ROCKS AND MINERALS
FOR THE COLLECTOR

Geological Survey of Canada
Miscellaneous Report 58

Îles de la Madeleine, Quebec, the Island of Newfoundland, and Labrador

Ann P. Sabina

2003

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Cover illustration

Pendant: labradorite set in sterling silver. Designed and handcrafted by Ann Jensen, Terrasse Vaudreuil, Quebec. The pendant measures 5 cm from top to bottom. The labradorite is from Tabor Island, Labrador. Photograph by H. Gary Ansell. GSC 1999-001A

Labradorite sculpture by Dolorès Michaud, Ottawa. The sculpture measures 18 cm from top to bottom. The labradorite is from Tabor Island, Labrador. Photograph by H. Gary Ansell. GSC 1999-001B

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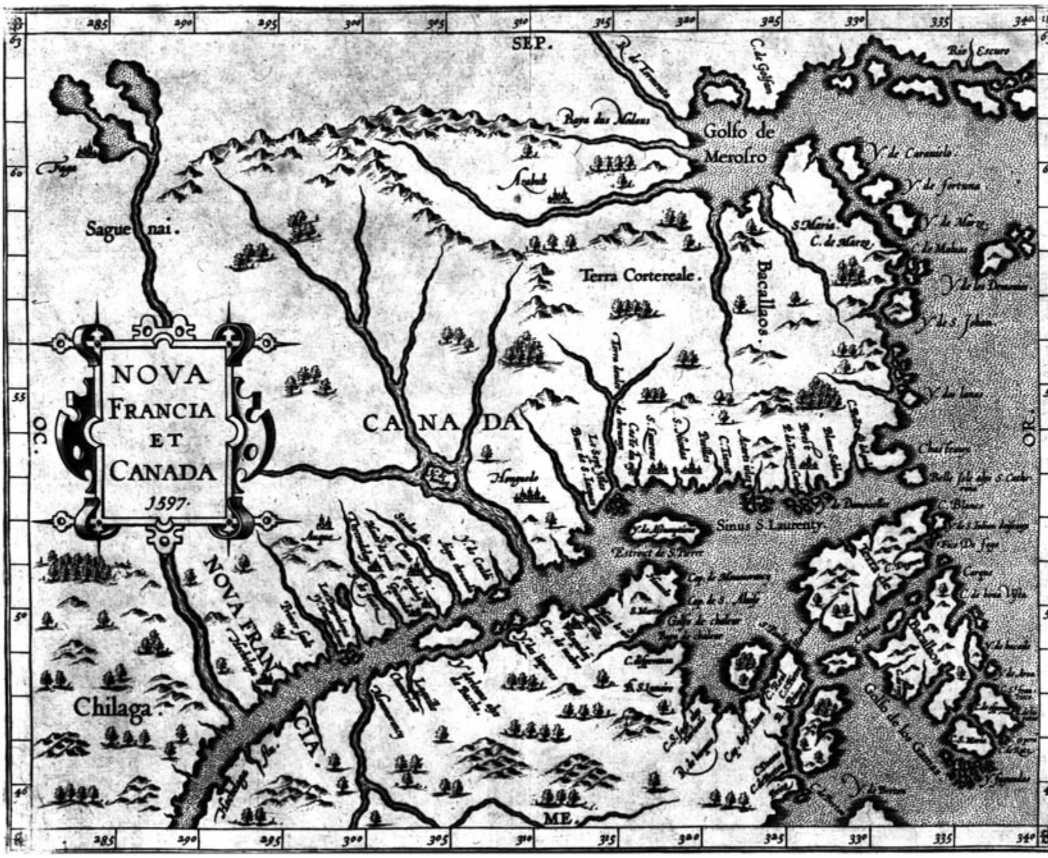

Frontispiece. Nova Francia et Canada, 1597. This map is one of a series of maps of North America produced by Cornelius Wytfliet and published in Louvain in 1597. Newfoundland and Labrador are referred to as 'Terra de Bacallaos' — Land of the codfish. Most sixteenth-century maps depict Newfoundland as an archipelago, which it was thought to be by explorers of that time. The single-island concept became accepted in the seventeenth century. National Archives Canada C75897

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Abstract

This booklet describes mineral and rock collecting localities in the Îles de la Madeleine (Quebec), the Island of Newfoundland, and Labrador. A variety of mineral, rock, and fossil collecting sites await the tourist, the amateur and professional mineralogist, and the hobbyist. The Îles de la Madeleine provide several varieties of gypsum, calcite, and quartz crystals, and specularite, pyrite, epidote, magnetite, dolomite, and manganese minerals. Fossils of late Paleozoic age are found in some localities. Recent exploration resulted in the discovery of natural gas and salt deposits.

Mining activity in Newfoundland and Labrador began two centuries ago. The province is Canada's sole producer of pyrophyllite. Other operating mines yield iron, gypsum, asbestos, gold, base metals, limestone, and silica. Mining in the past produced copper, lead, antimony, arsenic, fluorite, barite, and coal. Both the inactive and active mines provide mineral collecting sites; other occurrences furnish celestine, quartz crystals, beryl, scheelite, prehnite, and manganese minerals. For the gem-cutter or sculptor, there is amethyst, xonotlite, labradorite, hypersthene 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 and can be reached by automobile and a short hike and, less commonly, by boat. The localities in Labrador are reached by boat, by air, or by snowmobile.

Résumé

Le présent rapport décrit les endroits des îles de la Madeleine (Québec), de l'île de Terre-Neuve et du Labrador les plus intéressants pour les collectionneurs de minéraux et de roches. Ces îles offrent aux touristes, aux minéralogistes amateurs et professionnels et aux collectionneurs, une variété de sites riches en minéraux, roches et fossiles. Les îles de la Madeleine recèlent plusieurs variétés de cristaux de gypse, de calcite et de quartz, ainsi qu'une gamme de minéraux (spécularite, pyrite, épidote, magnétite, dolomite et minéraux manganésifères). On trouve en certains endroits des fossiles du Paléozoïque tardif. 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-et-Labrador remontent à deux siècles. La province est le seul producteur canadien de pyrophyllite. D'autres mines en exploitation fournissent du fer, du gypse, de l'amiante, de l'or, des métaux communs, du calcaire et de la silice. Dans le passé, les mines ont produit du cuivre, du plomb, de l'antimoine, de l'arsenic, de la fluorine, de la barytine et du charbon. Les mines, en exploitation ou non, sont des sites idéaux pour le collectionneur de minéraux; d'autres indices recèlent des minéraux comme la célestine, le quartz en cristaux, le béryl, la scheelite, la prehnite et des minéraux manganésifères. Pour le lapidaire ou le sculpteur, il y a l'améthyste, la xonotlite, le labrador et le jaspe ainsi qu'une variété de pierres ornementales : pyrophyllite, roche à mica chromifère («virginite»), marbre,

granite et roches volcaniques. Les coupes en tranchée le long des routes et les affleurements le long des côtes contiennent des cavités tapissées de menus cristaux de quartz et de pyrite ainsi que d'autres minéraux qui se prêtent merveilleusement au micromontage.

La plupart des sites intéressants sont facilement accessibles en voiture et après une courte promenade, ou plus rarement, par bateau. Les sites au Labrador sont accessibles par bateau, par aéronef ou par motoneige.

ROCKS AND MINERALS FOR THE COLLECTOR: ÎLES DE LA MADELEINE, QUEBEC, THE ISLAND OF NEWFOUNDLAND, AND LABRADOR

INTRODUCTION

This booklet describes mineral, rock, and fossil occurrences in the Îles de la Madeleine, Quebec, the Island of Newfoundland, and Labrador (Fig. 1).

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 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 pages 203-204.

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; descriptions of these mines are included only as a point of interest to the collector. Some 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 and Labrador 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 Labrador; 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. Much of the information on occurrences in Labrador was provided by J.R. Meyer, Newfoundland and Labrador Department of Mines and Energy, and by R.F. Emslie, Geological Survey of Canada.

COLLECTING ALONG THE ROUTE

The main collecting route in the Îles de la Madeleine is along Highway 199 (Fig. 2); on the Island of Newfoundland, it is along the Trans-Canada Highway (Fig. 3). The distance in kilometres along the main routes is shown in bold print. Numerous side trips lead from the main routes.

Information on each locality is listed systematically as follows: name of the mine or occurrence; minerals or rocks found in the deposit (shown in capital letters); mode of occurrence; descriptive notes on the deposit with special features of interest to the collector; location and access; references to other publications (indicated by a number that is listed in the 'References' section); references to maps of the National Topographic System (T), and to geological maps (G) of the Geological Survey of Canada (GSC), the Newfoundland and Labrador Department of Mines and Energy (NDME), and Quebec's ministère des Ressources naturelles (MRNQ).

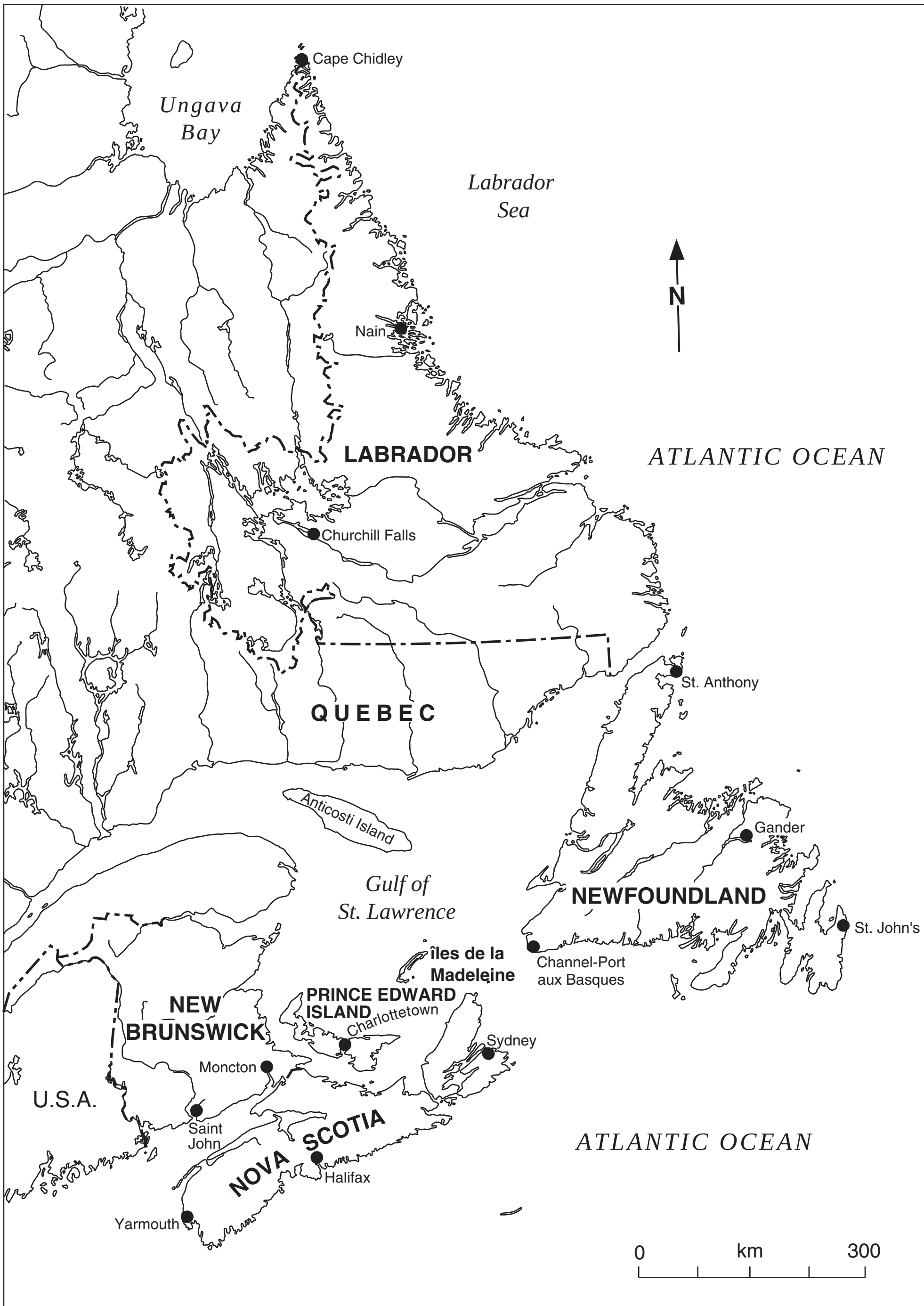


Figure 1. Map showing the geographical location of the Îles de la Madeleine, the Island of Newfoundland, and Labrador.

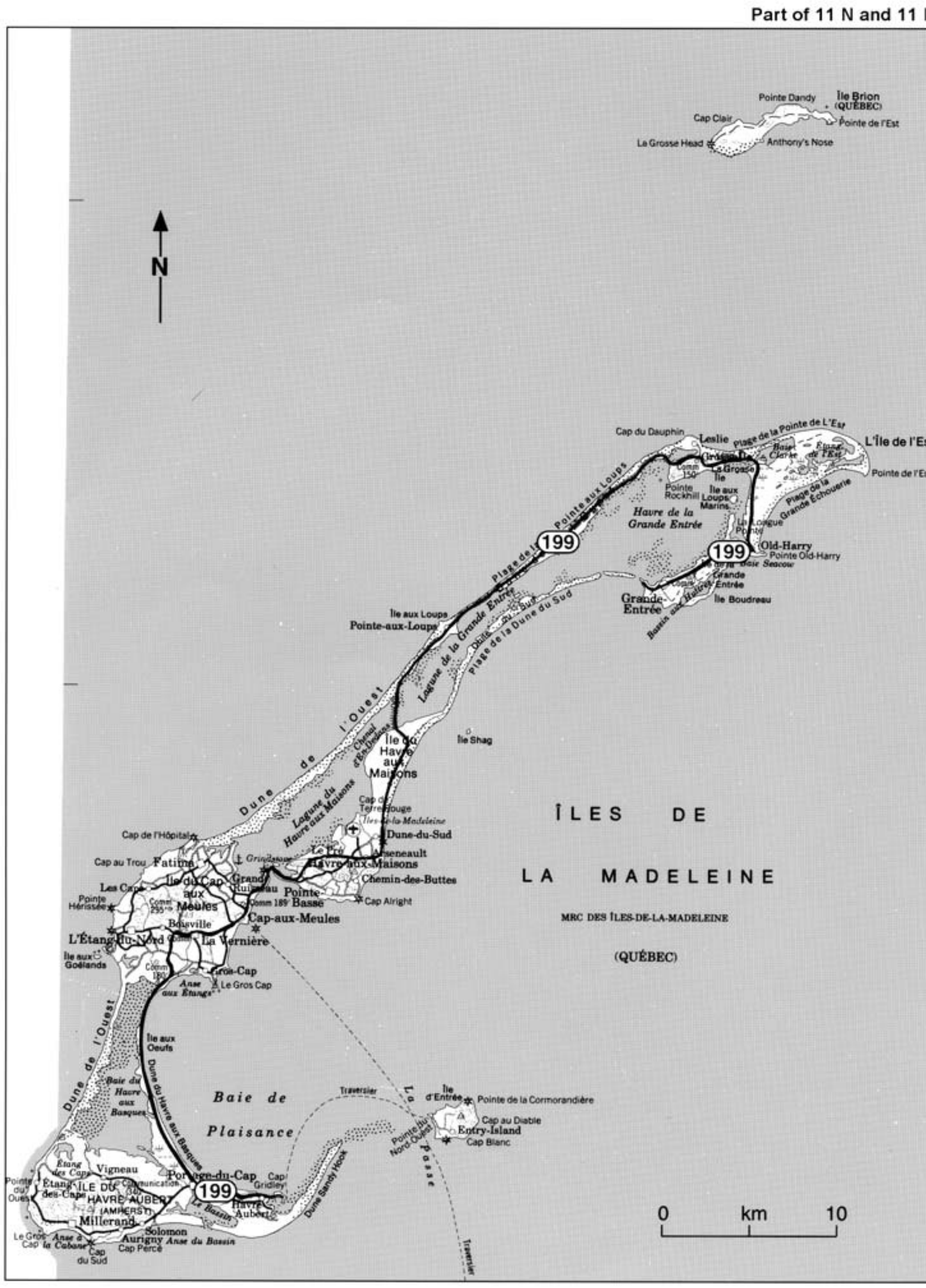


Figure 2. The Îles de la Madeleine: map showing the collecting route.

UNITS OF MEASUREMENT

Units of measurement obtained from geological reports referred to in the text have been converted from Imperial to the International System (SI). The following conversions were used:

1 inch = 2.54 cm	1 foot = 0.305 m
1 mile = 1.609 km	1 acre = 0.40469 ha
1 ounce (troy) = 31.103 g	1 pound = 0.453 kg
1 ton (short) = 0.907 t	1 oz (troy)/ton (short) = 34.285 g/t

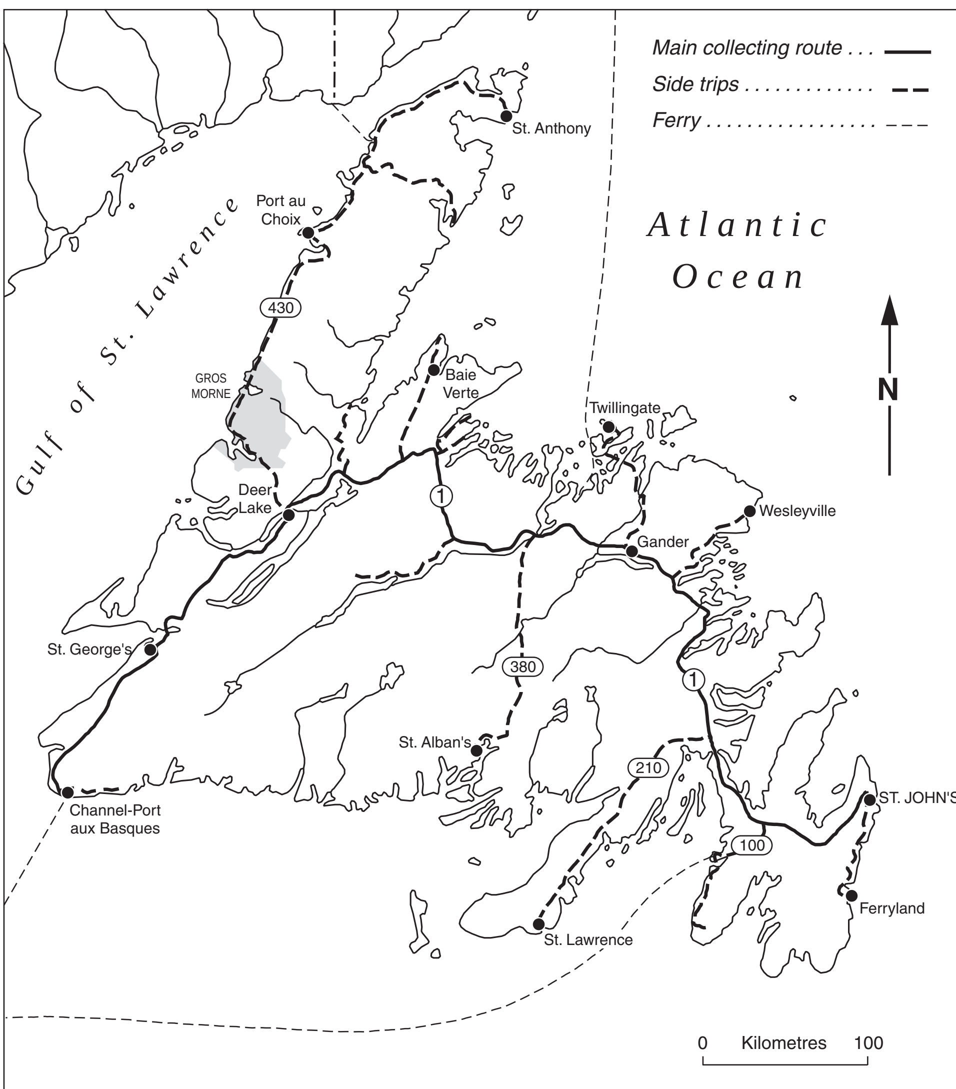


Figure 3. The Island of Newfoundland: map showing the collecting route.

ÎLES DE LA MADELEINE

Islands

The Îles de la Madeleine, 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 Île du Havre Aubert, Île du Cap aux Meules, Île du Havre aux Maisons, Île aux Loups, La Grosse Île, Île de l'Est, Île de la Grande Entrée, and Boudreau Island. The detached islands include Île d'Entrée, the only inhabited offshore island; Brion Island, the largest of the outlying islands; Rochers aux Oiseaux, where the vertical shoreline cliffs provide a haven for hundreds of birds of many species; Le Corps-Mort, Shag Island, and Île aux Goélands — 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 except Le Corps-Mort. Along these shallow shorelines, shoals, reefs, and rocky points represent navigational hazards to all but the smaller boats.

Topography

Physiographically, the Îles de la Madeleine 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. The surface is slightly rolling with elevations varying from 3 m to 45 m above the sea. Conical domes and steep-sided ridges rise from this surface to maximum elevations of 170 m on Île d'Entrée, 165 m on Île du Cap aux Meules, and 145 m on Île du Havre Aubert. 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 3 to 30 m 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 metres to 2500 m wide and up to 40 km long. In places, the accumulating sands have formed sandspits that project from the islands into the open waters of the gulf. These belts of sand make up nearly one third of the total area of the archipelago.

The lagoon-separated belts of duned sand were perceived by Jacques 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 (1535–1536) 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 9 m to 38 m in height.

The 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 at times 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.

Cliffs

Vertical cliffs, generally less than 30 m 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 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 Cap de Terre Rouge, Cap au Trou, and Étang des Caps.

Most higher cliffs — those that are 30 m to 60 m 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 Île d'Entrée and Île du Havre aux Maisons, the high cliffs of Noir Cape, and the shore of the Collines de la Demoiselle.

Fringing the cliffs are beaches of ivory-coloured sand composed almost entirely of quartz. This beach sand and the sand forming the sandbars and sandspits are 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.

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 islands. Being the last-formed rock, it covers all other rock formations except those making up 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 Île du Cap aux Meules, Île du Havre aux Maisons, Île du Havre Aubert, and Île d'Entrée. 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 the Collines de la Demoiselle Hill on Île du Havre Aubert, along the shore north of Cap aux Meules, on the south shore of Boudreau Island, and along the south and east shores of Île d'Entrée.

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 Île du Havre aux Maisons, and on the south shore of Île d'Entrée.

During Pleistocene time, the Îles de la Madeleine and eastern North America, to which they were then attached, were depressed under 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 1.

Table 1. Geological history of the Îles de la Madeleine.

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	
250	Paleozoic	Permian		
		Pennsylvanian	Red sandstone	Rocher aux Oiseaux, Brion and Shag islands, Île aux Loups, Île de la Grande Entrée; Rouge Island; Île aux Cochons, southern and western shores of Île du Havre Aubert; north half of Île du Havre aux Maisons; west half of Île d'Entrée; Rouge Point, Pointe à Richard, and western shore of Île du Cap aux Meules
			Grey sandstone	Cap aux Meules, Basse Point, Le Gros Cap, shoreline at Collines de la Demoiselle, Shea Point, Cap au Dauphin, Rockhill Point, Pointe de la Grosse Île, Brion Island, Rocher aux Oiseaux
		Mississippian	Gypsum, argillite, shale, limestone, sandstone, volcanic rocks	Eastern shore of Île d'Entrée; shoreline at Collines de la Demoiselle, north of Cap aux Meules, Butte Ronde, Buttes Pelées, Cap au Taureau, Anse à Damase, Boudreau Island, Noir Cape, Anse à la Cabane
			Limestone conglomerate Limestone, volcanic rocks Volcanic rocks	Eastern shore of Île d'Entrée Magdalen Manganese mine Chemin des Buttes quarry; Le Corps-Mort
		Devonian Silurian Ordovician Cambrian	Not represented in area	
544	Precambrian			

Mineral deposits

Although deposits of gypsum and manganese minerals are found on Île du Havre Aubert, Île du Havre aux Maisons, and Île du Cap aux Meules, there has been no commercial production. Natural gas was found on Île du Havre Aubert 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 165 m. Subsequent drilling programs have revealed additional salt deposits on Rochers du Dauphin, Île d'Entrée, and La Grosse Île. A commercial salt mine has been in operation since 1982 on La Grosse Île.

Collecting on the islands

There are numerous accessible localities on the Îles de la Madeleine 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 match 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 Îles de la Madeleine is on Île du Havre aux Maisons. Île d'Entrée is the only offshore island connected to the main islands by a ferry service. The other islands can be reached by small boats.

Refs.: 1 p. 623-645; 27; 38 p. 134–137; 57 p. 5–7; 60 p. 333–335; 81 p. 275–278, 323–324; 84 p. 1–10; 147 p.1–2; 202 p. 468–469; 203 p. 711; 208 p. 1–10; 219 p. 16–49, 53; 280 p. 39–41; 290; 292 p. 1.

Maps (T): 11 N and 11 M Îles de la Madeleine
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

CAP-AUX-MEULES TO GRANDE-ENTRÉE

km	**0**	Cap-aux-Meules, at the junction of Highway 199 (Principal Road) and the road leading to the Cap-aux-Meules pier. The road log is along Highway 199 from Cap-aux-Meules to Grande-Entrée.

Île du Cap aux Meules

This, the largest of the islands, is the commercial centre of the Îles de la Madeleine. A double line of sandbars 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 reaching 135 m to 165 m 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 Île aux Goélands at the southwest end.

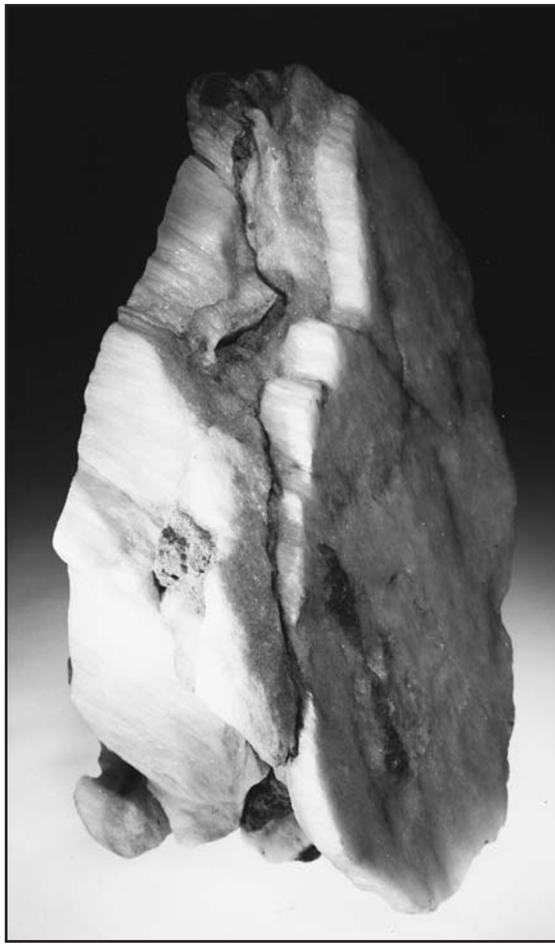


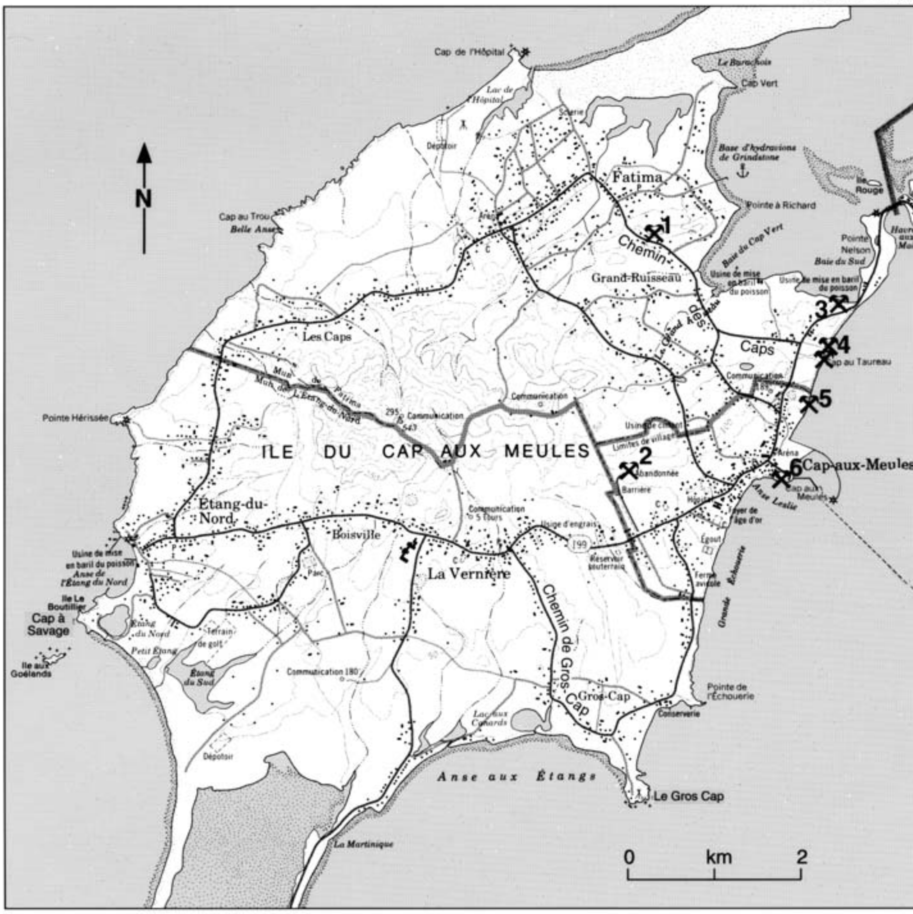
Plate 1

Fibrous gypsum (selenite), Îles de la Madeleine. GSC 1994-614C

Plate 2

Water-worn banded gypsum, shoreline north of Cap-aux-Meules pier, Île du Cap aux Meules. GSC 202820-B

Part of 11 N/5



1. Fatima quarry
2. Magdalen Manganese mine
3. Baie du Sud manganese occurrence
4. Cap au Taureau gypsum occurrence
5. Cap aux Meules gypsum occurrence
6. Cap aux Meules calcite occurrence

Map 1. Île du Cap aux Meules.

The island contains occurrences of gypsum and of manganese minerals. Sandstone quarries are found near Fatima.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

Cap aux Meules calcite occurrence

CALCITE CRYSTALS

In grey sandstone

Crystals of colourless to white calcite (dogtooth spar) occupy cavities and veins 5 to 10 cm wide in the sandstone. The crystals average about 5 mm in diameter.

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 30 m 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' (Île du Cap aux Meules). The grey sandstone is capped by red sandstone.

The occurrence is readily accessible from the Cap-aux-Meules pier, 0.3 km east of Highway 199. Proceed south from the pier. *See* Map 1.

Refs.: 1 p. 640–641; 219 p. 37.

Maps: (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360).

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 variety 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 microcrystals of colourless quartz, pink and white dolomite, and colourless to white calcite, and 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 Îles de la Madeleine. Although small shipments of gypsum were made by supply boats returning to the city of Québec sometime before 1880, the deposits remain undeveloped. They differ from those of New Brunswick, Nova Scotia, and Newfoundland and Labrador 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 455 m north of Cap-aux-Meules. The outcrop area extends northward for about 80 m. 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, 0.4 km long, leading northeast from the junction of Highway 199 and the Cap-aux-Meules pier road. It leads to the beach at the south end of the gypsum-bearing cliffs. *See* Map 1.

Refs.: 1 p. 638, 648; 129 p. 100; 208 p. 9; 246 p. 4–6, 14.

Maps: (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km **1.3** Junction, road on right leading east 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 3 cm 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, 0.3 km long, leading east from Highway 199 at **km 1.3**. One exposure begins about 90 m south of the point where the road meets the shore; here the gypsum-bearing rocks extend over a length of about 120 m. The other occurrence is about 200 m north of the end of the road. *See* Map 1.

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

Refs. : 17 p. 158–174; 219 p. 20, 26; 246 p. 14.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km **1.4** Junction, Chemin des Caps leading west.

Fatima quarry

SANDSTONE

Grey sandstone is exposed in a quarry on the southeast side of a 45 m 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 Île du Cap aux Meules 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 2.6 km from Highway 199 and is

visible from it. *See* Map 1.

Ref.: 219 p. 43.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km	**2.1**	Baie du Sud on left (west) side of the highway; 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 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, 275 m to 365 m 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, 0.8 km west of Highway 199.

These occurrences can be reached by walking along the shore west of **km 2.1** on Highway 199. *See* Map 1.

Ref.: 246 p. 14.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km	**3.4**	Bridge at Chenal du Havre aux Maisons.

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

km	**5.1**	Junction, Chemin du Cap-Rouge.

Île du Havre aux Maisons

Just beyond **km 5**, the highway turns away from the gulf shore and begins its traverse through the hilly part of Île du Havre aux Maisons, an area that comprises all but the island's northwestern part, which is flat and only a few metres above the level of the Lagune du Havre aux Maisons. 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 60 m high. All but two of the hills are composed of interbedded sedimentary and volcanic rocks. The exceptions are Mount Alice at the island's extreme west end and a 23 m hill on the west side of Highway 199 at **km 8.7**; they are formed of grey sandstone. This resistant sandstone also forms two headlands, one at Basse Point 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.

Plate 3

Buttes along chemin des Buttes, Île du Havre aux Maisons. GSC 202765

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km 5.8 Junction, Chemin de la 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 and includes 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.

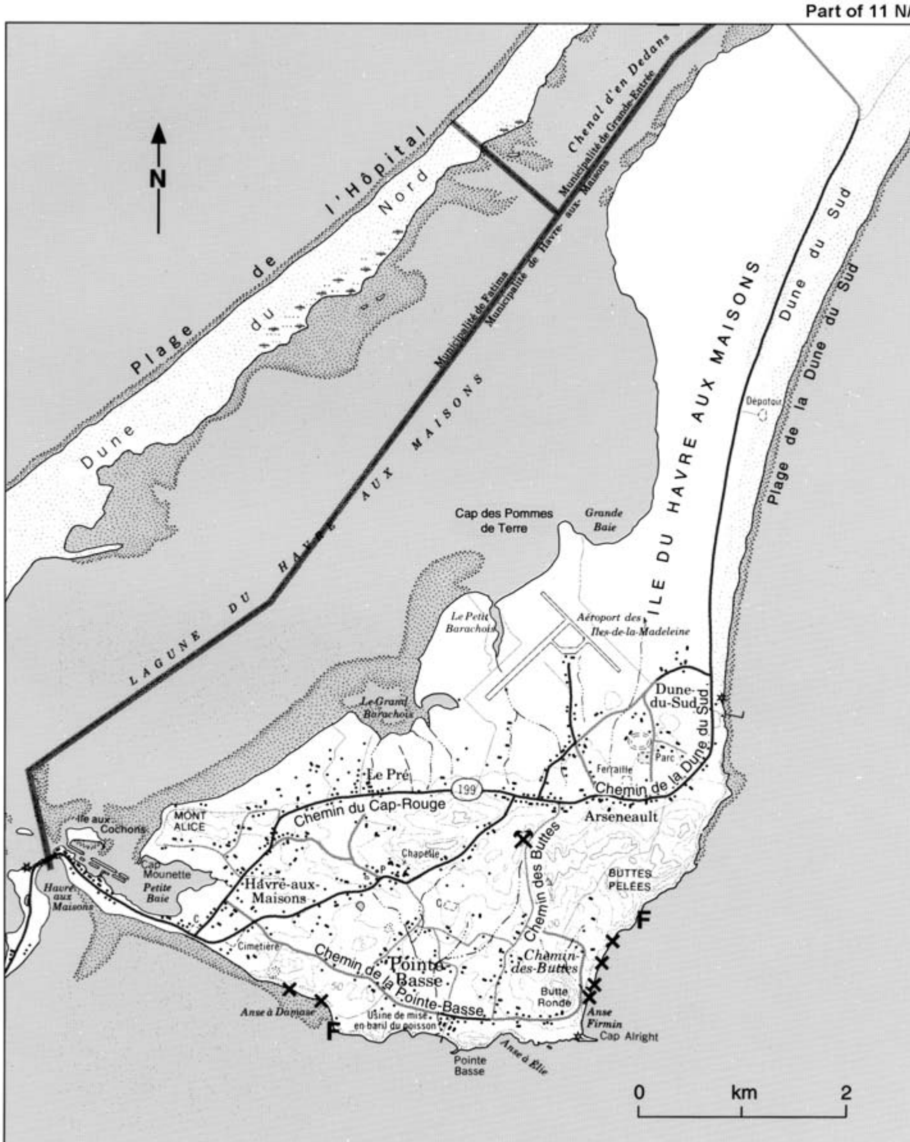
The rocks containing the gypsum and fossils are exposed along the shoreline cliffs at Anse à Damase, on the south shore of Île du Havre aux Maisons. *See* Map 2.

Road log from Highway 199 at **km 5.8**:

km	0	Proceed onto Chemin de la Pointe Basse.
	1.4	Junction; turn right.
	2.1	End of the road at the shore. The occurrence is in the cliffs near the road.

Refs.: 219 p. 29, 43; 246 p. 11, 12.

Part of 11 N/5



⚒ – chemin des Buttes quarry **x** – gypsum occurrences F – fossil occurrences

Map 2. île du Havre aux Maisons.

Maps: (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

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. It is grey to almost black, massive, and cut by veins of white gypsum.

The gypsum-bearing rocks here and at other localities on the Îles de la Madeleine are highly contorted as a result of 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 the 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 Chemin de la Pointe Basse.

Along this road at the foot of Butte Ronde (km 3.2 on the road log below), the pebbles in the gravels and broken rock fragments provide white fibrous and massive gypsum in sedimentary rocks; amygdaloidal basalt with cavities (measuring about 2 cm across) containing platy aggregates of specularite and microcrystals of calcite, quartz, and epidote; and crystalline layers of epidote in basalt. *See* Map 2.

Road log from Highway 199 at **km 5.8**:

km 0 Proceed onto Chemin de la Pointe Basse.

1.45 Junction, road to Anse à Damase; continue straight ahead.

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

The road log continues straight ahead.

3.2 Butte Ronde on left. This 300 m hill is typical of the beehive-shaped hills or buttes that rise abruptly from the slightly undulating plains on this island and on Île du Cap aux Meules and Île du Havre Aubert. 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. Broken rocks at the foot of the butte provide specimens of gypsum, epidote, and calcite-quartz-epidote.

Along the shore, the faulted contact of the red sandstone with the underlying volcanic rocks can be seen at a point 170 m 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 Îles de la Madeleine where the red sandstone strata have been disturbed; elsewhere, as seen along the shoreline cliffs, the sandstone 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.

3.4 Junction, access road to the shore at the foot of Butte Ronde. The gypsum-bearing rocks outcrop along the sea cliffs north and south of the road. They extend 150 m southward from the road. The exposures north of the road stretch for 455 m northward from a point 150 m from the road. The fossils occur near the northern end of these exposures.

Refs.: 1 p. 638, 642, 644; 219 p. 21, 25, 43; 246 p. 7, 9, 12.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km 8.6 Red sandstone is exposed in a low outcrop along the highway; the hill beyond on the left (north) side of the highway is composed of grey sandstone.

km 8.7 Junction, Chemin de la Dune du Sud (on right) and Chemin du Cap Rouge (on left).

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 irregular masses of hematite and aggregates of white calcite crystals (dogtooth spar) with individual crystals averaging 5 mm in diameter. The calcite fluoresces pink when exposed to ultraviolet light. Patches of a greenish-grey clay occur as an alteration product 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 accomplished 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 30 m from the surface.

Road log from Highway 199 at **km 8.7**:

km 0 Junction, Highway 199 and Chemin de la Dune du Sud; proceed east along Chemin de la Dune du Sud.

0.4 Junction, Chemin des Buttes; proceed south along Chemin des Buttes.

0.9 Quarry on the west side of the road. *See* Map 2.

Ref. : 219 p. 18–19.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

Buttes Pelées

The Buttes Pelées are a series of hills or buttes that form a ridge extending eastward from Chemin des Buttes to the gulf shore. They reach uniform maximum elevations of over 90 m above the sea. The ridge is steep-sided at its western end, along the road, where it reaches its maximum elevation of 110 m. It terminates in 30 to 60 m 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 the Buttes Pelées, a bed of grey limestone particularly rich in Mississippian shell fossils is exposed near the shore at an elevation of 15 m. This limestone weathers black and is associated with argillite and gypsum; volcanic rocks are interbedded with these rocks. The fossil occurrence is about 730 m north of the access road leading to the shore from Butte Ronde. *See* Map 2.

The Chemin des Buttes parallels the western edge of the Buttes Pelées for 1.3 km from its junction with Chemin de la Dune du Sud.

Refs.: 1 p. 638; 219 p. 21, 25.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km	**9.5**	Junction, Chemin de l'Aéroport.
km	**10.8**	Junction, road leading east to Plage de la Dune du Sud.

Plage de la Dune du Sud

Along this sandy beach, south of the access road, the low shoreline cliffs of red sandstone bear 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 are a continuing geological process resulting in an ever-changing shoreline.

Dune du Sud

At about this point the highway begins its course along Dune du Sud — the 21 km sandbar extending from Île du Havre aux Maisons to the entrance of Havre de la Grande Entrée. With Dune du Nord, it forms a double link enclosing a very shallow, protected interior passage comprising Lagune du Havre aux Maisons, Lagune de la Grande Entrée, Chenal d'en Dedans, and Havre de la Grande Entrée. The highway leads north along the southern part of the sandbar. At this end the sandbar bulges out onto the lagoon and attains its maximum width of 2300 m. As the dune passes Shag Island, it narrows abruptly, forming a crescent that separates Lagune de la Grande Entrée from the Gulf of St. Lawrence.

km	**18**	The highway leaves Dune du Sud and bridges the interior channel, which at this point is 1700 m wide.
km	**20**	Dune du Nord

Dune du Nord

From this point to **km 40**, the highway route is along Dune du Nord, the immense 40 km sandbar that connects Cap de l'Hôpital on Île du Cap aux Meules to La Grosse Île, enclosing Île aux Loups at about the midpoint. This is the longest of the sandbars linking the islands of the archipelago. Its width varies from 800 m to just slightly more than the width of the highway.

Plate 4

Sea arches produced by wave erosion along the shore at Plage de la Dune du Sud. Île d'Entrée is visible in the distance. GSC 202764

km	**22**	Le Buttereau-du-Nègre on right. This is a group of duned islets in Lagune de la Grande Entrée.
km	**25**	Île aux Loups

This irregularly shaped island, with a maximum elevation of only 15 m above the sea, is formed of red sandstone. It is about 1300 m wide and almost 2400 m long.

km	**30**	From this point to **km 35**, Dune du Nord is dotted with numerous shallow pools of water separated by marshy areas. It reaches its maximum width of about 800 m in this section.
km	**40**	Rochers du Dauphin

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

Seleine mine

HALITE, ANHYDRITE, SYLVITE, CARNALLITE

In argillite

The salt deposit consists of layers of commercial-grade halite, thick layers of anhydrite or interlayered anhydrite-halite, and minor layers of potash (sylvite and carnallite).

This deposit is one of seven salt domes discovered in four of the islands: Brion Island, La Grosse Île, and the adjacent Rochers du Dauphin, Île du Havre Aubert, and Île d'Entrée. The La Grosse Île–Rochers du Dauphin deposits form one of the largest salt structures in North America. The first salt deposit was struck in 1970 at a depth of 2473 m by La Société acadienne de recherches pétrolières Ltée on Brion Island during an oil exploration project. Between 1972 and 1974, drilling by SOQUEM resulted in the discovery of the remaining deposits. In preparation for mining the La Grosse Island deposit, the channel from Grande Entrée to La Grosse Île was dredged to allow access for ships, a wharf and loading facilities were built, a production shaft was sunk to 253 m, and crushing and storage facilities were installed underground. In 1983, Mines Seleine began production and continued until 1988 when Canadian Salt Co. Ltd., the current operator, took over. Total salt production to the end of 1992 is estimated at 10 560 900 t valued at about $196 112 818.

The Seleine mine is on the south side of Highway 199 at **km 40**. *See* Map 3.

Refs.: 35 p. 18–20; 62 p. 4–7; 79 p. 138–140; 80 p. 93–99; 246 p. 92–96.

Maps (T): 11 N/11 and 11 N/12 Île de l'Est
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence
(MRNQ, 1:63 360)

km 41 Causeway and bridge connecting Dune du Nord to La Grosse Île. The Baie de la Grosse Île (on left) projects deeply into La Grosse Île, nearly cutting it in two.

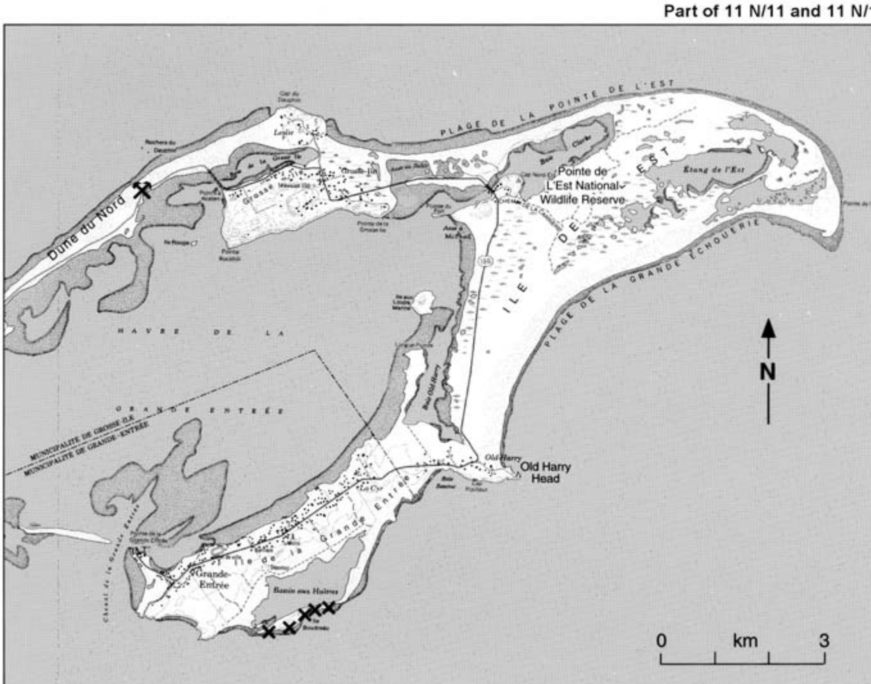
La Grosse Île

This island is composed of two parts joined by a narrow neck of land and duned sand separating the Baie de la Grosse Île from the Gulf of St. Lawrence. The larger, southern part is made up of a series of hills with elevations from 75 m to 90 m. A single 46 m hill, its northern side cut by 30 m cliffs overlooking the gulf, makes up the northern part. The 3 km long southern shore of the island is bordered by a continuous 15 m cliff. Red sandstone underlies all of the island except Rockhill Point and Pointe de la Grosse Île, which are formed of the older grey sandstone.

Maps (T): 11 N/11 and 11 N/12 Île de l'Est
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence
(MRNQ, 1:63 360)

Plate 5

La Grosse Île viewed from south of Havre de la Grande Entrée.
GSC 202825



⚒ – Seleine mine **x** – Boudreau Island occurrence

Map 3. La Grosse île, île de la Grande Entrée, île de l'Est, and Boudreau Island.

Brion Island

Brion Island is an uninhabited island 16 km north of La Grosse Île. It was named by Jacques Cartier who made a landing on the island in 1534; the name is in honour of Phillippe Chabot, Sieur de Brion, the Grand Admiral of France and patron of Cartier's expedition to the New World.

Brion Island is nearly 8 km long and up to 1500 m wide. It is composed of red sandstone with some grey sandstone. Its rolling surface rises to an elevation of 75 m in the central part. It is bordered by vertical cliffs 15 m to 60 m high. Along much of the shoreline, cliffs form smooth sweeping curves in contrast to the jagged edges and sea-sculptured features characteristic of the other islands. Elsewhere the coastline is intricately indented with countless coves and headlands.

The island has been designated as an ecological reserve by Environnement Québec to conserve its unique flora and fauna. It is home to more than 140 species of birds. Visits to the island for educational purposes may be arranged through the Corporation pour l'accès et la protection de l'Île Brion at Cap-aux-Meules.

Refs.: 1 p. 631; 81 p. 275; 219 p. 1, 5.

Maps (T): 11 N/14 Île Brion
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

Rochers aux Oiseaux

The uninhabited Rochers aux Oiseaux consist of a rock island — Rocher aux Oiseaux — and a cluster of rock islets known as 'Rochers aux Margaulx'. These islands were the first of the Îles de la Madeleine to be sighted by Jacques Cartier on his discovery voyage of June 1534 as he sailed from the Strait of Belle Isle into the Gulf of St. Lawrence.

Rocher aux Oiseaux is a flat-topped, oval island only 320 m long with cliffs about 37 m 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 enumerable crumbly ledges where the many species of birds perch and nest. The Rocher aux Oiseaux is a bird sanctuary where colonies of aquatic birds make their home. The Rochers aux Margaulx comprises jagged rock islets and small towers of rock that project upward from the gulf floor about 1300 m northwest of Rocher aux Oiseaux.

The Rochers aux Oiseaux are located 35 km northeast of La Grosse Île and about 20 km east of Brion Island. Excursions may be arranged through Tourisme Îles de la Madeleine, in Cap-aux-Meules.

Refs.: 1 p. 631; 81 p. 275; 219 p. 1, 5.

Maps (T): 11 N/14 Île Brion
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km	**47**	Bridge at Clarke Bay; Nord-Est Cape is to the left (northeast) of the bridge.

Île 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 Nord-Est Cape that rise conspicuously from the flat surrounding area are formed of red and grey sandstone. They make up the only rocky area in the island; the rest is duned sand — the broadest stretches of sand in the Îles de la Madeleine.

Maps (T): 11 N/11 and 11 N/12 Île de l'Est
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km 49.3 Entrance to the Pointe-de-l'Est Wildlife Refuge. The refuge is an area of sand dunes, marshes, and ponds where birds gather during their migrations. It is rimmed by two beaches, Plage de la Pointe de l'Est on the north side and Plage de la Grande Échouerie on the south side.

km 52.3 Junction, road on left leading to Old-Harry Head.

Old-Harry Head

An access road, 0.8 km long, 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.

Île de la Grande-Entrée

The rock exposures at Old-Harry Head mark the end of the vast dune country of Île de l'Est and the beginning of Île de la Grande Entrée.

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 30 m 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 — La Longue Pointe — and from its southern shores, a sandbar linking Boudreau Island. This narrow island (Boudreau) with its sand-duned link encloses Bassin aux Huîtres. Its 15 m 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. *See* Map 3.

Refs.: 1 p. 634, 636, 638, 641; 219 p. 31–37.

Maps (T): 11 N/11 and 11 N/12 Île de l'Est
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km 52.8 Seacow Bay on left. The west shore of this bay is one of two locations on this island where the shore is bounded by sea cliffs. These low sandstone cliffs have been sculptured and etched by the sea, producing the typical features of marine erosion.

km 54.6 From this point to about **km 57**, 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 15 m to 30 m above sea level, occupies the area between the highway and Bassin aux Huîtres. It is sparsely vegetated with shrubs and low-growing trees (refs.: 1 p. 634; 202 p. 467).

Plate 6

Sea caves in sandstone cliffs, Old-Harry, Île de la Grande Entrée. Canadian Government Photo Centre 72-1591

Plate 7

Sculptured shoreline, Seacow Bay, Île de la Grande Entrée. The constant lashing of sea waves produced this series of caves and sea arches along the shore. GSC 202747

km 55.0 Junction, Chemin du Bassin Est. This road, about 1 km long, leads across the island and part way into the sandbar that connects Boudreau Island to Île de la Grande Entrée.

Boudreau Island occurrence

GYPSUM, FOSSILS

In sedimentary rocks

Massive white gypsum occurs in crisscrossing veins and in masses in argillite and siltstone that form part of a sedimentary sequence exposed by cliffs on Boudreau Island. 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 15 m cliffs on the gulf shore of Boudreau Island. In places, they are capped by a conspicuous layer of red sandstone. They 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 du Bassin Est) to the cliffs, a distance of about 1.2 km. *See* Map 3.

Refs.: 1 p. 636–638, 642; 219 p. 31–37.

Maps (T): 11 N/11 and 11 N/12 Île de l'Est
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km	**58.1**	Grande-Entrée, at the junction of Chemin du Bassin Ouest.
km	**58.4**	Junction of Chemin de l'Anglais and Chemin des Pealey.

This is the terminal point of Highway 199 through the northern part of the archipelago. Chemin de l'Anglais continues for 1 km to Pointe de la Grande Entrée and the entrance to Havre de la Grande Entrée.

CAP-AUX-MEULES TO HAVRE-AUBERT

This section describes the collecting localities and points of interest along Highway 199 (Principal Road) south of Cap-aux-Meules. The road log begins at Cap-aux-Meules and proceeds to Havre-Aubert.

km	**0**	Cap-aux-Meules, at the junction of Highway 199 and the road to Cap-aux-Meules pier. Proceed south along Highway 199.
km	**1.3**	Junction, Chemin de Gros-Cap leading south to Le Gros Cap.

Le Gros Cap is a cliffed headland composed of red sandstone. It projects from the southeast corner of Cap aux Meules into the Baie de Plaisance. The headland displays the etched, grooved, and sculptured features of marine erosion including several sea arches and caves.

The road log continues west along Highway 199.

km	**1.8**	Junction, Chemin de la Mine leading north.

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 up to 45 cm 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 Île du Cap aux Meules has been known since about 1903. 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 tonnes 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 30 m shaft from the bottom of the pit, but the results were unfavourable and work was discontinued.

This mine, now abandoned, is 0.8 km north of Highway 199 at **km 1.8**. *See* Map 1.

Refs.: 1 p. 645–648; 184 p. 69–73; 219 p. 49–50; 282 p. 187; 283 p. 329.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km 4.5 Junction. Highway 199 turns left (south). The road leading straight ahead (west) is Chemin de l'Étang-du-Nord.

Butte du Vent

The hill north of this junction is Butte du Vent; it rises to an elevation of 165 m, the highest summit on Île du Cap aux Meules and the second highest in the Îles de la Madeleine. It is composed mostly of volcanic rocks.

L'Étang-du-Nord

The Chemin de l'Étang-du-Nord leads to the western shores of the island where a continuous line of sandstone sea cliffs extends northward from Anse de l'Étang du Nord to a point about 1500 m southwest of Cap de l'Hôpital. The cliffs have been notched in places allowing streams that drain the hilly central region to flow into the sea.

From the junction, Highway 199 leads south through the south-central part of the

island and through the sandbar links to Île du Havre Aubert. The road log continues along Highway 199.

km 8.5 La Martinique bridge

Baie du Havre aux Basques

The Martinique bridge connects Île du Cap aux Meules to Île aux Oeufs, a 15 km long strip of duned sand. This is the first of two sandbar links connecting Île du Havre Aubert to the chain of islands forming the Îles de la Madeleine group. Together with Dune de I'Est it forms a twin line of banked sand enclosing the Baie du Havre aux Basques, a saltwater 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, crashed against the unlighted cliffs or were trapped in the treacherous sands. Since the existing system of fog signals and lights was installed, losses have been rare.

km	**14.9**	Bridge over the passage separating Île aux Oeufs from Dune de 1'Est.
km	**20**	South end of Dune de 1'Est. The highway begins its short journey through Île du Havre Aubert.

Île du Havre Aubert

This is the most southerly and the largest of the Îles de la Madeleine. Its topography is dominated by La Montagne, an east-west ridge of resistant volcanic and sedimentary rocks forming the backbone of the island. The 145 m summit near the east end of the ridge is the island's highest point and the third highest on the Îles de la Madeleine.

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 Collines de la Demoiselle region, the shoreline is flat and near the level of the surrounding waters.

Le Bassin, at the southeastern end of the island, is a shallow lagoon where seawater 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 sandspit — Sandy Hook Dune — curves into the Baie de Plaisance; its submerged tip swings out eastward extending to within 3 km of Île d'Entrée.

Maps (T): 11 N/4 Havre-Aubert
11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

Plate 8

La Montagne, Île du Havre Aubert. This ridge, composed of erosion-resistant volcanic and sedimentary rocks, rises above the lowlands that are underlain by easily eroded red sandstone. GSC 202759-A

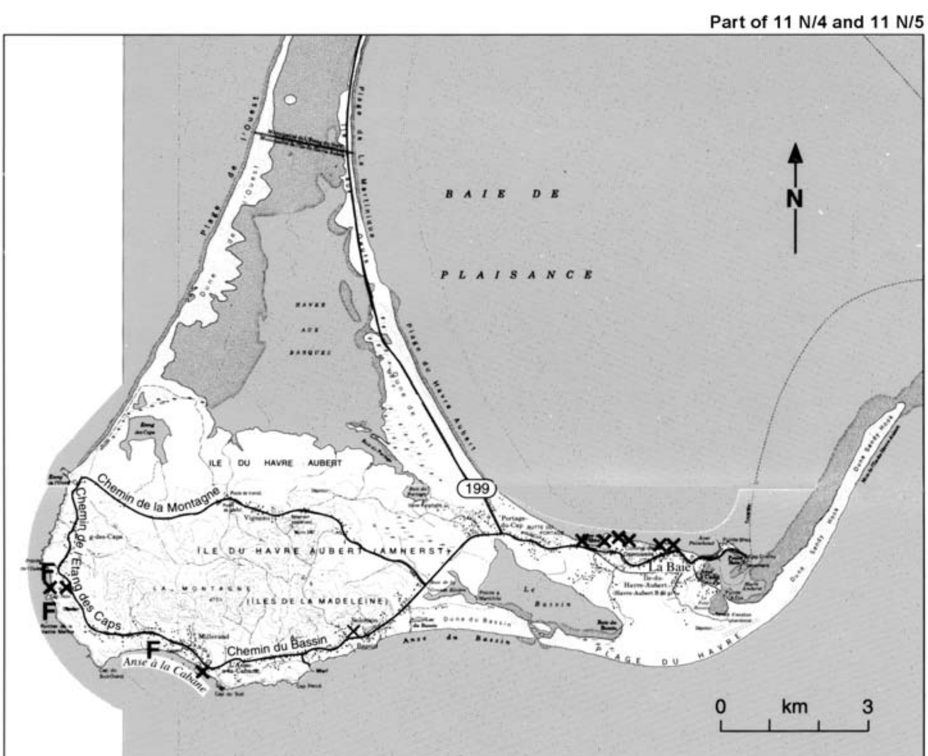
km 20.7 Portage-du-Cap, at the junction of Highway 199 and Chemin du Bassin leading to the central part of Île du Havre Aubert.

Le Bassin, a saltwater lagoon, is on the south side of this junction; it is 3 km long and 1 km 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. Points of interest in central Île du Havre Aubert are described on pages 31-33.

km 22.6 La Baie, Highway 199 ends. Continuing eastward is the scenic route to Cape Gridley. The road log continues along the scenic route.

Anse au Plâtre, on the left (north) side of the road, is a small bay on the south side of the Baie de Plaisance. 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. *See* Map 4.

km 23.0 The road begins its climb up the west slope of the Collines de la Demoiselle, circles its south slope, then proceeds eastward paralleling the south shore of Baie de Plaisance as it approaches the end of its course.



x – gypsum occurrences **F** – fossil occurrences

Map 4. Île du Havre Aubert.

Collines de la Demoiselle

The Collines de la Demoiselle is a broad-based, conical hill rising conspicuously from the low-lying surrounding area to an elevation of 85 m. Its seaward slope is sliced by a 45 m cliff. The hill is composed of volcanic rocks. Near its summit is a memorial to Jacques Cartier, discoverer of the Îles de la Madeleine.

km	**24.8**	Painchaud Cove is on the left (north) side of the road and on the east side of the Collines de la Demoiselle.

Collines de la Demoiselle 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 the Collines de la Demoiselle. The gypsum-bearing sedimentary rocks alternate with volcanic rocks to form the cliffs. They extend westward for about 800 m beginning on the shore opposite **km 24.8.** The gypsum is associated with argillite that has been deformed and contorted by earth movements in the geological past. It is white with a reddish tint; both granular massive and fibrous varieties are found.

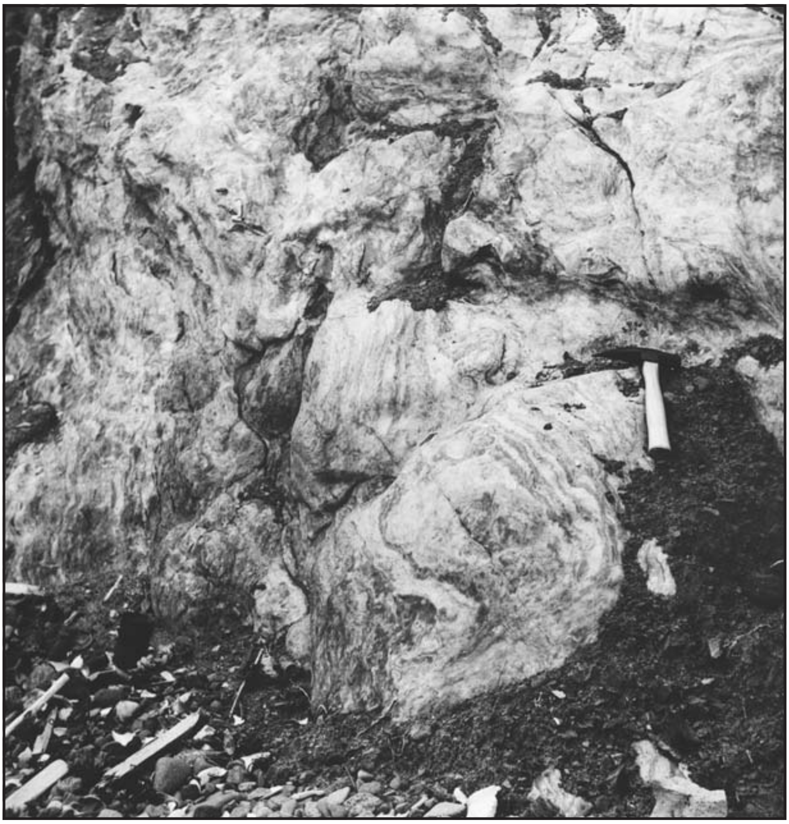


Plate 9

Crenulated gypsum-bearing rock exposed along the shore of Collines de la Demoiselle, Île du Havre Aubert. GSC 202768

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 'long' rays); colourless quartz crystals; and platy specularite aggregates. These crystals are generally very small and are suitable for micromounting. The manganese mineral birnessite occurs as a coating on the rock. Some volcanic rock has been epidotized and contain fractures 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 Îles de la Madeleine was reported. Fragments of manganese minerals weighing up to 7 kg were found in the fallen rock at the base of the cliffs by James Richardson during his 1880 geological survey of the 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 Île du Cap aux Meules.

These shoreline cliffs can be reached by walking down the bank from the road at **km 24.8** to the shore. The first rock exposure is about 50 m west of this point. *See* Map 4.

Refs.: 1 p. 639; 208 p. 10; 246 p. 20–21.

Maps (T): 11 N/4 Havre-Aubert
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

km 26.5 End of scenic route at Cape Gridley.

Sandy Hook Dune

Opposite Cape Gridley, Sandy Hook Dune, an 8 km long crescent-shaped sandspit, curves out from the south shore of Île du Havre Aubert toward the open waters of the gulf. Its tip is underwater for a distance of about 500 m.

The spit is built up of sand churned and swept up by the combined action of waves and shoreline currents moving northeastward toward and beyond the south shore of the island. A southeastward-moving current from Baie de Plaisance prevents these sands from accumulating onward toward Île d'Entrée, thus maintaining an open channel, La Passe, that would otherwise link this island to the chain of islands. The distance between Île d'Entrée and the exposed tip of the sandspit fluctuates, depending upon the relative strengths of the two sets of currents. Records indicate that since 1765, the maximum separation was 5484 m and the minimum, 5069 m. In 1956, the distance was 5313 m; in 1959, 5069 m (ref.: 126 p. 9). The ferry from Souris, Prince Edward Island, to Cap-aux-Meules passes through this channel.

Île du Havre Aubert circle tour

This side trip begins in Portage-du-Cap and proceeds along Chemin du Bassin, Chemin de l'Étang des Caps, and Chemin de la Montagne, forming a loop through the central part of Île du Havre Aubert. 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 Le Bassin.

Road log to central Île du Havre Aubert:

km	0	Portage-du-Cap, at the junction of Highway 199 and Chemin du Bassin; proceed onto Chemin du Bassin.
	2.1	Junction, Chemin de la Montagne. This road leads west along the north side of the hilly central region and constitutes the northern part of the circle tour. The road log continues along Chemin du Bassin toward the south shore of the island.
	3.7	Bassin, at church. Massive white gypsum outcrops at the side of a hill overlooking Bassin. The exposure is about 350 m 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 by surface weathering. This topography is a common feature of regions underlain by gypsum-bearing rocks. *See* Map 4.
	5.1	Junction, Chemin du Moulin leading south to the shore. This road leads to the beaches bordering the sea cliffs on the south shore of the island. The headland, Percé Cape, is immediately southwest of the end of the road. Its cliffs as well as those between Cap du Sud and Dune du Bassin are composed of red sandstone. A conspicuous thin white layer is found near the tops of the cliffs; this is sandstone that has been decoloured by organic acids seeping down from the mantle of vegetation above it.
	6.7	The highest point on the island is north of the road at this point. It is the 145 m 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 the maximum elevation reaches 76 m. Because the ridge is composed mostly of resistant volcanic rocks, it has survived the erosion that levelled the surrounding rocks.
	7.0	Junction, Chemin du Phare leading to the cliff tops at the Cap du Sud lighthouse. Between Cap du Sud and Cap du Sud-Ouest, Anse à la Cabane forms a broad, gently curved arc about 3 km 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. *See* Map 4.
	9.5	Cap du Sud-Ouest is south of the road at this point.
	9.8	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 volcanic rock is interbedded with sedimentary rocks to form the hilly region in the south-central part of the island.
	10.8	Noir Cape is about 460 m west of the road at this point.

Noir Cape

The steep 45 m cliffs forming Noir Cape 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 Noir Cape headland. Inland, this gypsum-bearing rock outcrops along the slope between the shoreline and the pond that lies about 200 m west of the road at km 10.8. See Map 4.

About 600 m south of Noir Cape, an erosional rocky remnant — the Rocher de la Vache Marine — emerges from the shallow waters as an isolated offshore rock. Several such detached rocks lie off the coastal parts of the Îles de la Madeleine.

km 11.4 Rouge Point is about 400 m west of the road at this point.

Rouge Point

Red sandstone forms the headland at Rouge Point (formerly called 'Pointe de l'Ouest') and the sea cliffs that continue northward to Dune de l'Ouest. The bay between this headland and Noir Cape is bordered by cliffs exposing grey and brown sedimentary and some volcanic rocks. Shell fossils of Mississippian age occur in the sedimentary rocks (siltstone) on the southeast side of Rouge Point. See Map 4.

Fragments of manganese ore weighing 6 to 9 kg were found many years ago in an outcrop of volcanic rock near Rouge Point.

Le Corps-Mort

This oblong island, only 400 m long, lies isolated in the Gulf of St. Lawrence 14 km west of Rouge Point. Viewed from the sea toward either end, it rises like a steeply sloping pyramid 50 m high. Its lengthwise view is irregular in outline and, to early explorers, resembled that of a body laid out for burial, a resemblance that gave rise to its name.

This is the most westerly of the Îles de la Madeleine; 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.

km 13.7 Junction, Chemin de la 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 5 km of its scenic woodland course, it climbs from near sea level to an elevation of about 55 m at km 19. Its 2 km descent brings it down to the low-lying meadowland on the west side of Le Bassin. 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 Îles de la Madeleine where a major road penetrates a wooded area.

km 21.9 Junction, Chemin du Bassin. This ends the circle tour around central Île du Havre Aubert.

Refs.: 1 p. 639; 81 p. 275–278; 184 p. 71; 208 p. 5; 219 p. 24, 28; 246 p. 17–20.

Maps (T): 11 N/4 Havre-Aubert
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

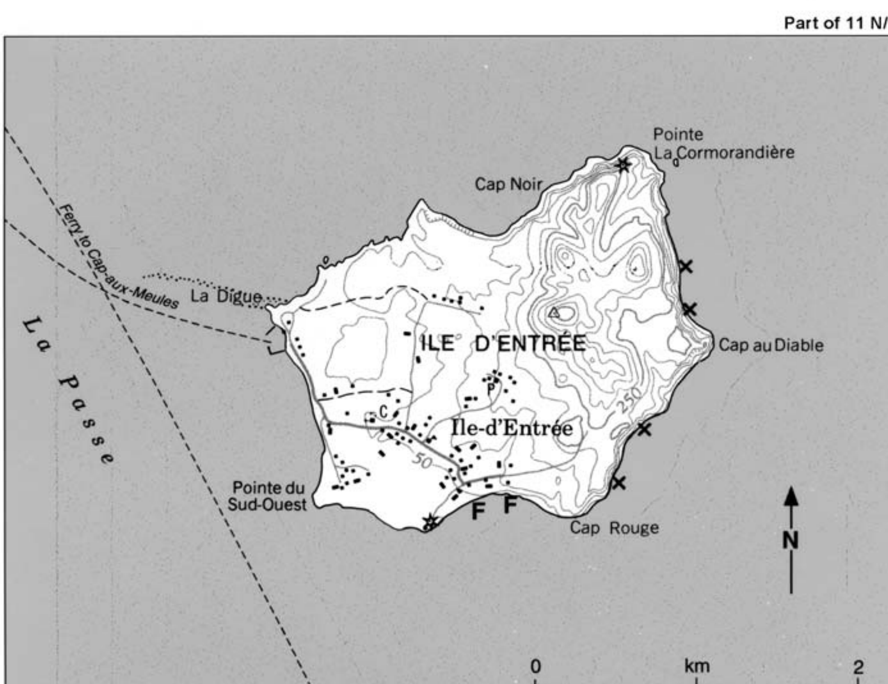
Île d'Entrée

This is the only inhabited offshore island. It is connected by a regularly scheduled ferry service to Cap-aux-Meules.

The island is 1600 m to 2400 m wide and 3200 m long. Its rugged, hilly eastern half rises abruptly from the sea to peaks of over 150 m above it, in striking contrast to the gently rolling, low-lying western part. The 170 m summit in the heart of the island is the highest elevation on the Îles de la Madeleine. As elsewhere on these islands, the hills are underlain by resistant volcanic and sedimentary rocks and 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 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. *See* Map 5.



x – gypsum occurrences **F** – fossil occurrences

Map 5. Île d'Entrée.

Refs.: 1 p. 639; 129 p. 99; 219 p. 20, 24, 28; 246 p. 20, 22.

Maps (T): 11 N/5 Île du Cap aux Meules
(G): 1482 Magdalen Islands Archipelago, Gulf of St. Lawrence (MRNQ, 1:63 360)

THE ISLAND OF NEWFOUNDLAND

The island

The Island of Newfoundland is triangular and extends about 515 km along each side. Its landmass of 112 251 km² 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 18 km from mainland Canada. Cape Breton Island is 105 km 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.

Topography

The Island of Newfoundland is a gently undulating, southeastward-tilted plateau with an average elevation of 600 m in its mountainous western side sloping gradually to an average of 200 m 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 790 m above sea level. Eastward the elevations of hills and ridges decrease steadily to a maximum of about 300 m 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 one third of the surface is occupied by lakes, rivers, ponds, and bogs. Woodland areas are confined to the major river valleys such as those of the Humber, Exploits, and Gander rivers.

Shoreline

Most of the Island of Newfoundland is bordered by steep, rocky coastal cliffs that plunge into the sea from heights of up to 150 m. The jagged, 9600 km long shoreline is 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 80 km 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 kilometres 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 flooded by the sea. Today's coastal indentations are the inland sections of river valley systems that continue seaward for several kilometres 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 the coast of the Island of 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 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 consist of the narrow coastal strip of low-lying, slightly deformed sedimentary rocks along the western shore. The Appalachian region in the Island of Newfoundland forms the northeasterly tip of the Appalachian mountain system — a 3200 km long belt of strongly folded and faulted rock formations extending along coastal North America from Alabama to the Island of Newfoundland and beyond beneath the Atlantic Ocean to the continental shelf.

The Appalachian region consists of highlands, lowlands, and uplands. The Newfoundland Highlands are 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 Topsails, 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 Northern Peninsula and of a gently rolling basin of mostly Paleozoic rocks surrounding Notre Dame Bay and extending southward to the central part of the island. The uplands constitute the remainder of the island including the area east of Gander, the south shore, and the Avalon Peninsula, a region ranging from rugged to rolling terrain with elevations between 180 m and 300 m.

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 Îles de la Madeleine. The waters of the gulf and of the continental shelf are relatively shallow, 100 m to 200 m deep. The shelf slopes gradually from the coast of the Island of Newfoundland to its outer edge 240 to 320 km from the island, where it drops steeply into the depths of the Atlantic Ocean.

Geological history

The geological history of Newfoundland and Labrador 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 gneiss, schist, and quartzite. 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 the western part of the Island of Newfoundland — in the Hare Bay–Canada Bay and Daniel’s Harbour–Port au Port areas — rock masses composed of sedimentary rocks, lava, gabbro, and ultrabasic rocks lie upon rock formations of the same early Paleozoic age, but formed differently. 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 about 64 km 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 immense 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, i.e. on the Northern Peninsula, near the head of St. Mary’s Bay, near Grand Lake, and 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 a 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 2.

Mineral deposits

The Island of Newfoundland contains a variety of metallic and nonmetallic mineral deposits. The metallic deposits include gold, iron, copper, lead, zinc, manganese, molybdenum, nickel, antimony, arsenic, and chromium. Among the nonmetallic deposits are pyrophyllite, gypsum, asbestos, fluorite, and barite. Structural or building materials include granite, slate, quartzite, sandstone, limestone, and marble.

In addition to these deposits, there are numerous ocurrences of minerals including beryl, quartz, scheelite, amethyst, anhydrite, and celestine. Jasper, xonotlite, labradorite, epidote, chrome-mica rock (‘virginite’), marble, and rhyolite are some of the ornamental materials that are found on the island.

Mining history

Mining was first attempted in the Newfoundland in 1778 when a copper-bearing vein was unsuccessfully exploited at Shoal Bay, Avalon Peninsula. In 1857, the La Manche lead mine

Table 2. Geological history of the Island of Newfoundland and Labrador.

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
65	Mesozoic	Tertiary	Not represented in area	
250				
	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 Roadcuts: Trans-Canada Highway km 822 to km 836 Shoreline west of Aguathuna quarry
		Devonian	Granite Gabbro, diorite Peridotite	Roadcuts: Trans-Canada Highway near Square Pond and Highway 210 at Swift Current; Centreville–Wesleyville area; Petites; Bay d'Espoir, Powder Horn Hill Advocate mine; roadcuts: Highway 410 Flat Water Pond
		Silurian	Conglomerate Sandstone	Roadcuts: New World Island and Trans-Canada Highway near Halls Bay Roadcut: Trans-Canada Highway near Bishop's Falls

Table 2. (cont.)

AGE (millions of years)	ERA	PERIOD	ROCKS FORMED	WHERE TO SEE THEM
	Paleozoic	Ordovician	Iron-formation, shale, limestone	Wabana mines, Bell Island
			Argillite	Roadcut: Trans-Canada Highway at Red Cliff overpass
			Limestone	Aguathuna quarry
			Slate	Roadcuts: 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 mines; roadcuts: Highway 380; Harry's Harbour
			Pillow lava	Roadcuts: Little Bay road; shoreline: Snooks Arm, Little Bay, Betts Cove
			Serpentinite	North Arm, Winter House Brook xonotlite occurrences
			Gneiss, schist	Roadcuts: Highway 470; shoreline from Channel-Port aux Basques to Rose Blanche
		Cambrian	Shale, limestone, conglomerate	Manuels River at Highway 60 bridge
			Slate	Roadcuts: Trans-Canada Highway near junction Highway 202; Clarke's Beach quarry
			Crystalline limestone (marble)	Limestone Junction quarry
544				
	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	Roadcuts: Trans-Canada Highway in Terra Nova National Park
			Quartzite	Villa Marie quarry
			Volcanic rocks	Roadcuts: Trans-Canada Highway between St. John's and Glovertown
			Granite	Roadcuts: Trans-Canada Highway between highways 60 and 61
			Anorthosite	Indian Head; Labrador
			Gneiss, schist	Long Range Mountains (Northern Peninsula), Steel Mountain

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 1890s, the Wabana iron mines on Bell Island began their 72 years of continuous operations, the longest sustained mining operation in the province. At about 1900, minor production was obtained from gold, barite, chromite, and antimony-arsenic mines. Two gold bars — one weighing 342 g and the other 1150 g — were produced from a gold mine at Ming's Bight and 4665 g 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 the central part of the Island of 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 1930s, by the opening of the Burin Peninsula fluorite mines. New mines producing gypsum, asbestos, and pyrophyllite were opened in the 1950s, 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 1960s, a zinc mine in 1975, and a gold mine in 1989.

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. Roadcuts, shoreline exposures, gravel pits, and beach gravels are additional sources of mineral and rock specimens. Some 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 collecting sites are easily accessible from the Trans-Canada Highway and branch roads. A short hike is required to reach some localities and a boat is needed for some shoreline occurrences.

Refs.: 4; 13; 24; 45; 75; 92; 95; 101; 102; 153 p. 1729–1756; 161; 176; 177; 185; 200; 201; 215; 221; 228; 237; 251; 271; 272; 277; 281; 290.

Maps (G): 1231A Island of Newfoundland, Newfoundland (GSC, 1:1 000 000)
90-01 Island of Newfoundland (NDME, 1:1 000 000)
91-13 Industrial minerals of Newfoundland (NDME, 1:1 000 000)

ST. JOHN'S TO CHANNEL-PORT AUX BASQUES

The collecting route begins in St. John's at the junction of Prince Philip Drive (Trans-Canada Highway) and Portugal Cove Road (Highway 40). The main road log is along the Trans-Canada Highway. Several side trips lead from the Trans-Canada Highway.

St. John's–Renews occurrences

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

Plate 10

Avalon shoreline near Ferryland. The steep, rugged shoreline with numerous offshore rocks and islets is typical of the Avalon Peninsula's eastern sea coast. GSC 202770

km	0	Junction of Prince Philip Drive and Portugal Cove Road; proceed south-east along Portugal Cove Road.
	0.5	Junction; continue straight ahead onto New Cove Road.
	1.85	Intersection. Kenna's Hill (on left) leads to Logy Bay Road and to the White Hills quarry, the Logy Bay amethyst occurrence, the Middle Cove and Outer Cove occurrences, and the Torbay quarry. 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.
	2.65	Cavendish Square; turn right onto Duckworth Street. The road on the 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 210 m to 240 m 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 metres 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.

3.2 Turn left onto Prescott Street.

3.3 Turn right onto Water Street.

4.7 Water Street, at the turnoff to Job's bridge over the Waterford River. This is the turnoff 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. The road log continues along Water Street, which continues as Waterford Bridge Road.

5.55 Turnoff (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 lighthouse, constructed of granite from England and local timber, dates back to the 1830s. The road log continues along Waterford Bridge Road.

8.0 Junction; follow the road on the left (Highway 10) leading toward Petty Harbour and Bay Bulls.

16.9 Junction, road to Petty Harbour.

As this road approaches Petty Harbour, it follows the base of a gorge that cuts through a ridge about 150 m high. The steep walls of the gorge show red conglomerate and red sandstone of Precambrian age, their colour due to hematite staining and to the colour of their constituents. Pebbles and small boulders of rhyolite and rhyolite porphyry are common constituents of the conglomerate.

The road log continues along Highway 10.

22.5 Bay Bulls Big Pond on right. This is one of the innumerable small bodies of water occupying basins 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.

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 over 150 m 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 over 245 m above the sea.

33.0 Junction, road to Bay Bulls. Pebbles similar to those at Witless Bay (*see* page 48) occur along the shore of Bay Bulls.

33.6 Gravel pit at the 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.

38.3 Witless Bay, at the turnoff to the shoreline.

40.2 Peat bog on left.

41.8 Mobile, at the bridge over Mobile River.

56.9 Turnoff (left) to La Manche Valley Provincial Park.

57.9 Highway crosses a peat bog.

63.1 Junction, road to Brigus South.

63.7 Roadcuts extending to km 65.6 show Precambrian sandstone, siltstone, and slate; this rock formation makes up the cliffs that form the steep walls of Cape Broyle Harbour.

66.8 Cape Broyle Harbour.

79.2 Ferryland, at the turnoff to the lighthouse at Ferryland Head.

97.7 Turnoff to Renews.

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (GSC, 1:253 440)

White Hills quarry

QUARTZ CRYSTALS, PREHNITE, CALCITE, CHERT

In sandstone

Colourless to white crystals of quartz about 6 mm in diameter occur in veins of white to greenish-white massive quartz cutting greenish-grey sandstone. Massive white calcite and narrow bands of 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 belongs to Capital Ready Mix; it is located on the western slope of a ridge known as the White Hills.

Road log from New Cove Road at km 1.85, the junction of New Cove Road and Kenna's Hill:

km 0 Proceed onto Kenna's Hill.

0.4 Junction; turn right onto Logy Bay Road.

2.7 Turn right onto the road to the quarry.

4.0 White Hills quarry.

Maps (T): 1 N/10 St. John's
(G): 85-67 St. John's, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Logy Bay amethyst occurrence

AMETHYSTINE QUARTZ

In conglomerate

Transparent amethystine to colourless quartz crystals averaging 5 mm in diameter line crevices in purplish-red conglomerate. The crystals are stubby and 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 conglomerate rock extends along the coast southward to Petty Harbour.

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

km	0	Proceed onto Kenna's Hill.
	0.4	Junction; turn right onto Logy Bay Road.
	4.3	Junction; turn right onto the road to Logy Bay.
	6.6	Memorial University's Marine Science Research Laboratory. The quartz-bearing conglomerate is exposed in the vicinity of the university buildings.

Maps (T): 1 N/10 St. John's
(G): 85-69 Torbay, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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 5 mm in diameter. Cubes of pyrite, about 2 cm 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.

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

km	0	Proceed onto Kenna's Hill.

	0.4	Junction; turn right onto Logy Bay Road.
	4.3	Junction; continue straight ahead.
	8.8	Junction. To reach Middle Cove, follow the road on left for 0.3 km to an access road leading to the shore. To reach Outer Cove, follow the road on right for 1.3 km to the shore. Roadcut at the junction shows Precambrian sedimentary rocks cut by quartz veins containing crystals of colourless to white quartz.

Refs.: 164 p. 2; 258 p. 190.

Maps (T): 1 N/10 St. John's
(G): 85-69 Torbay, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Torbay quarry

QUARTZ CRYSTALS, CALCITE, CHERT

In sandstone

Tiny quartz crystals averaging 4 mm 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 the junction of Kenna's Hill:

km	0	Proceed onto Kenna's Hill.
	0.4	Junction; turn left onto Torbay Road (Highway 20).
	8.4	Turn left onto a single-lane road.
	9.9	Junction, quarry road; turn right.
	10.3	Torbay quarry.

Maps (G): 85-69 Torbay, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Bauline Road occurrence

QUARTZ CRYSTALS, EPIDOTE

In volcanic rocks

Colourless to white quartz crystals occur in a chloritized volcanic rocks. The crystals measure about 5 mm across. Greenish-yellow epidote occurs as small patches in white calcite. Dark green chlorite is associated with epidote.

The occurrence is explosed in roadcuts on Highway 21 near Bauline.

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

km	0	Proceed onto Kenna's Hill.
	0.4	Junction; proceed onto Highway 20, the Torbay Road.
	10.9	Torbay, at the junction of Highway 21, the Bauline Road; turn left (west) onto the Bauline Road.
	21.5	Roadcuts.

Maps (T): 1 N/10 St. John's
(G): 85-72 Bauline, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Quidi Vidi Lake occurrence

PREHNITE, QUARTZ CRYSTALS, CHLORITE, PYRITE

In sandstone

Light yellowish-green to chalk white prehnite occurs as narrow bands, about 6 mm wide, in massive white quartz veins that traverse greenish-grey sandstone. The prehnite has a transverse columnar structure and fluoresces weakly (yellowish white) under long ultraviolet rays. The quartz has a more vitreous appearance and is more transparent than 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 2.1 km from the intersection of New Cove Road, Kenna's Hill, and The Boulevard. The Quidi Vidi Lake occurrence is behind the oil tanks.

Ref.: 192 p. 1569.

Maps (T): 1 N/10 St. John's
(G): 85-07 St. John's, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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 are exposed along the road in the park.

These outcrops have been striated, groove, 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 (150 m above sea level) is the site of 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 light grey sandstone.

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

Ref.: 192 p. 1569.

Maps (T): 1 N/10 St. John's
(G): 85-07 St. John's, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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 the Waterford Bridge Road.

km	0	Turn left onto the access to Job's bridge.
	0. 3	Turn left onto Southside Road.
	0. 8	South Side Hills quarry on right.

Refs.: 192 p. 1569; 212 p. 56.

Maps (T): 1 N/10 St. John's
(G): 85-07 St. John's, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Miner Point (Shoal Bay) mine

CHALCOCITE, BORNITE, CHALCOPYRITE, TETRAHEDRITE, MALACHITE

In sandstone and conglomerate

The copper minerals — chalcocite, bornite, chalcopyrite and tetrahedrite — occur in quartz-calcite veins in sandstone and conglomerate. Malachite occurs as a coating on the ore minerals.

This mine is believed to be the first mining venture in the Island of Newfoundland. In 1773, Alexander Dunn of St. John's heard about a copper deposit at Shoal Bay and in 1776, was joined by John Agnew and George Stewart of England to develop the deposit. Miners hired from Cornwall, England, sank a shaft and a shipped copper ore to England. Because of poor returns, the venture came to an end in 1778. The prospect was worked again for a short time in 1839 by Captain Sir James Pearl of the Royal Navy, but there are no records of ore having been shipped.

The Miner Point mine is on the shore of Miner Point, which is about 2 km northeast of Shoal Bay and 5 km due east of Bay Bulls Big Pond. This part of the shoreline is accessible by boat only.

Refs.: 59 p. 4, 7; 156 p. 8; 212 p. 44, 55.

Maps (T): 1 N/7 Bay Bulls
(G): 85-70 Petty Harbour, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Witless Bay shoreline occurrences

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

In beach gravels along the 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 the province. These volcanic rocks are also referred to as 'felsite'. 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 pebbles, and as crystalline aggregates filling amygdales 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 waterworn 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 the road log on page 40-43) along the eastern shore of the Avalon Peninsula; they include the beaches at Bay Bulls, Witless Bay, Mobile Bay, and Ferryland. Innumerable other accessible beaches along the province's shores yield a similar array of pebbles suitable for lapidary purposes.

Refs.: 164 p. 5–6; 258 p. 188, 190.

Maps (T): 1 N/2 Ferryland
1 N/7 Bay Bulls
(G): 1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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-eighteenth 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 0.8 km from Highway 10 at Renews (km 97.7, p. 43).

Maps (T): 1 K/15 Renews
(G): 1468A Trepassey, Newfoundland (GSC, 1:250 000)

This completes the description of occurrences in the St. John's–Renews area.

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 0.5 mm in diameter) composed of alternating concentric layers of hematite and chamosite and cemented by siderite. The general appearance

Plate 11

Wabana mine, Bell Island. Open-cut mining conducted by Nova Scotia Steel and Coal Company, about 1900. National Archives of Canada PA-51491

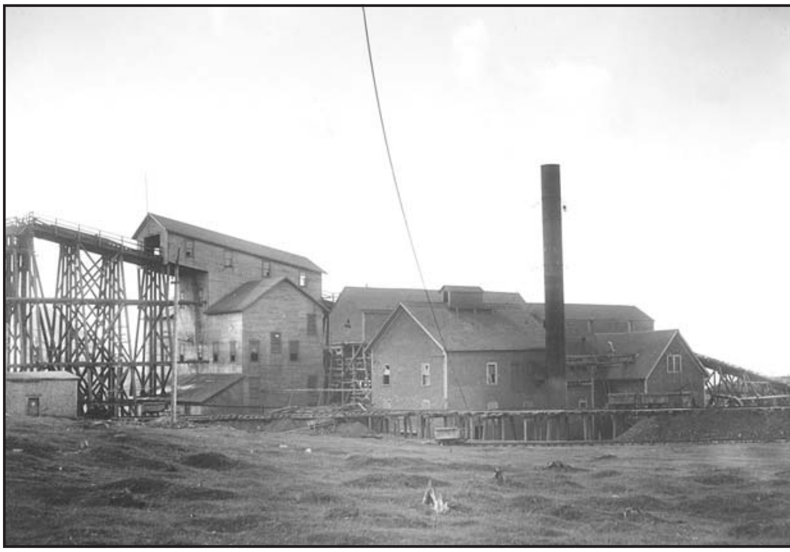


Plate 12

Wabana mine buildings, about 1900. Provincial Archives of Newfoundland and Labrador F42-2

of the hand ore specimen found in the dumps is of a reddish-brown to black, finely granular mass with a submetallic 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 in the dumps; the crystals are stubby, terminated at one or both ends, and up to 2 cm in diameter. The calcite is coarsely cleavable, colourless and transparent (Iceland spar variety), or white, and 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 Pit 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 metres thick and extending over several hundred to a few thousand metres. The iron-bearing rock broke characteristically in rectangular blocks.

The occurrence of a 2.5 m band of bright red sandstone on the northwest shore of Bell Island was first reported in 1819 by J.B. Jukes following his visit to the island. For many years before that, local residents had noticed the blocks of reddish rock fallen from the sea cliffs and strewn along the beaches, and had used them as anchors and ballast and for building purposes. In the late 1880s, Jabez Butler of Port de Grave picked up some of the loose iron-bearing rock to use as ballast for his boat on his journey to St. John's. In 1892, his son Esau Butler had the rock analyzed and, when the results indicated iron ore, the Butlers and James Miller staked the property. They leased the claims in 1894 to the New Glasgow Iron, Coal and Rail Company of Nova Scotia, which began mining in 1895.

The first shipment of ore was made in December 1895 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 two companies mined the deposit separately 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 production coming from the submarine workings beneath the floor of Conception Bay. These workings extend over an area of 15 km^2; the deepest is 565 m below sea level with 460 m of rock above it. There is a minimum of 61 m of rock cover above the upper workings. The room-and-pillar method of underground mining was used, the pillars measuring 21.4 m by 12.2 m wide with roof spans of up to 8.2 m. 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 6400 m. 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 because of ore exhaustion. In 72 years of production, it yielded 71 643 396 t of iron ore; the peak was reached in 1960 when 2 548 670 t 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 the Trans-Canada Highway in St. John's:

km	0	Junction of Portugal Cove Road and Prince Philip Drive (Trans-Canada Highway); proceed northwest along Portugal Cove Road (Highway 40).
	12.7	Roadcuts 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.
	13.4	Portugal Cove, at the ferry landing; proceed onto the ferry for the 4.8 km journey to Bell Island in Conception Bay. This flat-topped, steep-walled island measures 10 km by 4 km with a maximum elevation of 122 m 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 61 m 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 1 km and 1.6 km southwest of The Beach.

		From the ferry landing, proceed onto the road to Wabana.
16.1		Wabana, at the town square. A road leads 11 km 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.
16.6		Dump on right. Ore specimens are found in this dump.

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

16.9 Dump and remnants of a treatment plant on left.

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

Refs.: 31 p. 1; 34 p. 274–298; 90 p. 123–125, 133; 91 p. 4–17; 97 p. 4–8, 24–28, 136; 113 p. 626–642; 156 p. 52–59; 160 p. 554–555; 212 p. 33–34, 44–45, 46–53; 222 p. 193, 200; 284 p. 112.

Maps (T): 1 N/10 St. John's
(G): 1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

This completes the description of collecting localities in the St. John's area.

Occurrences along the Trans-Canada Highway between St. John's and Channel-Port aux Basques are described in the text that follows.

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

For the first 90 km, 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 local monadnocks rising a few hundred metres 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.

km 18.8 Turnoff to Cochrane Pond Provincial Park.

A peat bog is located on the south side of the park at the west end of Cochrane Pond (ref.: 199). 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.

km 22.4 Bridge over Manuels River.

km 23.2 Roadcuts 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 roadcut at km 25.3.

km 25.6 Roadcut 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.

km 26.9 Roadcuts expose pink to grey granite over 0.3 km. Epidote occurs as finely crystalline aggregates forming coatings, veinlets, and bands (about 6 mm 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.
km	**27.3**	Junction, road to Foxtrap (Highway 61).

Foxtrap mine

PYROPHYLLITE, QUARTZ, DIASPORE, BARITE, RUTILE, PYRITE, JASPER

In conglomerate and rhyolite

Pyrophyllite resembles talc in its physical properties and can be put to the same uses. The pyrophyllite in this deposit is generally cream-white, but is commonly tinted in shades of yellow, green, pink, brown, and reddish to purplish. It is compact, massive, and 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 light brown rutile, and grains and nodules of quartz and light blue to purplish-grey diaspore (rare) intergrown with grey barite. The diaspore-bearing pyrophyllite makes an attractive stone when 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 about 1897, the mineral was referred to as 'agalmatolite', a general term used to designate soft, carvable substances like talc and steatite. Specimens were included in an 1898 exhibit of Newfoundland minerals displayed in England. Pyrophyllite is currently fashioned by artisans into appealing carved ornaments featuring wildlife subjects, and these are available from several outlets in the province.

The pyrophyllite deposit lies along a narrow belt extending south about 9.5 km from Manuels; its host rock is sheared rhyolite and conglomerate. Development of the deposit began in 1903 with the opening of a quarry just west of Johnnys Pond and about 0.4 km south of the currently operated quarry. The operator — North American Talc Company — constructed an aerial

Plate 13

Foxtrap mine, open-pit operations, 1973. GSC 202744

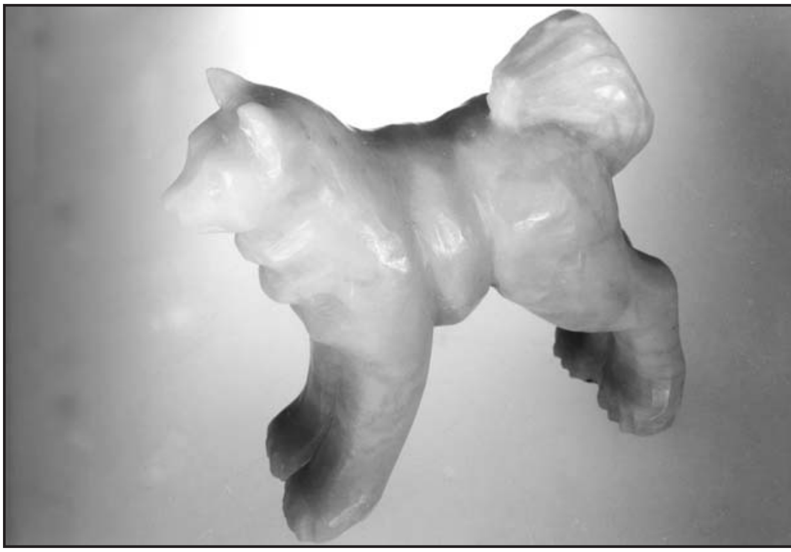


Plate 14

Pyrophyllite carving. The pyrophyllite, from the Foxtrap mine, was carved by a Labrador Inuit. GSC 202820-G

tramway to the railway and a loading wharf at Seal Cove, and in 1904–1905 shipped a total of approximately 7030 t 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 Newfoundland Minerals Limited which constructed a new mill and a wharf at Long Pond on the shore of Conception Bay. The ore was shipped to the company's plant in Pennsylvania for use in the manufacture of ceramic tile.

Road log from the Trans-Canada Highway at **km 27.3**, the junction Highway 61:

km	0	Proceed onto the road to Foxtrap (Highway 61).
	1.3	Granite is exposed along the road.
	4.7	View of Conception Bay, the villages along its shore, and Bell Island in the distance.
	7.9	Junction, Highway 60. Enquiries regarding visits to the mine should be directed to the company's office at Long Pond. To reach the mine, turn right onto Highway 60.
	9.8	Junction of the mine road at the east end of the bridge over Conway Brook; turn right.
	13.2	Foxtrap mine.

Refs.: 8 p. 203; 36 p. 113–121; 111 p. 546; 112 p. 570; 156 p. 36; 164 p. 6, 8; 193 p. 1–9; 195 p. 9–11; 196 p. 443–444; 254 p. 1, 4–8, 13, 24–26; 258 p. 190; 289 p. 243–244.

Maps (T): 1 N/7 Bay Bulls
1 N/10 St. John's
(G): 85-73 Topsail, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Manuels River occurrence

BIRNESSITE, RHODOCHROSITE, HEMATITE, BARITE, PYRITE

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 15 mm in diameter), and as thin bands and lenses in the rock.

Plate 15

Manuels River conglomerate exposure below the Highway 60 bridge. Jasper and rhyolite pebbles occur in the conglomerate. The Manuels River manganese occurrence is downstream from this bridge. GSC 202745

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 Cambrian shale exposed along the steep cliffs just beyond the sharp bend in 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 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 occurrence may be reached by walking about 370 m from the Highway 60 bridge over Manuels River, or by descending the riverbank from the school.

Road log from Trans-Canada Highway at **km 27.3**, the junction of Highway 61:

km	0	Proceed onto the road to Foxtrap (Highway 61).
	7.9	Junction, Highway 60; turn right.
	9.8	Turnoff to Foxtrap mine; continue straight ahead.
	12.5	Bridge over Manuels River. The occurrences may also be reached by descending the steep riverbank from the school yard on the east side of the river: continue east along Highway 60.
	12.9	Turnoff (left) to the school. The Manuels River manganese occurrence is in the cliff behind the school.

Refs.: 30 p. 2–3; 49 p. 377–418; 123 p. 151–156; 212 p. 28–32, 53–55.

Maps (T): 1 N/10 St. John's
(G): 85-73 Topsail, Newfoundland (NDME, 1:25 000)
78-36 Pouch Cove–St. John's, Newfoundland (NDME, 1:50 000)
1018A Torbay, Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Kelligrews quarries

FOSSILS

In limestone

Several species of trilobites occur in limestone interbedded with mudstone and shale exposed in two quarries south of Kelligrews. In places, fossils make up most of the rock, forming a coquina limestone. The fossils are of Cambrian age.

One of the quarries is being worked sporadically by Garrison Construction Limited of Kelligrews. The rubble that is removed is used for driveways.

Road log from the Trans-Canada Highway at **km 27.3**, the junction of Highway 61:

km	0	Proceed onto Highway 61.
	7.9	Junction of Highway 60; turn left (west) onto Highway 60.
	10.6	Junction; turn left onto a road leading south.
	11.9	Junction. One of the quarries is at this junction. The road log continues to the other quarry.
	12.1	Quarry.

Ref.: 26 p. 10–15, 49–52.

Maps (T): 1 N/6 Holyrood
(G): 54-3 Holyrood, Newfoundland (GSC, 1:63 360)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 27. 3 Trans-Canada Highway at the junction of Highway 61.

km 28.5 Roadcuts from here to Kellys Pond (**km 33.9**) expose pink to grey granite containing epidote as veinlets and bands and as surface coatings. Cavities in the rock are commonly lined with small, colourless to white crystals of quartz.

km 31.5 Soldiers Pond on left with the northern extension of Hawke Hills in the background. This series of hills extends southwestward for about 24 km, their rounded summits reaching elevations of 244 m above sea level at the north end and 335 m at 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 the sparse vegetation. They are composed of Precambrian granitic, volcanic, and sedimentary rocks. The Trans-Canada Highway parallels the Hawke Hills to **km 41.0**.

km 33.9 Kellys Pond on left.

km 36.8 Roadcut exposes dark grey volcanic rock traversed by veins of epidote and quartz; tiny crystals of quartz occur in epidote fracture fillings.

km 37.1 Turnoff to Butter Pot Provincial Park.

Within the park are several ponds and wooded hills. Butter Pot, a steep-sided, oval hill at the western boundary of the park, is the highest in the area with an elevation of 310 m above sea level; it is capped by a layer of quartz gabbro overlying granite.

km 38.6 Roadcuts expose granite and a chloritized volcanic rock that contains colourless 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 the Island of 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. Roadcuts along the way expose these **rocks; minerals occur in veins or lenses in some exposures.**

km	**53.4**	Junction, Highway 90.
km	**62.9**	Turnoff to Gushue's Pond Provincial Park.
km	**63.6**	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 was originally explored by a shallow shaft over 100 years ago. It is on the north side of a bend in the Colliers River, south of Highway 60. *See* Map 6.

Road log from Trans-Canada Highway at **km 63.6**, the junction of the road to Conception Harbour:

km	0	Proceed onto the road to Conception Harbour.
	4.8	Witch Hazel Peak on right; it rises to a height of 90 m above the surrounding countryside.
	7.6	Junction; turn left.
	8.5	Bridge over Colliers River.
	8.7	Junction, single-lane road on left leading 0.65 km to a baseball diamond and municipal dump. The Colliers River copper occurrence is about 70 m to the left of the road and at the end of the municipal dump.

Ref.: 59 p. 145.

Maps (T): 1 N/6 Holyrood
(G): 1168A Whitbourne (St. John's, west half), Newfoundland (GSC, 1:253 440)
54-3 Holyrood, Newfoundland (GSC, 1:63 360)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

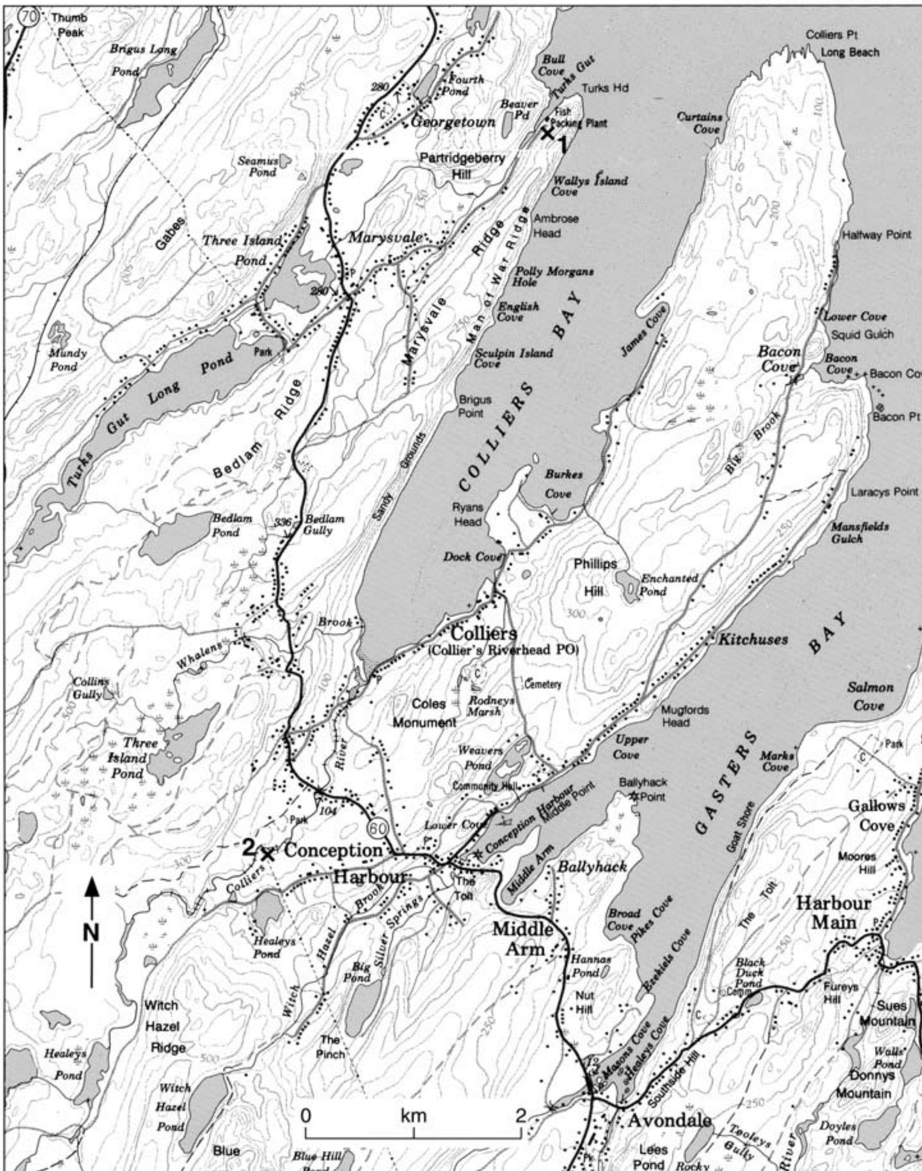
Turks Gut copper occurrence

CHALCOPYRITE, BORNITE

In amygdaloidal basalt

Massive chalcopyrite and bornite occur as fracture fillings and in amygdales in basalt.

Part of 1 N/6 and 1 N/11



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

Map 6. Colliers Bay area.

The deposit was explored using 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 Collier Bay. *See* Map 6.

Road log from Trans-Canada Highway at **km 63.6**, the junction of the road to Conception Harbour:

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

Ref.: <u>59</u> p. 5, 145.

Maps (T): 1 N/11 Harbour Grace
(G): 1035A Harbour Grace, Newfoundland (GSC, 1:63 360)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**65.6**	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 faces; they commonly measure 2 to 10 cm by 12 to 20 cm. Some crystals measuring up to 18 cm long and 9 cm in diameter have been found.

The deposit has been exposed by shallow pits and trenches on a low ridge near Forked Pond, about 11 km northwest of Adams Cove on the western shore of Conception Bay. Quartz crystals were formerly extracted from the deposit by Clifford Baggs of Adams Cove.

Road log from Trans-Canada Highway at **km 65.6**, the junction of Highway 70:

km	0	Proceed onto Highway 70. About 8 km 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.
	14.3	Junction of Highway 60; turn left.
	17.4	Clarke's Beach.
	19.6	Slate quarry on left. The slate (grey) contains lenses of greyish-green chert and white massive quartz.
	70.8	Adams Cove.

Refs.: <u>20</u> p. 122–123; <u>96</u> p. 13; <u>152</u> p. 190.

Plate 16

Quartz crystals, Trans-Canada Highway roadcut at **km 110.7**. The clear crystals at the top of the cluster measure 5 mm in diameter. GSC 202514-P

Maps (T): 1N/14 Heart's Content
(G): 1168A Whitbourne (St. John's, west half), Newfoundland (GSC, 1:253 440)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Workington (Lower Island Cove) mine

HEMATITE, GOETHITE

In slate and argillaceous sediments

Hematite occurs with goethite forming red lumpy masses in veins in the host rock. The goethite is characterized by a botryoidal and colloform structure.

Iron ore was discovered by Andrew Colford of Redlands in 1895. In the summer of 1898, H. Spencer and Company of Workington, England, prepared for mining operations. Mining equipment was installed at the mine, a machine shop and bunkhouses were built, and a railway was built from the mine across Bay de Verde Peninsula to a pier at Old Perlican. Seven shafts were sunk without reaching economic ore. In 1898–1899, Newfoundland Iron Ore Company of Manchester, England, mined several hundred tonnes of ore and made a trial shipment to England.

The mine is on the west side of Mares Pond, west of Lower Cove.

Road log from the Trans-Canada Highway at **km 65.6**, the junction of Highway 70:

km	0	Proceed north along Highway 70.
	75	Adams Cove.
	91	Lower Cove, at the junction of a road leading west. Proceed along this road for 2.5 km to the Workington mine.

Refs.: 92 p. 36–37; 128 p. 137–138; 156 p. 59–60.

Maps (T): 2 C/3 Old Perlican
(G): 1130A Bonavista, Newfoundland (GSC, 1:253 440)
88-01 The Avalon Peninsula, Newfoundland (NDME, 1:250 000)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 85.4 Junction, Highway 80.

Near this junction, the highway dips to a low point (elevation about 45 m 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.

km 86.6 Junction, Highway 100.

Silver Cliff mine

GALENA, SPHALERITE, PYRITE, QUARTZ CRYSTALS, CHALCOPYRITE, BARITE

In a brecciated fault zone in volcanic and sedimentary rocks

Argentiferous galena, the ore mineral at this former silver mine, occurs as small crystals (less than 6 mm 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, 2 cm to 5 cm in diameter, are lined with microcrystals of colourless, transparent quartz that, in places, are studded with microcrystals of chalcopyrite, pyrite, and/or barite.

The Silver Cliff deposit was originally explored by John Burke, his brother, and Charles Fowler of Placentia between 1880 and 1883. The Cliff Silver Mines Company Limited of London worked the mine from 1883 to 1884. A company from Edinburgh removed some ore in 1887, but the shipment sank in the Atlantic Ocean and the company withdrew. The main orebody was not located until John W. Foran of St. John's revived mining between 1892 and 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 45 t/day mill. About 1800 t of ore were mined from two adits, each about 120 m long.

The mine is in the canyon of Broad Cove Brook, about 520 m inland from Broad Cove on the east shore of Placentia Bay near Argentia.

Road log from the Trans-Canada Highway at **km 86.6**, the junction of Highway 100:

km 0 Proceed onto Highway 100 to Argentia.

47.0 Junction; turn left.

47.9 End of the road. From this point, follow the path leading about 500 m to the shore of Broad Cove. Then proceed east along Broad Cove a few metres to the mouth of Broad Cove Brook. The Silver Cliff mine is located on the west bank of this creek, about 520 m from the mouth. The adits are about 10 m apart.

Refs.: 156 p. 36–37; 159 p. 119–121; 228 p. 81–84.

Maps (T): 1 N/5 Argentia
(G): 55-11 Argentia, Newfoundland (GSC, 1:63 360)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Cuslett barite occurrences

BARITE

In conglomerate

Barite occurs as white to salmon-pink platy aggregates in veins in conglomerate of Cambrian age. The vein varies in width from 6 cm to about 1 m. It is exposed along a 30 m cliff on the east shore of Placentia Bay, about 500 m north of Cuslett. *See* Map 7.

Road log from the Trans-Canada Highway at **km 86.6**, the junction of Highway 100:

km	0	Proceed onto Highway 100 toward Argentia.
	85.5	Trail on right leads west to the Cuslett barite occurrence.
	86.1	Cuslett, at the junction of a road leading west to the shore.

Refs.: 36 p. 22; 119 p. 18–21; 228 p. 100–102.

Maps (T): 1 L/16 St. Bride's
(G): 84-58 St. Bride's map area, Newfoundland (NDME, 1:50 000)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Cross Point barite occurrence

BARITE

In a vein cutting sedimentary rocks

White to pink barite occurs as radiating platy aggregates in a vein varying from a few centimetres to 1.5 m wide. The vein is in a rock formation consisting of shale, siltstone, and quartzite.

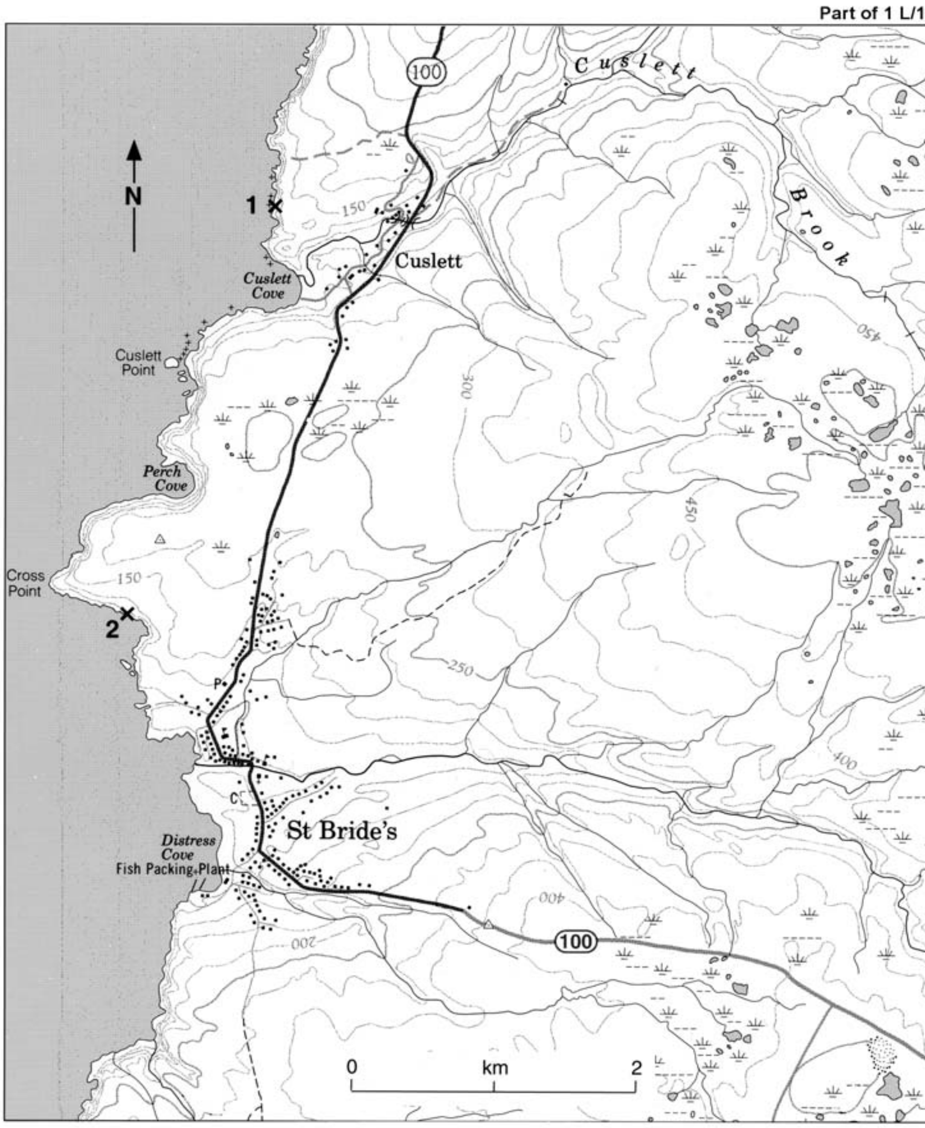
The vein is exposed in a 10 m cliff along the east shore of Placentia Bay about 700 m southeast of Cross Point, between Cuslett and St. Bride's. *See* Map 7.

Road log from the Trans-Canada Highway at **km 86.6**, the junction of Highway 100:

km	0	Proceed onto Highway 100 toward Argentia.
	86.1	Cuslett, at the junction of a road leading to the shore; continue along Highway 100.
	90.0	St. Bride's, at the junction of a trail leading west to the shore. Follow the trail to the shore, a distance of about 600 m. The occurrence is about 600 m north of this point.

Refs.: 36 p. 22; 119 p. 18–21; 228 p. 100–102.

Maps (T): 1 L/16 St. Bride's
(G): 84-58 St. Bride's map area, Newfoundland (NDME, 1:50 000)



1. Cuslett barite occurrence 2. Cross Point barite occurrence.

Map 7. Cuslett–St. Bride's area.

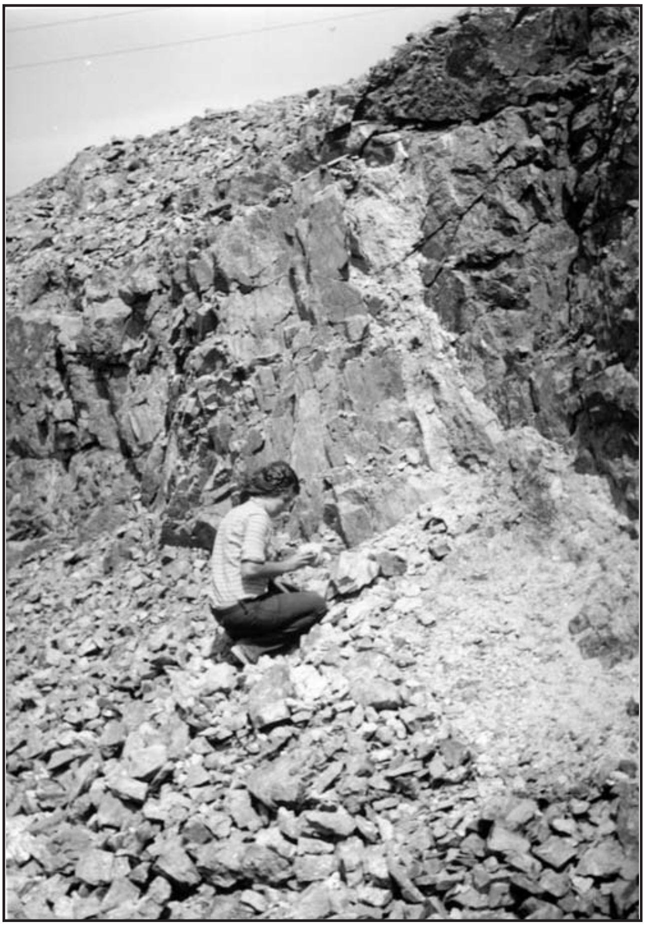


Plate 17

Barite vein cutting volcanic rock, Trans-Canada Highway roadcut at **km 119.1**. GSC 202762

85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**90.1**	Roadcuts 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 211 m above sea level), an isolated steep hill on the south side of the highway, is composed of Cambrian gabbro that intruded slate of an earlier Cambrian age. Peak Pond is in the foreground.
km	**93.6**	Roadcuts from here to the junction of the Long Harbour Road (Highway 202) expose maroon, green, and grey slate of Cambrian age. Rock surfaces 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 **km 97.0**.
km	**98.8**	Junction, Long Harbour Road (Highway 202).

Villa Marie quarry

QUARTZITE

Light grey to white quartzite was formerly 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 was in operation from 1968 to 1988.

Road log from Trans-Canada Highway at **km 98.8**, the junction of Highway 202.

km	0	Proceed onto Long Harbour Road (Highway 202).
	8.7	Junction; turn left onto the road to Placentia, Argentia.
	23.2	Junction; turn right onto the quarry road.
	24.8	Villa Marie quarry.

Ref.: 75 p. 35.

Maps (T): 1 N/5 Argentia
(G): 55-11 Argentia, Newfoundland (GSC, 1:63 360)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 98.8 Junction, Long Harbour Road.

From this point to **km 153**, the Trans-Canada Highway follows a narrow neck of land — the isthmus of Avalon — that joins the Avalon Peninsula to the main part of the island. It separates Trinity Bay from Placentia Bay,

km 101.8 Roadcuts expose Precambrian sedimentary rocks (siltstone and arkose) from this point to the turnoff to Bellevue Beach at **km 114.4**. 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 roadcuts between **km 110.7** and **km 112.9**, clusters of colourless, transparent, terminated crystals of quartz up to 6 mm in diameter occupy cavities in massive quartz; microcrystals of pink plagioclase are associated with the quartz crystals.

km 114.4 Junction, road to Bellevue Beach Provincial Park.

Collier Cove barite mine

BARITE

In vein cutting arkose

Barite occurs as aggregates of coarse tabular crystals with individual crystals up to 5 cm long; most of the barite is white, but a pink to red colour variation is also present.

Barite occurs in a vein with an average width of 6 m over a distance of 90 m. The vein was discovered in 1902 by prospector Mark Gibbons. Robert Rendell leased the property and formed the Collier Cove Barite Company, which operated the deposit from 1902 until 1905. Production amounted to about 4600 t of barite. The openings at tidewater consisted of an open cut, a 12 m shaft, and an adit. In 1980, J. Tyler Mining Limited produced about 9000 t of barite from an open cut.

Plate 18

Tabular barite crystals, Trans-Canada Highway at **km 119.1**. GSC 202820-E

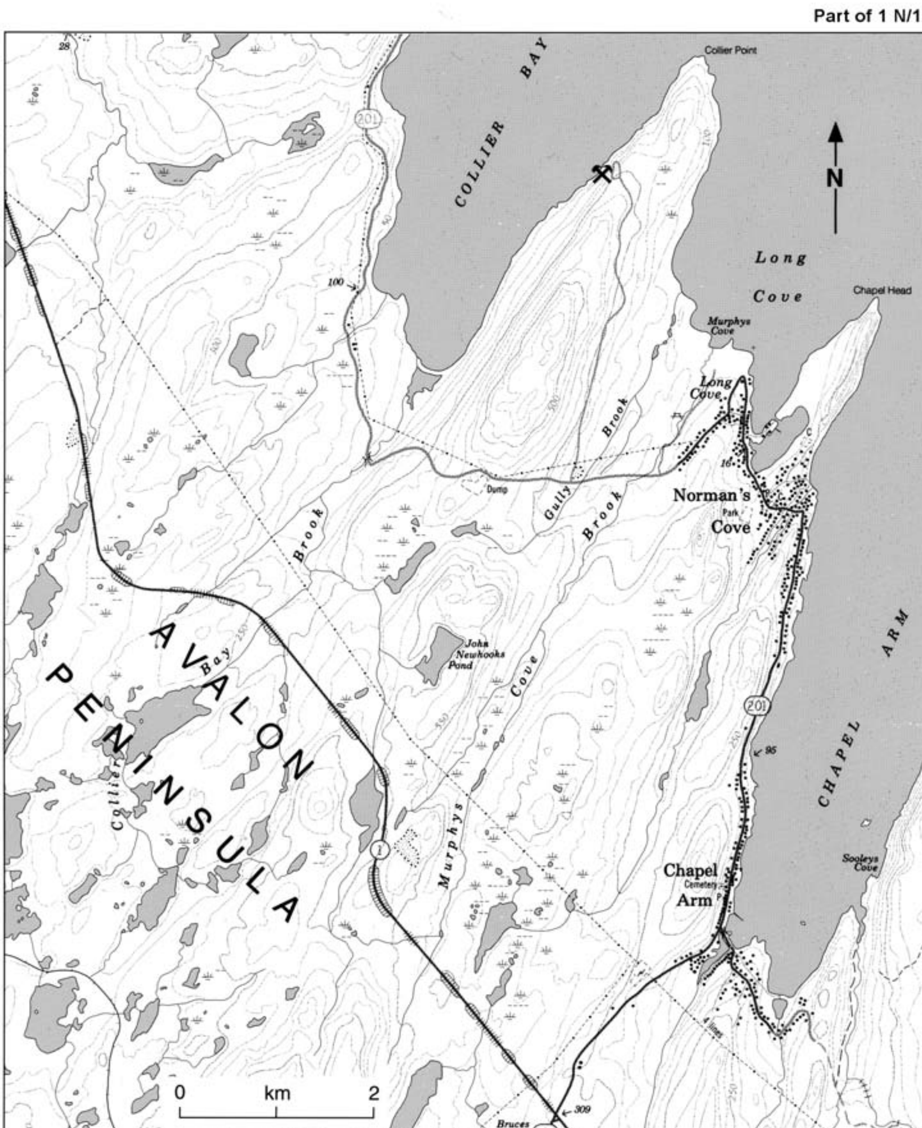
The mine is on the shore of a steep-walled peninsula that forms the east side of Collier Bay. It is accessible by boat from Thornlea. *See* Map 8.

Road log from the Trans-Canada Highway at **km 114.4**:

km	0	Proceed onto the road to Bellevue Beach Provincial Park.
	0.95	Junction; turn right (south).
	6.9	Junction; turn right (southeast).
	9.3	Thornlea, at the wharf. The Collier Cove barite mine is on the opposite side of Collier Bay, 2.8 km southeast of the wharf.

Refs.: 36 p. 19–22; 53 p. 49; 54 p. 12; 156 p. 36; 159 p. 121–123.

Maps (T): 1 N/12 Dildo
(G): 13-1956 Dildo, Avalon Peninsula, Newfoundland (GSC, 1:63 360)



Map 8. Collier Cove mine

km	**116.3**	Roadcuts expose purple volcanic rocks. Finely crystalline epidote, microcrystals 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 roadcut at **km 117.8**.
km	**119.1** **119.5**	Roadcuts on both sides of the highway just beyond a bend and between two powerline crossings to expose rusty coloured volcanic rocks cut by veins of pink to white bladed barite. Earthy yellow goethite coats the rock.
km	**119.9**	Roadcut 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.
km	**121.3**	Junction, road to Chance Cove.
km	**122.9**	Roadcut on right. The highway cuts through purplish-grey rhyolite that contains small cavities lined with pink tabular crystals of barite and colourless prismatic microcrystals 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 **km 124.7** and **km 127.4**.
km	**123.7**	Roadcut exposes volcanic breccia similar to the breccia at **km 119.9**.
km	**126.0**	Junction, road to Little Harbour. Roadcuts expose green slate cut by quartz veins.
km	**127.0**	Roadcuts expose dark green, fine-textured conglomerate containing white cleavable masses of calcite. The calcite fluoresces pink under ultraviolet rays. It contains small cubes of pyrite and patches of glassy greenish quartz.
km	**133.4**	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

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 about 6 mm along the edge. It is associated with pyrite and dark brown sphalerite in white, grey, to mauve 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 12 m long. Opal has been reported from the deposit. In its early days, large quantities of

Plate 19

Director mine, about 1956. GSC 1994-365

'prill ore' — blocks of galena weighing "several pounds" — were found in vugs and pockets in the mine.

The deposit was discovered in the 1840s 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 17 017 t of ore. The workings consist of a 514 m adit driven from the shore near high tide level, a 125 m shaft located 453 m from the portal of the adit, and another shaft 790 m northeast of the portal.

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

Road log from the Trans-Canada Highway at **km 133.4**:

km	0	Turn left (at the highway sign indicating a bend in the road) onto a single-lane road.
	4.0	Junction; turn right.
	5.8	La Manche mine, at the shore.

Refs.: 98 p. 25–26; 115 p. 233, 247; 159 p. 115–119; 227 p. 86–88.

Maps (T): 1 N/12 Dildo
(G): 13-1956 Dildo, Avalon Peninsula, Newfoundland (GSC, 1:63 360)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**134.7**	Junction, road to Southern Harbour.

km	**134.8**	Roadcut 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.
km	**136.9**	Turnoff to Jack's Pond Provincial Park.
km	**149.3**	Turnoff (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.
km	**149.5**	Viewpoint on right. From an elevation of 76 m above sea level, the view to the east is of Trinity Bay with the village of Sunnyside in the foreground; to the west is Placentia Bay. The narrow strip of land — less than 5 km wide — separating these bays is the isthmus of Avalon. It joins the Avalon Peninsula to the main part of the Island of Newfoundland.
km	**154.3**	Centre Hill, in the distance on right, is the highest point in the area. Its conical peak rises abruptly from a plateau averaging 120 m above sea level to an elevation of 1823 m. 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 319 m), due west of the Trans-Canada Highway at km 156.7.
km	**160.3**	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 was a major producer of fluorite for 44 years. The fluorite occurred as finely granular to coarsely crystalline masses. Aggregates of crystals occurred in vugs, the individual crystals measuring about 5 cm along the edge. The cube was the most common form, but the octahedron was also present. The crystals were commonly coated with a reddish-brown mixture of goethite and clay. During mining operations, crystals 30 to 45 cm in diameter were encountered. Banded and nodular varieties were included in the ore. The former consisted 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 bluish white and the yellow fluoresces pink. Associated with fluorite in the vugs were crystals of calcite and quartz. Massive white to pink calcite fluoresces bright pink under short ultraviolet rays. Barite occurred as dense pink platy aggregates. Minerals present in minor amounts included galena, pyrite, brownish-red sphalerite, chalcopyrite, chalcocite, hematite, pyrolusite, uraninite, and limonite; the secondary copper minerals — malachite, chrysocolla, and azurite — occupied pockets in the fluorite. An unusual occurrence was 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 filled spaces between fluorite crystals and occurred as a botryoidal crust on crystalline masses of fluorite.

Plate 20

Miners working underground, St. Lawrence fluorite mine, 1962. National Archives of Canada PA-130785

About 40 fluorite-bearing veins have been outlined in an area 50 km² in the St. Lawrence district. They generally occurred as fissure fillings in pink quartz-feldspar granite. The higher grade veins were less than 1.5 m wide, but the lower grade ones measured up to 10 m wide; one vein had a maximum width of 27.5 m. The vein length varied from a few hundred metres to 2135 m. Mining was conducted by underground methods to a maximum depth of 275 m (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 in 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 Gulch mine. 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 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. Production was also obtained from the Blue Beach mine in the 1970s. The concentrates were shipped to the Alcan aluminum smelter in Arvida, Quebec. Mining in the St. Lawrence fluorite district ended in 1977. Total production for the district amounted to 4 240 509 t of fluorite. The locations of the mines are shown on Map 9.

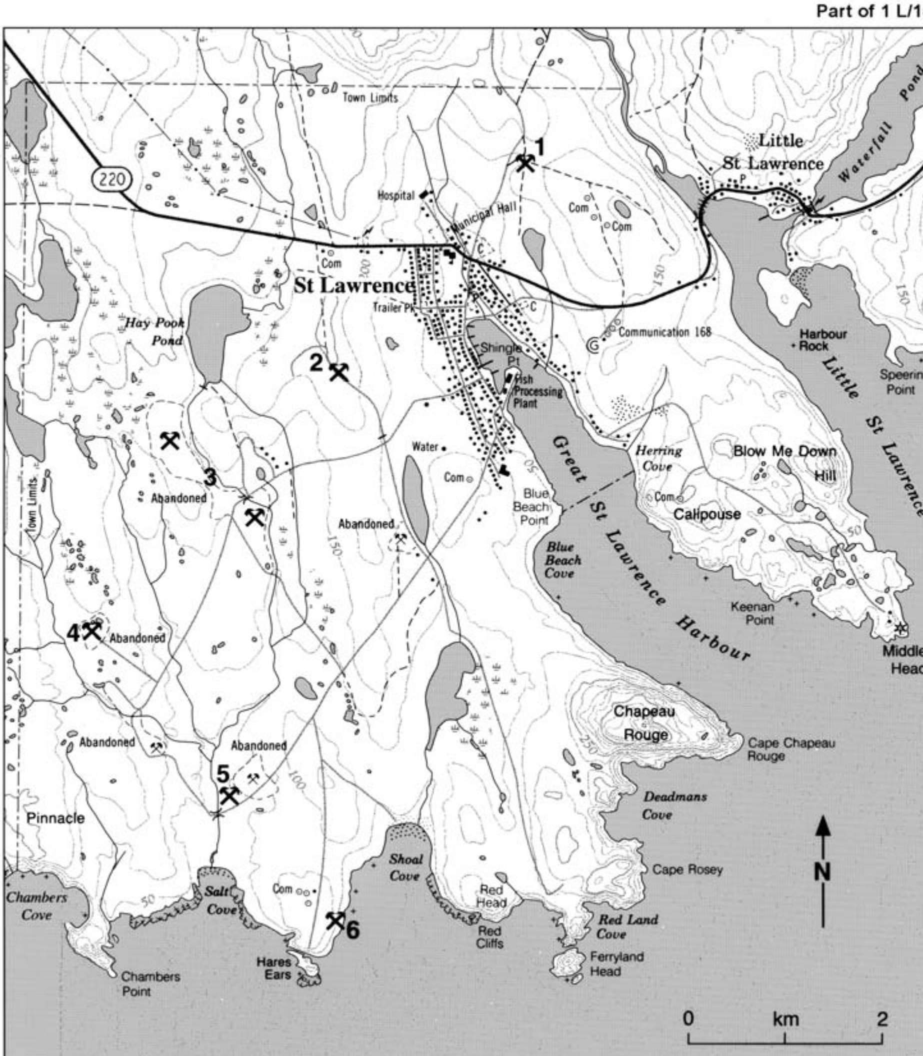
Plate 21
Fluorite crystals, St. Lawrence. GSC 202820-F

Road log from Trans-Canada Highway at **km 160.3**, the junction of the Burin Peninsula Road:

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

The Burin Peninsula is a narrow, boot-shaped upland, about 30 km wide, projecting into the Atlantic Ocean between Fortune Bay and Placentia Bay. Its subdued, gently undulating surface with an average elevation of

122 to 152 m 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 metres. 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. Black Duck mine 2. Blue Beach mine 3. Director mine 4. Tarefare mine 5. Iron Springs mine 6. Lord and Lady Gulch mine

Map 9. St. Lawrence fluorite mines.

2.1 Roadcut exposes dark grey volcanic rock containing veins, lenses, and bands of epidote. Similar rock is exposed by roadcuts at intervals to km 14.2.

12.7 Junction, road to North Harbour.

15.6 Roadcuts expose pink granite from here to just beyond the bridge over Pipers Hole River (km 30.1). Small patches and thin veinlets of epidote occur in the granite. This rock represents the exposed part of a batholithic granite mass — Northern Bight granite — over 48 km long with a maximum width of nearly 16 km. It extends southwestward from Clarenville beyond Pipers Hole River, which cuts a broad valley across it.

23.8 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 365 m, among the highest in the Burin Peninsula. Toby Lookout, a 362 m monadnock hill, is one of these hills.

30.1 Bridge over Pipers Hole River.

30.7 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.

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

66.3 Junction, road to Grand Le Pierre.

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

112.6 Bridge over Rushoon River.

113.7 Roadcuts expose silicified rhyolite.

114.1 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.

126.1 Junction, road to Red Harbour.

133.4 Roadcut exposes volcanic rock containing conspicuous bands composed essentially of green epidote and orange-red feldspar.

144.8 Turnoff to Marystown.

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

146.6 Junction, turn left.

156.6 Junction, turn right.

169.6	Roadcut exposes dark purple volcanic rock containing lenses of white feldspar and quartz with patches of yellowish-green, finely crystalline epidote.
169.6	Roadcuts 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 5 mm in diameter.
186.3	Intersection at St. Lawrence. The road on right leads north 0.9 km to the Black Duck mine. The road log continues west along Highway 220.
186.7	Junction; turn left (south).
187.9	Junction; turn right onto the mine road leading west.
188.7	Junction, road on right leading 0.6 km north to the Blue Beach mine.
189.9	Junction, road on right leading 0.7 km to the Director mine (main shaft). The Director mine No. 3 shaft is opposite this junction.
191.6	Junction, road on right leading west 0.7 km to the Tarefare mine.
193.3	Turnoff (left) to the Iron Springs mine.
194.3	Junction, road on right leading south 1.8 km to the Lord and Lady Gulch mine.

Refs.: 14 p. 323–328; 36 p. 51–65; 53 p. 67–68; 75 p. 31; 116 p. 22–28; 119; 121 p. 295–300; 211; 241 p. 1–2; 245 p. 6–8; 253 p. 1, 4–7, 23–33; 275 p. 90–120; 276 p. 90–97; 289 p. 26.

Maps (T): 1 L/14 St. Lawrence
(G): 23 St. Lawrence, Burin district (NDME, 1:63 360)
77-21 St. Lawrence, Burin district (NDME, 1:50 000)
85-62 Avalon Peninsula, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 160.3 Junction, Burin Peninsula Road (Highway 210).

km 169.3 Junction, road to Queen's Cove.

Roadcuts between this junction and the junction of the road to Hillview expose Precambrian sedimentary rocks and volcanic and intrusive rocks commonly coated with epidote.

km 170.7 Turnoff 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 the Island of Newfoundland. Their steep walls rise abruptly 60 to 90 m 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 sea level 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.

km **173.0** 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 183 m above sea level, but farther west its peaks reach elevations of 305 m to 365 m above sea level.

km **176.5** Junction, road to Adeytown.

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

km **184.2** Roadcut, opposite a viewpoint, exposes red granite. This granite represents the northern tip of the Northern Bight batholith, which extends into the Burin Peninsula.Viewpoint on right overlooks Random Island and Northwest Arm of Trinity Bay.

km **187.0** Turnoff to Clarenville.

From here to Port Blandford, the highway cuts through an area of rounded hills, their broad summits reaching elevations of up to 305 m above sea level. The region is underlain predominantly by Precambrian sedimentary rocks.

km **210.6** Roadcuts expose grey and dark red volcanic rocks containing epidote-quartz bands up to 1 m wide. Some epidote-quartz rock is an attractive green and is suitable for use as an ornamental rock.

km **219.1** Junction, road to Port Blandford.

km **227.7** Entrance to Terra Nova National Park.

Terra Nova National Park

The park comprises approximately 390 km² 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 236 m above sea level and relief of about 91 m, 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 193 m. 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 (GSC, 1:253 440)
1130A Bonavista, Newfoundland (GSC, 1:253 440)

km 243.3 For the next 5 km, roadcuts 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.
km	**243.9**	Junction, road to Charlottetown.
km	**250.8**	Turnoff 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 229 m 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 conglomerate consisting of pebbles and boulders of volcanic rocks in a sandy matrix outcrops at the tower.
km	**251.5**	Junction, road to Terra Nova.
km	**261.8**	Turnoff to Blue Hill lookout tower. The lookout is situated on Blue Hill 229 m 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.
km	**269.5**	Northwest entrance to Terra Nova National Park.
km	**295.2**	Junction, Highway 320. This road provides access to the Wesleyville occurrences, and the Trinity Bay–Centreville 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 up to 15 mm in diameter and 5 to 7 cm 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, purple fluorite and light blue vitreous apatite grains, pink to peach garnet crystals, reddish-brown titanite, yellowish-green epidote, dark green chlorite, and amphibole (as black prisms and 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 covers an area about 210 km long, from the south coast at Fortune Bay to the northeast coast north of Bonavista Bay, and 4 to 6 km wide. Beryl and the accessory minerals occur in outcrops along the Wesleyville Road (Highway 40) and in a roadside quarry. *See* Map 10.

Road log from the Trans-Canada Highway at **km 295.2**, the junction of Highway 320:

km	0	Proceed onto Highway 320.
	2.9	Roadcuts expose white granite. Porphyritic granite was noted at km 9.8.
	3.2	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.
	7.6	Turnoff to David Smallwood Provincial Park.
	17.7	Bridge over Traverse Brook.
	18.3 to 18.8	Roadcuts 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.
	44.7	Trinity, at the wharf.
	48.9	Centreville, at the turnoff to Wareham.
	52.1	Bridge over Indian Bay Brook; continue along Highway 320.
	75.7	Junction; turn left (north).
	77.4	Junction; turn left onto a road leading west. The beryl-bearing granitic rocks outcrop on both sides of this road beginning 2.5 km from this junction, and extending westward for about 3 km.

Refs.: 127 p. 8, 10; 128 p. 90.

Maps (T): 2 F/4 Wesleyville
(G): 1227A Westleyville, Newfoundland (GSC, 1:253 440)
78-70 Wesleyville–Musgrave Harbour (east), Newfoundland (NDME, 1:50 000)
84-23 Wesleyville, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Trinity Bay–Centreville occurrences

AMETHYST

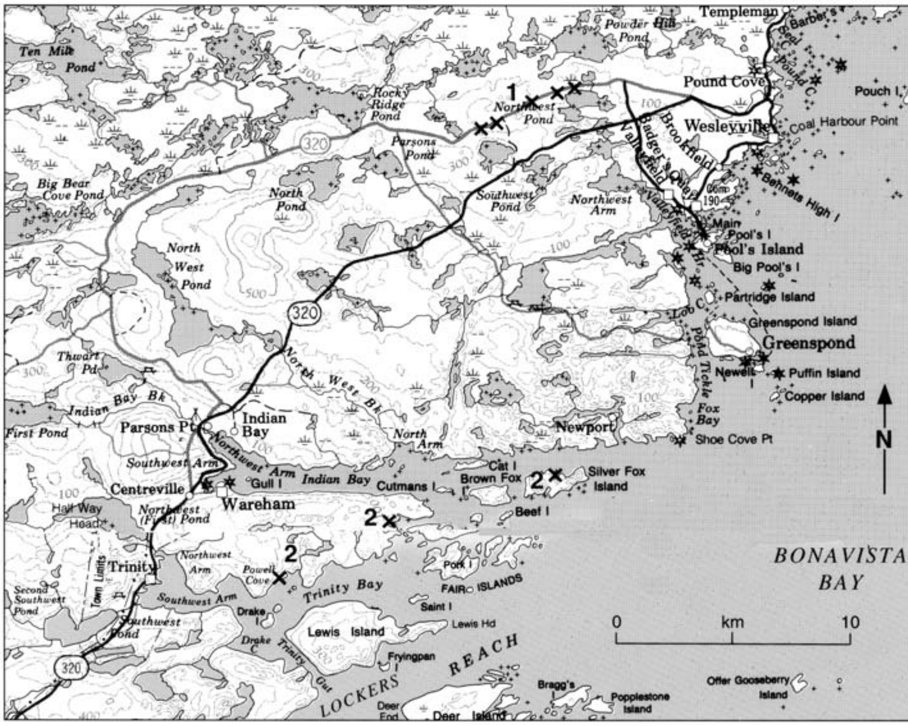
In granite

Transparent, light to medium-dark violet crystals of amethyst occur in cavities and fractures in white granitic rocks in the Trinity Bay area, north shore of Bonavista Bay. The crystals measure about 5 cm in diameter and are used locally for jewellery.

The amethyst occurs at a number of shoreline localities, including Diamond Head and Man Rock Cove on the north shore of Trinity Bay, and at Silver Fox Island.

The shoreline occurrences are accessible by boat from Trinity and Centreville. Diamond Head is 5.5 km from Trinity, Man Rock Cove is 10.5 km from Trinity. Silver Fox Island is about 14 km from Centreville. See Map 10.

Part of 2 C and 2 F



1. Wesleyville beryl, chrysoberyl occurrences 2. Trinity Bay–Centreville occurrences

Map 10. Wesleyville–Trinity area.

Maps (T): 2 C/13 and 2 C/14 St. Bredan's
2 F/4 Wesleyville
(G): 1227A Wesleyville, Newfoundland (GSC, 1:253 440)
78-70 Wesleyville–Musgrave Harbour (east), Newfoundland (NDME, 1:50 000)
84-23 Wesleyville, Newfoundland, mineral occurrence map (NDME, 1:250 000)
84-21 Bonavista, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**297.0**	Viewpoint, 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 kilometres inland and represent the various types of rocks of which the Island of Newfoundland is composed.

km	**304.9**	Roadcuts 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.
km	**305.5**	Turnoff to Square Pond Provincial Park.
km	**311.2**	Roadcuts expose pink granite. 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 1890s for use in building the railway bridge. This quarry is on the south side of the railway, about 2.5 km east of the Trans-Canada Highway.
km	**313.8**	Gander Lake. At about this point the Trans-Canada Highway completes its 315 km 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 Northern Peninsula. The route of the Trans-Canada Highway is within this region to about the junction of Highway 410 (**km 548.3**). The region is a gently rolling lowland varying from sea level to an elevation of about 150 m with some prominent hills reaching elevations of almost 580 m 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.
km	**315.8**	Roadcuts expose granite at its contact with partly metamorphosed sedimentary rocks (greywacke and sandstone). Andalusite porphyroblasts are reported to occur in the metamorphosed rocks.
km	**316.8**	View of Gander Lake, the third largest lake on the Island of Newfoundland after Grand Lake and Red Indian Lake. Gander Lake is 55 km long, 1.5 to 3 km wide, with a maximum depth of 275 m. 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 213 m 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 90 m 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 6500 km². The water level of the lake fluctuates 1.8 to 2.5 m between the spring runoff 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.
km	**333.8**	Junction, road to Gander airport. Roadcuts extending several kilometres east and west of this junction expose Ordovician slate containing pyrite crystals and quartz pods and veinlets. The rock was quarried for building of the Trans-Canada Highway and for maintenance of the airport facilities.

km	**337.9**	Junction, Highway 330. This road provides access to Gander Bay scheelite occurrence, Moreton's Harbour mine, Taylor's Room occurrence, Stewart mine, and Cobbs Arm quarry.

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 northerly for more than 1200 m inland. It was discovered in 1952 by T.O.H. Patrick of the Geological Survey of Canada and has since been explored by trenching.

Road log from the Trans-Canada Highway at the junction of Highway 330 at Gander:

km	0	Junction of Highway 330 and the Trans-Canada Highway; proceed onto Highway 330.
	41.2	South Gander; proceed onto Highway 331.
	51.8	Junction at Rodgers Cove; turn right.
	53.9	End of the road. Walk along the beach for about 1600 m to Charles Cove, which is on the west side of the first prominent headland.

Ref.: 150 p. 201–202.

Maps (T): 2 E/7 Comfort Cove
2 E/8 Carmanville
(G): 60-1963 Botwood, Newfoundland (GSC, 1:253 440)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Moreton's Harbour (Stuckless) mine

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

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. Fluorite occurs with galena. Secondary minerals include valentinite, as white, flat, acicular crystals in small cavities, stibiconite, as yellow, powdery coatings on stibnite and on quartz, and goethite, as rusty brown coatings on quartz and on the host rocks. Kermesite, cervantite, and scorodite have been reported from the deposit. The ore carries values in gold and silver.

Metallic ore on the west side of Moreton's Harbour was noted in 1876 by peat diggers who believed the ore to be lead. In the early 1880s, the deposit was staked by George Hodder, Corbett Pittman, and John Templeton who began mining operations. In 1890, ore valued at $1200 was shipped, and in 1906 a shipment of 73.5 t of hand-sorted ore was made. The mine was worked briefly during World War I. It was examined in 1953 by Newmont Mining Corporation Limited and in 1965 by Newfoundland and Labrador Corporation Limited.

Plate 22

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

The mine is on the steep side of a hill on the south shore of Cross (Frost) Cove on the west side of Moreton's Harbour, New World Island in Notre Dame Bay. It is about 365 m east of the bottom of Cross Cove. It consists of a 70 m adit 3 m above tidewater with a shaft to the surface at its inner end, and a 30 m adit at a level of 17 m. The rock dumps along the slope are partly overgrown. *See* Map 11.

Access to the mine is by boat from Cross (Frost) Cove, or from Moreton's Harbour.

Road log from the Trans-Canada Highway at the junction of Highway 330:

km	0	Proceed onto Highway 330.
	15.6	Turnoff to Jonathan's Pond Provincial Park. Roadcuts along the highway expose Ordovician argillite.
	27.3	Ultramafic rocks containing serpentine are exposed along the highway.
	41.2	South Gander, at the junction of Highway 331; turn left onto Highway 331.
	51.8	Junction, Rodgers Road leading to the Gander Bay scheelite occurrence. The road log continues along the highway.
	68.8	Junction; turn right onto Highway 340.
	71.1	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.
	72.4	Causeway over The Reach, a channel separating Chapel Island from the main island.

72.9 Chapel Island. This island is 11 km long with a maximum width of 7 km. The road traverses its northern end.

79.8 Dildo Run, separating Chapel Island from New World Island. Its many islands are low-lying with a noticeably subdued topography.

81.9 Southern tip of New World Island.

87.7 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.)

94.1 The hill to the left has an elevation of 121 m above sea level, the highest elevation on New World Island.

97.0 Junction; turn right.

98.3 Moreton's Harbour, at the junction of the road to Tizzard's Harbour; continue straight ahead (north).

99.9 Cross Cove, at the wharf. Moreton's Harbour mine is about 800 m from the wharf.

Refs.: 105 p. 39–44, 49–50; 135 p. 97–99; 156 p. 27–28; 228 p. 68–69; 239 p. 39–42.

Maps (T): 2 E/10 Twillingate
(G): 2 Bay of Exploits, Notre Dame district (NDME, 1:63 360)
33-1963 Twillingate, Newfoundland (GSC, 1:63 360)
Twillingate, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Taylor's Room occurrence

SPHALERITE, CHALCOPYRITE, PYRRHOTITE, GALENA, PYRITE, ARSENOPYRITE, STIBNITE

In quartz veins in sheared lava

The main metallic minerals at this occurrence were sphalerite, chalcopyrite, and pyrrhotite with minor galena, pyrite, and arsenopyrite. Stibnite was rare. These minerals occurred in milky quartz veins and in the altered host rock. The veins carried values in gold, arsenic, and silver.

This occurrence was investigated for gold in the 1930s. Three veins at 21 m, 26 m, and 38 m above sea level were exposed by trenches and pits. The occurrence is about 120 m from the shore and about 250 m north of Cross (Frost) Cove. *See* Map 11.

Road log from the Trans-Canada Highway at the junction of Highway 330 at Gander:

km 0 Junction of Highway 330 and the Trans-Canada Highway; proceed onto Highway 330.

41.2 South Gander; proceed onto Highway 331.

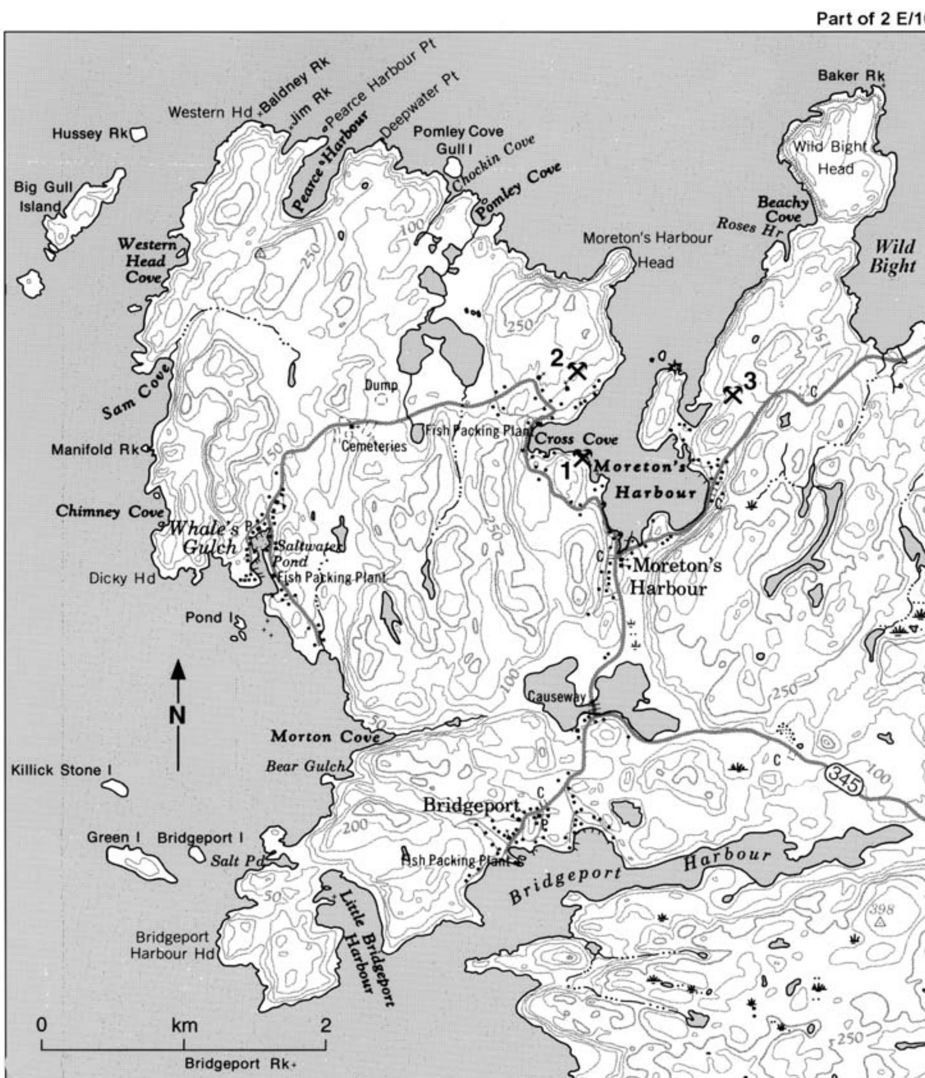
87.7 Virgin Arm; proceed west along Highway 345.

98.3 Moreton's Harbour, at the junction of the road to Tizzard's Harbour; continue straight ahead (north).

100.0 Cross Cove, at the junction of a road leading northeast. The Taylor's Room occurrence is about 350 m northeast of this junction.

Refs.: <u>105</u> p. 49–50; <u>135</u> p. 99; <u>226</u> p. 32–33; <u>239</u> p. 42.

Maps (T): 2 E/10 Twillingate
(G): 2 Bay of Exploits, Notre Dame district (NDME, 1:63 360)



1. Moreton's Harbour mine 2. Taylor's Room occurrence 3. Stewart mine

Map 11. Moreton's Harbour area.

33-1963 Twillingate, Newfoundland (GSC, 1:63 360)
Twillingate, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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 opened by Capt. John R. Stewart of Little Bay in 1896. A shipment of 113 t of arsenopyrite was made in 1897. By 1900 a shaft was sunk to a depth of 33 m, but operations were discontinued a short time later. A trench 18 m deep and about 30 m long exposes the vein.

The Stewart 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. *See* Map 11. Access is by boat from Moreton's Harbour village or from Cross Cove, each being about 1.5 km from the mine. *See* the road log for Moreton's Harbour mine.

Refs. : 105 p. 46–49; 136 p. 92; 226 p. 30–31; 228 p. 69; 239 p. 34–39.

Maps (T): 2 E/10 Twillingate
(G): 33-1963 Twillingate, Newfoundland (GSC, 1:63 360)
Twillingate, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Cobbs Arm quarry

CALCITE, PYRITE

In crystalline limestone

Colourless, white, and pink coarsely cleavable calcite occurs in veins in the limestone. Some 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.

Quarrying of the limestone deposit began in 1870 by Thomas Burridge of St. John's. The limestone was used for building construction in St. John's and for flux in the Betts Cove and Little Bay copper mines. In 1891, John Score of St. John's took over operations, then sold it in 1912 to George Davel and James R. Chalker of St. John's. The new owners formed the Newfoundland Lime Manufacturing Company Limited, which worked the deposit until 1967. The limestone was shipped from the nearby dock to St. John's where it was processed 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 is on the north side of a limestone ridge on the south shore of Cobbs Arm.

Road log from the Trans-Canada Highway at the junction of Highway 330 at Gander:

km	0	Junction of Highway 330 and the Trans-Canada Highway; proceed onto Highway 330:
	87.7	Virgin Arm, at the junction of Highway 340; proceed onto Highway 340.
	89.1	Turnoff to Dildo Run Provincial Park; the road log continues along Highway 340.
	93.3	Roadcut on left exposes altered lava cut by veins of white quartz banded with green epidote. The veins are about 15 cm wide. The quartz-epidote rock is an attractive ornamental rock.
	93.5	Junction, road leading west to Fairbanks East.
		Fairbanks East fossil locality. Brachiopods occur in sandstone of Ordovician age. The fossiliferous rock is exposed along a west-facing beach just south of the western headland forming the cove at Fairbanks East. The distance from Highway 340 is about 2.6 km.
	99.2	Junction; turn right (east) onto Highway 346.
	106.8	Junction at Cobbs Arm; turn right (southeast).
	107.1	Junction; turn right (south)
	107.2	Cobbs Arm quarry, east end.

Refs.: 36 p. 91–92; 94 p. 2, 30–31; 110 p. 6; 156 p. 45; 228 p. 27–28; 269 p. 27–28.

Maps (T): 2 E/10 Twillingate
(G): 33-1963 Twillingate, Newfoundland (GSC, 1:63 360)
Twillingate, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**337.9**	Junction, Highway 330.
km	**353.3**	Turnoff to Glenwood Provincial Park.
		Roadcuts opposite the entrance to the park expose Ordovician slate. Pyrite cubes averaging 10 cm 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 2.5 km south of the bridge over the Gander River. Graptolites occur in the rock at the south end of the quarry.
km	**358.2**	Bridge over Gander River.
km	**381.0**	Turnoff to Notre Dame Provincial Park.
km	**382.1**	Junction, Highway 340, the Road to the Isles. This road provides access to New World Island jasper occurrences and Sleepy Cove mine.

New World Island jasper occurrences

JASPER

In conglomerate

The conglomerate rock containing jasper pebbles is exposed at several localities on the northeastern end of New World Island. The conglomerate underlies a narrow area extending southwestward from Herring Head, along the south side of Goldston (Goshens) Arm to Indian Cove. The most accessible localities are given in the road log that follows.

Road log from the Trans-Canada Highway at **km 382.1**, the junction of Highway 340:

km	0	Junction of Highway 340 and the Trans-Canada Highway; proceed onto Highway 340.
	77.0	Virgin Arm, at the junction of Highway 345; continue along Highway 340.
	86.5	Junction of Highway 346 to Cobbs Arm and Pikes Arm. Jasper conglomerate is exposed along the shore of Herring Neck in the vicinity of Pikes Arm village; the distance from this junction to Pikes Arm is 12 km. The road log continues along Highway 340 toward Twillingate.
	87.8	Junction of the road to Herring Neck. The jasper conglomerate is exposed in a roadcut opposite this junction and in a quarry behind the roadcut. It is also exposed along the road to Herring Neck, about 150 m from this junction.

Refs.: 7 p. 11–12; 136 p. 3–7.

Maps (T): 2 E/10 Twillingate
(G): 33-1963 Twillingate, Newfoundland (GSC, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Sleepy Cove mine

PYRITE, PYRRHOTITE, CHALCOPYRITE, EPIDOTE

In chloritized volcanic rock

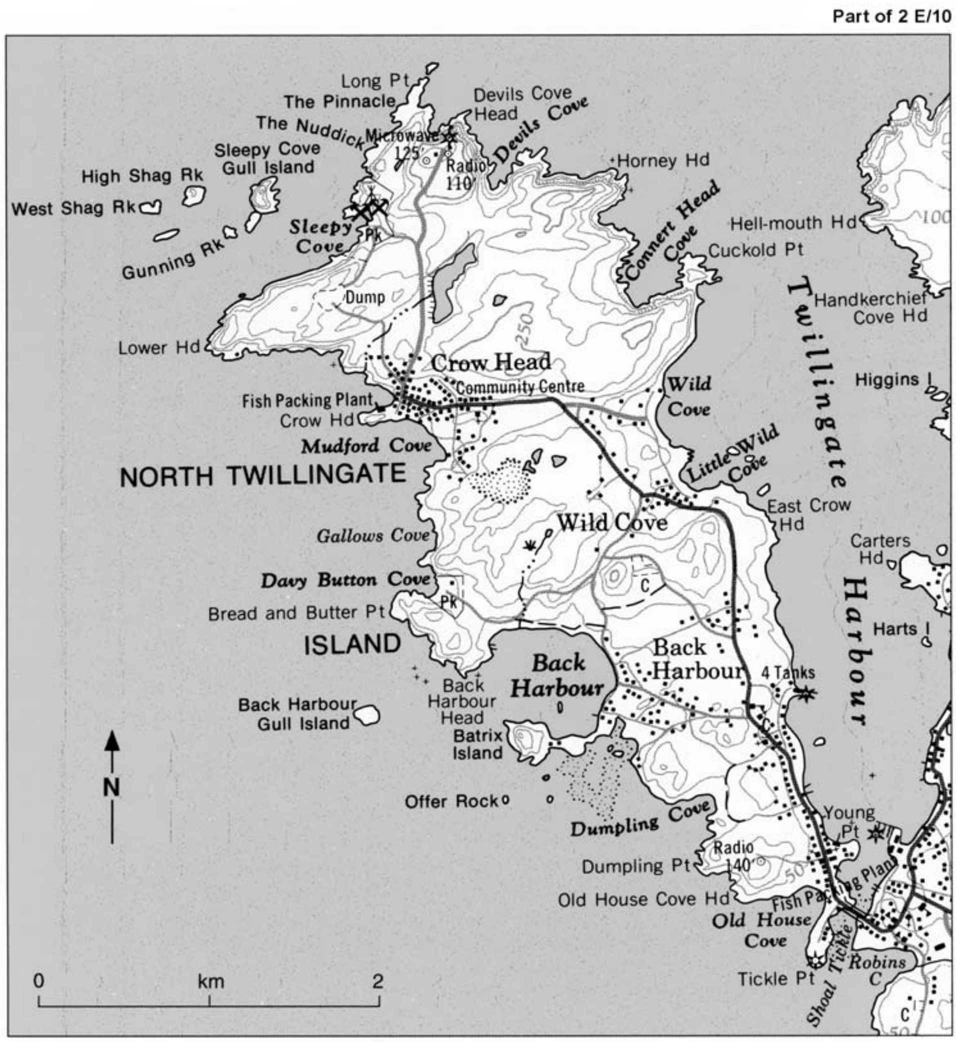
Pyrite, pyrrhotite, and chalcopyrite occur as massive patches and as disseminations in the chloritized volcanic rock. Epidote occurs in the volcanic rock.

The deposit was staked in the early 1900s by James Hodder and his son Edgar Hodder of Crow Head, North Twillingate Island. The property was sold to Obediah Hodder who formed the Great Northern Copper Company Limited to develop the deposit. Development consisted of a shaft, 36.5 m deep, and an open cut about 49 m long. In 1898, The Newfoundland Copper Company Limited sank two new shafts about 300 m west of the original workings. Two shipments of ore were made before the mine closed in 1917.

The mine is on the north shore of Sleepy Cove on the west side of North Twillingate Island. *See* Map 12.

Road log from the Trans-Canada Highway at **km 382.1**, the junction of Highway 340:

km	0	Junction of Highway 340 and the Trans-Canada Highway; proceed onto Highway 340.



Map 12. Sleepy Cove mine

75.0	Virgin Arm, at the junction of Highway 345; continue along Highway 340.
86.5	Junction of Highway 346 to Cobbs Arm; continue along Highway 340 toward Twillingate.
103.7	Junction, at Crow Head; turn right (north) onto the road to Devil's Cove Head.
104.7	Junction; turn left (west) onto the road to Sleepy Cove Park.
105.0	Sleepy Cove Park. From the parking lot, proceed down the trail to the shore. Walk west along the north shore of Sleepy Cove for about 100 m to the Sleepy Cove mine.

Refs.: 156 p. 22, 26–27; 239 p. 37–38.

Maps (T): 2 E/10 Twillingate
(G): 33-1963 Twillingate, Newfoundland (GSC, 1:63 360)
Twillingate, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 395.0 Roadcut exposes diorite cut by white quartz-feldspar veins up to 20 cm 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 clinozoisite (as sugary and microscopic bladed aggregates) occur in the quartz-feldspar rock.

km 410.8 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 the Island 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 60 to 90 m above sea level, rising gradually to an elevation of 152 m at Miguels Lake, then to a maximum of 259 m at about km 85 (35 km 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, Northwest Gander River, Little Gull River, Twillick Brook, and Conne River. Their gently sloping, wooded valleys are bordered by flat-topped hills and ridges with a maximum relief of 91 m. The hills are underlain by Ordovician sedimentary and volcanic rocks. The highest hills (at km 67 and km 114) reach an elevation of 275 m above sea level. At about km 22, the highway leaves the Newfoundland Central Lowland physiographic region and enters the Atlantic Uplands of Newfoundland for the duration of its course . Atlantic Uplands make up the entire southeastern part of the island from Cape Freels, north of Bonavista Bay to Channel-Port aux Basques.

The 48 km 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 form the walls of North Bay and much of East Bay are composed of granitic rocks. The most spectacular cliff is the breathtaking 305 m overhanging cliff at the Devils Dancing Table near Doting Cove in North Bay, about 3 km from its mouth. The less resistant sedimentary rocks making up much of the shoreline have been eroded by the sea, forming caves and arches, chasms, and stacks.

The water of Bay d'Expoir averages 180 m to 365 m deep, but reaches a depth of 713 m near Goblin Head. The shoreline rises to 244 m above the sea at its head at Northwest Brook and to over 335 m 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.

Ref.: 130 p. 1–6.

Maps (T): 1 M Belleoram
2 D Gander Lake
2 E Botwood
(G): 1280A Burgeo (east half), Newfoundland (GSC, 1:253 440)
13 Baie d'Espoir sheet, south coast (NDME, 1:63 360)

km	**413.0**	Junction, Highway 350. This road provides access to Lockport mine and Cook mine. *Roadcuts* in the vicinity of the junction expose red sandstone of Silurian age.

Lockport mine

PYRITE, CHALCOPYRITE

In chlorite schist

Pyrite occurs as disseminated grains and cubes in quartz and in the host chlorite schist. Chalcopyrite is associated with the pyrite.

The mine was operated in 1880 by William Pill. The workings consist of three pits, about 10 m, 21 m, and 27 m long respectively, and two shafts believed to be at least 7 m deep. Extensive mine dumps are found around the workings. There is no record of production.

The mine is on the west side of Mine Pond, west of Glover Harbour. *See* Map 13.

Road log from the Trans-Canada Highway at **km 413**, the junction of Highway 350:

km	0	Junction of the Trans-Canada Highway and Highway 350; proceed north along Highway 350.
	20.8	Junction of Highway 352; continue along Highway 350.
	61.8	Junction; follow the road on left leading west to Glovers Harbour.
	64.6	Glovers Harbour, at the junction of a trail leading west; proceed along this trail for 600 m to the Lockport mine.

Refs.: 59 p. 60–62; 126 p. 17; 156 p. 26.

Maps (T): 2E/6 Point Leamington
(G): 90-124 Geology of the New Bay area (parts of 2 E/6 and 2 E/11), Notre Dame Bay (NDME, 1:50 000)
60-1963 Botwood, Newfoundland (GSC, 1:253 440)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

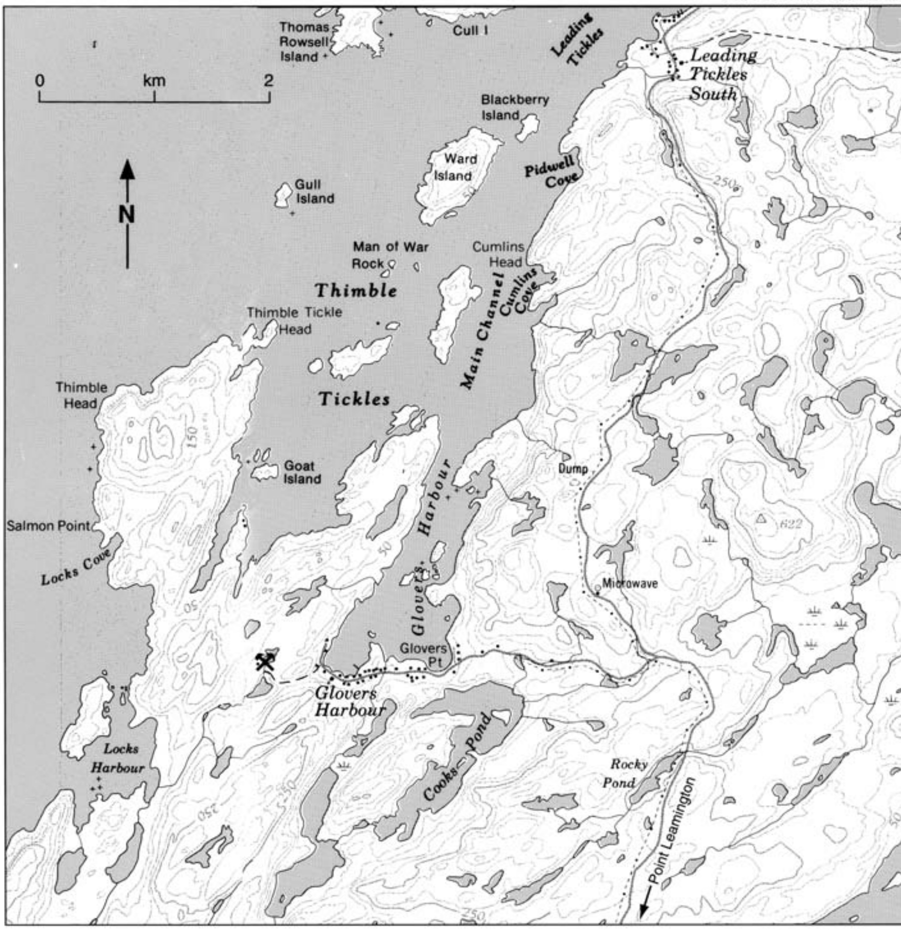
Cook mine

HEMATITE

In chert

The ore consists of hematite veinlets up to 2 cm wide in Ordovician chert. Radiolaria occur in the chert. A manganese zone is associated with the hematite-bearing chert.

Part of 2 E/5 and 2 E/6



Map 13. Lockport mine

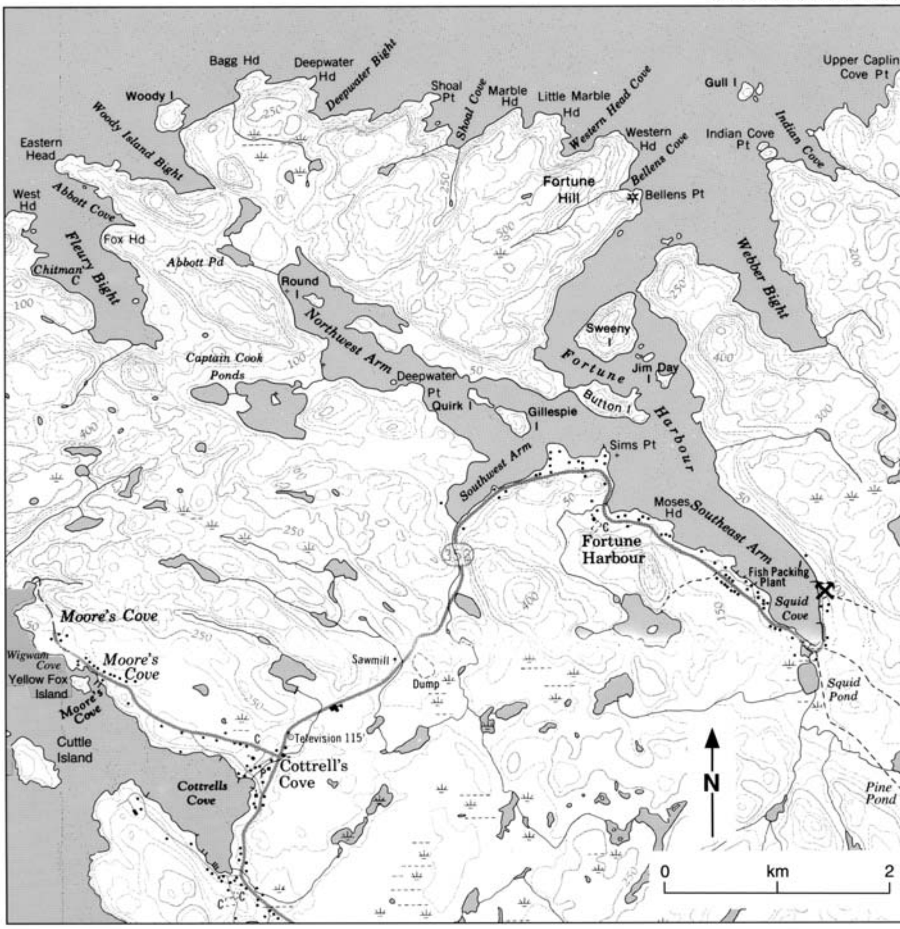
The mine was worked for iron and manganese. Prior to its development, the deposit furnished red ochre to the Beothuck Indians of Fortune Harbour peninsula, and later to European settlers. In 1897, William Cook, a butcher from St. John's, staked the iron deposit and began mining operations. Development consisted of a shaft and an adit driven 24.4 m into a hillside. A shipment of 1360 t of manganiferous iron ore valued at $18 000 was made in 1897 to the Workington Iron and Steel Company in England.

The mine is on the east shore of Southeast Arm, Fortune Harbour. It is 245 m from the shore and 800 m from the south end of Southeast Arm. *See* Map 14.

Road log from the Trans-Canada Highway at **km 413**, the junction of Highway 350:

km	0	Junction of the Trans-Canada Highway and Highway 350; proceed north along Highway 350.
	17.0	Fortune Harbour village; continue along the road for 2.7 km to the Cook mine on the east side of the road.

Part of 2 E/6 and 2 E/11



Map 14. Cook mine

Refs.: 105 p. 54; 156 p. 28.

Maps (T): 2 E/11 Exploits
(G): 2 Bay of Exploits, Notre Dame district (NDME, 1:63 360)
Exploits, metallogenic map of the Notre Dame area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 433.6 Grand Falls, at the turnoff to Windsor. Grand Falls, on the Exploits River, is a major pulp- and paper-producing centre.

km 436.5 Turnoff to Beothuck Provincial Park. The park bears the name of the Aboriginal tribe — the Beothucks — who were early inhabitants of Newfoundland. They became extinct early in the nineteenth century (ref.: 242).

km	**442.3**	Roadcuts, west side of Red Cliff overpass. Pyrite occurs abundantly as finely crystalline aggregates and as microscopic cubes in argillite. Goethite forms a rusty powdery coating on the rock.
km	**443.4**	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 114 km course from Red Indian Lake to the Bay of Exploits where it enters Notre Dame Bay. The Exploits drainage basin with an area of about 11 910 km² is the largest in the province. 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 1200 m opposite **km 446.5** 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.
km	**445.8**	Bridge over Leech Brook.
km	**446.5**	Roadcuts expose pyrite in slate.
km	**448.9**	Turnoff to Pearson's Peak, a tower faced with pink granite fieldstone. The tower is at the midpoint in the Island of 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 91 m above sea level and overlooks the Exploits River, at this point less than 30 m below. The prominent monadnock hill in the distance south of the river and topped by a fire tower is 244 km above sea level.
km	**451.9**	Turnoff to Aspen Brook Provincial Park.
km	**462.1**	Badger, at the Junction of Highway 370.

Buchans mines

PYRITE, CHALCOPYRITE, SPHALERITE, GALENA, TETRAHEDRITE, TENNANTITE, CHALCOCITE, PROUSTITE, BORNITE, ARGENTITE, NATIVE SILVER, COVELLITE, HEMATITE, BARITE, LAUMONTITE, BROCHANTITE, ANTLERITE, KTENASITE, SERPIERITE, BEAVERITE, SMITHSONITE, ANGLESITE, HEMIMORPHITE, GYPSUM, CHALCANTHITE, ROZENITE, GUNNINGITE

In altered and brecciated felsic volcanic rocks

The Buchans mines were in production for 57 years beginning in 1928. The ore consisted of a massive intergrowth of pyrite, chalcopyrite, sphalerite, and galena in a barite-calcite gangue. Crystals of pyrite and barite occurred in the brecciated host rock and in cavities in the gangue. Less abundant minerals associated with the ore included tetrahedrite, tennantite, chalcocite, proustite, bornite, argentite, native silver, covellite, and hematite. Laumontite occurred as pink veinlets up to 2 cm wide in the volcanic rocks. Secondary minerals were reported from ore specimens found along the open pit. These included coatings of green brochantite, antlerite, and ktenasite, light blue serpierite, and yellow to yellowish-brown beaverite; associated with these minerals were smithsonite, anglesite, hemimorphite, gypsum, chalcanthite, rozenite, and gunningite.

Plate 23

Hans Lundberg (far right), the discoverer of the rich orebody that became the Buchans mine, and some of his crew, 1927. GSC 1993-040-D

The deposit was discovered in 1905 by Matty Mitchell, a Micmac Indian prospector, who found a small orebody in the bed of Buchans River. The discovery site is at a bend in the river, just northeast of Buchans. Underground development of the prospect was undertaken by the Anglo-Newfoundland Development Company between 1906 and 1911, but was discontinued because of metallurgical difficulties in processing the ore. A successful flotation process was developed later by the American Smelting and Refining Company (Asarco Inc.), followed by a program of geophysical prospecting in 1926. This resulted in the discovery of two high-grade orebodies, the Oriental, 610 m to the east, and the Lucky Strike, 1220 m to the west of the original Buchans River deposit. A concentrator and the Buchans townsite were built and production began from an open pit and shallow underground workings in 1928 at the Lucky Strike mine. In 1955, the Rothermere mine came into production. It was developed by a shaft 766.5 m deep. The MacLean mine was developed by a shaft to a depth of 1074.5 m; production began there in 1963. In 1981, production of barite from the tailings was started. From 1928 until mining ended in 1984, production amounted to 16 196 876 t of ore grading 14.51% zinc, 7.56% lead, 1.33% copper, 126 g/t silver, and 1.37 g/t gold.

The mines are in Buchans, which is connected to the Trans-Canada Highway by a 73 km road (Highway 370). The Lucky Strike mine is on the south side of the town. The Rothermere mine is west of the Lucky Strike mine and the MacLean mine is about 900 m northwest of the Rothermere mine.

Refs.:12 p. 77–78; 54, p. 14; 75 p. 23–27; 125 p. 75–106; 181 p. 406–413; 228 p. 15–18; 229 p. 349–352; 235 p. 143–160; 238 p. 618–626; 243 p. 84–91; 244 p. 126–137; 247 p. 84–91; 289 p. 28.

Maps (T): 12 A/15 Buchans
(G): 79-125 Buchans area, Newfoundland (NDME, 1:50 000)
91-172 Red Indian Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Plate 24

Buchans mines, 1957. The Lucky Strike ‘glory hole’ (open pit) is in the left centre and the MacLean mine is in the upper left. GSC 109420

km	**471.8**	Turnoff to Catamaran Provincial Park.
km	**472.4**	Roadcut exposes a fine-grained, grey diabase rock, its surfaces encrusted with aggregates of microscopic crystals of epidote, microcrystals of quartz, and tiny crystals of pyrite.
km	**477.1**	Roadcuts expose pink granite cut by epidote-quartz bands up to 2 cm wide. Small grains of brown titanite and flaky aggregates of chlorite occur in the rock.
km	**494.3**	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, black foliated chlorite, and greyish fibrous and rosette-like aggregates of anthophyllite.

The deposit was discovered in 1905. Original underground development was done in 1918 by the 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 four-compartment shaft sunk to a depth of 320 m and a mill with a capacity of 1814 t/day. The mine produced a total of 18 873 847 kg of copper from 2 172 472 t of ore milled. The ore averaged about 1.1% copper.

The Gullbridge mine is located at Mineral Point on the west side of Gull Lake. Some small dumps furnishing ore specimens are found on the property. Access is by a road, 5.1 km long, leading from the Trans-Canada Highway at km 494.3.

Refs.: 59 p. 36–43; 133; 228 p. 46–47; 252 p. 1065–1068; 288 p. 129.

Maps (T): 12 H/lE Gull Lake
(G): 54-4 Gull Pond, Newfoundland (GSC, 1:63 360)
83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**506.5**	Hall Hill on right (elevation 305 m above sea level).
km	**515.4**	South Brook, at the junction of Highway 380. This road provides access to Crescent Lake mine, Miles Cove mine, Pilley's Island mine, and Highway 380 jasper occurrences.

Crescent Lake mine

CHALCOPYRITE, PYRITE, GALENA, PYRRHOTITE, SPHALERITE

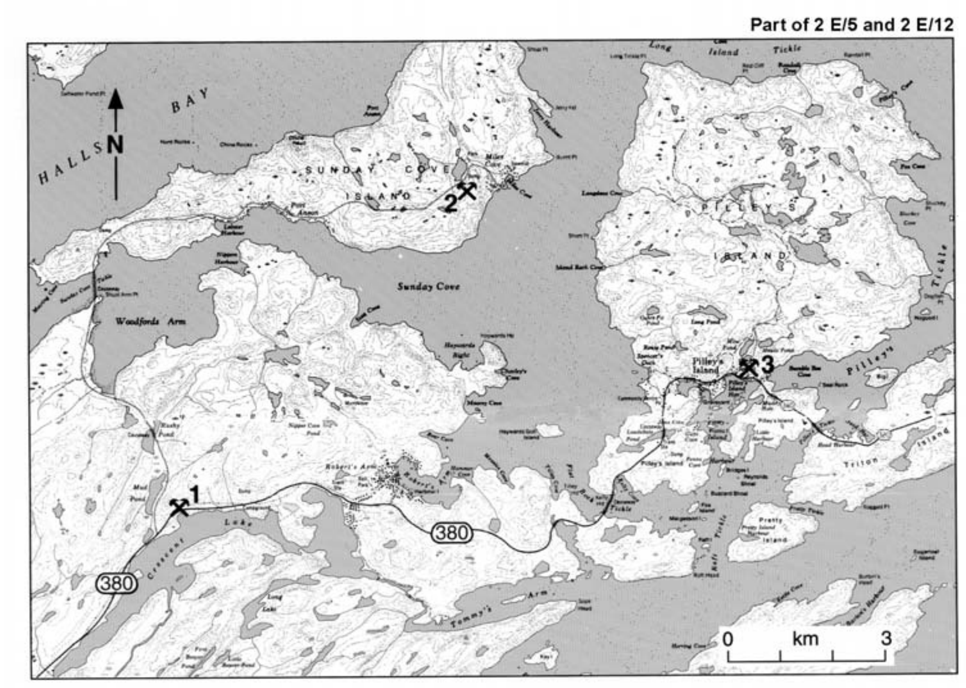
In veins cutting altered volcanic rocks

Chalcopyrite and pyrite, the main metallic minerals, occur in quartz veins cutting chloritized volcanic rocks. Galena, pyrrhotite, and sphalerite occur in minor amounts.

The deposit was discovered in 1878 by lumbermen who stumbled on copper-bearing outcrops along the north shore of Crescent Lake. Captain Philip Cleary, who held the claims covering the areas, leased the property to Betts Cove Mining Company, which produced about 1143 t of 28% copper ore from 1879 to 1881. Between 1924 and 1926, the Reid Newfoundland Company mined about 1800 t of ore grading 12% copper. The development consists of three inclined shafts and two vertical shafts, the deepest being 76.2 m.

The Crescent Lake mine is on the north side of Crescent Lake and south of Highway 380. *See* Map 15.

Road log from the Trans-Canada Highway at **km 515.4**, the junction of Highway 380:



1. Crescent Lake mine 2. Miles Cove mine 3. Pilley's Island mine

Map 15. Robert's Arm area.

km	0	South Brook, at the junction of highway 380 and the Trans-Canada Highway; proceed onto Highway 380.
	21.0	Junction of the road to Port Anson; continue along Highway 380.
	23.1	Powerline crosses the highway. Walk east for about 300 m along the powerline to the old workings. The shafts have been filled and most of the dumps removed.

Refs.: 23 p. 75–76; 59 p. 7; 67 p. 43–44; 138 p. 121–122; 156 p. 24.

Maps (T): 2 E/5 Robert's Arm
(G): 3 Pilleys Island, Green Bay district (NDME, 1:63 360)
Robert's Arm, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Miles Cove mine

PYRITE, CHALCOPYRITE, MAGNETITE

In chlorite schist

Pyrite and chalcopyrite occur as grains and in massive form in quartz veins in chlorite schist. Magnetite is present in small amounts; specimens of oxidized magnetite, occurring as brown platy aggregates, have been found on the dumps.

The deposit was worked by Tharsis Sulphur and Copper Company in 1898–1899. Development consisted of one shaft sunk to a depth of 17.2 m, two others to depths of 9.1 m, and two trenches. Production amounted to 190.5 t of ore grading about 10% copper.

The mine is about 0.5 km west of Miles Cove on the east side of Sunday Cove Island. *See* Map 15.

Road log from the Trans-Canada Highway at **km 515.4**, the junction of Highway 380:

km	0	South Brook, at the junction of Highway 380 and the Trans-Canada Highway; proceed onto Highway 380.
	21.0	Junction of the road to Port Anson; proceed north toward Port Anson and Miles Cove.
	31.5	Port Anson; continue along the highway toward Miles Cove.
	35.0	At this point, there is a pond on left (north) side of the road. Walk southeast around a rock exposure on the south side of the road to a clearing; continue south across the clearing to a trail leading east to the Miles Cove mine. The total distance from the road is about 450 m.

Refs.: 59 p. 102–103; 67 p. 44; 158 p. 116–117, 120–121.

Maps (T): 2 E/12 Little Bay Island
(G): 3 Pilleys Island, Green Bay district (NDME, 1:63 360)
Little Bay Island, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-07 Little Bay Island, Newfoundland (NDME, 1:50 000)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Pilley's Island mine

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

In rhyolite

The Pilley's 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.

A pyrite-bearing rock outcrop on the west side of an inlet in Pilley's Island Harbour was known in 1875. Mining began in 1889. The mine was operated from 1891 to 1899 by Pyrites Company Limited, which shipped 272 100 t of ore before terminating operations because of mining difficulties. Between 1901 and 1908, a further shipment of 204 075 t of ore was obtained by the Pilley's 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 Pilley's Island Harbour, south side of Pilley's Island in Notre Dame Bay. *See* Map 15.

Road log from the Trans-Canada Highway at **km 515.4**, the junction of Highway 380:

Plate 25

Site of Pilley's Island mine, Pilley's Island Harbour, 1973. GSC 202753

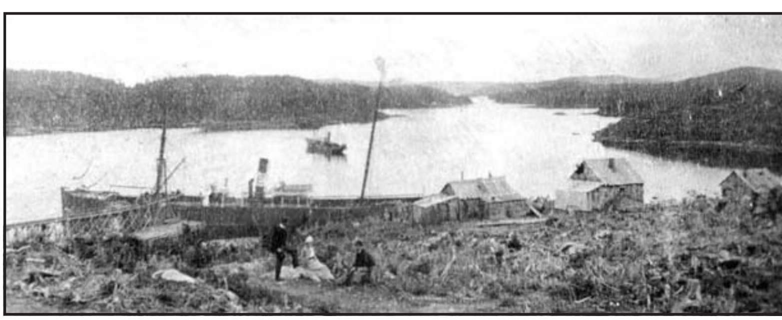


Plate 26

Pilley's Island loading pier, about 1891. Provincial Archives of Newfoundland and Labrador A32-49

km		
	0	South Brook, at the junction of Highway 380 and the Trans-Canada Highway; proceed onto Highway 380.
	21.0	Junction of the road to Port Anson; continue along Highway 380.
	25.0	Junction, road to Robert's Arm; continue along Highway 380.
	33.5	Pilley's Island village at the junction of the road to Spencer's Dock; continue straight ahead.
	34.6	Turnoff (left) to the mine.
	34.7	Pilley's Island mine.

Refs. : 23 p. 74; 36 p. 144–146; 67 p. 31–41; 197 p. 173–174, 177–178; 228 p. 44–45, 117–118.

Maps (T): 2 E/12 Little Bay Island
(G): 3 Pilley's Island, Green Bay district (NDME, 1:63 360)
87-07 Little Bay Island, Newfoundland (NDME, 1:50 000)
Little Bay Island, metallogenic map of Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)
60-1963 Botwood, Newfoundland (GSC, 1:253 440)

Highway 380 jasper occurrences

JASPER, EPIDOTE

In volcanic rocks

Jasper occurs as veins and lenses in Ordovician volcanic rocks exposed by roadcuts along Highway 380. Some jasper zones measure up to 1 m wide, as at the roadcut at km 10.6. The colour ranges from orange red to maroon red and brownish red. Some jasper is banded and mottled in various shades of red; it is cut by epidote-quartz or chlorite-quartz veinlets. Fracture-free specimens can readily be obtained from most 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.

Road log from the Trans-Canada Highway at **km 515.4**, the junction of Highway 380:

km	0	South Brook, at the junction of Highway 380 and the Trans-Canada Highway; proceed onto Highway 380.
	8	Jasper occurs in roadcuts from here to km 11.
	21.0	Junction of the road to Port Anson.
	25.0	Turnoff to Robert's Arm. Jasper occurs in roadcuts from here to Pilley's Island.

Maps (T): 2 E/5 Robert's Arm
(G) 19-1962 Botwood (west half), Newfoundland (GSC, 1:153 440)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km **518.1** Halls Bay on right.

The 32 km 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 occupied by a multitude of lakes and ponds and by a series of granite hills — The Topsails — with elevations of 477 m to 580 m above sea level. The head of the bay near the Trans-Canada Highway is drift-covered and low lying; its sides rise abruptly 90 to 244 m above the sea to form flat-topped ridges.

Westward along the head of Halls Bay, the highway reaches an elevation of 91 m, providing an excellent view of the bay and of South Brook village. It then completes its 233 km course within the Newfoundland Central Lowland and approaches the Newfoundland Highlands physiographic region for the remainder of its route.

The Highlands is a rugged area containing the highest hills (with elevations to nearly 825 m above sea level) and some of the most spectacular scenery in the province. 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.

km	**522.6**	Roadcuts expose red conglomerate of Silurian age. The pebbles in the conglomerate consist of volcanic rocks, porphyry, and some red jasper.
km	**528.2**	Junction, Highway 390. This road provides access to Whalesback and Little Deer mines, Little Bay mine, Rendell Jackman mine, McNeily mine, Colchester mine, Silverdale mine, Nickey's Nose occurrence, and Harry's Harbour jasper occurrences.

Whalesback mine, Little Deer 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 in the 1920s. In 1960, British Newfoundland Exploration Corporation Limited undertook a program of surface exploration that resulted in outlining an orebody 366 m long and up to 40 m wide, the ore grading 1.75% copper with some silver and gold. Production began in 1965. Development consisted of a 332 m shaft and an underground connection, about 1000 m long, to

Plate 27

Whalesback mine, 1973. GSC 202754

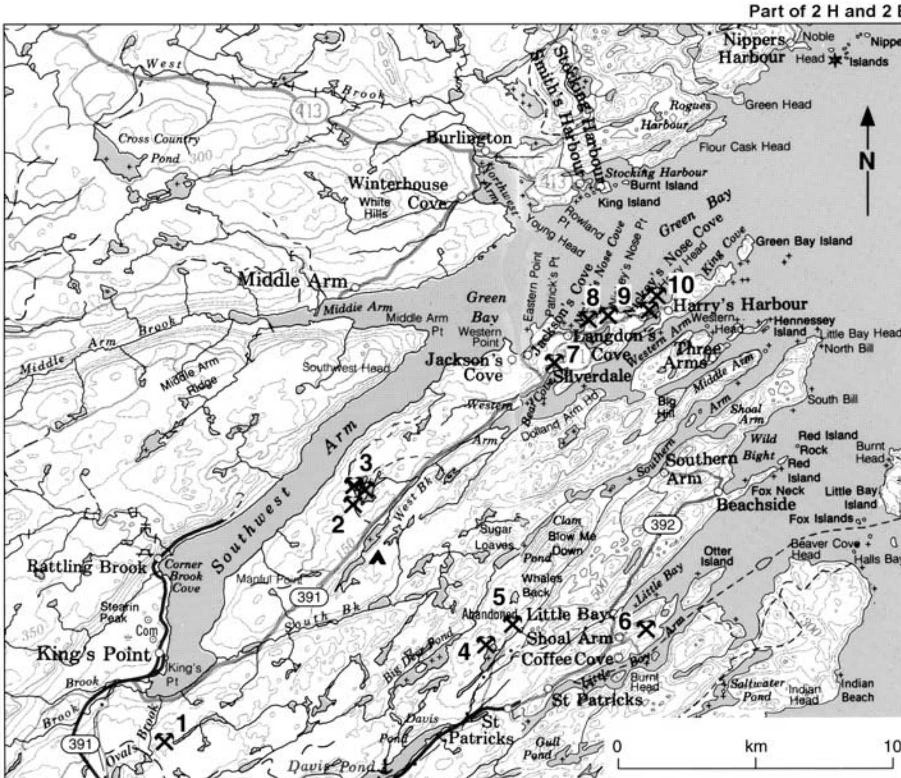
another orebody, the Little Deer deposit. A mill was installed at the mine site. The concentrates were trucked 11 km to the dock at Little Bay for shipment to the Noranda smelter in Gaspé. Operations ended in 1968 because of ore exhaustion. In 1974, Green Bay Mining Company Limited produced 68 025 t of ore from the Little Deer deposit.

The mines are northwest of St. Patricks. *See* Map 16.

Road log from the Trans-Canada Highway at **km 528.2**, the junction of Highway 390:

km	0	Junction of the Trans-Canada Highway and Highway 390; proceed onto Highway 390.
	2.5	Junction of Highway 391; proceed along Highway 391 toward Springdale.
	7.2	Junction; proceed straight ahead onto Highway 392 toward St. Patricks.
	16.7	Junction of the mine road; turn left.
	19.9	Junction; turn left.

Part of 2 H and 2 E



1. Rendell Jackman mine 2. McNeily mine 3. Colchester mine 4. Little Deer mine 5. Whalesback mine 6. Little Bay mine 7. Silverdale mine 8. Nickey's Nose occurrence 9. Wheeler's shaft 10. Harry's Harbour jasper occurrences

Map 16. Little Bay–King's Point area.

21.2 Whalesback mine. The Little Deer mine is 1 km southwest of the Whalesback mine.

Refs.: 87 p. 847–848; 134 p. 1387–1395; 140 p. 141–142; 154 p. 36; 191 p. 101–102; 194 p. 181–192; 197 p. 176–177; 289 p. 54.

Maps (T): 12 H/9 E King's Point
(G): 22 Little Bay, Green Bay district (NDME, 1:63 360)
87-06 King's Point (NDME, 1:50 000)
King's Point, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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. A mass weighing over 4.5 kg was found in more recent (1966) operations. The ore was massive and occurred as lenses, pods, and disseminations. The gangue minerals were quartz, epidote, and calcite. Ore specimens are available from the dumps; they are commonly coated with yellow powdery jarosite and rusty earthy goethite.

The discovery of copper ore near the shores of Little Bay was made in 1878 by Robert Colbourne, a hunter from Wild Bight. The discovery site was on claims held by Dr. Henry Eales of London and Adolph Guzman of the Betts Cove Mining Company, which began development immediately. Miners and machinery were brought in across Green Bay from the Betts Cove mine, which was in decline at the time. Shafts were sunk and the first ore shipment was made in 1878 to Swansea. Between 1881 and 1894, The Newfoundland Consolidated Copper Mining Company operated the mine and installed smelters. The workings consisted of seven shafts, the deepest being 433 m. Additional work was done from 1898 to 1901 by the Newfoundland Copper Company Limited. 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 mill in operation. The ore was hoisted through a 628 m shaft opening 11 levels. Mining ceased in 1969 because of ore exhaustion. The nine-year operation yielded a total of 25 729 247 kg of copper from 2 571 454 t of ore.

The mine is 0.8 km 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. *See* Map 16.

Road log from the Trans-Canada Highway at **km 528.2**, the junction of Highway 390:

km 0 Proceed onto Highway 390.

16.7 Turnoff to Whalesback mine; continue straight ahead.

22.7 Junction of the mine road; turn right.

23.5 Little Bay mine.

Refs.: 36 p. 143–144; 75 p. 19; 139 p. 134–136; 154 p. 23–25; 156 p. 21–23; 191 p. 101–104; 197 p. 175–176; 198 p. 41–48; 228 p. 47–49; 268 p. 14–15; 270; 289 p. 36.

Maps (T): 2 E/12 Little Bay Island
(G) 87-07 Little Bay Island, Newfoundland (NDME, 1:50 000)
Little Bay Island, metallogenic map of Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)
60-1963 Botwood, Newfoundland (GSC, 1:253 440)

Rendell Jackman (Hammer Down) mine

PYRITE, CHALCOPYRITE, SPHALERITE, GALENA, RUTILE, NATIVE GOLD, EPIDOTE

In chlorite schist

The deposit was originally investigated as the Rendell Jackman prospect for copper, and more recently as the Hammer Down prospect for gold. The copper ore consisted of massive and disseminated pyrite, nodular chalcopyrite with sphalerite, quartz, and calcite in chlorite schist. The ore was banded and contained pyrite cubes. Mineralization in the Hammer Down prospect consists of pyrite with minor chalcopyrite, sphalerite, and galena in quartz veins; rutile and visible native gold have also been reported. Epidote occurs in altered volcanic rock.

Copper mineralization in the vicinity of Ovals Brook was discovered in 1909 by Esau Burt of King's Point while he was moose hunting. The news of the discovery was passed on by James M. Jackman of Tilt Cove to Robert Rendell of St. John's who filed a claim on the property. In 1909 development began under the direction of John Stewart. Exploration consisted of three shafts, two to depths of 18 m and one to 61 m. No ore was shipped and operations ended in 1913. A stockpile estimated to contain 1088 t of hand-picked copper ore averaging 3% to 4% copper was left on the site, near the southernmost shaft. In 1986–1987, Noranda Exploration Company Limited explored the property and discovered several gold-bearing, sulphide-rich quartz-carbonate veins; this zone, known as the 'Hammer Down deposit', was exposed by several trenches.

The deposit is on the east side of Ovals Brook, about 2.4 km south of King's Point. *See* Map 16.

Road log from the Trans-Canada Highway at **km 528.2**, the junction of Highway 390:

km	0	Junction of the Trans-Canada Highway and Highway 390; proceed onto Highway 390.
	2.5	Junction of Highway 391; proceed along Highway 391 toward King's Point.
	13.7	Junction of the road to King's Point; continue along Highway 391 toward Harry's Harbour.
	14.9	Junction of a trail on right, just east of the bridge over Ovals Brook. This trail leads south 1600 m to the Rendell Jackman mine.

Refs.: 2 p. 146–151, 154; 59 p. 86–91; 126 p. 18; 154 p. 26–28; 156 p. 23–24.

Maps (T): 12 H/9 King's Point
(G): 22 Little Bay, Green Bay district (NDME, 1:63 360)
87-06 King's Point (NDME, 1:50 000)
King's Point, metallogenic map of the Notre Dame Bay area, Newfoundland

(NDME, 1:63 360)
83-60 Sandy Lake, Newfoundland, mineral occurrence map
(NDME, 1:250 000)

McNeily mine

MAGNETITE, PYRITE, CHALCOPYRITE, PYRRHOTITE, SPHALERITE, NATIVE GOLD

In chlorite schist

Fine-grained magnetite containing veinlets of pyrite and chalcopyrite occurred with quartz. Pyrrhotite, sphalerite, and native gold (rare) occurred with chalcopyrite in quartz-carbonate veins.

The deposit was discovered in 1891. In 1892, Andrew Whyte and John R. Stewart raised 590 t of ore and processed it in an on-site crushing plant. In 1897, Stewart hauled the ore to Little Bay. In 1898, Tharsis Sulpher and Copper Company made one shipment of ore, leaving about 4500 t on the dumps. Development consisted of two main shafts (17 m and 37 m deep respectively) and a 30 m prospect shaft about 120 m south of the main shafts.

The mine is northeast of King's Point. *See* Map 16.

Road log from the Trans-Canada Highway at **km 528.2**, the junction of Highway 390:

km	0	Junction of the Trans-Canada Highway and Highway 390; proceed onto Highway 390.
	2.5	Junction of Highway 391; proceed along Highway 391 toward King's Point.
	13.7	Junction of the road to King's Point; continue along Highway 391.
	25.1	Junction of the road to Colchester Lake; turn left (west).
	26.2	Junction; turn left onto the mine road. (The road on right leads 500 m to the Colchester mine.)
	26.6	McNeily mine.

Refs.: 59 p. 62–64; 154 p. 30–31; 156 p. 23.

Maps (T): 12 H/9 King's Point
(G): 22 Little Bay, Green Bay district (NDME, 1:63 360)
87-06 King's Point (NDME, 1:50 000)
King's Point, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
83-60 Sandy Lake, Newfoundland, mineral occurrence map
(NDME, 1:250 000)

Colchester mine

CHALCOPYRITE, PYRITE, PYRRHOTITE, SPHALERITE, GALENA

In chlorite schist

Chalcopyrite occurred with pyrite as disseminations, veinlets, and in massive form in quartz-carbonate veins and in the host chlorite schist. Pyrrhotite, sphalerite, and galena were present in minor amounts.

The deposit was discovered in the early 1870s by James Batstone, a farmer from Jackson's Arm. The mine was worked by the Betts Cove Mining Company from 1878 to 1880, the Consolidated Mining Company from 1880 to 1884, and the Newfoundland Copper Company from 1898 to 1901. Two zones were developed. The main zone development consisted of three shafts, each 91 m deep, and an adit driven 15 m into the hillside. The west zone, 300 m to the west, was developed by a shaft and an open cut. About 110 t of ore were shipped.

The Colchester mine is northeast of King's Point. *See* McNeily mine for the road log. *See* Map 16.

Refs.: 59 p. 62–64; 154 p. 30–31; 156 p. 23.

Maps (T): 12 H/9 King's Point
(G): 22 Little Bay, Green Bay district (NDME, 1:63 360)
87-06 King's Point (NDME, 1:50 000)
King's Point, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Silverdale (Bear Cove) mine

GALENA, PYRITE, HEMATITE, CHALCOPYRITE, TETRAHEDRITE, CERUSSITE, ANGLESITE

In quartz carbonate veins

Argentiferous galena occurs with pyrite, specular hematite, chalcopyrite, and tetrahedrite in quartz-calcite veins in altered basalt. Cerussite and anglesite occur as coatings on ore specimens.

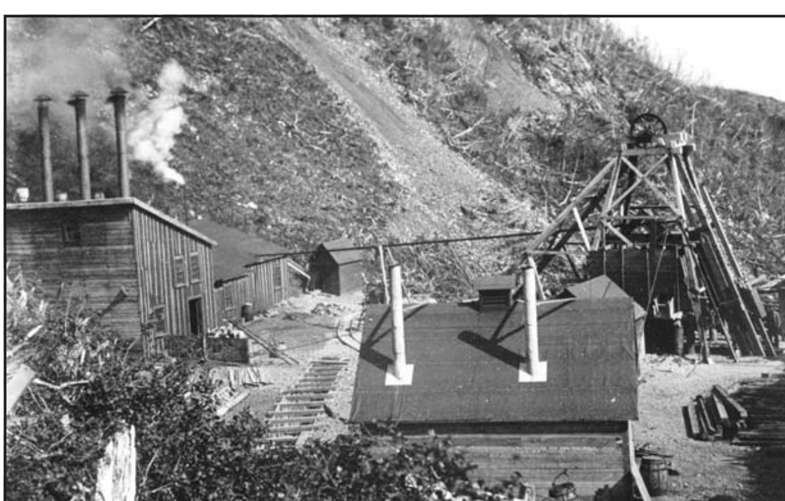


Plate 28

Colchester mine, about 1890. Provincial Archives of Newfoundland and Labrador B4-247

The deposit was originally explored in the 1890s by William Cook, John R. Stewart, and others. Development work was done in 1905 by Newfoundland Exploration Syndicate, and in 1908 by Bear Cove Mines Company Limited. The development consisted of a shaft sunk to a depth of 18 m and a trench 15 m long.

The mine is on the northwest side of Highway 391. *See* Map 16.

Road log from the Trans-Canada Highway at **km 528.2**, the junction of Highway 390:

km	0	Junction of the Trans-Canada Highway and Highway 390; proceed onto Highway 390.
	2.5	Junction of Highway 391; proceed along Highway 391 toward King's Point.
	13.7	Junction of the road to King's Point; continue along Highway 391 toward Harry's Harbour.
	35.3	Silverdale mine, on the left side of the road.

Refs.: 154 p. 35; 155; 156 p. 28; 228 p. 78.

Maps (T): 2 E/12 Little Bay Island
(G): 22 Little Bay, Green Bay district (NDME, 1:63 360)
80-07 Little Bay Island, Newfoundland (NDME, 1:50 000)
Little Bay Island, metallogenic map of the Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Nickey's Nose occurrence

PYRITE, PYRRHOTITE, MAGNETITE, JASPER

In argillite

The mineralization at this copper prospect consists of banded pyrite-pyrrhotite and magnetite-bearing argillite. Magnetite-bearing jasper is associated with the deposit.

The occurrence was known as early as the 1860s when a licence to mine the prospect was obtained by Robert Knight, a government surveyor. It was explored by shallow shafts and trenches in about 1917. About 25 t of ore were removed from a shaft (Wheeler's shaft) on the south side of Nickey's Nose Point. The same mineralization is exposed along the shore of Nickey's Nose Point, north of Nickey's Nose Cove. *See* Map 16.

Road log from the Trans-Canada Highway at **km 528.2**, the junction of Highway 390:

km	0	Junction of the Trans-Canada Highway and Highway 390; proceed onto Highway 390.
	2.5	Junction of Highway 391; proceed along Highway 391 toward King's Point.
	13.7	Junction of the road to King's Point; continue along Highway 391 toward Harry's Harbour.
	36.7	Junction, at Nickey's Nose Cove. The shoreline exposure is accessed by walking along the shore at low tide for about 1200 m. Wheeler's shaft is on the north side of the highway at a point 1.4 km east of this point.

Refs.: <u>59</u> p. 67–69; <u>141</u> p. 152–155; <u>154</u> p. 33; <u>156</u> p. 18.

Maps (T): 2 E/12 Little Bay Island
(G): 22 Little Bay, Green Bay district (NDME, 1:63 360)
87-07 Little Bay Island (NDME, 1:50 000)
Little Bay Island, metallogenic map of Notre Dame Bay area, Newfoundland (NDME, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)
60-1963 Botwood, Newfoundland (GSC, 1:253 440)

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 jasper 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 roadcuts, shorelines, and in outcrops near Harry's Harbour, a village on the narrow irregular peninsula between Green Bay and Western Arm, Notre Dame Bay. Jasper pebbles and boulders occur in the beach deposits along the adjacent shores. *See* Map 16.

Road log from the Trans-Canada Highway at **km 528.2**, the junction of Highway 390:

km 0 Junction of the Trans-Canada Highway and Highway 390.

2.5 Junction; turn left onto Highway 391.

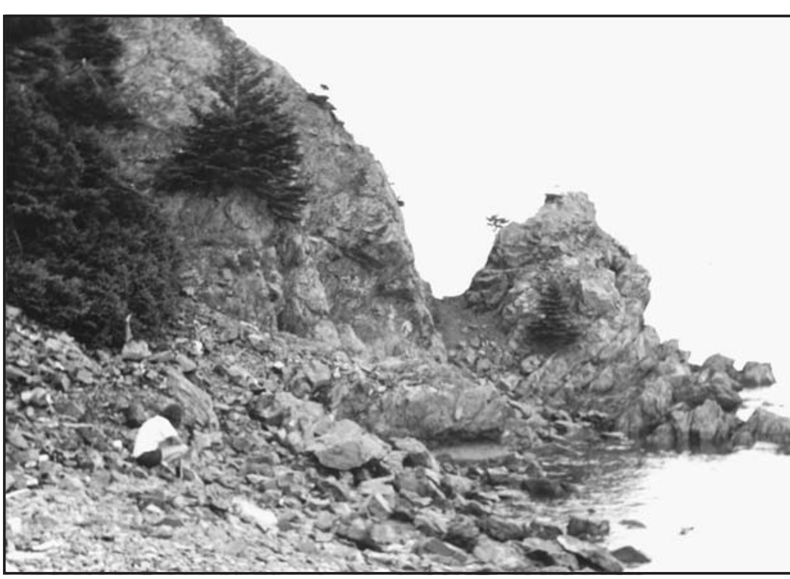


Plate 29

Harry's Harbour jasper occurrence. Jasper occurs in volcanic rocks exposed along the shores of Harry's Harbour. GSC 202755

13.7	Junction at King's Point; turn right and continue along Highway 391.
34.3	Junction at Silverdale; turn right.
36.7	Junction at Nickey's Nose Cove; turn right.
39.6	Junction at Harry's Harbour; turn left.
40.1	Jasper occurs in the roadcut on left and along the shore below.
40.2	Harry's Harbour wharf. Continue beyond the wharf and along the single-lane shoreline road.
41.2, 42.3	Outcrops of volcanic rock containing jasper occur along both sides of the road.
42.5	Salmon Cove shore. Jasper-bearing volcanic rock is exposed along the shoreline cliffs on the west side of the cove. Jasper pebbles and boulders occur along the shore.

Refs.: 154 p. 35; 228 p. 78.

Maps (T): 2 E/12 Little Bay Island
(G): 60-1963 Botwood, Newfoundland (GSC, 1:253 440).
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 528.2 Trans-Canada Highway at the junction of Highway 390.

For the next 35 km the highway parallels the broad valley of Indian Brook. Ridges bordering the south side of the highway reach elevations of up to 457 m above sea level, those on the north side, to about 305 m. The valley's thick mantle of glacial sand, gravel, and till can be seen on both sides of the highway.

km 548.3 Junction, Highway 410. This road provides access to Purbeck's Cove quarry, Flat Water Pond chrome-mica rock occurrence, Rambler mines, Deer Cove occurrence, Goldenville mine, Betts Cove mine, Tilt Cove mines, Terra Nova mine, and Advocate mine.

Purbeck's Cove quarry

MARBLE

Fine- to coarse-grained marble was formerly quarried from this deposit. The marble varies from white to cream-white to brownish grey. Its polished surface displays a subtle, low lustre. The marble was quarried over 60 years ago for local use and for lime.

The Purbeck's Cove quarry is about halfway up a steep hillside on the north side of Purbeck's Cove midway into the harbour.

Road log from the Trans-Canada Highway at **km 548.3**, the junction of Highway 410:

km	0	Junction of Highway 410 and the Trans-Canada Highway; proceed north along Highway 410.
	41.3	Junction; proceed west onto Highway 411 to Westport.
	77.0	Purbeck's Cove.

Refs.: 3 p. 21–24; 55 p. 47–48.

Maps (T): 12 H/15 Jackson's Arm
(G): 40-1962 Sandy Lake (east half), Newfoundland (GSC, 1:253 440)
83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Flat Water Pond chrome-mica rock occurrence

CHROME-MICA ROCK, MAGNESITE, MAGNETITE

In serpentinized ultramafic rock

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

The chrome-mica rock is exposed in two roadcuts at Flat Water Pond on Highway 410, 44.6 km and 45.2 km from its junction with the Trans-Canada Highway.

Maps (T): 12 H/16 Baie Verte
(G): 40-1962 Sandy Lake (east half), Newfoundland (GSC, 1:253 440)
83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Rambler mines

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

In quartz-sericite schist

The Rambler mine comprises four copper-gold-silver mines, the Main, the East, the Big Rambler Pond, 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 containing cubic crystals of pyrite commonly measuring 10 mm 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 20 m 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 183 m 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. 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

Plate 30

Roadcut on the Baie Verte Road opposite Flat Water Pond exposes chrome-mica rock ('virginite'). GSC 202758

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 285 m. The Main mine came into production in 1964. When its operations ended in 1967, it had produced a total of 399 080 t of ore grading 1.30% copper, 2.16% zinc, with 5.143 g/t gold and 29.142 g/t silver. The East mine was developed to a depth of 343 m; between 1965 and 1967 it produced 1 932 747 t of ore grading 1.04% copper. From 1971 to 1982 the Ming mine produced 1 924 161 t of ore containing 3.50% copper, 2.40 g/t gold, and 20.57 g/t silver; its underground workings extended to a depth of 823 m. In 1970–1971, the Big Rambler Pond mine produced 45 351 t of ore averaging 1.2% copper; it was operated from an open pit.

The mines are along Highway 414 near the junction of Highway 418. *See* Map 17.

Road log from the Trans-Canada Highway at **km 548.3**, the junction of Highway 410:

km 0 — Junction of Highway 410 and the Trans-Canada Highway; proceed onto Highway 410 toward Baie Verte.

58.2 Junction of highways 410 and 414; proceed east along Highway 414.

70.2 Junction; Ming mine shaft is on the north side of the highway and 500 m from the highway. A road, 1.7 km long, leads south to the Main mine.

Plate 31

Picrolite, Baie Verte Road (km 45.8). GSC 202820-A

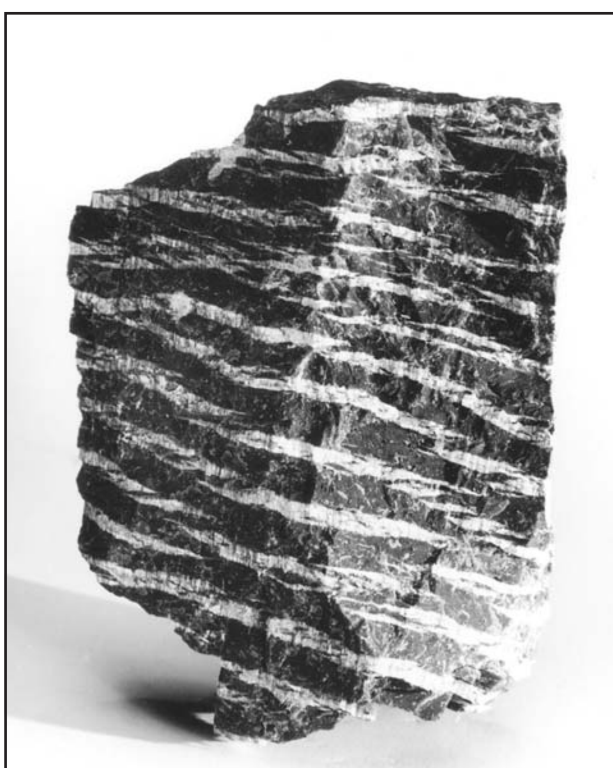


Plate 32

Ribbon-fibre asbestos, Advocate mine. GSC 202820-C

Plate 33

Ming mine, Rambler mines, 1973. GSC 202756

70.5 Junction of Highway 418.

71.2 Junction; another Ming mine shaft is on the north side of the highway and 600 m from the highway. To reach the other mines follow the road leading south 1.8 km to a junction: the road on left leads 1.3 km to the East mine; the road straight ahead leads south 2.3 km to the Big Rambler Pond mine.

Refs.: 40 p. 184–193; 59 p. 81–86; 100 p. 77–82; 178 p. 35–36; 206 p. 305–310; 228 p. 58; 260 p. 29–34; 285 p. 97–98; 286 p. 105; 291 p. 93; 293 p. 84.

Maps (T): 12 H/16 Baie Verte
(G): 78-69 Baie Verte (east half)–Fleur de Lys (east) (NDME, 1:50 000)
10-1958 Baie Verte, White Bay and Green Bay districts, Newfoundland (GSC, 1:63 360)
21 Baie Verte–Mings Bight, White Bay district (NDME, 1:30 000)
83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

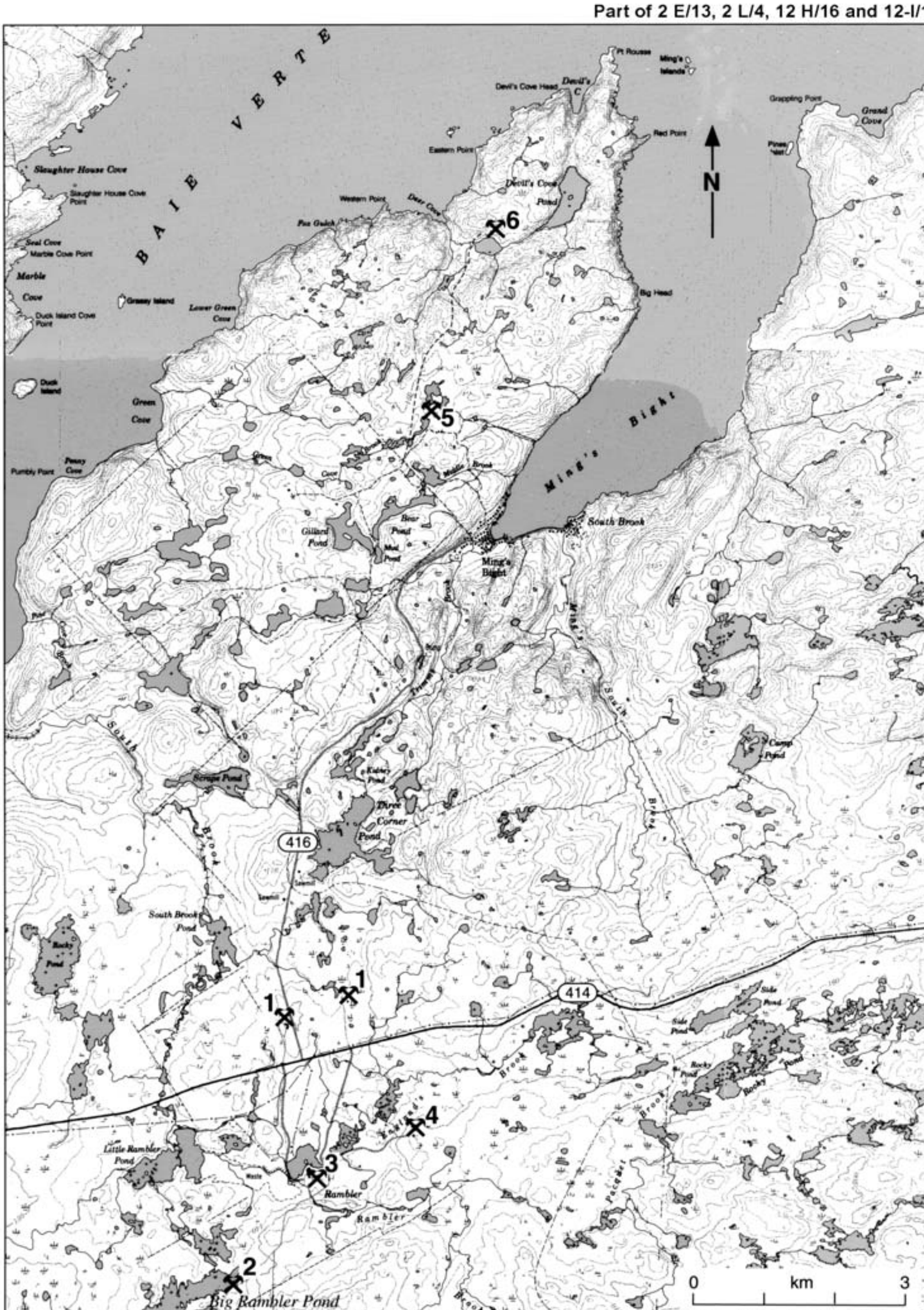
Deer Cove occurrence

NATIVE GOLD, PYRITE, CHALCOPYRITE, ARSENOPYRITE, HEMATITE, TALC, MAGNESITE

In quartz veins in altered volcanic rocks

Native gold, pyrite, and minor chalcopyrite, arsenopyrite, and hematite occur in brecciated quartz veins and in the host rock. The gold occurs as free gold and in association with pyrite.

Part of 2 E/13, 2 L/4, 12 H/16 and 12-I/1



1. Ming mine 2. Big Rambler Pond mine 3. Main mine 4. East mine
5. Goldenville mine 6. Deer Cove occurrence

Map 17. Ming's Bight area.

The ore is within a talc-magnesite alteration zone.

Spectacular visible gold was found on this property by Noranda Exploration Limited in 1986. The deposit has been explored using trenches and an adit.

The prospect is located at Deer Cove, about 4.5 km north of the village of Ming's Bight. Access is via a road, 6.5 km long, leading north from Highway 418. *See* Map 17.

Road log from the Trans-Canada Highway at **km 548.3**, junction of Highway 410:

km	0	Junction of Highway 410 and the Trans-Canada Highway; proceed onto Highway 410 toward Baie Verte.
	58.2	Junction of highways 410 and 414; proceed east along Highway 414.
	70.5	Junction; proceed north along Highway 418 toward Ming's Bight.
	77.7	Junction; turn left onto the access road.
	81.2	The Goldenville mine is about 500 m east of the road at this point; continue along the road toward Deer Cove.
	84.7	Deer Cove adit.

Ref.: 86 p. 165–171.

Maps (T): 12 I/1 Fleur de Lys
(G): 80-30 Fleur de Lys, White Bay south district (NDME, 1:50 000)
85-30 Port Saunders, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Goldenville mine

NATIVE GOLD, PYRITE, CHALCOPYRITE, MAGNETITE, HEMATITE, JASPER

In iron-formation in chlorite schist

The ore consisted of microscopic grains of native gold associated with pyrite and chalcopyrite in quartz veins and as disseminated grains in iron-formation. The iron-formation consisted of interbanded magnetite, hematite, and jasper. Small crystals of pyrite and veinlets of specular hematite and chlorite occurred in the host rock.

The deposit was originally staked in 1897 by Daniel J. Henderson who worked it until 1902, finding only traces of gold. In 1902, gold was discovered in surface gravels in the Ming's Bight area by John R. Stewart. In that year and in the following year, he recovered fine gold by washing the gravels, located the source of the gold, and formed the Goldenville Mining Company Limited to develop the deposit. An inclined shaft was sunk to a depth of 5.2 m; about 21 t of ore were removed and produced a gold brick weighing 342.13 g. The shaft was deepened to 30.5 m and two additional shafts were sunk. In 1906, a 10-stamp mill was installed; 4572.1 g of gold valued at $3000 were produced. Operations were discontinued because of low returns.

The mine is on the northeast side of Ming's Pond, about 2 km north of Ming's Bight village. *See* Map 17.

Road log from the Trans-Canada Highway at **km 548.3**, the junction of Highway 410:

km	0	Junction of Highway 410 and the Trans-Canada Highway; proceed onto Highway 410 toward Baie Verte.

58.2 Junction of highways 410 and 414; proceed east along Highway 414.

70.5 Junction; proceed north along Highway 418 toward Ming's Bight.

80.5 Ming's Bight. Access to the Goldenville mine is by a trail, 1.5 km long, leading west from the shore of Ming's Bight at a point 1.5 km northeast of the village.

Refs.: 107 p. 214–217; 156 p. 34–35; 226 p. 22–24; 260 p. 27–29.

Maps (T): 12 H/16 Baie Verte
(G): 21 Baie Verte–Mings Bight, White Bay district (NDME, 1:30 000)
10-1958 Baie Verte, White Bay and Green Bay districts (GSC, 1:63 360)
83-36 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Betts Cove mine

CHALCOPYRITE, PYRITE, SPHALERITE, GALENA

In chlorite schist

The ore of this former copper producer consisted of massive and banded sulphides in which pyrite was dominant. Chalcopyrite was present with minor sphalerite and galena. These minerals were associated with quartz and calcite in chlorite schist.

The mine was opened by the Betts Cove Mining Company in 1875. It was developed by six shafts. In 1877, a smelter was installed. In 1880, the property was taken over by Newfoundland Consolidated Copper Company Limited which continued mining until 1883 when a landslide devastated the mine buildings and caused a cave-in of the mine roof, ending mining operations. The last shipment of ore was made in 1886; total shipments amounted to 105 585 t. A stockpile of three ore dumps was left at the mine site. In 1900, Newfoundland Copper Concentrating Company drove an adit from the shore of Betts Cove for a distance of 137 m toward the bottom of the deposit. There was no further production.

The mine is located on the west side of Mine Hill, about 1 km west of Betts Cove. *See* Map 18.

Road log from the Trans-Canada Highway at **km 548.3**, the junction of Highway 410:

km 0 Junction of Highway 410 and the Trans-Canada Highway; proceed onto Highway 410 toward Baie Verte.

58.2 Junction of highways 410 and 414; proceed east along Highway 414.

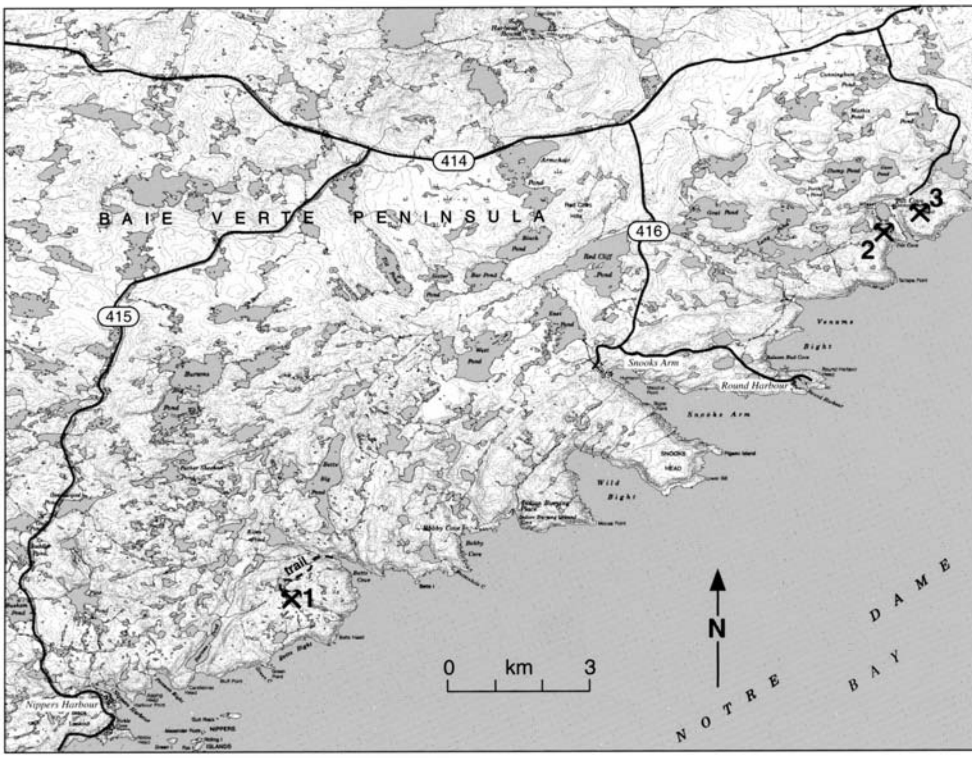
93.3 Junction; proceed onto Highway 415.

110.3 Nippers Harbour. Access to the Betts Cove mine is by boat from Nippers Harbour to the bottom of Betts Cove, a distance of 7 km; from the bottom of Betts Cove, a trail leads west, then south for about 1900 m to the mine.

Refs.: 56 p. 45; 59 p. 23–26; 107 p. 199–202; 220 p. 194–202; 227 p. 52–55.

Maps (T): 2 E/13 Nippers Harbour
(G): 51-21A Burlington Peninsula, Newfoundland (GSC, 1:63 360)

Part of 2 E/13



1. Betts Cove mine 2. Tilt Cove West mine 3. Tilt Cove East mine

Map 18. Betts Cove–Tilt Cove area.

22-1958 Nippers Harbour, Newfoundland (GSC, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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 Tilt Cove mines were the Island of 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 800 m 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.

Plate 34

Tilt Cove mine during early mining operations. National Archives of Canada C-74887

The occurrence of copper ore in the cliffs around Tilt Cove was made known to Smith McKay in 1857 by a fisherman, Isaac Winser. At that time, McKay was involved in opening the Terra Nova mine, and when mining ended there, he returned to Tilt Cove and, along with Charles Fox Bennett, formed the Union Mining Company in 1864 to work the deposit. Miners were brought in from Cornwall, England and began mining the Union (West) mine in 1864. The mine was worked by an open cut, adits, and a shaft 73.2 m deep. Hand-cobbed ore containing 12% copper was transported from the mine via a tramway to a pier for shipment to Swansea, Wales.

A few years later, nickel ore was discovered in the deposit and between 1869 and 1876, a total of 372.8 t of high-grade nickel ore valued at $32 740 was shipped to England. In the late 1870s 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% sulphur and 3.2% to 3.5% copper. It 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 the Island of Newfoundland. Total shipments were 1 352 460 t of ore, 70 760 t of matte, and 4912 t of ingots. To 1912, the West mine's output was estimated at 76 594 t of hand-picked ore averaging 9.1% copper, and from 1888 to 1910 the East mine yielded over 907 000 t of ore averaging 4% copper and 35% to 40% sulphur.

After 1918, the mines were inactive. In 1957, production was renewed for a 10 year period by First Maritime Mining Corporation Limited. Mining was conducted from a four-compartment 834 m shaft opening 14 levels. Ore was processed in a 1860 t mill. Total production during this period was 83 169 498 kg of copper and 1 319 544.8 g of gold from approximately 6 711 800 t of ore milled.

The Tilt Cove mines are located at Tilt Cove, northeast shore of Notre Dame Bay. *See* Map 18.

Road log from the Trans-Canada Highway at **km 548.3**, the junction of Highway 410.

km	0	Junction of Highway 410 and the Trans-Canada Highway; proceed onto Highway 410 toward Baie Verte.
	58.2	Junction of highways 410 and 414; proceed east along Highway 414.
	93.3	Junction, Highway 415; continue along Highway 414.
	104.8	Junction; turn right (south).
	110.2	Tilt Cove.

Refs.: 36 p. 146–149; 58 p. 54–56; 59 p. 104–130; 113 p. 626–642; 156 p. 12–15; 190 p. 27–30; 228 p. 51–54; 268 p. 14; 278 p. 91–92; 279 p. 62, 91–92; 287 p. 144–145.

Maps (T): 2 E/13 Nippers Harbour
(G): 60-1963 Botwood, Newfoundland (GSC, 1:253 440)
22-1958 Nippers Harbour, Newfoundland (GSC, 1:63 360)
80-4 Botwood, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Terra Nova mine

PYRITE, PYRRHOTITE, CHALCOPYRITE, SPHALERITE, ARSENOPYRITE, NATIVE COPPER, ROZENITE, GOETHITE, SIDEROTIL

In chlorite schist and serpentinite

The deposit was formerly worked for copper. The ore consisted of massive pyrite with pyrrhotite and chalcopyrite. Sphalerite and arsenopyrite were minor accessories. Native copper has been reported to occur in calcite veins in serpentinite. Secondary minerals occurring on ore specimens found on the dumps include white rozenite, bluish-white siderotil, and rusty yellow goethite. The ore carried values in gold and silver.

In 1857, Smith McKay discovered copper ore in a stream bed. In 1860, he organized the Terra Nova Mining Company to develop the deposit. Between 1860 and 1864, five shafts were sunk, but only two of them intersected the orebody; they were sunk to depths of 36.6 m and 195.2 m respectively. Production amounted to about 181 t of ore. Between 1902 and 1906, Terra Nova Company resumed operations and produced 35 202 t of ore. Cape Copper Company Limited worked the deposit from 1906 until about 1915, shipping some ore and stockpiling the remainder. The stockpile burned in a fire in 1946.

The mine is at the junction of Baie Verte River and South West Brook. One of the production shafts was sunk into the bed of Baie Verte River, the other, on the north side of it.

Road log from the Trans-Canada Highway at **km 548.3**, the junction of Highway 410:

km	0	Junction of Highway 410 and the Trans-Canada Highway; proceed onto Highway 410 toward Baie Verte.
	60.3	Junction of Highway 412 (Seal Cove Road). The Terra Nova mine is opposite this junction.

Refs.: 59 p. 13–22; 107 p. 217–223; 260 p. 21–27.

Maps (T): 12 H/16 Baie Verte
(G): 21 Baie Verte–Mings Bight, White Bay district (NDME, 1:30 000)
10-1958 Baie Verte, White Bay and Green Bay districts (GSC, 1:63 360)
83-360 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Advocate mine

CHRYSOTILE, SERPENTINE, MAGNETITE

In peridotite

Cross-fibre chrysotile asbestos was produced from this mine for nearly 30 years. The chrysotile is light to medium green. Fibres up to 3 cm long occur in the deposit, although the average length is about 7 mm. Ribbon-fibre asbestos is also present. Massive green serpentine (antigorite) and magnetite are associated with the chrysotile.

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. Open-pit mining began in 1963 and ended in 1991. In 1993, Terranov Mining Corporation produced asbestos from the tailings.

The mine is north of Baie Verte village.

Road log from the Trans-Canada Highway at **km 548.3**, the junction of Highway 410:

km	0	Proceed onto Highway 410.
	40.9	Turnoff to Flatwater Pond Provincial Park.
	41.3	Junction, road to Westport (Highway 411).
	44.6	Roadcuts expose green chrome-mica rocks (*see* page 111).
	45.2	Flat Water Pond on right.
	45.8	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 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.
	46.0	Junction, road to Burlington (Highway 413).
	63.9	Baie Verte village, at the church. Continue straight ahead.
	68.5	Junction; turn right.
	70.1	Advocate mine.

Refs.: 42 p. 3–5; 122 p. 314–315; 178 p. 36; 228 p. 58; 260 p. 21–27; 291 p. 20; 293 p. 19.

Maps	(T):	12 H/16 Baie Verte
	(G):	78-69 Baie Verte (east half)–Fleur de Lys (east) (NDME, 1:60 000) 10-1958 Baie Verte, White Bay and Green Bay districts, Newfoundland (GSC, 1:63 360) 21 Baie Verte–Mings Bight sheet, White Bay district (NDME, 1:30 000) 83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**572.3**	Mount Sykes (elevation 464 m) is seen south of the highway.
km	**586.0**	Sandy Lake on left.
km	**596.6**	Roadcuts expose pink and grey Devonian granite.
km	**599.6**	Junction, Highway 420, the Sop's Arm Road. This road provides access to Doucers Brook marble occurrence and Browning's mine. 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. The lowland is marshy with an elevation of 60 m to 99 m and is dissected by numerous streams and by one major river, the Upper Humber River. From this junction to **km 621**, 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 24.5 m and is underlain by Mississippian sandstone and conglomerate. This upland extends to White Bay.

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. It forms a discontinuous narrow belt that outcrops along a valley between Taylors Pond and Jackson's Arm Pond. Doucers Brook flows through part of this valley, which occupies a major fault zone. The marble belt crosses Main River about 915 m 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 45 m cliff on the west bank of Doucers Brook at a point 800 m 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. *See* Map 19.

Road log from the Trans-Canada Highway at **km 599.8**, the junction of Highway 420:

km	0	Proceed onto Highway 420 toward Sop's Arm.
	0.5	Turnoff to Squires Memorial Park; continue along the highway.

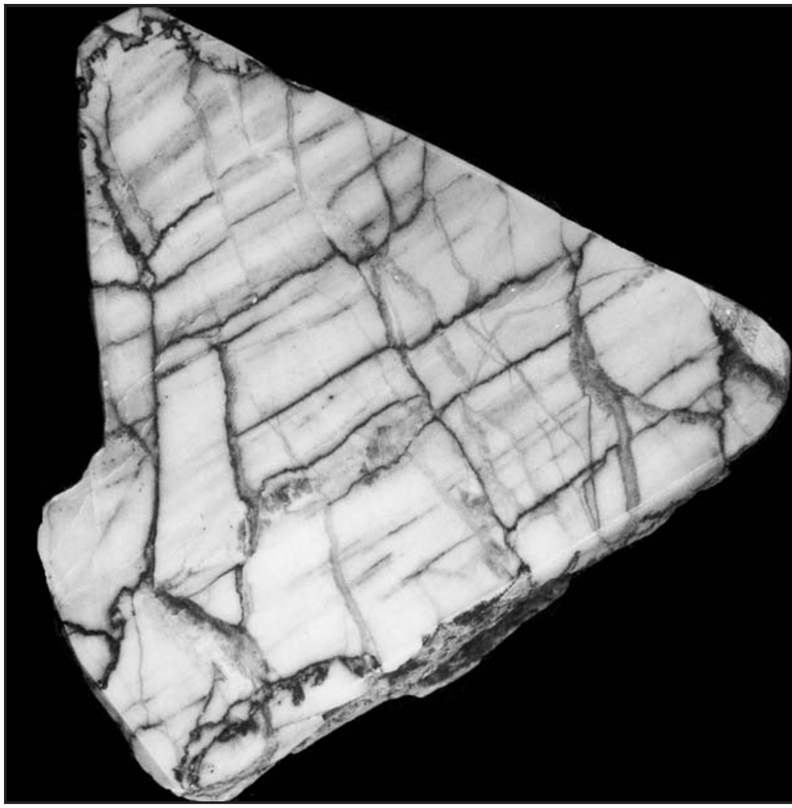


Plate 35

Marble, Doucers Brook. The marble is white with orange-red veinlets.
GSC 1994-614A

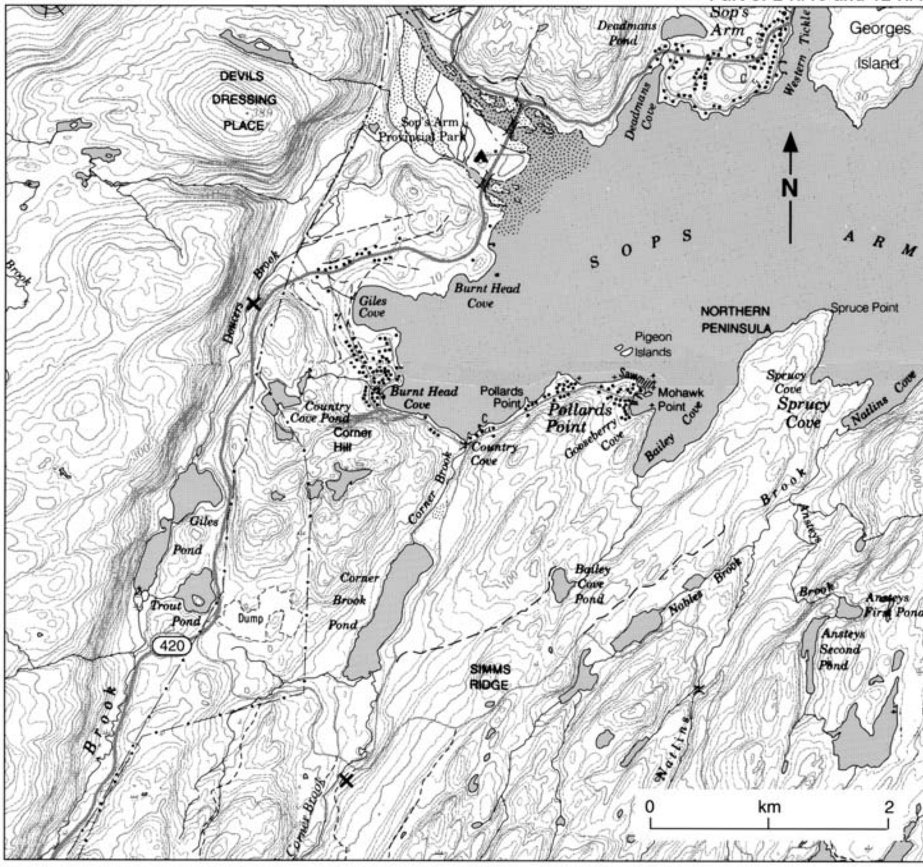
9.5 Junction; turn left. From this junction the road heads west for the next 8 km crossing a ridge with an elevation of about 213 m above sea level. It then parallels the steep west side of the ridge to a junction at **km 31.9**. To the west of the road and ridge, there is a lowland underlain by Mississippian 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 and the west side, of Devonian granitic rocks. The Long Range Mountains are visible in the distance west of the lowland.

31.9 Junction; turn right.

40.2 Taylors Pond is on the left side of the road. For the next 16 km the road follows the valley occupied initially by Taylors Pond and for the last 9 km, 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 95 km away; Doucers Brook, on the north side of the divide, flows north to Sops Arm reaching the sea in only 9.5 km. This drainage divide is the result of damming by glacial drift.

56.5 Junction, road to Giles Cove and Sop's Arm.

Part of 2 H/10 and 12 H/15



1. Doucers Brook marble occurrence 2. Browning's mine

Map 19. Sops Arm area.

Sops Arm is the largest indentation in the steep, rugged, remarkably even shoreline of White Bay. This V-shaped bay extends 88 km from Hampden to Partridge Point on the Atlantic Ocean. It is unusually deep with the 100 fathom line extending southward into the bay to within 4.8 km 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 Dressing Place, a prominent 389 m granite hill immediately west of Sop's Arm Provincial Park, is the highest hill bordering White Bay.

The road log continues along Highway 420.

58.4 Bridge over Doucers Brook.

58.7 Sop's Arm Provincial Park (on left) between the outlets of Doucers Brook and Main River. The 2.4 km 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.

58.9 Bridge over Main River.

62.4 Sop's Arm village, at the wharf.

Refs.: <u>3</u> p. 15–19; <u>22</u> p. 2–3, 19–21; <u>36</u> p. 104–105; <u>106</u> p. 9–10; <u>164</u> p. 10; <u>178</u> p. 10–11; <u>228</u> p. 133.

Maps (T): 12 H/15 Jackson's Arm
12 H/10 Hampden
(G) 40-1962 Sandy Lake (east half), Newfoundland (GSC, 1:253 440)
6 Sops Arm sheet, White Bay district (NDME, 1:63 360)
83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Browning's (Sops Arm) mine

NATIVE GOLD, PYRITE, CHALCOPYRITE, GALENA, SPHALERITE, HEMATITE

In veins in sericitized shale and altered carbonate rock

Gold mineralization was in the form of visible gold grains in quartz and as gold contained in galena and sphalerite. The metallic minerals, including pyrite, chalcopyrite, galena, sphalerite, and specular hematite, occurred in quart-calcite-ankerite veins.

The Browning's mine was the first gold producer in the Island of Newfoundland. Native gold in a quartz vein was discovered in the Sops Arm area in 1896 by James M. Jackman, who was surveying for timber. This led to more prospecting and the discovery of another deposit immediately to the south that became the Browning's mine. This deposit was staked in 1900 by A. Stewart for John Browning and Robert Rendell of St. John's. Development consisted of two shafts on the bank above Corner Brook and a 10.7 m adit; a middle shaft was sunk 12 m to the adit. In 1903, the mine produced about 4634 g of gold from about 907 t of ore. Some gold was also recovered from the river gravels. The gold was valued at $3000. Operations ended in 1904 because of low ore grade.

The mine is on the east bank of Corner Brook, about 850 m south of Corner Brook Pond. *See* Map 19.

Road log from the Trans-Canada Highway at **km 599.8**, the junction of Highway 420:

km 0 Junction of Highway 420 and the Trans-Canada Highway; proceed onto Highway 420 toward Sop's Arm.

53.0 Junction; turn right (east) onto Pinkstons Woods Road.

55.2 Bridge over Corner Brook.

55.3 Trail on the right (south) side of the road. Proceed along this trail for about 300 m to the Browning's mine on the east bank of Corner Brook. The adit is just above the water's edge; the shafts are above the brook.

Refs.: <u>156</u> p. 35; <u>226</u> p. 40–41; <u>279</u> p. 79.

Maps (T): 12 H/10 Hampden
(G): 40-1962 Sandy Lake (east half), Newfoundland (GSC 1:253 440)

83-60 Sandy Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**644.9**	Deer Lake, at the junction of Highway 430 to Bonne Bay and to the Northern Peninsula.

The Northern Peninsula

The Northern Peninsula is a broad, 280 km long strip of land extending from Bonne Bay to Cape Bauld. Its northern end reaches within 18 km 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 and the highlands, by Precambrian metamorphic 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 806 m near Bonne Bay, gradually decreasing in elevation to about 305 m at the northern end. Its indented, almost featureless eastern edge is marked by sheer 305 m 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.

Through most of its course, the 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 8 to 24 km wide along the western shore. The Central Lowland makes up the eastern part of the peninsula from Canada Bay northward to the tip of the peninsula.

Points of interest accessible from Highway 430, the Viking Trail, in the Northern Peninsula are noted in the text that follows.

km 0 Deer Lake, at the junction of Highway 430 and the Trans-Canada Highway; proceed onto Highway 430.

7.5 Junction, Highway 422 to Cormack.

Cormack limestone quarry, on the northwest side of Highway 422 at a point 0.5 km from its junction with Highway 430, was operated between 1947 and 1951 for agricultural uses.

km 30 Wiltondale, at the junction of Highways 430 and 431; continue along Highway 430.

Gros Morne National Park

Gros Morne National Park, a UNESCO World Heritage Site, occupies a coastal area of 1425 km² including most of the shoreline from Trout River to Parsons Pond. Inland, it extends into the Long Range Mountains with an irregular boundary, 15 km to 40 km from the coast. Within this park are scenes of rugged and unrivalled beauty that include some of the Island of Newfoundland's highest peaks and most spectacular valley gorges. Gros Morne, a bald, flat-topped mountain, has an elevation of 806 m and is the highest peak in the Long Range Mountains, and the second highest on the island. The geological points of interest in the park are described *in* Geology, topography, and vegetation, Gros Morne National Park, Newfoundland (Geological Survey of Canada, Miscellaneous Report 54).

76 Bakers Brook. The headwaters of Bakers Brook is in the Long Range Mountains about 24 km east of the highway. There, at an elevation of 610 m, the drainage systems divide, the waters of Bakers Brook and of the Humber River system flowing in opposite directions.

79 Green Point.

Fossil occurrence. Graptolites occur in Cambro-Ordovician shale exposed along the north and west shores of the headland at Green Point. Erosion-resistant sedimentary rocks form the prominent headland.

99 Bridge over Western Brook.

Western Brook Pond

Western Brook is a meandering stream that cuts across Gulls Marsh carrying the water from Western Brook Pond (5 km to the southeast) to the Gulf of St. Lawrence. Western Brook Pond occupies a spectacular 12 km 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, 732 m 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.

100 Turnoff 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. A quarry on the north side of the point exposes this rock formation.

105 St. Pauls Inlet

Fossil occurrence. Graptolites occur in Ordovician shale exposed along the shore of St. Pauls Inlet just north of the highway bridge.

St. Pauls Inlet, on the east side of the bridge, is a saltwater tidal lagoon extending 9 km from the bridge to the mountain front. Unlike other coastal ponds, this and Parsons Pond are filled with salt water as their outlets are low enough to admit seawater. 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 conglomerate 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 from 2 cm to 1 m long. Black, grey, and brown chert fragments occur in the exposures at the west end of the inlet. This rock, known as the 'Cow Head conglomerate', is exposed on Cow Head 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. The first well at St. Pauls Inlet was drilled on the inlet's west side in 1896. Further drilling was carried out in 1952–1953 (ref.: 10).

km 110 Turnoff to Cow Head.

Cow Head occurrences

Cow Head, a peninsula extending into the Gulf of St. Lawrence, is a world famous geological locality where a limestone conglomerate is spectacularly developed. The rock, known as the 'Cow Head conglomerate', consists of a densely packed, chaotic jumble of variously sized

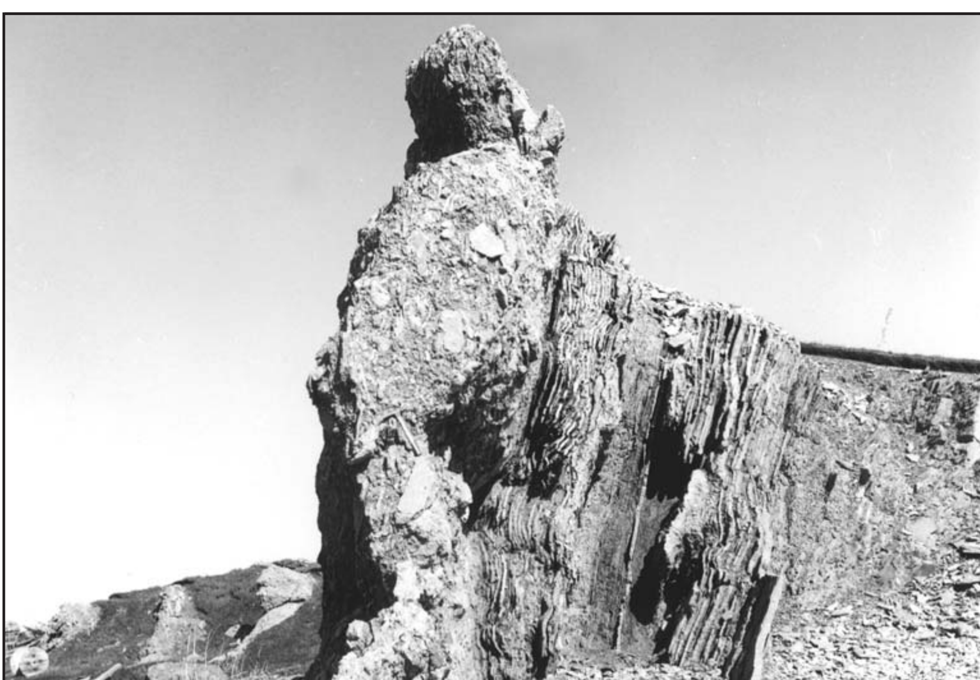


Plate 36
Cow Head conglomerate, Broom Point. GSC 149737

limestone fragments embedded in a fine-grained, sandy or dolomitic limestone matrix. The fragments, in various shades of grey, range from flat angular chips 5 mm to several centimetres long, to enormous slabs, blocks, and slightly rounded boulders up to several hundred metres long. An immense slab measuring 183 m by 122 m by 6 m 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 protruding boulders and fragments, the result of weathering by the sea, wind, and rain. This conglomerate is unusual in that it is extremely coarse grained and 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, Martin Point, Lower Head, and Green Point.

The Cow Head conglomerate 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. The rocks are exposed in a roadside quarry southeast of Cow Head. To reach it, follow the road to Cow Head for 1.5 km from Highway 430 at km 110 to a junction; turn left (south) and proceed 1 km to the quarry.

Cow Head is slightly more than 1600 m long, a maximum of 800 m wide, and rises to form a hill 67.5 m 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 multipatterned volcanic rocks are found. They are suitable for ornamental purposes.

km 113 Turnoff to Cow Head Harbour.

Stearing Island, White Rock Islets

Stearing Island, 4 km 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 conglomerate weathered to a white, knobby surface. The adjacent reefs are also formed of this rock. Stearing Island is 800 m long and 185 m wide. At its southwestern end, black shale interbedded with dark grey limestone is conspicuously contrasted with the light-coloured conglomerate. The White Rock Islets form a 1600 m long, crescent-shaped string of white islets and reefs; the conglomerate there is composed of fragments averaging 5 cm long.

122 *Quarry*, on the southwest side of Parsons Pond Hill (on right), exposes limestone conglomerate interbedded with shale, similar to the rock formation exposed at Cow Head.

127 Parsons Pond River bridge. Parsons Pond is a tidal lagoon where salt water extends as far as the Long Range Mountains. Graptolite fossils occur in Ordovician shale exposed along the north shore of the pond.

Parsons Pond oil

The presence of oil in the St. Pauls–Parsons Pond area was noted as early as 1812 when 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. John

Silver, drilled a well to a depth of 213 m 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 869 m, yielded 1.5 to 6.5 barrels of oil a 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 1920s, Mr. Jack Henry drilled three wells and operated a small refinery on the site, producing gasoline and kerosene. Drilling was continued intermittently until 1965 when a 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.

km 136 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.

154 Daniel's Harbour.

158 Junction, road leading east to the Newfoundland Zinc mine.

Newfoundland Zinc mine

SPHALERITE, GALENA, PYRITE, MARCASITE, DOLOMITE, CALCITE

In brecciated dolomitic limestone of Ordovician age

Sphalerite, the ore mineral, occurs as light yellow, coarsely crystalline aggregates and, less commonly, as colloform masses in cavities and veins. Minor amounts of galena, pyrite, and marcasite are associated with it. The gangue minerals are white dolomite and calcite.

The deposit is located about 11 km east of Daniel's Harbour. It was discovered by Newfoundland Zinc Mines Limited (renamed Tecam Limited in 1975) during a diamond-drilling program carried out between 1963 and 1967. The investigation was sparked by the discovery of zinc mineralization near Daniel's Harbour by two prospectors, M. Lobchuk and J.T. Meagher. The ore was estimated to average 8.8% zinc. Operations began in 1975. Ore was obtained from open pits and from underground at a depth of 137 m reached by a decline 1617 m long. The 1360 t mill had a capacity to produce 36 160 000 kg of zinc a year. The mine operated until 1990 when it was closed due to ore exhaustion. Total production amounted to 508 789 kg of zinc.

Access to the Newfoundland Zinc mine is by a road, 8.5 km long, leading east from Highway 430 at km 158.

Refs.: 48 p. 102; 68 p. 20–24; 291 p. 238; 294 p. 371.

Maps (T): 12 I/6 Blue Mountain
(G): 85-63 Bellburns, St. Barbe South district, Newfoundland (NDME, 1:50 000)
85-30 Port Saunders, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 169 Bellburns

Table Point Ecological Reserve

Table Point forms a broad headland about 3 km north of Bellburns. From the south side of the point to a cove about 5 km to the north, sea cliffs expose fossiliferous rocks of Ordovician age. 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. Dolomitic limestone exposed along Highway 430 between Table Point and Bateau Cove contains cavities lined with dolomite crystals. A permit is required to visit the reserve; it may be obtained from the Parks Division, Department of Tourism, Government of Newfoundland and Labrador.

172 Blue Mountain (elevation 649 m) 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 its north side.

192 River of Ponds Provincial Park. This park occupies a gently sloping area on the west side of River of Ponds, including a 1600 m stretch of the river bank. The river drains River of Ponds Lake and Eastern Blue Pond.

211 Hawke's Bay and Torrent River Nature Park. Torrent River, the outlet of Western Brook Pond, flows from the Long Range Mountains. Its headwaters are at an elevation of 366 m, 32 km east of its mouth at Hawke's Bay.

219 Junction, road to Port Saunders.

223 *Quarry.* The roadside quarry exposes Cambrian–Ordovician limestone containing trilobites and gastropods (ref.: 76 p. 12–13).

229 Turnoff 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 is 14 km from this turnoff.

Port au Choix National Historic Site

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 BC. 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 people lived on the Northern Peninsula from about AD 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, about 10 km from Gargamelle. The rocks contain cavities lined with crystals of calcite, dolomite, or quartz. Ordovician fossils including gastropods, cephalopods, trilobites, graptolites, brachiopods, pelecypods, bryozoans, and conodonts occur in the limestone. These rocks are exposed at the following localities: a) Pointe Riche Peninsula, on the northwest side, on the southeast side (shore of Gargamelle Cove), and on the southwest end of Pointe Riche; b) Port au Choix Peninsula, on the northwest shore, on the north shore west of Barbace Point, on the southeast end (shore of Back Arm); c) along the shore of St. John Bay midway between Port au Choix Peninsula and Bustard Cove. Cavities lined with white, pink, and red fluorite crystals have been reported from exposures near Bustard Cove (ref.: 234 p. 28, 30).

km 232 Eddies Cove West

Fossil occurrences. Trilobites occur in Ordovician dolomitic limestone exposed along the shore of Old Man Cove, and in limestone exposed along the north shore of St. John Island, which is 7 km northwest of Eddies Cove West.

The highway parallels the Highlands of St. John, a 32 km long, steeply sloped ridge consisting of several flat, barren summits, with elevations of up to 625 m. Cambrian sedimentary rocks overlie a basement of Precambrian rocks to form this ridge.

263 Junction, road to Shoal Cove and New Ferolle.

Fossil occurrences. Fossils, including cephalopods and gastropods, occur in Ordovician limestone exposed along the shoreline at the following localities: on the east side of Shoal Cove just south of Black Point, on the west shore of Green Cove, and on the west shore of New Ferolle Cove. These localities are 11.2 km, 12.6 km, and 14.5 km from the junction of the road to Shoal Cove and New Ferolle.

277 Junction, Highway 432. This highway leads eastward along the southern edge of the lowlands that occupy the region north of the Long Range Mountains. Mount St. Margaret, a prominent 279 m hill, is at the northwestern end of the mountain range and southeast of the junction at km 277. Highway 432 ends at Englee, Canada Bay.

Canada Bay marble occurrences

MARBLE

In Ordovician carbonate rocks

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 to compact, porcelain-like, and take an excellent polish. One variety is cream-white to ivory or slightly pinkish, 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. Nodules of chert occur in the marble.

The white marble is exposed at several localities in the Canada Bay area. It occurs in a zone extending south from Canada White Point to a point 2400 m south of Canada Harbour, and beneath the bay to and along the east side of Englee Island and to Englee village. It is exposed conspicuously along cliffs at White Point on the southern tip of Englee Island, and along shoreline cliffs on the west side of Bide Arm, notably between Bide Head and Seal Cove.

Blue-grey marble is exposed at Burnt Point, 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.

Canada Bay marble was originally quarried in the mid-1860s by Charles Bennett who shipped two loads to England. In 1912, William and Robert Edgar formed the Colonial Mineral and Trading Company to quarry the deposit. The company opened two quarries on the north end of Marble Ridge, which extends southward from Canada Harbour; the main quarry measures 42 m by 24 m. Mining and dressing equipment and a tramway were installed, but the venture came to an end in about 1915 due to the high shipping costs attributed to World War I. The marble is used by hobbyists and sculptors as an ornamental stone.

The marble occurrences at Canada Bay are accessible by boat from Englee. The main quarry on Marble Ridge is about 400 m southwest of the bottom of Canada Harbour. *See* Map 20.

Refs.: 3 p. 8–9, 25–40; 21 p. 35–43; 36 p. 103–104; 56 p. 54–60; 117 p. 160–163; 156 p. 45; 228 p. 131–132.

Maps: (T): 12 I/9 Englee
12 I/16 Roddickton
(G): 12 Canada Bay, northern Newfoundland (NDME, 1:63 360)
86-64 Roddickton, Newfoundland (NDME, 1:50 000)
85-30 Port Saunders, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 299 St. Barbe, at the turnoff to the ferry connecting the Island of Newfoundland to Labrador.

314 Deadmans Cove.

Fossil occurrence. Trilobites occur in Cambrian dolomitic limestone exposed along the shore of Deadmans Cove.

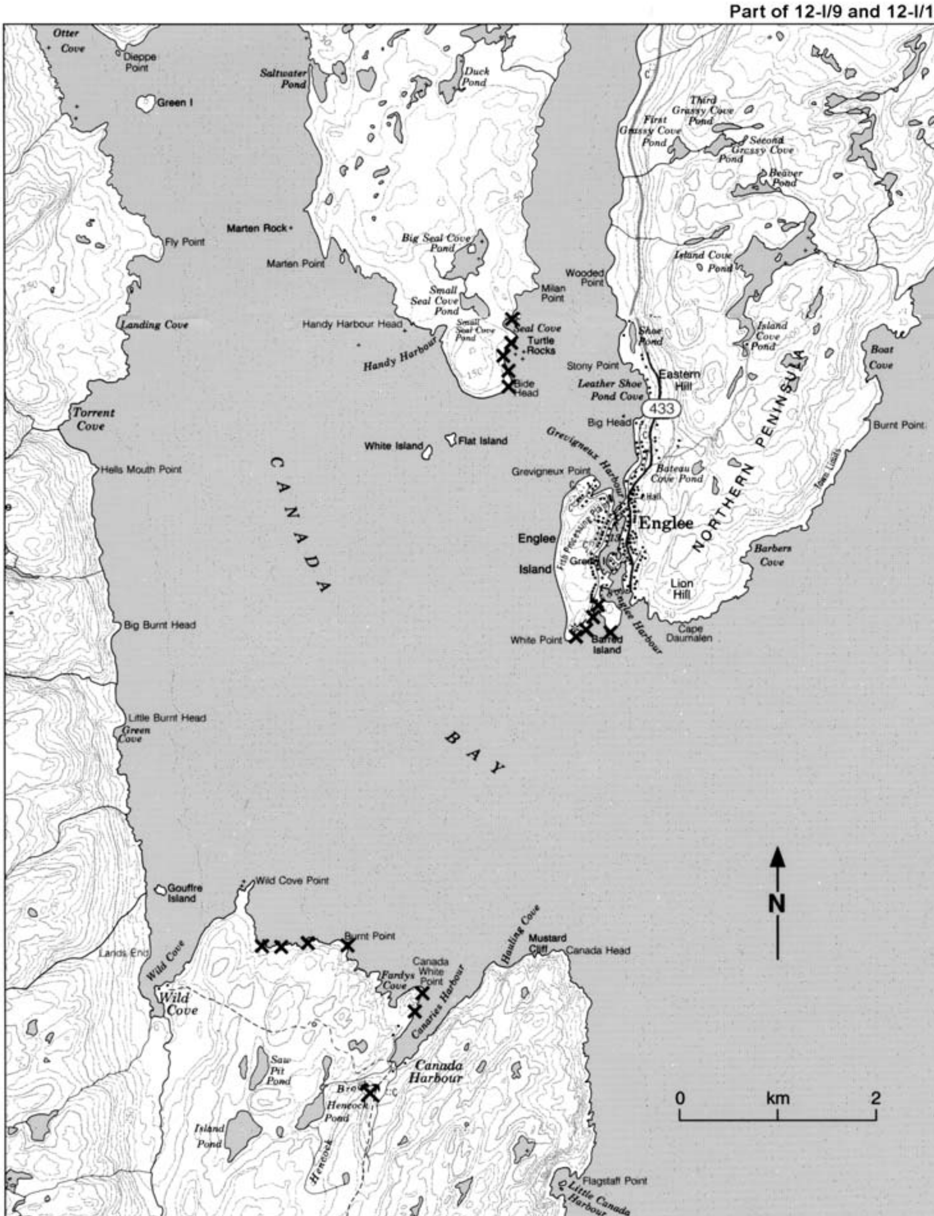
327 Savage Cove. Savage Point, on the north side of Savage Cove, is the nearest point on the Island of Newfoundland to mainland Canada. Amour Point, Labrador, is about 18 km away on the opposite shore of the Strait of Belle Isle.

343 Eddies Cove, junction of Highway 430, the Viking Trail, and the shoreline road (old Viking Trail).

Fossil occurrence. Trilobites occur in a Cambrian rock formation consisting of limestone interbedded with shale exposed along the shore of Eddies Cove.

The road log continues along Highway 430, which takes an easterly inland direction crossing the tip of the Northern Peninsula. It cuts across the northern end of the Coastal and Central lowlands.

Part of 12-I/9 and 12-I/16



X: marble quarry **x**: marble occurrences

Map 20. Canada Bay area.

Quarries along Highway 430 at km 344.4, km 347.4, km 352.7, km 355.3, and km 357.0 expose Cambrian dolomitic limestone.

km 396 Junction, Highway 435 to Pistolet Bay.

Fossil occurrences. Fossiliferous Ordovician limestone is exposed along the shore of Pistolet Bay. Limestone containing graptolites is exposed on the south shore of Shallow Bay (west side of Pistolet Bay), on the south and east shores of Pistolet Bay, and on the south shore of Burnt Island (ref.: 250 p. 501–513).

407 Junction, Highway 436 to L'Anse aux Meadows and to Highway 437 leading to Ha Ha Bay.

L'Anse aux Meadows National Historic Site

The park, a UNESCO World Heritage Site, marks the site of a Norse settlement dating back to A.D. 1000. It includes islands in Sacred Bay and an 11 km 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 15 to 45 m. 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 Islands (Épaves) Bay, was discovered in 1960. Several Viking-type house sites including a multiroom site measuring 21.3 m by 16.8 m, a smithy and smelting pit, fragments of slag and lumps of bog iron ore,

Plate 37

L'Anse aux Meadows archeological site, 1974. GSC 202643 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 29.6 km 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 18 m wide and 12 m high at the entrance and extends inward 90 m. At the entrance, the water is 9 m, 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 69 m long with an entrance 12.8 m wide and 20 m high.

Whale 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 1.5 m south of Burnt Cape. Burnt Island is a flat-topped ridge, about 4 km long, rising to an elevation of 61 to 76 m above the surrounding waters. Access to the cave is by boat from Raleigh, a settlement just off Highway 437 at a point 18.3 km from Highway 430.

km 418 St. Anthony, the northernmost port on the Island of Newfoundland.

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

Refs.: 11 p. 1–17; 19; 25 p. 11–13; 44 p. 1–4, 27–31; 46 p. 5–6; 47 p. 5–9; 48 p. 76–98; 73 p. 20–24; 74 p. 18–25; 77 p. 63–64; 78 p. 3–7, 20–22; 88 p. 28–31; 112 p. 567; 114 p. 643–649; 124 p. 222–224; 137 p. 1–4; 142 p. 238–239; 145 p. 140–149; 146 p. 1–8; 164 p. 5, 6; 179 p. 9; 187 p. 5–6, 19–43; 223 p. 21–86; 228 p. 109–110; 248 p. 8–13.

Maps (T): 2 M St. Anthony
12 H Sandy Lake
12 I and 12 L Port Saunders
12 P Blanc Sablon
(G): 1231A Island of Newfoundland, Newfoundland (GSC, 1:1 000 000)
90-01 Island of Newfoundland (NDME, 1:1 000 000)

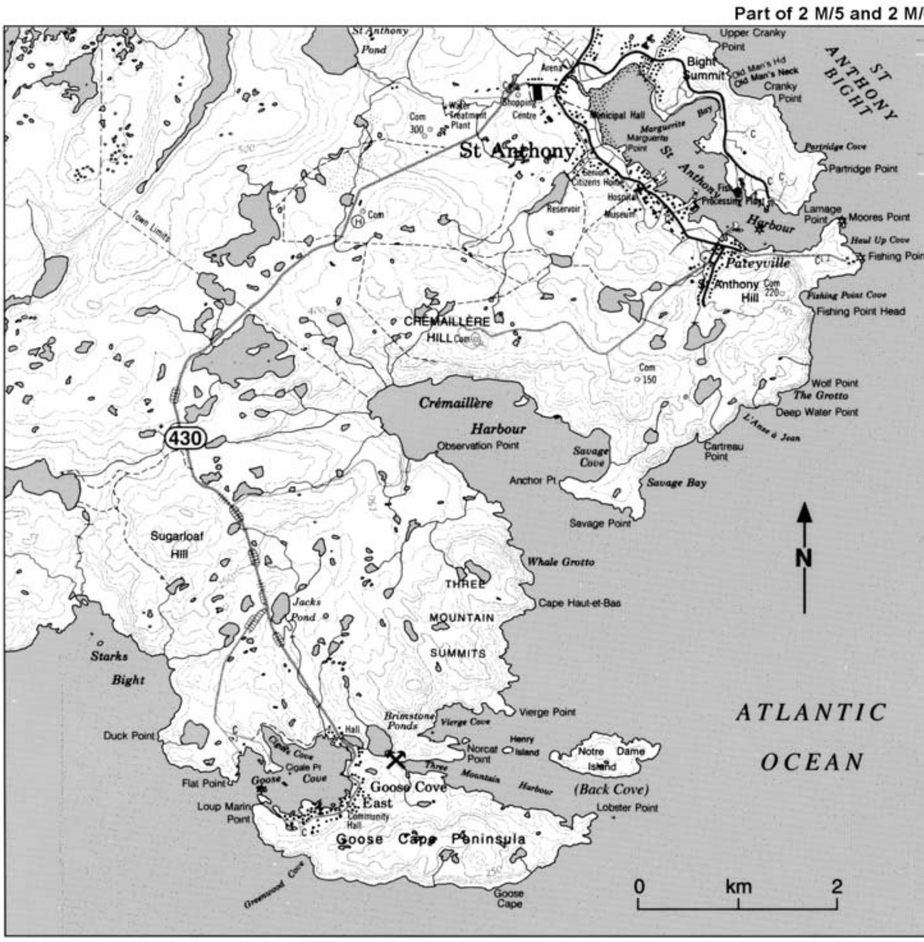
Goose Cove mine

CHALCOPYRITE, PYRITE, PYRRHOTITE, SPHALERITE, MAGNETITE, EPIDOTE

In chlorite-amphibole schist

The ore consisted of lenses of massive chalcopyrite and pyrite with pyrrhotite and minor amounts of sphalerite and magnetite. It occurred as stringers and bunches in the schist. Epidote, quartz, calcite, and hornblende are associated with the deposit.

The deposit was staked in 1904 by Erastus Moores of Tilt Cove. Between 1907 and 1911, it was developed by The Cove Copper Mines Limited. Six shafts were sunk on the deposit, one to a depth of over 30 m, and several pits were opened. A 380 m tramway was built from the shaft to



Map 21. Goose Cove mine.

the wharf at Vierge (Big Back) Cove. Miners' barracks, a shaft house, and a blacksmith shop were also built on the site. About 1600 t of ore averaging 2% to 12% copper were mined and left on the site.

The mine is located between Goose Cove and Three Mountain Harbour (Little Back Cove), and southeast of Brimstone Ponds. It is about 230 m east of Highway 430 at Goose Cove. *See* Map 21.

Refs.: 44 p. 27–32; 156 p. 34; 228 p. 39, 59; 274 p. 132.

Maps (T): 2 M/5 and 2 M/6 St. Anthony
(G): 7 Hare Bay sheet, northern Newfoundland (NDME, 1:63 360)

1495A Strait of Belle Isle area, northwestern insular Newfoundland, southern Labrador, and adjacent Quebec, sheet 2 (GSC, 1:125 000)
82-52 Blanc-Sablon/St. Anthony, Newfoundland (NDME, 1:250 000)
84-24 St. Anthony, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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

km	**644.9**	Deer Lake, at the junction of Highway 430. Deer Lake is about 27 km long and from 1.5 to 3 km 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.
km	**678.0**	Little Rapids village. At this point the Humber River broadens to its maximum of 400 m. Its steep valley slopes rise to rounded hills with elevations of up to 518 m on its south side and to 305 m on the opposite side. In places, it is walled by 76 m cliffs. The headwaters of the Humber River are about 95 km to the north in the Long Range Mountains. The water is discharged into 24 km Humber Arm, the longest of the arms branching from 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.
km	**688.2**	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, 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 large blocks as 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 76 m cliff overlooking the Humber River and the Trans-Canada Highway. It was quarried from 1925 to 1943 by Bowaters Newfoundland Pulp and Paper Company Limited for use in its plant at Corner Brook.

The turnoff to the quarry is at **km 688.2**.

Refs.: 55 p. 83–84; 255 p. 46–47.

Maps (T): 12 A/13 Corner Brook
(G): 8-1957 Red Indian Lake (west half) Newfoundland (GSC, 1:253 440)

Plate 38

Banded marble, Limestone Junction quarry. GSC 1994-614B

35 Corner Brook–Stephenville, districts of Humber, St. Georges-Port au Port (NDME, 1:63 360)
91-172 Red Indian Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**690.4**	Junction, road to Cox's Cove (Highway 440).

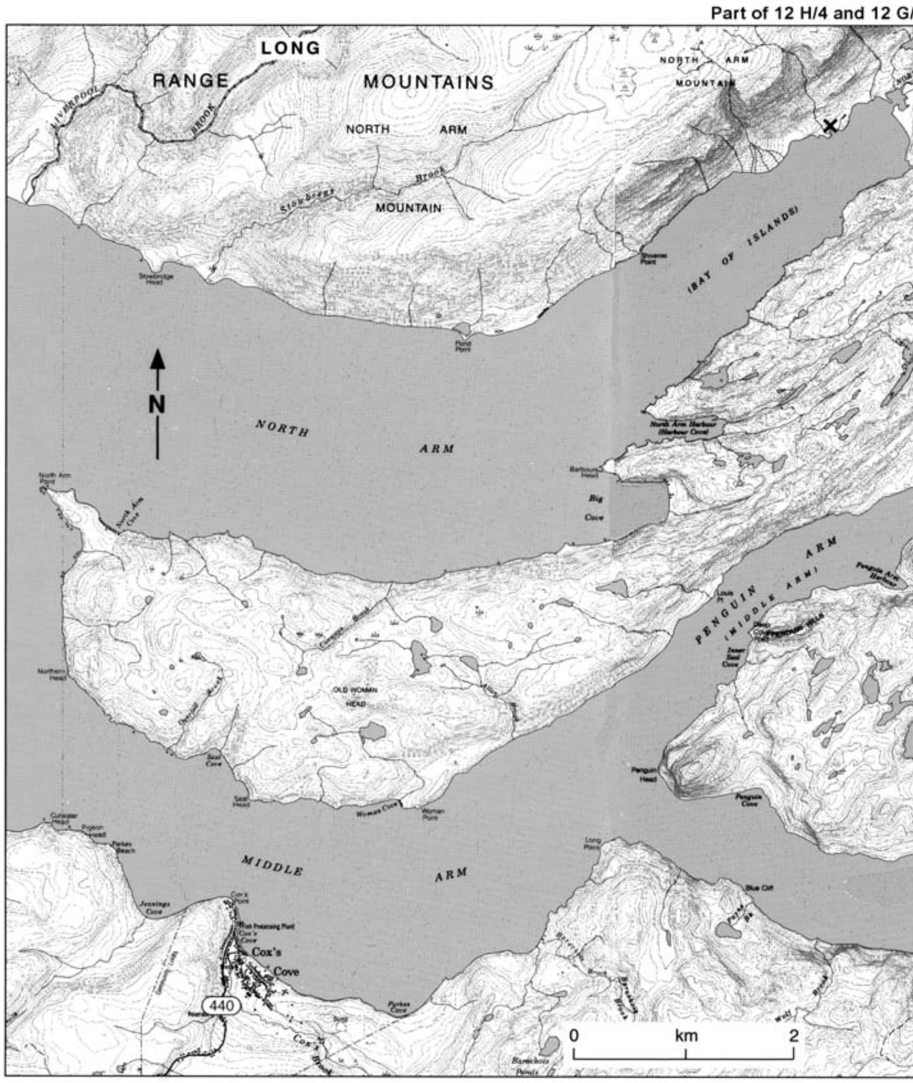
North Arm xonotlite occurrence

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. Some specimens containing concentrations of xonotlite large enough to produce a cabochon are available.

The occurrence is on the steep slope of North Arm Mountain where it is incised by a south-flowing stream about 1600 m 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 21 km. *See* Map 22.



Map 22. North Arm xonotlite occurrence.

Refs.: 224 p. 531–532; 225 p. 48–50.

Maps (T): 12 H/4 Pasadena
12 G/lE Bay of Islands
(G): 1057A Bay of Islands, Island of Newfoundland (GSC, 1:126 720)
83-60 Sandy Lake, Newfoundland, mineral occurrence map
(NDME, 1:250 000)

km	**681.9**	Roadcut 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.

km	**691.5**	*Quarry* on the left (south) side of the highway exposes marble similar to the rock at the Limestone Junction quarry.
km	**694.1**	North Star Cement Limited plant on right. Shale from a quarry near the plant and limestone from two adjacent quarries 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.
km	**695.6**	Turnoff to the Dormston quarry 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 1943 to 1956 by Bowaters Newfoundland Pulp and Paper Company Limited for use in their Corner Brook manufacturing plant. In the 1950s, marble from the quarry was used for the Corner Brook Memorial Hospital. The quarry was opened into the steep west side of an escarpment, its face having a height of 90 m. It is at an elevation of 198 m above Humber Arm.

Road log from the Trans-Canada Highway at **km 695.6**:

km	0	Turn left (east).
	0.15	Turn right onto the quarry road.
	0.5	Dormston quarry.

Refs.: 36 p. 93; 55 p. 86–87; 165 p. 89–90; 228 p. 28; 255 p. 44–46.

Map (T): 12 A/13 Corner Brook
(G): 8-1957 Red Indian Lake (west half), Newfoundland (GSC, 1:253 000)
35 Corner Brook–Stephenville, districts of Humber, St. Georges–Port au Port (NDME, 1:63 360).
91-172 Red Indian Lake, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**695.7**	Turnoff to Corner Brook.
km	**700.3**	Junction, Highway 450.

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 deposit was discovered in 1893 by prospector Daniel Henderson. In 1897, Henderson and A.J. Harvey of St. John's began mining. Four shafts were sunk and ore was transported by a tramway to the shore. By 1899, 453.5 t of ore had been removed and left on the shore of Bay of Islands. In 1900, York Harbour Copper Company of Manchester shipped 90.7 t of ore. From 1902 to 1905, Humber Consolidated Mining and Manufacturing Company extended the underground workings, built a new tramway to the shore and shipped 13 605 t of ore to the United States. York Harbour Mine (Newfoundland) Limited took over operations in 1909 and made a final shipment of 13 605 t of ore in 1913. The mine development consists of the main shaft (148 m deep), three other shafts, and an adit 244 m long.

The mine is at York Harbour, Bay of Islands. *See* Map 23.

Road log from the Trans-Canada Highway at **km 700.3**:

km	0	Junction of Highway 450 and the Trans-Canada Highway; proceed onto Highway 450.
	30.5	Frenchman's Cove; continue along Highway 450..
	41.2	Highway bridge over Mine Brook. (This is 6 km east of York Harbour.) About 200 m west of the bridge, a trail leads south 1.7 km to the old workings on the east side of a branch of Mine Brook. The newer workings are on the south side of the highway, just east of the bridge over Mine Brook.

Refs.: 43 p. 51–52; 61 p. 53–61; 156 p. 33–34; 228 p. 63; 273 p. 5.

Maps (T): 12 G/1 Bay of Islands
(G): 1 Blow Me Down sheet, Humber district (NDME, 1:63 360)
1355A Bay of Islands, Newfoundland (GSC, 1:125 000)
84-44 Bay of Islands, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**696.4**	Roadcuts extending for a distance of about 11 km expose black marble similar to the Dormston marble deposit. Some reddish-buff marble occurs with the black.
km	**713.7**	Pinchgut Lake on left.
km	**721.8**	Turnoff to Blue Ponds Provincial Park.
km	**745.8**	Junction, Highway 460. This highway leads to Stephenville, a distance of 43 km. Roads from Stephenville provide access to Cliff mine, Lower Drill Brook mine, Upper Drill Brook mine, Indian Head labradorite occurrence, Indian Head mine, Romaines Brook gypsum occurrence, Aguathuna quarry, and Port au Port occurrences.

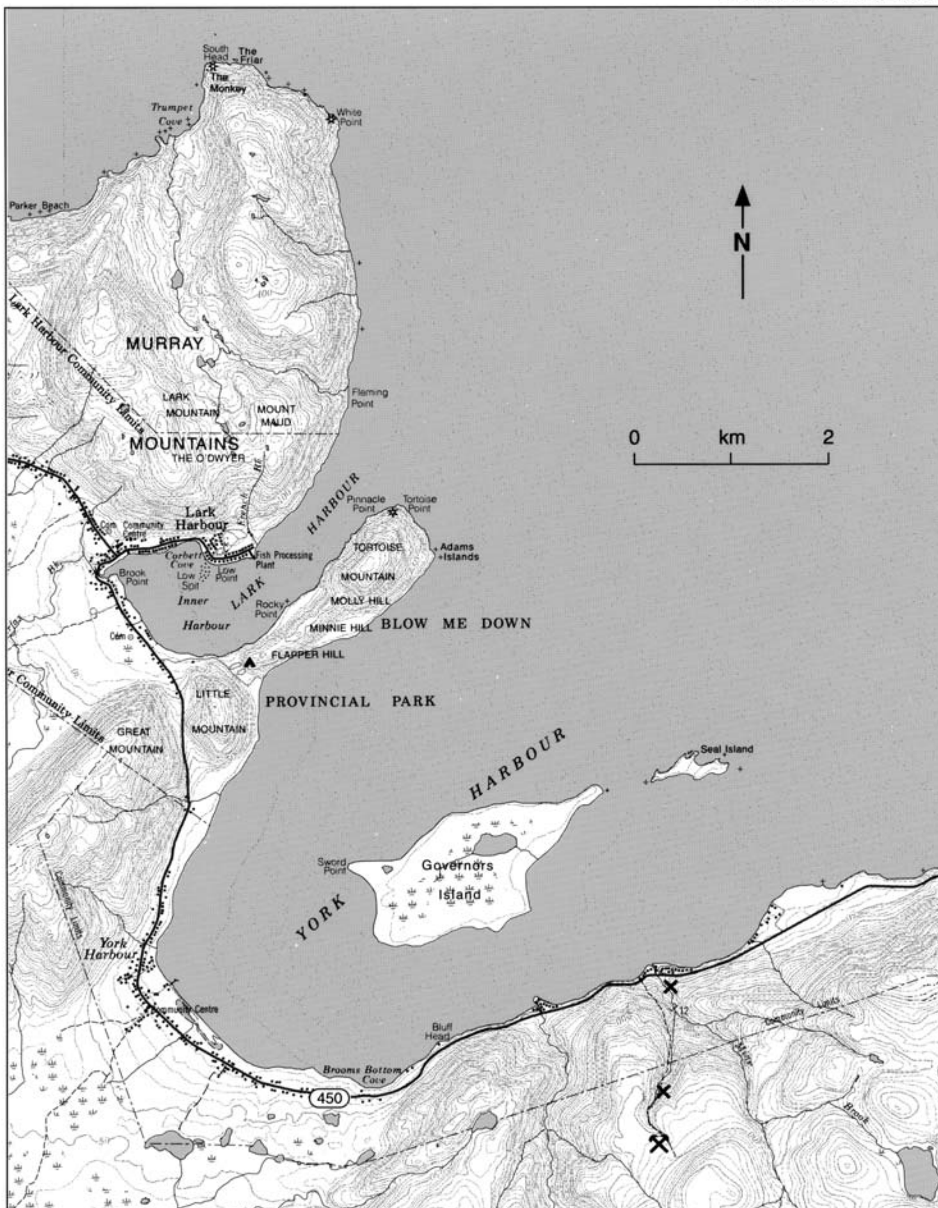
Cliff mine, Lower Drill Brook mine, Upper Drill Brook mine

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.

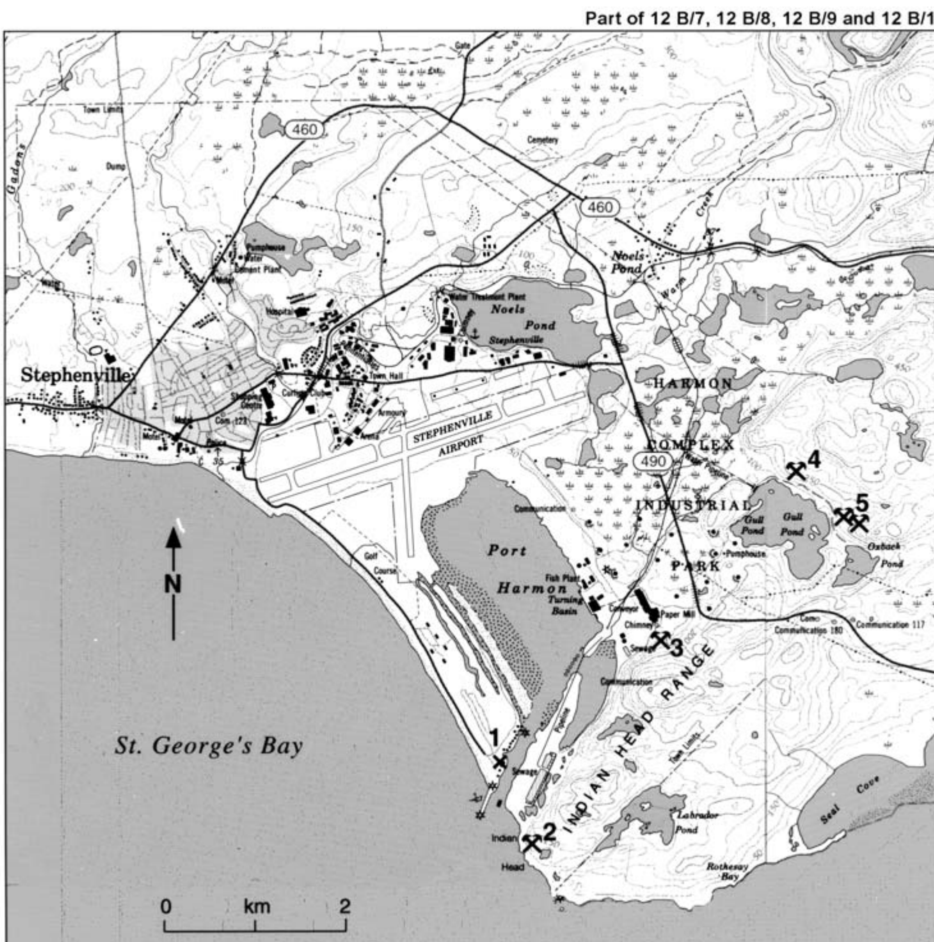
Part of 12 G/1 and 12 G/2



Map 23. York Harbour mine.

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.

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 38 m above the pond. It consists of a pit, 122 m by 18 m, and an 8.5 m adit driven into the face of the ridge about 6 m east of the west end of the pit. The Lower Drill Brook mine — a pit measuring 61 m by 30 m — is on a wooded slope facing the northwestern end of Oxback Pond, and the Upper Drill Brook mine, also an open pit, is 100 m east of the Lower Drill Brook mine. *See* Map 24.



1. Indian Head labradorite occurrence 2. Indian Head labradorite quarry
3. Indian Head mine 4. Cliff mine 5. Upper and Lower Drill Brook mines

Map 24. Stephenville area.

Road log from Stephenville:

km	0	Intersection of Main and West streets; proceed along Main Street.
	1.0	Intersection of Queen Street; continue along Main Street.
	1.8	Intersection of Prince Rupert Drive; continue straight ahead.
	5.2	Junction of Highway 490; proceed south along Highway 490.
	7.7	Junction; turn left (east) onto the road to Gull Pond.
	9.3	Cliff mine on left.
	10.3	End of the road at St. Stephen's parish building, between Gull and Oxbow ponds. From this point an old road leads north about 100 m to the Lower Drill Brook mine. The Upper Drill Brook mine is 100 m to the east.

Refs.: 91 p. 34–36; 104 p. 52, 54–59; 213 p. 74–76; 214 p. 88; 228 p. 74–75; 277 p. 121.

Maps (T): 12 B/10 Stephenville
12 B/9 W Harrys River
(G): 1579A Stephenville map area, north half (GSC, 1:100 000)
79-123 Stephenville, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Indian Head labradorite occurrence

LABRADORITE

In anorthosite

Light grey labradorite exhibiting a light to medium blue iridescence 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.

Plate 39

Indian Head anorthosite occurrence. Labradorite occurs in the blocks of anorthosite in the foreground. GSC 202741

The anorthosite is exposed at Indian Head along a conspicuous, dazzling white cliff that is visible for many kilometres from distant points along St. George's Bay. Indian Head is the southern extremity of the Indian Head Range that extends northward for 27 km rising to a maximum elevation of 549 m 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 and the product used as rock fill, dimension stone, and railroad ballast. The quarry is difficult to reach, but an accumulation of blocks of the anorthosite has been left across the channel from Indian Head, south of Stephenville Pond. *See* Map 24.

Road log from Stephenville:

km	0	Intersection of West and Main streets; proceed east along West Street.
	0.8	Junction; turn right and proceed along the road to the golf course. This road parallels the shore of St. George's Bay.
	5.1	End of the 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.: 36 p. 68–69; 104 p. 61; 151 p. 66; 209 p. 36–37; 228 p. 122.

Maps (T): 12 B/10 Stephenville
(G): 1579A Stephenville map area, north half (GSC, 1:100 000)
79-123 Stephenville, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Indian Head mine

MAGNETITE, HEMATITE

In norite gneiss

Massive magnetite occurs as thin bands and lenses in norite gneiss. Hematite is a minor constituent.

An attempt to investigate the iron deposit at Indian Head was made in 1914 by Dr. Elizabeth Ingraham who brought drillers from the United States. World War I intervened and the project was abandoned. In 1923, Reid Newfoundland Company Limited explored the property. Between 1941 and 1944, Dominion Steel and Coal Corporation Limited of Sydney, Nova Scotia, worked the deposit from an open pit 45 m long and about 8 m wide. Production amounted to 2721 t of hematite and 11 791 t of magnetite.

The mine is in the north end of the Indian Head Range, southeast of Stephenville. *See* Map 24.

Road log from Stephenville:

km	0	Intersection of Main and West streets; proceed along Main Street toward Highway 490.
	5.2	Junction of Highway 490; proceed south along Highway 490.
	7.7	Junction of the road to Gull Pond; continue along the highway.
	8.1	Junction; turn right (west).
	8.3	A trail on the left (south) side of the road leads 400 m to the mine.

Refs.: 91 p. 34–36; 104 p. 50; 156 p. 60–61; 209 p. 56.

Maps (T): 12 B/10 Stephenville
(G): 1579A Stephenville map area, north half (GSC, 1:100 000)
79-123 Stephenville, Newfoundland, mineral occurrence map (NDME, 1:250 000)

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 about 365 m. At the mouth of the brook, it forms a 21 m cliff. The gypsum in the cliff on the north side of the highway is finely granular, massive, snow-white, and 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 light yellow

Plate 40

Romaines Brook gypsum occurrence. GSC 202742 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.

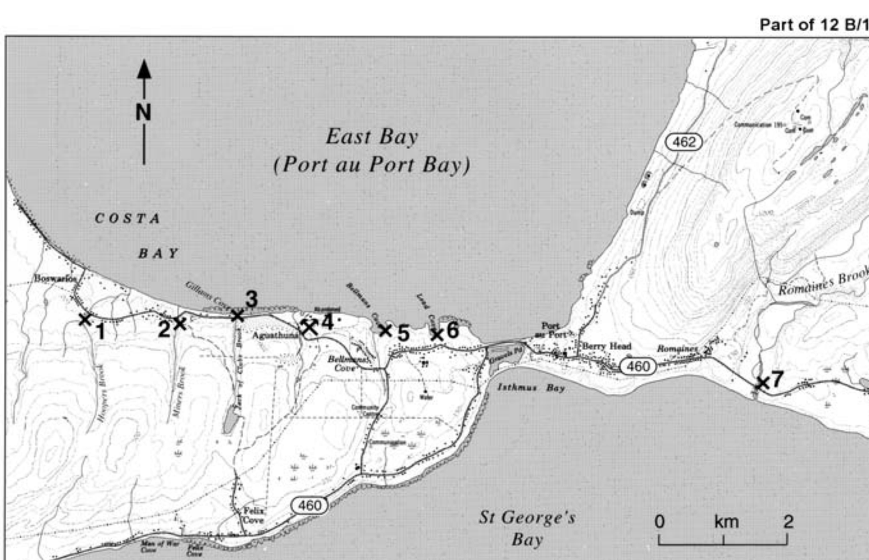
The deposit was explored in 1926 by Reid Newfoundland Company Limited. Two adits were driven into the outcrops north of the highway bridge. *See* Map 25.

Road log from Stephenville:

km	0	Intersection of Main and West streets; proceed west along West Street.
	0.8	Junction, Hanson Highway (Highway 460); proceed west along this road.
	6.7	Bridge over Romaines Brook. Walk north about 135 m 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.: 36 p. 80; 99 p. 29; 163 p. 14–15; 165 p. 14–15; 228 p. 124–125; 256 p. 80.

Maps (T): 12 B/10 Stephenville
(G): 35 Corner Brook–Stephenville districts of Humber, St. Georges–Port au Port (NDME, 1:163 360)
1579A Stephenville map area, north half (GSC, 1:100 000)
79-123 Stephenville, Newfoundland, mineral occurrence map (NDME, 1:250 000)



1. Ronan (Boswarlos) occurrence 2. Miners Brook occurrence
3. Gillams Cove occurrence 4. Aguathuna quarry 5. Bellmans Cove occurrence
6. Lead Cove occurrence 7. Romaines Brook gypsum occurrence

Map 25. Port au Port area.

Aguathuna quarry

CELESTINE, BARITE, CALCITE, MARCASITE, FOSSILS

In limestone

The Aguathuna quarry was formerly worked for limestone. The rock contains a mineralized zone consisting of celestine, barite, calcite, and marcasite. The celestine occurs as light blue transparent tabular crystals and 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 celestine. 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 to 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 1500 m paralleling the south shore of East Bay, Port au Port Bay. Its face varies from 4 m to 36 m 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.

The quarry is on the south side of East Bay, Port au Port Bay. *See* Map 25.

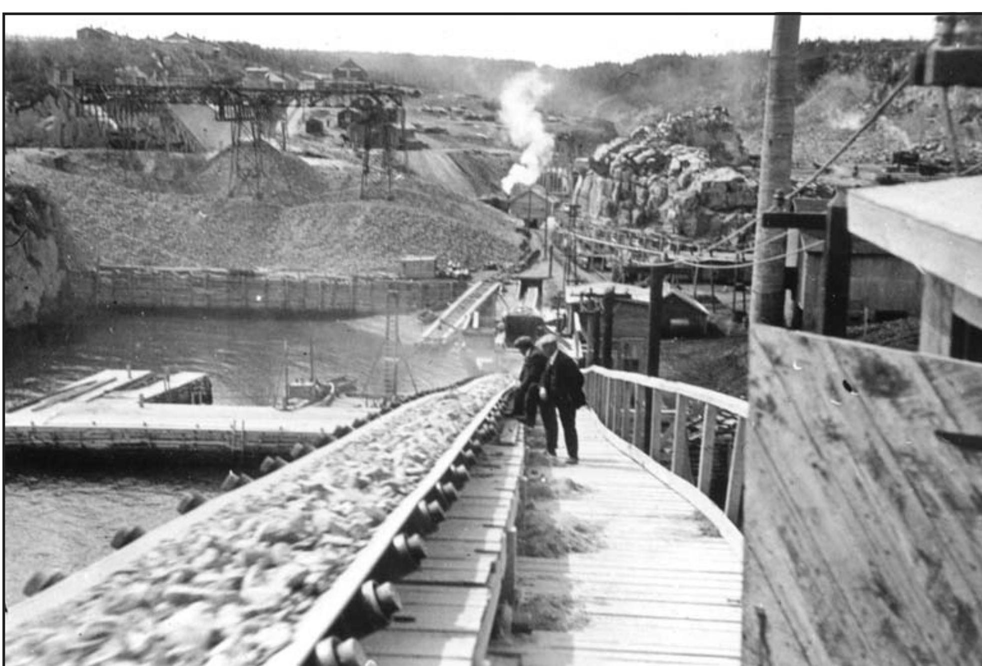


Plate 41

Aguathuna quarry operations, about 1914. Provincial Archives of Newfoundland and Labrador A37-149

Road log from Stephenville:

km 0 Intersection of West and Main streets; proceed west along West Street.

0.8 Junction; proceed west along Highway 460.

6.7 Bridge over Romaines Brook.

After crossing the brook, the highway skirts the steep southern end of Table Mountain. This long ridge extends northeastward 14.5 km rising to a flat summit at an elevation of 377 m above Port au Port Bay, which borders its west side. It is formed of Ordovician sedimentary rocks.

9.9 Port au Port at the junction of Highway 462. This village is situated on an elevated marine terrace lying 30 m above high tide. Highway 462 leads to Fox Island River where pebbles of carnelian agate occur in the beach gravels.

11.0 Isthmus of Port au Port. A pond — Gravels Pond — occupies nearly the entire 800 m 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 along sea cliffs to the northwest, southwest, and southeast of the isthmus; 2.4 km to the northeast — at Black 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 40 km 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 354 m 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 15 m to 122 m 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.

11.5 Junction; proceed straight ahead (west).

13.5 Junction; continue along the road to Aguathuna.

15.1 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 815 m, the highest mountain on the Island of Newfoundland. Visible to the west is the 8 km strip of marshy land terminating at Shoal Point, and north is The Bar with Long Point at its north end.

Refs.: 36 p. 86–90; 55 p. 91; 82 p. 192–194; 99 p. 18–19; 131 p. 5–6, 10–13; 157 p. 30–34; 209 p. 3–5, 17–34, 55; 223 p. 46–51, 65–73; 228 p. 25–26.

Maps (T): 12 B/10 Stephenville
(G): 1579A Stephenville map area, north half (GSC, 1:100 000)
79-123 Stephenville, Newfoundland, mineral occurrence map
(NDME, 1:250 000)

Port au Port occurrences

GALENA, PYRITE, MARCASITE, CELESTINE, BARITE, ARAGONITE

In limestone

The Port au Port occurrences consist of sulphide and sulfate mineralization at Lead, Bellmans and Gillams coves, Miners Brook, and Boswarlos. Galena, pyrite, marcasite, and barite occur as grains in porous limestone exposed along the shores of Lead Cove and Bellmans Cove. These coves are on the shore of East Bay (Port au Port Bay), 1200 m and 2000 m respectively west of the isthmus of Port au Port.

Farther west, at Gillams Cove, light blue celestine occurs as crystalline aggretates associated with barite, calcite, and aragonite in limestone exposed at the base of a cliff at the cove, and in trenches along the east side of the brook leading to it. Galena, pyrite, and marcasite occur with minor barite and celestine in limestone at Miners Brook.

At the Ronan (Boswarlos) deposit, celestine occurs as blue crystal aggretates and white radiating platy crystals associated with massive aragonite and white, reddish, and brownish massive barite in limestone; crystals of celestine also occur in cavities in the limestone. The Ronan deposit is exposed by several trenches along Hoopers Brook in Boswarlos.

These occurrences are shown on Map 25.

Road log from Stephenville:

km	0	Intersection of West and Main streets; proceed west along West Street.
	11.0	Isthmus of Port au Port.
	11.5	Junction; proceed west toward Aguathuna.
	15.1	Aguathuna quarry; continue west.
	16.1	Jack of Clubs Brook. Gillams Cove is at the mouth of this brook.
	17.1	Miners Brook. An adit, driven into the mineralized zone, is about 150 m south of the road at this point.
	18.5	Hoopers Brook. The Ronan (Boswarlos) deposit is south of the road; the trenches extend over about 85 m on the east side of Hoopers Brook.

Refs.: 119 p. 29–34; 131 p. 10–15; 157 p. 30–34.

Maps (T): 12 B/10 Stephenville
(G): 1579A Stephenville map area, north half (GSC, 1:100 000)
79-123 Stephenville, Newfoundland, mineral occurrence map
(NDME, 1:250 000)

km **745.8** Trans-Canada Highway at the junction of Highway 460.

For the next 30 km, the highway traverses a low-lying marshy and drift-covered area. The remaining 135 km 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 549 m. From the remarkably flat, barren crest of this range, hills here and there rise to elevations of about 610 m above sea level (as at **km 74.6**), gradually decreasing to about 457 m 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 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.

km 753 View of Long Range Mountains.

km 761.5 Turnoff to Barachois Pond Provincial Park.

km 773.3 St. George's Bay on left.

The bay is an embayment of the Gulf of St. Lawrence. Its shoreline is very regular and 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.

km 777.1 Junction, road to St. George's.

This is an alternate access route from the Trans-Canada Highway to Stephenville, a distance of 32 km. Cairn Mountain (elevation 259 m) is on the east side of this junction. To the southeast, 366 m Steel Mountain rises steeply from the valley of Flat Bay Brook. From this junction to about km 890 the highway traverses a region underlain by Mississippian sedimentary rocks.

km 780.8 Junction, Flat Bay Road, on the south side of the 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, or light grey, finely granular massive, and 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 gypsum deposits in the St. George's Bay and 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 15 m high and 152 m long. The quarry was operated by

Domtar Inc. The quarry is southeast of Flat Bay and the dock and shipping facilities are at St. George's.

The quarry is on the Flat Bay Road at a point 6.8 km from its junction with the Trans-Canada Highway at **km 780.8**.

Refs.: 9 p. 495–502; 36 p. 76–77; 54 p. 14; 99 p. 29; 164 p. 4, 7; 165 p. 1–3, 15–16; 228 p. 126.

Maps (T): 12 B/7 Flat Bay
(G): 77-4 Flat Bay–Main Gut, Newfoundland (NDME, 1:50 000)
1117A Stephenville, Newfoundland (GSC, 1:253 440)
79-123 Stephenville, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km 796.8 Bridge over Fischells Brook

Shoreline occurrence. The gravels of Fischells Brook contain jasper pebbles and a variety of volcanic and granitic rock pebbles and boulders.

km 808.5 Junction, Robinsons Road (Highway 404).

Beach deposits along the shore of St. George's Bay 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.

km 808.8 Bridge over Robinsons River.

km 810.8 Bridge over Middle Barachois River

Coal seams occur in Pennsylvania rocks along the banks of Robinsons River and Middle Barachois River, about 10 km upstream from their respective highway bridges. Coal in the western part of the Island of Newfoundland was noted in about 1765 by Captain James Cook, the explorer who for several years was the official surveyor of Newfoundland. The coal was extracted by local inhabitants for their own use. Between 1918 and 1929, St. George's Coal Fields Limited excavated several hundred tonnes of coal and made a shipment of 135 t to the International Power and Paper Company of Corner Brook.

km 818.2 Turnoff to Crabbe's River Provincial Park.

km 822 .8 Roadcuts, extending over the next 19 km, expose red sandstone and siltstone of Mississippian age.

Anguille Mountains

The northern tip of the Anguille Mountains range is on the south side of the highway at about **km 822**. These mountains form a flat-topped upland or ridge composed of Mississippian sedimentary rocks. The ridge extends over a distance of 50 km 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 Grand Codroy River system to a flat regular surface with an average elevation of about 457 m and a maximum of 536 m. 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 runs within this valley to **km 890**. 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 the Island of Newfoundland.

km **836.7** Codroy Pond on left.

km **839.4** The summit on the west side of the highway is the highest point on the Anguille Mountains, with an elevation of 536 m above sea level.

km **874.8** Turnoff to Grand Codroy Provincial Park.

km **876.1** Junction, Highway 406, the Codroy Valley Road.

Between this turnoff and km 885, the highway skirts the southeastern edge of the picturesque Codroy Lowland that extends to the Gulf of St. Lawrence shore; it 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 137 m 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 **km 876.1** is a close-up view of the 610 m flat summits of the Long Range Mountains, deeply notched by stream valleys that were carved into broad chasms by glacial action.

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 of the two. Colourless, transparent selenite is less abundant. It occurs as coarse, tabular crystals and as veins in the massive gypsum; tabular plates up to 30 cm in diameter have been reported from the deposit. Yellow, red, and black massive gypsum varieties are found, but are not common.

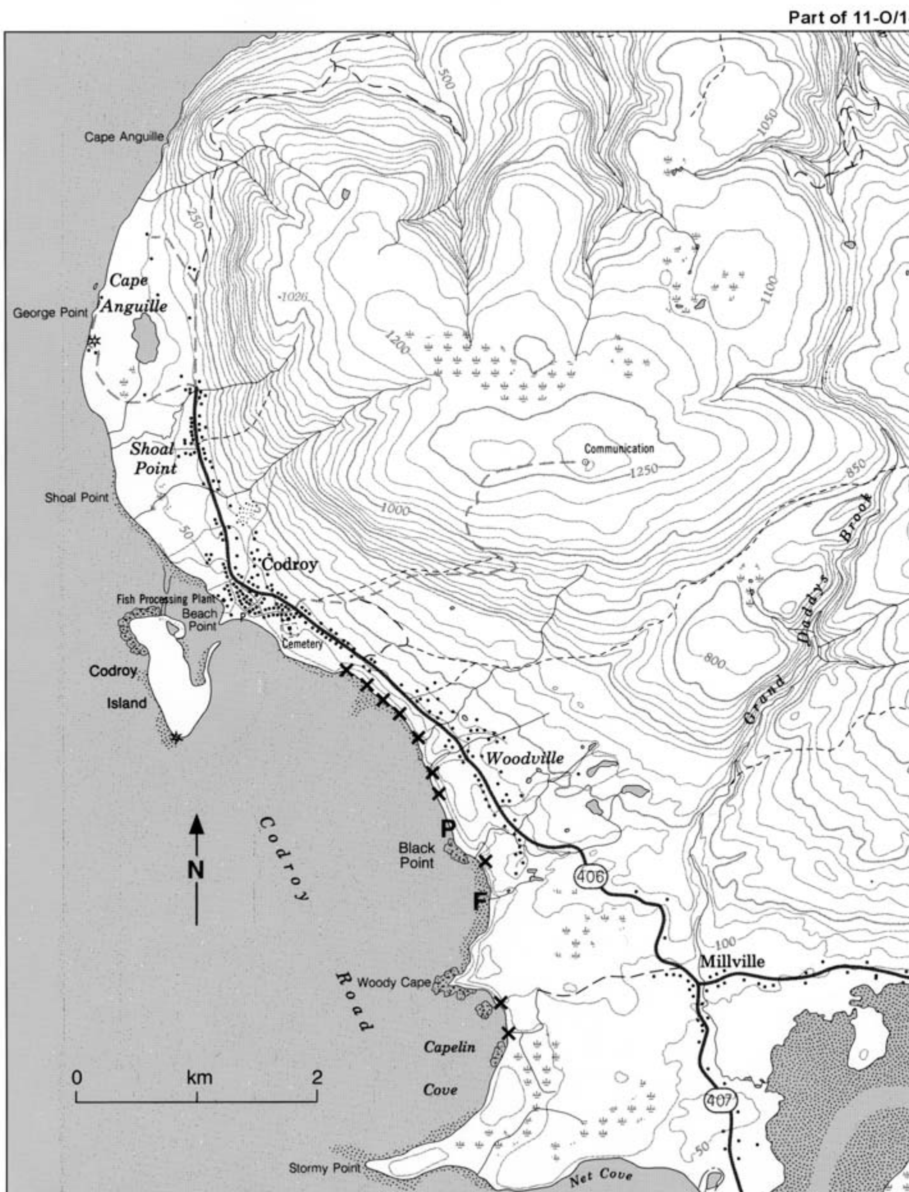
The gypsum beds outcrop in the seacliffs along the shore of Cabot Strait between Codroy village and Woody Cape. One series of exposures is 1067 m to 2135 m from Codroy, another 3000 m to 3660 m from the village.

Pyrite nodules and cavities lined with pyrite cubes occur in yellowish-brown limestone at Black Point, a headland 2592 m 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 about 550 m 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 1600 m of the Codroy shore, the land surface is pitted with sinkholes — depressions caused by the solution of gypsum-bearing strata that underlie the area. Many 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, 17.4 km from the Trans-Canada Highway at **km 876.1**. *See* Map 26.

Refs.: 6 p. 157–159; 99 p. 11–15, 29.

Maps (T): 11 O/14 Codroy
(G): 1340A Port aux Basques, Newfoundland (GSC, 1:250 000)



x gypsum occurrences **P** pyrite occurrence **F** fossil occurrence

Map 26. Codroy area.

84-61 Port aux Basques, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**885**	Turnoff to Mummichog Provincial Park. The park comprises the south shore of Little Codroy River and a peninsula jutting into its mouth.
km	**890**	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 5 km. From here to the end of its course, it traverses a region underlain by Paleozoic granitic and metamorphic rocks of which the Long Range Mountains are composed. These rocks are exposed in roadcuts beginning at **km 908.6** and along the Rose Blanche Road (Highway 470).
km	**891**	The Tolt, 399 m 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.
km	**907.9**	Junction, road leading south to Grand Bay.
km	**908.4**	Roadcut exposing kyanite-garnet gneiss.

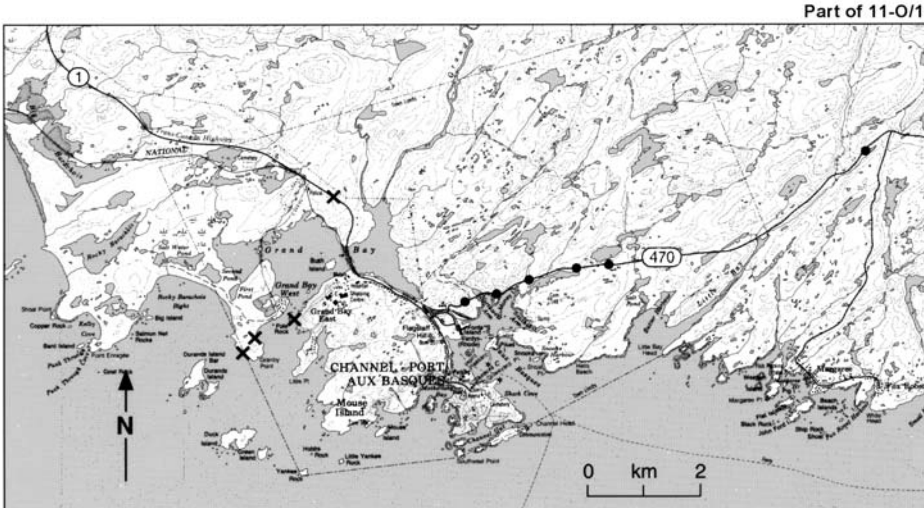
Port aux Basques occurrences

GARNET, KYANITE

In mica schist and gneiss

Garnet crystals up to 10 mm in diameter occur in biotite schist in the Grand Bay–Port aux Basques area and eastward to Burnt Island. Sillimanite is commonly associated with the garnet. The most accessible occurrences are roadcuts along Highway 470; their locations are noted along the road log on Highway 470 and on Map 27.

Part of 11-O/11



• garnet occurrences   **x** kyanite occurrences

Map 27. Port aux Basques area.

Kyanite occurs with garnet in the Grand Bay area. Blades of blue-green kyanite up to 4 cm in diameter occur in quartz gneiss at a roadcut on the south side of the Trans-Canada Highway at **km 908.4**. Occurrences of gneiss and schist containing kyanite crystals up to 4 cm long, garnet crystals up to 15 mm across, and staurolite crystals have been reported to occur in the following localities in the vicinity of Grand Bay: in outcrops along the beach on the east shore of Granby Point; along the western shore of Granby Point; and on a rock island at the east end of the causeway connecting Grand Bay East and Grand Bay West. At the causeway occurrence, green kyanite crystals up to 2 cm long have been reported.

The road to Grand Bay leads south from the Trans-Canada Highway at **km 907.9**. The causeway is 2.8 km from the Trans-Canada Highway. *See* Map 27.

Refs.: 29 p. 3; 118 p. 245–250; 120 p. 355.

Maps (T): 11 0/11 Port aux Basques
(G): 77-2 Port aux Basques (NDME, 1:50 000)
84-61 Port aux Basques, Newfoundland, mineral occurrence map (NDME, 1:250 000)

km	**908.6**	Roadcuts expose garnetiferous biotite-quartz-feldspar schist and gneiss. The garnet crystals and grains are small, measuring less than 6 mm in diameter.
km	**910.8**	Causeway across Grand Bay. The south-flowing Grand Bay River empties into Grand Bay.
km	**912.8**	Channel-Port aux Basques, at the junction of Highway 470 and the turnoff to the ferry landing.

South Shore occurrences

GARNET, SILLIMANITE, TOURMALINE, EPIDOTE, APATITE, TITANITE, PYRITE, SERPENTINE, JAROSITE

In biotite gneiss and schist

Roadcuts 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 up to 12 mm 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 the South Shore occurrences from Channel-Port aux Basques:

km	0	Trans-Canada Highway at the turnoff to the ferry landing; proceed toward the ferry landing.

0.15 Junction; follow the road on left (Highway 470) leading to Rose Blanche.

0.3 Junction; continue along Highway 470.

0.8 Roadcut 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.

1.4, *Roadcuts.* Sillimanite and garnet occur in coarse biotite schist,

2.2 tourmaline in quartz associated with the schist.

3.2 *Roadcuts.* Pink to red grains and crystals of garnet occur in grey granitic rocks that are cut by veins consisting of quartz and red feldspar.

3.7, *Roadcuts.* Garnet and sillimanite occur in biotite schist and gneiss.

8.8

9.5 Junction; road to Fox Roost, Margaree.

10.5 *Roadcut.* Garnet and sillimanite occur in biotite schist and gneiss.

12.1 *Roadcut.* Garnet crystals 6 mm in diameter are common in biotite-feldspar gneiss exposed in a roadcut on the west side of the bridge over Isle aux Morts River. Prismatic aggregates of yellowish-green epidote occur with dark green chlorite in a coarse-grained, pink granitic rock.

12.4 to 17.1 Roadcuts expose biotite schist and gneiss containing garnet and sillimanite.

16.4 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.

20.6 *Roadcut.* Garnet crystals 10 mm 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 roadcut and in the roadcuts extending toward Burnt Island village and beyond.

21.6 White pegmatite outcrops on the south side of the road. Garnet crystals occur in the pegmatite.

22.5 Roadcut exposes biotite-garnet gneiss containing sillimanite.

23.3 Turnoff to Otter Bay Provincial Park.

24 Butterpot Hill on right.

26.2 Roadcut exposes biotite gneiss containing garnet crystals up to 10 mm in diameter. God Bay and Burnt Island can be seen below the roadcut.

27.5 Turnoff to Burnt Island village.

43.1 Junction, road leading south to Diamond Cove and to the Diamond Cove occurrence.

43.4 Bridge over Rose Blanche Brook.

45.0 Rose Blanche.

Refs.: 36 p. 69–71; 83 p. 2–3; 156 p. 44; 228 p. 70, 122.

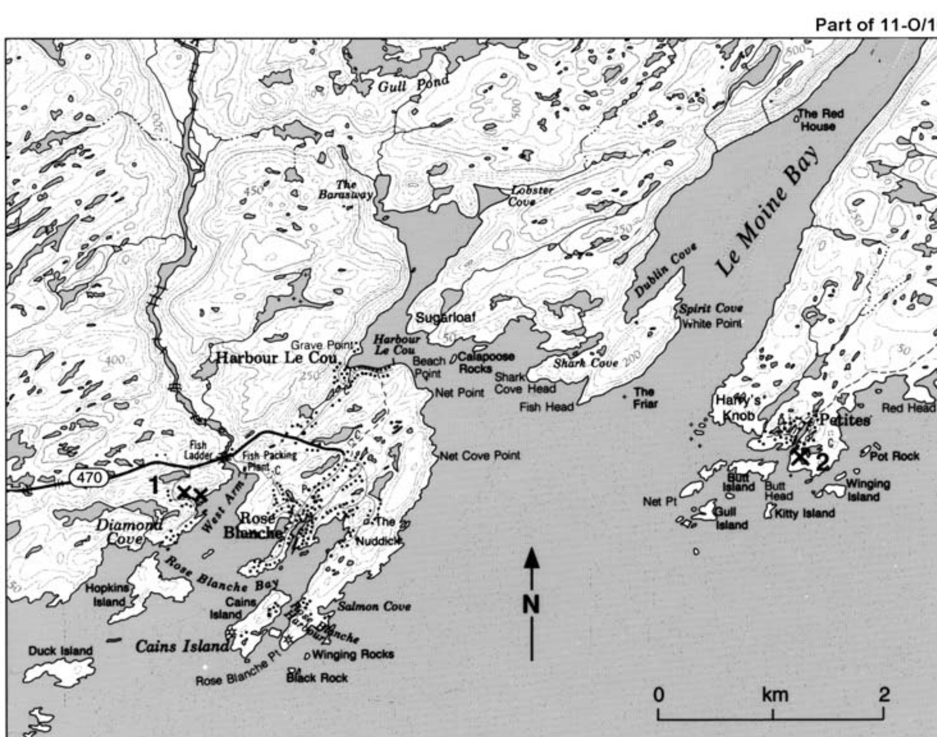
Maps (T): 11 O/10 Rose Blanche
11 O/11 Port aux Basques
(G): 1340A Port aux Basques, Newfoundland (GSC, 1:250 000)
84-61 Port aux Basques, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Diamond Cove occurrence

PYRITE, ARSENOPYRITE, SPHALERITE, CHALCOPYRITE, SCORODITE, QUARTZ CRYSTALS, CHALCEDONY

In quartz

Pyrite occurs with minor amounts of arsenopyrite, sphalerite, and chalcopyrite in a massive white quartz body that forms Quartz Hill. Nuggets of native gold are reported to have been collected from the quartz. Scorodite and goethite have been reported to occur as alteration products of arsenopyrite. The massive quartz is a giant vein 50 m wide; cavities in the quartz contain quartz crystals and chalcedony.



1. Diamond Cove occurrence 2. Petites granite quarries

Map 28. Rose Blanche area.

The prospect was staked for gold by Luke Chafe of Rose Blanche. In 1900 he leased the property to Harvey and Company which worked it until 1902. A shipment of about 27 t of ore was made to Nova Scotia. The development consisted of several trenches and pits on the southwest slope of Quartz Hill, and an adit driven 10.4 m into the south side of the hill near the shore. Interest was revived in the 1930s following the publication of reports of high gold assays on specimens collected from one of the old trenches and from an exposure near the Rose Blanche cemetery.

The occurrence is in Diamond Cove on the west shore of West Arm, Rose Blanche Bay. The Diamond Cove Road leaves Highway 470 at a point 0.3 km west of the bridge over Rose Blanche Brook. The pits and trenches are east and west of the road at a point 350 m from Highway 470. To reach the adit, continue along the road for another 300 m to the shore; proceed east for about 100 m to the adit. *See* Map 28.

Refs.: 28 p. 15; 156 p. 35; 226 p. 34–36; 227 p. 77.

Maps (T): 11 0/10 Rose Blanche
(G): Rose Blanche (*in* ref. 28; NDME, 1:50 000)
84-61 Port aux Basques, Newfoundland, mineral occurrence map
(NDME, 1:250 000)

Petites–Rose Blanche granite

Fine-grained grey granite was quarried in the 1870s at Rose Blanche. It was used in the construction of lighthouses.

The granite at Petites is generally pink with a coarse texture. It is composed of feldspar with some quartz and minor amounts of biotite. Four quarries have been worked in the vicinity of Petites.

Granite at Petites was originally exploited by William J. Ellis, of St. John's, who discovered the deposit in 1894 while on a government survey of building stone. Ellis, a mason and contractor, worked a quarry in 1898–1899 that produced stone for cobblestones for Water Street in St. John's, and for facing the St. John's Court House. Quarries at Petites were last worked in about 1916.

The quarries have been opened into hillsides facing the harbour at Petites, 4.5 km east of Rose Blanche. Access is by boat. *See* Map 28.

Refs.: 28 p. 10–11; 36 p. 69–71; 156 p. 44.

Maps (T): 11 O/10 Rose Blanche
(G): Rose Blanche (*in* ref. 28; NDME, 1:50 000)
84-61 Port aux Basques, Newfoundland, mineral occurrence map
(NDME, 1:250 000)

Hope Brook (Chetwynd) mine

NATIVE GOLD, CHALCOPYRITE, PYRITE, BORNITE, COVELLITE, GALENA, MOLYBDENITE, BISMUTHINITE, CASSITERITE, NATIVE SILVER, TIN, ANDALUSITE, MUSCOVITE, PARAGONITE, PYROPHYLLITE, KAOLINITE, ALUNITE, TOPAZ, DIASPORE, FLUORITE, BARITE, CHLORITE, CHLORITOID, CORDIERITE, TOURMALINE, APATITE, NATROALUNITE, CORUNDUM

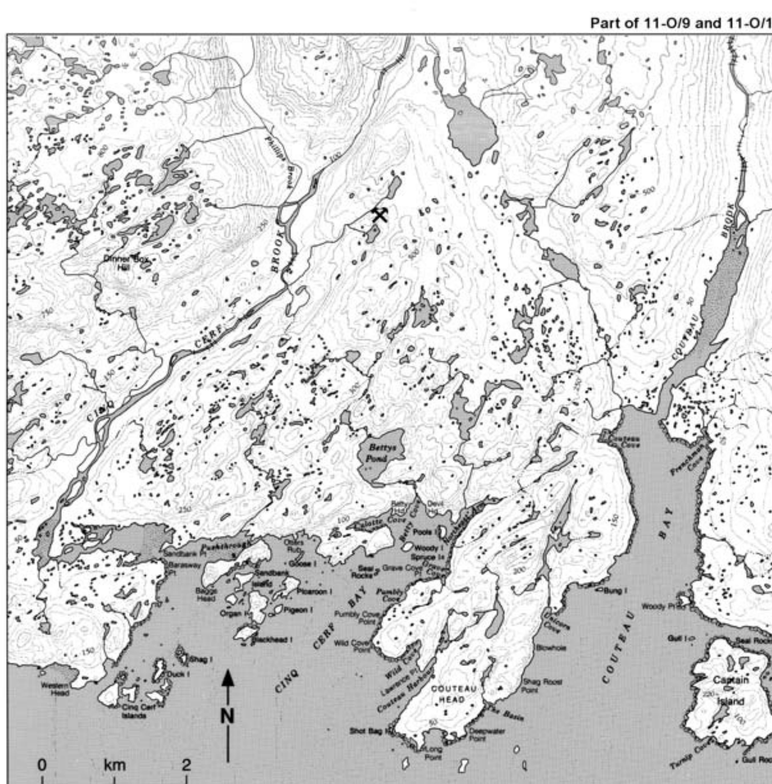
In aluminous and silicified shear zone

The orebody consists of disseminated native gold in pyrite associated with chalcopyrite in an intensely silicified zone within an altered rock system. Free gold is microscopic. Bornite and covellite are alteration products of chalcopyrite. Galena, molybdenite, and hematite are associated with the ore. Microscopic grains of bismuthinite, cassiterite, native silver, tin, and tellurides have been reported. The alumina- and silica-rich alteration zone that hosts the orebody consists of fine-grained quartz with rutile, andalusite, muscovite, paragonite, pyrophyllite, and kaolinite. Other minerals reported from the deposit include alunite, topaz, diaspore, barite, fluorite, chlorite, chloritoid, cordierite, tourmaline, apatite, natroalunite, and corundum.

This gold-copper deposit was discovered in 1983 by Selco Division of BP Resources Canada as a result of diamond drilling. It was estimated to contain 11.2 million t of ore grading 4.54 g/t gold. A test production in 1985 from an open pit resulted in the recovery of 31 000 g of gold. In 1986, Hope Brook Gold Inc. was formed to develop the deposit. Underground operations via a decline completed to 1491 m began in 1989. Production from 1988 to 1990 amounted to 8 009 204 g of gold. This company suspended operations in 1991. In June 1992, Royal Oak Mines Inc. resumed operations and poured its first gold bar in July of that year. Production in 1992 amounted to 1 576 704.3 g of gold.

The mine is in the valley of Cinq Cerf Brook, 4 km northwest of Couteau Bay and 12 km northeast of Grand Bruit. Access is by air. *See* Map 29.

Refs.: 31 p. 5–6, 12–13; 37 p. 12; 162 p. 137–148; 230 p. A125; 231 p. A119; 232 p. A105; 233 p. 101–136; 294 p. 200; 295 p. 316–317; 296 p. 304–305.



Map 29. Hope Brook mine.

Maps (T): 11 O/9 La Poile
(G): 90-07 Geology of the La Poile Bay–Couteau Bay region
(Parts of 11 O/9 and 11 O/16), southwest Newfoundland (NDME, 1:50 000)
87-04 Gold deposits and occurrences in Newfoundland (NDME, 1:1 000 000)
84-61 Port aux Basques, Newfoundland, mineral occurrence map
(NDME, 1:250 000)

LABRADOR

Physiography and geology

Labrador is separated from the rest of the province by the Strait of Belle Isle. It has an area of about 285 000 km², about 2.5 times that of the island part of the province. Its barren, rugged coastline is deeply indented by numerous inlets and fiords extending up to 250 km inland. The interior consists of plateaus that reach elevations of 600 m above sea level. The Labrador Highlands extending from Cape Chidley toward Nain contain three mountain ranges with elevations up to 1600 m, the highest peaks east of the Rockies.

Geologically, Labrador comprises the eastern end of the Precambrian Canadian Shield. It is underlain predominantly by granitic and gneissic rocks with volcanic and sedimentary rocks in the western part and in parts of the coastal northeast. Large intrusive masses composed of anorthositic rocks occur in central and northern Labrador, including the Nain, the Harp Lake, the Michikamau, and the Mealy Mountains complexes. An important geological feature is the Labrador Geosyncline (Labrador Trough), a belt of folded volcanic and sedimentary rocks that extends from Ungava Bay to beyond Wabash and contains the important iron ore deposits of Labrador and Quebec. Younger Cambrian strata that have survived the long period of erosion during Paleozoic and Mesozoic times overlie the basement Precambrian rocks along the Strait of Belle Isle (ref.: 89).

Mineral deposits

The most important economic deposits have been the iron ore ranges in the Wabash area of the Labrador Geosyncline in western Labrador. These mines came into production in the 1950s. Metallic mineralization includes native copper at Seal Lake, copper-nickel mineralization along the eastern side of the Labrador Geosyncline in western Labrador, and graphite near Labrador City. Nonmetallic mineral resources include anorthosite, dolomite, silica, beryllium, rare earths (yttrium), titanium sands, and soapstone. The gem labradorite and ornamental labradorite rock deposits in the Nain area are Canada's only commercially exploited deposits of this material. In recent years, kimberlitic rocks have been located in the Saglek Bay and Makkovik areas during exploration for diamond, and a nickel-copper-cobalt deposit at Voisey Bay is being prepared for mining.

Collecting in Labrador

Access to coastal Labrador is by air, or by car ferry and freighter boat services from Lewisporte on the Island of Newfoundland. The western and central interior of Labrador can be reached by regularly scheduled air services; a highway connects Happy Valley-Goose Bay with Churchill Falls and Labrador City-Wabush, which connects with a highway to Baie-Comeau, Quebec. Mineral localities are accessible by chartered boats or by snowmobile in the winter from the nearest settlement, or by aircraft from Goose Bay. Localities furnishing material relevant to the lapidary arts — labradorite and soapstone — are described in this section of the guidebook.

LABRADORITE OCCURRENCES

Labradorite, regarded as the most magnificent of all the feldspars, is the mineral emblem of Newfoundland and Labrador. The proclaimation was made by the Newfoundland House of Assembly on June 11, 1976, just about 200 years after the mineral made its way from Labrador to Europe and was officially established as a mineral species.

Labradorite is used in the lapidary arts as gem labradorite for cut jewellery stones and carvings, and as ornamental labradorite rock for decorative stone. The gem variety occurs as crystals large enough for a jewellery stone to be cut from it; the most common style of cut is the cabochon cut, a dome-shaped stone with a base that may be round, oval, or any geometric shape. Ornamental labradorite rock (anorthosite) is composed of a mass of small, more or less equal-sized, uniformly distributed labradorite crystals with a small amount (less than 5%) of black pyroxene; it is used as an ornamental stone and as a decorative building stone.

Most labradorite is grey and nearly opaque. Gem labradorite is light to dark grey with brilliant iridescent colours visible at certain viewing angles along cleavage planes. Iridescent colours are usually blue, but may also be green, gold, bronze, violet, and copper-red. These colours may grade one to another resulting in colour zoning or banded colours. This display of colour is referred to as 'iridescence', 'schiller', 'labradorescence', or 'chatoyancy'. It is due to light interference produced by a parallel intergrowth of alternating microscopic layers (lamellae) of labradorite, each layer having slightly different chemistry. On a flat surface, the iridescence is seen as a sheet of brilliant colour that glides across the stone as it is tilted, then vanishes, but resurfaces when the stone is tilted again. On domed or convex surfaces, the iridescence shows up as pools of luminous colour that float across the stone as it is turned (ref.: 261).

Labradorite contains microscopic inclusions in the form of needles or rods of magnetite and plates or grains of ilmenite. These dark inclusions may cause a darkening of the grey colour of labradorite and, if sufficiently numerous, may produce spangled light reflections or a sunstone effect.

Ornamental labradorite rock varies from medium grey to dark grey depending on the proportion of dark minerals (pyroxene or biotite) present. The random orientation of the crystals in the labradorite rock ensures that iridescent colours are visible at any angle of view.

Labradorite is the sole or main constituent of anorthositic rocks which include anorthosite, and gabbroic rocks, such as gabbro, norite, and troctolite. Hypersthene and black ilmenite are minor constituents of anorthosite. Anorthositic rocks are subdivided into three categories, dark, light, and buff-weathering. Labradorite showing the more intense deep blue iridescence is most common in dark grey anorthosite, and the lighter blue iridescence is characteristic of light grey anorthosite; iridescent labradorite is least common in the anorthosite that weathers to a buff colour (ref.: 264 p. 1557–1558). Individual gem labradorite crystals measure up to 150 cm long.

Iridescent labradorite may occur in any of the anorthositic rocks, but not all anorthosite bodies have labradorite displaying this property. Iridescent labradorite is most abundant in the anorthosite of the Nain Plutonic Suite, and less common in the Michikamau and Harp Lake intrusions. Although iridescent labradorite is considered to be absent or very rare in the Mealy Mountains anorthosite intrusion (on the south side of Lake Melville), anorthosite boulders containing iridescent labradorite have been reported to occur along the south shore of Lake Melville, west of Long Point (ref.: 143 p. 69).

The discovery of labradorite was made in 1772–1773 by Brother Joachim Wolfes, a missionary of the United Brethren (Unitas Fratrum or Moravian), who was involved in conducting barter trade with the native population in Labrador. The discovery location was given as Pownals

Island, now known as 'Paul Island', which is also referred to as 'Isle of Saint Paul' in some old reports. Specimens of the newly discovered iridescent stone were brought to London by Brother Layritz in 1773 (ref.: 108). Some specimens were given to the eminent London jeweller, J. Cox, for cutting; Cox was so impressed with this spectacular stone with blue flashes that had never before been seen in Europe, that he arranged to have some specimens presented as gifts to the King and Queen and other dignitaries (J.J. Brummer, unpub. rept., 1984). A suite of 39 polished slabs of labradorite, including one that measured 58 cm by 29 cm by 2 cm, was presented by Reverend Benjamin Latrobe of the United Brethren to the British Museum in 1777 (A.M. Clark, Natural History Museum, London, pers. comm., 1994). Cut and polished labradorite was displayed at the Geological Survey of Canada exhibit at the Colonial and Indian Exhibition in London in 1886 (ref.: 277 p. 161).

Labradorite was originally described by Leske in the journal, *Der Naturforscher*, published in 1776, and was introduced as a new mineral species in 1780 by A.G. Werner (ref.: 109). At that time it was referred to by various names including 'Labrador stone', 'pierre de Labrador', 'Labrador spar', and 'Labradorstein'. The early localities were given as "different places on Paul's Island, a fresh water lake called Nunaingok, which lies at no great distance inland from the head of a bay to the northwestward of Nain...and a bay a short distance to the southward" (ref.: 18 p. 12DD).

Hypersthene, an orthorhombic variety of pyroxene, is a common constituent of the anorthositic rocks. It is dark brown to blackish brown with a striking silky bronze or copper sheen. This sheen is due to reflection of light from microscopic inclusions of platy ilmenite or iron oxide films along cleavage planes. Hypersthene is generally granular massive, but also occurs as small to giant prismatic crystals up to 50 cm long. It also occurs as masses of small interlocking crystals in random orientation; this mass of crystals displays zigzag patterns on polished surfaces. It forms a very unique and attractive ornamental rock. The large individual crystals can be cut for use as a jewellery stone; a cabochon style stone may show a cat's-eye effect (ref.: 85 p. 269).

In the late nineteenth century, hypersthene was much esteemed as an ornamental stone in Europe, especially in France where it was referred to as 'Labrador hornblende' and 'Paulite', after the locality from which it came, Paul Island, Labrador; the hypersthene from Labrador was regarded as the finest in the world (ref.: 16 p. 451–452).

Large crystals of hypersthene occur in the Nain, Michikamau, and Harp Lake anorthositic intrusions. Notable localities are Paul Island and Pearly Gates in the Nain area, and Atikonak Lake and Romaine River in southwestern Labrador.

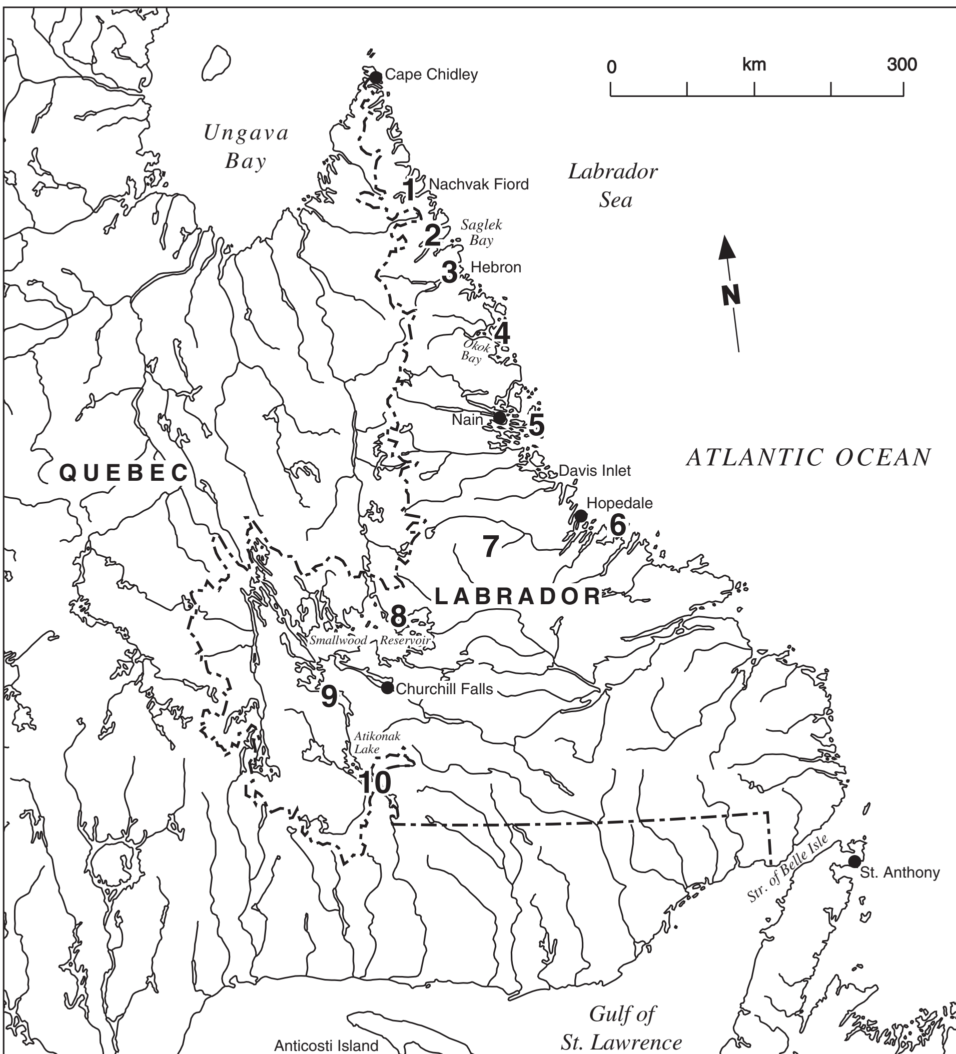
The localities from which iridescent labradorite and hypersthene have been reported are described in the text that follows. The descriptions are compiled from geological reports and are presented in the following order: coastal occurrences immediately to the south of Nain; South Aulatsivik Island and islands east of it; Paul Island and nearby islands; Kikkertavak, Nochalik and Nukasusutok islands; Tunungayualok Island and nearby islands; mainland occurrences west of Nain (Fig. 4).

Nain area labradorite occurrences

Gem labradorite occurs as iridescent coarse crystals embedded in pegmatitic anorthosite at several locations in the Nain area. The anorthosite is a component of the Nain Plutonic Suite (Fig. 5), a body of mid-Proterozoic intrusive rocks that includes anorthositic and granitic rocks along with gabbro, norite, diorite, syenite, and monzonite. These rocks cover an area of about 20 000 km² extending from Voisey Bay north to Port Manvers, and from the coastal islands east of Nain for about 95 km inland. These rocks are exposed in the islands in the vicinity of Nain and in valleys and hillsides on the mainland. The anorthosite rocks of the Nain area are shown in Figure 5.

Ref.: 262 p. 611–642.

Maps (T): 14 S.W. Nain Nutak
(G): 90-44 Nain Plutonic Suite and surrounding rocks (Nain-Nutak, NTS 14 S.W.) (NDME, 1:500 000)



1. Nachvak Fiord soapstone 2. Saglek Bay area soapstone 3. Hebron soapstone
4. Okak Island area soapstone 5. Nain area labradorite 6. Hopedale area soapstone
7. Harp Lake area labradorite 8. Michikamau Lake labradorite
9. Ossokmanuan Lake labradorite 10. Romaine River labradorite

Figure 4. Labrador: map showing the location of labradorite and soapstone occurrences.

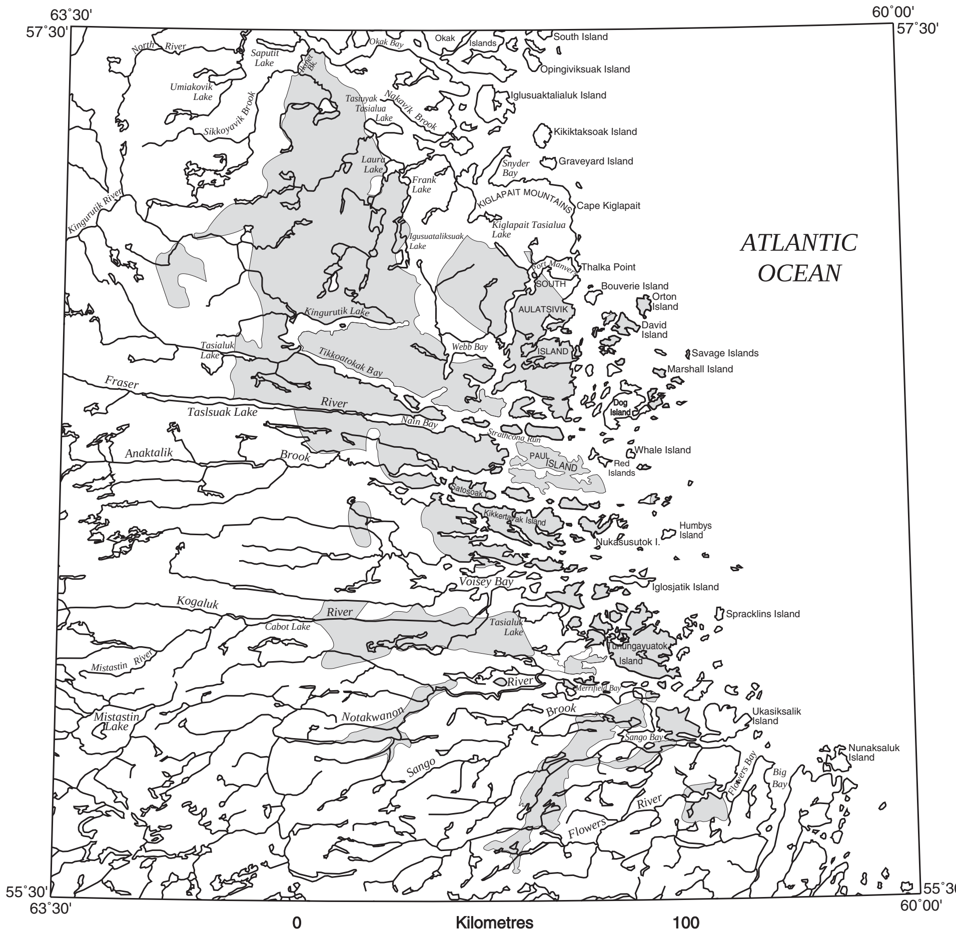


Figure 5. Nain area: map showing anorthosite rocks of the Nain Plutonic Suite.

81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)
80-14 Nain, Labrador North district (NDME, 1:200 000)

Tabor (Taber) Island

Iridescent labradorite occurs as coarse to very coarse crystals in gabbroic anorthosite in various localities on the island. The best known locality is the Grenfell quarry at the southwestern end of the island where crystals from 1.5 cm to 1.5 m in diameter occur in pegmatitic veins 3 m to 10 m wide. Another locality furnishing coarse crystals is at the northern end of the island. Dark blue and blue-green are the most common iridescent colours; gold and bronze colours are also present.

Tabor Island furnished fine specimens of labradorite that reached museums soon after the mineral was discovered in about 1773. The quarry is the sole commercial source of gem labradorite. It was opened in 1892 by Ralph G. Taber of Red Wing, Minnesota, to supply gem material to the jeweller, Tiffany and Company of New York. In 1894, he made a shipment of about 7 t to the

Plate 42

Tabor Island shoreline with Grenfell quarry in the left foreground, 1969. GSC 1994-617A

Plate 43

Grenfell quarry, Tabor Island, 1969. GSC 1994-617B

United States. A larger shipment of about 41 t was made in 1934 to the United States by Dr. Louis Wheelock, an amateur explorer. From 1934 until 1959, the International Grenfell Association mined the deposit sporadically, producing labradorite for its lapidary shop at St. Anthony. In 1959, Brinex Limited extracted 6555 kg of labradorite to test the gem market potential with the co-operation of Labradorite Manufacturing Company of Corner Brook and Mr. Sam Ronson, a lapidary from Montréal. Brinex Limited continued operations until 1963 producing a total of 65 t. Between 1964 and 1978, Labradorite Manufacturing Company worked the deposit and, in 1979, the Nain Crafts Council removed 1800 kg of labradorite for its use in Nain. In 1981, the Labrador Inuit Development Corporation took over the rights to the deposit and shipped rough material to Nain. In 1991, a subsidiary, Torngaitujaganniavingit Corporation, was formed to operate the quarry.

Tabor Island is a small island about 950 m by 600 m; it is located south-southwest of Nain, between the western tip of Kikkertavak Island and the mainland. Tabor Island, originally referred to by the Eskimo name 'Napoktulagatsuk Island' or 'Napartuligharsuk Island', was also known as 'Taber Island' after its original owner, Ralph Taber. The island is about 24 km from Nain. *See* Map 30.

Refs.: 18 p. 11DD–13DD; 42 p. 50; 50 p. 216–218; 93; 171 p.129–131; 173 p. 2; 186 p. 198; 259 p. 4, 7; 263 p. 56.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Kemaktulliviktalik (Khemakfuliviktalik) Island

Dark grey anorthosite containing some very coarse pods of iridescent labradorite is reported from this island; the pods measure about 1 m by 1 m. The anorthosite rock is mainly dark grey mottled with scarce iridescence; it could be used as an ornamental stone.

Kemaktulliviktalik Island is immediately south of the southwestern end of Satosoak Island, about 27 km southwest of Nain. The labradorite occurrence is on the western side of the island. *See* Map 30.

Refs.: 93; 173 p. 9.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

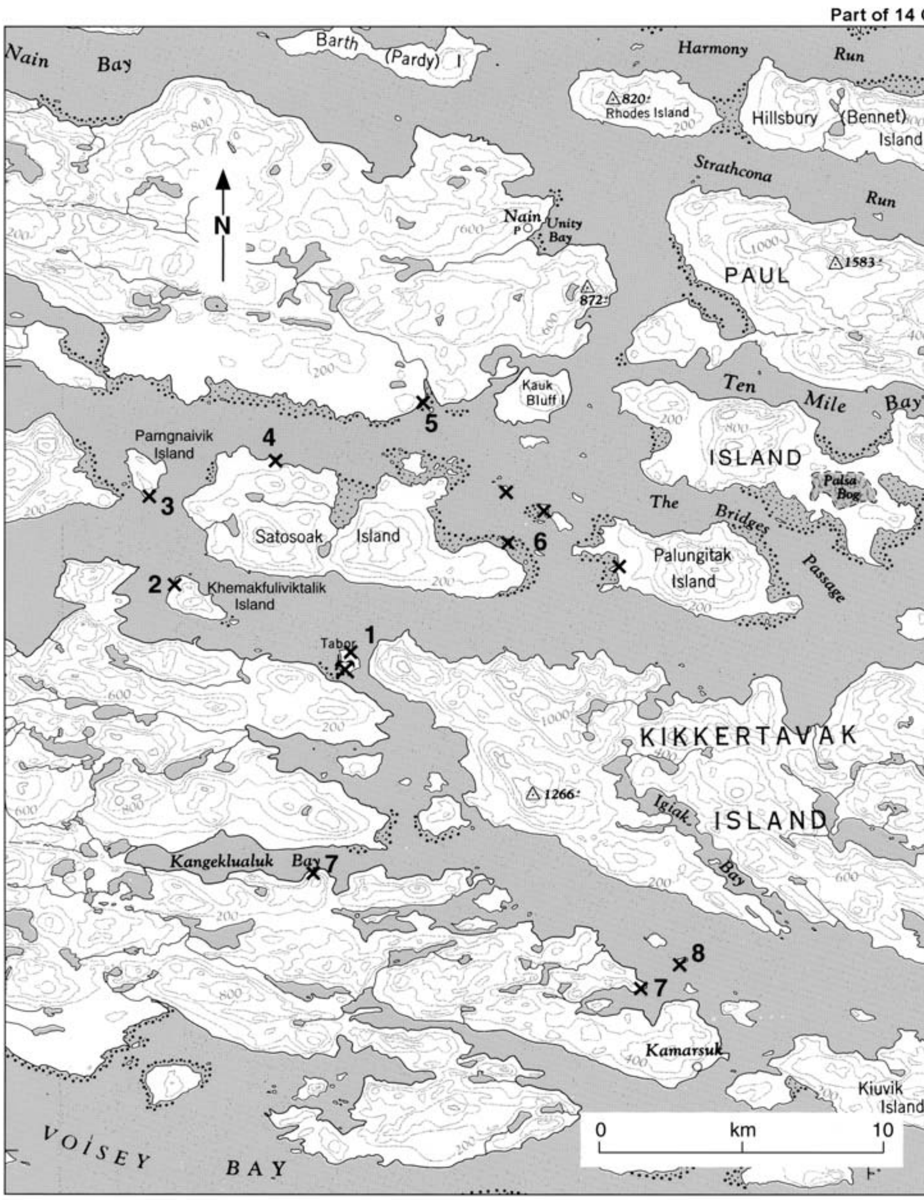
Parngnaivik Island

Labradorite crystals showing scarce iridescence occur in dark grey anorthosite. Only a few zones containing crystals larger than 7 cm to 10 cm are reported.

Parngnaivik Island is between Satosoak Island and Akuliakatak Peninsula on the mainland. It is about 25 km southwest of Nain. The occurrence is at the southern tip of the island. *See* Map 30.

Refs.: 93; 173 p. 4.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)



1. Tabor Island 2. Kemaktulliviktalik Island 3. Parngnaivik Island
4. Satosoak Island 5. Kauk Bay 6. Palungitak Island and islets
7. Kangeklualuk Bay 8. Middle Island

Map 30. Nain south area labradorite occurrences.

81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Satosoak Island

Iridescent labradorite occurs at the northwestern end of this island. The iridescent colours include copper and bronze as well as violet, red, and blue-green. The zone containing coarse iridescent crystals is exposed over a distance of about 100 m.

The occurrence is exposed along the northern shore of the island near its northwestern end. The exposure extends from the water's edge up the slope to an elevation of about 25 m.

Satosoak Island is about 23 km south-southwest of Nain. *See* Map 30.

Refs.: 93; 259 p. 7–8.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Kauk Bay

Dark grey anorthosite containing local iridescent labradorite crystals up to 8 cm long occurs just west of the mouth of a brook west of Kauk Harbour on the mainland about 10 km south of Nain. *See* Map 30.

Refs.: 93; 173 p. 4.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Palungitak Island

Strongly zoned iridescent crystal aggregates of labradorite up to 70 cm across occur in light grey gabbroic anorthosite outcrops on the western end of Palungitak Island. The zoning consists of blue rims with green and yellow cores.

Labradorite showing deep blue iridescent colours occurs in a group of small islands and islets in the channel off the western end of Palungitak Island and just north of the eastern end of Satosoak Island.

Palungitak Island and the islands at its western end are about 13 km south of Nain on the route to Tabor Island. *See* Map 30.

Refs.: 65 p. 54–55; 93; 259 p. 9.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)

81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Kangeklualuk Bay

A small zone of excellent coarse iridescent labradorite crystals occurs in grey anorthosite that is exposed on the mainland point on the southern shore of Kangeklualuk Bay, about 4 km northwest of Karmarsuk. The iridescent colours are green, blue, bronze, and orange; some nearly clear black labradorite is also reported. The zone of iridescent crystals measures about 23 m by 6 m.

Another occurrence of gem labradorite is reported on the southern shore of Kangeklualuk Bay about 13 km west of the locality described above.

The localities are on the northern shore of a peninsula extending eastward from the mainland, about 25 km south of Nain. *See* Map 30.

Refs.: 93; 173 p. 9.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Middle Island

Labradorite showing scarce iridescence is reported to occur in coarse to very coarse, grey anorthosite exposed on Middle Island. This island is in Kangeklualuk Bay, between Karmarsuk and Kikkertavak Island. *See* Map 30.

Refs.: 93; 173 p. 11.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

South Aulatsivik Island

Iridescent labradorite has been reported from the following localities on South Aulatsivik Island:

Ringbolt Tickle, on the eastern shore of the northern part of the island: green to blue iridescent labradorite occurs spottily in grey to dark grey medium- to very coarse-grained anorthosite. *See* Map 31.

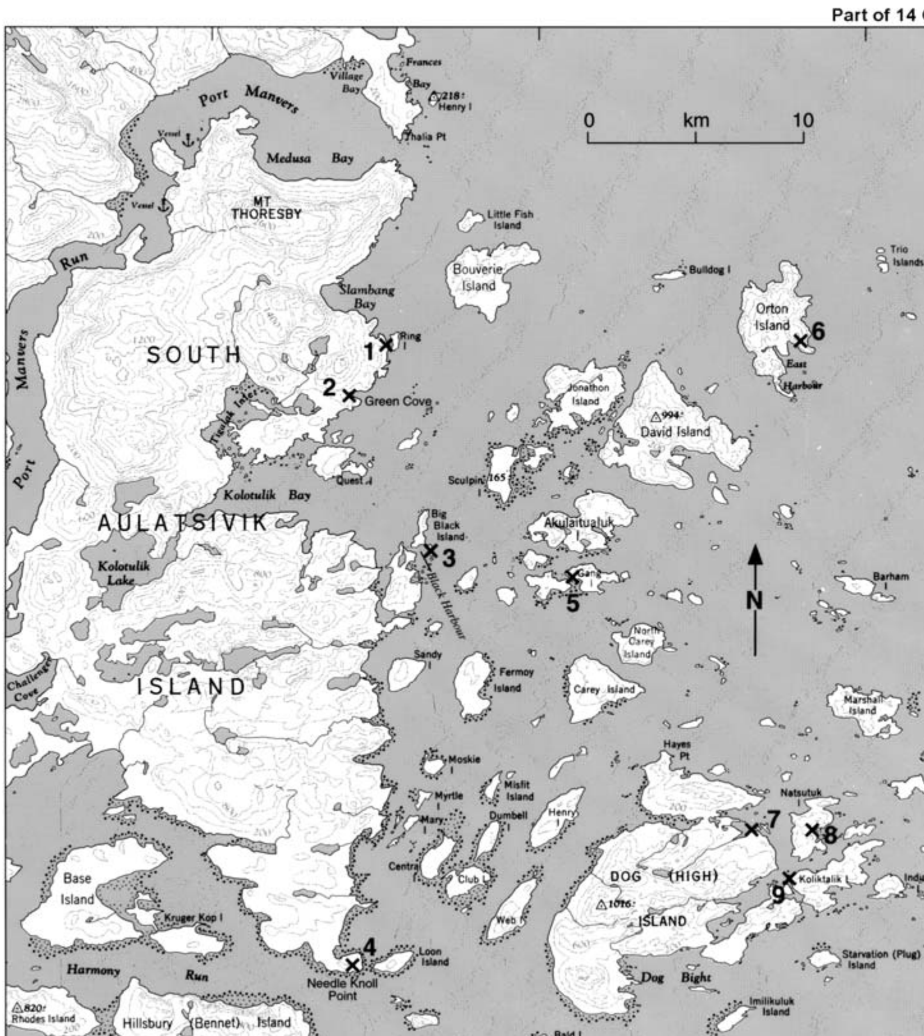
Green Cove, on the eastern side of the northern part of the island: some iridescent labradorite occurs in both coarse-grained and finer grained anorthosite near this cove. *See* Map 31.

Black Island Harbour, on the eastern shore of the island: iridescent grains of labradorite occur in dark grey, medium-grained anorthosite. Gabbroic anorthosite containing iridescent labradorite occurs in a small island in the harbour. *See* Map 31.

Needles Knoll Point, on the southeastern tip of the island: iridescent labradorite occurs in light grey, medium-grained diorite. This rock is suitable for use as an ornamental or decorative building stone. *See* Map 31.

Refs.: 41 p. 47; 93; 173 p. 8–9, 11.

Maps (T): 14 C/11 Dog Island
14 C/14 David Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)



1. Ringbolt Tickle 2. Green Cove 3. Black Island Harbour 4. Needles Knoll Point
5. Gang Island Tickle 6. Orton Island 7. Evilik Bay 8. September Harbour
9. Queens Lakes Tickle

Map 31. South Aulatsivik Island area labradorite occurrences.

Gang Island Tickle

Scarce iridescent labradorite occurs in coarse to very coarse, grey anorthosite. The exposure and beach rubble occur on the shore of Gang Island Tickle, a narrow channel between eastern and western Gang Island, about 5 km east of South Aulatsivik Island. *See* Map 31.

Refs.: 93; 173 p. 9.

Maps (T): 14 C/14 David Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Orton Island

Iridescent labradorite is reported to occur on the eastern side of the island. Orton Island is northeast of David Island and about 10 km east of South Aulatsivik Island. *See* Map 31.

Refs.: 93; 173 p. 9.

Maps (T): 14 C/14 David Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Dog Island area

Labradorite showing rare iridescence occurs in a few coarse zones of anorthosite in fine- to medium-grained gabbro. Occurrences are at Evilik Bay at the northeastern end of Dog Island, at September Harbour on the eastern side of Natsutuk Island, and in the Queens Lakes Tickle region in eastern Dog Island. Dog Island is about 7 km east of the southern end of South Aulatsivik Island. *See* Map 31.

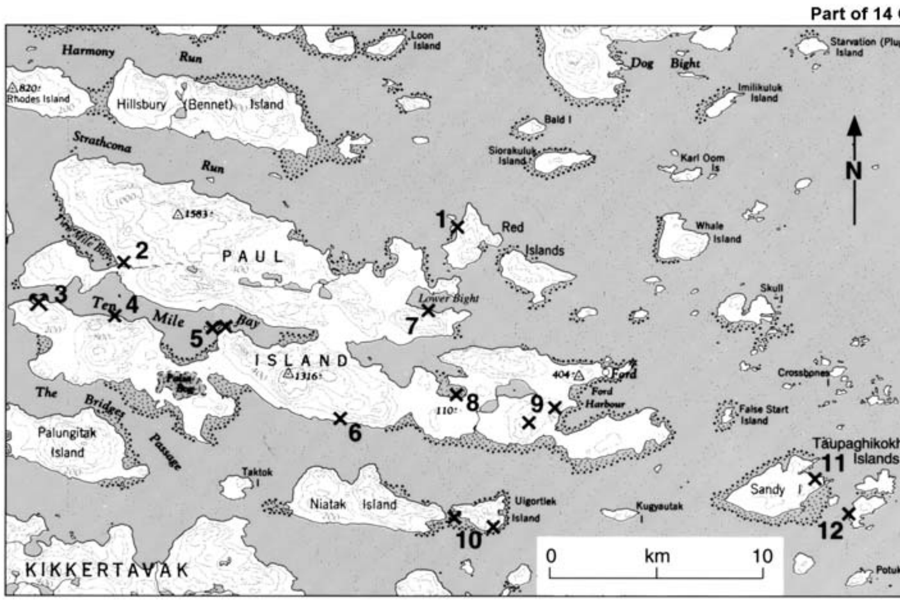
Refs.: 93; 173 p. 11.

Maps (T): 14 C/11 Dog Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Two Mile Bay, Paul Island

Iridescent labradorite is reported to occur in the vicinity of a stream at the head of Two Mile Bay, at the northwestern end of Paul Island. *See* Map 32.

Refs.: 93; 173 p. 8.



1. West Red Island 2. Two Mile Bay 3. Ten Mile Bay quarry
4, 5. Ten Mile Bay occurrences 6. southern Paul Island 7. Lower Bight
8. Higher Bight 9. Ford Harbour, Mount Pikey 10. Uigortlek Island
11. Sandy Island 12. Taupaghikokh Islands

Map 32. Paul Island area labradorite occurrences.

Maps (T): 14 C/12 Nain
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Ten Mile Bay quarry

The quarry produces attractive ornamental labradorite rock (anorthosite) which is sold under the trade names *REFLECT BLUE* and *STARLIGHT*. The rock is light to medium grey, medium grained with evenly distributed, uniformly sized iridescent labradorite crystals in random orientation. The labradorite crystals, averaging slightly over 1 cm across, show a blue to violet-blue iridescence and make up about 18% of the rock. Between the crystals are narrow margins of white granular labradorite and streaks of pyroxene-biotite. The rock is suitable for use as an ornamental stone as well as a decorative building stone.

The quarry has been opened into a large area of anorthosite rock that rises steeply 75 m to 100 m from the southern shoreline of Ten Mile Bay. In 1960, Brinex with the assistance of National Granite Limited opened the quarry and extracted several tonnes of stone for testing. In 1990–1991, Labrador Inuit Development Corporation and The Newfoundland Department of Mines and Energy collaborated to evaluate the deposit and quarried a 10 t test block. In 1992, Torngaitujaganniavingit Corporation, a subsidiary of the Labrador Inuit Development Corporation, undertook development at a site 125 m east of the original quarry. The first shipment was made to Europe in 1993. The stone is marketed in Europe as REFLECT BLUE by Wibestone A.G., an Italian-German company. Another Italian company manufactures 30 cm by 30 cm tiles that are sold under the name STARLIGHT.

The quarry is on the southern side of Ten Mile Bay, about 1.6 km from the entrance to the bay and 10 km southeast of Nain. *See* Map 32.

Refs.: 65 p. 56; 93; 166 p. 7; 167 p. 80–81; 171 p. 129–138; 173 p. 4–5.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Ten Mile Bay occurrences

Labradorite showing scarce iridescence occurs in medium grey to dark grey anorthosite exposed along the face of a cliff on the southern side of Ten Mile Bay, about 3 km east of the Ten Mile Bay quarry. About 9 km east of the quarry, anorthosite containing iridescent labradorite occurs on a headland on the southern shore of the bay and on a nearby island. *See* Map 32.

Refs.: 93; 173 p. 5.

Maps (T): 14 C/5 Kamarsuk
14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Southern Paul Island

Iridescent labradorite occurs in coarse to very coarse, dark grey to medium grey gabbroic anorthosite. Crystals are commonly 2 cm to 8 cm across in pods measuring up to 18 cm. Colour zoning is common. The occurrence is on the southern shore of Paul Island, directly north of Niatak Island. *See* Map 32.

Refs.: 93; 173 p. 5.

Maps (T): 14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Lower Bight, Paul Island

Labradorite displaying very scarce iridescence occurs in medium to coarse anorthosite that outcrops on the south shore of Lower Bight, at the eastern end of Paul Island. *See* Map 32.

Refs.: 93; 173 p. 5.

Maps (T): 14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)

81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Higher Bight, Paul Island

Iridescent labradorite occurs in noritic anorthosite along the southern shore of Higher Bight, at the eastern end of Paul Island. The labradorite shows colour zoning with bronze in the cores grading outward to orange, yellow, green, and blue. This iridescent labradorite occurs as broken fragments along the shore. *See* Map 32.

Labradorite showing zoned iridescence occurs along the north shore of Higher Bight (R.F. Emslie, pers. comm., 1994). Spectacular zones of giant hypersthene and plagioclase crystals occur in anorthositic rock along the north shore of the bight.

Ref.: 66 p. 34–37.

Maps (T): 14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Ford Harbour, Paul Island

Iridescent labradorite has been found in anorthosite boulders strewn on the hills on the west side of Ford Harbour. Labradorite has also been reported to occur on Mount Pikey, southwest of Ford Harbour. Ford Harbour is at the eastern end of Paul Island. *See* Map 32.

Ref.: 50 p. 216–218.

Maps (T): 14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

West Red Island

Iridescent labradorite occurs in very coarse, dark grey anorthosite masses enclosed in medium-grained diorite that also contains some iridescent labradorite. The anorthosite masses measure up to 4.5 m by 15 m. Blue iridescent patches measure up to 0.6 m by 1 m. The occurrence is on the west side of West Red Island, which is off the northeastern end of Paul Island. *See* Map 32.

Refs.: 93; 173 p. 8.

Maps (T): 14 C/11 Dog Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Uigortlek Island

Pods of iridescent labradorite crystals up to 5 cm long occur in medium-grained to coarse-grained grey anorthosite along the southern shore of Uigortlek Island. The pods measure up to 6 m by 3 m. Some iridescent labradorite occurs in coarse-grained, dark grey anorthosite exposed on the islet in the channel between Uigortlek Island and Niatak Island to the west; the crystals commonly measure 5 cm to 7 cm, but may reach as much as 20 cm. Pegmatitic anorthositic rocks on Uigortlek Island and on the western and eastern parts of Niatak Island contain crystals of labradorite displaying zoned iridescence with red cores and blue rims with various colours in between.

Uigortlek Island is about 35 km southeast of Nain and south of Paul Island. *See* Map 32.

Refs.: 52 p. 60–61; 93; 173 p. 6.

Maps (T): 14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Sandy Island

Iridescent labradorite occurs in coarse-grained anorthositic gabbro on the eastern part of the island.

Sandy Island is about 45 km southeast of Nain and near the eastern end of Paul Island. *See* Map 32.

Ref.: 216 p. 390.

Maps (T): 14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Taupaghikokh Islands

Iridescent labradorite crystals occur sparingly in medium- to coarse-grained anorthosite exposed at the southwestern end of southern Taupaghikokh Island (East Sandy Island). These islands are immediately east of Sandy Island. *See* Map 32.

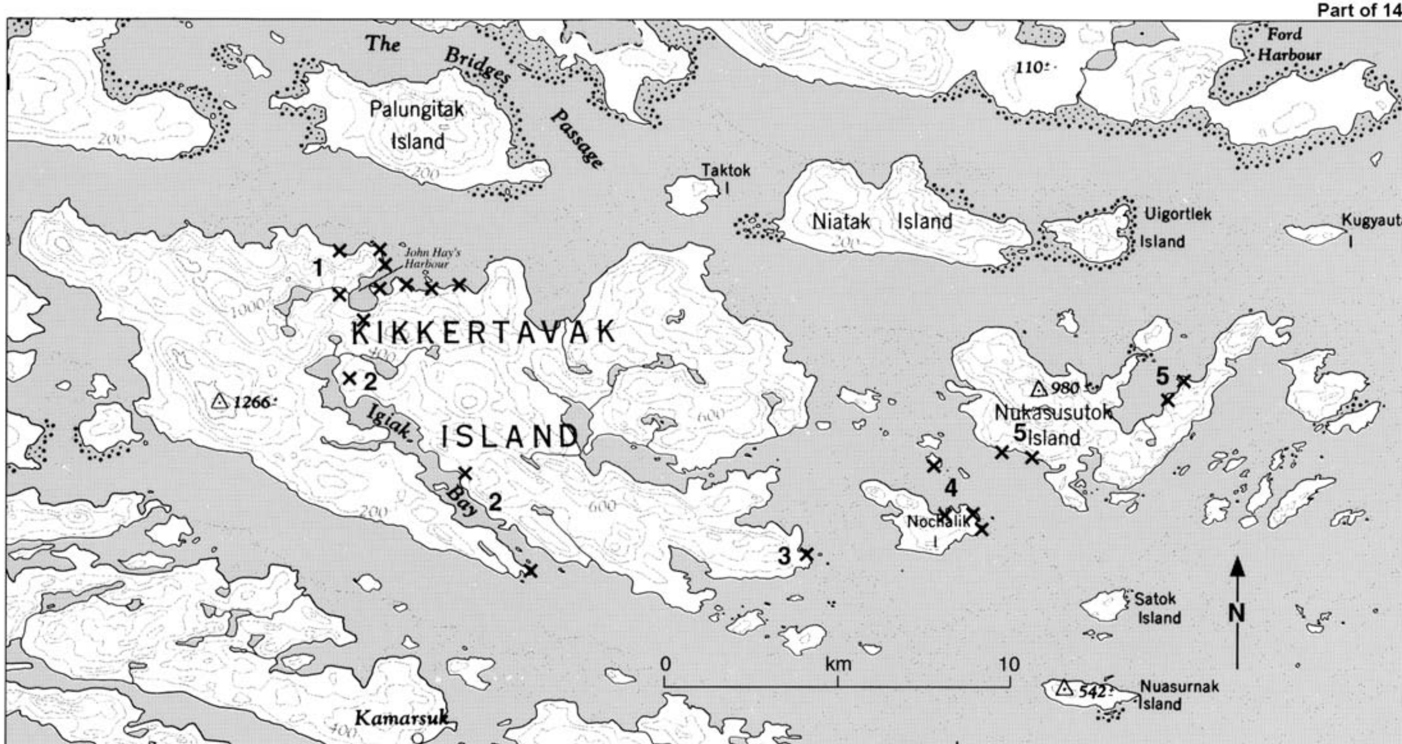
Refs.: 93; 173 p. 8.

Maps (T): 14 C/6 Ford Harbour
14 C/7 Satoaluk Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

John Hay's Harbour, Kikkertavak Island

Fine quality iridescent labradorite occurs in medium- to coarse-grained gabbroic anorthosite on the east and west sides of the harbour. The labradorite is dark grey with blue, green, gold, red, and violet iridescence. Some crystals show zoning in iridescent blue-green-gold-bronze colours. The crystals are commonly 1.5 cm to 5 cm across, but may reach 8 cm across. Iridescent labradorite makes up 10% to 20% of the rock. The anorthosite encloses zones of very coarse iridescent labradorite ranging from 1 m to 9 m across by 30 m; crystals in these zones measure from 7 cm to 45 cm long and from 2 cm to 15 cm wide. Large crystals of hypersthene occur in the anorthosite.

Part of 14 C



1. John Hay's Harbour 2. Igiak Bay 3. Kikkertavak Island southeast 4. Nochalik Island and islet 5. Nukasusutok Island

Map 33. Kikkertavak Island area labradorite occurrences.

The occurrences on the east side of the harbour have been explored by six small shallow pits up to 1.5 m deep; the largest pit measures 3 m by 13 m. The pits are at or below the high tide level.

The occurrence on the west side of the harbour is up the slope of a hill overlooking the cove. It is exposed over an area of about 800 m by 1000 m and extends from the water's edge to an elevation of about 60 m.

At the south end of John Hay's Harbour (500 m south of the harbour bottom), labradorite occurs in anorthosite outcrops 80 to 90 m above the harbour. Some exploratory blasting was done in 1987 by the Newfoundland Department of Mines and Energy. The labradorite crystals are up to 5 cm long, brownish, with up to 20% of them exhibiting dark blue iridescence with green to yellow to bronze zoning. The anorthosite enclosing them is medium to coarse grained and contains some hypersthene and ilmenite. The rock is suitable as an ornamental stone.

The northern shoreline to the east and west of John Hay's Harbour exposes coarse gabbroic anorthosite containing up to 10% iridescent labradorite crystals, commonly 1 cm to 8 cm across.

John Hay's Harbour, also referred to as 'Kikkertavak Harbour', is on the northern side of Kikkertavak Island, about the midpoint. *See* Map 33. Kikkertavak Island is about 20 km south-southeast of Nain.

Refs.: 65 p. 56; 93; 166 p. 7; 167 p. 78–80; 173 p. 2–4, 8, 9, 11; 259, p. 7.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Igiak Bay, Kikkertavak Island

Massive, coarse-grained anorthosite containing uniformly distributed dark blue to blue-green iridescent labradorite crystals occurs on the east side of Igiak Bay. The prospect is on a hill 1.5 km south of the John Hay's Harbour occurrence and 60 to 70 m above the east side of the head of Igiak Bay. The iridescent labradorite crystals range from 0.5 cm to 30 cm across, the colour varying from blue to blue-green with some yellow zoning. Iridescent labradorite makes up to 5% of the rock; a hypersthene content of about 3% to 5% gives the rock a dark appearance. The rock is suitable as an ornamental and building stone.

Similar ornamental rock is exposed at the following localities: at about the midpoint on the north shore of Igiak Bay; at the point on the southern shore of the island at the entrance to Igiak Bay; and at the southeastern point of the island. *See* Map 33.

Igiak Bay is a long, narrow indentation on the south central part of Kikkertavak Island and directly south of John Hay's Harbour.

Refs.: 65 p. 56; 93; 166 p. 7; 167 p. 79–80; 173 p. 2–4, 8, 9, 11.

Maps (T): 14 C/5 Kamarsuk
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)

81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Nochalik Island

Iridescent blue and blue-green labradorite occurs as small pods in anorthosite; some labradorite is zoned in blue, red, and gold iridescent colours. Along with this coarse labradorite, a medium-grained anorthosite rock contains iridescent labradorite crystals about 2 cm across; this rock is suitable for use as an ornamental stone. The iridescent labradorite occurrences are exposed along the northern, northeastern, and eastern shores of Nochalik Island. They are accessible only at low water.

Iridescent labradorite occurs on an island north of Nochalik Island, between Nochalik and Nukasusutok islands. The labradorite crystals occur in zones of very coarse-grained anorthosite enclosed in less coarse-grained grey anorthosite. The zones are about 3 m by 3 m. The crystals show a blue iridescence that may include colour zoning.

Nochalik Island is southeast of Nain, between Kikkertavak Island and Nukasusutok Island. The localities are about 35 km from Nain. *See* Map 33.

Refs.: 93; 173 p. 10–11; 259 p. 8–9.

Maps (T): 14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Nukasusutok (Nukasorsuktokh) Island

Iridescent labradorite occurs in anorthosite throughout the island. Very coarse crystals of fine quality iridescent labradorite occur in anorthosite on the southern and western shores of this island. The crystals measure up to 15 cm long and exhibit a blue iridescent colour with some zoned colours. On the west side of the island, the zone of iridescent crystals extends over a 3 km stretch of shoreline. Gabbroic anorthosite with some blue iridescent labradorite occurs on the eastern side of North Bay at the eastern end of the island.

Nukasusutok Island is immediately to the east of Kikkertavak Island and about 38 km southeast of Nain. *See* Map 33.

Refs.: 52 p. 61; 93; 173 p. 6–8; 174 p. 3–5.

Maps (T): 14 C/6 Ford Harbour
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Tunungayualok Island

Iridescent labradorite occurs as angular to rounded crystals in brecciated anorthositic rock. The crystals range from 1 cm to 35 cm, are fractured and are cut by thin white feldspar veinlets. Iridescent labradorite makes up about 15% of the rock, the colours being dark blue, blue-green to yellow with colour zoning. The matrix enclosing the crystals is composed mainly of white to grey labradorite weathering to yellow and orange-brown. Gem-quality crystals are present and may be retrieved by hand-sorting. The zones containing iridescent labradorite measure up to several hundred metres across and are exposed along the following shorelines:

Kayutak Bay: at the east end of the bay, a steep talus slope extending 75 m from the outcrop to the shore contains blocks of labradorite breccia rock up to 2 m across. Rounded to angular iridescent labradorite crystals measuring up to 30 cm occur in the white to grey labradorite matrix. Many of the crystals have excellent iridescent colour and colour zoning. Most crystals are fractured.

Kayutak Bay is on the northwestern side of Tunungayualok Island. *See* Map 34.

Islands in Nuvudluktok Bay: labradorite breccia is exposed at the western end of the more easterly of the two larger islands in the bay. Large iridescent labradorite crystals up to 15 cm long display a variety of colours and colour zoning, but are generally fractured. Similar exposures of labradorite breccia occur along the shoreline of the bay.

Nuvudluktok Bay is on the west side of Tunungayualok Island. *See* Map 34.

Tunungayualok Island is about 60 km southeast of Nain and about 16 km northwest of Davis Inlet.

Refs.: 168 p. 167–170; 266 p. 37–40; 267 p. 21–23.

Maps (T): 14 C/3 Akpiktok Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

South Tunungayukaluk (Tunvungayukuluk) Island

Iridescent labradorite crystals up to 45 cm in diameter, but averaging about 5 cm, occur in orange-weathered anorthosite exposed on the northeastern corner of the island. The crystals display a variety of colours and colour zoning, but are fractured and cut by white feldspar veinlets. The anorthosite occurs as rounded inclusions up to 1 m in diameter in breccia.

South Tunungayukaluk Island is immediately northwest of Tunungayualok Island, opposite Kayutak Bay. *See* Map 34.

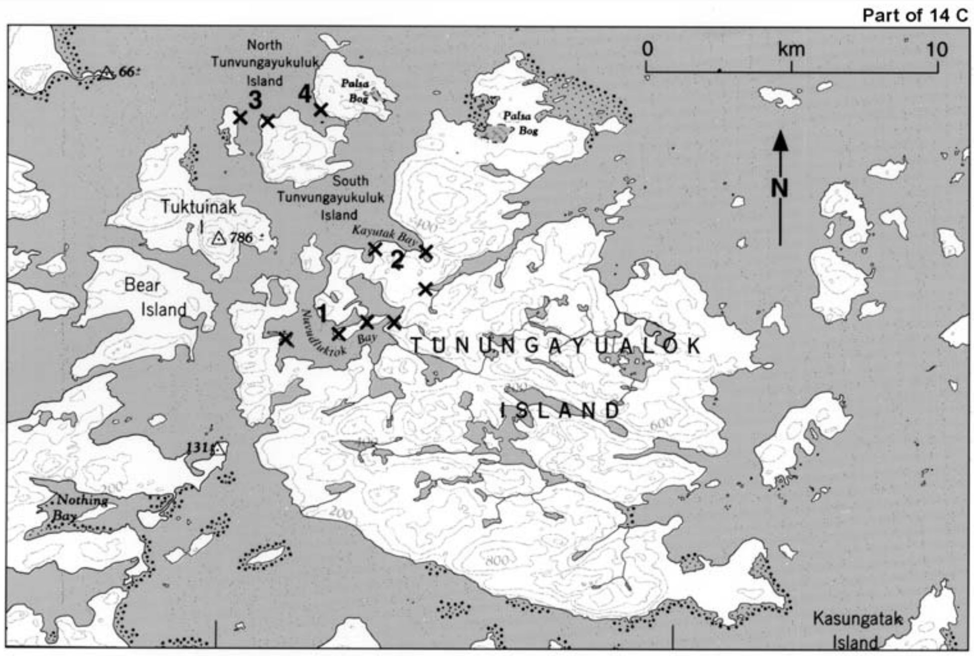
Refs.: 168 p. 167–170; 266 p. 37–40; 267 p. 21–23.

Maps (T): 14 C/3 Akpiktok Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

North Tunungayukaluk (Tunvungayukuluk) Island

Irridescent labradorite occurs in dark anorthosite on the southwestern shore of this island.

North Tunungayukaluk Island is immediately northeast of South Tunungayukaluk Island. *See* Map 34.



1. Nuvudluktok Bay   2. Kayutak Bay   3. South Tunungayukaluk Island
4. North Tunungayukaluk Island

Map 34. Tunungayualok Island area labradorite occurrences.

Ref.: 174 p. 2.

Maps (T): 14 C/3 Akpiktok Island
(G): 1437A Nain, Newfoundland (GSC, 1:250 000)
81-16 Nain, Torngat Mountains district, Newfoundland, mineral occurrence map (NDME, 1:250 000)

Tikkoatokak Bay

Blue and blue-green iridescent labradorite occurs in coarse- to very coarse-grained anorthosite along the south shore of the western part of Tikkoatokak Bay.

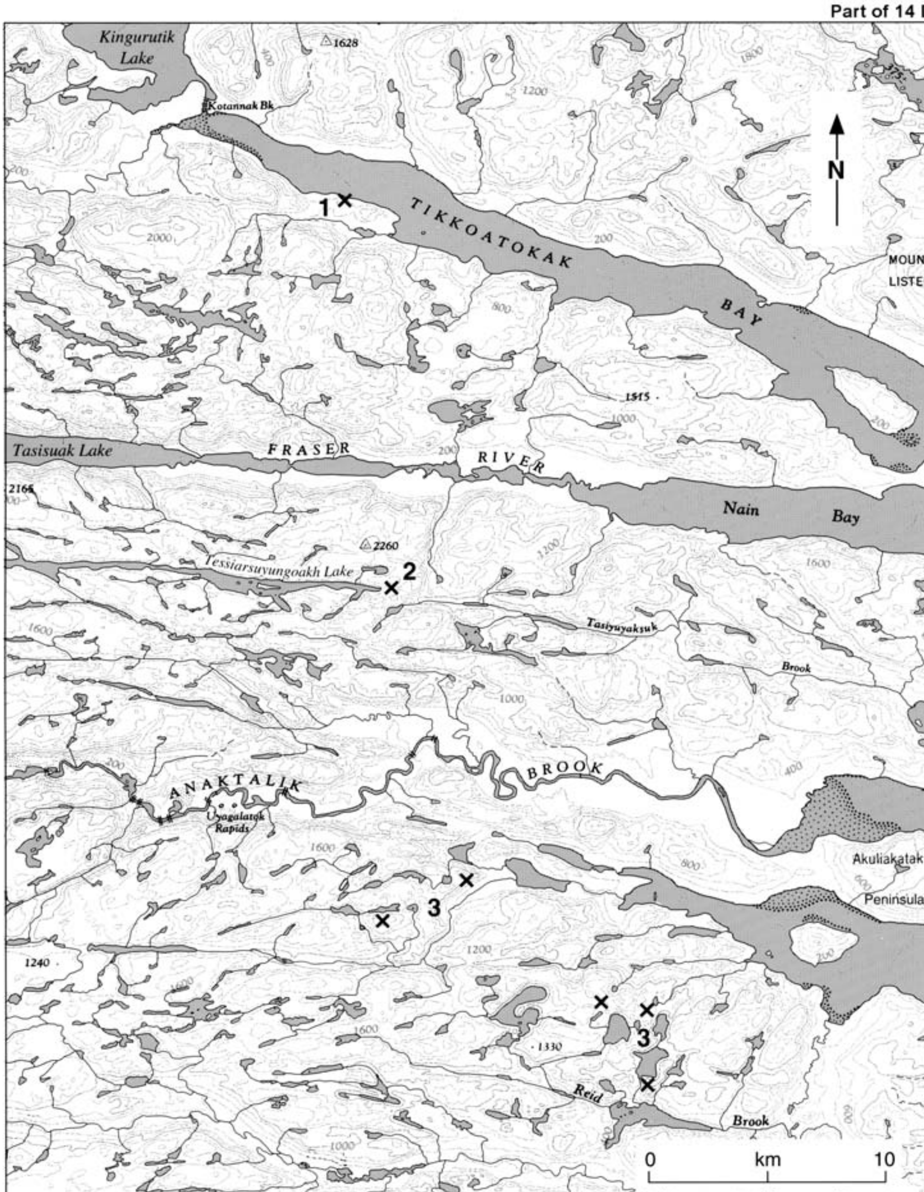
The occurrence is on the mainland, about 35 km northwest of Nain. *See* Map 35.

Ref.: 175 p. 130.

Maps (T): 14 D/9 Tikkoatokak Bay
(G): 1438A Tasisuak Lake, Newfoundland–Québec (GSC, 1:250 000)
80-13 Tasisuak Lake, Labrador (NDME, 1:200 000)

Pearly Gates

The most spectacular and extensive occurrence of iridescent labradorite in the area west of Nain is at this locality. Crystals measure up to 75 cm across. The iridescence varies from deep blue to blue-green to yellowish green, with colour zoning in some of the crystals. The labradorite crystals



1. Tikkoatokak Bay 2. Pearly Gates 3. Reid Brook–Anaktalik Brook area.

Map 35. Nain west area labradorite occurrences.

occur in fine-grained, light grey anorthosite. Large crystals of hypersthene occur in the anorthosite.

Labradorite occurs as talus at the base of a steep-walled valley at the east end of Tessiarsuyungoakh (Jumbo) Lake on the mainland, about 16 km west of Nain. The talus consists of rock fragments weathered from the cliffs above; they range in size from fist-sized to blocks measuring 5 m by 5 m by 10 m. The talus on the valley floor covers an area 100 m by 25 m. Large quantities are available. Anorthosite in the surrounding area displays local zones of similar character. Iridescent labradorite is also found along the traverse from the Pearly Gates occurrence across the ridge to the Fraser River, a distance of about 4 km.

Pearly Gates is south of Nain Bay and between Fraser River and Anaktalik Brook, about 43 km west of Nain. The locality may be reached by air in summer or by snowmobile in winter. *See* Map 35.

Refs.: 66 p. 51–52; 217 p. 62–63, 69; 259 p. 8; 265 p. 196–197.

Maps (T): 14 D/9 Tikkoatokak Bay
(G): 1438A Tasisuak Lake, Newfoundland–Québec (GSC, 1:250 000)
80-13 Tasisuak Lake, Labrador (NDME, 1:200 000)

Reid Brook–Anaktalik Brook area

Iridescent labradorite occurs in the area between Reid Brook and Anaktalik Brook. The iridescent labradorite occurs as randomly distributed crystals in small areas ranging from about 10 m² to 15 m², in medium-grained anorthosite or anorthositic gabbro. The iridescence varies from green to blue-green, and includes bronze colour zoning.

The area is south of Nain Bay and 35 km to 40 km west-southwest of Nain. *See* Map 35.

Ref.: 218 p. 80, 84, 86.

Maps (T): 14 D/8 Reid Brook
(G): 85-66 Anaktalik Brook–Kogaluk River area, Labrador (NDME, 1:100 000)
1438A Tasisuak Lake, Newfoundland–Québec (GSC, 1:250 000)

Michikamau Lake labradorite occurrences

The occurrence of iridescent labradorite in western Labrador was first reported by A.P. Low who conducted a geological survey of the area in 1893–1894 for the Geological Survey of Canada. His report states that "labradorite of the precious variety occurs in great abundance on the north-east side of Michikamau Lake, where large and beautiful crystals of this mineral are seen continuously along the shore for more than ten miles" (ref.: 152 p. 289L). The crystals are reported to measure up to 15 cm by 20 cm with blue to green and bronze iridescence, including zoning in these colours.

The anorthosite is dark violet-grey, coarsely crystalline, and is reported to contain crystal aggregates of dark brown hypersthene 20 to 25 cm across, small irregular masses of ilmenite, and mica. The anorthosite mass is the western edge of the Michikamau Intrusion, which was emplaced in mid-Proterozoic time. It covers an area of about 2000 km² extending northward about 60 km from the northeastern side of Michikamau Lake to the Newfoundland and Labrador–Quebec border. The areal extent of the intrusion is shown in Figure 6.

Michikamau Lake forms the north central part of the Smallwood Reservoir, which was created in 1972 by backing up the Churchill (formerly the Hamilton or Grand) River for the hydro-power development at Churchill Falls. The southern end of the intrusion is about 70 km north of Churchill Falls.

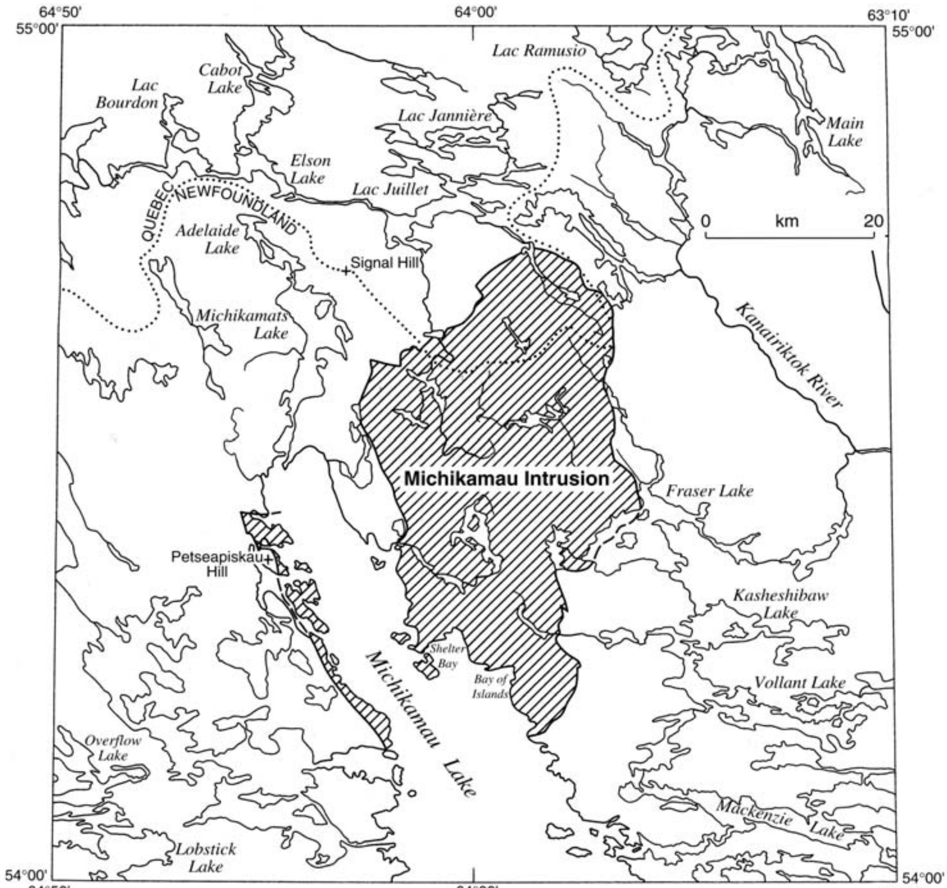


Figure 6. Michikamau Lake area: map showing the Michikamau intrusion (ref.: 63 Fig. 3).

Refs.: 63 p. 11–73, 83; 66 p. 12–17; 152 p. 201L–202L, 229L–230L, 289L; 183 p. 149–153, 161.

Maps (T): 13 L/4 Agnes Lake
13 L/5 Fraser Lake
13 L/12 Spot Lake
23 I/8 Petscapiskau Hill
23 I/9 Signal Hill

(G): 19-1968 Michikamau Intrusion de Michikamau (west half - moitié ouest), Newfoundland–Quebec–Terre-Neuve (GSC, 1:63 360)
586 Labrador Peninsula, south east sheet (GSC, 1:1 584 000)
Geological map of Labrador (NDME, 1:1 000 000)

Ossokmanuan Lake reservoir labradorite occurrences

Iridescent labradorite is reported to occur in dark anorthosite exposed on islands in Ossokmanuan Lake, east of Gabbro Lake. Anorthosite is also exposed along the south shore of Ossokmanuan Lake, but it is reported to be without the iridescence seen in the rocks of Michikamau Lake.

Ossokmanuan Lake reservoir is about 75 km west of Churchill Falls. Highway 500 crosses the lake in the vicnity of the islands where the anorthosite rock is exposed; this highway leads southwest from Highway 501 at a point 32 km west of Churchill Falls. *See* Map 36.

Ref.: 152 p. 231L–232L, 289L.

Maps (T): 23 H/6 Newfoundland
(G): 91-85 Ossokmanuan Lake (23 H/SW)–Lac Joseph (23 A/NW) area, Labrador (NDME, 1:1 000 000)
586 Labrador Peninsula, south east sheet (GSC, 1:1 584 000)
17-1961 Ossokmanuan Lake, Newfoundland (GSC, 1:253 440)
Geological map of Labrador (NDME, 1:1 000 000)

Harp Lake labradorite occurrences

Iridescent labradorite occurs in a large body of anorthositic rocks that constitutes most of a large igneous intrusion known as the 'Harp Lake Complex' in central Labrador. The complex intrudes earlier granitic gneiss. It is oblong and covers an area of about 10 000 km² extending from the east end of Harp Lake to about 15 km east of the Newfoundland and Labrador–Quebec border.

Blue and green iridescent labradorite occurs in medium- to coarse-grained anorthosite, as crystals up to 10 cm across, and in the enclosing massive labradorite. The anorthosite is mostly medium grey, but may vary from light grey to dark grey; it is generally coarse-grained with some pegmatitic areas. Large crystals of hypersthene and some clinopyroxene occur in the anorthositic rocks.

Reported occurrences of iridescent labradorite are given in the text that follows.

Harp Lake

Coarse labradorite showing blue and green iridescence is common in anorthosite and in gabbroic rocks surrounding the northeastern part of Harp Lake. Many crystals are colour zoned, with greenish cores and blue rims. Bronze iridescent crystals occur in an anorthosite layer, 1 m thick, enclosed in a gabbroic rock (troctolite) along the southern shore of the lake.

Arc Lake

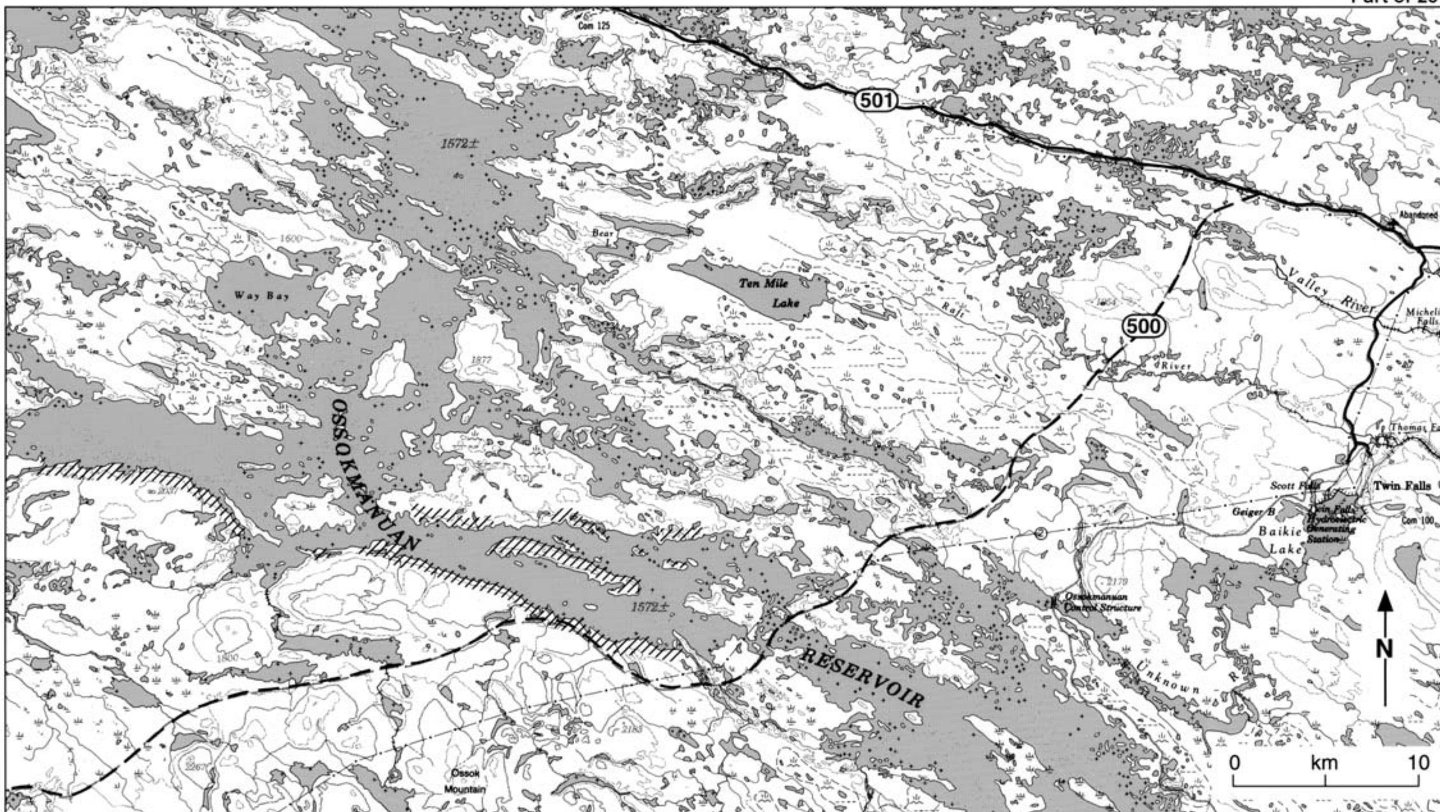
Blue iridescent labradorite is common in medium- to coarse-grained anorthosite and gabbro. These rocks are exposed as rusty outcrops south and southeast of Arc Lake.

Arc Lake is about 20 km north of Harp Lake.

Esker Lake

Blue iridescent labradorite is common in coarse- to very coarse-grained anorthosite and gabbro exposed in outcrops around the southern and eastern shores of Esker Lake. Labradorite crystals

Part of 23 H



Map 36. Ossokmanuan Lake. Anorthosite containing labradorite is exposed on the islands and along the south shore of the lake.

measuring 2 cm to 5 cm are abundant, and crystals measuring from 10 cm to 15 cm are common. Similar rocks occur northwest of Esker Lake. South of Esker Lake, blue iridescent plagioclase occurs as crystals up to 40 cm by 60 cm in gabbroic rock. Iridescent labradorite is also present in layers of coarse-grained anorthosite and gabbro. Iridescent labradorite crystal fragments occur in conglomerate blocks and slabs that are found as erratics on the large island in the southeastern part of Esker Lake.

Esker Lake is about 40 km west of Harp Lake.

Cleaver Lake

Light blue iridescent labradorite crystals up to 30 cm occur in a body of light to medium grey anorthosite north and northeast of Cleaver Lake. This body extends over an area of about 25 km by 10 km and is shown in Figure 7.

Cleaver Lake is about 50 km southwest of Harp Lake.

Boomerang Lake

Blue and greenish-blue iridescent labradorite occurs in anorthosite west of Boomerang Lake. The labradorite crystals vary from 2 cm to 10 cm across.

Boomerang Lake is about 50 km northwest of Harp Lake.

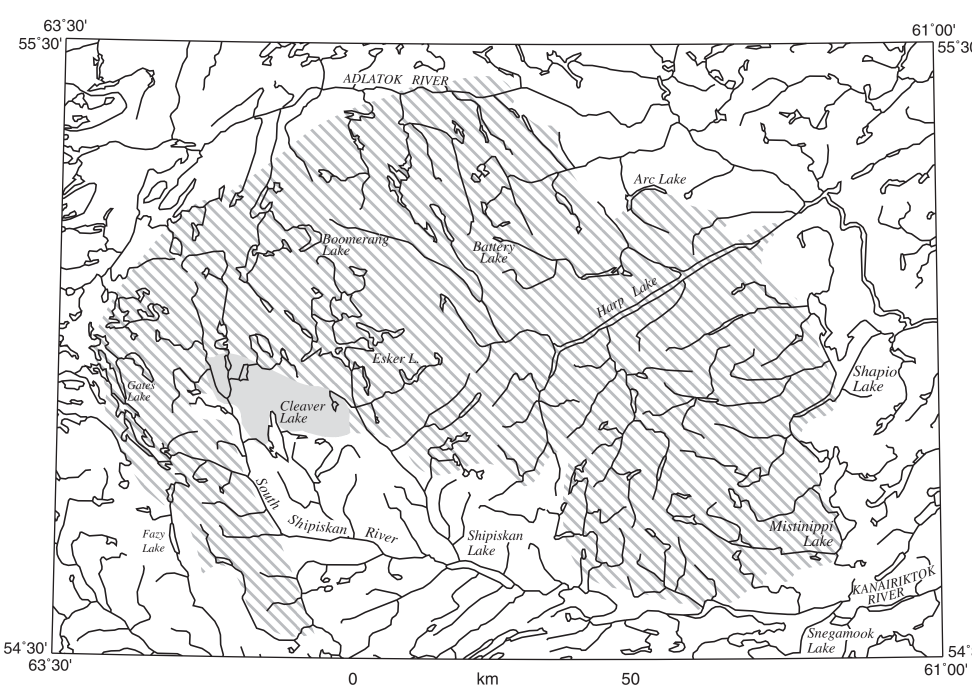


Figure 7. Harp Lake area: map showing anorthositic rocks of the Harp Lake Complex. The shaded area shows the location of the anorthosite body containing iridescent labradorite at Cleaver Lake (ref.: 64 Fig. 1).

Battery Lake

Bronze iridescent labradorite occurs in coarse-grained anorthosite that outcrops about 10 km north of Battery Lake. The labradorite measures up to 12 cm across.

Battery Lake is about 20 km north-northwest of Harp Lake.

The Harp Lake intrusion is in central Labrador, southwest of Hopedale. Its northern margin is just south of the Adlatok River, about 120 km south of Nain. Access is by air. *See* Figure 7.

Refs.: 64 p. 17–35, App. 2 p. 8, 10–11, 18, 24, 57; 66 p. 24–25; 240 p. 9.

Maps (T): 13 K Snegamook Lake
13 L Red Wine Lake
14 M Mistastin Lake
14 H Hopedale
(G): 1079A Snegamook Lake, coast of Labrador, Newfoundland (GSC, 1:253 440)
1342A Kasheshibaw Lake (east half), Newfoundland–Quebec (GSC, 1:250 000)
3-1964 Kasheshibaw Lake (west half), Newfoundland–Quebec (GSC, 1:253 440)
1442A Mistastin Lake, Newfoundland–Quebec (GSC, 1:250 000)
1443A Hopedale, Newfoundland (GSC, 1:250 000)
Geological map of Labrador (NDME, 1:1 000 000)

Romaine River labradorite, hypersthene occurrences

Occurrences of iridescent labradorite along the Romaine River were noted by A.P. Low during his geological exploration of central Labrador in 1893–1894. The labradorite, displaying blue, green, and bronze iridescent colours, is reported to occur as coarse crystals in violet-grey anorthosite masses enclosed in white sugary anorthosite.

Anorthosite exposures were noted by Low at numerous places along the Romaine River above Burnt Lake, which is southeast of Atikonak Lake. The exposures were observed over about 7 km beginning at the mouth of a portage creek leading from the southeast bay of Atikonak Lake and extending to a marshy area along Marc Lake (*see* Map 37). Brown hypersthene occurring as a mass of zigzag, crumpled crystal aggregates (several centimetres in diameter), and irregular masses of ilmenite were noted in sugary white anorthosite exposed along the shores of the Romaine River opposite the mouth of the portage creek referred to above. The iridescent labradorite was noted on the small islands in the Romaine River at the head of a rapid 3 km below the junction of this creek.

These occurrences are about 6 km southeast of the southeast bay of Atikonak Lake, or about 125 km south of Churchill Falls. The Romaine River forms the boundary between Quebec and Newfoundland and Labrador in this area. Hypersthene is reported to be abundant in some of the islands in the middle of Atikonak Lake.

Ref.: 152 p. 233L–235L, 239L.

Maps (T): 23 A/8 Newfoundland–Québec
(G): 23-1967 Lac Joseph, Newfoundland–Québec (GSC, 1:253 440)
586 Labrador Peninsula, south east sheet (GSC, 1:1 584 000)
Geological map of Labrador (NDME, 1:1 000 000)

Part of 23 A/8

1. hypersthene occurrence 2. labradorite occurrence

Map 37. Romaine River.

SOAPSTONE OCCURRENCES

Soapstone was used by prehistoric peoples along the Labrador coast as far back as 8000 years ago. Prehistoric Indian and Eskimo sites have revealed that soapstone was used functionally for plummets, cooking vessels, pots, and lamps, and nonfunctionally for harpoon heads, ornaments, and talismen. The raw material is believed to have been obtained from local coastal sources (Refs.: 70 p. 103–118; 71 p. 3, 7, 15, 23, 25, 30, 31, 38, 39).

Before modern articles were brought by Europeans to Labrador, soapstone was used by the Inuit for household utensils. Lamps and kettles have been found in the Okak area and are believed to have been made from soapstone obtained from local deposits. The lamps were saucer-shaped and measured up to 43 cm by 30 cm and 7.5 cm high with a thickness of 2 cm; they contained up to 3.5 L of oil. The lamps were used to heat cooking kettles, which were suspended over them by sealskin thongs. The large kettles measured 57 cm by 365 cm with a depth of 17 cm and had a capacity of about 18 L (ref.: 96 p. 89–92, 201, 203). Such large objects hollowed out of the rough material suggests that large blocks of soapstone were available.

Soapstone is reported to occur in numerous places along the Labrador coast. It occurs as an alteration product of ultramafic rocks associated with granitic gneiss. Diabase dykes are common in the gnessic rocks along coastal Labrador and soapstone may result from the alteration of these dykes. Any localities exposing diabase dykes are potential sources of soapstone.

Occurrences of soapstone have been investigated by the Newfoundland and Labrador Department of Mines and Energy with a view to providing sources for carving material. The text that follows is based on reports of these investigations and on other geological reports.

Hopedale area soapstone occurrences

Semiak Island

Grey and greyish-red, soft to medium soft soapstone boulders up to 5 m in diameter occur on the western side of the island. Serpentinized ultramafic rock extending over a distance of 1 km on the same side of the island contains soft, greenish-white altered zones consisting of a massive tremolite-actinolite-chlorite rock that is suitable for carving.

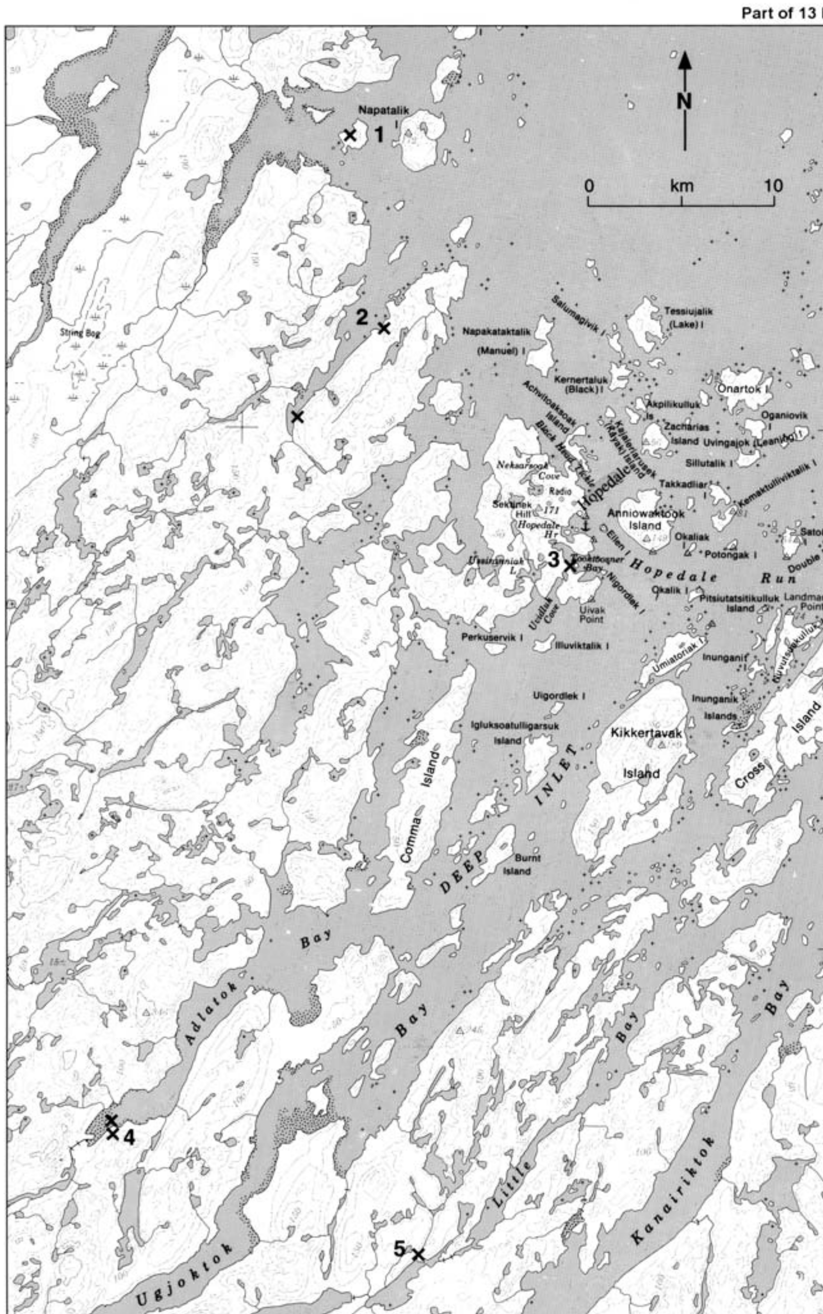
Semiak Island is 25 km north of Hopedale and just west of Napatalik Island. *See* Map 38.

Ref.: 170 p. 155.

Maps (T): 13 N/9 Napatalik Island
(G): 1443A Hopedale, Newfoundland (GSC, 1:250 000)
Geological map of Labrador (NDME, 1:1 000 000)

Fred's Bay

Serpentinized ultramafic rock along both sides of Fred's Bay contain altered zones that provide carving material. Soapstone boulders occur halfway down the eastern side of the bay; the soapstone is grey, green-grey and blue-grey with varied hardness. The boulders measure up to 8 m long and have been worked by local carvers. Light to dark blue-grey soapstone is associated with an ultramafic lens near the southwestern end of the eastern side of the bay; smaller outcrops of light to dark blue-grey soapstone occur directly north of this lens.



1. Semiak Island 2. Fred's Bay 3. Tooktoosner Bay
4. Adlatok Bay 5. Little Bay south

Map 38. Hopedale area soapstone occurrences.

Fred's Bay is on the mainland, about 15 km northwest of Hopedale. *See* Map 38.

Ref.: 170 p. 155.

Maps (T): 13 N/8 Hopedale
13 N/9 Napatalik Island
(G): 1443A Hopedale, Newfoundland (GSC, 1:250 000)
Geological map of Labrador (NDME, 1:1 000 000)

Tooktoosner Bay

Boulders of dark green serpentinite occur in Tooktoosner Bay. The rock is hard and takes a good polish. The boulders are derived from a body of ultramafic rock that extends over a distance of 1 km.

Tooktoosner Bay is 1 km south of Hopedale. *See* Map 38.

Ref.: 170 p. 155.

Maps (T): 13 N/8 Hopedale
(G): 1443A Hopedale, Newfoundland (GSC, 1:250 000)
Geological map of Labrador (NDME, 1:1 000 000)

Adlatok Bay

Soapstone is exposed on a small island at the southern end of Adlatok Bay and along a steep hill on the southeastern side of the bay opposite the island. Soapstone from this island was quarried and used by prehistoric cultures.

Adlatok Bay is on the mainland, about 40 km southwest of Hopedale. *See* Map 38.

Ref.: 170 p. 153.

Maps (T): 13 N/2 Ugjoktok Bay
(G): 1443A Hopedale, Newfoundland (GSC, 1:250 000)
Geological map of Labrador (NDME, 1:1 000 000)

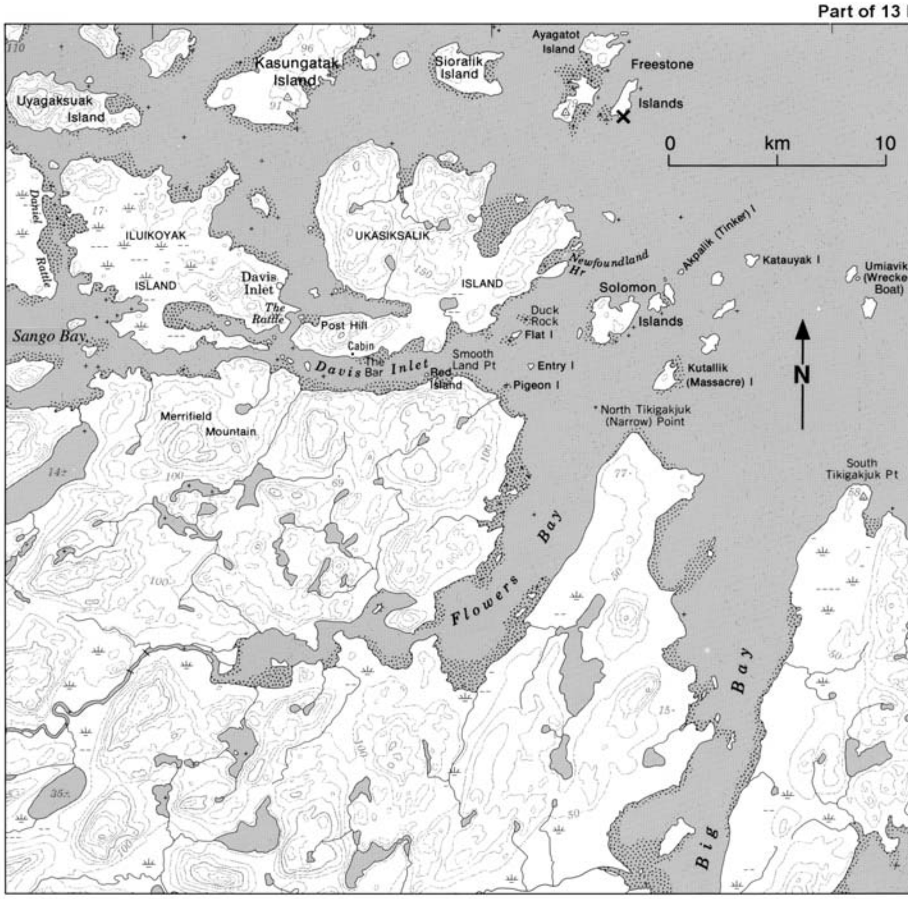
Little Bay south

Soapstone occurs in a series of lenses on the western bank of a river entering the southern extension of Little Bay. The lenses range from 2 m to 15 m long. They are exposed in the intertidal zone below the river bank, along the river bank, and in the woods directly behind. The soapstone varieties include light to dark green, soft to medium hard; dark grey-black, medium hard; dark green-black, very hard; and red, soft to medium hard. Fragments of soapstone broken from the lenses are found at the base of the river bank.

The Little Bay south occurrence is at the southern extension of Little Bay, which is on the mainland about 40 km south of Hopedale. *See* Map 38.

Ref.: 170 p. 153.

Maps (T): 13 N/1 Kanairiktok Bay
(G): 1443A Hopedale, Newfoundland (GSC, 1:250 000)
Geological map of Labrador (NDME, 1:1 000 000)



Map 39. Freestone Islands soapstone occurrence.

Freestone Islands

A soapstone deposit on Freestone Islands is reported to have been a source for raw material used by prehistoric cultures.

Freestone Islands are off the northeastern tip of Ukasiksalik Island, at Davis Inlet. *See* Map 39.

Ref.: 69 p. 40.

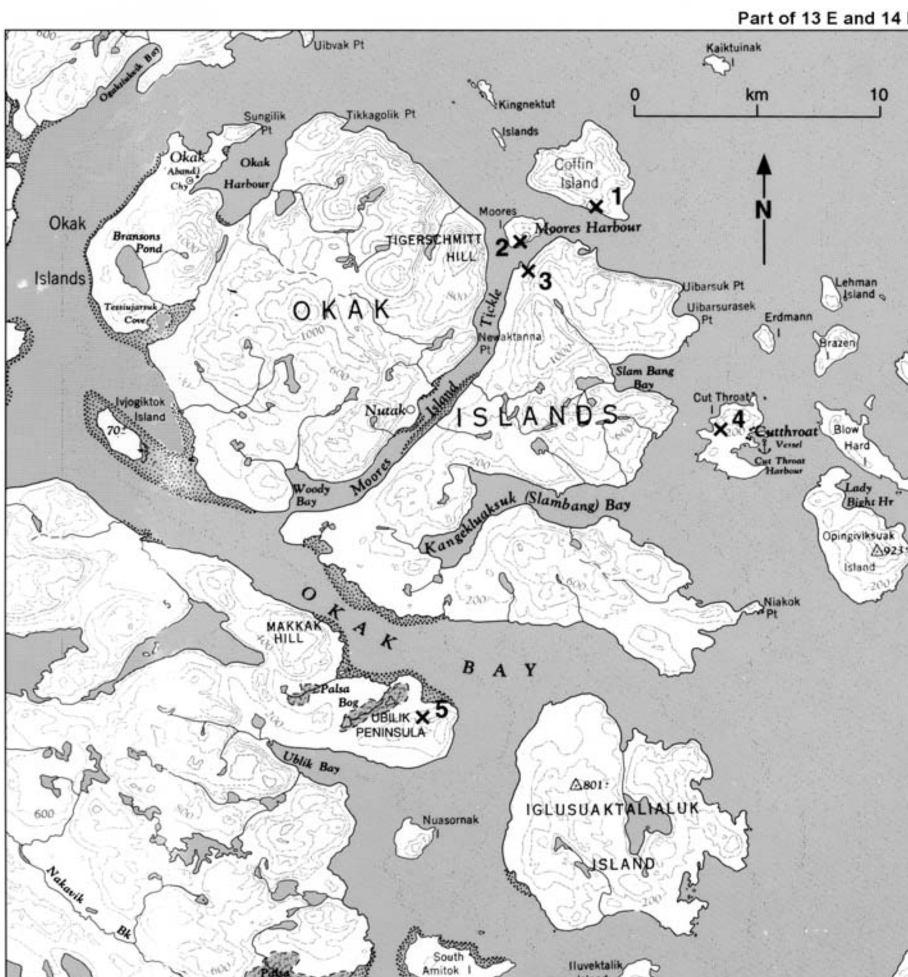
Maps (T): 13 N/15 Davis Inlet
(G): 1443A Hopedale, Newfoundland (GSC, 1:250 000)
Geological map of Labrador (NDME, 1:1 000 000)

Okak area soapstone occurrences

Coffin Island

Dark greyish-green soapstone occurs in a band 8 m to 10 m wide in quartz-feldspar gneiss on the southern side of this island. The soapstone weathers to brownish grey. Weathering of the soapstone has produced a gully that cuts across a hillside; loose blocks of soapstone measuring several metres across occur in the gully. Green soapstone has been reported from other parts of the island.

Coffin Island is just north of eastern Okak Island. *See* Map 40.



1. Coffin Island 2. Moores Island 3. Eastern Okak Island
4. Cut Throat Island 5. Ublik Peninsula

Map 40. Okak area soapstone occurrences.

Ref.: 169 p. 359.

Maps (T): 14 F/12 Okak Harbour
(G): 1436A North River–Nutak, Newfoundland–Québec (GSC, 1:250 000)
80-12 Nutak, Labrador North district (NDME, 1:200 000)
90-44 Nain Plutonic Suite and surrounding rocks (Nain–Nutak, NTS 14 S.W.) (NDME, 1:500 000)

Moores Island

Soapstone occurs in narrow zones exposed on the southern side of the island. The occurrence is directly north of the Okak Islands occurrence. *See* Map 40.

Moores Island is a small island in Moores Harbour, which is between eastern and western Okak Islands.

Ref.: 169 p. 359–360.

Maps (T): 14 F/12 Okak Harbour
(G): 1436A North River–Nutak, Newfoundland–Québec (GSC, 1:250 000)
80-12 Nutak, Labrador North district (NDME, 1:200 000)
90-44 Nain Plutonic Suite and surrounding rocks
(Nain–Nutak, NTS 14 S.W.) NDME, 1:500 000)

Eastern Okak Island

Greenish-grey to blackish-grey soapstone occurs in a lens at the northwestern corner of eastern Okak Island. It is exposed at low tide on the shore of Moores Island Tickle. The lens measures 30 m by 15 m. The soapstone weathers to brown. Large blocks of soapstone broken away from the lens lie on the shore.

The Okak Islands are about 100 km north of Nain. *See* Map 40.

Ref.: 169 p. 359–360.

Maps (T): 14 F/12 Okak Harbour
(G): 1436A North River–Nutak, Newfoundland–Québec (GSC, 1:250 000)
80-12 Nutak, Labrador North district (NDME, 1:200 000)
90-44 Nain Plutonic Suite and surrounding rocks
(Nain–Nutak, NTS 14 S.W.) NDME, 1:500 000)

Cut Throat Island

A soapstone deposit on this island furnished the raw material used by Paleo-Eskimo cultures for lamps, cookware, and other uses.

Cut Throat Island lies immediately east of the Okak Islands. *See* Map 40.

Refs.: 69 p. 40; 169 p. 357.

Maps (T): 14 F/12 Okak Harbour
(G): 1436A North River–Nutak, Newfoundland–Québec (GSC, 1:250 000)
80-12 Nutak, Labrador North district (NDME, 1:200 000)
90-44 Nain Plutonic Suite and surrounding rocks
(Nain–Nutak, NTS 14 S.W.) (NDME, 1:500 000)

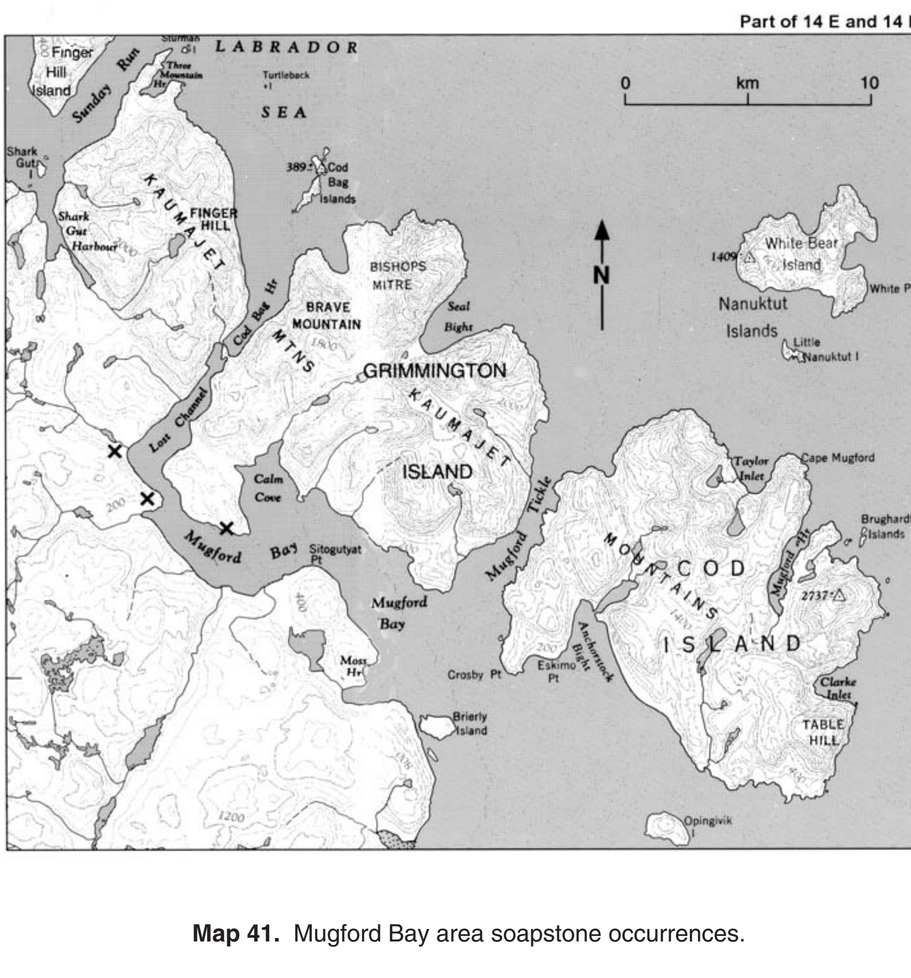
Ublik Peninsula

Greenish-black soapstone occurs in the highlands on this peninsula. The soapstone is fine grained, very hard, and weathers to reddish brown.

Ublik Peninsula extends eastward from the mainland, on the south side of Okak Bay. *See* Map 40.

Ref.: <u>169</u> p. 360.

Maps (T): 14 F/5 Nutak
(G): 1436A North River–Nutak, Newfoundland–Québec (GSC, 1:250 000)
80-12 Nutak, Labrador North district (NDME, 1:200 000)
90-44 Nain Plutonic Suite and surrounding rocks
(Nain–Nutak, NTS 14 S.W.) (NDME, 1:500 000)



Map 41. Mugford Bay area soapstone occurrences.

Mugford Bay

Several soapstone occurrences are found in the northwestern part of Mugford Bay. The colour, texture, and hardness vary. Blue-grey, medium hard soapstone occurs in pods exposed at the southwestern end of Lost Channel, the northern extension of Mugford Bay; the pods measure up to 10 m across. The soapstone is cut by fine stringers of magnetite.

Soapstone varying from yellow-green, medium grained, and very soft to green-grey, fine grained, and medium hard is exposed along a rock face and as boulders along the terrace below it, on the southern side of Mugford Bay, 2 km southeast of Lost Channel. The rock terrace extends over an area 135 m long and 30 m wide; the boulders are believed to be derived from the rock face above it.

Dark grey, medium-hard soapstone outcrops in three places along the northern shore of Mugford Bay, directly west of Calm Cove.

Mugford Bay separates Grimmington Island from the mainland. It is about 30 km northwest of the Okak Islands and about 135 km north of Nain. *See* Map 41.

Ref.: 169 p. 360–361.

Maps (T): 14 E/16 Finger Hill
(G): 1436A North River–Nutak, Newfoundland–Québec (GSC, 1:250 000)
90-44 Nain Plutonic Suite and surrounding rocks
(Nain–Nutak, NTS 14 S.W.) (NDME, 1:500 000)

Hebron soapstone occurrence

Soapstone is reported to occur in ultramafic rocks enclosed in granitic gneiss along the shore in the vicinity of Hebron.

Hebron is on the northern coast of Labrador, about 200 km north of Nain.

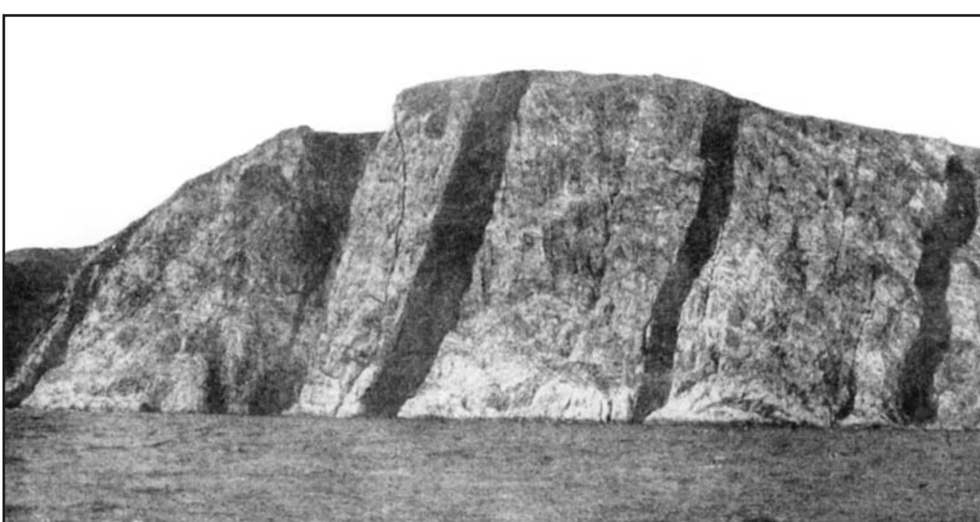
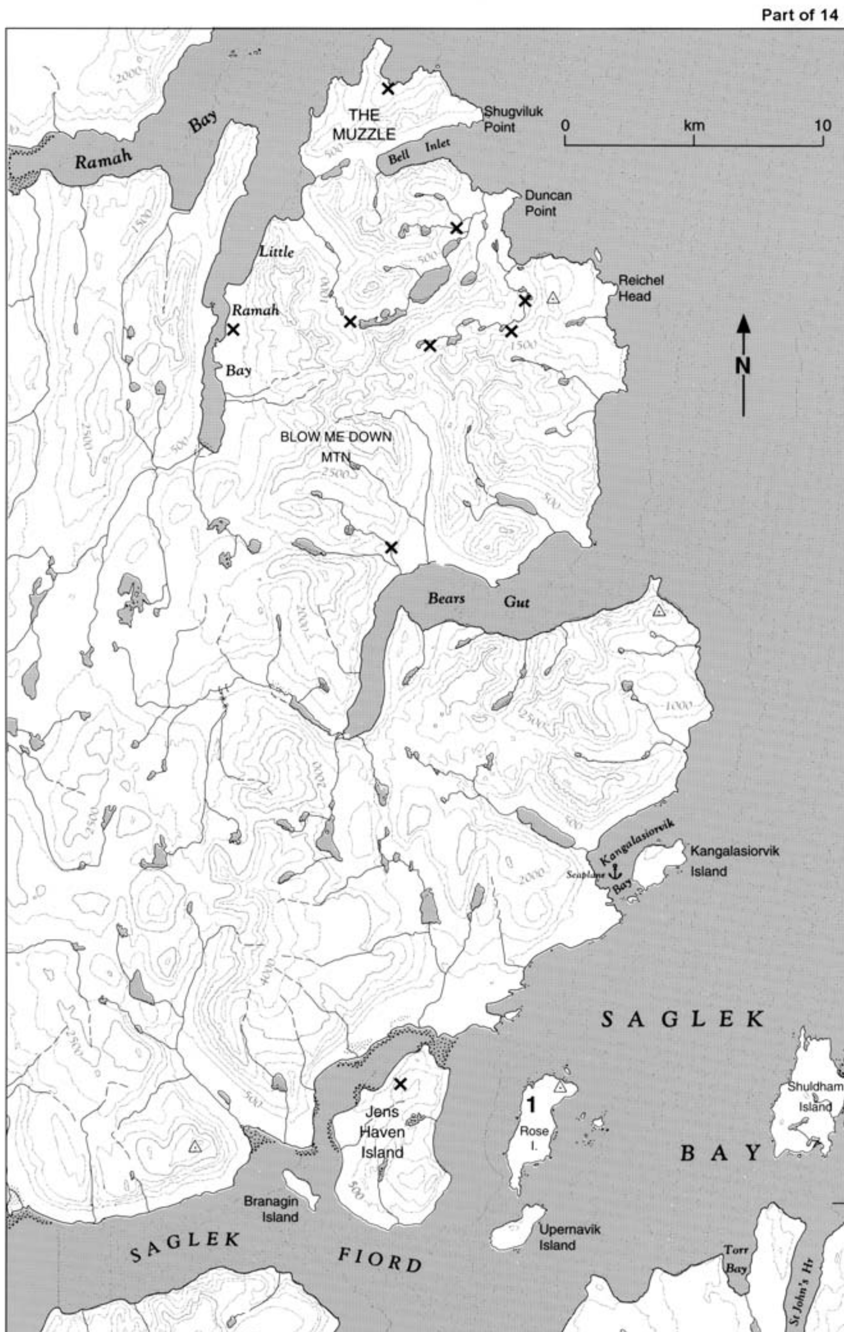


Plate 44

Diabase dykes, such as these in granitic gneiss in the Saglek Fiord area, are a prominent feature along the Labrador coast. Soapstone, a product of the alteration of the diabase rock, may occur in any of the localities where diabase is exposed. GSC 1994-758A



1. Rose Island occurrence x: ultramafic rock bodies that may contain soapstone

Map 42. Saglek Bay–Ramah Bay soapstone occurrences.

Refs.: 42 p. 50; 148 p. 17.

Maps (T): 14 L/2 Hebron
(G): 1431A Hebron, Newfoundland-Québec (GSC, 1:250 000)
Geological map of Labrador (NDME, 1:1 000 000)

Saglek Bay–Ramah Bay soapstone occurrences

Saglek Fiord

Soapstone deposits at Saglek Fiord are reported to have furnished the raw material used by Paleo-Eskimo cultures in the period 700 BC to AD 300. The grey soapstone was used for making lamps, cooking pots, bowls, and harpoon heads. Two sources of the soapstone are reported: one was on the west side of Rose Island, which is at the entrance to Saglek Fiord (*see* Map 42), and the other was near Big Falls, which is a 305 m waterfall on the north shore of Saglek Fiord, about 16 km west of Rose Island.

Saglek Fiord, the westward extension of Saglek Bay, is on the northern coast of Labrador, about 250 km northwest of Nain.

Refs.: 69 p. 40; 249 p. 31, 72–73, 107, 149, 156, 180–181, 187–188.

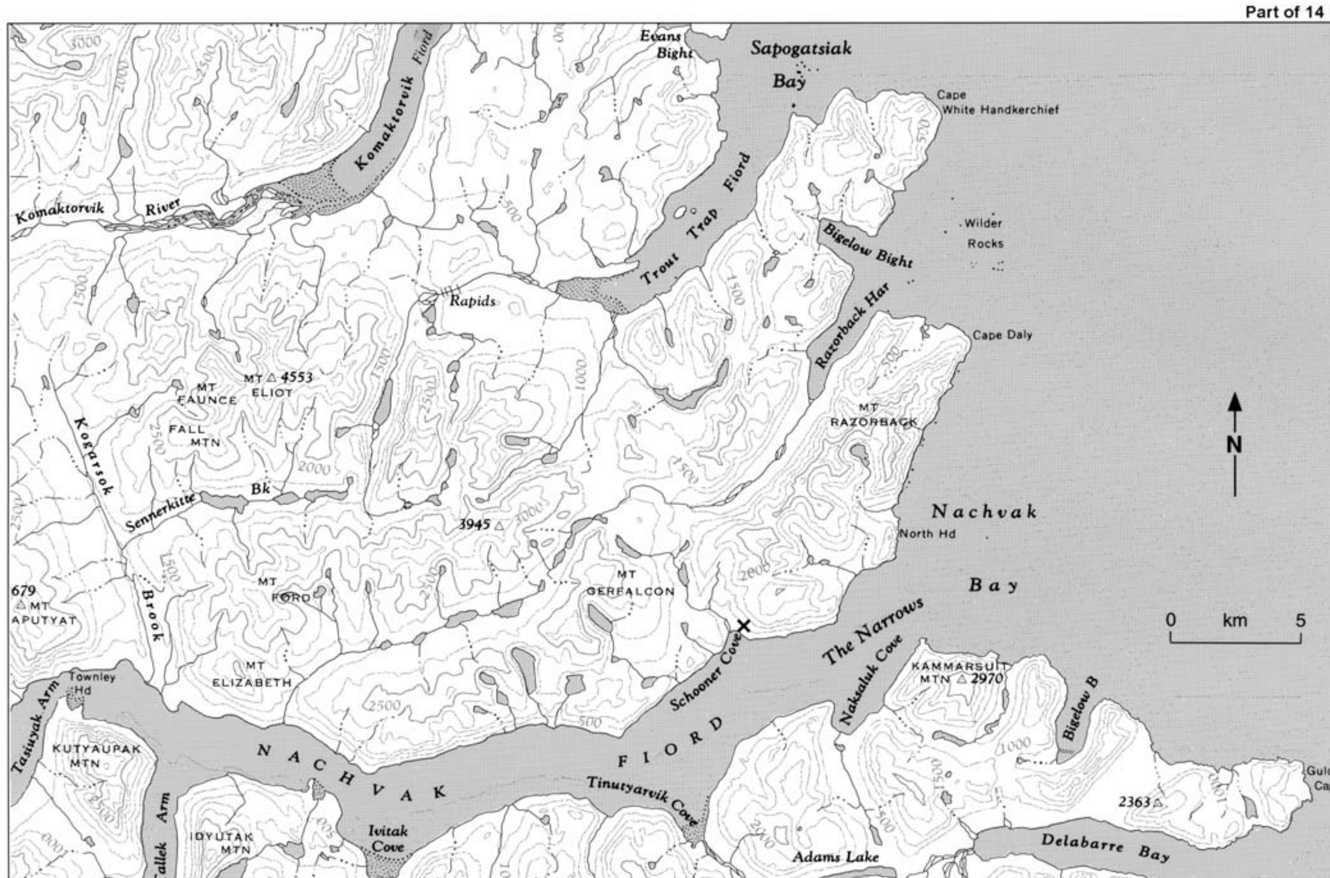
Maps (T): 14 L/10 Saglek Bight
14 L/11 Jens Haven Island
(G): 6-1974 Nachvak Fiord–Saglek Fiord area, Newfoundland (GSC, 1:125 000)
1478A Bears Gut–Saglek Fiord, Newfoundland (GSC, 1:50 000)
Geological map of Labrador (NDME, 1:1 000 000)

Little Ramah Bay area

Soapstone occurs in some metamorphosed ultramafic rocks in granitic gneiss between Little

Plate 45

Nachvak Fiord, looking toward Tasiuyak Arm, about 1880. The steep, serrated peaks, here reaching elevations of about 1100 m, are typical of the northern Labrador coast. GSC 1994-758B



Map 43. Nachvak Fiord soapstone occurrence.

Ramah Bay and Bears Gut. The ultramafic rocks can be recognized by a rusty green or brown surface; they occur as lenticular bodies up to 400 m by 1200 m, or as elongated bodies up to 2815 m long and 61 m thick. Soapstone may occur in any of these ultramafic bodies, which are shown on Map 42 and on the Geological Survey of Canada maps listed below.

The Little Ramah Bay–Bears Gut area is 25 to 40 km north of Saglek Bay and about 290 km northwest of Nain.

Ref.: 172 p. 5.

Maps (T): 14 L/11 Jens Haven Island
14 L/14, 15 Ramah Bay–Reichel Head
(G): 1469A Nachvak Fiord–Ramah Bay, Newfoundland–Québec (GSC, 1:50 000)
1478A Bears Gut–Saglek Fiord, Newfoundland (GSC, 1:50 000)
6-1974 Nachvak Fiord–Saglek Fiord area, Newfoundland (GSC, 1:125 000)
Geological map of Labrador (NDME, 1:1 000 000)

Nachvak Fiord

In 1884, Robert Bell of the Geological Survey of Canada made an expedition to investigate the geology, mineralogy, zoology, and botany of the coast of Labrador. His report states that "the Eskimo obtained a kind of soapstone for making their pots, in the vicinity of Skynner's Cove" (ref.: 18 p. 15DD). This cove was later renamed 'Schooner Cove' because of the fishing schooners that came to anchor there.The country rock is gneiss cut by diorite dykes, with some mica-hornblende schist at the cove.

Another early Geological Survey of Canada report notes that soapstone is "found in a number of places in masses large enough for Eskimo lamps" (ref.: 41 p. 52).

Schooner Cove is on the northern side of Nachvak Fiord, about 7 km from the entrance. *See* Map 43. Nachvak Fiord is on the northern coast of Labrador, about 300 km north of Nain.

Refs.: 18 p. 14DD–15DD; 41 p. 33, 50–52; 257 p. 68–90.

Maps (T): 14 M/4 Nachvak Fiord
(G): 1443A Cape White Handkerchief, Newfoundland (GSC, 1:250 000)
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GLOSSARY

Acanthite. Ag_2S. H = 2–2.5. Iron-black, metallic, prismatic aggregates. Sectile. Low-temperature form of silver sulphide, argentite being the high-temperature form. Ore of silver associated with other silver minerals.

Acmite. Not a valid mineral name; renamed 'aegirine'.

Actinolite. $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$. H = 5–6. Bright green to greyish-green, columnar, fibrous, or radiating prismatic aggregates. Occurs in metamorphic rocks. Commonly associated with epidote. Monoclinic variety of amphibole.

Adularia. Transparent to translucent, generally colourless variety of K-feldspar; may exhibit an opalescent effect, or schiller, as in moonstone. Occurs as pseudorhombohedra in low-temperature hydrothermal veins in schist and gneiss.

Aegirine. $NaFeSi_2O_6$. H = 6. Dark green to almost black or greenish-brown; prismatic, commonly elongated and striated crystals. Monoclinic variety of pyroxene.

Agate. Patterned and variously coloured variety of microcrystalline quartz (chalcedony). Translucent to opaque; colours are due to metallic oxide mineral impurities. Used as an ornamental stone.

Agglomerate. Rock formed by the consolidation of angular fragments ejected by volcanoes.

Agrellite. $NaCa_2Si_4O_{10}F$. H = 5.5. White, greyish, or greenish flat prismatic crystals with excellent cleavage; pearly lustre. Occurs in alkalic rocks. Originally described from the Kipawa area, Quebec.

Akermanite. $Ca_2MgSi_2O_7$. H = 5. Colourless, greyish-green, brown to black; generally massive. Vitreous to resinous lustre. Subconchoidal fracture. Not readily distinguished in the hand specimen from other members of group. Melilite group.

Aktashite. $Cu_6Hg_3As_4S_{12}$. Grey, metallic. Occurs as grains with other mercury sulphide minerals.

Alaskite. Granitic rock composed of microcline, orthoclase, and quartz with few or no dark minerals such as amphibole, biotite, or pyroxene.

Albertite. Hydrocarbon. H = 1–2. Black with brilliant lustre. Occurs in shale in Albert County, New Brunswick. Also known as 'albert coal'. Name is derived from the locality.

Albite. $NaAlSi_3O_8$. H = 6. White, tabular, striated crystals, or cleavable masses. Vitreous lustre. Variety of plagioclase feldspar. Used in the manufacture of ceramics.

Allanite. $(Ce,Ca,Y)_2(Al,Fe)_3(SiO_4)_3(OH)$. H = 6.5. Black or dark brown tabular aggregates, or massive with conchoidal fracture. Vitreous or pitchy lustre. Generally occurs in granitic rocks, in pegmatite, and is commonly surrounded by an orange halo. Distinguished by its weak radioactivity.

Allargentum. $Ag_{1-x}Sb_x$. Grey, metallic grains occurring in native silver or as veinlets in calcite containing high-grade silver ore.

Allemontite. A mixture of stibarsen and arsenic or antimony. Not a valid mineral species.

Alloclasite. (Co,Fe)AsS. Light grey, metallic; compact radiating crystal aggregates. Occurs in cobalt deposits.

Allophane. Amorphous hydrous aluminosilicate. H = 3. Light blue, green, brown, yellow, or colourless encrustations or powdery masses, also stalactitic or mammillary. Vitreous to waxy. Decomposition product of aluminous silicates such as feldspar. Not a valid mineral species.

Alluaudite. $(Na,Ca)Fe(Mn,Fe,Mg)_2(PO_4)_3$. H = 5–5.5. Yellow to brownish-yellow, massive granular or compact radiating fibrous aggregates. Generally opaque. Occurs as an alteration of varulite-hühnerkobelite in pegmatite.

Almandine. $Fe_3Al_2(SiO_4)_3$. H = 7–7.5. Dark red transparent to opaque dodecahedral or trapezohedral crystals; also massive. Generally occurs in mica schist or gneiss; also in granite and pegmatite. Used as an abrasive (sand paper); transparent variety used as a gemstone. Garnet group.

Altaite. PbTe. H = 3. Light grey, metallic, with bronze tarnish. Generally massive, but may occur as cubic or cubo-octahedral crystals. Sectile with perfect cleavage. Occurs with native gold and with other tellurides and sulphides in vein deposits.

Alunogen. $Al_2(SO_4)_3{\bullet}17H_2O$. H = 1.5–2. White fibrous crusts; powdery. Vitreous to silky lustre. Acid, sharp taste. Secondary mineral associated with pyrite or marcasite.

Amazonite. $KAlSi_3O_8$. H = 6. Green variety of microcline feldspar. Colour is due to natural irradiation of microcline containing Pb and H_2O. Occurs in pegmatite. Used as a gemstone and for ornamental purposes.

Amethyst. Violet variety of quartz. Colour is due to natural irradiation of quartz containing Fe. Generally occurs in igneous and volcanic rocks. Transparent variety is used as a gemstone.

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.

Amygdaloidal lava. Fine-grained lava (basalt) with cavities (amygdales) that may be filled with quartz, calcite, chlorite, zeolites, etc.

Analcime (Analcite). $NaAlSi_2O_6{\bullet}H_2O$. H = 5–5.5. Colourless, white, yellowish, or greenish vitreous, transparent, trapezohedral crystals, or massive granular. Distinguished from garnet by its inferior hardness. Often associated with other zeolites.

Anatase. TiO_2. H = 5.5–6. Yellowish or reddish-brown pyramidal or tabular crystals with adamantine lustre; also grey or blue. Massive. Also known as 'octahedrite'.

Ancylite. $SrCe(CO_3)_2(OH){\bullet}H_2O$. H = 4–4.5. Light yellow, yellowish-brown, or grey translucent prismatic crystals or rounded crystal aggregates. Splintery fracture. Soluble in acids. Rare mineral.

Andalusite. Al_2SiO_5. H = 7.5. White, grey, rose red, or brown prismatic crystals with almost square cross-section. Vitreous to dull lustre. Transparent to opaque. Chiastolite variety has carbonaceous inclusions arranged in crossed lines that are evident in cross-section. Occurs in metamorphosed shale. Used in the manufacture of mullite refractories, spark plugs; transparent variety used as a gemstone.

Andesite. A dark-coloured volcanic rock composed mainly of plagioclase feldspar with amphibole or pyroxene.

Andorite. $PbAgSb_3S_6$. H = 3–3.5. Dark grey, metallic, striated prismatic or tabular crystals; massive. Conchoidal fracture. Black streak. Soluble in HCl. Associated with sulphides and other sulphosalts.

Andradite. $Ca_3Fe_2(SiO_4)_3$. H = 7. Yellow, green, brown or black dodecahedral or trapezohedral crystals; massive. Occurs in chlorite schist, serpentinite, crystalline limestone. Gem varieties are demantoid (green), topazolite (yellow), and melanite (black). Garnet group.

Anglesite. $PbSO_4$. H = 2.5–3. Colourless to white, greyish, yellowish, or bluish tabular or prismatic crystals, or granular. Adamantine to resinous lustre. Characterized by high specific gravity (6.37) and adamantine lustre. Effervesces in HNO_3. Secondary mineral, generally formed from galena. Ore of lead.

Anhydrite. $CaSO_4$. H = 3–3.5. White, bluish, or greyish with vitreous lustre. Generally granular massive. Alters to gypsum by absorption of water. Distinguished from gypsum by its superior hardness. Used as a soil conditioner and in portland cement.

Ankerite. $Ca(Fe,Mg,Mn)(CO_3)_2$. Variety of dolomite from which it cannot be distinguished in the hand specimen.

Annabergite. $Ni_3(AsO_4)_2 \bullet 8H_2O$. 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. Referred to as 'nickel bloom'.

Anorthite. $CaAl_2Si_2O_8$. H = 6. White or greyish cleavable masses; prismatic, striated crystals. Plagioclase feldspar.

Anorthoclase. $(Na,K)AlSi_3O_8$. H = 6–6.5. Colourless, white with reddish, greenish, or yellowish tint. May exhibit polysynthetic twinning. Occurs in volcanic and other igneous rocks. Feldspar group.

Anorthosite. An igneous rock composed almost entirely of plagioclase.

Anthophyllite. $(Mg,Fe)_7Si_8O_{22}(OH)_2$. H = 6. White, light grey to brown fibrous or prismatic aggregates with vitreous or silky lustre. 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 resistance to heat. Orthorhombic variety of amphibole.

Anthraxolite. Hydrocarbon. H = 3–4. Black, massive. Submetallic to pitchy lustre. Uneven to conchoidal fracture. Friable, combustible. Exposed surface partly altered to orange powder.

Antigorite. $Mg_3Si_2O_5(OH)_4$. H = 2.5. Green translucent variety of serpentine with lamellar structure.

Antimony. Sb. H = 3–3.5. Light grey, metallic, cleavable, massive, also radiating or botryoidal. Perfect cleavage. Occurs in hydrothermal veins with silver, antimony, and arsenic ores. Minor source of antimony for use in alloys of lead and tin, and for flame-proofing textiles, paints, and ceramics.

Antiperthite. Lamellar intergrowth of potassium and sodium feldspars in which sodium feldspar is dominant.

Antlerite. $Cu_3SO_4(OH)_4$. H = 3.5. Emerald-green to dark green, tabular, prismatic, or acicular microscopic crystals. Vitreous lustre. Secondary mineral occurring in copper deposits. Ore of copper.

Apatite. $Ca_5(PO_4)_3(F,Cl,OH)$. H = 5. Green to blue, colourless, brown, or red hexagonal crystals or granular to sugary massive. Vitreous lustre. May be fluorescent. Distinguished from beryl and quartz by its inferior hardness; massive variety is distinguished from calcite and dolomite by lack of effervescence in HCl, and from diopside and olivine by its inferior hardness. Used in the manufacture of fertilizers and in the production of detergents. Apatite is a mineral group that includes the species fluorapatite, chlorapatite, hydroxylapatite, carbonate-fluorapatite.

Aplite. A light-coloured igneous (dyke) rock with fine-grained granitic texture and composition similar to granite.

Aplowite. $(Co,Mn,Ni)SO_4 \bullet 4H_2O$. H = 3. Pink, powdery, with vitreous lustre and white streak. Occurs as coatings on barite-siderite-sulphide specimens. Soluble in water. Originally described from the Magnet Cove barite mine, Walton, Nova Scotia, and named in honour of A.P. Low, director of the Geological Survey of Canada (1906–1907).

Apophyllite. $KCa_4(Si_4O_{10})_2(F,OH) \bullet 8H_2O$. H = 5. Colourless, grey, white, green, yellow, or less commonly, pink square, prismatic, or pyramidal crystals with pearly or vitreous lustre. Perfect basal cleavage and pearly lustre on cleavage face are diagnostic. Commonly associated with zeolites in basalt.

Aragonite. $CaCO_3$. H = 3.5–4. Colourless to white or grey and, less commonly, yellow, blue, green, violet, or rose-red prismatic or acicular crystals; also columnar, globular, or stalactitic aggregates. Vitreous lustre. Transparent to translucent. Distinguished from calcite by its cleavage, superior hardness, and higher specific gravity (2.93). Effervesces in dilute HCl. Pearly inner surfaces of sea shells and pearls are composed of aragonite.

Arfvedsonite. $Na_3(Fe,Mg)_4FeSi_8O_{22}(OH)_2$. H = 5–6. Greenish-black to black tabular or long prismatic crystals. Vitreous lustre. Occurs in alkalic igneous rocks. Monoclinic variety of amphibole.

Argentite. Ag_2S. H = 2–2.5. Dark grey, metallic, cubic or octahedral crystals; arborescent, massive. Very sectile. Occurs in sulphide deposits with other silver minerals. Inverts to acanthite at temperatures below 180°C.

Argillite. A clayey sedimentary rock without slaty cleavage or shaly fracture.

Arizonite. $Fe_2Ti_3O_9$. H = 3.5. Brown to black, platy or granular. Opaque; submetallic lustre. Reddish-brown streak. Alteration product of ilmenite.

Arkose. A sandstone in which feldspar grains predominate over quartz.

Armenite. $BaCa_2Al_6Si_9O_{30}$•$2H_2O$. H = 7.5. Colourless, white, or greyish-green prismatic crystals. Vitreous lustre. Associated with axinite, zoisite.

Arsenic. As. H = 3.5. Light grey to black, submetallic. Massive, reniform, or stalactitic. Volatile without fusion, giving off garlic odour. Occurs in veins with silver, cobalt, and nickel ores.

Arsenolite. As_2O_3. H = 1.5. White, botryoidal, stalactitic, earthy encrustations. Vitreous to silky lustre. Sweetish astringent taste. Secondary mineral formed by oxidation of arsenopyrite, smaltite, and other arsenic minerals.

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.

Artinite. $Mg_2(CO_3)(OH)_2$•$3H_2O$. H = 2.5. White acicular crystals; fibrous aggregates forming botryoidal, spherical masses and crossfibre veinlets. Transparent with vitreous, silky, or satin lustre. Occurs in serpentine. Distinguished from calcite by its form and lustre.

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 (crossfibre) 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.

Asbolite. A mixture of manganese oxides (wad) containing cobalt oxide with or without oxides of nickel and copper. Occurs as dull-black earthy or compact masses.

Ashcroftine. $K_9Na_9(Y,Ca)_{12}Si_{28}O_{70}(OH)_2(CO_3)_8$•$3H_2O$. Pink fibrous, prismatic, or powdery aggregates. Occurs in alkalic igneous rocks.

Asterism. Intersecting lines or bands of light forming a star, as seen in transmitted light in mica, or in reflected light in cabochon-cut sapphire, garnet, etc. Caused by light reflected from microscopic inclusions arranged along crystallographic directions.

Astrophyllite. $(K,Na)_3(Fe,Mn)_7Ti_2Si_3O_{24}(O,OH)_7$. H = 3. Golden-yellow to bronze-brown elongated crystals or blades, often radiating; also micaceous with pearly or splendent lustre. More brittle than mica. Generally occurs in nepheline syenite.

Atacamite. $Cu_2Cl(OH)_3$. H = 3–3.5. Green, prismatic, tabular aggregates; granular massive, fibrous. Adamantine to vitreous lustre. Soluble in acids. Associated with other secondary copper minerals.

Augite. $(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$. Dark green to black. Important constituent of basic and ultrabasic rocks. Monoclinic variety of pyroxene.

Augite syenite. A relatively coarse-textured igneous rock composed mainly of feldspar and pyroxene (augite) with little or no quartz. Used as a building stone.

Aurichalcite. $(Zn,Cu)_5(CO_3)_2(OH)_6$. H = 1–2. Light green or blue silky to pearly acicular or lath-like crystals forming tufted, feathery, plumose, laminated, or granular encrustations. Transparent. Soluble in acids and in ammonia. Secondary mineral occurring in oxidized zones of copper and zinc deposits, associated with other secondary copper and zinc minerals.

Aurostibite. $AuSb_2$. H = 3. Dark grey, metallic. Occurs as grains with gold and sulphide minerals. Resembles galena. Not readily identified in hand specimen.

Axinite. $(Ca,Mn,Fe,Mg)_3Al_2BSi_4O_{15}(OH)$. H = 7. Violet, pink, yellow to brown wedge-shaped crystals or massive, lamellar. Vitreous lustre. Fuses readily with intumescence. Occurs commonly in contact-altered calcareous rocks. Transparent varieties are used as gemstones.

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 lustre; transparent. Secondary copper mineral. Effervesces in acids. Ore of copper.

Baddeleyite. ZrO_2. H = 6.5. Cream-white, yellowish, or amber scaly, finely granular, powdery aggregates. Greasy to dull lustre. Associated with fluorite, dawsonite at the Francon Quarry, Montréal.

Barite. $BaSO_4$. H = 3–3.5. White, pink, yellowish, or blue tabular or prismatic crystals; granular massive. Vitreous lustre. Characterized by high specific gravity (4.5) and perfect cleavage. Used in glass, paint, rubber, and chemical industries, and in oil-drilling technology.

Barylite. $BaBe_2Si_2O_7$. H = 7. Colourless, white, or bluish tabular, prismatic crystals, or massive. Transparent, vitreous. Perfect cleavage.

Basalt. Dark, fine-grained volcanic rock or lava composed predominantly of an amphibole or a pyroxene with plagioclase. Amygdaloidal basalt contains cavities that may be hollow or occupied by one or more minerals.

Basaluminite. $Al_4(SO_4)(OH)_{10}•5H_2O$. White, powdery to compact, massive. Dull lustre. Conchoidal fracture. Secondary mineral, associated with gypsum, aragonite.

Bassanite. $2CaSO_4•H_2O$. White microscopic prisms, fibres, plates. Silky to dull lustre. Associated with gypsum on which it may form chalky coatings. Dehydration product of gypsum; also occurs in volcanic rocks.

Bastnaesite. $(La,Ce)(CO_3)F$. H = 4–4.5. Yellowish to reddish-brown and grey platy, lath-shaped, or granular masses with dull, greasy, or pearly lustre; also greenish brown, earthy. Occurs with other rare-element minerals. Soluble in HCl. Difficult to identify in hand specimen.

Batholith. A very large body of coarse-textured igneous rocks such as granite or diorite.

Baumhauerite. $Pb_3As_4S_9$. H = 3. Grey, metallic, striated prismatic or tabular crystals. Brown streak. Occurs with other lead sulphosalt minerals.

Bavenite. $Ca_4Be_2Al_2Si_9O_{26}(OH)_2$. H = 5.5. White; greenish-, pinkish-, or brownish-white prismatic crystals; also fibrous or radiating lamellar aggregates. Vitreous lustre. Associated with beryl in granite pegmatite.

Behoite. $Be(OH)_2$. H = 4. Colourless, white pseudo-octahedral crystals. Vitreous lustre. Occurs in granitic pegmatite and in syenite.

Berthierite. $FeSb_2S_4$. H = 2–3. Dark steel-grey, metallic, striated prismatic crystals; fibrous or granular masses. Tarnished surface is iridescent or brown. Generally associated with stibnite and not readily distinguished from it in hand specimen.

Bertrandite. $Be_4Si_2O_7(OH)_2$. H = 6–7. Colourless or light yellow tabular or prismatic crystals. Vitreous or pearly lustre. Associated with beryl in granite pegmatite.

Beryl. $Be_3Al_2Si_6O_{18}$. H = 8. White, yellow, green, or blue hexagonal prisms, or massive with conchoidal or uneven fracture. Vitreous lustre; transparent to translucent. Distinguished from apatite by superior hardness, from topaz by its lack of perfect cleavage; massive variety distinguished from quartz by its higher density. Ore of beryllium with numerous uses in nuclear energy, space, aircraft, electronic, and scientific equipment industries; used as alloying agent with copper, nickel, iron, aluminum, and magnesium. Gem varieties include emerald and aquamarine.

Betafite. $(Ca,Na,U)_2(Ti,Nb,Ta)_2O_6(OH)$. H = 4–5.5. Brown to black, waxy to submetallic octahedral or modified octahedral crystals. Metamict. Occurs with euxenite, fergusonite, cyrtolite in granite pegmatite and in calcite veins.

Beta-uranophane. $(H_3O)_2Ca(UO_2)_2(SiO_4)_2•3H_2O$. H = 2.5–3. Yellow to yellowish-green aggregates of acicular crystals or short prismatic crystals. Silky to waxy lustre. May fluoresce green in ultraviolet light. Secondary mineral occurring in granitic rocks and calcite veins containing uranium minerals.

Beudantite. $PbFe_3(AsO_4)(SO_4)(OH)_6$. H = 3.5–4.5. Dark green, brown, or black rhombohedral crystals; also yellow earthy or botryoidal masses. Vitreous, resinous to dull lustre. Secondary mineral occurring in iron and lead deposits. Difficult to distinguish in hand specimens from other yellowish secondary minerals.

Beyerite. $(Ca,Pb)Bi_2(CO_3)_2O_2$. H = 2–3. White, yellow, greenish-yellow to green or grey platy, tabular crystals, or earthy. Vitreous to dull lustre. Occurs as encrustations, or fillings in cavities and fractures. Secondary mineral formed from bismuth minerals.

Bindheimite. $Pb_2Sb_2O_6(O,OH)$. H = 4–4.5. Yellow to brown, white to grey or greenish powdery to earthy encrustations; also nodular. Secondary mineral found in antimony-lead deposits. Difficult to identify except by X-ray methods.

Biomicrite. Limestone composed of skeletal fossil debris and carbonate mud (micrite). Described by major fossil type present, e.g. crinoid biomicrite.

Biotite. $K(Mg,Fe)_3(Al,Fe)Si_3O_{10}(OH,F)_2$. H = 2.5–3. Dark brown or greenish-black, transparent, hexagonal, platy crystals; platy or scaly aggregates. Splendent lustre. Occurs in pegmatite, calcite veins, pyroxenite. Constituent of igneous rocks (granite, syenite, diorite, etc.) and metamorphic rocks (gneiss, schist). Elasticity of individual plates or sheets distinguishes it from chlorite. Sheet mica is used as electrical insulators and for furnace and stove doors (isinglass); ground mica is used in the manufacture of roofing materials, wallpaper, lubricants, and fireproofing material. Mica group.

Birnessite. $Na_4Mn_{14}O_{27}•9H_2O$. H = 1.5. Black opaque grains, granular aggregates, earthy. Dull lustre. Secondary mineral associated with other manganese minerals. Difficult to identify except by X-ray methods.

Bismoclite. BiOCl. H = 2–2.5. Cream-white to grey, brownish; greasy to silky, or dull lustre. Massive, earthy, columnar, fibrous, or scaly. Soluble in acids. Secondary mineral formed by alteration of bismuthinite or native bismuth.

Bismuth. Bi. H = 2–2.5. Light grey, metallic, reticulated crystal aggregates; also foliated or granular. Iridescent tarnish. Used as a component of low melting-point alloys and in medicinal and cosmetic preparations.

Bismuthinite. Bi_2S_3. H = 2. Dark grey, striated, prismatic, acicular crystals; also massive. Iridescent on tarnished surface. Ore of bismuth.

Bismutite. $Bi_2(CO_3)O_2$. H = 2.5–3.5. Yellowish-white to brownish-yellow, light green, or grey earthy or pulverulent masses; also fibrous crusts, spheroidal aggregates, scaly, or lamellar. Dull, vitreous, or pearly lustre. Effervesces in HCl. Uncommon secondary mineral formed by alteration of bismuth minerals.

Bitumen. Natural mixture of hydrocarbons that may be liquid (petroleum) or solid (asphalt or mineral pitch).

Bityite. $CaLiAl_2(AlBeSi_2)O_{10}(OH)_2$. H = 5.5. White, yellow, or brownish-white transparent tabular, pseudohexagonal crystals, or micaceous. Associated with lithium minerals in granite pegmatite.

"Black diamond". A siliceous hematite that, when polished, takes a high, mirror-like lustre. Used as a gemstone.

Boehmite. AlO(OH). H = 3. White with pearly to silky lustre. Flaky, fibrous, granular, or powdery aggregates; also pisolitic. Associated with other aluminum minerals.

Bog iron ore. Loose porous iron ore formed by precipitation of water in bogs or swampy areas. Ore consists of limonite, goethite, and/or hematite.

Bohdanowiczite. $AgBiSe_2$. H = 3. Dark grey, metallic, microscopic grains associated with other selenides and with sulphides.

Boltwoodite. $(H_3O)K(UO_2)(SiO_4)$. H = 3.5–4. Light yellow acicular, fibrous aggregates. Silky, vitreous, to dull lustre. Fluoresces dull green in ultraviolet light. Secondary mineral formed from uranium minerals.

Boracite. $Mg_3B_7O_{13}Cl$. H = 7–7.5. Colourless, white, yellow, green, or grey cubic or dodecahedral crystals; fibrous or granular aggregates. Transparent with vitreous lustre. Occurs in gypsum, halite, and potash deposits. Soluble in HCl.

Bornite. Cu_5FeS_4. H = 3. Reddish-brown, metallic. Usually massive. Tarnishes to iridescent blue, purple, etc. Ore of copper. Also known as 'peacock ore', 'variegated copper', 'vitreous copper', and 'purple copper ore'.

Botallackite. $Cu_2Cl(OH)_3$. Light green to bluish-green columnar crystals forming crusts. Secondary mineral associated with other copper minerals.

Boulangerite. $Pb_5Sb_4S_{11}$. H = 2.5–3. Dark bluish-grey, metallic; striated, elongated, prismatic to acicular crystals; also fibrous, plumose aggregates. Fibrous cleavage is distinguishing characteristic. Ore of antimony.

Bournonite. $PbCuSbS_3$. H = 2.5–3. Grey to blackish-grey, metallic. Short prismatic or tabular crystals with striations; massive. Occurs in veins with sulphides and sulphosalts. Not readily identified in the hand specimen.

Brannerite. $(U,Ca,Y,Ce)(Ti,Fe)_2O_6$. H = 4.5. Black opaque grains, prismatic crystals, granular masses. Resinous to dull lustre. Brownish-yellow on weathered surfaces. Conchoidal fracture. Radioactive. Ore of uranium.

Bravoite. $(Ni,Fe)S_2$. Yellow to grey, metallic, with violet tinge. Pyrite group. Resembles pyrite except for colour.

Breccia. A rock composed of angular fragments; may be attractively patterned and coloured and used as an ornamental rock.

Breithauptite. NiSb. H = 5.5. Light copper-red with violet tint. Metallic lustre. Occurs as disseminated grains, massive, arborescent, and rarely as tabular or prismatic crystals. Reddish-brown streak. Associated with silver and nickel minerals in vein deposits.

Breunnerite. A variety of magnesite containing iron. White, yellowish- to brownish-white.

Britholite. $(Y,Ce,Ca)_5(SiO_4,PO_4)_3(OH,F)$. Tan to brown prisms, platy aggregates, and massive. Resinous lustre. Difficult to distinguish in the hand specimen.

Brochantite. $Cu_4(SO_4)(OH)_6$. H = 3.5–4. Green acicular crystal aggregates; massive, granular. Vitreous lustre. Secondary mineral formed by oxidation of copper minerals. Distinguished from malachite by lack of effervescence in HCl.

Brookite. TiO_2. H = 5.5–6. Dark brown to black tabular or pyramidal crystals with metallic, adamantine lustre. Not readily identifiable in the hand specimen.

Brucite. $Mg(OH)_2$. H = 2.5. White, grey, light blue, or green tabular, platy, foliated, or fibrous aggregates; also massive. Pearly or waxy lustre. Soluble in HCl. Distinguished from gypsum and talc by its superior hardness and lack of greasy feel. Resembles asbestos, but lacks silky lustre. More brittle than muscovite. Used for refractories and as a minor source of magnesium metal.

Brugnatellite. $Mg_6Fe(CO_3)(OH)_{13}•4H_2O$. H = 2. White silky, pearly, or waxy; flaky, aggregates, or foliated lamellar nodules; may be tinted reddish, yellowish, brownish. Associated with brucite and serpentine.

Burbankite. $(Na,Ca)_3(Sr,Ba,Ce)_3(CO_3)_5$. H = 3.5. Tiny yellow or greyish-yellow hexagonal crystals, massive; also colourless to reddish-pink fine hair-like aggregates in cavities with calcite. Associated with other rare-element minerals. Effervesces in HCl. Not readily identifiable in the hand specimen.

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.

Cadmoselite. CdSe. H = 4. Black microscopic grains with resinous to adamantine lustre. Rare mineral associated with other selenium and cadmium minerals.

Cafarsite. $Ca_8(Ti,Fe,Mn)_{6–7}(AsO_3)_{12}•4H_2O$. Dark brown cubic, octahedral, or dodecahedral crystals. Opaque. Conchoidal fracture. Yellowish-brown streak.

Calaverite. $AuTe_2$. H = 2.5–3. Brass-yellow to silver-white, metallic, bladed, lath-like, or striated short prismatic crystals. Fuses readily; on charcoal, gives bluish-green flame and gold globules. Ore of gold. Occurs in veins with pyrite, native gold.

Calcite. $CaCO_3$. H = 3. Colourless or white rhombohedral, scalenohedral crystals; cleavable, granular massive. May be variously coloured due to impurities. Transparent to opaque. Vitreous, pearly, or dull lustre. May fluoresce in ultraviolet light. Effervesces in dilute HCl. Distinguished from dolomite by its inferior hardness and superior solubility in HCl. Major constituent of chalk and limestone.

Cancrinite. $Na_6Ca_2Al_6O_{24}(CO_3)_2$. H = 6. Yellow, pink, or grey massive or prismatic crystals; vitreous to greasy lustre. Effervesces in warm HCl. Associated with nepheline and sodalite in nepheline syenite.

Carbonate-cyanotrichite. $Cu_4Al_2(CO_3,SO_4)(OH)_{12}•2H_2O$. H = 2. Light blue to medium blue, finely granular encrustations with vitreous lustre; also silky fibrous. Secondary mineral formed from copper minerals and associated with other secondary copper minerals. Dissolves in HCl.

Carbonatite. Carbonate rock formed by the reaction of basic magma with limestone and dolomite.

Carletonite. $KNa_4Ca_4Si_8O_{18}(CO_3)_4(F,OH)•H_2O$. H = 4–4.5. Colourless, pink, or light blue flakes. Transparent to translucent; vitreous to pearly. New species originally described from Mount Saint-Hilaire, Quebec, where it is associated with pectolite, albite, arfvedsonite, calcite, fluorite, and apophyllite. Named in honour of Carleton University where this and several other new species have been identified.

Carnallite. $KMgCl_3.•6H_2O$. H = 2.5. Colourless to white tabular crystals, or granular massive. Greasy or dull lustre. Deliquescent and soluble in water. Bitter taste. Occurs with halite and sylvite.

Carnelian. Red to reddish-brown or reddish-yellow translucent variety of chalcedony. Used as a gemstone.

Carrollite. $Cu(Co,Ni)_2S_4$. H = 4.5–5.5. Grey, metallic; tarnishes to copper-red or violet-grey. Granular massive; octahedral crystals. Occurs with other sulphide minerals in vein deposits.

Cassiterite. SnO_2. H = 6–7. Yellow to brown prismatic crystals; twinning common. Also radiating fibrous, botryoidal, or concretionary masses; granular. Adamantine to splendent lustre. White to brownish or greyish streak. Distinguished from other light-coloured nonmetallic minerals by its high specific gravity (6.99), from wolframite by its superior hardness. Ore of tin. Concentrically banded variety is used as a gemstone. Occurs with gold in placers in Yukon Territory.

Catapleiite. $Na_2ZrSi_3O_9•2H_2O$. H = 6. Light yellow, tan, yellowish-brown, or colourless hexagonal plates with vitreous to greasy lustre. Occurs in nepheline syenite where it can be distinguished by its platy habit.

Cattierite. CoS_2. H = 4. Pinkish metallic granular intergrowths with other sulphide minerals; cubic crystals to 1 cm across.

Caysichite. $Ca,GdY_4Si_8O_{20}(CO_3)_6(OH)\bullet 2H_2O$. Colourless, white, yellow, or green coatings or encrustations with divergent columnar structure. Associated with other yttrium minerals. Originally described from the Evans-Lou mine near Wakefield, Quebec. Named for the elements Ca, Y, Si, C, H.

Celadonite. $K(Mg,Fe)(Fe,Al)Si_4O_{10}(OH)_2$. H = 2. Bluish-green to greyish-green scaly, fibrous, or earthy compact masses. Occurs in basalt with zeolites and quartz. Mica group.

Celestine. $SrSO_4$. H = 3–3.5. Transparent, colourless, white, or light blue tabular crystals; also fibrous, massive. Vitreous lustre. Perfect cleavage. Flame test produces crimson colour. Resembles barite but not as heavy. Ore of strontium.

Cement rock. *See* waterlime.

Cenosite. *See* kainosite.

Cernyite. Cu_2CdSnS_4. H = 4. Steel-grey, metallic. Occurs as rare grains in pegmatite at the type locality, the Bernic Lake (Tanco) mine, in Manitoba. Named in honour of Professor Petr Cerny, University of Manitoba.

Cerussite. $PbCO_3$. H = 3–3.5. Transparent white, grey, or brownish tabular crystals with adamantine lustre; also massive. High specific gravity (6.5) and lustre are distinguishing features. Secondary mineral formed by oxidation of lead minerals. Fluoresces yellow in ultraviolet light. Soluble in dilute HNO_3. Ore of lead.

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.

Chabazite. $CaAl_2Si_4O_{12}\bullet 6H_2O$. H = 4. Square colourless, white, yellowish, or pinkish crystals. Vitreous lustre. Occurs in cavities in basalt. Distinguished from other zeolites by its almost cubic crystal form, from calcite by its superior hardness and its lack of effervescence in HCl.

Chalcanthite. $CuSO_4\bullet 5H_2O$. H = 2.5. Light to dark blue tabular or short prismatic crystals; massive, granular. Vitreous lustre. Metallic taste. Secondary mineral formed in copper sulphide deposits. Distinguished from azurite by lack of effervescence in HCl.

Chalcedony. SiO_2. H = 7. Translucent microcrystalline variety of quartz. Colourless, grey, bluish, yellowish, reddish, brown. Formed from aqueous solutions. Attractively coloured chalcedony is used for ornamental objects and jewellery. Varieties include agate, carnelian, jasper, etc.

Chalcoalumite. $CuAl_4(SO_4)(OH)_{12}\bullet 3H_2O$. H = 2.5. Light blue, bluish-green, or bluish-grey, transparent to translucent, platy, fibrous aggregates. Vitreous to dull lustre. Secondary mineral associated with copper 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', 'sulphurette of copper', and 'copper glance'. 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' and 'yellow copper'. Ore of copper.

Chalcostibite. $CuSbS_2$. H = 3–4. Dark grey metallic blade-like crystals, or massive. Associated with copper and antimony minerals.

Chamosite. $(Fe,Mg)_5Al(Si_3Al)O_{10}(O,OH)_8$. H = 3. Yellowish to dull green or grey earthy or clay-like masses. Occurs in some sedimentary iron deposits. Chlorite group.

Chapmanite. $SbFe_2(SiO_4)_2(OH)$. H = 2. Yellowish-green lath-shaped crystals; powdery. Alteration product of silver-antimony minerals. Associated with native silver. Originally described from the Keeley mine, Cobalt district, Ontario. Named in honour of Edward J. Chapman, professor of mineralogy (1853–1895), University of Toronto.

Chert. SiO_2. H = 7. Massive opaque variety of chalcedony; generally drab colours: various tints of grey or brown.

Chloanthite. $(Ni,Co)As_3$. Member of the skutterudite series, high in nickel. Not distinguishable in hand specimen from other members of the series — smaltite and skutterudite in which the cobalt-nickel content is variable. Variety of nickel-skutterudite; not a valid mineral name.

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 by its flexible, but nonelastic, flakes. Occurs in metamorphic, igneous, and volcanic rocks. Alteration product of amphibole, pyroxene, biotite.

Chloritoid. $(Fe,Mg,Mn)_2Al_4Si_2O_{10}(OH)_4$. H = 6.5. Dark grey to black tabular crystals; also platy, scaly, foliated aggregates and massive. Translucent. Pearly lustre. Occurs in schist, lava.

Chlorophane. A variety of fluorite that phosphoresces bright green when heated. Not a valid mineral name.

Chondrodite. $(Mg,Fe)_5(SiO_4)_2(F,OH)_2$. H = 6–6.5. Orange-yellow grains and granular masses. Vitreous to slightly resinous lustre. Subconchoidal to uneven fracture. Occurs in crystalline limestone and in skarn deposits. Orange colour is distinguishing feature. Distinguished from tourmaline by its inferior hardness, from apatite by its superior hardness. Humite group.

Chrome-mica. Green chromium-bearing mica. Also known as "fuchsite".

Chromite. $FeCr_2O_4$. H = 5.5. Black metallic octahedral crystals (rare); generally massive. Distinguished from magnetite by its brown streak and weak magnetism. Commonly associated with serpentine. Ore of chromium.

Chrysoberyl. $BeAl_2O_4$. H = 8.5. Yellow, green, or brown tabular or short prismatic crystals commonly striated and twinned forming six broad radiating spokes. Vitreous; transparent to opaque. Transparent variety is used as a gemstone. Other gem varieties include alexandrite, which is green in natural light and red in artifical light, and cat's-eye, which exhibits a movable streak of light when cut in the cabochon style. Occurs in pegmatite and in mica schist.

Chrysocolla. $(Cu,Al)_2H_2(Si_2O_5)(OH)_4$•$nH_2O$. 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; being mixed with these minerals gives chrysocolla a superior hardness that renders it suitable for use in jewellery and ornamental objects. Minor ore of copper.

Chrysotile. Fibrous variety of serpentine (asbestos).

Cinnabar. HgS. H = 2–2.5. Orange-red to brownish-red, dark grey, rhombohedral, tabular, or prismatic crystals; also granular to earthy massive. Adamantine, metallic, or dull lustre. Opaque. Perfect cleavage. Occurs in veins formed at low temperatures. Commonly associated with pyrite, marcasite, and stibnite in silica-carbonate gangue. Ore of mercury.

Clausthalite. PbSe. H = 2.5–3. Dark grey metallic with bluish tint. Granular massive, foliated. Associated with other selenides in ore deposits.

Cleavelandite. Platy, tabular, or lamellar variety of albite; white with pearly lustre.

Clinopyroxene. Monoclinic Pyroxene group. Includes aegirine, augite, clinoenstatite, diopside.

Clinosafflorite. $(Co,Fe,Ni)As_2$. Monoclinic variety of safflorite. Associated with skutterudite in cobalt deposits.

Clinozoisite. $Ca_2Al_3(SiO_4)_3(OH)$. H = 7. Light green to greenish-grey prismatic crystals; also granular or fibrous masses. Vitreous lustre. Perfect cleavage. Epidote group. Occurs in metamorphic rocks.

Cobalt bloom. Term used by miners for erythrite.

Cobaltite. CoAsS. H = 5.5. Light grey metallic crystals (cubes, pyritohedrons), or massive. Perfect cleavage. Pinkish tinge distinguishes it from other grey metallic minerals. Crystals resemble pyrite, but differ in colour. Associated with cobalt and nickel sulphides or arsenides. Ore of cobalt.

Cobalt pentlandite. Co_9S_8. A rare mineral intimately associated with sulphides and arsenides in ore deposits at Cobalt, Ontario.

Coffinite. $U(SiO_4)_{1-x}(OH)_{4x}$. H = 5–6. Black with adamantine lustre; dull brown. Finely granular massive. Associated with uraninite from which it is indistinguishable in the hand specimen.

Colemanite. $Ca_2B_6O_{11}{\bullet}5H_2O$. H = 4.5. Colourless to white prismatic crystals; cleavable or granular massive. Transparent to translucent with vitreous lustre. Flame test produces green colour. Occurs in borate and gypsum deposits.

Colerainite. $(Mg,Fe)_5Al(Si_3Al)O_{10}(OH)_8$. Thin, colourless to white, hexagonal plates forming rosettes and botryoidal aggregates. Pearly lustre. Associated with serpentine. Named for Coleraine Township, Quebec, where it was first found. Variety of clinochlore. Not a valid mineral name.

Coloradoite. HgTe. H = 2.5. Dark grey to black, metallic, granular masses. Soluble in HNO_3. Occurs with gold and silver tellurides.

Columbite. $(Fe,Mn)(Nb,Ta)_2O_6$. H = 6–7. Brownish-black to black prismatic or tabular crystals forming divergent or parallel groups; also massive. Submetallic lustre. Black to reddish-brown streak. Occurs in pegmatite. Ore of niobium used in high-temperature steel alloys.

Colusite. $Cu_{26}V_2(As,Sn,Sb)_6S_{32}$. H = 3–4. Bronze-yellow to bronze-brown granular massive or tetrahedral crystals. Associated with other copper minerals in ore deposits.

Concretion. Rounded mass formed in sedimentary rocks by accretion of some constituent (iron oxides, silica, etc.) around a nucleus (mineral impurity, fossil fragment, etc.).

Conglomerate. A sedimentary rock composed of rounded pebbles or gravel.

Connellite. $Cu_{19}Cl_4(SO_4)(OH)_{32}•3H_2O$. H = 3. Light azure-blue, translucent, acicular crystals. Vitreous lustre. Distinguished from azurite by lack of effervescence in HCl and by lighter colour.

Cookeite. $LiAl_4(Si_3Al)O_{10}(OH)_8$. H = 2.5–3.5. White, pink, greenish, yellowish, or brown pseudohexagonal plates; also scaly. Transparent to translucent with pearly or silky lustre. Occurs with lithium minerals in granite pegmatite. Chlorite group.

Copiapite. $Fe_5(SO_4)_6(OH)_2•20H_2O$. H = 2.5–3. Light yellow to orange-yellow and greenish-yellow granular to scaly aggregates; also tabular crystals. Transparent to translucent. Vitreous to pearly lustre. Secondary mineral formed by oxidation of sulphides, especially pyrite. Yellow colour is characteristic.

Copper. Cu. H = 2.5–3. Massive, filiform, or arborescent; crystals (cubic or dodecahedral) rare. Hackly fracture. Ductile and malleable. Occurs in lava.

Coquimbite. $Fe_2(SO_4)_3•9H_2O$. H = 2.5. White, yellowish, greenish, or violet, massive; also prismatic crystals. Vitreous lustre. Astringent taste. Secondary mineral formed from pyrite ore.

Cordierite. $Mg_2Al_4Si_5O_{18}$. H = 7. Blue to purplish-blue, bluish-grey, or 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 (schist, gneiss). Gem variety is known as iolite.

Cordylite. $(Ce,La)_2Ba(CO_3)_3F_2$. H = 4.5. Short colourless or yellowish hexagonal prisms. Transparent; greasy to adamantine, pearly lustre. Occurs in nepheline syenite rocks.

Corundum. Al_2O_3. H = 9. Blue, red, yellow, violet, or brown hexagonal prisms or barrel-shaped, pyramidal, or flat tabular crystals. Uneven to conchoidal fracture. Adamantine to vitreous lustre. Distinguished by its hardness and characteristic barrel-shaped form. Used as an abrasive. Transparent red (ruby), blue (sapphire), yellow, and violet varieties are used as gemstones. Translucent varieties may produce star ruby and star sapphire gemstones.

Cosalite. $Pb_2Bi_2S_5$. H = 2.5–3. Dark grey, metallic, prismatic, needle-like, fibrous, or feathery aggregates; massive. Soluble in HNO_3. Associated with smaltite and cobaltite.

Covellite. CuS. H = 1.5–2. Inky blue, metallic; iridescent in shades of brass yellow, purple, coppery red. Massive; platy crystals (hexagonal) rare. Distinguished from chalcocite and bornite by its perfect cleavage and colour.

Crandallite. $CaAl_3(PO_4)_2(OH)_5•H_2O$. H = 5. Minute yellow to white or grey prisms; also fibrous, nodular, or finely granular massive. Transparent to translucent with vitreous or dull lustre. Occurs with other secondary phosphate minerals.

Criddleite. $TlAg_2Au_3Sb_{10}S_{10}$. Fine grey metallic grains (up to 50 µm) associated with aurostibite; recognized only by microscopic examination of polished sections. Occurs in the Hemlo gold deposit, the type locality. Named in honour of ore mineralogist Alan J. Criddle, British Museum, London.

Cristobalite. SiO_2. H = 6.5. White, grey, bluish octahedral (less than 1 mm) crystals; fibrous, massive, stalactitic, botryoidal. Translucent to opaque; vitreous to dull lustre. Occurs in volcanic rocks.

Crocidolite. Blue or bluish-grey asbestiform variety of riebeckite (amphibole). Known as 'blue asbestos'. Used as an insulator. Not a valid mineral name.

Crocoite. $PbCrO_4$. H = 2.5–3. Red-orange to yellow prismatic crystals; massive. Transparent to translucent; adamantine to vitreous lustre. Secondary mineral formed by oxidation of minerals containing lead and chromium.

Cryolite. Na_3AlF_6. H = 2.5. Colourless, yellow, reddish, or brownish, massive granular; crystals with cubo-octahedral aspect. Transparent; vitreous to greasy. Appears to disappear when immersed in water. Soluble in H_2SO_4.

Cryptomelane. KMn_8O_{16}. H = 6–6.5. Grey, greyish-black to black compact to loosely granular massive; also radiating fibres, botryoidal. Metallic to dull lustre. Brownish-black streak. Secondary mineral associated with manganese minerals.

Crystalline limestone. A limestone that has been metamorphosed or recrystallized. Also known as 'marble'. Used as building, monument, and ornamental stone. Dolomitic crystalline limestone contains a high proportion of dolomite.

Cubanite. $CuFe_2S_3$. H = 3.5. Brass-yellow to bronze-yellow tabular crystals, or massive. Distinguished from chalcopyrite by its strong magnetism. Associated with other copper-iron sulphides. Rare mineral.

Cuprite. Cu_2O. H = 3.5–4. Red to almost black octahedral, dodecahedral, or cubic crystals, massive, earthy. Adamantine, submetallic, or earthy lustre. Brownish-red streak. Distinguished from hematite by its inferior hardness, from cinnabar and proustite by its superior hardness. On charcoal, it is reduced to a metallic globule of copper. Soluble in concentrated HCl. Associated with native copper and other copper minerals. Ore of copper.

Curite. $Pb_2U_5O_{17}{\bullet}4H_2O$. H = 4–5. Orange, yellow-brown, greenish yellow to greenish-brown, finely granular. Waxy to dull lustre. Strongly radioactive. Associated with uraninite.

Cyanotrichite. $Cu_4Al_2(SO_4)(OH)_{12}{\bullet}2H_2O$. Minute sky-blue to azure-blue acicular crystals commonly radiating; also extremely fine, plush or wool-like aggregates. Silky lustre. Secondary mineral found sparingly in copper deposits.

Cyrtolite. A radioactive zircon containing uranium and rare elements. Not a valid mineral name.

Dachiardite. $(Ca,Na_2,K_2)_5Al_{10}Si_{38}O_{96}{\bullet}25H_2O$. H = 4–4.5. Colourless to white prismatic crystals, or fibres forming parallel, divergent groups. Transparent; vitreous to silky lustre. Zeolite group.

Dacite. An igneous rock composed mainly of plagioclase with some quartz and pyroxene or hornblende.

Danaite. (Fe,Co)AsS. Variety of arsenopyrite containing up to 9% cobalt. Not a valid mineral name.

Danburite. $CaB_2(SiO_4)_2$. H = 7. Transparent colourless, light yellow prismatic crystals; white nodules. Clear, colourless danburite is used as a gemstone.

Datolite. $CaBSiO_4(OH)$. H = 6.5. Short, transparent, colourless, light yellow, green, or white prismatic crystals; also botryoidal porcelain-like masses, or granular. Vitreous lustre. Easily fusible. Distinguished by its colour, glassy appearance, crystal form, and ease of fusibility.

Dawsonite. $NaAl(CO_3)(OH)_2$. H = 3. Transparent, striated, square prismatic crystals; rosettes or encrustations of bladed or acicular crystals; tufts of colourless needles; also very fine micaceous aggregates. Lustre is vitreous or pearly in crystals, and silky in micaceous variety. Effervesces in HCl. Distinguished by its striated crystal form. Generally difficult to identify in the hand specimen because crystals are very small. Originally found in Montréal, Quebec, near the McGill University campus. Named for John William Dawson (1820–1899), geologist and principal of McGill University.

Devilline. $CaCu_4(SO_4)_2(OH)_6 \bullet 3H_2O$. H = 2.5. Bright green to bluish-green, transparent, platy crystals forming rosettes or tiny masses. Associated with azurite, malachite on copper-bearing rocks; not readily distinguishable from other secondary copper minerals in the hand specimen.

Diabase. Dark-coloured igneous rock composed mostly of lath-shaped crystals of plagioclase and pyroxene. Used as a building, ornamental, and monument stone.

Diaspore. AlO(OH). H = 6.5–7. White, grey, yellow, brown, light violet, pink, or colourless foliated, scaly, granular, or massive aggregates. Platy or acicular crystals. Pearly, vitreous, or brilliant lustre. Associated with aluminous minerals in igneous and metamorphic rocks.

Diatomite. Pulverulent material composed of the siliceous remains of tiny organisms (diatoms), which accumulated on the bottoms of lakes and swamps in Recent geological time. Lightweight and resembles chalk. Used for insulation, filtration, abrasives, absorbents, etc.

Digenite. Cu_9S_5. H = 2.5–3. Bluish-black to black with submetallic lustre. Occurs as pseudocubic crystals or as intergrowths with other copper sulphides.

Diopside. $CaMgSi_2O_6$. H = 6. Colourless, white, grey, green, blue. Transparent to opaque with vitreous lustre. Occurs as short prisms or granular masses in calcium-rich metamorphic rocks. Monoclinic variety of pyroxene.

Diorite. A dark-coloured igneous rock composed mainly of plagioclase and amphibole or pyroxene.

Djurleite. $Cu_{1.96}S$. Properties similar to those of chalcocite from which it is indistinguishable in the hand specimen. Occurs in some Cobalt, Ontario, ore deposits.

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. Common vein-filling mineral in ore deposits and essential constituent of dolomitic limestone and dolomitic marble. Ore of magnesium used in the manufacture of lightweight alloys.

Dolomitic limestone. Limestone containing 10% to 50% dolomite.

Domeykite. Cu_3As. H = 3–3.5. Light grey, metallic; massive, reniform, or botryoidal. Becomes yellowish to brown or iridescent when tarnished. Occurs with other copper minerals. Soluble in HNO_3 but not in HCl.

Donnayite. $NaCaSr_3Y(CO_3)_6 \bullet 3H_2O$. H = 3. Yellow, colourless, white, grey, brown, or reddish-brown platy, tabular, columnar, or granular aggregates. Vitreous lustre. Associated with microcline, analcime, calcite, natrolite, chlorite, aegirine, and arfvedsonite in nepheline syenite at the type locality, Mount Saint-Hilaire, Quebec. It was named in honour of Professors J.D.H. Donnay and Gabrielle Donnay, McGill University.

Doverite. *See* synchysite-Y.

Doyleite. $Al(OH)_3$. H = 2.5–3. White platy crystals forming rosettes; pulverulent to compact globules, crusts. Dull lustre. Originally described from Mount Saint-Hilaire, Quebec, where it occurs in albitite, and from Francon quarry, Montréal, where it occurs on weloganite, calcite, and quartz. Named in honour of its discoverer, mineral collector E.J. Doyle of Ottawa.

Dresserite. $Ba_2Al_4(CO_3)_4(OH)_8 \bullet 3H_2O$. H = 2.5–3. White to colourless spheres commonly 3 to 4 mm in diameter; blade-like crystals with oblique terminations forming tufts, spheres. Transparent to translucent, opaque; silky to vitreous lustre. Effervesces in HCl. Distinguished from dawsonite by its oblique termination. Associated with weloganite in quartz-albite-lined cavities in igneous sill rock at the Francon quarry, Montréal, Quebec, the type locality. Named in honour of geologist John A. Dresser (1866–1954) in recognition of his geological work in the Monteregian Hills, Quebec.

Dufrenoysite. $Pb_2As_2S_5$. H = 3. Long, grey, metallic, striated tabular crystals. Reddish-brown streak. Perfect cleavage. Associated with sphalerite and arsenic minerals.

Dumortierite. $Al_7(BO_3)(SiO_4)_3O_3$. H = 7. Blue, violet, or greenish-blue columnar or fibrous masses; also massive. Vitreous or dull lustre. Transparent to translucent. Difficult to distinguish from cordierite except by X-ray methods. Used in the manufacture of porcelain spark plugs and as a gemstone.

Dundasite. $PbAl_2(CO_3)_2(OH)_4 \bullet H_2O$. H = 2. White silky to vitreous radiating crystals, spherical aggregates, matted encrustations. Effervesces in acids. Secondary mineral associated with lead minerals.

Dunite. Fine-grained, dull grey-black ultramafic igneous rock composed mainly of olivine.

Dyke. A long narrow body of igneous rock cutting across the structure of other rocks that it intrudes.

Dyscrasite. Ag_3Sb. H = 3.5–4. Light grey, metallic, tarnishing to dark grey. Granular massive, foliated; also pyramidal crystals. Sectile. Occurs in veins with silver minerals and sulphide minerals. Decomposed by HNO_3.

Ekanite. $ThCa_2Si_8O_{20}$. H = 5. Dark reddish-brown, yellow, or green tetragonal prisms, or massive. Vitreous lustre. Transparent variety is used as a gemstone. Originally found in gem gravel of Sri Lanka.

Electrum. (Au,Ag). H = 2.5–3. Yellow, metallic. Natural alloy of gold and silver with 20% gold content.

Ellsworthite. Amber yellow to dark brown, massive; adamantine lustre. Originally found in 1922 at the McDonald mine near Bancroft, Ontario, and named in honour of H.V. Ellsworth, mineralogist, Geological Survey of Canada. Subsequently found to be a uranpyrochlore. Not a valid mineral name.

Elpidite. $Na_2ZrSi_6O_{15}$•$3H_2O$. H = 7. White, light green, or grey fibrous, prismatic crystals or massive. Vitreous or silky lustre. Found in nepheline syenite. Not readily identifiable in the hand specimen.

Enargite. Cu_3AsS_4. H = 3. Greyish-black to iron-black, metallic (dull when tarnished), prismatic or tabular crystals; also massive or granular. When twinned, it forms star-shaped cyclic trillings. Perfect cleavage. Associated with pyrite, galena, sphalerite, and copper sulphides. Good cleavage is characteristic. Ore of copper.

Enstatite. $MgSiO_3$. H = 6. White, green, or brown with vitreous lustre. Occurs as coarse cleavable masses in pyroxenite, peridotite. Orthorhombic variety of pyroxene.

Epididymite. $NaBeSi_3O_7(OH)$. H = 5.5. White prismatic crystals, massive. Silky lustre. Occurs sparingly in nepheline syenite. Not readily identifiable in the hand specimen.

Epidote. $Ca_2(Al, Fe)_3(SiO_4)_3(OH)$. H = 6–7. Yellowish-green massive or fibrous aggregates. Vitreous lustre. Often associated with quartz and pink feldspar, producing attractive mottled or veined patterns (unakite). Forms during metamorphism of igneous rocks and limestone, and in veins. Takes a good polish and can be used for jewellery and other ornamental objects.

Epistilbite. $CaAl_2Si_6O_{16}$•$5H_2O$. H = 4. Colourless to reddish twinned prismatic crystals, spherical aggregates, or granular massive. Vitreous lustre. Occurs with stilbite and other zeolite minerals in cavities in basalt. Zeolite group.

Erythrite. $Co_3(AsO_4)_2$•$8H_2O$. H = 1.5–2.5. Rose-red to crimson globular, radial, or reniform aggregates; also earthy or pulverulent; prismatic to acicular crystals (rare). Dull to adamantine lustre. Soluble in HCl. Secondary mineral formed by the oxidation of cobalt arsenides. Referred to as 'cobalt bloom'.

Esker. A long stream-deposited ridge or mound formed by the accumulation of sand, gravel, and boulders left by retreating glaciers.

Eucairite. CuAgSe. H = 2.5. Light grey, metallic; tarnishes to a bronze colour. Granular massive. Associated with other selenides in copper deposits.

Eucryptite. $LiAlSiO_4$. H = 6.5. Short colourless or white hexagonal prisms; more commonly massive granular. Transparent with vitreous lustre. Fluoresces pink in ultraviolet light. Occurs with lithium minerals in granite pegmatite.

Eudialyte. $Na_4(Ca,Ce)_2(Fe,Mn,Y)ZrSi_8O_{22}(OH,Cl)_2$. H = 5–5.5. Pink, red, yellow, brown, massive; as grains, or tabular or rhombohedral crystals. Transparent with vitreous lustre. Occurs in nepheline syenite. Difficult to identify in the hand specimen.

Eulytite. $Bi_4(SiO_4)_3$. H = 4.5. Yellow, grey, light green, brown, or white tetrahedral crystal aggregates, also spherical forms. Associated with bismuth minerals.

Euxenite. $(Y,Ca,Ce,U,Th)(Nb,Ta,Ti)_2O_6$. H = 5.5–6.5. Black massive or prismatic crystals forming parallel or radial groups. Brilliant, submetallic, or greasy lustre. Conchoidal fracture. Radioactive. Distinguished from other radioactive minerals by X-ray methods.

Evaporite. Sedimentary rock formed by evaporation of minerals such as gypsum or halite from saline waters.

Ewaldite. $Ba(Ca,Y,Na,K)(CO_3)_2$. Bluish-green aggregates of microcrystals; tiny white tabular crystals. Associated with mckelveyite.

Facet cut. Polished gemstone featuring numerous flat surfaces, as in diamond.

Facies. A distinctive rock type corresponding to a certain environment or mode of origin.

Fairfieldite. $Ca_2(Mn,Fe)(PO_4)_2 \bullet 2H_2O$. H = 3.5. White, greenish-white, or yellow transparent prismatic crystals; also foliated, fibrous, lamellar, or radiating aggregates. Brilliant or pearly lustre. Soluble in acids. Occurs in granite pegmatite.

Faujasite. $(Na_2,Ca)Al_2Si_4O_{12} \bullet 8H_2O$. H = 5. Colourless or white octahedral crystals. Vitreous lustre. Distinguished from fluorite by its superior hardness.

Fault. Structural feature produced by the movement of one rock mass relative to another; the terms 'shear zone', 'brecciated zone', and 'fault zone' refer to the region affected by the movement.

Feldspar. A mineral group consisting of aluminosilicates 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 glass, ceramics, porcelain enamel, porcelain, pottery, scouring powders, and artificial teeth.

Felsic. A term describing an igneous rock composed mostly of light-coloured minerals such as feldspar, feldspathoids, quartz, and muscovite.

Felsite. A dense, fine-grained, light-coloured (pink or grey) igneous rock composed mainly of feldspar with little or no quartz.

Ferberite. $FeWO_4$. H = 4–4.5. Black striated wedge-shaped prisms; also bladed or massive. Metallic lustre. Brownish-black to black streak. Weakly magnetic. Ore of tungsten.

Fergusonite. $(Y,Ce,La,Nd)(Nb,Ti)O_4$. H = 5.5–6.5. Black prismatic or pyramidal crystals; also massive. Brilliant to submetallic lustre on fresh surfaces; grey, yellowish, or brownish on exposed surfaces. Subconchoidal fracture. Radioactive. Occurs in granite pegmatite. Distinguished from other radioactive minerals by X-ray methods.

Fersmite. $(Ca,Ce,Na)(Nb,Ta,Ti)_2(O,OH,F)_6$. H = 4–4.5. Dark brown to black striated prisms; also tabular. Subvitreous to resinous lustre. Greyish-brown streak. Occurs with niobium minerals in marble and in pegmatite.

Fibroferrite. $Fe(SO_4)(OH) \bullet 5H_2O$. H = 2.5. White, yellow, or greenish fibrous masses; also radiating fibres. Silky or pearly lustre. Formed by oxidation of pyrite and associated with other secondary iron minerals from which it is distinguished by X-ray methods.

Fischesserite. Ag_3AuSe_2. H = 2. Metallic grains associated with clausthalite, native gold, chalcopyrite, pyrite, and other selenides.

Flint. Yellowish-grey or brown, dark grey to black opaque variety of chalcedony. Used by primitive peoples for tools.

Fluoborite. $Mg_3(BO_3)(F,OH)_3$. H = 3.5. Colourless, white, or pink transparent to translucent hexagonal prisms, prismatic or granular aggregates; vitreous, silky, or pearly lustre. May fluoresce white in ultraviolet light. Resembles apatite, but has an inferior hardness. Occurs in crystalline limestone.

Fluorescence. Property of certain substances to glow when exposed to ultraviolet light, X-rays, or cathode rays. It is caused by impurities in the substance or by defects in its crystal structure. Two wavelengths are commonly used to produce ultraviolet fluorescence: long wave (320 to 400 nm), short wave (253.7 nm).

Fluorite. CaF_2. H = 4. Transparent, colourless, blue, green, violet, or 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, steel-making, ceramics.

Fluor-richterite. $Na(Ca,Na) Mg_3Si_8O_{22}F_2$. H = 5–6. Dark grey to dark greenish-grey long prismatic crystals or aggregates of crystals. Fluorine-rich variety of richlerite; amphibole group. Not a valid mineral name.

Forsterite. Mg_2SiO_4. H = 6.5. White or light green square prismatic or tabular crystals; also massive. Vitreous lustre. Conchoidal fracture. Member of the olivine group; distinguished from other members of the group by X-ray methods. Used in the manufacture of refractory bricks.

Franconite. $Na_2Nb_4O_{11}•9H_2O$. White microscopic globules and globular aggregates (about 0.5 mm across) with vitreous to silky lustre. Dissolves in HCl. Occurs on weloganite, calcite, and quartz crystals at the Francon quarry, Montréal, the type locality. Named for the locality.

Freibergite. $(Ag,Cu,Fe)_{12}(Sb,As)_4S_{13}$. A silver-rich member of the tetrahedrite-tennantite series.

Freieslebenite. $AgPbSbS_3$. H = 2–2.5. Grey, metallic, striated prismatic crystals. Grey streak. Associated with silver and lead ores.

Frohbergite. $FeTe_2$. H=4. Pinkish white, metallic. Occurs as intergrowths with other telluride minerals, chalcopyrite, and native gold. Distinguishable from other metallic minerals only by microscopic examination of polished surfaces. Originally found in the Robb-Montbray mine, near Arntfield, Quebec. Named in honour of mining geologist Dr. M.H. Frohberg of Toronto, Ontario.

Froodite. $PdBi_2$. H = 2. Grey, metallic grains associated with arsenic-lead-copper ores. Originally described from the Frood mine, Sudbury district, Ontario, for which it is named.

Fuchsite. An emerald-green chromian muscovite. Not a valid mineral name. Also called chrome-mica.

Gabbro. A dark, coarse-grained igneous rock composed mainly of calcic plagioclase and pyroxene. Used as a building stone and monument stone.

Gadolinite. $(Ce,La,Nd,Y)_2FeBe_2Si_2O_{10}$. H = 6.5–7. Black prismatic crystals, or massive. Vitreous lustre. Occurs in pegmatite.

Gahnite. $ZnAl_2O_4$. H = 7.5–8. Dark blue-green, yellow, or brown octahedra, rounded grains, massive. Vitreous lustre. Occurs in granite pegmatite and in marble. Spinel group.

Gaidonnayite. $Na_2ZrSi_3O_9•2H_2O$. Colourless, white to light yellowish-brown striated bladed crystals. Transparent; vitreous. Occurs in nepheline syenite at Mount Saint-Hilaire, Quebec, as crystals on analcime, in cavities in natrolite; also occurs in pegmatite dykes with catapleiite, elpidite, hilairite, albite, microcline, chlorite, aegirine, epididymite, and goethite. Named in honour of Gabrielle Donnay, professor of crystallography, McGill University.

Galena. PbS. H = 2.5. Dark grey, metallic, cubic crystals or crystal aggregates; also massive. Perfect cleavage. Distinguished by its high specific gravity (7.58) and perfect cleavage. Ore of lead; may contain silver.

Galkhaite. $(Cs,Tl)(Hg,Cu,Zn)_6(As,Sb)_4S_{12}$. H = 3. Orange-red cubic crystals; granular aggregates. Vitreous to adamantine lustre. Occurs in arsenic-antimony-mercury deposits.

Garnet. Silicate of Al, Mg, Fe, Mn, Ca. H = 6.5–7.5. Transparent red dodecahedral crystals, or massive; also colourless, yellow, brown, orange, green, black. Used as an abrasive; transparent garnet is used as a gemstone. Distinguished by its crystal form. Mineral group consisting of several species including almandine, grossular, pyrope, spessartine.

Genthelvite. $Zn_4Be_3(SiO_4)_3S$. H = 6–6.5. Light yellow to brown, yellowish-green, or reddish-brown tetrahedral crystals, and massive. Vitreous lustre. Uneven to conchoidal fracture. Helvite group.

Genthite. Hydrous nickel silicate, also known by the general term 'garnierite'. Not a valid mineral species.

Gersdorffite. NiAsS. H = 5.5. Light to dark grey, metallic; octahedral, pyritohedral crystals or granular massive. Associated with other nickel minerals in vein deposits.

Getchellite. $AsSbS_3$. H = 1.5–2. Dark red, resinous, microscopic crystals; also granular or micaceous. May show violet or green iridescence. Associated with stibnite, realgar, orpiment.

Gibbsite. $Al(OH)_3$. H = 2.5–3.5. White, six-sided, tabular crystals; massive. Translucent, vitreous to pearly, or dull; earthy. Secondary mineral formed by alteration of aluminum minerals.

Gittinsite. $CaZrSi_2O_7$. H = 3.5–4. White fibrous radiating masses. Occurs as intergrowths with apophyllite in pegmatite. Originally described from the Kipawa area, Quebec, and named in honour of Professor John Gittens, University of Toronto.

Gladite. $PbCuBi_5S_9$. Dark grey, metallic, prismatic crystals. Associated with other lead-bismuth sulphide minerals.

Glaucodot. (Co,Fe)AsS. H = 5. Light grey to reddish-grey, metallic, striated prismatic crystals, or massive. May form cruciform twins. Decomposed by HNO_3 forming a pink solution. Associated with cobaltite from which it is distinguished by crystal form and colour.

Glauconite. $(K,Na)(Fe,Al,Mg)_2(Si,Al)_4O_{10}(OH)_2$. H = 2. Greyish, bluish, or yellowish-green fine platy aggregates. Commonly occurs in sedimentary rocks. Mica group.

Gmelinite. $(Na_2,Ca)Al_2Si_4O_{12}\bullet 6H_2O$. H = 4.5. Colourless, white, light yellow, green, or pink striated tabular, pyramidal, or rhombohedral crystals. Transparent, vitreous. Occurs in basalt and other igneous rocks. Zeolite group.

Gneiss. A coarse-grained, foliated, metamorphic rock composed mainly of feldspar, quartz, and mica. Used as a building stone and as monument stone.

Godlevskite. $(Ni,Fe)_7S_6$. Light yellow, metallic. Occurs as microscopic grains and aggregates associated with nickel and copper ores.

Goethite. FeO(OH). H = 5–5.5. Dark brown, reddish- or yellowish-brown earthy, botryoidal, fibrous, bladed, or loosely granular masses; also prismatic, acicular, or tabular crystals, or scaly. Characteristic 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. Rusty oxidation product consisting of hydrated iron oxides derived from the weathering of pyrite and pyrrhotite. Commonly occurs as an outcrop of the upper zone of pyrite-bearing veins.

Götzenite. $Na_2Ca_5Ti(Si_2O_7)_2F_4$. Light yellowish-brown to colourless radiating acicular aggregates. Vitreous lustre. Rare mineral, difficult to identify in the hand specimen. Occurs with pectolite, natrolite, apophyllite at Mount Saint-Hilaire, Quebec.

Granite. Relatively coarse-grained grey to reddish igneous rock composed mainly of feldspar and quartz. Used as a building stone and as monument stone.

Granite gneiss. Gneiss having the mineral composition of granite.

Granite pegmatite. Pegmatite having the mineral composition of granite.

Granodiorite. A coarse-grained igneous rock with composition intermediate between granite and diorite.

Graphic granite. A granitic rock composed of a regular intergrowth of quartz and K-feldspar producing a geometric pattern resembling hieroglyphic writing. An attractive ornamental stone.

Graphite. C. H = 1–2. Dark grey to black, metallic, flaky or foliated masses. Flakes are flexible. Greasy to touch. Black streak and colour distinguish it from molybdenite. Usually occurs in metamorphic rocks. Used as a lubricant in the manufacture of 'lead' pencils and refractories.

Greenockite. CdS. H = 3–3.5. Yellow earthy coating; rarely as pyramidal crystals. Resinous to adamantine lustre. Associated with sphalerite. Dissolves in HCl giving strong H_2S odour.

Greenstone. A metamorphosed volcanic rock composed mainly of chlorite.

Greywacke. Sedimentary rock containing large amounts of amphibole or pyroxene and feldspar.

Grossular. $Ca_3Al_2(SiO_4)_3$. H = 6.5–7. Colourless, white, yellow, pink, orange, brown, red, black, or green, transparent to opaque, dodecahedral or trapezohedral crystals; massive granular. Vitreous lustre. Occurs in metamorphosed limestone and skarn zones with other calcium silicates. Transparent varieties are used as a gemstone. Garnet group.

Groutite. MnO(OH). H = 5.5. Black, lustrous, acicular, prismatic, wedge-shaped crystals. Associated with other manganese minerals.

Gudmundite. FeSbS. H = 6. Light to dark grey, metallic, elongated, striated prismatic crystals; also massive, lamellar. Light bronze when tarnished. Not readily distinguishable from other grey metallic sulphides in the hand specimen.

Gunningite. $ZnSO_4 \bullet H_2O$. H = 2.5. White powder occurring as an efflorescence on sphalerite from which it has oxidized. First described from the Keno Hill, Yukon Territory, deposits, and named for Dr. H.C. Gunning, a former geologist with the Geological Survey of Canada and later head of the Geology Department, University of British Columbia.

Gustavite. $PbAgBi_3S_6$. Dark grey, metallic, tabular grains. Rare mineral associated with bismuth-lead-silver sulphosalt minerals.

Gypsum. $CaSO_4 \bullet 2H_2O$. H = 2. White, grey, light brown, granular massive; also fibrous (satin spar), or colourless transparent (selenite). Distinguished from anhydrite by its inferior hardness. Occurs in sedimentary rocks. Used in the construction industry (plaster, wallboard, cement, tiles, paint) and as a soil conditioner and fertilizer. Satin spar, selenite, and alabaster (fine-grained translucent variety) are used for carving into ornamental objects.

Gyrolite. $NaCa_{16}(Si_{23}Al)O_{60}(OH)_5 \bullet 15H_2O$. H = 3–4. Colourless to white concretions with a radiating internal structure. Vitreous lustre. Associated with zeolite minerals in cavities in basalt. Zeolite group.

Hackmanite. $Na_8Al_6Si_6O_{24}Cl_2S$. H = 6. Light violet to bluish-violet, massive. Fades on exposure to sunlight. Vitreous to greasy lustre. Fluoresces yellow when exposed to ultraviolet rays. Variety of sodalite.

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. Used for the production of sodium, chlorine, hydrochloric acid, and in natural state as table salt.

Halotrichite. $FeAl_2(SO_4)_4 \bullet 22H_2O$. H = 1.5. White hair-like crystals; spherical aggregates. Vitreous lustre. Astringent taste. Secondary mineral formed by weathering of pyrite.

Harmotome. $(Ba,K)_{1-2}(Si,Al)_8O_{16} \bullet 6H_2O$. H = 4.5. Colourless, white, grey, yellow, pink, or brown cruciform penetration twins or radiating aggregates. Transparent to translucent, vitreous. Occurs in basalt and other igneous rocks. Zeolite group.

Hatchettolite. H = 4. Amber to black irregular masses. Occurs with radioactive zircon (cyrtolite) in pegmatite. Not a valid mineral name. Accepted name is 'uranpyrochlore'.

Hauchecornite. $Ni_9Bi(Sb,Bi)S_8$. H = 5. Light yellow, metallic, tarnishing to dark bronze; tabular, bipyramidal, prismatic crystals. Conchoidal fracture. Black streak. Occurs in nickel-bismuth ores.

Hausmannite. Mn_3O_4. H = 5.5. Brownish-black, greasy to submetallic, fine grained massive. Associated with other manganese minerals and difficult to distinguish from them in the hand specimen. Ore of manganese.

Hawleyite. CdS. Bright yellow powdery coating; earthy. Associated with sphalerite and siderite. First described from the lead-silver-zinc deposit at the Hector-Calumet mine, Elsa, Yukon Territory. Named for Professor J.E. Hawley, Queen’s University, Kingston.

Heazlewoodite. Ni_3S_2. H = 4. Yellow, metallic; massive, granular, or platy aggregates. Distinguished from pyrite by its inferior hardness.

Hedenbergite. $CaFeSi_2O_6$. H = 6. Green to black short prismatic crystals or massive. Translucent to opaque; vitreous to dull. Monoclinic variety of pyroxene.

Hellandite. $(Ca,Y)_6(Al, Fe)Si_4B_4O_{20}(OH)_4$. H = 5.5. Red to brown tabular, prismatic crystals. Occurs with tourmaline and rare-earth minerals in granite pegmatite.

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.

Hemimorphite (Calamine). $Zn_4Si_2O_7(OH)_2{\bullet}H_2O$. H = 5. White, brownish, light blue, or green thin tabular crystals; also massive, stalactitic, or mammillary. Vitreous lustre. Associated with smithsonite in zinc deposits; distinguished from it by lack of effervescence in HCl and superior hardness. Minor ore of zinc.

Hemloite. $(As,Sb)_4(Ti,Fe,V,Al)_{24}(O,OH)_{48}$. Black, metallic to submetallic, with black streak. Occurs as grains associated with rutile, molybdenite, titanite, pyrite, sphalerite, arsenopyrite, vanadian muscovite, microcline, and quartz in the Hemlo gold deposit, the type locality. Named for the locality.

Hessite. Ag_2Te. H = 2–3. Grey, metallic, finely granular, massive. Sectile. Occurs with native gold and with other tellurides in vein deposits.

Heterogenite. CoO(OH). H = 3–4. Black to dark brown, reddish globular or reniform masses with conchoidal fracture. Alteration product of smaltite.

Heulandite. $(Na,Ca)_{2-3}Al_3(Al,Si)_2Si_{13}O_{36}{\bullet}12H_2O$. H = 3–4. Colourless, white, pink, or orange tabular crystals. Vitreous or pearly lustre. Distinguished from other zeolites by its crystal form.

Hexahydrite. $MgSO_4{\bullet}6H_2O$. Colourless, white, finely fibrous, columnar; also globular encrustations. Pearly to vitreous lustre. Bitter, saline taste. Occurs sparingly as an alteration product of epsomite. Originally found at a Bonaparte River locality in British Columbia. Associated with other sulphates from which it is not readily distinguished.

Hibschite. $Ca_3Al_2(SiO_4)_{3-x}(OH)_{4x}$. H = 6. Colourless, light yellow, or greenish-white octahedral crystals (minute), or massive. Vitreous to greasy lustre. Uncommon mineral, not readily identifiable in hand specimen. Garnet group.

Hilairite. $Na_2ZrSi_3O_9{\bullet}3H_2O$. H = +4. Very small, trigonal, light brown, transparent crystals, and pink, porcelain-like, opaque crystals. Associated with analcime, natrolite, microcline, catapleiite, elpidite, aegirine, and chlorite in nepheline syenite at Mount Saint-Hilaire, Quebec, the type locality for which the mineral was named.

Hilgardite. $Ca_2B_5O_9Cl{\bullet}H_2O$. H = 5. Colourless, transparent, tabular crystals. Vitreous lustre. Occurs in salt deposits and in gypsum or anhydrite deposits.

Hiortdahlite. $(Ca,Na)_3(Zr,Ti)Si_2O_7(O,F)_2$. H = 5.5. Yellow to brown tabular crystals. Translucent to transparent; vitreous. Occurs in alkalic igneous rocks.

Hisingerite. $Fe_2Si_2O_5(OH)_4{\bullet}2H_2O$. H = 3. Black to brownish-black, compact, massive with conchoidal fracture. Greasy to dull lustre. Alteration product of iron-bearing minerals.

Hochelagaite. $(Ca,Na,Sr)Nb_4O_{11}•8H_2O$. H ~ 4. White microscopic globules composed of radiating blades. Vitreous lustre. Occurs on crystals of weloganite, calcite, and quartz at the Francon quarry, Montréal, the type locality. Indistinguishable from franconite in the hand specimen. Named for Hochelaga, the original name for Montréal.

Hollingworthite. (Rh,Pt,Pd)AsS. H = 6. Grey, metallic grains intergrown with platinum minerals such as sperrylite.

Holmquistite. $Li_2(Mg,Fe)_3Al_2Si_8O_{22}(OH)_2$. H = 5–6. Violet to light blue prismatic, acicular to fibrous aggregates; also massive. Transparent to translucent with vitreous lustre. Associated with lithium-rich pegmatite occurring in wall rock. Orthorhombic member of amphibole.

Hornblende. $Ca_2(Fe,Mg)_4Al(Si_7Al)O_{22}(OH,F)_2$. H = 6. Dark green, brown, or black prismatic crystals, or massive. Vitreous lustre. Common rock-forming mineral. Monoclinic variety of amphibole.

Howlite. $Ca_2B_5SiO_9(OH)_5$. H = 3.5. Colourless to white, vitreous, granular masses; transparent elongated tabular crystals; compact nodular masses. Crystals distinguished from selenite by superior hardness. Occurs in sedimentary rocks. Named after Henry How, Nova Scotia mineralogist who first described it in 1868.

Humite. $(Mg,Fe)_7(SiO_4)_3(F,OH)_2$. H = 6–6.5. Yellow to orange, granular or massive. Vitreous to resinous lustre. Difficult to distinguish from other members of the humite group (chondrodite, norbergite, clinohumite). Occurs in crystalline limestone.

Hydroboracite. $CaMgB_6O_8(OH)_6•3H_2O$. H = 2–3. Colourless, transparent, vitreous, prismatic crystals; white fibrous masses with silky lustre. Occurs in salt and borate deposits. Soluble in acids.

Hydrocarbon. Naturally occurring compounds of carbon and hydrogen such as paraffin, and compounds of carbon, hydrogen, and oxygen such as amber, petroleum, coal. Compounds are of organic origin and are not classified as minerals.

Hydrocerussite. $Pb_3(CO_3)_2(OH)_2$. H = 3.5. Tiny colourless to white or grey hexagonal scales and plates. Transparent to translucent with adamantine or pearly lustre. Associated with cerussite from which it is not readily distinguished. Alteration product of lead, galena.

Hydrodresserite. $BaAl_2(CO_3)_2(OH)_4•3H_2O$. H = 3–4. White spheres and hemispheres (2 to 4 mm across) composed of radiating blades. Translucent to opaque. Dehydrates to dresserite from which it cannot be distinguished in hand specimen. Effervesces in HCl. Occurs with quartz, dawsonite, and weloganite at the Francon quarry, Montréal, the type locality. Named for its chemical relationship to dresserite quarry..

Hydromagnesite. $Mg_5(CO_3)_4(OH)_2•4H_2O$. H = 3.5. Colourless or white, transparent, flaky, acicular, or bladed crystals, aggregates forming tufs, rosettes, or encrustations; also massive. Vitreous, silky, or pearly lustre. Associated with serpentine, brucite, magnesite. Effervesces in acids. Distinguished from calcite by its habit.

Hydronepheline. Pink to orange-red nodular or irregular patches in nepheline syenite. Not a valid species. In the Bancroft, Ontario, area, what was referred to as 'hydronepheline' is natrolite.

Hydrotalcite. $Mg_6Al_2(CO_3)(OH)_{16}•4H_2O$. H = 2. White, transparent, foliated, lamellar aggregates; also platy. Pearly to waxy lustre. Greasy feel. Distinguished from talc by its effervescence in dilute HCl and by its superior hardness. Associated with talc, serpentine deposits.

Hydroxylbastnaesite. (Ce,La)(CO_3)(OH,F). H = 4. Yellow to brown, pinkish-brown, or dark green, opaque, irregular to reniform masses. Waxy, greasy, or resinous lustre. Associated with other rare-earth minerals.

Hydrozincite. $Zn_5(CO_3)_2(OH)_6$. H = 2–2.5. White to grey, yellowish, brownish, or pinkish, fine- grained, compact to earthy or gel-like masses; also stalactitic, reniform, pisolitic, concentrically banded, or radially fibrous aggregates; flat, blade-like crystals. Dull, silky, or pearly lustre. Fluoresces light blue or light violet in ultraviolet light. Secondary mineral found in oxidized zones in zinc deposits.

Hypersthene. $(Mg,Fe)_2Si_2O_6$. H = 6. Brown to blackish-brown prismatic crystals or granular to cleavable masses. May have a bronze lustre (bronzite). Occurs in anorthosite, peridotite, and pyroxenite. Intermediate member of the orthorhombic enstatite-ferrosilite series, pyroxene group. Bronze variety used as a gemstone.

Igneous. Said of rocks that have crystallized from magma or from the melting of other rocks; usually composed of feldspar, quartz, and hornblende, pyroxene, or biotite.

Ilesite. $(Mn,Zn,Fe)SO_4 \bullet 4H_2O$. Green to white, loose prismatic crystal aggregates. A secondary mineral formed by oxidation in sulphide veins.

Illite. $(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2 \bullet H_2O$. H = 1-2. White, finely micaceous to clay-like. Dull lustre. Perfect cleavage. Mica-clay mineral.

Ilmenite. $FeTiO_3$. H = 5–6. Black, metallic to submetallic. Compact or granular massive; thick tabular crystals. Black streak distinguishes it from hematite. Ore of titanium.

Ilmenomagnetite. Titanium-bearing magnetite containing ilmenite in exsolution. Not a valid mineral name.

Ilmenorutile. $(Ti,Nb,Fe)_3O_6$. H = 6. Black to greenish-black plates, rosettes. Opaque; velvety to submetallic lustre. Occurs in dawsonite, calcite at the Francon Quarry, Montréal.

Insizwaite. $Pt(Bi,Sb)_2$. Metallic grains and massive. Associated with pentlandite, chalcopyrite, and nickel and platinum minerals.

Inyoite. $Ca_2B_6O_6(OH)_{10} \bullet 8H_2O$. H = 2. Colourless, transparent, prismatic to tabular crystals; granular massive. Vitreous lustre. Occurs in gypsum and borate deposits. Soluble in dilute acids and in hot water.

Irarsite. (Ir,Ru,Rh,Pt)AsS. Black, metallic, massive. Associated with platinum minerals.

Iridosmine. (Os,Ir). H = 6–7. Light grey, metallic, tabular, or rarely, short prismatic crystals; flakes, flattened grains. Perfect cleavage. Associated with gold and platinum in placer deposits.

Iron. Fe. H = 4. Dark grey to greyish-black metallic blebs, or massive. Malleable and magnetic. Soluble in dilute HCl and in acetic acid. Occurs in meteorites. Terrestrial native iron (uncommon) occurs in volcanic rocks.

Iron-formation. Metamorphosed sediment containing iron minerals and silica.

Ixiolite. $(Ta,Nb,Sn,Fe,Mn)_4O_8$. H = 6–6.5. Grey, metallic, prismatic crystals. Occurs in granite pegmatite.

Jade. Term used for two gemstones, nephrite and jadeite.

Jamesonite. $Pb_4FeSb_6S_{14}$. H = 2.5. Dark grey, metallic, acicular, fibrous, columnar, or plumose aggregates commonly striated. Iridescent tarnish. Decomposes in HNO_3. Occurs in veins with other lead sulphosalts and sulphides.

Jarosite. $KFe_3(SO_4)_2(OH)_6$. H = 2.5–3.5. Yellow to brownish pulverulent coating associated with iron-bearing rocks and with coal. Distinguished from iron oxides by giving off SO_2 when heated.

Jasper. An opaque, dark red to brown, yellow, green, or light violet variety of chalcedony. Used as an ornamental stone and as a gemstone.

Jaspilite. A rock consisting of alternating bands of red jasper and iron oxides. An attractive ornamental rock.

Joaquinite. $Ba_2NaCe_2Fe(Ti,Nb)_2Si_8O_{26}(OH,F)_2$. H = 5.5. Yellow to brown tabular or stubby pyramidal crystals. Transparent to translucent; vitreous. Occurs with aegirine and microcline in cavities in breccia at Mount Saint-Hilaire, Quebec. Rare mineral.

Junoite. $Pb_3Cu_2Bi_8(S,Se)_{16}$. Metallic grains (up to 0.5 mm across) associated with chalcopyrite, sphalerite, colbaltite, kesterite, and mawsonite in the Kidd Creek mine, Timmins, Ontario.

Kaersutite. $NaCa_2(Mg,Fe)_4Ti(Si_6Al_2)O_{22}(OH)_2$. H = 5–6. Dark brown to black short prismatic crystals, or massive. Translucent to opaque; vitreous to resinous. Occurs in volcanic rocks. Amphibole group.

Kainosite (cenosite). $Ca_2(Y,Ce)_2Si_4O_{12}(CO_3)\bullet H_2O$. H = 5–6. Yellow to brown, colourless, or pink prismatic crystals. Transparent, vitreous. Occurs in igneous rocks.

Kaolinite. $Al_2Si_2O_5(OH)_4$. H = 2. 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 the manufacture of ceramics.

Karpinskyite. Mixture of leifite [$Na_2(Si,Al,Be)_7(O,OH,F)_{14}$] and zinc-bearing montmorillonite. Not a valid mineral name.

Kasolite. $Pb(UO_2)SiO_4\bullet H_2O$. H = 4–5. Yellow, greenish-yellow, or brown, finely granular; also minute prismatic crystals. Dull to resinous lustre. Radioactive. Soluble in acids. Associated with uraninite and secondary radioactive minerals from which it is not easily distinguished in the hand specimen.

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 characteristic. Minor ore of antimony.

Kesterite. $Cu_2(Zn,Fe)SnS_4$. H = 4.5. Greenish black, opaque, massive. Associated with sulphide minerals. Related structurally to stannite.

K-feldspar. $KAlSi_3O_8$. H = 6. Potassium feldspar includes sanidine (colourless), orthoclase (white, pink), and microcline (white, pink, green).

Kiddcreekite. Cu_6SnWS_8. Microscopic metallic irregular grains. Originally found intimately associated with scheelite, clausthalite, tennantite, and tungstenite in a bornite zone in the Kidd Creek mine, Timmins, Ontario. Named for the locality. Identified by microscopic examination of polished surfaces.

Kieserite. $MgSO_4•H_2O$. H = 3.5. White, granular, massive. Occurs in salt deposits. Dissolves slowly in water.

Kimberlite. Porphyritic igneous rock composed mainly of serpentinized olivine and chloritized phlogopite forming phenocrysts and the fine-grained matrix enclosing them. Common host rock for diamond.

Klockmannite. CuSe. H = 2–3. Grey, metallic, tarnishing to bluish black. Granular aggregates; tabular. Associated with other selenides in ore deposits.

Kornerupine. $Mg_4(Al,Fe)_6(Si,B)_4O_{21}(OH)$. H = 6.5. Yellow, brown, red, blue, and green elongated prisms; also fibrous and columnar. Vitreous lustre. Transparent. Occurs in metamorphic rocks. Transparent variety used as a gemstone.

Kotulskite. Pd(Te,Bi). Metallic minute grains intergrown with chalcopyrite and platinum-group minerals. Identified by microscopic examination of polished surfaces.

Krennerite. $AuTe_2$. H = 2–3. Light grey to yellow, metallic, prismatic, striated crystals. Occurs with other gold tellurides and with native gold in vein deposits.

Kyanite. Al_2SiO_5. H = 4–5, 6–7. Blue, green, greyish-blue, long, bladed crystals and bladed masses. Vitreous to pearly lustre. Hardness is 4 to 5 along the length of the crystal and 6 to 7 across it. Occurs in schist and gneiss. Colour and varied hardness are distinguishing characteristics. Used in the manufacture of mullite refractories.

Labradorite. $(Ca,Na)(Al,Si)AlSi_2O_8$. H = 6. Grey, vitreous, transparent to translucent. Commonly exhibits blue, green, yellow, or bronze iridescence and is used as a gemstone. Chief constituent of anorthosite and gabbro. Named for Labrador. Variety of plagioclase feldspar.

Labuntsovite. $(K,Ba,Na)(Ti,Nb)(Si,Al)_2(O,OH)_7•H_2O$. H = 6. Pink, orange, red, or brownish-yellow prismatic, acicular crystals. Perfect cleavage. Occurs in nepheline syenite at Mount Saint-Hilaire, Quebec.

Laitakarite. $Bi_4(Se,S)_3$. H = soft. Grey, metallic, foliated plates and sheets to 2 mm across. Associated with junoite in the bornite zone at the Kidd Creek mine, Timmins, Ontario.

Lamprophyre. A dark porphyritic igneous rock with hornblende, pyroxene, and biotite forming phenocrysts in a fine-grained matrix composed of the same mafic minerals.

Langisite. (Co,Ni)As. Pinkish, light brown, metallic. Occurs as grains, lamellae in safflorite. Named for the Langis mine, Cobalt, Ontario, where it was orignally found.

Langite. $Cu_4(SO_4)(OH)_6•2H_2O$. H = 2.5–3. Transparent tiny blue crystals forming aggregates on copper-bearing rocks. Vitreous to silky lustre. Formed by oxidation of copper sulphides. Difficult to distinguish from other copper sulphates in the hand specimen.

Lapieite. $CuNiSbS_3$. H = 4–5. Grey, metallic, microscopic grains associated with pyrite, polydymite, gersdorffite, and millerite in a matrix consisting of quartz with altered spinel, magnesite, and bright green mica. Named for the Lapie River, Yukon Territory, which was named for an Indian guide to explorer Robert Campbell.

Larosite. $(Cu,Ag)_{21}(Pb,Bi)_2S_{13}$. Whitish, light brown, acicular crystals associated with chalcocite, stromeyerite in silver-copper ores. Originally found in the Foster mine, Cobalt, Ontario. Named for Mr. Fred LaRose, one of the discoverers of silver-cobalt ore in Cobalt.

Latite. A porphyritic igneous rock consisting of approximately equal amounts of plagioclase and K-feldspar phenocrysts, with little or no quartz, in a fine-grained to glassy matrix.

Laumontite. $CaAl_2Si_4O_{12}{\bullet}4H_2O$. H = 4. White to pink or reddish-white, vitreous to pearly, prismatic crystal aggregates; also friable, chalky due to dehydration. Characteristic alteration distinguishes it from other zeolites.

Lava. Rock resulting from a volcanic eruption; also referred to as volcanic rock.

Lavenite. $(Na,Ca)_2(Mn,Fe)(Zr,Ti)Si_2O_7(O,OH, F)_2$. H = 6. Yellow to dark brown or brownish-red, prismatic, fibrous, acicular aggregates, or massive. Translucent; vitreous to greasy or dull lustre. Occurs in alkalic igneous rocks.

Lazulite. $MgAl_2(PO_4)_2(OH)_2$. H = 5.5–6. Blue pyramidal or tabular crystals; massive. Vitreous lustre. Soluble in hot acids. Transparent variety used as a gemstone.

Lead. Pb. H = 1.5. Grey, metallic, platy, dendritic, rounded masses; less commonly octahedral, dodecahedral, or cubic crystals. Malleable and ductile. Rare mineral occurring in various rock environments and in placer deposits. Decomposes readily in HNO_3.

Leadhillite. $Pb_4(SO_4)(CO_3)_2(OH)_2$. H = 2.5–3. Colourless, white, light blue to green tabular or prismatic crystals, or granular massive. Secondary lead mineral associated with galena and other lead minerals. Soluble in HNO_3. Exfoliates in hot water.

Lemoynite. $(Na,Ca)_3Zr_2Si_8O_{22}{\bullet}8H_2O$. H = 4. White or yellowish-white, minute, prismatic crystals, spheres. Occurs in nepheline syenite associated with microcline at Mount Saint-Hilaire, Quebec, the type locality. Named for Charles Lemoyne and his sons, seventeenth century explorers of New France.

Leonhardtite. Not a valid mineral name. Renamed starkeyite.

Lepidocrocite. FeO(OH). H = 5. Reddish-brown, submetallic, scaly or fibrous masses. Characteristic orange streak. Associated with goethite as an oxidation product of iron minerals.

Lessingite. $(Ce,Ca)_5(SiO_4)_3F$. H = 4.5. Colourless, greenish, or reddish yellow. Vitreous lustre. Occurs with allanite, bastnaesite, cerite.

Leucophanite. $(Ca,Na)_2BeSi_2(O,F,OH)_7$. H = 4. Green to greenish-yellow tabular crystals with vitreous lustre. Occurs sparingly in nepheline syenite. Not readily distinguished in the hand specimen.

Leucosphenite. $BaNa_4Ti_2B_2Si_{10}O_{30}$. H = 6.5. Light blue, white prismatic crystals; also tabular. Vitreous lustre. Occurs sparingly in nepheline syenite. Not readily distinguished in the hand specimen.

Leucoxene. A general term for alteration products of ilmenite. Not a valid mineral species.

Levyne. $(Ca,Na_2,K_2)Al_2Si_4O_{12}{\bullet}6H_2O$. H = 4–4.5. Colourless, transparent, tabular crystals or sheaf-like aggregates; also reddish or yellowish. Vitreous lustre. Occurs in cavities in basalt. Zeolite group.

Liebigite. $Ca_2(UO_2)(CO_3)_3{\bullet}11H_2O$. H = 2.5–3. Light green, or yellowish-green short prismatic crystals; also scaly, granular, botryoidal aggregates. Transparent to translucent with vitreous to pearly lustre. Fluoresces green in ultraviolet light. Secondary mineral formed in uranium deposits.

Limestone. Soft, white, grey, or greyish-brown sedimentary rock formed by deposition of calcium carbonate. Dolomitic limestone contains varied proportions of dolomite and is distinguished from 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 metamorphosed limestone and is used as a building and ornamental stone, as a filler for paper and paints, for the production of magnesium metal, and as crushed stone.

Limonite. Field term referring to natural hydrous iron oxides. Yellow-brown to dark brown, earthy, porous, ochreous masses; also stalactitic or botryoidal. Secondary product of iron minerals. Not a valid mineral species.

Linnaeite. Co_3S_4. H = 4.5–5.5. Light to dark grey, metallic, tarnishing to copper-red. Octahedral crystals, massive. Decomposed by HNO_3. Uncommon mineral associated with cobalt ores.

Lithiophilite. $LiMnPO_4$. H = 4–5. Yellow, yellowish-brown, brown, pink, cleavable to compact massive; crystals (prismatic) are rare. Transparent to translucent with vitreous to subresinous lustre. Becomes brown, dark grey to black on weathered surfaces. Soluble in acids. Occurs with other lithium and phosphate minerals in granite pegmatite. Forms a series with triphylite.

Lithiophosphate. Li_3PO_4. H = 4. Colourless, white, or pink prismatic crystals, or massive. Vitreous lustre. Perfect cleavage. Occurs with other lithium minerals in granite pegmatite.

Loellingite. $FeAs_2$. H = 5–5.5. Light to dark grey, metallic, prismatic crystals; also pyramidal crystals or massive. Occurs with nickel and cobalt minerals in the Cobalt, Ontario, deposits.

Lokkaite. $CaY_4(CO_3)_7 \bullet 9H_2O$. White radiating fibrous aggregates; massive. Alteration product of yttrium minerals.

Ludwigite. Mg_2FeBO_5. H = 5. Greenish-black, opaque, longitudinally striated prisms; dull to submetallic lustre. Also fibrous, acicular, or granular masses. Occurs with brucite, serpentine in contact metamorphic zones.

Lyndochite. Th-Ca-Euxenite. H = 6.5. Black, lustrous, flat, prismatic crystals. Conchoidal fracture. Vitreous lustre. Occurs in pegmatite. Named for Lyndoch Township, Ontario. Not a valid mineral species.

Mackinawite. $(Fe,Ni)_9S_8$. H = 2.5. Yellow, metallic; light grey metallic on freshly broken surfaces. Tetragonal, platy, or pyramidal crystals; also massive, finely lamellar aggregates. Associated with sulphide ore minerals.

Mafic. A term describing an igneous rock composed mostly of dark (ferromagnesian) minerals such as amphibole, pyroxene, biotite.

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 and by superior hardness. Used in the manufacture of refractory bricks, cements, flooring, and magnesium metal.

Magnetite. Fe_3O_4. H = 5.5–6.5. Black metallic octahedral, dodecahedral, or cubic crystals; massive granular. Occurs in vein deposits, in igneous and metamorphic rocks, and in pegmatite. Strongly magnetic. Ore of iron.

Malachite. $Cu_2CO_3(OH)_2$. H = 3.5–4. Green granular, botryoidal, earthy masses; usually forms coatings with other secondary copper minerals on copper-bearing rocks. Distinguished from other green copper minerals by effervescence in HCl. 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 black manganese minerals in the hand specimen. Ore of manganese.

Manganocolumbite. $(Mn,Fe)(Nb,Ta)_2O_6$. H = 6. Black, brownish-black tabular crystals. Occurs in granite pegmatite. Forms series with manganotantalite and ferrocolumbite.

Manganotantalite. $MnTa_2O_6$. H = 6–6.5. Brownish-black, tabular, short prismatic crystals, or massive. Dark red streak. Vitreous to resinous lustre. Iridescent on tarnished surfaces. Occurs in granite pegmatite. Columbite group.

Manganous manganite. $Na_4Mn_{14}O_{27}•9H_2O$. H = 1.5. Occurs as black to bluish-black, submetallic to dull, fine-grained powdery coating associated with other manganese minerals and hematite. Synonym for birnessite.

Marble. *See* limestone.

Marcasite. FeS_2. H = 6–6.5. Light bronze to grey, metallic, radiating, stalactitic, globular, or fibrous; twinning produces cockscomb and spear shapes. Yellowish to dark brown tarnish. Massive variety is difficult to distinguish from pyrite in the hand specimen.

Mariposite. Bright green. Chrome variety of muscovite. Not a valid mineral name.

Martite. Fe_2O_3. H = 5.5–6.5. Black octahedral crystals. Dull to splendent lustre. Hematite pseudomorphous after magnetite.

Matildite. $AgBiS_2$. H = 2.5. Black to grey, metallic, granular massive; striated indistinct prismatic crystals (rare). Uneven fracture. Occurs intergrown with galena from which it alters. Associated with sulphide minerals in deposits formed at moderate to high temperatures.

Mattagamite. $CoTe_2$. Grey, metallic, with violet to pink tinge. Occurs as microscopic grains and bladed aggregates with altaite, pyrrhotite, and chalcopyrite. Named for Mattagami Lake, Quebec, which is near the mine where it was originally found.

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.

Mawsonite. $Cu_6Fe_2SnS_8$. H = 3.5–4. Metallic microscopic irregular to rounded grains associated with bornite and other copper sulphide minerals.

Mckelveyite. $Ba_3Na(Ca,U)Y(CO_3)_6•3H_2O$. Green, yellowish-green, or yellow crystal aggregates or platy crystals. Occurs with donnayite, natrolite, microcline in carbonate cavities at Mount Saint-Hilaire, Quebec.

Mckinstryite. $(Ag,Cu)_2S$. Steel grey, metallic, becoming black on exposure to air. Associated with silver ore minerals. Originally found in the Foster mine, Cobalt, Ontario.

Melaconite. CuO. Dull powdery coatings or masses; lustrous, resembling coal; reniform or colloform masses. Soluble in HCl or HNO_3. Known as 'copper pitch ore'. Name changed to tenorite.

Melanterite. $FeSO_4 \bullet 7H_2O$. H = 2. Greenish-white to green or blue, massive, pulverulent; also stalactitic, concretionary, fibrous, or capillary; short prismatic crystals (less common). Vitreous to dull lustre. Metallic, astringent taste. Soluble in water. Secondary mineral associated with pyrite and marcasite.

Melilite. $(Ca,Na)_2(Mg,Fe,Al)(Al,Si)O_7$. H = 5. White, light yellow, greenish; square or octagonal prisms. Vitreous to resinous lustre. Conchoidal to uneven fracture. Difficult to identify in the hand specimen.

Melonite. $NiTe_2$. H = 1–1.5. Reddish-white, metallic, tarnishing to brown. Tiny hexagonal plates or lamellae. Dark grey streak. Perfect cleavage. Occurs with sulphides and other tellurides in nickel-copper deposits.

Meneghinite. $Pb_{13}Sb_7S_{24}$. H = 2.5. Blackish-grey, metallic. Slender, striated prismatic crystals, fibrous, massive. Oxidized by HNO_3. Associated with sulphides and sulphosalts.

Merenskyite. $(Pd,Pt)(Te,Bi)_2$. Minute metallic grains intergrown with platinum minerals. Distinguished from associated minerals by microscopic examination of polished surfaces.

Mertieite. $Pd_{11}(Sb,As)_4$. Yellow metallic grains, massive. Sparingly associated with platinum minerals.

Mesolite. $Na_2Ca_2Al_6Si_9O_{30} \bullet 8H_2O$. H = 5. Colourless or white acicular crystals and radiating aggregates; as tufts. Vitreous lustre. Generally associated with other zeolites in amygdaloidal basalt and distinguished from them by X-ray methods.

Metagabbro. A metamorphosed gabbro.

Metamict mineral. Mineral rendered amorphous by the destruction of its crystal structure by radiation from radioactive elements it contains. Zircon and allanite may be metamict.

Metasedimentary rock. Metamorphosed sedimentary rock.

Metavolcanic rock. Metamorphosed volcanic rock.

Miargyrite. $AgSbS_2$. H = 2.5. Black to dark grey, metallic, striated tabular crystals; massive. Red streak. Occurs with other silver sulphosalts and with sulphide minerals in low-temperature hydrothermal veins.

Mica. A mineral group of hydrous aluminum silicates characterized by sheet-like platy structure producing perfect basal cleavage. Muscovite, biotite, and phlogopite are common members of this group.

Michenerite. (Pd,Pt)BiTe. H = 2.5. Greyish-white, metallic, minute grains; massive. Black streak. Associated with gold, platinum, and bismuth minerals. Originally described from the Frood mine, Sudbury, Ontario, and named in honour of geologist C.E. Michener who discovered the mineral.

Microcline. $KAlSi_3O_8$. H = 6. White, pink to red, or green (amazonite) crystals or cleavable masses. Distinguished from other feldspars by X-ray diffraction and chemical analysis. Triclinic member of K-feldspar.

Microlite. $(Ca,Na)_2Ta_2O_6(O,OH,F)$. H = 5–5.5. Yellow to brown, reddish octahedral crystals, grains, or massive. Translucent to opaque with vitreous lustre. Occurs with lithium minerals in granite pegmatite.

Micropegmatite. A granitic rock composed of an irregular microscopic intergrowth of quartz and K-feldspar. Synonym of granophyre.

Millerite. NiS. H = 3–3.5. Light 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.

Minium. Pb_3O_4. H = 2.5. Bright red to brownish-red, earthy, pulverulent masses with greasy to dull lustre. Orange-yellow streak. Affected by HCl and HNO_3. Secondary mineral formed by alteration of galena, cerussite.

Miserite. $K(Ca,Ce)_6Si_8O_{22}(OH,F)_2$. H = 5.5–6. Pink to light violet fibrous, scaly, or cleavable masses. Vitreous or pearly lustre. Associated with wollastonite, eudialyte, scapolite.

Mixite. $BiCu_6(AsO_4)_3(OH)_6 \bullet 3H_2O$. H = 3–4. Green acicular crystals with brilliant lustre; hair-like tufts; compact spherical masses. Occurs in copper and bismuth deposits.

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.

Molybdite. MoO_3. Very soft, yellow, fibrous or earthy crusts or coatings. Secondary mineral formed by alteration of molybdenite.

Molybdomenite. $PbSeO_3$. H = 3.5. Colourless to white, yellowish-white scaly aggregates. Pearly to greasy lustre. Occurs with clausthalite from which it forms.

Monadnock. A residual hill or mountain rising conspicuously above a peneplain having resisted the long erosion that produced the plain.

Monazite. $(Ce,La,Nd,Th)PO_4$. H = 5–5.5. Yellow, reddish-brown, or brown equant or flattened crystals and grains. Resinous to vitreous lustre. Radioactive. Resembles zircon, but it is not as hard. Distinguished from titanite by its superior hardness and radioactivity. Occurs in granitic rocks. Ore of thorium.

Montbrayite. $(Au,Sb)_2Te_3$. H = 2.5. Greyish-white to yellowish-white, metallic. Occurs as intergrowths with other telluride minerals, chalcopyrite, and native gold. Distinguishable from other metallic minerals only by microscopic examination of polished surfaces. Originally found in the Robb-Montbray mine, Montbray Township, near Arntfield, Quebec. Named for the type locality.

Monteregianite. $(Na,K)_6(Y,Ca)_2Si_{16}O_{38} \bullet 10H_2O$. H = 3.5. Colourless, white, grey, rarely light violet or light green. Transparent; vitreous to silky lustre. Acicular radiating or tabular crystals. Occurs in cavities in nepheline syenite at Mount Saint-Hilaire, Quebec, the type locality, where it is associated with calcite, pectolite, microcline, albite, aegirine, arfvedsonite. Named for the Monteregian Hills, Quebec, igneous monadnocks protruding from Ordovician limestone; Mount Saint-Hilaire is one of the Monteregian Hills.

Monticellite. $CaMgSiO_4$. H = 5. Colourless, grey, small prismatic crystals or grains. Vitreous lustre. Occurs in calcite and crystalline limestone. Related to the olivine group. Not readily identifiable in the hand specimen.

Montmorillonite. $(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \bullet nH_2O$. H = 1–2. White, grey, greenish, yellowish, flaky or finely granular massive. Waxy to dull lustre; opaque. Expands with absorption of water, becoming viscose, gelatinous.

Montroyalite. $Sr_4Al_8(CO_3)_3[(OH),F]_{26} \bullet 10–11H_2O$. H = 3.5. White, translucent, distorted spheres (1 mm across) with bumpy to botryoidal surface. Dull lustre. Soluble in HCl. Fluoresces white in ultraviolet light. Occurs on platy albite and quartz lining of cavities in silicocarbonatite sill at the Francon quarry, Montréal, the type locality. Named after Mont Royal, the name given by Jacques Cartier to Mount Royal from which the name Montréal is derived.

Moorhouseite. $(Co,Ni,Mn)SO_4 \bullet 6H_2O$. H = 2.5. Pink, powdery, with vitreous lustre and white streak. Occurs as coatings on barite-siderite-sulphide specimens. Soluble in water. Originally described from the Magnet Cove barite mine, Walton, Nova Scotia, and named in honour of W. Wilson Moorhouse, professor of geology, University of Toronto.

Mordenite. $(Ca,Na_2,K_2)Al_2Si_{10}O_{24} \bullet 7H_2O$. H = 3–4. White, pink, or reddish tabular crystals; also as spheres or nodules with compact fibrous structure. Crystal form is not easily distinguished from other zeolites; compact fibrous structure is characteristic. Named for Morden, Nova Scotia, where it was first found.

Morenosite. $NiSO_4 \bullet 7H_2O$. H = 2–2.5. Light green to greenish-white fibrous encrustations; stalactitic. Generally translucent to opaque. Vitreous to dull lustre. Astringent metallic taste. Soluble in water. Secondary mineral formed by oxidation of nickel sulphide minerals.

Mosandrite. Alteration product of rinkite. Not a valid mineral name.

Mudstone. Hardened mud-like sediment composed chiefly of clay minerals.

Muscovite. $KAl_2(Si_3Al)O_{10}(OH,F)_2$. H = 2–2.5. Colourless or light green, grey, brown; transparent with splendent or pearly lustre. Tabular hexagonal crystals, sheet-like, platy, or flaky aggregates. Occurs in pegmatite. Constituent of granitic and metamorphic rocks. Sericite is a white, silky, fine, scaly aggregate of muscovite that occurs as an alteration of minerals such as topaz, kyanite, feldspar, spodumene, and andalusite. Used as electrical and heat insulator; in cosmetics, paints, and wallpaper to produce a pearly lustre; in the manufacture of simulated pearls; as a filler for plastics.

Mylonite. Chert-like rock with streaky, banded, or flow structure.

Nacrite. $Al_2Si_2O_5(OH)_4$. H = 2–2.5. White thin tabular crystals; scaly or granular massive. Silky to earthy lustre. Kaolinite group.

Nahcolite. $NaHCO_3$. H = 2.5. Colourless, white prismatic crystals; fibrous, concretionary; fibrous, porous masses. Transparent to translucent; vitreous to resinous. Associated with sodium chloride, carbonate, borate, and sulphate minerals.

Narsarsukite. $Na_2(Ti,Fe)Si_4(O,F)_{11}$. H = 7. Yellow tabular or short prismatic crystals. Vitreous lustre. Weathers to brownish grey or brownish yellow. Rare mineral occurring in nepheline syenite and pegmatite.

Natrojarosite. $NaFe_3(SO_4)_2(OH)_6$. H = 3. Yellow to brownish-yellow, earthy, minute tabular crystals. Dull lustre. Secondary mineral formed from alteration of iron minerals such as pyrite, marcasite.

Natrolite. $Na_2Al_2Si_3O_{10}•2H_2O$. H = 5. Colourless, white, reddish needle-like crystals often forming radiating or nest-like aggregates; also nodular or slender prisms. Vitreous to pearly lustre. May be distinguished from other zeolites by its acicular habit. Occurs with other zeolite minerals in amygdaloidal basalt and in some igneous rocks.

Naumannite. Ag_2Se. H = 2.5. Dark grey to black, metallic, tarnishing to iridescent brown. Granular massive, platy; cubic crystals. Associated with copper minerals and gold in vein deposits.

Nemalite. A fibrous variety of brucite.

Nenadkevichite. $(Na,Ca)(Nb,Ti)Si_2O_7•2H_2O$. H = 5. Dark brown to pink foliated masses. Opaque; dull lustre. Occurs in alkalic igneous rocks.

Nepheline. $(Na,K)AlSiO_4$. H = 6. White to grey irregular masses, less commonly as hexagonal prisms. Greasy to vitreous lustre. Distinguished from feldspar and scapolite by its greasy lustre and by its gelatinizing in HCl. Used in the manufacture of glass and ceramics.

Nephrite. $Ca_2(Fe,Mg)_5Si_8O_{22}(OH)_2$. H = 6. Dense, compact, fibrous variety of tremolite-actinolite group. Green to black, grey, white. Occurs in metamorphic rocks, peridotite, or serpentinite. Very tough. Nephrite is one variety of jade used as a gemstone and as an ornamental stone; another variety is jadeite.

Neptunite. $KNa_2Li(Fe,Mn)_2Ti_2Si_8O_{24}$. H = 5–6. Black, dark red, prismatic crystals. Vitreous lustre. Occurs in nepheline syenite. Rare mineral.

New mineral. A mineral approved by the Commission on New Minerals and New Mineral Names of the International Mineralogical Association upon determining that the mineral's physical, structural, optical, and chemical properties are distinct from those of any known mineral. The proposed name of the new mineral must also be approved.

Niccolite. *See* nickeline.

Nickel bloom. Term used by miners for annabergite.

Nickeline. NiAs. H = 5–5.5. Copper-coloured to pinkish coppery, 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. Colour is distinctive. Formerly known as 'niccolite'.

Niggliite. PtSn. H = 3. Silver-white, metallic, minute grains. Associated with platinum and palladium minerals.

Niocalite. $Ca_{14}Nb_2(Si_2O_7)_4O_6F_2$. H = 6. Yellow prismatic crystals with vitreous lustre; also massive granular. Occurs commonly as twinned crystals. Associated with other niobium minerals. Granular variety resembles apatite, but is harder. Originally found in the niobium deposit at Oka, Quebec; named for the elements niobium and calcium.

Norbergite. $Mg_3(SiO_4)(F,OH)_2$. H = 6–6.5. Yellow to orange, transparent to translucent squat crystals, grains. Vitreous to resinous lustre. Occurs in crystalline limestone. Humite group; distinguished from other members of the group by X-ray diffraction and chemical analysis.

Nordmarkite. A quartz-bearing syenite. Used as a building stone and an ornamental stone.

Nordstrandite. $Al(OH)_3$. H = 3. Colourless to white, yellowish, or greyish-white transparent, tabular, blade-like crystals or fine crystal aggregates. Vitreous, pearly to greasy lustre. Occurs in limestone and altered igneous rocks.

Norite. A gabbro with orthopyroxene (hypersthene) as the dominant ferromagnesian component.

Ochre. Impure iron oxides composed of limonite or goethite (yellow ochre), or of hematite (red ochre). Pulverulent, yellow, brownish red, massive. Used as a pigment.

Okenite. $Ca_{10}Si_{18}O_{46}{\bullet}18H_2O$. H = 4.5–5. White, vitreous to pearly, blade-like crystals; compact fibrous massive. Occurs in amygdaloidal basalt.

Oligoclase. $(Na,Ca)(Al,Si)Si_2O_8$. H = 6–6.5. Colourless, white, pink, grey, greenish, yellowish, or brown transparent to translucent cleavable masses; tabular crystals (less common). Vitreous to pearly lustre. Occurs in pegmatite, granitic rocks. Plagioclase feldspar group.

Olivine. $(Mg,Fe)_2SiO_4$. H = 6.5. Yellowish- to brownish-green, vitreous, granular masses or rounded grains; also colourless, yellowish to brownish, black. Distinguished from quartz by its cleavage, from other silicates by its yellowish-green colour. Used in the manufacture of refractory bricks; transparent variety (peridot) used as a gemstone. Mineral group that includes the fayalite-forsterite series.

Opal. $SiO_2{\bullet}nH_2O$. H = 5.5–6.5. Colourless, green, grey to black with waxy lustre, and iridescence (play of colour) in gem varieties. Common or nongem variety lacks iridescence, 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 sedimentary and volcanic rocks; silica is in the form of cristobalite.

Orpiment. As_2S_3. H = 1.5–2. Yellow foliated, columnar, fibrous, reniform, botryoidal, granular to powdery aggregates; short prismatic crystals (rare). Transparent to translucent with pearly or resinous lustre. Alteration product of arsenic minerals, notably realgar. Associated with arsenic and antimony minerals.

Orthoclase. $KAlSi_3O_8$. H = 6. Colourless, white, pink, green, grey, yellow transparent to translucent squat prismatic or tabular crystals; cleavable massive. Vitreous to pearly lustre. Perfect cleavage. Occurs as a constitutent of pegmatite and granitic rocks. Distinguished from plagioclase feldspar by the absence of twinning striations. Monoclinic variety of K-feldspar.

Orthogneiss. A gneiss derived from the metamorphism of an igneous rock.

Orthopyroxene. Orthorhombic variety of pyroxene, including enstatite and hypersthene.

Ottrelite. $(Mn,Fe,Mg)_2Al_4Si_2O_{10}(OH)_4$. H = 6.5. Green, grey to black tabular crystals; also scaly, platy, or foliated. Lamellar varieties resemble mica or chlorite, but are distinguished by their brittleness and hardness. Occurs in metamorphosed sedimentary rocks.

Overite. $CaMgAl(PO_4)_2(OH){\bullet}4H_2O$. H = 3.5–4. Light green to colourless platy crystals and aggregates; massive. Vitreous lustre. Soluble in hot HNO_3. Associated with other phosphate minerals.

Paragneiss. A gneiss derived from a sedimentary rock.

Parapierrotite. $Tl(Sb,As)_5S_8$. Black, semimetallic, small prismatic crystals. Occurs in cavities in realgar.

Pararammelsbergite. $NiAs_2$. H = 5. Light grey, metallic, rectangular tablets, or massive. Exposed surfaces alter readily to erythrite. Associated with nickel and cobalt minerals in the Cobalt district, Ontario.

Pararealgar. AsS. H = 1–1.5. Yellow, orange-yellow to orange-brown powdery to granular aggregates. Vitreous to resinous lustre. Associated with realgar, stibnite.

Paratacamite. $Cu_2(OH)_3Cl$. H = 3. Green, dark green to greenish-black vitreous, translucent, to semi-opaque rhombohedral crystals; also granular massive, powdery encrustations, or fibrous or spherulitic aggregates. Easily soluble in acids. Secondary mineral formed by alteration of copper minerals.

Pargasite. $NaCa_2(Mg,Fe)_4Al(Si_6Al_2))_{22}(OH)_2$. H = 5–6. Bluish-green, light brown to brown, grey prismatic crystals, or massive. Occurs in igneous and metamorphic rocks. Monoclinic member of the amphibole group.

Parisite. $Ca(Ce,La)_2(CO_3)_3F_2$. H = 4.5. Yellow, brownish, or greyish-yellow hexagonal pyramids or rhombohedral crystals. Striated. Transparent to translucent; vitreous, resinous, or pearly lustre. Soluble in hot acids.

Parkerite. $Ni_3(Bi,Pb)_2S_2$. H = 2. Bronze, metallic. Exhibits lamellar twinning. Occurs as microscopic grains intimately associated with bismuthinite, native bismuth, cobalt pentlandite, siegenite, and bravoite at the Langis mine, Cobalt, Ontario. Effervesces in dilute HNO_3.

Pavonite. $AgBi_3S_5$. Grey, metallic, lath-like or elongated grains. Occurs in bismuthinite-matildite-native bismuth intergrowths in the Keeley mine, Cobalt, Ontario.

Pearceite. $Ag_{16}As_2S_{11}$. H = 3. Black, metallic, hexagonal tabular prisms with bevelled edges and triangular striations on the basal face. Decomposed by HNO_3. Associated with silver minerals such as argentite, native silver.

Pectolite. $NaCa_2Si_3O_8(OH)$. H = 5. White needle-like crystals forming radiating and globular masses. Silky to vitreous lustre. Decomposed by warm dilute HCl. Associated with zeolites in basalt. Blue gem variety known as 'larimar stone'.

Pegmatite. A very coarse-grained igneous rock occurring as dykes, lenses, and veins at the margins of batholiths.

Pekoite. *PbCuBi*$_{11}$(S,Se)$_{18}$. Grey, metallic, thin-bladed crystals associated with lead-bismuth minerals.

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. Non-magnetic. Ore of nickel.

Periclase. MgO. H = 5.5. Colourless to grey and, less commonly, yellow, green, or black octahedrons or grains. Transparent with vitreous lustre. Soluble in dilute HCl. Distinguished from spinel by its inferior hardness; spinel is not soluble in HCl.

Peridotite. An igneous rock consisting almost entirely of olivine and pyroxene with little or no plagioclase feldspar.

Peristerite. White or reddish albite having a blue schiller (iridescence). Intergrowth of K-feldspar and albite. Also called moonstone. Used as a gemstone.

Perovskite. $CaTiO_3$. H = 5.5. Reddish-brown to black cubic or octahedral crystals; also granular massive. Adamantine to metallic lustre. Uneven fracture. White to grey streak. Distinguished from titanite by its crystal form, from pyrochlore by its lustre and streak.

Perrierite. $(Ca,Ce,Th)_4(Mg,Fe)_2(Ti,Fe)_3Si_4O_{22}$. H = 5.5. Dark reddish-brown to black, opaque, striated tabular plates, or flat prismatic crystals; resinous to greasy lustre. Occurs in crystalline limestone, in weathered tuff. Resembles titanite; striations, platy habit, and lustre distinguish it from titanite.

Perthite. A subparallel intergrowth of pink microcline or orthoclase and colourless albite. Exhibits silky sheen with golden aventurescence. Named for Perth, Ontario, where it was originally found. Used as a gemstone. Not a valid mineral species.

Petalite. $LiAlSi_4O_{10}$. H = 6–6.5. Colourless, white, grey, or yellow, cleavable, massive. Vitreous to pearly lustre. Transparent to translucent. Associated with lepidolite in granite pegmatite.

Petarasite. $Na_5Zr_2Si_6O_{18}(Cl,OH){\bullet}2H_2O$. H = 5–5.5. Amber yellow, greenish yellow, massive. Transparent to translucent; vitreous. Associated with biotite, microcline, catapleiite, apatite, zircon, aegirine in nepheline syenite at Mount Saint-Hilaire, Quebec, the type locality. Named in honour of Dr. Peter Tarassoff, collector and amateur mineralogist from Dollard-des-Ormeaux, Quebec.

Petzite. Ag_3AuTe_2. H = 2.5–3. Light to dark grey, metallic; massive granular. Associated with other tellurides in vein deposits. Decomposed by HNO_3.

Phenocryst. Distinct crystal in a fine-grained igneous rock referred to as porphyry.

Phillipsite. $(K,Na,Ca)_{1-2}$ $(Si,Al)_8O_{16}{\bullet}6H_2O$. H = 4–4.5. White radiating aggregates of prismatic crystals with pyramidal terminations. Translucent to opaque, vitreous. Associated with other zeolites in basalt.

Phlogopite. $KMg_3Si_3AlO_{10}(F,OH)_2$. H = 2.5. Amber to light brown variety of mica. Used in the electrical industry.

Phosphorescence. Property of certain substances to continue to glow after heating or exposure to ultraviolet rays.

Phyllite. A lustrous metamorphic rock with a texture between that of schist and slate.

Picrolite. A nonflexible fibrous variety of antigorite (serpentine).

Piemontite. $Ca_2(Al,Mn,Fe)_3(SiO_4)_3(OH)$. Violet-red, reddish-brown to reddish-black prismatic or acicular crystals; also fibrous, massive. Occurs in igneous rocks and in schists. Epidote group. Also known as piedmontite.

Pitchblende. Massive uraninite containing trace amounts of thorium and rare earths. Not a valid mineral name.

Placer. Sand or gravel deposit containing gold and/or other heavy minerals; generally refers to deposits in paying quantities.

Plagioclase. $(Na,Ca)Al(Al,Si)Si_2O_8$. H = 6. White or grey tabular crystals and cleavable masses having twinning striations on cleavage surfaces. Vitreous to pearly lustre. Distinguished from other feldspars by its twinning striations. Feldspar group.

Platinum. Pt. H = 4–4.5. Grey, metallic grains, scales, nuggets, cubic crystals (rare). Hackly fracture. Malleable and ductile. Occurs in mafic and ultramafic igneous rocks and in placers.

Plumbojarosite. $PbFe_6(SO_4)_4(OH)_{12}$. Yellowish-brown to dark brown, dull to silky, powdery, earthy, or compact encrustations; microscopic hexagonal plates. Soft, and feels like talc. Dissolves slowly in acids. Oxidation product of lead ores. Not readily identified in the hand specimen.

Pollucite. $(Cs,Na)_2Al_2Si_4O_{12}\bullet H_2O$. H = 6.5–7. Colourless, white, grey, massive; crystals (cubic) are rare. Transparent to translucent with vitreous to pearly lustre. Conchoidal to uneven fracture. Associated with spodumene, amblygonite in granite pegmatite. Resembles quartz, but has a slightly greasy lustre. Zeolite group. Ore of cesium.

Polybasite. $(Ag,Cu)_{16}Sb_2S_{11}$. H = 2–3. Black, metallic, tabular crystals, or massive. Thin splinters are dark red. Decomposed by HNO_3. Occurs with silver-bearing minerals in veins.

Polycrase. $(Y,Ca,Ce,U,Th)(Ti,Nb,Ta)_2O_6$. H = 5.5–6.5. Black prismatic crystals; parallel to radial aggregates of crystals, or massive. Submetallic to greasy lustre. Yellowish, greyish, or reddish-brown streak. Radioactive. Conchoidal fracture. Occurs in granite pegmatite.

Polydymite. Ni_3S_4. H = 4.5–5.5. Grey, metallic, octahedral crystals, massive. Associated with other sulphide minerals in hydrothermal vein deposits.

Polylithionite. $KLi_2AlSi_4O_{10}(F,OH)_2$. H = 2.5–4. White, pink, micaceous; tabular crystals. Pearly lustre. Variety of lepidolite.

Polymorph. Mineral having the same chemical composition as another mineral, but a different crystal structure.

Porphyroblast. A large crystal formed in a metamorphic rock by recrystallization, e.g. garnet in schist. Also referred to as metacryst.

Porphyry. A dyke rock consisting of distinct crystals (phenocrysts) in a fine-grained matrix. The matrix may be diorite, diabase, rhyolite, etc.; these terms are then used to describe the rock.

Posnjakite. $Cu_4(SO_4)(OH)_6\bullet H_2O$. H = 2–3. Minute, blue, flaky, radiating, sheaf-like aggregates on copper-bearing rocks. Associated with other secondary copper minerals; not readily distinguished from them in the hand specimen.

Prehnite. $Ca_2Al_2Si_3O_{10}(OH)_2$. H = 6.5. Light green, globular, stalactitic masses with fibrous or columnar structure; tabular crystals. Vitreous lustre. Colour and habit are distinguishing features. Associated with zeolite minerals in basalt, and as an alteration of plagioclase.

Priceite. $Ca_4B_{10}O_{19}\bullet 7H_2O$. H = 3–3.5. White, earthy, nodular or irregular masses. Occurs in gypsum and borate deposits. Soluble in acids.

Pringleite. $Ca_9B_{26}O_{34}(OH)_{24}Cl_4\bullet 13H_2O$. H = 3–4. Colourless or orange prismatic crystals and platy aggregates. Transparent to translucent with vitreous lustre. Occurs with hilgardite, halite, and sylvite. Originally described from the Penobsquis potash mine, Sussex, New Brunswick, and named in honour of Gordon J. Pringle, Geological Survey of Canada.

Probertite. $NaCaB_5O_7(OH)_4 \bullet 3H_2O$. H = 3.5. Colourless, transparent acicular crystals; radiating crystal aggregates; massive. Occurs with other borate minerals. Soluble in dilute acids.

Proustite. Ag_3AsS_3. H = 2–2.5. Red with adamantine lustre. Prismatic crystals or massive. Associated with other silver minerals. Known as ruby silver. Ore of silver.

Pseudoixiolite. A disordered columbite-tantalite. Not a valid mineral name.

Pseudorutile. Renamed 'arizonite'.

Psilomelane. $(Ba,H_2O)Mn_5O_{10}$. 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 superior hardness, black streak, and amorphous appearance. Ore of manganese. Not a valid mineral name. Renamed romanechite.

Pumpellyite. $Ca_2(Mg,Fe)Al_2(SiO_4)(Si_2O_7)(OH)_2 \bullet H_2O$. H = 5.5. Bluish-green to green or white tiny fibrous aggregates; also platy, massive. Silky to vitreous lustre. Occurs in amygdaloidal basalt and in metamorphic rocks.

Pyrargyrite. Ag_3SbS_3. H = 2.5. Dark red prismatic crystals, or massive. Adamantine lustre. Dark red streak. Occurs in veins carrying other silver minerals. Known as ruby silver. Ore of silver. Colour is identifying characteristic.

Pyrite. FeS_2. H = 6–6.5. Light brass-yellow (iridescent when tarnished) metallic crystals (cube, pyritohedron, octahedron), or massive granular. Distinguished from other sulphides by colour, crystal form, and superior hardness. Source of sulphur.

Pyroaurite. $Mg_6Fe_2(CO_3)(OH)_{16} \bullet 4H_2O$. H = 2.5. Colourless, yellowish, blue, green, or white, flaky, nodular or fibrous. Pearly or waxy lustre. Crushes to talc-like powder. Effervesces in HCl. Becomes golden yellow and magnetic when heated. Occurs with brucite in serpentine and in crystalline limestone.

Pyrochlore. $(Na,Ca)_2Nb_2O_6(OH,F)$. H = 5–5.5. Dark brown, reddish-brown to black octahedral crystals, or irregular masses. Vitreous or resinous lustre. Light brown to yellowish-brown streak. Distinguished from perovskite by its lustre and streak, from titanite by its crystal form. Ore of niobium.

Pyrochroite. $Mn(OH)_2$. Colourless, yellow, light green, or blue, altering to dark brown and black on exposure to air. Associated with manganese minerals.

Pyroclastic rock. A rock composed of fragments of volcanic rocks.

Pyrolusite. MnO_2. H = 6–6.5 (crystals), 2–6 (massive). Light to dark grey, metallic, with bluish tint. Columnar, fibrous, or divergent masses; reniform, concretionary, granular to powdery and dendritic. Soils fingers easily and marks paper. Ore of manganese.

Pyromorphite. $Pb_5(PO_4)_3Cl$. H = 3.5–4. Green, yellow to brown prismatic crystals; also rounded barrel-shaped or spindle-shaped forms, subparallel crystal (prismatic) aggregates; globular, reniform, or granular. Resinous to subadamantine lustre. Crystal form, lustre, and high specific gravity (7.04) are distinguishing features. Soluble in acids. Secondary mineral formed in oxidized galena deposits.

Pyrope. $Mg_3Al_2(SiO_4)_3$. H = 7–7.5. Red transparent dodecahedral or trapezohedral crystals; grains. Vitreous lustre. Occurs in serpentinite, peridotite, and kimberlite. Used as a gemstone. Garnet group.

Pyrophanite. $MnTiO_3$. H = 5. Dark red or reddish-brown thin tabular crystals or fine flakes. Metallic to adamantine lustre. Conchoidal fracture. Ilmenite group.

Pyrophyllite. $Al_2Si_4O_{10}(OH)_2$. H = 1–2. White, grey, green, or yellow foliated, lamellar, fibrous, or granular compact masses. Pearly, greasy, or dull lustre. Resembles talc, but has slightly superior hardness. Used for carved ornamental objects, in the manufacture of ceramics and insecticides, and for refractories.

Pyroxene. A mineral group consisting of Mg, Fe, Ca, and Na silicates related structurally. Diopside, augite, aegirine, jadeite, spodumene, enstatite, and hyperstene 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 pyrite and other bronze sulphides.

Quartz. SiO_2. H = 7. Colourless, yellow, violet, pink, brown, or black six-sided prisms with transverse striations, or massive. Transparent to translucent with vitreous lustre. Lack of cleavage distinguishes it from other colourless and white minerals. Rock-forming mineral. Occurs in veins in ore deposits. Used in glass and electronic industries. Transparent varieties used as gemstones.

Quartzite. A quartz-rich rock formed by metamorphism of sandstone. Used as a building stone, a monument stone, and an ornamental stone; high-purity quartzite is used in the manufacture of glass.

Radioactive minerals. Minerals that give off radiation due to spontaneous disintegration of uranium or thorium atoms. Detected by Geiger counter.

Raite. $Na_4Mn_3Si_8(O,OH)_{24}•9H_2O$ (?). H = 3. Gold to brown acicular crystals. Occurs in alkalic igneous rocks.

Rammelsbergite. $NiAs_2$. H = 5.5–6. Light grey, metallic, tinged with red; massive with granular texture or prismatic, radial fibrous structure. Occurs in vein deposits with nickel and cobalt minerals such as smaltite, nickeline.

Ramsayite. $Na_2Ti_2Si_2O_9$. H = 6. Colourless fine acicular crystals. Vitreous lustre. Occurs in nepheline syenite. Rare mineral. Not readily identifiable in the hand specimen. Not a valid mineral name; renamed lorenzenite.

Ramsdellite. MnO_2. H = 3. Black massive or platy crystal aggregates. Metallic lustre and black streak. Associated with other manganese minerals in manganese deposits.

Rancieite. $(Ca,Mn)Mn_4O_9•3H_2O$. Black, dark brown, grey metallic, massive; also lamellar. Associated with manganese minerals.

Rare-earth elements. A series of elements from atomic number 57 (lanthanum) to 71 (lutetium) and yttrium that were originally believed to be of rare occurrence.

Realgar. AsS. H = 1.5–2. Orange-red to orange-yellow, granular to compact massive; also striated, short, prismatic crystals. Resinous to greasy lustre. Transparent on freshly broken surface. Alters to light yellow to reddish-yellow powder (consisting of orpiment and arsenolite) on exposure to light. Occurs with orpiment and other arsenic minerals and with ores of antimony, lead, silver, and gold. Decomposed by HNO_3 and aqua regia.

Retgersite. $NiSO_4•6H_2O$. H = 2. Dark green to blue-green fibrous encrustations and veinlets; crystals (prismatic) rare. Vitreous lustre. Greenish-white streak. Alteration product of nickeline.

Rhabdophane. $(Ce,La)PO_4•H_2O$. H = 3.5. Pinkish, yellowish-white, or brown stalactitic or botryoidal encrustations with radial structure. Translucent; waxy lustre. Occurs in pegmatite.

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 lustre, transparent. Soluble in warm HCl. Distinguished from rhodonite by its inferior hardness. Ore of manganese.

Rhodonite. $MnSiO_3$. H = 6. Pink to rose red, massive, commonly veined with black manganese minerals. Conchoidal fracture, very tough. Resembles rhodochrosite from which it is distinguished by its superior hardness and lack of effervescence in HCl. Associated with manganese ores. Used as a gemstone and an ornamental stone.

Rhyolite. A fine-grained volcanic rock with composition similar to granite.

Richterite. $Na_2Ca(Mg,Fe)_5Si_8O_{22}(OH)_2$. H = 5–6. Green, brown to brownish-red, yellow, rose-red long prismatic crystals. Transparent to translucent; vitreous. Monoclinic member of amphibole.

Rickardite. Cu_7Te_5. H = 3.5. Purplish-red, metallic; massive. Soluble in HNO_3. Associated with other tellurides from which it is distinguished by its colour resembling tarnished bornite.

Rinkite. $(Na,Ca,Ce)_3Ti(Si_2O_7)_2OF_3$. H = 5. Yellow, yellowish-green to brown tabular or prismatic crystals, and massive. Vitreous to greasy lustre. Rare mineral occurring in nepheline syenite. Not easily identified in the hand specimen.

Rock wool. Felted or matted fibres produced by blowing or spinning molten self-fluxing siliceous and argillaceous dolomitic limestone. Used as insulating material and for acoustic tiles. Now replaced by fibreglass for insulation.

Roemerite. $Fe_3(SO_4)_4•14H_2O$. H = 3–3.5. Yellow to rust- or violet-brown, pink, powdery, granular, crystalline (tabular) encrustations; also stalactitic. Oily to vitreous; translucent. Saline, astringent taste. Formed from oxidation of pyrite. Not easily distinguished in the hand specimen from other iron sulphates.

Romeite. $(Ca,Fe,Mn,Na)_2(Sb,Ti)_2O_6(O,OH,F)$. H = 5.5–6.5. Yellow to brown small octahedral crystals; massive. Vitreous, greasy, or subadamantine lustre. White to light yellow streak. Occurs with rhodonite and other manganese minerals.

Roquesite. $CuInS_2$. H = 3.5–4. Grey, metallic, with bluish tint. Microscopic grains associated with copper ore minerals.

Roscoelite. $K(V,Al,Mg)_2(AlSi_3)O_{10}(OH)_2$. H = 2.5. Reddish-brown to greenish-brown scaly aggregates. Pearly lustre. Occurs in gold and vanadium deposits. Mica group.

Rose quartz. Pink to rose variety of quartz; used as an ornamental stone.

Routhierite. $TlHgAsS_3$. Reddish-black metallic grains and veinlets associated with stibnite, sphalerite, pyrite, realgar, and orpiment.

Roxbyite. Cu_9S_5. H = 2–3. Bluish-black metallic grains; bronze flakes. Occurs with other copper sulphides.

Rozenite. $FeSO_4{\bullet}4H_2O$. White or greenish-white, finely granular, botryoidal, or globular encrustations. Metallic astringent taste. Difficult to distinguish in the hand specimen from other iron sulphates with which it is associated.

Ruby silver. The silver minerals, pyrargyrite and proustite, are known as ruby silver because of their colour.

Ruitenbergite. $Ca_9B_{26}O_{34}(OH)_{24}Cl_4{\bullet}13H_2O$. Monoclinic polymorph of pringleite with which it is associated and identical in appearance. Originally described from the Penobsquis potash mine, Sussex, New Brunswick, and named in honour of Arie A. Ruitenberg of the New Brunswick Geological Survey.

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.

Sabinaite. $Na_4Zr_2TiO_4(CO_3)_4$. White powdery coatings, compact, finely flaky aggregates. Silky to pearly lustre. Effervesces in warm HCl. Commonly coated with white powdery gibbsite-like mineral that fluoresces strongly in ultraviolet light. Associated with weloganite, dawsonite, quartz, calcite, and dresserite in igneous sills at the Francon quarry, Montréal, the type locality. Named in honour of Ann P. Sabina, Geological Survey of Canada.

Safflorite. $(Co,Fe)As_2$. H = 4.5–5. Light grey, metallic, massive, with radiating fibrous structure; prismatic crystals resembling arsenopyrite. May form cruciform or six-ray star twins. Occurs with cobalt and nickel minerals and with native silver in vein deposits.

Samarskite. $(Y,Er,Ce,U,Ca,Fe,Pb,Th)(Nb,Ta,Ti,Sn)_2O_6$. H = 5–6. Black, brownish-black prismatic or tabular crystals, massive. Vitreous, resinous, or splendent lustre. Radioactive. Exposed surfaces alter to brown or yellowish-brown. Conchoidal fracture. Dark brown to reddish or yellowish-brown streak. Occurs in granite pegmatite.

Samsonite. $Ag_4MnSb_2S_6$. H = 2.5. Dark grey to black metallic striated prisms. Associated with silver and manganese minerals.

Sanidine. Colourless glassy monoclinic variety of potash feldspar.

Sandstone. A sedimentary rock composed of sand-sized particles, mostly quartz.

Sapphirine. $Mg_{15}Al_{12}Si_2O_{27}$. H = 7.5. Light to dark blue, greenish-blue grains; also tabular crystals. Vitreous lustre. Uncommon mineral. Difficult to identify except by X-ray methods.

Scapolite. $Na_4Al_3Si_9O_{24}Cl - Ca_4Al_6Si_6O_{24}(CO_3,SO_4)$. H = 6. White, grey, or less commonly pink, yellow, blue, or green prismatic and pyramidal crystals; also massive granular with splintery, woody appearance. Vitreous, pearly to resinous lustre. Distinguished from feldspar by its square prismatic form, its prismatic cleavage, its splintery appearance on cleavage surfaces. May fluoresce under ultraviolet rays. Clear varieties may exhibit chatoyancy (cat's-eye effect) when cut in the cabochon style. Mineral group including marialite, meionite.

Schapbachite. High-temperature form of matildite, $AgBiS_2$. Not a valid mineral name.

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 used in prospecting for this tungsten ore mineral.

Schiller. Internal near-surface reflection of light, producing a display of spectral colours, or iridescence, as in feldspar (peristerite).

Schist. A metamorphic rock composed mainly of flaky minerals such as mica and chlorite.

Scolecite. $CaAl_2Si_3O_{10}•3H_2O$. H = 5. Colourless to white prismatic crystals (generally twinned); also radiating acicular to fibrous aggregates. Vitreous lustre. Occurs in cavities in basalt. Zeolite group.

Scorodite. $FeAsO_4•2H_2O$. H = 3.5–4. Green, greyish-green to brown crusts composed 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. Colourless, transparent variety of gypsum.

Selenium. Se. H = 2. Grey, metallic, acicular, tube-like crystals; aggregates of crystals forming sheets. Red streak. Associated with pyrite deposits.

Seligmannite. $PbCuAsS_3$. H = 3. Dark grey to black, metallic; short prismatic to tabular crystals. Brown to purplish-black streak. Associated with sulphide and sulphosalt minerals.

Senarmontite. Sb_2O_3. H = 2–2.5. Colourless to greyish white, transparent; octahedral crystals or granular, massive. Forms crusts. Resinous to subadamantine lustre. Soluble in HCl. Secondary mineral formed by oxidation of antimony minerals. Minor ore of antimony.

Sepiolite. $Mg_4Si_6O_{15}(OH)_2•6H_2O$. H = 2–2.5. White, greyish, yellowish, fibrous, scaly, earthy, clay-like, or compact nodular; silky, waxy, or dull lustre. Secondary mineral formed from serpentine, magnesite. Massive variety is referred to as meerschaum and was used for making tobacco pipes.

Serandite. $Na_6(Ca,Mn)_{15}Si_{20}O_{58}•2H_2O$. Pink to reddish prismatic crystal aggregates. Vitreous lustre. Occurs with analcime, aegirine in nepheline syenite. Distinguished by its colour and crystal form.

Sericite. Fine scaly or fibrous muscovite; an important constituent of some schist and gneiss.

Serpentine. $(Mg,Fe)_3Si_2O_5(OH)_4$. 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 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 ornamental objects.

Serpentinite. A metamorphic rock consisting almost entirely of serpentine.

Serpierite. $Ca(Cu,Zn)_4(SO_4)_2(OH)_6 \bullet 3H_2O$. Light blue, minute, elongated, lath-like crystals; also tufts, crusts of flattened fibres. Transparent with vitreous to pearly lustre. Secondary mineral associated with other sulphate minerals in copper deposits.

Shale. A fine-grained sedimentary rock composed of clay minerals and having a laminated structure.

Shear zone. A region in which lateral movement along rock planes has produced crushed or brecciated rocks.

Siderite. $FeCO_3$. H = 3.5–4. Brown rhombohedral crystals, cleavable masses, earthy, botryoidal. Soluble in HCl. Distinguished from calcite and dolomite by its colour and higher specific gravity, from sphalerite by its cleavage. Ore of iron.

Siderotil. $FeSO_4 \bullet 5H_2O$. White, light green to bluish fibrous crusts, needle-like crystals, or finely granular encrustations. Vitreous lustre. Metallic, astringent taste. Not distinguishable in the hand specimen from other iron sulphates.

Siegenite. $(Ni,Co)_3S_4$. H = 4.5–5.5. Grey, metallic, tarnishing to copper-red. Octahedral crystals or massive granular. Uncommon mineral occurring with copper, nickel, or iron sulphides in vein deposits.

Silex. An obsolete term for flint. Used in the Gaspé region, Quebec, for grey to brown chalcedony pebbles found in the area.

Siliceous sinter. H = 7. White porous quartz. Occurs in cavities in basalt.

Sill. A long narrow body of igneous rock that parallels the structure of the rock it intrudes.

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 schist and gneiss.

Siltstone. A very fine-grained sedimentary rock with composition between sandstone and shale, lacking the fissility of shale.

Silver. Ag. H = 2.5–3. Grey, metallic, arborescent, wiry, leaf, 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.

Sinhalite. $MgAl(BO_4)$. H = 6.5–7. Colourless, yellow, pink, greenish to pinkish-brown, or dark brown transparent vitreous grains, or massive. Occurs in skarn zones, in marble, and in crystalline limestone. Transparent varieties used as a gemstone.

Sjogrenite. $Mg_6Fe_2(CO_3)(OH)_{16}•4H_2O$. H = 2.5. Transparent tiny thin flexible hexagonal plates; colourless to yellowish- or brownish-white. Glistening, vitreous, or pearly lustre. Rare mineral associated with pyroaurite.

Skarn. An altered rock zone in limestone and dolomite in which calcium silicates (garnet, pyroxene, epidote, etc.) have formed.

Sklodowskite. $(H_3O)_2Mg(UO_2)_2(SiO_4)•2H_2O$. H = 2–3. Light yellow to greenish-yellow small acicular crystals or fibres forming rosettes, radial tufts; also powdery to earthy. Silky, vitreous to dull lustre. Secondary mineral formed from uranium minerals.

Skutterudite. $CoAs_{2–3}$. H = 5.5–6. Grey, metallic, cubic, cubo-octahedral, or pyritohedral crystals; massive, colloform. Resembles arsenopyrite, but is distinguished by its crystal form. Associated with other cobalt and nickel minerals in vein deposits.

Slate. A fine-grained compact metamorphic rock characterized by a susceptibility to split into thin sheets.

Smaltite. $(Co,Ni)As_{3–x}$. An arsenic-deficient variety of skutterudite. Not a valid mineral name.

Smithsonite. $ZnCO_3$. H = 4–4.5. Greyish-white to grey, greenish or bluish; also yellow to brown. Generally botryoidal, reniform, stalactitic, granular, porous masses; also indistinct rhombohedral crystalline aggregates. Vitreous lustre. Has high specific gravity (4.4). Effervesces in acids. May fluoresce bluish white under ultraviolet rays. Associated with zinc deposits.

Smythite. Fe_3S_4. Bronze to brownish-black metallic plates or flakes. Magnetic. Resembles pyrrhotite from which it is distinguished by X-ray diffraction. Occurs with other sulphides such as pyrrhotite, pyrite, chalcopyrite, marcasite.

Soapstone. A metamorphic rock composed chiefly of talc; massive fibrous texture and unctuous feel. Used as a carving medium, for refractory bricks, as marking crayons for metalworkers, and as heat-resistant pads and plates.

Sodalite. $Na_8Al_6Si_6O_{24}Cl_2$. H = 6. Royal blue to purplish-blue granular masses, dodecahedral crystals. Vitreous lustre. Resembles lazurite, but is harder; also distinguished by its association: sodalite in nepheline rocks, lazurite in crystalline limestone.

Soddyite. $(UO_2)_2SiO_4•2H_2O$. H = 3.5. Yellow, amber-yellow to yellowish-green small bipyramidal or tabular crystals or radial fibrous aggregates; powdery to earthy masses and crusts. Vitreous, resinous to dull lustre. Secondary mineral formed from uraninite.

Spangolite. $Cu_6Al(SO_4)(OH)_{12}Cl•3H_2O$. H = 3. Green tabular or prismatic crystals. Transparent with vitreous lustre. Secondary mineral occurring in copper deposits.

Specularite. Black variety of hematite having a brilliant lustre.

Sperrylite. $PtAs_2$. H = 6–7. Light grey, metallic, cubic or cubo-octahedral crystals. Associated with pyrrhotite-pentlandite-chalcopyrite ores.

Spertiniite. $Cu(OH)_2$. Blue to blue-green transparent vitreous lath-like crystals forming microscopic botryoidal aggregates. Soluble in acids and decomposes in hot water. Associated with native copper, chalcocite, atacamite. Named in honour of Dr. Francis Spertini, geologist at the Jeffrey mine, Asbestos, Quebec, the type locality.

Spessartine. $Mn_3Al_2(SiO_4)_3$. H = 7–7.5. Orange to orange-red and brown transparent dodecahedral or trapezohedral crystals; grains. Vitreous lustre. Occurs in granite pegmatite. Used as a gemstone. Garnet group.

Sphalerite. ZnS. H = 3.5–4. Yellow, brown, or black, granular to cleavable massive; also botryoidal. Resinous to submetallic. Light yellow streak. Soluble in HCl, giving off H_2S. Ore of zinc.

Sphene. Synonym for titanite.

Spinel. $MgAl_2O_4$. H = 7.5–8. Dark green, brown, black, dark blue, pink, or red grains or octahedral crystals; also massive. Conchoidal fracture. Vitreous lustre. Distinguished from magnetite and chromite by its superior hardness and lack of magnetic property. Transparent varieties used as gemstones.

Spionkopite. $Cu_{39}S_{28}$. Grey to black, metallic, with green, violet iridescence; microscopic flakes forming aggregates. Generally intergrown with other copper sulphides. Originally described from sandstone and quartzite copper deposits in the Yarrow Creek and Spionkop Creek areas, southwestern Alberta; named for the locality.

Spodumene. $LiAlSi_2O_6$. H = 6.5. White, grey, pink, violet, green long prismatic crystals or platy masses. Perfect cleavage. Vitreous lustre. Distinguished by its form and cleavage. Occurs in granite pegmatite. Ore of lithium. Used in ceramics. Transparent pink (kunzite), green (hiddenite), and yellow varieties are used as gemstone.

Stannite. Cu_2FeSnS_4. H = 4. Grey to greyish-black, metallic; granular massive or disseminated grains. Bluish tarnish. Black streak. Occurs in tin-bearing veins associated with chalcopyrite, sphalerite, tetrahedrite, pyrite, and cassiterite.

Starkeyite. $MgSO_4 \bullet 4H_2O$. Dull white encrustations. Bitter, metallic taste. Difficult to distinguish visually from other sulphates. Formerly known as leonhardtite.

Staurolite. $(Fe,Mg,Zn)_2Al_9(Si,Al)_4O_{22}(OH)_2$. H = 7. Brownish-yellow to brown prismatic crystals commonly twinned forming cruciform shapes. Vitreous to resinous lustre. Colour and habit are diagnostic. Occurs in schist and gneiss.

Steenstrupine. $(Ce,La,Na,Mn)_6(Si,P)_6O_{18}(OH)$. H = 5. Reddish-brown to black rhombohedral crystals or massive. Opaque. Occurs in nepheline syenite.

Stephanite. Ag_3SbS_4. H = 2–2.5. Black, metallic, striated prismatic or tabular crystals, or massive. Decomposed by HNO_3. Occurs in veins in silver deposits.

Stibarsen. SbAs. H = 3–4. Tin-white, reddish-grey, metallic; fibrous, lamellar, reniform, mammillary, or finely granular masses. Tarnishes to grey or brownish black. Perfect cleavage in one direction. Fuses to a metallic globule. Occurs in veins with other arsenic and antimony minerals, and in pegmatite containing lithium minerals.

Stibiconite. $Sb_3O_6(OH)$. H = 4.5–5. Yellow, vitreous, granular to powdery encrustations; also radiating fibrous aggregates (pseudomorphs after stibnite), botryoidal, or concentric. 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 or bladed masses, and granular. Soluble in HCl. Most important ore of antimony.

Stichtite. $Mg_6Cr_2(CO_3)(OH)_{16}•4H_2O$. Light violet scaly micaceous masses associated with serpentine. Also occurs as blebs and veinlets in serpentine.

Stilbite. $NaCa_2Al_5Si_{13}O_{36}•14H_2O$. H = 4. Colourless, pink, or white platy crystals commonly forming sheaf-like aggregates. Vitreous, pearly lustre. Transparent. Sheaf-like form distinguishes it from other zeolites with which it is associated in volcanic rocks. Also occurs in metamorphic and granitic rocks.

Stillwellite. $(Ce,La,Ca)BSiO_5$. Grey, pink, brownish-yellow, brownish-red to brown translucent to opaque, hexagonal tabular or rhombohedral crystals; also massive, compact, porcelain-like. Waxy to resinous lustre. Occurs with other rare-element minerals in marble.

Stilpnomelane. $K(Fe,Al)_{10}Si_{12}O_{30}(OH)_{12}$. H = 4. Black, dark green, golden to reddish-brown foliated plates, fibrous aggregates. Associated with magnetite, hematite, goethite in iron deposits, and with chlorite and epidote in schist.

Stromeyerite. CuAgS. H = 2.5–3. Dark grey, metallic, with blue tarnish. Prismatic crystals or massive. Soluble in HNO_3. Distinguished from arsenopyrite by its darker colour and inferior hardness.

Strontiodresserite. $(Sr,Ca)(Al_2CO_3)_2(OH)_4•H_2O$. White silky flakes forming coatings; white spheres (1 mm in diameter). Effervesces in HCl. Associated with weloganite, strontianite, quartz in igneous sill rock, Francon quarry, Montréal, the type locality. Named for its chemical relationship to dresserite.

Strüverite. Black. Tantalum-rich variety of rutile.

Sudburyite. (Pd,Ni)Sb. Microscopic metallic grains occurring in cobaltite and maucherite. Identified by microscopic examination of polished section of ore minerals. Originally described from the Copper Cliff South and Frood mines, Sudbury, Ontario, and named for the locality.

Sulphur. S. H = 1.5–2.5. Yellow, reddish, greenish tabular, bipyramidal crystals; massive. Transparent; greasy to resinous lustre. Black when admixed with pyrite from which it alters.

Sunstone. A feldspar (orthoclase or oligoclase) containing flaky inclusions of goethite or hematite that cause bright copper-coloured reflections. Used as a gemstone.

Syenite. An igneous rock composed mainly of feldspar with little or no quartz. Used as a building stone.

Sylvanite. $(Au,Ag)Te_2$. H = 1.5–2. Light grey to dark grey, metallic; prismatic or tabular crystals, bladed aggregates, granular. Associated with native gold and tellurides in vein deposits. Distinguished from other gold tellurides by its inferior hardness.

Sylvite. KCl. H = 2.5. Colourless, white, orange-red cubic crystals, or granular massive. Vitreous lustre. Sectile. Bitter taste. Soluble in water. Occurs with halite and gypsum. Used in fertilizers.

Synchisite. (Ce,La)$Ca(CO_3)_2F$. H = 4.5. Yellow to brown tabular or platy aggregates. Greasy, vitreous, or subadamantine lustre. Translucent. Soluble in acids. Associated with other rare-element minerals in pegmatite. Not easily distinguished in the hand specimen.

Synchisite-Y. (Y,Ce)$Ca(CO_3)_2F$. H = 6–7. Small pink to reddish-brown prisms; massive granular. Associated with yttrium minerals. Also known as doverite.

Szaibelyite. (Mg,Mn)$(BO_2)(OH)$. H = 3–3.5. White, fine, fibrous or platy matted or hair-like aggregates. Silky lustre. Soluble in acids. Uncommon mineral not readily identified in the hand specimen.

Szmikite. $MnSO_4H_2O$. H = 1.5. White to pink, reddish stalactitic, botryoidal masses. Earthy. Secondary mineral found with manganese minerals.

Szomolnokite. $FeSO_4{\bullet}H_2O$. H = 2.5. White to pinkish-white, fine, hair-like aggregates or finely granular encrustations; also botryoidal, globular crusts. Vitreous lustre. Metallic taste. Associated with pyrite and other iron sulphates from which it is not readily distinguishable in the hand specimen.

Talc. $Mg_3Si_4O_{10}(OH)_2$. H = 1. Grey, white, green, finely granular or foliated. Translucent with greasy feel. Massive impure 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, ceramics, paint, plastic, rubber, chemical, roofing, and paper industries.

Tancoite. $HNa_2LiAl(PO_4)_2(OH)$. H = 4–4.5. Colourless to pink equant or tabular crystals, often elongated and commonly in parallel multiple growth. Transparent with vitreous lustre. Conchoidal fracture and two cleavages. Associated with lithiophosphate and apatite in spodumene-bearing pegmatite. Soluble in dilute HNO_3 and in HCl. Originally described from the Bernic Lake (Tanco) mine, Bernic Lake Manitoba, for which it is named.

Tapiolite. Fe(Ta,Nb)$_2O_6$. H = 6–6.5. Black, short, prismatic or equant crystals with submetallic to subadamantine lustre. Rusty or greyish-brown to brownish-black streak. Occurs in granite pegmatite.

Tellurantimony. Sb_2Te_3. Pink, metallic, lath-like microscopic grains associated with altaite. Originally found in the Mattagami Lake mine, Mattagami, Quebec. Named for its composition.

Tellurbismuth. Bi_2Te_3. H = 1.5–2. Dark grey, metallic, platy, foliated aggregates. Laminae flexible; sectile. Triangular striations on cleavage surfaces. Occurs in auriferous quartz veins. Accepted name is tellurobismuthite.

Temiskamite. Name was given to a bronze-coloured material with radiating structure occurring in the Elk Lake-Gowganda (Ontario) silver-cobalt deposits. Synonym for maucherite. Not a valid mineral name.

Tengerite. $CaY_3(CO_3)_4(OH)_3{\bullet}3H_2O$. Dull white, powdery, fibrous coating, or encrustations; associated with yttrium minerals from which it alters.

Tennantite. (Cu,Fe)$_{12}As_4S_{13}$. H = 3–4.5. Dark grey to greyish-black, metallic, tetrahedral crystals; compact to granular massive. Black, brown to red streak. Occurs in hydrothermal veins with copper, lead, zinc, and silver minerals. Forms a series with tetrahedrite, but is much less abundant.

Tenorite. CuO. H = 3.5. Steel-grey to black, metallic, platy, lath-like, scaly aggregates; also black, submetallic, earthy, or compact masses with conchoidal fracture. Associated with other copper minerals; melaconite occurs in the oxidized portion of copper deposits. Ore of copper.

Tetradymite. Bi_2Te_2S. H = 1.5–2. Light grey, metallic, indistinct pyramidal crystals; also bladed, foliated, or granular aggregates. Blades are flexible, inelastic. Tarnishes to dull or iridescent surfaces. Soils paper as does graphite. Occurs with telluride and sulphide minerals in gold-quartz veins formed at moderate to high temperatures, and in contact metamorphic deposits.

Tetrahedrite. $(Cu,Fe)_{12}Sb_4S_{13}$. H = 3–4.5. Dark grey to greyish-black, metallic, tetrahedral crystals; granular to compact massive. Black to brown streak. Ore of copper; silver-rich variety may be important ore of silver. Occurs with chalcopyrite, galena, pyrite, sphalerite, bornite, and argentite in hydrothermal veins. Forms a series with tennantite.

Tetranatrolite. $Na_2Al_2Si_3O_{10}\bullet 2H_2O$. White prismatic crystals and fibrous aggregates; earthy. Translucent to opaque; vitreous to dull lustre. Transparent in specimens freshly broken from the rock, becoming white, opaque, friable on exposure to air. Associated with natrolite, analcime, microcline in nepheline syenite at Mount Saint-Hilaire, Quebec. Named for its structure, tetragonal natrolite. Zeolite group.

Thaumasite. $Ca_3Si(OH)_6(CO_3)(SO_4)\bullet 12H_2O$. H = 3.5. Colourless to white, acicular or massive. Transparent to translucent; vitreous, silky lustre to greasy. Occurs with calcium silicate and sulphate minerals.

Thenardite. Na_2SO_4. H = 2.5–3. Colourless, white, greyish, reddish, yellowish, brownish, powdery; tabular, dipyramidal crystals. Dull to vitreous lustre. Formed from evaporation of salt lakes.

Thomsonite. $NaCa_2Al_5Si_5O_{20}\bullet 6H_2O$. H = 5–5.5. White, pinkish-white to reddish, light green radiating columnar or fibrous masses; also compact. Vitreous to pearly lustre. Transparent to translucent. Associated with other zeolites. Massive variety used as a gemstone.

Thorbastnaesite. $Th(Ca,Ce)(CO_3)_2F_2\bullet H_2O$. White silky fibres forming spheres less than 1 mm in diameter; coatings. Associated with baddeleyite, zircon (cyrtolite) at the Francon quarry, Montréal.

Thorianite. ThO_2. H = 6.5. Dark grey to black cubic crystals or rounded grains. Dull to submetallic lustre. Grey streak. Radioactive. Soluble in HNO_3 and H_2SO_4. Occurs in pegmatite, crystalline limestone, stream gravels.

Thorite. $ThSiO_4$. H = 5. Black to reddish-brown tetragonal prisms with pyramidal terminations; also massive. Resinous to submetallic lustre. Conchoidal fracture. Radioactive. Distinguished by its crystal form, radioactivity. Source of thorium. Occurs in pegmatite, crystalline limestone, and hydrothermal veins.

Thorogummite. $Th(SiO_4)_{1-x}(OH)_{4x}$. Grey, light brown, yellowish brown to dark brown, earthy, nodular, massive; encrustation or replacement of thorite or thorium minerals. Secondary mineral formed from thorium minerals.

Thucholite. Hydrocarbon containing U, Th, rare earth elements, and silica. H = 3.5–4. Jet black with brilliant lustre and conchoidal fracture. Occurs in pegmatite. Not a valid mineral species.

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.

Tochilinite. $6Fe_{0.9}S \bullet 5(Mg,Fe)(OH)_2$. Black, finely fibrous, acicular, flaky, or platy aggregates; bronze lustre. Occurs in serpentine and in serpentine-bearing marble. Distinguished from graphite by its bronze lustre. Alteration product of pyrrhotite.

Tomichite. $(V,Fe)_4Ti_3AsO_{13}(OH)$. Minute, black, opaque, tabular crystals. Black streak. Associated with vanadian muscovite and quartz.

Tonalite. A quartz-rich diorite containing hornblende and biotite as the chief dark minerals.

Topaz. $Al_2SiO_4(F,OH)_2$. Colourless, white, light blue, yellow, brown, grey, or green prismatic crystals with perfect basal cleavage; also massive granular. Vitreous lustre, transparent. Distinguished by its crystal habit, cleavage, and hardness. Used as a gemstone.

Tourmaline. $Na(Mg, Fe)_3Al_6(BO_3)_3Si_6O_{18}(O,OH,F)_4$. H = 7.5. Black, dark green, blue, pink, brown, or yellow prismatic crystals; also columnar, granular. Prism faces are vertically striated. Vitreous lustre. Conchoidal fracture. Distinguished by its triangular cross-section in prisms and by its striations. Used in the manufacture of pressure gauges; transparent varieties are used as gemstones. Mineral group consisting of several species including dravite, schorl, elbaite, and uvite.

Trachyte. A light-coloured lava composed essentially of orthoclase with minor biotite, amphibole, and/or pyroxene.

Trap rock. Dark-coloured, fine-grained dyke rock.

Trembathite. $(Mg,Fe)_3B_7O_{13}Cl$. H = 6–8. Colourless to light blue transparent rhombohedral crystals. Vitreous lustre. Occurs with hilgardite and halite. Originally described from the Salt Springs potash deposit, Sussex, New Brunswick, and named in honour of Professor Lowell T. Trembath, University of New Brunswick.

Tremolite. $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$. H = 5–6. White, grey, striated prismatic crystals, bladed crystal aggregates, or fibrous; perfect cleavage. Usually occurs in metamorphic rocks. Fibrous variety is used for asbestos. Monoclinic member of amphibole.

Triphylite. $LiFePO_4$. H = 4–5. Greenish to bluish grey, cleavable to compact massive; prismatic crystals rare. Transparent to translucent with vitreous to subresinous lustre. Occurs with lithium and phosphate minerals in granite pegmatite.

Troctolite. A gabbro with olivine as the dominant ferromagnesian component.

Trondhjemite. A light-coloured igneous rock composed mainly of Na-plagioclase with quartz and biotite.

Tuff. A rock formed from volcanic ash.

Tundrite. $Na_2Ce_2(Ti,Nb)SiO_8 \bullet 4H_2O$. H = 3. Brownish or greenish-yellow acicular crystals occurring individually or forming spheres. Occurs in nepheline syenite.

Tungstenite. WS_2. H = 2.5. Dark grey, metallic, massive, or fine scaly aggregates. Associated with scheelite, wolframite, and sulphide minerals.

Tungstite. $WO_3 \bullet H_2O$. 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.

Tungusite. $Ca_4Fe_2Si_6O_{15}(OH)_6$. H ~ 2. Green to yellow-green platy aggregates resembling chlorite. Pearly lustre. Associated with analcime and other zeolites in lava.

Tvalchrelidzeite. $Hg_{12}(Sb,As)_8S_{15}$. Dark grey, metallic, granular aggregates with dark reddish tint. Adamantine lustre. Associated with cinnabar and realgar.

Twinnite. $Pb(Sb,As)_2S_4$. Black, metallic, minute grains. Streak is black with brownish tint. Rare mineral associated with other sulphosalts. Originally described from a prospect pit near Madoc, Ontario.

Type locality. Locality from which a mineral species was originally described.

Ulexite. $NaCaB_5O_6(OH)_6 \bullet 5H_2O$. H = 1. White with silky lustre. Occurs as nodules composed of fine fibres and as compact fibrous veins. Source of borax. Occurs in gypsum deposits in Nova Scotia and New Brunswick.

Ullmannite. NiSbS. H = 5–5.5. Silver-white to grey, metallic, cubic, octahedral, or pyritohedral crystals with striations on cube faces. Greyish-black streak. Perfect cleavage. Occurs with nickeline and other nickel minerals in vein deposits. Distinguished from pyrite by its colour.

Umangite. Cu_3Se_2. H = 3. Bluish-black grains or massive granular. Metallic lustre. Associated with copper sulphide and selenide minerals such as chalcocite, chalcomenite, and chalcopyrite.

Unakite. A rock consisting of pink to orange-red feldspar, epidote, and some quartz. Used as an ornamental stone.

Uraconite. Probably a uranium sulphate. Yellow to green, earthy, nodular, scaly, or botryoidal crust. Not a valid mineral species.

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 its high specific gravity (10.3 to 10.9), crystal form, and radioactivity.

Uranophane. $(H_3O)_2Ca(UO_2)_2(SiO_4)_2 \bullet 3H_2O$. H = 2–3. Yellow fibrous, radiating aggregates; massive. Occurs with uraninite from which it alters.

Uranothorite. $(Th,U)SiO_4$. H = 4.5–5. Black prismatic crystals, grains. Pitchy lustre. May have orange-coloured sunburst effect on enclosing rock. Radioactive. Occurs in granitic and pegmatitic rocks. Granular variety distinguished from thorite and uraninite by X-ray methods. Variety of thorite containing uranium. Not a valid mineral name.

Uranpyrochlore. $(U,Ca,Ce)_2(Nb,Ta)_2O_6(OH,F)$. H = 4.5. Yellowish-brown to black octahedral crystals, or massive. Resinous to adamantine lustre. Occurs in granite pegmatite. Pyrochlore group.

Valentinite. Sb_2O_3. H = 2.5–3. Colourless, 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 secondary antimony oxides resulting from oxidation of metallic antimony minerals.

Valleriite. $4(Fe,Cu)S{\bullet}3(Mg,Al)(OH)_2$. Very soft, sooty. Bronze-black, platy, massive with perfect cleavage. Occurs in high-temperature copper deposits.

Veatchite. $Sr_2B_{11}O_{15}(OH)_5{\bullet}H_2O$. H = 2. Colourless, transparent, platy or prismatic crystals; white fibrous masses with silky lustre. Occurs with howlite, colemanite, and other borate minerals.

Vermiculite. $Mg_3Si_4O_{10}(OH)_2{\bullet}xH_2O$. H = 1.5. Silvery-amber or light brown, flaky, sheet-like aggregates. Pearly lustre. Expands or exfoliates on heating, which distinguishes it from mica. Formed by alteration of phlogopite and biotite. Used as an insulator in the construction industry, for concrete and plaster, as a lubricant, and as a soil conditioner.

Vesuvianite. $Ca_{10}Mg_2Al_4(SiO_4)_5(Si_2O_7)_2(OH)_4$. H = 7. Yellow, brown, green, violet transparent, prismatic, or pyramidal crystals with vitreous lustre; also massive, granular, compact, or pulverulent. Distinguished from other silicates by its tetragonal crystal form; massive variety is distinguished by its ready fusibility and intumescence in a blowpipe flame. Also known as idocrase. Transparent varieties are used as a gemstone.

Villiaumite. NaF. H = 2–2.5. Dark red, pink, orange, finely crystalline or massive. Transparent; vitreous. Occurs in nepheline syenite.

Vinogradovite. $(Na,Ca,K)_4Ti_4AlSi_6O_{23}{\bullet}2H_2O$. H = 4. Colourless to white fibrous and spherical aggregates; prismatic crystals less common. Transparent; vitreous. Occurs in nepheline syenite.

Violarite. $FeNi_2S_4$. H = 4.5–5.5. Light grey, brilliant metallic; tarnishes to violet-grey. Massive. Distinguished by its violet tarnish. Associated with copper, nickel, and iron sulphides in vein deposits. Rare mineral.

Vivianite. $Fe_3(PO_4)_2{\bullet}8H_2O$. H = 1.5–2. Colourless transparent on fresh surfaces, becoming blue, greenish-blue to dark blue translucent due to oxidation. Vitreous to dull lustre. Prismatic crystals; bladed, globular, fibrous, powdery to earthy aggregates. Streak is colourless to bluish white, quickly altering to dark blue or brown. Soluble in acids. Darkens in H_2O_2. Occurs as a secondary mineral in metallic ore deposits and as a weathering product of iron-manganese phosphates in pegmatite.

Vlasovite. $Na_2ZrSi_4O_{11}$. Colourless to light brown crystals and grains. Vitreous, pearly, or greasy lustre. Excellent cleavage. Occurs in alkalic rocks.

Voggite. $Na_2Zr(PO_4)(CO_3)(OH){\bullet}2H_2O$. Colourless, transparent, acicular, microscopic crystals; white matted fibres. Occurs in centimetric cavities in an amygdaloidal basalt dyke cutting a weloganite-bearing sill at the Francon quarry, Montréal, the type locality. Resembles dawsonite. Name in honour of its discoverer, mineral collector Adolf Vogg of Arnprior, Ontario.

Volkovskite. $KCa_4[B_9O_8(OH)_4]_4[B(OH)_3]_2Cl{\bullet}4H_2O$. H = 2.5. Colourless to pink thin platy crystals. Transparent with vitreous lustre. Occurs with other borate minerals in potash deposits.

Voltaite. $K_2Fe_9(SO_4)_{12}{\bullet}18H_2O$. H = 3. Greenish-black to black, dark green cubic or octahedral crystals; also massive granular. Resinous lustre. Greyish-green streak and conchoidal fracture. Decomposed by water, leaving a yellow precipitate. Soluble in acids. Associated with other iron sulphate minerals.

Wacke. A sandstone consisting of generally unsorted angular mineral and rock fragments in a clay-silt matrix.

Wad. A field term used for substances consisting mainly of manganese oxides.

Wakefieldite. YVO_4. H = 5. Amber, yellow, brownish, white, grey, pulverulent; coatings. Dull lustre. Occurs in pegmatite with rare-element minerals. Named for Wakefield Lake, Quebec, which is near the Evans-Lou mine, the type locality.

Wallrock. Rock forming the walls of a vein, dyke, or other ore deposit.

Warwickite. $(Mg,Ti,Fe,Al)_2(BO_3)O$. H = 3.5–4. Black opaque prismatic crystals without terminations, rounded grains, granular aggregates. Adamantine to submetallic, dull, or pearly lustre. May have coppery-red tarnish on the surface. Occurs with spinel, chondrodite, serpentine in crystalline limestone.

Waterlime. A clayey limestone containing alumina, silica, and lime in the proper proportions to produce cement by the addition of water. Also known as 'cement rock'.

Wehrlite. Mixture of hessite (Ag_2Te) and pilsenite (Bi_4Te). Not a valid mineral species.

Weloganite. $Sr_3Na_2Zr(CO_3)_6{\bullet}3H_2O$. H = 3.5. Transparent yellow to orange-yellow, colourless prismatic crystals terminated by pyramids; also massive. Conchoidal fracture. Vitreous lustre. Effervesces in HCl. Originally found at the Francon quarry, Montréal, and named for Sir William E. Logan, first director of the Geological Survey of Canada.

Whitlockite. $Ca_9(Mg,Fe)H(PO_4)_7$. H = 5. Colourless to white, grey, or yellowish rhombohedral crystals; granular to earthy massive. Transparent to translucent with vitreous to subresinous lustre. Soluble in dilute acids. Occurs in phosphate rock deposits and in pegmatite.

Willemite. Zn_2SiO_4. H = 5.5. Colourless, yellow, green, white, reddish brown, massive or granular; also prismatic crystals. Vitreous lustre. Soluble in HCl. May fluoresce green. Nonfluorescent variety difficult to identify in hand specimen. Minor ore of zinc.

Wilsonite. An altered scapolite (to muscovite). Pink, rose-red, mauve to violet. Translucent variety used as a gemstone. Named for Dr. James Wilson of Perth, Ontario, where it was originally found. Not a valid mineral name. Pinite is the preferred term for muscovite alteration from scapolite, feldspar, or spodumene.

Witherite. $BaCO_3$. H = 3–3.5. Colourless to white, greyish, yellowish, greenish, or brownish six-sided dipyramids and prisms; also tabular, globular, botryoidal, fibrous, or granular massive. Transparent to translucent with vitreous to resinous lustre. Effervesces in dilute HCl. Occurs with barite and galena in low-temperature hydrothermal veins.

Wittichenite. Cu_3BiS_3. H = 2–3. Grey, metallic, tabular crystals, or columnar, acicular aggregates; massive. Fuses easily. Soluble in HCl and gives off H_2S; decomposed by HNO_3. Alters readily to yellowish brown, red, blue, and eventually forms covellite.

Wodginite. $(Ta,Nb,Sn,Mn,Fe)_{16}O_{32}$. H ~ 6. Reddish-brown to dark brown and black irregular grains. Submetallic lustre. Occurs in granitic rocks. Ore of tantalum with uses in electrolytic, nuclear reactor, and aircraft industries.

Wöhlerite. $NaCa_2(Zr,Nb)Si_2O_8(O,OH,F)$. H = 5.5–6. Yellow, brown, orange tabular or prismatic crystals. Vitreous lustre. Occurs in nepheline syenite. Rare mineral.

Wolframite. $(Fe,Mn)WO_4$. H = 4–4.5. Dark brown to black, short, prismatic striated crystals; lamellar or granular. Submetallic to adamantine lustre. Perfect cleavage in one direction. Distinguishing features are colour, cleavage, and high specific gravity (7.1–7.5). Ore of tungsten.

Wollastonite. $CaSiO_3$. H = 5. White to greyish white compact, cleavable, or fibrous masses with splintery or woody structure. Vitreous to silky lustre. May fluoresce in ultraviolet light. Distinguished from tremolite (H = 6) and sillimanite (H = 7) by its inferior hardness and by its solubility in HCl. Occurs in crystalline limestone and skarn zones. Used in ceramics and paints.

Woodhouseite. $CaAl_3(PO_4)(SO_4)(OH)_6$. H = 4.5. Violet, pink, white, or colourless tiny, pseudocubic striated crystals. Vitreous, transparent. Secondary mineral associated with topaz, lazulite, pyrophyllite.

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 streak. Occurs with sulphide minerals.

Xanthoconite. Ag_3AsS_3. H = 2–3. Dark red to orange or brown tabular or lath-shaped crystals. Adamantine lustre. Orange-yellow streak. Fuses readily. Associated with ruby silver; at LaRose mine and at Keeley mine, Cobalt, Ontario.

Xenotime. YPO_4. H = 4.5. Reddish or yellowish-brown, grey prismatic crystals similar to zircon. Vitreous to resinous lustre. Distinguished from zircon by its inferior hardness. Occurs in pegmatite and alkalic igneous rocks.

Xonotlite. $Ca_6Si_6O_{17}(OH)_2$. 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 is used as a gemstone.

Yarrowite. Cu_9S_8. Dark grey to black, metallic, flaky or platy (microscopic) aggregates with green-violet iridescence. Associated with chalcopyrite, bornite, and other copper minerals from which it alters. Indistinguishable in the hand specimen from spionkopite. Originally described from the sandstone and quartzite copper deposits in the Yarrow and Spionkop Creeks area, southwestern Alberta; named for the locality.

Yofortierite. $Mn_5Si_8O_{20}(OH)_2(OH_2)_4{\bullet}8\text{–}9H_2O$. H = 2.5. Pink to violet radiating fibres. Associated with analcime, serandite, eudialyte, polylithionite, aegirine, microcline, and albite in pegmatite veins cutting nepheline syenite at Mount Saint-Hilaire, Quebec, the type locality. Named in honour of Dr. Y.O. Fortier, Arctic geologist and director (1964–1973) of the Geological Survey of Canada.

Yttrofluorite. Yttrian fluorite with yttrium substituting for Ca. Yellow, brown, violet, or blue, granular massive. Density and hardness are somewhat greater than in fluorite. Not a valid mineral name.

Yttrotantalite. $(Y,U,Fe)(Ta,Nb)O_4$. H = 5–5.5. Black to dark brown prismatic or tabular crystals; irregular grains, massive. Submetallic, vitreous to greasy lustre and conchoidal fracture. Grey streak. Occurs in pegmatite.

"Yukon diamond". A term used in the North for concentrically banded black, dark brown, or tan cassiterite pebbles found in placers in the Yukon Territory. Also known as 'wood tin'. Used as a gemstone.

Yukonite. $Ca_3Fe_3(AsO_4)_4OH{\bullet}12H_2O$. H = 2–3. Black to dark brown irregular masses. Decrepitates at low heat and when immersed in water. Easily fusible. Found originally at Tagish Lake, Yukon Territory. Named for the locality.

Zavaritskite. BiOF. Yellow to grey, granular to powdery, with greasy to submetallic lustre. Associated with bismutite, bismuthinite, bismuth.

Zeolites. A group of hydrous silicates of related composition, but differing crystallization; water is given off continuously when heated, but can be taken up again. Heulandite, chabazite, stilbite, natrolite, analcime belong to this group. Formed from magmatic or hydrothermal solutions, or by alteration of feldspar minerals. Used as water softeners, as gas and impurity absorbents, and in heat reservoirs.

Zinc. Zn. H = 2. Light grey, metallic crystals, grains, scales. Brittle. Perfect cleavage. Formed from oxidation of sphalerite.

Zinkenite. $Pb_9Sb_{22}S_{42}$. H = 3–3.5. Grey, metallic, columnar to radial fibrous aggregates, massive; indistinct slender striated prisms. Tarnishes to iridescent surfaces. Occurs with stibnite, jamesonite, and other sulphosalts, and galena, pyrite, and sphalerite in veins formed at low to moderate temperatures.

Zircon. $ZrSiO_4$. H = 7.5. Pink, reddish to greyish-brown tetragonal prisms terminated by pyramids; also colourless, green, violet, or grey. May form knee-shaped twins. Adamantine lustre. May be radioactive. Distinguished by its crystal form, hardness. Ore of zirconium and hafnium. Used in moulding sand, ceramics, and refractory industries; transparent varieties are used as gemstones.

Zoisite. $Ca_2Al_3(SiO_4)_3(OH)$. H = 6.5. Grey to brownish-grey, yellowish-brown, violet-pink, green aggregates of long prismatic crystals (striated); also compact fibrous to columnar masses. Vitreous to pearly lustre. Transparent to translucent. Massive variety distinguished from amphibole by its perfect cleavage. Transparent varieties used as gemstones; pink variety known as 'thulite', transparent blue variety, as 'tanzanite'.

References: 15; 38; 51; 72; 103; 109; 132; 144; 149; 182; 188; 189; 207; 210; 261.

CHEMICAL SYMBOLS FOR SELECTED ELEMENTS

Ag - silver
Al - aluminum
As - arsenic
Au -gold
B - boron
Ba - barium
Be - beryllium
Bi - bismuth
Br - bromine
C - carbon
Ca - calcium
Cd - cadmium
Ce - cerium
Cl - chlorine
Co - cobalt
Cr - chromium
Cs - cesium
Cu - copper
Dy - dysprosium
Er - erbium
F - fluorine
Fe - iron
Ga - gallium
Gd - gadolinium
Ge - germanium
H - hydrogen
Hf - hafnium
Hg - mercury
I - iodine
In - indium
Ir - iridium
K - potassium
La - lanthanum
Li - lithium
Mg - magnesium
Mn - manganese
Mo - molybdenum
N - nitrogen
Na - sodium
Nb - niobium
Nd - neodymium
Ni - nickel
O - oxygen
P - phosphorus
Pb - lead
Pd - palladium
Pt - platinum
Rb - rubidium
Re - rhenium
Rh - rhodium
Ru - ruthenium
S - sulphur
Sb - antimony
Sc - scandium
Se - selenium
Si - silicon
Sm - samarium
Sn - tin
Sr - strontium
Ta - tantalum
Te - tellurium
Th - thorium
Ti - titanium
Tl - thallium
U - uranium
V - vanadium
W - tungsten
Y - yttrium
Yb - ytterbium
Zn - zinc
Zr - zirconium

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LABRADOR