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MINES AND RESOURCES

BULLETIN 191

PRECAMBRIAN GEOLOGY NORTHWESTERN BAFFIN ISLAND, DISTRICT OF FRANKLIN

R. G. Blackadar

Ottawa
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1970

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By

R. G. Blackadar

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BULLETIN 191 — Präkambrische Geologie des nordwestlichen Baffinlandes, im Franklin-Distrikt

Von R. G. Blackadar

Ein frühproterozoischer Gneiskomplex ist durch eine dicke Schichtfolge von beinahe flachgelagertem vulkanischem Gestein und von spätproterozoischen fossillosen klastischen und karbonatischen Schichten überlagert.

БЮЛЛЕТЕНЬ 191 — Геология докембрия северозападной Баффиновой Земли, район Франклина

Р. Г. Блэкадар

Гнейсовый комплекс ранне-протерозойского возраста покрыт мощной серией почти-что горизонтальных вулканических пород и немыми обломочными и карбонатными слоями поздне-протерозойского возраста

PREFACE

This report describes the stratigraphy and structural geology of the Precambrian rocks of northwestern Baffin Island west of longitude 80 degrees. Granitic and gneissic rocks of Aphebian age are overlain by a thick succession of Helikian volcanic and sedimentary strata, which in the central part of the area has been intruded by a swarm of anastomosing, northwest-trending gabbro dykes.

Lead-zinc mineralization occurs in one of the carbonate formations a few miles east of Arctic Bay. This was examined by the Geological Survey in 1954 and later staked by a major mining corporation who have carried out extensive development work. The possibility that similar deposits exist has resulted in exploration by other companies in different parts of the region in recent years. The area examined is west of an extensive magnetite-hematite deposit currently being explored at Mary River and it is possible that within the map-area similar deposits may occur beneath a cover of Paleozoic or Late Proterozoic rocks.

Y.O. Fortier,
Director, Geological Survey of Canada

Ottawa,
December 16, 1968

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PRECAMBRIAN GEOLOGY NORTHWESTERN BAFFIN ISLAND, DISTRICT OF FRANKLIN

ABSTRACT

Exploration in northern Baffin Island early in this century disclosed a thick succession of nearly flat lying volcanic rocks and unfossiliferous clastic and carbonate strata overlying a gneissic complex. Gold, silver, platinum, lead, and zinc were reported.

Reconnaissance studies by R.G. Blackadar and R.R.H. Lemon in 1954 established the stratigraphic succession for these rocks and for the overlying Paleozoic strata, and extended their known outcrop pattern some distance inland from the coasts of Admiralty Inlet and its tributaries.

During an aircraft-supported geological reconnaissance in 1963, the Precambrian formations of northwestern Baffin Island were mapped in some detail. The gneissic complex is made up mainly of leucocratic, granitic textured gneisses of Aphebian age. This complex is overlain by a thick Helikian succession comprising the Eqalulik and Uluksan Groups and possible equivalents along the shores of Fury and Hecla Strait. The Eqalulik Group consists of a volcanic succession and a quartzite sequence; the Uluksan Group, at least 23,000 feet thick, is composed of seven formations that include calcareous shale, dolomite, limestone, mudstone, siltstone, and sandstone.

All Precambrian rocks are intruded by gabbro dykes, which occur in swarms that most commonly trend northwest with some trending north-northwest.

RÉSUMÉ

L'exploration du nord de l'île Baffin, au début du siècle, avait révélé une épaisse succession presque horizontale de roches volcaniques et de sédiments clastiques et carbonatés non fossilifères sus-jacents à un complexe gneissique. On y avait trouvé de l'or, de l'argent, du platine, du plomb et du zinc.

À la suite d'études sur le terrain en 1954, MM. R.G. Blackadar et R.R.H. Lemon ont établi l'ordre stratigraphique de ces roches et des sédiments paléozoïques qui les recouvrent, poursuivant l'identification de leurs affleurements à quelque distance à l'intérieur des terres à partir de l'inlet de l'Amirauté et des baies attenantes.

En 1963, des levés aériens de reconnaissance géologique ont permis de dresser des cartes assez détaillées des formations précambriennes du nord-ouest de l'île Baffin. Le complexe gneissique renferme surtout des gneiss leucocrates et granitiques de l'époque aphébienne. Ce complexe géologique repose sous une épaisse succession hélikienne qui comporte les groupes d'Eqalulik et d'Uluksan et peut-être

leurs équivalents sur les rives du détroit de Fury et Hecla. Le groupe d'Eqalulik est composé d'une succession volcanique et d'une séquence de quartzite; le groupe d'Uluksan, d'une puissance d'au moins 23,000 peids et composé de sept formations, comprend des schistes calcareux, de la dolomite, du calcaire, et des grès.

Toutes les roches précambriennes renferment des dykes intrusifs de gabbro qui se présentent en essaims, généralement orientés vers le nord-ouest mais parfois vers le nord-nord-ouest.

INTRODUCTION

In 1963 the Geological Survey of Canada undertook the geological reconnaissance of northwestern Baffin Island and preliminary results of this study were published by Blackadar (1965) and Trettin (1965). Neither of these preliminary reports was accompanied by a complete geological map because the new National Topographic Series of 1:250,000 maps covering northern Baffin Island were not available at the time. The new, contoured base maps, have since become available and eight geological maps have been published on a scale of 1 inch to 4 miles. These maps, covering both the Precambrian and Paleozoic geology of northwestern Baffin Island are issued separately and each is accompanied by marginal notes and thus any map can be used independently of the others and of the two final reports, G.S.C. Bulletin 157 by H.P. Trettin and this report. However, the maps and reports are designed to be used in conjunction, the one with the other.

The geological maps are the following: Milne Inlet (1235A), Navy Board Inlet (1236A), Arctic Bay-Cape Clarence (1237A), Moffet Inlet-Fitzgerald Bay (1238A), Phillips Creek (1239A), Agu Bay-Easter Cape (1240A), Berlinguet Inlet-Bourassa Bay (1241A) and Erichsen Lake (1242A).

LOCATION AND ACCESSIBILITY

Baffin Island, the largest of the Canadian Arctic Islands and one of the largest islands in the world, extends from slightly south of latitude 62° N to just south of latitude 74° N, and has an area of about 183,800 square miles, but if Bylot Island and other nearby off-shore islands are included, the area exceeds 190,000 square miles. This report is concerned with that part of the island lying west of longitude 80° W or about 50,000 square miles.

Arctic Bay, a small trading and administrative centre situated on a partly enclosed bay on the north shore of Adams Sound, is the only settlement within this vast area. A small Hudson's Bay Company store, a school, various other government facilities, and several Eskimo families comprise the settlement. Eskimo camps are found along the shores of Admiralty Inlet and Navy Board Inlet but the Prince Regent Inlet coast of Baffin Island is rarely visited. A camp on Bernier Bay has not been occupied in recent years. The

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Iglulingmiut, the people of Igloolik, hunt and camp along Fury and Hecla Strait and semipermanent camps are located at Agu Bay.

Northwestern Baffin Island is most readily reached by air. At present (1967) a commercial air service is operated from Montreal to Hall Beach and Resolute on a not less than weekly schedule. During the summer months light aircraft are available for charter at Resolute. An increasing interest in the mineral potential of northern Baffin Island (the most outstanding examples are the Texas Gulf Sulphur Company property east of Arctic Bay and Baffinland Iron Mines deposit at Mary River just east of the area discussed in this report) will undoubtedly alter the transportation picture in the future.

Heavy cargo is sent by sea. The open water season, which normally extends from about late July to October, can be lengthened considerably by icebreaker support. Little trouble is experienced in reaching northern Baffin Island ports but the shallow waters of Foxe Basin render access to northern Baffin Island from Hudson Strait difficult and hazardous. Few ships have navigated Fury and Hecla Strait and to date only icebreakers have circumnavigated Baffin Island.

HISTORY OF DISCOVERY

Although northern Baffin Island may well have been sighted by Norse explorers from Greenland and was known to Bylot and Baffin from their explorations of 1616 which took them to the head of Baffin Bay, there was little active exploration until early in the present century. Prior to that period, however, the broad outlines of northern Baffin Island have been delineated through the explorations of British Naval expeditions.

As is well known, a new era in the exploration of North American polar regions was initiated by the voyage of Sir John Ross in 1818 in search of the Northwest Passage. Ross entered Lancaster Sound but failed to penetrate it claiming that a range of mountains, extending north from the vicinity of Somerset Island, blocked the passage. His second-in-command, W. E. Parry, disagreed vehemently with this interpretation and was dispatched by the British Admiralty the following year to prove or disprove the existence of a passage west of Lancaster Sound. It was during Parry's first voyage, 1819-1820, that Navy Board Inlet, Prince Regent Inlet and Admiralty Inlet, three great geographical features of northern Baffin Island, were first reported. The principal effort of this expedition, however, was concentrated to the west on Melville Island where the party wintered.

The years 1821-1823 found Parry again searching for the Northwest Passage, this time north of Hudson Bay in the waters first seen by Foxe in 1631. It was during this voyage that the southern limits of the area studied by the writer were delineated. Parry's first winter was spent near Lyon Inlet, southern Melville Peninsula, but by mid-July in 1822, H. M. S. 'Fury' and H. M. S. 'Hecla' arrived off Igloolik Island. During the preceding winter Parry had obtained rather accurate sketch maps from several Eskimo, and he was therefore gratified but not unduly surprised when he found a passage opening to the west, a passage named to honour his ships. Heavy ice prevented a traverse of the strait by the ships but several parties explored both coasts, one reaching Autridge Bay on the Baffin coast. The ships wintered at Igloolik where traces of their stay are still to be seen and exploratory parties were again sent out in the spring of 1823. The straits remained choked with ice all summer and because scurvy had made its appearance amongst his crew Parry reluctantly ordered a return to England.

Port Bowen, western Brodeur Peninsula, was the site of Parry's winter quarters during his third voyage, 1824-1825. The coast was explored between Fitzgerald Bay and Cape York and an unsuccessful overland attempt was made to reach Admiralty Inlet.

Despite these explorations the true form of northern Baffin Island remained uncertain, and mid-nineteenth century maps show postulated channels thought to divide the land mass into several large islands. Indeed this uncertainty persisted well into the present century. A geological map accompanying a report by A. P. Low (1906) terminates Admiralty Inlet at Yeoman Island whereas the map accompanying a report by Bernier (1911) portrays a northeast-trending inlet extending from Cape Kater towards a truncated Admiralty Inlet.

One result of the explorations carried out under the auspices of the British Admiralty was the development of an extensive whale fishery in and about the waters of Lancaster Sound. That this must quickly have followed the initial exploration is shown by the rescue of Sir John Ross in 1833 by a whaler off the north coast of Bylot Island. Ross had abandoned his ship in 1832 on the east coast of Boothia Peninsula and by sled and small boat he and his crew had retreated northward and were successful in making contact with whalers. In northern Baffin Island Scottish whalers predominated in contrast to Hudson Bay where Americans dominated the industry which flourished until early in this century. Undoubtedly additions were made to geographic knowledge by the captains of the whaling ships, but for the most part any new information appears to have been considered as a valuable business secret and was concealed. It is known however that the whalers penetrated Admiralty Inlet, naming some of the deep bays on its east coast. Captain Adams in 1872 gave his name to a sound and that of his ship to a bay, now the site of the settlement of Arctic Bay. The continuity of Navy Board Inlet with Eclipse Sound was proven by whalers, and it is likely that the south coast of Eclipse Sound including Milne Inlet was thoroughly explored by them.

Canada in 1903 initiated voyages designed to render effective sovereignty over the Arctic territories ceded in 1880 by Great Britain. The need for this had become apparent following the explorations of Peary and Sverdrup in what are now known as the Queen Elizabeth Islands. Effective occupancy and not mere claims resting on prior discovery might be needed if Canada was to retain control of these vast lands. This was the impetus that led among other things to the varied scientific programs now being carried out throughout the north.

The first of these voyages, commanded by A. P. Low (1906) did not land within the confines of area considered in this report and it was left to Bernier, who commanded many Arctic expeditions in the early decades of this century, to initiate scientific exploration within northwestern Baffin Island. During his voyage of 1906 Bernier penetrated Admiralty Inlet to the narrows at Shimik that lead into Berlinguet Inlet, and in 1909 he traversed Navy Board Inlet. During the winter 1910-1911 Bernier wintered his ship 'Arctic' at Arctic Bay and extensive exploration was carried out. In October 1910 one party traversed Admiralty Inlet to Bell Bay, and thence by way of Saputing Lake to Agu Bay and west to about Cape Landry. Others examined Adams and Strathcona sounds, and in December a trip was made to Pond Inlet following the coasts of Admiralty Inlet, Lancaster Sound, and Navy Board Inlet. Spring trips in 1911 included a crossing of Brodeur Peninsula from Saint Patricks Canyon to Port Bowen, south along the east coast of Prince Regent Inlet to the western entrance of Fury and Hecla Strait, and thence north to the ship by way of Saputing Lake, Admiralty Inlet, and Moffet Inlet. The south coast of Eclipse Sound including Milne Inlet was examined by steam launch in August 1911.

A. Tremblay, a member of a private prospecting and trading expedition to Pond Inlet in 1912 led by Captain Bernier, made a remarkable trip through northern Baffin Island (Tremblay, 1921). He travelled from Arctic Bay to Igloolik by way of Gifford River, and thence to Pond Inlet by way of Murray Maxwell Bay and Milne Inlet. Unfortunately Tremblay lacked adequate maps and much of the information in his reports cannot be placed with any accuracy on existing maps.

From a base at Winter Harbour about 250 miles south of Fury and Hecla Strait, members of the Fifth Thule Expedition carried out geological and geographical studies in northwestern Baffin Island between 1922 and 1924. In the early spring of 1922 P. Freuchen sledged from Igloolik, then only an Eskimo camp, to Agu Bay; in April of the same year T. Mathiassen made a journey up Gifford River to Bell Bay and thence north along the east coast of Admiralty Inlet to a valley north of Eqalulik River. He crossed Admiralty Inlet to Giants Castle and returned to Igloolik along the west shores of the Inlet and Gifford River.

In 1923 Mathiassen travelled overland from Igloolik to Pond Inlet by way of Murray Maxwell Bay, Steensby Inlet, Inuktorfik Lake, Phillips Creek and Milne Inlet. Freuchen followed a similar route in March 1924 although he crossed Neergaard and Erichsen Lakes rather than Steensby Inlet. From Pond Inlet he travelled to Cape York, the northern point of Brodeur Peninsula, following the coast of Navy Board Inlet to Lancaster Sound. Violent gales swept the ice out of Lancaster Sound and Freuchen was forced to return overland to Eclipse Sound and Pond Inlet. He proceeded south along the east coast of Admiralty Inlet to Eqalulik River, thus tying together his and Mathiassen's mapping, and thence to Moffet Inlet. On May 29, together with a teenage Eskimo, Mala[1], he set off from the head of Fabricius Fiord and reached Koluktoo Bay on June 12.

These journeys added considerably to geographical and geological knowledge of northwest Baffin Island. No further major geographical information was added to the knowledge of northern Baffin Island until after World War II when trimetrogon photography allowed the preparation of adequate maps. With the completion of vertical photo coverage early in this decade, refined, contoured topographical maps are now available for all parts of the area on a scale of 1:250,000.

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[1] In honour of this man and at the suggestion of members of Operation Admiralty, the Canadian Permanent Committee on Geographic Names has designated the large river that drains eastward to Navy Board Inlet just south of latitude 73° N, Mala River.

PREVIOUS GEOLOGICAL INVESTIGATION

Science played an increasingly important role as the nineteenth century progressed and observations on natural history usually form extensive appendices to the reports of arctic explorations. Parry (1824) reported the widespread occurrence of flat-lying limestone around the shores of northern Foxe Basin, the presence of sandstone (quartzite), shale, and gabbro along Fury and Hecla Strait, and the wide distribution of granitic rocks on Baffin Island northeast of Fury and Hecla Strait. Dr. Neill (in Parry, 1826), in his discussion of the geological character of the coasts visited by Parry in 1824-1825, noted the flat-lying, stratified carbonate rocks around Port Bowen, Brodeur Peninsula.

The Dominion Government Expedition of 1910-1911, under Captain Bernier, was accompanied by a prospector, A. English, who reported the presence of copper, iron, nickel, platinum, silver, antimony, gold, and lead, mainly from the vicinity of Strathcona and Adams Sounds (Bernier, 1911, pp. 147-153). He also commented on the "sandstone cliffs that tower above dark, close-grained rocks" along the shores of Adams Sound.

Mathiassen (1933) noted numerous outcrops of nonfossiliferous red sandstone as well as the presence of basaltic and amygdaloidal rocks along the east coast of Admiralty Inlet and the existence of nonfossiliferous strata as well as granitic rocks at Milne Inlet. The geological results of the Fifth Thule Expedition, including sections devoted to paleontology, are contained in the reports of Mathiassen (1933, 1945) and Teichert (1937).

A brief report on the geology in the immediate vicinity of Arctic Bay was made by Weeks (1926, p. 95C).

Prospecting in the vicinity of Arctic Bay was carried out in 1937 by J. F. Tibbitt and J. W. McInnes who were attracted to the area by Bernier's report. These men made a remarkable trip by dogteam and small boat from Churchill, Manitoba, but arrived so late in the season that they were able to stake only two claims and do some prospecting before the arrival of the annual supply ship on which they were to return south.

The author, assisted by R. R. H. Lemon, conducted a geological reconnaissance of Admiralty Inlet area in 1954 (Lemon and Blackadar, 1963). A doctoral dissertation submitted by Lemon was based on a part of this work (Lemon, 1956). During the same season W. L. Davison carried out reconnaissance studies in the Pond Inlet area and mapped as far west as the coast of Navy Board Inlet and Tremblay Sound. The studies carried out by Lemon and Blackadar in 1954 established a stratigraphic succession that can be applied with minor additions to all of northwestern Baffin Island.

During the summer of 1957 the principal sulphide deposit in Admiralty Inlet area reported first by Bernier and later in somewhat more detail by the author in his preliminary report on Admiralty Inlet area (Blackadar, 1956) was staked by Texas Gulf Sulphur Company, and considerable geological and geophysical exploration has been done from time to time on the 230 claims held by the company. To date published results have been limited to brief descriptions of tonnage and grade.

PRESENT INVESTIGATIONS AND ACKNOWLEDGMENTS

This report presents the results of an airborne geological reconnaissance program (Operation Admiralty), and although concerned primarily with Precambrian geology, includes a résumé of operation data and a description of physiography and other topics of general interest. The geological studies of the Precambrian rocks were carried out mainly by means of traverses flown along a definite pattern, usually rectangular with lines spaced 6 miles apart, each line being about 100 miles long. It is thus obvious that the results are preliminary in nature and that more detailed studies may well change some of the interpretation contained in this report and in the geological maps published separately.

Operation Admiralty, carried out between late May and late August, 1963, initiated the major geological reconnaissance of Baffin Island. Up to that time coastal reconnaissance studies had been made in widely separated parts of the island but the bulk of the island, one of the largest in the world, remained geologically unknown.

The project was directed by the author who together with W. L. Davison and T. O. Frisch, a graduate student, carried out studies in the Precambrian succession (Blackadar, 1965). H. P. Trettin, assisted by A. A. Petryk, a graduate student, was responsible for the study of the Paleozoic strata. His results are presented in other publications (Trettin, 1965, in press) B. G. Craig studied the Pleistocene geology and his preliminary results are the subject of a separate paper (Craig, in preparation). F. C. Wedge served competently as radio operator and R. Senneville admirably filled the position of cook. A resident of Arctic Bay, Mukpaloo, was attached to the project and proved an excelled handyman around camp and a fine companion in the field.

Hospitality and assistance typical of the north were extended to members of the party by Mr. Jim Cummings, at the time manager of the Hudson's Bay Company store at Igloolik, and by Mr. Frank Connelly, the then manager of the Arctic Bay store.

Two campsites were occupied during the operation. The first was about 4 miles south of the settlement of Arctic Bay and was near the shore of Marcil Lake; the second was on the east coast of Jungersen Bay between Jungersen and Magda rivers. Both places offered suitable unprepared landing sites for Otter aircraft and Piper Super Cub aircraft equipped with low-pressure, over-sized tires.

Although helicopters have been used in geological reconnaissance in arctic regions since 1952, improved operational features in these aircraft have radically altered the techniques used in their application to the problems of geological surveying. By the time Operation Admiralty was planned, helicopters with greatly increased fuel capacity were available thus permitting extended traverses and at the same time reducing the number of small fuel caches needed to support the aircraft. The Bell 47 G2A-1 helicopter similar in many respects to later G4 and G4A models was selected. In addition to the increased fuel capacity, it has a larger cabin that made it possible, when necessary, for both a surficial and bedrock geologist to traverse together with minimum confusion. The large fuel tanks allowed traverses in excess of 400 miles, a great improvement over the less than 100 miles possible with the machines used 10 years earlier.

Figure 1. Brantly B-2 helicopter. Photo by B. G. Craig G. S. C. 152993.

Somewhat in the nature of an experiment was the use of a Brantly B-2 helicopter (Fig. 1). This machine, much smaller than the Bell, could carry only one passenger and about 75 pounds of extra equipment. The per hour cost, however, was considerably less than that for the larger helicopter and it was felt that greater flexibility would be gained with this machine than was available with fixed-wing aircraft. The Brantly B-2 has a range of not more than 200 miles. On Operation Admiralty it was used mainly in the study of surficial geology, where frequent landings were required to measure elevations of emerged strandlines, and in placing stratigraphers at sections for a days work. Although the Brantly B-2 proved useful, the operational experience gained indicated that the machine was not too suitable for use under arctic conditions.

The Piper Super Cub aircraft, equipped with low-pressure over-sized tires and modified undercarriage, has been widely used in the Arctic by the Geological Survey since 1957. Although this aircraft was used during Operation Admiralty primarily in a support role, such as placing gas caches, and moving mail and supplies from Hall Beach the point of contact with commercial air services, it was also used extensively to deploy the stratigraphers near the sections they wished to measure. Extended reconnaissance flights were also made when broad, rapid coverage was desired.

All chartered aircraft were positioned from Carp, Ontario, and were depositioned to that station at the close of field operations. Helicopters were chartered from Universal Helicopters, Ltd. The Bell 47 G2A-1 was piloted by G. R. Fields and the Brantly B-2 by W. Thomas. The Piper Super Cub aircraft was chartered from Gananoque Air Services and was piloted by

J. Bryant. All these pilots did their part to make the project a success. A total of about 250 hours flying was done in the field by the Piper Super Cub, 150 hours by the Brantly B-2 and about 260 hours by the Bell G2A-1. These times do not include ferrying to and from the field which was about 40 hours each way for each machine.

In addition to chartered aircraft, a ski-equipped Otter aircraft belonging to Thomas Lamb Airways was used in the spring to place large fuel caches in the field and to transport the party from Hall Beach to Arctic Bay. An Otter aircraft, equipped with low-pressure tires and belonging to Bradley Air Services, was used during the summer to move camp and to return the party south to Hall Beach at the close of operations.

CLIMATE

Although surrounded by large bodies of salt water the climate of northwestern Baffin Island is influenced by these only in summer. The long period during which these waters are ice-covered results in an effective continental climate in winter.

Seasons are ill-defined except winter. By late May temperatures in the sun exceed freezing and the snow cover begins to disappear rapidly; by early June small rivers are flowing and vegetation is in bloom. These events mark the beginning of summer, a season lasting until late August when freezing temperatures again occur. In northwestern Baffin Island autumn is a time of violent storms, usually of short duration, and is followed in late October by the true winter season, a time of more stable weather conditions.

Precipitation in the area is low and is mainly in the form of rain during the spring and summer months.

As in most northern regions calm periods are rare except in winter, and winds exceeding 10 miles per hour are common.

During the summer months the proximity of large bodies of water to northwestern Baffin Island results in frequent fogs, especially along the coasts. Commonly, dense fog may persist for 10 miles or more inland from the coast, beyond which point clear weather may be expected.

TOPOGRAPHY

Six physiographic divisions characterize northwestern Baffin Island (Fig. 2). The names applied to these are adapted from those suggested by Bostock (1964) except for North Borden Lowland which is a subdivision of Bostock's Lancaster Plateau.

The northern part of the area studied, that is the northern three quarters of Brodeur Peninsula and that part of Borden Peninsula north of Jungersen River[1], is part of Lancaster Plateau. Within the plateau there are areas of more undulating topography such as Steensby Peninsula but when seen from the air the entire region presents a most uniform appearance, rising gradually from south to north and broken by few discordant elevations.

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[1] Most geographic names referred to appear in Figure 9, in pocket.

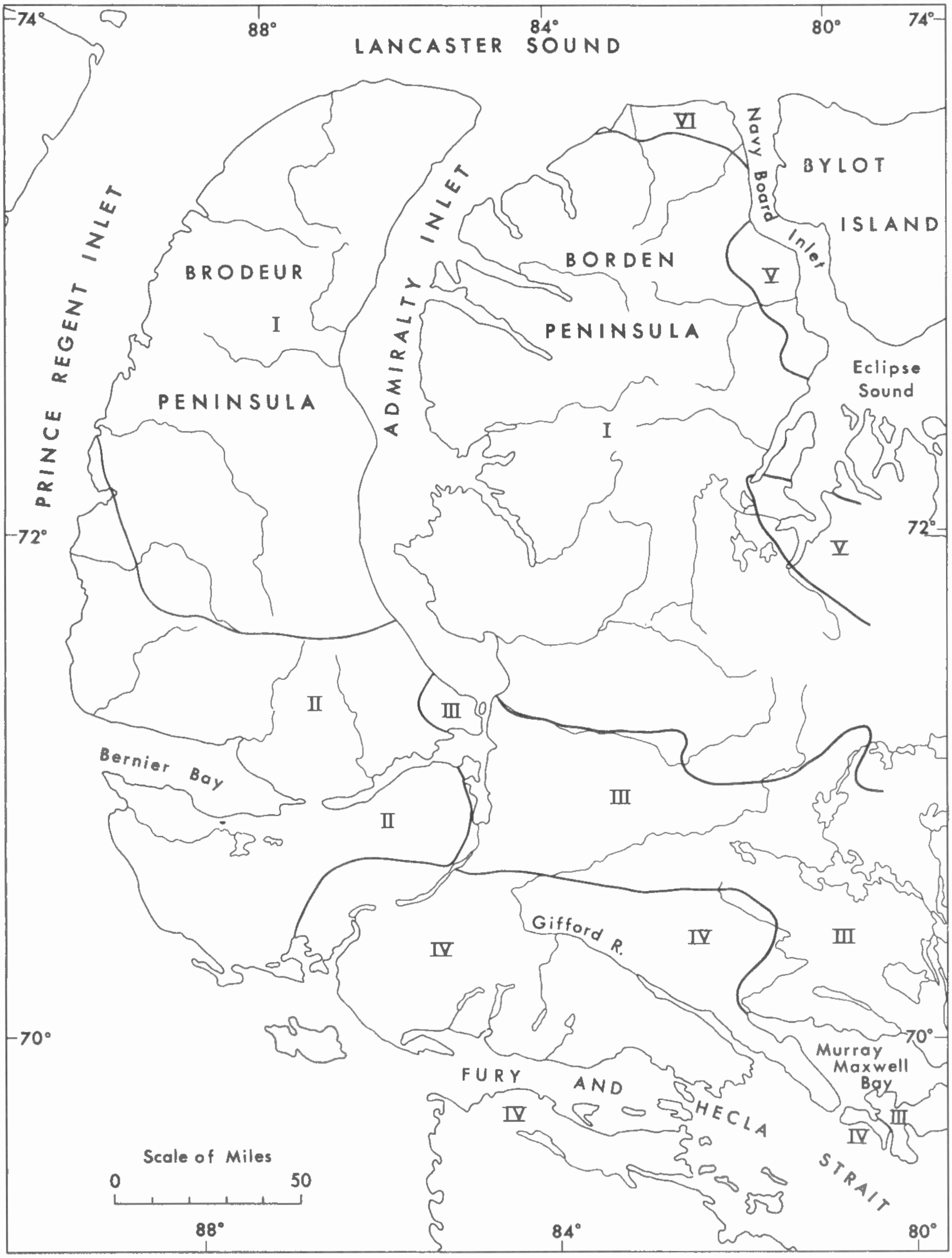

Figure 2. Physiographic subdivisions, northwestern Baffin Island.
I, Lancaster Plateau; IV, Melville Upland;
II, Boothia Lowland; V, Baffin Upland;
III, Foxe Lowland; VI, North Borden Lowland.

Lowland topography predominates on the peninsula between Agu Bay and Bernier Bay and extends eastward to Steensby Inlet. This feature combines parts of the Boothia and Foxe lowlands. It extends north and east from Bernier Bay and includes the southern quarter of Brodeur Peninsula, the coasts of Bell Bay and southwestern Admiralty Inlet, an ill-defined area between Jungersen and Gifford rivers, and extends eastward to Steensby Inlet and Murray Maxwell Bay. Bell Bay is used as an arbitrary dividing line between Boothia and Foxe lowlands because to the west of the bay the lowland is underlain by Paleozoic strata whereas to the east gneissic rocks predominate. The resultant topography in the two areas is distinctive.

An upland topography, developed on the Precambrian metamorphic and sedimentary rocks north of Fury and Hecla Strait, forms the northern extension of Melville Upland.

A small rugged area southwest of Milne Inlet together with that part of the west coast of Navy Board Inlet between the snowfields and Alfred Point, constitute the northwestern prolongation of Baffin Upland, the physiographic feature that dominates much of Baffin Island.

North Borden Lowland, a narrow plain, margins the north coast of Borden Peninsula.

Lancaster Plateau

Brodeur Peninsula. Northern Brodeur Peninsula presents a remarkably uniform and desolate appearance that has been the subject of comment by almost all who have visited the area. Sheer cliffs of flat-lying Paleozoic sedimentary strata rising 1,000 feet or more above the sea are cut by a few major rivers that offer the only access to the interior from sea level (Fig. 3). Elevations in excess of 1,500 feet are found in northwestern Brodeur Peninsula but the height of the plateau surface decreases from north to south and the magnificent cliff sections disappear south of about 73° N on the Prince Regent coast and south of 72° 30' on Admiralty Inlet coast (Fig. 4).

The plateau surface for the most part comprises carbonate rocks. Vegetation is scanty and the stark, unrelieved whiteness of the bedrock characterizes the region.

Brodeur, Jackson, and Eardley rivers flow across the plateau in deeply incised valleys. The first named heads within a few miles of the west coast of Admiralty Inlet. For the most part the rivers are incised only in their lower reaches and the upper limits of most streams are poorly defined. In winter the lack of well-marked stream valleys makes visual navigation of aircraft difficult.

There are few lakes in the northern part of the plateau, but towards the south lakes become more abundant as the plateau surface becomes lower and as a greater variety of glacial deposits is encountered.

Five small ice caps, two of which are visible in Figure 3, and smaller permanent snowbanks, are present in northeast Brodeur Peninsula.

Borden Peninsula. More varied topography characterizes the plateau surface east of Admiralty Inlet. Indeed the smooth, regular, and more or less semicircular trace of the west coast of Admiralty Inlet is in marked contrast to the deeply indented east coast, which is a reflection of more variable bedrock geology. Like Brodeur Peninsula, most of Borden Peninsula is

Figure 3. Lancaster Plateau, northern Brodeur Peninsula. Looking west from Admiralty Inlet to Prince Regent Inlet. Several small ice-caps occur on the high land near the Admiralty Inlet coast. The cliffs are about 1,200 feet high (E. M. R. photo T 252-L-178).

Figure 4. Cliffs about 800 feet high on east coast of Prince Regent Inlet north of Jackson Inlet. Note the uniform surface of Lancaster Plateau. Photo by B.G. Craig G.S.C. 152992.

underlain by sedimentary strata, but these are of diverse lithologies and have been affected in different ways by the processes of erosion.

The highest point on Borden Peninsula, 4,300 feet, is the summit of the ice cap east of Elwin Inlet (Fig. 5), but throughout most of northern Borden Peninsula elevations in excess of 2,000 feet are common. As is the case on Brodeur Peninsula the elevation of the plateau decreases southwards and the highest elevation on Magda Plateau, north of Jungersen River, is about 1,300 feet.

Prolonged erosion of the predominantly sedimentary succession of northern Borden Peninsula has resulted in the development of smaller plateau blocks. Although valley sides are commonly scree-covered, good cliff sections such as those seen on Figure 5, are not uncommon.

Many rivers in Borden Peninsula are of considerable size and length, and the plateau on the whole has a well-developed drainage pattern. Several of the largest rivers occupy through valleys. Thus the Adams and Alfa rivers, the former draining northwest into Adams Sound and the latter southeast into Tremblay Sound, occupy a broad valley underlain mainly by argillaceous rocks of the Arctic Bay Formation. The southwest-flowing Fleming River (which flows into 'Fleming Lake') seems to be extending its headwaters towards this valley and may ultimately behead one or both of the other streams. Only a low divide separates the headwaters of the east-flowing Mala River from those of 'Strathcona River' and several smaller streams draining west to Strathcona Sound. In the southern part of Borden

Figure 5. Northern Borden Peninsula; "Elwin Ice-cap" in distance. Looking east, (E. M. R. photo T 250-R-127).

Peninsula Robertson and Magda rivers closely approach one another as do the headwaters of Magda and Moffet rivers. Many rivers, at least in their lower reaches, occupy broad valleys and some, like the Mala or the north branch of Magda River, are highly braided. Small deltas form where these rivers reach the sea. Tributary to the principal rivers are immature, steep-floored, turbulent streams which in their upper reaches flow in ill-defined beds.

The southeastern part of Lancaster Plateau has been dissected in a most impressive manner; this area is covered by map-sheet 47H, Phillips Creek. Multicoloured sedimentary strata of the lower formations of the Paleozoic succession predominate and the impressiveness of the region is enhanced by the monotonous repetition of erosional blocks in an area of relatively constant lithology.

The southern boundary of Lancaster Plateau is marked by a scarp that more or less parallels Jungersen River. East of Magda Plateau the surface merges gradually with an area of low, undulating hills, in which drift is widespread, and this in turn merges with Baffin Upland, a physiographic subdivision of that part of Baffin Island underlain by the main crystalline complex.

Gneiss outcrops on Steensby Peninsula give rise to an upland topography that could be considered a western extension of Baffin Upland although outliers of lower Paleozoic strata reflect the persistence of the Lancaster Plateau surface. Elevations slightly in excess of 900 feet are found on both the crystalline and Paleozoic rocks.

North Borden Lowland

Lancaster Plateau is separated from Lancaster Sound by a coastal plain or lowland of variable width. This unit is recognizable from a few miles southwest of Cape Joy to a point opposite Tay Bay on Bylot Island. In places drift is extensive, elsewhere low cliffs in stream valleys expose the sedimentary bedrock and in still other places the surface appears to comprise shattered bedrock (felsenmeer) rather than drift. Raised beaches are widespread near the coast (Craig, in preparation). Discontinuous bluffs or steep slopes rise to about 200 feet inland from the zone of emerged strandlines and inland from the bluffs is an undulating surface of variable width. A steep rise (rarely cliffed due to the gentle northward dip of the bedrock) marks the contact between coastal plain and plateau (Fig. 6).

Baffin Upland

West of Low Point on Navy Board Inlet and southeast of Tremblay Sound and Milne Inlet are irregular-shaped areas of highly dissected terrain developed on crystalline rocks. In the south the names Uvajo and Krag mountains have been applied to these features. Elevations exceed 2,300 feet in Krag Mountains and 4,000 feet on the ice cap west of Low Point. The surface developed on these crystalline rocks is more irregular than that found on Lancaster Plateau and these areas are considered a western extension of Baffin Upland.

Figure 6. North Borden Lowland. The darker coloured strata underlying the high ground on the right are the Elwin Formation; the lighter coloured rocks are Paleozoic in age. These outcrop to the shores of Lancaster Sound which is to the left in the photograph.

Figure 7. Buttes of Paleozoic rocks south of Jungersen River. The underlying Precambrian crystalline rocks are almost completely drift covered. (E. M. R. photo T 241-R-39).

Boothia and Foxe Lowlands

The extensive lowland stretching in a semicircular trace from the Gulf of Boothia through Bernier Bay, Berlinguet Inlet, southernmost Brodeur Peninsula to Erichsen Lake, Murray Maxwell Bay and Steensby Inlet, is part of an extensive lowland that margins much of the Gulf of Boothia, Committee Bay and Foxe Basin. The western part of this lowland, the Boothia Lowland, is underlain on Baffin Island mainly by Paleozoic carbonate strata most of which are covered by drift of variable thickness. Lakes are numerous, drainage is poorly developed and many of the streams flow through poorly defined boulder beds. Raised beaches are particularly abundant around Bernier Bay. Northward the lowland merges with Lancaster Plateau, the boundary between the two being the height of land.

On both sides of eastern Berlinguet Inlet crystalline rocks are exposed but elevations seldom exceed 500 feet and much of the area is less than 300 feet above sea level. This change in bedrock lithology is taken as the boundary between Boothia and Foxe lowlands. The surface is studded by innumerable lakes and drift is widespread. Compared to much of northwestern Baffin Island vegetation is relatively abundant.

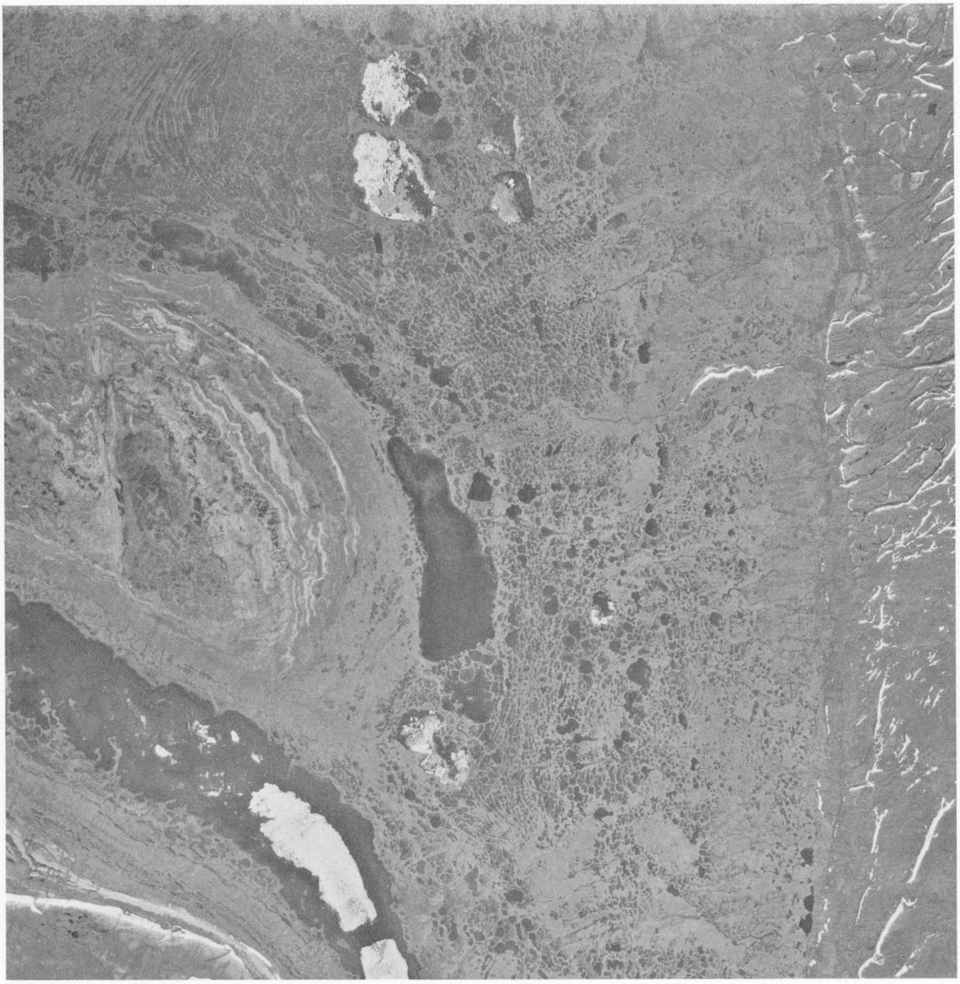

Figure 8. Lake-studded terrain between Bell Bay and Gifford River.

In contrast to the imperceptible merging of lowland and plateau surfaces encountered on Brodeur Peninsula, a scarp not more than 300 feet high separates the lowlands from Lancaster Plateau on the north side of Jungersen River. At the base of this scarp are low outcrops of crystalline rocks. South of the main plateau, outliers of the Paleozoic formations of the southern plateau region form low isolated buttes (Fig. 7) that rise as much as 200 feet above the lowland surface. Drift is extensive and lakes are few, but east and south of the headwaters of Gifford River the gently undulating, drift-covered plain becomes studded with small lakes as larger bodies of water such as Quartz, Taser, and Erichsen lakes are approached. Similar topography persists to the shores of Murray Maxwell Bay. Scarps several hundreds of feet high mark the south side of Neergaard Lake and the unnamed lake southwest of it, but in general the area is continuous with the Boothia Lowland and low, discontinuous Paleozoic outcrops overlie igneous rocks. The lowland extends as far east as the east side of Steensby Inlet where it terminates abruptly against a high, north-northwest trending scarp marking the boundary of Baffin Upland.

Between Bell Bay and the big bend of Gifford River an outlier of lower Paleozoic strata rises several hundreds of feet above the lowlands. The sides of this outlier are deeply channelled and some of the stream beds are as much as 100 feet deep. Southwest of this channelled terrain the lowland is studded with lakes so numerous that they impart a lace-like appearance to the terrain (Fig. 8).

Melville Upland

The northward extension of Melville Upland to Baffin Island comprises three distinct parts, an area of extensive drift, a rugged area underlain by crystalline rocks, and an area developed mainly on quartzitic sandstones.

Extensive drift characterizes the northern part of Melville Upland and this extends south from the margin of Boothia and Foxe lowlands to Gifford Fiord and lower Gifford River. From the air the surface presents the monotonous appearance of a gently undulating terrain unrelieved by distinct topographic features. Although granitic rocks comprise the principal bedrock type, exposures are rare being more commonly represented by felsenmeer deposits.

Gifford River, the most prominent topographic feature of this part of Melville Upland, flows in a broad, sand-filled valley broken here and there by boulder-filled stretches. It is a shallow river and, except during spring run-off, is scarcely deep enough to float a rubber boat. The upper reaches of the river lie within Lancaster Plateau, and the river drops 500 feet in the first 50 miles, but the gradient decreases abruptly within Foxe Lowland. Gifford River is deeply incised within the upland, and where it reaches the sea in Gifford Fiord the valley is about 700 feet deep.

South of Gifford River and Gifford Fiord the terrain is more rugged and more varied. Two distinct types can be recognized. Those parts underlain by gently dipping sedimentary strata and basic sills of Helikian age are characterized by high rounded hills, and by serrated ridges where gabbro dykes outcrop. The slopes of the hills are long and present a distinctive, step-like appearance because most are oriented at right angles to the dip of the strata. The few large lakes of this terrain are in marked contrast to the rugged, lake-studded land underlain by gneissic and granitic rocks which comprises the second type of terrain.

Melville Upland has a maximum elevation of 1,800 feet just east of Cape Ejnar Mikkelsen but this decreases eastward towards Murray Maxwell Bay and Siorarsuk Peninsula where the upland surface merges imperceptibly with Foxe Lowlands.

Melville Upland between the west end of Autridge Bay and Sikosak Bay is bordered by a low, gently inclined plain as much as 3 miles wide. At elevations greater than about 300 feet above sea level the gradient is much steeper and Melville Upland proper is encountered. Recent marine sediments are widespread, but it appears that the plain is underlain by quartzitic sandstone.

Upland surfaces underlain by crystalline rocks south of Gifford River have less drift cover, are highly jointed, and are crossed by prominent linear features. These factors result in a land surface rugged in detail, although elevations do not exceed 1, 100 feet.

STRATIGRAPHY AND STRUCTURAL GEOLOGY

Widely distributed and varied volcanic and sedimentary lithologies of Helikian (Middle Proterozoic) age are the most outstanding geological feature of northwestern Baffin Island (Fig. 9 in pocket). This succession appears to be one of the thickest and most extensive sequences of late Precambrian rocks known from Arctic North America. The horizontal to gently inclined strata are exposed in magnificent cliff sections along the shores of the great inlets that extend eastward from Admiralty Inlet and southwest from Eclipse Sound, and along the valleys of the deeply incised rivers of Borden Peninsula, the landmass between Admiralty Inlet and Eclipse Sound. This late Precambrian succession has been divided into two groups comprising eleven formations.

A gneissic complex, composed mainly of granitic or quartz-feldspar rocks, forms the oldest rocks in northwestern Baffin Island (Fig. 9). On the basis of potassium-argon age determinations this complex is dated as not younger than Aphebian (Lower Proterozoic). Although here and there more varied lithologies obtain, readily mappable units could not be determined on the scale of mapping carried out. Gneissic rocks predominate south of Jungersen River, outcrop widely on Steensby Peninsula and south of Fabricius Fiord, and form a high mountainous terrain west of Navy Board Inlet near Low Point. Block faulting has brought gneissic rocks to the surface elsewhere such as along the shores of Adams Sound and east of 'Elwin Ice-Cap'.

An angular unconformity separates the lower succession of Helikian sedimentary and volcanic rocks from the older gneissic rocks. On northern Borden Peninsula this succession, named Eqalulik Group, comprises andesitic and basaltic flow rocks with minor tuff and agglomerate, and quartzitic sandstone with minor conglomerate and shale. North of Fury and Hecla Strait volcanic rocks are absent and rocks equivalent to the Eqalulik Group comprise a thick succession of quartzitic sandstones overlain by micaceous siltstone, shale, and ferruginous dolomite.

The Eqalulik Group is conformably overlain by a thick succession of diverse sedimentary strata, the Uluksan Group, that reflects a varied sedimentary history commencing with shaly beds that are gradational from Eqalulik Group quartzites through to impure dolomite, dolomite, and limestone formations and ending with the deposition of more than 9, 000 feet of varicoloured mudstones, siltstones and sandstones.

One or more periods of igneous activity followed the deposition of the Uluksan Group. On Borden Peninsula a network of anastomosing northwest or north-northwest-trending basic dykes were emplaced. Some of these can be traced for more than 100 miles; they are most abundant on the peninsula between Adams and Strathcona sounds, and can be followed southeastward to the head of Tremblay Sound and southeastward across Milne Inlet to the limits of the area mapped. Smaller numbers of dykes are present

TABLE OF FORMATIONS

AGE	GROUP (thickness in feet)	FORMATION (thickness in feet)	LITHOLOGY
Helikian			gabbro and diabase
	intrusive contact		
	Uluksan ($\pm$23,000)	Elwin ($\pm$ 5,000)	sandstone, siltstone, shale
		Strathcona Sound ($\pm$4,000)	mudstone, siltstone
		Athole Point ($\pm$5,000)	limestone
		Victor Bay ($\pm$1,600)	dolomite, minor shale, edgewise conglomerate
		Society Cliffs ($\pm$1,000)	dolomite
		Fabricius Fiord ($\pm$5,400)	quartzite, shale, conglomerate
		Arctic Bay ($\pm$1,000)	calcareous shale, dolomite
	conformable (gradational) contact		
	Eqalulik ($\pm$6,000)	Autridge ($\pm$1,500)	siltstone, shale, dolomite
		Fury and Hecla ($\pm$15,000)	quartzite, minor shale and conglomerate
		Adams Sound ($\pm$4,000)	quartzite, minor shale and conglomerate
		Nauyat ($\pm$2,000)	andesite and basalt flows, tuff
erosional disconformity			
Aphebian			granitic gneiss migmatite, banded gneiss

elsewhere in the area. Although dykes are present north of Fury and Hecla Strait, the intrusive activity there resulted mainly in the emplacement of gabbroic sills. Potassium-argon determinations on these intrusive rocks indicate a Neohelikian (Upper Middle Proterozoic) age.

An angular unconformity separates the Uluksan Group from overlying Paleozoic strata.

APHEBIAN

THE GNEISSIC COMPLEX

Gneissic rocks outcrop widely in the southern part of the area mapped during Operation Admiralty and form about 75 per cent of the bedrock exposed east of Agu Bay and south of latitude 71° 30'N. Steensby Peninsula and an area extending about 15 to 20 miles east of Moffet Inlet and south of Fabricius Fiord are underlain by similar rocks (Fig. 10) which are also exposed beneath the volcanic and sedimentary Eqalulik Group rocks between Adams Sound and Fabricius Fiord. Granitic and gneissic rocks also occupy a large area west of Low Point and outcrop extensively around the head of Milne Inlet.

Elsewhere faulting has exposed small, commonly restricted areas of gneissic rock as along the north shore of Adams Sound and southeast of 'Elwin Ice Cap' where an isolated peak of garnetiferous migmatite rises several thousands of feet above the surrounding Paleozoic strata.

Although in detail the gneissic rocks are extremely variable, great difficulty was encountered in attempting to establish mappable units. So much of the area comprises pinkish or grey, massive to poorly foliated granitic gneiss, that any other, more distinctive rock types seemed merely to be oases in a sea of granite lacking any mappable limits. On the separately published geological maps the author has, therefore, resorted to spot designations of the more exotic types without making any attempt to define their extent. In many parts of the area more detailed mapping will permit the recognition of numerous units, but because the field work on which this report is based was carried out by means of traverses 6 or even 8 miles apart and several hundreds of miles in length (a procedure dictated by logistical requirements for completing reconnaissance mapping of a large area in two months) the author considered that any attempt to connect isolated observations could give a totally fallacious impression of the geology of the gneissic complex.

STRUCTURAL FORMS

The principal structural forms are massive and banded gneisses, and migmatites. Throughout much of northwestern Baffin Island the gneissic rocks are essentially massive, at least megascopically. From the air no foliation can be discerned in these predominantly leucocratic rocks, and even a closer examination of the outcrop discloses none except for a rather random orientation of mica and other similar platy minerals.

Banded or *lit-par-lit* gneiss is locally abundant and reflects an increase in leucocratic material in an area of mafic-rich rocks. Such rocks

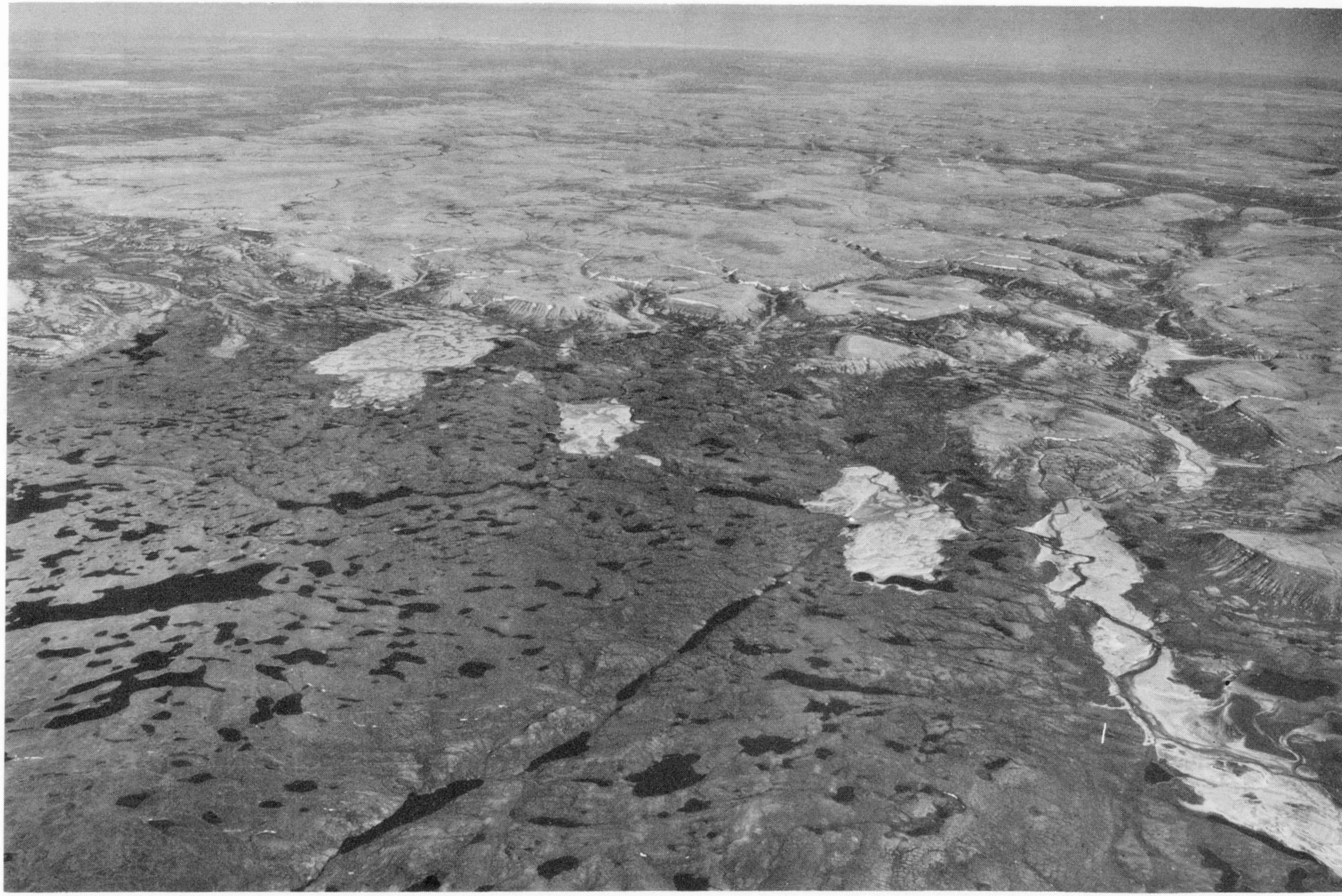

Figure 10. Aphebian gneissic rocks overlain by Paleozoic outliers. Looking east from Moffet Inlet across southern Borden Peninsula.

possess a layered or stromatitic structure and this fabric has been controlled by the original parallel layering of the country rock.

Next to the relatively massive leucocratic rocks, migmatites are the most abundant. The most common migmatite structures found are flow structure, vein structure, layer structure, fold structure, augen structure, and schlieren structure.

In the first of these, fragments of unaltered or little-altered original rock comprise less than half the total rock and show multiple rotational and deformational textures. Many fragment margins show some resorption.

Vein structure is a term used to describe rocks commonly referred to as arterite or venite without implying mode of origin. The newer granitic component has an unoriented veined appearance.

In layer structure the newer granitic component appears to be interbedded with the original rock. These structures may derive from injection of newer material into older and thus include the classic lit-par-lit gneiss, or they may result from metamorphic differentiation in situ.

Fold structure is commonly seen in the gneissic rocks of northwestern Baffin Island, especially on wave-washed surfaces where fine detail is easily observed. The folds may be relatively complex and may include curly and knotty folds. Fold structures reflect a more intense deformation of layer structure probably accompanied by an increase in fluidity.

Augen structure is characteristic of a considerable area northwest of Neergaard Lake (Geol. Surv. Can., Map 1242A, Erichsen Lake). In the typical augen structure the newer component is distributed in an ellipsoidal manner throughout the older. Porphyroblasts of pinkish feldspar comprise the newer component, and these are set in a rather schistose biotite gneiss.

Increasing mobility due to increased temperature and pressure may convert the preceding structures into schlieren structure wherein the original rock forms irregularly shaped, discontinuous masses within a predominantly leucocratic matrix. With still further metamorphism the original rock becomes barely recognizable, being separated from the newer component by extremely blurred and clouded boundaries. Such rocks exhibit a nebulitic structure.

Still more intense metamorphism than that which causes the development of nebulitic structure results in the formation of homogeneous structure, massive and unoriented and thus resembling truly igneous rocks.

In northwestern Baffin Island schlieren and nebulitic structures were seldom encountered and vein, layer and fold structures are by far the most common types. Many of the areas of massive granoblastic gneiss may be the product of prolonged metamorphism, a possibility borne out by the absence of any observations indicating igneous contacts even in the case of the most obviously granitic-looking rocks.

LITHOLOGY

The gneisses have been separated into five divisions, granitic gneiss (in part granite), migmatite, rusty schistose gneiss, mafic gneiss, and banded gneiss.

The granitic gneisses are relatively homogeneous, leucocratic rocks composed mainly of feldspar and quartz but usually with some mafic minerals, which, depending on their abundance, impart the obvious foliation.

These rocks are usually pinkish grey in overall colour. Rocks such as buff granulite or charnockite, commonly associated with granitic gneisses in southern Baffin Island, were not seen during the reconnaissance study of the crystalline rocks of northwestern Baffin Island.

The term migmatite is used to indicate the presence of the wide variety of structural forms described above. Such rocks lack definite boundaries and commonly grade into one another and into banded gneisses. Well-banded gneisses seem to form a more or less recognizable lithology in restricted areas and when studied in greater detail will probably be broken down into still smaller units.

The term mafic gneiss is applied to rocks rich in pyroxene or hornblende which do not show the structural forms of migmatite. Such rocks comprise one of the essential constituents of the contrasting parts of the banded gneisses, but for the purposes of mapping the term is restricted to larger, mappable occurrences of these mafic-rich rocks. Such rocks are not widespread in northwestern Baffin Island and no obvious pattern can be derived from the limited observations available. Such rocks may represent metamorphosed basic volcanic or intrusive rocks. Unlike southern Baffin Island, rusty schists and gneisses are not common. A few deeply weathered schistose rocks outcrop on Yeoman Island and on the mainland to the east of Admiralty Inlet, but these are the only occurrences that were seen. These rocks are garnetiferous and may also contain flecks of graphite.

In the following pages only granitic gneiss and banded gneiss will be discussed. The other units are of only local importance.

Granitic gneisses

Composition. Most of the crystalline rocks of northwestern Baffin Island are pink or grey, homogeneous to poorly foliated, leucocratic rocks, and are grouped together because they lack any clearly recognizable distinctions at least when mapped on a reconnaissance scale. Massive to slightly foliated red, pink or grey granite and granite gneiss of quartz monzonite to quartz diorite composition are especially abundant in the Erichsen Lake and Agu Bay map-areas (Geol. Surv. Can., maps 1242A and 1240A). These rocks are generally coarse grained, poorly banded and commonly contain pods and lenses of quartz. Principal mineral constituents are quartz plagioclase and microcline.

In the tables that follow (Tables I-III) the results of modal analyses of specimens of granitic gneiss from widely separated parts of northwestern Baffin Island are given. Three different rock types were recognized and in order of abundance they are: quartz diorite, granodiorite, and quartz monzonite. The relative absence of potash-rich feldspar, reflected in the absence of true granite and the paucity of quartz monzonite, is in contrast to many gneissic terranes. There is a random distribution of the various rock types throughout the entire outcrop area of gneissic rocks in northwestern Baffin Island. The specimens of the three rock types used for modal and chemical analyses were selected from specimens described as typical by the various field observers.

Table I
Modal Analyses of Quartz Monzonite
(Volume %)

	1	2	3	4	5
quartz	34.0	30.0	35.8	36.4	48.4
plagioclase	24.8	38.4	38.4	36.8	27.0
microcline	31.0	23.4	23.0	21.4	18.2
pyroxene	-	0.2	-	-	-
hornblende	0.2	-	2.0	5.0	-
biotite	3.4	2.6	-	-	6.4
chlorite	-	2.6	-	-	-
magnetite	0.2	1.6	0.8	0.4	-
epidote	-	1.2	-	-	-
perthite	6.0	-	-	-	-
% An	25	n.d.	36	n.d.	33

Table II
Modal Analyses of Granodiorite
(Volume %)

	1	2	3	4	5	6	7
quartz	45.5	61.9	33.9	36.4	48.4	36.0	43.4
plagioclase	35.8	26.1	48.5	43.0	33.8	43.2	32.4
microcline	3.3	0.1	8.4	10.8	15.0	3.4	14.0
hornblende	8.6	-	-	4.4	-	3.0	1.2
biotite	6.5	4.1	1.1	4.6	2.8	13.8	7.4
chlorite	-	-	5.3	-	-	-	0.2
magnetite	-	4.5	0.6	-	-	-	0.6
apatite	0.1	0.5	-	0.4	-	0.6	0.4
sphene	-	2.5	-	0.4	-	-	-
% An	29	25	28	29	28	23	26

Table III
Modal Analyses of Quartz Diorite
(Volume %)

	1	2	3	4	5	6	7
quartz	10.8	40.8	30.2	33.0	38.6	38.6	31.8
plagioclase	74.4	49.0	62.2	64.2	32.0	42.8	50.6
microcline	-	4.6	1.0	tr	14.4	-	-
pyroxene	1.0	-	-	-	-	-	-
hornblende	6.0	0.8	4.2	1.8	-	-	-
biotite	6.4	4.6	2.0	-	8.8	-	15.2
chlorite	-	-	-	-	3.0	15.8	2.0
magnetite	-	tr	-	0.2	1.6	1.8	tr
apatite	0.2	-	0.4	-	-	0.4	0.4
sphene	-	0.2	-	-	1.2	-	-
muscovite	-	-	-	0.8	-	-	-
carbonate	1.2	-	-	-	-	-	-
% An	32	40	35	-	35	36	33

The results of rapid method chemical analyses carried out on 9 specimens of granitic gneiss are given in Table IV. These analyses were made by the staff of the chemical and spectrographic analyses laboratories of the Geological Survey. The 'rapid method' of chemical analysis combines the use of X-ray fluorescence spectroscopy and chemical methods and is designed to produce results from a large number of samples in a short time. As many as thirteen constituents may be determined and the result of a single analysis is considered satisfactory if it falls between 97.5 and 102.5 per cent.

The probable error for each oxide in an individual determination is as follows:

(a) Determined simultaneously by X-ray fluorescent spectroscopy (%)

SiO_2 (30 to 75%)	1.2
Al_2O_3 (up to 20)	0.7
Total Fe as Fe_2O_3 (up to 15)	0.5
CaO (up to 40)	0.3
MgO (up to 40)	1.0
K_2O (up to 5)	0.1
MnO (up to 1)	0.02

(b) Determined separately by chemical methods (%)

FeO (up to 15%)	0.2
Na_2O (up to 10)	0.15
P_2O_5 (up to 1)	0.04
CO_2	0.1
H_2O (total)	0.1

A comparison of the data in Table IV with those in Tables V and VI indicates that the granitic gneisses of northwestern Baffin Island are somewhat richer in Na_2O than possible igneous source rocks. However although the average Na_2O content may be greater, the values fall within the ranges of Na_2O content found in published data. Thus Johannsen (1932, p. 344) gives a possible range for Na_2O in his average granodiorite of 2.40 to 6.95 and for K_2O a range of 1.09 to 5.45 is indicated.

The Baffin Island rocks are also slightly richer in SiO_2 and lower in Al_2O_3 than comparable igneous rocks but again the values are within the possible limits.

It appears therefore that if the granitic gneisses of northwestern Baffin Island are meta-intrusives then:

(1) they are more siliceous than their probable plutonic source-rocks;

(2) they are less aluminous than their probable plutonic source-rocks;

(3) the Na_2O/K_2O ratio is higher than that found in most probable source-rocks;

(4) in general they contain less CaO than their probable plutonic source-rocks.

If the ubiquitous leucocratic granitic gneisses of northwestern Baffin Island are derived from plutonic rocks, then considerable metasomatism occurred during their metamorphism. If on the other hand the gneisses are

Table IV
Chemical Analyses of Granitic Rocks
(Weight %)

	A		B		C				
	1	2	3	4	5	6	7	8	9
SiO_2	70.1	73.9	66.0	69.2	73.1	67.8	66.5	69.9	63.8
Al_2O_3	14.7	15.2	14.4	16.1	18.7	16.7	16.2	13.6	16.2
Total Fe as Fe_2O_3	1.4	1.4	8.0	1.8	0.8	2.1	1.6	2.0	3.4
MgO	1.4	1.4	1.4	0.6	1.4	0.5	<0.5	1.1	2.2
CaO	0.6	0.3	2.8	2.0	1.5	2.3	1.4	1.5	1.7
Na_2O	3.9	2.7	4.9	4.6	5.3	4.8	4.4	5.1	4.9
K_2O	4.96	6.26	0.63	2.61	2.69	2.34	4.62	1.33	3.55
TiO_2	0.24	0.14	0.77	0.29	0.16	0.26	0.16	0.20	0.65
P_2O_5	0.08	0.04	0.14	0.07	0.03	0.09	0.05	0.17	0.20
MnO	0.01	<0.01	0.13	0.03	0.02	0.04	0.02	<0.01	0.04

A - quartz monzonite
B - granodiorite
C - quartz diorite

For modal analyses of these determinations see Tables I-III.

Analysis 1	Table 1 No. 2		Analysis 6	Table II No. 6
2	Table 1 No. 4		7	Table III No. 3
3	Table II No. 2		8	Table III No. 4
4	Table II No. 3		9	Table III No. 5
5	Table II No. 5			

sedimentary in origin then it is probable that these rocks would be derived from arkose or greywacke. If derived from greywacke the Na_2O/K_2O ratio should be high because such clastic rocks are formed under conditions that did not permit leaching of soda. In contrast arkose forms from material commonly subjected to prolonged weathering. Much soda is leached before deposition takes place and the resultant rock is enriched in potash relative to soda.

In Table VII chemical analyses for average sedimentary rocks and three averages of granitic gneisses from northwestern Baffin Island are presented. It will be seen that although the Baffin Island rocks are in general more aluminous than possible sedimentary source rocks yet in general the data do not offer significant support either for or against a sedimentary origin.

Banded Gneiss

Banded gneiss outcrops here and there throughout northeastern Baffin Island. This rock type is composed of mafic-rich bands variously containing hornblende, biotite or both minerals, and quartz-plagioclase-microcline bands. Garnet may be relatively abundant. The mafic bands may show considerable continuity but with an increase in felsic components this

In Tables V and VI the results of classical chemical analyses of granitic rocks are presented.

Table V
Analyses of Granodiorite, Monzonite and Diorite
(weight %)

	1	2	3
SiO_2	66.88	55.36	51.86
Al_2O_3	15.66	16.58	16.40
Fe_2O_3	1.33	2.57	2.73
FeO	2.59	4.58	6.97
MgO	1.57	3.67	6.12
CaO	3.56	6.76	8.40
Na_2O	3.84	3.51	3.36
K_2O	3.07	4.68	1.33
TiO_2	0.57	1.12	1.50
P_2O_5	0.21	0.44	0.35
MnO	0.07	0.13	0.18

1 - granodiorite; Barth, 1962, p. 58
2 - monzonite; Barth, 1962, p. 58
3 - diorite; Barth, 1962, p. 58

Table VI
Analyses of Granodiorite
(Weight %)

	1	2	3
SiO_2	67.86	65.41	66.13
Al_2O_3	14.97	15.72	15.50
Fe_2O_3	1.75	1.57	1.62
FeO	2.18	2.92	2.70
MgO	1.38	1.88	1.73
CaO	2.82	4.08	3.70
Na_2O	3.29	3.66	3.55
K_2O	3.58	2.99	3.17
TiO_2	0.51	0.58	0.51
P_2O_5	0.17	0.17	0.17
MnO	0.05	0.07	0.07

1 - Average of 24 granodiorites (Johannsen, 1932, p. 331)
2 - Average of 56 more basic granodiorites (op. cit. p. 344)
3 - Average of 80 granodiorites (op. cit. p. 344)

Table VII
Chemical Analyses of Sedimentary and Gneissic Rocks
(weight %)

	1	2	3	4	5
SiO_2	69.7	75.5	69.02	72.0	66.7
Al_2O_3	13.5	11.4	15.5	14.95	15.3
Fe_2O_3	0.7	2.4	3.17	1.4	2.3
FeO	3.1	-			
MgO	2.0	0.1	.97	1.4	1.26
CaO	1.9	1.6	2.15	.45	.15
Na_2O	4.2	2.0	4.9	3.3	4.8
K_2O	1.7	5.6	2.07	5.61	3.16
TiO_2	0.4	-	.37	.19	.34
P_2O_5	-	-	.08	.06	.14
MnO	-	.2	.05	.01	.035
H_2O	2.3	0.6	nd	nd	nd
CO_2	-	0.4	nd	nd	nd

1 - average of 3 greywacke (Engle and Engle, 1953, p. 1039)
2 - arkose, after Pettijohn, 1949, p. 259
3 - average (4) granodiorite gneiss, this study
4 - average (2) quartz monzonite gneiss, this study
5 - average (3) quartz diorite, this study

Table VIII
Modal Analyses of Banded Gneiss
(Volume %)

	1	2	3	4	5	6
quartz	34.4	30.4	28.4	8.3	31.9	9.9
plagioclase	31.0	10.2	26.2	12.0	40.1	55.3
microcline	30.0	25.0	24.0	26.0	-	-
perthite	-	-	3.8	4.6	-	-
pyroxene	-	-	-	3.3	-	-
hornblende	2.2	15.8	7.4	42.6	12.8	21.6
biotite	1.0	17.8	9.4	2.3	14.2	12.9
chlorite	-	-	.6	-	-	-
magnetite	-	0.6	-	-	-	-
muscovite	1.4	-	-	-	-	-
apatite	-	-	.2	.6	-	-
sphene	-	-	-	-	.4	.2
% An	nd	31	33	nd	35	58

continuity becomes less and the rocks grade into migmatite. Similarly with a decrease in felsic content the rocks grade into the mafic gneisses. In the following table modal analyses are given of felsic and mafic bands from different location in northwestern Baffin Island.

Modal analyses 3 and 4, and 5 and 6 were made on two thin sections that include the contact between mafic and felsic phases. In both there is a sharp contact between the phases. Quartz content decreases rapidly away from the contact in the mafic phase. In the last pair the abrupt change in anorthite content of the plagioclase is also remarkable.

Amphibolite bands are not common in the mafic gneiss but here and there some were seen. Modal analyses for two such bands follow:

Table IX
Modal Analyses of Amphibolite
(Volume %)

	1	2
quartz	13.6	12.6
plagioclase	19.8	29.8
hornblende	66.8	56.2
sphene	1.8	1.4
% An	39	38

Equivalent chemical data for these rocks as well as that for an average basalt are given in the following table.

Table X
Chemical Analyses of Amphibolite
(weight %)

	1	2	3
SiO_2	50.2	50.4	50.83
Al_2O_3	16.5	14.5	14.07
Fe_2O_3			2.88
Fe_2O_3 + FeO	10.6	9.7	
FeO			9.06
CaO	10.6	9.0	10.42
MgO	4.3	6.9	6.34
Na_2O	3.3	4.1	2.23
K_2O	0.61	0.57	0.82
TiO_2	0.66	0.64	2.03
P_2O_5	0.06	0.06	0.23
MnO	0.19	0.21	0.18
H_2O	nd	nd	0.91

1 - Table IX, No. 1
2 - Table IX, No. 2
3 - typical effusive tholeiite (Barth, 1962, p. 59)

The specimens from northwestern Baffin Island are similar to the typical tholeiite and it is probable that the amphibolites are metamorphosed igneous rocks.

The presence of high grade iron deposits in granitic gneisses about 60 miles southeast of the head of Milne Inlet (the Mary River deposit of Baffinland Iron Mines Ltd.) has an important bearing on any speculation regarding the origin of the gneisses. The iron-formation is part of a group of acid and basic metavolcanics and metasediments that has been infolded and faulted within granitic rocks. Iron-formation showings have been reported from a few places within Phillips Creek map-area (Geol. Surv. Can., Map 1239A). A small pinnacle of black, massive hematite was observed by W. L. Davison within the Society Cliffs dolomite a few miles southeast of Adams Sound. This may be a window of iron-formation similar to the Mary River deposit.

As the area east of 80° W has not yet been mapped it is impossible to outline the distribution of the metasedimentary and metavolcanic rocks in that area but from reconnaissance observations made by various geologists, such rocks seem to become more abundant to the southeast. Thus it is possible that at least parts of the gneissic complex mapped during Operation Admiralty are metasediments and metavolcanics but that they are no longer recognizable as such because of more intense metamorphism.

W. L. Davison (personal communication, 1967) reports that during the mapping he carried out in 1954, ultrabasic rocks were seen on the north shore of the peninsula that terminates in Bruce Head near the southern end of Milne Inlet. The relationship of these rocks to the gneissic complex is not clear but it is interesting to note that, as pointed out to the author by G. D. Jackson, they lie more or less on a line joining the principal deposits at Mary River and a showing of massive hematite seen by Davison south of Adams Sound (see section on Economic Geology).

AGE OF THE GNEISSIC COMPLEX

Three age determinations have been made on material from northwestern Baffin Island collected during Operation Admiralty.

A specimen of medium-grained, grey, biotite-quartz-feldspar gneiss collected at 72° 10'N, 83° 32'W (Geol. Surv. Can., Map 1235A) was analyzed. This rock comprises quartz 40 per cent, biotite 10 per cent, hornblende 15 per cent, plagioclase 25 per cent, K-feldspar 10 per cent, and traces of magnetite, carbonate, apatite, and sphene. The date obtained, GSC 64-29, is 1,975 ± 60 m. y.

A schistose, biotite-rich layer in quartz-feldspar gneiss that outcrops in Agu Bay-Cape Easter map-sheet (Map 1240A) (specimen collected at 70° 50'N, 86° 50'W) gave an age of 1,730±55 m. y. (GSC 64-30).

The third new age determination was made on a specimen of biotite-quartz-feldspar gneiss from south of the mouth of Mala River (Map 1236A). This rock also gave an age (GSC 64-31) of 1,730 ± 55 m. y.

Including the two ages quoted in Lemon and Blackadar (1963) there are now five age determinations available for the crystalline complex of northwestern Baffin Island.

GSC 62-85	1,590 m.y.
GSC 62-86	1,700 m.y.
GSC 64-29	1,975 m.y.
GSC 64-30	1,730 m.y.
GSC 64-31	1,730 m.y.

These dates are consistent with placing the crystalline complex in the Churchill Structural Province and indicate an Aphebian age for the latest metamorphism of the rocks.

HELIKIAN

EQALULIK GROUP

Sandstone, outcropping in towering cliffs above dark, close-grained rocks along the shores of Admiralty Inlet were commented on by early observers (Bernier, 1911, p. 152; Mathiassen, 1933, pp. 35-43). Mathiassen also noted the presence of boulders of basalt and amygdaloidal rocks in the delta of Eqalulik River. This succession, mapped by the writer in 1954, was named Eqalulik Group (Lemon and Blackadar, 1963, p. 10) and a Proterozoic and/or Early Cambrian age was assigned to it. As originally defined the group included three members, Lower and Upper Quartzite Members separated by the Volcanic Member.

Observations made in 1963 led the writer (Blackadar, 1965, p. 14) to delete the Lower Quartzite Member from the stratigraphic succession on the basis that it forms neither a mappable nor a unique unit.

Outcrops of Eqalulik Group rocks are most abundant between Strathcona Sound and Fabricius Fiord, and extend east to about 83° W. Faulting along the through valley occupied by Alfa and Adams rivers has exposed rocks of this group in several restricted outcrops, and similar faulting exposes the group along the sides of 'Elwin River' valley and also east and west of the north part of the 'Elwin Ice Cap'.

A small outcrop near sea level on the west shore of Admiralty Inlet at Giants Castle is the only known exposure of Eqalulik Group rocks on Brodeur Peninsula.

The group includes two units: the Nauyat and Adams Sound formations.

Nauyat Formation

The assemblage of massive basalts, amygdaloidal basalts, basalt flows with well-formed pillow structures, andesites and thin tuffaceous beds previously referred to as the Volcanic Member is here named Nauyat Formation, a name derived from the prominent cliff east of Admiralty Inlet and north of Moffet Inlet that forms the southwesternmost exposure of the formation. There the volcanic succession is about 1,000 feet thick and is separated from gneisses of Aphebian age by a thin quartzite bed. It was this relationship, in part at least, that led the writer to postulate the presence of the Lower Quartzite Member, a term now discarded.

Distribution and thickness

The most extensive outcrops of the Nauyat Formation are south of Adams Sound, mainly the area covered by Map 1238A. Rocks of this formation are, however, usually found wherever the upper formation of the Eqalulik Group is found. The block faulting along the north shore of Adams Sound exposes more than 1,000 feet of the formation which there directly overlies Aphebian rocks (see Pl. II, Lemon and Blackadar, 1963). Faulting exposes rocks of the Nauyat Formation east of Elwin Inlet and along the north side of 'Elwin River' valley.

Several small exposures of volcanic rocks overlain by quartzite are present on Magda Plateau west of the southernmost ice cap of Borden Peninsula.

Complete sections have not been measured, but the excellent exposures of the formation in the steep canyons in Moffet Inlet map-area indicate thickness in excess of 2,000 feet.

Lithology

Rocks of the Nauyat Formation are usually green-brown to black in colour, dense, and relatively unaltered. Interbedded are rocks more variable in texture and composition. Commonly these are amygdaloidal but elsewhere textures approaching porphyrytic are responsible for the variability.

Although weathered surfaces are usually dark, shades of brown, and here and there pale red (5R 6/2)[1], occur. Such rocks are amygdaloidal.

In thin section the typical fine-grained volcanic rock exhibits a diabasic texture. Laths of plagioclase (commonly sericitized or saussuritized) and pyroxene and hornblende are the major constituents. Chlorite frequently replaces the mafic minerals. Interstitial carbonate is present in some specimens examined. Few thin sections studied contain quartz and potassic feldspar is equally uncommon.

In a cliff section east of Peter Richards Islands white weathering bands are present within the darker greenish or reddish rocks. Although no ground observations were possible, close-up air observations suggest that these are not sedimentary interbeds but are also volcanic, possibly tuffaceous, beds.

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[1] Colours have been determined by use of the rock-colour chart of the National Research Council (U.S.) (Goddard, E.N., et al., distributed by the Geological Society of America; 2nd printing, 1961).

A chemical analysis was made of a greyish red (5 R 4/2) columnar jointed, amygdaloidal basalt from south of Adams Sound and the results are given in Table XI below.

Table XI
Chemical Analysis of Amygdaloidal Basalt
(Weight %)

SiO_2	53.9
Al_2O_3	15.2
Fe_2O_3	8.9[1]
MgO	5.1
CaO	3.6
Na_2O	5.6
K_2O	2.71
TiO_2	0.95
P_2O_5	0.08
MnO	0.13

[1] Total iron as Fe_2O_3

This rock is somewhat lower in Al_2O_3 and CaO and higher in alkalis than basalt or andesite but these variations may reflect the presence of zeolites such as analcime and stilbite in the amygdules of these volcanic rocks.

Structural relationships

The Nauyat Formation is separated from the underlying Aphebian crystalline complex by a nonconformity, and in most localities where overlying strata have not been eroded, it is overlain conformably by the Adams Sound Formation. However, despite the fact that in most places the Nauyat Formation rests directly on Aphebian gneissic rocks, there are places where the volcanic rocks occur above quartzitic sandstones of variable thickness. In addition to the thin quartzite exposed beneath the volcanic rocks at Nauyat Cliff, the original type locality for the Lower Quartzite Member (Lemon and Blackadar, 1963, p. 10), quartzitic rocks are revealed beneath and above dark massive, fine-grained rocks southeast of Cape Cunningham. The dark rocks appear similar to the volcanic sequence although the possibility of their being gabbroic sills cannot be dismissed. In the interior of the peninsula between Adams Sound and Fleming Inlet, in an area centring around 72°45'N and 85°00'W, field observations indicate that quartzite and volcanic rocks are intimately interbedded. Unfortunately this high part of the plateau was still extensively covered with snow at the time traversing was carried out in 1963 and observations are fragmentary, but air photographs of this region show a distinct pattern of alternating light and dark beds indicative of alternation of sedimentary and volcanic strata.

At the southern margin of 'Elwin Ice Cap' dark fine-grained rocks are exposed in a restricted area. These rocks lie at an elevation of 2,500 feet and extend to the edge of the glacier at 3,000 feet and appear as small

Figure 11. Eqalulik River Valley. Adams Sound Formation forms high cliff on left and Nauyat Formation (volcanic rocks) outcrop on the right. The latter are capped by Adams Sound quartzite. Photo by B. G. Craig G. S. C. 152991.

nunataks within the main ice-mass. Quartzitic sandstones of the Adams Sound Formation outcrop from the floor of 'Elwin River' valley up to 2, 500 feet elevation and are inclined gently northward. The volcanic rocks thus lie above a considerable thickness of quartzite. On the north side of the ice cap the volcanic rocks underlie north-dipping quartzitic rocks.

Near the southwestern end of 'Elwin Ice Cap' a fault block of volcanic rocks is exposed. About 800 feet below the top of the exposure there is a 200-foot-thick band of quartzite.

These observations indicate that although in general volcanic rocks underlie the sedimentary succession there are exceptions. Whether or not volcanic rocks interbedded with quartzite should be included in the Nauyat Formation is problematical. However pending more detailed work and with some reservations the author has placed all such volcanic rocks in the Nauyat Formation.

The Nauyat Formation for the most part represents an accumulation of many relatively thin volcanic flows. The comparative absence of tuff or breccia, the considerable extent of various bands, and the relative conformity of one band to another, indicate that the activity that gave rise to the volcanic rocks was similar to that giving plateau basalts.

A whole-rock potassium-argon age determination (GSC No. 64-32) made on a specimen of basalt from the Nauyat Formation gave an age of

Figure 12. Glacier flowing southwest off 'Elwin Ice Cap' and forming headwaters of 'Elwin River'. This photograph illustrates how the Eqalulik Group and lower Uluksan Group formations are exposed by faulting. The Eqalulik quartzite outcrops to left of glacier; to the right quartzite is overlain by black micaceous beds presumed to be Arctic Bay Formation and these in turn are overlain by undivided Society Cliffs - Victor Bay Formations. In foreground faulting has raised quartzite well above its greatest elevations to the right of the glacier. Photo by B. G. Craig G. S. C. 152994.

903 ± 140 m.y. indicating a Neohelikian age for the unit (but see pages 75-76 for a fuller discussion of this result).

Adams Sound Formation

The more or less flat-lying, pale orange to reddish brown quartzitic sandstones that overlie the Nauyat Formation were originally named the Upper Quartzite Member of the Eqalulik Group (Lemon and Blackadar, 1963, p. 11), but inasmuch as the regional extent of these rocks is now known accurately, and thicknesses and contact relationships are better understood, the writer proposes the name Adams Sound Formation for the succession.

The formation outcrops for many miles on both sides of Adams Sound and here and there sheer cliffs tower 1,000 feet or more above the sea. It is also well exposed along the valley of Eqalulik River (Fig. 11) and at Nauyat Cliff.

Distribution and thickness

The Adams Sound Formation outcrops mainly between Adams Sound and Fabricius Fiord and outcrops of this main mass are found as far east as about 82° 30'W. Faulting along the valley occupied by Alfa and Adams rivers exposed two large blocks of Eqalulik Group rocks, mainly quartzite. The formation outcrops on the west side of the southernmost ice cap on Borden Peninsula and also about 10 miles to the southeast.

Faulting along the valley of 'Elwin River' has caused the gneissic rocks of Aphebian age to be exposed east of the main ice cap and the Eqalulik Group has also been exposed both east and west of the ice cap. Quartzite outcrops near the head of 'Elwin River' on both sides of the valley, but the principal outcrops are on the north side where steep slopes and cliffs rise several thousands of feet to the main mass of the ice cap.

The only known outcrop of the formation on the west shores of Admiralty Inlet is a small exposure near sea level at the base of Giants Castle, more or less due west of the mouth of Adams Sound.

Complete sections have not been measured but structural data indicate that the thickness of the formation may exceed 4,000 feet.

Lithology

The Adams Sound Formation is primarily an assemblage of relatively pure quartzite, quartz-pebble conglomerate and minor arkose. The colour varies from very pale orange (10YR 8/2) through dark yellowish orange (10YR 6/6) to moderate reddish brown (10 R 4/6) and dark reddish brown (10 R 3/4). Crossbedded and ripple-marked structures are locally common. The rocks are medium- to thick-bedded and most appear to be silica cemented.

Conglomerate beds are not common and where present are not necessarily found in the basal beds.

Here and there thin layers of shale are included in the succession. Chlorite is common in these.

In thin section subangular, subrounded, or rounded quartz grains predominate. Equigranular textures are common but in many rocks two distinct sizes of quartz occur. Many sections show a fine film of red iron oxides surrounding the grains and this of course, is responsible for the coloration of the formation. Silica deposited in optical continuity with the original clastic grains has resulted in a compact quartzose texture.

There are few accessory minerals. Chlorite and sericite may be present as scattered flakes throughout some specimens. Leucoxene is found in some as are well-rounded zircon grains.

The results of two semiquantitative spectrographic analyses are included in Table XIV as part of the discussion on the geochemistry of the sedimentary rocks.

Structural relations

The Adams Sound Formation conformably overlies the Nauyat Formation and is separated from the lowermost formation of the Uluksan Group, the Arctic Bay Formation, by a gradational contact. The transition beds vary in thickness but are usually a few tens of feet thick and comprise alternating red-brown shale and quartzitic sandstone, or medium grey shale and quartzitic sandstone.

Gentle dips are common and areas of horizontal strata are widespread. Dips exceeding 20 degrees were not observed; more commonly the strata are inclined from 5 to 10 degrees.

Considerable block faulting has taken place - a fine example is shown in Plate II, Lemon and Blackadar, 1963. Similar faulting along Elwin, Alfa, and Adams rivers has resulted in the exposure of the formation in areas dominated by younger rocks.

Origin

Crosslaminated and ripple-marked structures and the presence of conglomerate beds here and there throughout the succession are indicative of deposition in more or less shallow water.

The almost complete absence of any mineral but quartz is surprising in view of the fact that the probable source rocks, the gneisses of Aphebian age, outcrop nearby. This absence suggests either that the Adams Sound Formation represents reworked material or that a long period of abrasion and winnowing took place prior to the deposition of the sands.

ROCKS SIMILAR TO THE EQALULIK GROUP

Fury and Hecla Formation

The relatively unaltered, gently folded sequence of quartzitic sandstone that outcrop on the north side of Fury and Hecla Strait has been described previously (Blackadar, 1958, 1963, 1965), but was not named in earlier publications. The name Fury and Hecla Formation is now proposed for this succession which forms a readily mappable unit. Members of Sir Edward Parry's Second Expedition, 1821-1823, were the first to report the existence of sandstones overlying crystalline basement rocks north of Fury and Hecla Strait (Parry, 1824, p. 348). Members of the Fifth Thule Expedition, 1921-1924, extended somewhat the knowledge of the geographic extent of these rocks and indicated that sandstones or quartzites outcrop west from Sikosak Bay towards Nyeboe Fiord.

The writer examined the Fury and Hecla Formation in 1956 and 1957 (Blackadar, 1958) and with the aid of trimetrogon air photographs was able to draw the northern contact of the formation north of Fury and Hecla Strait with some accuracy. Field work carried out by members of Operation Admiralty modified this in detail but did not disclose any significant discrepancies. Although lithologically similar to the Adams Sound Formation of the Eqalulik Group, the distance that separates this formation from the Adams Sound outcrop area, precludes correlation of the two.

Distribution and thickness

The principal outcrop area lies north of Fury and Hecla Strait and extends from about 4 miles west of the western entrance of Adolf Jensen Sound to the west shore of Nyeboe Fiord, a distance exceeding 125 miles. The width of the outcrop is variable but the greatest width appears to be about 25 miles.

South of the strait the formation outcrops on Liddon Island, on a low plain about 4 miles wide and 16 miles long that separates the higher gneissic terrain of northern Melville Peninsula from the sea from opposite Amherst Island to 4 miles east of East Cape, and in a 25-square mile area 2 miles south of East Cape. Inasmuch as field work during Operation Admiralty was restricted to Baffin Island, these latter outcrops were not visited and the reader is referred to the earlier published studies made by the writer (Blackadar, 1958, 1963, 1965) for additional information.

No complete stratigraphic sections have been measured but assuming no repetition of strata across the maximum width of the outcrop (a supposition that appears not improbable from observations made in 1963) and assuming an average dip of 10 degrees south (again an observation consistent with observed data), then a thickness in excess of 15,000 feet is indicated.

Lithology

The Fury and Hecla Formation is composed primarily of greyish orange-pink (10 R 8/2) to pale red (5 R 6/2) massive to medium-bedded quartzite and quartzitic sandstone. Grit layers and conglomerate bands, although present, are of minor importance. Conglomerate layers were observed only in the lower part of the succession but they do not form the actual basal beds. Clasts in the conglomerate vary in diameter from 1 inch to 1 foot and all appear to be derived from sedimentary rocks.

In addition to the principal rock type, strikingly varicoloured beds are included in the succession. These comprise blocky, well-jointed dusky red (5 R 3/4) to dusky red-purple (5 RP 3/2) quartzite and quartzitic sandstone interbedded with more fissile layers. The latter include papery shales, rusty-red, hematite-stained shales and black to greenish black (5 GY 2/1) shales. There are mudcracks with sandy fillings on some of the shale surfaces.

Spectrographic analyses were made on ten specimens by the Isotope Geology Section of the Geological Survey; these results are included in Table XXIV.

Several partial sections were measured by the writer in 1956 and 1957 (see Fig. 13 for location of these). Two of these sections are described as follows.

Figure 13. Location map for stratigraphic sections.

Locality 5 (Fig. 13)

Cape Ejnar Mikkelsen; composite section measured from coast to narrows of lake about 2 miles inland.

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
	Top of section		
4	greyish orange to light brown quartzitic sandstone	3,000	5,500
3	mainly quartzitic sandstone, minor argillaceous beds. Gabbro sill 200 or more feet in thickness	1,000	2,500
2	pale to dusky red quartzitic sandstone; dark red shaly sandstone; minor conglomerate	500	1,500
1	quartzitic sandstone, minor gabbro sills	1,000	1,000
	Base of section		
	Sea level		

Locality 6 (Fig. 13)

6.5 miles northeast of Cape Tordenskjold

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
	Top of section		
4	greyish red, crossbedded, quartzitic sandstone; minor very dusky red shale	500	1,600
3	moderate reddish brown to greyish red, quartzitic sandstone; crossbedded	300	1,100
2	greyish red quartzitic sandstone; crossbedded	400	800
1	greyish orange-pink quartzitic sandstone	400	400
	Base of section		
	Underlying rocks, Aphebian granitic gneiss; unconformable contact.		

Structural relations

The Fury and Hecla Formation rests unconformably on granitic and gneissic rocks. Here and there a basal conglomerate is present but more commonly, quartzitic sandstone rests directly on a highly irregular surface of crystalline rocks.

The Autridge Formation conformably overlies the Fury and Hecla Formation but throughout most of the area covered by this report the Autridge was either not present originally or has since been removed by erosion, and the quartzitic sandstones of the Fury and Hecla Formation form the present land surface.

Autridge Formation

The succession of black micaceous siltstone, black shale, slate and ferruginous dolomite that overlies the Fury and Hecla Formation has been previously described (Blackadar, 1958, 1963, 1965), but it was neither named nor separated from the quartzitic sandstone sequence. The name Autridge is now proposed for this formation. The type locality is the area west of the head of Autridge Bay.

Although members of Parry's 1821-1823 expedition reported the presence of these rocks no additional information was obtained until the writer began geological reconnaissance studies of the outcrop area in 1956.

Distribution and thickness

Outcrops of the Autridge Formation are found on Amherst Island, Alfred Island and on Baffin Island between Autridge Bay and about two and one-half miles west of Cape Appel. The first two localities are just south of the limits of the area mapped during Operation Admiralty.

At the latter place the strata outcrop mainly below gabbro sills of considerable extent (Frontispiece) and nowhere within or beyond the map-area have beds overlying the formation been seen. Within the area covered by this report the exposed thickness exceeds 1,500 feet (west of Autridge Bay) and it appears that this is about the greatest thickness now present.

Lithology

Rocks of the Autridge Formation were first described by Parry (1824) from observations made on Amherst Island, near the south shore of Fury and Hecla Strait. He reported that this island "... is an argillaceous schist of various qualities from a very fine and soft to a compact coarse variety which answers to the greywacke schist of geologists. The kinds alternate with each other and those of intermediate quality are remarkable for having the surfaces of the laminae divided into parallel longitudinal beds by narrow but deeply impressed lines... Flat circular depressions are also seen occasionally upon the surface... The more elevated ridges... are formed of the disintegrating remains of a super-incumbent stratum of compact limestone. It does not burn to quicklime" (op. cit. p. 348).

Close to the lower contact of the formation near Cape Appel bands of micaceous siltstone a few inches thick are interbedded with quartzites of the Fury and Hecla Formation. Mudcracks similar to those described by Parry are common on the surfaces of these interbeds which rapidly become the predominant lithology and the outcrop assumes a black, rounded appearance due to the presence of abundant fissile shale fragments.

Just west of the west end of Autridge Bay black shale, slate, and thin beds of ferruginous dolomite outcrop on a 700-foot-high hill and appear to lie above the micaceous siltstones described above. There the formation is about 1,500 feet thick and there too the strata are overlain by a thick gabbro sill.

Spectrographic analyses were made of five specimens. The results are given in Table XXIV.

Structural relations

The Autridge Formation overlies with gradational contact the Fury and Hecla Formation. The upper contact of the formation has not been observed within or without the map-area.

ULUKSAN GROUP

The Uluksan Group comprises seven formations, Arctic Bay, Fabricius Fiord, Society Cliffs, Victor Bay, Athole Point, Strathcona Sound, and Elwin, and has an estimated thickness of 23,000 feet. Rocks of the group outcrop widely on Borden Peninsula north of an imaginary line extending southeast through Adams Sound to the head of Milne Inlet and to a lesser extent southwest of such a line to the vicinity of Fabricius Fiord. The succession includes calcareous shale, dolomite, limestone, mudstone, siltstone, and sandstone. Where observed the contact between the Eqalulik and Uluksan groups appears to be gradational.

Arctic Bay Formation

The basal unit of the Uluksan Group, the Arctic Bay Formation (Lemon and Blackadar, 1963, p. 15) outcrops extensively throughout central Borden Peninsula. Although the type section at Arctic Bay comprises only 350 feet of black, fissile, medium- to fine-grained argillaceous limestone and dolomite, elsewhere much greater thicknesses and more variable lithologies obtain.

Distribution and thickness

The principal outcrop of this formation extends southeastward from near the centre of the peninsula between Adams and Strathcona Sounds to at least the east shores of Milne Inlet, a distance of more than 100 miles. Structural effects expose the formation several times south of the main outcrop area and extensive faulting east of Elwin Inlet results in the formation being exposed in truncated exposures (Fig. 12).

At the type locality (near the settlement of Arctic Bay) 350 feet of strata are exposed, but at the head of Adams Sound the thickness appears to exceed 1,000 feet and along Alfa River thicknesses in excess of 2,000 feet appear probable.

On the south side of Adams Sound, opposite Arctic Bay, beds dipping north at as much as 20 degrees are exposed beneath the Paleozoic Admiralty Group clastic rocks. At this location (only a few miles south of the type section) thickness in excess of 1,000 feet is indicated.

Because of its lithological composition the Arctic Bay Formation is commonly marked by terrain of low relief and poor outcrop.

Lithology

The type section of the formation consists of fissile, black, fine-grained limestone with nearly paper-thin laminae above which are more dolomitic rocks in which fissile bands are reduced to thin intercalations.

Between Tremblay Sound and Milne Inlet the unit appears rather argillaceous, and weathers to flaky fragments wherein rusty patches mark more resistant shale.

Fifteen miles west-northwest of the southernmost ice cap in Milne Inlet map-area (G.S.C. Map 1235A) more than 300 feet of Arctic Bay strata are exposed. There the unit comprises a succession of grey, brownish or greenish shales, and more indurated shales. Rusty patches of shale are found here and there.

East of the head of Elwin Inlet there is a succession of dark sedimentary rocks which from its stratigraphic position has been correlated with the Arctic Bay Formation. These rocks are more arenaceous than those comprising the type section. Mudcracks occur on some bedding surfaces. The individual beds within the succession average 1/8 inch in thickness. Micaceous laminae are abundant and the outcrop has a fine platy surface.

The hill Anmagraluit on the east shore of Milne Inlet, south of the mouth of Eskimo Inlet, comprises a thick succession of black shales overlain by a succession of red-brown sandstones and black shales. This succession dips north at 10 degrees and on the north side of the inlet is overlain by grey dolomite that has been correlated with the Society Cliffs Formation. On the basis of this correlation the sequence has been correlated with the Arctic Bay Formation despite the presence of interbedded sandstones and shales, a lithology not found at the type locality at Arctic Bay.

Throughout the entire area mapped, deposits of white salts characterize the weathered surface of the formation, and this feature facilitates recognition and aids in differentiating this unit from the rather similar-appearing argillaceous parts of the Victor Bay Formation.

Structural relations

The Arctic Bay Formation is separated from the Adams Sound Formation by a gradational contact. The nature of the contact is not well-exposed at the type locality but is clearly seen east of Elwin Inlet where the light yellowish brown to maroon quartzitic sandstones of the lower group become increasingly argillaceous, the argillaceous material forming distinct layers. Within about 20 feet, quartzite is replaced by dark micaceous argillaceous strata.

The Arctic Bay Formation is conformably overlain by the carbonate rocks of the Society Cliffs Formation.

Origin

The lack of any definite break between the Arctic Bay and Society Cliffs Formations suggests that with changing conditions of deposition, clastic material ceased to be readily available and deeper-water - in part stagnant - conditions of deposition prevailed. It is significant that the amount of carbonates in the Arctic Bay Formation decreases away from the section. Even on the south shore of Adams Sound, only 15 miles from the type section, the formation is more argillaceous and contains more silty layers. Eastward, with increasing thicknesses, the relative proportion of carbonate material decreases. On the east side of Milne Inlet the formation consists of interbedded sandstone and slate, yet these exposures can, in the writers view, be traced with confidence all the way to Adams Sound and beyond.

Fabricius Fiord Formation

East of Fabricius Fiord a succession of black shale, siltstone and quartzitic sandstone with minor conglomerate beds outcrops across a considerable area. These rocks were first examined in the course of the field work on which this report is based and the name Fabricius Fiord Formation was applied to them (Blackadar, 1965). The alternation of shale and more resistant beds, especially in the lower half of the succession, and the dip of between 10 and 20 degrees, gives rise to a distinctive ribbed outcrop pattern.

Distribution and thickness

The Fabricius Fiord Formation outcrops in a restricted area extending about 18 miles east from the head of Fabricius Fiord. At its widest the outcrop area is about 5 miles broad. A thickness of 5,430 feet was obtained from a composite section measured across the formation at locality 4 (Fig. 13). The lower member, alternating shales and siltstones, is 2,595 feet thick and the upper quartzitic sandstone member has a thickness of 2,835 feet.

The uppermost beds of the formation are faulted against gneissic rocks of Aphebian age, thus the total thickness of the formation remains unknown. Near the fault, that is south of the top of unit 63 in the stratigraphic section that follows, the heretofore south dipping strata become broadly folded with dips of between 30 and 40 degrees north and south. Similar lithologies predominate but quartz-pebble conglomerate appears more abundant.

Lithology

The type section is exposed across a series of south dipping ridges about 9 miles east of the head of Fabricius Fiord. Two major lithological types are present, firstly a predominantly shaly succession with thin, more arenaceous beds and secondly a mainly arenaceous succession. This division is reflected in the topographic expression of the outcrop.

Black, thin-bedded, fissile shale and minor siltstone bands comprise about 70 per cent of the strata in the lower member of the formation. Although these beds weather readily and give rise to gentle slopes covered by shattered shale debris, bedrock is usually close to the surface and is commonly exposed in stream valleys.

South, and stratigraphically above the shaly unit, the terrain is more rugged in appearance and is underlain by predominantly quartzose sandstone although towards the top the unit is more arkosic and includes minor conglomerate beds.

Thin sections of the arenaceous beds of the lower unit show subrounded grains of quartz set in a matrix of finer grained quartz. Silica-cemented grains are the rule but in unit 24 carbonate has developed interstitially to the quartz grains. In this unit also a ring of dust-like impurities more or less parallel to the present grain boundaries suggests that there may have been recrystallization of the detrital grains.

The darker units in the lower succession contain varying amounts of sericite, biotite, hornblende, and pyroxene. Unit 22 contains as much as 20 per cent biotite. Fibrous biotite wraps around quartz grains giving a matted appearance in thin section.

A thin arkosic unit appears near the middle of the lower succession. This contains abundant brown biotite as well as chlorite and a few rounded apatite grains.

Sorting in the lower member appears poor to moderate, but in no section examined are there well demarcated boundaries between grains of one size and those of another.

The upper part of the Fabricius Fiord Formation was measured about one mile southwest of the lower beds. Unit 33 was recognizable at both localities. This part of the formation is mainly arenaceous and becomes increasingly arkosic towards the top. Although there are covered intervals they do not seem to be underlain by shaly units. Sorting in the upper member is poor to moderate.

Stratigraphy

The following section was measured in detail and constitutes the type section for the Fabricius Fiord Formation.

Locality 4 (Fig. 13)

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
	Top of section		
63	mainly covered but primarily arkosic rocks with minor sandstone	85	5,430

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
62	similar to unit 61	20	5, 345
61	arkose, very pale orange, medium grained	30	5, 325
60	covered interval	70	5, 295
59	arkose, coarse grained, moderate reddish orange	10	5, 225
58	covered interval	105	5, 215
57	arkose, quartz pebbles, very pale orange	5	5, 110
56	arkose, very pale orange	15	5, 105
55	covered interval	30	5, 090
54	arkose, medium grained, greyish orange	20	5, 060
53	covered interval	10	5, 040
52	similar to unit 48	50	5, 030
51	covered interval	265	4, 980
50	arkose, interbedded dolomite	10	4, 715
49	covered interval	95	4, 705
48	conglomerate, quartz pebbles, arkosic matrix	55	4, 610
47	covered interval	430	4, 555
46	arkose, coarse grained, greyish orange	405	4, 125
45	covered interval	160	3, 720
44	sandstone, medium grained, light olive grey	10	3, 580
43	sandstone, yellowish grey, massive, medium grained, mica	10	3, 570
42	covered interval	15	3, 560

Unit	Lithology	Thickness (feet) Unit	from base
41	sandstone, massive, greyish green	10	3,545
40	covered interval	90	3,535
39	sandstone, medium grained, well-bedded, light olive-grey	60	3,445
38	covered interval	40	3,385
37	sandstone, greyish orange	50	3,345
36	shale, finely bedded, minor siltstone	375	3,295
35	sandstone, argillaceous, medium grey, finely bedded	5	2,920
34	covered interval; mainly shale debris	715	2,915
33	siltstone, dark grey, massive, light olive-grey weathering	5	2,600
32	covered interval, very poor outcrop of black shale	780	2,595
31	sandstone, quartzitic, massive, medium grey, carbonate cement	15	1,815
30	shale	120	1,800
29	sandstone, quartzitic, massive, yellowish grey	10	1,680
28	shale, minor siltstone, fine bedded	535	1,670
27	arkose, argillaceous, micaceous, olive-grey	10	1,135
26	sandstone, quartzitic, coarse grained, quartz-pebble conglomerate light olive-grey	10	1,125
25	shale	380	1,115
24	sandstone, coarse grained, carbonate cement, yellowish grey	10	735
23	shale	35	725

Unit	Lithology	Thickness (feet) Unit	from base
22	sandstone, quartzitic, finely bedded, light olive-grey	5	690
21	shale	70	685
20	similar to unit 1	5	615
19	sandstone, quartzose, medium grained	10	610
18	shale	167.5	600
17	siltstone, minor shaly interbeds sand-filled cracks, well bedded, fine grained	2.5	432.5
16	shale	30	430
15	siltstone, minor shaly interbeds, medium dark grey, fine grained	10	400
14	shale	70	390
13	arkose, medium grained, yellowish grey	5	320
12	siltstone, medium grained with coarse-grained lenses, medium dark grey	5	315
11	shale	30	310
10	sandstone, coarse grained, pale yellowish brown, abundant hematite stain	2.5	280
9	sandstone, quartzitic, medium grained, well bedded, light olive-grey	2.5	277.5
8	shale	50	275
7	siltstone, quartzitic micaceous, dark grey	10	225
6	shale	45	215
5	sandstone, quartzitic, pale yellowish brown, limonite stained	10	170
4	shale, thin-bedded, minor siltstone	120	160
3	sandstone, quartzitic, medium grained, pinkish grey	5	40

Unit	Lithology	Thickness (feet) Unit	from base
2	shale, thin bedded, black	30	35
1	sandstone, quartzitic, light grey	5	5
	Base of section underlying beds Adams Sound Formation		

Structural relations and origin

In the western part of the outcrop area of the unit the Fabricius Fiord Formation overlies the Adams Sound Formation whereas east of longitude 83° 45'W, the underlying beds are Arctic Bay Formation. Wherever the contact of the Fabricius Fiord Formation with the underlying beds was seen it appeared gradational. Thus the formation may locally represent greatly thickened transitional beds comparable to the shaly beds that commonly mark the Adams Sound-Arctic Bay contact.

Society Cliffs Formation

The type section of this formation was measured in the spectacular St. Georges Society Cliffs that extend for 6 1/2 miles from the entrance to Arctic Bay to the mouth of Adams Sound (Lemon and Blackadar, 1963, p. 19). There the succession comprises dense, medium- to fine-grained dolomite, in part slightly calcareous, varying in colour from dark grey (N3) to light grey (N7). These rocks are vaguely bedded or massive and weather a distinctive moderate reddish orange (10 R 6/6) colour, the result of hematite staining. This feature aids greatly in recognizing the formation away from the type section. The formation's physical characteristics, massive or but slightly bedded, and the relatively uniform lithology, result in a cliff-forming unit.

At the type section 900 to 1,000 feet of strata are exposed.

Distribution and thickness

The principal outcrops extend southeast from the type locality. Open folds in gently inclined Uluksan Group strata result in the succession being exposed in two broad belts, the northern about 4 miles in breadth and the southern, comprising nearly horizontal strata, between 6 and 10 miles in width. Southeast of Tremblay Sound only one broad outcrop area is present which extends an unknown distance east of Eskimo Inlet at the eastern margin of the mapped area.

In addition to these principal outcrops there are outcrops of massive dolomitic rocks which, from their position in the stratigraphic succession, are presumed to be part of the Society Cliffs Formation. East of Elwin Inlet several hundreds of feet of dolomite, in part cherty, is exposed beneath unconformably overlying lower Paleozoic strata. The Uluksan Group rocks are exposed due to block faulting which in places exposes not only the Arctic Bay Formation but also Eqalulik Group rocks.

Twelve miles east of the mouth of Mala River there are outcrops of dolomitic rocks similar to the type Society Cliffs Formation. These rocks are well exposed in steep-walled canyons and like the type section are commonly cliff forming.

Several irregularly shaped dolomite outcrops overlie the Arctic Bay Formation in the broad belt of clastic rocks east of Fabricius Fiord. Here and there these rocks are faulted against the Aphebian gneissic and form the southernmost exposures of the Uluksan Group. Rocks of the Society Cliffs Formation are also exposed on a 2,000-foot-high hill a few miles west of the head of Tremblay Sound.

At the type section the formation comprises 900 to 1,000 feet of strata and between Tremblay Sound and Milne Inlet a section 785 feet thick was measured. Although detailed sections have not been measured elsewhere it appears that the Society Cliffs Formation does not vary in thickness to the same extent as the Arctic Bay Formation.

Lithology

At the type section the base of the formation is marked by 20 feet of black dolomite above which is massive to poorly bedded medium- to coarse-grained dolomite (Lemon and Blackadar, 1963, p. 109). The following stratigraphic section was measured between Tremblay Sound and Milne Inlet (locality 2, Fig. 13) and shows the similarity between this section and the type locality although they are more than 100 miles apart.

Locality 2 (Fig. 13)

Overlying beds Victor Bay Formation; contact conformable

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
15	dolomite, fine grained, medium to thick bedded, brownish grey, laminated structure	70	770
14	dolomite, thick bedded, brownish grey, brownish orange weathering	100	700
13	covered interval	130	600
12	dolomite, fine grained, medium bedded, yellowish brown, yellowish orange weathering	90	470

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
11	dolomite, light grey, fine to medium grained, medium to thick bedded, crystalline, vuggy, grey weathering	95	380
10	grit, dolomitic matrix, coarse-grained quartz grains	15	285
9	dolomite, very fine grained, medium to thick bedded, yellowish brown, grey weathering	5	270
8	covered interval, dolomite talus	95	265
7	dolomite, fine grained, thick bedded, dark grey, greyish orange or grey weathering, minor brown petroliferous - smelling material	35	170
6	covered interval, talus of fine-grained pale grey or yellowish brown dolomite	40	135
5	limestone, thick bedded, medium grey, grey weathering	25	95
4	covered interval	45	70
3	dolomite, fine grained, thick bedded, brown, brown weathering	15	25
2	dolomite, calcareous, medium to pale grey, yellowish brown weathering	5	10
1	dolomite, minor edgewise conglomerate, pale grey, thick-bedded, yellowish brown weathering	5	5
	Underlying beds Arctic Bay Formation contact conformable		

East of Fabricius Fiord (approximate co-ordinates 72° 17'N, 83° 20'W) similar carbonate rocks lie above the Arctic Bay Formation. These rocks are fine grained, laminated, massive, light grey to medium grey dolomite weathering to grey or dark yellowish orange colours.

South of Mala River the rocks mapped as Society Cliffs Formation are more or less fine grained, thickly bedded to massive and are light to medium grey in colour and weather grey or dark yellowish orange.

Spectrographic analyses were carried out on two specimens and the results are included in Table XXIV.

Structural relations and origin

The Society Cliffs Formation conformably overlies the Arctic Bay Formation and is overlain conformably by the Victor Bay Formation.

The time during which this formation was deposited must have been one of clear water deposition and relative stability. Although Society Cliffs rocks outcrop over a distance of more than 150 miles, the lithology is remarkably uniform and with very minor exceptions, is entirely carbonate. The close of Society Cliffs time initiated a period of greater instability and instead of dolomite, black, fine-grained shales, argillaceous dolomites, conglomerates and edgewise conglomerates were deposited. These comprise the Victor Bay Formation.

Victor Bay Formation

The type section of the Victor Bay Formation as described by Lemon and Blackadar (1963, p. 20) comprises an alternating succession of dolomites and limestones, and interbedded argillaceous dolomite. This section, measured between Arctic Bay and Victor Bay, is 521 feet thick.

Studies of the formation made elsewhere in northwestern Baffin Island, indicate considerable variations in both lithology and thickness. Such variations are not surprising because, as discussed below, this formation is presumed to represent deposition during a period of instability.

Distribution and thickness

The principal outcrop of the Victor Bay Formation forms a band of gently northeast-dipping strata that extends southeast from the west shore of Strathcona Sound, across Borden Peninsula to Tremblay Sound. The formation, or its equivalent, extends an unknown distance east of Milne Inlet, the eastern limit of the area covered by this report.

Exposures of the formation are also found south of Baillarge Bay and between Strathcona Sound and Elwin Inlet. East of Elwin Inlet a thick dolomite succession, which from its stratigraphic position is considered to be Victor Bay Formation, can be traced eastward to 'Elwin IceCap'. East of the ice cap a carbonate unit several thousands of feet thick lies above Eqalulik Group rocks and below the Strathcona Sound Formation. These carbonate rocks outcrop more or less continuously to the west coast of Navy Board Inlet. Similar rocks are exposed southeast of the ice cap. These carbonate rocks represent the Society Cliffs and Victor Bay formations but it was not possible to separate the two and on the geological maps (published separately) these rocks are shown as undivided Victor Bay and Society Cliffs. The writer considers that although Society Cliffs Formation may be present here and there in these undivided rocks, the lithologies, where examined, tend on the whole to resemble more closely the Victor Bay Formation than the Society Cliffs Formation.

Figure 14. Central Borden Peninsula looking east to Eclipse Sound, ice-covered peaks of Bylot Island in upper left. Victor Bay Formation in centre of photo. (E. M. R. photo T-241-R-94)

Victor Bay beds are exposed in a small west-plunging anticline along Mala River about 25 miles west of the mouth of the river.

A section measured at locality 1 (Fig. 13) gave a thickness of 1,665 feet for the formation. At locality 2 a thickness of 1,645 feet was obtained and at locality three 1,031 feet of strata are present. The well-bedded, nearly flat-lying dolomite succession, presumed to be Victor Bay Formation, that outcrops at the head of Elwin Inlet forms a spectacular, nearly vertical cliff, 2,500 feet high. This feature is clearly visible in the left-centre of Figure 5.

Lithology

The shaly, very dark grey or black dolomite members noted by Lemon and Blackadar (1963, p. 20) as interbeds in the dolomitic Victor Bay succession were observed throughout the principal outcrop belt. At the head of Strathcona Sound grey or greenish grey shales and minor sandstone

Figure 15 Looking east along Strathcona Sound. Strathcona Sound Formation underlies much of the foreground and is capped by somewhat lighter-coloured lowermost Paleozoic clastic rocks (E. M. R. Photo T 252-R-169)

members outcrop near the base of the exposed section, which at this point is at least 800 feet thick. Above these members more massive carbonates predominate.

Ten miles southeast of the head of the sound similar black shales were observed in outcrops continuous with the type Victor Bay succession, and similar argillaceous interlayers were noted 36 miles southeast of Strathcona Sound.

East of the latter locality the outcrop presents a darker appearance although showing no discontinuity with outcrop traceable to the type locality, and although still showing the typical banded outcrop appearance (Fig. 14). Field observations show that although the formation consists mainly of dolomite, considerable argillaceous material is included. Fresh surfaces are dark grey or greyish brown, and shaly interbeds are more common to the east.

Lemon (1956, p. 67) notes that at English Bay, on the north side of Strathcona Sound, the Victor Bay Formation comprises several hundreds of feet of argillaceous dolomite and limestones and clastic dolomites and limestone with edgewise fragments. The top of this succession is marked by silty, poorly sorted sandstone and conglomerate. He further notes (op. cit. p. 68) that the English Bay succession is much more argillaceous than the type section, that the proportions of edgewise conglomerate and thick-bedded carbonate are reduced, and that (op. cit. p. 79) the succession at English Bay may prove to be more typical than that at Victor Bay.

From observations made during Operation Admiralty it appears that the carbonate succession that lies conformably beneath the Strathcona Sound Formation and is by definition Victor Bay Formation, is lithologically variable. The thickening of the argillaceous members noted by Lemon a few miles east of the type locality and noted by him to be rather pronounced at English Bay, increases towards the head of Strathcona Sound where indeed talus slopes developed on this unit are so argillaceous that they could easily be mistaken for outcrops of Arctic Bay Formation.

At locality 1 (Fig. 13), calcareous beds are proportionately more abundant, but air observations of the Victor Bay Formation between Strathcona Sound and this point all make reference to black shale as well as to dolomite.

The section described from locality 3 (Fig. 13) is illustrative of facies variation within this formation. Unlike sections 1 and 2, the formation is most argillaceous in the upper 500 feet at locality 3. However, as it is traced westward along the south side of Baillarge River, the upper beds become less argillaceous until at a point about 2 miles west of locality 3, well-bedded dolomite underlies a remarkable conglomerate, and the red beds of the Strathcona Sound Formation (see Fig. 16). East of locality 3 the Victor Bay beds are even more argillaceous but to the north across Baillarge River carbonates predominate.

East of locality 1 the argillaceous content of the Victor Bay Formation again increases to such an extent that it becomes difficult to recognize the formation from air photographs, but at locality 2 on the peninsula between Tremblay Sound and Milne Inlet, carbonate beds are once again dominant.

North of English Bay and Strathcona Sound the argillaceous facies is dominant at least to locality 3 although, as previously noted, north of 'Strathcona River' carbonate appears to be much more abundant.

Figure 16. Conglomerate in Strathcona Sound Formation. Photo by R. G. Blackadar G. S. C. 152995.

East of Elwin Inlet the Victor Bay Formation is almost entirely carbonate facies and this aspect persists throughout the extension of these outcrops east of 'Elwin Ice Cap', an extension in which both Society Cliffs and Victor Bay Formations are included.

The carbonate facies is also dominant west of the mouth of Tremblay Sound at Alfred Point where a northwest-striking unit of light- to medium-grey dolomite and limestone beds unconformably overlies Aphebian gneiss. The carbonates weather white in contrast to the grey of the Victor Bay Formation a few miles south as exposed in cliffs along Tremblay Sound, yet, stratigraphically they appear to be Victor Bay and probably represent a facies of the formation. Similar light-coloured carbonate rocks persist along strike for about 12 miles, but beyond this point they become gradually darker with increasing argillaceous content.

Stratigraphy

Three sections were measured, the first at locality 1 (Fig. 13) where the overlying beds are Strathcona Sound Formation, the second at locality 2 where carbonates of the Athole Point Formation form the overlying strata, and the third at locality 3 where Strathcona Sound beds overlie the measured section but where nearby the Victor Bay beds are unconformably overlain by the Paleozoic Gallery Formation.

Structural relationships and origin

The Victor Bay Formation conformably overlies the Society Cliffs Formation. The contact is transitional, being marked by an increase in the amount of argillaceous material. Where observed, the upper contact of the formation is conformable with the overlying Strathcona Sound Formation. At Athole Point, in the eastern part of the area, the formation is conformably overlain by a black carbonate unit, the Athole Point Formation.

Lemon (1956, p. 66) notes the presence of conglomerate beds near the top of the Victor Bay Formation. About 3/4 mile south-southwest of Victor Bay the top of 10 feet of the formation comprises a conglomerate with angular to subrounded fragments, several inches in diameter, of rusty-weathering dolomite with an arenaceous matrix. Six miles west of English Bay, the top of the Victor Bay Formation is marked by a "thick conglomerate with angular, dark grey, dolomite limestone fragments" (Lemon, op. cit., p. 67). A similar but thicker conglomerate outcrops east of Baillarge Bay.

Locality 1 (Fig. 13)

Overlying beds Strathcona Sound Formation
contact conformable

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
16	covered interval	65	1,665
15	dolomite, silty in part, fine grained, medium to dark grey, flaggy weathering	25	1,600
14	covered interval	95	1,575
13	dolomite, argillaceous, silty, fine grained, thin to medium bedded, black	90	1,480
12	covered interval	190	1,390
11	dolomite, argillaceous, fine grained, thin to very thin bedded, laminated, black, dark yellowish orange to grey weathering	15	1,200
10	dolomite, minor edgewise conglomerate, thick bedded, dark grey, dark yellowish orange weathering	55	1,185
9	covered interval	77.5	1,130
8	dolomite, argillaceous, fine grained, thin bedded, laminated, black to grey	2.5	1,052.5

Unit	Lithology	Thickness (feet) Unit	from base
7	covered interval	17.5	1,050
6	dolomite, argillaceous, very fine grained, very thinly bedded, black, black to pale yellowish brown weathering	2.5	1,032.5
5	covered interval	80	1,030
4	dolomite, minor edgewise conglomerate, thick bedded, fragments of chert and carbonate, dark grey, weathers pale yellowish brown to dark yellowish orange	125	950
3	covered interval - talus of flaggy dolomite and argillaceous siltstone	200	825
2	siltstone, argillaceous, dolomite interbeds	10	625
1	siltstone, argillaceous, very fine grained, very thin to thinly bedded, micaceous, black, black weathering	615	615

Underlying beds, Society Cliffs Formation, contact conformable

Locality 2 (Fig. 13)

Overlying beds Athole Point Formation contact conformable

Unit	Lithology	Thickness (feet) Unit	from base
6	dolomite, minor edgewise conglomerate, thick bedded, fine grained, vuggy or crystalline in places, pale grey, rarely dark grey or brownish, brownish or dark yellowish orange weathering	970	1,645
5	dolomite, medium to thick bedded, fine grained, minor edgewise conglomerate, dark grey to greyish brown, grey or brown weathering	25	675

Unit	Lithology	Thickness (feet) Unit	from base
4	dolomite, medium to thick bedded; fine grained, minor edgewise conglomerate, pale grey, grey weathering	270	650
3	covered interval; mainly edgewise conglomerate	90	380
2	dolomite, edgewise conglomerate, pale grey, thin bedded, grey weathering	205	290
1	covered interval; dolomite talus and intraformational conglomerate	85	85
	Underlying beds Society Cliffs Formation, contact conformable		

Locality 3 (Fig. 13)

Overlying beds Strathcona Sound Formation contact conformable

Unit	Lithology	Thickness (feet) Unit	from base
20	mainly steep talus slope, black shale and minor argillaceous dolomite	510	1,031
19	shale, fine bedded, black	40	521
18	covered interval, thin ledges of dolomite project through talus of argillaceous dolomite	105	481
17	dolomite, massive, medium-dark grey, irregular masses of black chert	20	376
16	dolomite, massive, black chert, dark grey	10	356
15	dolomite, cherty nodules, medium grey	.5	346
14	dolomite, medium bedded, medium grey	10	345.5
13	dolomite, medium grained, massive, medium grey	5	335.5
12	dolomite, medium bedded, medium grey	15	330.5

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
11	chert, black	.5	315.5
10	dolomite, medium bedded, medium grey	14	315
9	dolomite, black chert	1	301
8	dolomite, medium bedded, medium grey	20	300
7	dolomite, medium bedded, medium grey; many en echelon calcite veinlets	10	280
6	dolomite, fine bedded, medium grey	1	270
5	dolomite, minor black chert nodules, medium grey	1.5	269
4	dolomite, fine grained, fine bedded, medium grey	2.5	267.5
3	dolomite, massive, medium grey	15	265
2	dolomite, medium bedded, dark grey	75	250
1	dolomite, massive to medium bedded, dark grey	175	175
	base of section		

Lemon (op. cit. p. 66) and Lemon and Blackadar (1963, p. 23) considered that these conglomerates mark the transition to the overlying Strathcona Sound Formation, and placed the contact at the place where the sandstones and mudstones of the Strathcona Sound Formation replaced the calcareous beds of the Victor Bay. The writer is now inclined to place the contact at the appearance of the first conglomerate unit. The conglomerate units invariably comprise a matrix of reddish mudstone or siltstone typical of the Strathcona Sound beds. Similar conglomerate beds are present throughout the lower part of the Strathcona Sound Formation. They are found in areas not mapped by Lemon and Blackadar, and persist through a thousand or more feet of the formation. In contrast such conglomerates are found only at the very top of the Victor Bay (as defined by Lemon and Blackadar) and are in no way characteristic of that formation. This change in the position of the contact makes no difference in the contacts shown on Map 1133A accompanying the report by Lemon and Blackadar (1963) as only a few feet of strata are involved.

Without exception Victor Bay time saw an increase in the supply of noncarbonate material to the areas of deposition. The prevalence of well-bedded argillaceous, commonly pyritiferous beds suggests that conditions were relatively quiet and that deposition took place in deep or moderately deep waters. Edgewise conglomerate beds are found mainly in the carbonate facies beds and invariably are carbonate-derived. The fragments show no evidence of transportation while soft, and thus probably are derived from shallow shelf areas that underwent emergence and desiccation from time to time.

The close of Victor Bay time, and especially the beginning of Strathcona Sound time, was one of instability.

Athole Point Formation

A succession of medium grey to medium-light grey argillaceous limestones and cherts, and well-bedded argillaceous limestone with minor beds of intraformational conglomerate, and platy limestone overlies the Victor Bay Formation east of Tremblay Sound and south of Athole Point. These rocks were first examined by W. L. Davison in 1954. The name Athole Point was proposed by the writer in 1963 for this succession (Blackadar, 1965).

Distribution, thickness and stratigraphy

Outcrops of the formation are found on the peninsula between Tremblay Sound and Milne Inlet and extend south from Athole Point for about 8 miles. Similar carbonate rocks outcrop east of Tremblay Sound, but in this area the contacts of the formation are not precisely known.

Detailed examination of the formation was not made by Davison in 1954 but he made a traverse across it with the following results:

Locality 2 (Fig. 13)

Unit	Lithology Top of section	Thickness (feet) Unit	from base
6	limestone, platy, dark grey (N3), calcite veins	600	5,000
5	limestone, fragmental, massive, dark grey	1,200	4,400
4	limestone, medium-light grey (N6), calcite veins, minor fluorite	1,000	3,200
3	limestone, argillaceous, well banded, calcite veinlets, medium grey (N5)	1,000	2,200
2	limestone, argillaceous, dark grey (N3)	600	1,200

Unit	Lithology	Thickness (feet) Unit	from base
1	limestone, argillaceous, minor dark grey shale, minor fragments, light olive-grey (5Y6/1) sandy limestone, chert	600	600
	Underlying beds Victor Bay Formation contact conformable		

The Athole Point Formation conformably overlies the Victor Bay Formation. The top of the formation has not been seen and its relationship to the Strathcona Sound Formation that usually overlies the Victor Bay Formation is unknown.

Strathcona Sound Formation

A widespread clastic formation overlying the Victor Bay Formation was named by Lemon and Blackadar (1963, p. 23) for the prominent body of water from the shores of which the succession was first described. A thickness of between 1,500 and 2,000 feet was suggested for this unit, although the authors stated that greater thicknesses might obtain. On the basis of incomplete sections and on structural grounds a thickness in excess of 4,000 feet is now postulated.

Distribution and thickness

The Strathcona Sound Formation covers a large area of northern Borden Peninsula although it is not found on the extreme east coast of the peninsula. The principal area of outcrop extends southeastward from Uluksan Peninsula and the north shores of Strathcona Sound and is a broad belt, as much as 20 miles wide, of gently inclined to horizontal strata (Fig. 15). The northern contact of the belt is in most places a major fault which has elevated the Aphebian gneissic and granitic rocks to such a height that they form the highest terrain on Borden Peninsula and support the largest ice caps. North of the crystalline belt most of the Eqalulik Group and Uluksan Group formations are repeated, and several hundreds of square miles of northern Borden Peninsula are underlain by Strathcona Sound Formation rocks.

The formation is not found south of the prominent through valley occupied by Adams and Alfa rivers. Where folding and faulting have caused repetition of Eqalulik and lower Uluksan Group formations, units younger than Victor Bay have not been found.

Outcrops of Strathcona Sound Formation have not been observed east of about 81° W, where the Athole Point Formation appears to be the youngest Precambrian unit.

Complete sections were not measured but on structural grounds the lower unit, predominantly red-coloured mudstone and siltstone, is at least 2, 500 feet thick, and the upper grey sandstone and siltstone unit is 1, 500 feet thick.

Lithology

As originally defined (Lemon and Blackadar, 1963, p. 23) the Strathcona Sound Formation comprised the monotonous succession of fine-grained, laminated, dark grey to very dusky red or dark reddish brown siltstone and shale sequence lying above the Victor Bay Formation.

Studies made during the 1963 field program indicate that this succession is divisible into two main members, one of dark red mudstones and shales and the other a succession of grey sandstones and siltstones. The former are usually lower in the stratigraphic succession than the latter, but interfingering of the two has been observed. The normal situation obtains throughout most of the outcrop area east of the mid-point of Strathcona Sound. There the lighter coloured grey arenaceous rocks cap many of the hills.

An interfingering of the two lithologies is especially well displayed on the high cliff faces on the south side of the valley that extends east from Baillarge Bay. There a thick succession of westerly dipping dark red mudstone and shale grades within about a mile into a predominantly grey siltstone-sandstone succession which, however, contains many thin bands of dark red mudstone. The latter in turn disappear and along the south shore only grey siltstones and sandstones of the upper member are exposed, and these in turn are overlain by the succeeding Elwin Formation.

A widespread period of instability characterized later Victor Bay time and continued throughout much of Strathcona Sound time. Intraformational conglomerate beds are widespread throughout the formation especially west of the head of Strathcona Sound. An outstanding example is a light-weathering intraformational conglomerate that outcrops on both sides of the valley east of Baillarge Bay (Fig. 16). This unit is about 2 miles long and is lens shaped, with a maximum thickness exceeding 100 feet. In the thickest part, the basal beds contain interbedded black argillaceous dolomite and shale, whereas the uppermost part contains interbedded dark red shale and mudstone.

This unit comprises fragments up to 1 foot in length of medium grey dolomite set in a matrix of dark red mudstone. Many fragments weather dark yellowish orange (10 YR 6/6) and impart a most remarkable appearance to the unit.

Dolomite is locally abundant in the Strathcona Sound Formation, especially in the lowermost part of the succession. About 5 miles north-northwest of the head of Strathcona Sound the intermixture of dolomite and red mudstone imparts a particular knobby appearance to the outcrops. It is probable that these beds are transitional between the Victor Bay and Strathcona Sound formations.

Thin sections of specimens collected from the siltstone in the lower member show that they are composed of subrounded to subangular grains of quartz. Perthite, microcline, and plagioclase are present in varying amounts. The matrix is similar in composition but also includes biotite and chlorite. Quartz is by far the most abundant mineral and on the basis of the distribution of the other constituents, these rocks are more correctly classed as subarkose.

Microscopic examination of the drab clastic rocks of the upper member shows subangular to subrounded quartz grains separated by a fine-grained matrix of hornblende, biotite, and muscovite. Plagioclase is present but is not common. More than one-third of the quartz grains in one thin section contained inclusions. On the basis of mineral composition these rocks are classed as greywacke.

Spectrographic analyses were made of three specimens from the Strathcona Sound Formation and the results are included in Table XIV.

Stratigraphy, structural relations and origin

No complete sections were measured in the Strathcona Sound Formation. Where well-exposed in cliff sections, such as south of Baillarge Bay, the outcrop is so deeply weathered and rotten that it is impossible to climb. Rock falls are common and valley floors bordering these cliffs are filled with debris ranging in size from a few inches to blocks many tens of feet in length. Elsewhere the formation underlies gently undulating terrain and exposures are limited to sections a few tens of feet in thickness.

A section was measured of a few tens of feet of the several thousands of feet exposed in a gorge southeast of Baillarge Bay. The results typify a lithology, which appears from the nature of the scree to be characteristic.

Locality 3 (Fig. 13)

Incomplete section overlying beds, Strathcona Sound Formation

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
13	intraformational conglomerate, some fragments exceed 1 foot in length	4.0	58.5
12	subarkose, massive, medium grey minor argillaceous bands	24.0	54.5
11	similar to unit 5	6.0	30.5
10	similar to unit 2	2.0	24.5
9	subarkose, medium grained, medium grey	4.5	22.5
8	subarkose, fine bedded, 6-inch intraformational conglomerate bed at top	2.0	18.0

Figure 17. Contact between Strathcona Sound Formation and Paleozoic Gallery Formation, south side Baillarge River Valley about 5 miles from Baillarge Bay. Photo by R. G. Blackadar G.S.C. 152996.

Unit	Lithology	Thickness (feet) Unit	Thickness (feet) from base
7	similar to unit 5	3.0	16.0
6	intraformational conglomerate	2.0	13.0
5	subarkose, medium grey, minor bands of sandstone up to 1/2 inch thick	6.0	11.0
4	similar to unit 2	.7	5.0
3	subarkose, similar to unit 1	1.5	4.3
2	subarkose, finely laminated	1.7	2.8
1	subarkose, argillaceous, massive, medium grey	1.1	1.1

Stream deposits below

The contact between the Victor Bay and Strathcona Sound formations is conformable and transitional but, as noted in the discussion of the Victor Bay Formation, the writer has redefined the position of the contact and now places the base of the Strathcona Sound Formation at the first appearance of the brightly coloured interformational conglomerate such as shown in Figure 16.

The formation is gradational into the overlying Elwin Formation and there is usually little difficulty in separating the two. The more colourful and more varied lithologies of the Elwin Formation are markedly different from the drab greys of the upper member of the Strathcona Sound Formation.

In places the Strathcona Sound Formation is overlain unconformably by the lowest unit of the lower Paleozoic Admiralty Group (Fig. 17).

The considerable thickness, in excess of 4,000 feet, and the lithological uniformity over a large area, indicate prolonged subsidence. The presence of numerous beds of intraformational conglomerate in the lower part of the succession indicates a period of considerable instability, but this was apparently followed by more stable conditions during which time the predominantly subarkosic rocks of the formation were deposited.

Elwin Formation

The Elwin Formation (Lemon and Blackadar, 1963, p. 25) is the uppermost formation of the Uluksan Group, and includes all pre-Admiralty Group strata lying above the Strathcona Sound Formation. Rocks of this formation are most abundant north of a line extending east from the midpoint of Elwin Inlet to Navy Board Inlet. The formation also outcrops between Strathcona Sound and Baillarge Bay, and similar strata are present in the valleys of the peninsula between Elwin Inlet and Baillarge Bay.

Lithology

The formation is a varicoloured assemblage of alternating reddish or bright orange-weathering quartzitic sandstones, reddish silty sandstones and micaceous shales. The type section (Lemon and Blackadar, 1963, p. 28) comprises 1,297 feet of strata. No complete sections have been measured but on structural grounds the thickness of the Elwin Formation appears to exceed 5,000 feet.

The quartzitic sandstones are medium grained, hard, and many are crosslaminated. In thin section the grains are seen to be subrounded and many specimens contain little interstitial material. In others there is a matrix composed of fine-grained quartz and red iron oxides. These rocks vary from moderate red (5 R 4/6) through yellowish grey (5 Y 8/1) to light grey (N 7) in colour, the yellowish shades being the most common. They weather greyish orange (10 YR 7/4) or moderate yellowish brown (10 YR 5/4). Most are medium to thick bedded, and here and there ripple-marked surfaces were seen.

Fine-bedded quartzitic sandstone interbedded with micaceous shale appears to be the most abundant lithology in the Elwin Formation. Such a succession is exposed on the west shore of Navy Board Inlet in northern Borden Peninsula. The shaly beds vary in thickness from one-half inch to several feet and are usually greyish red (10 R 4/2) or dark reddish brown (10 R 3/4) in colour. They comprise about a quarter of the succession, the remainder being light-coloured sandstone and siltstone.

The contact between the Elwin Formation and the Strathcona Sound Formation is gradational. The upper contact is a disconformity above which may be rocks of Paleozoic age. Where the lower formations of Paleozoic age occur above the Elwin some difficulty may be experienced in separating the two. However, banding is much more prominent in the Elwin Formation than in the overlying Paleozoic clastic strata, the beds being thinner and lithologically more variable. This feature serves as a field guide in separating the younger rocks from the Elwin Formation.

Origin

The presence of crosslaminated structures and ripple-marked surfaces suggests that the Elwin Formation was deposited in relatively shallow seas. The alternation of beds of quartzitic sandstone and more impure, commonly micaceous beds, indicates that changes of depositional environment were common. The reconnaissance scale of mapping used during Operation Admiralty precluded tracing individual beds, or series of beds, and thus the dimensions of the depositional basins in which the varied lithologies were laid down remain unknown. The lithological similarity of the formation from one side of Borden Peninsula to the other together with the structures just described, indicate that this part of northwestern Baffin Island was probably subjected to a periodic advance and recession of near-shore conditions during Elwin time.

GABBRO DYKES AND SILLS

Dykes, or here and there sills, of diabasic gabbro intrude all rocks older than the Gallery Formation of Cambrian and/or Lower Ordovician age. These intrusions are part of the 'Diabase Series' described by Fortier (1957) from studies made in various parts of the Canadian Arctic. Data accumulated in the past few years indicates that more than one period of intrusion is involved and that the dykes can be placed in several groups each of which appear to have a distinct age (W. F. Fahrig, personal communication).

A remarkable series of basic dykes trends northwest from Milne Inlet and the head of Tremblay Sound, at the eastern limit of the area mapped, to Uluksan Peninsula on the east shore of Admiralty Inlet (Fig. 9, in pocket). Smaller and less extensive clusters of northwest-trending dykes are found east of Fleming Inlet and Fabricius Fiord, in northern Borden Peninsula, and north of Fury and Hecla Strait.

There is a second preferred dyke orientation direction, north or north-northwest, but fewer dykes are involved and there is less constancy of orientation. Here and there the two sets intersect but no data are available on their relative ages.

North of Fury and Hecla Strait there are sills as well as dykes. Here and there the sills are intruded by dykes, and one of the best examples of this is seen in the large sill south of Autridge Bay illustrated by the frontispiece.

The dykes intrude Aphebian, Eqalulik and Uluksan Group rocks, but do not cut the Admiralty Group or younger strata and are thus by definition older than Cambrian and/or Lower Ordovician.

The dykes are commonly more resistant to erosion than the rocks they intrude and as a consequence they outcrop as steep ridges that rise as much as several hundreds of feet above the surrounding terrain. Dykes near Cape Appel and Sikosak Bay near Fury and Hecla Strait in the south and those paralleling Alfa and Adams rivers, in the region southeast of Adams Sound, all provide especially good examples of this resistance to erosion.

Dykes

Of the two predominant trend directions, northwest and north or north-northwest, the former is by far the more prevalent. However petrographically there does not appear to be any marked distinction between the two sets. Plagioclase is the principal mineral present and together with pyroxene usually comprises more than 75 per cent of the rock. Usually only clinopyroxene is present but some rocks contain both clinopyroxene and orthopyroxene. In most specimens examined quartz is a minor constituent, although one narrow dyke south of Gifford Fiord contains more than 15 per cent quartz. Olivine is randomly present. In the wider dykes plagioclase is commonly extensively altered usually to sericite but here and there to a fine, unidentifiable opaque mass, possibly comprising clay minerals.

North-trending dykes

In general the north-trending dykes are narrow but several near Charles Yorke River in northern Borden Peninsula exceed 200 feet in width. These dykes exhibit chilled contacts against the Uluksan sedimentary strata that they intrude and are medium grained towards the centre, but otherwise do not show marked variations. There does not appear to be any development of a siliceous centre, the so-called granophyre or red-rock, and the grain size variation is not unusual, indeed it is not even what might normally be expected in a dyke of this width. The presence of up to 4.1 per cent micropegmatite does however suggest that there has been some differentiation. Contact metamorphic effects seem limited to the chilling of the diabase; none was observed in the country rocks. Such alterations might not be expected where the intruded rocks are the relatively pure sandstones of the Elwin Formation or the dolomites of the Society Cliffs Formation, but even where rocks as susceptible to reflecting metamorphic effects as the shales and mudstones of the Strathcona Sound Formation or the argillaceous dolomite of the Victor Bay Formation have been intruded, contact metamorphic effects seem negligible.

A modal analysis of a specimen from near the centre of the largest north-trending dyke that crosses Charles Yorke River near the Elwin Formation-Strathcona Sound Formation contact is given in Table XII and the corresponding chemical data in Table XIII.

Table XII

Modal Analysis, Gabbro Dyke

(volume %)

amphibole	10.8
pyroxene	20.4
magnetite	5.0
quartz	2.9
plagioclase	56.6
biotite	00.2
micropegmatite	4.1

Table XIII

Chemical Analysis, Gabbro Dyke

(weight %)

SiO_2	50.1
Al_2O_3	18.7
Fe_2O_3 (total Fe)	10.8
CaO	10.4
MgO	3.4
Na_2O	2.8
K_2O	0.88
TiO_2	1.76
P_2O_5	0.14
MnO	0.17

Table XIV

Modal Analysis, Gabbro Dyke

(volume %)

amphibole	4.7	14.1*
pyroxene	24.6	14.0
magnetite	3.2	5.7
quartz	0.9	5.5
plagioclase	65.7	50.9
biotite	0.3	3.6
olivine	0.6	0.6
chlorite	--	1.2
micropegmatite	--	3.7

* average of 28 analyses, Lemon and Blackadar (1963, p. 37)

Northwest-trending dykes

Northwest-trending dykes are most abundant on the peninsula between Strathcona Sound and Adams Sound and the southeastward projection of this geographic feature. These intrusions extend southeast and cross the eastern boundary of the area mapped in 1963 slightly north of Koluktoo Bay. W. L. Davison (personal communication) encountered similar basic intrusions during mapping carried out in 1954 in the area east of that mapped during Operation Admiralty.

Although a northwesterly trend predominates the dykes do not follow invariable trends. Some wander in a somewhat sinuous fashion across the countryside, splitting, joining and sending off minor offshoots. These features are more readily seen from an examination of geological maps 1237A, Arctic Bay - Cape Clarence, 1238A, Moffet Inlet - Fitzgerald Bay and 1235A, Milne Inlet, than can be illustrated on a small scale map such as Figure 9.

A modal analysis made of a specimen taken from near the centre of a dyke cutting the Society Cliffs Formation 2 1/2 miles west of the mouth of Arctic Bay is given in Table XIV and is contrasted with the average composition of a dyke 2 miles east of Arctic Bay settlement. Data for the latter column is the average of the data quoted in Lemon and Blackadar (1963, p. 37).

These data indicate that there are differences between various intrusions. The larger the intrusion the greater appears to be the quartz and micropegmatite content. Alteration of pyroxene also appears to be more characteristic of the wider dykes. The total pyroxene-amphibole-biotite-chlorite content of both sets of data is similar but alterations of pyroxene are greater in the data quoted from Lemon and Blackadar from a 400-foot-wide dyke, than in the first set of data which are from an intrusion of about only one half the width. Plagioclase alteration also appears to be much more common in the wider dykes.

Micrometric data from dykes in the southern part of the map-area are presented in Table XV.

Table XV

Modal Analyses, Gabbro Dykes

(volume %)

	1	2	3	4	5	6
amphibole	4.2	43.0	53.6	2.9	9.8	15.6
pyroxene	27.3	-	-	39.6	32.0	42.1
magnetite	5.5	5.8	0.3	7.6	5.0	2.2
quartz	2.2	16.6	14.6	tr	2.5	-
plagioclase	60.8	23.0	25.6	34.3	48.2	39.1
biotite	-	3.6	4.1	-	2.6	-
sericite	-	3.8	-	15.2	-	-
sphene	-	2.8	1.5	-	-	-
chlorite	-	0.6	-	-	-	-
serpentine	-	0.8	-	-	-	-
olivine	-	-	-	-	-	0.5
%An	63	34	33	66	-	70

The first is an analysis of a specimen from one of a pair of adjacent, northwest-trending dykes that cross the upper reaches of Gifford River (Erichsen Lake, 1242A map-sheet). Felsenmeer masks the contacts but each dyke appears to be about 500 feet wide. Both orthopyroxene and clinopyroxenes are present in this rock.

The second and third analyses are from a ten-foot-wide dyke from the south side of the entrance to Gifford Fiord. Despite the small size of this intrusion it exhibits more prominent differentiation effects than most of the larger dykes. In hand specimen blotchy reddish areas can be seen throughout the rock. In thin section these are seen to be much corroded plagioclase phenocrysts set in an unaltered diabasic groundmass. Quartz commonly contains numerous inclusions in this dyke. The amphibole is a blue-green hornblende and suggests that the magma was soda rich. Small wedges of sphene are common to both specimens examined.

The fourth and fifth results are from a 45-foot-wide, northwest-trending dyke north of Fury and Hecla Strait. Analysis 4 is from the contact whereas analysis 5 is from near the centre of the intrusion. In this dyke plagioclase alteration has been more intense at the margin than at the centre. Both specimens contain only clinopyroxene.

The last specimen is from a dyke that cuts shaly rocks of the Arctic Bay Formation 26 miles east of the head of 'Fleming Lake', (north of Fleming Inlet). The margins of this intrusion are very fine grained but no contact metamorphic effects were seen. The dyke becomes very coarse grained towards the centre.

Chemical data for specimens 1, 3 and 4 of Table XV are given in the following table.

Table XVI

Chemical Analyses, Gabbro Dykes

(weight %)

	1	3	4
SiO_2	51.2	52.6	47.9
Al_2O_3	17.8	16.4	13.3
FeO	9.1	6.3	10.2
Fe_2O_3	1.3	1.7	2.5
CaO	10.8	6.4	9.7
MgO	4.7	4.2	6.1
Na_2O	2.8	3.8	2.6
K_2O	0.47	1.59	0.57
TiO_2	0.93	1.14	1.78
P_2O_5	n.d.	n.d.	n.d.
MnO	0.21	0.13	0.23

A well-exposed dyke, 150 feet wide, north of Fury and Hecla Strait was sampled at 15-foot intervals from south to north across strike. This dyke cuts quartzite of the Fury and Hecla Formation and is but slightly weathered.

TABLE XVII

Modal Analyses, Gabbro Dyke, north of Fury and Hecla Strait

(volume %)

	1	2	3	4	5	6	7	8	9
pyroxene	47.9	33.4	21.2	8.3	32.3	5.6	27.4	27.6	36.3
chlorite	5.8	8.9	0.2	-	-	-	-	-	-
magnetite	5.6	4.2	8.8	3.4	3.6	13.6	1.8	3.5	7.7
sericite	3.6	25.4	10.0	59.8	44.3	5.0	6.8	0.9	-
quartz	0.3	-	2.0	2.1	0.8	4.4	1.3	0.7	2.7
plagioclase	36.8	28.1	44.5	4.1	2.5	56.3	55.4	57.7	43.9
micropegmatite	-	-	0.4	-	-	-	-	-	-
biotite	0.1	-	1.0	7.1	0.3	3.1	2.2	0.6	0.6
amphibole	-	-	12.0	14.9	15.0	11.8	4.9	8.9	7.7
apatite	-	-	-	0.1	0.3	-	-	-	-
carbonate	-	-	-	-	0.3	-	-	-	-
% An	62*	68		67				68	69

*An_{78} in zoned phenocrysts

Chemical data for specimens 1, 7, and 9 are given in Table XVIII

Table XVIII

Chemical Analyses, Gabbro Dyke

(weight %)

	1	7	9
SiO_2	47.6	47.7	48.3
Al_2O_3	15.0	16.9	13.2
FeO	10.6	9.8	12.5
Fe_2O_3	1.5	0.9	1.5
CaO	10.3	9.6	9.7
MgO	6.0	4.9	5.8
Na_2O	2.6	3.1	2.6
K_2O	0.58	0.75	0.61
TiO_2	1.63	1.44	2.08
MnO	0.22	0.19	0.26

The high degree of plagioclase alteration found in the southern two thirds of this dyke is not easily explained. It does not appear to follow any change in plagioclase composition; in fact this mineral is remarkably constant in composition and is much more calcic than is common in the northwestern Baffin Island dykes. Orthopyroxene was noted only in specimen number 8.

Sills

Several large sills of gabbro are exposed in the southern part of the map-area. These are emplaced in the Fury and Hecla Formation, an assemblage of quartzites with minor shale interbeds, and the overlying Autridge Formation, an assemblage of black, micaceous siltstone, black shale, slate, and ferruginous dolomite. The intrusions are usually found near the contact between the two formations. Some sills are at least 600 feet thick. They are remarkably uniform in appearance from top to bottom and, except at the margins, show but slight variation in grain size. A rectilinear joint pattern, well displayed by the Autridge Bay sill (Frontispiece) is common to most sills.

A modal analysis of the Cape Appel sill is given below together with data from a sill north of Cape Ejnar Mikkelsen and from the Autridge Bay sill. These latter data were published previously (Blackadar, 1963, p. 12).

Table XIX

Modal Analyses, Gabbro Sills

(volume %)

quartz	-	1.5	tr
amphibole	0.8	3.0	-
plagioclase	48.7	55.4	53.8
biotite	1.1	0.9	-
chlorite	-	1.1	20.0
apatite	-	tr	tr
magnetite	2.1	1.2	3.0
olivine	4.0	-	-
pyroxene	43.3	36.8	21.1

1 - sill at Cape Appel
2 - sill west of Dybbol Harbour
3 - sill north of Cape Ejnar Mikkelsen

A comparison of these data with comparable data from diabase dykes presented in Tables XII, XIV, XV and XVII indicates that there are no significant mineralogical differences and that it is probable that both sills and dykes represent the same period of intrusion.

The chemical data presented in Tables XIII, XVI and XVIII and the mineralogical composition of the basic intrusive rocks, indicate that these rocks are members of the tholeiite assemblage of flood basalts rather than the olivine basalt association. Tholeiites have a higher SiO_2 content and lower Na_2O, K_2O and MgO content than do olivine basalts. Mineralogically tholeiites are characterized by a quartzo-feldspathic groundmass and by the presence of pigeonite, a mineral present in some but no means all of the specimens of basic intrusive rock examined from northwestern Baffin Island. In characteristic tholeiites some olivine may be present although it is usually absent from the largest bodies. Turner and Verhoogen (1951, p. 183) note that the micropegmatite and commonly high content of iron ores (as much as 10 per cent) common to these basic rocks may result from a high concentration of volatiles in residual liquids developed late during the crystallization of the magma.

The absence of assimilation of country rock by any of the intrusions examined from northwestern Baffin Island suggests that the magma has a low water content. This supposition is strengthened by the fact that pyroxene-plagioclase rather than hornblende-biotite-plagioclase is the principal mineral association. In the larger dykes slight differentiation led to an increased water content resulting in an increase in the hornblende-biotite content such as that found in the dyke the modal analysis of which is given in Table XV or in the dyke east of Arctic Bay settlement quoted in Lemon and Blackadar (1963, p. 37). It is surprising that this effect has not affected the sills which are actually much thicker than the widest dykes.

Age

Two potassium-argon age determinations were carried out on specimens of dyke rock from near Arctic Bay. The results, quoted in Table XX, indicate a Neohelikian age for the dykes.

AGE AND CORRELATION OF THE EQALULIK AND ULUKSAN GROUPS, AND RELATED FORMATIONS

The volcanic and sedimentary strata comprising the Eqalulik and Uluksan groups, and the similar strata north and south of Fury and Hecla Strait, are probably the most extensive successions of late Precambrian rocks in the North American arctic regions.

All formations are cut by gabbroic dykes but these are not known to intrude strata younger than the Elwin Formation which is separated from the lower Paleozoic Gallery Formation by an erosional disconformity.

Four potassium-argon age determinations have been made by the staff of the Geochronology section of the Geological Survey on specimens from the basic intrusive rocks; the data are tabulated below.

Table XX

Age Determinations, Gabbro Dykes and Sills

GSC No.	Rock	Mineral dated	%K	Ar_{40}/K_{40}	Radiogenic argon	Age (m. y.)
63-19	diabase	biotite	0.36	.0689	100	915
63-20	diabase	biotite	0.62	.0914	85	1140
64-33	basalt	whole rock	5.8	.04448	96	639 $\pm$ 25
K-Ar 989	gabbro	whole rock	3.0	.0316	50	475 $\pm$ 81

Much of the material collected by members of Operation Admiralty proved unsuitable for dating and the few dates available merely serve to indicate the problems that remain to be solved. No ages have been obtained from the north-northwest trending dykes which outcrop mainly north of the northwest-trending Milne Inlet - Adams Sound swarm but which in places intersect the latter or outcrop south of it. The relationships of dykes and sills that occur together in the southern part of the map-area remain obscure. It is expected that future airborne reconnaissance work in northern Baffin Island will permit a more thorough study of these problems.

Two determinations were made on material collected from a thick sill near Cape Appel in the southwestern part of the area mapped. The first of these, G.S.C. 64-33, was made on a sample of chilled basalt from directly above the contact between the intrusion and a shaly member of the Autridge Formation. A second determination, K-Ar 989 was made on coarser grained gabbro from several hundreds of feet above the contact. The two ages, 639 and 475 ± 81 m.y., lend support to the concept that there was more than one period of intrusion although the younger date, 475 ± 81 m.y. appears improbable from geological relationships.

The first two dates in Table XX are from a 400-foot-wide diabase dyke (co-ordinates 73° 02'N, 85° 05'W) that outcrops near Arctic Bay in the northern part of the area mapped. The first result is from a fine-grained rock collected from near the contact of the dyke and the second, a coarser grained specimen, is from near the centre of the intrusion (see Wanless, et al., 1965, p. 25 for additional data). Experience gained in recent years in age determination studies suggests that more reliance should be placed on analyses made on fine-grained contact material than on coarser grained samples and therefore it is tentatively suggested that the Milne Inlet-Adams Sound belt of northwest-trending dykes was intruded about 915 m.y. ago and that a later period of intrusion, resulting in the formation of sills and possibly dykes, occurred about 639 m.y. ago.

As already mentioned, a potassium-argon age determination was made on a whole rock concentrate of a specimen of the volcanic Nauyat Formation collected at 72° 37'N, 85° 00'W. The results are given in the following table.

Table XXI

Age Determination, Nauyat Formation

GSC No.	Rock	Mineral dated	%K	Ar_{40}/K_{40}	Ragiogenic argon	Age (m.y.)
64-32	basalt	whole rock	.47	.0678	79	903 ± 140

The Nauyat Formation, like all other formations, is cut by gabbroic dykes which are presumed to be of similar relative age. It is thus surprising to find a radioactive age less than that indicated for the dyke rocks. However if the margins of possible error are considered the discrepancies are not irreconcilable.

If an age of between 900 and 1,100 million years is assigned to the crystallization of the volcanic rocks and the gabbroic intrusions then it appears that both the Eqalulik and Uluksan Groups are Proterozoic in age and fall within the Neohelikian sub-era.

The Fury and Hecla and Adams Sound formations are lithologically similar although the former is thought to be considerably thicker than the latter. If these two formations are equivalent then the Autridge Formation could be the equivalent of the lower formations of the Uluksan Group. Inasmuch as more than 100 miles separates the southernmost exposures of the Eqalulik Group and the northernmost outcrops of the Fury and Hecla Formation, it is more probable that the outcrops north and south of Fury and Hecla Strait and those on Borden Peninsula represent similar depositional histories that took place in distinct basins but at comparable times.

Relatively unmetamorphosed sedimentary and volcanic successions are known from several locations in arctic North America. Possibly the best known is the Thule Group of Northwest Greenland. According to Troelsen (1950, p. 35) the succession on Inglefield Land comprises three formations, the Rensselaer Bay sandstone, Cape Leiper dolomite, and Cape Ingersoll dolomite. Kurtz and Wales (1951) studied a similar unfossiliferous succession near Thule, the type area whence Koch (1929, 1933) had derived the original description. There they found greatly increased thicknesses. Whereas on Inglefield Land less than 700 feet of strata are present, at Thule the succession exceeds 8,400 feet. At Thule more than 6,800 feet of cyclically deposited red siltstone, grey dolomites, and porous dolomites are present but similar strata are completely lacking on Inglefield Land.

Christie (1967) suggests that the similarities between the Thule and Inglefield Land succession is insufficient to justify the use of the name Thule outside the type area.

Marked similarities exist between basal strata on either side of Kane Basin, and Christie (op. cit.) indicates that correlation can be made with confidence between the succession at Bache Peninsula, Ellesmere Island, and that on Inglefield Land, Greenland.

At Copes Bay, 45 miles north of Bache Peninsula, Thorsteinnson (in Fortier et al., 1963, p. 388) described a succession similar in many respects to Bache Peninsula and tentatively suggested correlation with the Rensselaer Bay Formation. Kerr (1963) described Lower Cambrian fossils from beds at Scoresby Bay correlatable to the Cape Leiper and Cape Ingersoll formations and Christie (op. cit.) suggests a Cambrian age for the Cape Leiper and Cape Ingersoll formations and for part at least of the underlying Rensselaer Bay Formation at Bache Peninsula.

The writer (in Lemon and Blackadar, 1963, p. 32) indicated possible correlation between the Eqalulik Group and Rensselaer Bay Formation. The evidence now available indicates that although lithological similarities exist the Eqalulik Group is much older than the Rensselaer Bay Formation and the possible equivalents of that formation in Northwest Greenland.

Unfossiliferous sedimentary strata outcrop south of Aston Bay, Somerset Island. First described by Woakes (Blackadar, in Fortier et al., 1963, pp. 143-147) this succession comprises two formations, the Aston which is primarily quartzite with minor siltstone, shale and conglomerate members, and the Hunting, mainly dolomite with minor shale and conglomerate. Field work carried out in 1962 by the writer indicated that the Hunting Formation includes considerable interbedded quartzite (Blackadar, 1963, 1967). More detailed studies of these rocks have been made by members of a research project sponsored by the University of Ottawa (Dineley, 1965). Both the Aston and Hunting formations are intruded by dykes and sills of gabbro whereas the Ordovician-Silurian dolomites of the overlying Allen Bay Formation are not. The similarities between the succession on Somerset

Island and that on northwest Baffin Island suggest a similar age for both sequences but as yet no dates are available from the gabbroic intrusions on Somerset Island.

Tuke et al. (1966) discuss the Aston and Hunting formations in some detail. Stromatolite beds are described - one from the base of the Aston and a wide range from the Hunting - and the authors suggest that a correlation of the Aston and Hunting formations with Paleozoic strata on Boothia Peninsula is probable.

The study of the Helikian sedimentary and volcanic rocks indicates that although depositional history has usually followed a similar trend, it is impossible to extend correlations any great distance. Most of the successions commence with deposition of quartzite and minor conglomerate although basal conglomerate is unusual. This is followed by carbonate deposition, and in some instances the period of deposition ends with a recurrence of clastic deposition.

GEOCHEMISTRY OF THE EQALULIK AND ULUKSAN GROUPS, AND RELATED FORMATIONS

The results of 30 spectrographic analyses carried out in the laboratories of the Geological Survey are presented in Table XXIV. The following elements were tested for: Fe, Ca, Mg, Ti, Mn, Sr, Ba, Cr, Zr, V, Cu, Ni, Co, B, Pb. The last four were not found to be present in any of the material analyzed. Similar data, derived from Lemon and Blackadar (1963) and converted to percentages, are given in Table XXV.

The Helikian strata comprise all three principal sedimentary rock types, although on the basis of volume the clastics are by far the most abundant. The Adams Sound and Fury and Hecla formations, the upper parts of the Fabricius Fiord and Strathcona Sound formations and the Elwin Formation are sandstones in the broadest sense of the term; the Society Cliffs, Victor Bay and Athole Point formations are carbonates; much of the lower part of the Fabricius Fiord and Strathcona Sound formations and parts of the Autridge Formation are shales.

THE SANDSTONES

Sandstones are usually classified on the basis of their components and thus vary from nearly pure quartz sandstone or othoquartzite through quartz-feldspar sandstone or arkose to rocks composed of a wide variety of lithic fragments. As a result the chemical composition of sandstones is varied. An important factor affecting the variability of the chemical composition is the nature of the cementing material. Silica-cemented sandstones will obviously show a higher silica content; carbonate cements are common and depending on their nature will markedly affect the Mg, Ca, Fe content of the rock.

The major element chemical composition of sandstones has been studied by Pettijohn (1963), and analyses for a wide range of sandstones published. For comparative purposes the results of the analyses (a composite of 253 sandstone analyses, op. cit., p. 53) is given in Table XXII.

Table XXII

Chemical Analysis of Sandstone

composite of 253 samples

(Pettijohn, 1963)

SiO_2	78.66
Al_2O_3	4.73
Fe_2O_3	1.08
FeO	0.30
MgO	1.17
CaO	5.52
Na_2O	0.45
K_2O	1.32
H_2O+	1.33
H_2O-	0.31
TiO_2	0.25
P_2O_5	0.08
MnO	trace
CO_2	5.04
SO_3	0.07
Cl	trace
BaO	0.05
SrO	0.05

According to Pettijohn (1963) "little systematic work has been reported on the minor elements of sandstones, although much work has been done on the minor accessory minerals . . ." The concentrations of minor elements depend on several factors; composition of source rock and mineral stability are of particular importance. Minerals such as zircon, tourmaline, or apatite are relatively stable and, if present in the source rock, may in the sandstones become relatively concentrated. Considerable substitution of elements may occur in feldspar or mica, for example barium substituting for sodium in feldspar, but because these minerals are less stable it is less likely that they will be concentrated.

In the spectrographic analyses given in Table XXIV the wide variation in Fe content is directly related to the colour of the specimen, the redder the specimen the higher the iron content. It is not however a reflection of the nature of the cementing material. The Ca content bears no direct relationship to the Fe content thus it appears that siderite is not responsible for the commonly remarkably high Fe content. Many of the results from the Fury and Hecla Formation, a varicoloured assemblage, exceed 10 per cent Fe. From a thin section study it is apparent that most of the Fe in such rocks is present as hematite which forms interstitially and in some cases appears to be the cementing material.

The Ca and Mg content of the sandstones is variable but in general is much less than the 5.52 and 1.17 per cent given by Pettijohn, which indicates a scarcity of carbonate cements, a fact substantiated by petrographic examination.

Pettijohn gives 0.25 per cent as the average Ti content for sandstone. Values exceeding 0.50 are uncommon in the Helikian clastic sediments of northwestern Baffin Island; one specimen from the Fury and Hecla Formation has a content of 1.3 per cent but many rocks contain less than 0.05 per cent Ti. As most of the sedimentary rocks are considered to have been derived from the comparatively leucocratic gneissic terrain, the relative absence of titanium is not remarkable.

Manganese is more abundant in a few of the Baffin Island sandstones than it is in the 'average sandstone' and there is as much as 0.15 per cent Mn in one subgreywacke from the Strathcona Sound Formation. Next to titanium, manganese is the most abundant trace element in igneous rocks (Rankama and Sahama, 1950) but, unlike titanium, manganese is seldom present as manganese minerals but rather is present in the structure of other minerals. Like titanium, manganese is most abundant in ultrabasic rocks and its relative abundance in specimens from the Fury and Hecla Formation, which was apparently derived from leucocratic gneisses, remains unexplained. The concentration of 0.15 per cent in the Fabricius Fiord Formation may reflect derivation of some of the constituent material of this unit from the Nauyat Formation, a volcanic assemblage which, according to data given in Table XI, contains 0.13 per cent Mn.

Strontium and barium seldom form independent minerals in igneous rocks but more commonly substitute for other elements; thus in sandstones, which are derived from the mechanical disintegration of igneous rocks, the Sr and Ba content will be a reflection of the degree to which this substitution has taken place. Pettijohn (1963, p. S11) gives the average Sr content of sandstones as 0.0035 per cent and Ba as 0.03 per cent. Most sandstone samples from northwestern Baffin Island approximate these averages, but in the Fabricius Fiord and Strathcona Sound formations some specimens contain as much as 0.13 per cent Ba. These rocks are more arkosic and contain both plagioclase and microcline fragments. According to Rankama and Sahama (1950) the feldspars are the most 'important habitat' for the two elements, thus in the more arkosic clastic rocks the observed increase in Ba and Sr content is expectable.

Chromium is present in most Fury and Helca Formation specimens examined, but is absent from most other clastic units, although in the data presented by Lemon and Blackadar (1963; this report Table XXV) small amounts of Cr are reported from the Strathcona Sound and Elwin formations. Pettijohn (1963, p. S11) quotes an approximate average of 10 to 20 ppm or 0.001 to 0.002 per cent. The values for the Fury and Hecla Formation are several times this average and thus may be significant. Chromium, like titanium and manganese, forms definite minerals, the most common being chromite; spinels and garnets also have chromium members. According to Rankama and Sahama (1950, p. 623) chromite is the most important source of chromium in sedimentary rocks. They note, however, that Cr can replace ferrous iron and manganese in many mineral structures although not in the feldspars. The actual host for the Cr in the northwestern Baffin Island sandstones is unknown.

Pettijohn (1963) gives the average zirconium content of sandstones as 37 to 820 ppm; the zirconium content of the clastic units of the Eqalulik and Uluksan groups are generally within these limits. Most zirconium is present in zircon, a detrital mineral found in almost all sandstones. Zirconium is more abundant in granitic rocks (460 ppm) than in more basic rocks, thus its generally greater abundance in the Fury and Hecla Formation compared to the Adams Sound or Fabricius Fiord formations is understandable as the latter two may in part be derived from the erosion of the andesitic Nauyat Formation.

According to Pettijohn (1963, p. S13) vanadium is present in many sandstones especially those with relatively high ferruginous or argillaceous contents. This observation is borne out by the analyses of northwestern Baffin Island rocks. In the Adams Sound Formation, a relatively pure orthoquartzite, no vanadium was found; specimens from the Fury and Hecla Formation that contain determinable amounts of vanadium are invariably representative of the reddish or purplish argillaceous sandstones that occur throughout the otherwise relatively pure quartzitic succession; specimens analyzed from the Fabricius Fiord Formation were all representative of the most quartzitic phases of the lithologically diverse unit and none contained identifiable vanadium. The only vanadium-bearing specimen examined from the Strathcona Sound Formation was a dark red, argillaceous siltstone and this too would be expected to contain the element. The average sandstone contains 0.001 to 0.002 per cent vanadium; on the average the Baffin Island rocks that contain the element contain ten times as much as does the average sandstone (Pettijohn, 1963, p. S11).

Copper forms about the same percentage of the average sandstone as does vanadium; it occurs in some of the Helikian formations of northwestern Baffin Island and is in about the same amounts as in the average sandstone.

CARBONATE

The principal carbonate minerals, calcite and dolomite, take few elements into solid solution although manganese and strontium are exceptions to this. Many limestones are principally, if not entirely, biogenic in origin but the history during lithification of the trace elements originally contained in the fleshy parts of organisms is unknown. As D. L. Graf (1962, p. 849) points out "the abundance of minor elements in carbonate rocks thus particularly depends on the non-carbonate materials, including detrital minerals, accessory authigenic precipitates, non-carbonate skeletal material, organic matter, phases formed during diagensis and the elements absorbed on all of these materials".

Graf (1960, p. 71) presents a table comprising estimates of the average concentrations of minor elements in carbonate rocks. Some of his data is compared with data for northwestern Baffin Island in Table XXIII.

From the data given in Table XXIII it is clear that the trace elements present in the Helikian carbonate formations of northwestern Baffin Island do not differ significantly from available data concerning similar rocks from various parts of the world. Even where there are divergences, as for example the high Ti content of a specimen from the Arctic Bay Formation or the high Ba content of a specimen from the Society Cliffs Formation, the values are still within the known extremes as given by Graf (1960). In the case of the titaniferous specimen (3) a hand specimen examination disclosed that the medium grey, dense, carbonate rock contains many grains and nodules of pyrite; only in this manner does it differ from the other analyzed specimen from the same formation.

Table XXIII

Average concentration in per cent of minor elements
in carbonate rocks

	Ti	Mn	Sr	Ba	Cr	Zr	V	Cu
1	.015-.045	.05	.04-.05	.004-.026	.005-.014	.013-.021	.007-.015	.005-.023
2	.018	.079	.012	.004	nf	nf	nf	.0058
3	.12	.008	.0034	.08	nf	.0079	.0024	.0021
4	.006	.041	.0053	.17	nf	nf	nf	nf
5	<.001	.087	.045	.002	nf	nf	nf	nf
6	.003	.03	.01	nd	.0002	nd	.001	.0006
7	.0008	.025	.001	nd	.00015	nd	.0003	.00035
8	.034	.016	.0016	nd	.0003	.0006	.0006	.0004

1 - Graf, 1960, p. 71
2, 3 - this study, Arctic Bay Formation
4, 5 - this study, Society Cliffs Formation
6 - Lemon and Blackadar, 1963, Arctic Bay Formation, average of 2
7 - Lemon and Blackadar, 1963, Society Cliffs Formation, average of 2
8 - Lemon and Blackadar, 1963, Victor Bay Formation, average of 3

nf - not found
nd - not determined

Table XXIV

Spectrographic Analyses of the Eqalulik and Uluksan Groups

(Quantitative determinations by method QN9A by the staff of the Spectrographic Laboratory, Geological Survey of Canada)

		Fe	Ca	Mg	Ti	Mn	Sr	Ba	Cr	Zr	V	Cu
Adams Sound Formation	1	1.0	.032	.036	.044	n.f.	.0028	.0077	n.f.	.016	n.f.	n.f.
Fury and Hecla Formation	2	.15	.02	.03	.0064	n.f.	n.f.	.0098	n.f.	n.f.	n.f.	n.f.
	3	2.0	.02	.39	.037	n.f.	.0034	.0058	n.f.	.0099	n.f.	n.f.
	4	5.5	.15	1.4	.14	.044	n.f.	.0056	.0031	.011	.0075	.0015
	5	>10	.12	1.3	1.3	.069	.0040	.023	.022	.027	.032	.030
	6	>10	.028	.66	.50	.0088	<.002	.017	.0053	.025	.019	<.0008
	7	>10	<.02	.0096	.032	n.f.	n.f.	.018	n.f.	.0082	.021	n.f.
	8*	6.5	<.02	1.9	.21	.0093	n.f.	.014	n.f.	.001	.0045	n.f.
	9	.06	<.02	.032	.0078	n.f.	<.002	.0092	n.f.	n.f.	n.f.	n.f.
	10	6.0	.39	2.7	.25	.14	n.f.	.054	.0083	.0099	.0095	.014
	11	>10	.093	.66	.073	.012	n.f.	.0072	n.f.	.0050	.010	n.f.
Autridge Formation	12	7.5	<.02	1.1	.021	.14	.0026	.017	n.f.	.010	n.f.	n.f.
	13	3.0	<.02	.77	.45	.035	.0090	.029	n.f.	.16	n.f.	n.f.
	14	7.5	<.02	.22	.23	.061	n.f.	.015	n.f.	.011	n.f.	n.f.
	15	3.5	<.02	>10	.021	.11	.0021	.0021	n.f.	n.f.	n.f.	n.f.
	16	8.0	.11	1.7	.90	.035	.0038	.072	.0056	.018	.012	n.f.
Arctic Bay Formation	17	2.5	>5.00	>10	.018	.079	.012	.0040	n.f.	n.f.	n.f.	.0058
	18	9.0	.16	1.3	.12	.0080	.0034	.080	n.f.	.0079	.0024	.0021
	19	>10	.82	.99	.057	2.5	n.f.	.0092	n.f.	n.f.	n.f.	n.f.
Fabricius Fiord Formation	20	.25	.038	.18	.030	n.f.	.0075	.13	n.f.	.0040	n.f.	n.f.
	21	.70	.029	1.1	.050	.018	.0096	.075	n.f.	.0069	n.f.	n.f.
	22	.60	.45	.46	.041	.036	.0061	.13	n.f.	.0039	n.f.	n.f.
	23	1.0	.054	.65	.055	.0037	.0058	.085	n.f.	.0060	n.f.	n.f.
	24	3.0	.52	.59	.28	.15	.0042	.041	<.02	.065	n.f.	.0030
Society Cliffs Formation	25	.90	>5.0	>10	.0066	.041	.0053	.17	n.f.	n.f.	n.f.	n.f.
	26	.90	>5.0	2.1	<.001	.087	.045	.0021	n.f.	n.f.	n.f.	n.f.
Strathcona Sound Formation	27	3.0	1.3	2.7	.41	.082	.0059	.11	<.02	.017	.0034	.0021
	28	4.0	1.9	.48	.33	.11	.0051	.063	n.f.	.013	n.f.	n.f.
	29	2.0	5.7	1.1	.15	.019	.0049	.13	n.f.	.013	n.f.	n.f.
Elwin Formation	30	.30	<.02	.090	.0089	n.f.	<.002	.015	n.f.	<.003	n.f.	n.f.

* contains 0.011 Co

N.B. Quantitative determinations are expected to be accurate to within 15% of reported value

Table XXV

Spectrographic analyses of the Uluksan Group

(after Lemon and Blackadar, 1963)

		Ti	Mn	Sr	Ba	Cr	Zr	V	Cu	Ni	B	Pb	Co
Arctic Bay	1	.004	.04	.02	n. d.	.0004	n. d.	.001	.0008	.0008	.0004	n. f.	n. d.
Formation	2	.002	.02	.001	n. d.	n. f.	n. d.	.001	.0004	n. f.	.0004	n. f.	n. d.
Society Cliffs	3	.001	.02	.001	n. d.	.0002	n. d.	.0006	.0004	n. d.	.0006	.001	n. d.
Formation	4	.0006	.03	.001	n. d.	.0001	n. d.	n. f.	.0003	n. d.	.0004	n. f.	n. d.
Victor	5	.001	.02	.0002	n. d.	.0001	n. f.	.0006	.0004	.0003	.0004	n. f.	n. d.
Bay	6	.10	.02	.002	n. d.	.0004	.002	.0007	.0005	.0008	.003	n. f.	n. f.
Formation	7	.002	.01	.001	n. d.	.0003	n. f.	.0005	.0003	n. f.	.0004	.001	n. f.
Strathcona Sound Formation	8	.55	.013	.002	.15	.0013	.02	.0015	.0006	.0015	.001	.0005	.0004
Elwin	9	.60	.004	.002	.02	.0007	.02	.002	.003	.001	.02	.001	.0002
Formation	10	.05	.01	.002	.007	.0002	.007	.0006	.002	.0008	.002	n. f.	.0004

n. d. not determined
n. f. not found

1-2 – Lemon and Blackadar, p. 18
3-4 p. 19
5-7 p. 21
8 p. 24
9-10 p. 27

ARGILLACEOUS ROCKS

Analyses 13 to 15, Table XXIV, are typical of the lower beds of the Autridge Formation which is predominantly argillaceous siltstone. In this section the rock represented by analysis 13 comprises quartz and carbonate grains, the latter being surrounded by a reddish brown amorphous alteration. Sericite and amphibole are widespread. In many respects the other rocks from this formation are similar. The low Ca content of all four analyses is surprising having regard to the fact that carbonate grains are visible in the specimens.

ECONOMIC GEOLOGY

The economic possibilities of northwestern Baffin Island have attracted interest from time to time since Bernier's expedition in 1910-11. A. English, a prospector who accompanied that expedition discovered a deposit of pyrite with minor sphalerite and galena on the south side of Strathcona Sound. In addition to the minerals mentioned, English (in Bernier, 1911, pp. 145-147) reported gold, silver, platinum, copper, nickel, and antimony.

In 1937 J. F. Tibbitt and J. W. McInnes made a remarkable trip from Churchill to Arctic Bay with the object of exploring the showings listed in Bernier's report. Two claims were staked but these were allowed to lapse the following year. When the author and R. R. H. Lemon carried out their reconnaissance in 1954 several shallow trenches on the Strathcona Sound deposit testified to the activity of Tibbitt and McInnes.

Most of the mineral localities mentioned in Bernier's report were relocated by the writer in 1954 (see Lemon and Blackadar, 1963, pp. 77-80) and formed the basis for a short section in G. S. C. Paper 55-6 published in 1956. Spectrographic analyses of specimens collected from the Strathcona Sound deposit disclosed only faint traces of silver and no gold and the source of the argentiferous breithauptite said to have been collected by Bernier's party, was not found.

Soon after the publication of the Geological Survey's preliminary report, the Arctic Bay area attracted the attention of the Texas Gulf Sulphur Company and during the summer of 1957 thirty-seven claims were staked on the Strathcona Sound deposit. By 1965 the company held 230 claims in the area and had done 55,000 feet of diamond drilling. The main deposit, which lies in the Society Cliffs Formation, is reported to be a single body, 15,000 feet long, 300 to 500 feet wide, and 30 to 50 feet thick. Several en échelon bodies are also reported. Little additional exploratory work has been reported since 1964 but at that time company officials stated that "ore averaging about 20 per cent zinc or equivalent net value with lead and silver can be mined profitably" (Northern Miner, issue of February 6, 1964). This report also noted that several million tons of ore of this grade is included in the several tens of millions of tons of sulphides outlined in the deposit up to 1964.

The small deposits of metallic minerals commonly associated with gabbro dykes are discussed at some length in Lemon and Blackadar (1963) and as no new information resulted from the field studies carried out in 1963, they will not be discussed further.

Magnetite- and hematite-rich beds were seen in the Paleozoic Gallery and Turner Cliffs Formations west of Navy Board Inlet. Hematite-rich beds were also seen in the quartzites of the Fury and Hecla Formation which outcrop in the southern part of the area mapped. Southeast of Adams Sound a small pinnacle of massive, black hematite occurs in the Society Cliffs Formation. According to W. L. Davison (personal communication) this may be in a window of gneiss of Aphebian age and may be similar to the extensive Mary River iron-formation deposits that occur to the east.

The Mary River area, discovered in 1962 and subsequently explored by Baffinland Iron Mines Limited, was visited briefly by W. L. Davison in 1963 during Operation Admiralty but as it was beyond the limits of the project area no consecutive mapping was carried out. According to Gross (1966) these deposits, which lie about 60 miles southeast of the head of Milne Inlet, occur in a group of acid and basic metavolcanics and metasediments that have been infolded and faulted within a granitoid massif. Gross states that the deposits are of Algoma type and that they form conspicuous lenticular masses in the volcanic-sedimentary sequence. A distinctive feature is the occurrence of beds of nearly pure magnetite (here and there hematite) which range in thickness from a few inches to tens of feet and which are interlayered with thinly laminated quartz-magnetite beds. The Mary River deposits are of great potential value and since their discovery an extensive exploration program has been carried out as have feasibility studies designed to create a producing mine.

It is possible that similar deposits, covered by Helikian or Paleozoic strata, occur in the area mapped during Operation Admiralty and, as noted above, the massive black hematite seen by Davison south of Adams Sound may be such an exposure.

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