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PAPER 64-42

GEOLOGICAL RECONNAISSANCE OF THE PRECAMBRIAN OF NORTHWESTERN BAFFIN ISLAND, NORTHWEST TERRITORIES

(Report and 1 figure)

R. G. Blackadar

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ABSTRACT

In northwestern Baffin Island gneissic and granitic rocks of the Churchill Province are overlain by a thick succession of unfossiliferous sedimentary and volcanic rocks.

Two groups, the Eqalulik and Uluksan, have been recognized. Near Fury and Hecla Strait the thickness of the former exceeds 16,500 feet whereas further north it is only 5,000 feet. The Uluksan Group outcrops only in the northern part of the map-area and is 23,000 feet thick.

Both groups are intruded by gabbro dykes and sills dated as lowermost Upper Proterozoic.

A sulphide deposit near Arctic Bay has been drilled by Texas Gulf Sulphur Company but no plans have been made public for further development.

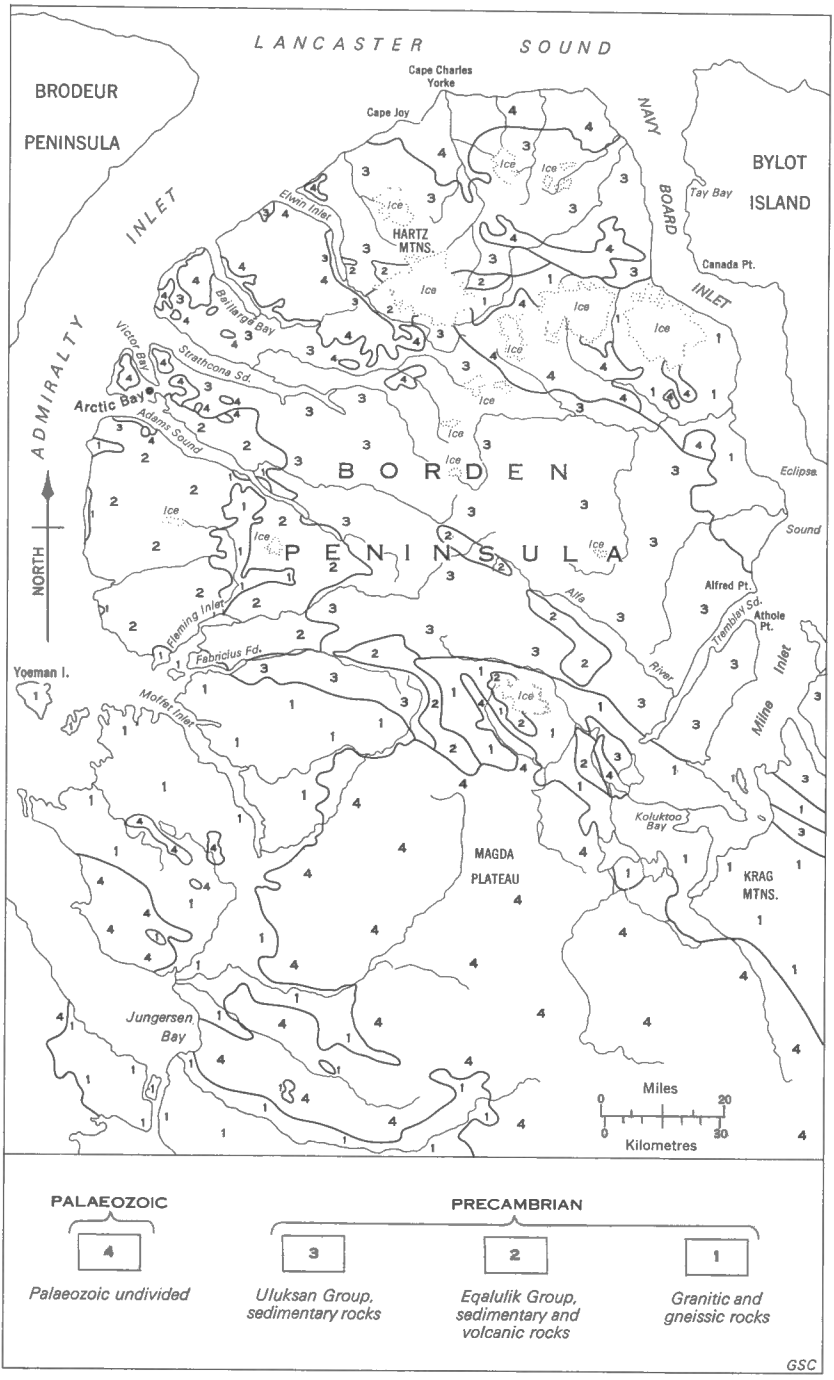

Figure 1. Geology of Borden Peninsula, northwest Baffin Island, showing outcrop pattern of Precambrian and Palaeozoic rocks

GEOLOGICAL RECONNAISSANCE OF THE PRECAMBRIAN OF NORTHWESTERN BAFFIN ISLAND

(Operation Admiralty)

INTRODUCTION

This report presents some preliminary results of an airborne geological reconnaissance program (Operation Admiralty) of that part of Baffin Island west of 80 degrees and north of Fury and Hecla Strait, an area of about 55,000 square miles. This paper is concerned mainly with the Precambrian geology but also contains a general account of topography and operational data. The Palaeozoic succession is the subject of a paper by H.P. Trettin and the Pleistocene and Recent Geology of the area is described in a paper by B.G. Craig.

A new series of topographical maps on a scale of 1:250,000 will soon be available. It has been decided to withhold publication of a complete geological map of northwest Baffin Island until this greatly improved base map series becomes available. For this reason only a sketch map of part of the area covered accompanies this report (Figure 1). Map 1133A, accompanying GSC Memoir 328, and Maps 3-1958 and 4-1958, show additional information on formational distribution and National Topographic System Maps 47, NE, NW (Bernier Bay), 57, NE, NW (Boothia), 48, SE, SW (Admiralty Inlet) and 58, SE, SW (Somerset Island) give general topographic data.

LOCATION AND ACCESSIBILITY

Commercial air services are available at Hall Beach, 60 miles south of the southern boundary of the map-area and at Resolute, about 150 miles northeast of the map-area. These services offer weekly connections with Montreal and greatly facilitate mail and supply services to the region.

Both the northern and southeastern parts of the area are readily accessible by sea during August and September and heavy freight is usually moved by sea.

Overland travel within the area is influenced strongly by topography. Travel by dog team, until recently the only mode of extensive travel, usually is confined to the ice of the large inlets or to well-established routes along the major river valleys, although the relatively low terrain that characterizes the southeastern and southwestern parts of the area would not preclude widespread travel. On northern Brodeur and Borden Peninsulas deeply incised valleys make overland travel all but impossible.

Tracked vehicles have not, to the author's knowledge, been used extensively in northern Baffin Island, but the large waterways, frozen for about 8 months of the year, and the relatively low snowfall should make their use feasible.

Aircraft are widely used for travel to and from northern Baffin Island although the absence of abundant freshwater lakes and uncertain ice conditions, even after break-up, limit the use of float-equipped aircraft. Large transport aircraft have landed successfully on ice-strips within the map-area and smaller, ski-equipped aircraft can be landed in various parts of the region.

PRESENT INVESTIGATION AND ACKNOWLEDGMENTS

Operation Admiralty, carried out between late May and late August, 1963, was the first of several airborne geological reconnaissance projects planned to complete the preliminary geological investigation of Baffin Island. The project was directed by R.G. Blackadar who together with W.L. Davison and T.O. Frisch, a graduate student, carried out studies in the pre-Palaeozoic rocks. H.P. Trettin, assisted by A.A. Petryk, a graduate student, was responsible for the study of the Palaeozoic strata. B.G. Craig examined the Pleistocene geology and his results are the subject of a separate report. F.C. Wedge served as radio operator and R. Senneville filled the position of cook. Mukpaloo, a resident of Arctic Bay, was attached to Operation Admiralty and was a commendable handyman.

Special thanks are expressed to Mr. Jim Cummings, manager of the Hudson's Bay Company store at Igloolik, and to Mr. Frank Connelly, manager of the store at Arctic Bay, who hospitably received members of the operation and facilitated the program in many ways.

Aircraft used on Operation Admiralty comprised of a Piper Super Cub equipped with low-pressure tires, chartered from Gananoque Air Services and piloted by J. Bryant; two helicopters — a Bell 47 G 2A-1 and a Brantly B-2, piloted by G.R. Fields and W. Thomas and chartered from Universal Helicopters Ltd.; a ski-equipped Otter aircraft from Thomas Lamb Airways (to place gas caches in the spring), and an Otter aircraft equipped with low-pressure tires, belonging to Bradley Air Services (to assist in camp moves from time to time during the field operation).

Although helicopters have been used in geological reconnaissance in arctic regions since 1952, improved operational features in these aircraft have altered the techniques used in their application to geological surveying. The Bell 47 G 2A-1 has a greater fuel capacity and a larger cabin than its predecessor, the 47 G 2A. The former feature permitted traverses in excess of 400 miles with only one fuel cache. At times the Pleistocene and Precambrian geologists traversed together thus avoiding a duplication of traverse routes. The wider cabin of the Bell 47 G 2A-1 made it possible for both to carry out mapping from the air with a minimum of confusion.

Somewhat in the nature of an experiment was the use of a Brantly B-2 helicopter. This aircraft, much smaller than the Bell, can carry only one passenger and about 75 pounds of extra equipment and has a range of about 200 miles. It was used extensively in the study of Pleistocene geology, where frequent landings were required to measure elevations of emerged strand lines, and in placing stratigraphers at sections for a day's work.

The Piper Super Cub on low-pressure tires has been widely used by the Geological Survey since 1957. Although during Operation Admiralty this aircraft was used primarily in a support role — placing gas caches and moving mail and supplies from Hall Beach (the point of contact with commercial air services) — it was also used to set out stratigraphic teams and to make long reconnaissance flights when broad, rapid coverage was desired.

All chartered aircraft were from Carp, Ontario, and were returned to that station at the close of the field work.

HISTORY OF DISCOVERY

Although northern Baffin was probably seen by Bylot and Baffin in 1616 it was not the site of active exploration until early in the present century.

As is well known a new era in the exploration of the North American polar regions began with the voyage of Sir John Ross in 1818 in search of the Northwest Passage. His failure to penetrate Lancaster Sound led to the dispatch of Sir Edward Parry in 1819 to prosecute the search, and it was during this voyage that Navy Board Inlet, Prince Regent Inlet, and Admiralty Inlet, three great geographic features of northern Baffin Island, were first reported. The years 1821-23 found Parry again searching for the Northwest Passage, this time exploring the waters north of Hudson Bay; it was on this voyage that the southern limits of the map-area were delineated. Fury and Hecla Strait proved impassible due to heavy ice and in 1823 Parry returned to England. But the winter of 1824-25 found him once again on Baffin Island, this time at Port Bowen on the west coast of Brodeur Peninsula.

Despite these explorations the true form of northern Baffin Island was unknown, and nineteenth century maps portray several imaginary channels which were thought to divide the land mass into several large islands.

One result of the exploratory work carried out under the auspices of the British Admiralty was the development of an extensive whale fishery in and around Lancaster Sound. This flourished until early in the present century and undoubtedly some extensions to geographic knowledge were made, but these appear to have been concealed as valuable business secrets.

In 1903 Canada initiated voyages designed to render effective her sovereignty in the arctic territories ceded by Great Britain in 1880. During the voyage of 1906 Captain Bernier penetrated to the head of Admiralty Inlet and in 1910-11 he wintered at Arctic Bay. Extensive exploratory trips were made by members of his crew, resulting in much new information on the geography of northern Baffin Island.

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)[1] from Arctic Bay to Igloolik via Gifford River and thence to Pond Inlet by way of Murray-Maxwell Bay and Milne Inlet.

Two members of the Danish Fifth Thule Expedition, T. Mathiassen and P. Freuchen, travelled extensively in northern Baffin Island between 1922 and 1924 and made significant contributions to scientific knowledge (Mathiassen, 1933, 1945).

With the completion of trimetrogon photography after World War II, adequate maps of northern Baffin Island at last became available and it has been possible to orient more recent projects to specialized ends such as geology, geography or archaeology.

PREVIOUS GEOLOGICAL WORK

Observations on natural science were prominent in the studies carried out by nineteenth century expeditions and geological observations can usually be found in the reports on these expeditions. Parry (1824) reported the widespread outcrops of flat-lying limestone around the shores of northern Foxe Basin, the presence of sandstone (quartzite), shale, and gabbro from Fury and Hecla Strait and the wide distribution of granitic rocks on Melville Peninsula and on Baffin Island northeast of Fury and Hecla Strait. Neill, the medical officer who accompanied Parry's third voyage, 1824-25, published observations on the geology of the east coast of Prince Regent Inlet, indicating that here carbonate strata predominate.

Bernier's 1910-11 expedition 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).

The geological results of the Fifth Thule Expedition are contained in the reports of Mathiassen (1933, 1945) and Teichert (1937).

Officers of the Geological Survey accompanied several of the seaborne Eastern Arctic Patrols, instituted in 1922 by the Canadian Government, and the geology in the vicinity of Arctic Bay was examined by L.J. Weeks in 1925 (Weeks, 1927).

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[1]Names and/or dates in parentheses refer to publications listed in the References.

A geological reconnaissance in the vicinity of Admiralty Inlet was carried out by the present writer in 1954, assisted by R.R.H. Lemon (Lemon and Blackadar, 1963) and in the same year the eastern coast of Borden Peninsula was examined by W.L. Davison working out of Pond Inlet. Reconnaissance studies were carried out in the southern part of the map-area in 1956 and 1957 (Blackadar, 1958a, b; 1963).

TOPOGRAPHY

Northwestern Baffin Island may be divided into three great physiographic subdivisions and although a finer subdivision has been proposed (Rand Corp. report, 1963), these three major units form the basis for the following discussion.

The northern part of the map-area, Brodeur Peninsula and that part of Borden Peninsula north of 'Jungersen River'[1] forms part of the Jones-Lancaster Plateau (Fortier, 1957, p. 402) although here and there more undulating topography prevails, notably on Steensby Peninsula. Lowland topography predominates on the peninsula between Agu Bay and Bernier Bay. This lowland, part of the Boothia-Regent Lowlands (Fortier, 1957, p. 404) extends east from Bernier Bay and includes the coasts of Berlinguet Inlet, Bell Bay, southwestern Admiralty Inlet, an ill-defined area between Jungersen and Gifford Rivers, and extends to Steensby Inlet and Murray-Maxwell Bay. An upland topography, developed on the metamorphic and late Precambrain sedimentary rocks in the southern part of the area, forms the northern extension of the Southampton-Melville Uplands (Fortier, 1957, p. 401).

Jones-Lancaster Plateau

Northern Brodeur Peninsula presents a remarkably uniform appearance. Sheer cliffs of flat-lying Palaeozoic sedimentary strata rising 1,000 or more feet above the sea characterize all the northern coasts, and access from sea-level is all but impossible save at the mouths of the larger rivers. Elevations in excess of 1,500 feet are found in northeastern Brodeur Peninsula but the elevation of the plateau surface decreases from north to south and this is reflected in the disappearance of the magnificent cliffed sections south of about 73°N on the Prince Regent coast and south of 72°30'N on the

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[1]Name proposed for the large west-flowing river that enters south Jungersen Bay.

Admiralty Inlet coast. Although the average elevation in the north is about 1,200 feet, south of 72°30' no elevations exceed 1,000 feet.

The plateau surface is gently undulating and for the most part comprises shattered carbonate rock. Vegetation is extremely sparse and the land has a most desolate appearance. Following the spring melt this surface is extremely soft but by mid-July it is rock-hard.

Near the coasts rivers are deeply incised, some flowing in valleys 1,000 feet or more in depth but the upper limits of all streams are most indistinct, the rivers merely occupying gentle depressions in the surface.

Five small ice-caps in northeastern Brodeur Peninsula are described in a later section.

Borden Peninsula in contrast to Brodeur Peninsula is more varied topographically. This is mainly a reflection of more diverse geology and with minor exceptions the entire area north of 71°30' forms part of the Jones-Lancaster Plateau.

The highest elevation, slightly in excess of 4,000 feet, is the high point of the ice-cap east of Elwin Inlet but throughout most of northern Borden Peninsula elevations in excess of 2,000 feet are common. The southward decrease in the elevation of the plateau surface observed on Brodeur Peninsula also prevails on Borden Peninsula and the highest elevation noted from Magda Plateau, north of 'Jungersen River', is about 1,300 feet.

Between Elwin Inlet and the mouth of Tremblay Sound the plateau surface is separated from the waters of Lancaster Sound and Navy Board Inlet by a narrow coastal plain. Outcrops are rare and are for the most part confined to low cliff sections in river valleys.

Prolonged erosion has cut deeply into the predominantly sedimentary succession underlying the plateau of northern Borden Peninsula, resulting in many smaller plateau-blocks, or mountains where crystalline rocks have been exposed. The valley sides are commonly scree covered but, depending on the bedrock, good cliff sections may be found.

The rivers vary from immature, steep-floored, and turbulent streams to mature, sluggishly flowing, meandering rivers. Those draining north and east from the plateau are for the most part large and flow through the coastal plain in wide, flat-floored, deeply incised valleys. Small deltas have formed where these rivers reach the sea.

Many of the rivers in Borden Peninsula are of considerable extent and the plateau on the whole has a well-developed drainage pattern. The northwest strike prevalent in most sedimentary formations, also the strike direction of the diabase dyke swarms, has controlled the orientation of certain rivers and shows the strong influence of bedrock structure on the drainage pattern.

A gabbro dyke complex imparts a distinct appearance to the plateau surface between Adams and Strathcona Sounds and the southeastward projection of these features. The dykes are 10 to 400 feet wide and may rise several hundred feet above the general plateau surface, imparting a serrated appearance to this area.

Erosion in the southern part of the plateau area of Borden Peninsula has formed an impressive, dissected plateau. Rivers are deeply incised and flow in valleys more than 500 feet deep, along the sides of which are exposed the multicoloured strata of the lower formations of the Palaeozoic succession. In common with Brodeur Peninsula the surface here is a desert, formed of shattered rock and is all but devoid of vegetation.

The southern contact of the plateau is marked by a scarp, roughly parallel to 'Jungersen River' — the large west-flowing stream that reaches the sea in southeast Jungersen Bay. East of Magda Plateau and west of the main crystalline complex of Baffin Island, the plateau surface merges gradually with an area of low, undulating hills wherein elevations rarely exceed 1,000 feet. Although underlain by sedimentary rocks, drift is extensive and large areas of poorly drumlinized till are present.

Gneissic outcrops on Steensby Peninsula give rise to an upland topography although outliers of Palaeozoic strata reflect the persistence of the Borden Plateau surface even here. Elevations do not exceed 600 feet in contrast to the 1,500 feet or more on Magda Plateau to the east.

Icefields and patches of permanent snow and ice are common, especially in northern Borden Peninsula; these are discussed in a later part of this report.

Boothia-Regent Lowlands

The extensive lowland area roughly forming a semi-circle from the Gulf of Boothia through Bernier Bay and Berlinguet Inlet to Erichsen Lake, Murray-Maxwell Bay and Steensby Inlet, is part of the Boothia-Regent Lowlands. The western limits of this lowland, around Bernier Bay and western Berlinguet Inlet, are underlain by carbonate strata covered for the most part by a variable drift cover. Lakes are widespread in contrast to the plateau area described above and drainage is more or less disorganized, many of the streams flowing through poorly defined boulder beds. Raised beaches are abundant, particularly south of Bernier Bay. North of Bernier Bay and Berlinguet Inlet the lowland surface merges imperceptibly with that of the Jones-Lancaster plateau.

On both sides of eastern Berlinguet Inlet and south of 'Jungersen River' gneissic rocks outcrop. Elevations rarely exceed 500 feet, and the lake-studded drift-covered surface is gently undulating. Drift deposits are widespread and, in comparison with most other parts of the map-area, vegetation is abundant. This lowland extends eastward through the headwaters of Gifford River to Quartz and Erichsen Lakes and thence to Steensby Inlet where it terminates abruptly against a high north-northwest-trending scarp in gneissic rocks. Similar lake-studded, relatively low-lying terrain extends south from Erichsen Lake to Murray-Maxwell Bay. Low mesas of lower Palaeozoic strata here and there cap the plateau surface south of 'Jungersen River'.

Drift cover is extensive on most parts of the lowland and the southern boundary of this physiographic division is indefinite, the lowland merging gradually with the drift-covered surface of the Somerset-Melville Upland.

Somerset-Melville Upland

The Somerset-Melville Upland on Baffin Island comprises three distinct parts. Heavy drift characterizes the northern part, extending south from the margin of the lowlands to about Gifford River and Gifford Fiord. Granitic rocks underlie most of this area but bedrock exposures are sparse, being more commonly represented by felsenmeer deposits. The surface of the upland is gently undulating with few elevations exceeding 500 feet.

Gifford River and Gifford Fiord are the most prominent topographic features of the northern part of the upland. The river flows throughout much of its length in a broad sand-filled valley, broken here and there by boulder-filled stretches. Throughout much of its extent the river is braided and except during periods of flood is very shallow. The river heads about 30 miles south of Milne Inlet and although it drops 500 feet in the first 50 miles, the drop is only 300 feet in the remaining 120 or more miles from just west of Quartz Lake. Asta Lake, a moraine-dammed feature, is 55 feet above sea-level. From this lake Gifford River descends in a 6-mile series of shallow rapids to Gifford Fiord, a steep-sided narrow inlet some 40 miles long.

South of the 'Gifford-line' the terrain is much more rugged, elevations exceed 1,700 feet and bedrock exposure is common. High rounded hills characterize the part of the upland underlain by gently dipping Late Precambrian quartzites; serrated ridges result from numerous gabbro sills and dykes; and high, rough, lake-studded terrain is common where gneissic rocks prevail. This last-mentioned terrain extends east to Murray-Maxwell Bay and Siorarsuk Peninsula, but eastwards the upland merges with the southward extension of the Boothia-Regent Lowlands discussed above.

ICE-FIELDS

Numerous ice-fields are found on Borden Peninsula in addition to five small fields in northeastern Brodeur Peninsula. The largest accumulation of ice lies north of Elwin Inlet where there are six large ice-fields and several tens of smaller patches of permanent ice. The largest field is east of Elwin Inlet, capping the highest surface on Borden Peninsula. This field has an area of about 100 square miles. Outlet glaciers are highly crevassed and one reaches the valley of the river draining into Elwin Inlet at about 300 feet above sea-level, a drop of more than 3,700 feet from the high point of the mass only 6 miles away.

In a study of written information, early photographs, and air photographs of the glaciers of northern Baffin Island, Falconer (1962) deduced that there have been no marked variations in the past few decades except for a slight marginal recession of some of the ice-fields and small valley glaciers. Observations made during Operation Admiralty are consistent with this deduction.

South of the outlet glacier from the 'Elwin Ice-field' that reaches 'Elwin River' the quartzitic bedrock is totally free from lichen growth for several hundreds of feet but beyond this line lichens become more abundant. Similar clean surfaces were seen around some of the snow-fields that lack any outlet glaciers. The absence of lichens suggests a relatively recent retreat of the ice at these places.

Many of the small snow-fields appear to be only a few tens of feet thick and in some, small boulders actually project through the ice cover, forming miniature nunataks, yet these small snow-fields have changed but little since 1958 when the air photographs were taken.

Falconer (1962) observes that the large valley glaciers are often bordered by morainic ridges and that terminal moraines are situated close to present termini, suggesting that these glaciers may be close to their most advanced positions in post-glacial times. Observations made on Operation Admiralty are in agreement with these conclusions. Terminal moraines of the ice-field that reaches Navy Board Inlet are only a few tens of feet in front of the ice although in the case of the one examined, they rise steeply for about 75 feet from the valley floor.

No glaciological studies have been made on the ice-fields of Borden Peninsula thus no data exist for comparing accumulation and melting. However the wreck of a DC-3 aircraft on the ice-field south of Adams Sound, dating from 1958, is still visible on the surface after the winter's snows have melted, suggesting either that accumulation and wastage are in balance or the wastage exceeds accumulation.

GENERAL GEOLOGY

Granitic and gneissic rocks overlain by a thick sequence of unfossiliferous, relatively flat-lying sedimentary strata comprise the Precambrian succession of northwestern Baffin Island. Potassium-argon age determinations suggest that these rocks range in age from Middle Proterozoic to lowermost Upper Proterozoic.

TABLE OF FORMATIONS

Age	Group (thickness in feet)	Formation (thickness in feet)	Lithology
			Gabbro and diabase
		Intrusive contact	
Upper Proterozoic	Uluksan (±23,000)	Elwin (+5,000)	Sandstone, siltstone shale
		Strathcona Sound (±4,000)	Mudstone, siltstone
		Athole Point (±5,000)	Limestone
		Victor Bay (±1,600)	Dolomite, minor shale, edgewise conglomerate
		Society Cliffs (±1,000)	Dolomite
		Fabricius Fiord (±5,400)	Quartzite, shale, conglomerate
		Arctic Bay (±1,000)	Calcareous shale, dolomite
		Conformable (gradational) contact	
	Eqalulik 5,000 (in north) 16,500 (in south)	North: Quartzite (4,000); Volcanic member (1,000)	South: Quartzite (15,000); 1,500
		North: Quartzite, minor conglomerate; Andesite and basalt flows, tuff	South: Quartzite, minor shale; Siltstone, shale, dolomite
		Erosional disconformity	
Middle Proterozoic			Granitic gneiss, migmatite, pyroxene gneiss, biotite gneiss

PRECAMBRIAN

Middle Proterozoic

Granitic and Gneissic Rocks

Granitic and gneissic rocks outcrop extensively east of Admiralty Inlet south of a line extending southeast from Adams Sound to the head of Tremblay Sound and Milne Inlet and thus form the bedrock in much of the southeastern part of the map-area. Similar rocks outcrop on the west coast of Navy Board Inlet north from the mouth of Tremblay Sound to the large ice-fields west of Low Point. An age determination (GSC 62-85) on biotite from a specimen from Yeoman Island gave an age of 1,590 m.y. and a second determination (GSC 62-86) on biotite from a specimen of gneiss at the head of Steensby Inlet (just east of the southeastern part of the map-area) gave an age of 1,700 m.y. A third determination from east of Moffett Inlet gave an age of 1,975 m.y. and two specimens, one from south of Tremblay Sound and one south of Berlinguet Inlet, have been dated at 1,730 m.y. These dates suggest that the gneissic and granitic rocks in the map-area are part of the Churchill province and following the nomenclature of Stockwell (1963) are probably Middle Proterozoic in age.

The predominant rocks are greyish or pinkish, medium- to coarse-grained plagioclase-quartz-microcline gneiss with or without varying amounts of biotite and hornblende. These rocks vary from well-banded gneisses, in which bands composed essentially of quartz and feldspar alternate with those rich in mafic constituents, to migmatite and hybrid gneiss in which the mafic components have lost all coherence and appear as schlieren. Garnet is locally abundant in the gneisses.

A dark red colour characterizes zones of shearing and such zones commonly are streaked with shattered veins of white quartz. Alteration of mafic constituents appears to be more extensive near the shear zones.

A large area around Gifford River and Gifford Fiord contains rocks noticeably less gneissic than other exposures. The rock here is commonly a coarse-grained biotite-hornblende granite. Here and there porphyroblasts of pinkish potassic feldspar have developed in the granitic matrix.

All granitic rocks are cut by variously oriented quartz or quartz-feldspar pegmatite dykes. A few of these dykes contain coarse-grained biotite or hornblende crystals.

Upper Proterozoic

Eqalulik Group

The presence of sandstones, outcropping in towering cliffs above dark close-grained rocks, was reported from the Admiralty Inlet area by early observers (Bernier, 1911, p. 152; Mathiassen, 1933, pp. 35-43). This succession was mapped by the present writer in 1954 and named Eqalulik Group (Lemon and Blackadar, 1963, p. 10). At that time three units were recognized: a Lower Quartzite, a Volcanic Member, and an Upper Quartzite Member. Although here and there quartzites of variable thickness underlie the Volcanic Member, elsewhere this member is absent and volcanic rocks rest directly on gneissic rocks. In the vicinity of the small ice-field due south of Arctic Bay several quartzitic bands appear interbedded with volcanic rocks. It would appear that the Lower Quartzite Member does not form a mappable nor unique unit and it is proposed to delete this unit from the stratigraphic succession proposed for this area.

Outcrops of Eqalulik Group rocks are most abundant between Strathcona Sound and Fabricius Fiord. Faulting along the major through valley extending from the headwaters of Adams River to Alfa River has exposed rocks of this group and similar faulting results in the exposure of outcrops of Eqalulik Group rocks east of the head of Elwin Inlet (Fig. 1).

The Volcanic Member comprises relatively unaltered basic flows, massive basaltic rocks, amygdaloidal basalts, andesites, and thin tuffaceous beds. Pillow structures are not common.

The thickness of the member is variable but at its greatest this member probably exceeds 1,000 feet.

The Quartzite Member commonly forms multicoloured castellated cliffs, some rising 1,000 feet or more above the sea or valley floors. Although mainly composed of relatively pure quartzite, quartz-pebble conglomerate and arkosic bands are not uncommon. The rocks of this member vary in colour from very

pale orange through dark yellowish orange to moderate reddish brown and dark reddish brown. They are medium to thick bedded and here and there ripple-marked and cross-bedded structures are common. Most appear to be silica cemented. Dips seldom exceed 10 degrees and a series of broad folds, variously oriented, is characteristic.

The maximum thickness of the Quartzite Member exceeds 4,000 feet. Where observed the contact between this unit and the overlying Arctic Bay Formation is conformable. The uppermost beds of the Quartzite Member, about 50 feet thick, are alternating red-brown shale and quartzite. These are followed without apparent break, by the dark grey argillaceous units of the Arctic Bay Formation.

Eqalulik Group Equivalents (North of Fury and Hecla Strait)

Quartzite — A succession of multicoloured quartzitic sandstones with minor shale and conglomerate beds outcrops on the north side of Fury and Hecla Strait between Nyeboe Fiord and Sikosak Bay. At its greatest width this band extends 20 miles inland. This succession is similar in many respects to the Quartzite Member of the Eqalulik Group but because more than 100 miles separates the two and because the overlying beds are different in the two cases, these quartzitic beds have not been grouped together. This succession was examined by the writer in 1956 and 1957 (Blackadar, 1958a, 1963).

Although these rocks are primarily greyigh orange-pink (10R 8/2)[1] to pale red (5R 6/2) massive to medium-bedded quartzite, strikingly different coloured beds are included in the succession. These comprise blocky, well-jointed, dusky red (5R 3/4) to dusky red-purple (5RP 3/2) quartzite and quartzitic sandstone interbedded with more fissile layers. These last-named include papery shales, rusty-red hematite-stained shales and black to greenish black (5GY 2/1) shales. Some shale surfaces show mud-cracks with sandy fillings.

Grit layers and conglomerate bands comprise a minor part of the succession. The latter are confined to the lower beds of the succession although they do not actually form the basal beds. Pebbles in the conglomerate are all derived from sedimentary rocks.

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[1]Colours have been determined by use of the rock-colour chart of the National Research Council (Goddard, N.E., Chairman, and others, 1948).

These quartzitic rocks overlie gneissic rocks unconformably and are overlain conformably by the sequence described below. No complete sections were measured but inasmuch as all beds appear to dip southerly at low angles, it would appear from the outcrop pattern that 10,000 to 15,000 feet of strata is present.

Siltstone, Shale, Dolomite — The quartzitic succession is overlain conformably by a sequence of black, micaceous siltstone, black shale, slate and ferruginous dolomite. Within the area mapped during Operation Admiralty these rocks are exposed only in a narrow band west and south of Autridge Bay. Similar strata outcrop on Alfred, Amherst and Liddon Islands in Fury and Hecla Strait (Blackadar, 1958a, 1963).

The contact between these rocks and the underlying quartzitic rocks is gradational. Bands of micaceous siltstone, a few inches thick, are interbedded with the quartzite in the uppermost beds of that succession. These rapidly become the predominant lithology and the outcrop assumes a black, rounded appearance due to the abundance of fissile shale fragments.

Nowhere within or beyond the map-area has the top of this unit been seen, but within the map-area the exposed thickness exceeds 800 feet and, as noted previously (Blackadar, 1963), the total thickness probably exceeds 1,500 feet. The lithology and the nature of the lower contact of this unit are similar to features found in the lower members of the Uluksan Group described in the following section. It is possible that this unit is an Uluksan Group equivalent rather than an Eqalulik equivalent. However, too great a distance separates this unit from the Uluksan Group outcrops to permit more than speculation on this possible relationship.

Uluksan Group

The Uluksan Group is a succession of shales, dolomites, limestone, mudstones, siltstones, and sandstones, with a thickness exceeding 23,000 feet. No outcrops of Uluksan Group rocks are present south of about 72°N nor are they present on Brodeur Peninsula.

The Uluksan Group as defined by Lemon and Blackadar (1963) comprised five sedimentary formations — Arctic Bay, Society Cliffs, Victor Bay, Strathcona Sound, and Elwin. Mapping carried out during Operation Admiralty disclosed the presence of two additional formations: a succession of interbedded shale, siltstone, sandstone and minor conglomerate — the Fabricius Fiord Formation that outcrops east of Fabricius Fiord — and a black limestone formation — the Athole Point Formation that forms the northern part of the peninsula between Tremblay Sound and Milne Inlet, and may extend about 25 miles to the northwest.

The Uluksan Group overlies the Eqalulik Group conformably, the contact commonly being gradational. The group is overlain by Palaeozoic rocks and is separated from that succession by an erosional disconformity.

Rocks of the Uluksan Group extend an unknown distance southeast from Milne Inlet, at the eastern border of the map-area.

Arctic Bay Formation — The type section of the Arctic Bay Formation at the settlement of Arctic Bay (Lemon and Blackadar, 1963, p. 15) consists of 350 feet of black, fissile, medium- to fine-grained argillaceous limestone and calcareous dolomite.

Outcrops of Arctic Bay Formation are present on the floor of the valley of Adams and Alfa Rivers, at the head of Elwin Inlet, and throughout an extensive area southeast of Adams Sound. In the eastern part of the map-area the formation outcrops extensively south of Eskimo Inlet. The relatively soft rocks of this formation weather readily and areas underlain by it are areas of subdued topography. Throughout the entire map-area the weathered surfaces of the Arctic Bay Formation are characterized by deposits of white salts, a feature that facilitates ease of recognition.

The formation consists primarily of well-bedded shale with interbedded more-resistant layers of argillaceous dolomite. Although usually black in colour, reddish and greenish shales are found here and there in the succession. Some argillaceous dolomite beds are relatively rich in pyrite, weathering on hillsides to form large rusty patches.

Thicknesses increase eastwards from the type section and at the head of Tremblay Sound the formation may exceed 1,000 feet in thickness.

Fabricius Fiord Formation (Original description) — Outcropping east of Fabricius Fiord is a succession of black shales, siltstones and quartzitic sandstones with minor conglomerate beds. These rocks are beyond the area mapped by Lemon and Blackadar and have not previously been reported. The alternation of shale and more-resistant beds, particularly in the lower half of the succession, and the dip of between 10 and 20 degrees, give rise to a distinctive outcrop pattern and the limits of the map-unit are readily determined from air photographs. The name Fabricius Fiord Formation is proposed for this succession.

A thickness of 5,430 feet was obtained from a section measured across this formation about 9 miles east of the head of Fabricius Fiord. Here the lower 2,595 feet comprises alternating black, thin-bedded, silty and in part pyritiferous shales and thin- to medium-bedded grey or brownish weathering siltstone and shaly siltstone. The upper beds comprise yellowish, greenish, or grey, coarse to conglomeratic quartzitic sandstones and arenites. Shaly beds appear to be absent from the upper part of the succession.

This sequence appears to overlie conformably the Eqalulik quartzite and to grade eastward into the Arctic Bay Formation. Locally it may thus represent a greatly thickened aspect of the gradational contact commonly found between the Eqalulik Group and the lowermost formation of the Uluksan Group.

Society Cliffs Formation — The type section of this formation, measured in the spectacular St. Georges Society Cliffs near Arctic Bay (from which its name is derived), consists of a succession of vaguely bedded to massive grey or light grey dolomites, 900 to 1,000 feet thick (Lemon and Blackadar, 1963, p. 19). The formation weathers into prominent cliffs, commonly stained by hematite, making it easy to recognize.

Structural effects cause the Society Cliffs Formation to be exposed in two broad bands; the southern band in places exceeds 10 miles in width and extends southeast from the type locality to beyond the eastern limits of the map-area.

The formation varies in thickness. At the type section it is 900 to 1,000 feet thick. A section measured between Tremblay Sound and Milne Inlet comprises 785 feet of pale grey to light olive-grey fine- to medium-bedded dolomite. Intraformational conglomerate occurs in the lowermost 30 feet.

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

Victor Bay Formation — The varied series of dark to pale grey, medium- to coarse-grained dolomite, chert, edgewise conglomerate, and interbedded dark grey limestone and mudstone overlying the Society Cliffs Formation was named the Victor Bay Formation (Lemon and Blackadar, 1963, p. 20). Outcrops extend from the type locality at Victor Bay, through the head of Strathcona Sound to near the mouth of Tremblay Sound. Rocks of this formation also outcrop north of Strathcona Sound. Edgewise conglomerate and cherty blebs and vermiform cherty masses characterize this formation throughout the map-area.

Eastward from the type locality the Victor Bay Formation thickens rapidly. At Victor Bay 520 feet of strata comprises the formation but southeast of the head of Strathcona Sound it is 1,665 feet thick, and east of Tremblay Sound at least 1,645 feet of strata is present.

East of Elwin Inlet a formation which from its position in the stratigraphic succession is presumed to be Victor Bay is less argillaceous than Victor Bay beds at the head of Strathcona Sound. At the head of Elwin Inlet on the south side this unit of nearly flat-lying, well-bedded dolomite forms a spectacular nearly vertical cliff, 2,500 feet high.

Eight miles upstream from the head of Baillarge Bay at least 1,025 feet of Victor Bay beds is exposed although the base of the formation was not seen. The lower 375 feet comprises massive to medium-bedded, dark grey dolomite, with minor chert in the beds above 300 feet. The upper beds are more argillaceous and form extensive scree slopes. However, outcropping here and there are beds of dolomite 4 inches to 1 foot thick interbedded with fissile beds of argillaceous dolomite.

Where observed the upper contact of the Victor Bay Formation is conformable with the overlying Strathcona Sound Formation. Lemon and Blackadar (1963, p. 20) noted that silty sandstone and conglomerate are sometimes present in the uppermost beds and suggest that these features indicate widespread instability at the close of deposition of Victor Bay rocks. Observations made during the present field work indicate that locally at least, this instability continued during deposition of the Strathcona Sound Formation.

Athole Point Formation (Original Description) — A succession of medium grey to medium light grey limestones overlies the Victor Bay Formation east of Tremblay Sound and extends about 8 miles southwest from Athole Point. These rocks were first examined by W.L. Davison in 1954. Similar rocks are present on Borden Peninsula northwest of Athole Point, but precise contacts for these outcrops have not been determined. The name Athole Point Formation is proposed for this succession.

At Athole Point the formation comprises a sequence of argillaceous limestone and chert, well-banded argillaceous limestone with minor beds of intraformational conglomerate, and platy limestone. On a structural basis the thickness of the unit appears to exceed 5,000 feet.

The black carbonate rocks at Athole Point stand in marked contrast to the light-coloured strata on the north shore of Tremblay Sound and form an easily recognized unit. The Athole Point Formation conformably overlies the Victor Bay Formation.

Strathcona Sound Formation — The monotonous succession of dark red mudstones, shales, grey siltstones, and sandstones overlying the Victor Bay Formation is the Strathcona Sound Formation (Lemon and Blackadar, 1963, p. 23). It covers a large area of north-central Borden Peninsula, although not found on the extreme east coast. This formation can be divided into two broad divisions: one of dark red mudstones and shales, the other a sequence of grey sandstones and siltstones. Although the former commonly are lower in the stratigraphic succession than the latter this relationship does not always obtain and the two may interfinger. This relationship is particularly well displayed on the high cliff faces on the south side of the valley that extends east from Baillarge Bay. Here a thick succession of westerly dipping dark red mudstones and shales grades, within about a mile, into a predominantly grey siltstone-sandstone succession which, however, contains many thin bands (less than a foot thick) of dark red mudstone. These latter in turn disappear, and along the south shore of Baillarge Bay only the grey siltstone-sandstone sequence is present.

The widespread instability at the close of deposition of the Victor Bay Formation apparently continued during deposition of the Strathcona Sound Formation. A most remarkable example of this is a light-weathering intraformational conglomerate unit that outcrops on both sides of the valley east of Baillarge Bay. 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 (10YR 6/6) imparting a remarkable appearance to the rock. This unit is about 2 miles long and is lens-shaped, with a maximum thickness exceeding 100 feet. In its thickest part the basal beds contain interbedded black argillaceous dolomite and shales whereas the uppermost part contains interbedded dark red shales and mudstones. Elsewhere the intraformational conglomerate unit rests directly on the Victor Bay Formation and is overlain by the Strathcona Sound Formation.

Similar but much thinner intraformational conglomerate beds, also with dark yellowish orange fragments, occur in the upper grey siltstone-sandstone succession.

No complete sections of the Strathcona Sound Formation have been measured but on structural grounds the dark red succession in places exceeds 2,500 feet. On the south shore of Baillarge Bay the overlying grey siltstone-sandstone succession appears to be at least 1,500 feet thick.

The Strathcona Sound Formation appears gradational into the overlying Elwin Formation. The contact is placed where the relatively monotoned siltstones and sandstones of the lower formation are replaced by a more colourful and varied clastic succession, the Elwin Formation.

The upper Strathcona Sound beds on the south side of Baillarge Bay comprise a well-banded, dull-coloured succession. Thin resistant, buff-weathering layers are interbedded with softer, medium grey rocks. About 15 miles southeast of Ship Point this sequence is overlain by the Elwin Formation. A similar lithological change marks the contact between the two formations east of Elwin Inlet.

The Elwin Formation (Lemon and Blackadar, 1963, p. 25), a varicoloured assemblage of alternating reddish or bright orange-weathering quartzitic sandstones, reddish silty sandstones and micaceous shales, is the uppermost formation of the Uluksan Group. Rocks of this formation are most abundant north of a line extending east from the mid-point of Elwin Inlet to Navy Board Inlet. However outcrops of Elwin Formation are present between Strathcona Sound and Baillarge Bay and similar rocks outcrop in the valleys of the peninsula between Elwin Inlet and Baillarge Bay.

The contact between the Elwin Formation and the Strathcona Sound Formation is gradational. The upper contact is a disconformity above which rocks of Palaeozoic age may be found. Where the lower formations of the Palaeozoic succession are present (Gallery and Turner Cliffs Formations) difficulty may be experienced in separating the Elwin from the younger formations. However banding is more prominent in the Elwin Formation than in the overlying formations and this serves as a field guide.

No complete section was measured in the Elwin Formation but on structural grounds the thickness of the formation exceeds 5,000 feet.

Gabbro Sills and Dykes

A remarkable series of anastomosing basic dykes trends northwest from Milne Inlet and the head of Tremblay Sound to Uluksan Peninsula. Smaller and less extensive clusters of northwest-trending dykes are found elsewhere in the map-area, for example east of Fleming Inlet and Fabricius Fiord, north of Fury and Hecla Strait, and in extreme northern Borden Peninsula. Less common are similar dykes trending north-northwest or north. Here and there the two groups intersect. Sills as well as dykes are present in Eqalulik Group equivalents in the southern part of the map-area. Gabbro dykes intersect these sills.

The dykes intrude all formations older than the Ordovician Gallery Formation. Two K-Ar age determinations made on gabbroic rocks from near Arctic Bay gave ages of 915 and 1,140 m.y., thus suggesting that the Uluksan Group is not younger than lowermost Upper Proterozoic (Stockwell, 1963, Fig. 3).

Except for chilled margins the intrusive rocks have had little effect on the intruded strata. Differentiation within the gabbroic masses usually resulted only in the development of coarser-grained phases but here and there patches of "red-rock", rich in quartz and micropegmatite were formed. Even in the large sills near Autridge Bay in the southern part of the map-area, the gabbroic masses are surprisingly homogeneous. A fuller description of the gabbroic rocks is given in Lemon and Blackadar (1963, pp. 33-38).

ECONOMIC GEOLOGY

A. English, the prospector who accompanied the Canadian Government Expedition of 1910-11, discovered a deposit of pyrite with minor sphalerite and galena on the south side of Strathcona Sound. This deposit was examined by the writer in 1954 and a brief report accompanied GSC Paper 55-6.

During the summer of 1957 the deposit was staked by Texas Gulf Sulphur Company and since that time considerable exploration has been done. According to the Northern Miner (1964) company officials have stated that at the Strathcona Sound locality "ore averaging about 20 per cent zinc or equivalent net value with lead and silver can be mined profitably." The report states that several million tons of ore of this grade is included in the tens of millions of tons of sulphides outlined to date in the deposit. More than 55,000 feet of diamond-drilling had been completed by the autumn of 1963.

The main deposit is a single body, 15,000 feet long, 300 feet to 500 feet wide and 30 to 50 feet thick. There are several other en échelon bodies. At present Texas Gulf Sulphur Company holds 230 claims in the area. The body lies within the Society Cliffs Formation of the Uluksan Group.

Baffinland Iron Mines is conducting exploration on a deposit of magnetite and hematite near Mary River east of the area mapped during Operation Admiralty. This deposit is said to be extensive, with a tonnage of 36 million tons estimated for one deposit. The material is very high grade with an average composition of 69.76 per cent Fe. Further exploratory work in 1964 disclosed a minimal tonnage of 187 million tons. The ore is direct shipping, premium grade ore.

Magnetite- and hematite-rich beds were observed in the Palaeozoic Gallery and Turner Cliffs Formations west of Navy Board Inlet. These are possibly derived from erosion of the Baffinland Iron Mines deposit. Hematite-rich beds were also seen in the Proterozoic quartzites north of Fury and Hecla Strait. Southeast of Adams Sound a small pinnacle of black massive hematite appears to cut the Society Cliffs dolomite. None of these occurrences is of any significant size.

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