GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA

PAPER 77-15

STRATIGRAPHIC SUBDIVISION OF THE APHEBIAN RAMAH GROUP, NORTHERN LABRADOR

I. KNIGHT
W.C. MORGAN

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

1976

GEOLOGICAL SURVEY
PAPER 77-15

STRATIGRAPHIC SUBDIVISION OF THE APHEBIAN RAMAH GROUP, NORTHERN LABRADOR

I. KNIGHT
W.C. MORGAN

1977

Printing and Publishing
Supply and Services Canada,
Ottawa, Canada K1A 0S9,

from the Geological Survey of Canada
601 Booth St., Ottawa, K1A 0E8

or through your bookseller.

Catalogue No. M44/77-15
ISBN - 0-660-00824-6

Price: Canada: $2.50
Other Countries: $3.00

Price subject to change without notice

CONTENTS

Illustrations

Oblique aerial photograph looking east across the Torngat Mountains, south of Nachvak Fiord. EMR Photo T251R-174. The Ramah Group (ARG) lies unconformably on Archean gneisses (Agn) that are cut by diabase dykes. Archean gneisses reworked during the Hudsonian Orogeny (A'gn) occur in the foreground and have been thrust east over the Ramah Group. Dark weathering diabase sills in the Ramah Group and gneissic banding in the Archean are locally visible.

STRATIGRAPHIC SUBDIVISION OF THE APHEBIAN RAMAH GROUP, NORTHERN LABRADOR

Abstract

The Aphebian Ramah Group, located in the Hebron Fiord - Nachvak Fiord area of the Torngat Mountains, northern Labrador, is composed of 1702 m (5582 ft.) of clastic and carbonate sedimentary rocks and a single thin volcanic flow. In this report it is divided into six new formations that are named and defined. Two contrasting lithological sequences are present. The lower sequence, formed by the Rowsell Harbour and Reddick Bight formations, consists of thick multicoloured quartzites, sandstones and laminites that were chiefly deposited on a shallow marine shelf. The upper sequence is formed by monotonous shales and slates, the Nullataktok and Typhoon Peak formations, by the intervening predominantly dolomitic Warspite Formation, and by greywackes and slates of the uppermost unit, the Cameron Brook Formation. Type sections are designated for each formation.

Résumé

Le groupe de Ramah de l'Aphébien, situé dans la région des fiords Hebron et Nachvak de la partie nord du Labrador est composé de 1702 m (5582 pieds) de roches sédimentaires clastiques et carbonatées et d'une seule coulée volcanique mince. Dans ce rapport le groupe est divisé en six nouvelles formations qui sont nommées et définies. Deux successions lithologiques en contraste s'y trouvent. La succession inférieure, formée par les formations de Rowsell Harbour et de Reddick Bight consiste en d'épais quartzites multicolores, de grès et de laminites qui ont été en grande partie déposés sur un plateau marin peu profond. La succession supérieure est formée à la base par les formations de Nullataktok et de Typhoon Peak constituées de schistes argileux et d'ardoises monotones, vient ensuite se superposer la formation Warspite à prédominance dolomitique et au sommet la formation de Cameron Brook constituée de grauwackes et d'ardoises. Les coupes sont désignées pour chaque formation.

INTRODUCTION

This paper presents the results of field work undertaken in 1971 and 1972 to map and investigate the Precambrian Ramah Group and the contact between Nain and Churchill Structural Provinces in part of the Torngat Mountains, northern Labrador (Fig. 1). Six formations were identified in the Ramah Group and mapping, for publication at a scale of 1:50 000, of their distribution was carried out between Saglek Fiord and Nachvak Fiord (parts of NTS map-sheets 14L/6, L/11, L/14, M/3, M/4). Part of a detailed study of the stratigraphy and sedimentology of the group that formed the basis of a doctoral thesis to be submitted by Knight to Memorial University of Newfoundland is incorporated here.

The aim of this report is to name, define and describe the six new formations that have been established in the Ramah Group in accordance with the Code of Stratigraphic Nomenclature of the American Commission on Stratigraphic Nomenclature (1961). Type sections of each formation are delineated in an appendix.

History of Investigation

The occurrence of sedimentary rocks in the area, first noted by Moravian missionaries was reported by Steinhauer (1814) and later by Bell (1884, 1895) who observed that these rocks outcropped from Ramah Bay to Nachvak Fiord. The Ramah Group was named the Ramah Sedimentary Series by Daly (1902) and extended south to the vicinity of Saglek Fiord on the basis of exploration carried out by Delabarre (1902). Stratigraphic sections of the Ramah Group and brief lithological descriptions were given by Coleman (1921), Christie (1952) and Douglas (1953). Progress reports and descriptions of the lithological formations that are presented here have been given by Knight (1973) and Morgan (1972, 1975).

General Geology

The Ramah Group, which is composed chiefly of sedimentary rocks with a maximum thickness of 1702 m (5582 ft.), occurs in a north trending linear fold belt that extends from Hebron Fiord to Nachvak Fiord (Fig. 1), a distance of about 112 km (70 miles). The belt is narrow, commonly varying in width from 8 km to 16 km (5 to 10 miles) in an east-west direction, but becoming more attenuated south of Saglek Fiord. This supracrustal fold belt separates Archean basement rocks of Nain Structural Province to the east from chiefly reworked Archean basement rocks of Churchill Structural Province to the west.

In the Nachvak Fiord - Saglek Fiord area (Fig. 2) the Ramah Group is preserved in a doubly plunging synclinorium that plunges south in the north and north in the south. There is a considerable increase in the intensity of deformation in this synclinorium towards the west. Whereas the eastern margin of the belt is formed by an unconformity surface against an Archean craton, the western margin is bounded by west dipping thrusts and faults that separate strongly folded Ramah Group rocks from a mobile zone of granulite facies basement rocks reworked by the

Original manuscript submitted: December 31, 1976
Approved for publication: January 27, 1977

TABLE OF FORMATIONS

EON	ERA	GROUP	FORMATION		THICKNESS	LITHOLOGY
PROTEROZOIC	APHEBIAN					Diabase, sills; transgress bedding; locally differentiated with ultramafic core.
			Intrusive Contact			
		RAMAH GROUP Maximum measured thickness 1702 m (5582 ft.)	Cameron Brook Formation		200 m + (656 ft.)	Greywacke - sandstones and mudstones.
			Typhoon Peak Formation		85-130 m (279-426 ft.)	Slates; some sandstone and limestone.
			Warspite Formation		165 m (541 ft.)	Dolomitic breccias and sandstones; dololutites; some limestone and calcareous mudstone; argillite, mudstone.
			Nullataktok Formation		595 m (1952 ft.)	Varicoloured mudstones and shales; graphitic pyritiferous; chert; pyrrhotite-pyrite unit; calcareous and dolomitic mudstones.
			Reddick Bight Formation		53-143 m (174-469 ft.)	Black quartzite; grey muddy sandstone; sandstone-siltstone laminites; yellow weathering dolomite unit.
			Rowsell Harbour Formation 251-470 m (835-1542 ft.)	Upper White Quartzite Member	46-267 m (151-876 ft.)	White quartzite; some conglomerate; interbedded shale and mudstone.
				Phyllite Member	15-44 m (49-144 ft.)	Laminated purple mudstone and very fine grained sandstone.
				Purple Quartzite and Mudstone Member	75-157 m (246-515 ft.)	Pink quartzite; alternating units of purple quartzite and purple mudstone; grey sandstone and shale.
				Volcanic Member	0-9 m (0-30 ft.)	Altered tholeiitic basalt flow.
				Lower White Quartzite Member	31-97 m (102-318 ft.)	Granitic wash; pebble conglomerate; white quartzite with heavy mineral laminae; white quartzite; pebbly, coarse grained sandstone.
		Unconformity				
					0-12 m (0-39 ft.)	Regolith
						Diabase dykes; eastward trending swarm
		Intrusive Contact				
ARCHEAN						Granitic gneiss; migmatite; granulite; mafic gneiss; metasediments.

Hudsonian Orogeny (Morgan 1974, 1975). Mylonitized rocks are common in the Ramah Group along its western margin and also occur associated with local west dipping thrust faults that cut the group.

The regional metamorphic grade of the Ramah Group is chiefly in the greenschist facies but increases to amphibolite facies in the west and south.

A Rb-Sr whole-rock errorchron age of 1892 ± 92 m.y. has been obtained from an altered, thin tholeiitic basalt flow and related feeder dyke that occurs near the base of the Ramah Group. The age is considered to be a minimum for the time of deposition of the Aphebian Ramah Group which was metamorphosed and folded with underlying basement gneisses during the Hudsonian Orogeny (Morgan, in press).

The pronounced flat or gently inclined unconformity surface at the base of the Ramah Group along the eastern margin of the fold belt represents an extensive peneplain cut in Archean gneisses prior to deposition of the group. The authors agree with the conclusion of Douglas (1953) that many of the present day gneissic mountain sides marginal to the group in the east probably represent this exhumed peneplain. In parts of the area, for example in the vicinity of Bears Gut (Fig. 2), the unconformity is irregular with deep, local erosion of the underlying basement.

A regolith, commonly 1 to 3 m (3 to 10 ft.) thick (but locally up to 12 m (39 ft.)), in which Archean gneisses and pre-Ramah diabase dykes are highly altered, occurs beneath the unconformity. This pre-Ramah Group weathering has obliterated textures and fabrics, replaced original feldspars with clay minerals, corroded relict quartz grains, and locally enriched mafic gneiss and diabase with iron, titanium and chromium. These mafic rocks are commonly brown or red and contain conspicuous euhedral magnetite crystals. Spheroidal weathering of basement gneiss in the regolith is well developed on the north side of Reddick Bight.

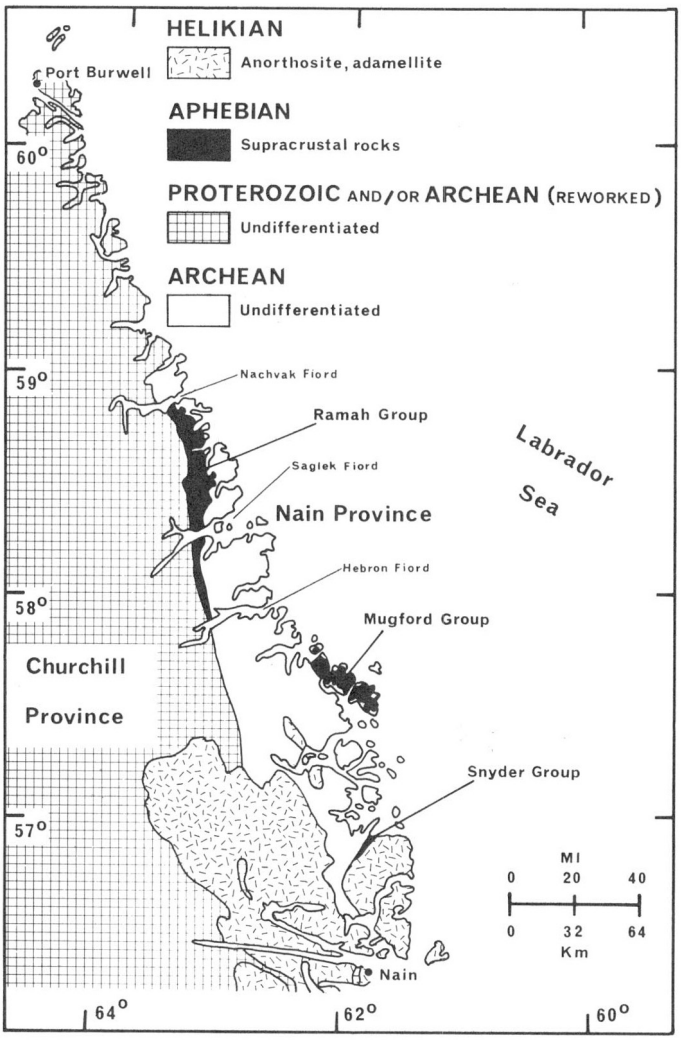

Figure 1. Index map showing location of the Ramah Group in northern Labrador.

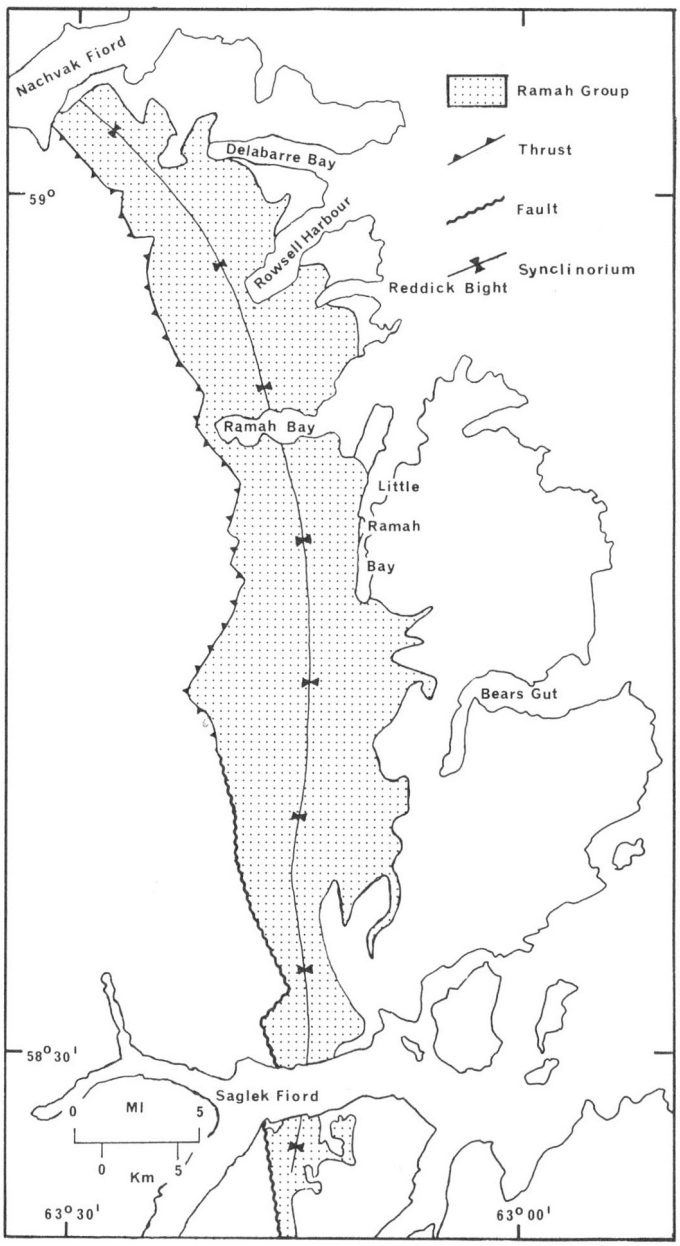

Figure 2. Location map of the Nachvak Fiord - Saglek Fiord map-area showing the Ramah Group and geographic names referred to in the text.

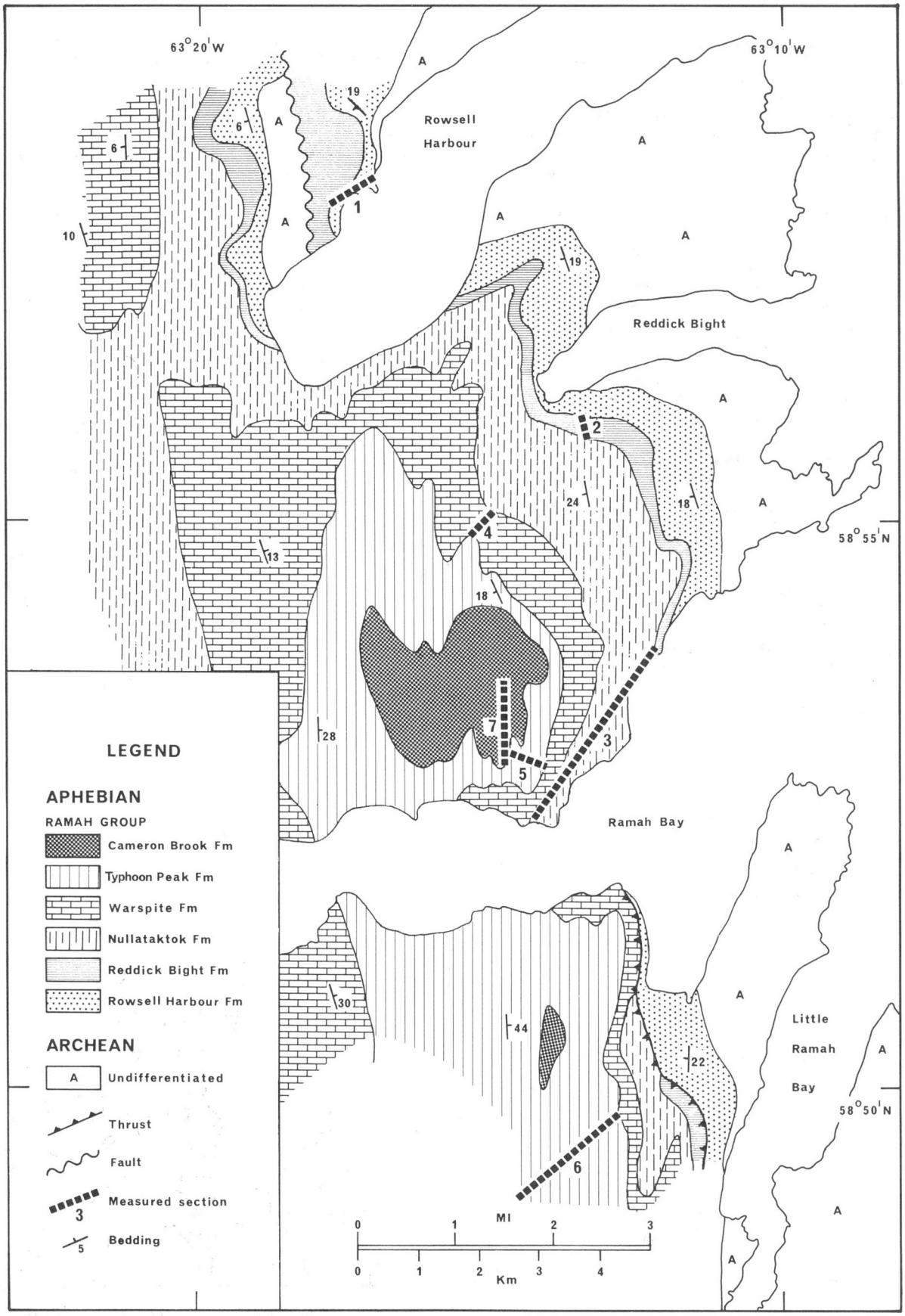

Figure 3. Location map showing measured sections in the Ramah Group.

THE RAMAH GROUP

The 1702-m (5582 ft.)-thick Ramah Group is composed of clastic and carbonate sedimentary rocks with a single thin volcanic flow near its base and with several diabase sills at different stratigraphic levels throughout the group. Names are proposed below for the six formations into which the group is subdivided (Table I).

Since the group is preserved in a doubly plunging synclinorium it is possible to map the lower formations (Rowsell Harbour Formation, Reddick Bight Formation and lower part of Nullataktok Formation) throughout the Saglek Fiord - Nachvak Fiord map-area (Fig. 2). The upper part of Nullataktok Formation and Warspite Formation can be traced discontinuously from Delabarre Bay to west of Bears Gut. Typhoon Peak and Cameron Brook formations, however, occur in the centre of the synclinorium and are limited to the high plateau areas, extending from Rowsell Harbout to west of the south end of Little Ramah Bay, on either side of Ramah Bay.

Formation names and type sections are from this central part of the synclinorium (Fig. 3). Here diabase sills cut only the Typhoon Peak Formation and metamorphic grade is low. Depositional structures are common and are very well preserved. Although the upper formations in the centre of the structure are tightly folded and cleaved, the lower competent formations are little deformed. In these basal formations cleavage, chloritoid porphyroblasts and metamorphic sericite are confined to fine grained argillaceous horizons.

Two contrasting sequences of sedimentary rocks that differ in grain size, composition and sedimentary structures occur in the Ramah Group. The lower sequence, formed by Rowsell Harbour and Reddick Bight formations, consists of a thick succession of multicoloured quartzites, grey sandstones and laminites that in general contain coarse detritus derived from nearby Archean basement rocks. A pure dolomite unit that is always present at the top of Reddick Bight Formation, marks the end of a shallow marine deposition phase. Above this, in contrast, is a thick succession of very fine grained rocks that are initially composed of black, pyritiferous slates with sedimentary pyrite-pyrrhotite and chert horizons, but are increasingly calcareous and dolomitic from the upper part of Nullataktok Formation into the dominantly dolomitic Warspite Formation. The Warspite Formation grades transitionally upwards into a generally monotonous assemblage of black slates that form the Typhoon Peak Formation which, in turn, is overlain transitionally by greywacke sandstones and slates of the Cameron Brook Formation, the highest unit preserved. The upper sequence represents deep, quiet-water, basinal deposition and records a change from argillaceous to fine carbonate deposition as the basin was infilled and shallowed. The carbonates revert to a clastic sequence that coarsens upwards suggesting that unstable conditions prevailed towards the end of the depositional history of the group.

Rowsell Harbour Formation

The name of this formation is derived from Rowsell Harbour, a sea bay, on both sides of which are excellent exposures. The type section, on the northern shore of Rowsell Harbour, extends from UTM grid zone 20: 483,700 E, 6,536,200 N, to 483,000 E, 6,535,800 N (Fig. 3; *see* Appendix). Rowsell Harbour Formation is well exposed throughout the map-area at the periphery of the synclinorium. The type section is 251 m (823 ft.) thick and the formation thickens to the south where a maximum measured thickness of 470 m (1542 ft.) was recorded.

The formation consists predominantly of quartzite and sandstone with some mudstone and slate, and with a single thin volcanic flow. Sedimentary structures are well displayed. A subdivision into five lithological members (*see* Table of Formations), that vary in thickness throughout the area, has been made.

Lower White Quartzite Member

The lower quartzite member, which is equivalent to the lower arkosic quartzite of Douglas (1953), lies unconformably on Archean basement rocks and consists of a number of subfacies. Thickness of this member ranges from 31 to 97 m (102 to 318 ft.).

A thin, poorly sorted, unbedded or crudely bedded granitic wash commonly overlies the unconformity. This resembles the upper parts of the underlying regolith but may contain scattered pebbles and is locally separated from the regolith by a conglomerate lens. The conglomerate fills depressions in the unconformity surface and contains clasts of white quartz, purplish quartz and jasper. The last two were probably derived from jasper bodies in the regolith that developed from weathering and decomposition of mafic gneiss and amphibolite. White conglomerates and white pebbly quartzites overlie the granitic wash, and are in turn overlain by a white quartzite unit with abundant black heavy mineral lamellae that delineate foresets and basal scour surfaces of cross-beds. At Delabarre Bay, this heavy mineral subfacies rests directly on Archean basement; elsewhere it rests upon the basal granitic wash. It occurs throughout the map-area but thins to the south.

The heavy mineral subfacies of the quartzite is overlain gradationally by yellow-brown weathering, white quartzites. This unit, which lacks heavy mineral lamellae, forms the bulk of the member and consists of cross-bedded and ripple-marked quartzites that decrease in grain size upwards from coarse to fine. The quartzites are relatively pure, contain only a few per cent of feldspar, are well sorted except in the basal part, and are cemented by calcium carbonate. Between Delabarre Bay and Nachvak Fiord they are striped yellow and white due to partial replacement of calcite cement by yellow weathering dolomite in layers parallel to bedding.

The upper unit of the member is a dolomitic conglomerate or pebbly coarse grained or very coarse grained sandstone that is trough cross-bedded. The top of this unit is stained by iron oxides leached from the overlying volcanic flow, and this enables the horizon to be recognized where the flow has been removed from the succession by erosion.

Volcanic Member

This member is composed of a single flow that can be traced discontinuously north from west of Bears Gut to the south shore of Rowsell Harbour, a

distance of 32 km (20 miles). At the type section of the formation the flow occurs in a covered interval, but it is absent a few kilometres north in the vicinity of Delabarre Bay.

The flow, which is commonly 6 to 9 m (20 to 30 ft.) thick, is a highly altered tholeiitic basalt (Morgan, in press) that has been described as latite (Christie, 1952) and andesite (Taylor, 1969). Subaerial flow features can be distinguished in the field. The flow is characterized by vertical vesicle pipes (Waters, 1960), spheroidal iron rings previously interpreted as pillows (Douglas, 1953) and an amygdaloidal and brecciated top. Locally, at Little Ramah Bay, numerous flattened pahoehoe toes occur in the upper part of the flow. Chalcedony and dolomite are common as secondary replacement minerals in the reddened flow top.

Purple Quartzite and Mudstone Member

About 4 to 25 m (13 to 82 ft.) of well sorted, pink quartzite rests directly upon the volcanic member throughout the map-area. This unit is overlain by an alternating sequence of pink to purple, fine grained to very fine grained quartzites and laminated to massive grey to purplish mudstones. The quartzites are cross-bedded and contain abundant ripple marks.

Between Delabarre Bay and Nachvak Fiord the pink quartzite at the base of the member thickens and changes considerably. Medium grained quartzites with some heavy mineral lamellae alternate with pink and grey, fine grained to very fine grained sandstones and grey shales. The sandstones are rich in muddy, grey laminae which pick out foresets of cross-beds.

Mudstone units containing thin beds of purple quartzite spotted by green metamorphic chlorite clusters are increasingly important towards the top of this member which ranges in thickness from 75 to 157 m (246 to 515 ft.).

Phyllite Member

This member, which is commonly poorly exposed, has a thickness of 15 to 44 m (49 to 144 ft.). It is composed of 2 to 15 cm thick beds of purplish grey and yellowish pink mudstones that overlie the Purple Quartzite and Mudstone Member with a sharp conformable contact. The lower part of individual beds, above an irregular scoured base, is laminated or ripple-laminated, and consists of either mudstone or of white or grey, calcareous, muddy, very fine grained sandstone.

The top of the Phyllite Member is defined as the base of the first white quartzite unit in the Upper White Quartzite Member, although similar mudstones and shales do occur for some metres into the lower part of that succeeding member.

Upper White Quartzite Member

This member, with a thickness of 46 to 267 m (151 to 876 ft.), is generally similar to the Lower White Quartzite Member and was called the upper arkosic quartzite by Douglas (1953). The upper member is, however, quite distinct from the lower member. Coarsening upward sequences 14 to 20 m (46 to 66 ft.) thick of cross-bedded and laminated, very fine grained grading upwards into medium or coarse grained quartzites and commonly culminating in a thin, quartz pebble conglomerate, intercalated horizons of conglomerate, and interbeds of shale and mudstone are present in the Upper White Quartzite Member. A number of units of horizontal, thin bedded, fine grained quartzites, displaying laminations and parting lineations, alternating with thin beds of shale, also occur in this upper member.

Green quartzites intercalated with thin green shales occur locally in the vicinity of Bears Gut.

In the type section at Rowsell Harbour, the upper contact is placed at the first occurrence of black quartzite which is assigned to the overlying Reddick Bight Formation. To the south, however, white quartzites at the top of Rowsell Harbour Formation pass gradationally up, over a few metres, into grey sandstones, and the upper contact is defined by the absence of white quartzites.

Reddick Bight Formation

The formation name is derived from Reddick Bight, a small sea bay a few miles north of Ramah Bay. The type section is on the south side of Reddick Bight, and extends from UTM grid zone 20: 487,100 E, 6,532,400 N, to 487,200 E, 6,532,000 N (Fig. 3; *see* Appendix). Reddick Bight Formation is well exposed throughout the map-area. The type section is 121 m (397 ft.) thick. The formation thickens from north to south and ranges in thickness from 53 to 143 m (174 to 469 ft.).

Reddick Bight Formation consists of a complex assemblage of predominantly clastic rocks that show rapid vertical and lateral facies changes. Three major facies occur. These are (a) black and dark grey quartzites which are well developed at the base of the formation near Bears Gut but are thin in the Rowsell Harbour - Reddick Bight area. A thick sequence of this facies also occurs in the upper part of the type section south of Reddick Bight. (b) Grey, poorly sorted, muddy sandstones that are present throughout the area at various levels in the formation. Two distinct subfacies are present: (i) sandstones which display planar and trough cross-bedding, and (ii) sandstones which exhibit features typical of turbidites. The turbidite subfacies occurs in the vicinity of Ramah Bay whereas the cross-bedded sandstones are dominant in the southeast particularly near Bears Gut. The cross-bedding suggests that the sandstones were being transported towards the northwest. Features resembling trace fossils were observed in these sandstones near Bears Gut. (c) Laminites composed of alternations of dark and light grey, very fine grained sandstone with siltstone laminae. The laminite facies occurs towards the middle and also near the top of the formation throughout the area and contains numerous structures that resemble remains caused by organic activity. This banded facies was called Ramah Quartzite by Douglas (1953).

Rapid alternations of the cross-bedded grey sandstone and the laminite facies occur at Bears Gut. A lensoid mudflow consisting of rolled and attenuated sandstone and mudstone fragments set in a sand-mud matrix was distinguished near the top of the formation at Reddick Bight. In the north, where the formation thins, only a thin sequence of laminites and quartzites overlie the upper white quartzite of Rowsell Harbour Formation.

Sandy dolomitic areas replace original sandstones in the upper part of the formation. The top of Reddick Bight Formation is placed at the upper surface of a very distinctive, bright yellow weathering secondary dolomite unit. The dolomite unit is typified by 1 to 3-cm-thick, fine grained massive dolomite layers, commonly broken or fragmented, cemented by and alternating with coarse prismatic crystalline dolomite. The massive and crystalline dolomite layers are commonly arranged into large dome and basin structures 30 to 100 cm high and 50 to 100 cm wide. In many places, however, the layering is horizontal. Chaotic breccias also occur. Later chert and dolomite veining is common. Relict patches of original sediment occur near the base of the unit and include dolomitic sandstones in the vicinity of Little Ramah Bay and laminated and thin bedded calcilutite and dololutite near Adams Lake. Whereas the upper contact is sharp and planar, the lower contact is gradational into the underlying sandstones. The unit may represent deposition of dolomite at a disconformity associated with subaerial conditions and percolating groundwater solutions.

Nullataktok Formation

The name of this formation is derived from Nullataktok Bay, the Eskimo name for Ramah Bay. Nullataktok Bay is referred to by Coleman (1921) and is also shown on two of the maps that accompany his memoir on the geology of northeastern Labrador. The type section is located on the northeast shore of Ramah Bay, and extends from UTM grid zone 20: 488,400 E, 6,528,500 N, to 486,300 E, 6,525,700 N (Fig. 3; *see* Appendix).

Nullataktok Formation consists of a thick section of varicoloured cleaved mudstones and shales that outcrop from west of Delabarre Bay south to the vicinity of Saglek Fiord. Because of its fine grained nature it is commonly poorly exposed, and folding, associated with regional cleavage, is developed in upper parts of the formation. On inland exposures colour and sedimentary structures are masked by weathering and the broken nature of outcrops, and are only occasionally visible along washed stream sections. These features are, however, particularly well displayed on the major coastal section at Ramah Bay, where the type section, which is 595 m (1952 ft.) thick, is located. Nullataktok Formation contrasts sharply with the underlying formations and can be divided into a number of distinctive units.

The basal part of the formation is composed of structureless black, graphitic, sulphurous shales, now altered to slates, that contain abundant pyrite nodules, and pyrite laminae that are commonly deformed into large slump folds. Colour banding occurs above this in the sequence and commences with alternations of blue-black mudstones and light green-grey muddy siltstones.

The colour banded mudstones are, however, interrupted by a striking sequence composed of pyrrhotite-pyrite, chert, and dololutite-argillite. This sequence can be traced south from Rowsell Harbour to the south end of Little Ramah Bay. North of Rowsell Harbour the chert thickens considerably, whereas the pyrite thins and is not present on the south side of Delabarre Bay. The pyrrhotite-pyrite unit displays a variety of textures that include original sedimentary lamination in the area between Ramah Bay and Rowsell Harbour. The laminated pyrrhotite-pyrite unit is commonly brecciated and has been recemented by massive pyrite. From Little Ramah Bay to Bears Gut the pyrrhotite-pyrite unit is composed predominantly of structureless pyrrhotite that is rich in spherical white quartz and green-grey phyllitic clasts. The overlying white to black chert displays undulose bedding, and although it is usually structureless, faint internal lamination and thin interbeds and lenses of mudstone are locally present. A dololutite-argillite sequence occurs above the chert, and at Delabarre Bay this sequence is overlain by a second, but thinner, chert horizon.

Above the dololutite-argillite the colour banded and lithologic banded sequence continues with a blue-black and green-grey mudstone-siltstone assemblage. Brown, very fine grained sandstone beds are, however, also present and result in a very striking colour banded assemblage that probably represents the Zebra Slates of Douglas (1953). This colour banded sequence is overlain by a green weathering, black shale unit.

Overlying parts of the succession, which is increasingly calcareous and dolomitic upwards, are associated with an alternation of thick units of brown to yellow weathering calcareous and dolomitic mudstones with grey, noncalcareous mudstones. Sedimentary structures are readily distinguished within this sequence and include 1-cm-thick beds that alternate from structureless to laminated. Lensoid sandstone beds display lamination and small scale, ripple cross-lamination. Intraformational sandy breccias are common, as are large scale slump folds, slump breccias, sedimentary faults, folds and mudflow deposits. Widespread solution pitting in the calcareous and dolomitic mudstones occurs in the north of the area. Three black limestone turbidites are present south of Delabarre Bay. They consist of 20- to 56-cm beds of limestone alternating with grey shales. The limestones overlie erosive bases and internally include a structureless interval overlain by laminations, convolute laminations and ripple-drift. No grading is apparent within the limestone bed.

Carbonate horizons in the upper part of the sequence include pure yellow dololutites, argillaceous dololutites, grey limestones, calcareous mudstones and pure white limestones. The latter occur as beds, boudinaged and brecciated horizons, and breccia clasts in other lithologies near the top of the formation. They are composed of calcite that replaces original limestones, and probably originated as a result of early post-depositional recrystallization.

Warspite Formation

Warspite Formation[1] is named after Warspite Brook, a stream draining into the southwest end of Reddick Bight. Warspite is referred to by Douglas (1953) in his report on geology of coastal Labrador and is shown on a map (Fig. 9) that accompanies his report. The type section, located about 1.5 miles southwest of the head of Reddick Bight, extends

[1] The names Warspite, Typhoon Peak and Cameron Brook, have been submitted to the Canadian Permanent Committee on Geographical Names but as of January 1977 have not been approved.

from UTM grid zone 20: 485,600 E, 6,530,800 N, to 485,300 E, 6,530,500 N (Fig. 3; *see* Appendix). The formation is fairly well exposed and extends discontinuously from west of Delabarre Bay to west of Bears Gut. Warspite Formation is 165 m (541 ft.) thick at the type section.

The formation consists of a sequence of dolomitic breccias, dolomitic sandstones, dololutites, argillaceous dololutites, limestones and calcareous mudstones. In upper parts of the formation the dolomitic and calcareous horizons are interbedded with argillites and mudstones.

The base of the formation is defined as the first dolomitic breccia that truncates the underlying dolomitic mudstones at the top of the underlying Nullataktok Formation. Several dolomitic breccias and sandstone units that form the basal portion of the formation are well-exposed at Reddick Bight, Delabarre Bay, Little Ramah Bay and also inland along the western limb of the synclinorium. They are interpreted as debris flows comparable to those described by Hendry (1971) and Mountjoy *et al.* (1972). In the north, the breccias are composed of clasts comparable to the lithologies found in the underlying formation but at Little Ramah Bay, they are composed of similar lithologies mixed with sandy dolomite and dolomitic sandstone clasts. The clasts range from small pebble to boulder size and are set in a polymictic matrix of fine dolomitic fragments, grit and sand sized quartz grains and fine dolomitic mudstone or in a totally structureless mudstone matrix.

An unconformity may underlie the debris flow breccias near Little Ramah Bay. The breccias onlap a steep but covered surface that cuts at least 90 m (295 ft.) into the underlying mudstones of Nullataktok Formation. This may possibly represent one side of a submarine canyon. Study of aerial photographs reveals no apparent fault in this area and whereas the dolomitic breccias of the Warspite Formation form a cumulative thickness of 88 m (289 ft.) north of this contact, they are only about 20 m (66 ft.) thick south of it. Both sequences are overlain conformably by dolomitic mudstones and argillites of the upper part of the Warspite Formation and slates of the Typhoon Peak Formation.

Basal breccias of debris flow origin are not present in the eastern part of the Warspite Formation in the vicinity of Ramah Bay and Rowsell Harbour. At these localities the base of the formation is located at the occurrence of other breccia horizons, composed of dololutite, dolomitic mudstone, calcilutite and white limestone clasts, that probably formed by post-depositional brecciation of a layered sedimentary sequence. These breccias formed by several processes including recrystallization, localized small scale soft sediment deformation and small scale slumping. Transportation of some of these breccias is suggested by their location in deep erosional scours. These processes of brecciation may have been important in providing clasts for the more widely developed debris flow deposits.

Above the basal breccias the succession is dominated by laminated dololutites and dolomitic sandstones but these give way in the upper half of the formation to dark grey mudstones and argillites. Near Ramah Bay and Rowsell Harbour the dolomitic sandstones are very thinly and sparsely developed compared to other parts of the area. The top of Warspite Formation is placed at the last unit of dolomitic mudstone recorded in the sequence.

Typhoon Peak Formation

The name of this formation is derived from Typhoon Peak, a mountain located on the north side of Ramah Bay. Typhoon Peak is referred to by Douglas (1953) and is shown on his map of the Ramah Group (Fig. 9). The type section is on the north side of Ramah Bay and extends from UTM grid zone 20: 486,500 E, 6,526,700 N, to 485,900 E, 6,526,900 N (Fig. 3; *see* Appendix).

This formation, composed dominantly of slates, extends from the vicinity of Rowsell Harbour to south of Little Ramah Bay, and is generally poorly exposed. It is also difficult to interpret because of the occurrence of diabase sills, the presence of tight folds deforming the sequence, and ubiquitous cleavage. Thickness of the formation varies, and ranges from approximately 85 m (279 ft.) at the type section to 130 m (426 ft.) on the south side of Ramah Bay. A section from the latter locality is given in the appendix to illustrate the rapid variation that exists over a distance of only 7 km (4.5 miles).

Typhoon Peak Formation grades transitionally up from the underlying formation through a series of laminated yellow dolomitic mudstone units, typical of Warspite Formation, that alternate with grey mudstone units that are characteristic of Typhoon Peak Formation.

North of Ramah Bay the formation consists of a monotonous sequence of rusty weathering slates with rare, thin beds or nodules of sandstone. However, south of Ramah Bay the slates are rich in white, very fine grained sandstone units, have some black limestone beds, and contain a horizon with large spherical concretions of grey quartzite.

Cameron Brook Formation

The name of this formation is derived from Cameron Brook, a stream on the north side of Ramah Bay. Cameron Brook is referred to by Douglas (1953) and is shown on one of the maps (Fig. 9) that accompany his paper. The type section is at Cameron Brook and extends from UTM grid zone 20: 485,800 E, 6,526,600 N, to 485,800 E, 6,528,000 N (Fig. 3; *see* Appendix). Cameron Brook Formation is very poorly exposed and is of limited extent, forming isolated patches north and south of Ramah Bay and west of Little Ramah Bay. At the type section, which is incomplete, the formation has a thickness of approximately 200 m (656 ft.).

The succession in this uppermost formation of the Ramah Group is a rhythmic sequence of grey, fine to coarse grained greywacke sandstone units and mudstones. The sandstones are graded and show a variety of structures typical of a turbidite (Bouma, 1962). They are rich in fresh plagioclase, have abundant mud clasts and contain rare basic volcanic clasts.

The base of the formation is gradational with the passage of the underlying slate formation through a sequence of slates with thin grey sandstones into the greywacke sandstone-mudstone succession. At the type section, the basal sandstone units lie upon tectonically brecciated slates of Typhoon Peak Formation in the core of a syncline. Inland, south of Ramah Bay and east of Little Ramah Bay, a thick diabase sill intrudes close to or along the basal contact.

REFERENCES

Allen, J.R.L.
1963: The classification of cross-stratification units with notes on their origin; Sedimentology, v. 2, p. 93-114.

American Commission on Stratigraphic Nomenclature
1961: Code of Stratigraphic Nomenclature; Bull. Am. Assoc. Pet. Geol., vol. 45, p. 645-665; amended 1970 and issued separately by Am. Assoc. Pet. Geol.

Bell, R.
1884: Observations on the geology, mineralogy, zoology and botany of the Labrador coast, Hudson's Strait and Bay; Geol. Surv. Can., Rept. Prog. 1882-85, pt. DD.

1895: The Labrador Peninsula; Scot. Geogr. Mag., v. 11, p. 335-361.

Bouma, A.H.
1962: Sedimentology of some flysch deposits; Elsevier, Amsterdam.

Christie, A.M.
1952: Geology of the northern coast of Labrador, from Grenfell Sound to Port Manvers, Newfoundland; Geol. Surv. Can., Paper 52-22.

Coleman, A.P.
1921: Northeastern part of Labrador, and New Quebec; Geol. Surv. Can., Mem. 124.

Daly, R.A.
1902: The geology of the northeast coast of Labrador; Bull. Mus. Comp. Zool., Harvard, v. 38, Geol. Ser. v. 5, no. 5, p. 205-270.

Delabarre, E.B.
1902: Report of the Brown-Harvard expedition to Nachvak, Labrador, in the year 1900; Geogr. Soc. Philadelphia, Bull., v. 3, p. 65-212.

Douglas, G.V.
1953: Notes on localities visited on the Labrador coast in 1946 and 1947; Geol. Surv. Can., Paper 53-1.

Hendry, H.E.
1971: Breccias deposited by mass flow in the Breccia Nappe of the French Pre-Alps; Sedimentology, v. 18, p. 277-292.

Knight, I.
1973: The Ramah Group between Nachvak Fiord and Bears Gut, Labrador; *in* Report of Activities, Part A, Geol. Surv. Can., Paper 73-1A, p. 156-161.

Morgan, W.C.
1972: Ramah Group and Proterozoic-Archean relationships in northern Labrador; *in* Report of Activities, Part A, 1971; Geol. Surv. Can., Paper 72-1A, p. 125-128.

1974: The Nain-Churchill boundary in the Torngat Mountains, north Labrador: an Archean-Proterozoic Structural Province contact in the Canadian Precambrian Shield; Geol. Soc. Am., Abstr., Annual Meeting, Miami, p. 876-877.

1975: Geology of the Precambrian Ramah Group and basement rocks in the Nachvak Fiord-Saglek Fiord area, north Labrador; Geol. Surv. Can., Paper 74-54.

Ramah Group volcanics, Labrador; *in* Wanless, R.K. and Loveridge, W.D., Rubidium-Strontium Isochron Age Studies, Report 2; Geol. Surv. Can., Paper, in press.

Mountjoy, E.W., Cook, M.E., Pray, L.C., and McDaniel, P.N.
1972: Allochthonous carbonate debris flows - world-wide indicators of reef complexes, banks or shelf margins; Int. Geol. Congr., 24th, Canada, Rep., Sect. 6, p. 172-189.

Steinhauer, H.
1814: Notice relative to the geology of the coast of Labrador; Geol. Soc. London, Trans., v. 2, p. 488-494.

Taylor, F.C.
1969: Reconnaissance of a part of the Precambrian Shield, northeastern Quebec and northern Labrador; Geol. Surv. Can., Paper 68-43.

Waters, A.C.
1960: Determining direction of flow in basalts; Am. J. Sci., v. 258-A, p. 350-366.

Wentworth, C.K.
1922: A scale of grade and class terms for clastic sediments; J. Geol., v. 30, p. 377-392.

APPENDIX

SELECTED MEASURED SECTIONS (1-7)

Where terrain and outcrop permitted type sections were measured by means of a graduated measuring stick. In unsuitable or poorly exposed terrain this method was combined with or replaced by use of an altimeter and measuring tape; thicknesses being adjusted for both dip of beds and slope of ground. All thicknesses are considered to be accurate to 1 cm. Sediment grain size was determined in the field according to the Wentworth (1922) scale. Bed thickness was subdivided as follows:

thick bedded ..... greater than 16 cm
medium bedded ..... 4-16 cm
thin bedded ..... 1-4 cm
very thin bedded ..... 0.25-1 cm
lamination ..... less than 0.25 cm

(Lamination is also used to refer to internal bedding structures)

Cross-bed unit size is classified after Allen (1963):

large scale cross-bed ..... greater than 5 cm thick
small scale cross-bed ..... less than 5 cm thick

The numbers in parenthesis following the formation name refer to the location of the measured section shown in Figure 3.

ROWSELL HARBOUR FORMATION (1)

This type section is exposed along low cliff exposures on the north shore of Rowsell Harbour (UTM grid zone 20: 483,700 E, 6,536,200 N, to 483,000 E, 6,535,800 N).

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
	Upper White Quartzite Member (units 25 to 56)		
56	Quartzite, white, medium grained, small scale trough cross-bedded, ripple-marked; shale partings	3.00	251.21
55	Quartzite and shale, interbedded; quartzite, 1-15 cm thick, white, medium grained, commonly lensoid; shale, 1 cm thick, grey, ripple-marked tops, mudcracks; one black grit horizon	1.30	248.21
54	Quartzite, white, very coarse grained, large scale trough cross-bedded	2.00	246.91
53	Quartzite, white, fine grained, planar cross-bedded, ripple-marked	4.00	244.91
52	Shale, grey; interbedded thin, ripple-marked, very fine grained sandstone; top of unit mudcracked	0.15	240.91
51	Quartzite, white, fine grained, planar cross-bedded	2.00	240.76
50	Shale, grey; interbedded thin, ripple-marked, very fine grained sandstone ...	0.15	238.76
49	Quartzite, white, medium to fine grained, planar and trough cross-bedded; shale clasts; grey shale partings up to 1 cm thick	2.00	238.61
48	Quartzite, white, fine grained; in part pebbly; some shale clasts; large planar and trough cross-bedded units; minor load casts; bedding planes ripple-marked; siltstone partings towards top, mudcracked, ripple-laminated	12.00	236.61

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
47	Shale, grey, almost phyllitic; interbedded thin, lensoid, white sandstone, ripple-marked tops	1.00	224.61
46	Quartzite, white, coarse grained grading to medium grained; thin planar cross-bedded units; some lensoid siltstone	2.00	223.61
45	Shale, grey, calcareous, almost phyllitic; interbedded lensoid, white sandstone, arenaceous and calcareous, very fine grained, planar and ripple-marked tops	3.00	221.61
44	Quartzite, white, coarse to very coarse grained; minor conglomerate grading to medium grained; large scale trough cross-beds overlain by small trough cross sets associated with ripple-marked bedding surfaces; some 5 cm flat bedded units	7.00	218.61
43	Conglomerate, white, small clasts, pebbles predominantly white quartz with minor siltstone, trough cross-bedded	0.50	211.61
42	Quartzite, white, fine to medium grained, large scale planar and trough cross-bedded; mudstone partings between beds display syneresis cracks ...	10.00	211.11
41	Covered interval; blocks show medium-grained, black quartzite overlain by thin bedded, grey, fine grained sandstone interbedded with mud-cracked black siltstone	4.00	201.11
40	Quartzite, white, medium grained, well sorted, large scale trough cross-bedded	0.60	197.11
39	Conglomerate, white, poorly sorted, 1 cm pebbles of white, purple, red, green and opalescent quartz, pink feldspar and jasper; no internal bedding	0.10	196.51
38	Quartzite, white, fine grained; 3 cycles of trough cross-bedding, about 1 m thick, containing several sets of cross-beds, overlain by 15 cm flat bedding with parting lineations; shale partings between cycles	1.40	196.41
37	Quartzite, white, medium grained, well sorted, large scale trough cross-bedded, several sets in the unit	4.50	195.01
36	Quartzite, white, fine grained; basal festoon, large scale trough cross-beds, overlain by flat bedding with parting lineation; ripple-laminations towards top	1.00	190.51
35	Mudstone, interbedded thin, cream, very fine grained, laminated sandstone ...	0.30	189.51
34	Sandstone, cream, very fine grained, laminated, planar top and base; base deformed by flame structures in underlying mudstone	0.30	189.21
33	Sandstone and mudstone, interbedded; sandstone, cream, very fine grained, laminated; base of beds infill mudcracks and display rain pits; mudstone, yellow	0.20	188.91
32	Sandstone, cream, very fine grained, calcareous, laminated; bedding planes with parting lineations, ripple-marked tops in main beds	0.25	188.71
31	Mudstone and sandstone, interbedded; mudstone yellow; sandstone, thin bedded (1 cm thick), brown weathering, white, very fine grained, ripple-marked; beds thicken upwards to 3 cm and also grade upwards into 3 cm mudstone	3.50	188.46
30	Mudstone and shale, interbedded less than 1 cm thick sandstone, brown-purple, laminated, ripple-marked tops	1.50	184.96
29	Mudstone and sandstone, interbedded; mudstone, yellow; sandstone, thin bedded, pink-brown, very fine grained, laminated, grading upwards into structureless mudstone	0.50	183.46

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
28	Quartzite, white, yellow weathering, medium grained grading to fine grained, planar cross-bedded; shale partings	1.25	182.96
27	Mudstone and sandstone, interbedded; mudstone, yellow, structureless; sandstone, thin bedded, pink-brown, very fine grained, laminated, grading upwards into mudstone	1.25	181.71
26	Quartzite, white, yellow weathering, fine grained; herring bone planar and festoon cross-beds; red siltstone clasts; thin green shale partings; straight, sinuous and interference ripple-marks on tops of major cross-bed units	4.00	180.46
25	Quartzite and siltstone, interbedded; quartzite, white, 15-30 cm thick, medium grained grading to fine grained, grading upwards into siltstone; abundant irregular siltstone clasts; siltstone, 12 cm thick; minor horizontally laminated sandstone	2.00	176.46
	Phyllite Member (units 22 to 24)		
24	Mudstone and shale, purple-grey, massive and laminated, rich in chloritoid; interbedded thin sandstone, very fine grained, lensoid, ripple-laminated, laminated	2.00	174.46
23	Mudstone, yellow weathering, massive; interbedded thin sandstone, pink-brown, very fine laminated grading up into mudstone	5.00	172.46
22	Mudstone and shale, purple-grey, massive, laminated; minor interbedded 1-3 cm thick sandstone, white, calcareous, very fine grained, lensoid; minor 5-7 cm brown-purple sandstone, very fine grained, muddy, laminated, ripple-marked, rich in chloritoid	7.00	167.46
	Purple Quartzite and Mudstone Member (units 8-21)		
21	Quartzite, purple, medium grained; herring bone planar cross-beds; mudstone clasts; ripple-marked tops	4.50	160.46
20	Mudstone and sandstone, interbedded; mudstone, rusty weathering, purple, laminated; sandstone, dark brown, micaceous, fine to very fine grained; festoon ripple-drift and climbing ripple-laminations; sedimentary boudinage and dykes	2.00	155.96
19	Sandstone, rusty weathering, grey to purple, fine grained; abundant mudstone clasts; festoon trough cross-bedding	0.35	153.96
18	Mudstone and quartzite, interbedded; mudstone, purple-grey, massive and finely laminated; quartzite, thin bedded (1 cm thick), commonly lensoid or flaser, purple with green spots, calcareous cement, ripple-marked	4.00	153.61
17	Quartzite, purple, fine grained, large and small scale trough cross-bedded; rib, furrow and crescent ripple-marked tops	2.30	149.61
16	Quartzite, white, coarse grained, poorly sorted; purple mudstone clasts; large, straight ripple-marks with small, subsidiary ripple-marks in troughs	2.20	147.31
15	Quartzite, purple with green spots, coarse to medium grained, trough cross-bedded with elliptical scour-marks; 30 cm laminated, fine grained sandstone at top	22.20	145.11
14	Quartzite, purple, fine grained; massive base passing upwards into cross-bedded top; cross-beds convoluted beneath overlying scour structures	1.00	122.91

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
13	Quartzite and mudstone, interbedded; quartzite, purple, fine grained, cross-bedded, ripple-marked; shale partings; grey shale clasts; mudstone, grey; beds 2-20 cm thick	4.80	121.91
12	Quartzite and silty mudstone, interbedded; quartzite, purple, fine to medium grained, fine laminated, cross-laminated; laminae green; silty mudstone, lavendar purple, commonly massive; some faint laminations; contains thin lenses and flaser beds of sandstone	9.50	117.11
11	Quartzite, purple, fine to medium grained; planar, tabular cross-beds at base with horizontal laminations near top; ripple-marked tops	1.30	107.61
10	Quartzite and mudstone, interbedded; quartzite, purple, fine grained, fine laminated; asymmetrical straight ripple-marks at top; beds 10-15 cm thick; mudstone, grey	2.00	106.31
9	Quartzite and shale; quartzite, purple, muddy, fine to very coarse grained; rich in grey shale clasts; large scale trough cross-bedding; low and high angle planar cross-bedding; some parting lineation; thin, grey shale partings between beds; horizontal laminations; 140 cm thick horizon of interbedded, thin bedded ripple-laminated sandstone and grey shale	15.00	104.31
8	Covered interval; probably contains pink, coarse to medium grained, well sorted quartzite that overlies the volcanic flow south of Rowsell Harbour		
	Volcanic Member (unit 7)		
7	Covered interval; probably contains a volcanic flow that is exposed south of Rowsell Harbour; the flow is highly altered, has a brecciated top, and is rich in vesicle pipes	10.00	89.31
	Lower White Quartzite Member (units 1-6)		
6	Conglomerate, dolomitic, poorly sorted, trough cross-bedded; 0.5 cm diameter pebbles of white and purple quartz; cross-bedding indicated by heavy mineral laminae; top 0.5 cm is black to brown, rich in iron oxides, and probably related to volcanism above this horizon south of Rowsell Harbour	0.06	79.31
5	Quartzite, white, yellow-brown weathering; coarse grained base; medium grained top; large scale trough and planar cross-bedding; ripple-marked	55.75	79.25
4	Quartzite, white, very coarse to coarse grained; black heavy mineral laminae pick out erosional bases of small scale cross-bedding	13.50	23.50
3	Quartzite, white, very coarse grained, arkosic; includes some white grit; black heavy mineral laminae outline bases of small scale trough cross-bedding; small pebble conglomerate in elliptical scours	2.50	10.00
2	Conglomerate and quartzite; conglomerate, thin; at base of large to small scale trough cross-beds; 1-5 cm diameter pebbles of white, red and purple quartz, ironstone, feldspar and granite; maximum clast size 15 x 17 cm; quartzite, white, coarse to medium grained	6.00	7.50
1	Granite wash; poorly sorted pebbly grit and coarse grained sandstone, rich in angular grains of quartz and pink to bleached feldspar	1.50	1.50
	Unit 1 rests on a planar unconformity surface cut into Archean gneisses that are intruded by diabase dykes. The gneisses and dykes were weathered, prior to deposition of Rowsell Harbour Formation, to a depth of 7-8 m beneath the unconformity.		
	Total thickness of Rowsell Harbour Formation	251.21	

REDDICK BIGHT FORMATION (2)

This type section occurs along a stream that flows north into the southern side of Reddick Bight (UTM grid zone 20: 487,100 E, 6,532,400 N, to 487,200 E, 6,532,000 N).

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
48	Dolomite, yellow weathering, light grey, finely crystalline; cut by fractures infilled with coarse crystals of dolomite and minor white quartz	7.50	120.87
47	Laminite; regular alternation of grey, very fine grained sandstone and black coarse lamination; some rusty weathering 6 cm beds of very fine laminated sandstone that thin to 1 cm towards top of unit	15.00	113.37
46	Sandstone and laminite; sandstone, grey, fine grained, beds 10-48 cm thick; massive base grades up into lamination, overlain by 30 cm very fine sandstone-shale laminite; base of sandstone beds commonly deformed; groove casts	3.74	98.37
45	Sandstone and shale; 5 beds of grey, fine grained sandstone; massive at base, passing up into laminated sandstone near top, overlain by 1 cm black shale; convolute folds deform top of each bed	1.28	94.63
44	Sandstone and shale; 25 cm grey, fine grained sandstone with massive base, laminated top, commonly deformed; overlain by 10 cm black shale	0.35	93.35
43	Sandstone and shale; grey, fine grained, massive sandstone at base, rich in large angular shale clasts; lamination at top; convolute folds; overlain by 3 cm black shale	0.42	93.00
42	Sandstone, medium bedded (10-12 cm thick), grey, fine grained, internally massive	0.40	92.58
41	Sandstone and laminite; 4 cm rusty weathering, grey, fine grained sandstone, deformed, some shale laminae; alternating with 4 cm, laminated, very fine grained sandstone and shale; thin shale at top	0.77	92.18
40	Laminite and shale; laminite, very fine grained, grey sandstone and black shale; sandstone laminae, discontinuous, lensoid and in ripple-form; some 3 cm, rusty weathering, internally deformed, fine grained sandstone; 3 cm black shale at top; cut by sandstone dykes from unit 34	0.36	91.41
39	Sandstone, black, fine grained, massive; contains pseudonodules of laminite, large shale clasts	0.59	91.05
38	Mudflow; mixture of sand and mud; contains balls and pseudonodules of laminite and thin layers of brown-weathering, fine grained sandstone; numerous irregular laminite clasts	2.80	90.46
37	Shale, black	0.15	87.66
36	Sandstone, dark grey, muddy, very fine grained; large black shale clasts	0.20	87.51
35	Shale, black	0.10	87.31
34	Quartzite, black, very fine grained; rounded grey shale clasts; shale laminae at top; mudcracked	0.55	87.21
33	Quartzite, black, very fine grained, small scale trough cross-bedded; shale partings, mudcracked	0.90	86.66
32	Conglomerate; grades up into medium grained black quartzite; small, rounded pebbles of white and grey quartz and white feldspar; cross-bedded; dolomite patches	0.15	85.76

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
31	Quartzite, black; fine grained base passing up into medium grained top; large scale trough and planar cross-bedding; some flat bedding; some groove casts and flute casts; scours locally infilled with grey shale partings; resistant to weathering	46.75	85.61
30	Quartzite, black, fine grained, small scale trough cross-bedded; shale partings	0.70	38.86
29	Quartzite, black, fine grained, trough cross-bedded, 1 cm grey shale at top, mudcracked	3.10	38.16
28	Quartzite, black, fine grained, large scale trough cross-bedded; thin black shale at top, mudcracked	1.00	35.06
27	Quartzite and shale; quartzite, black, fine grained, laminated, 4 cm thick units alternate with 4 cm mudcracked grey shale	0.70	34.06
26	Quartzite, black, fine grained, large scale trough cross-bedded; thin mudcracked grey shale at top	1.03	33.36
25	Quartzite, black, fine grained, flat bedded	0.40	32.33
24	Quartzite, black, fine grained, large scale trough cross-bedded; mudcracked shale partings	0.69	31.93
23	Quartzite, black, fine grained, large scale trough cross-bedded	3.49	31.24
22	Sandstone, grey, fine grained; undulose shale laminae; rusty concretions at base	0.04	27.75
21	Quartzite, black, fine grained, trough cross-bedded	0.60	27.71
20	Laminite; fine laminations of alternating white to grey, very fine grained sandstone and black shale; laminae flat to unduolse; some small scale elliptical scour marks, groove casts, linear ridges, worm trails and spherical protuberances	8.72	27.11
19	Sandstone and shale; alternating thin beds of laminated, very fine grained, grey sandstone and dark grey shale; some pyrite	0.30	18.39
18	Laminite; light grey, very fine grained sandstone and black shale laminae; laminations flat, rarely undulose; flame structures	1.21	18.09
17	Shale, dark grey with very thin laminations of very fine grained sandstone	0.55	16.88
16	Sandstone, grey, muddy, very fine grained, cross-bedded; top and base deformed; shale clasts	0.15	16.33
15	Shale; dark grey with very thin laminations of very fine grained sandstone; mudcracked	0.14	16.18
14	Sandstone, grey, muddy, very fine grained, laminated; deformed base	0.05	16.04
13	Shale dark grey with very thin laminations of very fine grained sandstone	0.25	15.99
12	Sandstone, grey, fine grained; large scale trough cross-bedding, overlain by smaller cross-bedded units with ripple-marked bedding surfaces; shale partings, mudcracks, flame structures	2.38	15.74
11	Shale, grey; several lensoid, very fine grained sandstone horizons near base; ripple-marks, mudcracks	0.28	13.36

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
10	Quartzite, black, fine to medium grained, large and small scale trough cross-bedded, ripple-marked; shale partings, mudcracks; mudstone infilled ripple troughs	4.14	13.08
9	Shale, grey, mudcracked; interbedded ripple-laminated, black, very fine grained, lensoid sandstone; isolated sand filled mudcracks	0.30	8.94
8	Quartzite, black, medium grained, large scale trough cross-bedded, ripple-marked	1.47	8.64
7	Shale, dark grey, mudcracked; some thin lenses of ripple-marked, fine grained grey sandstone; some thin laminite beds	0.15	7.17
6	Grit, black, cross-bedded, ripple-marked top	0.15	7.02
5	Shale, dark grey, mudcracked	0.10	6.87
4	Quartzite, black, medium grained; large scale trough cross-bedding overlain by smaller cross-bed sets; some planar cross-bedding, ripple-marks, shale partings and mudcracks; mudstone infilled ripple troughs	4.83	6.77
3	Quartzite, black, fine grained, small scale trough cross-bedded; some horizontal laminations, ripple-marks, rib-and-furrow structures, shale partings and mudcracks	0.69	1.94
2	Shale, dark grey; some lensoid, black, poorly-sorted, medium to very coarse grained quartzite; cross-laminations; ripple-marked tops	0.28	1.25
1	Quartzite, black, fine to medium grained, large scale trough cross-bedded, ripple-marked; 3 cm grey shale partings	0.97	0.97
	Unit 1 overlies white, medium to coarse grained quartzites of the Upper White Quartzite Member of Rowsell Harbour Formation. The contact is transitional through a 60 cm thick grey sandstone unit that is associated with black, mudcracked shales.		
	Total thickness of Reddick Bight Formation	120.87	

NULLATAKTOK FORMATION (3)

This type section occurs along steep cliffs on the north side of Ramah Bay (UTM grid zone 20: 488,400 E, 6,528,500 N, to 486,300 E, 6,525,700 N). Although exposure is good the section is folded above the 350-metre mark and is cut by thrust faults.

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
12	Mudstone, calcareous and dolomitic; alternations of 40-60 cm bands form 2-4 m colour banded horizons. Calcareous mudstone, grey and silver-grey, thin bedded; laminated and massive beds alternate; thin lenses and interbeds of ripple-laminated very fine grained dolomitic sandstone. Dolomitic mudstone, yellow to brown, thin bedded; 1-3 cm laminated and massive beds, 1 cm ripple-laminated and laminated very fine grained sandstone beds. 5-15 cm intraformational dolomite breccia; fragments of dolomitic mudstone and white calcite limestone. Some white calcite limestone layers up to 60 cm thick with interbeds of dolomitic mudstone and 1-4 cm grey chert bands. Sedimentary faulting and deformation in all lithologies; some mass slump deposits and mudflows	180.00	594.67

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
11	Mudstone and shale, calcareous, dark grey and silver grey, brown weathering; some 1 cm dolomitic mudstone and sandstone beds; 4-6 cm dark grey limestone near base	31.00	414.67
10	Mudstone, calcareous and dolomitic; thick bands of dark grey and silver-grey calcareous mudstone alternate with yellow to brown dolomitic mudstone; calcareous mudstone includes massive or finely laminated green-grey muddy siltstone and blue-black mudstone; dolomitic bands commonly very fine grained sandstone and intraformational breccia composed of grey mudstone clasts in sandy dolomitic matrix	15.00	383.67
	Although the base of this unit is represented by a thrust fault, there is probably no major loss of the section.		
9	Mudstone and shale, blue-black, chiefly structureless; some thin, rusty, very fine grained sandstone and green-grey siltstone	260.60	368.67
8	Shale, black, green weathering; flat concretions of siliceous limestone near top	5.40	108.07
7	Mudstone and siltstone, colour banded; massive or fine laminated blue-black mudstone alternates with green-grey laminated siltstone; some 1 cm brown weathering, graded, very fine grained sandstone, commonly boudinaged	50.70	102.67
6	Argillite, brown weathering, dark grey, siliceous, laminated	0.86	51.97
5	Sandstone and dololutite; sandstone, dolomitic, very fine grained, laminated; 8 cm thick beds; interbedded siltstone, green-grey and brown, laminated and massive	1.26	51.11
4	Chert, white to dark grey; 10-45 cm beds; interbedded green, laminated mudstone with pyrite and rare chalcopyrite; dolomite pods in the chert; some cherty quartz veins; base irregular	4.45	49.85
3	Pyrite; brown, rusty weathering, bedded and internally laminated; post-depositional brecciation, recementation and recrystallization	0.40	45.40
2	Mudstone and shale; chiefly blue-black, massive and fine laminated; some alternations of light grey muddy siltstone; some rusty weathering very fine grained sandstone	33.00	45.00
1	Shale, black, sulphurous, graphitic, pyritiferous; pyrite laminae and nodules; slump folds outlined by pyrite laminae	12.00	12.00
	Unit 1 overlies the dolomite unit at the top of Reddick Bight Formation. The contact is sharp and planar; the underlying yellow dolomite displaying dome and basin structures associated with its fracturing and recrystallization. Reddick Bight Formation is 139 m thick at this locality.		
	Total thickness of Nullataktok Formation	594.67	

WARSPITE FORMATION (4)

This type section is located on a plateau to the south of the stream that flows into the head of Reddick Bight (UTM grid zone 20: 485,600 E, 6,530,800 N, to 485,300 E, 6,530,500 N).

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
145	Mudstone, dolomitic, yellow-brown, laminated	0.40	165.08
144	Mudstone, light and dark grey, thin bedded, laminated and massive	3.95	164.68
143	Mudstone, dolomitic, yellow, laminated; rich in pyrite cubes	0.75	160.73
142	Mudstone, light and dark grey, thin bedded, laminated and massive; large convolute folds	5.40	159.98
141	Mudstone, dolomitic, brown-yellow, laminated	3.00	154.58
140	Mudstone, light and dark grey, rusty-weathering, thin bedded (0.5-1 cm), laminated and massive	15.00	151.58
139	Breccia, dolomitic, intraformational, graded; clasts of massive yellow dololutite and laminated dololutite	0.55	136.58
138	Mudstone, dark grey, massive and laminated	12.90	136.03
137	Dololutite, yellow, very fine and coarse laminated; deformed bedding	2.76	123.13
136	Mudstone, dark and light grey; alternating 1-2 cm massive and laminated layers	0.50	120.37
135	Siltstone, dark grey, laminated; sandstone laminations in lower part; black shale at top	0.08	119.87
134	Sandstone, white, very fine grained; ripple-marked top	0.18	119.79
133	Shale, black, mudcracked	0.01	119.61
132	Sandstone, white, very fine grained; convolute bedding; deformed base; flame structures	0.25	119.60
131	Siltstone and sandstone; interbedded; black, laminated siltstone with laminated 1 cm beds of white sandstone	0.28	119.35
130	Sandstone, white, very fine grained; deformed base; asymmetrical convolute lamination	0.18	119.07
129	Shale, black	0.02	118.89
128	Sandstone, white, very fine grained, structureless	0.25	118.87
127	Siltstone and sandstone; interbedded; siltstone, dark grey, laminated; sandstone, 5 cm thick, ripple-laminated; convolute bedding, mudcracks	1.40	118.62
126	Sandstone, white, very fine grained, ripple-laminated; deformed base, flame structures, load casts, internal convolutions	0.25	117.22
125	Shale, black	0.02	116.97
124	Sandstone, white, very fine grained, ripple-laminated, planar base	0.12	116.95
123	Siltstone and sandstone; black, laminated siltstone with fine grained sandstone lenses	0.24	116.83

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
122	Sandstone, white, very fine grained, ripple-laminated, planar base	0.20	116.59
121	Siltstone and sandstone; alternation of 1-5 cm beds of dark grey, laminated siltstone with thin, ripple-laminated, sandstone stringers and 3 cm beds of laminated, white, fine grained sandstone; mudcracks	1.50	116.39
120	Covered interval	1.25	114.89
119	Calcilutite, dolomitic, argillaceous; thin bedded, alternations of structureless and laminated bedding; inclined bedding associated with convolutions; local disrupted bedding	0.30	113.64
118	Argillite, green-weathering, dark grey, laminated and massive; some 1 cm lenses of dolomitic, white, very fine grained sandstone	2.30	113.34
117	Argillite, dark grey, laminated and massive	2.24	111.04
116	Mudstone, dark grey, laminated; 8 cm bed of white, very fine grained sandstone at base	1.04	108.80
115	Mudstone, dark grey, laminated	1.33	107.76
114	Mudstone, dark grey, laminated	0.32	106.43
113	Mudstone; alternations of dark grey, massive mudstone with laminated, light grey mudstone; 5 cm white, very fine grained sandstone	0.70	106.11
112	Mudstone, light and dark grey, laminated and massive; 10 cm white, very fine grained sandstone at base	0.57	105.41
111	Mudstone, light and dark grey, laminated and massive; 7 cm laminated, white very fine grained sandstone at base	0.48	104.84
110	Mudstone, light and dark grey, laminated and massive; 8 cm laminated, white, very fine grained sandstone at base	0.69	103.36
109	Mudstone, light and dark grey, laminated and massive	0.57	102.67
108	Dololutite, yellow-weathering; sharp, planar erosive base; laminated	0.12	102.10
107	Breccia; grades up into sandstone; breccia 50 cm thick, composed of yellow, massive and some laminated dololutite clasts; clasts chiefly in vertical positions, enclosed in very fine grained sandstone matrix; grades up into deformed, laminated, very fine grained sandstone, convolutions, truncated; breccia not present up dip but thickens down dip and northward along strike	0.70	101.98
106	Mudstone, dolomitic, yellow-weathering, laminated; some interbedded mudstone, laminated and massive, light and dark grey, with ripple-drift lenses of very fine-grained sandstone; one 3 cm bed of laminated and ripple-laminated, very fine grained sandstone divides unit	2.16	101.06
105	Sandstone, white; medium grained grading up to very fine grained sandstone; some dolomitic mudstone pods, laminated; deformed base	1.53	98.90
104	Dololutite, yellow-weathering, coarse and very fine laminated; some 1 cm ripple-drift lenses and beds; large recumbent sedimentary folds	2.27	97.37
103	Dololutite, yellow-weathering, coarse and very fine laminated; some 1 cm ripple-drift beds; local deformation	0.62	95.10
102	Dololutite, yellow weathering, 2-15 cm layers of coarse lamination alternate with 1-3 cm very fine laminated horizons; some 2-8 cm ripple-drift laminated, sandy dololutites; laminated areas commonly deformed	2.47	94.48

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
101	Sandstone, white, dolomitic, fine to very fine grained, laminated	0.13	92.01
100	Dololutite; thick sequences of coarse lamination alternating with thin sequences of very fine lamination; yellow weathering; some 1-4 cm sandy dololutite with ripple-drift lamination	2.37	91.88
99	Dololutite, yellow weathering, coarse and very fine laminated; some ripple-drift lenses of dolomitic, very fine grained sandstone	1.91	89.51
98	Dololutite and breccia; laminated dololutite passes up into soft sediment breccia with deformed dololutite laminae and clasts enclosed in dololutite and sandstone matrix; overlies elliptical scour	0.42	87.60
97	Sandstone, dolomitic, very fine grained, laminated	0.10	87.18
96	Dololutite, yellow, very fine laminated	0.05	87.08
95	Breccia; soft sediment deformation of laminated dololutite; dololutite clasts in sandy dololutite matrix; grades up into deformed, laminated dololutite	0.50	87.03
94	Dololutite, coarse and fine laminated; some ripple-drift lamination; numerous elliptical scours	1.72	86.53
93	Sandstone, white, medium grained grading up to fine grained; massive bedding overlain by large scale tabular, planar cross-bedding; some flat bedding; irregular thickness along depositional direction	0.64	84.81
92	Dololutite, coarse and very fine laminated, sandy, ripple-laminated, 1 cm beds	0.89	84.17
91	Sandstone, white, medium grained; one set of planar, tabular cross-bedding on irregular, eroded base	0.10	83.28
90	Dololutite, coarse laminated; several 2-3 cm ripple-laminated, sandy dololutite horizons	1.41	83.18
89	Sandstone, white, fine grained, laminated	0.07	81.77
88	Dololutite, coarse laminated; 3 horizons of sandy dololutite with ripple-drift lamination	0.24	81.70
87	Sandstone, white, very fine grained, laminated	0.06	81.46
86	Dololutite, coarse laminated; some very fine ripple-drift laminated sandy dololutite; large elliptical scours	0.57	81.40
85	Sandstone, white, fine grained; laminated overlain by ripple-laminated; unit lenses out down dip	0.08	80.83
84	Dololutite, coarse laminated; some thin layers of very fine lamination; some sandy dolomite with ripple-drift lamination	1.70	80.75
83	Sandstone, white, dolomitic, medium grained grading to very fine grained; single large set of cross-beds at base overlain by laminated sandstone; ripple-drift lamination	0.36	79.05
82	Dololutite, coarse and fine laminated; some dolomitic very fine grained sandstone with ripple-drift lamination	0.34	78.69
81	Sandstone, white, fine grained, laminated; interbedded very fine laminated dololutite	0.12	78.35

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
80	Dololutite, coarse laminated; rare ripple-laminated dolomitic very fine grained sandstone	0.64	78.23
79	Sandstone, white, fine grained; deposited upon irregular erosion surface; inclined bedding parallel base; flame structures at base	0.15	77.59
78	Dololutite, coarse and fine laminated; some ripple-laminated very fine grained dolomitic sandstone	0.79	77.44
77	Sandstone, white, dolomitic, fine grained; contains laminated dololutite clasts; erosive base with lamination parallel base; horizontal lamination near top of bed	0.14	76.65
76	Dololutite, coarse and fine laminated	0.20	76.51
75	Sandstone, dolomitic, fine grained, laminated, convoluted	0.14	76.31
74	Dololutite, coarse and fine laminated; some thin interbeds of sandy dololutite; ripple-drift lamination	1.02	76.17
73	Sandstone, dolomitic, very fine grained; alternations of laminated dololutite	0.30	75.15
72	Dololutite, laminated	0.08	74.85
71	Sandstone, white, dolomitic, coarse grained grading to medium grained; single trough cross-bed overlain by breccia; clasts of laminated dololutite and fine grained sandstone in sandy dololutite matrix; disrupted bedding	1.34	74.77
70	Dololutite and sandstone; laminations of dololutite alternate with dolomitic very fine grained sandstone	0.03	73.43
69	Sandstone, dolomitic, medium to coarse grained; irregular erosive deformed base; planar cross-bedding	0.06	73.40
68	Dololutite and sandstone; dololutite, laminated; laminae of dolomitic, very fine grained sandstone and coarse siltstone; laminae broken, deformed into pseudonodules and flame-like convolutions	0.18	73.34
67	Dololutite, coarse and very fine laminated with thin interbeds of ripple-laminated, dolomitic, very fine grained sandstone; early fractures infilled by laminated dololutite; sedimentary deformation; symmetrical flame-like stuctures	1.61	73.16
66	Dololutite, yellow, coarse and fine laminated; interbedded thin, ripple-laminated, dolomitic, very fine grained sandstone	1.04	71.55
65	Dololutite, yellow, coarse and fine laminated; some lenses and thin interbeds of ripple-laminated, dolomitic, very fine and fine grained sandstone; some thick horizons of deformed laminated dololutite	1.54	70.51
64	Sandstone and dololutite; sandstone, dolomitic, white, flat bedded, laminated; alternations of massive and laminated dololutite	0.25	68.97
63	Dololutite, yellow, coarse and very fine laminated; interbedded lenses and beds of ripple-laminated, dolomitic, fine grained sandstone	5.13	68.72
62	Mudstone, silver-grey, calcareous, massive and laminated, thin bedded	0.30	63.59
61	Sandstone, dolomitic, white, fine grained, planar cross-bedded	0.18	63.29
60	Dololutite, yellow, laminated; 0.5 cm interbeds of laminated, dolomitic, fine grained sandstone	0.64	63.11

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
59	Breccia, intraformational; disintegrated horizon originally composed of alternating thin bedded, laminated dololutite and dolomitic fine grained sandstone	0.34	62.47
58	Dololutite, yellow, coarse and very fine laminated; 0.5 cm interbeds and lenses of laminated, dolomitic, very fine grained sandstone	0.97	62.13
57	Sandstone, dolomitic, fine grained; irregular erosive base; single unit of trough cross-bedding	0.10	61.16
56	Dololutite, yellow, coarse and fine laminated; some 0.5-2.0 cm beds and lenses of ripple-laminated, dolomitic, fine grained sandstone	1.97	61.06
55	Dololutite, yellow, coarse and fine laminated; lenses of laminated, dolomitic, fine grained sandstone	1.38	59.09
54	Sandstone, dolomitic, fine grained; deformed cross-bedding at base overlain by lamination	0.34	57.71
53	Dololutite, yellow, coarse and fine laminated; thin beds of laminated and cross-laminated, dolomitic, fine grained sandstone	1.28	57.37
52	Sandstone, dolomitic, white, fine grained, laminated	0.15	56.09
51	Dololutite, yellow, coarse and fine laminated; thin beds of laminated, dolomitic, fine grained sandstone; deformed; convolutions	1.72	55.94
50	Sandstone, dolomitic, white, coarse grained, trough cross-bedded	0.22	54.22
49	Sandstone, dolomitic, white, coarse grained grading to fine grained, irregular erosive base; dololutite and dolomitic fine grained sandstone clasts at base, overlain by trough cross-bedding and flat bedding	0.47	54.00
48	Dololutite, yellow, coarse and fine laminated	0.40	53.53
47	Dololutite, yellow, coarse and fine laminated; beds and lenses of laminated and cross-laminated, dolomitic sandstone, chiefly fine grained; some thin layers of coarse and medium grained sandstone grading up into very fine grained sandstone	2.76	53.13
46	Covered interval	2.00	50.37
45	Breccia, intraformational; clasts of laminated dololutite showing bedding set in very fine grained sandstone-dololutite matrix; some chert nodules	0.33	48.37
44	Dololutite, yellow, coarse and fine laminated; some lenses of ripple-laminated, dolomitic, very fine grained sandstone	0.64	48.04
43	Breccia, intraformational; large angular clasts of laminated dolomitic very fine grained sandstone and dololutite set in sandstone-dololutite matrix	0.70	47.40
42	Dololutite, yellow, coarse laminated; thin interbeds of fine laminated dololutite; some laminated and ripple-laminated dolomitic, very fine grained sandstone	0.45	46.70
41	Breccia, intraformational; clasts of laminated dololutite, laminated, dolomitic, fine and very fine grained sandstone; some chert concretions, randomly distributed; dololutite matrix	1.87	46.25
40	Dololutite, yellow, coarse laminated; some thin fine laminated horizons; lenses of ripple-laminated, dolomitic, fine grained sandstone; some convolutions	1.51	44.38

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
39	Mudstone, silver-grey, calcareous and dolomitic, laminated and massive; some lenses of ripple-laminated, dolomitic, very fine grained sandstone	1.58	42.87
38	Breccia, intraformational; laminated dololutite passing laterally into disrupted dololutite and dolomitic sandstone set in sandy dololutite matrix	0.25	41.29
37	Mudstone, silver-grey, laminated and massive; lenses of ripple-laminated dolomitic very fine grained sandstone	0.34	41.04
36	Dololutite, yellow, coarse and fine laminated	0.89	40.70
35	Mudstone, silver-grey, massive and laminated; some ripple-laminated, dolomitic, very fine grained sandstone	3.79	39.81
34	Sandstone, dolomitic, white, medium to very fine grained, laminated, convoluted	0.22	36.02
33	Sandstone, dolomitic, white, fine to medium grained, laminated, convoluted; cross-laminated at top; boudinage	0.45	35.80
32	Sandstone, white, very fine grained, laminated; some lenses with cross-lamination	0.87	35.35
31	Sandstone and shale; alternations of white, laminated, very fine grained, dolomitic sandstone and grey shale	1.76	34.48
30	Mudstone, silver-grey, calcareous and dolomitic, laminated; elliptical erosion surfaces	0.70	32.72
29	Sandstone, yellow, dolomitic, very fine grained, laminated	0.45	32.02
28	Dololutite and mudstone; yellow, laminated dololutite alternating with massive and laminated, calcareous mudstone; passes laterally into breccia with fragments of dololutite and mudstone	1.00	31.57
27	Mudstone, yellow, dolomitic; passes up into silver-grey, laminated and massive mudstone with some yellow dolomitic laminae	0.75	30.57
26	Mudstone, silver-grey and dark brown, calcareous and dolomitic, laminated and massive; 10 cm layers of inclined lamination and thin bedding; some inclined bedding bound by sharp slide planes at base and top	7.00	29.82
25	Breccia, intraformational; graded, passing up to fine grained sandstone at top; clasts, laminated and massive dololutite and grey mudstone; abundant rounded grit-sized quartz grains; poorly sorted; sandy mudstone matrix; sandstone at top is laminated and cross-laminated	0.46	22.82
24	Dololutite and mudstone; interbedded, colour banded; dololutite, yellow; mudstone, silver-grey; both lithologies laminated, massive, thin bedded	0.85	22.36
23	Covered interval	3.00	21.51
22	Dololutite and mudstone; interbedded, colour banded; dololutite, yellow, laminated; mudstone, silver-grey, thin bedded; alternations of massive and laminated	1.00	18.51
21	Sandstone, yellow, dolomitic, fine grained, laminated	0.40	17.51
20	Sandstone, dolomitic, very coarse grained, flat-bedded	0.78	17.11
19	Dololutite, yellow, laminated	0.10	16.33

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
18	Breccia and sandstone; graded; large angular clasts of laminated and rare massive dololutite in poorly sorted, sandy to gritty, dolomitic mudstone matrix; grades up into dolomitic very coarse grained sandstone with rare intraclasts; planar base	1.76	16.23
17	Dololutite, yellow, laminated, domal structures	0.30	14.47
16	Breccia, graded, poorly sorted; megaclasts to angular pebble-sized clasts of laminated dololutite, randomly oriented; irregular erosive base	1.50	14.17
15	Dololutite, yellow, laminated; some undulose lamination	0.79	12.67
14	Breccia, graded; clasts, angular, laminated and massive dololutite; irregular erosive base	1.03	11.88
13	Sandstone, yellow, dolomitic, very fine grained, thin bedded, laminated ...	0.28	10.85
12	Breccia, graded; clasts, angular, laminated dololutite, some massive dololutite; planar base	1.02	10.57
11	Sandstone, yellow, dolomitic, medium to fine grained, laminated	0.03	9.55
10	Breccia, not graded; clasts, elongate, angular, massive and laminated, dololutite and dolomitic sandstone; matrix, poorly sorted, dolomitic, medium to very coarse grained sandstone	1.38	9.52
9	Sandstone, yellow, dolomitic, very fine grained, fine laminated	1.36	8.14
8	Sandstone, black, dolomitic, very fine grained, fine laminated; 1.0 cm horizon of cross-lamination and ripple-marks at top	0.15	6.78
7	Sandstone, yellow, dolomitic, muddy, fine grained, thin bedded, laminated; cross-lamination at top overlain by thin black shale	1.15	6.63
6	Sandstone, yellow, dolomitic, very fine laminated	0.48	5.48
5	Breccia, yellow; grades up to laminated, very fine grained sandstone; clasts, elongate and angular, massive and laminated, dololutite and dolomitic sandstone; matrix, dolomitic, fine grained sandstone	1.44	5.00
4	Sandstone and dololutite; interbedded; sandstone, very fine grained; alternations of massive and laminated	0.20	3.56
3	Breccia, graded; large, angular fragments of white limestone, laminated grey limestone, laminated yellow dololutite and massive dololutite	1.03	3.36
2	Covered interval	0.60	2.33
1	Breccia, muddy; scattered angular fragments of laminated and massive dololutite, grey argillaceous limestone, white limestone and grey siltstone; matrix, dolomitic sandy mudstone; erosional base	1.73	1.73
	Unit 1 overlies a sequence of alternating grey argillaceous limestone, yellow dolomitic calcilutite, thin yellow dololutite and grey mudstone.		
	Total thickness of Warspite Formation	165.08	

TYPHOON PEAK FORMATION (5,6)

The type section of this formation (5) occurs on the north side of Ramah Bay (UTM grid zone 20: 486,500 E, 6,526,700 N, to 485,900 E, 6,526,900 N). The formation is poorly exposed, is intruded by a number of diabase sills that transgress the bedding, and is tightly folded. To illustrate the variation in this formation a second section (6), measured on the south side of Ramah Bay (UTM grid zone 20: 487,700 E, 6,520,900 N, to 486,000 E, 6,519,500 N) is given.

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
	Typhoon Peak Formation (5; type section)		
8	Shale, brecciated by intense tectonic compression; unknown thickness		
7	Slate, rusty weathering, poorly exposed	21.70	85.31
6	Diabase, coarse grained; unknown thickness		
5	Slate, rusty-weathering, dark grey to black; some thin beds and nodular layers of very fine grained sandstone and siltstone	3.61	63.61
4	Diabase, medium grained, brown-green weathering	4.50	60.00
3	Slate, rusty weathering, dark grey to black	12.00	55.50
2	Diabase, medium grained, brown-green weathering	7.50	43.50
1	Slate, rusty weathering, dark grey to black	36.00	36.00
	Unit 1 conformably overlies grey, thin bedded mudstone and dolomitic mudstone of Warspite Formation.		
	Minimum thickness of Typhoon Peak Formation, including diabase but excluding units 6 and 8	85.31	
	Typhoon Peak Formation (6)		
30	Slate, rusty weathering, dark grey	7.86	130.57
29	Sandstone, light grey to white, green-brown weathering, fine grained, thin bedded (0.5-1.0 cm), laminated, well sorted	18.11	122.71
28	Sandstone, grey, coarse to medium grained, graded, internally massive; similar to greywacke of Cameron Brook Formation	0.80	104.60
27	Shale, dark grey, cleaved	3.25	103.80
26	Sandstone, light grey, fine grained, thin bedded (1 cm), fine laminated	6.00	100.55
25	Diabase; unknown thickness		
24	Mudstone, dark grey, green-brown weathering, siliceous, laminated	2.50	94.55
23	Sandstone, white, very fine grained, thin bedded, fine laminated	3.80	92.05
22	Slate, rusty weathering, dark grey	6.30	88.25
21	Siltstone, light grey, thin bedded (0.5 cm); contains large (108 by 75 cm) grey quartzite concretions; internal spherical banding; centre cracked	3.00	81.95
20	Sandstone and siltstone, white and dark grey; sandstone, very fine grained, calcareous, fine laminated	7.35	78.95

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
19	Mudstone, dark grey	0.65	71.60
18	Limestone, grey, laminated, lensoid	0.37	70.95
17	Sandstone and siltstone, dark grey, calcareous, fine laminated	0.91	70.58
16	Slate, rusty weathering, dark grey	3.00	69.67
15	Diabase	7.50	66.67
14	Slate, rusty weathering, dark grey	2.10	59.17
13	Diabase, coarse grained	3.90	57.07
12	Slate, rusty weathering, dark grey	6.60	53.17
11	Diabase	0.30	46.57
10	Slate, rusty weathering, dark grey	6.00	46.27
9	Diabase	0.52	40.27
8	Slate, rusty weathering, dark grey	2.70	39.75
7	Sandstone, white, very fine grained, calcareous, laminated	1.20	37.05
6	Mudstone, green-brown weathering, siliceous, laminated	1.50	35.85
5	Slate, rusty weathering, dark grey, fine laminated	15.00	34.35
4	Sandstone and siltstone, light grey to white; sandstone, very fine grained; 2-4 cm beds; fine laminated; some cross-lamination	1.50	19.35
3	Mudstone, grey, calcareous, laminated	1.05	17.85
2	Limestone, black, brown-weathering, fine laminated; some 3 cm lenses and beds of white, very fine grained sandstone and grey siltstone, fine laminated	1.80	16.80
1	Slate, rusty weathering; poorly exposed	15.00	15.00
	Unit 1 overlies yellow, laminated, dolomitic mudstone, rich in pyrite cubes, that is equivalent to unit 143 of Warspite Formation.		
	Total thickness of Typhoon Peak Formation	130.57	

CAMERON BROOK FORMATION (7)

This incomplete type section is located at Cameron Brook on the north side of Ramah Bay (UTM grid zone 20: 485,800 E, 6,526,600 N, to 485,800 E, 6,528,000 N). Cameron Brook Formation, the highest stratigraphic unit in the Ramah Group, is poorly exposed in its limited outcrop area.

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
69	Covered interval; some scattered outcrops and felsenmeer blocks indicate that the succession is composed of dark grey, very fine grained, muddy sandstone; sandstone, massive bedded, numerous siltstone clasts, grades up into laminated, coarse siltstone and very fine grained sandstone; some ripple-lamination; thin shale and mudstone at top of each unit	28.50	191.55
68	Sandstone, grey, very fine grained, muddy, graded, laminated, ripple-laminated, convoluted; massive base	0.20	163.05
67	Sandstone, grey, fine and medium grained, graded, laminated, ripple-laminated; massive base; irregular erosive base; shale at top	0.29	162.85
66	Sandstone, grey, very fine grained; massive base grading up into festoon ripple-lamination; convolutions; 4 cm shale at top	0.50	162.56
65	Covered interval	2.34	162.06
64	Sandstone, grey, fine grained; massive base; graded; sandstone dykes; 6 cm laminated mudstone at top	0.38	159.72
63	Sandstone, grey, very fine to medium grained; muddy; massive base; 1 cm grey shale at top	0.17	159.34
62	Sandstone, grey, very fine to medium grained, muddy; massive base; graded; 1.5 cm laminated and massive mudstone at top	0.20	159.17
61	Covered interval; scattered poor outcrops of muddy greywacke sandstone; abundant white plagioclase grains; black mudstone clasts; thin mudstone or shale at top of sandstone units	91.00	158.97
60	Sandstone, grey, fine to coarse grained; mudstone clasts; massive base; graded; some thin bedded; ripple-lamination; 3 cm shale at top	0.36	67.97
59	Covered interval	9.00	67.61
58	Sandstone, black, very fine to medium grained, muddy, massive, graded, thin bedded near top; 3 cm ripple-laminated siltstone at top	0.28	58.61
57	Covered interval	3.90	58.33
56	Mudstone, dark and light grey, thin bedded, laminated	0.18	54.43
55	Sandstone, black, fine to medium grained; massive with mudstone clasts near base	0.49	54.25
54	Covered interval	1.20	53.76
53	Sandstone, black, medium grained, massive; numerous mudstone clasts at base	0.25	52.56
52	Broken, poor outcrop; 60 cm beds of sandstone with thin shale interbeds; sandstone, coarse grained, rich in mudstone clasts; some basal scours ...	7.50	52.31
51	Sandstone, grey, fine to very fine grained, graded; massive base; 5 cm laminated, convoluted siltstone at top	0.70	44.81

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
50	Sandstone, grey, very coarse and coarse grained; elliptical scour at base infilled by trough cross-bedding; overlain by massive, very coarse grained sandstone, rich in shale clasts, grading up into thin bedded, fine grained sandstone with shale laminations	0.40	44.11
49	Sandstone, grey, medium grained; grey shale intraclasts; massive, grading up into thin bedded and laminated very fine grained sandstone; 6 cm laminated, sandy mudstone at top	0.74	43.71
48	Sandstone, grey, medium grained, muddy; massive base; laminated siltstone at top	0.26	42.97
47	Covered interval	3.00	42.71
46	Sandstone, grey, medium to very fine grained; massive, graded base overlain by lamination; 3 cm shale at top; deformed basal scour	0.83	39.71
45	Sandstone, grey, medium to fine grained; shale clasts near base; massive; graded; overlain by thin bedded sandstone and shale; 12 cm grey shale at top	1.34	38.88
44	Covered interval	9.00	37.54
43	Shale, grey	0.18	28.54
42	Sandstone, black, medium to very fine grained, graded, thin bedded; some shale partings	0.69	28.36
41	Mudstone, grey, laminated	0.14	27.67
40	Sandstone, grey, coarse to fine grained, muddy, thin bedded; some shale partings and shale clasts; grades up into laminated and convoluted sandy siltstone displaying dish structures; shale at top	1.20	27.53
39	Sandstone, grey, medium grained grading to very fine grained, thin bedded with shale partings; load casts at base	0.83	26.33
38	Covered interval	4.50	25.50
37	Sandstone, grey, very fine grained; deformed ripple-lamination; concretions	0.12	21.00
36	Sandstone, grey, fine grained, massive bedded; grades up into laminated, coarse siltstone; 8 cm shale at top; basal scour deformed by flame structures	1.13	20.88
35	Sandstone, grey, very fine grained, muddy, massive bedded; 6 cm laminated siltstone and shale at top	0.19	19.75
34	Sandstone, grey, very fine grained, muddy, massive bedded; 6 cm laminated siltstone and shale at top	0.12	19.56
33	Sandstone, grey, fine grained grading to siltstone; massive; elongate grey shale clasts; overlain by laminated and ripple-laminated siltstone; 9 cm shale at top; flute marks on basal planar scour	0.77	19.44
32	Sandstone, grey, very fine grained grading up to siltstone; massive; 5 cm shale at top	0.19	18.67
31	Sandstone, grey, fine grained grading to very fine grained, muddy; massive overlain by lamination; 2 cm shale at top	0.19	18.48
30	Sandstone, grey, medium grained grading up to very fine grained, muddy; massive overlain by laminated and ripple-laminated; deformed basal scour; flame structures; 4 cm shale at top	0.51	18.29

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
29	Sandstone, grey, very fine grained, muddy, massive; 1 cm shale at top	0.17	17.78
28	Sandstone, grey, very fine grained, muddy, massive; 8 cm grey shale at top	0.12	17.61
27	Sandstone, grey, very fine grained; massive grading up into laminated and convoluted siltstone; 5 cm grey shale at top	0.56	17.49
26	Sandstone, grey, fine grained, massive, graded, muddy; large angular mudstone clasts	0.15	16.93
25	Sandstone, grey; fine grained grading to siltstone; shale clasts; cross-bedded; lamination and cross-lamination; sandstone dykes and convolutions; 5 cm shale at top	0.59	16.78
24	Mudstone, dark grey, thin bedded	0.12	16.19
23	Sandstone, grey, very fine grained, cross-laminated; grey shale at top	0.10	16.07
22	Mudstone, light and dark grey, thin bedded	0.15	15.97
21	Sandstone, grey, fine grained grading to siltstone; massive overlain by laminated; groove casts; 1 cm shale at top	0.16	15.82
20	Sandstone, grey, very fine grained grading to siltstone; massive overlain by laminated siltstone; 4 cm shale at top	0.69	15.66
19	Sandstone, grey, fine to very fine grained, massive, graded; grey shale clasts; grey shale at top	0.30	14.97
18	Sandstone, grey, very fine grained, muddy; grey shale clasts; massive overlain by laminated; 2 cm shale at top	0.17	14.67
17	Sandstone, grey, fine to very fine grained, muddy, graded; massive overlain by laminated and cross-laminated; convolutions; 5 cm shale at top	0.97	14.50
16	Sandstone, grey, fine to very fine grained, muddy; massive grading up into laminated; deformed base; 1 cm shale at top	0.35	13.53
15	Sandstone, grey, very fine grained, muddy; massive overlain by laminated; 5.5 cm shale at top	0.34	13.18
14	Sandstone, grey, very fine grained, muddy; massive overlain by laminated siltstone	0.64	12.84
13	Covered interval	0.30	12.20
12	Sandstone, grey; fine grained grading to siltstone; muddy; shale clasts; lamination; 8 cm shale at top	0.62	11.90
11	Sandstone, grey, fine grained grading to siltstone; muddy; shale clasts; laminated; 8 cm shale at top	0.62	11.28
10	Sandstone, grey, medium grained, muddy; shale clasts; thin bedded; laminated at top; 3 cm shale at top	0.48	10.66
9	Sandstone, grey, medium grading to very fine grained; shale clasts; massive overlain by laminated; 4 cm shale at top	0.24	10.18
8	Sandstone, grey, medium grained grading to siltstone; massive overlain by laminated and cross-laminated; 7 cm shale at top	1.08	9.94
7	Sandstone, grey, fine grained grading to sandy siltstone; massive overlain by laminated; shale stringers in massive sandstone	0.97	8.86

Unit	Lithology	Thickness in metres: Unit	Thickness in metres: Total from base
6	Sandstone, grey, medium grained grading to very fine grained; massive overlain by laminated and cross-laminated; shale at top	0.30	7.89
5	Covered interval	4.50	7.59
4	Sandstone, grey, fine grained grading to very fine grained; massive overlain by laminated; some cross-lamination; 3 cm shale at top	1.60	3.09
3	Covered interval	0.43	1.49
2	Sandstone, grey, coarse grained grading to very fine grained; massive overlain by laminated; 16 cm shale at top	0.59	1.06
1	Sandstone, grey, medium grained grading to very fine grained; massive overlain by laminated	0.47	0.47
	Unit 1 overlies a breccia produced by tight folding, squeezing and flowage of slate in Typhoon Peak Formation.		
	Maximum total thickness of Cameron Brook Formation	191.55	