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RECONNAISSANCE GEOLOGY OF A PART OF THE PRECAMBRIAN SHIELD, NORTHEASTERN QUEBEC, NORTHERN LABRADOR AND NORTHWEST TERRITORIES

F.C. Taylor

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Preface

Northern Labrador has long been noted for its spectacular scenery. Several peaks in the Torngat Mountains rise more than 1500 m above sea level, and steep mountain slopes drop hundreds of metres directly into the sea. The coast is characterized by numerous bays, inlets and islands. Several large fiords extend 50 km inland and offer excellent geological cross-sections as well as adding to the scenic splendor of the area. The coastal areas have been settled for several centuries and many rock samples had been collected by missionaries and seamen before the first geological work was done in 1885 by Robert Bell of the Geological Survey of Canada. From then until the major study, which is the basis of this report, almost all geological work in the area had been restricted to the coast or to the interior areas underlain by rocks of the Labrador Trough, whose economic importance justified the expense of detailed studies.

One of the Geological Survey's main objectives is determining the mineral resources available to Canada and providing the geoscientific information needed to facilitate the discovery of such resources. A prime requirement to meet this objective is an adequate data base, and this is gained in large part by regional geological mapping.

The 168 000 km^2 area covered by this study is underlain almost totally by rocks of Precambrian age. Such rocks have been the source of much of our mineral wealth, and adequate mapping of this large, virtually unknown area was obviously needed to permit more accurate assessments of mineral potential to be made. The helicopter-supported fieldwork, which occupied three summers—1967, 1969 and 1971—together with subsequent office and laboratory work have resulted in this report and the 17 multicoloured geological maps released early in 1978.

Archean rocks underlie about 20 000 km^2 of the area mapped, mainly along the coast; almost all other rocks are Proterozoic and include strata of diverse ages, origins and lithologies. Most of this report is devoted to describing these rocks in terms of lithology, metamorphic history and structure.

The survey did not uncover any economic mineral deposits although mineral showings, chiefly in the layered Aphebian rocks, were observed. These rocks offer the best hope for future commercial discoveries and should be given priority in prospecting programs. The Archean gneisses, granites and migmatites are much less favourable.

D.J. McLaren
Director General
Geological Survey of Canada

Ottawa, January 1978

Contents

Plates

RECONNAISSANCE GEOLOGY OF A PART OF THE PRECAMBRIAN SHIELD, NORTHEASTERN QUEBEC, NORTHERN LABRADOR AND NORTHWEST TERRITORIES

Abstract

The area occupies 168 000 km² of the northeastern mainland Precambrian Shield. Landforms range from low plains in the southwest to alpine mountains in the northeast, where peaks are over 1500 m above sea level. Except for some mountain tops the entire area was covered by ice during the Pleistocene.

Parts of two structural provinces are present—the Nain, which forms a block up to 95 km wide and 500 km long along the Labrador coast, and the Churchill, which comprises the remainder.

Most of the Nain Province is underlain by Archean migmatite, gneissic granite, granulite, granite, granodiorite, paragneiss and amphibolite, and includes some rocks 3600 Ma old. Small areas of Aphebian strata (the Ramah, Mugford and Snyder groups) lie unconformably on these rocks. In the Makkovik Subprovince rocks consist chiefly of the Aphebian Aillik Group and basic and acidic intrusive rocks.

The Churchill Province not only is underlain mostly by Aphebian migmatite, granitic gneiss, granodiorite and granulite, but also includes Aphebian stratiform rocks of the Kaniapiskau Supergroup, the Lake Harbour Formation, and unassigned metasedimentary and mafic rocks.

Paleohelikian batholiths of adamellite and anorthosite and allied rocks intrude the older rocks of both provinces.

Scattered, small occurrences of rocks, including diabase dykes, range in age from Archean to Triassic.

Metamorphism in the Nain Province is dominantly in the amphibolite facies with local granulite and greenschist. In the Churchill Province, although amphibolite facies is the most common, a progressive increase from greenschist in the southwest to granulite in the northeast is evident.

Structures in the Nain Province are northerly overall with well defined folds and west-dipping thrust faults in the Ramah Group and underlying rocks, whereas in the Churchill Province structures trend northwest to north-northwest with well defined folds and east-dipping thrust faults in the extreme southwest in the Kaniapiskau Supergroup. In the northeast there is a zone of well defined folds, east of which a broad zone of mylonite forms much of the contact with the Nain Province.

There are no known mineral deposits.

Original manuscript submitted: May 19, 1977
Approved for publication: January 26, 1978

Résumé

La zone étudiée occupe 168 000 km² du nord-est du Bouclier précambrien continental. La topographie est caractérisée au sud-ouest par des plaines basses, au nord-est par des montagnes de type alpin dont les sommets s'élèvent à plus de 1500 m au-dessus du niveau de la mer. À l'exception de certains sommets montagneux, toute la région a été recouverte par les glaces pendant le Pléistocène.

Des portions de deux provinces structurales sont représentées, à savoir la province de Nain, qui forme un bloc atteignant 95 km de large et 500 km de long et bordant le littoral du Labrador, et la province de Churchill, qui englobe le reste.

La majeure partie de la province de Nain est recouverte par des migmatites, granites gneissiques, granulites, granites, granodiorites, paragneiss et amphibolites de l'Archéen, et contient par endroits des roches de 3600 Ma. Des strates aphébiennes de faible étendue (les groupes de Ramah, Mugford et Snyder) reposent en discordance sur ces roches. Dans la sous-province de Makkovik, on rencontre surtout le groupe aphébien de Aillik, et des roches intrusives basiques et acides.

Le sous-sol de la province de Churchill est principalement composé de migmatites, gneiss granitiques, granodiorites et granulites de l'Aphébien et comprend aussi les roches aphébiennes stratiformes du supergroupe de Kaniapiskau, la formation de Lake Harbour, ainsi que des roches mafiques et métasédimentaires non désignées.

Des batholites paléohélikiens composés d'adamellite, d'anorthosite et de roches apparentées sont intrusifs dans les roches les plus anciennes des deux provinces.

On rencontre en divers endroits des zones peu étendues de roches dont l'âge se situe entre l'Archéen et le Trias y compris des dykes de diabase.

Dans la province de Nain, le métamorphisme se situe principalement au niveau du faciès des amphibolites avec quelques zones de granulites et de schistes verts. Dans la province de Churchill, bien que le faciès des amphibolites soit le plus commun, on observe un passage progressif du faciès des schistes verts au sud-ouest, à celui des granulites au nord-est.

Les éléments structuraux de la province de Nain ont dans leur ensemble une orientation nord; le groupe de Ramah et les roches sous-jacentes sont caractérisés par des plissements et des chevauchements de pendage ouest bien définis tandis que dans la province de Churchill, les éléments structuraux ont une orientation nord-est à nord–nord-ouest; dans la pointe sud de la province de Churchill, le supergroupe de Kaniapiskau est caractérisé par des plissements bien définis, et des chevauchements de pendage est. Au nord-est, il existe une zone de plissements bien définis, à l'est desquels une vaste zone de mylonite forme la majeure partie du contact avec la province de Nain.

On n'y connaît pas de gîtes minéraux.

Introduction

This report presents the results of a reconnaissance geological survey, called Operation Torngat, of an area of about 168 000 km² in northern Labrador, northeastern Quebec and islands adjacent to Quebec that are part of the Northwest Territories. The fieldwork occupied three complete field seasons of helicopter-assisted mapping, which was undertaken in 1967, 1969 and 1971. Brief visits to suitable campsites and gasoline caches were made in 1964, 1966 and 1968.

Field techniques used follow closely those described by Eade (1959) with modifications in traverse intervals so that in most of the map area a four-mile (6.4 km) interval was used. Two Bell G47 Series helicopters under full-time charter were used in 1967 and 1969 and field transport was provided by a chartered DHC-3 Otter aircraft. In 1971 a single Bell G4A helicopter was used for mapping, and casual charter of an Otter and other aircraft provided necessary services flights.

The geology of the report area is illustrated by 17 maps (1428A to 1444A) at a scale of 1:250 000 (Fig. 1). Due to size limitations the legend, which is common to all maps, is published separately as G.S.C. Map 1462A. Individual copies of all maps and the legend are available from the Publication Distribution Office, Geological Survey of Canada, 601 Booth St., Ottawa, Ontario K1A 0E8; price $1.00 each.

Location, access and habitation

The map area includes all of Quebec and Labrador north of latitude 55°N and east of longitude 58°W except for map sheet 23O in the southwest part (Fig. 1). The centre of the map area lies 320 km north-northeast of Schefferville, Quebec, a mining community well served by rail and regularly scheduled air service. With few exceptions, services and goods are available in Schefferville. Charter air services are available from Laurentian Air Services Limited and Larivière Air Service Limited in Schefferville and from St. Félicien Air Service in Fort Chimo, Quebec, which is 24 km west of the map area at latitude 58°06′W. Fort Chimo has regular air service and is also supplied by summer sealift. There are two airstrips—a military strip at Saglek Fiord, operated and maintained by the United States Air Force in conjunction with a base at the same locality; and a strip at Border Beacon near the southern boundary of the map area at the site of a Ministry of Transport weather station.

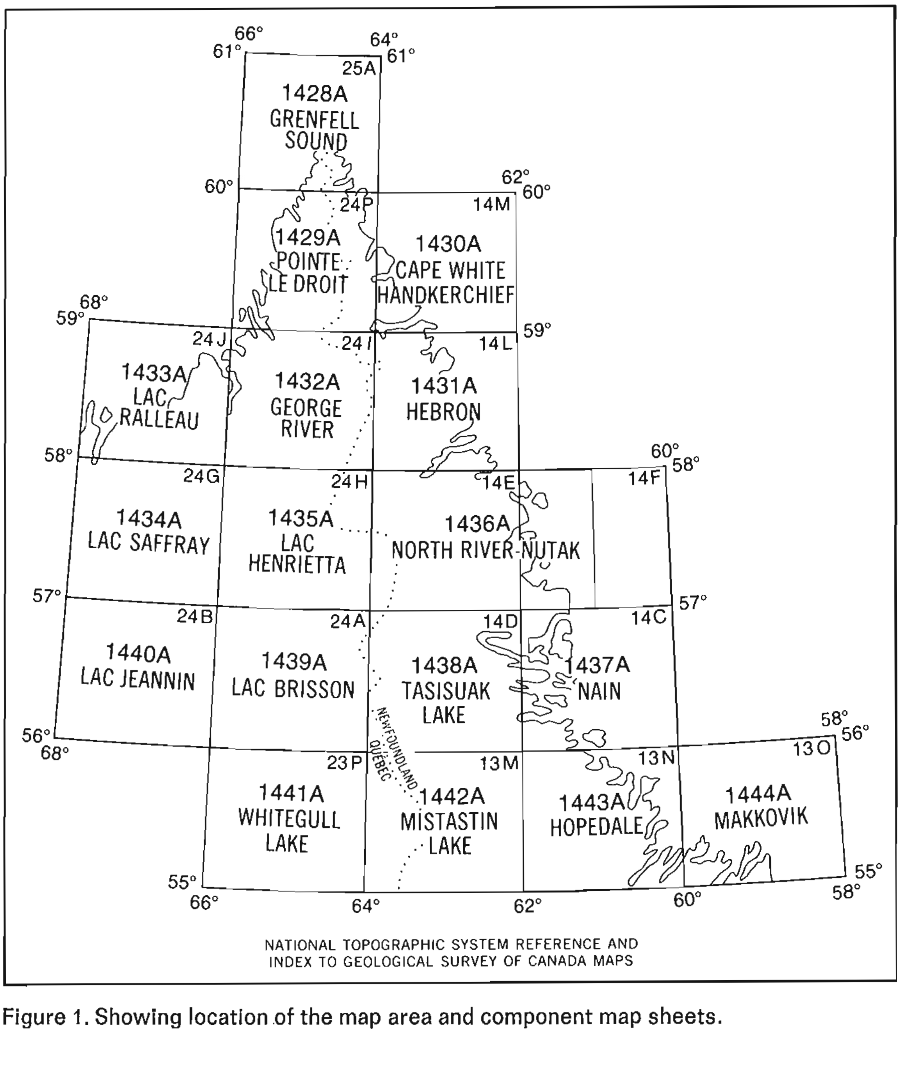

Figure 1. Showing location of the map area and component map sheets.

There are several small settlements, all of which are on the coast. In the northwest two Eskimo settlements—Port-Noveau-Québec (George River) and Port Burwell, N.W.T.—are equipped with fish processing and freezing plants as well as the usual schools and handicraft establishments. At one time, villages and missions were established at Nutak, Hebron and Ramah along the Labrador coast; but these have been abandoned, and in most places the buildings were either removed or destroyed. At present, villages are present at Makkovik, Hopedale, Davis Inlet and Nain, all of which depend on a precarious fishing and hunting economy. These small communities offer a haven to sea voyagers but do not serve as adequate supply bases for larger expeditions. Postal facilities, Newfoundland Government stores and radio communications are available at each. The R.C.M.P. maintain detachments at Nain and Hopedale, and a nursing station is operated by the Grenfell Mission. Harbours freeze in the winter so that the shipping season is limited; however, during the shipping season CN ships visit Nain and other coastal ports roughly every 3 weeks, with voyages commencing at St. John's, Newfoundland.

Operations

Gasoline for Operation Torngat was all supplied in 10-gallon kegs. In 1967, 10 000 gallons were supplied through Schefferville and 6000 gallons through Fort Chimo. The latter was delivered by sea during the 1966 shipping season. A Canso aircraft was used to establish preselected gasoline caches, chiefly at campsites. The gasoline supply for 1969, 16 000 gallons, was all routed through Schefferville and transported to the field as required by chartered Otter aircraft. Sufficient gasoline was left in Schefferville each season to satisfy the requirements of the Otter. Similarly, fuel supplies in 1971 were handled through Schefferville and transferred to field camps under casual charter arrangements. Provisions were purchased in Schefferville on a weekly basis. All camp gear, personnel and provisions were moved by Otter.

The western half of map sheet 23P was mapped while based in Schefferville prior to the spring breakup of Squaw Lake, the seaplane base. The remainder of the area was mapped after breakup from 10 field base camps. As good campsites are scarce, especially in the mountainous regions, the sites used during Operation Torngat are shown on maps 1428A to 1444A. Four camps were established in 1967, five in 1969 and two in 1971. Ice conditions on Chapiteau Lake (map area 13M) prevented the use in 1971 of this 1969 campsite.

Forest cover

Whereas much of the area lies north of the treeline, forest cover is locally extensive, particularly in the southern part of the area. At higher elevations (above 500 m) trees are confined to valley bottoms and other places protected from the elements. The treeline is poorly defined and very sensitive to variations in elevation as well as to latitude.

Black spruce is by far the commonest species, followed by balsam fir, white spruce, rare tamarack, aspen and balsam poplar, and very rare white birch. Small amounts of commercial timber are available in the Hopedale area (Wilton, 1964). Small sawmills cut lumber for local consumption at Port-Nouveau-Québec and Makkovik.

Wildlife

Caribou, the only common large animal species, are confined chiefly to the George River drainage system. In summer these animals migrate to higher elevations, and individuals and small herds are frequently encountered on snowfields during the warm weather. Black bear are seen occasionally and are more common in the treed parts of the area. Fox, wolf, porcupine and hare were sighted infrequently.

The major streams flowing into Ungava Bay—the George, Tunulic and Whale rivers—provide excellent fishing for lake trout, speckled trout and arctic char. The George River is noted as a particularly prolific Atlantic salmon source. Small rivers and lakes in the mountainous parts of the map area contain few fish, and the angler must rely on migration of arctic char for success.

Tourist camps for sport fishing and caribou hunting have been established in many places on the George and Whale rivers.

Drainage

Two distinct and separate drainage patterns are present. One empties into Ungava Bay and the other into the

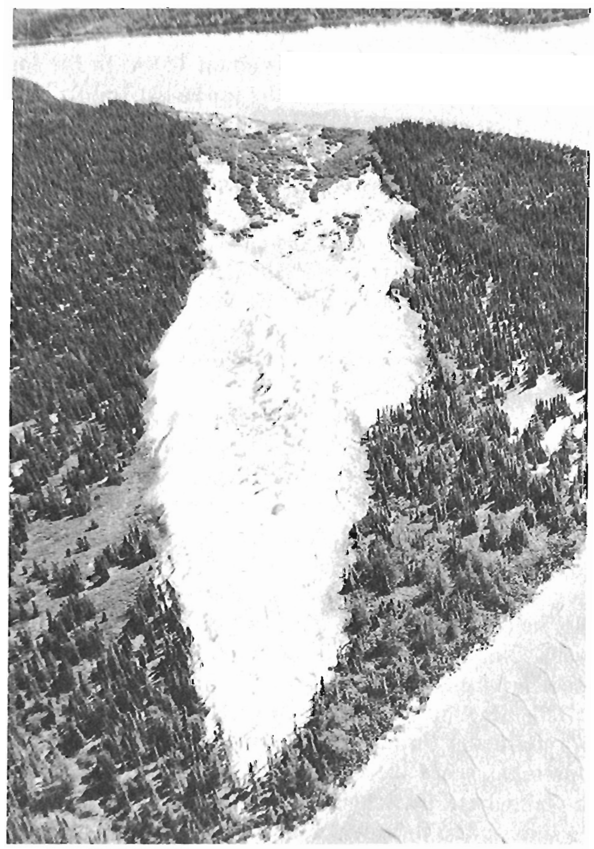

Plate 1. Active sand blow-out along the north side of the Korok River (map area 24I). C.K.B. 172002.

Labrador Sea. The Ungava Bay drainage consists primarily of four large rivers—the Whale, Tunulic, George and Korok—and their tributaries. These and smaller north and westward flowing streams drain about 60 per cent of the map area. The main rivers are navigable by canoe throughout most of their lengths, and falls and rapids occur sparingly. The eastward flowing streams on the other hand are, for the most part, deeply incised, in places occupying distinct canyons, such as the Fraser River, and consist almost entirely of falls and rapids. Travel along these rivers is laborious.

The Ungava Bay shoreline is mostly low, and the high tides, which range up to 18 m, leave large areas of clean outcrop in the intertidal zone at low tide periods. The Labrador Sea drainage commonly terminates in fiords, and the coast in this area is typical of a submerged shoreline with precipitous cliffs in many places.

Climate

The climate over the entire map area is severe with the yearly mean temperature being below freezing. Along the Labrador coast January mean temperatures range from −18°C in the north to −12°C in the south. Temperatures in the interior are considerably lower. Summer temperatures in coastal areas are cool due to the influence of cold offshore waters and range from 7 to 10°C. Inland temperatures in summer are 2 to 5°C warmer with extreme temperatures as much as 30°C. The frost-free period is brief, especially in the north, and an occasional snowfall can occur in any summer month.

Annual total precipitation is about 76 cm in the south tapering off to about 50 cm in the north. At Indian House Lake total precipitation averages 56.3 cm made up of 37.9 cm of rain, chiefly in July, and 184.4 cm of snow (Department of Transport records). Snow cover can last as long as 8 months in the northern parts, and small snow and ice fields persist the year round at higher elevations.

Fog is frequent in summer along the coasts, particularly with onshore winds, but usually does not extend far inland. Along the rugged northeast coast fog is often limited to the fiords and adjoining valleys so that it does not interfere with work at higher elevations.

Whereas wind conditions in the interior of the map area are typical of most of the Canadian Shield, winds in the mountainous coastal region commonly attain gale force as they sweep through the valley and fiord country. Gusts over 160 km/h are not uncommon. Strong winds, accompanied by severe turbulence, make flying hazardous, and those planning to work in the northeastern part must expect to be inconvenienced by wind conditions that not only prevent flying but also make living conditions difficult unless housed in permanent buildings (Pl. 1).

The time of the spring breakup in lakes and rivers varies markedly throughout the area. Some small lakes in the mountains are ice covered all year. Squaw Lake, the float-plane base at Schefferville, normally is free of ice some time in the third week of June but in some years has been unusable until nearly July. By the time this lake is free of ice many lakes at lower elevations to the north are open and larger rivers, such as the George, are clear of ice. Ice on lakes in the northeast takes longer to melt.

For example, the lake on which Campsite 7 was situated (438 m elevation) was about two-thirds covered by candle ice July 15, 1964. In 1969 the same lake was three-quarters covered by hard ice on July 14, and it was July 31 before all ice melted.

The map area lies north of the −1°C mean annual air temperature isotherm and is therefore in the zone of discontinuous permafrost (Brown, 1967). This zone includes areas and layers of unfrozen ground, depending on type of material and degree of shelter as well as temperature. As isotherms in the map area trend north-northeasterly, permafrost is more widespread in the northwestern parts than elsewhere. Data are not available at present as to the occurrence of permafrost in the mountains, but undoubtedly it is more prevalent at higher elevations.

Previous work

Although the coastal areas are relatively accessible and many rock samples had been collected by seamen and missionaries, probably the first geologist to work in the map area was Robert Bell (1885). His observations were confined to brief descriptions of the geology at Nain, Nachvak, Ford Harbour and Port Burwell. Low (1896, 1899) visited localities along the Ungava Bay coast, particularly in the vicinity of the mouths of the George and Whale rivers and reported the presence of granitic rocks and sedimentary gneisses.

The first geological investigations of any significance were made by Daly (1902), during which he recognized the Aillik, Ramah and Mugford groups and named the last two. In 1915 and 1916 Coleman (1921) visited the Labrador coast and made significant and accurate contributions to the geology of the areas he saw, chiefly in the area between Mugford and Komaktorvik or Seven Islands Bay.

Since Coleman's report numerous popular articles, many with excellent photographs mostly dealing with the scenery, have been published. Geological studies of the bedrock have been limited to a few authors, the most prominent being E.P. Wheeler, who spent most of his career working along the Labrador coast in the vicinity of Nain. His contributions extend over 20 years (Wheeler, 1933, 1935, 1942, 1955, 1958, 1960, 1964, 1965, 1968). Another major contributor is Kranck (1939a,b, 1953). Christie (1952, 1953) briefly examined the entire Labrador coast, and Douglas (1953) investigated several localities in detail at widely spaced points. Recently Morse (1961, 1963, 1969) made a detailed study of the intrusive rocks of the Kiglapait Mountains. Almost all of the above studies are of rocks at or near the coast. The main published work dealing with the interior describes the Labrador Trough rocks. There, Dimroth (1964, 1967) has mapped two 1-mile areas in the southwestern part of this map area (23B/4 and 23B/5) as part of an overall stratigraphic study of Labrador Trough. Also in the Labrador Trough, Fahrig (1962, 1964) studied Griffis Lake map area (23P/4) paying particular attention to the ultrabasic rocks.

British Newfoundland Explorations Ltd. made a reconnaissance study of the Labrador portion of the map area during the 1950's.

Recently S.A. Morse has led a series of field parties along the coastal areas (Morse, 1971, 1973, 1974, 1975, 1976) sponsored by the United States of America National Science Foundation. These, chiefly ship-based operations, have examined several localities in detail, primarily between Nain and the Kaumajet Mountains. This continuing work is adding important new detailed petrologic and geochronologic data and should be consulted by those interested in the geology of northern Labrador.

Numerous papers on physiography and surficial geology have been published in the last 15 years, but because the present work is a study of the bedrock no attempt is made to list these.

The interior regions of northeastern Quebec and Labrador were virtually unknown geologically prior to the present investigation. Where any geological work has been done it has been by private companies and individuals and is not published, and although all of Labrador was covered by British Newfoundland Exploration Company in a reconnaissance manner, Quebec was unexplored.

Preliminary maps and reports covering this map area have been published previously (Taylor, 1969, 1970a, 1972b).

Physiography

The map area shows a great diversity of land forms, ranging from low plains to alpine mountains. Hare (1959) and Bostock (1970) divided the map area into several physiographic regions following a study of air photographs and small scale topographic maps. Their divisions are poorly defined on the ground in many places and have not been used here.

In the extreme southwestern parts of the map area, the region underlain by rocks of the Labrador Fold Belt, the topography is typical of a mature folded mountain system consisting of ridges and valleys. Elevations of ridges in this region range from 600 to 720 m above sea level, which is about 200 to 300 m above the valley floors in the southwest corner of map area 24B. The relief is more subdued and elevations lower in the western part of map area 23P, but it is still typically ridge and valley topography. The eastern limit of the ridge and valley topography is poorly defined but lies roughly along the upper reaches of Wheeler River in map area 24P and about the longitude of Lake Tudor in map area 23P.

East of the Labrador Fold Belt the land surface is gently rolling with local bedrock hills with steep, clifflike faces, characteristic of many parts of the Canadian Shield. Much of the surface of this region, for example the western half of map area 24G, displays a north-trending grain, which is the result of glacial action rather than bedrock influence. The character of the bedrock surface is masked by drift, outwash, eskers, ribbed minor moraines and drumlinoid ridges. Elevations near the headwaters of the major rivers are around 400 to 450 m, and from these elevations there is a gradual descent toward sea level at Ungava Bay, where the surface forms a low plain (Pl. 2).

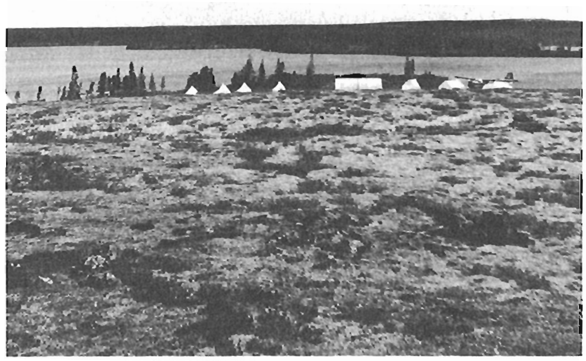

Plate 2. Campsite 1, 10 km southeast of Lac Secondon (map area 24B) shows terrain typical of that in the Wheeler and Whale rivers drainages. F.C.T. 171277.

East of George River, elevations increase quite rapidly northeastward until the highest summits of the Torngat Mountains are reached, whereas to the east and southeast the increase in elevation is less marked, being characterized by a gradual slope to a maximum elevation of around 720 m. The surfaces between the George River valley and the Torngat Mountains in many places present a level skyline, but much of it is incised by rapidly flowing, youthful streams with numerous rapids and waterfalls. Local relief in this region ranges from 250 m to as much as 640 m in the Korok River valley.

Much of the George River valley and the headwaters of the Whale River were the sites of extensive glacial lakes (Prest et al., 1968). In these areas terraced hills are common with relatively smooth and flat terrace surfaces. These features have been the subject of several studies, chiefly by Ives (1960) and Matthew (1961). Smaller ancient lakes were present farther north in drainages now occupied by the Korok, Barnoin and Abloviak rivers.

The Torngat Mountains, which extend roughly from Hebron Fiord in the south to Eclipse River in the north in a belt about 75 km wide, are typical of a postglacial mountainous terrain displaying numerous cirques, cols, arêtes and hanging valleys. A few northerly-facing cirques contain permanent ice, but no active glaciers are known (Pl. 3).

A rock glacier is present on North Aulatsivik Island (map area 24P) on a northwest sloping face about 1.5 km south of False Bay.

The highest peaks in the Torngat Mountains are west of Ramah Bay. Several peaks exceed 1500 m above sea level, but in general these mountains are less than 1350 m. In many places very steep mountain slopes drop hundreds

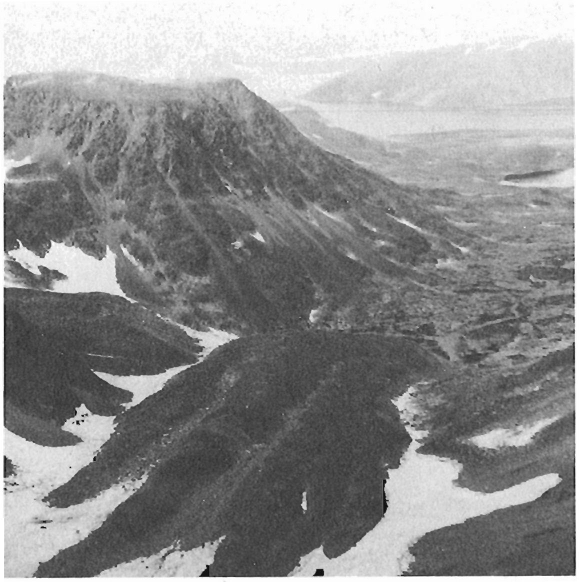

Plate 3. Rock glacier on North Aulatsivik Island east of Scolt Lake; French Bight in right background (map area 24P). F.C.T. 171508.

of metres directly into the sea to fashion the most scenic terrain on the eastern mainland of North America (Pl. 4).

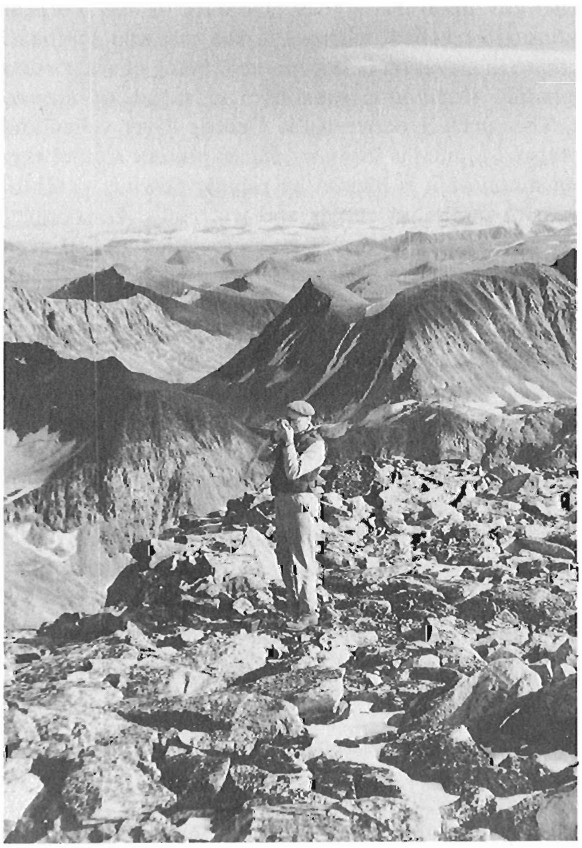

Plate 4. View southward from the summit of the Four Peaks showing typical terrain of the Torngat Mountains (map areas 14M and 24P). C.K.B. 172153.

Plate 5. View northward along North Arm, Saglek Fiord showing U-shaped valley. White weathering garnet-quartz-feldspar gneiss (**Afg**) visible in the foreground (map area 14L). F.C.T. 172437.

Similar alpine topography is also evident in the Kaumajet Mountains, and to a lesser degree in Kiglapait Mountains and the region north of Kingurutik Lake.

The Kaumajet Mountains, although of limited areal extent, have been noted for their majestic peaks from the time of the earliest exploration. The entire range shows sheer cliffs throughout the seaward side, which accentuate the height of these 1200 m mountains. The Kiglapait and other mountains on the mainland, with local relief ranging from 600 to 960 m, have summits in the order of 900 m.

The mountainous coastal areas are intersected by several well developed fiords, the largest of which, Hebron and Saglek fiords, extend inland for about 50 km. These fiords provide excellent cross-sections of the geology and add to the scenic splendor of the region (Pl. 5).

North from the Torngat Mountains the land surface slopes gently northward to sea level at the northern tip of the map area.

Southward from the Kiglapait Mountains the land surface is characterized by rocky, rounded hills, with local relief ranging from less than 100 to 600 m. Much of this area is underlain by intrusive rocks; and in those areas bare, massive, steep-sided outcrops separated from one another by low, glacial debris-filled valleys are typical.

Summit elevations decrease gradually southward along the coast, and similarly a gentle slope exists from west of Harp Lake, where a maximum of 763 m is reached, eastward to the coast.

Several conspicuous, east trending, linear canyons, their floors commonly over 300 m below the general land surface, are present west and southwest of Nain. The largest, occupied by Fraser River and Tasisuak Lake, is over 450 m deep with precipitous walls throughout most of its 98 km length. These canyons are probably the site of relatively recent faults. Harp Lake (map area 13N), a similar northeast-striking chasm, is probably also structurally controlled (Pl. 6).

The entire map area, with the possible exception of the highest mountains, was covered by glacial ice during the Pleistocene. Evidence of this ice is present in many places throughout the region in the form of glacial striae, grooves, and stoss and lee slope hills, the latter particularly common south of Ungava Bay. Retreat of the ice and its melting has left extensive deposits of glacial debris, particularly in the lowland areas, in the form of drumlinoid ridges, eskers, outwash plains and ribbed minor moraines.

Raised beaches are present in many places in the coastal region, marking the site of postglacial sea rises.

A summary of the Pleistocene geology is given in Prest (1970) and Prest et al. (1968) (Pl. 7).

Acknowledgments

The successful completion of this project was only due to the enthusiasm and devotion to the task undertaken by those engaged in it. Officers of the Geological Survey who participated are: C.K. Bell, E.W. Reinhardt and R. Skinner in 1967; E.W. Reinhardt, E. Froese and W.C. Morgan in 1969; and A.J. Baer in 1971. At the risk of offending others, I wish to single out Wade Reinhardt for his selfless and untiring dedication during the 2 years he participated in Operation Torngat. The co-operation of the aircrews of Universal Helicopters Limited (1967), Skyrotors Limited (1969) and Viking Helicopters Limited (1971), without whom success was impossible, is gratefully appreciated. These people are: D. Kirk, G. Simmons, R. Tessier, pilots, and E. Mundy, engineer (1967); J. Crawford and T. Smith, pilots, and M. McGuire, engineer (1969); and R. Watson, pilot-engineer (1971). Laurentian Air Services Limited provided fixed-wing aircraft and the co-operation of the company in maintaining radio communications and aiding with supplies was essential to its success. The service rendered by this company's staff, particularly J. Irvin, chief pilot and E. Bennett, base manager at Schefferville, is recognized.

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General geology

Although the consolidated rocks in the map area range in age from Archean to Mesozoic, they are primarily Precambrian. The Archean forms about 20 000 km² along the Labrador coast; almost all of the remainder of the map area is Proterozoic. All eras and suberas of the Proterozoic are represented, with the largest part being Aphebian. There are also large areas of Paleohelikian plutonic rocks.

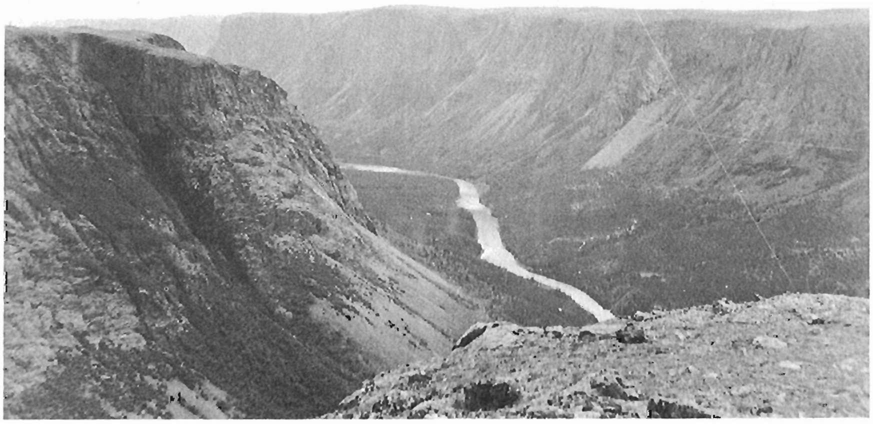


Plate 6. View of steep-walled and deeply incised Fraser River, upstream from Tasisuak Lake. Valley is probably the site of a major fault (map area 14D). W.C.M. 172530.

Neohelikian rocks are chiefly dykes, but there are also rare sedimentary and volcanic rocks. The Hadrynian, too, is mainly represented by dykes, along with rare sedimentary rocks. The Paleozoic is represented by a few diabase and lamprophyre dykes and limestone boulders. Mesozoic rocks are confined to a small area at Mistastin Lake and Ford's Bight.

The Precambrian rocks embrace parts of the Churchill and Nain Structural provinces as defined by Taylor (1971, 1972a). The rocks in the Churchill Structural Province are almost entirely Proterozoic, whereas those in the Nain include both Archean and Proterozoic rocks.

Archean rocks consist primarily of migmatites and granitic gneisses with varying amounts of metasedimentary rocks occuring chiefly as inclusions. In a few localities metasedimentary rocks occur in sufficiently large areas to be separated from the migmatitic terrane, but in general these areas are too small to be distinguished at the present scale of mapping. Amphibolite forms a significant portion of this terrane and is probably of diverse origin. Some amphibolites are known to be old dykes, whereas others may be of sedimentary or volcanic origin. A few ultrabasic rocks occur sporadically. One of the most characteristic features of the Archean rocks is the abundance of diabase dykes. These are particularly common in the northern and southern parts. The Archean rocks are predominant in the amphibolite metamorphic facies, but some have been downgraded from the granulite facies to greenschist.

The Proterozoic includes a great number of rocks of different ages, origins and lithologies. Although the mutual relationships of these rocks are unclear, a tentative chronological sequence can be established. The oldest are Aphebian and include several different rock stratigraphic units, large gneissic terranes and granitic intrusive rocks. The stratified rocks are dominated in the west by units of the Labrador Trough, including elements of the Kaniapiskau Supergroup and the Montagnais Group. The Lake Harbour Formation, consisting chiefly of metamorphosed sedimentary rocks, outcrops in the north-central part of the map area. Numerous small areas of paragneisses, amphibolites and schists between these two units are probably of the same age. Along the Labrador coast Aphebian layered rocks are represented by the Ramah, Mugford and Snyder groups in the north-central part and by the Aillik Group in the south, the latter unit being the main rock unit in the Makkovik Subprovince.

Unconformable relationships with Archean rocks are well established for the Kaniapiskau Supergroup, and the Ramah and Mugford groups. The other units are also considered to be Aphebian because of similarities with known Aphebian rocks, age data and less definitive field relationships.

Large areas of granitic gneissic rocks, and migmatite, occur east of the Labrador Trough and south of Ungava Bay. These rocks, the product of the Hudsonian Orogeny, are intruded by large plutons of granodiorite and allied rocks. Extensive areas of well layered granulite facies rocks lie east of the silicic gneisses and migmatites forming a broad, irregular band extending almost the entire length of the map area southward from Cape Chidley.

In the Makkovik Subprovince post-Aillik Group intrusive rocks consisting of gabbro, syenite and granite, emplaced in that order are widely distributed.

During the Paleohelikian, large plutons of anorthosite and adamellite were emplaced into both Archean and Aphebian rocks in the southeastern third of the map area. These posttectonic, high level intrusions probably reached the surface in some areas.

Both Neohelikian and Hadrynian times saw the deposition of continental-type sediments, the former represented by elements of the Seal Group and the latter the Siamarnekh Formation. These two units now occupy small areas in the south and east-central parts of the map area.

A few large boulders of Lower Paleozoic limestone occur along the Labrador coast and in the vicinity of Port

Plate 7. Polished roche mountonnee with chattermarks on adamellite (Pam) 19 km southwest of Sango Bay (map area 13N). A.J.B. 172574.

Plate 8. Highly contorted Archean migmatite (Amg) 3 km south-southwest of Burnt Island, Ugjoktok Bay (map area 13N). F.C.T. 172248.

Plate 9. Archean migmatite (Amg) 3 km south-southwest of Burnt Island, Ugjoktok Bay (map area 13N). F.C.T. 172247.

Burwell. Those in the north are probably derived from submarine rocks to the north or west, whereas those along the east coast may have been derived from offshore Paleozoic strata.

A tiny outcrop of Mesozoic breccia occurs on the Labrador coast near Makkovik, lying unconformably on rocks of the Aillik Group. Breccias and andesite, products of meteoritic impact of probable Triassic age, outcrop at Mistastin Lake.

Diabase and lamprophyre dykes, ranging in age from Archean to Paleozoic, occur throughout the region in variable degrees of abundance.

Archean (A)[1]

Archean rocks comprise the largest part of the Nain Structural Province, forming a strip up to 95 km wide and 500 km long, that extends from Trout Trap Fiord in the north to the southern boundary of the map area. The central part of this strip is the site of extensive intrusions of younger anorthositic and adamellitic rocks; and there, only small areas of Archean rocks, probably roof pendants, are present. Seaward, Archean rocks probably continue about 40 km from the coast, as limited seismic data at latitude 56°39′N suggests layered rocks occur eastward from there (Grant, 1966).

Included with these rocks are those called Hopedale Gneiss by Kranck (1939a, 1953) in the region of Hopedale village. The same name has subsequently been used by Stevenson (1970), Gandhi et al. (1969) and more recently called Hopedale Gneiss Complex by Sutton et al. (1971).

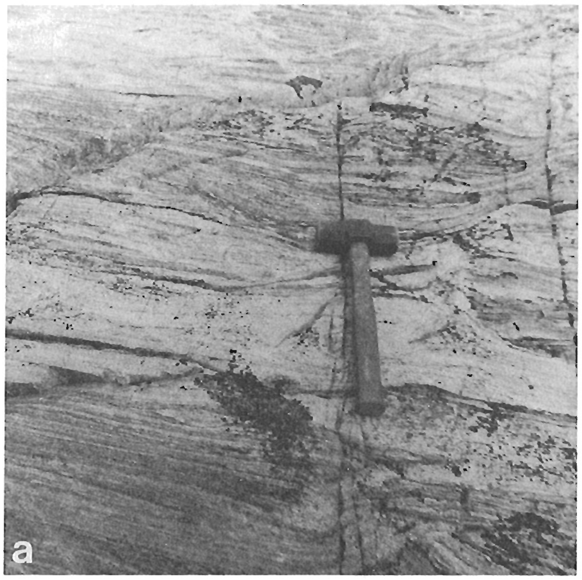
[1]Typesetting difficulties preclude the use in this text of the specialized symbols found on maps 1428A to 1444A. However, the use of conventional type to approximate these symbols does not seem to introduce any unacceptable problems if the map legend 1462A is used when referring from text to map.

The Archean terrane is composed of various gneissic rocks, predominantly migmatites and quartzofeldspathic rocks. Amphibolite is locally abundant, and small ultrabasic plutons occur sporadically. Metasedimentary rocks, including rare limy rocks, are present throughout much of the Archean terrane, and commonly form a significant part of the migmatite. Pegmatite dykes are numerous in the migmatite areas. A characteristic feature of much of the Archean is an abundance of diabase dykes.

Migmatite (Amg)

By far the largest area of Archean rocks consists of migmatite, which consist primarily of angular to lens-shaped fragments of metasedimentary rocks and amphibolite intruded by granitic veins, sills and dykes. The scale involved in the migmatization is highly variable, and the paleosome portion ranges from 2.5 cm size to several tens of metres. Similarly the neosome portion may consist of veinlets of less than 1 cm to several metres thick. In many places the terms net-veined, layered, lit-par-lit, ptygmatic, agmatitic and schlieren can be used in describing the myriad shapes characteristic of these rocks. Boudins, primarily amphibolite, are locally abundant.

The paleosome consists mainly of metasedimentary rocks of dominantly quartzofeldspathic composition. However, in many places amphibolite or other mafic rocks comprise a significant proportion of the paleosome. Less commonly, the paleosome consists of light coloured granitic rock. In part, well defined foliation is present, whereas elsewhere massive rock is characteristic. Grain size is variable, but medium grained rocks are most typical. Mineralogically the paleosome is dominated by feldspar, quartz, hornblende and biotite; other minerals such as garnet, sillimanite and cordierite(?) are present only here and there. Some paleosome fragments, particularly from the Saglek Bay area and



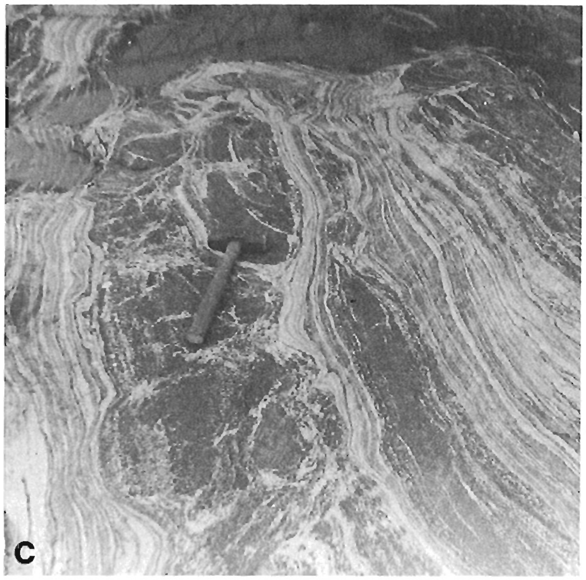
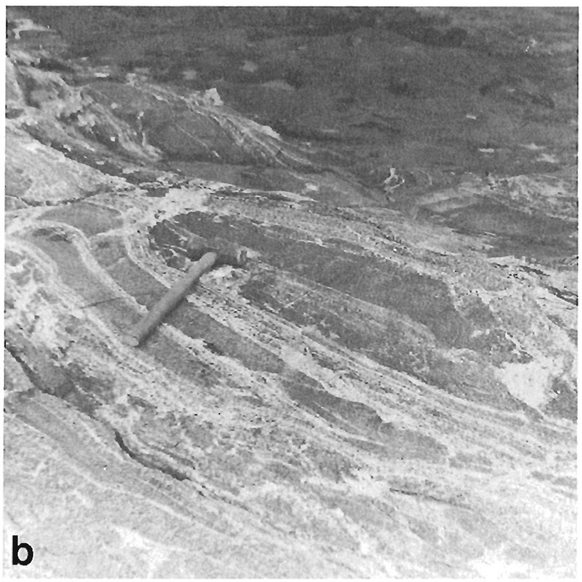


Plate 10a–c. Archean migmatite (Amg) on the east coast of island east of Windy Tickle (map area 13N). F.C.T. 172224, 172225, 172228.



north, show retrogressive characteristics having at one time been in the granulite metamorphic facies (Pls. 8 to 13).

The neosome portion is characteristically medium to coarse grained, equigranular, light grey, white or pale pink and massive. Gneissic or schlieren zones are present in some larger neosome segments. In general, mafic minerals are scarce, but where present consist of biotite and/or muscovite and very rarely, hornblende.

Pegmatite consistently appears as the youngest part of the neosome phase of the migmatite, commonly cutting across both paleosome and earlier neosome parts of the rock.

Although a wide variation in foliation orientation exists in the migmatite on a small scale, on a large scale a distinct northerly regional trend is apparent.

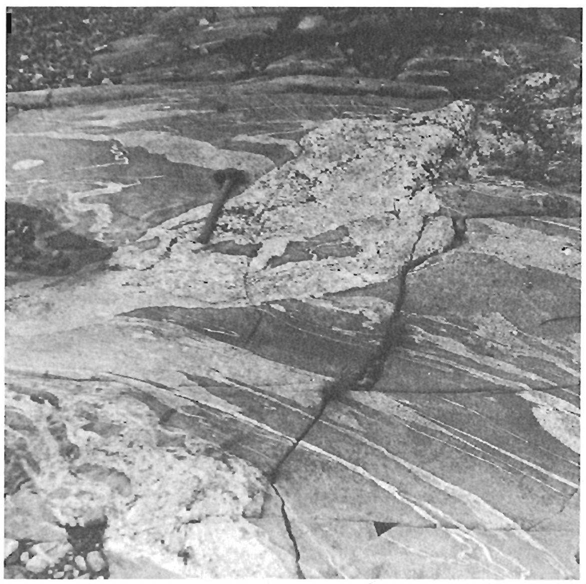


Plate 11. Archean migmatite (Amg) with late pegmatite dykelet, 8.5 km east-southeast of Campsite 10 (map area 13N). F.C.T. 172350.

Gneissic granite (Agg)

Gneissic granite and related granitic rocks occur throughout the Archean terrane and where they form the major portion of the rock are shown under the symbol Agg. These rocks grade into those mapped as migmatite (Amg) and granulite (Agl). Gradation from one unit to the other ranges from a few metres to a broad zone several tens of metres wide, over which change from one unit to the other is barely perceptible. Gneissic granite is somewhat more abundant in the northern part of the Archean than elsewhere but is also

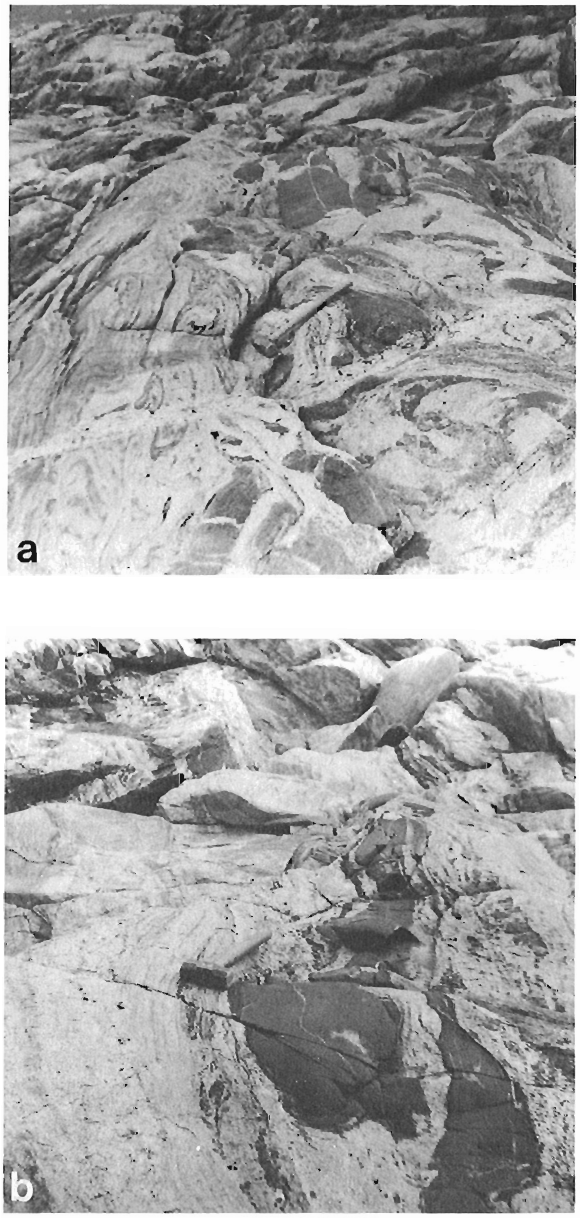


Plate 12a,b. Archean migmatite (Amg) on north end of Cut Throat Island (map area 14F). F.C.T. 172383, 172385.

locally well represented in the interior parts near the south boundary of the map area.

These rocks are chiefly medium grained, well foliated, grey to pink, layered, quartzofeldspathic rocks, commonly containing either biotite or hornblende, and in some places both ferromagnesian minerals. Layering is marked primarily by thin horizons of ferromagnesian minerals and less commonly by a segregation of quartz and feldspar.

In both the southern and northern parts of the map area, chlorite is present in many outcrops as an alteration product of the ferromagnesian minerals, imparting a greenish colour to some rocks. This alteration is locally complete. Epidote is also erratically distributed in the southern part of the map area but is rarer than chlorite.

Bluish quartz is characteristic of some rocks in the northern parts of the map area. Feldspars consist of perthitic potash feldspar, commonly microcline and antiperthitic plagioclase, and compositionally both granite and granodiorite are represented. Amphibolite bands, layers and fragments are abundant.

Granulite (Agl)

Archean granulites are confined to the northern part of the Nain Province. They are poorly defined areally and therefore are not separated from other rock types. Granulites grade into both migmatite (Amg) and gneissic granite (Agg). Typically these rocks are light greyish-green, moderately foliated, medium grained, quartzofeldspathic gneisses, characterized by bluish quartz and a medium grey-green weathered surface with dark grey-green spots. Mineralogically they are characterized by altered hypersthene, but some granulites in map area 14E north of Okak Bay are unaltered. Typically, hypersthene is altered to biotite, chlorite, magnetite and antigorite. A few rocks contain a clinopyroxene, and almost all have a reddish-brown biotite and light olive to greenish-brown hornblende. Plagioclase, approximately An_{30}, is commonly antiperthitic. Besides quartz, the following minerals occur in small quantities: garnet, microline, apatite, magnetite, zircon, calcite and epidote. In brief, most of the Archean granulites show evidence of retrogression, which makes most of them readily distinguishable in the field from those considered to be Proterozoic (Agl).

Granite, granodiorite, syenite (Agr, Agd, Asy)

Only rarely are large areas of massive granitic rock present in the Archean. A few of these, sufficiently large enough to show at the present map scale, are present at White Bear

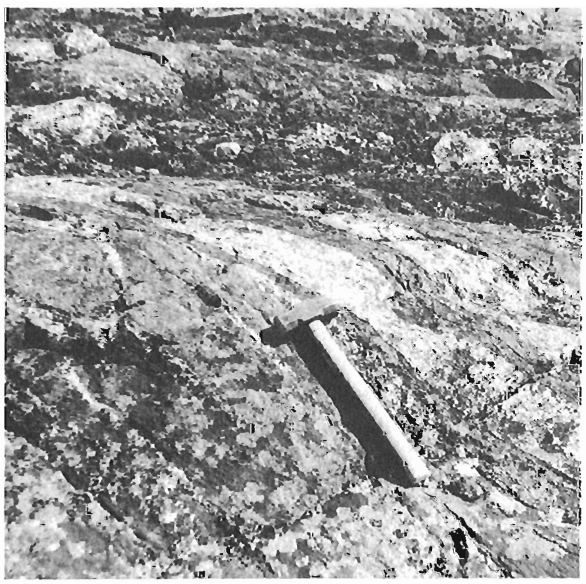


Plate 13. Banded Archean migmatite (Amg) with alternating amphibolite and granite bands; 10 km southwest of Mugford Bay (map area 14E). F.C.T. 172450.

and Kikiktaksoak islands. Small localities of massive rock are scattered throughout much of the migmatite and granitic gneiss terrane (Amg, Agg) forming crosscutting veins, dykes and sheets up to several metres thick. These consist commonly of a coarse grained, white to light pink biotite granite and pegmatite. Contacts of these small intrusions are abrupt and rarely show any foliation or other indications of deformation. In many places the contacts with other rock types are either gradational or obscured by drift or water. Morgan (1975) was able to outline an area of orthogneiss surrounding Naksaluk Cove on the south side of Nachvak Fiord, which consists of a megacrystic quartz monzonite to granodiorite with local quartz diorite and contains amphibolite and thin bands of mafic gneiss.

The rock on White Bear and Opingiviksuak islands is a homogeneous, mottled pink, medium to coarse grained, well jointed, buff weathering, biotite-hornblende granite. On White Bear Island minor amounts of fine grained granite form rounded masses within the rock mass and grade into the coarser rock. On Opingiviksuak Island traces of fluorite, pyrite and magnetite are present, and Christie (1952) reported molybdenite in an aplite dyke on the south shore. Farther south on Kikiktaksoak Island a similar biotite granite is present. Although similar to the two aforementioned localities, this rock differs in that chlorite occurs also along with some gneissic inclusions. These granite areas may be much younger than the migmatite terrane (Amg), and it is possible that they are part of the adamellite suite (Pam).

Much farther south on Kasungatak Island and the island to the northwest (map area 13N) a light grey, fine grained, eguigranular, biotite granodiorite outcrops. This rock intrudes the gneisses and contains abundant inclusions that impart a marked streakiness. As this rock is megascopically dissimilar to nearby exposures of the adamellite suite, it is considered to be Archean.

Barton (1974) dated, by Rb-Sr isochron methods, a medium grained leucocratic granite that cuts migmatite and other rocks at Okak at 2386±30 Ma (initial ratio 0.7154±0.0010). This intrusion is included in the Archean in this report as it may be a very late Kenoran intrusive.

North-northeast of Harp Lake (map area 13N) a light red, medium to coarse grained, massive to weakly foliated syenite forms a small stock of unknown dimensions. It is characterized by approximately 20 per cent dark green pyroxene and accessory sphene, which forms anhedral, maroon grains. Feldspars are almost entirely string and rod type perthites with very small amounts of albitic plagioclase. Less than 2 per cent quartz, apatite, calcite and zircon are also present. In thin section the pyroxene can be seen to be a light coloured augite.

This outcrop is intruded by a diabase dyke with a K-Ar age of 1748±50 Ma. Hence it is possible that this syenite may be early Aphebian. At present its age is uncertain, and it is included in the Archean in view of its location well within the Archean terrane.

Ultrabasic rocks (Aub, Ase, Apx)

Ultrabasic rocks occur sporadically in the Archean terrane, being most abundant in the Hopedale area (map area 13N) and in the area west and south of the Mugford Group (map area 14E and 14F). Most ultrabasic occurrences are small, chiefly less than 50 m thick, with a few in the order of 200 m thick and 300 m long. Some are as small as 0.1 by 2 m. Most are lens-shaped, but a few are almost equidimensional in plan. An exception is a sill in amphibolite (Aab) south of Hunt River, that ranges from 15 to 40 m thick and is 6 km long.

Typically these rocks display a conspicuous yellowish-brown to reddish-brown weathered surface not found in other rock units. However, the long sill mentioned above is white weathering serpentinite. Almost all ultrabasic rocks show a distinct foliation parallel to their greatest dimension, and most show a crude lithologic layering, particularly near the border of the pluton. The foliation is, in general, parallel to that in the host rocks, which are almost invariably migmatites (Amg). The layering, which is parallel to the contact, consists chiefly of alternation of clinopyroxene-rich and clinopyroxene-poor horizons and less commonly, amphibolite. Ordinarily the clinopyroxene is coarse grained so that the weathered surface in the clinopyroxene-rich horizons is knobby. These horizons range from 1 cm to several centimetres thick. Away from the contact zone, which is rarely more than 5 m thick, the ultrabasic rocks are massive to weakly foliated but devoid of layering. They are predominantly serpentinized peridotite with lesser amounts of pyroxenite, amphibolite and dunite.

The white weathering serpentinite (Ase) sill, south of Hunt River, is a very fine grained, greenish-black, weakly foliated rock consisting of serpentine with small amounts of calcite, colourless mica (probably muscovite), magnetite and rare pyrite. The serpentine matrix is mostly very fine grained, whereas the mica grains are up to 1 mm long.

Pyroxenites (Apx) are light to medium grey-green crystalline rocks that are variously massive to foliated. They consist chiefly of clinopyroxene, with variable amounts of calcite, phlogopite, magnetite, and less commonly, plagioclase, hornblende, talc and pyrite. Some plutons, for example, the pyroxenite 15 km southwest of the head of Pistolet Bay (map area 14E) contain both clino- and orthopyroxene. This particular ultrabasic rock, which is entirely pyroxenite, is well banded and foliated; the banding is accentuated by the presence of the second pyroxene. Small amounts of carbonate occur in the lowest band of this body, and along a shear at the west margin both carbonate and serpentine are present.

These Archean ultrabasic rocks are presumed to have been emplaced either prior to or during the major deformation period because of the concordant foliation and layering they show with their hosts. A few are cut by small, white granite dykes similar to many comprising the latest stages of migmatization. A northwest-striking diabase cuts the white weathering serpentinite.

Recently Collerson et al. (1976) reported textural and chemical results of a study of the ultramafic rocks near Hunt River and at Saglek.

Paragneiss (Apg)

Although chiefly present as paleosome elements in the migmatite terrane, metasedimentary rocks locally form mappable units. For instance, on the east side of Iglusuaktalialuk Island (map area 14F) well foliated, but contorted, light grey, equigranular, medium grained, garnet-biotite-quartz-feldspar paragneiss is interlayered with granitic gneiss also possibly of sedimentary origin. Sillimanite is common in some layers of the paragneiss. The same outcrop area includes a few amphibolite pods or lenses and a tiny serpentinized peridotite body as well.

A similar rock occurs south of Winnie Bay in Hebron Fiord, where sillimanite is concentrated in slightly rusty layers. Thin sections show the garnets to be extensively altered to chlorite, attesting to retrograde metamorphism in this area.

On the mainland, 8 km southwest of Winsor Harbour Island, a light yellowish-green, well banded, fine grained, weakly feldspathic, quartzite forms an extensive zone in the migmatite terrane. The yellowish-green colour is due to the presence of considerable epidote, which is possibly related to mylonitization that has affected part of this outcrop. Associated with the quartzite are bands of schistose garnetiferous amphibolite, which make up about 30 per cent of the total. On a small island another 11 km to the southwest a similar, very well banded, highly mylonitized, quartzose rock, possibly a quartzite, occurs with about 10 per cent amphibolite.

Graphite occurs in some of the paragneiss. For example, 11 km southwest of Hunt Lake a variegated grey, well banded, graphite-bearing, garnet-biotite-quartz-feldspar paragneiss forms a thin horizon in the migmatite. In part, this rock is rusty weathering and graphite content is higher in rusty horizons. About 10 per cent of the outcrop consists of pegmatite that is parallel to the foliation in the paragneiss. Graphite also occurs in a well foliated, highly rusted light grey, biotite paragneiss on the island west of Kasungatak Island (map area 13N) where it forms lit-par-lit structure with a white, medium grained, garnet-bearing granodiorite.

Amphibolite(Aab)

Amphibolite is the second most abundant mafic rock in the migmatite (Amg) but only at one place does it form a sizable mappable unit. This is to the south of Hunt River (map area 13N) where, along with small amounts of intercalated sedimentary rocks, amphibolite forms a unit up to 2.3 km wide in three roughly lens-shaped outcrop areas, each with a slightly different lithology.

The northern part of the outcrop area is dominated by the presence of a white weathering serpentinite (Ase) sill that is traceable for 5 km. This ultrabasic rock is not present in southern and central outcrop areas. A partial traverse, across strike, from the east edge of the outcrop area shows the following sequence of rocks. The easternmost 120 m of the sequence consists of primarily dark greenish-grey, fine grained, moderately well foliated amphibolite. Near the eastern edge this amphibolite is schistose and has a knotted appearance due to the presence of mica clusters parallel to the schistosity. The latter rock is greenish black and medium grained. Bordering the amphibolite to the west is a 15 m sill of white weathering serpentinite. On the eastern edge of the serpentinite an intermittent band up to 1.5 m thick is present, whereas on the west a 1 m thick band of a garnet-rich paragneiss and a 30 cm thick amphibolite band occupy the first 3 m west of the serpentinite. In the next 200 m west of the serpentinite the rocks are chiefly well foliated, medium grained, clinopyroxene-quartz-feldspar paragneiss and/or with local hornblende. Mineral percentages show a wide variation in the latter, which are probably all of sedimentary origin as they are very well layered.

A partial section from east to west across part of the central outcrop area east of Hunt River shows quite a different lithology and rock sequence. There, the easternmost 60 m consist of a very fine grained, dark greenish-grey, well laminated amphibolite locally containing very thin carbonate laminae. A 1 m thick bed of light brown weathering, fine grained dolomite (Adm) is present at the 60 m mark. This is followed by 13 m of garnet amphibolite, which in turn is overlain by another 1 m of dolomite. Another 7 m of amphibolite is succeeded by a 1.5 m thick dolomite bed. West of the third dolomite band the rock is chiefly biotite-hornblende-quartz-feldspar paragneiss. A 0.3 m band of amphibolite occurs 6 m above the dolomite. In some places garnet occurs in this paragneiss. At the western contact the latter rock grades into a granitic gneiss forming part of the migmatite (Amg).

The southern part of the outcrop area consists mostly of dark grey-green, fine to medium grained, poorly to well foliated and/or banded amphibolite. Foliation commonly parallels the banding. In part, however, a dark grey, equigranular, medium grained, garnet-biotite-hornblende-quartz-feldspar paragneiss is present in which there are bands of amphibolite a few metres thick. Locally sillimanite is present in this paragneiss and shows as rusty bands on the weathered surface. Near the southwest end of the outcrop area an irregularly oriented, white granite dyke cuts amphibolite. In the same area many rusty horizons are present, which consist of amphibolite with disseminated pyrrhotite, pyrite, and more rarely molybdenite and chalcopyrite.

Although no volcanic structures were located, some of the amphibolite is probably of volcanic origin, whereas other parts may be of sedimentary origin, particularly those amphibolites that are well banded and contain significant amounts of quartz and biotite. The amphibolite in the southern and central outcrop areas is probably chiefly of volcanic origin.

The contacts with the migmatites are known in several places to be faults. In other places, however, the contacts are drift covered, and in the central outcrop area there is a suggestion of a gradational contact on the western side.

Calc-silicate rocks, limestone (Acs)

Rare and small amounts of crystalline limestone and calc-silicate rocks occur in the migmatite terrane. These are predominantly medium grained, light grey to grey-green rocks that show moderately well developed banding that is presumed to be relict bedding. Most of these occurrences are too small to map on the present scale, and hence only a few localities are shown.

On Okak Islands, northwest of Woody Bay (map area 14F) a light grey, medium grained calc-silicate is interbedded with granite gneiss and paragneiss. This rock is composed of diopside, quartz, garnet and small amounts of fine calcite and is typical of most calc-silicates.

A typical occurrence of crystalline limestone is present at South Tikigakjuk Point (map area 13N) where interlayered metasedimentary and metavolcanic rocks about 200 m wide border a sheared granodiorite. This sequence includes biotite-garnet paragneiss, a garnetiferous, muscovite feldspathic quartzite in bands 5 to 15 cm thick, and 1 to 2 cm thick layers of biotite-bearing, light green, fine grained crystalline limestone, the latter commonly interbanded with limy biotite paragneiss across a few metres. The volcanic rocks, which make up about half the sequence, consist of fine grained, dark green, massive amphibolite.

A somewhat similar occurrence is present on the mainland southwest of Ivjogiktok Island (map area 14E) where serpentinized olivine crystalline limestone forms 2 m bands in migmatite. This pale brown, medium grained rock is characterized by abundant diopside, which makes a knotted surface and small, yellowish serpentinized olivine grains.

A small area of calc-silicate on a small island west of Graveyard Island (map area 14F), although shown as Archean, is possibly part of the Snyder Group.

Quartzite (Aqz)

Quartzite is rare in the Archean terrane. None was observed in the northern part of the map area and only a few sporadic occurrences, chiefly in the south, are known. None is known to be extensive either along or across strike. At Tikigakjuk Point (map area 13N) a fine grained, yellowish-grey quartzite forms 5 to 15 cm thick bands in a mixed sequence of layered rocks. This rock, which is feldspathic in part, consists of closely packed subangular to rounded, quartz and feldspar grains with very little matrix. It contains less than 3 per cent of muscovite, epidote, extensively chloritized garnet, zircon and chlorite. On the east side of the island bordering Windy Tickle a light olive-grey, well banded, nearly pure, fine to medium grained quartzite forms a very small proportion of the paleosome part of the migmatite (Amg).

The largest exposure of quartzite occurs 8 km southwest of Winsor Harbour Island (map area 13O) where quartzite is interbanded with amphibolite, the latter forming about 30 per cent. The outcrop is slightly mylonitized. This quartzite is very well banded and characterized by the presence of up to 10 per cent epidote. A greyish-yellow, fine grained, equigranular rock is most typical, but some samples that contain feldspar are pinkish grey and medium grained. Approximately 5 per cent of actinolite is present in the sample examined microscopically. Zircon and apatite are present in trace amounts (Pl. 14).

The relationship of this quartzite-amphibolite occurrence to the surrounding migmatite is not clear. In some grosser aspects it is similar to parts of the Aillik Group (AA) and may be an outlier of it. Extensive lichen cover inland from the shore effectively hides its contact with the migmatite (Amg). It is assumed to be Archean.

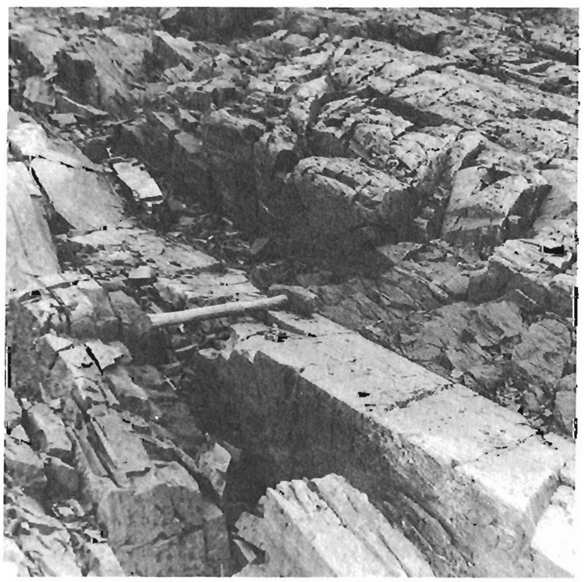


Plate 14. Interlayered Archean quartzite and amphibolite (Aqz, Aab), in part mylonitized parallel to the layering, on island at the mouth of Kanairiktok Bay (map area 13N). F.C.T. 172245.

Argillite (Aal), *siltstone* (Asn), *schist* (Asc), *breccia* (Abc)

North of Ugjoktok Bay, metasedimentary rocks consist primarily of poorly laminated, very fine to fine grained, light to yellowish-grey, limy argillite (Aal) with lesser amounts of dark grey to dark greenish-grey siltstone (Asn). Associated with these are amphibolite (Aab) and bands up to 15 cm thick of rusty weathering argillite containing disseminated pyrite. Much of the argillite is sheared parallel or nearly so with the bedding, so that the latter in places is not discernible. In the southwest part of this unit, local intense shearing has produced narrow zones of micaceous schist (Asc). Laminae range from 1 to 5 mm where present, but in many places the argillite is brecciated (Abc). Quartz pods up to 1 cm thick, and narrower veinlets, are common throughout much of the outcrop where shearing is extensive. In a few places a weak shearing at 70° to the bedding is present also. Where shearing is less intense, bedding laminae range from 1 to 5 mm. Although only a small portion of this area was examined, much of the rock is brecciated (Abc), particularly where shearing is absent or weak. Breccia fragments, chiefly in the range from 1 to 5 cm, are cemented by very thin calcite and calcite plus chlorite veinlets. The fragments themselves show almost no displacement.

Thin sections show the argillite to consist of angular to subrounded quartz, feldspar and rare apatite and quartzite. In part, original grain boundaries have been destroyed either by recrystallization or shearing. The matrix consists chiefly of chlorite, calcite and epidote in different proportions. Biotite and muscovite are locally common with the former usually altered to chlorite. Ilmenite and pyrite occur widely. Calcite with lesser amounts of chlorite and epidote occur along microshears and as tiny veinlets. Calcite is probably primary with that occurring as veins having been remobilized.

The siltstone grades into the argillite and does not form discrete beds. Thin section shows it to be a finely laminated rock with rounded to subangular fragments of quartz and plagioclase in a matrix of white mica, chlorite and epidote. Calcite occurs both interstitially and along tiny fractures.

Amphibolite associated with the limy argillite is fine grained, equigranular and garnet-bearing and was only mapped in the northeastern part of this unit.

West of Ugjoktok Bay, these limy argillites occur in a fault block, and extensive shearing is evident near the margins of this unit. Their stratigraphic relationship to the migmatites that form the bulk of the country rock is uncertain, but they are assumed to be contemporaneous with other metasedimentary rocks. The presence of later diabase dykes in this unit is of little use in establishing its age, as dykes in the general area are of many ages.

Plate 15. Diabase dykes (Adb) in a cirque wall cutting migmatite (Amg) 5 km east-southeast of Mount Cladonia (map area 14L). Terrain is typical of this mountainous part of the map area. F.C.T. 171367.

Lamprophyre (Alp)

West of Razorback Harbour (map area 14M) several irregularly oriented lamprophyre dykes, up to 1 m thick, intrude a moderately foliated and banded light grey granitic gneiss and are themselves cut by several diabase dykes ranging from 10 cm to 25 m thick. A K-Ar whole-rock age on the chill zone of one of the diabase dykes gave an age of 2483±66 Ma, and these lamprophyres are therefore considered to be Archean.

This unit is a greyish-red weathering, olive-grey, medium grained, equigranular rock consisting of about 60 per cent augite and 35 per cent biotite, with small amounts of magnetite. All minerals are fresh and undeformed.

No doubt other Archean lamprophyres will be disclosed by more detailed mapping.

Diabase (Adb)

One of the most noticeable features of the Archean terrane is the presence of vast numbers of diabase dykes. They are particularly common in the Hopedale and Saglek districts. More than one age of dyke may occur, but present data do not permit any breakdown. In the northern part most dykes trend easterly, whereas in the south, a northeasterly orientation predominates. Other orientations, however, are by no means rare. Similarly, vertical or very steep dips are the rule, but low disp occur also. Dykes range in thickness from a few centimetres to about 35 m, with the majority about 15 m thick (Pl. 15).

These diabases are massive, fine to medium grained, subophitic to ophitic, grey-green rocks consisting of very slightly altered plagioclase (An_{30-55}) and clinopyroxene greatly altered to pale green uralite. Plagioclase is locally weakly zoned and partially altered to white mica. Clinopyroxene occurs only as cores within uralite or less commonly as green or bluish-green hornblende and in some samples has been completely replaced. The amphibole has in part been converted to chlorite. Small amounts of brown and green biotite, magnetite, ilmenite, apatite, pyrite, epidote and sphene are present in many samples. Lithologically the Archean diabases are distinguishable from many of the other diabases in the map area by the tendency of the pyroxene to be extensively or completely altered to uralitic amphibolite, whereas the plagioclase is only very slightly altered.

The Archean age for these dykes is established through their relationship to the Aphebian Ramah and Mugford groups. These two groups lie unconformably on dykes of this map unit in several places and this relationship is well displayed near Quartzite Mountain and south of Ramah Bay.

Fahrig (1970) obtained a K-Ar, whole-rock age of 2425±225 Ma from a vertical diabase dyke about 30 m thick, striking 075° azimuth at Little Ramah Bay (map area 14L) confirming a late Archean age. A similar age, 2483±66 Ma, was obtained on the chill zone of an east striking dyke from south of Trout Trap Fiord (Taylor, 1974).

Aphebian (A)

Aphebian rocks form most of the Churchill Structural Province, much of the southeastern part of the Nain Structural Province and smaller areas in the north and centre.

In the Churchill Structural Province, Aphebian rocks are in some places readily assigned to rock-stratigraphic units. In the southwest many of the rocks consist of elements of the Kaniapiskau Supergroup and the Montagnais Group. East of Ungava Bay, units of the Lake Harbour Formation cover several hundred square kilometres. However, by far the largest part of the province is underlain by Aphebian gneisses, migmatites and plutonic rocks that extend from Cape Chidley to the southern boundary of the map area.

These cannot as yet be assigned with certainty to rock-stratigraphic units.

In the Nain Structural Province, Aphebian age rocks form the Ramah, Snyder and Mugford groups in the northern and central part of the province. In the south, the Makkovik Subprovince is composed chiefly of Aphebian rocks, including the Aillik Group, the Long Island Gneiss, and plutonic rocks, notably the Adlavik gabbros and the Strawberry granitic suite.

Kaniapiskau Supergroup

Rocks forming part of the Kaniapiskau Supergroup (Frarey and Duffell, 1964), which lies unconformably on Archean rocks to the west of the map area, outcrop in the southwest quarter of map area 24B and in the western half of 23P. Elements of both the Doublet and Knob Lake groups are present. Outcrop is scarce in most of these two areas, and more detailed mapping is necessary to subdivide the two groups into their respective formations with certainty. However, it is probable that most of the volcanic rocks, and their associated sedimentary rocks, belong to the Willbob Formation, with a few forming part of the Murdoch Formation in the vicinity of longitude 67°06′ at the south boundary of 24B. The carbonates are probably representative of the Denault Formation, as the only other major carbonate unit present in the Knob Lake Group is confined to the western side of the Labrador Trough. Baragar (1967) shows carbonate rocks immediately south of map area 24B contiguous with those in the present area as Denault Formation. Dimroth (1967) assigned diverse sedimentary rocks in the vicinity of southern Lac Romanet and Lac Paillot to the Wishart Formation.

Knob Lake Group (AKS)

Knob Lake Group rocks form a heterogeneous rock unit consisting of interbedded pelites, arenites and carbonates (AKS). The argillaceous rocks are predominantly grey and black, well laminated, in part graphitic, slates with lesser amounts of green argillite. Interbanding is commonly on a small scale, for example, 1300 m east of Lac Du Chambon limestone and dolomite are rhythmically banded.

The arenaceous rocks, which are commonly interbedded with the argillaceous strata, consist of white or grey orthoquartzite, pale red arkose and small amounts of greywacke.

The orthoquartzite is remarkably pure and thickly bedded in part, with beds up to 3 m in many places. Elsewhere, such as 600 m west of Lac Marique, 10 per cent of brown weathering dolomite is interbedded with orthoquartzite.

Seven miles southwest of Lac Romanet interlayered greywacke, quartzite and minor amounts of slate and interformational slate-chip conglomerate, lying between gabbro and basalt, is 30 m thick. A few very thin chert beds are present in the quartzite. In places these rocks have been metamorphosed so that the term schist is more appropriate.

Carbonates (AKls) include grey, white or pink limestone, brown weathering dolomite, sandy dolomite and various arenaceous rocks with disseminated carbonate. Stromatolites are present in some of these rocks (Dimroth, 1964, 1967) and are common in some dolomites. In part, the carbonates contain disseminated, well rounded sand grains up to 2 mm in diameter, which make up 30 per cent of the rock. Greyish-orange dolomite 1300 m east of Lac Ronsin is extremely fine grained (lithographic) and forms beds a few centimetres to 1 m thick. More detailed descriptions of these rocks are given by Dimroth, (1964, 1967).

In map area 23P two thin bands of grey to white limestone occur within schists (AKsc). The band east of Lac Berthé is 30 m thick and is bounded on the west by a garnet-hornblende schist and probably on the east by a thin amphibolite layer. Both bands contain tremolite, up to 7 cm long in the outcrop near Rivière De Pas, and quartz veins are common in parts of the bands.

Arkose and conglomerate (AKak). Interbedded with schists

Plate 16. Arkosic conglomerate (AKak); 14 km south-southwest of Lac Vieuxpont (map area 24B). R.S. 171682.

(AKsc) are linearly extensive bands of arkose and pebble conglomerate. These bands are composed chiefly of medium to coarse grained, pale red to greyish-orange–pink arkose. Feldspar, quartz and muscovite are the chief constituents, and fragments are commonly subangular to rounded, where preserved. In some places, mainly the northeastern outcrops in map area 23P, recrystallization has destroyed most detrital grain boundaries. Thin hematite seams are typical of many outcrops along with segregation of white quartz that forms pods and veins. Granitic veinlets occur in some outcrops.

These rocks are known to grade into quartzite, similar to map unit AKqz, both along and across strike, and in many places these rocks can be described as arkosic quartzite.

None of the conglomerate contains any exotic fragments. Every fragment is similar to the arkose itself.

The arkose and conglomerate 14 km south-southwest of Lac Vieuxpont (map area 24B) is noteworthy in that it contains boulders up to 0.6 m in diameter in a well bedded arkosic matrix. Bedding planes range from 7 cm to 0.3 m thick. The fragments, which are well rounded, appear to be slightly flattened parallel to the bedding plane and consist primarily of arkose or arkosic quartzite with hematite spots and magnetite. A few pebbles of biotite quartzite and feldspar are the only other fragments. Fundamentally the matrix and the fragments are compositionally the same, consisting of quartz, feldspar and muscovite (Pl. 16).

No contacts with other rock units are exposed. Foliation in a migmatite (Amg) outcrop to the northeast is parallel to the bedding in the conglomerate, both showing low dips to the northeast.

Microscopically these rocks are seen to consist of up to 60 per cent detrital quartz and 30 per cent detrital feldspar. In some places potash feldspar predominates; in others, plagioclase is the chief feldspar, and locally the only one.

Plate 17. Thinly laminated biotite-quartz-feldspar schist of the Knob Lake Group (AKsc). Primary bedding is parallel to the hammer handle. Five km south of Lac Nachicapau (map area 24B). F.C.T. 171265.

Where pebbles occur these are potash feldspar, and mixed quartz and potash feldspar, and quartz and plagioclase. The matrix is predominantly metamorphic muscovite with rare biotite and chlorite. Trace amounts of detrital zircon, apatite and epidote are present locally. In some places magnetite and lesser amounts of ilmenite form up to 5 per cent of the rock. Rosettes of brilliant magenta tourmaline, probably a manganiferous elbaite, are present in some thin sections.

Quartzite (AKqz). Some of the higher ridges in map area 23P are underlain by a well bedded quartzite. This white to slightly pink, medium grained rock is commonly composed almost entirely of quartz. Locally muscovite, and more rarely biotite and feldspar, occurs sparingly. Beds range from 3 mm to 1.2 m thick. A few thin pebble horizons are present in the westernmost parts of this quartzite band, which also contains small granitic veinlets. In the same area the quartzite is less pure and evidently grades into schists (AKsc) to the west so that it does not occur in map area 23O (Baragar, 1967).

From the meagre information at hand, speculation as to the stratigraphic position of this quartzite in the Knob Lake Group is not warranted.

Schists (AKsc). Schistose metasedimentary rocks are restricted to the western quarter of map area 23P and a small area in northwestern 24B. Outcrop is scarce in both areas. The large area shown as drift cover in the southeastern part of 24B may be underlain by these rocks.

These schists include rocks variously referred to as Laporte Group (Fahrig, 1951), Laporte Complex (Fahrig, 1964), Laporte Group (Frarey, 1967), or the term used by geologists of Labrador Mining and Exploration Company, Laporte Series (Frarey and Duffell, 1964).

These schists are chiefly light to dark grey with light olive-grey phases, fine to locally medium grained rocks that are thin (0.5–1.5 cm) to thick bedded (15 cm). Schistosity commonly parallels the bedding so that where schistosity is prominent, bedding is observed. The highly schistose elements usually are crenulated, but a moderate schistose equigranular rock that produces a fissile or flaggy rock on weathered surfaces is most typical. Milky quartz lenses, up to 5 cm thick, lying parallel to the bedding, are a characteristic feature. Widely disseminated calcite is present in two of the outcrops examined (Pl. 17).

Thin beds of quartzite and striped amphibolite are intercalated locally, and there are boudins of amphibolite in some outcrops.

These schists consist primarily of equidimensional quartz, plagioclase (in part untwinned), biotite and muscovite. Chlorite, garnet, sillimanite and hornblende occur erratically and in tiny amounts only. Apatite, zircon and tourmaline, the latter with overgrowths, are widely distributed in trace amounts and are all probably of detrital origin as they are subrounded to rounded. Opaque minerals consist of tiny grains of magnetite and graphite with extremely rare pyrite and ilmenite. Grain size of the major mineral constituents ranges from 0.1 to 0.3 mm. Biotite, the more common of the micas, and muscovite show a strong preferred orientation parallel to the laminations or bedding. Both chlorite and garnet grains are slightly larger than most of the matrix, averaging 0.4 mm.

The structure and composition of the schists suggests that they were derived from shales and subgreywackes or greywackes.

Schists grade into biotite-quartz-feldspar paragneiss and granitic gneiss. Here and there within the area shown as schist, small lens-shaped masses of gneiss occur.

The relationship of these schists to the rocks of the Kaniapiskau Supergroup was discussed by Baragar (1967). Evidence at that time strongly favoured the view that they were metamorphic equivalents of the Labrador Trough rocks. No evidence to the contrary has been forthcoming and therefore they are shown as forming part of the Knob Lake Group. Dimroth et al. (1970) and Dimroth (1970) show Laporte "Schists" as equivalent to the upper portion of the Kaniapiskau Supergroup embracing all of his Ferriman Subgroup, which includes the Sokoman Iron Formation. As the Laporte Group is most characteristic of a metamorphosed shale to fine grained greywacke, an equivalence with the Attikamagen Formation seems more reasonable.

Dimroth et al. (1970) reported that "Laporte Schist(s) overlie the Archean gneisses in the extreme east of the Trough." No evidence to support the contention was discovered during the present work.

Doublet Group (ADV, ADab)

The Doublet Group, the uppermost known division of the Kaniapiskau Supergroup, consists chiefly of light to dark green (most commonly medium greenish grey), rusty weathering, massive and pillowed metabasalt flows. Grain size is variable and ranges from aphanitic to locally porphyritic, the latter consisting of altered plagioclase phenocrysts and clusters of plagioclase phenocrysts from 1 to 5 cm in diameter. Fahrig (1964) considered that only one major layer of porphyritic basalt is present in the Griffis Lake map area where it provides a valuable horizon marker. Chlorite, calcite, quartz and chert occur between pillows or in cavities in the upper parts of pillows in some places. Other volcanic structures are rare and flow tops discernible only locally. Dimroth (1967) reported about "30 basalt flows of a thickness varying between 50 and 400 feet" east of Lac Romanet.

Thin layers, up to 10 m thick, of flow breccia, tuff and agglomerate, are intercalated with the basalt flows. Frarey (1967) reported similar occurrences in the Doublet Group of the Willbob and Thompson Lake map areas and that these rocks are of limited lateral extent and lens out within a few hundred feet. Some massive medium to coarse grained rocks, in part with columnar joints, may be sills but are undoubtedly genetically related to the extrusive rocks and are included with them.

Interbedded with the volcanic rocks are thin bands of black carbonaceous slate, locally pyritiferous, quartzite and subgreywacke. Frarey (1967) placed an upper thickness limit of 45 m for these sedimentary rocks, but Baragar (1967) reported that they range from 150 to 215 m in the Lac Ahr map area.

Chlorite schist occurs erratically throughout the Doublet volcanics but is more common near or at the margins of the map unit.

In thin section the Doublet volcanics are seen to consist of a mesh of actinolite and clinozoisite with small amounts of augite, chlorite, plagioclase, biotite, quartz, magnetite and sphene. In the medium to coarse grained rocks plagioclase outlines are visible, and in some samples it can be determined to be andesine. In the fine grained varieties the only feldspar identifiable is secondary albite, which forms tiny untwinned interstitial grains.

Amphibolite (ADab). Much of the amphibolite in map areas 23P, 24B and 24G, closely associated with schists and limestone assigned to the Knob Lake Group (AKsc, AKls), is considered to be metamorphosed members of

Plate 18. Columnar jointing in Wakuach Gabbro (Awg) 10 km northeast of Lac Briscan (map area 24B). The foreground consists of interlayered sedimentary rocks of the Knob Lake Group. C.K.B. 171836.

the Doublet Group. Amphibolites that are remote from rocks readily recognizable as members of the Kaniapiskau Supergroup are dealt with under map unit Aab.

These amphibolites are mostly massive green to dark green, banded and feather type. A well developed foliation is typical in many places as well as banding. Although locally coarse grained, medium grained varieties predominate.

Montagnais Group

Rocks of the Montagnais Group underlie parts of map area 23P W/2 and 24B W/2. They include elements of both the Retty Peridotite and Wakuach Gabbro formations. Similar rocks northeast of and remote from the Labrador Trough are not included with the Montagnais Group; although it is recognized, the rocks may belong to the same intrusive period.

Wakuach Gabbro (Awg). Wakuach Gabbro sills, which were named by Frarey and Duffell (1964), form prominent hills in the southwestern part of map area 23B. Smaller sills intrude the Doublet Group and schists (AKsc) in the western half of 23P. In both places many of these rocks lie on strike with those shown by Baragar (1967) in map area 23O to the south and west. These sills are well exposed for the most part and commonly project well above the surrounding terrane, contrasting sharply with their more easily eroded sedimentary and volcanic host rocks.

In many places these gabbros display excellent columnar jointing and a series of planar joints at right angles to the columnar ones (Pl. 18). They range in thickness from about 1 m to over 600 m, although many of the thicker ones may be composite sills.

The similarity of some of the finer grained gabbros to some of the Doublet Group volcanic rocks has been noted by several geologists (for example Frarey, 1967) so that unless contacts are exposed the origin of some of the rock shown as gabbro is in doubt.

The areas shown as Wakuach Gabbro commonly include intersill layers of volcanic sedimentary rocks, the latter primarily slates and shales.

Baragar (1960) divided the gabbros to the west into three main types on the basis of field characteristics—normal gabbro, glomeroporphyritic gabbro (leopard rock) and metagabbro; the latter being the metamorphic equivalent of the normal type. This division was not made in the present map area; however, as far as is known the glomeroporphyritic type is not represented. Baragar (1967) indicated that gabbros west of about longitude 67°25′ west, at south boundary of this map area, are typical normal gabbros and those to the east typical metagabbros, which suggests that the larger gabbro sills shown in map area 24B are the normal type.

The gabbros are chiefly grey-green, medium grained rocks that locally are fine grained, especially at the margins, and in part coarse grained. Texturally they are equigranular and massive to ophitic. The fresh rocks consist almost entirely of calcic plagioclase and clinopyroxene, whereas the altered ones contain albitic plagioclase, epidote, actinolite or hornblende, and chlorite. Opaque minerals, sphene and apatite, occur as accessories. Scapolite is present in some of the metagabbros in map area 23P. Detailed petrographic and chemical descriptions of the Wakuach Gabbros are available in reports by Baragar (1960, 1967).

Retty Peridotite (ARp). Frarey and Duffell (1964) introduced the name Retty Peridotite for laterally extensive ultrabasic sills well exposed in the vicinity of Retty Lake 5 km west of the map area. In part these sills are contiguous with those mapped by Fahrig (1970) in the southwestern part of map area 23P. Other sills close to Labrador Trough strata and petrographically similar to sills within the trough are also assigned to this formation. Some of the latter occur in gneisses and schists similar to some reported by Baragar (1967) and Fahrig (1964).

The sills have a maximum thickness of about 600 m and are invariably concordant with their host rocks (Fahrig, 1964). Most are less than 300 m thick however, and with the exception of those in Fahrig's map area, none can be traced for more than 5 km along strike.

These rocks consist predominantly of dark brown weathering, greenish-grey to dark green, medium to coarse grained massive peridotite. Well developed jointing and irregular cracks filled with serpentine and magnetite are typical. In the Griffis Lake map area (23P/4) Fahrig (1962) reported a zoning parallel to sill borders consisting

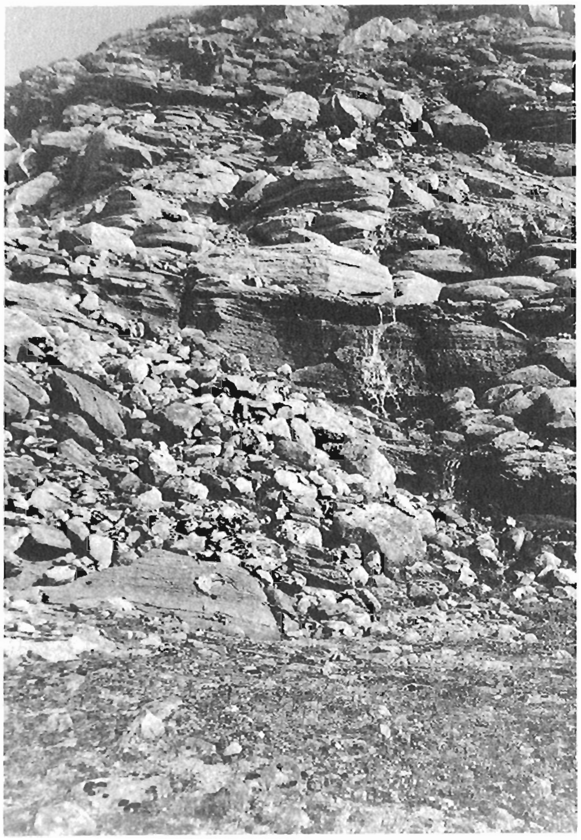


Plate 19. Nearly horizontal marble of the Lake Harbour Formation (ALls) at the south end of the crescent-shaped lake 8 km north of the Korok River in the north-central part of map area 24I. C.K.B. 172008.

Plate 20. Well bedded marble of the Lake Harbour Formation (**A**Lls) on the southwest side of Weymouth Inlet (map area 24P). F.C.T. 171429.

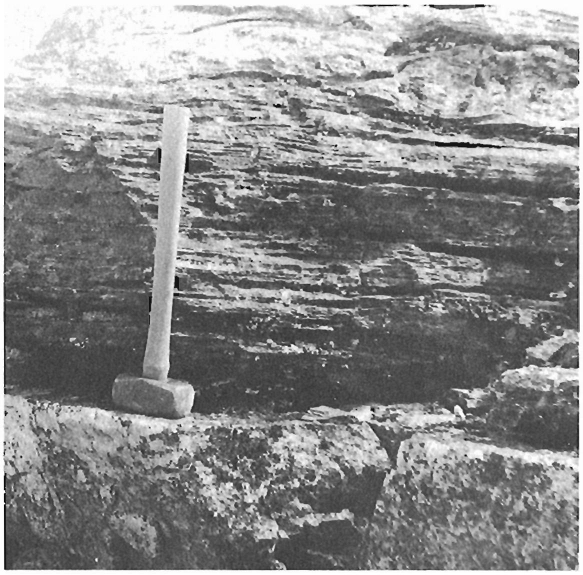


Plate 21. Banded amphibolite of the Lake Harbour Formation (**A**Lab) 10 km north-northeast of Campsite 3. Hammer head is on quartzite, which is interbedded with the amphibolite (map area 24I). F.C.T. 171410.

of an outer or actinolite zone, an intermediate or highly serpentinized zone, and a central zone containing olivine. The outer zone is thicker at the top of the sill and actinolite, pseudomorphous after pyroxene, forms larger crystals locally comprising 80 per cent of the rock. For an excellent petrologic and geochemical description of these rocks the reader is referred to Fahrig (1962).

Lake Harbour Formation (**A**L)

Jackson and Taylor (1972) introduced the name Lake Harbour Group for a distinctive assemblage of dominantly sedimentary metamorphic rocks that occur in southern Baffin Island and extend into the present map area on the east side of Ungava Bay. The name was derived from the settlement of Lake Harbour, Baffin Island, where this unit is well exposed and has been examined extensively by Davison (1959). The rock-stratigraphic term formation is used here in order to conform with the Code of Stratigraphic Nomenclature (American Association of Petroleum Geologists, 1961). The formation comprises the major portion of the Dorset Fold Belt (Jackson and Taylor, 1972), which extends from Cape Dorset on Baffin Island to the present map area. The mapped extent of this formation in the present map area has been limited to the region north of Lac Daniel (24I), but metasedimentary rocks farther south, such as quartzite (**A**qz) 20 km east-northeast of Slip Knot Lake and 3.2 km east of Indian House Lake, may also form part of this formation.

The Lake Harbour Formation consists of marble, rusty graphitic quartz-rich gneisses, quartzite, amphibolite and minor amounts of andesite.

The stratigraphic sequence of the lithologies comprising this formation is uncertain because of extensive deformation, dearth of top determinations and the reconnaissance nature of the mapping. The mafic volcanic rocks overlie quartzite where seen, but several horizons of quartzite are probably present as it is widespread. The quartzite beneath the volcanic rocks may be the most extensive. W.L. Davison (pers. comm., 1971) thinks the crystalline limestone is low in the succession in the Lake Harbour map area on Baffin Island, but no data either confirming or refuting this are at hand.

Crystalline limestone (**A**Lls). Crystalline limestone is the most distinctive member of the Lake Harbour Formation. It is particularly common east of Keglo Bay, where it forms about 30 per cent of the total rock mass. Only the thicker units are shown, and thin crystalline limestone beds are present in rusty graphitic gneiss and paragneiss throughout much of the formation, particularly near thicker and mappable horizons.

Crystalline limestone horizons range in thickness from a few millimetres to several hundred metres. Being particularly susceptible to flowage, reliable thickness measurements are scarce, but a single, slightly deformed bed near Gregson Inlet has a maximum thickness of about 1200 m. The total thickness of this member is unknown (Pls. 19, 20).

Small amounts of rusty graphitic paragneiss (**A**rc) and biotite-quartz-feldspar paragneiss (**A**pg) are intercalated with the limestone in some outcrops. The sharp contacts are chieflly conformable with bordering rocks. A few contacts, particularly with paragneiss (**A**pg), show a gradation over 1 m or so, and there lime-silicates are characteristic.

This crystalline limestone is a grey to white, rarely orange, medium to coarse grained, friable rock. The last characteristic results in the surface of some outcrops consisting of a coarse calcite sand. The coarse grained rocks commonly display crystals of 2 to 3 cm diameter, with

Plate 22. Amphibolite (ALab) of the Lake Harbour Formation in the core of a syncline 17 km north of the Korok River (map area 24I). F.C.T. 171358.

Plate 23. White, medium grained, well bedded quartzite with garnet and sillimanite-bearing interbeds (ALqz) of the Lake Harbour Formation, 17 km north of Korluktok Falls (Korok River) in map area 24I. F.C.T. 171355.

some as much as 10 cm. The orange variety is of limited areal extent, occurring on a broad peninsula near the mouth of Rivière Baudoncourt, where it forms patches in the grey to white variety. There is evidently no stratigraphic significance to the orange colour.

Bedding is the sole primary structure preserved and in most outcrops is readily discernible. In some places bedding is highly contorted, whereas in others it is relatively undisturbed on a small scale. Individual beds range from a few millimetres to about 0.5 m thick. Bedding is marked in many outcrops by a concentration or appearance of metamorphic silicate minerals that impart a ribbed surface to the outcrop.

This rock consists entirely of calcite in some places but more commonly contains scattered to concentrated metamorphic minerals, reflecting the impure nature of the original limestone. These minerals are chiefly diopside (up to 15 per cent) and tremolite (2–20 per cent); however, in places, serpentinized olivine, phlogopite, scapolite and sphene are present. Tremolite is not present in all members. These metamorphic minerals are chiefly medium grained, but some tremolite and diopside crystals attain lengths of 2 to 5 cm. Graphite, showing pronounced metallic lustre, occurs commonly. A few grains of feldspar are also present, but these minerals may be primary. Davison (1959) reported a large number of minerals, including wilsonite and lazurite, from this formation in the Lake Harbour map area, and these same minerals possibly occur in the present map area also.

Tremolite is white and occurs in typical radiating clusters. Moderate yellow-green to dark yellowish-green diopside is characteristic and forms euhedral stubby crystals. Serpentinized olivine grains (forsterite) are pale yellowish green to moderate yellow. Scapolite and sphene are only known from thin sections.

A few grains of detrital quartz, plagioclase and potash feldspar are present in some samples but only form a small proportion of the rock.

Unlike most of the rock units in this map area, contacts with bordering lithologies are chiefly well defined and sharp, although locally gradational contacts occur with paragneiss and rusty graphitic gneiss.

Amphibolite (ALab). Lake Harbour Formation amphibolite forms well defined bands in quartzite and other metasedi-

Plate 24. Campsite 3 in central part of map area 24I showing typical topography in this part of the map area. Foreground consists of Lake Harbour Formation quartzite (ALqz). Campsite is in left middle ground on an abandoned lake terrace. F.C.T. 171362.

mentary rocks of the formation. In some places, such as east of Campsite 3 (lake elevation 469 feet or 143 m), amphibolite horizons can be extended with high degree of certainty, for distances as great as 25 km, even though seldom more than 7 m thick (Pl. 21).

A moderately foliated, dark green, medium grained rock devoid of primary textures is typical. Biotite, clinopyroxene and garnet occur locally, with plagioclase and hornblende. Whereas the origin of most of this rock is unknown, some individual beds east of Campsite 3 can be traced into biotite-rich metasedimentary rocks. These amphibolites display good laminations parallel to the bedding in the nearby quartzite. The latter rocks also form thin beds in quartzites at the same locality. Other amphibolites may be of intrusive or extrusive derivation. For example, pyroxene-rich layers occur in some amphibolite in the same area, suggesting an igneous origin (Pl. 22).

Fine grained amphibolite south of Campsite 3 is interlayered with quartzite, with each averaging about 150 m thick. At one point a thin (0.3 m) slabby band on a sharp concordant contact with the quartzite consists of a magnetite iron-rich sediment. There the amphibolite consists of 65 per cent hornblende, 15 per cent plagioclase, 15 per cent quartz, and minor amounts of sphene, magnetite and apatite. In part, this amphibolite shows a feather amphibolite texture, and some samples show a few tiny garnets.

About halfway between Campsite 3 and Korok River, amphibolite interbedded with quartzite (the latter dominant) forms bands 2.5 cm to 7 m thick with at least two of the thicker ones. At one place the amphibolite grades along strike into a biotite-quartz-feldspar paragneiss. This amphibolite is well laminated, and these laminations are parallel to the bedding in the adjacent quartzite.

Amphibolite 4.5 km south of Korok River is a fine grained, dark grey, massive to thinly laminated rock containing minor biotite. There, it forms two 15 m thick bands in quartzite and a biotite-bearing feldspathic quartzite, both of which are of similar thickness. A few white granite sills less than 0.3 m thick are also present.

Quartzite (ALqz). Quartzite forms about 20 per cent of this formation, occupying an extensive area south of Korok River. Thin, unmappable bands occur sporadically intercalated with the other members of the formation. Contacts with bordering rock types may be sharp or gradational (Pls. 23, 24).

The thickness of this member is not known accurately. Unquestionably, the thickest part lies south of Campsite 3, where it forms the major part of a mountain. Approximately 1200 m of quartzite is exposed there. Elsewhere, thicknesses are much less, and individual quartzite horizons are seldom more than 200 m.

The thickest part is typical of the member as a whole, consisting of white to light grey, well bedded, massive, medium grained rock with individual beds ranging 7 cm to 1 m. A few interbeds up to 30 cm thick contain knots of sillimanite, up to 2.5 cm in diameter, in a biotite-quartz gneiss. Also present are rare, thin interbeds, chiefly less than 30 cm thick, of sillimanite-muscovite-quartz gneiss that contain hematite, which occurs in pebblelike spots up to 7 mm in diameter. In part these interbeds are sheared so that the hematite spots are lens-shaped.

To the south of Campsite 3 local thin interbeds consist of garnetiferous phyllite.

Locally the quartzite is darker grey, in particular where the biotite content is higher. Only rarely is any other mineral besides quartz present in significant amounts. Feldspar, biotite and garnet occur in a few places.

Rusty graphitic gneiss (ALrc). Rusty graphitic gneiss in the Lake Harbour Formation is well exposed north of the Korok River and northward toward the Abloviak River. Highly rusted cliffs along the Korok River well display the most characteristic feature of this member—the rusty weathered surface. Scattered throughout much of this unit are white, irregularly shaped, pegmatite dykes that contrast sharply in colour with the rusty hues of the host.

The thickness of this member, like the other units of the formation, is highly variable. North of Korok River these rocks are at least 5000 m thick unless unknown isoclinal folding is present. Along the coast of Ungava Bay thicknesses in the order of 1000 to 1500 m are common.

The description given for the unassigned rusty graphitic paragneiss (Arc) applies to these Lake Harbour Formation rocks also.

Andesite (ALad). Recognizable volcanic rocks form only a minuscule part of the Lake Harbour Formation, occurring only south of the Korok River about 5.5 km and west-northwest of the lake on which Campsite 3 was located. The only sizable exposure consists of a fine grained, massive well laminated, grey-green, strongly lineated meta-andesite. A suggestion of pillow shows at one point, and epidote veinlets and patches are locally present. Interbedded with the meta-andesite are several conformable beds of massive, white quartzite up to 10 m thick. The andesite is commonly banded near the contacts with the quartzite, and large scale crenulations are present for 1 m or so from the quartzite. Near the base of the hill, which provides approximately 225 m of section, meta-andesite bands are progressively thinner, and these pass into a rusty biotite-quartz-feldspar paragneiss containing rare garnet and sillimanite and pyrite mineralization.

Thin sections show these volcanic rocks to be entirely metamorphosed to amphibolite, with approximately 65 per cent green hornblende, 30 per cent andesine, and accessory amounts of sphene, magnetite, ilmenite and quartz. Epidote is most probably a retrometamorphic product.

Some other amphibolite in the same general area, particularly that associated with quartzite, may also be of volcanic origin, but as much of the amphibolite in the Lake Harbour Formation can be demonstrated to be of sedimentary origin, it is not shown as being part of this member.

Paragneiss (ALpg). Paragneiss, which is intimately associated with other members of the Lake Harbour Formation and commonly includes small amounts of the same li-

Plate 25. Ramah Group sediments (ARs), chiefly slate, lying unconformably on Archean migmatite (Amg) in foreground and light rock in central middle ground, at Reddick Bight (map area 14L). F.C.T. 171378.

Plate 26. Ramah Group–Archean unconformity on the north side of Ramah Bay (map area 14L). The base of the Ramah Group lies at the bottom of the talus slope. F.C.T. 171383.

thologies (limestone, quartzite and rusty graphitic gneiss), comprises this map unit. Typically this rock is a moderately well foliated, medium grey, medium grained rock that displays compositional layering. This layering, which is a reflection of biotite content, ranges from 1 mm to 5 cm thick. Light grey to white feldspar segregations are prominent in some outcrops, whereas in others a higher biotite content produces a darker, more schistose rock. Pale red to pale red-purple garnets, up to 5 mm in diameter, are common. The major constituents are plagioclase, quartz and biotite, with local potash feldspar comprising less than 5 per cent. Feldspar augen, up to 10 cm long, and graphite are rare constituents. In parts of this paragneiss white pegmatite dykes and sills up to 2 m thick are common. North of the Korok River, for example, pegmatite forms a network of dykes making up about 15 per cent of the total rock.

Origin of Lake Harbour Formation. Jackson and Taylor (1972) considered this formation to be predominantly miogeosynclinal or shelf-type strata. The presence of extensive areas of carbonate rocks, graphitic sedimentary rocks and pure quartzite in the formation shows a strong affiliation with shallow-water–derived sedimentary rocks.

The great thickness, albeit locally, of the sedimentary rocks of the Lake Harbour Formation requires a slow submergence of the depositional area, and the distribution of the three major rock types indicates a marked variation in source material, sorting agencies and basin conditions from place to place.

The carbonates, which are possibly low in the stratigraphic sequence, are probably allochthonous in view of the presence of impurities and thin argillaceous interbeds. The source area is probably to the west, similar to that from which the sediments in the Labrador Trough came.

The quartzites, which on the whole are quite pure, are most probably derived from the extensive weathering of the Archean. Although no data are available with regard to current directions, the source area is probably the Superior Province to the west.

The presence of graphite-bearing rocks suggests a

Plate 27. View of Quartzite Mountain, which consists of Ramah Group sedimentary rocks (ARs) (light) and dark amphibolite band (ARab). Archean migmatite (Amg) in the foreground extends to the base of the talus slope on Quartzite Mountain. An old diabase in the migmatite is present beyond the lake and extends to the unconformity (map area 14L). F.C.T. 171406.

Table 1. Table of formations in the Ramah Group*

Formation	Thickness (m)	Lithology
VI	200	Metagreywacke and slite; minor meta-arkose and calcareous or dolomitic metasandstone; local phyllite and mica schist
V	125–150	Thin bedded slate with minor quartzite, metasandstone, calcsilicate rocks and crystalline limestone; locally graphitic with pyrite and/or pyrrhotite; rare concretions
IV	160–300	Dolomite, chiefly argillaceous; calcareous and dolomitic slates; intraformational dolomite breccias and conglomerates including turbidites; minor crystalline limestone, quartzite, metasandstone and slate
III	300–450	Colour banded slates; in part dolomitic, calcareous, graphitic or pyrite-rich; minor chert, dolomite and crystalline limestone; a thin massive pyrite bed; local phyllite and schist
II	60–140	Quartzite and pelite, chiefly interbanded or laminated; some turbidites; minor replacement dolomite; local slate, phyllite and schist
I	250–400	Quartzite, meta-arkose and metasandstone; includes a thin metabasalt volcanic flow, minor pebble orthoconglomerate, breccia and pelite; local slate, phyllite and schist

*After Morgan (1975) and Knight (1973).

closed euxinic environment, attesting to conditions much different than those existing during the deposition of the carbonates and quartzites.

On the whole the formation is similar in lithology to elements of the Kaniapiskau Supergroup with which it is tentatively correlated.

Ramah Group (ARs, ARab, ARbl)
The Ramah Group lies in the Torngat Mountains in map areas 14L and 14M and forms some of the most spectacular scenery associated with these magnificent peaks. The group is about 13 km wide and was thought to extend from Nachvak Fiord in the north to Saglek Fiord in the south, a distance of 70 km. More recent fieldwork, however, has shown that elements of this group extend as far south as Hebron Fiord in map area 14E (W.C. Morgan, pers. comm., 1971) and possibly farther. Morgan kindly made his data available, and these have been incorporated in the G.S.C. Maps 1428A to 1444A.

According to Daly (1902) rocks forming the Ramah Group were first reported as early as 1811 and were commonly mentioned in the literature. For example, Bell (1885) noted the existence of much slate in the area. This rock unit owes its name to Daly. Its approximate areal extent was established by Delabarre (1902), a member of the same expedition as Daly. Following Daly's brief visit to the area, Coleman (1921) examined parts of the group in more detail and established its relationship to the underlying rocks. Coleman also examined large parts of the group, recognizing its dominantly sedimentary character, its approximate thickness and the diversity of sedimentary rock types that comprise it. Two partial stratigraphic sections were measured in the Nachvak region.

In the mid-1940's an expedition led by G.V. Douglas (1953) mapped a portion of the group north of Ramah Bay at a scale of 3000 ft to 1 in. This mapping outlined several amphibolite sills and revealed the presence of a volcanic unit at Ramah Bay.

Christie (1952) measured an incomplete section near tidewater on the north shore of Ramah Bay. This section was the most detailed examination of the Ramah sequence to that date.

Most recently, Morgan (1975) has mapped the Ramah Group and immediate area and kindly provided me with additional new data. Knight (1973), working under Morgan's direction and also independently, has measured sections in detail in several places.

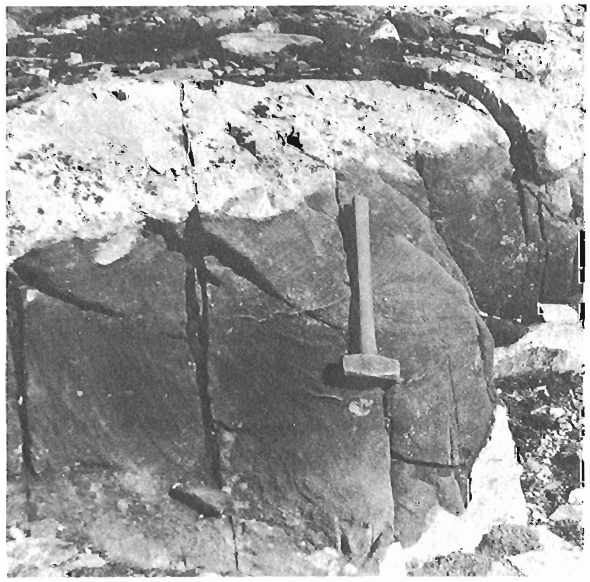


Plate 28. Cross-bedded dolomitic sandstone overlain by white quartzite forming part of the Ramah Group (ARs) at the northern end of Quartzite Mountain (map area 14L). F.C.T. 171399.

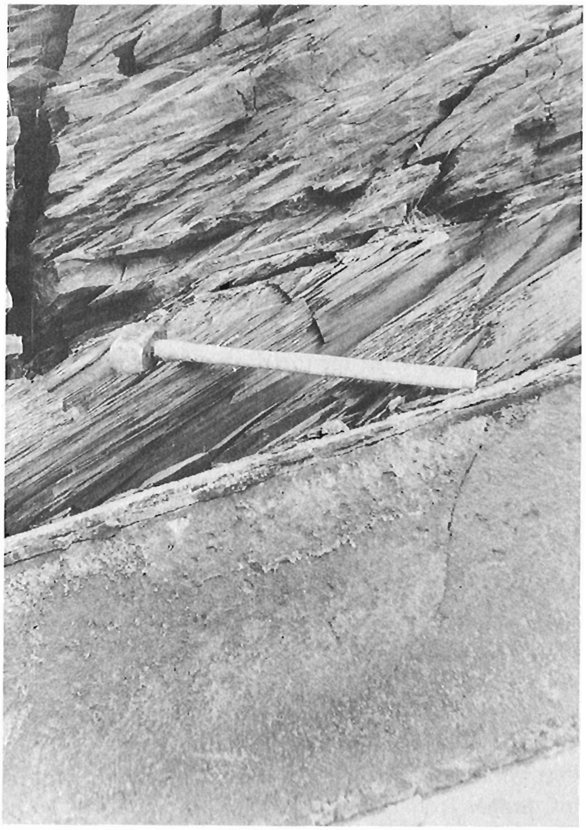


Plate 29. Bedding-cleavage relationships in sedimentary rocks of the Ramah Group (ARs). Massive quartzite bed at bottom with minor flame structures. Outcrop near the base of the group 5 km west of the southern end of Bears Gut (map area 14L). C.K.B. 172106.

Relationship to Archean rocks. The Ramah Group lies unconformably on the underlying Archean rocks. This unconformity is at high angles and is well displayed on many cliff faces where the low dipping stratiform rocks of this unit are in contact with the Archean. The cliff walls along Saglek Fiord also display exposures of the folded unconformity surface, a feature also recognized by Morgan (1975) at Quartzite Mountain (Pls. 25, 26).

The old pre-Ramah erosion surface shows a regolith, up to 12 m thick in some places, whereas elsewhere rock directly beneath the Ramah is fresh. Morgan (1975) noted that pre-Ramah weathering has obscured compositional banding and mineral foliation, but that grain size and pegmatitic zones are preserved. He also observed that the precise contact in some places cannot be determined, an observation also made during the present survey. Morgan wisely takes the first sign of sedimentary stratification as the base of the group (Pl. 27).

The Ramah Group consists chiefly of sedimentary

Plate 31. Probable pillows in Ramah Group basalt (ARbl) 5.5 km west of Bears Gut (map area 14L). F.C.T. 171485.

Plate 30. Vertically dipping quartzite of the Ramah Group (ARs) 12.5 km southwest of the southern end of Little Ramah Bay. This outcrop is close to the fault that forms the western boundary of the group in this area (map area 14L). C.K.B. 171958.

rocks with minor amounts of diabase or amphibolite sills and a single volcanic flow near the base. The rocks have been divided into six units by Morgan (1975) and Knight (1973) as shown in Table 1. Only a brief summary of their descriptions is given here, and reference to their work is recommended to the reader interested in a more detailed description.

The basal unit, which is up to 450 m thick, is characterized by quartzite and metabasalt. Both Morgan (1975) and Knight (1973) have recognized five members. The lowermost member is dominantly quartzite and arkosic metasandstone. Locally, a 1.5 to 10 m thick pebble conglomerate, which in some places contains cobble-sized, subrounded to subangular clasts of jasper, white quartz and rare silicic gneiss, is present at the base. A pale yellow to white quartzite with magnetite-rich laminae is the most abundant rock type in the first 70 to 100 m above the base (Pl. 28).

During the present survey the basal section at Quartzite Mountain was carefully examined, and the following basal relationship was observed. The regolith in the underlying basement is irregular with some of the less altered rock lying closest to the base of the Ramah Group. The base of the Ramah, which lies in a large cirque at Quartzite Mountain, consists of 0.5 to 1 m of quartz-pebble conglomerate with pebbles mostly less than 1 cm, but a few up to 3 cm, chiefly in a siliceous matrix. In places the matrix is dolomite. This conglomerate passes upward into a quartzite, dipping 40° east, which becomes interbedded, in beds 0.1 to 0.3 m thick, with a sandy dolomite about 15 m above the unconformity. The bedding planes close to the unconformity are at lower angles. In places, dolomite forms irregular anastomosing 'veins' about 10 cm thick in the quartzite, which in part is green. Hematite forms vuggy botryoidal masses locally in the quartzite. Between 30 and 70 m of quartzite and sandy dolomite occur between the unconformity and metabasalt that overlies them. The metabasalt, which is 25 to 30 m thick, lies on dolomitic quartzite (Pls. 29, 30).

A very fine grained, dark grey rock is present at the base of the flow, but grades upward into a medium grained, grey-green massive rock with local epidote. Near the top the flow is vesicular and in places is a breccia. The upper contact of the flow is not exposed.

The metabasalt flow (ARbl) ranges from 7 to 20 m thick and lies about 100 m above the base of the group. Morgan (1975) reported it with certainty only on the east side of the group where it has been mapped discontinuously for 32 km from Rowsell Harbour to Bears Gut. A grey-green, massive, aphanitic to very fine grained rock with up to 20 per cent disseminated carbonate is typical. Amygdules, and possible pillows, are present. Chemically it is a tholeiite and consists of carbonate, plagioclase, amphibole, chlorite, quartz and opaques (Morgan, 1975) (Pl. 31).

This amygdaloidal metabasalt locally lies directly on the basement rocks 3.5 km west of the west side of the Bears Gut. At one point a tongue of metabasalt is present, filling a crack in the old sheared basement rocks. In the same area sandy dolomite forms the lowermost Ramah rocks, and sandstone dykes fill fissures in the basement.

The second unit consists of a mixed quartzite, metasandstone, pelite and dolomite sequence that ranges from 70 to 170 m thick. Contact with the underlying unit is conformable and variously sharp to gradational. The base consists of grey or black quartzite, which contrasts sharply with the white quartzite of the lowermost unit. A well laminated, grey, purple and pink, very fine to fine grained quartzite and metasandstone with pelite occurs at different stratigraphic horizons within this unit. Red-brown, grey-green and blue-grey slates with thin quartzite beds are present in the Ramah Bay area where they overlie turbidites that occur sporadically. At the top of this unit is a 3 to 10 m thick, yellow or yellow-brown dolomite, which forms a persistent and readily recognized marker horizon. Morgan (1975) considers it to be of secondary origin as its lower contact is irregular and transgressive to bedding in the underlying quartzite. Dolomite also encloses and replaces laminated calcareous and dolomitic slates.

The third unit, ranging from 330 to 500 m thick, consists of graphitic slates, grey-blue, red-brown or green slates, a discontinuous pyrite bed and several chert horizons. Contact with the underlying dolomite is conformable and sharp. Near the top of this unit slates are dolomitic, and beds of dolomite and crystalline limestone are common. Diabase sills are present in the western parts of the unit. The chert horizon, which is the most distinctive member of this unit, ranges from 1.7 to 7 m thick. It lies about 50 to 80 m above the base. North of Ramah Bay, four individual chert beds are present. Although chiefly massive, this white, grey or black chert displays bedding locally. The pyrite bed, which is 1.7 to 3 m thick, does not occur throughout this unit, being represented in some places only by nodules or thin filaments of pyrite. It is overlain by the chert beds.

The fourth unit, which is approximately 300 m thick, is mostly cleaved, argillaceous dolomite interbedded with calcareous and dolomitic slate. Small amounts of slate, crystalline limestone, dolomite, quartzite and metasandstone are also present. The contact with the underlying slates is gradational and is considered by Morgan (1975) to be where carbonate beds are numerous in carbonate-rich slates. Rocks are primarily bluish grey, green, grey, brown and black, depending upon composition and argillaceous or arenaceous content. Intraformational breccias and conglomerates are common, particularly in the lower half of the unit, as are soft sediment deformation features such as ball and pillow structures, clastic dykes, and convolute laminations.

The fifth unit, about 170 m thick, consists of dark grey to black slate with minor amounts of quartzite, metasandstone, calcsilicate rocks and crystalline limestone. The contact with the underlying dolomite unit is gradational. The slates are commonly pyritiferous and rusty. Except for bedding laminations, primary structures are scarce; but crosslaminations, scour and fill, and concretions are present. Several diabase sills, locally transgressive, are prominent north and south of Ramah Bay.

The sixth and uppermost unit is composed of metagreywacke and slate, with small amounts of meta-arkose.

The contact with the underlying slates is gradational. This unit, which is approximately 200 m thick, outcrops primarily between Rowsell Harbour and Ramah Bay. Slate and greywacke are interbedded with beds 0.3 to 0.6 m thick. Both slate and greywacke are dark grey to black. Graded beds, scour and fill, load casts, flame structures and convolute bedding are common.

Diabase sills occur in all six units of the Ramah Group (Morgan, 1975) but only rarely in the second and fourth from the base. None are known to cut across the unconformity at the base of the group. Whereas most sills are less than 70 m thick, a few are up to 130 m thick. Locally they are transgressive and some thicken or thin and end abruptly. Transgressive chilled contacts, the presence of sedimentary xenoliths, minor apophyses, and contact metamorphism show their intrusive origin (Morgan, 1975).

All are altered, although primary textures and minerals are preserved in some sills. Deformation, shown in the form of schistosity or foliation, is less extensive in these rocks than in diabase in basement rocks to the west (Morgan, 1975). A few now are massive hornblende amphibolite, and one thick sill, 6.4 km west of the west end of Bears Gut, contains a serpentine and talc core.

Depositional environment and current directions. Morgan (1975) and Knight (1973) have attempted to elucidate the depositional history of the Ramah Group. Their results show the group to have a record of conditions ranging from a period of shallow marine, intertidal and offshore deltaic conditions during its early history (the lowermost unit) to turbidity current conditions at the end of its preserved history (the uppermost unit). The interval between consisted of periods of quiet, deep water deposition, in part involving restricted circulation, shallow basin deposition, turbidity and subaerial deposition. This complex environmental history is summarized by Morgan (1975) as being representative of a transgressive sequence of miogeosynclinal sediments.

Current direction data involving such a complicated depositional history are incomplete. Morgan's and Knight's work shows, however, a general westerly transport, but with many local and diverse aberrations.

Age and correlation. The age of the Ramah Group is not known with certainty. Stratigraphic evidence shows it to be younger than the Archean basement rocks, which were deformed during the Hudsonian Orogeny and a swarm of dominantly east-striking diabase dykes of probable earliest Aphebian age. One of these dykes, at Little Ramah Bay, has been dated as 2425±225 Ma, using K-Ar whole-rock methods (Fahrig, in Wanless et al., 1970). The presence of highly deformed and metamorphosed elements of the Ramah Group well to the south of Saglek Fiord that possibly grade into Aphebian granulite (**Agl**) and mylonite, strongly suggests an Aphebian age for the Ramah Group. An Aphebian age for the group was first suggested by Christie (1952), who recognized lithological and structural similarities with the rocks of the iron belt of Quebec and interior Labrador (the Kaniapiskau Supergroup).

Isotopic dating of Ramah Group rocks is limited to two K-Ar determinations and one Rb-Sr isochron (Tables 2 and 4). A K-Ar whole-rock determination, using a sample of the metabasalt (**ARbl**) returned an age of 1180±60 Ma (Taylor, in Wanless et al., 1970). This sample is from a rock consisting of a very fine grained matte of sericite with small amounts of epidote and scattered medium grained crystals of greyish-yellow to moderate green chlorite. Small amounts of quartz, calcite, magnetite and ilmenite are also present. There is no identifiable feldspar, and only the faintest outline of feldspar grains is visible. The alteration is possibly deuteric, but it may be metamorphic. In any event, the extensive alteration of this rock leaves the value of the age determination in doubt.

The second K-Ar determination is on muscovite from a chloritoid schist and gives an age of 1213±32 Ma (Morgan, 1975). This sample and also the 1180±60 Ma age, he attributes to the Elsonian event. It is questionable that the Elsonian event affected this region.

The Rb-Sr isochron study is reported by Morgan (1975). This study, which is a preliminary result, indicates an age for the metabasalt flow (**ARbl**) of between 1800 and 1900 Ma. He assumes this to be a metamorphic age, so that the time of extrusion is somewhat older, and for which he suggests an Aphebian age. I agree with this suggestion.

Although an Aphebian age is not definitely established, such an age seems more probable as each additional bit of evidence is gathered.

Assuming an Aphebian age, the Ramah Group is correlated with the Kaniapiskau Supergroup and the Lake Harbour Formation. Its relationship with the Mugford and Aillik groups is discussed later.

Mugford Group (**AMV, AMS**)
The Mugford Group is confined to the areally small but spectacularly scenic Kaumajet Mountains along the coast in map areas 14E and 14F. The superb peaks of these mountains, dominated by Brave Mountain at 1300 m, extend nearly vertically from the ocean on the seaward side. The group forms most of Cod, Grimmington and Finger Hill islands, and Finger Hill itself, a peak exceeding 1065 m.

This map unit was also named by Daly (1902), who noted the presence of abundant and slightly metamorphosed stratified sedimentary and volcanic rocks. He also reported that the unconfirmity between the Mugford Group and the Archean was exposed in several places.

Coleman's (1921) brief visit did not enable him to add significantly to Daly's observations. Kranck (1939a) measured a partial section on Grimmington Island and also reported the presence of dykes in the volcanic strata, which he considered cogenetic with the volcanism. Douglas (1953) examined the areas around Green Cove and Anchorstock Harbour on Cod Island in detail and was of the opinion that some of the rocks were members of the Ramah Group, an interpretation also made by Christie (1952) after examining these rocks at Neisser Inlet.

Recently, Murthy and Deutsch (1972) made a paleomagnetic study of some of the volcanic rocks. Age and chemical studies of the volcanic strata have been undertaken recently by Barton (1975a), and Smyth (1975) mapped the area to establish the economic potential.

The unconformity between the Mugford Group and the underlying Archean rocks is exposed in many places. The angularity of this unconformity depends upon the attitudes in the underlying rocks (Pl. 32). In some places the two rock units appear conformable. At Green Cove the contact between slates and Archean gneiss is a fault along which extensive carbonatization has occurred. Attitudes of foliation, cleavage and bedding are all parallel along the contact.

Whereas in most places the basal rock of the Mugford Group is sedimentary, chiefly slate, in other places the volcanic rocks lie directly on the Archean.

The old Archean erosion surface locally shows a regolith that is less than 1 m thick.

Lithology. The Mugford Group consists of a mixed sedimentary and volcanic rock sequence. Until the group is mapped in detail, the ratio of volcanic to sedimentary rocks will be in doubt. A cursory examination from the landward side would indicate a dominance of volcanic rocks, but the precipitous cliffs on the seaward side show 200 m of slate lying beneath the volcanic rocks. These slates are not so prominent on the landward side. The partial section measured by Kranck (1939a) suggests about 25 per cent sedimentary rock. The total thickness of the group is 1600 m according to Christie (1952).

The sedimentary rocks are chiefly dark grey to black slate although some are green, brownish or pale cream hues. Medium grey to grey-green limestone layers a few centimetres thick are common in the slates at some localities.

Plate 32. Porphyry dyke (Ppp) cutting nearly horizontal slate, chert and carbonate of the Mugford Group (Ams) at Green Cove, southern end of Cod Island (map area 14F). The helicopter is on gravel overlying Archean migmatite (Amg). F.C.T. 172459.

Dark grey-green chert beds occur within the slates at Green Cove and at Anchorstock Harbour. Christie (1952) reported a dolomite band, a few feet above the base of the group on the seaward side. He also reported quartzite, dolomite and argillite at Cod Bay Harbour. Kranck (1939a) noted thin hematite layers associated with "quartz-rich sediments."

The volcanic rocks consist of basalt, in part pillowed, and associated breccias and pyroclastic rocks. Douglas (1953) counted 25 flows on the hills above the northeastern end of Anchorstock Harbour. The majority of the flows are massive, but vesicular, amygdaloidal and pillowed flows (Douglas, 1953) are also present. Quartz, jasper, carbonate and epidote occur commonly in the voids.

Age and correlation. Douglas (1953) and Christie (1952) thought that the sedimentary rocks underlying the volcanic rocks formed part of the Ramah Group. Christie remarked on the similarity of a narrow dolomite layer at Neisser Inlet (Cod Bay Harbour) to that in the Ramah Group and also the possible existence of an iron-rich bed common to both groups. Douglas considered that slates at Green Cove resembled those of the Ramah Group so closely that they were probably part of the latter group. At both Green Cove and Anchorstock Harbour, Douglas observed that volcanic rocks lay unconformably on some of the sedimentary rocks and few intrusive rocks, strengthening his belief that the lower strata were Ramah Group rocks.

A brief re-examination of the Green Cove and Anchorstock Harbour exposures confirmed Douglas' observations concerning the presence of an unconformity. However, Douglas' comment that a quartz porphyry dyke which cuts the slates at Green Cove is truncated by the volcanic rocks is questionable, as at least 45 m of talus covers the interval between the highest porphyry outcrop and the lowest volcanic outcrop.

The question is not whether there is an unconformity or not, but whether the rocks beneath are indeed Ramah Group or are part of the Mugford Group; in the latter case the unconformity would be of local significance only. At present there is no evidence except for a lithological similarity to warrant calling the sedimentary strata beneath the unconformity Ramah Group. Therefore in this report they are assigned to the Mugford Group, and the unconformity between the volcanic and sedimentary rocks is considered to be of local importance only.

Although a detailed examination of the sedimentary rocks of the Mugford Group, including direction analysis, has not yet been made, no detritus typical of the anorthosite or adamellite, so abundant only 40 km to the south and southwest, has been identified. This negative information implies that these intrusive rocks were not emplaced or not exposed at the time of the Mugford deposition. Therefore, it is possible that the Mugford is older than the Paleohelikian anorthosite and adamellite intrusive rocks, and it is conceivable that they are as old as the Kaniapiskau Supergroup, as suggested by Christie (1952).

Perhaps of significance is the lithological similarity between the quartz porphyry dyke at Green Cove and some of the porphyries associated with the Flowers River adamellite pluton. If these two rocks are related, then there is good field evidence for the prior existence of the Mugford Group vis-a-vis the anorthosite-adamellite intrusions.

A paleomagnetic study by Murthy and Deutsch (1972) of Mugford volcanic rocks indicated a pole located at 49°N, 143°W with dp=9°, dm=11°. As the age of the Mugford is most probably in excess of 2.07 Ga, and possibly as old as 2.3 Ga, the paleomagnetic pole position is assuredly not a primary pole, as suggested by Murthy and Deutsch, which would at 2.0 Ga lie far to the southeast of 49°N, 143°W, but related instead to a much later event. The time and nature of this event is at present speculative, but the period of anorthosite-adamellite intrusion must be considered.

A single K-Ar whole-rock age determination on a sample of volcanic rock gave an age of 948±90 Ma (Taylor, in Wanless et al., 1966). This sample is from a grey-green, aphanitic basalt that is almost entirely altered, possibly deuterically so that only scraps of its original mineralogy are discernible microscopically. This age is undoubtedly much too young. Recently Barton (1975a) reported four K-Ar whole-rock ages of 1181, 1491, 1493 and 1366 Ma on samples from vesicle-free rocks of some of the lower flows. These K-Ar ages suggest a minimum age considerably older than that previously reported. In the same paper Barton reports a Rb-Sr isochron study of the same rocks that indicates the possibility that they may be 2369 Ma old, with an intial $^{87}Sr/^{86}Sr$ of about 0.7033±0.0002.

If this latter age is at least in the correct range, then the Mugford is of Aphebian age, like the rocks of the Labrador Trough.

Snyder Group (Ass)

A small area of metamorphosed sedimentary rocks occurs on Snyder Island and the adjacent mainland (map area 14F). These rocks, which were first reported by Wheeler (1942), were called the Kiglapait Group by Morse (1961). More recently, Morse (1969), who mapped this unit in conjunction with his studies of the Kiglapait intrusion, changed the name to Snyder Group. In the 1970's Morse and his associates re-examined the area, and the following is a summary of their work.

The underlying migmatite shows an uneven erosion surface at the base of the Snyder Group with crosscutting pegmatite stringers truncated at the contact (Morse, 1971). Hollows in the erosion surface contain quartz-pebble conglomerate and locally derived migmatite fragments occur in basal quartzite. The presence of an unconformity is unquestionable.

The stratigraphy, structure and metamorphism of the group has been mapped and described by Speer (1973), who subdivided it into 5 depositional units. These are from the base upwards: a lower quartzite unit 110 m thick, which includes conglomerate horizons; a quartz gneiss unit 10 m thick; a quartz marble unit 8 m thick; a sulphide-hornfels unit 12 m thick; and an upper quartzite unit of unknown thickness. All these units are metamorphosed and show extensive development of garnet, andalusite, sillimanite and cordierite in the aluminous zones.

A predeformational, fine grained intrusive rock, called grey breccia by Morse (1969) cuts both the basement and the Snyder Group. This sill-like intrusion contains rounded fragments of the basement rocks but none of the Snyder Group. Compositionally it consists of equal proportions of quartz, plagioclase and potash feldspar with brown biotite and minor green hornblende (Morse, 1969). The group also contains highly deformed diabase and sheared garnet-bearing dykes on Snyder Island (Speer, 1973).

Age. The Snyder Group is older than the Kiglapait intrusion and younger than the basement migmatites, amphibolites and granitic rocks. Rb-Sr isotopic data reported by Barton and Barton (1975) on samples of the matrix of the grey breccia indicate an age of 1842±17 Ma, with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7044±0.0002. As this is a minimum age for the deposition of the Snyder Group, Barton and Barton suggested the group may be contemporaneous with the sedimentary rocks of the Labrador Trough. This interpretation is most probable and provides an Aphebian depositional age for the Snyder Group, in which case, this group is also contemporaneous with the Mugford and Ramah groups. The lithologic similarity, discounting more extensive metamorphism in the Snyder Group, is similar to parts of the Ramah Group.

Aillik Group (Aa)

The Aillik Group is the major layered rock unit in the Makkovik Subprovince. Most of the area between Kaipokok Bay and Big Bight in the easternmost part of the map area is underlain by rocks of this group. A narrow band of metasedimentary rocks and minor amphibolite west of Kaipokok Bay is included with this group.

Daly (1902) was the first geologist to report the presence of layered rocks near Aillik Bay, describing them as "variegated banded quartzites." At the same time, he recognized a thick band of conglomerate at Pomiadluk Point. Subsequently, Kranck (1939a) named them the "Aillik Formation" and the same rocks were later referred to as the "Aillik Series" by Kranck (1953) and Douglas (1953). Recently, Stevenson (1970) renamed an extension of these rocks, in the map area to the south, the Aillik Group, to conform with modern stratigraphic usage.

Kranck (1939a, 1953) reported the presence of limestone and mica schist as occurring with the rocks previously reported by Daly. Douglas (1953) suggested much of the group had been granitized and, although of granitic composition, retained some of its sedimentary structure. The most comprehensive study of the Aillik Group to date is work by Gandhi et al. (1969). This study established a stratigraphic sequence of rock units, which permitted the elucidation of the major fold structures. Gandhi also found that mafic volcanic rocks were present in the group. East of Aillik Bay, Barua (1969) recognized that many of the silicic rocks in the Aillik Group, previously considered to be of sedimentary origin, were derivations of acid volcanism, a conclusion also reached by Clark (1971) working to the southwest of the area investigated by Barua.

Structural relationships. The Aillik Group is assumed to lie unconformably on the Hopedale Gneiss, although nowhere is an unquestionable unconformity exposed. Gandhi et al. (1969) noted that the Hopedale Gneiss apparently grades into the formations of the Aillik Group. Stevenson (1970) was unable to locate any sharp dividing line separating these two rock units and also assumed their contact to be gradational. Structures in the two are conformable in the contact

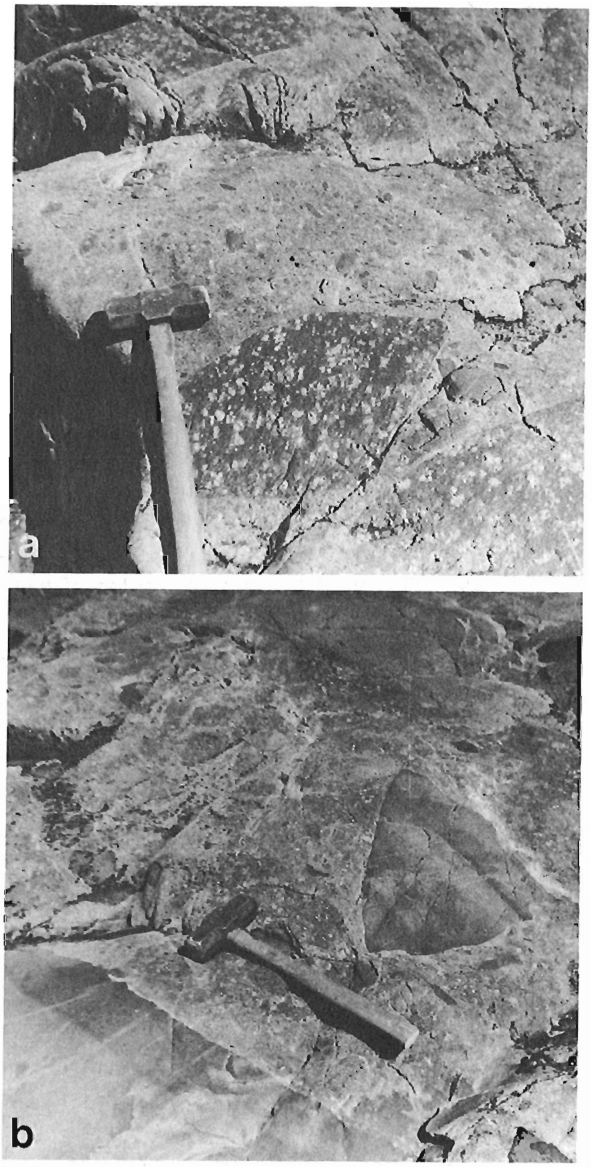


Plate 33a–e. Volcanic breccia of the Aillik Group (AAbc) on largest island 5 km north-northwest of Aillik village. Angular and rounded fragments of aphanitic to porphyritic varieties of trachyte and more siliceous volcanic rocks in dykes and probable flows with matrices of similar compositions (map area 13O). F.C.T. 172326, 172329, 172330, 172333, 172335.

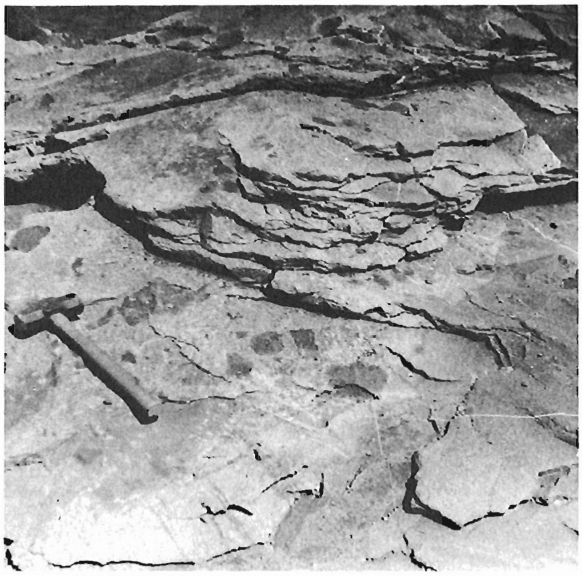


Plate 34. Volcanic breccia of the Aillik Group (AAbc) at Cape Aillik (map area 13O). F.C.T. 172338.

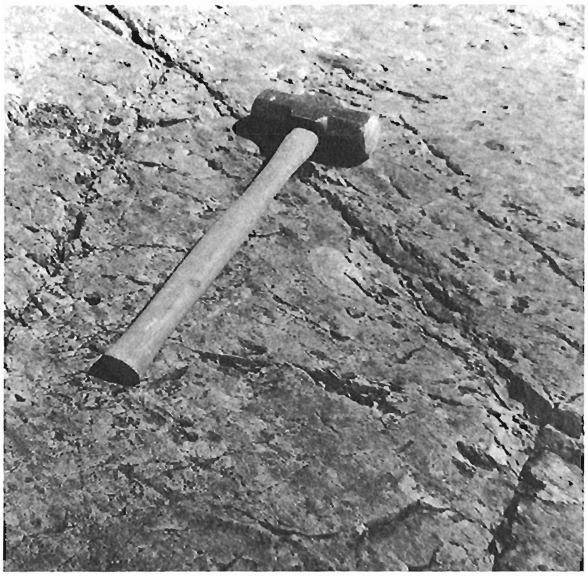


Plate 35. Volcanic breccia of the Aillik Group (AAbc) on the west side of the mainland east and opposite of the north tip of Long Island (map area 13O). F.C.T. 172375.

zone. However, as the Hopedale Gneiss has Archean isotopic ages in areas remote from the influence of the deformation of the Aillik Group, it is most probable that the Aillik Group lies unconformably on it. Remobilization of the Hopedale Gneiss during deformation of the Aillik probably destroyed the evidence of an unconformity.

Thickness. The stratigraphic thickness of the Aillik Group was estimated by Gandhi et al. (1969) to be in the order of 7600 m. No other reliable figures are available. Clark (1971) provided a partial section that ranges from approximately 1100 to 3500 m thick. The mafic volcanic rocks range from 6 to 150 m thick.

Siliceous tuffs and volcanic breccia (**A**Atf), **A**Abc). The Aillik Group, in decreasing order of abundance, consists of a mixture of metamorphosed pyroclastic, sedimentary and mafic volcanic rocks. Pyroclastic rocks are mainly of two types, breccias and tuffs; the former having been previously considered to be conglomerates (Kranck, 1953; Gandhi et al., 1969) and many of the latter mapped as various types of quartzites. Small amounts of rhyolite (**A**Arl) and trachyte (**A**Atc) are also present (Pls. 33–36).

The volcanic breccias of the Aillik Group consist chiefly of angular fragments less than 0.3 m in greatest dimension, although locally up to 1 m. In many outcrops of breccia the original shape of the fragments has been modified by shearing so that now they are commonly lens-shaped. Only rarely are well rounded fragments present,

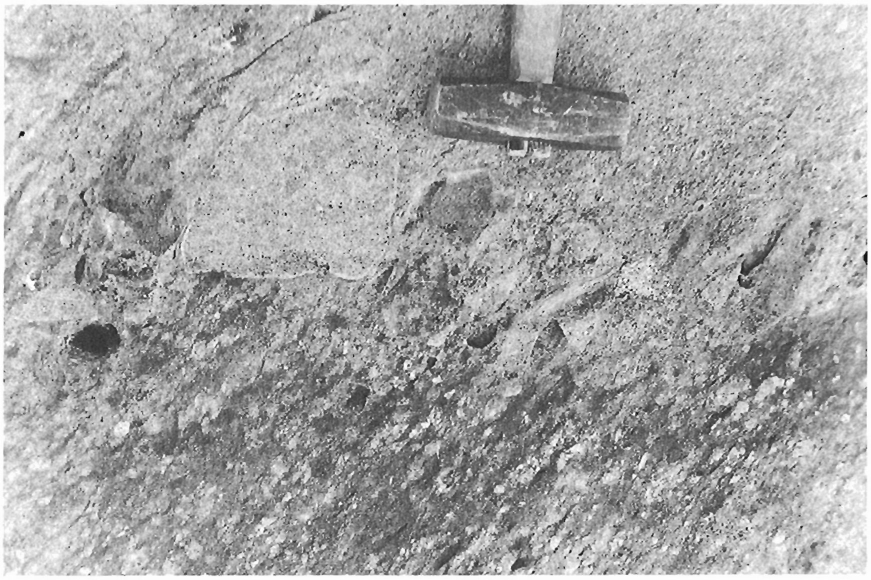


Plate 36. Bedding-cleavage relationships in Aillik Group pyroclastic rocks (AAtf) 4 km west of Big Island, Makkovik Bay (map area 13O). A.J.B. 172585.

Plate 37. Thinly bedded siliceous tuffs of the Aillik Group (**A**Atf) at Aillik village (map area 13O). F.C.T. 172368.

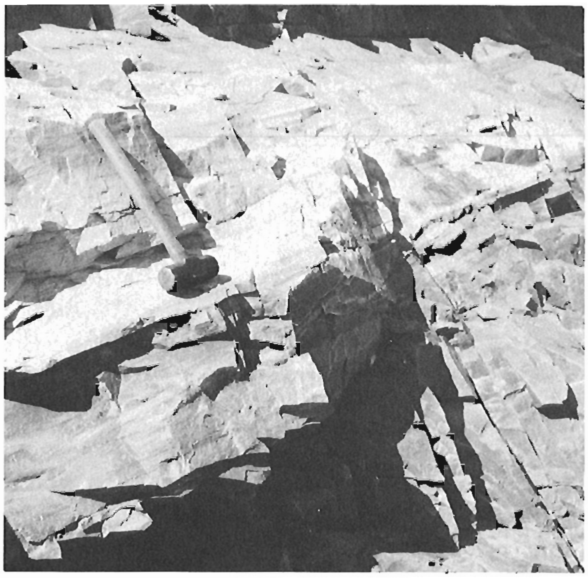


Plate 38. Banded lamprophyre (**A**lp) in well banded, siliceous, light coloured, tuff of the Aillik Group (**A**Atf) at Aillik village. Banding in the intrusive is parallel to that in the host at this point (map area 13O). F.C.T. 172370.

and these are primarily small (less than 1 cm) quartz and quartzite fragments. Lithologically the fragments are the same as the bulk of the Aillik Group itself. This volcanic breccia is particularly well exposed on the largest island of the Turnavik Islands underlain by the Aillik Group. There, the fragments consist primarily of variegated grey, fine grained, foliate, porphyritic metacrystal tuff and a dark grey, medium grained, equigranular, massive trachyte. The same rock types also form the matrix, and the latter also forms dykes up to a few metres thick (a prominent one strikes east and dips 15° south) that cut the breccia. Tongues of the dyke rock penetrate into the metacrystal tuff and contain fragments of it. A later breccia in the same outcrop shows an aplite and pegmatite matrix, which contains a few rounded fragments up to 5 mm in diameter of metacrystal tuff. The most foreign looking fragment is a low-quartz trachyte containing more mafic minerals than most of the rocks. At this point none of the fragments are accidental.

Other breccia localities show some accidental fragments. At Bents Cove on the east side of Kaipokok Bay opposite the north end of Long Island, white, medium grey and greyish-pink quartzite fragments, some of which are rounded, occur sporadically. The same medium grey quartzite forms a significant portion of the matrix at this locality. Rarer, deformed amphibolite fragments also are present At this place some fragments are well layered, similar to layering in other Aillik strata. Fragments are chiefly angular, but shearing is extensive and epidotization, with some chloritization and development of actinolite, is prominent. Some fragments are almost entirely altered to epidote, which is abundant in the matrix also. Fluorite, possibly a late mineral, is present at one place in the breccia at Bents Cove.

Southwest of the site of Aillik village the volcanic breccia contains fragments similar to those exposed on the islands to the north. This is the area considered by Kranck (1953) to be a conglomerate, which is here interpreted as a volcanic breccia.

Rocks classified as siliceous tuffs display a great variation in colour and texture but show considerable uniformity mineralogically. Almost all siliceous tuffs are light coloured, although less commonly medium shades of grey, orange pink and yellowish brown. Greyish orange pink and pale yellow brown are possibly the most abundant hues, with yellowish and olive greys well represented. However, colours show no consistency, even in individual outcrops. The dominant colour feature is, however, the generally light shades exhibited. Texturally, siliceous tuffs are fine to medium grained, locally porphyritic rocks that are usually weakly gneissic to schistose although locally well banded and in places massive. Porphyritic types display sub- to anhedral individual grains of potash feldspar, quartz and plagioclase or, as seen microscopically, individual clusters of these minerals that megascopically appear to be a single grain. The feldspar phenocrysts are commonly greyish orange pink to very pale orange and range from 3 mm to 1 cm in greatest dimension. In some samples what megascopically appear to be phenocrysts are in fact rock fragments that are dominated by a single quartz or feldspar grain, which is possibly a phenocryst. Others consist of mineral aggregates of quartz and potash feldspar. The matrix of the porphyritic rocks consists of an equigranular mosaic. In some places the banded rocks display great uniformity over short distances, with laminae ranging from 1 mm or so to about 1 cm. Elsewhere, laminae are restricted along strike and in part form elongate, narrow lenses, some as short as 10 cm. Graded bedding is locally present but is not discernible in most places. In part, banding is accentuated by concentrations of amphibole and other ferromagnesian minerals. Local crossbedding is present. The banded siliceous tuffs are difficult to distinguish from normal sedimentary strata and grade into them in some areas. A few gneissic types display a flaser texture (Pls. 37, 38).

Mineralogically these rocks consist primarily of potash feldspar, plagioclase and quartz in variable proportions. In some samples quartz forms up to 50 per cent; but, in general, potash feldspar is the most abundant mineral, forming up to 70 per cent. Whereas most feldspars are fresh, some are cloudy, and a few, particularly the larger plagioclase, contain white mica and more rarely chlorite and extremely fine grained clinozoisite(?). Potash feldspars are predominantly microline, but orthoclase is present in some samples. Some of the larger grains are perthitic, but none of the matrix potash feldspars are of this type. Plagioclase ranges from An_3 to An_{34} although Clark (1971) reported andesine also. Similar to the potash feldspars, some larger plagioclases are antiperthitic.

Ferromagnesian minerals are not abundant in these light coloured rocks and in many form less than 10 per cent. However, a few contain up to about 20 per cent, and in these a pale yellowish-brown to very pale orange biotite is the chief mineral. A greyish–blue-green to medium greenish-yellow hornblende is present in some rocks, but in general, where amphibole is common, biotite is absent and vice versa, although locally both are equally represented. Some biotite shows partial alteration to chlorite, but most is fresh. A few grains display pleochroic haloes.

It is likely that many of the now schistose or gneissic siliceous tuffs were once banded rocks with subsequent tectonism destroying or modifying the primary structures. The massive siliceous tuffs, which are in general equigranular, are less common. Whereas the banded schistose and gneissic types probably were stratiform because of normal water or air ash fall deposition, the massive types may be ignimbrites and of nuée ardente origin. A summary pertinent to the recognition of this rock type is given in Skinner (1974).

Mafic volcanic rocks (AAab). The mafic volcanic rocks of the Aillik Group now consist mostly of a massive, fine to coarse grained, equigranular, dark grey-green to dark green amphibolite. In part the amphibolite is foliated and locally lineated. Epidote, and less commonly calcite, form irregular blebs and veinlets. Gandhi et al. (1969) reported pillows in the amphibolite near the west shore of Makkovik Bay, but primary structures are not known elsewhere. This amphibolite is composed of approximately 60 per cent hornblende and 35 per cent of extensively altered intermediate plagioclase. Accessory minerals include epidote, biotite, magnetite, sphene and chlorite. Gandhi et al. (1969) reported garnet also as a rare constituent. Epidote commonly occurs in tiny veins, miarolitic cavities and irregular aggregates. An amphibolite from west of Kaipokok Bay contains microscopic veinlets of prehnite(?).

Sedimentary rocks (AAs). The sedimentary elements of the Aillik Group are metamorphosed sandstones, chiefly quartzites and feldspathic quartzites, along with lesser quantities of limestone, greywacke and argillaceous rocks. The arenaceous rocks form poor to well bedded bands throughout the group. These range in thickness from a few centimetres to a few hundred metres. The most extensive area of quartzite probably occurs in the unit shown by Gandhi et al. (1969) as banded quartzite. However, much of that map unit is known to consist of tuffs. The quartzites are fine to medium grained, light grey to pale red and well bedded. Cross-bedding and rare flame structures are present, and ripple marks and load casts have been reported (Kranck, 1953; Clark, 1971).

Microscopically the quartzites are seen to be almost completely recrystallized, so that detrital characteristics are seldom preserved. Only rarely is the quartz content greater than 80 per cent, and most rocks contain appreciable quantities of feldspar so that there is a gradation into the metatuffs previously described. Biotite, hornblende, epidote, calcite, muscovite and, rarely, zircon occur in variable amounts.

A few rocks are fine to medium grained, various shades of grey and display good bedding and colour banding, some with schistose tops. Typical are those bordering Kaipokok Bay on the east side. Some muscovite-biotite-quartz-feldspar schist forms discrete bands at this point. These rocks are completely recrystallized and also show extensive development of biotite and muscovite in most places. Quartz content ranges from 45 to 75 per cent. Feldspar is chiefly plagioclase, but K-feldspar is also present. Apatite, zircon, magnetite, epidote and tourmaline occur as accessories.

Thin amphibolite bands, up to 1 m, are interbedded with these metagreywackes. A band 30 m thick of rusty weathering pyritiferous feldspathic quartzite or greywacke occurs with these rocks south of Long Island.

Similar rock occurs on the southernmost of the Ironbound Islands, where a 2 m thick band of very fine grained, medium grey, equigranular biotite schist is associated with metatuff and a greywacke containing blebs of granite. The biotite is extremely chloritized, and fine grained sericite is common in the matrix. The chlorite development is probably related to the granite emplacement.

Limestone comprises only a few outcrops. The most prominent is on the east side of Aillik Bay near its head, where a coarse grained orange marble forms the matrix of 6 m thick breccia containing cherty sediment fragments. A thin, discontinuous limestone band is present southwest of Kitts Pond.

Many other rock types contain tiny amounts of carbonate. Its presence in the tuffs has previously been mentioned. At Cape Aillik a fine grained, weakly foliated, pale greenish-yellow lime-silicate rock forms a discrete band in the tuff horizons. This rock consists of a nearly equigranular mosaic of quartz, feldspar and diopside, with slightly larger grains of subhedral, pale yellowish-brown garnet, probably chiefly grossular. Small amounts of calcite, sphene, zircon and chlorite are also present.

The Aillik Group shown west of Kaipokok Bay is an extension of strata mapped by Stevenson (1970) to the south. These rocks are more intensely laminated than those on the east side of the bay. They consist of a mixture of amphibolite and metasedimentary rocks. Dark greenish-grey, fine grained, thinly laminated amphibolite forms bands 20 to 30 cm thick in the metasedimentary rocks near the southern boundary of the map area. The metasedimentary rocks are light or variegated grey, fine grained, well laminated, equigranular rocks composed mainly of quartz, plagioclase and potash feldspar. Biotite and muscovite form about 5 per cent of the rock, with the former slightly more common. Epidote, magnetite and zircon occur as accessories. Granitic veinlets are common, and in the south thin aplitic veins occur parallel with the foliation. The structural relationship of these rocks with the Hopedale Gneiss is unknown, with foliation in each being parallel. On strike from these rocks, Sutton (1972) mapped greenstones that display pillows south of his map area. This tends to confirm that these rocks are part of the Aillik Group rather than elements of the Hopedale Gneiss.

Age and correlation. As previously indicated, structural relations between the Aillik Group and the Hopedale Gneiss are unclear, but an unconformity between the two is most probable thus the Aillik is post-Archean.

Gandhi et al. (1969) concluded the group was Aphebian, based on isotopic and field data.

The relationship of this group to other Aphebian rocks is discussed elsewhere.

Long Island Gneiss (**A**LIg)

The name Long Island Gneiss was introduced by Gandhi et al. (1969) for rocks exposed on Long Island in Kaipokok Bay and to the south on the mainland within and beyond the present map area. They reported that this unit intrudes both the Hopedale Gneiss (**A**) and the Aillik Group (**A**A) and is itself intruded by granite gneiss and postmetamorphic intrusions. Clark (1971) tentatively correlated a "lighter coloured gneiss of granitic composition" that occurs at Long Point on Makkovik Bay (shown here as being part of the Strawberry granitic suite (**A**sgr) with the Long Island Gneiss. Gandhi et al. (1969) noted that the boundary between the Long Island Gneiss and both the Aillik Group and Hopedale Gneiss is generally sharp and irregular and that it truncates formations of the former and the attitude of the banding in the latter. Irregular dykelike bodies of Long Island Gneiss cut banded units of Hopedale Gneiss. Significantly, they state that the eastern boundary of the "gneiss with feldspathic quartzite (Aillik Group) is also sharp and irregular, but generally follows the trend of the foliation and bedding of the formation." Also, foliation in this gneiss, where well developed, is nearly parallel to that of the feldspathic quartzite (Aillik Group). The contact between this unit and fine grained, dark green, foliate amphibolite (**A**Aab) on the west side of Long Island is parallel to the foliation in both rock units, and there is no indication of an intrusive relationship at this locality.

A common feature is the presence of inclusions ranging from about 1 cm up to 0.6 m in overall length. These are variously well rounded to angular, in part lensoid and elongate. Inclusion-matrix boundaries are sharp and well defined.

Megascopically this rock is chiefly a medium grained, variegated grey, weak to moderately foliated quartzofeldspathic gneiss. Locally, fine grained elements are present, and some parts display feldspar grains and clusters of grains up to about 0.5 cm in length. Gandhi et al. (1969) reported it to be massive locally. Both biotite and hornblende are present, comprising from 10 to 15 per cent of the rock. In thin section, feldspar can be seen to consist of roughly equal amounts of K-feldspar (chiefly microcline) and plagioclase (An_{28}). Although most are fresh, some show partial alteration to sericite, albite and epidote. Quartz forms about 10 per cent. Biotite is pleochroically olive brown to pale greenish yellow, and some grains are partially to entirely chloritized. Hornblende is dark yellowish green to moderate greenish yellow and fresh. Sphene, apatite, calcite, epidote, magnetite and zircon occur in accessory amounts with sphene much the commonest.

The mineral composition of the inclusions in the Long Island Gneiss is identical with that of their host, with the exception of amphibolite and diorite reported by Gandhi et al. (1969), which were not seen during the present survey. The percentage composition, however, is quite variable, with some inclusions being rich in mafic minerals, whereas others are relatively poor in dark minerals.

Origin. Gandhi et al. (1969) considered the Long Island Gneiss to be an orthogneiss of granodiorite composition because of apparent intrusive relationships with the Aillik Group and Hopedale Gneiss. The existence of a K-Ar age of 1832 ± 58 Ma (an age considerably older than that obtained for samples from the Aillik Group and post-Aillik intrusive rocks) on a mixed sample of hornblende and biotite, dominantly the former, was explained as being an anomalous figure due to a higher argon retention of hornblende despite the fact that hornblende was also used for some of the supposedly older rocks.

Clark (1971) was unable to confirm an intrusive relationship with the Aillik Group in the Kaipokok Bay area (neither was the present survey) and suggested that the Long Island Gneiss was part of the pre-Aillik basement, as a mafic 'pebble' band occurs along the contact that he interpreted as evidence for an unconformity. Whereas the intrusive character of the Long Island Gneiss into the Aillik Group is supposedly well displayed at Swell Lake south of the present map area, Clark suggested that the Swell Lake rocks, which are evidently lithologically dissimilar to the type Long Island Gneiss, may be a different rock altogether; this suggestion, the writer finds most reasonable.

Whereas Clark's interpretation is not without merit, the writer is of the opinion that the Long Island Gneiss is in fact part of the Aillik Group itself. Except for a somewhat coarser grain size and weak to moderate foliation, it is mineralogically similar to many of the metavolcanic elements of the Aillik Group, in particular those exposed near Aillik Village and the islands to the north. The presence of numerous inclusions similar in mineralogical composition to the matrix is readily explained by a volcanogenic origin for the Long Island Gneiss. Many of these inclusions and the host itself are almost indistinguishable from some of the more metamorphosed parts of the Aillik Group. The presence of a pebble horizon, noted by Clark (1971) as proof of an unconformity between this gneiss and the Aillik Group, is very weak evidence. Pebble horizons occur in many places within the Aillik Group, and although they do indicate a break in the depositional history they are not of major stratigraphic significance.

There seems little doubt that the Long Island Gneiss overlies the Hopedale Gneiss unconformably, as Gandhi et al. (1969) first recognized. However, during subsequent tectonic movements this unconformity has been obliterated in most places as the basement in the immediate vicinity of the Aillik Group was involved in its deformation, as Gandhi et al. (1969) indicated when interpreting the 1728±32 Ma K-Ar biotite age from a sample of Hopedale Gneiss. (Most Hopedale Gneiss ages are in the order of 2400 to 2600 Ma—see Table 2). The suggestion that the 1832±58 Ma for the Long Island Gneiss is anomalous is probably erroneous, and if anything, this is closer to the true age of deposition of the Aillik Group than any other ages reported to date. Ages reported for the Aillik Group by Gandhi et al. (1969) (1497±22 and 1545±14) have most probably been affected by the emplacement of the Strawberry intrusive suite and are much too young for the depositional age for these rocks.

In summary, the writer considers the Long Island Gneiss to be part of the Aillik Group, an Aphebian silicic metavolcanic rock that lies unconformably on the Hopedale Gneiss.

The Long Island Gneiss (**ALig**) is shown separately on the present map in order to conform to Stevenson's (1970) map to the south, and to emphasize the minor differences between it and the major part of the Aillik Group (**AAs**, **AAtf**).

Unassigned map units

Many rocks, chiefly gneisses lying to the east of the Labrador Trough and extending to the Nain-Churchill province boundary, cannot be assigned with certainty to any of the foregoing rock units. These rocks, predominantly of sedimentary origin, are considered to have been deposited during the early Aphebian and metamorphosed and deformed during the Hudsonian Orogeny. Insufficient data are available to make a meaningful assignment to the presently named rock units. However, it is deemed likely that all are closely related to the named units. Some, as previously indicated for the quartzite east of Indian House Lake, may be outliers of the Lake Harbour Formation. Others, such as map unit **Aak**, are probably part of the Kaniapiskau Supergroup, but most are either too remote from named

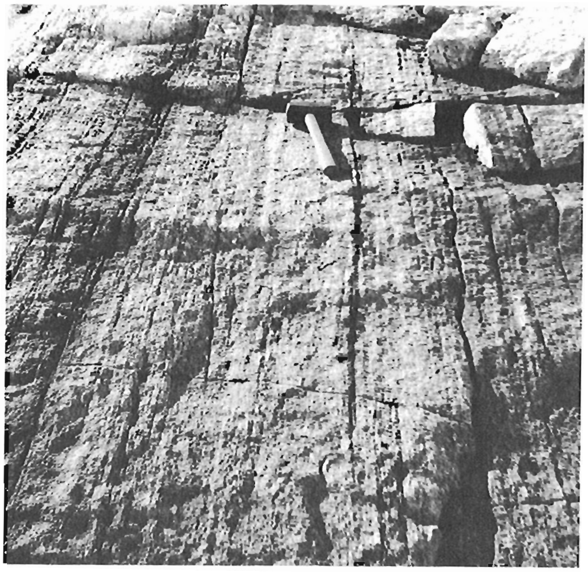


Plate 40. Banded granulite (**Agl**) typical of this map unit. Large hypersthene crystals are visible as dark spots. Northeast corner of map area 24I, 5 km south of Mount Silene. F.C.T. 171364.

Plate 39. Well layered granulite (**Agl**) 6 km southeast of Upper Kangalaksiorvik Lake (map area 24P). C.K.B. 172179.

units or too intensely metamorphosed to attempt a correlation.

Granulite (Agl). Granulite underlies two major areas, one chiefly in map area 23P and the other, the larger, occupying the major portion of the central part of the map area. The latter forms a linear zone extending from Killinek Island, N.W.T. in the north (map area 25A) to Cabot Lake (map area 14D) in the south, over 450 km long and up to 90 km wide. The medium grained crystalline rocks are typically very well layered (Pl. 39), representing most probably relict bedding and commonly show a streaky foliation. A light rusty brown to white weathered surface and a pale yellowish-brown fresh surface is characteristic (Pl. 40).

The northern part of this belt is somewhat more massive than the rest of the belt and also coarser grained, and in a few places displays large garnet porphyroblasts. Hornblende is more common, so that the rock is a darker shade on the whole than elsewhere (Pl. 41).

At a few places granulites are much coarser grained than normally encountered. This greater grain size is particularly prevalent with respect to hypersthene; in some outcrops this mineral is up to 1 cm long. Extremely large hypersthene crystals occur at a few points. For example, 3 km east of the headwaters of Palmer River (map area 24I) 15 to 30 cm 'sills' of granulite are present in the 'normal' granulite. Hypersthene crystals in these sills are up to 15 cm long in a medium grained matrix of quartz and plagioclase.

Locally associated with the granulites are thin, pale pink to light grey, medium grained equigranular granitic rocks that form sills or bands in the granulite up to 3 m thick but are most commonly a few centimetres thick. These rocks are in part composed entirely of quartz and feldspar whereas others contain small amounts of biotite and a few hornblende or hypersthene. These sills are probably formed from mobilized elements derived from the granulite itself (Pl. 42).

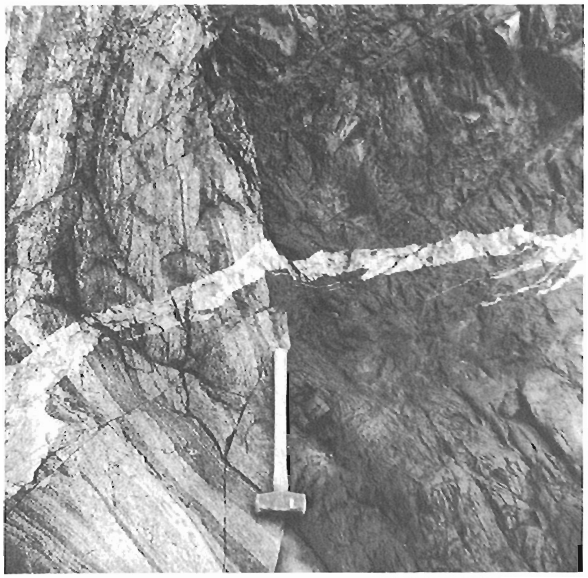


Plate 42. Red granite dykelet (white in photo) intruding a diabase dyke and biotite-quartz-feldspar gneiss with local hypersthene (Agl) 1.3 km west of Hassell Head (map area 14M). F.C.T. 171527.

Included in this rock unit are thin bands of white weathering garnet-quartz-feldspar gneiss (Afg), paragneiss (Apg), more rarely rusty graphitic quartz-feldspar gneiss (Arc), granitic gneiss (Agg) and some amphibolite horizons. The garnet-quartz-feldspar gneiss, paragneiss and rusty gneiss are identical to those described elsewhere, but the amphibolite present in the granulite terrane in many places contains hypersthene and in some places a clinopyroxene also. Garnet is present in some of these amphibolites, which locally form up to 40 per cent of the rock, in well defined

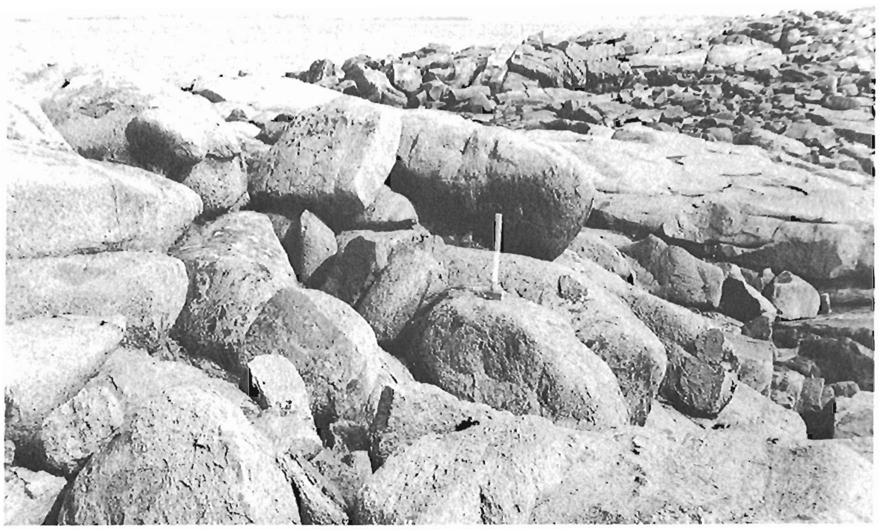


Plate 41. Massive, dark brown weathering, mafic granulite (Agl); 12 km south of Cape William Smith, east side of Ungava Bay (map area 25A). R.S. 171763.

bands up to a few metres thick. Amphibolite also form pods, streaks and schlieren in the granulite. In some of these amphibolite bands hornblende is commonly coarse grained, whereas the amphibolites as a whole are medium grained.

Compositionally this granulite is dominantly a plagioclase-quartz rock with variable amounts of hypersthene, biotite, hornblende, garnet and clinopyroxene in decreasing order of abundance. Most samples consist solely of biotite, hypersthene, quartz and plagioclase. Hypersthene is usually strongly pleochroic and chiefly fresh; however, some grains are partially altered to hornblende, but an alteration to a reddish-brown, semiopaque product (possibly iddingsite) is more common. Elsewhere alteration to uralite and chlorite occurs. Biotite in the granulites is characteristically strongly pleochroic from pale yellow orange to a bright foxy reddish brown, colours not seen in biotites less highly metamorphosed. In rocks where hypersthene is scarce, the presence of this reddish biotite is a good indicator that the rocks belongs to this unit. Plagioclase, predominantly fresh but locally slightly sericitized, ranges from An_{28} to An_{46} and averages An_{38}. Some plagioclase is antiperthitic, and a few thin sections show minor amounts of potash feldspar. Hornblende, which rarely forms as much as 10 per cent, is variously yellowish brown to grey green. Clinopyroxene, in part uralitized, occurs rarely and is colourless to very pale green salite. Garnet, which is sub- to euhedral, is rare. Apatite, zircon, magnetite, calcite and allanite are present as accessories.

The granulite mass extending from Mina Lake to the southern boundary (map areas 24A, 23P) is petrographically, and probably mainly genetically, different from the main granulite area. This granulite is primarily a light brown to dark grey, grey-green to olive-green, weakly to moderately foliated, hypidiomorphic to porphyritic rock. Where porphyritic, alkali feldspar crystals showing Carlsbad twins are up to 6 cm long. In some places these are aligned roughly parallel to the foliation in the matrix. Locally, banding in dark and light bands is present, in part as thin as 1 cm but in general is scarce. At one point 20 km northeast of Arjay Lake (map area 23P) numerous fragments, some stretched up to 75 cm long and 15 cm wide, occur within this granulite. The fragments, which are angular to ovoid, consist of amphibolite and leucocratic granitic rocks that are themselves granulites. This occurrence is interpreted as a metaconglomerate.

Compositionally this granulite differs from the major area of granulite in that almost everywhere green hornblende and/or clinopyroxene are present, along with significant amounts, up to 25 per cent, of potash feldspar. Plagioclase (An_{28-38}) content, which ranges from 20 to 65 per cent, is commonly antiperthitic and slightly altered to sericite. Hypersthene, 1 to 20 per cent, is chiefly fresh but chloritized and serpentinized locally. Biotite is primarily a dark yellow to very pale orange and only rarely the bright foxy reddish brown, so typical of the major granulite area. Accessory amounts of magnetite, chlorite, calcite, apatite, zircon, muscovite and pyrite occur.

The well banded granulites in the central part of the map area are almost certainly metamorphosed sedimentary strata with possible local metavolcanic rocks that are now amphibolites. The porphyritic granulite is probably, at least in part, charnockite, an intrusive rock. The presence of minor banding in a conglomerate horizon suggests that some of this granulite may also have a sedimentary ancestry. Contact relationships with bordering rocks are ill defined but are in part gradational, which trends to support a metamorphic origin.

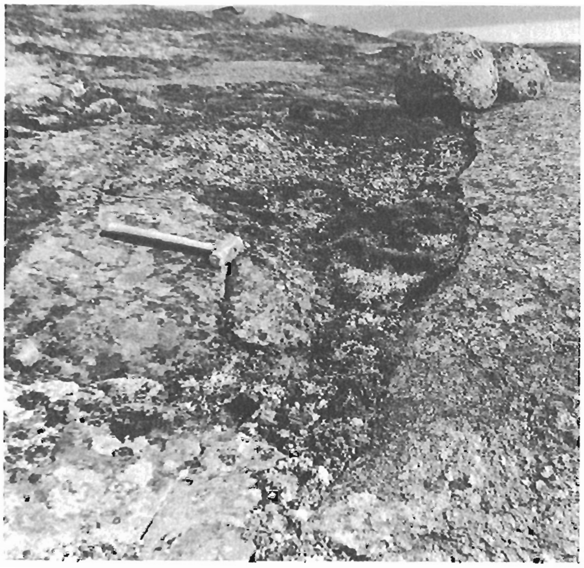


Plate 43. Contact between garnet-quartz-feldspar gneiss (**Afg**) on left with foliation parallel to hammer handle, and granodiorite (**Pgd**) forming part of the adamellite suite. Contact metamorphic effects are negligible in the gneiss, and the granodiorite is coarse grained up to the contact; 2 km west of Southern Bight, Voisey Bay (map area 14D). F.C.T. 172476.

Garnet-quartz-feldspar gneiss (Afg.) An extensive area of garnet-quartz-feldspar gneiss lies along much of the boundary between the Nain and Churchill provinces. The same rock also occurs within part of the granulite terrane (Agl) extending to the northwest to the coast of Ungava Bay. In the southern part of the map area it is engulfed by various elements of the anorthosite-adamellite intrusive suite and has been extensively recrystallized (Pl. 43).

This rock is noteworthy for its petrographic uniformity consisting almost invariably of garnet, quartz and feldspar and a characteristic white weathering that makes it readily recognizable from the air. Extensive mylonitization is typical and is manifested in lenticular outlines of quartz and feldspar grains, which are commonly over 2 cm long and 2 mm thick. This attribute forms a strong and consistent foliation. The extensive rodding of quartz and feldspar apparent in some outcrops imparts a strong subhorizontal lineation. Less common is an equigranular, fine to medium grained, massive rock. Although most probably a metasedimentary rock, bedding is extremely rare because of the penetrative foliation, which is probably parallel to the bedding plane. Where present, bedding is marked by thin sillimanite and graphite layers. In some places it is apparent that the garnet grains have been rotated within this plane of foliation, whereas in others, crushed garnets form augen-shaped grains. Where this rock has been affected by the intrusion of the anorthosite-adamellite suite, recrystallization has resulted in the destruction of the typical foliation and a coarse grained equigranular rock is representative.

Within this unit thin bands of granulite (**A**gl), granitic gneiss (**A**gg), and less abundantly, quartzite (**A**qz) and amphibolite (**A**ab) are present locally.

This gneiss ranges from fine to coarse grained, and in the latter rocks garnet grains are up to 1.2 cm in diameter. Garnets are pale red to greyish red purple, and less commonly pale red purple to pale purple, and comprise from 5 to 10 per cent of the rock. Feldspar, which is light grey to white and which comprises between 55 and 77 per cent, consists of plagioclase (An_{28-38}) primarily with K-feldspar forming less than 5 per cent. As well as the major constituents, small amounts of biotite are present in some places along with rare graphite, sillimanite and pyrite. Locally thin bands with one or all of the above minerals form distinctive members within this unit. These are characterized by a darker or rusty weathered surface.

The relationship of this gneiss with other rock units is not well defined. It is interbanded with granulite (**A**gl) west of Saglek Bay and farther to the north, and is no doubt itself primarily in the granulite metamorphic facies. Its eastern boundary defines the Churchill-Nain province contact, which is probably a fault. As it includes small areas of graphitic gneiss (**A**rc) calc-silicate rocks (**A**cs) and other strata of sedimentary origin and is compositionally compatible with sedimentary rocks, it too is considered to have a sedimentary origin. An improbable great thickness of this unit occurs in the Hebron Fiord region (over 40 km), which suggests that the unit is isoclinally folded, an impression also gained from the map pattern in the Saglek Fiord area where it is intertongued with granulite (**A**gl). The amount of isoclinal folding is unknown.

Quartzite (**A**qz). Mappable amounts of quartzite are present in a few places in the gneissic terrane, but occurrences of quartzite too small to show on the present scale of mapping are distributed quite abundantly throughout the region, particularly in the paragneisses (**A**pg). The most conspicuous quartzite area lies 3.2 km east of Indian House Lake in map area 24A. Lithologically this quartzite is typical of this rock unit and consists of a well banded, white, light yellow to light pink, equigranular, medium grained rock. Many of these quartzites contain small amounts of feldspar, some are feldspathic quartzites, and muscovite is present locally. The large quartzite area east of Indian House Lake differs from the other quartzites in that it contains a few conglomerate layers containing well rounded quartz pebbles up to 6 cm in diameter. Bedding is also better preserved than elsewhere, and rare crossbeds are discernible (Pl. 44).

The quartzite south of the Korok River is a white to light grey, well bedded rock with individual beds ranging from 6 cm to 1 m thick. A few interbeds of sillimanite-biotite-quartz gneiss up to 2.5 cm thick, form less than 1 per cent of the strata. Other interbeds, less than 25 cm thick, contain hematite spots up to 0.8 cm across that in some places may be pebbles. Elsewhere a few argillaceous zones contain garnet as well as sillimanite.

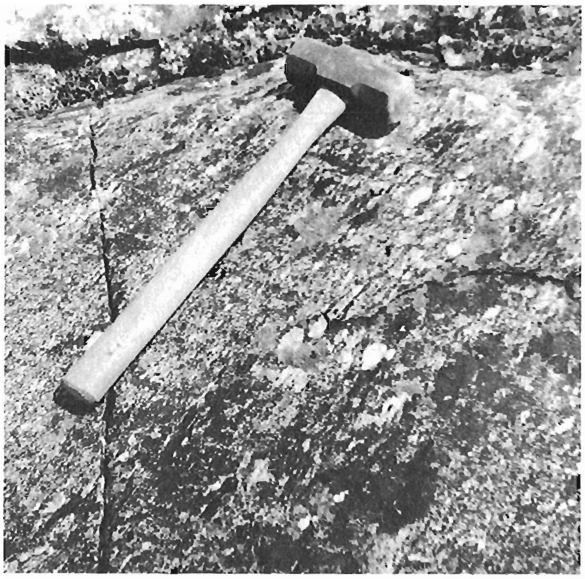


Plate 44. Quartz pebble horizon in quartzite (Aqz) east of Indian House Lake (map area 24A). F.C.T. 172399.

Other quartzites are similar to those described above (Pl. 45). Graphite and pyrite occur in some of the smaller quartzite areas but are in general rare constituents.

Arkose, conglomerate (**A**ak). In map areas 24A and 24B two outcrop areas of meta-arkose and conglomerate lie within areas of granitic gneiss (**A**gg). Their relationship to rocks of the Labrador Trough is not clearly defined, but lithologically they are similar to parts of the Knob Lake Group (**A**κak). About 5 km west of Lac Jeannin a greyish-pink, medium to coarse grained, feldspathic quartzite to meta-arkose lies in an area of gneissic granite (**A**gg). This meta-arkose is characterized by large muscovite metacrysts, up to 1 cm in diameter, small, well formed magnetite grains, which commonly form thin laminae, and scattered detrital quartz pebbles. Its relationship to the enclosing gneiss is unknown, but a streaky foliation in the meta-arkose is parallel to that in the gneiss, suggesting simultaneous deformation.

In map area 24A, about 7 km west of Mina Lake, a similar but more highly deformed, partly schistose rock is present. Although chiefly massive, this rock, where laminated, displays thin, contorted, magnetite layers similar to those in meta-arkose west of Lac Jeannin. Large muscovite metacrysts are present in this outcrop area also. There are local lenticular quartzofeldspathic veins as well as irregular granitic layers.

Amphibolite (**A**ab). Small areas of amphibolite are present throughout much of the gneissic terrane east of the Labrador Trough, but most are too small to show on the present maps. They range in size from 1 m or so to tens of metres thick and up to several kilometres long. Most amphibolites occur in linear masses oriented so that their greatest dimension lies parallel to the regional trend. However, some of the smallest masses form irregular shapes, particularly those amphibolites lying within migmatite (**A**mg) and massive granitic rocks (**A**gd, **A**gr). Contacts with bordering rocks are chiefly sharp, but gradational contacts also are represented.

Lithologically, amphibolite is typically a dusky green to greenish-black, fine grained, equigranular, moderately well foliated rock consisting essentially of hornblende and plagioclase. However, a great diversity of structure, texture and grain size is displayed by rocks of this map unit. Structurally amphibolites are variously banded, massive or schistose, and grain size ranges from fine to coarse. Although dominantly equigranular, a few amphibolites are porphyritic, cataclastic and more rarely show feldspar augen. Thin sections similarly show a great diversity in mineral percentages, degree of alteration, and varietal and accessory minerals present. Amphibolite content, which ranges from 25 to 80 per cent, consists mainly of green hornblende with local pale green actinolite in some of the southwesternmost outcrops. A few samples show both hornblende and small amounts of actinolite. Plagioclase (An_{28-50}) is variously fresh to extensively altered. Zoning is present in some samples, and in a few fine grained samples plagioclase is untwinned. Alteration consists of a cloudiness or development of sericite and epidote. Biotite, although not invariably present, is the commonest varietal mineral, forming up to 5 per cent. Chloritization is extensive in some samples. Dusky red garnet comprises up to 5 per cent in the few amphibolites in which it occurs. Accessory minerals, identified from a variety of amphibolites, include chlorite, calcite, sphene, clinopyroxene, epidote, apatite, magnetite, pyrite, zircon and quartz.

As most of these rocks are concordant with their bordering rocks, they are probably derived primarily from basic volcanic rocks or sills. The total absence of primary volcanic structures suggests a probable intrusive origin.

Schist (**A**sc). Two schist zones, which occur in map area 23P and 24A well east of rocks generally considered to comprise elements of the Labrador Trough, comprise this map unit. The most extensive outcrop area lies near the junction of the Rivière De Pas and George River south of Indian House Lake where a 600 m wide schist zone lies within paragneiss (**A**pg). The second area lies on strike about 5 km to the south.

The northern zone consists of a fine to medium grained, medium grey to light brown, equigranular to locally augen schist interlayered with up to 40 per cent paragneiss and less commonly, 10 per cent white, fine grained, garnetiferous quartzite. In the central part of the zone white, medium grained, granite forms irregular dykes up to 5 m thick and a few sills. The southern zone consists of a fine grained, rusty to medium grey-green, equigranular schist with rare light grey, fine grained greywacke beds up to 5 m thick. White quartzite beds, up to 15 cm thick, are interlayered in some places. Quartz lenses up to 5 cm thick lie along foliation planes in a few places.

These schists are composed of about 10 per cent each of light to reddish-brown biotite and muscovite, quartz, plagioclase and potash feldspar. Garnet and andalusite metacrysts up to 1 cm long are present in the southern zone. Accessory minerals include tourmaline, apatite, zircon and magnetite. These schists undoubtedly are the site of a small argillaceous horizon within what was a major arenaceous sedimentary terrane.

Rusty graphitic paragneiss (**A**rc). Rusty graphitic paragneiss, which forms a significant part of the Lake Harbour Formation, is also widely scattered throughout the gneisses northeast of the Labrador Trough. Only in a few places does it form mappable amounts outside the area assigned to the Lake Harbour Formation.

Individual horizons of rusty graphitic paragneiss range from 1 m or so up to 1525 m in thickness, but most are less than 150 m thick. Contacts with neighbouring crystalline

Plate 45. Quartzite (**A**qz) 7 km south-southeast of Lac Testu (map area 24B). Hammer lies along bedding plane. C.K.B. 171850.

limestone and granitic gneiss are conformable and sharp for the most part, particularly within limits of the Lake Harbour Formation. Elsewhere contacts are partly gradational, especially with migmatite (**Amg**). Thin and commonly irregular white granite and pegmatite dykes occur throughout much of this unit (Pl. 46).

This massive to poorly bedded rock is characterized by its rusty weathered surface, which is readily recognized from the air and hence easily distinguished from other rock units. It is fine to medium grained rock with white to creamy fresh surfaces, consisting essentially of quartz, plagioclase, biotite and graphite, the latter being ubiquitous although forming only 1 or 2 per cent of the total. Pyrite is probably also common as the weathering of this mineral undoubtedly produces the rock's rusty character. Quartz makes up at least half the content and plagioclase (approximately An_{34}) up to about one third. Biotite comprises up to 20 per cent, but most samples contain 5 per cent or less. Locally small amounts of euhedral garnet are present. Accessory minerals are magnetite, zircon and muscovite.

This unit is possibly a very lean sulphide facies iron-formation and if so, suggesting a restricted anaerobic environment.

Calc-silicate rocks (**Acs**). Scattered erratically through the gneissic terrane east of the Labrador Trough are small areas underlain by calc-silicate rocks. These rocks are most commonly associated with granitic gneisses (**Agg**) with smaller amounts with paragneiss (**Apg**) and migmatite (**Amg**). Contacts with the bordering rocks are variously gradational or sharp; those with other metasedimentary rocks being chiefly gradational. Amphibolite occurs with calc-silicate rocks in many places, and interbanding of the two rock types is displayed in several outcrops. Many calc-silicate exposures are characterized by the presence of numerous small white pegmatite and granite dykes and sills, which form up to 30 per cent of the rock.

Included with these rocks are localities where calc-silicate rocks form only a small proportion of the outcrop. In some places calc-silicates occur only as lens-shaped inclusions in granitic rocks and in others as angular fragments in agmatites. Also included in this map unit is a 100 m thick band of relatively pure crystalline limestone that outcrops north of Border River (map area 13M).

Characteristically calc-silicate rocks are moderately well layered, locally thinly laminated, fine to medium grained, and light to medium grey weathering. On fresh surfaces the rock is variously white, light grey or pale green to grey-green. Well formed grains of diopside commonly give a speckled appearance. In some outcrops weathering is pronounced, and the rock is friable.

Compositionally these rocks consist of a granular mosaic of diopside, tremolite, plagioclase, quartz, garnet, hornblende, biotite, phlogopite and scapolite in various proportions. Garnet and bright green diopside are commonly euhedral. Not all the foregoing minerals are present everywhere, but characteristically at least several of them are. Whereas many rocks contain some calcite, some do not. Small amounts of sphene, apatite, iron ores and epidote are present in most samples.

At the mouth of the Whale River (map area 24J) an outcrop typical of the rock association of the calc-silicate rocks is well exposed. Amphibolite containing garnetiferous bands, ranging from a few centimetres to 1 m thick, grades into grey to dark grey, medium to coarse grained, well foliated, biotite-quartz-feldspar paragneiss with garnets in some horizons. In part the latter rock is contorted and contains boudins of quartzite 0.6 m long. Other quartzite beds, up to 0.6 m thick lie adjacent to the calc-silicate rock, which also shows zones rich in garnet and some quartzite boudins.

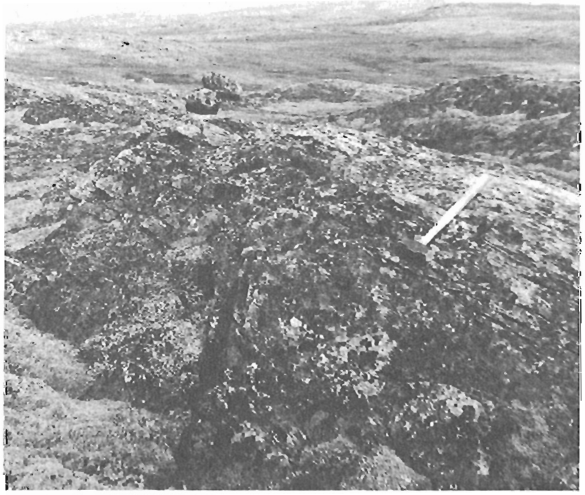


Plate 46. Well layered metasedimentary rocks consisting of quartzite (**Aqz**) and a minor amount of rusty graphitic quartz-rich paragneiss (**Arc**) 19 km north of the Pyramid Hills (map area 24H). F.C.T. 172424.

Paragneiss (**Apg**). Rocks included in this map unit are all believed to be of sedimentary origin and derived from rocks equivalent in age to the Knob Lake Group and Lake Harbour Formation. They exhibit various degrees of foliation ranging from markedly foliated, almost schistose rocks, commonly rich in biotite, to weakly foliated, nearly massive rocks. The latter may form bands intercalated with more gneissic representatives. In some places well laminated or layered rocks are characteristic, and these features are interpreted as relict bedding. In other places thin laminae consist of white feldspar, which is possibly of metamorphic derivation. Where both are present, foliation attitudes chiefly coincide with layering so that where the latter is absent foliation may be a reflection of primary bedding. For example, garnet-biotite-quartz-feldspar gneiss southwest of the Lake Harbour Formation shows good banding and a poorly developed foliation. These planar features are highly contorted in some outcrops, but in others a persistent uniform strike is typical.

Amphibolite-paragneiss contacts are sharp or gradational over a few centimetres. Where adjacent to other

Plate 47. Medium to coarse grained biotite-quartz-feldspar paragneiss (Apg) with local feldpar augen developed. Foliation and lamination both probably parallel to original bedding; 1 km south of south end of Lac Jeannin (map area 24B); F.C.T. 171293.

metasedimentary rocks, such as quartzite (**A**qz), an abrupt contact is prevalent, although interbanding is also present and less commonly a gradation into one another (Pls. 47–49).

Internally the layered rocks show both gradational and abrupt relationships, which are probably a reflection of the primary bedding. The variation in foliation development commonly is gradational within individual outcrops, but in places where foliation approaches schistosity a sharp break is locally present between extremely well foliated rocks and more massive members. Foliation is marked chiefly through alignment of biotite grains and less commonly by oriented hornblende. Layering is manifested by mineral segregation, either felsic or mafic.

Grey is the dominant colour of these equigranular rocks. Medium grey shades predominate, but light and dark hues are well represented and slightly pinkish-grey rock is locally prevalent. Biotite and hornblende content is greatest in the darker rocks and where biotite-rich these rocks are nearly black. A salt and pepper appearance is typical, particularly where foliation is weak to moderate.

Contacts with adjacent rock types are manifold. The most prevalent relationship is gradational, however, and this is particularly characteristic between this unit and granitic gneiss (**A**gg) and migmatite (**A**mg). The gradation is expressed through an increase in felsic content in the paragneiss, which may be spread over a few centimetres or several metres. A decrease in mafic mineral content is apparent in some outcrops. Elsewhere contacts with granitic gneiss (**A**gg) are abrupt. Some contacts with migmatite show both an increase in felsic constituents in the paragneiss and the presence of many small granitic intrusions including pegmatite. Contacts with massive granitic rocks (**A**gd, **A**gr) show both gradational and sharp contacts. Those parallel to the foliation are predominantly gradational, whereas those crosscutting are sharp. Increase in felsic content is locally marked by development of feldspar augen in the paragneiss.

Medium grained rocks are most characteristic, but fine and coarse grained rocks are common. Fine grained types are prevalent in the southwest part of the map area, whereas coarse grained types are most abundant near the mouth of

Plate 48. Well banded biotite-quartz-feldspar paragneiss (Apg) with about 5 per cent amphibolite bands up to 15 cm thick and rare white granite veinlets. Amphibolite bands are boudinaged in some places; Whale River valley 13 km south of north boundary of map area 24B. F.C.T. 171295.

Plate 49. Drag folds in well banded paragneiss (Apg) in Wheeler River valley 13 km upstream from north border of map area 24B. F.C.T. 171299.

the George River and to the east. Local feldspar augen, chiefly pink, up to 3 cm long, occur in rocks of all grain sizes.

Mineralogically, this map unit is chiefly a biotite-quartz-feldspar gneiss. Feldspar is predominantly plagioclase (An_{24-32}). Potash feldspar content is highly variable with those rocks grading into granitic gneiss showing a higher content than is commonly present. Biotite forms up to 30 per cent, and quartz content is extremely variable. Hornblende is present in many places, either alone or with biotite. Where both biotite and hornblende occur, biotite is ordinarily more plentiful. Garnet, rarely up to a centimetre in diameter, is prominent in some parts of the map area such as southwest of the area underlain by the Lake Harbour Formation. Sillimanite occurs sporadically forming fibrous clusters along limited, commonly mica-rich, zones in intensely foliated paragneiss. Kyanite is present only southwest of Lac Jeannin (map area 24B) where it is associated with garnet, biotite, muscovite, quartz and plagioclase (An_{32}).

Post-Aillik Group intrusive rocks (ABgb, Asy, Asgr)
The Makkovik Subprovince is the site of several post-Aillik Group intrusions. These range in size from small dykes to batholiths and in composition from gabbro to granite. Gabbro is the oldest rock type, followed by syenite and granite. Much younger dykes of diabase and lamprophyre cut these larger plutons.

Big Bight intrusives. Gabbro (ABgb). Gabbro occurs in several small stocks, chiefly among the Turnavik Islands and to the south, at Big Bight and at the entrance to Makkovik Bay. In several places gabbro occurs on isolated islands, probably due to the resistance of this rock type to erosion.

Gabbros show a diversity in their mineralogy and textures. For example, on the island at the entrance to Makkovik Bay, a layered, equigranular, medium grained, dark, olivine-bearing green rock with dioritic phases is typical, whereas at Big Bight a coarse grained, massive, dark grey-green, biotite gabbro is characteristic. At Black Islands and Cape Roy a coarse grained, weakly porphyritic hornblende gabbro with some biotite is present, and on West Turnavik Island a massive, coarse grained porphyritic rock, with augite grains to 1 cm and greenish plagioclase is typical. Pyrite is present at some localities.

Gabbro on the Turnavik Islands cuts migmatites forming part of the Hopedale Gneiss, but nowhere in the present map area is it in contact with the Aillik Group rocks. However, in the map area to the south the Adlavik Gabbro, a member of the same intrusive suite, cuts folded Aillik Group strata (Gandhi et al., 1969; Stevenson, 1970) showing the gabbro to be post-Aillik Group and also postkinematic.

Granitic dykes, forming part of the Strawberry granitic suite, cut gabbro at Big Bight and also on West Turnavik Island. Pegmatite is present as well at the latter locality where these silicic intrusions are particularly common on the north side of the island.

As there is no evidence to the contrary, it is assumed that all the gabbros are the same age, being post-Aillik and pre-Strawberry intrusive.

At present, no isotopic age data are available from within this map area. However, a gabbro from the Adlavik Bay district in the map area to the south (13J) gave a K-Ar hornblende age of 1544±56 Ma. This age is probably a minimum figure and may be too young as the younger granitic rocks are in the order of 1600 Ma old.

Diorite (ABdr). A diorite on the east side of a large island in the Adlavik Islands (map area 13O) was sampled by W.R. Sutton of British Newfoundland Exploration Limited for an age determination. Separated biotite returned an age of 1610±55 Ma (K-Ar method) (Beavan, 1970). Its relationship to granitic rocks and syenite with which it occurs is not known. Presumably this rock forms part of the Big Bight basic suite and predates the granitic rocks.

Strawberry intrusives. Syenite (Asy). Syenite and related rocks occur in the extreme eastern part of map area 13O at Big Bight and on Ragged, Dunn and Long Tickle islands.

Ragged Islands consist of an extremely well jointed, dark yellowish-brown, massive, equigranular, coarse grained hornblende syenite. On the northeast side of the largest island a zone, about 15 m wide, of well rounded, medium grained, light olive-grey fragments of hornblende syenite occurs within the coarse grained syenite, which forms the matrix. These fragments range from 5 cm to 1.2 m in diameter. A lamprophyre dyke, 0.9 m thick, cuts the syenite at the same locality.

In thin section the rock is seen to consist of about 75 per cent perthitic potash feldspar and 15 per cent green hornblende. Small amounts of clinopyroxene, biotite, plagioclase, quartz, allanite, magnetite, apatite and zircon are also present. The rounded fragments have the same mineralogy except that they contain more clinopyroxene, which is chiefly altered to hornblende.

The syenite at Long Tickle Island is lithologically similar to the Ragged Islands stock but does not display good jointing. Locally a few granitic dykes intrude this syenite.

The northwestern tip of Dunn Island is underlain by a mottled, greyish-yellow, massive, equigranular, coarse grained syenite containing pyroxene, hornblende and biotite. Angular inclusions of Aillik Group rocks are present in many places; and Kranck (1953) stated that the contact is intrusive, showing the syenite to be younger than the layered unit. Hornblende pegmatite and lamprophyre dykes cut the syenite.

This syenite is composed of about 60 per cent perthitic potash feldspar, 10 per cent each of dark brown biotite, green hornblende and sodic plagioclase. Clinopyroxene, chiefly altered to hornblende, quartz, epidote, magnetite, apatite and pyrite occur also. Kranck (1953) reported the presence of riebeckite in this rock, but this mineral was not found in the present samples.

At Big Bight the syenite is a massive, fine grained, equigranular, light pink rock that forms the major part of an intrusive complex. Inclusions of amphibolite are common, and Gandhi et al. (1969) reported that ultramafic rocks, gabbro, diorite and Aillik Group rocks are also present in this sill-like pluton. Hornblende is common in the syenite. In some places there is a quartz-poor pegmatite phase.

As the syenite intrudes the Aillik Group and is intruded by the granite, their age relationships are clear. The relationship with the gabbro is less well defined. If the gabbro inclusions reported by Gandhi et al. (1969) at Big Bight were derived from the gabbro plutons previously described (AAgb) then the syenite is postgabbro and pregranite. This age relationship is used here.

Granite (Asgr). Granite in the Makkovik Subprovince forms several well defined stocks in the Makkovik area and a batholith in the Hopedale Gneiss in the Bay of Islands region. Kranck (1939) introduced the name Strawberry granite for rocks at Cape Strawberry, and this term has been applied to other lithologically similar rocks in the immediate area. Gandhi et al. (1969) used the name Monkey Hill granite for granite similar to that occurring at Monkey Hill, which lies on the south boundary of the map area. They distinguished the two granites on the basis of a higher potash feldspar content (predominantly perthite), a coarser grain size and the dominance of biotite over hornblende in the Strawberry type as opposed to a lower content of potash feldspar, chiefly microcline with some perthite, a prevalence of hornblende over biotite and a medium to coarse grain in the Monkey Hill type.

Gandhi et al. (1969) and Clark (1971) also discriminated between the massive granite (Monkey Hill and Strawberry types) and gneissic granite, which is also intrusive into the Aillik Group. Their gneissic granite is in places intruded by the massive variety so that it is unquestionably earlier than the massive granite. This gneissic granite is well exposed in the stock north-northwest of Big Island. Since both the gneissic and massive granites are younger than the Aillik Group and no doubt closely related genetically, they have not been separated in this report. As Gandhi et al. (1969) pointed out, the gneissic granite is a synkinematic intrusion, whereas the massive granite is postkinematic. The relationship of the gneissic granite to the gabbros and syenites is unknown.

Biotite is by far the commonest mafic mineral, but in some places hornblende is also present and in others occurs alone. The content of mafic minerals is variable, ranging from about 1 per cent to about 10 per cent, although Gandhi et al. (1969) reported 20 per cent mafics for some of the gneissic phases. Fluorite is a ubiquitous and characteristic accessory mineral. Other accessories are sphene, apatite, zircon, magnetite and molybdenite. Muscovite occurs with biotite locally, such as southwest of Kidlialuit Island.

The Strawberry granitic suite is chiefly light pink, less commonly light grey and locally medium pink, medium grey or light buff, medium to coarse grained, equigranular to porphyritic, massive to gneissic rock. Porphyritic varieties contain feldspar phenocrysts up to 5 cm that in places impart a foliation to an otherwise massive rock. Gneissosity elsewhere is marked by schlieren or biotite orientation. Inclusions of older rocks are locally common and in places are up to 5 m in diameter. Inclusions are predominantly mafic rocks derived from the Archean migmatite terrane, but blocks of migmatite and Aillik Group rocks are also present.

As well as the larger plutons, numerous small, commonly irregular, dykes of white to light grey granite and pegmatite are present. Less common are feldspar porphyry dykes up to 5 m thick that cut gabbro on the island in the mouth of Makkovik Bay and granite on the island southwest of Kidlialuit Island.

Granite dykes are well displayed at the northernmost tip of the island west of Cape Makkovik. There, north-trending, light grey, massive, medium grained, equigranular, biotite-bearing dykes up to 100 m thick are present. Inclusions of the tuffs occur in these dykes, which are themselves cut by later diabase and lamprophyres.

Contacts with the country rocks are variously gradational to sharp. For example, the contact between granite and crystal tuffs of the Aillik Group southwest of Kidlialuit Island shows many tongues of granite projecting into the tuffs, and foliation in the latter is cleanly cut. There are also many locations where granite envelopes Aillik tuffs. However, along the south coast of the island, foliations in both granite and country rock parallel the contact. The country rock consists of 3 m of light to dark grey, layered metagreywacke, in part with angular granitic fragments that may be of tuffaceous origin, which is bordered on the west by 2 m of dark grey, fine grained, banded, biotite schist and over 200 m of light grey, feldspar porphyry and crystal tuffs with rounded to angular quartz grains and minor amounts of fluorite and epidote. Nearby a pegmatite dyke striking normal to the contact shows the contact displaced along the length of the dyke. A short distance inland an inclusion of Aillik strata is present in the granite about 100 m from the contact.

Gandhi et al. (1969) reported that granite gneiss on the east shore of Aillik Bay graded into Aillik Group rocks. The gneissic to massive stock west of Makkovik Bay has a similar contact.

The eastern contact of the batholith southwest of Bay of Islands is a mixed zone over 2 km wide of Archean migmatite, possibly recrystallized, and intrusive granitic rock with abundant amphibolite inclusions and aplitic dykes. The western contact is more abrupt, in part possibly a fault, but also a mixed zone with foliation parallel on both sides of the contact. Near the south boundary of the map area the younger rock is gneissic, streaky and banded; this is probably a border phase of the intrusion. Cataclasis is present in some places and small feldspar augen in others.

The age of the Strawberry granitic suite is well established from field data. Evidence previously cited shows these rocks to be post-Aillik, postgabbro and postsyenite. They are intruded by diabase dykes, chiefly easterly trending, and by lamprophyres.

Isotopic data, consisting of K-Ar biotite and muscovite determinations (see Table 2) show these rocks to be about 1605 Ma years old (average of four determinations). To the south, an age of 1685±55 Ma was obtained on a sample from the Bay of Islands batholith that extends to the southwest. Whereas slight variations are evident, an Aphebian age is certain for these posttectonic rocks. An age on the gneissic phase by Gandhi et al. (1969) gives a somewhat younger age of 1531±38 Ma, which is rather anomalous.

Aplite (**A**sap). An aplite dyke cuts Archean migmatite (**A**mg) on White Bear Island (map area 13O). This fine grained, greyish-orange–pink aplite is associated with pegmatite, which together form 10 per cent of the outcrop.

Aplite is also present in migmatite south of Bay of Islands where it forms 5 per cent. There trace amounts of biotite and chlorite occur in this greyish-orange–pink aplite.

At both these localities the aplite 'appears' to be much younger than its host. It is assumed to form part of the nearby Strawberry granitic suite.

Quartz-feldspar porphyry (**A**pp)

Dykes or quartz-feldspar porphyry are present on Dunn Island, on the southernmost of the Ironbound Islands, and on a small island in Makkovik Bay. On Dunn Island porphyry dykes cut lamprophyre dykes (**A**lp), which are numerous in the Aillik Group host rocks (**AA**tf). On the southernmost of the Ironbound Islands a 2.5 m thick porphyry intrudes crystal tuff (**AA**tf) whereas in Makkovik Bay a 5 m thick dyke cuts gabbro (**AB**gb). They show diverse attitudes, and dips are locally low to horizontal.

These rocks are very fine to fine grained, chiefly massive, pinkish grey and greyish pink to light olive grey with anhedral to subhedral phenocrysts of feldspar and less commonly quartz to 0.5 cm. The dyke on the southernmost of the Ironbound Islands displays a moderate foliation, possibly due to flow, so that the hand specimen is identical to the crystal tuff, which it intrudes.

Thin sections show these rocks to consist of anhedral to euhedral phenocrysts of potash feldspar, plagioclase and less commonly quartz. In part, quartz and potash feldspar 'phenocrysts' are composed of clusters of small quartz grains. The same minerals comprise most of the matrix in which occur in accessory to trace amounts: biotite, muscovite, epidote, chlorite, clinopyroxene, hornblende, apatite, sphene, zircon, magnetite, iddingstie(?) and in the sample from the southernmost of the Ironbound Islands, fluorite. The samples from Dunn Island and Makkovik Bay are characterized by incipient spherulites and a myrmekitic perthite intergrowth of potash feldspar and plagioclase. The perthite consists of stringlets, strings and rods in part arranged radially. The spherulites are irregularly shaped with no well defined external outline, and most are only partly formed with perthite commonly occupying part of the spherule.

These porphyries, although similar lithologically to some of the Paleohelikian porphyries (**P**pp), are not considered to belong to that map unit because of the distance from the nearest Paleohelikian outcrops. As one postdates the Big Bight gabbro, which is younger than the Aillik Group, they are possibly genetically related to the Strawberry granitic suite with which they are spatially associated. However, as the dykes on Dunn Island cut lamprophyre also considered to be genetically related to the Strawberry granitic suite, the Dunn Island dykes at least must be an extremely late phase if part of the Strawberry suite. The dyke on the southernmost of the Ironbound Islands, which is so similar to the tuffs it intrudes, may be comagmatic with the tuffs in view of its petrographic dissimilarity with the other dykes. The presence of fluorite, which also occurs in the tuffs in many places, supports this.

Ultrabasic rocks (**A**ub, **A**px)

Ultrabasic rocks occur sporadically throughout the gneissic terrane east of the Labrador Trough. They are most abundant near and south of the headwaters of Ford River (map area 24H). Host rocks for these intrusions comprise a variety of lithologies, including migmatite, quartzite, granitic gneiss and paragneiss. Contact between the country rock and the ultrabasic plutons are commonly sheared, but a decrease in grain in the ultrabasic rock is evident in many places (Pl. 50).

Whereas the majority of the ultrabasic plutons are sills, a few are low angle dykes and some are roughly circular stocks. Many of the sills are lens-shaped, particularly those of little lateral extent. There is a great variation in size, but most of these plutons are between 15 and 50 m thick and between 150 and 700 m long. A few are as thin as 1 m and the largest, near the Ford River, is nearly 300 m thick and 9 km long.

Peridotite, amphibolite and pyroxenite in various proportions are the principal rock types. Only rarely does a pluton consist of a single type. Nearly all are characterized by a moderate to dark reddish-brown weathered surface, which is readily recognized from the air so that ultrabasic rocks are easily identified, even from a distance. The likelihood of any sizeable ultrabasic plutons other than those shown on the accompanying map being present is very doubtful.

Six kilometres west of the Rivière Tuctuc a massive, bright green, medium grained, equigranular pyroxenite

Plate 50. Layering in ultrabasic stock (**A**ub) 19 km south of the Ford River, defined by the presence of amphibolite bands up to 60 cm thick (map area 24H). F.C.T. 172429.

forms the top of a prominent hill. A brief examination of the hill indicated that most of the hill consists of massive granite. Pink, pegmatitic dykelets permeate the pyroxenite so that the latter consists mainly of fragments ranging from 2.5 cm to 2 m in length. This pyroxenite is composed of about 85 per cent clinopyroxene, 5 per cent each of apatite and magnetite and the remainder quartz, potash feldspar, plagioclase, sphene and allanite(?). The latter mineral is moderate reddish brown and displays a weak cleavage. This is one of the few ultrabasic occurrences composed of a single rock type.

A few of the ultrabasic plutons consist of coarse grained, altered rock dominated by rosettes of very pale greenish-yellow anthophyllite. Outcrops near Campsite 1, 16 km east-southeast of Wheeler Lake at longitude 66°37′W and the south border of map area 24B, are of this type. The first occurs as two lens-shaped, conformable bodies about 400 m long and 100 m thick at the thickest part, in a biotite-quartz-feldspar paragneiss that locally contains garnet and sillimanite. A 30 cm thick quartzite bed with minor amounts of biotite and a garnetiferous amphibolite layer 2 m thick are present in the paragneiss. This ultrabasic pluton is grey to dark grey green, massive, fine to coarse grained with crystals of anthophyllite up to 15 cm long and 7.5 cm thick.

The other plutons are very similar with rosettes of anthophyllite averaging 1.5 cm in diameter. These rocks also contain appreciable amounts of calcite, up to 50 per cent locally, and chlorite, magnetite and small amounts of pyrite.

The ultrabasic near the mouth of the Rivière Tunulic (24J) consists primarily of amphibolite, locally garnetiferous, with about 20 per cent green, medium to coarse grained pyroxenite that is weakly banded locally. The relationship between the pyroxenite and the amphibolite is not clear, but probably they grade into one another over a few centimetres. Blocks of this amphibolite are present in granitic gneiss in this outcrop area, showing this ultrabasic rock is pregranitic gneiss development. White granite dykes cut both the ultrabasic and gneissic granite.

Hornblendite (**A**hb)

A schistose, equigranular, medium grained hornblendite is present 8 km west of Indian House Lake (map area 24A). This medium green rock is cut in several places by a blue quartz-eye biotite granite. Plagioclase constitutes less than 10 per cent of the hornblendite, but close to the granite a local clustering of plagioclase is developed. The granite is probably part of map unit **A**gr. In thin section hornblende is seen to be a light green uralitic type, and plagioclase (An_{30}) is slightly altered to sericite and cloudy. Traces of biotite and magnetite are also present. Veinlets of chlorite, epidote and quartz occur erratically. Calcite occurs interstitially, comprising less than 5 per cent.

Gabbro (**A**gb)

Gabbro is limited to small plutons within the gneissic terrane east of the Labrador Trough, with the largest masses in map area 23P, and smaller ones in map areas 24A and B and mixed anorthosite-gabbro pluton in map area 13M. In general they are similar lithologically to the Wakuach Gabbros (**A**wg) and may be related to them. However, some of these plutons are discordant rather than sills, a structural property not characteristic of the Wakuach Gabbros, and hence may be of a different intrusive period. For example, the pluton north of Lac Raude is oriented so that its greatest dimension is athwart the regional structural trend.

The largest pluton at Lac Raude consists of variegated to dark grey-green, medium to coarse grained, equigranular to ophitic, biotite gabbro. Although dominantly massive, a weak, local foliation is present in its western part, and there is similar foliation in a pyroxene granite dyke (**A**gr) that intrudes the gabbro in this area. This dyke is about 15 m thick and contains contorted inclusions of gabbro up to 0.5 m in diameter. A thin section of the gabbro shows the presence of biotite, hornblende, clinopyroxene, plagioclase (An_{32}), rare quartz, apatite and magnetite. The clinopyroxene is partly altered to hornblende, which in turns shows minor chloritization. The age of the granite dyke, which also contains blue-green hornblende, biotite, apatite and magnetite, is uncertain and may be part of the adamellite suite, which outcrops a short distance to the east. However, as the dyke is weakly foliated, it is considered to be Aphebian as the adamellite suite is posttectonic.

The pluton southwest of Lac Résolution consists of a light grey, equigranular, medium grained gabbro containing both clinopyroxene and hornblende. A weak foliation is present that is parallel to faults that offset a 60 m thick diabase dyke (**N**db) suggesting that the foliation is a posttectonic feature.

A well jointed, massive, coarse grained gabbro outcrops 1 km northeast of Lac Testu in map area 24B. This gabbro consists of a light bluish-grey weathering plagioclase, greyish–olive-green weathering hornblende, and minor amounts of biotite. A K-Ar age determination on hornblende with about 5 per cent biotite contamination and a trace of attached quartz, gave an age of 1695 ± 60 Ma for this gabbro. On this basis the gabbro is considered to be syntectonic and a product of the Hudsonian Orogeny.

In map area 24A a stock 4 km west of Lac Terriault consists of a massive, medium grey-green, equigranular, medium grained, augite gabbro with less than 2 per cent biotite. Another pluton 7 km west of Lac Slanting consists of medium to coarse grained, medium grey-green, well jointed, massive, hornblende gabbro. This rock locally displays hornblende grains to 2.5 cm and rare plagioclase (An_{45}) of the same size. Although chiefly equigranular, it is locally subophitic. A weak foliation, present in some places, is probably related to postconsolidation shearing. About 5 per cent biotite, less than 1 per cent quartz and rare apatite, are also present.

In the same map area, east of Lac Dihourse, a linear, dykelike pluton of well foliated gabbro lies within a granulite terrane. This dark greenish-grey to greenish-black, medium grained, equigranular gabbro consists of 70 per cent fresh plagioclase, 15 per cent hornblende, 10 per cent brown biotite, and traces of ilmenite and sphene. In part a mineral layering is present, imparting a coarsely laminated or striped appearance. Rare pegmatite and tiny granitic veins are present.

About 9 km east of Lac Beaupré (map area 13M) a well banded mixed gabbro and anorthosite outcrops within an area of migmatite (**A**mg). The anorthosite phase consists of a fine to medium grained, pinkish-grey weathering, light bluish-grey rock with well developed mafic-rich bands up to 1 cm thick. Mafic bands are in part gradational into the felsic part, and in part show an abrupt change. The gabbro, which forms about 30 per cent of the outcrop, is a dark greenish-grey, fine to medium grained rock that displays femic bands up to 5 mm thick. Both the anorthosite and gabbro are mylonitized to some extent. The anorthosite consists of plagioclase (An_{42}) with a pale green amphibole and rare quartz, calcite and pyrite. The gabbro is similar compositionally but dominated by the amphibole.

Diorite (**A**dr)
About 5 km south of the headwaters of the Notakwanon River (map area 13M) a small well foliated diorite stock occurs in an area of granitic gneiss (**A**gg). It is intruded by fine grained amphibolite dykes ranging from 5 cm to 5 m thick, which have been deformed along with the diorite.

The diorite is a variegated greyish–olive-green and very light grey, medium grained rock consisting of plagioclase (An_{32}), green hornblende (25 per cent), greenish-brown biotite (10 per cent), and accessory amounts of epidote, quartz, sphene, apatite and a trace of pyrite. What appear megascopically to be individual plagioclase grains are commonly composed of many recrystallized small crystals. Plagioclase is mostly fresh, but some larger grains are partly cloudy and altered to sericite and epidote.

The amphibolite dykes are greenish-black, fine grained, foliated rocks consisting of 75 per cent hornblende and 25 per cent plagioclase. Parts of these dykes show a heavy gossan due to the weathering of pyrite, chalcopyrite and pyrrhotite. The latter minerals occur sparsely along tiny fractures and less abundantly disseminated.

This diorite is considered to be pretectonic because of extensive recrystallization and deformation, both of the diorite and contained amphibolite dykes.

Another diorite dyke, approximately 150 m thick, is chilled against drag-folded graphitic, garnetiferous paragneiss (**A**pg) at the north boundary of map area 23P. Several white granite dykelets are present within the diorite suggesting that this diorite predates the granitic rocks (**A**gr) of the area but postdates the tectonism.

Anorthosite and related rocks (**A**ar)
Rocks of this map unit occur chiefly in the northeastern part of the map area where they form a discontinuous zone of plutons extending from west of Ramah Bay northward to east of Ikkudliayuk Fiord in map areas 14L and 14M, 24P and 25A. Small amounts of anorthosite also occur north-northwest of Lac Vendremur in map area 24G and near the southern boundary of the map area in 23P. These latter rocks may not be related to those in the northeast.

In the northeast this unit primarily forms sill-like plutons up to 2 km wide and 40 km long. Some of these plutons are small however, such as one on the south shore of Ryans Bay, which is only 60 m thick. In other places elements of this map unit only form pods in granulite, such as on the peninsula west of Shoal Cove and south of Mount Cornelius (map area 14M). The contacts with bordering rocks are in most places concordant and gradational over a metre or so, but in a few places granitic veinlets penetrate the anorthosite forming an agmatitic border. Biotite pegmatite dykes (**A**pm) cut these rocks at several localities, showing these rocks to be Aphebian or earlier in age as biotite from one of these pegmatites returned a K-Ar age of 1530 ± 50 Ma.

Included in this unit are several rock types related to the anorthosite that include garnet anorthosite, gabbroic anorthosite, gabbro, quartz gabbro or quartz diorite. Mafic rocks present include amphibolite, garnet amphibolite and/or pyroxenite. Whereas some of these rock types are present in each pluton, none contain all of them. In some places various types grade into one another, whereas in others, gradations are over very limited distances or contacts are sharp. Some rock types, mafic rocks in particular, occur as dykes within the pluton.

The following descriptions will serve to show the variety of rock types present in this rock unit, and their relationships to one another.

The extensive anorthosite sill-like body 15 km west of Ramah Bay is a complex pluton that consists primarily of a medium grained, light grey, equigranular, moderately foliated anorthosite. Locally, however, anorthosite forms only a small part as gabbroic anorthosite, gabbro and amphibolite dominate. All rock types grade into one another. At the northern end, this body also includes some granulite (**A**gl) that is intimately mixed with the anorthositic rocks. Plagioclase, which ranges from An_{40} to An_{54}, form up to 90 per cent. Light olive to green hornblende, which forms lenses, layers and streaks as well as occurring in the groundmass, is the commonest ferromagnesian mineral comprising up to 20 per cent, although forming less than 1 per cent in some samples. Some outcrops contain, up to 10 per cent fresh hypersthene. Brown biotite, an alteration of hornblende, is prominent in some places. At Nachvak Fiord lenticular, medium grained, hypersthene clusters, in a plagioclase matrix up to 5 cm long, have rims of hornblende up to 50 mm thick. Moderate red garnets, up to 3 cm in diameter, occur sparsely. The amphibolite portions of this body also contain garnet in some places. A few anhedral, interstitial grains of scapolite also occur in some samples. Magnetite, apatite, zircon and pyrite, comprise the accessory minerals.

North and south of the east end of Kangalaksiorvik Lake an extensive area of this rock unit displays a diversity of rock types that is typical of the unit. Toward the north this body consists chiefly of medium to coarse grained, white to light grey, equigranular, predominantly massive, anorthosite, with thin amphibolite bands. In part the anorthosite is gneissic, with biotite and/or hornblende foliae up to 5 mm thick, which locally contain rare tiny garnet grains. The amphibolite is mottled greenish black, medium grained, equigranular and massive. Close to Kangalaksiorvik Lake the anorthosite contains more hornblende than farther south. There too the rocks are extensively brecciated and mylonitized parallel to the foliation. Amphibolite forms about 30 per cent of the rock in this area (Pl. 51). South of the lake a coarse grained, weakly foliated, variegated yellowish-grey and dark greenish-grey, gabbroic anorthosite to gabbro with plagioclase crystals to 2 cm and interstitial hornblende to 1 cm, is present, forming a band 15 m thick. Nearby a fine-grained, dark greenish-grey, amphibolite, that is cut by dykelets of anorthosite from 1 to 30 cm thick, occurs as bands 3 to 5 m thick in the gabbro. Another band, 10 m thick, consists of gneissic, medium grained gabbro. Brecciation is also present there and occurs in bands 5 to 6 cm thick parallel to banding and foliation. About 2.5 km south of the lake the anorthosite contains wide zones of amphibolite and pink, locally mylonitized, granite gneiss. Much of this anorthosite is coarse grained, white to light grey, with extremely rare tiny hornblende and biotite grains. Locally hornblende with minor biotite forms lensoid 'inclusions' in the anorthosite. Amphibolite is a mottled dark greenish-grey, medium grained, massive rock. Farther south bands of paragneiss, as well as granitic gneiss, are present. There a coarse grained, yellowish-grey, weakly foliated, hornblende anorthosite is characteristic. Amphibolite interlayers define a prominent banding.

Limited microscopic examination shows plagioclase ranges from An_{44} to An_{50}. As well as hornblend and biotite, epidote forms 10 percent in one sample in which scapolite also occurs sparingly.

The anorthosite rocks exposed at Four Peaks (map area 14M) are noteworthy because of the spectacular display of garnets. Subhedral, vitreous, clear, moderate red garnets, up to 10 cm in diameter, occur in a medium to coarse grained, very light grey, weakly foliated anorthosite, which forms the main rock type. Within the anorthosite a 15 m thick band of garnet-rich rock is present that locally consists of 80 per cent garnet. This garnet-rich band, which grades into the anorthosite, most typically consists of garnet

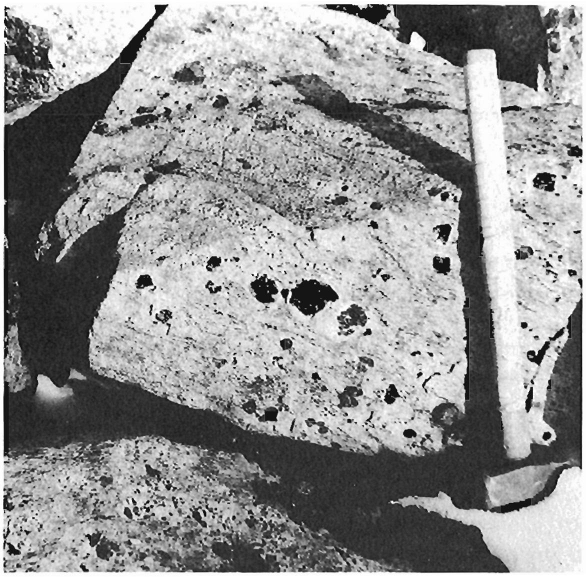


Plate 52. Subhedral garnets in foliated anorthosite (Aar) typical of the garnetiferous anorthosite at Four Peaks (map area 14M). F.C.T. 171465.

and clinopyroxene and/or hornblende. Some of the garnet-hornblende rock shows scattered medium grained, greyish-yellow orthopyroxene grains in the hornblende. Less commonly, significant amounts of plagioclase are present. Garnet crystals similar to those in the anorthosite, are up to 3 cm in diameter, whereas the clinopyroxene and hornblende are fine to medium grained. All gradations occur from a pure anorthosite to the most garnet-rich rock. The anorthosite west of the garnet-rich rock contains fewer garnets than that to the east (Pl. 52).

Thin sections of these rocks show plagioclase in the anorthosite to be labradorite (An_{54}) whereas that in the garnet rock is andesine (An_{42}). Hornblende is green to greenish brown, clinopyroxene is colourless and shows

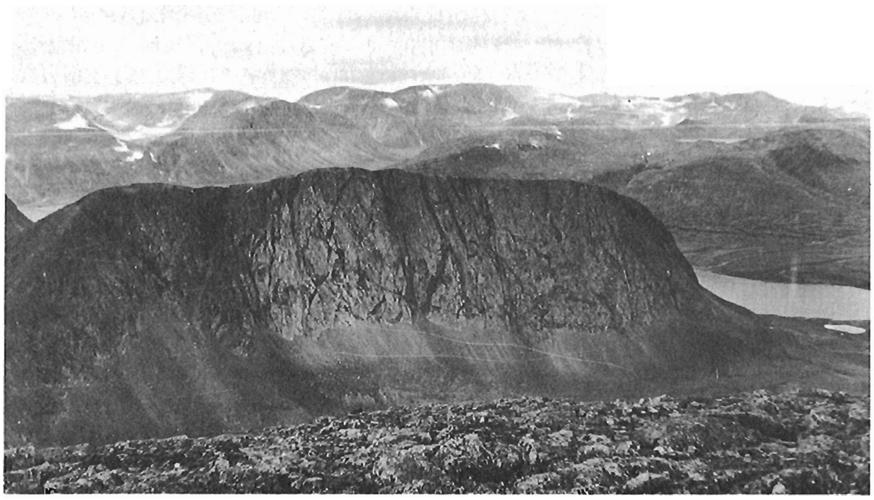


Plate 51. Amphibolite layers and dykes in anorthosite (Aar) on the southeast site of the hill between Tower Mountain and Upper Kangalaksiorvik Lake, part of which is visible in the right middle ground (map area 24P). C.K.B. 172176.

minor alteration to hornblende. Scapolite forms from 2 to 10 per cent in both the anorthosite and the garnet-rich band. However, in the latter it is, in part, filled with opaque inclusions, whereas scapolite in the anorthosite is clear. Biotite, magnetite and apatite occur in accessory or trace amounts.

A 60 m thick anorthosite band on the south shore of Ryans Bay (map area 14M) displays many of the rock types present in the larger occurrences. Both contacts, which are gradational, are exposed. The bordering rocks are well banded, light to medium grey, equigranular, medium grained, biotite-quartz-feldspar gneisses that lie within a general granulite terrane (Agl). The gneiss on the east also contains disseminated garnets. In the same outcrop area a diabase dyke cuts the anorthosite rocks, and it in turn is cut by a red granite 1 m thick, horizontal, dyke. A post-diabase fault at strike 055° and dip 80°NW is also present.

On the east this band consists of a yellowish-grey, medium grained, equigranular anorthosite with scattered lensoid hornblende grains up to 2 cm long that define a moderate foliation. Rare, fine grained biotite occurs locally. This anorthosite grades into a dark greenish-grey, weakly foliated, fine to medium grained garnet amphibolite that in part is brecciated. This rock contains approximately 10 per cent garnet, 35 per cent plagioclase An_{43} (part of which is untwinned), 5 per cent very pale green clinopyroxene and 50 per cent hornblende. This amphibolite grades into a medium grained, mottled light grey, well banded, equigranular anorthosite containing 5 per cent reddish-brown biotite, 3 per cent garnet, 1 per cent hornblende and 7 per cent quartz. The plagioclase (An_{41}) is usually untwinned and shows minor sericitic alteration. A coarse grained, weakly foliate, gabbroic anorthosite lies near the centre of the band. Pinkish-grey to white plagioclase grains, up to 2 cm long, in part contains tiny hornblende grains and has, commonly, tiny garnets, and these form the matrix for large hornblende-garnet clusters up to 7 cm long. Commonly, moderate red garnets form a rim 2 to 3 mm thick about dark greenish-grey hornblende clusters. Where these clusters coalesce, garnets occur within the hornblende. Locally a fine grained, greyish-yellow–green clinopyroxene, intimately mixed with fine grained hornblende grains, forms the core of the garnet-hornblende clusters.

West of the gabbroic anorthosite a well foliated, medium grained, garnetiferous gabbroic anorthosite is present. The foliation is defined by the segregation of the garnet, hornblende and plagioclase into layers 1 to 3 mm thick. A few larger lensoid hornblende and garnet grains up to 2 cm long lie in the foliation planes. A zone of garnetiferous anorthosite succeeds the above rock. This anorthosite is a medium grained, very light grey, equigranular rock with phenocrysts of greyish-red garnet up to 3 cm in diameter. Fine to medium grained garnet and hornblende grains, forming 10 per cent of the rock, are disseminated throughout and locally are concentrated so as to define banding. Garnet phenocrysts in part contain plagioclase grains and less commonly hornblende. The westernmost rock of this map unit is a moderately foliated, medium light grey, gabbroic anorthosite with greyish-red garnet phenocrysts to 4 cm in a matrix of plagioclase and tiny hornblende grains. Locally rare plagioclase and hornblende phenocrysts to 1 cm are present.

The elongate anorthosite body 7 km west of Ryans Bay (map area 24P) is also a complex body that shows both fine and coarse grained rocks. The coarse grained elements, which form bands up to 30 m thick, display subhedral plagioclase (An_{60}) in the fine grained rocks, up to 5 cm long, with interstitial green hornblende forming up to 30 per cent locally. Small amounts of biotite, quartz, epidote, pyrite, magnetite and sphene are also present in order of decreasing abundance. The fine grained rocks consist of generally equigranular, weakly foliated mosaic of plagioclase (An_{36}), green to blue-green hornblende, and brown biotite, with rare epidote, sphene, apatite, ilmenite, allanite and zircon. Allanite forms cores to some epidote grains. Quartz, which is finer grained than the major minerals and is probably late to crystallize, forms about 8 per cent in the one sample sectioned. In the southern part of this body the anorthosite is extensively mylonitized in some places, whereas in others, a massive rock is typical. In the same area tiny epidote crystals occur along plagioclase boundaries. Near the north end, pink pegmatite sills, ranging from 1 to 2 m thick, are present in the anorthosite.

On the southeast side of Noodleook Fiord (map area 24P) an irregular-shaped stock of anorthosite is cut by pegmatite dykes up to 10 m thick. In many places these north-trending pegmatites, which only locally contain biotite, also occur as sills. A K-Ar age determination on biotite from one of these gave an age of 1530 ± 50 Ma. The anorthosite is a complex body consisting of a variety of rocks ranging from monomineralic anorthosite to a monomineralic orthopyroxene rock. Parts of this stock are composed of a fine grained, banded rock in which the bands consist of anorthosite and hornblende-rich amphibolite. Bands, which range from a few millimetres to 5 cm thick, pinch and swell and commonly tail out. The anorthosite is a medium grained, massive to moderately foliated rock, consisting of plagioclase (An_{46-54}) with up to 10 per cent of hornblende and brown biotite. Epidote forms up to 3 per cent, occurring in the matrix and as tiny needles along plagioclase grain boundaries. One sample showed a trace amount of muscovite. Apatite, ilmenite and quartz occur as accessories. Some of the more strongly foliated anorthosite displays irregularly shaped clusters of hypersthene and hornblende with hornblende borders somewhat similar to those at Nachvak Fiord. These are probably derived from the deformation of hypersthene crystals, which in some parts of this stock occur as euhedral crystals up to 5 cm long, also with 1 to 3 mm thick hornblende borders or coronas (Pl. 53).

Orthopyroxene dykes, which are up to 0.5 m thick in places, consist of spectacular, olive-black crystals up to 25 cm long. These dykes form an anastomosing network throughout the southwestern part of the stock and are probably a late intrusive phase.

Gabbro forms a significant part of this pluton, and this rock is the only type present in the easternmost part. Elsewhere it is intermixed with the other rock types and on the west lies between two anorthosite bands, which possibly

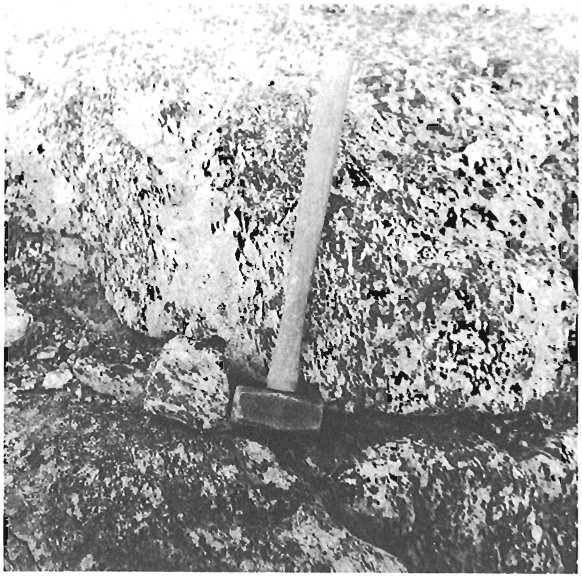


Plate 53. Streaky to massive anorthosite (Aar) showing hornblende, which is the dominant mineral in the left foreground, typical of much of the anorthosite on the south side of Noodleook Fiord (map area 24P). F.C.T. 171420.

describe a synform. This gabbro is a medium to coarse grained, chiefly massive, greyish–olive-green and light grey mottled rock consisting primarily of plagioclase (An_{41-46}) (35 to 70 per cent) and hornblende (20 to 40 per cent). In the east particularly, some of this gabbro is well foliated with distinct, although erratic, segregations of hornblende and plagioclase. Brown biotite forms up to 10 per cent, particularly in the eastern part of the pluton, whereas in the west it is absent, or present in trace amounts only. Colourless clinopyroxene is present locally but comprises less than 10 per cent and is chiefly altered to hornblende. In thin section the rock is fresh with hornblende pleochroic from pale greenish-yellow to moderate yellow-green. Alteration is limited to very minor sericite in the plagioclase and chlorite in biotite.

Epidote occurs interstitially and along plagioclase grain boundaries and in some samples comprises up to 3 per cent. Calcite, apatite, pyrite, magnetite and zircon occur sparingly. Quartz forms up to 10 per cent in some of the eastern exposures, and there the rock approaches quartz gabbro or quartz diorite. Moderate red garnet, up to 1 cm in diameter, is present in some foliated samples but is not widespread.

The northernmost occurrence of these rocks, at Hutton Peninsula (map area 25A), consists of a medium grained, equigranular, grey-green, gabbroic anorthosite containing amphibolite pods and bands. Lit-par-lit injections of garnetiferous pegmatite are present. Coarse grained layers of anorthosite with scattered hornblende crystals up to 2 cm long and rare moderate red garnets 1 mm in diameter are represented. Other layers consist of a coarse grained, greyish-green, weakly foliate, equigranular, hornblende-pyroxene rock with subordinate plagioclase. A white weathering, coarse grained, hornblende-rich anorthosite forms a large part of the outcrop. Hornblende crystals in this rock form a streaky foliation.

The most typical rock is composed of about 60 per cent fresh to weakly cloudy plagioclase (An_{38}), and 35 per cent green to greenish-brown hornblende that shows rare alteration to chlorite at grain extremities. A very pale biotite, apatite and magnetite occur in order of decreasing abundance. The hornblende pyroxene bands consist of about 40 per cent each of yellowish-brown to light olive hornblende and clinopyroxene. Plagioclase (An_{57}) forms 15 per cent and interstitial scapolite about 5 per cent. Trace amounts of apatite, quartz and magnetite are also present.

From the above representative descriptions it can be seen that this map unit consists of a variety of rocks with differing interrelationships. However, one common factor present in each pluton is the presence of anorthosite, albeit in varying degrees of purity and abundance. Banding is also prevalent and is defined by mineral segregation or discrete layers, chiefly amphibolite. Although some bodies contain massive zones, a foliation variously poorly to moderately well developed is characteristic. Plagioclase and hornblende are the only major minerals present in all plutons, but garnet is present in most. Most anorthosites, such as the batholithic plutons (**Par**) in this map area, have been ascribed an igneous origin. However, some are considered to have been derived from sedimentary rocks through metamorphism and/or metasomatism. The existence of massive anorthosite in some places and layering, of possible gravitational differentiation derivation, suggests these plutons are of magmatic origin. The presence of orthopyroxenes and anorthosite dykes in some plutons denotes the existence of magmatic phases of both felsic and mafic composition. Emplacement in the precursor rocks of the granulites (**Agl**) and other Aphebian metamorphic rocks is likely, as metamorphism of the anorthosite and related rocks and their hosts was probably contemporaneous as indicated by the gradational contacts and in some plutons the local intermixing of gneiss and anorthosite.

Extensive development of garnet, the coronalike development of hornblende around hypersthene and garnet around hornblende, the presence of scapolite, are all characteristic of metamorphosed anorthosite complexes. Garnet anorthosites have been reported from several localities and, in general, attributed to metamorphism. For example, Subramanian (1956) concluded that garnet anorthosite of the Sittampundi Complex of India was formed by the metamorphism of a layered gravity stratified sheet. Similarly, garnet anorthosites of the Adirondacks and Idaho are the result of metamorphism (Buddington, 1939; Hietanen, 1963). However, Rao (1964) made a case, albeit less convincing, for the formation of garnet anorthosite from magma for the garnet anorthosites of Oddanchatram, Madras State, India.

The development of corona structures is common in metamorphosed gabbroic rocks (Buddington, 1939) of the Adirondacks and also occur in the Sittampundi Complex (Subramanian, 1956). Baer (1976) reported coronitic textures in the Borgia meta-anorthosite from near La Tuque, Quebec that he interprets as having been formed during or after deformation.

The presence of scapolite is also a good indication that this map unit has been metamorphosed. Scapolite occurs in metamorphosed anorthosite in the Adirondacks (Buddington, 1939) and in both of the previously cited Indian anorthosite occurrences. Scapolite occurs chiefly in regionally metamorphosed calcareous rocks—a genesis also present in this map area—and skarns. Primary scapolite is almost unknown. Of interest is the fact that the unmetamorphosed anorthosite batholiths (**P**ar) in the southeastern part of the map area are free of scapolite.

Although it has been suggested that the present rocks are of igneous derivation, the possibility of a sedimentary origin has not been disregarded. The most persuasive case for the derivation of anorthosite from sedimentary rocks has been presented by Hietanen (1963), who postulated interbedded calcareous and clayey strata as source rocks. The Idaho anorthosites contain aluminum silicates and staurolite, minerals not represented in the present rocks, and hence the two occurrences are not analogous. The evidence in favour of such an origin for the present rocks is sparse. The occurrence of scapolite, generally conceded to be a product of lime metamorphism, is perhaps the major factor in favour. However, in the map area, metamorphism of limy rocks, although in some places producing scapolite, has nowhere resulted in rocks approaching anorthosite composition. Strangely, the Idaho rocks do not contain scapolite, which is present in nearby lime silicate rocks. Nowhere within these anorthosite plutons are there any crystalline limestone bands or relicts that might be anticipated if of sedimentary derivation. The complex compositional range present would require a sediment of most unusual stratigraphic section to give rocks of the composition such as the garnet-hornblende rock of Four Peaks.

The anorthosite and related rocks in the northeastern part of the map area are most probably of magmatic origin but have been subjected to later high grade metamorphism.

The anorthosite in map area 24G forms a sill-like body approximately 15 km long and 300 m thick, which is bordered on both sides chiefly by granitic gneiss with amphibolite inclusions, and less frequently, by migmatite or agmatite. Small pegmatite dykes are common. The anorthosite is fractured into 30 by 45 cm sized, angular blocks, which have been rotated and chaotically oriented, and intruded by a medium grained, biotite granite forming an agmatite. Granite generally forms about 10 per cent of the anorthosite body, although locally as much as 35 per cent. Some angular mafic fragments, only 7 cm in greatest dimension, are present in parts of this body.

This anorthosite is silvery-white weathering, medium grained, white to medium light grey, chiefly equigranular and massive to moderately foliated. Rare coarse grained hornblende and biotite grains randomly present in the plagioclase groundmass. More commonly clinopyroxene, biotite and hornblende, chiefly the latter, define the foliation either through a preferred orientation or by planar aggregates. Where the mafic content is low wispy schlieren may be developed. Hornblende also forms crosscutting veins up to 0.5 cm wide in some anorthosite blocks. Associated with the anorthosite is a medium grained, moderately well foliated amphibolite that also forms fragments in the agmatite.

Microscopically this anorthosite is seen to consist of about 80 per cent fresh labradorite and 10 to 15 per cent green hornblende. Augite occurs locally, and in part forms cores of hornblende grains. Pale brown biotite forms 3 per cent in one sample. Muscovite, calcite, chlorite and epidote occur sparingly.

This anorthosite pluton was emplaced prior to the intrusion of the Aphebian granitic rocks and is probably also Aphebian.

A similar anorthosite of unknown dimension occurs within foliated granodiorite (**A**gd) near the southern boundary in map area 23P. There, too, an agmatitic rock is characteristic. The anorthosite is, however, partly porphyritic,

Plate 54. Grey, medium grained, biotite granite gneiss (**A**gg) with amphibolite inclusions and late white, biotite granite dykelets; southwestern extremity of Big Island, mouth of the Whale River (map area 24J). R.S. 171702.

Plate 55. Well laminated granite gneiss (**Agg**) in the Tunulic River valley 17 km from the mouth (map area 24J). F.C.T. 171330.

Plate 56. Diabase dyke (**Ndb**) in the foreground intruding agmatite in an area dominated by granite gneiss (**Agg**); 7 km southwest of Cap Kernertut (map area 24J). F.C.T. 171337.

with anhedral labradorite grains up to 5 cm in greatest dimension, in a matrix of medium to coarse grained hornblende and labradorite.

These anorthosites are probably unrelated to those in the northeastern part of the map area as their mineralogy is somewhat different. It is assumed that they are of intrusive origin and were subsequently involved in the Hudsonian Orogeny and in part intruded by Aphebian granitic rocks. Although probably Aphebian themselves, as shown on the accompanying maps, they are possibly older.

Granite gneiss, granodiorite gneiss (**Agg**)

Gneissic rocks of granitic composition occur in varying amounts throughout the Churchill Province and form the major rock unit in many parts, particularly in map areas 24B, 24G, 24I and 24J. These rocks are characterized by a distinct foliation and/or banding marked chiefly by biotite and rarely hornblende orientation or concentration. Schlieren are a common feature and in some outcrops the sole structural element. These gneisses grade into many of the other Aphebian units, most notably migmatite (**Amg**) and paragneiss (**Apg**). However, they show sharp contacts with some rock units such as limestone and rusty graphitic gneiss of the Lake Harbour Group (**ALls** and **ALrc**). Inclusions are locally present and where abundant are indicated by the symbol **Agga** where primarily amphibolite, and **Aggp** where mostly paragneiss. Also included in this map unit are small dykes and sills of granite, granodiorite and pegmatite (**Agr**, **Agd** and **Apm**) (Pls. 54–59).

The typical rock of this unit is a pink, medium grained, biotite granite gneiss. Grey to light red varieties are well represented. Fine grained rocks are widely distributed, but coarse grained samples are rare. Whereas biotite is the commonest mafic mineral, hornblende occurs in some places, either with biotite or alone. Potash feldspar, predominantly microcline, forms from 5 to 50 per cent of the rock. Similarly, plagioclase (An_{23-32}), which is partly antiperthite, forms from 5 to 50 per cent, but higher plagioclase content is less common than for the potash feldspar, hence most of this gneiss is compositionally a granite. In places plagioclase occurs as augen up to 1 cm long. Compositionally granodiorite forms about 25 per cent and quartz monzonite 10 per cent. Feldspars are fresh except for minor sericite development. Myrmekite is a small but common constituent. Quartz forms a fairly uniform content of about 20 per cent. Green to brown biotite, which comprises 5 to 15 per cent,

Plate 57. Well laminated granite gneiss (**Agg**) near Nipkotok Island (map area 24J). F.C.T. 171338.

Plate 58. Grey and pink, well laminated and locally crenulated granitic gneiss on island in Ungava Bay in the northwest corner of map area 24I. F.C.T. 171343.

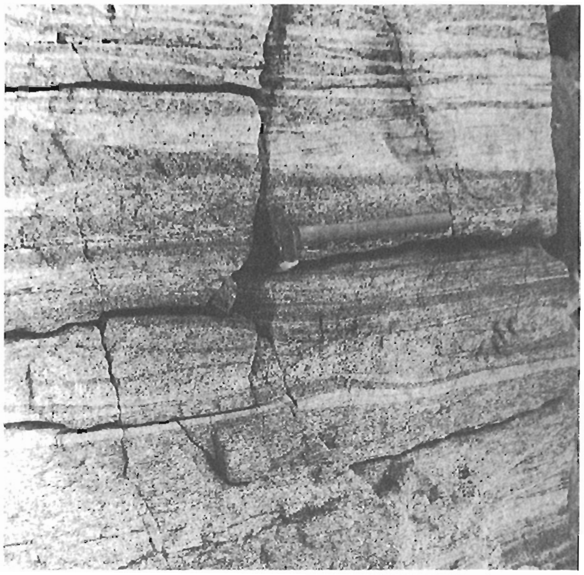


Plate 59. Well banded granite gneiss showing biotite-rich and poor layers (**A**gg) on North Aulatsivik Island, 3.5 km northeast of Maddon Cove (map area 24P). F.C.T. 171507.

shows minor alteration to chlorite. Hornblende, where present, totals less than 10 per cent. Muscovite, epidote, apatite, ilmenite, magnetite, zircon, calcite, pyrite and allanite occur in accessory amounts.

The derivation of the rocks of this map unit is uncertain. Some are probably metasedimentary rocks as they grade into well defined paragneiss (**A**pg) and are themselves well banded. Others may be of magmatic origin, in particular those outcrops characterized by the presence of abundant inclusions and those that may be sills and display sharp contacts, although not chilled with limestone.

Migmatite (**A**mg)

Rocks of this map unit underlie extensive parts of map areas 24A, 24G, 24H, 24J and 14E, plus smaller exposures throughout the central part of the map area. Excellent exposures occur along the tide-washed coast of Ungava Bay. Migmatite is intimately associated with rocks mapped as granite and granodiorite gneiss (**A**gg), and boundaries between these two units are arbitrarily drawn. Boundaries with other gneissic rock units are also poorly defined for the most part as gradations between units are common. Boundaries with mafic rocks, such as amphibolite (**A**ab), are better defined although these also are in places marked by zones of agmatite or lit-par-lit gneiss. Contacts between members of the granodiorite intrusive group (**A**gd) are variously abrupt to gradational, whereas those between the

Plate 60. Crenulated, finely banded migmatite (**A**mg) west side of False River, west of Tasker Point (map area 24J). R.S. 171707.

posttectonic anorthosite-adamellite suite, where seen, are well defined and sharp (Pl. 60).

These Aphebian migmatites are similar in general to the Archean migmatites present in the Nain Province to the east in that they are composed primarily of fragments and bands of amphibolite and metasedimentary rocks mixed with granitic rock. The paleosome fraction displays a vast number of shapes and sizes, with the latter ranging from a centimetre or so to several tens of metres in greatest dimension. Boudins of amphibolite are particularly prevalent in parts of migmatite that can be described as banded. Paleosome fragments range from angular to lens-shaped and include well rounded samples intermixed with other types. Where banded, the paleosome fraction forms from 20 to 30 per cent of the migmatite, and bands range from less than 1 cm to 1 m or so thick. The neosome fraction forms dykes, sills and irregular-shaped masses that in many places can be seen to intrude earlier neosome fractions. Schlieren are common in some of the granitic phases, and porphyroblasts and augen occur locally. Lit-par-lit structures are present in some areas, such as south of False River (24J), but are limited laterally as well as across strike. Although a general northerly trend exists throughout the migmatites, as indicated by foliation and banding, in many places contorted rocks are typical and ptygmatic, erratic folding is characteristic (Pl. 61).

Included with this unit are small areas of erratically distributed agmatite. This latter rock type consists principally of mafic angular fragments, commonly amphibolite, in a matrix of fine to medium grained pink, massive biotite granodiorite or granite. Fragments in agmatite are of various sizes but most commonly in the order of 1 m or less. Femic fragments are less abundant, but in a few places pink to grey granitic gneiss has been invaded by granitic magma to produce a femic agmatite (Pls. 62–66).

The paleosome consists mostly of metasedimentary rocks and amphibolite. The former are chiefly similar to paragneiss (**Apg**) consisting mainly of medium grained, grey

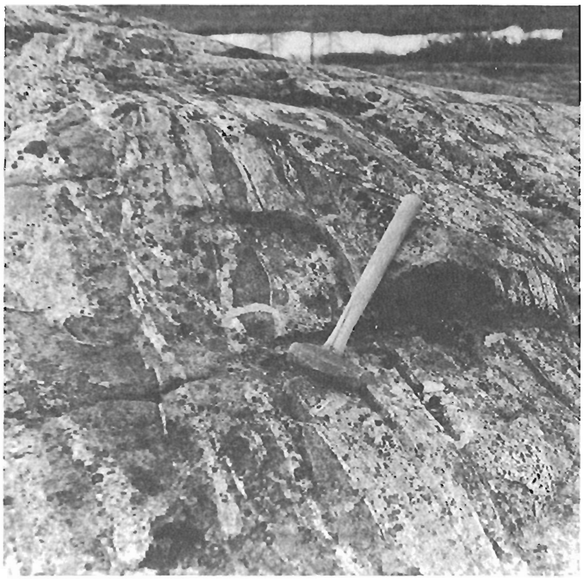


Plate 61. Irregularly layered migmatite (**Amg**), with local amphibolite boudins and paragneiss layers, typical of migmatite in the area southeast of Indian House Lake (map area 23P). F.C.T. 172192.

biotite-quartz-feldspar gneiss with lesser amounts of quartzite (**Aqz**), calc-silicates (**Acs**), rusty graphitic gneiss (**Arc**) and mica schist (**Asc**). In places these remnants of sedimentary rocks have been saturated with granitic material so that all gradations exist between the paleosome and neosome fractions. Amphibolite elements are similar to those in map unit **Aab**. A grey granitic gneiss paleosome is present in some outcrops, such as south of False River, where a medium grained, light grey, biotite-quartz feldspar gneiss with rare large feldspar metacrysts forms 50 per cent of the migmatite. In this paleosome biotite is segregated into layers and oriented parallel to layering in the migmatite, which is in part contorted.

Plate 62. Agmatite 7 km southwest of Cap Kernertut within an area chiefly consisting of granitic gneiss (**Agg**). Typical of some of the rock along the Ungava Bay coast in this area (map area 24J). C.K.B. 171916.

The neosome consists mainly of a medium grained, massive, pink to grey, less commonly white, biotite granite or granodiorite. Smaller amounts of fine or coarse grained rocks are also present and hornblende and muscovite varieties are represented. A white biotite and/or muscovite pegmatite, occurring predominantly as crosscutting dykes, is the youngest neosome phase in many migmatite outcrops.

The major difference between the Archean migmatite (Amg) and these migmatites (**Amg**) is the freshness of the present rocks. Only rarely are any of the mafic minerals altered, and alteration present consists of minor alteration of biotite and hornblende to chlorite. This difference is not everywhere apparent and migmatite outcrops, for example, from west of Hopedale (Amg) are indistinguishable from those in the George River valley (**Amg**).

The intrusive neosome fraction of this migmatite is no doubt cogenetic with the granite, granodiorite and pegmatite (**Agr**, **Agd** and **Apm**) with which it is spatially related.

Plate 64. Aphebian migmatite (**Amg**) with subangular blocks of garnetiferous amphibolite and numerous coarse grained granitic veins up to 1 m thick. East shore of Whale River at its mouth (map area 24J). F.C.T. 171315.

Granodiorite, granite (**Agd**, **Agr**)
Rocks in this map unit consist primarily of a massive, coarse grained porphyritic granodiorite (**Agd**) with relatively small amounts of granite (**Agr**). They occur most abundantly in map areas 23P, 24A, 24H and 24G, where they form intrusive bodies of batholithic proportions. Smaller plutons occur at widely scattered places throughout much of the gneissic Aphebian terrane east of the Labrador Trough. The major plutons generally show intrusive relationships with paragneiss (**Apg**) but in many places are gradational into migmatite (**Amg**) and granitic gneiss (**Agg**). Inclusions of amphibolite and metasedimentary rocks are locally present. These range from cobble-size fragments to rather extensive xenoliths several metres in greatest dimension. Fragments are variously rounded to angular, with rounding most prevalent amongst the smaller fraction. Where fragments are particularly abundant, they are indicated **Agda** where amphibolite, and **Agdp** where paragneiss. Undoubtedly some migmatite (**Amg**) is essentially similar to inclusion-rich areas of this granodiorite.

Whereas a massive, commonly well jointed, rock is most typical, a foliation or lineation is manifested in places through preferential orientation of biotite and feldspar grains. Examples of foliation due to biotite orientation are particularly well displayed west of Indian House Lake in map area 24H. These biotite plates are oriented parallel with the contact, a relationship that is also common elsewhere. Feldspar crystals show a good lineation in some outcrops, such as near the northwest corner of map area 24A, where 5 cm crystals define a strong horizontal south-

Plate 63. Local agmatite in granitic gneiss (**Agg**) at east boundary of map area 24B at latitude 56°45'N. At this point amphibolite forms 70 percent of the rock with agmatite 20 percent, and pegmatite and granite 10 percent. This type of rock occurs erratically in map units **Agg** and **Amg**. C.K.B. 171861.

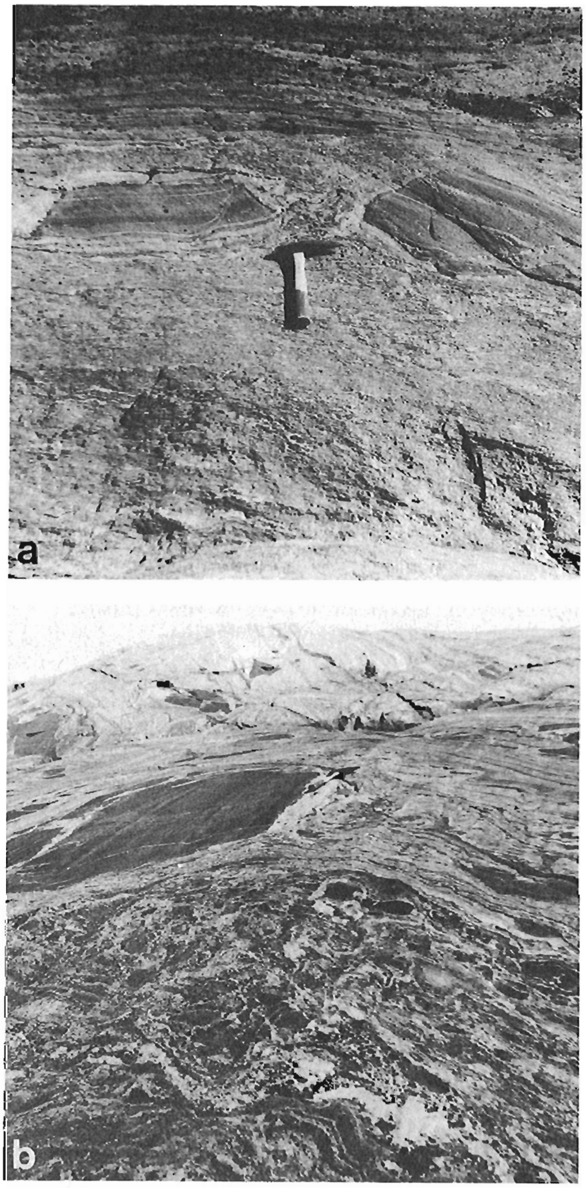


Plate 65a,b. Blocks of banded amphibolite in Aphebian migmatite (**Amg**). Note banding in amphibolite differs in attitude from that in migmatite. East shore of Whale River at mouth (map area 24J). F.C.T. 171320, 171322.

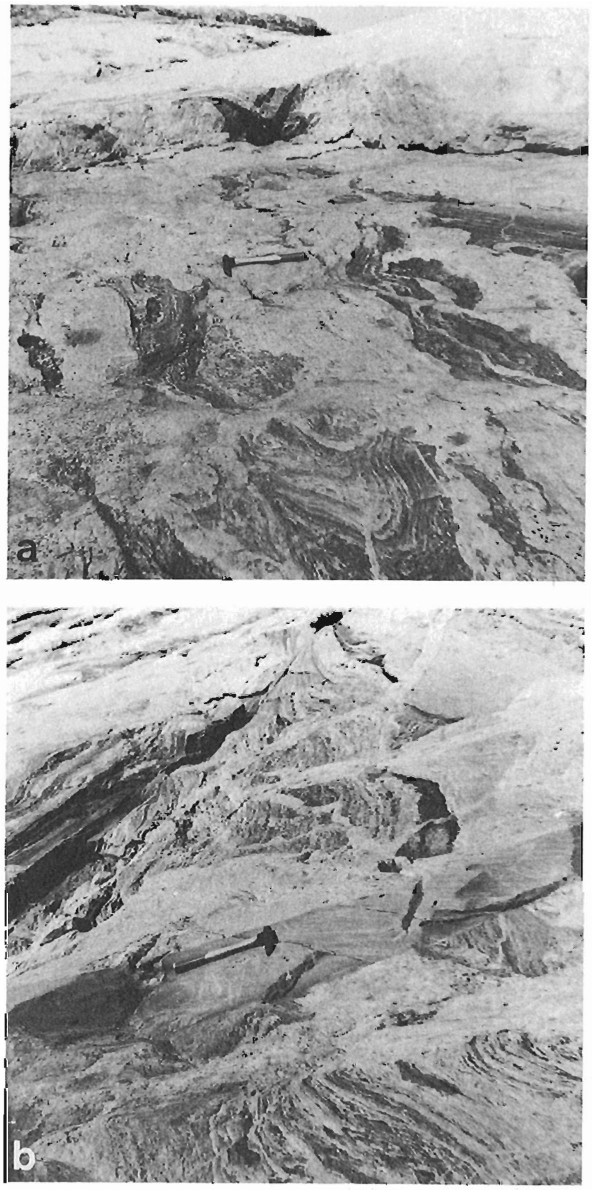


Plate 66a,b. Agmatite in migmatite terrane (**Amg**) on the west shore of Kohlmeister Lake at west boundary (map area 24J). Coarse grained to pegmatitic granite contains inclusion of amphibolite, paragneiss, granite and migmatite. F.C.T. 171323, 171325.

southeast trend. In other places feldspar phenocrysts lie in the plane of foliation as defined by biotite orientation (Pls. 67, 68).

This granodiorite is chiefly a coarse grained, porphyritic, greyish-pink rock. Locally an equigranular and/or medium grained phase is present, but the mineralogy is the same. Feldspar phenocrysts, which are subhedral to euhedral, are commonly 3 cm long and in a few places up to 10 cm. In general they are greyish pink, but a few are grey. This rock is about 20 per cent potash feldspar with both orthoclase and microcline, the latter frequently cloudy. Perthitic intergrowths are common. Plagioclase ranges from An_{12} to An_{28} and is locally antiperthitic. Greyish-olive-green biotite is the common mafic mineral, but locally, dark yellowish-green hornblende is more abundant. In part biotite is slightly chloritized. Rarely, hornblende grains show clinopyroxene cores. In some parts hornblende is absent or in trace amounts only. Quartz, although dominantly clear or grey, locally has a bluish cast. Accessory minerals are zircon, sphene, apatite, allanite, magnetite, muscovite, epidote and chlorite. Sericite locally occurs as a feldspar alteration product. Fluorite and epidote occur in veins in some sheared granodiorite northeast of the Rivière Tunulic near the western margin of map area 24H.

The rocks shown as **Agr** are dominantly medium grained, equigranular, light pink to buff biotite-bearing granite. A weak foliation is present in places. The granite near Whitegull Lake (23P) is light pink, locally dark grey, medium to coarse grained with biotite and, less commonly, hornblende. A few potash feldspar phenocrysts are present in some places. In part biotite is extensively chloritized. Felsic streaks occur locally. Jointing is weakly developed.

The granite (Agr) consists of up to 65 per cent potash feldspar, chiefly microcline, 10 per cent plagioclase, 20 per cent quartz and 5 per cent biotite. Muscovite, magnetite, sphene, zircon and apatite occur as accessory minerals.

Small areas of those rocks, notably in map areas 13M and 14D are possibly erroneously assigned. For example, the elongate area of granodiorite near the centre of map area 13M is possibly related to the Paleohelikian adamellite suite. This rock consists of a variegated pink, coarse grained, porphyritic, biotite granodiorite not unlike some of the adamellite suite. This pluton, however, shows a weak mineral foliation and orientation of paragneiss inclusions, which is not typical of the adamellite suite, hence the pluton is assigned to the Aphebian. Similarly, in map area 14D, a light pink, weakly foliated, coarse grained, porphyritic granite is considered Aphebian. The granodiorite in the western part of map area 14E lying within granulite terrane is a medium to coarse grained, mottled pink, weakly foliated rock with augenlike microcline lying in the foliation plane. Both hornblende and biotite are present in this dominantly homogeneous rock that shows a ghost layering.

This granodiorite and granite postdates the gneissic rocks east of the Labrador Trough as it contains inclusions of rocks considered to be the metamorphic equivalents of Kaniapiskau Supergroup rocks. It also, in part, transects structures parallel to those occurring in the Labrador Trough sequence, although pluton orientation in general is concordant with regional structure.

Isotopic age determinations, consisting of K-Ar mica determinations, range from 1580 to 1705 Ma indicate a middle Aphebian age for these late intrusive granitic rocks.

Plate 68. Porphyritic granodiorite (**A**gd) 8 km northeast of Lac Guérard (map area 24A). F.C.T. 172404.

Pegmatitic granite, pegmatite (Apm)

North and east of Lac Saint-Servan (map area 24B) and east and west of Lac Secondon, a white, coarse grained, pegmatitic, massive granite containing scattered coarse grained biotite and muscovite outcrops in a few places. Drift cover is extensive in the area, and these scattered outcrops may be dykes; but as their field relationships are doubtful they are shown as larger intrusives. Feldspar crystals in these rocks are in places up to 25 cm long. Although contacts with gneisses in the area are not exposed, this granite is unquestionably younger as it locally contains inclusions of biotite-quartz-feldspar paragneiss (Apg). A K-Ar age determination on muscovite from this rock gave an age of 1670±55 Ma.

Plate 67. Weakly foliated, coarse grained, porphyritic granodiorite (**A**gd) with pink pegmatite dykelets; 15 km east of Lac Gendre (map area 24G). R.S. 171690.

Numerous small and irregular pegmatite dykes are present throughout the granitic terrane (**A**gg, **A**mg). Most of these contain biotite only. A few pegmatites along the southeast shore of Ungava Bay contain a few per cent of magnetite.

Diabase (**A**db)

Diabase dykes assigned to the Aphebian clearly intrude folded and metamorphosed Aphebian rocks and are lithologically distinct from other dykes in the same vicinity, whose ages are known. The age of only one dyke is confirmed by isotopic dating; hence, the certainty of an Aphebian age for many of these is questionable and younger ages are possible.

Aphebian diabase is abundant both as dykes and sills in map area 14L and 14M, 24P and 25A. The greatest concentration is in the coastal area and inland between Cape Chidley Islands southward to Trout Trap Fiord. A few occur west of Ryans Bay and near the mouth of Lepers River (Pl. 69).

Some of the dykes, in the cliff walls along the Palmer River where they intrude granulite (**A**gl), are horizontal. Others in the region trend chiefly east to northeast with rare dykes trending north to north-northwest. Many dykes observed from the air in the mountainous terrane follow erratic courses through their host rocks.

These diabases are medium grained, greenish-brown, subophitic rocks consisting mostly of fresh plagioclase (An_{46-61}) and augite. Locally small amounts of white mica are present in the plagioclase. Small amounts of hornblende, biotite, magnetite, apatite, chlorite and calcite are also present. Micrographic intergrowths of quartz and potash feldspar comprise up to 3 per cent of the rock.

The age of these diabases is unknown, and they are presumed to be late Aphebian in view of their posttectonic relationships with the country rocks and lithologic dissimilarity with other diabases in the immediate region, namely those assigned to the Neohelikian (**N**db) and the Cambrian (**C**db).

Plate 70. Garnetiferous diabase dyke (**A**db) in granulite (**A**gl) 6 km north of Kangalaksiorvik Fiord at the east boundary of map area 24P. F.C.T. 171478.

A 0.3 m thick, medium grained, subophitic diabase near Korluktok Falls on the Korok River (map area 24I) differs from others in that it contains an appreciable amount of orthopyroxene. This orthopyroxene, which comprises 14 per cent, is weakly pleochroic and contains numerous very small inclusions, possibly magnetite, lying in cleavage planes. It also has very thin coronas of clinopyroxene or chlorite and some grains have both. Plagioclase (An_{55}) is zoned, unaltered and forms 48 per cent. Augite (23 per cent), is faintly pleochroic and in contrast with the orthopyroxene, free of inclusions. Brown hornblende, and brown

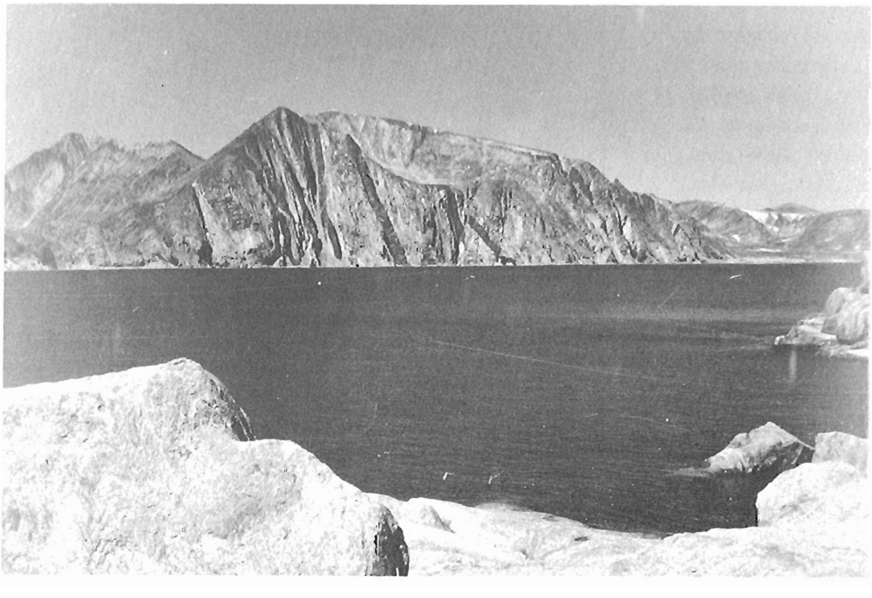


Plate 69. Diabase dykes (**A**db) cutting Archean migmatite on the north side of Bears Gut. A typical view of the Archean coast at this latitude. Note crenulated Archean paragneiss (**A**pg) in the left foreground (map area 14L). C.K.B. 171964.

and green biotite each form 3 per cent. Skeletal magnetite and small amounts of pyrite total 6 per cent. Quartz, apatite, chlorite, epidote and micrographic intergrowth of quartz and potash feldspar complete the mineralogy.

The age of this dyke is unknown. It is assigned to the Aphebian as a convenience. As it does not contain olivine, it is unlikely that it is part of the Big Lake swarm (**N**db) or those near Eclipse Harbour (**C**db).

The chill zone of a north-northwest trending diabase, that cuts Archean syenite (Asy) northeast of the Border River (Map area 13N), has been dated at 1748±50 Ma by the K-Ar method. A similar diabase, which abuts Archean migmatite south of Sango Brook, is assumed to be Aphebian also. A 0.5 m diabase sill in schist (**A**sc) west of the George River in map area 23P is included in this map unit (Pl. 70).

A number of metamorphosed diabase dykes from south of Four Peaks (map area 24P) that have been described by Morgan and Taylor (1972) are also included in this map unit.

Some of the K-Ar age determinations on dykes from Whale Island (map area 14M) have shown them to contain excessive amounts of argon resulting in ages much older than their host rocks. This is interesting because some diabase dykes on the west coast of Greenland, correlated with those of Labrador by some workers, also show excess argon and hence spurious ages (Bridgwater, 1970).

Lamprophyre (**A**lp)

Lamprophyre dykes are common along the southeast coast (map area 13O) where they intrude migmatite (**A**mg), elements of the Aillik Group and frequently silicic rocks of this region such as the Strawberry granite and granodiorite (**A**sgr, **A**sgd).

These dykes, which are commonly horizontal or dip at low angles, in some places, occur in great numbers of thin sheets (1 – 3 m thick) such as on Striped Island (map area 13O), which from a distance imparts a bedded appearance to the outcrop. They are also vertical in some places and regularly occur in or parallel to joints in the host rocks.

A dark greenish-grey, fine grained, massive rock is typical of the thinner dykes. Thicker ones are similar in the margins or chill zones, but toward the centre are dusky blue green and greenish grey with greyish orange-pink feldspars, equigranular, medium grained and massive. A 1 m thick dyke on Black Bear Island shows flow lines parallel to the walls and a well defined chill zone. Another dyke on Dunn Island displays 1 cm plagioclase phenocrysts.

All the lamprophyres of this map unit examined contain hornblende, in some cases forming 50 per cent of the rock. Plagioclase, extensively altered to clinozoisite, is zoned in part and is probably chiefly labradorite. Biotite occurs in a few places, where it forms less than 10 per cent. Present in order of decreasing abundance are clinopyroxene, calcite, quartz, epidote, chlorite, apatite, magnetite, pyrite and sphene. Kranck (1953) presented descriptions and analyses of some lamprophyres from the Aillik district.

An age determination on a dyke located 1 km north of Makkovik village gave an age of 1550±55 Ma. (Taylor, 1972c), which is probably the age of the intrusion. As most of these dykes are closely associated with elements of the Aillik Group and Strawberry intrusive suite they are probably derivatives from the same magmas or magma.

South of Saglarsuk Bay (map area 24P) a lamprophyre dyke 4 to 6 m thick intrudes gneisses at a very low angle to the foliation. This dark green, fine grained, very weakly foliated lamprophyre consists of anhedral phenocrysts of light green hornblende in a very fine grained mosaic of brown biotite, untwinned plagioclase, hornblende and magnetite, and a few grains of calcite and apatite.

The age of this lamprophyre is uncertain. As it is weakly foliated, it may have been emplaced during the latter stages of tectonism affecting the host rocks and therefore it has been assigned to the Aphebian.

Helikian

Paleohelikian (P)

Paleohelikian rocks are dominated by huge posttectonic intrusions of anorthositic and adamellitic rocks. These intrusions of batholithic proportions occur in both the Nain and Churchill structural provinces, with many of them lying along the boundary. Although chiefly anorthosite, the basic intrusions also include diorite, gabbro, and troctolite. The silicic intrusions are chiefly adamellite with lesser quantities of porphyry, granite, syenite, granodiorite, breccia and rhyolite (Fig. 2).

The only other Paleohelikian rocks consist of diabase dykes that cut these plutonic and other older rocks.

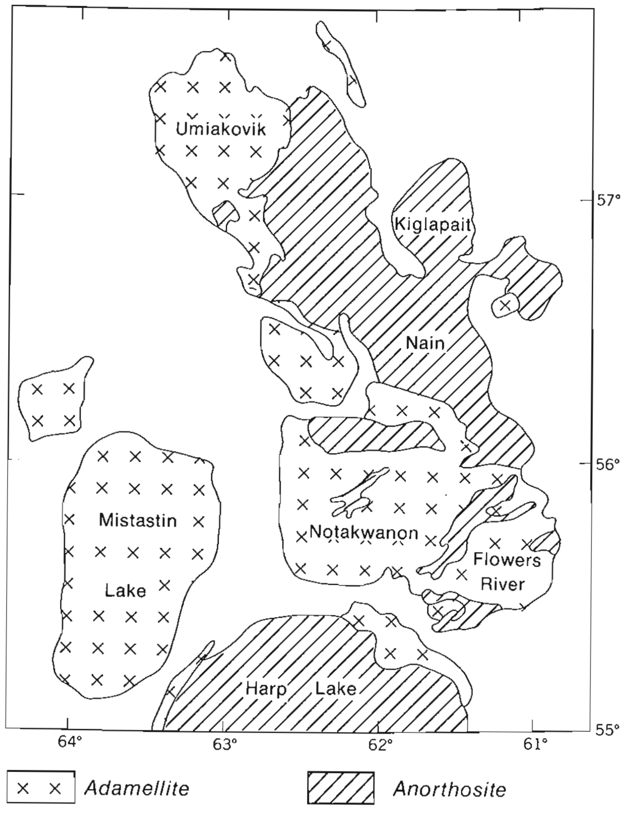


Figure 2. Paleohelikian intrusive plutons.

Anorthosite, gabbro (**Par**, **Pgb**)

The anorthosite suite is dominated by the Nain pluton that occupies much of the east coast from latitude 56 to 57°N extending inland for about 100 km. The other major area of anorthosite is the Harp Lake pluton along the southern boundary. Only about one half of this batholith lies within the map area, the remainder being in areas mapped by Emslie (1964a), Roscoe and Emslie (1973) and Fahrig (1959). Smaller areas of anorthosite occur in and around the Notakwanon adamellite pluton.

All these anorthosite occurrences have many similarities, the most pronounced being the fresh nature of the rock, which applies whatever the precise petrographic character. Although difficult to discern and absent in many places, probably all these plutons are cryptically layered. They also show clear intrusive relationships with older rocks, such as presence of dykes, contact metamorphism, inclusions of country rocks and finer grained border phases.

The attitude of the contact between the anorthosite plutons and their hosts is poorly known, as only rarely is it exposed, being drift- or water-covered in most places. Field relationships, however, suggest that contacts are steep, probably vertical or close to it. Along Border River the north boundary of the Harp Lake pluton is approximately vertical in the river canyon walls. Emslie (1972) more recently mapped this contact in detail and reports it nearly vertical. West of Webb Brook (map area 14D) the contact between the Nain pluton and migmatite (**Amg**) shows anorthosite cutting migmatite and is approximately vertical. A near vertical contact is also suggested northwest of Kingurutik Lake, where layering dips 80° parallel with the foliation in nearby granulite (**Agl**).

In the few places that the contact between the anorthosite plutons and their host rock is exposed, it displays intrusive characteristics. Although rare, dykes of anorthosite composition are present. For example, north of the Border River a 1 m thick dyke of fine grained, massive anorthosite intrudes a quartzofeldspathic gneiss (**Agg**). A second, similar anorthosite dyke, cuts both the country rock and the earlier dyke. Similarly, inclusions are also rare but present in sufficient numbers to provide evidence for intrusive origin for the anorthosite. South of Border River fragments and elongate masses of light rusty granulite occur in fine grained, dark grey anorthosite of the Harp Lake pluton. Emslie (1973) noted a large gneiss inclusion in the same pluton 1.6 km from the contact. Blocks of amphibolite are present in a medium grained gabbro phase of the Nain pluton on an island north of Uyagaksuak Island (map area 13N) where the gabbro also shows a fine grained margin. A decrease in grain size, from medium to fine, also occurs in the Nain pluton 15 km northwest of Kingurutik Lake where the anorthosite is in contact with granulite (**Agl**). Contact metamorphism is not well developed, but at the southern boundary along the east margin of the Harp Lake pluton the host rocks have been altered to a light olive, medium grained, pyroxene hornfels.

In some places in the Nain pluton, such as north and south of Laura Lake, the presence of gabbroic rocks in the contact zone characterizes the anorthosite. In this particular area the gabbro is up to 5 km wide at Laura Lake (map area 14E) but is chiefly in the order of 1 to 2 km. Farther south, south of Paul Island and in the Davis Inlet district, gabbroic phases are also common bordering the Archean migmatite (**Amg**).

Plate 71. Layering in anorthosite (**Par**) 1 km southwest of Flowers Lake (map area 13N). F.C.T. 172301.

Layering in the anorthosite is well defined in a few localities and possibly occurs much more commonly than encountered during the present survey, as many outcrops have extensive lichen growths. Emslie (1971, 1972, 1973) reported that layered structures are widely distributed in the Harp Lake pluton with dips at low to moderate angles (less 25°) and consisting of olivine-rich and plagioclase-rich bands. In this pluton Emslie noted that although layering is consistent over areas of 250 km² or more, across a valley or other lineament equally consistent dips may well be in a different direction, a phenomenon Emslie (1973) considered most likely "due to post-consolidation faulting and tilting of blocks, possibly due to cooling stresses."

Layering is also present in the smaller anorthosite bodies. For example, southwest of Flowers Lake[2] (map area 13N) steeply dipping layering is well displayed (Pl. 71). Like the Harp Lake pluton layering across the valley is in a different direction, southeast on one side and northeast on the other.

The Nain pluton also shows layering in some parts. South of Kingurutik Lake a small cliff face shows excellent layering (Pl. 72) in which well defined mafic bands consisting of deeply weathered pyroxene-rich bands are interlayered with light grey plagioclase-rich bands. The thickest band, which is 60 cm thick, shows a sharp upper contact and an undulatory lower contact. Below this thick mafic

[2]The name Flowers Lake has been applied informally to the lake centred at latitude 55° 39′ N, longitude 61° 30′ W. The river draining this lake, which empties into Flowers Bay, has been informally named Flowers River.

Plate 72. Primary layering in anorthosite (Par) 6 km southwest of Kingurutik Lake (map area 14D). E.W.R. 172632.

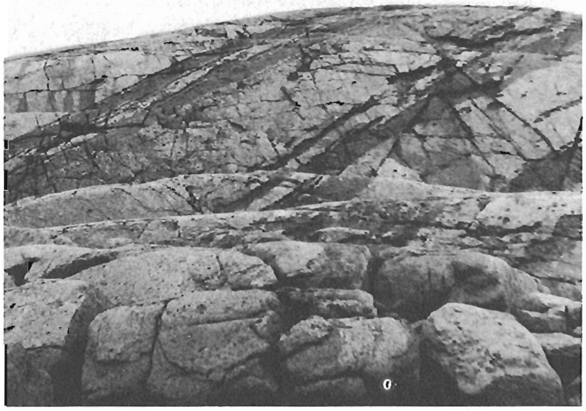


Plate 74. Layering in anorthosite on Marshall Island (map area 14C). F.C.T. 172494.

band are a few mafic clots, ovoid in section, and up to 0.5 m in greatest dimension. These have probably been detached from the irregular lower contact of the thick mafic band and sank in a semiconsolidated plagioclase-rich layer beneath (Pl. 73).

About 16 km south of Laura Lake a grey weathering, light brown, biotite anorthosite contains several 30 cm thick bands of dark grey, fine grained pyroxenite. The pyroxenite forms less than 5 per cent of the rock. At this point the banding is parallel to a foliation in the anorthosite. Layering is also well displayed on North Carey and Marshall islands (map area 14C). At the former, banding shows in light grey anorthosite because of grain size variations, whereas at the latter 30 to 90 cm thick bands of coarse grained gabbro occur in light grey anorthosite (Pls. 74, 75).

Layering on a fine scale is rarer. For example, 13 km southeast of the east end of Saputit Bay (may area 14E) a coarse grained, light grey, pyroxene-magnetite anorthosite, in part brecciated and veined by carbonate, shows rhythmic layering on a scale of about 1 cm (Pl. 76).

The most outstanding example of igneous layering is that present in the Kiglapait intrusion, which has been excellently mapped and described by Morse (1969). The reader is referred to that report for details of the Kiglapait pluton.

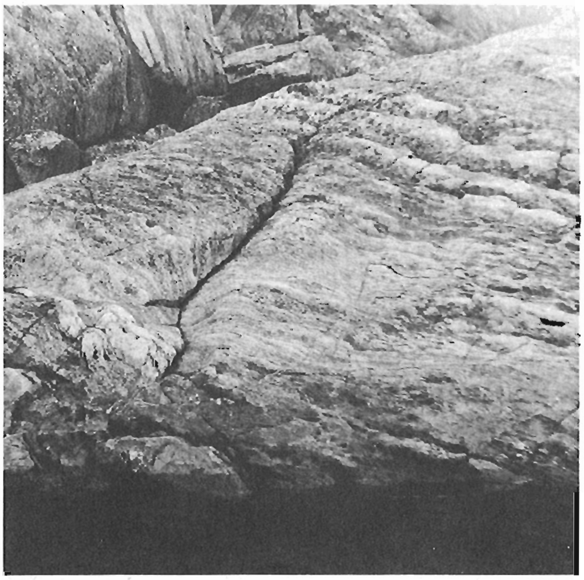


Plate 73. Streaky layering in coarse grained anorthosite (Par) on south shore of Kingurutik Lake southwest of island (map area 14D). E.W.R. 172644.

Plate 75. Layered coarse grained anorthosite (Par) on Marshall Island (map area 14C). F.C.T. 172496.

Besides layering the only other major internal features in the anorthosite are the presence of subrounded to irregularly shaped masses of anorthosite or gabbroic phases within anorthosite or gabbro. These masses range from a few centimetres to 1 m or so in diameter and are discernible because of grain size variations where present in rocks of the same lithology or by lithological differences. For example 8.5 km west of Sango Bay, gabbroic anorthosite contains angular to partly rounded blocks ranging from 0.5 to 3.0 m of white weathering anorthosite (Pl. 77). This gabbro is coarse grained with subhedral plagioclase crystals up to 10 cm long.

A local feature in the anorthosite plutons are streaks of mafic minerals. These are probably, in part at least, vestigial layering as they are ordinarily parallel to banding, where both are present.

Joints are a well developed feature of the anorthosites, particularly in the Harp Lake pluton. No attempt was made to analyze these. Locally a horizontal jointing or sheeting is also present.

A local slight brecciation of anorthosite, which is accentuated by development of carbonate vein matrix, is present 7 km north of Umiakoviarusek Lake (map area 14E).

The Harp Lake pluton shows a series of topographically prominent east-northeast striking lineaments, subparallel to Harp Lake. These are the site of a swarm of vertical, olivine gabbro dykes 15 to 60 m thick (Emslie, 1972). As these dykes do not extend beyond the intrusion boundaries, Emslie favoured a genetic relationship to the intrusion rather than a distinctly younger origin. Whether or not olivine gabbro or diabase dykes present in the Nain pluton are of similar origin, is not known. The same consistency and prominence of lineaments does not exist however. A K-Ar whole-rock age determination of a north-trending diabase on Kiuvik Island (map area 14C) gave an age of 1294±41 Ma, suggesting an age distinctly younger than the anorthosite.

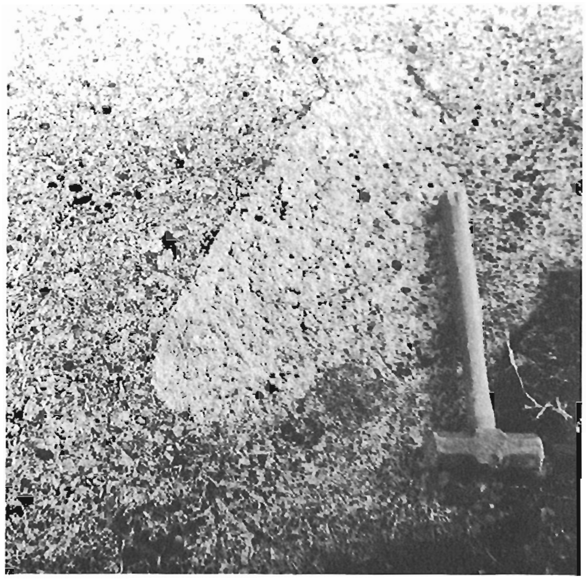


Plate 77. Rounded fragments of white weathering anorthosite (Par) in gabbroic anorthosite (Pgb) 8.5 km west of Sango Bay (map area 13N). Elsewhere in the same outcrop angular blocks of anorthosite up to 3 m long are present in the gabbroic rock. F.C.T. 172273.

A few fine to medium grained, light grey anorthosite dykes occur within the intrusions. For instance in the Harp Lake pluton anastomosing dykes, up to 3 m thick, occur in layered anorthosite about 32 km west of Harp Lake at the south boundary of the map area. In the same outcrop irregular patches or 'blobs' of fine grained anorthosite are also present that are similar to those described and illustrated by Emslie (1970) in the Michikamau intrusion.

About 8 km west of Iglusuataliksuak Lake (map area 14E), an easterly striking quartz gabbro dyke, ranging from 30 cm to 15 m thick, cuts medium grained, light grey anorthosite of the Nain pluton. This dyke is possibly genetically related to the anorthosite.

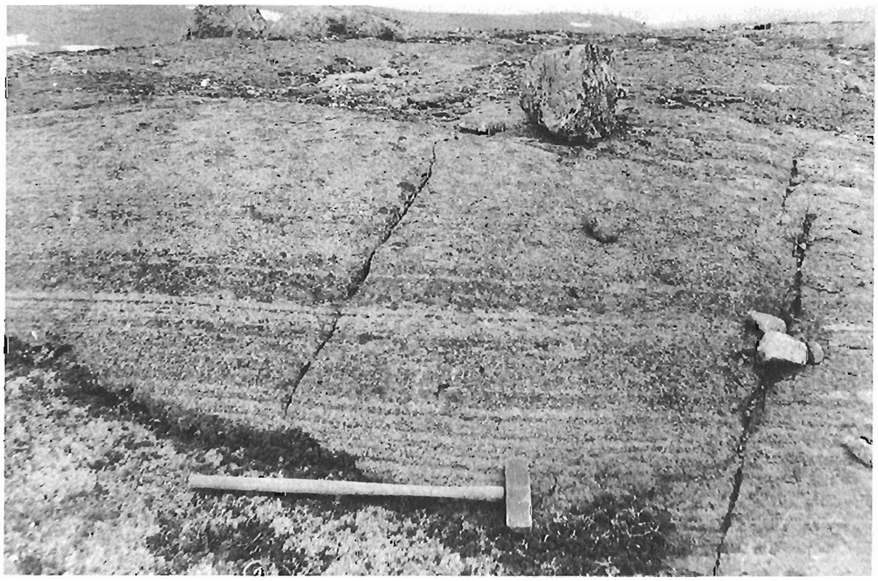


Plate 76. Thin primary layering in anorthosite (Par) 5 km south of Okak Bay (map area 14E). W.C.M. 172520.

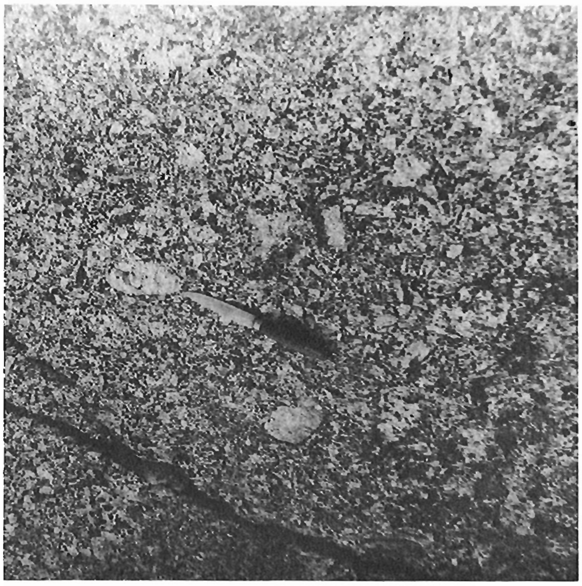


Plate 78. Large plagioclase crystals in gabbroic anorthosite (Pgb) 8.5 km west of Sango Bay (map area 13N). F.C.T. 172267.

Plate 80. Coarse grained anorthosite (Par) on island in Kingurutik Lake (map area 14D). E.W.R. 172638.

Anorthosite shows a wide range of colour from white to very dark grey, nearly black. The most common shade is light grey with a slight bluish cast. Grain size is highly variable, ranging from fine to very coarse, with a medium to coarse rock the most representative. Fine grained varieties tend to be lighter shades than the coarse or medium grained rocks. In a few places huge crystals, 1 m or more in length, occur notably in the vicinity of Kingurutik Lake. All rocks are crystalline and chatoyant crystals can be found in most localities where medium or coarse grained varieties are present (Pls. 78–81).

Except where sheared by fault movements, the anorthosite is completely fresh and has not undergone any significant alteration since its emplacement.

Plagioclase in the anorthosite ranges from An_{40} to An_{54}, is fresh except for minor sericite locally, and in a few places weakly antiperthitic. Whereas some samples are entirely plagioclase, others contain small amounts of one or more of hypersthene, olivine (commonly altered to iddingsite), clinopyroxene, biotite and hornblende. Other minerals present include magnetite, pyrite, calcite, apatite, quartz, muscovite, epidote and chlorite, all of which are rare. Pyroxene is in part uralitized and hornblende chloritized.

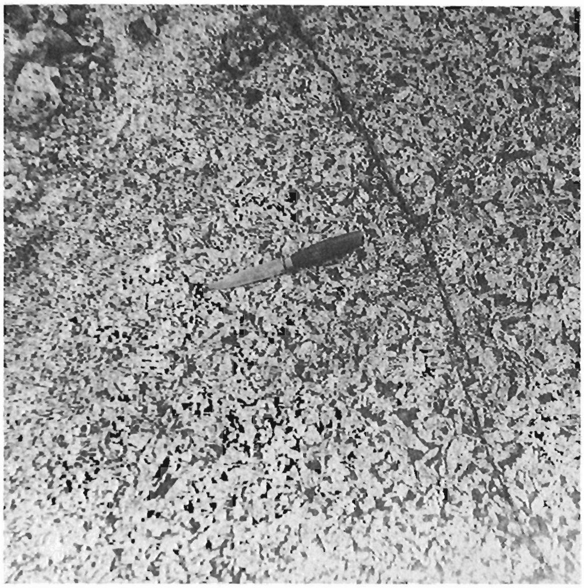


Plate 79. Coarse grained gabbroic anorthosite (Par) 8.5 km west of Sango Bay (map area 13N). F.C.T. 172265.

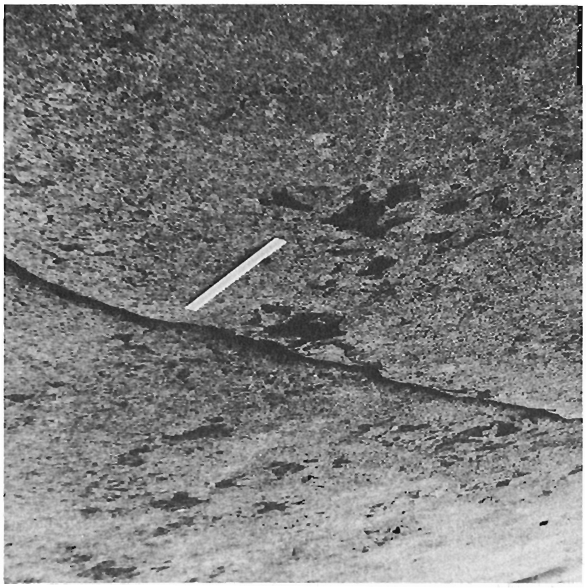


Plate 81. Coarse grained anorthosite (Par) on island in Kingurutik Lake (map area 14D). E.W.R. 172643.

Gabbro, which grades into anorthosite, is predominantly medium grained, equigranular, mottled grey-green, massive rock. In some places an ophitic texture is present and where layered, a segregation of felsic and mafic components. Plagioclase (An_{36-50}) is chiefly fresh, but some samples show sericite alteration up to about 50 per cent. Weakly pleochroic hypersthene and colourless clinopyroxene form the chief ferromagnesian minerals. Some samples contain only hypersthene and could be called norites. Green hornblende and more rarely biotite form up to 5 per cent. One sample showed iddingsite and chlorite, considered to be olivine alteration. In the same sample pyroxene is altered to a colourless amphibole, epidote and chlorite with magnetite along cleavage planes. A corona of biotite and chlorite is present around the pyroxene, whereas around the altered olivine coronas consist of a chlorite-magnetite mixture and two additional chlorite rims. Elsewhere, pyroxenes are partly to completely uralitized. Small amounts of apatite, chalcopyrite, pyrite, sphene and calcite are also present.

Age. The age of the anorthosites has until recently been assumed to be about 1400 Ma, based upon a K-Ar biotite determination from a sample of the Michikamau anorthosite pluton (Emslie, 1964b). U-Pb isotopic determinations on zircons from adamellites by Krogh and Davis (1973) of around 1450 Ma require the anorthosite to be somewhat older than this, possibly 1475 or even 1500 Ma. No reliable age determinations have been reported from the anorthosite itself. A pegmatitic lens of plagioclase, clinopyroxene and trondhjemitic granophyre from within anorthosite at Paul Island, near Nain, returned a 1418±25 Ma isochron (Barton, 1974). This age could well be related to adamellite and probably does not provide a reliable estimate of the age of the anorthosite.

Kiglapait intrusive (**PKgb**, **PKog**, **PKtr**)
Rocks comprising the Kiglapait layered intrusive were not mapped. A complete description of these rocks is given by Morse (1969), who mapped this intrusion on a scale of 1:50 000.

Map unit **PKgb** consists of a core of medium grained, massive troctolite to olivine gabbro, which is surrounded by grey gabbro; fine grained, massive olivine gabbro and ferrodiorite. These rocks are hypidiomorphic to allotriomorphic and slightly green on fresh surfaces. A rusty, deeply weathered surface is common.

Olivine gabbro, ferrodiorite and ferrosyenite (**PKog**) are characteristically layered and laminated with gabbro at the base and syenite at the top. Dark layers are common, consisting of augite-olivine with minor plagioclase and oxide-olivine. The olivine in the latter is yellow or greenish yellow. The oxide is ilmenite and/or magnetite-ulvospinel intergrowth.

The third map unit (**PKtr**) contains a diverse group of rocks. The outer margin of the pluton ranges from fine grained, flinty, massive rocks to fine grained banded rocks. Compositionally they range from ultramafic to gabbroic anorthosite. These rocks pass upward into subophitic, coarse grained to locally pegmatitic, massive gabbro characterized by a crumbly weathered surface. The major part of the map unit consists of a medium grained, hypidiomorphic troctolite with subhedral to euhedral plagioclase and anhedral, rounded or irregular olivine.

Adamellite and related rocks (**Pam**, **Pgd**, **Pgr**)
Spatially associated with the anorthositic and related intrusions (**Par**) are huge intrusions of adamellite. Similar to the anorthositic intrusions these are also commonly of batholithic proportions. For example, the Mistastin pluton embraces about 4100 km^2 and the Umiakovik pluton about 2300 km^2. Many smaller plutons are also present, and dykes of adamellite only a few metres thick are not uncommon.

Although much of the adamellitic rock is closely associated with the anorthosite, such as the partial rim about the perimeter of the Harp Lake pluton, some plutons are remote from anorthosite outcrops such as the pluton southeast of Lac Brisson (map area 24A). Although only rarely exposed, the contact of the adamellite is probably vertical or close to vertical in most places. The west side of the Notakwanan and Mistastin plutons shows a distinct topographic break over much of their length, suggesting a steep dip for the contact. In some places, however, such as 35 km west of Campsite 10 where anorthosite 'overlies' adamellite (Pl. 82), the contact is at a low angle. Similarly, along the north edge of the Umiakovik pluton adamellite underlying gneisses is exposed in hillsides about 24 km northwest of Saputit Lake. In general a steep contact is most typical, but low-angled contacts do occur, which is unlike the anorthosite that is characterized by steep contacts.

The age of the adamellite suite of rocks is well established by field and laboratory study. Field examination produced abundant evidence for intrusive relationships of the adamellitic rocks with the gneisses, both Proterozoic and Archean, and with the anorthosite. This evidence includes decrease of grain size at contacts, contact meta-

Plate 82. Well joined adamellite (Pam) intruding massive anorthosite (Par) approximately 35 km west of Campsite 10 (map area 13N). F.C.T. 172377.

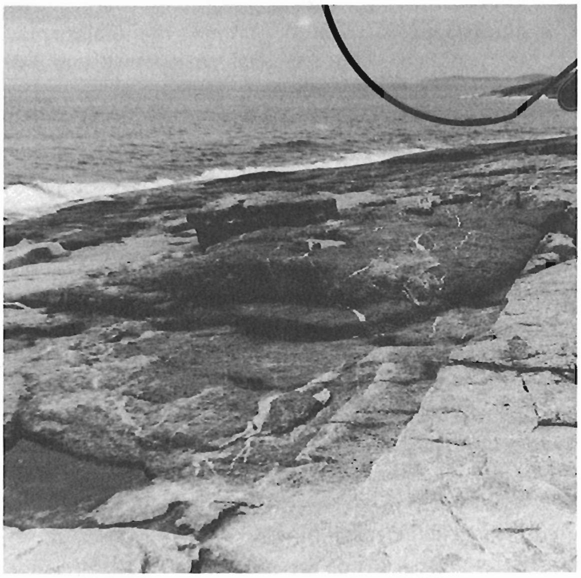


Plate 83. Large angular blocks of anorthosite (**P**ar) in granodiorite (**P**gd) on island 2 km east of Hayes Point, Dog Island (map area 14C). F.C.T. 172490.

morphism, inclusions, small apophyses and discordance (Pls. 83, 84).

Discordance is well displayed by the Umiakovik pluton west of Okak Bay (map area 14E) where well layered garnet-quartz-feldspar gneiss (**A**fg) is clearly cut by the adamellite on a major scale. In many places along the north margin of this pluton the contact between the two rock types is clearly defined and shows the adamellite discordant with the layering in the gneiss. Near Makhavinekh Mountain (map area 14D) the same relationship is also well marked. Similar relationships occur between the Natakwanon pluton and granitic gneiss (**A**gg) and are well displayed along the south contact of the pluton north of Border River (Pl. 85).

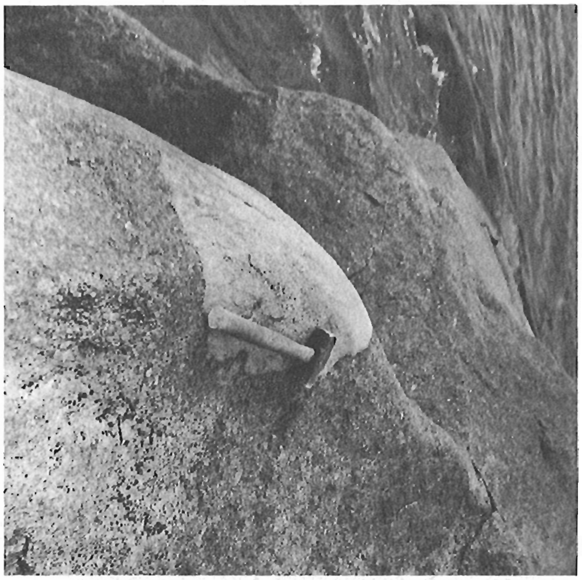


Plate 84. Subrounded inclusion of paragneiss in granodiorite (**P**gd) forming part of the adamellite suite on the south side of Voisey Bay (map area 14C). F.C.T. 172479.

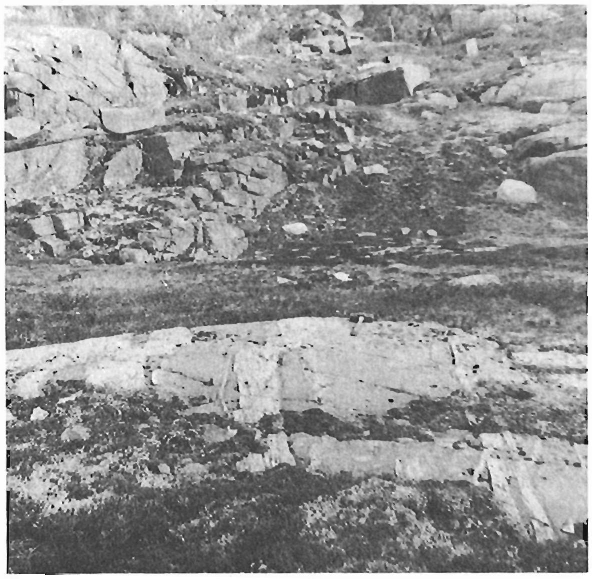


Plate 85. Banded, nearly vertical, gneissic granite with amphibolite (**A**gga) in the foreground cut at nearly a right angle by adamellite (**P**am) of the Natakwanon pluton in the background, 17.5 km north of the Border River (map area 13M). F.C.T. 172298.

Contact metamorphism of the host rocks is particularly well displayed along the north contact of the Umiakovik pluton. At the former, white weathering, garnet-quartz-feldspar gneiss (**A**fg) is discolored to a light brown and shows extensive recrystallization and development of large, up to 2 cm, dark grey, anhedral metacrysts. Microscopic examination shows these metacrysts to consist of a mixture of numerous, tiny dark green spinels and many small grains of untwinned plagioclase and cordierite. Sillimanite is also present but may be of regional metamorphic derivation. Moderately pleochroic hypersthene is intimately mixed with a myrmekitic intergrowth of quartz and feldspar. Away from the contact hypersthene, reddish-brown biotite, garnet, plagioclase, quartz and graphite are all typical of this gneiss.

East of Whitegull Lake, paragneiss, locally graphite-bearing, is intensely crenulated and deformed near the contact with adamellite. In some places the paragneiss is greenish and in others shows development of dark grey cordierite. A 10 m wide covering of overburden masks the precise contact, but the closest adamellite does not differ from that encountered remote from the margin except that it is white weathering, rather than medium grey or light pink. Microscopic examination shows extensive development of plagioclase, cordierite (slightly altered to pinite) and dark green spinel mixture. Sillimanite forms cores to some of the spinel-cordierite-plagioclase mixture and is probably a product of regional metamorphism. Garnet, red-brown biotite and rare muscovite are also probably remnants of regional metamorphism.

Small dykes and apophyses of adamellite extending into the host rocks are common. On the south shores of

Lake Mistinibi a coarse grained, east striking, vertical, adamellite dyke with rapakivi texture, only 1.5 m thick, is present 120 m from the nearest adamellite outcrop. In this same area the adamellite-paragneiss contact is exposed for only a few feet, and no chill zone exists; a coarse grained rock is present right up to the contact. However, a few inclusions of paragneiss are present in the adamellite.

Farther south, east of Whitegull Lake, undeformed veins of adamellite cut axial plane crenulations that are typical of the paragneiss in this area.

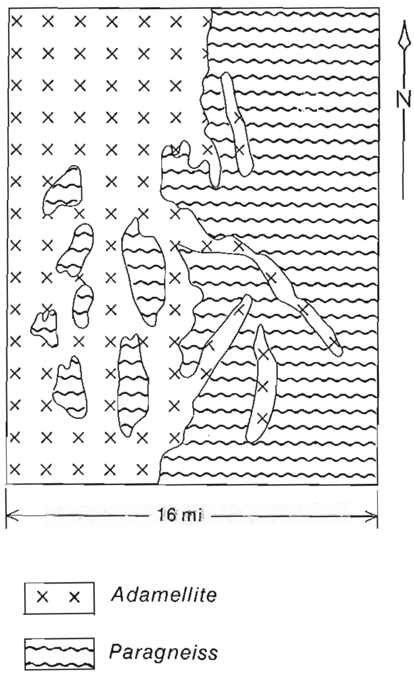
On the southeast side of the Mistastin pluton, north of Border Beacon, a coarse grained, massive, porphyritic, medium red adamellite cuts a highly contorted, dark pink, hornblende gneiss containing about 20 per cent fine grained granite that lies in the plane of foliation. The latter rock is folded with the gneiss, whereas the adamellite is not deformed.

About 30 km farther north, crosscutting veins of massive, white adamellite, form up to 20 per cent of a rock consisting chiefly of migmatite and paragneiss.

Ten kilometres east of Mistastin Lake the contact is somewhat different. It is well exposed and extends over about 15 m (Fig. 3). Bordering massive adamellite is a 3 m zone consisting of agmatite, which is succeeded by a central zone of about 6 m consisting of migmatite and gneiss, and a third or outer zone, also about 6 m thick, of gneiss cut by adamellite veins. Dips in the gneiss, which strikes southeast, are to both northeast and southwest. Away from the contact zone the paragneiss is strongly crenulated.

The contact between the Notakwanon pluton and migmatite is exposed along a part of the re-entrant on the southern margin. There adamellite cuts across the foliation at right angles and adamellite dykes penetrate granitic gneiss (Agg). The latter rock forms inclusions up to 90 m² in areal extent (Pl. 85). A slightly baked appearance is evident in the migmatite adjacent to the pluton.

The same pluton cuts gabbroic anorthosite on the north side of the Notakwanon River (northwest corner of map area 13N). There randomly oriented veins of rusty, medium grained adamellite penetrate the anorthosite. In general anorthosite fragments are angular, but in some places they are slightly rounded. Here the contact zone is at least 250 m wide (Pls. 86, 87).



MISTASTIN PLUTONIC

Figure 3. Adamellite contact 10 km east of Mistastin Lake.

Plate 86. Northerly striking adamellite dyke (**Pam**) 3 m thick cutting gabbroic anorthosite (**Pgb**) 8.5 km west of Sango Bay (map area 13N). F.C.T. 172269.

Plate 87. Blocks of gabbro (**Pgb**) in a matrix of granodiorite (**Pgd**) near the contact between these two rock types on the south shore of Voisey Bay (map area 14C). F.C.T. 172482.

In the southeast extremity of this pluton the anorthosite-adamellite contact is abrupt, as opposed to the above-mentioned locality. In a cliff face anorthosite can be seen 'overlying' adamellite (Pl. 82). In the same general area, dykes of adamellite up to 3 m thick are locally present in anorthosite.

Along the east contact of the Harp Lake adamellite, which is bordered with migmatite (Amg), a decrease in grain size in the adamellite from medium to fine occurs as the contact is approached. Rare xenoliths of migmatite, up to 15 m in diameter, are present within the adamellite. The eastern adamellite-anorthosite contact shows dykes of adamellite up to 2.5 m thick in anorthosite. North of Harp Lake lenses and streaks of adamellitic rock approximately 0.3 by 2 m occur in anorthosite along the contact zone. An alternation of anorthosite and microadamellite layers is typical of this contact zone.

Along the north contact of the Flowers River pluton (map area 13N), about 8 km south of Sango Bay, anorthosite-adamellite relationships are confusing. The contact zone consists of a series of breccias. A fine grained adamellite contains blocks of fine grained anorthosite, a fine grained anorthosite contains blocks of both anorthosite and adamellite; and a quartz-feldspar porphyry (part of the adamellite suite) contains blocks of adamellite. Both rounded and angular blocks are present.

The southern contact of this pluton north of Hunt River shows blocks of Archean migmatite within fine to coarse grained, light pink adamellite, and various sized and oriented dykes of adamellite in the migmatite. Both biotite and hornblende are common in this adamellite.

Along the west contact of the Umiakovik pluton, about 8 km west of the Kingurutik River (map area 14E) the contact zone in the adamellite is approximately 60 m wide. This zone shows a gradual decrease in grain size from coarse to fine, and near the contact a weak foliation is developed in the adamellite. Although the contact is abrupt, there is no chill. A few blocks of gneiss, up to 3 m long, occur as inclusions.

Lithology. The adamellite is primarily a coarse grained, porphyritic rock characterized by a propensity for deep weathering. Many outcrops consist almost entirely of rubble or rock that readily crumbles so that fresh specimens are difficult to obtain. Although possibly exceptional, a stream 10 km east of the interprovincial boundary at latitude 57°23′N (map area 14E) has exposed over 3 m of deeply weathered adamellite in which there are fragments of boulder-sized, relatively unweathered adamellite (Pl. 88). This characteristic weathering permits ready recognition of these rocks and boulders of it forming pedestals in various degrees of disintegration are common (Pl. 89). However, some adamellite outcrops display weathered surfaces similar to fresh surfaces and show no significant weathering.

The weathered surfaces of the adamellite are mostly various brown rusty colours. However, where obtainable, the fresh surfaces are variously grey, pinkish grey, pink and greenish grey.

Plate 88. Deeply weathered adamellite (**Pam**) forming part of the Umiakovik pluton, 10 km east of the Newfoundland-Quebec border near the west edge of the pluton (map area 14E). F.C.T. 172465.

The other members of this suite do not characteristically show the deep weathering associated with the adamellite. Weathered surfaces of granodiorite, granite and porphyry more closely correspond to fresh surface colours, being predominantly various shades of grey or pink.

The adamellite is chiefly massive and porphyritic with well formed feldspar crystals up to 4 cm long abundant (locally up to 7.5 cm) in a coarse grained matrix. Medium grained rocks are also present, but fine grained types are

Plate 89. Weathered adamellite (**Pam**) boulder. Typical of weathering of this rock type; 16 km northwest of Border Beacon airstrip (map area 13M). A.J.B. 172552.

rare. Equigranular members occur locally such as throughout some of the southernmost part of Notakwanon pluton. In general equigranular rocks are more commonly fine or medium grained, but coarse grained equigranular rocks are also well represented. A few of the porphyritic rocks, especially in the Mistastin pluton, display rapikivi texture (Pl. 90). Miarolitic cavities occur in some fine grained adamellites, for example, near the southwestern border of the Notakwanon pluton.

Granodiorite, granite and syenite are equigranular and primarily medium grained, although there are also fine and coarse grained types.

Mineralogically these rocks consist primarily of potash feldspar, plagioclase and quartz. The former is commonly perthitic and in part microcline. Plagioclase ranges from An_6 to An_{34} with the higher anorthite members more abundant, and is locally antiperthitic. Myrmekite occurs interstitially in some samples. Feldspar alteration, in the form of turbidness and/or development of sericite and kaolin, is variable and ranges from negligible to complete. A green, rarely brownish, hornblende is the most widespread mafic mineral, averaging roughly 10 per cent of the rock. Biotite is present in almost all samples and in a few exceeds hornblende in abundance; however, in general it forms 3 to 5 per cent. Clinopyroxene occurs locally in part as cores in hornblende. Hypersthene, displaying weak pleochroism, is rare and probably limited to the borders of the plutons. A few grains of olivine, invariably extensively or completely altered to a semiopaque, dark orange to yellow iddingsite are present in some thin sections. In a few samples mafic minerals show minor chloritization. Accessory minerals are apatite, magnetite, sphene, zircon, hematite and rarely, fluorite.

The Flowers River pluton contains minerals not encountered in the other plutons. Along the northern part of this pluton south of Sango Bay and Sango Brook and less commonly in the southwest, alkali pyroxenes and amphiboles form some or all the varietal minerals. Aegirine is the most common, up to 5 per cent, forming discrete medium grained crystals in some places and in others forming cores in the amphiboles or intermixed with them. Some aegirine contains olivine that is partly or entirely altered to iddingsite. Riebeckite, which occurs as an alteration product of aegirine and also as tiny, needlelike crystals in perthite, comprises less than 1 per cent. Arfvedsonite is less common than riebeckite. It occurs chiefly in parallel intergrowth with aegirine. Both soda amphiboles occur in a few samples. In these rocks perthitic potash feldspar forms up to 75 per cent with plagioclase (An_{6-16}), in part antiperthitic, less than 10 per cent and chiefly less than 5 per cent. Quartz ranges from 5 to 25 per cent.

Wheeler (1955) subdivided these rocks in the region between Davis Inlet and Nain into four mineralogical types based on a discontinuous reaction series: hypersthene, olivine (fayalite), hornblende and biotite. This subdivision was not used during the present work, but Wheeler's observation that the hypersthene-bearing rocks occur almost entirely in the margins of the plutons appears to be valid.

Fahrig and Jones (1976) made a paleomagnetic study of 70 cores from 11 sites within the Mistastin Lake pluton. This study showed a Pacific pole position of 185.5°W and 1.0°S with $An_{95}=7.6°$, which they interpret as the paleomagnetic pole at the time of cooling of this pluton.

Age. All early age determinations on samples from adamellite suite rocks were K-Ar determinations on biotite. These determinations showed a spread of ages from 1145 to 1325 Ma. Recent work using Rb-Sr techniques on both whole rocks and zircons have shown the K-Ar ages to be consistently too young. Marchand and Crocket (1974) reported a Rb/Sr whole-rock isochron age of 1346±15 Ma with an initial ratio of 0.7082±0.003 ($\lambda=1.39$) for the Mistastin Lake pluton. If $\lambda=1.47$ is used in this calculation, the age is 1272 Ma. Using the same method, Wanless obtained an age of 1246±32 Ma with an initial ratio of 0.7096±0.0013 for rocks from the Umiakovik pluton using $\lambda=1.47$ or

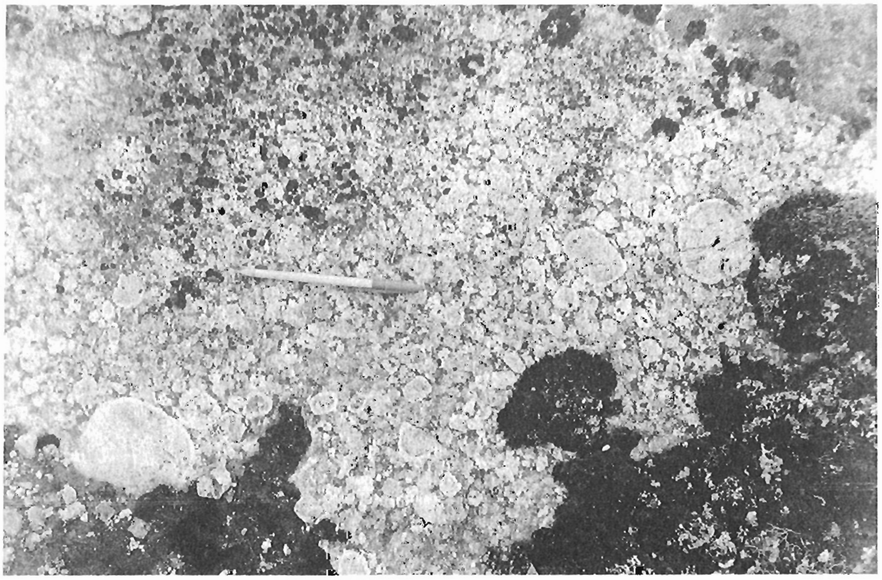


Plate 90. Porphyritic adamellite (Pam) with rapakivi textured feldspars, 15 km northwest of Border Beacon airstrip (map area 13MO). A.J.B. 172551.

1318 Ma using $\lambda = 1.39$. Krogh and Davis (1973) analyzed carefully selected zircon grains from the Harp Lake adamellite. U-Pb isotopic ages of these zircons showed remarkable concordance (Table 3) with ages of 1450 Ma. Clear zircons from near the eastern margin of the Nain adamellite body returned much younger ages ~1200 Ma. However, turbid grains indicated an age of 1321 Ma. These latter figures are probably too young as in all probability the adamellite plutons are the same age within a very few years. The most probable age for these rocks is about 1450 Ma.

Rhyolite (**Prl**)

Rhyolite is present only within a limited area of the Flowers River pluton. The most extensive outcrops are 6.5 km north-northwest of Campsite 10 where a suite of intrusive and extrusive phases of the adamellite are exposed on a hill, which is mostly capped by a nearly horizontal diabase dyke. This diabase, which is at least 9 m thick, is an ophitic, massive, medium grey-green, medium grained rock that in the centre has a thin granophyric phase. It displays conflicting age relationships with the adamellite suite. On the one hand the diabase is chilled against rhyolite and truncates banding in it, whereas on the other hand adamellite cuts diabase and is chilled against it. A small part of the hilltop is underlain by quartz-feldspar porphyry (**Ppp**) that probably overlies the diabase and extrusive rocks. However, its stratigraphic position is not known with certainty, and it may well be plutonic.

The base of the extrusive rocks is not exposed, so that their relationships to the adamellite batholith are not known with certainty. The superposition topographically suggests they overlie the main adamellite pluton.

A cursory examination of the extrusive rocks shows the following sequence from the top downward:

A crudely laminated and brecciated rock consisting of fluorite and clinoamphibole; toward the bottom of this member the rock is moderately well banded and consists of diopside and clinoamphibole with rare fluorite layers and veinlets.

A very fine grained to aphanitic, yellowish-grey to pale red banded rhyolite; approximately 15 m thick. Fine grained to aphanitic, faintly banded to massive, rhyolite in various shades of grey and greyish orange pink.

Fine grained, pale red, massive, equigranular 'microadamellite'.

Fine grained, pale red to pale reddish-brown spherulitic rhyolite; 10 to 30 m thick.

Fine grained, pale red, miarolitic adamellite.

Fine to medium grained, greyish-orange-pink, equigranular, homogeneous adamellite.

The fluorite-clinoamphibole rock consists of very fine grained pale purple fluorite and yellowish-grey clinoamphibole, the latter commonly forming irregular fragments, commonly 1 to 2 cm long, in the fluorite matrix. An imperfect lamination is also present which is defined by alternation of fluorite and clinoamphibole. The diopside-clinoamphibole rock beneath the fluorite consists predominantly of aphanitic to fine grained, yellowish-grey clinoamphibole with rare light greenish-grey diopside bands, up to 5 mm thick, some of which also contain fluorite. Variation in grain size in the clinoamphiboles also imparts a lamination. Microscopically the clinoamphibole is seen to consist of a very fine grained matte of anhedral grains in which a few fine grained, subhedral to euhedral crystals, in part fibrous and twinned, are locally present. The clinoamphibole is colourless, has a large 2V and is probably a member of the cummingtonite-grunerite series. Diopside is fine grained and anhedral. Fluorite is usually colourless, but a few grains are pale to moderate purple.

The rhyolite consists chiefly of turbid alkali feldspar with a variable quartz content. Up to 10 per cent sodic plagioclase is present in some samples. A colourless clinoamphibole occurring both as discrete crystals and radiating clusters locally comprises up to 15 per cent. This amphibole is similar to that present in the overlying rock and is probably in the cummingtonite-grunerite series. Trace amounts of epidote, biotite, muscovite, apatite and zircon are also present.

Spherules up to 2 cm in diameter are well formed and are composed of turbid alkali feldspar and minor amounts of quartz. Quartz is more abundant on the periphery of the spherules and forms a graphic intergrowth with the feldspar. A dusting of extremely fine hematite is present throughout the spherules but not everywhere in the matrix so that some of this rock shows a greyish-orange-pink matrix. Interspherule areas are mainly filled with quartz, alkali feldspar, plagioclase (An_{11}) and lesser amounts of magnetite and clinoamphibole. A few interspherule areas are largely miarolitic.

In thin section the lowermost member is seen to consist of turbid alkali feldspar commonly in a graphic intergrowth with quartz. Two sizes of intergrowth are present, with a fine one usually forming a core to the coarser of the two. Some of the fine quartz-feldspar intergrowth shows incipient spherulitic growth and others a stringlike form. Scattered crystals of aegirine comprise less than 5 per cent. Some of the larger aegirine grains are altered in part to riebeckite, which also forms tiny individual euhedral crystals. A few grains of purple fluorite are also present.

The pale red colour of many of these rocks is due to extremely finely divided hematite that is disseminated throughout them.

The extrusive elements are in some places cut by adamellite dykes. One dyke, up to 50 cm thick, consisting of fine grained, massive, equigranular, pale red adamellite penetrates nearly to the top of the volcanic pile cutting the rhyolite. However, it is not known to cut the fluorite-bearing rock. Similarly on the southwest side of the hill a 5 cm thick dyke of medium grained adamellite cuts rhyolite along with a few smaller veins or dykelets.

An adamellite dyke cuts diabase on the south side of the hill. Typically this adamellite is a coarse grained, equigranular, massive, greyish-orange, amphibole-bearing rock that, approximately 3 m from the contact with the diabase, grades into a porphyry with a fine grained, greenish-grey matrix in which greyish-orange, subhedral feldspars, up to 1 cm long, and less commonly angular to subrounded quartz grains 3 mm in diameter occur. Rare riebeckite phenocrysts and clusters up to 1.5 mm long are also present. At the contact the matrix is medium dark grey with euhedral to subhedral feldspar phenocrysts and a few subrounded quartz grains.

Rhyolite is also present southeast of Flowers River, where it is associated with breccia (**P**bc) and porphyry (**P**pp). There the rhyolite is a dark greenish grey or dark grey, aphanitic rock with tiny quartz eyes and rare minute feldspar phenocrysts.

Because of the close spatial and lithologic relationship between the extrusive rocks and the adamellite it is assumed that all are genetically related. Similar relationships have been described by Baer (1973) in the Bella Coola–Laredo Sound map area, British Columbia, where a fine grained granite of Miocene age grades through a porphyry into a rhyolitic flow rock over a distance of 9 m. Baer writes, "Such a transition indicates that the granite was emplaced very close to, and at some points at, the surface of the earth, where magmatic material flowed out as lava . . ." The same interpretation is made for the rocks north-northwest of Campsite 10 as the presence of typical extrusive layered strata, notably spherulitic rocks and banded rhyolite, show that these rocks reached the surface. The fluorite-clino-amphibole-diopside rocks are possibly an exhalative phase of this volcanic event as suggested by Ridler (1973).

The contradictory field evidence regarding the age of the diabase with respect to the adamellite suite suggests that silicic magmatic events occurred in pulses and extended over a period of time. Evidence on hand indicates a sequence of events starting with the emplacement of the main Flowers Bay pluton, which in its later stages broke through to the surface resulting in the formation of rhyolite and other extrusive rocks. A lull in the silicic magma activity was followed by the intrusion of the diabase, which truncated the banding in the extrusive rocks. Renewed activity by silicic magma source, probably limited to dykes only, resulted in the intrusion of adamellite, which is chilled against the diabase. This latter event possibly marked the end of igneous activity in this region. However, the time status of the porphyry 'overlying' the diabase is unknown.

Quartz-feldspar porphyry (**P**pp)

Quartz-feldspar porphyry is present in two of the adamellite plutons. This rock was first mapped by exploration geologists of British Newfoundland Exploration Company west of Big (Jack Lane) Bay within the Flowers River pluton. The same and similar rock occurs north of Hunt River at several points in the southeast part of this pluton. Several outcrops of porphyry are also present in the western part of the Notakwanon pluton and also form an easterly trending zone in the southwestern quarter. None of the other adamellite intrusions are known to contain these rocks. Porphyry dykes assigned to this map unit are present on Coopers and Cod islands (map area 14F).

Typically these porphyries are various shades of grey, greenish grey and olive grey, or more rarely pale red or yellowish brown, with round and oval quartz and feldspar grains up to 0.5 cm in diameter. The matrix is fine grained to aphanitic. Locally flow lines and flow type breccia are present, although a massive rock is most characteristic.

In the Notakwanon pluton the porphyry is an olive-grey to dark yellowish-brown rock. Its precise relationship to the main mass of the pluton is unknown, but inclusions of adamellite are present in some parts. For example, in the southwest part of the pluton, porphyry contains inclusions of adamellite, up to 5 m in length, and also locally of a white granite and paragneiss, the latter two rocks probably being part of the Proterozoic gneiss terrane. In the same area a few fragments, up to 1.2 cm, of another lithologically similar porphyry are also present. This porphyry is characteristically homogeneous with only a few faint 'flow lines' discernible in limited areas.

The phenocrysts consist of anhedral, partly altered perthite, plagioclase (An_{20}) and quartz. The matrix is dominantly the same minerals, with about 10 per cent clinopyroxene, partly uralitized and chloritized, and hornblende with rarer olivine (in part altered to serpentine and iddingsite), biotite, apatite and magnetite.

In the Flowers River pluton porphyry is most common near Big Bay Lake (map arèa 13N). At the west end of the lake a small area of porphyry, 50 by 50 m, caps the top of a hill. This dark greenish-grey porphyry, with moderate orange-pink to pinkish-grey feldspar, occurs as patches in adamellite and also contains adamellite fragments. It also shows a gradation from medium grained adamellite through porphyry to a dark greenish-grey aphanitic phase. Through this gradation the ratio of phenocrysts to matrix ranges from about 4:1 to the aphanitic rock. Phenocrysts consist of feldspar, very rare quartz and amphibolite, the latter fibrous and in clusters in some places. Microscopic examination shows the small hornblende clusters to consist in part of a core of iddingsite with a corona of magnetite, which in turn is surrounded by uralitic amphibole with or without interleaved brown biotite. Others consist of numerous tiny fibrous hornblende grains with a thin biotite corona. Feldspars, which are in part perthitic and are about half altered to sericite, include tiny clinopyroxene, hornblende, magnetite and apatite grains. Irregular veinlets of magnetite penetrate some phenocrysts. The matrix consists of the same minerals plus quartz, rare clinozoisite and chlorite, the latter an alteration of clinopyroxene and hornblende. To the northeast of Big Bay Lake a mafic, dark greenish-grey porphyry consisting of amphibole and feldspar phenocrysts in a fine grained to aphanitic syenitic matrix also forms a hilltop. Surrounding rocks are all typical adamellite.

Southeast of Flowers River a suite of porphyritic rocks covers an area of about 10 km^2. These rocks, chiefly medium to dark grey and pale reddish-brown quartz porphyry but with some quartz-feldspar porphyry, include various breccias, fragmentals, flow banded rocks and rhyolitic phases. In some places fragments of a red quartz-porphyry occur in a black aphanitic matrix. Elsewhere quartz porphyry is extensively brecciated (**P**bc) and a fragmental rock, interpreted as a flow phenomenon, shows black, white and red fragments plus phenoclasts. The banded rocks are also probably the result of flow, possibly at the surface, as the best examples are in rhyolitic rocks with quartz phenocrysts.

Some of these rocks are unquestionably tuffs as shards of weakly devitrified glass are visible in thin section. The shards, which display cuspate outlines and are up to 1 cm long, occur with clear, rounded and partly embayed quartz grains up to 3 mm in diameter. The matrix consists of finely divided quartz, indeterminate feldspar and white mica with rare chlorite and rarer biotite, magnetite and apatite. In total this tuff is probably a rhyodacite in composition.

Porphyry also outcrops 6.5 km north of Campsite 10 where a light olive-grey and dark greenish-grey quartz porphyry is present. Extensive hematite stain occurring in irregular patches and along fractures, characterizes this outcrop. Anhedral quartz and feldspar phenocrysts, the latter completely altered to a semiopaque matte or sericitized, are rimmed by an extremely fine grained mixture of quartz, feldspar and sericite(?). The fine grained matrix is almost entirely potash feldspar with rare quartz, magnetite, sphene and sericite.

Porphyry, outcropping 8 km southwest of Sango Bay (map area 13N), forms part of an intrusive breccia. There a medium dark grey, coarse grained, massive anorthosite, which contains fragments of anorthosite and adamellite, forms the major rock type. A pale reddish-brown, fine grained adamellite contains blocks of the anorthosite. The porphyry, which is pale red with subhedral to euhedral potash feldspar and quartz grains up to 8 mm, contains blocks of adamellite. Fragments are both rounded and angular.

The potash feldspar phenocrysts are cloudy throughout with only faint outlines of Carlsbad twins visible. The matrix, which is very fine grained, consists of potash feldspar, andesine, quartz and trace amounts of muscovite, chlorite, magnetite, iddingsite and zircon.

Porphyry dykes occur on Cod, Coopers and Shark islands (map area 14F). At Cod Island a 15 m thick vertical dyke cuts slate, chert and carbonate layers of the Mugford Group (**A**MS). A 45 m gap exists between the highest exposed porphyry and the volcanics of the Mugford Group so that its relationship to them is unknown. This rock has a very fine to fine grained, equigranular, light olive-grey matrix in which subhedral to anhedral potash feldspar and quartz, grains up to 1 cm long, are distributed. The matrix consists of potash feldspar, plagioclase (An_{32}) and quartz, with minor amounts of muscovite, calcite, epidote, apatite, hematite, pyrite and fluorite.

At Coopers and Shark islands where porphyry dykes, approximately 10 m thick, cut migmatite (Amg), a similar rock is present. However, this porphyry is pale red with phenocrysts up to 1.5 cm, some of which are plagioclase (An_{34}). The matrix is composed of the same minerals plus muscovite, epidote, hematite, pyrite and fluorite.

As one of these porphyry dykes intrudes elements of the Mugford Group it is probable that they are post-Aphebian, although they may predate the Mugford volcanics. Despite their remoteness from major adamellite plutons, it is suggested that they are related to them, otherwise a new period of silicic intrusive activity must be postulated. It may be that these three porphyry dykes and the Manvers Granite (**P**pm) of Morse (1969) are comagmatic.

Rocks mapped as part of this unit undoubtedly are of more than one origin. However, the close spatial and lithologic relationship between these porphyries and the adamellite suggests a common magma. Those porphyries that occur as dykes, grade into adamellite or contain large inclusions, such as in some of the Notakwanon pluton, are regarded as plutonic. Those that display 'flow lines' contain shards and are closely associated with rhyolitic rocks, such as those southeast of Flowers River, are deemed to be volcanic or tuffaceous, and in some outcrops both are probably present.

Breccia (**P**bc)

Breccias are present in two localities within the Flowers River pluton (map area 13N). The western occurrence consists of a fine grained, pale red, miarolitic adamellite in which irregularly shaped fragments of the same rock, up to 0.5 cm in diameter, are scattered. In the outcrop this rock forms a plane that is interpreted as a bedding plane and the breccia is considered to be a volcanic breccia.

The other breccia occurrence, 13 km north of Campsite 10, shows at least three different breccia types. One consists of black, white and red angular to subrounded fragments, up to 1 cm in diameter, and rare feldspar phenoclasts, up to 2 mm, in a very fine grained to aphanitic, medium to dark grey matrix. The red fragments are very fine grained adamellite, the black are similar to the matrix, whereas the white are chiefly clusters of quartz grains. The second breccia consists of pale red, angular fragments, up to 2 cm, of quartz porphyry in a fine grained, pale yellowish-brown quartz-feldspar matrix. The third shows a greyish-red angular, porphyry fragments, up to 1 cm, in a dark grey, aphanitic, rhyolitic matrix. These breccias are also interpreted as of volcanic origin and flow breccias at least in part. Extensive lichen cover at this locality prevented a complete examination and several types of breccia may be represented.

Syenite (**P**sy)

Syenite occurs as dykes in scattered localities in the area underlain by members of the anorthosite and adamellite suites. Only a few are shown on the accompanying maps, although thin, red dykes probably belonging to this map unit were seen elsewhere from the air. The most prominent syenite dyke is in the southeastern corner of the map area 14D intruding gabbro (**P**gb). There a massive, medium grained, equigranular, moderate orange-pink syenite lies along a fault line. This rock is characterized by the presence of hornblende and about 5 per cent quartz as well as the essential minerals potash feldspar and sodic plagioclase.

East of Conch Bay (map area 14C) and 4 km south of Nain Bay (map area 14D) moderate orange-pink to moderate reddish-orange syenite dykes cut anorthosite. At the first locality several thin dykes, less than 1 m thick and striking easterly, are present, whereas at the second, the dyke occurs in a cliff face. These syenites are miarolitic, massive, fine to medium grained rocks composed mostly of cloudy albitic plagioclase, perthite, microcline and accessory amounts of chlorite, magnetite and zircon.

These rocks are probably related to the major intrusions, but whether they are differentiates from the anorthosite magma or the adamellite magma is not known.

A 5 m thick syenite cutting migmatite (Amg) on Coffin Island (map area 14F), well beyond the limits of Paleohelikian batholiths, trends south-southeasterly and dips 65° west. This medium grained, equigranular, syenite has a pale red matrix of potash feldspar in which are scattered chloritized hornblende and magnetite grains. As it is similar lithologically to the long dyke in map area 14D, it is placed in this map unit, but it may be much older.

A larger body of syenite is shown to the north of Umiakoviarusek Lake in map area 14E. Its extent and relationship to the surrounding rocks is unknown. A medium brown, equigranular, medium to coarse grained, hornblende-rich syenite is typical.

Pegmatite (**P**pm)
A group of dykes, commonly irregular or conforming to the joint pattern, occur in the area underlain by the Kiglapait intrusion. These silicic rocks have been called the Manvers Granite by Morse (1969), who provided an adequate field, petrographic and petrologic description of them.

The present survey was limited to the sampling and examination of a dyke 2 km south-southeast of Cape Kiglapait (map area 14F). There several, southeast-trending pegmatite dykes, up to 2 m thick, cut troctolite (**PK**tr) and contain inclusions of it. The dyke sampled also shows biotite crystals, up to 3 cm long, oriented normal to the dyke walls.

A K-Ar determination on biotite gave an age of 1170±40 Ma. This age compares favourably with 1140±40 Ma reported by Beall et al. (1963) on biotite from a similar dyke 9 km to the south of the site of the present sample.

Morse (1969) considered these rocks and other similar late granites—particularly fluorite granites—that he examined along the coast, as not necessarily related to the adamellite suite but rather as the latest, most transgressive and shallowest acidic intrusives. Present data are insufficient to either confirm or refute this. However, as fluorite is present in many of the rocks that undoubtedly form part of the adamellite suite (fluorite is also present in the much older Strawberry granitic suite) this aspect of his reasoning is doubtful. For the present, these rocks are not grouped with the adamellite but if not related require a new, up to the present, unrecognized silicic magmatic period.

Diabase (**P**db)
A few diabase dykes are assigned to the Paleohelikian on the basis of K-Ar age determinations. Others are included in this map unit because of their proximity to those dated.

North of the Border River (map area 13M) a 15 m thick, north-trending dyke intrudes paragneiss (**A**pg). A chill sample gave an age of 1392±44 Ma for this dyke. It is possibly related to the anorthosite suite. In the same map area a small, deeply weathered diabase stock is present near the Notakwanon River. This latter rock, which is dark greenish grey, equigranular and massive, is assigned to this map unit solely because of its proximity to the dated member. A similar diabase stock outcrops in map area 23P near the George River. However, this diabase is medium to coarse grained, massive, ophitic and contains small amounts of biotite.

Two dykes in the southwest part of map area 14C, cutting migmatite (Amg), are assigned to this map unit because of similar northeasterly orientation to one dated south of Lac Mistinibi in map area 23P, which intrudes paragneiss (**A**pg). This latter diabase, which is 3 m thick, has an age of 1420±43 Ma.

About 5 km south of Sango Bay (map area 13N) a fine grained, equigranular, dark greenish-grey diabase contains fragments of pink adamellite. This ophitic diabase consists of olivine, clinopyroxene and plagioclase, with minor amounts of apatite and chlorite. Olivine is extensively altered to iddingsite, biotite and skeletal magnetite. Although placed in this map unit, it may be younger.

The erosion of a dyke 5.6 km southwest of Snyder Bay has formed a prominent, linear gorge now occupied by the Avakutak River for about 2.5 km (map area 14F). This dark grey, massive, fine grained diabase, about 15 m thick, cuts migmatite west of the Kiglapait intrusive body. Morse (1969) reported this diabase as being typical of ophitic olivine dolerites consisting of roughly 20 per cent pink augite, 15 per cent olivine and 10 per cent black ore plus minor apatite, in addition to tabular labradorite. Two smaller dykes cutting the Kiglapait pluton are practically identical in mineralogy and texture (Morse, 1969).

A K-Ar whole-rock age determination using chill material from the largest dyke yielded an age of 1420±110 Ma. This age is considered to be the approximate age of the intrustion of this diabase. The two similar dykes intruding the Kiglapait pluton may be the same age.

Lamprophyre (**P**lp)
A southeast striking lamprophyre cuts a white, medium grained anorthosite 13 km southwest of Frank Lake (map area 14E). This 0.3 m thick, fine grained, equigranular, olive-black dyke consists of equal parts brown amphibole and augite, and 5 per cent magnetite. Apatite forms 1 to 2 per cent, and plagioclase, chlorite and spinel occur in trace amounts. The amphibole is pleochroic from very pale orange to moderate yellowish brown with $Z \wedge C = 25°$.

This dyke is assigned to the Paleohelikian on the assumption that it is a late differentiate of the anorthosite magma.

Neohelikian (N)

The Neohelikian is represented by two small areas of layered rocks considered to belong to the Seal Group and numerous diabase dykes in the northwest and southeast.

Seal Group (**N**s)
Arkosic sandstone (**N**sss). Felsenmeer and debris of arkosic sandstone, some of which may be outcrop, near the centre of map area 13M is assigned to the Seal Group. Blocks of the same rock type occur along lakeshores south of the area shown as underlain by this rock unit, and it may underlie that area also. Glacial debris of this sandstone

occurs frequently to the east, the glacially downstream direction, almost to the coast, suggesting this rock unit was once widespread. Debris is very common in part of the area underlain by the Harp Lake anorthosite batholith so that it may well have overlain that intrusive body.

The sandstone is a dark to light red and moderate reddish-brown, fine to medium grained, well bedded rock. Some blocks show excellent crossbeds and ripple marks. Gypsum casts up to 3 cm long were found in one boulder. Bedding ranges from 1 mm to 5 cm and averages about 2 mm.

Fragments are chiefly subangular to subrounded, rarely rounded, and consist primarily of quartz, quartzite, plagioclase, K-feldspar. Feldspar totals about 30 per cent, equally divided between plagioclase and K-feldspar. Almost all the feldspar is clouded, pale red. There are few detrital grains of rounded apatite, zircon, and rarer magnetite, epidote and muscovite. The matrix consists of nearly colourless chlorite, sericite and hematite, the latter by far the commonest and coating virtually all the detrital grains.

Thickness and correlation. The thickness of the Seal Group sedimentary rocks in this map area is unknown, but their occurrence in low-lying areas, combined with a probable horizontal attitude, suggests that they are no more than a few tens of metres thick at the most.

These sandstones are correlated with lithologically similar continental-type sedimentary rocks forming part of the Seal Group that occur 53 km to the south (Roscoe and Emslie, 1973). There they nonconformably overlie Harp Lake anorthosite and are overlain conformably by intermediate volcanic rocks. The latter rocks, tuffs, were dated farther west by K-Ar whole-rock method at 843±125 Ma (Emslie, 1967). Emslie's interpretation was that this young age was due to argon loss from the specimen.

The present rocks are also lithologically similar to rocks of the Siamarnekh Formation that occur 190 km to the north. However, as they are so remote from the latter rocks, it is more likely that they belong to the Seal Group.

Andesite (Nsad). North of Border River is schistose, altered andesite occurs in an isolated outcrop. This rock is typically greyish green, fine grained and massive. Locally, plagioclase grains form clusters up to 5 cm in diameter and elsewhere, calcite occurs in tiny veinlets and blebs. A breccia band, with fragments up to 15 by 60 cm that is probably a flow top feature, is roughly parallel to the schistosity.

Microscopically this andesite consists of a schistose, mosaic of indeterminate plagioclase, epidote, chlorite and green biotite. Calcite occurs both intergranularly and as a fracture filling. Magnetite, which comprises up to 5 per cent, occurs in skeletal grains, as euhedral crystals and elsewhere, with coronas of epidote. Apatite and pyrite occur rarely.

As contact relationships with the surrounding Archean migmatites are not known, the age of this andesite is questionable. It is lithologically similar to volcanic rocks exposed along the Kanairiktok River (Williams, 1970) and also is of the same greenschist metamorphic grade so that it may be a correlative. A whole-rock K-Ar age of 1248±40 Ma supports a Neohelikian age for this volcanic rock. The major volcanic unit to the south of similar age is the Seal Group, and on this basis this unit has been assigned to this group.

Diabase (Ndb)

Neohelikian diabase occurs primarily in two swarms, one in the southeast and the other in the northwest. A few others assigned this age cut Paleohelikian plutonic rocks, and still others are scattered throughout the interior of the map area.

In the southeast, within the Nain Province, these dykes form a predominantly northeasterly-striking swarm, which includes some very long and thick representatives. For example, at the southern boundary of the map area 3 km west of Kanairiktok Bay one of these dykes is 300 m thick and one through Umiatoriak Island (map area 13N) is at least 9 km long. Although most of this swarm strikes northeast some members trend east, southeast, and south (Pls. 91–93).

Most of these dykes, which intrude migmatite (Amg), are massive, but some display a few plagioclase phenocrysts. The thicker members are coarse grained, whereas a medium grained rock is most typical. A bleached zone, up to 0.3 m wide, is present in the host rocks in some outcrops.

A typical sample from a 120 m thick dyke on Kernertaluk Island (Black Island) (map area 13N) contains about 10 per cent olivine, slightly altered to iddingsite and chlorite, but whether or not all these dykes contain olivine is not known. This dyke, which displays excellent ophitic texture, also contains fresh augite and plagioclase (An_{50}) with small or trace amounts of magnetite, chlorite, biotite, quartz and apatite.

Chill samples from three of these dykes have been dated by the K-Ar method at 1144±33, 1195±88 and 1125±37 Ma, indicating a Neohelikian age.

In the northwestern part of the map area a swarm of diabase dykes extends from the west boundary and as far

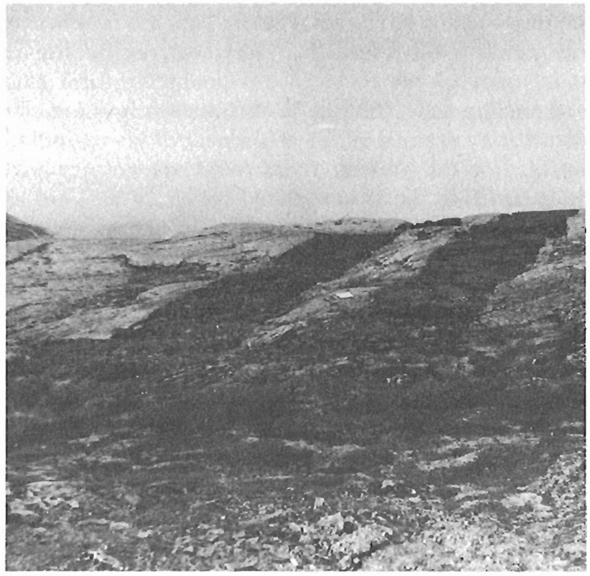


Plate 91. Southeast striking diabase dykes (Ndb) in migmatite (Amg) at the south end of Windy Tickle (map area 13N). F.C.T. 172215.

Plate 92. Easterly trending diabase dyke (**Ndb**) cutting Archean migmatite (Amg) 8.5 km east-southeast of Campsite 10 (map area 13N). F.C.T. 172352.

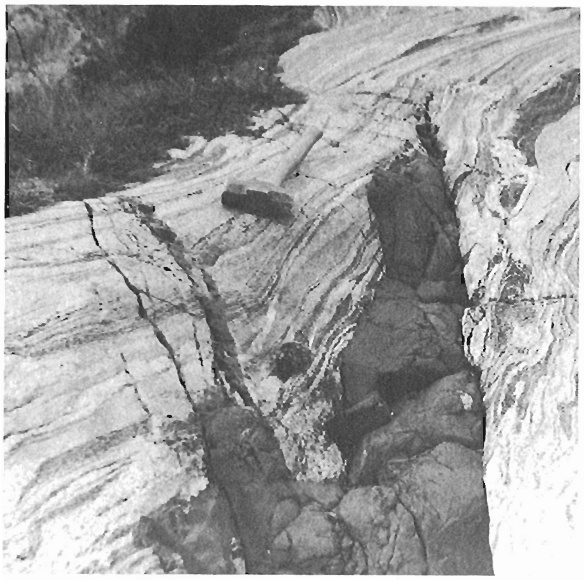


Plate 93. End of small diabase dyke (**Ndb**) in Archean migmatite (Amg) 3 km south-southwest of Burnt Island, Ugjoktok Bay (map area 13N). F.C.T. 172250.

north as Abloviak Fiord (map area 24P). They are most abundant in the area of Big Lake (map area 24J) where they form low-dipping, sheetlike dykes. As dips chiefly range between 10 and 20°, predominantly to the west and southwest, more rarely to the east, these dykes outcrop over quite extensive areas despite being only several metres thick. The dyke near Kohlmeister Lake is an extension of that mapped to the west by Gélinas (1960a,b). The most southerly representative occurs in the valley of the Whale River (map area 24G) where a 15 cm thick dyke, striking 110° azimuth and dipping 10° north, cuts paragneiss (**A**pg).

Whereas most of these dykes have low dips and strike north or northwest a few are vertical or steep dipping. For example, 3.2 km northeast of Rivière Tuctuc (map area 24J) a 15 m thick, grey, olivine diabase that cuts granodiorite (**A**gd) strikes northeast and dips 35° southeast. Similarly a 10 to 15 m thick dyke, 13 km southwest of Sukaluik Brook (map area 24I) strikes north-northwest. A few of the olivine diabases in the area of Keglo Bay occur as sills and lie in the plane of the foliation of the host rocks.

These sheetlike dykes are commonly deeply weathered so that exposures are poor. In a few places, such as south of Nauyut Islands (map area 24J), a spheroidal weathering is present. In the thick dykes the rock is typically grey-green, massive and coarse grained with plagioclase laths up to 1.5 cm in length. The thin dykes, however, are commonly fine grained or aphanitic and grey to black. A good ophitic texture is only locally developed (Pl. 94).

Thin sections show this diabase to consist primarily of olivine (2–10 per cent), augite (12–25 per cent) and plagioclase (An_{53-65}). Olivine, which forms small subhedral phenocrysts, is chiefly fresh but also shows some alteration to antigorite, iddingsite, chlorite, talc, carbonate and magnetite. Augite is usually pale purple and weakly pleochroic and is probably titanium-bearing. Plagioclase, which shows very minor alteration to white mica, is commonly zoned in the coarser grained phases. Orthopyroxene is present in a few samples and formed 16 per cent of one. Small amounts of actinolite, brown and green biotite, apatite, chlorite, calcite and magnetite are present also. Quartz is a rare constituent and a micrographic intergrowth with K-feldspar forms up to 3 per cent of the rock in some samples.

All these olivine diabases are posttectonic and clearly cut their host rocks and show no evidence of deformation themselves.

K-Ar age determinations have been made on three samples of this olivine diabase. Two whole-rock determinations on chill samples, one from near Big Lake and the other from 113 km south of Sukaluik Brook returned ages of 1270±115 Ma (Taylor, 1970b) and 1155±100 Ma (Fahrig, 1970) respectively. A biotite concentrate from the diabase at Kohlmeister Lake gave an age of 1240±45 Ma. These ages are thought to represent the approximate age of the intrusions.

The large (100 m thick) east-southeast–striking dyke near the mouth of Abloviak Fiord is extensively brecciated, showing evidence of postconsolidation tectonic adjustment in this area.

At the mouth of the George River a diabase exposed on a small island is entirely different mineralogically than the olivine-bearing swarm. The dyke consists of fine grained titanaugite, commonly altered to green hornblende, each of which comprise 20 per cent of the rock, and medium grained, fresh plagioclase (An_{47}) and minor hypersthene. Texturally this rock is weakly ophitic to granular with rare large plagioclase grains, so as to be weakly porphyritic. Small amounts of ilmenite, chlorite, biotite and magnetite are also present. Whether this dyke forms part of the olivine-bearing swarm is not known. More than one swarm may be present in this area.

Other Neohelikian dykes occur sporadically in the east-central part of the map area where they cut anorthosite and adamellite. Most of these trend either easterly or northerly. Wheeler (1933) described several from the coastal area around Nain. Few exceed 60 m thick, and most are in the order of 7 to 15 m. Both porphyritic and nonporphyritic diabase is present. For example, on the north side of Kiuvik Island (map area 14C) an 18 m thick porphyritic diabase with plagioclase crystals to 7 cm cuts granodiorite (probably a phase of the adamellite) that occurs as a dyke in anorthosite. On Tuktuinak Island, 24 km southeast, however, a nonporphyritic type is present in anorthosite.

Wheeler (1933) noted that some of these dykes are olivine diabase, whereas others are devoid of olivine. Data on hand are insufficient to subdivide them here.

Whereas the majority of these dykes are in areas underlain by anorthosite a few also occur in the adamellite. The latter group include a conspicuous northerly striking, 120 m thick dyke 10 km west of Umiakovik Lake (map area 14E). This coarse grained, well jointed, subophitic dyke is traceable for over 12 km through intermittent outcrops. It consists of 67 per cent plagioclase (An_{57}), 18 per cent olivine, slightly altered to iddingsite and antigorite, 6 per cent weakly pleochroic augite, 4 per cent biotite, both green and brown, 4 per cent magnetite, and minor amounts of apatite, chlorite and epidote.

Other olivine-bearing dykes are mineralogically similar to this large dyke, but small variations exist such as the degree of alteration and the relative percentage of the constituents. The anorthite content of the plagioclase ranges from 48 to 57.

Whether these olivine diabase dykes are identical in age with the olivine diabases in the Ungava Bay area is not known, but all are similar lithologically. They are therefore shown the same age on the accompanying maps.

Also intruding members of the anorthosite-adamellite suite of rocks are diabase or gabbroic dykes devoid of olivine. The ferromagnesian mineral in some of these is orthopyroxene and clinopyroxene, whereas others consist of very pale green hornblende with rare clinopyroxene cores.

The age of these dykes relative to the olivine-bearing diabases is not known. As they intrude the major plutonic rocks in the region, they are Paleohelikian or younger and assumed to be Neohelikian.

A K-Ar age determination of 1294±41 Ma on a chill sample from the diabase on Kiuvik Island supports a Neohelikian age for these dykes.

In the interior an age determination of 1199±40 Ma on a chill sample of a 1.2 m thick diabase dyke cutting granulite (**Agl**) and garnet-quartz-fold gneiss (**Afg**) shows Neohelikian dykes occur there also. They may be more extensive than shown. All are probably small, such as the northeast striking diabase only 0.6 m thick that cuts gabbro (**Agb**) south of Lac Résolution (map area 23P).

Hadrynian (H)

The Hadrynian is represented by rare diabase and lamprophyre dykes and two small areas of sedimentary rocks.

Siamarnekh Formation (Hsa)

Two small areas of flat lying sedimentary rocks lie north of the Kingurutik River about 48 km northwest of Kingurutik Lake. These rocks were discovered by Wheeler (1964) and named by him the Siamarnekh Formation, after a branch of the Kingurutik River.

The Siamarnekh Formation is assumed to lie nonconformably on adamellite and forms the top of a couple of low-lying hills. The strata are horizontal and occur in well developed beds 1.5 mm to 10 cm thick, with most beds in the 25 to 5 cm range. Most of the formation consists of fine to medium grained, pale red to buff, friable sandstone, but in part consists of thin beds of pebble conglomerate. The pebbles in the latter are primarily 6 mm in diameter

Plate 94. Deeply weathered olivine diabase dyke (**Ndb**) on Ungava Bay coast between Arvarlik and Nauyut islands (map area 24J). C.K.B. 171925.

or less, but locally quartz and feldspar grains are up to 2.5 cm. Wheeler (1964) observed quartzite cobbles up to 10 cm in boulders a short distance from the outcrop area. In part the sandstone is crossbedded and ripple marked, permitting confirmation of their tops-up attitude.

A scattering of pale yellowish-brown deoxidation spots is common in the sandstone.

Subangular to rounded quartz, K-feldspar and plagioclase form the major part of the rock. Quartz grains, many of which show strain shadows, include both individual and compound grains. Some of the larger grains are detrital orthoquartzite. K-feldspar is more common than plagioclase and the two total up to about 15 per cent so that much of the rock is subarkose (Pettijohn, 1957). A few detrital biotite flakes are present, some bent around quartz grains. Interstices are filled by very fine grained sericite and nearly colourless chlorite. Hematite is disseminated throughout most of the rock forming thin films around the grains, but some beds show higher concentrations than others. Rare grains of leucoxene, apatite, zircon are also present, and Wheeler (1964) reported green hornblende and biotite also.

Thickness and structural relationships

Wheeler (1964) reported 96 m of the formation at the northern end of the two outcrop areas. Only about 60 m of strata occur at the southern exposure.

Although the base of this horizontal formation is not exposed, it undoubtedly lies nonconformably on the underlying adamellite. The absence of metamorphism and lack of postdepositional disturbance suggests this formation is a young rock unit.

Age and correlation

The Siamarnekh Formation contains no fossils, and its age is unknown. However, its place in the geological column is problematical. It is lithologically similar to both the sandstone of the Seal Group (**N**sss) in map area 13M and to the Double Mer Formation, which lies 100 km south of the map area near Goose Bay. Stevenson (1970) assigned a Cambrian age to the latter formation on, as he says, rather meagre evidence, namely the similarity to Cambrian strata on the Strait of Belle Isle. It may be the Siamarnekh Formation is also Cambrian. On the other hand, it is indistinguishable from rocks assigned to the Seal Group and may well be part of that rock unit which is Neohelikian. It is possible, of course, that the continental type rock units—the Siamarnekh, the Seal Group and the Double Mer—are each the result of a discrete depositional period and unrelated to one another. The Siamarnekh Formation has been assigned to the Hadrynian solely as a matter of convenience.

Diabase (**H**db)

A swarm of diabase dykes occurs in the Makkovik Subprovince where they intrude elements of the Aillik Group and the post-Aillik intrusive rocks. This swarm, which consists of dykes commonly 12 m thick with a few up to 50 m, trends chiefly east-southeast with a few to the northeast and more rarely to the northwest. It consists in part of porphyritic diabase, in which plagioclase crystals or clusters of crystals up to 10 cm in diameter are common, and in part of massive diabase.

Petrographically these dykes are similar to the Neohelikian dykes in the Nain Province to the north.

On a large island, composed of granodiorite (**A**sgd), (map area 13O) two dykes of this map unit intersect. The older, which strikes north-northeast, and is 12 m thick, consists of massive, porphyritic diabase, whereas the younger, which strikes east-northeast and is 13 m thick, consists of weakly porphyritic diabase. The older dyke is characterized by the presence of individual and clusters of plagioclase phenocrysts, up to 7 cm long in a zone 2 m wide parallel to the dyke walls. The centres of both dykes are massive. The field relationships are substantiated by two K-Ar whole-rock age determinations on chill samples that give ages of 934±33 Ma for the older dyke and 846±30 Ma for the younger.

Several other dykes assigned to this map unit have also been dated giving ages that range from 729±55 to 995±13 Ma.

Lamprophyre (**H**lp)

Hadrynian lamprophyre dykes occur predominantly in map area 13O, and there most of them are near or at Cape Makkovik. One is also present (map area 13O) on Cut Throat Island (map area 14F). At the latter locality a northwesterly striking, vertical and near vertical lamprophyre cuts Archean migmatite (**A**mg). This 0.6 cm thick dyke is a fine grained, greenish-black, massive rock composed of equal parts of anhedral greyish-yellow-green to dark yellowish-green hornblende and very pale orange to dusky yellow-green biotite. Interstitial calcite forms about 3 per cent and plagioclase, magnetite and sphene, about 1 per cent each. This dyke is assumed to be Hadrynian; it could be older or even younger.

At Cape Makkovik and vicinity lamprophyres belonging to this map unit are thin, less than 3 m thick, vertical dykes that intrude elements of the Strawberry granitic suite (**A**sgr) and also other dykes of diabase (Stockwell and King, 1963). These lamprophyres are dark grey, massive to vesicular and characterized by local phenocrysts of biotite up to 3.5 cm in diameter. Vesicles, up to 0.5 cm long, in some places are filled with greyish-orange-pink calcite and stilbite(?). In thin section this rock is seen to consist of very pale orange to dark yellowish-orange biotite, colourless augite and magnetite phenocrysts in a matrix of biotite, plagioclase and augite. Small amounts of apatite and hornblende are also present.

Biotite from both the matrix and phenocrysts was analyzed in three separate age determinations by the K-Ar method for a lamprophyre from the east coast of Aillik Bay. These returned ages of 535, 585 and 590 Ma (Stockwell and King, 1963), which is the probable time of intrusion.

The dyke shown cutting granite (**A**sgr) on the east side of Manak Island is a fine grained, medium grey, biotite-rich lamprophyre.

On the south side of Bay of Islands a horizontal, 2 m thick fine grained lamprophyre dyke intrudes migmatite (**A**mg) that is a xenolith in granodiorite (**A**sgr). Inclusions of granodiorite, up to 30 cm long, are present in this dyke. Moderate reddish-orange plagioclase grains lie in a medium dark grey matrix of this amygdaloidal dyke. The amygdules, which are up to 2 mm in diameter, consist of calcite and stilbite. The major minerals are calcite, indeterminate plagioclase, moderate reddish-brown biotite and clinopyroxene. The plagioclase is cloudy and extensively altered. Biotite shows minor chloritization, and clinopyroxene is partly uralitized. Apatite is common, and small amounts of magnetite and pyrite are also present. This dyke is assumed to belong to this map unit as it shows some lithologic similarities to the lamprophyres near Aillik.

These lamprophyres are lithologically distinct from those assigned to the Aphebian (**Alp**), being characterized by biotite abundance.

Diorite (**Hdr**)

A gently dipping, east-northeast trending diorite dyke cuts rocks of the Aillik Group 1 km south of Aillik Bay (map area 13O). A whole-rock K-Ar age determination gave an age of 984±73 Ma (Fahrig, 1973). Kranck (1953) reported these low dipping intrusive rocks to be "grey quartz diorite, with black euhedral hornblende crystals as the main mafic component." These rocks were not examined during the present survey.

Paleozoic

Paleozoic rocks outcropping in the map area consist of a few diabase dykes in the north and a lamprophyre at Aillik Bay, but boulders of fossiliferous Paleozoic strata have been reported from several sites along the Labrador coast and very recently Gold (pers. com., 1977) located limestone boulders in the vicinity of Lac La Moinerie, which are probably also Paleozoic.

Most Paleozoic boulders, which were first reported by Bell (1885), occur in the area of and to the south of Killinek Island (map area 25A). Later, Lambe and Ami (in Low, 1906) identified fossils in limestone boulders collected by Low from Cape Chidley as Ordovician and Silurian. The same collection was re-examined by Schuchert (1914) confirming some fossils as Ordovician and identifying others as Lower Devonian. Another collection of fossils from the southeast end of Grenfell Tickle was given a Collingwood age (Upper Ordovician) by Little (1936). A few gastropods gathered during the present survey have been examined by T. E. Bolton (Rep. No. O/S-1-1970-TEB)[3]. These Bolton identified as parts of *Hormatoma* sp. a genus characteristic of Ordovician and Silurian strata. The same samples were examined for conodonts by C.R. Barnes (Rep. No. 01-1970-CRB)[3] who reports as follows:

Field No. SC325B67

Conodonts obtained (number of specimens indicated after each species):

Acodus auritus Harris (10)
A.n.sp. (7)
Acontiodus bialatus Mound (6)
Cordylodus sp. (2)
Distacodus sp. (3)
Drepanodus sp. of *D. homomcurvatus* Lindstrom (3)
D. subarcuatus Furnish (4)
Oistodus linguatus bilongatus Harris (3)
Ozarkodina ? sp. (1)
Scandodus sinuosus Mound (3)

Remarks: 840 g of limestone yielded the above fauna, all elements being hyaline. The fauna is indicative of a lower Middle Ordovician age, post-Canadian and pre-Blackriveran. Only a few poorly known faunas of this age have been described from North America, but many of the species occur in the fauna from the Joins Formation of Oklahoma described by Mount (1965, Tulane Studies in Geology, v. 4, no. 1, p. 1–46).

Field No. SC307D67

Conodonts obtained:

Panderodus gracilis (Branson and Mehl) (1)

Remarks: A single specimen of *Panderodus gracilis* was obtained from the 830 g sample. This is a long ranging species, first occurring in the Middle Ordovician (Chazyan) and extending at least to the top of the Ordovician.

Ordovician fossils also occur in dolomite boulders on Sculpin Island 38 km northeast of Nain (in map area 14C Roy, 1932, 1941). These consist of 4 genera and 6 species of gastropods and trilobites. This locality was not visited during Operation Torngat.

Source of fossiliferous boulders

The source of the limestone boulders of the Killinek Island area has variously been attributed to the Paleozoic strata of Akpatok Island (Low, 1906) and to Baffin Island (Schuchert, 1914). Schuchert based his opinion on the fact that the fossil assemblage in the Cape Chidley specimens was characteristic of Baffin Island rocks rather than those outcropping on Akpatok Island. Roy (1932) favoured Low's interpretation citing the closeness of Akpatok Island to Cape Chidley, the glacial direction and the lack of Richmond age fossils at Cape Chidley, which are common on Baffin Island. Whereas Akpatok Island may be the source for the boulders, it is more probable that they were derived from submarine outcrops of Paleozoic rocks from either Ungava Bay or Hudson Strait (Grant and Manchester, 1970).

Roy (1932) considered that the boulders at Sculpin Island came from the interior of Labrador, which at that time was unexplored. The present survey did not reveal Paleozoic strata anywhere in the interior of Labrador or Quebec. A few boulders of limestone of probable Silurian age near Lac La Moinerie in map area 24B reported by Gold (pers. comm., 1977) are 320 km west-northwest of Sculpin Island. The direction of glacial ice movement in the Lac La Moinerie district is north-northwest so that it is improbable there is any connection between the two occurrences. Grant's (1966) interpretation of a sparker seismic profile normal to the coast, 70 km southeast of Sculpin Island, is that near-horizontal sedimentary strata or possibly layered volcanic rocks form an outer shelf approximately 70 km from the coast. The Sculpin Island erratics are pos-

[3]These are unpublished Geological Survey of Canada reports that are not on open file.

sibly derived from this outer shelf. They may, on the other hand, have been transported by icebergs from some distance. Until the nature of the submarine strata is ascertained, the source will be in doubt.

The limestone boulders at Lac La Moinerie are possibly related to the Paleozoic rocks underlying Ungava Bay (Grant and Manchester, 1970) although the latter are at least 240 km to the north. This occurrence is probably similar to that at Clearwater Lake where Middle or Upper Ordovician strata are preserved in the Clearwater crater. The Lac La Moinerie occurrence suggests that Lower Paleozoic seas were more widespread throughout northern Quebec than previously believed, but subsequent erosion has removed almost all the evidence of their presence.

Cambrian

Diabase (Cdb)

Between Noodleook Fiord and Eclipse River (map area 24P) two slightly sinuous dykes, the larger 60 m thick and 21 km long and the smaller 7.5 m thick and 3.2 km long, intrude Proterozoic rocks. This subophitic, medium grained, grey-green to dark green diabase consists chiefly of slightly altered to fresh plagioclase (An_{58}) and colourless augite. Small amounts of green hornblende, brown biotite, chlorite, apatite, magnetite and calcite are also present. A thin section of the chill zone shows plagioclase, clinopyroxene and olivine as phenocrysts in a very fine grained matrix of plagioclase and clinopyroxene with small amounts of biotite, chlorite, hornblende and magnetite. The plagioclase (An_{64}) phenocrysts occur as fresh, zoned, well-shaped laths, which show a weak parallelism. The clinopyroxene phenocrysts are composed of two or more crystals and display rounded outlines as if filling voids. The olivine phenocrysts, which are much rarer and smaller than the clinopyroxene, are surrounded by thin coronas of an opaque mineral (magnetite?), colourless pyroxene(?) and mixed biotite, chlorite and small amounts of iron ore. A few olivine grains also show another colourless pyroxene(?) zone between the olivine and the magnetite. Whereas most olivine phenocrysts are fresh, others are completely altered to serpentine and chlorite.

An age of 524±78 Ma, which is thought to represent the approximate age of the intrusion, was obtained on a crushed whole-rock sample using K-Ar method (Fahrig, 1970). On the basis of this age determination these two dykes are assigned to the Cambrian. Gabbro-diabase sills in vertical paragneiss 3.2 km northwest of the age determination sample site are included with these dykes, but their age is not known with certainty. Without many age determinations the assignment of other dykes to the Cambrian is risky.

Devonian

Lamprophyre (Dlp)

On the west shore of Aillik Bay (map area 13O) two narrow, southeast striking, biotite lamprophyre dykes sampled by Fahrig (1973) gave K-Ar ages of 331±14 and 397±16 Ma on separated phlogopite. Fahrig interprets these figures to be minimum ages for these intrusions.

Mesozoic

King and McMillan (1975) recently published a paper describing the small outcrops of breccia along Ford's Bight (map area 13O). They report that this breccia, which consists of fragments of the underlying Aillik Group and other Precambrian rocks in a matrix of comminuted particles of the clasts, is intruded by a lamprophyre dyke and associated veinlets of lamprophyric-carbonate. Nannofossils present are of Early or Midle Jurassic and Cretaceous ages. The authors suggest that this breccia is in part a diatreme erupted through Mesozoic marine sediments. A K-Ar whole-rock age of 129±6 Ma (Wanless et al., 1974) was obtained on a sample of 'basalt' from a possible dyke associated with this breccia supporting, along with a 145±6 Ma age from Geochron Laboratories, an Upper Jurassic to Lower Cretaceous age.

A breccia of unknown age in Archean migmatite (Amg) near Hopedale (map area 13N) was interpreted by Taylor and Baer (1973) as an explosion breccia and is possibly of the same age as the breccia referred to above.

Triassic

Mistastin Formation (Tad)

Mistastin Lake, an elliptical depression in the northwestern part of map area 13M, is also the locus of very young consolidated rocks. First discovered by geologists of the British Newfoundland Exploration Limited (Brinex) these rocks are physiographically dominated by a buttelike hill of flat lying igneous rock about 1.5 km southwest of the lake. Another major physiographic features is a horseshoe-shaped island near the centre of the lake.

A brief examination of these occurrences was made by Taylor in the mid-1960's, which led to a brief paper with Dence (Taylor and Dence, 1969) suggesting a meteorite origin for the lake crater and flat-lying igneous rocks, because of the presence of shock metamorphic features. Currie (1968, 1971) examined the lake area in detail and showed that the extruded rock and its intrusive equivalents, plus breccias, form an almost continuous circular belt around the lake of which the buttelike hill is the most conspicuous representative. Petrographic and chemical analyses of various rock types exposed in the immediate area of the lake led Currie to suggest a cryptovolcanic origin for the rocks and lake basin. More recently a petrologic and chemical study of the impact melt by Grieve (1975) indicated that the melt can be generated from a mix comparable in composition to the country rocks.

A K-Ar whole-rock age determination on a sample from the buttelike hill returned an age of 202±25 Ma, suggesting a Triassic age (Wanless et al., 1966). Later, a paleomagnetic study by Currie and Larochelle (1969) partially confirmed this age as the paleopole has a Jurassic or upper Triassic position. Currie (1972) obtained K-Ar ages of 36 and 38 Ma for two whole-rock samples of scoriaceous, black aphanitic rocks from the northwest shore of the lake. These he concluded were anomalous, possibly because of argon loss from vesicular rocks. However, more recently, a $^{40}Ar/^{39}Ar$ age analysis by Mak et al. (1976) also returned an age of 38±4 Ma, suggesting an Eocene age for the event. If the later age is correct, these rocks are the youngest in the map area.

Cenozoic

A small circular structure (Merewether Crater) in overburden, in the southeast corner of map area 24I, was deemed by Meen (1957) to be a meteorite crater. A brief examination during the present survey failed to confirm Meen's interpretation and suggests that this 'crater' may have formed by slump over a deeply buried ice block.

Metamorphism

Almost all the layered rocks are regionally metamorphosed, the only exceptions being part of the Seal Group, the Siamarnekh Formation and the Mistastin Formation. Metamorphism is chiefly in the amphibolite facies with a significance area of granulite facies rocks. Relatively small areas are in the greenschist facies, notably parts of the Kaniapiskau Supergroup, the Ramah Group and possibly the Mugford Group (Fig. 4).

Contact metamorphism is insignificant and manifests itself chiefly along the contacts between the anorthosite-adamellite suite and their host rocks. Minor contact metamorphic effects are present in some places along the borders of diabase and lamprophyre dykes.

Regional metamorphism

Regional metamorphism of the rocks covered by Operation Torngat falls naturally into two groups: those lying within the Churchill Province embracing the Kaniapiskau Supergroup, the Lake Harbour Formation and unassigned Proterozoic metamorphic rocks; and those in the Nain Province. The latter are divisible into two major parts: firstly, the Archean rocks and the overlying Aphebian layered units, namely the Ramah, Snyder and Mugford groups; and secondly, the Makkovik Subprovince.

Nain Province

Regional metamorphism in the Archean rocks is almost entirely in the amphibolite facies with only local, poorly defined areas of granulite facies rocks in the north. Greenschist facies rocks are limited to the small fault-bounded area near Ugjoktok Bay in map area 13N, underlain by argillite, siltstones and breccias (Aal, Asn, Abc). There combinations of chlorite, muscovite, biotite, epidote and calcite are characteristic.

Granulite facies rocks occur sporadically in the gneissic and migmatite terrane, primarily in the Okak Bay district and north and south of Saglek Bay in map areas 14E and 14L. Many show retrogression and apparently grade into amphibolite facies rocks. Whereas they probably form mappable units, they are too erratically distributed to be differentiated here.

Granulite assemblages present are:

Hypersthene-hornblende-biotite-plagioclase-quartz
Hypersthene-hornblende-plagioclase-quartz
Hypersthene-clinopyroxene-garnet-plagioclase-quartz
Hypersthene-biotite-plagioclase-quartz (-potash feldspar)
Hypersthene-clinopyroxene-hornblende-plagioclase-quartz
Hypersthene-biotite-garnet-plagioclase-quartz

These rocks differ from the granulites in the Proterozoic terrane to the west in that retrogression is widespread, particularly in the ferromagnesian minerals. Hypersthene, for example, in some places is present only as cores to an inner amphibole rim and an outer chlorite rim, whereas in others it is extensively altered to iddingsite and chlorite, and less commonly with biotite. Clinopyroxene, hornblende and biotite are chloritized in most samples.

Common assemblages in the amphibolite facies are:

Sillimanite-garnet muscovite-plagioclase-potash feldspar-quartz
Hornblende-garnet-clinopyroxene-plagioclase
Hornblende-clinopyroxene-plagioclase (-quartz)
Hornblende-biotite-plagioclase-quartz (-potash feldspar)
Garnet-biotite-plagioclase-quartz
Hornblende-biotite-clinopyroxene-plagioclase
Biotite-plagioclase-potash feldspar-quartz (-muscovite)
Sillimanite-garnet-biotite-quartz
Sillimanite-garnet-biotite-muscovite-plagioclase-quartz
Hornblende-plagioclase
Hornblende-epidote-plagioclase-potash feldspar-quartz
Biotite-epidote-plagioclase-quartz

The amphibolite facies rocks also show retrogression, which is particularly pervasive in the southern part of the Archean terrane. This feature is displayed chiefly by the development of chlorite and less commonly by the local presence of abundant epidote. This retrogression is first evident megascopically at about the latitude of Cape Harrigan Island (map area 13N) and becomes more marked to the south toward the border of the Makkovik Subprovince.

The Aphebian rocks in the northern part of the Nain Province display various metamorphic characteristics. The Snyder Group has probably been subjected to intense contact metamorphism, but the Ramah and Mugford groups show regional effects.

Metamorphism of the Ramah Group is more diverse than any of the other units within the Nain Province. Preliminary study by Morgan (1975) shows that the grade of regional metamorphism increases mainly from north to south but also from east to west. He reported that between Nachvak Fiord and near Saglek Fiord the rocks lie in the greenschist and low amphibolite facies, whereas 9 km south of Saglek Fiord and southward to Hebron Fiord the grade is high amphibolite facies. Morgan also reported that pelitic rocks between Nachvak Fiord and about 6 km north of Saglek Fiord on the east consist of chloritoid-muscovite phyllites, whereas to the west they are conmmonly "mica schists with porphyroblasts and include local andalusite-muscovite schist."

The following assemblages occur in the southernmost part of the group (Morgan, 1975):

Sillimanite-biotite-muscovite
Garnet-biotite-muscovite (-sillimanite)
Sillimanite-staurolite-muscovite-biotite

Present data are very limited in comparison to Morgan's, and the accompanying assemblages cannot be considered either as complete or representative.

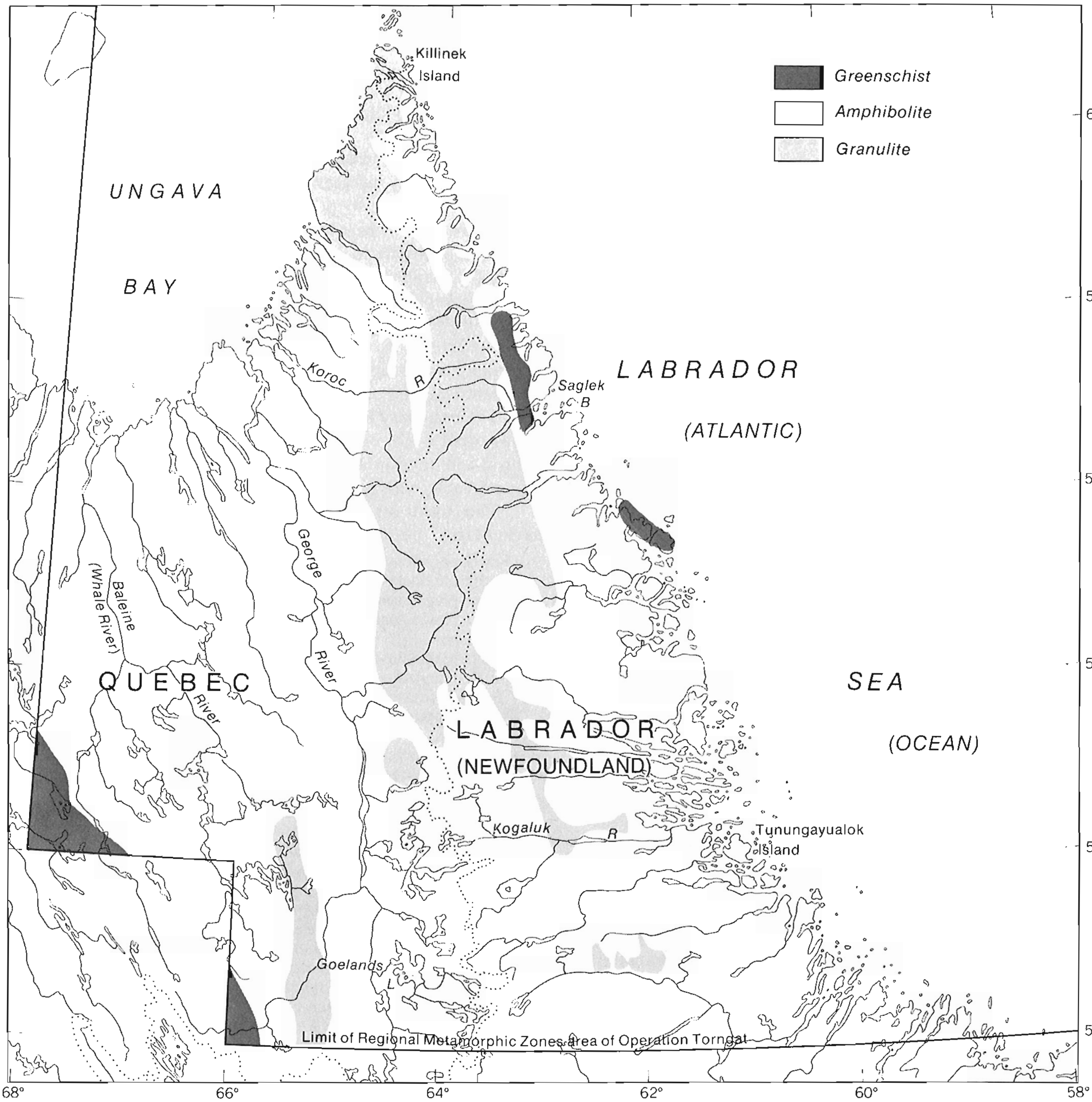


Figure 4. Distribution of metamorphic facies.

Pelitic and quartzofeldspathic	Quartz-albite-muscovite-biotite-chlorite Muscovite-calcite-chlorite-hematite
Basic	Albite-muscovite-chlorite-zoisite-epidote-sphene Muscovite-chlorite-calcite

As Morgan pointed out, original clastic grains are evident in quartzites along the east edge of the group. A few are also present along the northeastern extremities, and quartz and quartzite clasts are moderately well preserved only in the carbonates in the vicinity of Quartzite Mountain.

This limited information shows that the Ramah Group consists of both greenschist and amphibolite facies, attesting to a more complex history than recognized prior to the present survey and Morgan's research.

Data from the present survey are too sparse to be specific as to the metamorphic status of the Mugford Group.

Field observation suggests that the group is unmetamorphosed to lower greenschist facies. Barton (1975a) suggested that typical greenschist assemblages—albite-chlorite-actinolite-epidote-sphene—present in some of these rocks are probably due to deuteric alteration as they are interlayered with unmetamorphosed tholeiitic flows.

The sedimentary members have not been examined in sufficient detail to ascertain their place in the facies scheme. Field observations suggest that they are in the lower greenschist facies as chlorite and biotite are commonly present in the pelitic rocks.

Makkovik Subprovince

The layered rocks of the Makkovik Subprovince, chiefly the Aillik Group, were assigned by Gandhi et al. (1969) to the greenschist-amphibolite transition facies of Turner (1968). This facies has also been called albite-epidote-amphibolite (Turner, 1948) and quartz-albite-almandine subfacies (Turner and Verhoogen, 1960). The following assemblages are present:

Hornblende-epidote-albite-biotite (-garnet)
Quartz-albite-biotite-muscovite
Quartz-biotite-muscovite
Quartz-albite-hornblende-biotite
Quartz-calcite-diopside-garnet (-grossularite)
Quartz-albite-garnet (-grossularite)
Quartz-albite-hornblende-garnet
Quartz-albite-hornblende-biotite-epidote
Quartz-albite-biotite-muscovite (-spidote)
Quartz-albite-hornblende-biotite (-garnet)

Sphene and calcite are present in most samples and are possibly metamorphic. Microcline is locally common in the quartz-albite-biotite-muscovite and the quartz-albite hornblende-biotite assemblages but is, at least in part, of primary origin.

Partial chloritization of biotite and hornblende is the sole retrogressive metamorphic effect.

As none of the Aillik Group rocks are far from the younger Big Bight and Strawberry intrusives, some of the metamorphism could be due to contact metamorphism. No clear aureoles are apparent in the field, however, and present assemblage distribution shows no clear relationship to pluton boundaries, suggesting that metamorphism is dominantly if not entirely regional.

Churchill Province

In the Churchill Province the metamorphic grade increases in general from west to east across the map area. Baragar (1967) noted the same effect in the Wakuach Lake area, where he was able to show a progressive increase in metamorphic grade eastward from the unconformity between the Kaniapiskau Supergroup and the underlying Archean. The present investigation shows this progressive increase in metamorphic grade continues much farther to the northeast, where the amphibolites facies passes into granulite facies.

The boundary between greenschist and amphibole facies rocks roughly parallels the structure of the Labrador Trough, as shown by Baragar (1967), but the amphibolite-granulite boundary has a more northerly attitude. Dimroth (1964, 1967) shows the biotite isograd for map areas 24B/4 and 24B/5. This isograd passes through the southwestern quarter of map area 23P; but its absolute location is not demarcated because of wide dispersal of data points. The garnet isograd is poorly defined. Limited data suggest that it is near the biotite isograd and roughly parallel to the greenschist boundary.

Boundaries between the various facies are not clearly defined, especially between the greenschist and amphibolite. This is due in part to poor outcrop distribution (notably in map area 23P), part to the reconnaissance nature of the survey, and in part to transitional rather than abrupt mineralogical changes.

The amphibolite facies comprises the major part of the Churchill Province extending from the Labrador Trough to the granulite zone. A relatively small area lies east of the granulite zone along the northeast coast. These areas include the granitic gneiss and migmatite terrane.

The boundary between the greenschist and amphibolite facies rocks is not clearly defined due to lack of geological control and outcrop. However, the location shown on Figure 4 is probably within 1 km or so of being correct.

The following are the common amphibolite facies assemblages present in the Churchill Province:

Quartz-plagioclase-biotite (-potash feldspar) (-muscovite)
Quartz-plagioclase-biotite (-muscovite)-garnet
Quartz-plagioclase-sillimanite-biotite-potash feldspar
Quartz-plagioclase-sillimanite-biotite-garnet (-potash feldspar)
Quartz-plagioclase-sillimanite-biotite-garnet-muscovite
Quartz-plagioclase-sillimanite-biotite-muscovite (-potash feldspar)
Quartz-plagioclase-biotite-muscovite-andalusite-potash feldspar
Quartz-plagioclase-staurolite-sillimanite-kyanite-garnet-biotite-muscovite
Quartz-plagioclase-kyanite-garnet-muscovite
Quartz-staurolite-garnet-muscovite
Hornblende-plagioclase-quartz (-sphene)
Hornblende-biotite-plagioclase-quartz (-sphene)
Hornblende-biotite-plagioclase (-quartz)
Hornblende-biotite-epidote-plagioclase (-quartz)
Hornblende-biotite-garnet-plagioclase-quartz
Hornblende-biotite-scapolite-plagioclase-sphene
Hornblende-epidote-plagioclase-quartz-sphene
Hornblende-garnet-plagioclase-quartz
Hornblende-plagioclase-sphene
Hornblende-clinopyroxene-garnet-plagioclase (-quartz)
Hornblende-clinopyroxene-plagioclase
Hornblende-clinopyroxene-plagioclase-sphene (-quartz)
Hornblende-clinopyroxene-biotite-plagioclase-quartz
Hornblende-garnet-biotite-plagioclase-quartz-potash feldspar
Hornblende-clinopyroxene-scapolite-plagioclase-sphene

Assemblages in the calcareous rocks are:

Calcite-tremolite-quartz (-plagioclase)
Calcite-diopside
Calcite-diopside-scapolite-sphene
Calcite-olivine-tremolite-phlogopite
Calcite-olivine-diopside-phlogopite-spinel
Calcite-olivine-tremolite-diopside-sphene
Calcite-diopside-tremolite-phlogopite-sphene

A subdivision of the amphibolite facies has not been attempted as some assemblages, for example the kyanite-bearing rocks, are of very limited occurrence. Some assemblages are typical of Turner's (1968) amphibolite-granulite transition facies, but a progression toward the granulite terrane is not discernible on the basis of data on hand as the assemblages characteristic of the transitional facies are geographically scattered.

Plagioclase ranges from An_{24} to An_{52} but is chiefly in the An_{28} to An_{34} range. Biotite is dominantly brown and hornblende green. K-feldspar is primarily microcline and is locally perthitic.

The boundary between the amphibolite and granulite facies rocks is based on the appearance of hypersthene. Maps 1428A to 1444A reflect this as the boundaries of map unit **Agl** are drawn mainly on the basis of the presence of hypersthene. Map unit **Afg** is also in the granulite zone, but mineral assemblages for most of the area underlain by this map unit are not diagnostic and fall into Winkler's (1974) granoblastite. Local areas of hypersthene-bearing rocks (**Agl**) occur within the area of map unit **Afg**, providing evidence for the metamorphic history of most of the unit. Some small areas, such as in map area 13M north of Border River, are shown as being in the amphibolite facies as evidence supporting assignment to the granulite facies is lacking.

Assemblages present in the granulite zone are:

Hypersthene-plagioclase-quartz
Hypersthene-biotite-plagioclase-quartz-potash feldspar
Hypersthene-hornblende-plagioclase-quartz-potash feldspar
Hypersthene-hornblende-plagioclase
Hypersthene-biotite-hornblende-plagioclase-quartz-potash feldspar
Hypersthene-biotite-hornblende-plagioclase-potash feldspar
Hypersthene-clinopyroxene-biotite-hornblende-plagioclase-quartz-potash feldspar
Hypersthene-clinopyroxene-biotite-hornblende-plagioclase
Hypersthene-garnet-biotite-hornblende-plagioclase-quartz
Hypersthene-garnet-biotite-plagioclase-potash feldspar
Hypersthene-garnet-hornblende-plagioclase-quartz
Hypersthene-clinopyroxene-garnet-hornblende-plagioclase-quartz
Hypersthene-clinopyroxene-plagioclase
Hypersthene-clinopyroxene-biotite-plagioclase-quartz-potash feldspar
Hypersthene-clinopyroxene-hornblende-plagioclase
Hypersthene-clinopyroxene-hornblende-plagioclase-quartz-potash feldspar
Hypersthene-clinopyroxene-hornblende-biotite-plagioclase-quartz
Hypersthene-clinopyroxene-garnet-biotite-hornblende-plagioclase-quartz
Hypersthene-plagioclase-quartz-potash feldspar
Hypersthene-clinopyroxene-garnet-plagioclase-quartz
Hypersthene-clinopyroxene-garnet-hornblende-quartz
Hypersthene-clinopyroxene-plagioclase-quartz-potash feldspar
Biotite-plagioclase-quartz-potash feldspar
Biotite-hornblende-plagioclase-quartz
Clinopyroxene-hornblende-biotite-plagioclase-quartz
Clinopyroxene-garnet-hornblende-plagioclase
Hornblende-scapolite-biotite-plagioclase

Calcareous rocks have the following assemblages:

Clinopyroxene-scapolite-calcite-sphene-quartz (-plagioclase)
Clinopyroxene-scapolite-calcite-sphene
Clinopyroxene-scapolite-plagioclase-calcite-potash feldspar-sphene-quartz

Assemblages in map unit **Afg** that are probably also in the granulites facies are:

Clinopyroxene-garnet-biotite-plagioclase-quartz
Sillimanite-garnet-biotite-plagioclase-quartz-potash feldspar

Hypersthene in these rocks is mainly strongly pleochroic and unaltered. Minor alteration to iddingsite, which is present in a few places, is the commonest alteration. Less common is uralitization, or development of a chlorite-biotite-magnetite encrustation.

Alkali feldspar is dominantly perthite, whereas plagioclase which ranges from An_{25} to An_{54}, is chiefly in the range An_{36} to An_{40}, and is commonly antiperthitic. Although feldspar is commonly fresh, sericite is present on a small scale.

Clinopyroxene is light green to colourless and diopsidic. Hornblende is primarily in olive shades but not brown. Biotite, however, is very distinctive with foxy reddish-brown to very pale orange pleochroism common. Chlorite is a rare and minor alteration of biotite and garnet.

Rutile and spinel are rare members.

Contact metamorphism

The emplacement of the Paleohelikian plutons has, in places, resulted in the development of a narrow zone of contact metamorphism. This metamorphism is well developed along the western edge of the Mistastin pluton and along the northern border of the Umiakovik pluton.

At these localities cordierite and spinel are common in the host rocks within a few metres of the intrusion. Sillimanite, muscovite, biotite, garnet and plagioclase (An_{40}) are also present at the former locality and sillimanite, hypersthene, biotite, plagioclase and quartz at the latter. Some of the latter minerals, all of which are common in the host rocks, may well be of regional metamorphic derivation.

This sparse information is merely suggestive of low pressure zone of metamorphism.

Time of metamorphism

The time of the metamorphism of the Archean rocks is not clearly established. There are evidently two possible periods to which the main metamorphism can be assigned, the one generally acceptable period the Kenoran Orogeny, at around 2700 Ma, and an older, unnamed, recently recognized, orogeny around 3600 Ma (Hurst, 1975). Data on hand suggest that the Kenoran Orogeny played the dominant role as it was evidently widespread as ages characteristic of this orogeny have been obtained throughout the entire Archean. At present the older ages (3600 Ma) are limited to small areas that may be isolated remnants. Extensive age dating is necessary before this problem can be solved with an appreciable degree of certainty.

The retrogression of Archean granulite facies rocks, manifested for example in the extensive alteration of hypersthene, is likewise not clear. It can be assumed that the granulites were formed prior to the Kenoran Orogeny and downgraded at that time. However, no evidence as yet supports this assumption. Retrogression may be a Proterozoic event, a side effect occurring during the metamorphism of the Ramah Group. Similarly, the extensive development of chlorite and less commonly epidote in the southern part of the Archean terrane may be an Archean or Proterozoic episode, depending upon the time of the amphibolite facies metamorphism—presently considered as being a Kenoran orogenic product.

In view of the metamorphism of the Ramah and Aillik groups, it is highly improbable that the underlying Archean rocks escaped being subjected to the same physico-chemical conditions. Therefore the Archean rocks must have undergone, at least in those areas adjacent to the above-mentioned layered groups, a re-entry into conditions compatible with amphibolite metamorphism. However, as they were previously subjected to these conditions, evidence of their second involvement is effectively obscured. Only the presence of the younger metamorphic groups permits the recognition of this reinvolvement. As there does not appear to be any significant or at least undetected tectonism in the Archean rocks, it is assumed that their role was essentially static.

The regional metamorphism of the Ramah and Aillik groups is considered by the writer to be a product of the Hudsonian Orogeny, a contention which in the case of the Aillik Group is supported by numerous isotopic ages in the Makkovik Subprovince. Assuming the greenschist assemblages present in the Mugford Group are of regional metamorphic origin rather than deuteric, it is probable these two are also related to the Hudsonian Orogeny. The Snyder Group metamorphism is more consistent with the emplacement of the Kiglapait intrusion.

The regional metamorphism of the Churchill Province rocks is considered to be a product of the Hudsonian Orogeny. Age data, which reflect primarily the formation of the metamorphic minerals, notably biotite and hornblende, mostly range from 1536 to 2160 Ma, suggesting a lengthy metamorphic environment. With the exception of local contact metamorphism due to the intrusion of the adamellite-anorthosite suite and epirogenic effects, these rocks have been dormant since the end of the Hudsonian Orogeny.

Structural geology

The structural data shown on the accompanying maps are derived from observations on the ground, from the air (mostly at low altitude) and from a study of air photographs. Foliation, banding and bedding attitudes were estimated from the air, wherever possible, to supplement ground observations. Their abundance is commonly an indication of the amount of rock exposure and its cleanliness. Lichen cover substantially hampered air observation in some places.

Extensive use has been made of air photographs in delineating structural trends, which for the most part are traces of foliation planes and, less commonly, lithologic contacts. These are particularly well displayed in the granulite (**Agl**) terrane in map areas 14D and 14E and 24H and 24I, so that fold structures can be outlined in this map unit. Locally, such as southeast of Lac Jeannin in map area 24B, and north and south of the Korok River in map area 24I, similar structures are discernible in other Aphebian gneisses; but extensive drift combined with rock types, whose fabric is less conspicuous, migmatite for example, prevents this type of photo interpretation throughout vast areas. Only in small areas in the Archean rocks, for example south of Pistolet Bay (map area 14E) are trend structures well displayed on air photographs.

Traces of prominent lineaments visible on air photographs are also shown on the accompanying maps. These are most abundant in the Paleohelikian intrusive rocks, such as the Harp Lake anorthosite, but are also common in some other map units such as granulite (**Agl**) in map area 23P. As they are most abundant in the intrusive rocks, the majority of these lineaments are undoubtedly joints, but some are probably faults and others the loci of small dykes, especially in the anorthosite (**Par**).

A few measured joint attitudes are shown; however, since data are sparse no analysis was made as to their significance.

Each of the major structural elements of the map area, which are the Churchill and Nain provinces, and the Makkovik Subprovince, have their own structural characteristics of which the regional trend is the most prominent and led to their establishment (Taylor, 1971).

Nain Province

The Archean part of the Nain Province is characterized by a trend that is generally northerly but with many aberrations and contortions. Insufficient data are available to define folds in most of this structurally complex area. However, inclined and overturned isoclinal to subisoclinal folds observed in fiord walls in the northern part of the province can undoubtedly be deciphered with more detailed mapping. Morgan (1975) noted that individual folds cannot be traced far because even the thicker basic gneiss marker horizons die out. The most continuous are in map area 14E south of Pistolet Bay and southwest of Napaktok Bay.

In map area 13N, the general trend of foliation is northerly with local variations toward northwest and northeast. For example, in the Hopedale village area, the strike is generally northwest but interspersed are several northeast attitudes. Westerly from Hopedale the trend slowly swings to the northeast in the vicinity of the Hunt River where dips are chiefly vertical; elsewhere, dips as low as 40° are common, and in some places foliation planes are nearly horizontal. This change in attitudes can be reproduced on a larger scale in many outcrops where Archean rocks are well exposed. Two foliation directions are present in some places; for example, east of Shapio Lake (map area 13N) a vertical northwest attitude is imposed on an older northeast foliation, the latter dipping southeast at 45°. Fold axes, where discernible, such as in the southern part of map area 14L, show axial surfaces trending both northeasterly and northwesterly. Plunges on these folds range from near horizontal to 40° or more. Morgan (1975) reported axial surfaces dipping westerly at about 70°. He also reported amplitudes of 600 m for many folds.

Small scale folds, presumably a reflection of the larger structures, show a broad range of plunges. For example, near Napatalik Island (map area 13N) small fold axes plunge 80° south, whereas southwest of Napaktok Bay (map area 14E) S-plane intersections plunge 50° northwest, and east of Iglosiatik Island (map area 14C) fold axes plunge 25° southward.

Folds are probably primarily products of the Kenoran Orogeny, but the evidence for two fold periods and other isotopic ages (circa 3600 Ma) shows that some folds are possibly due to a pre-Kenoran orogeny. Certainly some folds are due to an Aphebian orogeny (the Hudsonian) as Archean strata bordering younger rocks, in particular the Ramah Group and the Aillik Group (Sutton, et al., 1971), have been deformed with them. How extensive this deformation was is uncertain; present data suggest it to be fairly restricted, as 'Kenoran' ages and Archean fold style is widespread (Pl. 95).

Faults in the Archean terrane are chiefly northerly striking and are marked by linear topographic depressions, shearing, brecciation and slickensides. Although the age of the faulting for the most part is unknown, at least three ages of faults are present: Archean; Aphebian or younger; and post-Paleohelikian.

Archean faults were recognized in the Bears Gut area (map area 14L), where elements of the Ramah Group overlie westerly striking cross faults in the basement. These were subsequently confirmed by Morgan (1975). These pre-Ramah faults are only recognizable where Ramah Group strata overlie them. Others are no doubt present but probably only recognizable in the area adjacent to the Mugford and Snyder groups.

Aphebian or younger faults are readily distinguished as they offset the layered rocks of the Ramah, Mugford and Snyder groups. Two types are present, strike faults and cross faults, with the former the more prominent.

Strike faults in the Ramah Group are predominantly west dipping thrust faults that also offset the Archean and the unconformity between the Ramah Group and Archean rocks (Pl. 96). The reader is referred to Morgan (1975) for details. Smyth (1975) reported that both east and west dipping thrusts occur in the Mugford Group with a west dipping thrust fault repeating the unconformity. The fault that forms the western margin of the Mugford Group is interpreted by Smyth as a normal fault.

Cross faults, some of which postdate the strike faults, are commonly of high angle, but displacements are probably small. Most are considered to be Aphebian, a part of the Hudsonian Orogeny; but some, particularly the cross faults, are possibly younger. No means of more closely dating these is known at present.

Post-Paleohelikian faults offset members of the anorthosite-adamellite suite and older rocks. Well defined east-trending canyons and valleys in map areas 14C and 14D are the loci of the more outstanding faults in this group. Although these topographic depressions are chiefly drift-filled so that fault characteristics such as breccias and schists are hidden, offsets of contacts between rock units are apparent. For example, at Tasisuak Lake, in map area 14D, the adamellite-anorthosite contact shows a left-hand separation of 13 km. Some of these faults possibly extend offshore far beyond the limits shown on the accompanying maps as bathymetry east-southeast of Nain shows a marked east trend. As these faults die out inland (toward the western margin of map area 14D) and offsets decrease inland, it is suggested that they are hinge-type faults with the hinge axis located roughly near the west boundary of map area 14D in the Churchill Province. The age of these faults can only be established as postadamellite, but they may be relatively recent and related to general uplift in the region, which is reflected in the mountainous character of much of the northeastern part of the map area.

Plate 95. Folds in Ramah Group strata (AR) looking north from the south side of Saglek Fiord. Felsenmeer in the foreground consists of Ramah Group quartzite (ARS) (map area 14L). F.C.T. 172440.

A Neohelikian diabase dyke is offset along a north-northwest–striking fault in map area 13N, showing that some adjustment is at least post-Neohelikian.

Makkovik Subprovince

The Makkovik Subprovince is characterized by north-northeasterly trends in the present map area. Gandhi et al. (1969) defined the main structural components. Their data are not repeated here except to point out that folding of the Aillik Group is by far the major structural feature with only a few postfolding faults northeast and north-northwest present. Folding is considered to be a product of Hudsonian Orogeny (Gandhi et al., 1969).

Summary

In brief, the major structural features of the Nain Province are: (1) overall northerly trend with north-northeast trend in the Makkovik Subprovince; (2) well defined folds and west dipping thrust faults in the Ramah Group and underlying rocks; (3) well defined folds in the Makkovik Subprovince; (4) post-Paleohelikian east-striking hinge faults.

Plate 96. Trace of west-dipping thrust fault that forms the Archean – Ramah Group contact on the west side of the Ramah Group exposed in a small, northeast trending stream valley 9 km south of Ramah Bay. Ramah Group to the right middle-ground and the highly crumpled fault in the left middle ground (map area 14L). F.C.T. 171393.

Churchill Province

The Churchill Structural Province regional trend is northwesterly in the southwestern portion of the map area and north to north-northwesterly in the remainder. In the southwest, in areas underlain by units of the Kaniapiskau Supergroup, a series of northwest to north-northwest folds generally typical of the Labrador Trough are present. In detail, however, Dimroth (1964, 1967) found the fold structures to be complex and variable within fault bounded blocks, with complex fold patterns and many variations from the prevalent northwesterly trend. In map area 23P both open and closed upright folds are present and overturning typical of many Labrador Trough folds is absent. Plunges up to 35°, both northerly and southerly, occur.

Folds within the gneissic terrane east of the Kaniapiskau Supergroup are ill defined for the most part, and only the dominantly northwesterly regional trend is discernible. However, aberrations in this trend exist; for example in the vicinity of Lac Jeannin in map area 24B, strong easterly trends are present. Throughout the areas underlain by gneissic granite and migmatite (**Agg**, **Amg**) structures are commonly chaotic in detail, but the general northwesterly trend is evident.

Fold styles are distinguishable in the areas occupied by the Lake Harbour Formation and the granulite (**Agl**). The former comprise a series of complex folds, variously open and closed, upright and overturned, whose axial surfaces trend mainly to the northwest. Local variations to this direction are present, notably 5 km north of the Korok River in map area 24I and at the north boundary of the same map area northeast of the Rivière Baudoncourt where northeast and north-northeast trends are present. Although plunge directions are not well-known, present data suggest plunges of up to 40°, both northwest and southeast.

A large part of the granulite terrane is marked by many well defined open and closed folds that, with rare exceptions, are upright and strike north-northwesterly. Plunges in general are low, less than 30°, both to the north and south. A small part of the granulite terrane and the major portion of the area underlain by garnet-quartz-feldspar gneiss (**Afg**), displays a uniform attitude over extensive areas. This uniformity may be the result of isoclinal folding in these rocks. Rare folds, such as those at Southwest Arm (Saglek Fiord) in map area 14L, suggest this possibility.

Faults in the Churchill Province are difficult to recognize because of the gneissic terrane where horizon markers are scarce. Dimroth (1964, 1967) mapped several thrust faults in the southwest part of map area 24B. These dip chiefly to the east and are typical Labrador Trough structures in that they indicate a westward movement of strata. Similarly, faults in the southwest corner of map area 23P were recognized as east-dipping thrust faults by Fahrig (1964). The present survey did not reveal any previously unknown thrust faults. The strike fault through Lac Tudor (map area 23P) and those parallel to it and on strike with it are probably normal faults with vertical or very steep dips, as the granulite to the east is expressed topographically in the form of hills 100 m higher than the rocks to the west. In the same area, cross and oblique faults offset sedimentary strata.

In the gneissic terrane northeast of the Labrador Trough rocks, a few strike faults are present. These are more common near Ungava Bay (map areas 24I and 24J) probably because of better exposure than to the south. In part these faults are defined by extensive mylonite zones and less commonly by fault breccias. Displacement and age of these breaks is unknown, but Neohelikian diabase dykes are not known to be disturbed.

Cross and oblique faults offset units of the Lake Harbour Formation, folds in the granulite, and some strike faults. An oblique fault offsets a Neohelikian diabase dyke 35 km southeast of Campsite 3 (map area 24I) so that at least some of these faults are relatively young.

The rocks of map unit **Afg** are all mylonitic, suggesting that the area underlain by this unit has been involved in extensive shearing. Lineations are nearly horizontal, suggesting a dominant strike slip movement in this broad zone. The western contact of this map unit with granulite (**Agl**) is shown as an approximate fault on the accompanying maps to indicate the tectonic significance of map unit **Afg**. This contact may be gradational.

Wheeler (1964) reported a north-northwest striking thrust fault that results in adamellite (**Pam**) being superimposed on part of the Siamarnekh Formation (**Hsa**). The existence of this fault was not confirmed during the present survey.

Although the structural history is not fully documented, the major deformation of the Churchill Province is probably the result of a single orogeny, an observation also made by Dimroth (1967) for a small part of map area 24B.

Summary

In summary, the salient structural features are:

1. A persistent northwest to north-northwest trend.
2. Well defined folds and east-dipping thrust faults in the extreme southwest.
3. A broad zone of chaotic folding in the core of the province with granodiorite intrusive rocks.
4. A zone of well defined folding east of the core area.
5. A broad zone of mylonite forming much of the contact with the Nain Province.

Geochronology

Isotopic age determinations are of four types: K-Ar mineral and whole-rock ages, Rb/Sr isochron ages, U/Pb ages, and $^{40}Ar/^{39}Ar$ ages. The K-Ar ages are widely distributed throughout the map area and are shown on Figure 5 and listed in Table 2. These ages, particularly the early determinations, are chiefly on biotites with about half as many hornblendes. Whole-rock determinations are mostly chill samples of diabase dykes. Rb/Sr isochrons, which have been undertaken for a few specific rock units, are listed in Table 3. U-Pb age analyses of zircons made by Krogh and Davis (1973) and Hurst (1975) are shown in Table 4. $^{40}Ar/^{39}Ar$ ages are available for the Mistastin Formation (Mak et al., 1976). For analytical details and interpretations the original references should be consulted particularly for the Rb/Sr and U/Pb results.

K-Ar ages in the Archean part of the Nain Province, exclusive of diabase dykes and one anomalous determination of 1655 Ma, range from 2050 to 2720 Ma and average 2594 Ma. These figures are indicative of the Kenoran Orogeny and are in good agreement with similarly derived data from the Superior Province. As all but four of these are hornblende ages, the average age of 2594 Ma closely approximates the age of crystallization.

Barton (1974) obtained an isochron age of 2386 Ma on samples from a leucocratic granite that intrudes migmatite at Okak Harbour (map area 14F). He (Barton, 1975a) interpreted this age to represent plutonism associated with the extrusion of the Mugford volcanic rocks. However, the Okak granite could possibly be a very late phase of the Kenoran Orogeny as no known early Aphebian silicic intrusive rocks are present along the coast.

Recent Rb/Sr and U/Pb analyses of rocks from Saglek, Lost Channel and Hebron (Hurst, 1975; Barton, 1974, 1975b) has established the existence of more than 3 Ga old rocks within the Nain Province. As this early history is imperfectly understood, the limited data available can only be interpreted in the broadest sense. To date these data suggest a metamorphic period around 3600 Ma, possibly accompanied by intrusion and deformation, followed about 500 Ma later by a thermal event resulting in remobilization and small-scale intrusion. Much detailed field work is necessary before extending these significant findings beyond their presently known occurrences.

Within the Nain Province, Aphebian ages are represented by isochrons for volcanic rocks of the Ramah and Mugford groups. The former at 1892 Ma, is believed by Morgan (1978) to be a record of the metamorphism (Hudsonian Orogeny), whereas Barton (1975a) considered the latter at 2369 Ma to reflect the extrusion of the volcanic rocks. As the isochron of 2369 Ma is anchored by one point on a komatiite sample, whereas the others are greenstones and tholeiitic basalts, this age is somewhat suspect and is probably too old by 200 or 300 Ma.

Barton and Barton (1975) obtained another Rb/Sr isochron age of 1842 Ma on samples of breccia in the Snyder Group which fixes a minimum age for this unit. As the Snyder Group overlies the Archean rocks, the group was laid down sometime in the early or middle Aphebian.

K-Ar ages in the Makkovik Subprovince, exclusive of dyke rocks, range from 1497 to 1832 Ma and average 1602 Ma. These include both country and intrusive rocks, all of which are considered as products of the Hudsonian Orogeny. Since half of them are biotite ages, they are probably reflections of the cooling period rather than the crystallization time. As the Hudsonian Orogeny is considered to have terminated 1800 Ma ago, a cooling interval of 200 Ma is possible. Whether this interval was a single event is an open question.

The K-Ar ages in the Churchill Province, exclusive of basic dyke rocks and the anorthosite-adamellite suite, range from 1175 to 2160 Ma and average 1604 Ma. An abnormal K-Ar isochron determination in map area 23P that gave an age of 2770 Ma is also excluded from these figures. The very low ages, 1175 and 1410 Ma, are considered to have been influenced by the emplacement of the anorthosite-adamellite suite and epeirogenic effects. Figure 5 shows that most of these low ages lie along the major intrusive axis. These low ages also are primarily granulite (5 biotites) and garnet-quartz-feldspar gneiss (2 biotites), so that there may also be a metamorphic cause that may have released argon. It is of interest to note that a hornblende from granulite gave an age of 1605 Ma, suggesting better argon retention. Unfortunately, however, another sample from which both biotite and hornblende were analyzed showed a biotite age of 1590 Ma and a hornblende age of 1351 Ma.

The ages from intrusive granitic rocks (**Agd** and **Agr**) average 1621 Ma, which by themselves agree closely with the average K-Ar age of granitic intrusive in the Makkovik Subprovince (1591 Ma).

These K-Ar ages for the Churchill Province typify the Hudsonian Orogeny.

The only Rb/Sr isochron in the Churchill Province is on samples of granulite (**Agl**), and this defines two lines —one at 2640 Ma and the other at 1865 Ma (Taylor, 1978b). The 1865 age, based on seven samples, is considered to represent the time of metamorphism, a product of the Hudsonian Orogeny. The older age, based on four samples, is believed to represent unmodified isotopic parameters from pre-existing rocks.

Probably the best dated rocks are members of the adamellite suite, with mineral and rock analyses of three types. K-Ar mineral ages average 1250 Ma, whereas whole-rock Rb/Sr isochrons gave ages of 1246 Ma (Taylor,

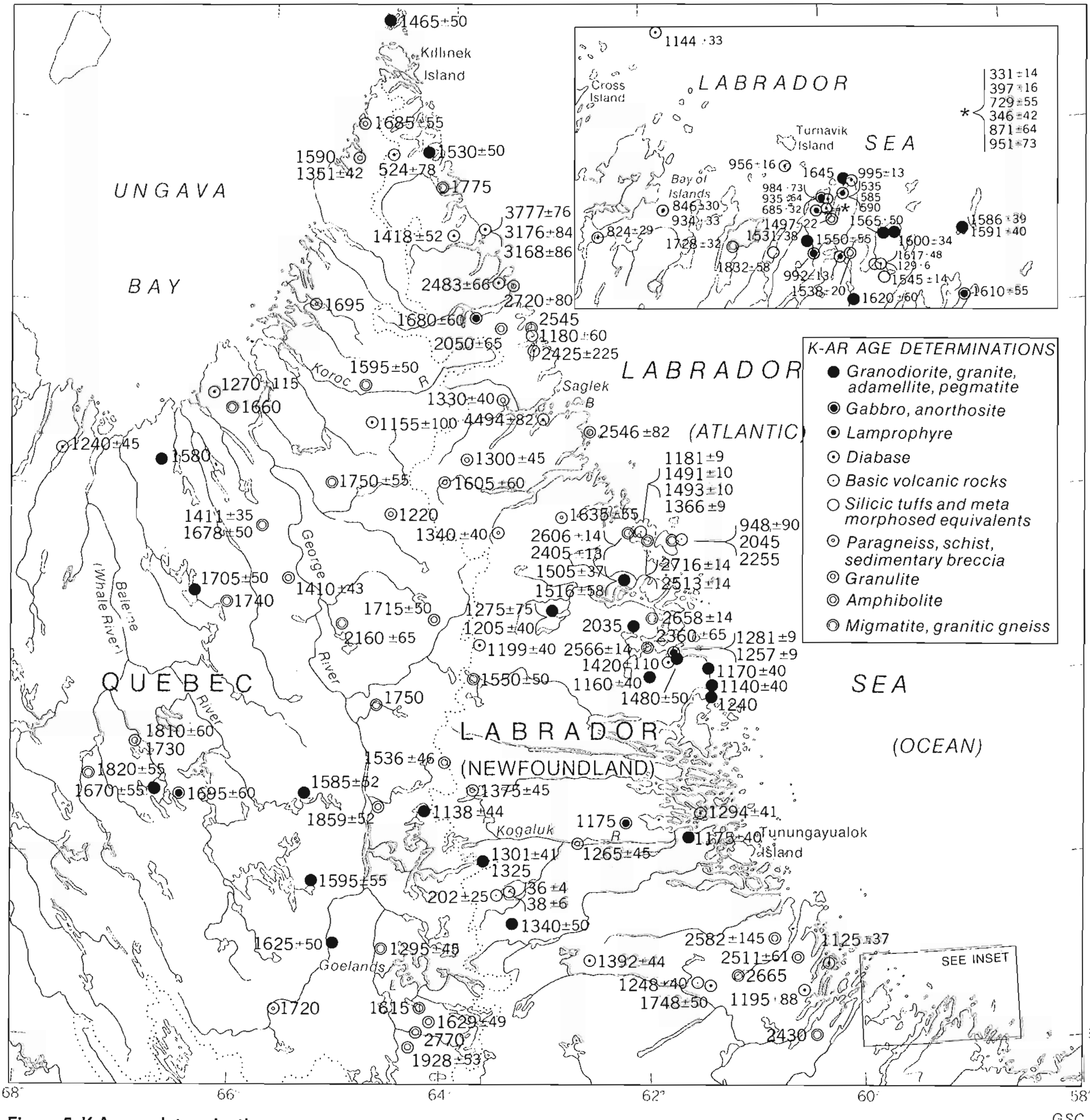


Figure 5. K-Ar age determinations.

Table 2. K-Ar age determinations

Map area	Rock type	Map unit	Mineral	Age	Reference
				(Ma)	GSC Paper
13M	Adamellite	Pam	Biotite	1340±50	64-17
	Andesite	Tad	Whole rock	202±25	65-17
	Andesite	Tad	Whole rock	38±6	71-2
	Andesite	Tad	Whole rock	36±4	71-2
	Diabase	Pdb	Whole rock	1392±44	74-2
13N	Granite gneiss	Agg	Biotite	2430	63-17
	Migmatite	Amg	Hornblende	2665	64-17
	Amphibolite*	Aab	Hornblende	2582±145	74-2
	Amphibolite	Aab	Hornblende	2511±61	74-2
	Diabase	Ndb	Whole rock	1125±37	74-2
	Diabase	Ndb	Whole rock	1195±88	74-2
	Diabase	Adb	Whole rock	1748±50	74-2
	Andesite	Nsad	Whole rock	1248±40	74-2
13O	Granite	Asgr	Biotite	1645	
	Lamprophyre	Hlp	Biotite	535	63-17
	Lamprophyre	Hlp	Biotite	585	
	Lamprophyre	Hlp	Biotite	590	
	Granite	Asgr	Biotite	1565±50	
	Diorite	ABdr	Biotite	1610±55	69-2A
	Granite	Asgr	Biotite	1620±60	
	Lamprophyre	Alp	Hornblende	1550±55	71-2
	Diabase	Hdb	Whole rock	729±55	
	Diorite	Hdr	Whole rock	984±73	
	Diabase	Hdb	Whole rock	346±42	
	Diabase	Hdb	Whole rock	871±64	
	Diabase	Hdb	Whole rock	951±73	73-2
	Diabase	Hdb	Whole rock	935±64	
	Diabase	Hdb	Whole rock	685±32	
	Lamprophyre	Dlp	Phlogopite	331±14	
	Lamprophyre	Dlp	Phlogopite	397±16	
	Diabase	Ndb	Whole rock	1144±33	
	Diabase	Ndb	Whole rock	846±30	
	Diabase	Ndb	Whole rock	934±33	74-2
	Diabase	Ndb	Whole rock	824±29	
	Granite	Asgr	Biotite	1591±40	
	Granite	Asgr	Muscovite	1586±39	
	Diabase	Hdb	Whole rock	956±16	
	Diorite	Hdr	Whole rock	992±13	
	Diabase	Hdb	Whole rock	995±13	
	Amphibolite	AAab	Hornblende	1497±22	
	Granite	Asgr	Hornblende and biotite	1531±38	Gandhi et al. (1969)
	Amphibolite	AAab	Whole rock	1538±20	
	Tuff	AAtf	Hornblende	1545±14	
	Granite	Asgr	Biotite	1600±34	
	Migmatite	Amg	Biotite	1728±32	
	Gneiss	ALIg	Hornblende and biotite	1832±58	
	Schist	AAtf	Hornblende	1617±48	GSC Paper 74-2
	Basalt		Whole rock	129±6	
14C	Diabase	Ndb	Whole rock	1294±41	GSC Paper 74-2
	Pegmatite	Ppm	Biotite	1140±40	Beall et al. (1963)
	Adamellite	Pam	Biotite	1175±40	GSC Paper 73-2
	Pegmatite	Ppm	Biotite	1240	Barton (1974)
					GSC Paper
14D	Granulite	Agl	Biotite	1375±45	66-17
	Adamellite	Pam	Hornblende	1325	64-17
	Granulite	Agl	Biotite	1265±45	66-17
	Garnet-quartz-feldspar gneiss	Afg	Biotite	1175	61-17
	Adamellite	Pam	Hornblende	1301	74-2

*Revised from 1999 ± 54.

Table 2. (continued)

Map area	Rock type	Map unit	Mineral	Age	Reference
				(Ma)	GSC Paper
14E	Pegmatite	Amg	Biotite	2035	62-17
	Adamellite	**P**am	Biotite	1275	63-17
	Paragneiss	Apg	Biotite	1635±55	64-17
	Garnet-quartz-feldspar gneiss	Afg	Biotite	1340±40	65-17
	Granite gneiss	Agg	Biotite	1550±50	66-17
	Migmatite	Amg	Hornblende	2360±65	67-2A
	Granodiorite	**P**gd	Biotite	1516±58	73-2
				1505±37	
	Adamellite	**P**am	Hornblende	1205±40	74-2
	Diabase	**N**db	Whole rock	1199±40	
	Migmatite	Amg	Hornblende	2606±14	
	Migmatite	Amg	Hornblende	2405±13	
	Basalt	AMV	Whole rock	1181±9	Barton (1975a)
	Basalt	AMV	Whole rock	1491±10	
	Basalt	AMV	Whole rock	1493±10	
	Basalt	AMV	Whole rock	1366±9	
					GSC Paper
14F	Migmatite	Amg	Biotite	2255	63-17
	Amphibolite	Amg	Hornblende	2045	64-17
	Basalt	AMV	Whole rock	948±90	65-17
	Granite	**P**gr	Biotite	1160±40	
	Diabase	**P**db	Whole rock	1420±110	73-2
	Pegmatite	**P**pm	Biotite	1170±40	
	Granodiorite	**P**gd	Biotite	1480±50	Beall et al. (1963)
	Migmatite	Amg	Hornblende	2716±14	Barton (1975a)
	Migmatite	Amg	Hornblende	2513±14	
	Breccia	Ass	Hornblende	1281±9	
	Breccia	Ass	Biotite	1257±9	Barton and Barton (1975)
	Migmatite	Amg	Hornblende	2566±14	
	Migmatite	Amg	Hornblende	2658±14	
					GSC Paper
14L	Migmatite	Amg	Hornblende	2545	64-17
	Granulite	Agl	Biotite	1300±45	
	Granulite	Agl	Biotite	1330±40	65-17
	Amphibolite	Aab	Hornblende	2050±65	
	Anorthosite	Aar	Hornblende	1680±60	69-2A
	Basalt	ARbl	Whole rock	1180±60	
	Diabase	Adb	Whole rock	2425±225	
	Amphibolite	Aab	Hornblende	2546±62	74-2
	Diabase	Adb	Whole rock	4494±82	
					GSC Paper
14M	Migmatite	Agl	Hornblende	2720±80	69-2A
	Diabase	Adb	Whole rock	3176±84	73-2
	Diabase	Adb	Whole rock	3168±86	
	Diabase	Adb	Whole rock	2483±66	74-2
	Diabase	Adb	Whole rock	3777±76	
					GSC Paper
23P	Granite gneiss	Agg	Biotite	1615	61-17
	Mica schist	AKsc	Muscovite	1720	62-17
	Migmatite	Amg	Biotite	1295±45	66-17
	Granodiorite	Agd	Biotite	1595±55	
	Granodiorite	Agd	Biotite	1625±50	71-2
	Amphibolite	Aab	Hornblende	1928±53	
	Amphibolite	Aab	Hornblende	1629±49	This report
	Amphibolite	Aab	Hornblende	2770 (isochron)	
	Diabase	**P**db	Whole rock	1420±43	GSC Paper 74-2

Table 2. (continued)

Map area	Rock type	Map unit	Mineral	Age	Reference
				(Ma)	GSC Paper
24A	Migmatite	Amg	Biotite	1750	61-17
	Granodiorite	Agd	Biotite	1585±52	73-2
	Granodiorite	Pgd	Hornblende	1138±44	
	Amphibolite	Amg	Hornblende	1536±46	74-2
	Amphibolite	Aab	Hornblende	1859±52	
					GSC Paper
24B	Amphibolite	Aab	Biotite	1810±60	64-17
	Amphibolite	Aab	Hornblende	1730	
	Gabbro	Agb	Hornblende	1695±60	69-2A
	Granite gneiss	Agg	Biotite	1820±55	71-2
	Pegmatitic granite	Apm	Muscovite	1670±55	
					GSC Paper
24G	Granite gneiss	Agg	Biotite	1740	64-17
	Granodiorite	Agd	Biotite	1705±50	69-2A
					GSC Paper
24H	Granulite	Agl	Biotite	1220	63-17
	Migmatite	Amg	Biotite	2160±65	67-2
	Amphibolite	Aab	Biotite	1410±43	74-2
	Migmatite	Amg	Biotite	1411±35	
	Migmatite	Amg	Hornblende	1678±50	
	Amphibolite	Aab	Hornblende	1715±50	This report
					GSC Paper
24I	Granite gneiss	Agg	Biotite	1595±50	65-17
	Migmatite	Amg	Biotite	1750±55	66-17
	Diabase	Ndb	Whole rock	1155±100	69-2A
	Granulite	Agl	Hornblende	1605±60	73-2
					GSC Paper
24J	Granite gneiss	Agg	Biotite	1660	63-17
	Granodiorite	Agd	Biotite	1580	
	Diabase	Ndb	Whole rock	1270±115	69-2A
	Diabase	Ndb	Biotite	1240±45	This report
					GSC Paper
24P	Granulite	Agl	Biotite	1590	63-17
	Paragneiss	Apg	Biotite	1695	
	Granite gneiss	Agg	Biotite	1775	
	Diabase	Cdb	Whole rock	524±78	69-2A
	Pegmatite	Apm	Biotite	1530±50	71-2
	Diabase	Adb	Hornblende	1418±52	73-2
	Granulite	Agl	Hornblende	1351±42	74-2
					GSC Paper
25A	Pegmatite	Apm	Biotite	1465±50	69-2A
	Granulite	Agl	Biotite	1685±55	

1978a) and 1346 Ma (Marchand and Crocket, 1974) for two separate plutons. U/Pb analysis of zircons from two other adamellite plutons gave ages of 1290 and 1457 Ma (Krogh and Davis, 1973), suggesting that adamellite intrusion extended over a considerable time interval. As the emplacement of these plutons marks the close of the Elsonian 'event', which divides the Helikian into its two components, it is now possible to assign a lower boundary age to the Paleohelikian, which was not possible when Stockwell (1973) revised the Precambrian time scale. An age of approximately 1275 Ma is suggested for the close of the Elsonian event.

A pegmatitic anorthosite with interstitial granophyre on Paul Island (map area 14C) was dated by Barton (1974) at 1418±25 Ma using the Rb/Sr isochron method, a date he interpreted as the time of the crystallization of the rock, which approximates the age of the Nain anorthosite pluton.

Many K-Ar ages on whole-rock samples of diabase

Table 3. Rb/Sr isochron ages

Map area	Rock type	Map unit	Rb/Sr isochron Age (Ma)	Initial ratio	Reference
13M	Adamellite	Pam	1346±15	0.7014±0.0008	Hurst et al. (1975)
14C	Anorthosite	Par	1418±25	0.7083±0.0003	Barton (1974)
14E	Adamellite	Pam	1246±36	0.7096±0.0013	Taylor (1978a)
14E, F	Basalt	AMV	2369±55	0.7033±0.0002	Barton (1975a)
14F	Breccia	Ass	1842±17	0.7044±0.002	Barton and Barton (1975)
14F	Granite	Amg	2386±30	0.715 ±0.0010	Barton (1974)
14L	Gneiss	Amg	3622±72	0.7014±0.0008	Hurst et al. (1975)
14L	Basalt	ARbl	1892±92	0.7163±0.0012	Morgan (1978)
14L	Granodiorite	Amg	3618±106	0.7044±0.0010	Barton (1975b)
14L	Gneiss	Amg	3121±160	0.7064±0.0012	Hurst et al. (1975)
14L, 24H	Granulite	Agl	2640±159	0.7018±0.0012	Taylor (1978b)
14L, 24H	Granulite	Agl	1865±40	0.7035±0.006	Marchand and Crocket (1974)

and lamprophyre dykes have permitted the assignment of these rocks to various time units where geological control is minimal.

The isotopic ages have confirmed division of the map area into provinces and a subprovince that had been made using field criteria, and have also provided absolute rather than relative age data with respect to various rock units. The establishment of very ancient rocks along the Labrador coast opens up a new and intriguing line of research.

Geophysics

Since completion of Operation Torngat field work, some of the southwest part of the area has been covered by airborne magnetic surveys (map areas 23P/11, 23P/12, 23P/13, 23P/14, 24A/W2 and 24B). Although this information (Geological Survey of Canada, 1974a,b,c) was not used in the compilation of the various map sheets, anomalies present conform for the most part with the geology. For example, in map area 23P, trends in elements of the Knob Lake Group revealed by mapping show clearly on the aeromagnetic maps, and the break between granulite (**Agl**) and paragneiss (**Apg**) along Lac Tudor is clearly marked. However, in some places, notably in the central part of map area 24B, the magnetic maps suggest the existence of unrecognized structural complexities and unseen rock types. Magnetic trends suggest that structures are much more complex than revealed during the geological mapping. Similarly, the geological source of a prominent anomaly 18 km west of Lac Du Parc was not recognized during the field work. Anyone desirous of working in these areas is advised to supplement the geological maps with the magnetic data.

A recent gravity survey that includes map areas 13M, N and O has been correlated with the geology by Thomas (1974), from which the following comments have been taken. In map area 13O Strawberry granodiorite (**Asgr**) in the Bay of Islands area is reflected in a negative anomaly of about 10 mgal, due most probably to a lower bulk density. To the west the Harp Lake anorthosite pluton is indicated by a relatively low Bouguer anomaly. A broad region of positive anomaly extending from the western headwaters of the Notakwanon River to the coast, an area underlain mostly by adamellite with lesser amounts of anorthosite and migmatite, may reflect a large basic body underlying the area. Another gravity high stretches southward from the Hopedale area to beyond Makkovik. In this area of complex geology a source at depth is likely as the bounding flank of the anomaly is normal to the structural grain.

Further gravity studies in the eastern Churchill Province by Thomas (1976) suggest the following:

> The boundary between the Churchill and Nain Provinces lacks the distinctive gravity signature characteristic of the other (province) boundaries. It is suggested that this boundary merely marks the edge of Hudsonian overprinting associated with reactivation of the Churchill craton.
>
> The gravity field of the Churchill Province east of the Labrador Trough is characterized by a series

Table 4. U-Pb isotopic ages

Map area	Rock type	Map unit	$^{207}Pb/^{235}U$ (Ma)	Reference
13M	Adamellite	Pam	1457.6	Krogh Davis (1973)
14C	Adamellite	Pam	1290.5	Krogh Davis (1973)
14E	Granite gneiss	Agg	3330	Hurst (1975)

of coextensive parallel regional anomalies. The anomalies parallel both the Trough and the boundary with the Nain Province. They have wavelengths ranging from about 50 km to 100 km, and are attributed largely to block structure of crustal dimensions. This interpretation of the anomalies supports surface structural data which were an important criterion in repositioning the Churchill-Nain boundary at the former boundary between western and eastern Nain sub-provinces. These regional anomalies and associated crustal blocks terminate southwards near the Grenville Front.

Regional synthesis

The present reconnaissance survey has provided sufficient data to reconstruct, in a preliminary form, the geological record of northeastern Quebec and northern Labrador. No doubt this reconstruction, with new and more detailed investigations, will be extensively modified in the future although hopefully the broad outline will survive. Since completion of the present fieldwork, significant new data, such as the revelation of plus 3 billion year old rocks on the Labrador coast, have already contributed to a better and truer understanding of the geology of this region. The following reconstruction uses data from these recent researches and reports covering areas to the west, in conjuction with information gathered during Operation Torngat.

In the simplest sense northeastern Quebec and northern Labrador consists of two Archean blocks—the Nain Province on the east, the Superior Province on the west—separated by a broad expanse of primarily Aphebian rocks—the Churchill Province. The early geological record is preserved in the two bounding Archean blocks.

In the Nain Province the earliest episode revealed to date is shown by the presence of rocks 3.6 Ga years old at Saglek (Hurst et al., 1975) and at Hebron (Barton, 1975b). These ancient metamorphic rocks are at present of unknown areal extent, but their very existence unfolds hitherto unknown geological parameters. A field description of these rocks at Saglek is given by Bridgwater et al. (1975), and petrological and chemical data for the same rocks are provided by Bridgwater and Collerson (1976). In brief, it appears that a plutonic, metamorphic and possibly tectonic event occurred about 3.6 Ga ago that was followed about 500 Ma later by a remobilization of at least some of the earlier rocks (Hurst et al., 1975).

Although some parts of the Nain Province have existed for over 3.6 Ga, the major recognizable episode that embraces all but the Makkovik Subprovince is the Kenoran Orogeny at approximately 2.6 Ga ago. This left its mark structurally, metamorphically, plutonically and geochronologically. Structures, albeit chaotic over short distances, are overall north trending. Metamorphism, consisting of widespread amphibolite facies and more local granulite facies, is attributed to this orogeny. Retrogression, which is evident in many places, may also be related to this orogeny but could also be related to younger events, such as the Hudsonian Orogeny or relatively recent epeirogeny. Plutonism consists primarily of small granitic intrusions and pegmatites in the migmatite terrane that may be due to anatexis. Small plutons, such as that dated by Barton (1974) at Okak at 2586 Ma, are probably late Kenoran Orogeny, as are larger plutons such as occur on Kikiktaksoak Island. Most of the age data indicate that this orogeny ended about 2500 Ma ago.

The bulk of the strata involved in the Kenoran Orogeny was probably deposited after the 3.1 Ga remobilization as locally relict sedimentary characteristics are preserved, such as at South Tikigakjuk Point and in a few places like Ugjoktok Bay sedimentary structures are well preserved. However, information as to the sedimentary environment extant prior to this orogeny is not forthcoming, although rare carbonate horizons imply relatively shallow conditions. Evidence for the existence of volcanic rocks is sparse, but some amphibolites such as those south of Hunt River are probably derived from extrusive rocks.

Upon termination of this mountain building a swarm of chiefly east-striking diabase dykes was emplaced in the northern part of the Nain Province.

In the Superior Province, to the west of the present map area, the Kenoran Orogeny took place concomitantly with that in the Nain Province. There, structures, unlike those in the Nain Province, are dominantly east trending to the west of the Labrador Trough (Eade, 1966; Stevenson, 1968). However, structures on a large scale are typically chaotic. Metamorphism is mainly in the amphibolite facies with granulite less abundant but quantitatively important. Plutonic rocks, chiefly granodiorite and granite, are more common in the Superior than in the Nain Province and are apparently syntectonic. Age information is similar to that encountered in most of the Nain Province, with K-Ar ages in the order of 2500 to 2600 Ma (Wanless, 1970).

Thus by the end of the Archean both flanks of the present region had undergone mountain building at the same time and were undergoing erosion. Except that no extensive emplacement of posttectonic diabase dykes occurred in the Superior Province, the history of these flanking areas was similar. Whether the greater than 3 Ga events took place in the Superior Province or not is at present unknown as this area has not, to date, received the same attention as the Labrador coast.

There is some question as to whether the area between the Nain and Superior provinces is presently the locus of Archean rocks. The evidence for older rocks in this area is slight and of limited areal extent. Dimroth (1972) and Dimroth et al. (1970) are of the opinion the granitic gneisses east of the Labrador Trough are Archean rather than metamorphosed equivalents of Labrador Trough strata, as shown on the maps 1428A to 1444A. Examination during the present survey of an area near the Wheeler River, in the eastern part of map area 24B/5 cited by Dimroth (1964) as a place where granitic rocks formed basement to the Kaniapiskau Supergroup, showed the granitic rocks to be intrusive and hence younger.

Geochronological evidence to date consists solely of a K-Ar isochron of 2770 Ma on hornblende from a garnetiferous emphibolite that outcrops in a swamp in map area

23P. Two other nearby samples, also from amphibolite, gave K-Ar hornblende ages of 1629±29 and 1928±53 Ma. These are in agreement with the vast majority of ages from east of the Labrador Trough so that the reliability of the 2770 age is in question. No other Archean ages are present in the map area, the oldest being 2160 Ma (biotite) from a migmatite in map area 24H.

Certainly the Aphebian rocks of the Churchill Province were deposited on Archean rocks but whether these now reach the surface is doubtful. If they do, they have been remobilized so as to be unrecognizable and geologic clocks reset to the Aphebian so that they are truly Aphebian, as much as any sediment derived from Archean rocks and deposited during the Aphebian is truly Aphebian.

Extensive isotopic dating and detailed mapping is required to resolve this issue.

Erosion and uplift occurred at the end of the Archean. Uplift was sufficient to expose through erosion rocks that had been subjected to amphibolite and granulite metamorphism, that is in the order of 15 km. Erosion reduced the Archean rocks to a peneplain, which in the Nain Province is preserved beneath the Ramah and Mugford groups. The same surface beneath the Aillik Group has been obscured by orogenesis and that beneath the Snyder Group by later intrusion. A lengthy period of subaerial erosion is indicated. A regolith, up to 15 m thick, is present beneath the Ramah Group (Morgan, 1975) and up to 3 m thick beneath the Mugford Group (Smyth, 1975). Morgan (1975) notes that a replacement dolomite is locally associated with the regolith. In part this regolith is kaolin-rich, suggesting a warm, moist climate.

Similarly, in the Superior Province this major erosion surface is preserved beneath the basal element of the Kaniapiskau Supergroup (Baragar, 1967).

The early Aphebian was a time of widespread deposition with respect to the area of Operation Torngat. In the Nain Province evidence consists of the Ramah, Mugford, Snyder and Aillik groups, whereas in the Churchill Province it consists of the Kaniapiskau Supergroup, the Lake Harbour Formation, granulite (**Agl**), garnet-quartz-feldspar gneiss (**Afg**) and undifferentiated metasedimentary rocks scattered throughout the terrane east of the Labrador Trough. The present limited lateral extent of the Ramah and Mugford groups is probably a remnant of a much more extensive terrane. The two groups are most probably correlative and in early Aphebian time may have been connected. Similarly, the Snyder Group, which was deposited prior to 1842 Ma (Barton and Barton, 1975) is considered to have been laid down during this time and is probably correlative with the Mugford and Ramah sedimentary rocks. The entire Nain Province Archean may well have been covered by Aphebian strata.

The Aillik Group, which consists primarily of tuffaceous strata, although considered to be early Aphebian, is presently so geographically remote from the other rock units in the Nain Province that a direct correlation at this time is rather speculative.

In the Churchill Province, to the west of the present map area, Kaniapiskau Supergroup rocks were laid down unconformably on the peneplained surface of the Archean rocks of the Superior Province. This mixed sequence, which extends into the map area, is deemed to have extended much farther east so as to embrace the Lake Harbour Formation and scattered paragneiss that is present throughout the migmatite and granitic gneiss terrane east of the Labrador Trough. The predecessors of the extremely well layered granulite (**Agl**) and garnet-quartz-feldspar gneiss (**Afg**) to its east are also regarded as having been deposited at the same time, so that the depositional basin extended well beyond the present conventional limits of the Labrador Trough. Many years ago Christie (1952) suggested that the Ramah Group was correlative with the Kaniapiskau Supergroup, a concept with which the writer agrees, so that early Aphebian sedimentation extended to the Labrador coast and beyond. Jackson and Taylor (1972) used the term Baffin geosyncline for this early Aphebian depositional area, which is here extended eastward and southward from the area as originally defined by them. Of course a large part of these strata has been lost through erosion or has been incorporated in the migmatite terrane.

The extent of the depression of the region in early Aphebian time can be measured by the thickness of the superincumbent strata. In the northern part of the Nain Province, the Ramah and Mugford groups each measure about 1600 m of layered rocks, but the south depression may have been much more as 7600 m of layered rocks of the Aillik Group (Gandhi et al., 1969) attest to great burial following erosion to peneplain status. In the west at least 7500 m of sedimentary and volcanic rocks are present in the Labrador Trough (Baragar, 1967) showing great depression of the underlying rocks in that area also.

The region embraced by the Baffin geosyncline was subjected to mountain building during the Aphebian—the Hudsonian Orogeny. This major orogeny, which left its mark through structural, metamorphic, plutonic and geochronological effects, was pervasive and intense. Structures are generally parallel with the unconformity on the west and trend north to northwesterly. Although data are limited, they suggest only one period of deformation. In the layered rocks in the west, east-dipping thrust faults are typical. Metamorphism in the Churchill Province shows a general increase in grade from the Superior Province, where rocks are unmetamorphosed at the unconformity, to granulite facies near the Nain Province boundary. Plutonism consists dominantly of syntectonic granodiorite batholiths in the amphibolite zone of metamorphism. Age data average 1604 Ma, whereas ages from the intrusive granitic rocks average 1621 Ma.

However, the effects of the Hudsonian Orogeny extend beyond the boundary of the Churchill Province. The Aphebian rocks lying within the Archean terrane to the east and the adjacent Archean rocks were also involved in this orogeny. Evidence of this involvement has been accumulated for the Ramah Group (Morgan, 1975) and the Aillik Group (Gandhi et al., 1969) consisting of structural, metamorphic, plutonic and geochronologic data. Although the other map units, the Snyder and Mugford groups, are not as clearly involved, present data can be so interpreted, particularly for the Mugford Group, although the effects are much less than in the Ramah. Although most of the Archean escaped deformation, parts may have been sufficiently heated to affect the rocks metamorphically and geochronologically. For example, widespread chloritization in the Archean migmatite (Amg) may have occurred at this time. Similarly, retrogression of some Archean granulites may also be attributed to this event.

Structures in the Aphebian rocks in the Nain Province trend northerly, but probably the most significant are west-dipping thrust faults that are present in the Ramah Group and its basement rocks. Metamorphism in these rocks ranges from very low grade or greenschist in the Mugford Group to amphibolite in parts of the Ramah Group. Plutonism is almost wholly confined to the Makkovik Subprovince.

By the end of the Hudsonian Orogeny a crude symmetry existed. This is made apparent by two bounding Archean blocks, west-dipping thrust faults in the east and east-dipping thrusts in the west, and if the Makkovik Subprovince is excluded, a zonation in the regional metamorphism with greenschist on each flank (the Kaniapiskau Supergroup in the west and the Mugford Group in the east) with an off-centre core area of granulite. The plutonic rocks, however, do not show this balance being confined chiefly to west of the granulite core.

The development of the mylonitic texture in the garnet-quartz-feldspar gneiss (**Afg**) probably occurred at the end of the Hudsonian Orogeny as its formation predates the intrusion of the anorthosite-adamellite suite and postdates garnet crystallization. Movement in the mylonite zone is probably chiefly horizontal, as indicated by the lineation, suggesting strike slip displacement. A major fault probably is present offshore parallel to the coast and extending through Frobisher Bay. The present mylonite zone and this offshore fault are essentially parallel and may be contemporaneous.

The width of this orogenic belt is in the order of 450 km, which can be compared with the Cordillera's 700 km extent. The seaward extent of this is unknown but may add another 75 km to its width.

The Hudsonian Orogeny was followed by a period of quiescence and erosion throughout the entire area. This tectonically tranquil period was broken by the high level emplacement of the anorthosite-adamellite suite during the Paleohelikian. The emplacement of these huge plutons, the anorthosite followed by the adamellite, was not accompanied by folding, regional metamorphism and other conventional orogenic characteristics. As several plutons lie along or close to the boundary between the Nain and Churchill structural provinces, this zone may have been a weak point in the crust at that time. The adamellite intrusions came to the surface at one point (the Flowers River pluton) and others may have also, attesting to their high level emplacement. The emplacement of these rocks probably provided sufficient heat to reset many of the geochronologic clocks in granulite (**Agl**) and garnet-feldspar gneiss (**Afg**), hence reducing K-Ar ages from those set during the Hudsonian Orogeny to ages in the general vicinity of the intrusions that average 1355 Ma. Erosion probably was continuous throughout the region during most of the Paleohelikian and into the Neohelikian, unroofing vast areas of anorthosite and adamellite.

The east striking post-Paleohelikian faults may have been active shortly after the plutonism, but a more recent date is more probable.

Although evidence is sparse, the Neohelikian saw erosion sufficiently advanced in the region, at least in the south, where continental sedimentation occurred as shown by the presence of Seal Group sediments in map area 13M, albeit probably on the northern flank of the main depositional site to the south in the Seal Lake area. Volcanism is also represented at one place in map area 13N—another outlier from the main depositional site.

Elsewhere in the region, notably in the northwest and southeast, intrusion of many diabase dykes took place, reflecting tensional forces active at this time.

Continental sedimentation was continued or repeated in the Hadrynian, which saw the deposition of the Siamarnekh Formation nonconformably on unroofed adamellite. Once again numerous diabase dykes, lamprophyre and diorite were intruded, this time in the Makkovik Subprovince, bringing to a close the Precambrian history.

The record during the Paleozoic era is far from complete. The Cambrian is represented solely by a few easterly striking diabase dykes in the northern part of the region. Relatively shortly afterward the sea once again covered parts of the region. How extensive this inundation was is not known with certainty. Lower Paleozoic fossiliferous limestone boulders along the northern and eastern coast are too scarce to suggest a total cover of the area. However, Gold's discovery of Paleozoic detritus around Lac La Moinerie, a probable meteorite impact crater, in the west-central part of the region suggests widespread Paleozoic carbonate sedimentation. If this is the case, erosion has effectively removed this cover.

Igneous activity is confined to a Devonian lamprophyre dyke on the southeast coast.

Andesite ejecta and associated dykes at the Mistastin meteorite impact structure are the prime Mesozoic rocks present. Of little areal extent in an assessment of the region as a whole, they show that the present surface rocks were probably exposed at the time of impact.

The existence of a tiny exposure of Mesozoic strata near Makkovik confirms marine deposition along the present coast. A postdepositional diatreme may be associated with these sedimentary rocks along with another in the Archean near Hopedale.

The development of mountainous terrain, particularly the Torngat and Kaumajet mountains with local relief in excess of 1500 m, is probably geologically a very recent event. Certainly some of the uplift postdates the glacial epoch as raised beaches up to 140 m high occur along the coast in some places. However, as mountain tops appear to be unglaciated, the major uplift undoubtedly took place prior to glaciation.

Uplift throughout the region differed from place to place and was at its maximum along the northeastern coast, becoming less significant to the south, west and southwest.

Presumably this uplift occurred following the Mesozoic, although no firm dating is possible at the present. Cooke (1929) concluded that peneplanation was a Pliocene event, and valley development was contemporaneous.

Economic geology

No economic mineral occurrences are known in the map area, but to date a thorough prospecting has not been undertaken in part due to the area's remoteness. The presence of large areas of gneissic, migmatitic and granitic rocks, unquestionably poor prospecting ground, and the absence of regional maps, has also discouraged the mine seeker.

Most of the known mineral showings are in the layered Aphebian rocks, and certainly these offer the best hope for commercial discoveries.

The present survey did not disclose any significant mineralization in the Archean rocks of the Nain Province, but more detailed examination by Morgan (1975) in the region of the Ramah Group revealed several small sulphide showings. The most outstanding is a 15 cm thick vein of galena on the north shore of Ramah Bay (lat. 58°54′48″N, long. 63°11′00″W). The lead mineralization penetrates the migmatite country rock up to 2.5 cm. Small amounts of chalcopyrite, sphalerite and pyrrhotite also are present in the vein. Morgan also reported small amounts of disseminated chalcopyrite in fault zones and basic gneiss bands. Lean, silicate oxide iron formation, mainly in 6 to 9 m thick bands, is present, associated with basic gneiss and paragneiss in the same area.

The remainder of the Archean terrane is not known to contain any appreciable mineralization. A few grains of chalcopyrite are present in many of the mafic portions of the migmatites, and ultrabasic rocks locally contain rare veinlets of hard, cross-fibre asbestos and magnetite. Douglas (1953) noted molybdenite and chalcopyrite on Kikkertarjote Island in the Nutak area in quartz veins or lenticles in migmatite.

The Aphebian layered rocks, as previously mentioned, contain most of the known showings. In the west the Kaniapiskau Supergroup and Montagnais Group are the site of minor sphalerite, chalcopyrite and chalcocite mineralization (Dimroth, 1964, 1967). Mineralization occurs in calcite veins, breccias and finely disseminated in many of the layered rocks, both volcanic and sedimentary. Dimroth notes the following favourable zones: breccia zones; near breccia zones at or near faults and shear zones connected with the main folding; and all upper stratigraphic contacts of basalts.

The gabbro intrusive rocks locally contain minor amounts of disseminated chalcopyrite. The presence of chalcopyrite in gabbros in the Labrador Trough sequence to the north (west of Fort Chimo) suggests these rocks may be worth careful examination. Although chrysolite asbestos showings occur in the Wilbob Lake map area (23O), Fahrig (1964) did not locate any in the large ultrabasic sills in the Griffis Lake map area. Fahrig also suggests that nickel and cobalt bloom, present in some of the ultrabasic sills, is derived from silicates rather than sulphide minerals. Extensive drift, particularly in the valleys in the area underlain by the Labrador Trough rocks, makes for expensive and difficult prospecting, but this part of the map area offers good possibilities for reward.

The rusty graphitic gneiss of the Lake Harbour Formation locally contains small, massive pyrite or pyrrhotite lenses. Although copper stain is present in some of these, assays of picked material returned only trace amounts of copper and zinc. The virtually ubiquitous rusty weathered surface of this member makes the search for sulphide concentrations difficult. About 15 km east-southeast of the mouth of the Korok River, minor amounts of chalcopyrite occur in a garnet-biotite-quartz-feldspar paragneiss horizon in rusty graphitic gneiss. Also present is a fine grained, grey, feldspar-biotite-quartz-amphibole gneiss that contains up to 50 per cent magnetite. Many gneisses are present in the immediate area. Although no economic minerals have been located in the crystalline limestones, the similarities between this member of the Lake Harbour Formation and host rocks of known stratiform lead-zinc deposits makes this member deserving of the prospector's attention.

Morgan (1975), after extensive examination of the Ramah Group, reported no mineral occurrences of economic importance within it. He located minor, thin veins of carbonate and quartz containing disseminated galena with minor sphalerite and chalcopyrite in the dolomite approximately 4.8 km south-southeast of Little Ramah Bay. A reexamination by Morgan of parts of a massive pyrite-pyrrhotite bed previously described by Coleman (1921) and Douglas (1953) failed to disclose more than traces of chalcopyrite. This bed, which is locally up to 2 m thick, assayed 0.1 per cent copper 3.5 km west of Bears Gut. Further examination of this bed and nearby rocks is warranted.

Neither the Mugford or Snyder groups are known to host any quantity of minerals of economic importance. The small areal extent of these two groups, particularly the Snyder, is not economically encouraging. Douglas (1953) mentioned rare galena at Green Cove in chert beds and chalcopyrite in the Anchorstock Harbour area.

The Aphebian rock unit most intensely prospected is the Aillik Group. British Newfoundland Exploration Limited have conducted extensive geological and geophysical surveys, particularly in the Makkovik area for many years. Some of the results of this work are incorporated in Gandhi et al. (1969) to which the reader is referred. A great variety of mineralization is known, including fluorite, chalcopyrite, galena and sphalerite, but uranium minerals and molybdenite are the most widespread and offer the best hope for development. Descriptions of the uranium showings are given in Beavan (1958) and of the molybdenite in Douglas (1953), King (1963) and Gill (1968).

The Aphebian gneissic rocks, although locally sites of small gossans, do not offer much encouragement to the prospector. Graphite has been reported from several places along the upper reaches of Nachvak Fiord, but it is doubtful if any event approaches commercial interest (Daly, 1902; Coleman, 1921; Christie, 1952; MacLean, 1957). The ultrabasic rocks within the gneissic terrane commonly show minor pyrrhotite mineralization. The most highly developed mineralization encountered was in a boulder of massive pyrrhotite found on the west side of the largest ultrabasic pluton in map area 24H. Although obtained from a loose block, this mineralized sample is undoubtedly of local origin. A spectrographic analysis shows the following results in percentages: Ni=0.30, Cu=0.20, Co=0.050, Ag=<0.00070, Au and Pt not found. Although this analysis is not ore grade, a thorough examination of this area, where there are several ultrabasic bodies, may be worthwhile. Some ultrabasic plutons contain small amounts of harsh chrysotile, but none are deemed to have economic potential.

The Paleohelikian anorthosite-adamellite suite locally contains a few economic minerals. Sparsely disseminated fluorite is present in many places in the adamellite, but only southwest of Hunt River is there any concentration of this mineral (see p. 00 for description). Chromite forms layers in the Kiglapait intrusion (Morse, 1961), but none are of economic importance at the present time. This particular phase of the anorthosite intrusive suite is probably worth examining for platinum. The anorthosite itself locally contains tiny amounts of ilmenite and magnetite, but nowhere were any sizable veins or masses discovered. Emslie (1974) reported that Kennco Explorations have located several showings of disseminated chalcopyrite and pyrrhotite in the Harp Lake pluton; these he considers syngenetic as some of the showings can be related to layered structures. Although these showings are outside the present map area, as Emslie notes "the widespread presence of chalcopyrite and pyrrhotite within the complex suggests that careful exploration of some large anorthositic masses may prove to be rewarding." Douglas (1953) reported a molybdenite occurrence within the Nain pluton in thin lenticles in gabbro and in small pegmatite or aplite dykes on Aulatsivik Island. He noted that in places the mineralization is entirely in the gabbro, but invariably close to a granitic dyke, which is undoubtedly related to the adamellite (**P**am). Somewhat similar occurrences were located by Christie (1952) on the south side of Okak Bay where molybdenite is present in a pegmatite close to adamellite and in an aplite dyke in granite in Opingiviksoak Island. The granite at latter occurrence may be part of the adamellite suite. These occurrences are of no commercial value but do suggest that the adamellite is a suitable environment for molybdenite mineralization.

For many years a small quarry was operated intermittently on Tabor Island, 20 km southeast of Nain. This quarry, sometimes referred to as the Grenfell Quarry, was the site of gem quality labradorite, which occurred in the Nain anorthosite in a coarse grained to pegmatitic lens, approximately 25 m long. All the best quality material has been removed, and as of 1978 no other gem quality labradorite had been located.

In summary, it is suggested that future prospecting in the area be directed toward the Labrador Trough rocks, the Lake Harbour Formation and the anorthosite-adamellite suite. As it is unlikely that any sizable surface deposits have not already been found, future work will have to embrace all the ingenuity of modern prospecting and sophisticated techniques that it entails.

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