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GEOLOGY OF THE NORTHERN COAST OF LABRADOR, FROM GRENFELL SOUND TO PORT MANVERS, NEWFOUNDLAND

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Illustration

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INTRODUCTION

General Statement

The area mapped is the northern part of the Labrador coast from latitude 56°50' north to Grenfell Sound at latitude 60°. The most northerly 10 miles of the coast, between Grenfell Sound and Cape Chidley, were not examined because it was blocked by pack-ice at the time of the writer's visit. Field work on which this report is based was done during the 1951 field season. The work was confined to the coast, but, as the coast-line is deeply dissected by numerous bays and fiords, it was commonly possible to observe a considerable width of terrain.

Transportation and accommodation for the party were provided by a chartered fishing schooner, the Effie E. Frederick, built and owned by Mr. Emmanuel Vokey of Little Harbour, Trinity Bay, Newfoundland. Traverses were made by motor-boat, with landings at as many points as possible to examine the rock formations. The inland geology south of latitude 57°30' is taken from the excellent work of E. P. Wheeler 2nd. Mr. Charles Leate, who has visited the Labrador coast for approximately 50 summers, was skipper of the boat. George Marsh, Harvey Marsh, and Frederick Vokey were members of the crew and performed their duties most efficiently.

The kindness and hospitality of the residents of the area, especially the Moravian missionaries and the post managers of the Northern Labrador Trading Company, are gratefully acknowledged.

Previous Geological Work

The first geologist to visit the area mapped was Lieber (11)[1] in 1860. In 1884, Bell (1, 2) passed through the area and spent several days making observations near Nachvak Fiord. Following his visit in 1900, Daly (5) wrote an interesting account of the glacial geology of the area and named the Mugford and Ramah series that rest unconformably on the older gneisses. In 1904, Low (12) collected some fossils from loose blocks of limestone of Ordovician or Silurian age near Cape Chidley. He believed these blocks were transported by ice from Apatok Island in Ungava Bay. In 1915 and 1916, Coleman (4) examined the area between Nachvak and Ramah, and made a few observations on other parts of the coast. In 1931, Odell (13) worked in the map-area as geologist of the Forbes Expedition. In 1937 and 1939, Kranck (10) studied the bedrock geology of the coast as far north as Hebron. In 1939, Gardner and Wilmot (7) paid a brief visit to the area and collected specimens that were later described by Madam E. Jérémine (9). The most important and most intensive work in the present area, however, is that done by Wheeler (18,19,20), who has worked in the vicinity of Nain and Nutak at intervals for the last 25 years. The inland geology shown on the accompanying geological map south of latitude 57°30' is based entirely on his excellent work.

[1]Numbers in parentheses are those of references listed at the end of this report.

Topography and Glaciation

The dominating topographic elements of the map-area from south to north are: (a) the Kiglapait Mountains, (b) the Kaumajet Mountains, and (c) the Torngat Mountains.

Labrador has been described as an old, uneven erosion surface that has been uplifted, the uplift being greatest on the east, close to the coast, and sloping gently to the west towards Hudson Bay. Since the uplift, this old erosion surface has been deeply dissected by glacial erosion and partly flooded by the sea. In post-Glacial times, the land has been rising, the many raised delta deposits and beaches remaining as evidence of the former sea-level.

The Kiglapait Mountains and those to the south are underlain by anorthosite and gabbro. The plateau there is some 2,000 to 3,000 feet in elevation. Mount Thoresby, just south of the area mapped, has an elevation of 3,007 feet; Man'o War Peak, 3,000 feet; and the four highest peaks of the Kiglapait Mountains proper, 2,900, 2,800, 2,600, and 2,500 feet respectively. The anorthosite and gabbro have, apparently, proved more resistant to erosion than the gneisses, all the above-mentioned peaks being in the anorthosite-gabbro area. The massive granitic rocks (including Wheeler's adamellite) also tend to be more resistant than the gneisses, although not so resistant as the anorthosite-gabbro.

North of the Kiglapaits, in the vicinity of Nutak and Okak Bay, the tops of the highest hills lie between 1,000 and 2,000 feet. This area is underlain predominantly by gneiss.

The Kaumajet Mountains are among the most impressive on the coast. Almost horizontal bands of volcanic rocks interstratified with lesser thicknesses of sedimentary beds, all of Proterozoic age, rise to elevations up to 4,300 feet (Brave Mountain) less than 2 miles from the sea. Undoubtedly the great elevations are due in part to the superior resistance to erosion of the volcanic rocks, chiefly basalt and andesite, of which these mountains are principally composed. Details of the form of these mountains are governed by minor folds and block faults. Inland from the Kaumajet Mountains, the hills, which are composed of gneiss, rise to elevations of 3,000 feet. Nanuktut Island (elevation, 1,600 feet), to seaward, owes its bold features to the resistance to erosion of the massive granite of which it is composed.

North of the Kaumajets, the hills, composed of granitoid gneisses, with minor gabbro or amphibolite, rise to just over 3,000 feet as far as Saglek Bay. There the south end of the Proterozoic Ramah series is only moderately resistant to weathering, as it is composed of gently dipping beds of interbedded quartzite, sandstone, shale, and graphitic schist. The steep shores of the West Arm of Saglek Bay are composed of the intermediate hypersthene-bearing gneisses.

Between Saglek Bay and Nachvak Fiord, the Ramah beds stand up to moderately great elevations, especially where composed principally of quartzite. The highest, Quartzite Mountain, reaches an elevation of over 4,000 feet; it would be a giant elsewhere on the coast, but is dwarfed by its proximity to Cirque Mountain and Mount Cladonia, both more than 5,000 feet high.

The Torngat Mountains include the highest on the entire coast. The highest peaks are Cirque Mountain (5,500 feet), Mount Packard (5,200 feet), Mount Cladonia (5,100 feet), and Mount Silene (5,000 feet), all in the vicinity of Nachvak Fiord. Northward, elevations gradually decrease: thus, between Nachvak Fiord and Kangalaksiorvik Fiord the highest hills are Mount Eliot (4,554 feet) and Mount Tetragona (4,510 feet); northward again between Kangalaksiorvik Fiord and Ryan Bay, the Four Peaks are 4,416, 4,114, 4,080, and 3,832 feet high; between Ryan Bay and Eclipse River, the highest hills rise to 3,870, 3,855, 3,545, and 3,495 feet; and between Eclipse River and Ikkudliayuk Fiord the highest hills are 2,935, 2,790 (Ikordlarsuk Mountain), 2,740, and 2,647 feet in elevation. These represent the northern extremity of the Torngat Mountains; farther north, to Cape Chidley and the Button Islands, no elevation exceeds 2,115 feet.

As may be seen on the accompanying geological map, the Torngat Mountains are composed of, or bounded on the seaward side by, a belt of intermediate, commonly clinopyroxene- or hypersthene-bearing gneisses, with minor gabbro or anorthosite. It is believed that the Torngats owe their great elevations in part to the superior resistance to erosion of these intermediate gneisses as compared with the more normal gneisses to the north and west.

On the Cape Chidley sheet of the United States Navy Hydrographic Office (Chart No. 5846), it may be seen that north of Nachvak Fiord the Torngat Mountains may be divided laterally into three elements, which, from east to west, comprise: (1) the coastal strip about 20 miles wide that includes the zone of intermediate hypersthene-bearing gneisses; (2) a depression, 2 to 5 miles wide, parallel with the coast; and (3) hills rising to heights almost as high as those of the coastal belt. Near the head of Nachvak Fiord, the only fiord that cuts across the prolongation of the above-mentioned topographic depression, a distinct change in lithology occurs from the hypersthene-bearing intermediate gneisses on the east to light-coloured granulites and gneisses containing crystalline limestone on the west. In this depression, near the north shore of Nachvak Fiord, Coleman (4) observed a "curious crush breccia of small gneiss fragments cemented by a black material like chert". Odell (13) confirmed this observation and termed the rock a pseudotachylite. The writer prefers to call this a zone of brecciation and mylonitization, and believes that the depression probably marks a zone of great crushing and faulting.

Between Ikkadliayuk Fiord and Cape Chidley, the highest elevations lie between 1,000 and 2,200 feet. This is an area of granitoid gneisses, containing only small bodies of gabbro and amphibolite.

The topography of the area mapped has been profoundly affected by the last glaciation. U-shaped valleys are the rule, with smaller, hanging tributary valleys common. The surfaces at the lower levels show the rounded, polished, and roche moutonnée forms typical of a glaciated area, and the higher mountains commonly bear cirques, cols, and arêtes, formed, presumably, by mountain glaciers.

The debris left by the glaciers, although of relatively small volume, forms some striking features in the area mapped: raised delta deposits occur at the head of nearly every bay and fiord, raised boulder beaches and wave-cut terraces are common, and ground moraine and erratics abound.

So many different opinions have been given by the previous investigators regarding the thickness of the glacial ice, the centres of distribution, and the correlation of the various raised wave-cut terraces, beaches, and delta deposits, that discussion of the evidence so far collected will not be attempted here.

GENERAL GEOLOGY

The following table indicates the probable geological succession in the area mapped. In brief, the oldest rocks are paragneisses, granitoid gneisses, gabbro-anorthosite, and intermediate rocks. All these are intersected by narrow gabbro dykes. The Ramah and Mugford series, predominantly of sedimentary and volcanic rocks respectively, rest unconformably on the older rocks.

Table of Formations

Era	Formations and lithology
Proterozoic	Ramah and Mugford series: basalt, andesite, trachyte, tuff, quartzite, argillite, slate, ferruginous dolomite, chert, and graphitic schist
	Unconformity
Archaean	Diabase (gabbro) dykes
	Granitoid gneisses and massive granite, including: (a) massive granite; (b) gneissic granite; (c) gneissic quartz monzonite; (d) gneissic granodiorite; and (e) gneissic quartz diorite
	Intermediate gneisses, including: (a) hypersthene diorite; (b) hypersthene quartz diorite; (c) hypersthene quartz monzonite; (d) augite diorite; and (e) augite quartz diorite
	Gabbro, anorthosite, diorite, and amphibolite; in part massive
	Paragneisses, including: (a) conglomeratic gneiss; (b) granulite; and (c) gneisses containing crystalline limestone. In places these are quartz-rich or sillimanite-bearing

Description of Map-units

Paragneisses

The term paragneiss has been applied to those gneisses that, in the opinion of the writer, are derived from sedimentary rocks. Those containing abundant sillimanite, those that contain more quartz than a normal igneous rock, and are considered to be metamorphosed quartzites, and the one minor occurrence of crystalline limestone are indicated separately on the accompanying geological map. Near the coast, and close to the northwest contact of the large anorthosite mass, an area of the gneiss contains recognizable pebbles and must be a metamorphosed conglomerate. This occurrence is also shown separately. Of less certain origin are the very light-coloured gneisses, here designated 'granulites', observed near the head of Nachvak and Hebron Fiords. These are highly garnetiferous, light-coloured, and strongly foliated rocks, commonly of even grain, although garnets or small lenses or rods of quartz may occur as porphyroblasts considerably larger than the other mineral grains. They are composed of abundant quartz, commonly containing innumerable tiny needles of rutile, microperthite, oligoclase-andesine plagioclase close to An_{30} in composition, a little biotite, and, more rarely, a mineral believed to be enstatite - the doubt arising because of the small optic axial angle. The granulites are associated in the field with recrystallized quartzites and carbonate rocks, and in consequence are believed to be derived from sedimentary rocks.

Many other gneisses of the map-area, those mapped as granitoid gneisses, contain garnet, graphite, and cordierite. If the occurrence of garnet in a gneiss be accepted as satisfactory evidence of a sedimentary origin, probably nearly one-half of the total volume of the gneisses in the area mapped should be considered as paragneisses. However, it is well established that garnets can occur in metamorphosed igneous rocks, particularly those of intermediate or basic types. Nor has graphite been accepted as good evidence of a sedimentary origin, because this mineral is common in shear zones where it is obviously secondary. Wheeler (20) reports cordierite-bearing gneisses in the vicinity of the large anorthosite and related bodies in the southern part of the map-area, but, in a personal communication, states that in at least some cases the cordierite has formed as an alteration product of garnet close to the intrusive rocks, doubtless as a result of thermal metamorphism.

Gabbro, Anorthosite, Diorite, and Amphibolite

The largest mass of basic to ultrabasic rocks, in the extreme south of the area mapped, has been well described by Wheeler (20). The gabbros, anorthosites, and diorites of this area are characteristically massive, but near the margins and in certain other zones may be markedly banded. In grain size, they range from medium to very coarse, with crystals up to 2 feet long. In composition, they range from peridotite (rare), to anorthosite, gabbro, and diorite. Plagioclase is the most abundant mineral, and varies in composition from andesine (An_{35}) to bytownite (An_{73}), but is most commonly between andesine (An_{40}) and labradorite (An_{58}). Monoclinic pyroxene and hypersthene are the chief mafic constituents, and olivine, hornblende, biotite, and apatite are common accessory minerals. Chatoyant[1]

[1] 'Chatoyant' is a technical term referring to the play of colours that characterizes the plagioclase feldspars, commonly labradorite, of some localities.

plagioclase is widely distributed, especially in the coarser feldspar-rich rocks. Wheeler (20) found its composition to range from labradorite (An_{58}) to andesine (An_{40}). Minute, oriented, opaque rods and brown platy inclusions are most common in the more calcic plagioclases, and commonly give the anorthositic rocks a dark colour. The more sodic (andesine) feldspars are most commonly lighter in colour as they lack the dark inclusions, commonly containing instead antiperthitic inclusions. The olivine crystals in these rocks commonly have a rim or corona composed of hypersthene. Locally, the pyroxene shows alteration to amphibole.

North of the main gabbro-anorthosite mass are numerous smaller intrusions of gabbro. In some places, as for example on the north shore of Kangalaksiorvik Fiord, 2 miles west of Brownell Point, a narrow dyke of gabbro cuts sharply across the foliation of the intermediate gneisses but is itself intersected by dykes of an acidic pegmatitic material that appears to be the youngest phase of the composite gneiss. Amphibolite occurs throughout the area mapped, especially in the granitoid gneisses of the northern part. Most of it is gabbro in which the pyroxenes are wholly or in part altered to amphibole; some, however, may represent metamorphosed sedimentary material.

Some difficulty was experienced in distinguishing gabbro dykes of this earlier generation from the later diabase (gabbro) dykes. Field characteristics that aid in making the distinction are: (1) the older gabbro may be cut by pegmatitic dykes, but the diabase is not; (2) the diabase commonly shows sharp, chilled edges against the intruded rocks, whereas the older gabbro commonly does not; and (3) the diabase occurs in relatively straight-walled dykes of limited size, whereas the older gabbro bodies may be of any size and are commonly less regular in shape.

Intermediate Gneisses

The intermediate gneisses are rocks considered to be intermediate in composition between the anorthosite-gabbro and the granitoid gneisses and massive granite. They embrace a variety of compositional types, as indicated on the accompanying geological map, including hypersthene diorite, hypersthene quartz diorite, hypersthene quartz monzonite, augite diorite, and augite quartz diorite[1]. Most of these rocks outcrop in the northern part of the map-area between Eclipse Harbour and Saglek Fiord; another group, shown after Wheeler (20), occurs in the south in the vicinity of the large anorthosite-gabbro mass.

In the area between Eclipse Harbour and Saglek Fiord, most of the intermediate gneisses are brownish on the weathered surface as contrasted with the normal grey of the granitoid gneisses. These intermediate gneisses, although commonly showing some directional banding, are less conspicuously foliated than the granitoid gneisses. They are also distinguished from the anorthosite-gabbro in that they contain an appreciable amount of quartz. Under the microscope, they are seen to consist mainly of plagioclase — andesine or more rarely oligoclase in composition — which commonly shows antiperthitic inclusions, quartz, and hypersthene or a monoclinic pyroxene, probably

[1]These rock names follow the definitions of Brown (3).

titan-augite. Accessory minerals are garnet, hornblende, biotite, iron oxides, and a scapolite. Locally, this rock contains darker segregations rich in pyroxene, and may be intersected by dykes composed of more siliceous material. At Cape White Handkerchief and Bigelow Bight, for example, the darker coloured, intermediate gneisses are cut by a light grey, massive rock containing abundant grains of opalescent quartz up to 8 mm. in diameter. Under the microscope, however, this rock is seen to be a hypersthene quartz diorite similar in composition to the surrounding rocks except in the higher percentage of felsic minerals and the lighter colour of the feldspar.

Included in this map-unit is a complex of banded, garnetiferous rocks intersected by a plagioclase pegmatite that is believed to form a border phase of the intermediate gneisses. For example, the rocks from the coast just north of Ryan's Bay are strongly foliated and irregularly banded; the bands are composed of the same minerals — andesine feldspar, titan-augite, quartz, garnet, and lesser hornblende and biotite — but differ greatly in the contained percentages of these minerals. The garnet content is considerably higher than in the more massive phase of the intermediate gneisses. These banded rocks are intersected, at this point, by several pure feldspar dykes consisting entirely of oligoclase of composition about An_{20}.

The intermediate gneisses shown on the accompanying geological map south of latitude 57°30' are after Wheeler (20), to whom the reader is referred for further details.

Granitoid Gneisses and Massive Granite

The greater part of the map-area is underlain by granitoid gneisses and massive granite, which vary greatly in composition and texture. The granitoid gneisses have been subdivided on the accompanying geological map into gneissic granite, gneissic quartz monzonite, gneissic granodiorite, and gneissic quartz diorite[1]. These are all foliated rocks, predominantly grey in colour, and many show augen structures. The principal mafic minerals are biotite and hornblende. Most commonly, narrow bands rich in biotite or amphibole alternate with more leucocratic bands; more rarely the gneisses contain lens-shaped inclusions of amphibolite. These granitoid gneisses appear to be of composite origin, the banded rocks referred to being injected by pegmatitic material, either parallel with the foliation or as crosscutting dykes. Many of the gneisses contain garnet, and a few contain minor graphite or cordierite. It is probable that many, or most, of these gneisses were derived, at least in part, from sedimentary rocks. However, as garnet, graphite, and cordierite are known to occur in metamorphosed igneous rocks, it has seemed best for the present not to make any definite assumption on the origin of the gneisses in which these minerals occur, but to include them, on the accompanying map, with the granitoid gneisses rather than with the paragneisses.

[1]These rock names follow the definition of Brown (3).

The massive granite of this map-unit includes the biotite granite with large phenocrysts of orthoclase (commonly 1 inch in diameter), of Nanuktut, Saddle, and Operngeviksoak Islands. Apart from these occurrences, the massive granite shown on the accompanying geological map is the "adamellite group" of Wheeler (20), a group considered to be the acidic differentiate, or relative, of the anorthosite-gabbro group. The rocks of the group are composed principally of quartz, orthoclase or microcline-perthite, commonly as large phenocrysts, oligoclase-antiperthite (about An_{25} in composition), amphibole, biotite, and, commonly, hypersthene, clinopyroxene, and olivine close to fayalite in composition. Accessory minerals are iron oxides, apatite, zircon, and sphene. Wheeler (20) reports that several specimens of the composition of biotite granite contain a little fluorite.

From the foregoing account it will be seen that although the bulk of the "adamellite" would be classed by the writer as granite or quartz monzonite, and is probably related to, or the same as, the massive porphyritic granite of Nanuktut Island, the more basic phases may be more closely related in composition to the intermediate rocks of the Torngat region. Wheeler (20) also states that in the vicinity of the anorthosite-gabbro intrusions, the adjacent granitoid gneisses commonly contain both monoclinic and orthorhombic pyroxenes, which may be the chief mafic minerals even in the more acidic phases of these gneisses.

Diabase (Gabbro) Dykes

Diabase dykes are found throughout the area mapped. Those in the southern part have been well described by Wheeler (20). The dykes are black, commonly between 2 and 50 feet wide, and seldom exceed 200 feet in width. The larger ones may be traced for several miles. They may strike in any direction, and their dips are commonly steep, but a few dykes dip gently or are flat-lying. The normal maximum grain size of these dykes is 1 to 4 mm., but plagioclase phenocrysts up to 3 or 4 cm. long occur in irregular, pegmatoid patches.

Under the microscope, the dyke rocks are seen to be composed of plagioclase (commonly labradorite, but rarely as sodic as oligoclase), 40 to 73 per cent; olivine, 0 to 35 per cent; monoclinic pyroxene, 4 to 27 per cent; and accessory, or rare, iron oxides, apatite, potash feldspar, quartz, and biotite.

Wheeler (20) has divided these diabase rocks into four types, depending on the percentage of olivine, the composition of the plagioclase, the type of pyroxene, and the occurrence or lack of hornblende, potash feldspar, and quartz. He considers these four types to be part of a continuous series, with all gradations from one to the other, and, therefore, of essentially the same geological age.

Ramah Series

The Ramah series was first named by Daly (5) in 1900. It includes probably 4,000 to 6,000 feet of sedimentary rocks, chiefly quartzite, argillite, slate, ferruginous quartzite, dolomite, chert, and graphitic schist; some volcanic rocks, with a maximum reported thickness of 240 feet, occur near the base. The Ramah series is in general gently dipping, and rests with pronounced discordance on the older, steeply dipping gneisses. Odell (13) states that the diabase dykes do not intersect the Ramah series, but are cut off below it at the basal unconformity. It is, therefore, presumed that this series is younger than the diabase dykes. No fossils have been found in it, and in structure and lithology it greatly resembles the sedimentary formations of the iron belt in the interior of Labrador and northern Quebec, which are of Proterozoic age.

The following incomplete section of the Ramah series was measured near tidewater on the north shore of Ramah Bay, from the base of the series westward to Lookout Point. At the base of the series are granitoid gneisses, the foliation of which strikes north 20 degrees east and dips 52 degrees to the west. The Ramah series rests on these with pronounced unconformity.

		Thickness Feet
(1)	Light grey to white quartzite, brown-weathering, in part crossbedded and ripple-marked. At the top is a 3-foot pebble-band containing rounded, $\frac{1}{4}$- to $\frac{1}{2}$-inch pebbles of opalescent quartz and rarer red vitreous quartz, in a sand-grained matrix	110
(2)	Grey-weathering, fine-grained volcanic rock, in places showing ellipsoidal and amygdaloidal structures, probably a latite in composition. Under the microscope, it is seen to be composed of oligoclase, sericite, carbonate, chlorite, and iron oxides. The amygdules are composed of carbonate and quartz	35
(3)	Brown-weathering quartzite	4
(4)	Light grey, sericitic argillite	20
(5)	Interbedded argillite and quartzite, in beds 1 inch to 1 foot thick	8
(6)	Brown-weathering and crossbedded white quartzite, with a few thin argillite bands	16
(7)	Interbedded quartzite and argillite, brown-weathering at the base and purplish grey at the top	3
(8)	Purplish grey, crossbedded, ferruginous quartzite	12
(9)	Grey argillite, with a prominent slaty cleavage; bedding strikes north 45 degrees west and dips 16 degrees southwest; cleavage strikes north 40 degrees west and dips 30 degrees southwest	6
(10)	Purplish grey, crossbedded quartzite, with minor, narrow argillite bands	17

		Thickness Feet
(11)	Grey argillite, with minor amounts of narrow ($\frac{1}{4}$ inch to 2 inches) quartzite bands; bedding strikes north 40 degrees west and dips 18 degrees southwest; flow cleavage strikes north 40 degrees west and dips 45 degrees southwest	25
(12)	Dark purplish grey ferruginous quartzite, with a few narrow argillite bands	15
(13)	Argillite, with minor narrow quartzite bands	24
(14)	Dark purplish grey ferruginous quartzite	18
(15)	Argillite	60
(16))	Drift-covered interval; if there is no faulting and the attitude of the beds does not change, about 500 feet of strata are missing	500
(17)	Dark grey, crossbedded quartzite, with a conchoidal fracture and containing $\frac{1}{4}$-inch cubes of pyrite and small lenses and irregular masses of dolomite	50
(18)	Grey argillite; bedding strikes north 20 degrees west and dips 13 degrees southwest; slaty cleavage strikes north 10 degrees west and dips westerly at 70 degrees	40
	(Small fault or fracture)	
(19)	Grey argillite; the bedding strikes north 20 degrees west and dips 18 degrees southwest	150
	(Narrow, drift-covered interval)	
(20)	Grey argillite, with rare thin bands of quartzite; the bedding strikes north 20 degrees west and dips 48 degrees southwest; the slaty cleavage strikes north 20 degrees west and dips 72 degrees southwest	136
(21)	Grey quartzite, interbedded with minor argillite and grading upward into argillite	27
(22)	Yellow to buff-coloured dolomite. Where pure, the surface of the carbonate rock is smooth; more commonly, however, the rock is intersected by veinlets of quartz $\frac{1}{4}$ inch wide that weather out as ridges in the softer carbonate rock; also, the rock commonly contains quartz grains and pebbles ..	26
(23)	Here the section is intersected by a fault, and it is estimated that 25 feet of argillite are missing	25

		Thickness Feet
(24)	Argillite and graphitic schist showing much limonite stain	100
(25)	Alternating, fine-grained quartzite and argillite bands 1 inch to 6 inches wide; the bedding strikes north 40 degrees west and dips 38 degrees southwest	40
(26)	Argillites, containing nodules or lenses of clear to smoky cherty quartz	35
	(Here a low-angle fault intersects the section and repeats Nos. 23, 24, 25, and 26 bands)	
(27)	Interbanded, dark and light grey argillite and fine-grained quartzite (bands ¼ inch to 2 inches wide) containing a few cherty nodules	50
(28)	Pyrite-rich band in the argillite. This is undoubtedly the same band and is in the same stratigraphic position as that examined for commercial pyrite at Rowsell's Harbour[1]	½ to 2
(29)	Chert, with minor interbedded dolomitic layers; the bedding strikes north 20 degrees west and dips 20 degrees southwest	12
(30)	Light brown dolomite, interbedded with green-grey argillite	6
(31)	Finely interbedded argillite and fine-grained quartzite, with rare, narrow, cherty lenses	180
(32)	Argillite, with good slaty cleavage that strikes north and dips 50 degrees west	50
	(Here the section is intersected by a slip or fault)	
(33)	Argillite	100
(34)	Grey argillites, with interbedded, brown-weathering quartzite bands	100
	Total	2,002

The upper end of the measured section, the top of unit 34, is the lowest seaward stratum at the end of Lookout Point. Westward, the strata, composed of argillite, quartzite, and slate, are too closely folded and too much faulted to justify measuring in detail, but it is estimated that at least an additional 2,000 feet is exposed on the north shore of Ramah Fiord.

[1]This band is of wide extent. Whenever a small, steep joint or fracture plane crosses this band, a streamer of orange-brown-yellow limonitic material stains the rock below it, and is capped abruptly by the band. Unit 28 is, therefore, conspicuous on the cliff faces.

Coleman (4) examined the Ramah series in the vicinity of Nachvak Fiord, and presents the following approximate sections, in descending order:

<u>Near First Cove</u>

	Feet
Slate	?
Quartzite	420
Slate	90
Arkose	45
Arkose and quartzite	290
Greenstone	240
Quartzite	200
Total	1,285+

Igneous gneiss

<u>One mile East of Second Cove</u>

	Feet
Slate	44
Grey quartzite	126
White quartzite	406
Slate	306
Carbonate	87
Quartzite	510
Slate	490
Quartzite	324
Total	2,293

At the southern extremity of the Ramah series, at Saglek Fiord, only about 500 feet of sedimentary beds is exposed.

The structure of the Ramah series, although simple on a broad scale, is complex in detail, as indicated by the section at Ramah Fiord. Near the eastern contact with the older gneiss, the beds strike north and dip about 16 degrees west. There they are intersected by a reverse fault that strikes north, parallel with the bedding, but dips slightly more steeply west than the beds. This reverse fault has caused the repetition of beds in the measured section noted under unit 26. It seems probable that this reverse fault was caused by the pressures responsible for the close folding farther west. Steeper faults in the same section, for example that mentioned in unit 23, have a normal movement, a small part of the section being missing here. These normal or tensional faults probably occurred later than the reverse faults, and are of smaller magnitude. They may be related to the block faulting noted in the Mugford series in the Kaumajet Mountain area.

Coleman (4) suggests that the west side of the Ramah series, between Nachvak and Ramah fiords, may be bounded by a fault. The writer agrees with this, but notes that farther south, at Saglek Fiord, the Ramah series has the form of a syncline, and no evidence of displacement was observed at its contact with the gneiss.

Mugford Series

The Mugford series was first named by Daly (5) in 1900. It includes probably 5,000 feet in all of basalt, andesite, trachyte, and tuff, interbedded with lesser quartzite, argillite, ferruginous quartzite, and dolomite. Dips rarely exceed 30 degrees, and average about 10 degrees. The series rests with pronounced unconformity on the older gneisses, the unconformity being clearly exposed at numerous places near the steep shores bordering the Kaumajet Mountains.

The volcanic rocks include massive flows, flow breccias, volcanic agglomerates, tuffs, and rocks showing well-developed pillow and amygdaloidal structures. Commonly, the volcanic rocks rest directly on the older gneisses, but in places 50 to 150 feet of sedimentary beds form the base of the series, as, for example, at Neisser Inlet, 3 miles north of the bottom of the inlet. There the volcanic rocks are underlain by less than 100 feet of sedimentary beds; the lowest band is a slightly ferruginous quartzite; above this is a narrow dolomite layer similar to that described in unit 22 of the Ramah series section at Ramah Fiord, and above this the beds are composed of argillite. The lithological and structural similarity of these rocks to those of the Ramah series is striking, and there can be little doubt that the two are of the same geological age.

Excellent sections of the Mugford sedimentary rocks are to be seen on the seaward-facing cliffs of the Kaumajet Mountains. Unfortunately, at the time of the writer's visit, the sea conditions prohibited a landing at these points. A few feet from the base of the series, however, and near a dolomite band, streamers of limonitic stain derived from a particular horizon in the series make it probable that the iron-rich band (unit 28 of the Ramah section) will be identified here. If so, unit 28, which is more than 1,500 feet above the base of the section at Ramah Fiord, is less than 100 feet above the base here.

The Mugford series has been gently folded and block faulted. Most of the strata dip gently toward the west and are bounded on the western side by a fault. Locally, as near Mugford Tickle, the series is considerably folded.

The lithology and structure of the Ramah and Mugford series greatly resemble those of the Proterozoic rocks of the iron belt of Quebec and the interior of Labrador. It is, therefore, probable that they are of the same geological age.

ECONOMIC GEOLOGY

Deposits of molybdenite, copper, nickel, graphite, pyrite, and magnetite are known to occur within the area mapped, and although no ilmenite was seen, the large area underlain by anorthosite at the southern boundary of the area would seem to be a favourable region for prospecting for it.

Molybdenite

Molybdenite was noted at two places. One occurrence is in an aplite dyke that cuts massive granite on the south shore of Operngeviksoak Island. There the molybdenite occurs as fine, disseminated flakes in the aplite. The second occurrence is on the south side of Okak Bay, where the molybdenite is in an amphibole-bearing pegmatite dyke close to the border of an area of massive granite (or adamellite).

Both of these occurrences may be related to the massive granite. South of the area mapped, in the region between Hopedale and Indian Harbour, Kranck[1] reports molybdenite associated with the Strawberry granite, an intrusion similar to the massive granite of the present area.

[1] Kranck, E. H.: McGill University; personal communication.

Copper and Nickel

The only occurrence of these metals noted was in disseminated sulphides in a banded garnetiferous gneiss on the shore of Hebron Fiord (See accompanying geological map). The sulphides were identified as pyrrhotite and chalcopyrite. A partial analysis of a specimen made in the X-ray laboratory of the Geological Survey revealed the presence of the following elements in approximately the amounts indicated:

	Per cent
Iron (Fe)	5 to 10
Copper (Cu)	0.5 to 1.0
Nickel (Ni)	0.1 to 0.5
Manganese (Mn)	0.5 or less

Although this rock contains appreciable chalcopyrite, no green copper stain was seen on the rock surface.

Graphite

Graphite occurs disseminated in some of the gneisses of the area mapped, and in certain sheared or crushed zones. Three occurrences toward the end of Nachvak Fiord are shown on the accompanying geological map. Coleman (4) states that: "Pieces of amorphous-looking graphite were found in a zone of crushing near a creek coming in on the north side of the fiord 6 miles east of the end". This is probably near the assumed fault shown on the accompanying geological map.

Iron Sulphides

In 1904-05 the Dupont Company of Wilmington, Delaware, explored a pyrite-rich band of the Ramah series at Rowsell Harbour (16). The band, which is correlated with unit 28 of the Ramah Fiord measured section, is of wide extent, and is commonly composed of almost pure sulphides, including pyrite, marcasite, and pyrrhotite (10). Its thickness varies from an inch or less to as much as 3 feet. In places it is finely banded, and appears to be of sedimentary origin; elsewhere, it occurs as thin veinlets of sulphide in the rock.

Magnetite

A shear and replacement zone containing much magnetite was noted on the south shore of Nachvak Fiord. There the garnetiferous gneisses are replaced by magnetite in an irregular zone about 1 foot wide. A chemical analysis of this material by the Mines Branch, Ottawa, gave the following results:

	Per cent
Iron	30.66
Titanium	0.30
Manganese	0.04
Insoluble	52.33

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