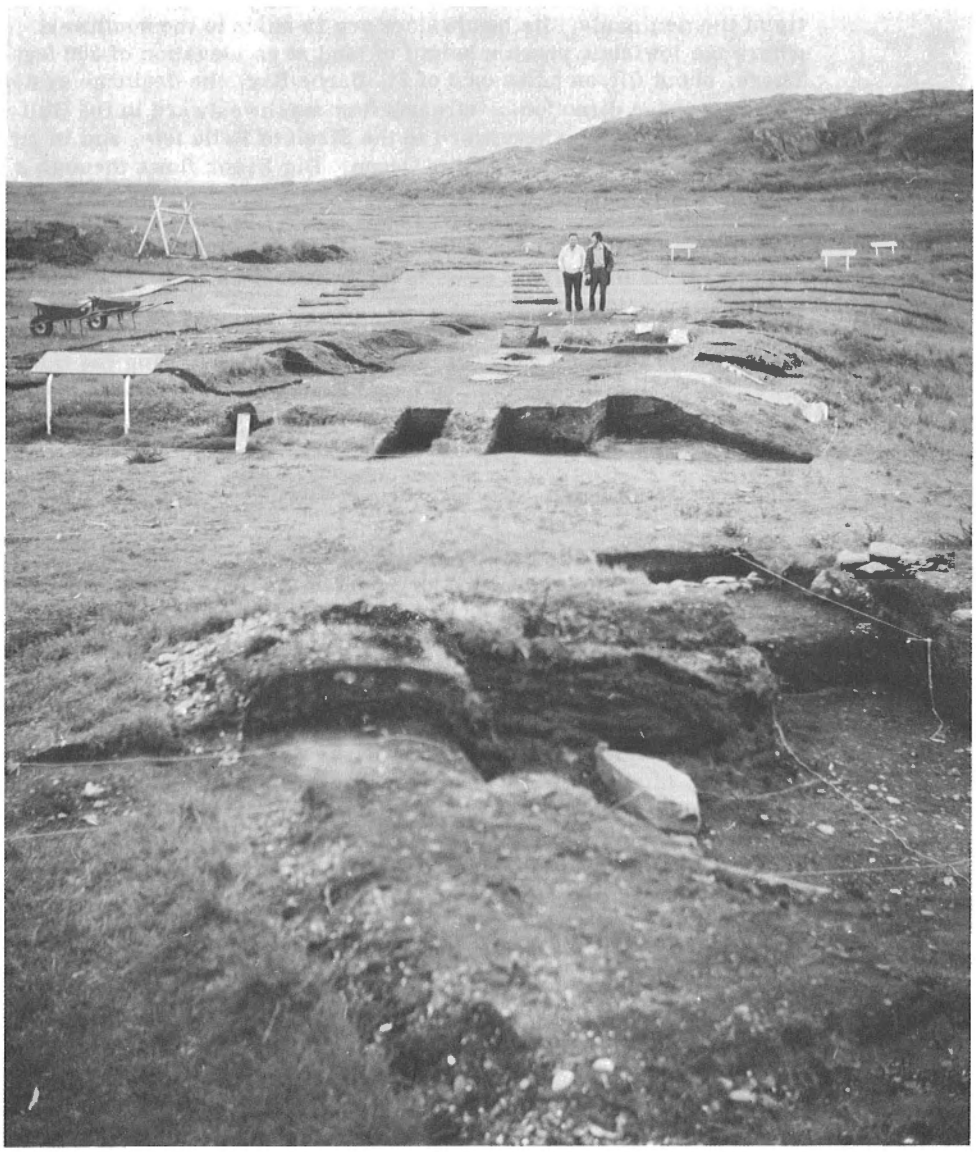


Plate XXXVII. L'Anse-au-Meadow archeological site. (GSC 202643)

Mile 210.0 Savage Cove on left. Savage Point, $\frac{3}{4}$ mile west of the highway, is the nearest point on the Island of Newfoundland to mainland Canada: Armour Point, Labrador is less than 11 miles away on the opposite shore of the Strait of Belle Isle.

Mile 238.0 Big Brook. This is the longest stream flowing through the northern tip of the peninsula. Its headwaters are 25 miles to the southwest where the lowlands reach a height of land at an elevation of 300 feet. There, about fifteen miles east of St. Barbe Bay, the drainage systems divide in three directions: streams flow southwestward to the Gulf of St. Lawrence, northeastward to the Strait of Belle Isle, and in an easterly direction to the Atlantic Ocean. Big Brook flows through a meandering course forming chains of lakes in glacier-scoured terrain riddled with lakes, ponds and swamps which, in places, occupy more than half the surface of the land. It ends its long, sluggish journey at Unfortunate Bay, Strait of Belle Isle where it forms rapids below the highway bridge.

244.0 The highway takes an easterly inland direction traversing the tip of the Great Northern Peninsula and ending its long shoreline journey. It cuts across the northern end of the Coastal and Central lowlands reaching the Atlantic shore at St. Anthony.

248.0 Junction Highway 435.

At about this point the highway enters the Newfoundland Central Lowland that comprises the eastern part of the peninsula from Cape Bauld, Quirpon Island to Canada Bay. It is a marshy region underlain by Cambrian and Ordovician sedimentary rocks except for a ridge — the White Hills — bordering the north side of Hare Bay. These hills are composed of peridotite rocks of Ordovician age.

255.0 Pistolet Bay on left. The boggy, remarkably flat lowland on the south side of the highway is 100 feet or less above the level of the sea and is dotted with hundreds of small lakes and ponds that in places cover half the land surface. In the distance to the south, the White Hills rise to form a rolling ridge surmounted by conical treeless peaks reaching a maximum elevation of about 1000 feet.

265.0 Junction, Highway 436 to L'Anse-au-Meadow and to Highway 437 leading to Ha Ha Bay.

L'Anse-au-Meadow National Historic Park

The park, occupying 30 square miles, marks the site of a Norse settlement dating back to A.D. 1000. It includes islands in Sacred Bay and a 7-mile strip of coastline extending west from South Road (bay) to Highway 436. The region is barren and near sea level. Hills and ridges rise from this low-lying surface to elevations of from 50 to 150 feet. The park is underlain by lower Paleozoic rocks with sedimentary rocks forming most of the area except for some islands such as Great Sacred and Little Sacred islands which are composed mostly of volcanic rocks.

The Norse archeological site located at Black Duck Brook near its mouth on Epaves Bay, was discovered in 1960. Several Viking-type house sites including a multi-room site measuring 70 feet by 55 feet, a smithy and smelting pit, fragments of slag and lumps of bog iron

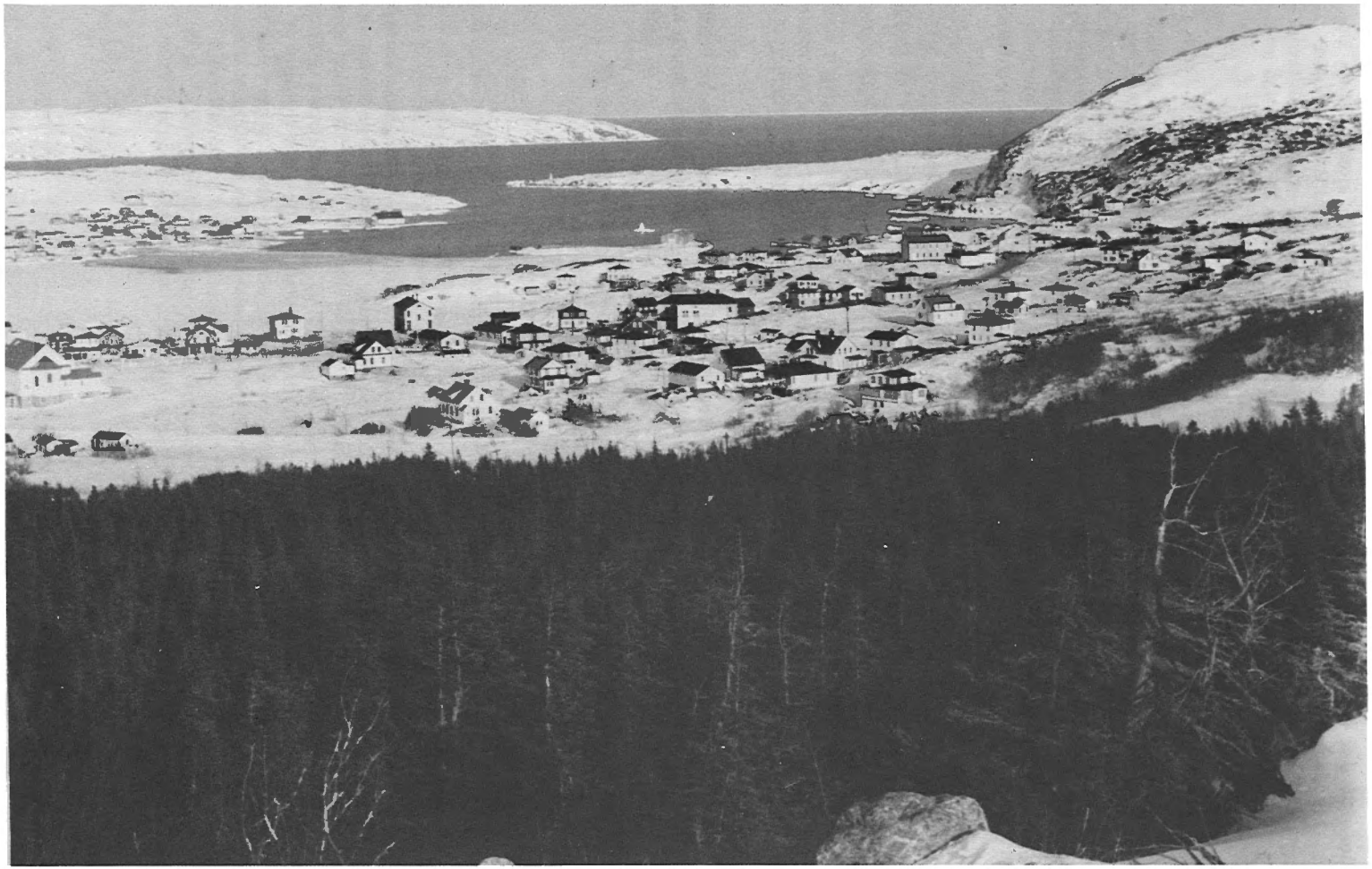


Plate XXXVIII. St. Anthony, the northernmost port on the Island of Newfoundland. Cape St. Anthony is the distant headland and St. Anthony Hill (400 feet) is on right. (Nfld. Dep. Tourism 970)

Mile 265.0 (cont.) ore, and artifacts and tools were uncovered in the excavations. Bog iron ore occurs in the soil at Black Duck Brook and it is believed that this was the source of iron ore used by these early inhabitants. The short access road to the park leads west from Highway 436 at a point 18.4 miles from its junction with Highway 430.

Whale Cave (The Big Oven), Burnt Island

A giant sea cave, known as the Whale Cave or the Big Oven, occurs on the west shore of Burnt Island, a peninsula forming the western side of Ha Ha Bay. The cave is 60 feet wide and 40 feet high at the entrance and extends inward a distance of 300 feet. At the entrance, the water is 30 feet deep allowing boats to enter when the weather is calm. Inside, midway into the cave, the water's edge is marked by a pebbly beach. At the back of the cave, the roof slopes gently to a pebble-covered floor.

Whale Cave is one of the largest sea caves known in the world. It ranks with the famous Hebridean caves including Fingal's cave which is 227 feet long with an entrance 42 feet wide and 66 feet high.

The cave was formed as a result of erosion by sea waves along a zone of structural weakness in dolomitic limestone. Burnt Island is underlain by limestone of Ordovician age. Its barren, rocky surface contains numerous sinkholes, ravines, and other erosional features.

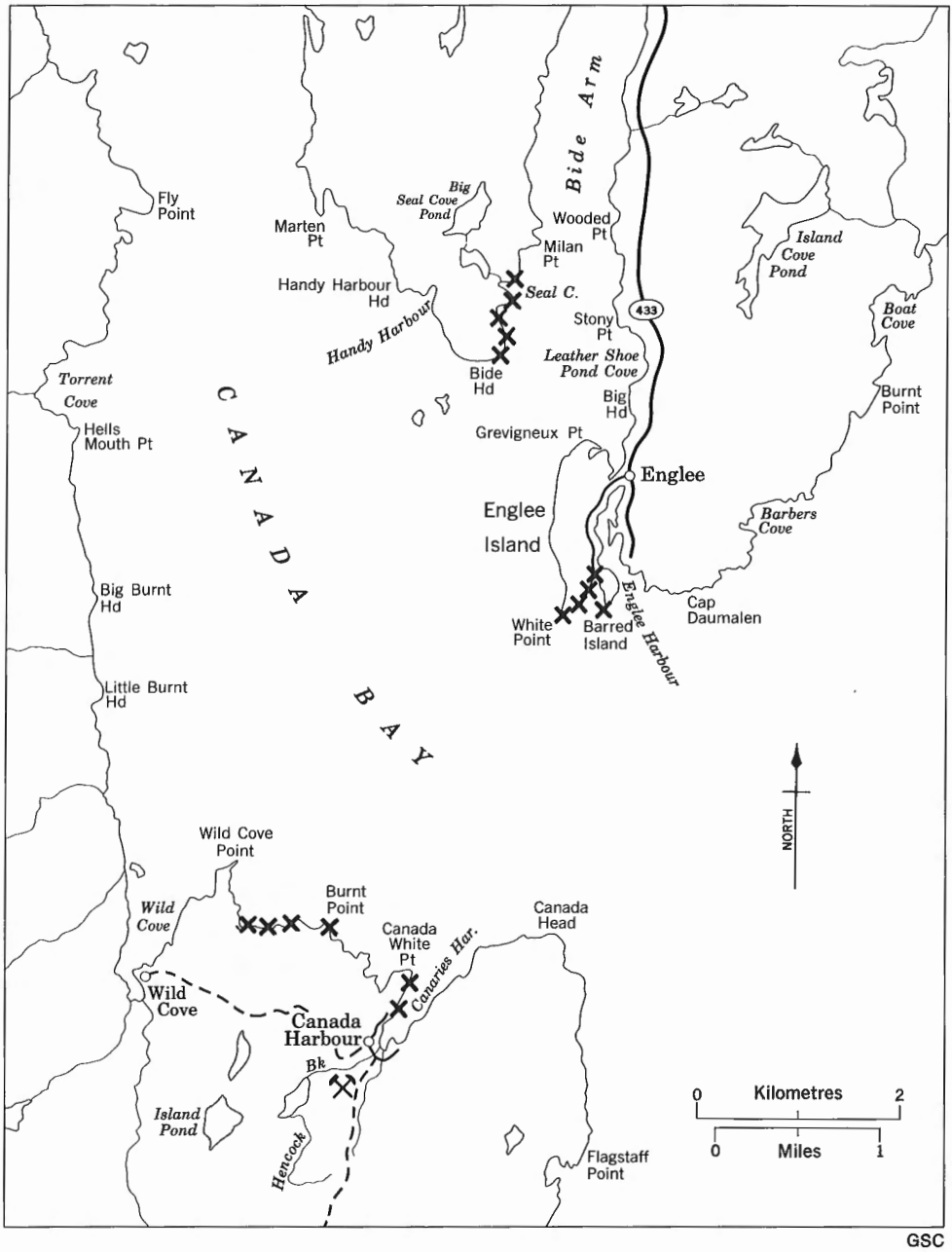
Whale Cave is on the west shore of the island, midway between Burnt Cape (at the northern tip) and Falaise Point, or about a mile south of Burnt Cape. Burnt Island is a flat-topped ridge, about 2½ miles long, rising to an elevation of 200 to 250 feet above the surrounding waters. Access to the cave is by boat from Raleigh, a settlement just off Highway 437 at a point 11.4 miles from Highway 430.

271.5 St. Anthony, the northernmost port on the Island.

278.0 Goose Cove, Hare Bay. The Great Northern Peninsula Road ends here.

Goose Cove Mine

The Goose Cove copper mine is located southeast of Brimstone Ponds on the narrow strip of land between Goose Cove and Three Mountain Harbour; it is 400 yards east of Highway 430 at a point 5.8 miles south of the turn-off to St. Anthony (Mile 271.5). It was developed over a period of several years beginning in 1908 by Brenton Symons of London. Several shafts were put down, one to a depth of over 100 feet. No shipments were made, and the ore removed was piled up at the site where it remains. The ore consists of pyrite, pyrrhotite and chalcopyrite with minor amounts of sphalerite and magnetite. It is associated with calcite, quartz, epidote, and hornblende in schist.



Map 12. Canada Bay marble quarry ⚒, and occurrences ×.

Refs.: 11 p. 1-17; 24 p. 1-4, 27-31; 26 p. 5-6; 27 p. 5-9; 38 p. 20-24; 39 p. 18-25; 42 p. 3-7, 20-22; 49 p. 28-31; 66 p. 567; 68 p. 643-649; 74 p. 222-224; 83 p. 1-4; 84 p. 238-239; 96 p. 5, 6; 101 p. 9; 105 p. 5-6, 19-43; 130 p. 21-86; 135 p. 109-110; 144 p. 8-13; 145 p. 501-513

Maps (T): 2M St. Anthony
12H Sandy Lake
12I + 2L Port Saunders
12P Blanc Sablon
(G): 1231A Island of Newfoundland (G.S.C., 1: 1 000 000)

Canada Bay Marble Occurrence

MARBLE

Two types of marble occur at Canada Bay, both suitable for carving and for cutting and polishing into ornamental objects. Both varieties are finely granular, compact and take an excellent polish. One variety is cream white to ivory or slightly pinkish in colour, the other is dark blue grey to almost blue black with a velvety appearance on its polished surface. Some of the dark marble is attractively patterned with straight veins of white calcite. The dark colour is due to graphite inclusions. A white marble that is veined and mottled with a mixed aggregate of green chlorite, mica, calcite, and quartz is also found in the deposit; it does not lend itself to cutting or carving.

Quarries were opened in the deposits about 60 years ago by the Colonial Mineral and Trading Company, but the rock was not put to commercial use. It is now used by hobbyists and lapidaries as an ornamental stone.

The marble (crystalline limestone) is of Ordovician age and is associated with limestone and dolomite overlain by slate and phyllite. Nodules of chert occur in the marble. It is exposed at several localities in Canada Bay, the second longest indentation (after Hare Bay) on the eastern side of the Great Northern Peninsula. The white marble occurs in a zone extending from 1½ miles south of Canada Harbour to Canada White Point and beneath the bay to and along the east side of Englee Island and to Englee village. It is conspicuously exposed along cliffs at White Point on the southern tip of Englee Island and along shoreline cliffs on the west side of Side Arm, notably between Bide Head and Seal Cove. Two quarries were opened at the north end of a 250-foot marble ridge that borders the east side of Hencock Brook and extends southward from Canada Harbour. The white marble grades into the blue grey variety at these localities.

Blue grey marble is also exposed at: Burnt Point (one mile west of Canada Harbour), the large cove east of Wild Cove, on Barred Island, at Englee village, and at Canada Harbour between the church and the shore where a quarry was opened.

The occurrences at Canada Harbour and Bide Arm are accessible by boat from Englee village.

Refs.: 3 p. 8-9, 25-40; 15 p. 35-43; 21 p. 103-104; 135 p. 131-132

Maps (T): 12 I/9 Englee
12 I/16 Roddickton
(G): 12 Canada Bay sheet, northern Newfoundland (Nfld. Dep. Mines Energy, 1 inch to 1 mile)

The Trans-Canada Highway road log is resumed.

Mile 400.8 Deer Lake, at junction, Highway 430. Deer Lake is almost 17 miles long and from 1 to 2 miles wide. It is formed by the broadening of the Humber River. The Trans-Canada Highway parallels its eastern shore for its entire length, then follows the south bank of the Humber River to Corner Brook.

421.4 Little Rapids village. At this point the Humber River broadens to its maximum of ¼ mile. Its steep valley slopes rise to rounded hills with elevations of up to 1700 feet on its south side and to 1000 feet on the opposite side. In places it is walled by 250-foot cliffs. The headwaters of the Humber River are about 60 miles to the north in the Long Range Mountains. The water is discharged into 15-mile-long Humber Arm, the longest of the arms branching from scenic Bay of Islands. Between Deer Lake and Humber Arm, the Humber River and the Trans-Canada Highway cut across the Long Range Mountains and, from Corner Brook to the end of its course, the Trans-Canada Highway parallels the west side of these mountains. Viewed from the highway, the southern Long Range Mountains are seen as a steeply sloped, flat-topped range with wooded flanks deeply furrowed by streams flowing west to St. George's Bay and to the Codroy valley. The mountains are underlain by Paleozoic metamorphic and granitic rocks.

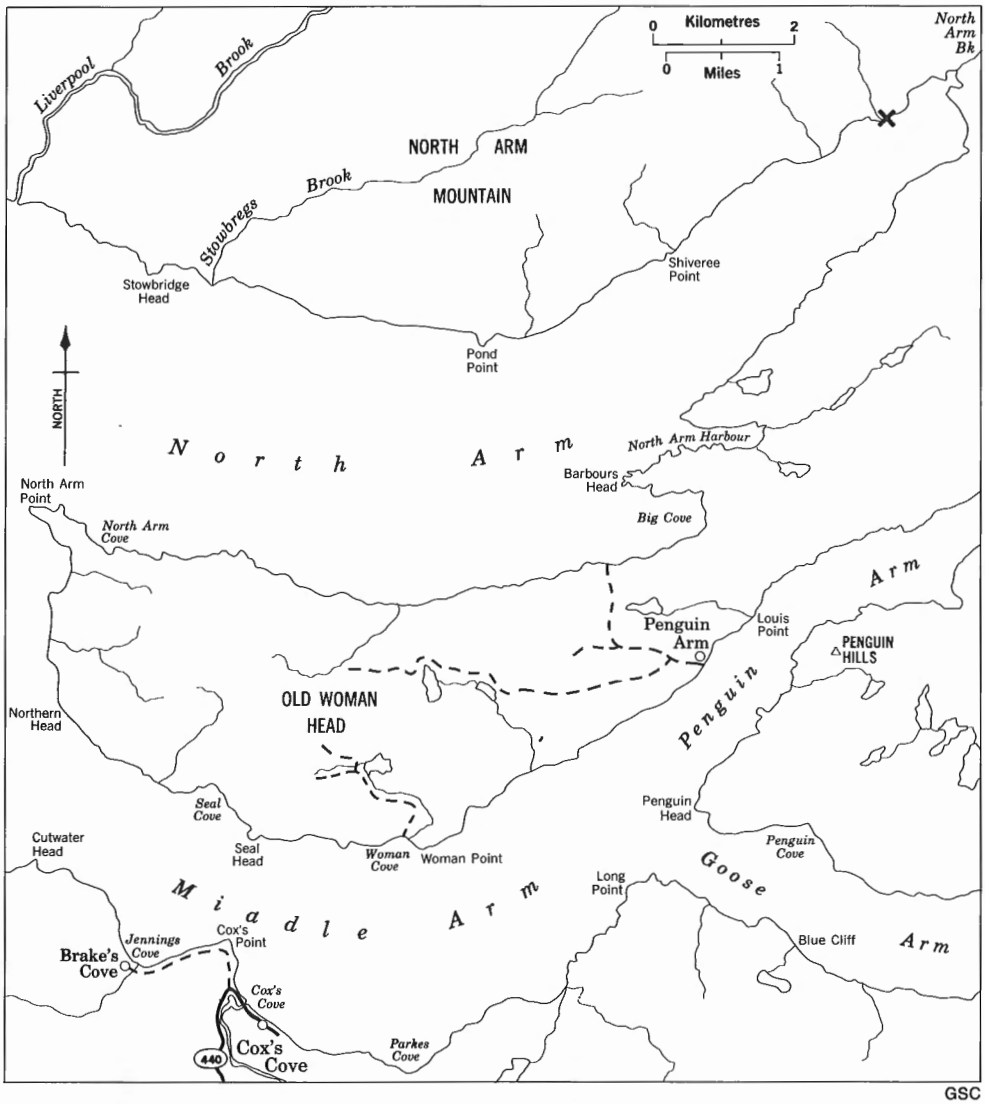
427.7 Limestone Junction quarry on left.

Limestone Junction Quarry

MARBLE

An attractive marble suitable for lapidary purposes occurs at this quarry. Its background colour is white, ivory, fawn coloured or grey, and it is patterned with clouds, streaks, spots and bands in shades of pink to rose, mauve to magenta, light green or yellow. It is a compact, finely textured rock that takes a good polish. It is intensely fractured thus precluding the extraction of the large blocks that would be required for building purposes. Blocks large enough for carving or cutting into ornamental objects are, however, readily available.

The marble is exposed on the face of a 250-foot cliff overlooking the Humber River and the Trans-Canada Highway. It was quarried many years ago by Bowaters Newfoundland Pulp and Paper Company Limited for use in its plant at Corner Brook.



Map 13. North Arm xonotlite occurrence.

The turn-off to the quarry is at Mile 427.7. Similar rock occurs in a quarry on the south side of the Trans-Canada Highway at Mile 429.8.

Ref.: 151 p. 46-47

Maps (T): 12 A/13 Corner Brook
(G): 8-1957 Red Indian Lake (west half) Newfoundland (G.S.C. 1 inch to 4 miles)
35 Corner Brook-Stephenville, districts of Humber, St. Georges-Port au Port (Nfld. Dep. Mines Energy, 1 inch to 1 mile)

Mile 429.1 Junction, road to Cox's Cove (Highway 440).

North Arm Xonotlite Occurrence

XONOTLITE, GARNET, PECTOLITE, PREHNITE, PLAGIOCLASE, CLINOZOISITE, CHLORITE, PUMPELLYITE, APATITE

In serpentinite

White, pink, and rose-pink xonotlite occurs with prehnite, pectolite, clinozoisite, plagioclase, feldspar, chlorite, and small amounts of pumpellyite, apatite and garnet along the valley walls of a stream flowing down the south slope of North Arm Mountain into North Arm, Bay of Islands. The xonotlite is similar to that at Winter House Brook. In both localities, some specimens containing concentrations of xonotlite large enough to produce a cut cabochon are available .

The occurrence is on the steep slope of North Arm Mountain where it is incised by a south-flowing stream about a mile west of the mouth of North Arm Brook. Specimens are available from the talus along the slope and along the beach below. Access to the occurrence is by boat from Cox's Cove, a distance of about 13 miles.

Ref.: 133 p. 48-50

Maps (T): 12 H/4 Pasadena
12 G/1E Bay of Islands
(G): 1057A Bay of Islands, Island of Newfoundland (G.S.C., 1 inch to 2 miles)

Mile 430.0 Road-cut on left exposes bluish to greenish grey marble commonly banded and spotted in shades of dark red. The marble is similar to that found at the Limestone Junction quarry and at the quarry at Mile 429.8.

431.4 North Star Cement Limited plant on right. Shale from a quarry near the plant, and limestone from two adjacent quarries located about a mile to the east are used by this company for the manufacture of portland cement. The limestone is Ordovician black crystalline limestone (marble) and is similar to the marble in the abandoned Dormston quarry. The cement plant has been in operation since 1952.
(Refs.: 97 p. 89-90; 135 p. 27)

Mile 432.3 Turn-off to Dormston quarry, visible on left.

Dormston Quarry

MARBLE

Fine to coarse textured black marble (crystalline limestone) of Ordovician age occurs at this abandoned quarry. White calcite occupies joints in the rock. The marble takes a good polish and is suitable for use as an ornamental stone.

The quarry was operated from 1925 to 1943 by Bowaters Newfoundland Pulp and Paper Company Limited for use in their Corner Brook manufacturing plant. It was opened into the steep west side of an escarpment, its face having a height of 300 feet. It is at an elevation of 650 feet above Humber Arm.

Road log from the Trans-Canada Highway at Mile 432.3:

Mile 0 Turn left (east).

0.1 Turn right onto quarry road.

0.3 Quarry.

Refs.: 21 p. 93; 97 p. 89-90; 135 p. 28; 151 p. 44-46

Maps (T): 12 A/13 Corner Brook
(G): 8-1957 Red Indian Lake (west half), Newfoundland (G.S.C. 1 inch to 4 miles)
35 Corner Brook-Stephenville, districts of Humber, St. Georges-Port au Port (Nfld. Dep. Mines Energy, 1 inch to 1 mile)

Mile 432.4 Turn-off to Corner Brook.

York Harbour (Blo-mi-don) Mine

PYRITE, CHALCOPYRITE, SPHALERITE, PYRRHOTITE, GALENA, RUTILE, BARITE, LIMONITE, MALACHITE

In chloritic rock

The metallic minerals occur as disseminated and massive intergrowths and as stringers and veinlets. Pyrite, chalcopyrite and sphalerite are the most abundant sulphides. Pyrrhotite is less abundant and galena and rutile are rare. Barite, limonite and malachite have also been reported from the deposit.

The mine was worked intermittently for copper from 1897 to 1912 by various companies including Harvey and Company of St. John's (in 1898) and the Humber Consolidated Mining Company (in 1904). A total of 30 000 tons of ore was shipped; one shipment made in 1908 averaged 3.25 per cent copper and 38 per cent sulphur. The old workings consist of the main 364-foot shaft, several other shafts, and an adit. A tramway connected the mine to a shipping pier at York Harbour.

The deposit was recently investigated by Independent Mining Corporation (1951-1953) by Nama Creek Mines Limited (between 1955 and 1966) which drove a 3500-foot adit, and by Long Lac Mineral Exploration Limited (1970) which did some underground development.

The old workings are on the east side of a branch of Mine Brook about a mile south of York Harbour, Bay of Islands. They are at an elevation of 1100 feet. Access is by a trail leading south from Highway 450 where it crosses Mine Brook at a point 7.6 miles west of Frenchman's Cove (at turn-off to the shore) or 4.3 miles west of the Highway 450 bridge over Blow Me Down River. The new workings are at the side of the highway at Mine Brook.

Refs.: 23 p. 51-52; 35 p. 53-61; 135 p. 63

Maps (T): 12 G/1 W Bay of Islands
(G): 1 Blow Me Down sheet, Humber district (Nfld. Dep. Mines Energy, 1 inch to 1 mile)

Mile 432.8 A series of intermittent road-cuts extending for a distance of about 7 miles exposes black marble similar to the Dormston marble. Some reddish buff-coloured marble occurs with the black.

443.6 Pinchgut Lake on left.

448.6 Turn-off to Blue Pond Provincial Park.

463.5 Junction, Highway 460. This highway leads to Stephenville, a distance of 27 miles. From Stephenville, access is given for these occurrences: Cliff Mine, Lower Drill Brook Mine, Upper Drill Brook Mine, Indian Head labradorite occurrence, Romaines Brook gypsum occurrence and to the Aguathuna quarry.

Cliff Mine, Lower Drill Brook Mine, Upper Drill Brook Mine

MAGNETITE, HEMATITE, PYRITE, CHALCOPYRITE, MOLYBDENITE, GARNET, CHLORITE, APATITE, GOETHITE

In lenses in norite gneiss and granite gneiss

A small amount of magnetite and hematite was produced from these iron mines in the Indian Head area, east of Stephenville. The ore consisted of massive magnetite and specular hematite. Plagioclase feldspar, dark red garnet, apatite and chlorite were associated with the iron minerals. Pyrite, chalcopyrite and molybdenite occurred at the Lower Drill Brook Mine. The magnetite carried some titanium and vanadium . Ore specimens can be obtained from the dumps of these old mines; they are commonly coated with a rusty yellow to brown powdery coating of goethite.

The iron deposits occur in the Indian Head Range. They were first reported in 1888 but had been known to the local inhabitants for many years. Original prospecting by trenching and diamond drilling was carried out in 1923 by the Reid Newfoundland Company Limited. Between 1941 and 1943, Dominion Steel and Coal Corporation Limited (DOSCO) of Sydney, Nova Scotia mined the deposits and shipped the magnetite and hematite to its plant in Sydney.

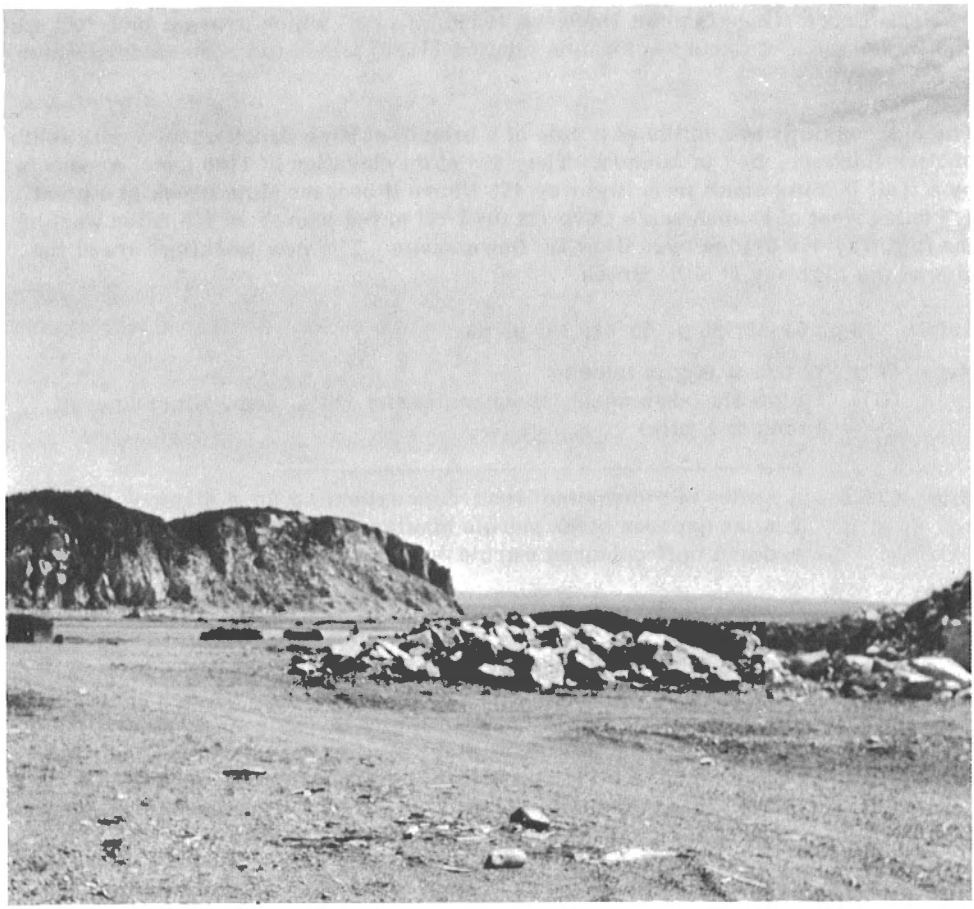


Plate XXXIX. Indian Head anorthosite occurrence. Labradorite occurs in the blocks of anorthosite in foreground. (GSC 202741)

Three deposits were opened in the vicinity of Gull Pond which is locally referred to as Mine Pond. The Cliff Mine is on the south slope of a steep granite ridge overlooking the north side of Gull Pond at an elevation of 125 feet above the pond. It consists of a pit, 400 feet by 60 feet, and a 28-foot adit driven into the face of the ridge about 20 feet east of the west end of the pit. The Lower Drill Brook Mine — a pit measuring 200 feet by 100 feet — is on a wooded slope facing the northwestern end of Oxback Pond, and the Upper Drill Brook Mine, also an open pit, is 300 feet east of the Lower Drill Brook Mine.

Road log from Stephenville:

Mile	0	Intersection Main and West streets; proceed along Main Street.
	0.6	Intersection Queen Street; continue along Main Street.
	1.3	Turn-off to airport terminal; continue straight ahead.

Mile 5.2 Junction at gate to Labrador Linerboard Limited plant; turn left onto gravel road.

5.8 Junction; turn right.

6.2 Junction; turn left.

6.6 Junction; follow road on right along the shore of Gull Lake.

7.2 Junction; turn right.

7.5 Dump of Cliff Mine on left.

7.9 End of road at St. Stephen's parish building between Gull and Oxbow ponds. From this point an old road leads north about 100 yards to the Lower Drill Brook Mine. The Upper Drill Brook Mine is 100 yards to the east.

Refs.: 51 p. 34-36; 62 p. 52, 54-59; 124 p. 74-76; 125 p. 88; 135 p. 74-75; 165 p. 121

Maps (T): 12 B/10 Stephenville
12 B/9 W Harrys River
(G): 1117A Stephenville, Newfoundland (G.S.C., 1 inch to 4 miles)

Indian Head Labradorite Occurrence

LABRADORITE

In anorthosite

Light grey labradorite exhibiting a light to medium blue labradorescence occurs in anorthosite rock at Indian Head, north shore of St. George's Bay. The labradorite lacks the depth of colour characteristic of the labradorite from Labrador, but it has an attractive appeal of its own that is revealed on the polished surface. It can be used for jewellery and for other ornamental purposes.

The anorthosite is exposed at Indian Head along a conspicuous, dazzling white cliff that is visible for many miles from distant points along St. George's Bay. Indian Head is the southern extremity of the Indian Head Range that extends northward for 17 miles rising to a maximum elevation of 1800 feet above sea level. The range is underlain by Precambrian granitic and gneissic rocks. A quarry was operated at the southwest tip of Indian Head in 1942 by the United States Government for use as rock fill, dimension stone, and railroad ballast. The quarry is difficult to reach but an accumulation of blocks of the anorthosite have been left across the channel from Indian Head, south of Stephenville Pond.

Road log from Stephenville:

Mile 0 Intersection West and Main streets; proceed east along West Street.

0.5 Turn right and proceed through gate and along road to golf course. This road parallels the shore of St. George's Bay.

Mile 3.2 End of road. Blocks of anorthosite from the Indian Head quarry are piled between the road and the shore. Indian Head is the terminal point of the Indian Head Range across the channel.

Refs.: 21 p. 68-69; 62 p. 61; 121 p. 36-37; 135 p. 122

Maps (T): 12 B/10 Stephenville
(G): 1117A Stephenville, Newfoundland (G.S.C., 1 inch to 4 miles)

Romaines Brook Gypsum Occurrence

GYPSUM

White gypsum is conspicuously exposed along a cliff that forms the steep east bank of Romaines Brook on the north side of Highway 460. The gypsum forms a series of cliffs extending over a distance of about 1200 feet. At the mouth of the brook, it forms a 70-foot cliff. The gypsum in the cliff on the north side of the highway is finely granular, massive, snow-white and is embedded with transparent to translucent light yellow and grey crystals of gypsum. The exposure on the east side of the mouth of Romaines Brook in St. George's Bay, contains white and orange massive gypsum and colourless, white and pink fibrous gypsum. Tabular crystals of colourless to pale yellow transparent gypsum and nodules of translucent orange gypsum occur in the massive variety. Specimens can be obtained from the outcrop and from broken fragments strewn along the base of the cliffs and in the bed of Romaines Brook.

The deposit was explored in 1926 by Reid Newfoundland Company Limited. Two adits were driven into the outcrops north of the highway bridge.

Road log from Stephenville:

Mile 0 Intersection Main and West streets; proceed west along West Street.

0.5 Junction Hanson Highway (Highway 460); proceed west along this road.

4.2 Bridge over Romaines Brook. Walk north about 150 yards along the east side of the brook to the gypsum cliffs. The shoreline exposure can be reached by following the east bank of the brook to St. George's Bay.

Refs.: 21 p. 80; 57 p. 29; 97 p. 14-15; 135 p. 124-125; 152 p. 80

Maps (T): 12 B/10 Stephenville
(G): 1117A Stephenville, Newfoundland (G.S.C. 1 inch to 1 mile)
35 Corner Brook-Stephenville districts of Humber, St. Georges-Port au Port (Nfld. Dep. Mines Energy, 1 inch to 4 miles)

Aguathuna Quarry

CELESTITE, BARITE, CALCITE, MARCASITE, FOSSILS

In limestone

The Aguathuna quarry was formerly worked for limestone. The rock contains a mineralized zone consisting of celestite, barite, calcite and marcasite. The celestite occurs as light blue transparent tabular crystals, the barite as pink to white platy aggregates forming hemispheres. Calcite is found as colourless transparent crystals and as white cleavable masses that fluoresce yellow in ultraviolet light. Crystal aggregates of marcasite are associated with the barite and celestite. The limestone contains abundant Mississippian fossils including brachiopods, bryozoa, pelecypods, worms, corals and ostracods. In places, concentrations of these marine fossil shells form coquina limestone.

The quarry was operated from 1913 until 1965 by Dominion Steel and Coal Corporation Limited (DOSCO). The limestone was shipped to the company's steel plant in Sydney, Nova Scotia for use as flux. The quarry extends for about a mile paralleling the south shore of East Bay, Port au Port Bay. Its face varies from 15 to 120 feet high. When the quarry was opened, the locality was known as Jack of Clubs Cove; the name was later changed to Aguathuna, an Indian word for white rock. In 1969, Sea Mining Corporation set up a plant near the quarry to extract magnesia from sea water; no shipments were made.

Similar barite-celesite mineralization is exposed in the cove immediately west of the quarry.

Road log from Stephenville:

Mile	0	Intersection West and Main streets; proceed west along West Street.
	0.5	Junction; turn left onto Hanson Highway.
	4.2	Bridge over Romaines Brook.
		After crossing the brook, the highway skirts the steep southern end of Table Mountain. This long ridge extends northeastward 9 miles rising to a flat summit at an elevation of 1235 feet above Port au Port Bay which borders its west side. It is formed of Ordovician sedimentary rocks.
	6.1	Port au Port at junction Highway 462. This village is situated on an elevated marine terrace lying 100 feet above high tide. Highway 462 leads to Fox Island River where pebbles of carnelian agate occur in the beach gravels.
	6.8	Isthmus of Port au Port. A pond — Gravels Pond — occupies nearly the entire ½-mile isthmus connecting Port au Port Peninsula to the main part of the Island of Newfoundland. Jasper pebbles are found along the beach gravels of the isthmus. Ordovician fossils including brachiopods, gastropods, and corals occur in limestone exposures

Mile 6.8 (cont.) along sea cliffs to the northwest, southwest and southeast of the isthmus, and 1½ miles to the northeast — at Black Shale Cove — graptolites occur in shale interbedded with fossiliferous limestone.

Port au Port Peninsula is a part of the Newfoundland Coastal Lowland physiographic region and is underlain by lower Paleozoic sedimentary rocks. Its 25-mile length from Port au Port village to Cape St. George consists of a range of resistant limestone and dolomite hills — the erosional remnants of a former highland. They reach a maximum elevation of 1160 feet in the White Hills at the western end of the peninsula, rising from a gently rolling lowland underlain by less resistant sandstone and shale. The shoreline of the peninsula, except for the low-lying northern shore along Port au Port Bay, is bound by 50- to 400-foot cliffs. Two dagger-like strips of land project from its north side, one terminating at Long Point, the other at Shoal Point. The former is the west shore of Port au Port Bay, the latter splits the bay into West Bay and East Bay. Shell fossils occur in the sedimentary rocks that form Long Point and the coastal cliffs along the northwestern and southern shores of the peninsula.

7.2 Junction; proceed straight ahead.

8.4 Junction; continue straight ahead.

9.4 Aguathuna quarry, east end.

From the quarry, the view to the east is of flat-topped Table Mountain with the higher summits of the Lewis Hills in the distant northeast. An unnamed peak in the Lewis Hills has an elevation of 2672 feet, the highest mountain on the Island of Newfoundland. Visible to the west is the 5-mile strip of marshy land terminating at Shoal Point, and north is The Bar with Long Point at its north end.

Refs.: 21 p. 86-90; 30 p. 91; 44 p. 192-194; 57 p. 18-19; 78 p. 5-6, 10-13; 121 p. 3-5, 55; 130 p. 46-51, 65-73; 135 p. 25-26

Maps (T): 12 B/10 Stephenville
(G): 1117A Stephenville, Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 463.5 Trans-Canada Highway at junction Highway 460.

In the next 19 miles, the highway traverses a low-lying marshy and drift-covered area. The remaining 85-mile course to the South Shore is along a valley bordering the steep western side of the Long Range Mountains, a westward facing escarpment or plateau with an average elevation of 1800 feet. From the remarkably flat, barren crest of this range, hills here and there rise to elevations of about 2000 feet above sea level (as at Mile 463) gradually decreasing to about 1500 feet at the southern end. Its slopes are indented by numerous streams, some of them cutting deep gorges into the scarp. Their broad, steep-walled valleys with cirque-like recesses produced by glaciation give the

Mile 463.5 (cont.) mountain range a rugged appearance. This range is underlain by Paleozoic igneous and metamorphic rocks. The region between it and the St. George's Bay shore is underlain by Mississippian sandstone, conglomerate, limestone, shale and siltstone.

Numerous gravel pits and gravel-bottomed streams along the highway provide collecting sites for pebbles of jasper, chert, and granitic and volcanic rocks.

468.1 View of Long Range Mountains from an elevation of 500 feet above sea level.

473.3 Turn-off to Barachois Pond Provincial Park.

480.6 View of St. George's Bay on left.

The bay is an embayment of the Gulf of St. Lawrence. Its very regular shoreline is indented only by small coves and much of it, except for the head of the bay, is fringed by cliffs or steep mountain slopes. The low-lying shoreline at its head is marshy with abundant sandbars and dunes just offshore.

483.0 Junction road to St. George's.

This is an alternate access route from the Trans-Canada Highway to Stephenville, a distance of 20 miles. Cairn Mountain (elevation 850 feet) is on the east side of this junction, and to the southeast is 1200-foot Steel Mountain rising steeply from the valley of Flat Bay Brook. From this junction to about Mile 553, the highway traverses a region underlain by Mississippian sedimentary rocks.

485.3 Junction Flat Bay Road, on south side of bridge over Flat Bay Brook.

Flat Bay Gypsum Quarry

GYPSUM, ANHYDRITE

In Mississippian sedimentary rocks

Gypsum has been quarried from this deposit since 1951. It is white, cream-coloured, or light grey, finely granular massive, and is commonly mottled white with grey. Small colourless to grey transparent to translucent selenite crystals occur in it. Other varieties of gypsum reported from the deposit include pink, light brown and black massive gypsum, white alabaster, and a fibrous gypsum (rare). Light blue to blue grey semitransparent massive anhydrite is associated with the gypsum. The anhydrite and some of the gypsum are suitable for carving into ornamental objects.

Although this gypsum deposit in the St. George's Bay and others in the Codroy areas were known as early as 1839, it was not until 1951 that commercial exploitation began. A quarry was opened in the Flat Bay deposit which consists of a cliff 50 feet high and 500 feet long. The gypsum is shipped to Corner Brook where it is used in the manufacture of gypsum products and in the cement plant. The quarry is operated

by Flintkote Mines Limited which took over operations in 1963 from Atlantic Gypsum Limited, the original operator. The quarry is near Flat Bay and the dock and shipping facilities are at St. George's.

The quarry is on the Flat Bay Road at a point 4.3 miles from its junction with the Trans-Canada Highway at Mile 485.3.

Refs.: 9 p. 495-502; 21 p. 76-77; 57 p. 29; 96 p. 4, 7; 97 p. 1-3, 15-16; 135 p. 126; 172 p. 146

Maps (T): 12 B/7 Flat Bay
(G): 1117A Stephenville, Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 495.2 Bridge over Fischell Brook

The gravels in the bed of this brook contain a variety of volcanic and granitic rock pebbles, and jasper.

502.5 Junction, Robinsons Road.

502.7 Bridge over Robinsons River.

503.9 Bridge over Barachois River.

Coal seams occur in Pennsylvanian strata along the banks of Robinsons River and Barachois Brook, about 6 miles upstream from their respective highway bridges. Coal in western Newfoundland was first noted in about 1765 by Captain James Cook, the famous explorer who for several years was Newfoundland's official surveyor. There has been no production from the Barachois or Robinsons coal seams (Ref.: 135 p. 103-105).

506.4 Junction, Jeffrey's Road.

This road and Robinsons Road lead to the shore of St. George's Bay where the beach deposits contain pebbles and cobbles of jasper and of granite streaked with epidote veinlets. One of the more accessible collecting sites is the shoreline at Robinsons where glacially deposited unconsolidated sands form 50-foot sea cliffs along St. George's Bay.

508.5 Turn-off to Crabb's River Provincial Park.

511.4 A series of road-cuts for the next 12 miles exposes red sandstone and siltstone of Mississippian age.

The Anguille Mountains

The northern tip of the Anguille Mountains range is on the south side of the highway at about Mile 511. These mountains form a flat-topped upland or ridge composed of Mississippian sedimentary rocks. The

Mile 511.4 (cont.) ridge extends over a distance of 31 miles from its steep northern tip at Robinsons River to its abrupt termination in a cliff at Cape Anguille, the westernmost point on the Island of Newfoundland. It borders the shore of St. George's Bay from Ship Cove to Cape Anguille. Its wooded slopes, furrowed by numerous streams and gulches, rise steeply from the shore of the bay and from the valley of the Codroy River System to a flat regular surface with an average elevation of about 1500 feet and a maximum of 1759 feet. The mountain range parallels the Long Range Mountains; the intermontane valley is occupied successively by Rainy and Mountain brooks (branches of the Highlands River), Crooked River, North Branch and South Branch of the Codroy River, Grand Codroy River and Little Codroy River. The Trans-Canada Highway is within this valley to Mile 553. The depression occupied by these streams is a major fault zone known as the Cabot fault which extends from White Bay to the southwestern tip of Newfoundland.

520.0 Codroy Pond on left.

521.7 The summit on the west side of the highway is the highest point on the Anguille Mountains: it has an elevation of 1759 feet above sea level.

524.5 Bridge over North Branch, Codroy River.

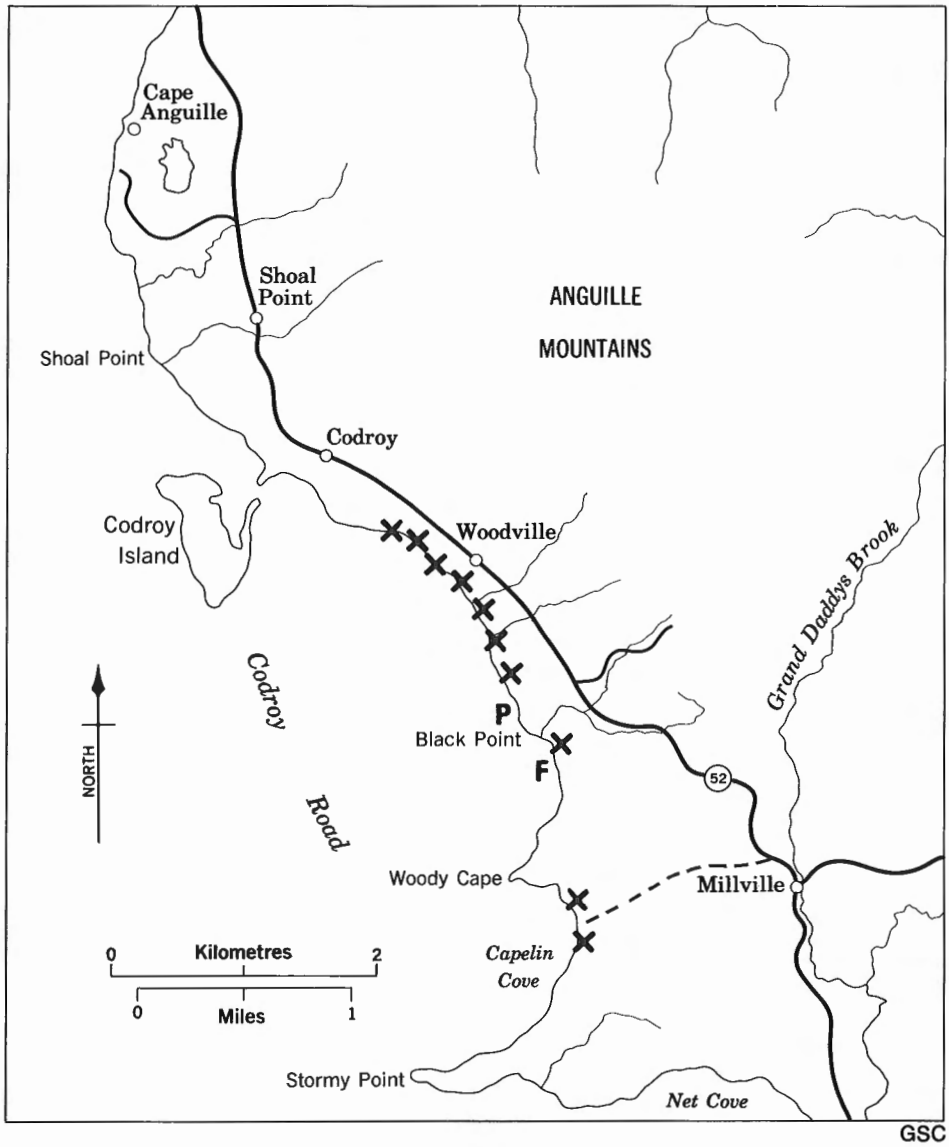
529.1 Bridge over South Branch, Codroy River.

543.7 Turn-off to Grand Codroy Provincial Park located on the south shore of an island-studded meander in the Grand Codroy River.

544.5 Junction, Highway 406, the Codroy Valley Road.

Between this turn-off and Mile 550, the highway skirts the south-eastern edge of the picturesque Codroy Lowland that extends to the Gulf of St. Lawrence shore and is hemmed in by the Anguille Mountains and the Long Range Mountains. The Codroy Valley Road passes through this region. The Grand Codroy and Little Codroy rivers respectively mark the northern and southern margins of the lowland. This pastoral, gently rolling region with a maximum elevation of 450 feet above the sea is thickly mantled with glacial debris that supports an abundant and lush vegetation and is in striking contrast to the barren, treeless summits of the surrounding mountains, and to the bleak, rocky South Shore. It is underlain by Carboniferous sandstone, shale and limestone.

Opposite the junction at Mile 544.5 is a close-up view of the 2000-foot flat summits of the Long Range Mountains, deeply notched by stream valleys that were carved into broad chasms by glacial action.



×, Gypsum occurrences. **P**, Pyrite occurrence. **F**, Fossil occurrence.

Map 14. Codroy area.

Codroy Occurrences

GYPSUM, PYRITE, FOSSILS

In limestone, shale and sandstone

Two varieties of gypsum occur in dark grey to black limestone exposed along shoreline cliffs southeast of Codroy. The compact, sugary massive variety varying from white to grey is the more common variety. Colourless, transparent selenite is less abundant. It occurs as coarse tabular crystals and as veins in the massive gypsum; tabular plates measuring up to one foot in diameter have been reported from the deposit. Yellow, red and black massive gypsum varieties are found but are not common.

The gypsum beds outcrop in the sea-cliffs along the shore of Cabot Strait between Codroy village and Woody Cape. One series of exposures is 3500 to 7000 feet from Codroy, another 10 000 to 12 000 feet from the village.

Pyrite nodules and cavities lined with pyrite cubes occur in yellowish brown limestone at Black Point, a headland 8500 feet south of Codroy. Farther south between Black Point and Woody Cape, fossiliferous limestone and shale of Pennsylvanian age are exposed along the shoreline cliffs. The rocks contain brachiopods, gastropods, pelecypods, cephalopods and ostracods. These rocks extend over a distance of about 1800 feet southward from the mouth of a brook on the south side of Black Point. Woody Cape is composed of greyish to reddish sandstone of Pennsylvanian age. Inland, within a mile of the Codroy shore, the land surface is pitted with sinkholes — depressions caused by the solution of gypsum-bearing strata which underlies the area. Many of the sinkholes are water-filled. This topography is typical of regions where gypsum-bearing rocks form the bedrock.

The shoreline cliffs are accessible from the wharf at Codroy, a distance of 10.8 miles from the Trans-Canada Highway at Mile 544.5.

Refs.: 6 p. 157-159; 57 p. 11-15, 29

Maps (T): 11 O/4 Codroy
(G): 1340A Port aux Basques, Newfoundland (G.S.C., 1 inch to 4 miles)

Mile 550.0 Turn-off to Mummichog Provincial Park.

The park comprises the south shore of Little Codroy River and a peninsula jutting into its mouth.

553.0 The Trans-Canada Highway reaches the south shore of the Island of Newfoundland and parallels the shoreline along the Gulf of St. Lawrence for the next 3 miles. From here to the end of its course the highway traverses a region underlain by Paleozoic granitic and metamorphic rocks of which the Long Range Mountains are composed. These rocks are exposed by road-cuts beginning at Mile 564.7, and along the Rose Blanche Road (Highway 470).

Plate XL. J. T. Cheeseman Provincial Park on shore of Little Barachois. In distance is the southern end of the Long Range Mountains with elevations of about 250 feet. (Nfld. Dep. Tourism 1488)

Mile 553.8 The Tolt, a 1308-foot hill, is on the east side of the highway. It is one of several prominent hills that mark the southern termination of the Long Range Mountains.

556.4 Big Pond on left.

Rising steeply from the east side of the pond is Cook Stone, a 1450-foot peak on the south side of 1900-foot Table Mountain.

557.4 Sugar Loaf, a 1005-foot conical hill, on right.

557.7 Junction, Cape Ray Road.

558.0 Billys Pond on left. The conical hill on right has an elevation of 750 feet. Viewed from Mile 559, this hill and Sugar Loaf appear as twinned cones.

561.4 Turn-off to J.T. Cheeseman Provincial Park. The park area extends to the South Shore and includes Little Barachois Lake.

564.7 A series of road-cuts exposes garnetiferous biotite-quartz-feldspar schist and gneiss. The garnet crystals and grains are small, measuring less than $\frac{1}{4}$ inch in diameter.

566.1 Causeway across Grand Bay. The south-flowing Grand Bay River empties into Grand Bay.

567.3 Channel-Port aux Basques, at junction, Highway 470 and turn-off to CN ferry-landing.

South Shore Occurrences

GARNET, SILLIMANITE, TOURMALINE, EPIDOTE, APATITE, TITANITE, PYRITE, SERPENTINE, JAROSITE

In biotite gneiss and schist

Road-cuts and shoreline outcrops between Channel-Port aux Basques and Rose Blanche expose biotite gneiss and biotite schist commonly containing garnet and sillimanite with lesser amounts of other minerals. The garnet occurs as red transparent grains and crystals measuring up to $\frac{1}{2}$ inch in diameter. Garnet is also found in pegmatitic rock associated with the metamorphic rocks; in the white pegmatite, the pink to purplish red garnet crystals and clusters of crystals are particularly conspicuous and make striking specimens. The sillimanite occurs abundantly as colourless to white and greenish white fibrous, flaky, foliated and columnar masses and layers in biotite gneiss and schist. Prismatic crystals of dark green pyroxene and black amphibole, and grains and tiny crystals of dark brown titanite, light green apatite, and pyrite occur in biotite gneiss and schist. Black prismatic crystals of tourmaline are present in white pegmatite and in white quartz lenses in schist. Epidote occurs as encrustations of fine crystal aggregates on pink and grey granitic rocks. Other minerals occurring in the biotite schist include light green serpentine, and colourless to light green mica. Yellow powdery jarosite occurs as a powdery coating on biotite gneiss.

Road log to South Shore occurrences from Trans-Canada Highway:

Mile	0	Trans-Canada Highway at turn-off to CN ferry-landing; proceed toward ferry.
	0.1	Junction; follow road on left (Highway 470) leading to Rose Blanche.
	0.2	Junction; turn right.
	0.5	Road-cut on right exposes biotite-feldspar gneiss containing tiny red garnets. Port aux Basques Bay is on the south side of the road; its rocky, barren shoreline is typical of the South Shore, a region of low relief and low elevation.
	0.9, 1.4	Road-cuts. Sillimanite and garnet occur in coarse biotite schist, tourmaline in quartz associated with the schist.
	2.0	Road-cuts. Pink to red grains and crystals of garnet occur in grey granitic rocks that are cut by veins consisting of quartz and red feldspar.
	2.3, 5.5	Garnet and sillimanite occur in biotite schist and gneiss exposed by these road-cuts. They also occur in the road-cut at Mile 6.5.
	5.9	Junction; road to Fox Roost, Margaree.
	7.5	Garnet crystals measuring $\frac{1}{4}$ inch in diameter are common in biotite-feldspar gneiss exposed by a road-cut on the west side of the bridge over Isles aux Morts River. Prismatic aggregates of yellowish green epidote occur with dark green chlorite in a coarse pink granitic rock.
	7.7 to 10.6	A series of road-cuts expose biotite schist and gneiss containing garnet and sillimanite.
	10.2	Island-studded Isle aux Morts Harbour is on the south side of the road. From this point to Rose Blanche the shoreline is sprinkled with hundreds of bleak, rocky islands composed of the same metamorphic rocks as those underlying the adjacent coastal area.
	12.8	Road-cut on left. Garnet crystals measuring $\frac{1}{2}$ inch in diameter occur in feldspar-biotite gneiss and in pegmatite veins cutting the gneiss. The garnetiferous rocks are also exposed in a quarry at the east end of the road-cut and in the road-cuts extending toward Burnt Island village and beyond. Sillimanite was noted in the road-cut at Mile 14.0.
	13.4	White pegmatite outcrops on south side of road. Garnet crystals occur in the pegmatite.
	14.5	Turn-off to Otter Bay Provincial Park located at the head of Otter Bay.

14.8 Butterpot Hill on right.

16.3 Road-cut on left. The gneiss at this road-cut is studded with ½ inch garnet crystals. Quartz veins cutting the gneiss also contain garnet. Below the road-cut is God Bay with Burnt Island village on the point of land in the distance.

16.9 Bridge.

17.1 Turn-off to Burnt Island village.

18.1 The highway parallels the shore of Grandy Sound for about 2½ miles, then continues along a more inland route to Rose Blanche.

27.0 Bridge over Rose Blanche Brook near its outlet on West Arm, Rose Blanche Bay.

28.0 Rose Blanche village, on Rose Blanche Bay.

Fine grained grey granite was formerly quarried at Rose Blanche and used in the construction of lighthouses. At Petites, across fiord-like Bay Le Moine, several quarries were opened in red porphyritic granite. An example of its use is in the exterior facing of the Court House in St. John's. These quarries were last worked about 50 years ago.

Quartz crystals and chalcedony occur in cavities in massive, milky quartz exposed on Quartz Hill, a prominent ridge that rises from the north side of Diamond Cove on the west shore of West Arm, Rose Blanche Bay. Pyrite and arsenopyrite occur in the quartz; the occurrence was investigated for gold about 40 years ago. West Arm is on the west side of Rose Blanche village. The Diamond Cove Road leaves Highway 470 at a point 0.2 mile west of the bridge over Rose Blanche Brook.

Refs.: 21 p. 69-71; 44 p. 2-3; 135 p. 70, 122

Maps (T): 11 O/10 Rose Blanche
11 O/11 Port aux Basques
(G): 1340A Port aux Basques, Newfoundland (G.S.C., 1 inch to 4 miles)

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GLOSSARY

Actinolite $Ca_2(Mg, Fe)_5Si_8O_{22}(OH)_2$. H = 5-6. Bright green to greyish green, fibrous or radiating prismatic aggregates. Variety of amphibole.

Amethyst SiO_2. H = 7. Violet variety of quartz.

Amphibole A mineral group consisting of complex silicates including tremolite, actinolite and hornblende. Common rock-forming mineral.

Amphibolite A metamorphic rock composed essentially of amphibole and plagioclase feldspar.

Andalusite Al_2SiO_5. H = 7.5. White, grey, rose-red, brown prismatic crystals with almost square cross-section. Vitreous to dull lustre, transparent to opaque. Chiastolite variety has carbonaceous inclusions arranged in crossed lines evident in cross-section. Occurs in metamorphosed shales. Used in manufacture of mullite refractories, especially spark plugs.

Andesite Dark coloured volcanic rock composed of plagioclase feldspar and amphibole or pyroxene.

Anhydrite $CaSO_4$. H = 3-3.5. White, bluish or greyish granular massive with vitreous lustre. Alters to gypsum by absorption of water. Distinguished from gypsum by its superior hardness. Used as a soil conditioner and in the manufacture of portland cement.

Ankerite Ca (Fe, Mg) $(CO_3)_2$. Variety of dolomite from which it cannot be distinguished in hand specimen.

Annabergite $(Ni, Co)_3(AsO_4)_2 \cdot 8H_2O$. H = 1.5-2.5. Light green finely crystalline or earthy encrustations. Soluble in acids. Secondary mineral formed by oxidation of cobalt and nickel arsenides. Colour and association with nickel minerals are distinguishing characteristics.

Anorthosite An igneous rock composed almost entirely of plagioclase feldspar.

Anthophyllite $(Mg, Fe)_7Si_8O_{22}(OH)_2$. H = 6. White, light grey to brown fibrous or prismatic aggregates with vitreous or silky lustre. Orthorhombic variety of amphibole. Distinguished from tremolite by its fibrous habit and silky lustre. Fibrous variety resembles asbestos but is more brittle. Used in asbestos cement, for boiler coverings and fireproof paints because of its heat resistant property.

Antigorite $Mg_3Si_2O_5(OH)_4$. H = 2.5. Green translucent variety of serpentine having lamellar structure.

Antimony Sb. H = 3-3.5. Light grey metallic, massive, granular, lamellar, or radiating. Occurs with antimony minerals. Used as a component of lead alloys for manufacture of storage batteries, cable coverings, solders, bearing metal; also for flame-proofing textiles, paints, and ceramics.

Apatite $Ca_5(PO_4)_3(F, Cl, OH)$. H = 5. Green, blue, colourless, brown red hexagonal crystals, or granular, sugary massive. Vitreous lustre. May be fluorescent. Distinguished from beryl and quartz by its inferior hardness; massive variety distinguished from calcite and dolomite by its superior hardness and lack of effervescence in HCl, and from massive diopside and olivine by its inferior hardness. Used in the manufacture of fertilizers and detergents.

Argentite Ag_2S. H = 2-2.5. Dark grey cubic, octahedral crystals; arborescent, massive, metallic. Very sectile. Occurs in sulphide deposits with other silver minerals. Inverts to acanthite at temperatures below 180°C.

Argillite A clayey sedimentary rock without a slaty cleavage or shaly fracture.

Arkose A sandstone in which feldspar grains predominate.

Arsenic As. H = 3.5. Light grey to black, sub-metallic. Massive, reniform or stalactitic. Volatile without fusion giving garlic odour. Occurs in veins with silver, cobalt, nickel ores.

Arsenopyrite FeAsS. H = 5.5-6. Light to dark grey metallic striated prisms with characteristic wedge-shaped cross-section; also massive. Tarnishes to bronze colour. Ore of arsenic; may contain gold or silver.

Asbestos Fibrous variety of certain silicate minerals such as serpentine (chrysotile) and amphibole (anthophyllite, tremolite, actinolite, crocidolite) characterized by flexible, heat- and electrical-resistant fibres. Chrysotile is the only variety produced in Canada; it occurs as veins with fibres parallel (slip fibre) or perpendicular (cross-fibre) to the vein walls. Used in the manufacture of asbestos cement sheeting, shingles, roofing and floor tiles, millboard, thermal insulating paper, pipe covering, clutch and brake components, reinforcing in plastics, etc.

Azurite $Cu_3(CO_3)_2(OH)_2$. H = 3.5-4. Azure blue to inky blue tabular or prismatic crystals; also massive, earthy, stalactitic with radial or columnar structure. Vitreous, transparent. Secondary copper mineral. Effervesces in acids. Ore of copper.

Barite $BaSO_4$. H = 3-3.5. White, pink, yellowish, blue tabular or platy crystals; granular massive. Vitreous lustre. Characterized by a high specific gravity (4.5) and perfect cleavage. Used in the glass, paint, rubber, and chemical industries, and in oil-drilling technology.

Basalt Dark coloured, fine grained volcanic rock or lava composed predominantly of an amphibole or pyroxene with plagioclase. Amygdaloidal basalt is one that contains cavities that may be occupied by one or more minerals.

Batholith A very large body of coarse textured igneous rocks such as granite or diorite.

Beryl $Be_3Al_2Si_6O_{18}$. H = 8. White, yellow, green, blue, hexagonal prisms, or massive with conchoidal or uneven fracture. Vitreous, transparent to translucent. Distinguished from apatite, by its superior hardness, from topaz by its lack of perfect cleavage, from quartz by its higher specific gravity. Ore of beryllium which has numerous uses in the nuclear energy, space, aircraft, electronic and scientific equipment industries; and used as alloying agent with copper, nickel, iron, aluminum, and magnesium. Includes gem varieties; emerald (bright green), aquamarine (blue or blue-green), morganite (pink), heliodor (yellow).

Birnessite $(Na_{0.7}Ca_{0.3})Mn_7O_{14} \cdot 2.8H_2O$. H = 1.5. Black or brownish black, greasy to sub-metallic finely granular coating, or flat nodules in sedimentary rocks.

Bornite Cu_5FeS_4. H = 3. Reddish brown metallic. Usually massive and tarnished to iridescent blue, purple, etc. Known as peacock ore and variegated copper ore. Ore of copper.

Breccia A rock composed of angular fragments; may be attractively patterned and coloured, and used as an ornamental rock.

Brochantite $Cu_4(SO_4)(OH)_6$. H = 3.5-4. Vitreous emerald green acicular crystal aggregates; massive, granular. Secondary mineral formed by oxidation of copper minerals. Distinguished from malachite by lack of effervescence in HCl.

Cabochon A polished gemstone having a convex surface; translucent or opaque minerals such as opal, agate, jasper and jade are generally cut in this style.

Celestite $SrSO_4$. H = 3-3.5. Transparent, colourless, white or pale blue tabular crystals; also fibrous massive. Vitreous lustre. Perfect cleavage. Resembles barite but is not as heavy. Ore of strontium.

Cervantite Sb_2O_4. H = 4-5. Yellow to yellowish white powdery or fibrous crust. Greasy, pearly or earthy lustre. Secondary mineral formed by oxidation of antimony minerals.

Chalcocite Cu_2S. H = 3.5-4. Dark grey to black metallic; massive. Tarnishes to iridescent blue, purple, etc. Also referred to as vitreous copper or sulphurette of copper. Soluble in HNO_3. Black colour and slight sectility distinguish it from other copper sulphides. Ore of copper.

Chalcopyrite $CuFeS_2$. H = 3.5-4. Brass-yellow massive, or as tetrahedral crystals. Iridescent tarnish. Brass colour distinguishes it from pyrrhotite. Distinguished from pyrite by its inferior hardness, from gold by its superior hardness and lower density. Also called copper pyrite. Ore of copper.

Chamosite Iron-rich chlorite.

Chert Massive opaque variety of chalcedony; generally drab coloured in various tints of grey or brown.

Chloanthite (Ni, Co) As_3. H = 5.5-6. Member of skutterudite series, high in nickel. Not distinguishable from other members of the smaltite-skutterudite series in which the cobalt-nickel content is variable. Light grey metallic. Massive granular or cubic and octahedral forms. Associated with other cobalt and nickel minerals.

Chlorite $(Mg, Fe, Al)_6(Al, Si)_4O_{10}(OH)_8$. H = 2-2.5. Transparent green flaky aggregates. Distinguished from mica by its colour and non-elastic flakes.

Chrysoberyl $BeAl_2O_4$. H = 8.5. Yellow, green, brown tabular or short prismatic crystals that are commonly striated and twinned forming six broad radiating spokes. Vitreous, transparent to opaque. Transparent variety used as a gemstone. Other gem varieties include: alexandrite, a gemstone that is green in natural light and red in artificial light; cat's eye which exhibits a movable streak of light when cut in a cabochon. Occurs in pegmatites and in mica schist.

Chyrsocolla $CuSiO_3 \cdot 2H_2O$. H = 2-4. Blue to blue-green earthy, botryoidal, or fine-grained massive. Conchoidal fracture. Secondary mineral found in oxidized zones of copper-bearing veins. Often intimately mixed with quartz or chalcedony, producing attractive patterns; because of being mixed with these minerals, the resultant superior hardness renders it suitable for use in jewellery and ornamental objects. Minor ore of copper.

Chyrsotile Fibrous varieties of serpentine (asbestos).

Clinozoisite $Ca_2Al_3Si_3O_{12}(OH)$. H = 7. Pale green to greenish grey prismatic crystals; also granular or fibrous masses. Vitreous lustre. Perfect cleavage. Member of epidote group. Occurs in metamorphic rocks.

Conglomerate A sedimentary rock formed of rounded pebbles or gravel.

Cordierite $(Mg, Fe)_2Al_4Si_5O_{18}$. H = 7. Blue to purplish blue, bluish grey, colourless massive or irregular grains. Vitreous lustre. Subconchoidal fracture. Alters readily to muscovite or chlorite. Distinguished by its colour and by its alteration products. Occurs in metamorphic rocks (schists, gneisses). Gem variety is known as iolite or dichroite.

Copper Cu. H = 2.5-3. Massive filiform or arborescent; crystals (cubic or dodecahedral) rare. Hackly fracture. Ductile and malleable. Occurs in lavas.

Covellite CuS. H = 1.5-2. Inky blue iridescent in shades of brass yellow, purple, coppery red. Massive; crystals (hexagonal plates) rare. Metallic lustre. Distinguished from chalcocite and bornite by its perfect cleavage and colour.

Cubanite $CuFe_2S_3$. Brass- to bronze-yellow tabular crystals or massive. Distinguished from chalcopyrite by its strong magnetism. Associated with other copper-iron sulphides. Rare mineral.

Diabase Dark coloured igneous rock composed mostly of lath-shaped crystals of plagioclase and of pyroxene. Used as a building ornamental and monument stone.

Diaspore $HAlO_2$. H = 6.5-7. White, grey, yellow, brown, light violet, pink, colourless foliated, scaly, granular, massive aggregates. Platy or acicular crystals. Pearly, vitreous, brilliant lustre. Associated with aluminous minerals in igneous and metamorphic rocks.

Diorite A dark coloured igneous rock composed mainly of plagioclase and amphibole or pyroxene.

Dolomite $CaMg(CO_3)_2$. H = 3.5-4. Colourless, white, pink, yellow or grey; rhombohedral or saddle-shaped crystals; also massive. Vitreous to pearly lustre. Slightly soluble in cold HCl. Ore of magnesium which is used in the manufacture of light-weight alloys.

Dyke A long narrow body of igneous rocks that cuts other rocks.

Epidote $Ca_2(Al, Fe)_3Si_3O_{12}(OH)$. H = 6-7. Yellowish green to deep green prismatic crystals, also fibrous or granular masses. Vitreous lustre. Yellow-green colour is distinguishing feature. Occurs in metamorphic and granitic rocks, and in basalt.

Erythrite $Co_3(AsO_4)_2.8H_2O$. H = 1.5-2.5. Rose-red to crimson globular, radial, reniform aggregates; also earthy or pulverulent; prismatic to acicular crystals (rare). Dull to adamantine lustre. Soluble in HCl. Secondary mineral formed by oxidation of cobalt arsenides.

Esker A long stream-deposited ridge or mound formed by the deposition of sand, gravel, and boulders in a stream flowing within or beneath a glacier.

Fault Structural feature produced by the movement of one rock mass relative to another; shear zone, brecciated zone, fault zone refer to the region affected by the movement.

Feldspar A mineral group consisting of alumino-silicates of potassium and barium (monoclinic or triclinic), and of sodium and calcium (triclinic). Orthoclase and microcline belong to the first group, plagioclase to the second. Used in the manufacture of ceramics, porcelain-enamel, porcelain, scouring powders, and artificial teeth.

Felsite A dense, fine grained, pink or grey igneous rock composed mainly of feldspar with little or no quartz.

Fluorescence Property of certain substances to glow when exposed to light from an ultraviolet lamp. It is caused by impurities in the substance or by defects in its crystal structure. Two wavelengths are commonly used to produce fluorescence: long wave (3200 to 4000 Angstrom units), short wave (2537 Angstrom units).

Fluorite CaF_2. H = 4. Transparent, colourless, blue, green, purple, yellow; cubic or, less commonly octahedral crystals; also granular massive. Vitreous lustre. Good cleavage. Often fluorescent; this property derives its name from the mineral. Used in optics, steelmaking, ceramics.

Fuchsite An emerald-green chromium-rich muscovite.

Gabbro A dark, coarse grained igneous rock composed mainly of calcic plagioclase and pyroxene. Used as a building and monument stone.

Galena PbS. H = 2.5. Dark grey metallic cubic crystals or crystal aggregates; also massive. Perfect cleavage. Distinguished by its high (7.58) specific gravity and perfect cleavage. Ore of lead.

Garnet Silicate of Al, Mg, Fe, Mn, Ca. H = 6.5-7.5. Transparent red dodecahedral crystals, or massive granular; also yellow, brown, green. Distinguished by its crystal form. Used as an abrasive. Clear garnet is used as a gemstone.

Gersdorffite NiAsS. H = 5.5. Light to dark grey metallic; octahedral, pyritohedral crystals, or granular massive. Associated with other nickel minerals in vein deposits.

Gneiss A coarse grained foliated metamorphic rock composed mainly of feldspar, quartz and mica. Used as a building and monument stone.

Goethite $HFeO_2$. H = 5-5.5. Dark brown, reddish or yellowish brown, earthy, botryoidal, fibrous, bladed or loosely granular masses; also prismatic, acicular, tabular crystals or scaly. Has characterisic yellowish brown streak. Weathering product of iron-rich minerals. Ore of iron.

Gold Au. H = 2.5-3. Yellow metallic irregular masses, plates, scales, nuggets. Rarely as crystals. Distinguished from other yellow metallic minerals by its hardness, malleability, high specific gravity (19.3). Precious metal.

Gossan A decomposed or weathered rusty covering on masses of pyrite or in upper zone of veins; consists of hydrated iron oxides.

Granite Grey to reddish coloured relatively coarse grained igneous rock composed mainly of feldspar and quartz. Used as a building and monument stone.

Granodiorite An igneous rock that is intermediate in composition between granite and diorite.

Greywacke Sedimentary rock containing large amounts of amphibole or pyroxene and feldspar.

Gypsum $CaSO_4.2H_2O$. H = 2. White, grey, light brown, granular massive; also fibrous (satin spar), or colourless transparent crystals (selenite). Distinguished from anhydrite by its inferior hardness. Occurs in sedimentary rocks. Used in construction industry (plaster, wallboard, cement, tiles, paint) and as a soil conditioner and fertilizer. Satin spar and alabaster (fine grained translucent variety) are used for carving into ornamental objects.

Halite NaCl. H = 2.5. Colourless, white, grey, yellow or blue transparent to translucent vitreous crystals (cubes) or granular masses. May be fluorescent. Water soluble. Occurs in sedimentary rocks, in springs, seas, and salt lakes, and in dried inland lake basins.

Hematite Fe_2O_3. H = 5. 5-6. 5. Reddish brown to black massive, botryoidal, or earthy; also foliated or micaceous with high metallic lustre (specularite). Characteristic red streak. Greasy to dull lustre. Ore of iron.

Hornblende $NaCa_2(Mg, Fe, Al)_5(Si, Al)_8O_{22}(OH)_2$. H = 6. Member of amphibole group. Dark green, brown, black prismatic crystals or massive. Vitreous lustre. Common rock-forming mineral.

Igneous Rocks that have crystallized from magma or from the melting of other rocks; composed of feldspar, quartz, and hornblende, pyroxene or biotite.

Ilmenite $FeTiO_3$. H = 5-6. Black compact or granular massive; thick tabular crystals. Metallic to submetallic lustre. Black streak distinguishes it from hematite. Source of titanium.

Iron-formation Metamorphosed sediment containing iron minerals and silica.

Jarosite $KFe_3(SO_4)_2(OH)_6$. H = 2. 5-3. 5. Yellow to brown pulverulent coating associated with iron-bearing rocks and with coal. Distinguished from iron oxides by giving off SO_2 when heated.

Jasper An opaque deep red to brown, yellow, green or mauve variety of chalcedony. Used as an ornamental stone and as a gemstone.

Kaolinite $Al_4Si_4O_{10}(OH)_8$. H = 2. Chalk-white, greyish, yellowish or brownish earthy masses. Dull lustre. Clay mineral formed chiefly by decomposition of feldspars. Becomes plastic when wet. Used as a filler in paper, and in manufacture of ceramics.

Kermesite Sb_2S_2O. H = 1-1. 5. Red hair-like or tufted radiating aggregates of lath-shaped crystals. Translucent with adamantine to semimetallic lustre. Sectile. Alteration product of stibnite. Colour and habit are distinguishing features. Minor ore of antimony.

Labradorite (Ca, Na) (Al, Si) $AlSi_2O_8$. H = 6. Variety of plagioclase feldspar. Grey, vitreous, transparent to translucent. Commonly exhibits blue, green, yellow or bronze light reflections and is used as a gemstone. Chief constituent of anorthosite and gabbro.

Lamprophyre A fine grained dyke rock composed of plagioclase feldspar and pyroxene or amphibole.

Leonhardtite $MgSO_4$. $4H_2O$. Dull white encrustations. Bitter metallic taste. Difficult to distinguish in hand specimen from other sulphates. Also known as starkeyite.

Limestone Soft, white, grey or buff sedimentary rock formed by the deposition of calcium carbonate. Dolomitic limestone contains variable proportions of dolomite and is distinguished from the normal limestone by its weaker (or lack of) effervescence in HCl. Used as a building stone and as road metal. Shell limestone (coquina) is a porous rock composed mainly of shell fragments. Crystalline limestone (marble) is a limestone that has been metamorphosed and is used as a building and ornamental stone.

Limonite Field term referring to natural hydrous iron oxide whose true identity is unknown. Yellow-brown to dark brown earthy, porous, ochreous masses; also stalactitic or botryoidal. Secondary product of iron minerals.

Mackinawite FeS. Grey metallic grains and plates. Changes to bronze on exposure to air. Associated with other sulphides.

Magnesite $MgCO_3$. H = 4. Colourless, white, greyish, yellowish to brown lamellar, fibrous, granular or earthy masses; crystals rare. Vitreous, transparent to translucent. Distinguished from calcite by lack of effervescence in cold HCl. Used in manufacture of refractory bricks, cements, flooring; for making magnesium metal.

Malachite $Cu_2CO_3(OH)_2$. H = 3.5-4. Bright green granular, botryoidal, earthy masses; usually forms coating with other secondary copper minerals on copper-bearing rocks. Distinguished from other green copper minerals by effervescence in HCl acid. Ore of copper.

Manganite MnO(OH). H = 4. Steel-grey to iron-black metallic prismatic striated crystal aggregates; also columnar, fibrous, stalactitic, finely granular. Not readily distinguishable from other dark manganese minerals in hand specimen. Ore of manganese.

Marble See limestone.

Marcasite FeS_2. H = 6-6.5. Pale bronze to grey metallic radiating stalactitic, globular or fibrous forms; twinning produces cockscomb and spear shapes. Yellowish to dark brown tarnish. Massive variety difficult to distinguish from pyrite in hand specimen.

Maucherite $Ni_{11}As_8$. H = 5. Grey metallic with reddish tinge tarnishing to copper-red. Tabular or pyramidal crystals; also massive, granular or radiating fibrous. Decomposed by acids. Associated with cobalt-nickel ores. May be referred to as temiskamite.

Millerite NiS. H = 3-3.5. Pale brass-yellow, slender, elongated, striated crystals; acicular radiating or hair-like aggregates. Grey iridescent tarnish. Distinguished from pyrite by its crystal form, and its inferior hardness. Ore of nickel.

Molybdenite MoS_2. H = 1-1.5. Dark bluish grey metallic tabular, foliated, scaly aggregates or hexagonal crystals; also massive. Sectile with greasy feel. Distinguished from graphite by its bluish lead-grey colour and by its streak (greenish on porcelain, bluish grey on paper). Ore of molybdenum.

Moraine An accumulation of sand, gravel, boulders that was carried and deposited by glaciers.

Nickeline NiAs. H = 5-5.5. Light copper-coloured, metallic, massive, reniform with columnar structure; crystals (tabular, pyramidal) rare. Exposed surfaces alter readily to annabergite. Occurs in veins with cobalt arsenides and native silver in cobalt deposits. Colour is distinctive. Formerly known as niccolite; the use of the new name was recommended recently by International Mineralogical Association's Commission on New Minerals and Mineral Names.

Norite A gabbro with more ortho-pyroxene than clinopyroxene.

Opal $SiO_2.nH_2O$. H = 5.5-6.5. Colourless, green, grey to black with waxy lustre and play of colour in gem varieties. Common or non-gem variety lacks the play of colour, is translucent to opaque, colourless to white, red, brown, grey, green, yellow, etc. Massive, botryoidal, mammillary or pisolitic forms. Distinguished from chalcedony by its inferior hardness, lower specific gravity. Formed at low temperatures by silica-bearing waters seeping into fissures and cavities in any type of rock.

Orthoclase $KAlSi_3O_8$. H = 6. Red, pink or white feldspar. Short prismatic crystals. Vitreous lustre. Perfect cleavage. Distinguished from plagioclase feldspar by absence of twinning striations.

Peat Dark brown decomposition product of mosses and plants in marshy areas. Used as fertilizer, soil conditioner, insulating material, packing material, etc.

Pectolite $Ca_2Na\,H\,Si_3O_9$. H = 5. White needle-like crystals, radiating and forming globular masses. Silky to vitreous lustre. Decomposed by warm dilute HCl. Associated with zeolites in basalt.

Pegmatite A very coarse grained dyke rock.

Pentlandite $(Fe, Ni)_9S_8$. H = 3.5-4. Light bronze-yellow massive, granular aggregates. Octahedral parting distinguishes it from pyrrhotite with which it is commonly associated. Nonmagnetic. Ore of nickel.

Peridotite An igneous rock consisting almost entirely of olivine and pyroxene with little or no plagioclase feldspar.

Picrolite A non-flexible fibrous variety of antigorite (serpentine).

Plagioclase $(Ca, Na)\,(Al, Si)AlSi_2O_8$. H = 6. White or grey tabular crystals or cleavable masses having twinning striations on cleavage surfaces. Vitreous or pearly lustre. Distinguished from other feldspars by its twinning striations.

Porphyry A dyke rock that consists of distinct crystals (phenocrysts) in a fine grained matrix.

Posnjakite Basic Cu sulphate. Minute blue flaky and radiating sheaf-like aggregates on copper-bearing rocks. Associated with other secondary copper minerals; not readily distinguished from them in hand specimen.

Prehnite $Ca_2Al_2Si_3O_{10}(OH)_2$. H = 6.5. Light green globular, stalactitic, masses with fibrous or columnar structure and crystalline surface. Vitreous lustre. Colour and habit are distinguishing features.

Psilomelane $BaMn''Mn_8O_{16}(OH)_4$. H = 5-6. Black massive, botryoidal, stalactitic, or earthy. Dull to submetallic lustre. Black streak. Associated with other manganese minerals from which it is distinguished by its superior hardness, black streak, and amorphous appearance. Ore of manganese.

Pumpellyite $Ca_4(Al, Fe, Mg)_6Si_6O_{23}(OH)_3 \cdot 2H_2O$. H = 5.5. Bluish green to green, white tiny fibrous aggregates; also platy, massive. Silky to vitreous lustre. Occurs in amygdaloidal basalt and in metamorphic rocks.

Pyrite FeS_2. H = 6-6.5. Pale brass-yellow metallic crystals (cube, pyritohedrons, octahedrons) or massive granular. Iridescent when tarnished. Distinguished from other sulphides by its colour, crystal form, and superior hardness. Source of sulphur.

Pyrolusite MnO_2. H = 6-6.5 (crystals), 2-6 (massive). Light to dark grey metallic, bluish tint. Columnar, fibrous or divergent masses; reniform, concretionary, granular to powdery and dendritic (on fracture surfaces). Soils fingers easily and marks paper. Ore of manganese.

Pyrophyllite $Al_2Si_4O_{10}(OH)_2$. H = 1-2. White, grey, green, yellow foliated, lamellar, fibrous or granular compact masses. Pearly, greasy or dull lustre. Resembles talc but has a slightly superior hardness. Suitable for use in carved ornamental objects. Used in the manufacture of ceramics.

Pyroxene A mineral group consisting of Mg, Fe, Ca and Na silicates, related structurally. Diopside, enstatite, aegirine, jadeite, etc. are members of the group. Common rock-forming mineral.

Pyroxenite An igneous rock composed mainly of pyroxene with little or no feldspar.

Pyrrhotite $Fe_{1-x}S$. H = 4. Brownish bronze massive granular. Black streak. Magnetic; this property distinguishes it from other bronze sulphides.

Quartzite A quartz-rich rock formed by the metamorphism of a sandstone. Used as a building and monument stone, and, if colour is attractive, as an ornamental stone; high purity quartzite is used in the glass industry.

Radioactive minerals Minerals that give off radiation due to spontaneous disintegration of uranium or thorium atoms. Detected by a Geiger counter.

Rammelsbergite $NiAs_2$. H = 5.5-6. Light grey metallic with red tinge. Massive granular or compact prismatic, fibrous aggregates. Associated with smaltite, nickeline and other cobalt and nickel minerals in vein deposits. Not readily identifiable in hand specimen.

Realgar AsS. H = 1.5-2. Red to orange-yellow striated prismatic crystals; granular or powdery encrustations. Resinous to greasy lustre. On long exposure to light, it disintegrates to reddish yellow powdery mixture of orpiment and arsenolite. Decomposed by HNO_3 and aqua regia. Occurs in vein deposits with stibnite and arsenic minerals.

Rhodochrosite $MnCO_3$. H = 4. Pink to rose, less commonly yellowish to brown, massive granular to compact; also columnar, globular, botryoidal; crystals (rhombohedral) uncommon. Vitreous, transparent. Distinguished from rhodonite (H = 6) by its inferior hardness. Ore of manganese.

Rhyolite A fine grained volcanic rock with composition similar to granite.

Rozenite $FeSO_4 . 4H_2O$. White or greenish white, finely granular, botryoidal or globular encrustations. Metallic astringent taste. Difficult to distinguish in hand specimen from other iron sulphates with which it is associated.

Rutile TiO_2. H = 6-6.5. Brownish red to black striated prismatic or acicular crystals; massive. Crystals are often twinned, forming elbow-shapes. Adamantine lustre. Resembles cassiterite, but not as heavy and has light brown streak (cassiterite has white streak). Ore of titanium.

Sandstone Sedimentary rock composed of sand-sized particles (mostly quartz).

Scheelite $CaWO_4$. H = 4.5-5. White, yellow, brownish; transparent to translucent massive. Also dipyramidal crystals. High specific gravity (about 6). Generally fluoresces bright bluish white under "short" ultraviolet rays; this property is utilized in prospecting for this tungsten ore.

Schist Metamorphic rock composed mainly of flaky minerals such as mica and chlorite.

Scorodite $Fe'''(As\ O_4) . 2H_2O$. H = 3.5-4. Green, greyish green to brown crusts of tabular or prismatic crystals; also massive, earthy, porous or sinter-like. Vitreous to subresinous or subadamantine lustre. Soluble in acids. Secondary mineral formed by oxidation of arsenopyrite.

Selenite See gypsum.

Sericite Fine scaly or fibrous muscovite, an important constituent of some schists and gneisses.

Serpentine $Mg_6(Si_4O_{10})(OH)_8$. H = 2-5. White, yellow, green, blue, red, brown, black massive; may be mottled, banded or veined. Waxy lustre. Translucent to opaque. Asbestos (chrysotile) and picrolite are the fibrous varieties. Formed by alteration of olivine, pyroxene, amphibole, or other magnesium silicates. Found in metamorphic and igneous rocks. Used as an ornamental building stone (verde antique) and for cutting and/or carving into ornamental objects.

Serpentinite A metamorphic rock consisting almost entirely of serpentine.

Shale Fine grained sedimentary rock composed of clay minerals.

Shear zone See fault.

Siderite $FeCO_3$. H = 3.5-4. Brown rhombohedral crystals, cleavable masses, earthy, botryoidal. Distinguished from calcite and dolomite by its colour and higher specific gravity, from sphalerite by its cleavage. Ore of iron.

Siderotil $FeSO_4 . 5H_2O$. White, pale green to bluish fibrous crusts, needle-like crystals, or finely granular encrustations. Vitreous lustre. Metallic, astringent taste. Not distinguishable in hand specimen from other iron sulphates.

Sillimanite Al_2SiO_5. H = 7. White, colourless fibrous or prismatic masses. Vitreous or silky lustre. Distinguished from wollastonite and tremolite by its superior hardness. Occurs in schists and gneisses.

Siltstone A very fine grained sedimentary rock composed predominantly of quartz grains.

Silver Ag. H = 2.5-3. Grey metallic arborescent, wiry, leafy, platy or scaly forms; crystals (cubic, octahedral, dodecahedral) rare. Tarnishes to dark grey or black. Hackly fracture. Ductile, malleable. Colour, form and sectility are identifying characteristics.

Skarn An altered rock zone in limestone and dolomite in which calcium silicates (garnet, pyroxene, epidote, etc.) have formed.

Slate A fine grained metamorphic rock characterized by a susceptibility to split into thin sheets.

Specularite Black variety of hematite having a high lustre.

Sphalerite ZnS. H = 3.5-4. Yellow, brown or black, granular to cleavable massive; also botryoidal. Resinous to submetallic. Honey-brown streak. Soluble in HCl, and gives off H_2S. Ore of zinc.

Stibiconite $Sb_3O_6(OH)$. H = 4.5-5. Canary yellow to pale yellow, vitreous, granular to powdery encrustations; also radiating, fibrous aggregates (pseudomorphs after stibnite), botryoidal or in concentric shells. Secondary mineral formed by oxidation of stibnite and other antimony minerals. Yellow colour distinguishes it from other secondary antimony oxides. Minor ore of antimony.

Stibnite Sb_2S_3. H = 2. Lead-grey, metallic (bluish iridescent tarnish), striated, prismatic crystals; also acicular crystal aggregates, radiating columnar, bladed masses, and granular. Soluble in HCl. Most important ore of antimony.

Talc $Mg_3(Si_4O_{10})(OH)_2$. H = 1. Grey, white, or various shades of green. Fine grained massive, foliated. Translucent with greasy feel. Massive varieties are known as steatite and soapstone, and because of their suitability for carving, are used for ornamental purposes. Formed by alteration of magnesium silicates (olivine, pyroxene, amphibole, etc.) in igneous and metamorphic rocks. Used in cosmetics.

Tennantite See tetrahedrite series.

Tetrahedrite-tennantite series $Cu_{12}Sb_4S_{13}$ — $Cu_{12}As_4S_{13}$. H = 3-4.5 (tennantite harder). Flint-grey to iron-black, metallic, tetrahedral crystals; also massive, granular to compact. Brown, black or deep red streak. Tennantite is less common than tetrahedrite. Ore of copper; also contains values in silver, antimony.

Titanite (sphene) $CaTiSiO_5$. H = 6. Brown wedge-shaped crystals; also massive granular. May form cruciform twins. Adamantine lustre. White streak. Distinguished from other dark silicates by its crystal form, lustre and colour.

Tourmaline $Na(Mg, Fe)_3Al_6(BO_3)_3(Si_6O_{18})(OH)_4$. H = 7.5. Black, deep green, blue, pink, brown, amber-coloured prismatic crystals; also columnar, massive granular. Prism faces striated vertically. Vitreous lustre. Conchoidal fracture. Distinguished by triangular cross-section in prism, by striations, fracture. Used in manufacture of pressure gauges; transparent variety used as a gemstone.

Tremolite $Ca_2Mg_5Si_8O_{22}(OH)_2$. H = 5-6. White, grey striated prismatic crystals, bladed crystal aggregates, fibrous. Perfect cleavage. Vitreous lustre. Generally occurs in metamorphic rocks. Fibrous variety used as asbestos; clear crystals are sometimes used as a gem curiosity.

Tuff A rock formed from volcanic ash.

Tungstite $WO_3.H_2O$. H = 2.5. Yellow to yellowish green aggregates of microscopic plates, or powdery to earthy masses. Resinous or pearly lustre. Oxidation product of tungsten minerals.

Uraninite UO_2. H = 5-6. Black, brownish black cubic or octahedral crystals; also massive, botryoidal. Submetallic, pitchy to dull lustre. Uneven to conchoidal fracture. Radioactive. Distinguished by high specific gravity (10.3 to 10.9), crystal form, radioactivity. Ore of uranium.

Valentinite Sb_2O_3. H = 2.5-3. Colourless, snow-white to greyish, prismatic or tabular, striated crystal aggregates; also massive with granular or fibrous structure. Adamantine to pearly lustre. Transparent. Associated with stibnite and other secondary antimony oxides resulting from oxidation of metallic antimony minerals.

Violarite Ni_2FeS_4. H = 4.5-5.5. Violet-grey, metallic, massive, granular to compact. Rare mineral occurring in nickel ores.

Wurtzite (Zn, Fe)S. H = 3.5-4. Brownish black resinous crystals (pyramidal, prismatic, tabular) or fibrous, columnar, concentrically banded crusts. Like sphalerite but has darker colour and brown streaks. Occurs with sulphide minerals.

Xonotlite $6CaSiO_3.2H_2O$. H = 6.5. Pink to white microscopic to fine compact fibrous masses. Vitreous to waxy lustre. Very tough. Weathered surface is chalk-white. Pink variety used as a gemstone.

CHEMICAL SYMBOLS FOR CERTAIN ELEMENTS

Ag — silver

Al — aluminum

As — arsenic

Au — gold

B — boron

Ba — barium

Be — beryllium

Bi — bismuth

C — carbon

Ca — calcium

Cb — columbium (niobium)

Ce — cerium

Cl — chlorine

Co — cobalt

Cr — chromium

Cu — copper

Er — erbium

F — fluorine

Fe — iron

H — hydrogen

K — potassium

La — lanthanum

Mg — magnesium

Mn — manganese

Mo — molybdenum

Na — sodium

Nb — niobium

Ni — nickel

O — oxygen

P — phosphorus

Pb — lead

R — rare earth elements

S — sulphur

Se — selenium

Si — silicon

Sn — tin

Sr — strontium

Ta — tantalum

Th — thorium

Ti — titanium

W — tungsten

Y — yttrium

Yb — ytterbium

Zn — zinc

Zr — zirconium

INDEX OF MINERALS AND ROCKS

Page