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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PAPER 63-40

GEOLOGICAL NOTES ON NORTHEASTERN DISTRICT OF MACKENZIE, NORTHWEST TERRITORIES

(Report and Map 45-1963)

J. A. Fraser

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By

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Illustration

GEOLOGICAL NOTES ON NORTHEASTERN DISTRICT OF MACKENZIE, NORTHWEST TERRITORIES

INTRODUCTION

The following is a preliminary account of the results of Operation Bathurst, a project of geological reconnaissance mapping carried out in the Bathurst Inlet area, Northwest Territories, in the summer of 1962, in which five Geological Survey of Canada geologists, using two helicopters, mapped the bedrock of an area of 55,000 square miles. This work represents a continuation of the program of reconnaissance mapping by helicopter begun by the Geological Survey in 1952 (Lord)[1].

The map-area lies between the 100 degree and 112 degree meridians, and extends from latitude 65 degrees, north to the Arctic coast. The settlement of Bathurst Inlet at 66°50'N, 108°00'W, is 360 miles north and east of Yellowknife and is most conveniently reached by air from that centre. Freight can also be transported to Bathurst Inlet from Mackenzie River ports, in August or September, in ships of the Northern Transportation Company. Some of the aviation gasoline required for Operation Bathurst was flown, late in June, 1962, to the esker airstrip north of Pelly Lake, at 66°03'N, 101°04'W. Although no longer maintained, this strip was found to be in satisfactory condition for use by Bristol Freighter aircraft.

The geology of the coastal regions and adjacent islands from Tree River east to Banks Peninsula was mapped by O'Neill (1924) between 1913 and 1918 as part of a larger area. His report contains a summary of previous exploration in the Bathurst Inlet area. A recent geographic report on the area (Bird and Bird, 1961) includes an outline of topographic features and their geological origin.

Relief in the map-area is greatest along the west side of Bathurst Inlet, where elevations of more than 1,000 feet occur within a few miles of the coast. Farther west, in the region drained by James, Hood, and Burnside Rivers, is a broad uplands in which hills underlain by Proterozoic sediments reach elevations of 2,000 feet above sea-level. Sharp local relief is found in stream valleys in these sediments and along escarpments of gently dipping strata capped by diabase. In the southwestern part of the map-area elevations are about 1,500 feet and local relief is nearly everywhere less than a few hundred feet.

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[1]Names and dates in parentheses are those of references given at the end of this report.

Topography is rugged in detail along the east side of Bathurst Inlet, but decreases in elevation and relief eastward. MacAlpine Lake is about 600 feet above sea-level and relief in the surrounding area is generally less than 200 feet. Between MacAlpine Lake and Queen Maud Gulf is a lowland plain in which bedrock is largely blanketed by post-glacial silts. Elsewhere in the map-area bedrock is generally well exposed.

The glacial features of the map-area have been described by Blake (1963).

Most of the area mapped is barren of trees but willow was observed along Tree River and near the mouth of Hood River and scrub birch and willow have been noted previously at many localities in Bathurst Inlet (Bird and Bird, 1961).

Wildlife is varied but, except in some localities, is scarce. Several thousand caribou were sighted about 50 miles northwest of MacAlpine Lake in late June. Smaller groups were observed in August south of James River. A total of two hundred and eleven muskoxen, of which fifty-two were calves, were observed in nineteen localities as single bulls and in herds containing as many as forty-seven animals. The largest herds noted were northwest and northeast of MacAlpine Lake. Muskoxen were also seen in the Burnside River valley, between James River and Grays Bay, and along Hood River near the western boundary of the map-area. In mid-August two moose were sighted at the mouth of Tree River and one barren lands grizzly bear north of Contwoyto Lake near Hood River. Other animals observed include Arctic wolves, hares, and ground squirrels. Several foxes, and numerous swans, cranes, and geese were sighted on Kent Peninsula and the adjacent mainland.

There are two settlements in the map-area, one at Bathurst Inlet, the other near the mouth of Perry River. In each is a Hudson's Bay post, a Roman Catholic mission, and a few Eskimo families. Eskimo camps are sparsely distributed along the coast near the settlements.

By June 7, snow cover in the vicinity of Contwoyto Lake was less than 15 per cent and outcrops were bare enough to permit mapping. At that time many of the lakes east of Contwoyto Lake were still ice covered from shore to shore, but by June 18 ice in these lakes had become unsafe for landing ski-equipped Otter aircraft. MacAlpine Lake was covered to the shore June 18 by ice more than 2 feet thick; on July 8 there was enough open water in some bays in this lake to allow Otter aircraft to land on floats, and most of the smaller lakes nearby were almost completely open. Out of seventy-four days spent in the field from June 5 to August 17, thirteen were unsuitable because of weather for helicopter flying.

ACKNOWLEDGMENTS

The writer acknowledges the able assistance of J.A. Donaldson, H.H. Bostock, W.H. Poole, and W. Blake Jr., all of the Geological Survey of Canada, and F.M.G. Williams and R.N. McNeely, seasonal assistants. Credit for compilation of the map is due principally to Donaldson, Bostock, and Williams.

Officials of the Canadian Nickel Company at Contwoyto Lake generously arranged for storage and handling at Contwoyto Lake of the aviation gasoline required before break-up. A. Payne of the Hudson's Bay Company and Father Menez of the mission kindly assisted in handling the gasoline cache at Bathurst Inlet.

Atlantic Helicopters, Limited, provided the helicopters and crews; Wardair (Canada), Limited, provided a DeHavilland Otter and crew. The cooperation of the crews is gratefully acknowledged.

GENERAL GEOLOGY

Geological coverage of the map-area was achieved by helicopter traverses run east and west at 6-mile intervals. Kent Peninsula was mapped by radial traverses originating from a base south of Elu Inlet. Detailed observations were made on the ground every 5 to 10 miles along the traverses and were supplemented by observations from the air, either from cruising altitude (above 300 feet) or from hover positions within 30 feet of the ground.

The area is underlain by massive granitic rocks and gneisses (70 per cent), by Archaean metasediments and metavolcanic rocks (10 per cent), by Proterozoic sediments and flows and younger sediments (20 per cent) and by diabase, diorite, gabbro, and anorthosite.

The terms Epworth Formation and Coppermine River Group have been retained in this paper in accordance with former usage although each of these assemblages contains two or more mappable units.

TABLE OF FORMATIONS

Era	Period or Epoch	Group, Formation, or Map-unit and Approximate Thickness (feet)		Lithology
Cenozoic	Pleistocene and Recent			Till, boulders, sand, gravel, marine silt
		Unconformity		
Palaeozoic	Cambrian to Silurian (?)	Map-unit 22 (280)		Dolomite
	Cambrian (?)	Map-unit 21 (280+)		Sandstone; minor shale
		Unconformity		
Proterozoic		Map-unit 20		Diabase dykes and sills
		Intrusive contact		
		Coppermine River Group	Map-unit 19 (200)	Sandstone, shale, argillite
			Map-unit 18 (2,500)	Basalt flows
		Erosional disconformity		
		Kanuyak Formation (100-200)		Dolomite, shale, calcareous sandstone, conglomerate
		Unconformity		
		Parry Bay Formation (540+)		Dolomite, limestone; minor sandstone, shale
		Contact not exposed		
		Map-unit 16 (thickness unknown)		Sandstone, conglomerate
		Angular unconformity		

	Goulburn Group	Map-unit 15 (thickness unknown)	Sandstone, conglomerate
		Map-unit 14 (1,000)	Siltstone and argillite, sandstone
		Map-unit 13 (800)	Dolomite, limestone
		Map-unit 12 (2,000)	Argillite, argillite with interlaminated limestone
		Map-unit 11 (7,500)	Quartzite, orthoquartzite; minor arkose, conglomerate
		Map-unit 10 (3,500)	Argillite, concretionary argillite, dolomite, quartzite, conglomerate

Relations unknown; probably correlative in part

	Epworth Formation	Map-unit 9 (300+)	Dolomite
		Map-unit 8 (200+)	Quartzite
		Map-unit 7 (100+)	Argillite, slate

Unconformably related to map-unit 5; relation to map-unit 6 unknown

	Map-unit 6	Diorite, gabbro, anorthosite

Intrusive contact

	Map-unit 5	Granite, granodiorite, and allied rocks

Intrusive and gradational contact

	Map-unit 4	Gneiss, migmatite

Gradational contact

Archaean	Yellowknife Group	Map-unit 2 (thickness unknown)	Metamorphosed greywacke, argillite; quartzite, schist, knotted schist
		Map-unit 1 (thickness unknown)	Greenstone, amphibolite

ARCHAEAN SEDIMENTARY AND VOLCANIC ROCKS

Yellowknife Group (1-3)[1]

Belts of metamorphosed volcanic and sedimentary rocks, intruded and replaced in part by granite, extend, with minor breaks, into adjacent map-areas (Folinsbee, 1949; Lord and Barnes, 1954), where they have been assigned to the Yellowknife Group of Archaean age. In these areas and elsewhere the metasediments (2) have been found, in general, to be younger than the metavolcanic rocks (1), and the same relationship is assumed to apply in this map-area.

Greenstone and Amphibolite (1, 3)

The oldest rocks in the map-area are greenstones and amphibolites derived from intermediate and acidic volcanic rocks. Map-unit 1 also includes minor undifferentiated sediments.

The greenstone (1) is exposed in two main belts. One extends from Grays Bay on Coronation Gulf southwards about 80 miles and at its southern end is broken but continues to the southwest. The other, east of Bathurst Inlet, extends from Hope Bay on Melville Sound southwards for about 50 miles. Each belt is about 8 miles wide but contacts with the bordering granite are, in many places, irregular and widths are variable.

The metavolcanic rocks (1) are light to dark green, fine grained, and massive or foliated. Porphyritic varieties contain white-weathering insets of feldspar about 3 mm long. Pillow structures are common and may be used in determining direction of flow tops. Vesicular structure and agglomerate are of local occurrence. Lenses and layers of carbonate, probably in part of sedimentary origin, are found throughout the eastern greenstone belt (1d) and at a few localities in the western belt. The weathered surfaces of carbonate-rich flows are typically brownish. In each greenstone belt steeply dipping foliation parallels the trend of the belt or follows local irregularities in the greenstone-granite contact. Small irregular veinlets and lenses of milky quartz intrude the greenstone along and across foliation.

At granite contacts the greenstones are commonly cut by granitic stringers and have been recrystallized to dark green or black, massive or foliated, medium- to coarse-grained amphibolite. Some or all of the mappable bodies of unit 1b amphibolite have probably originated in this way. The origin of isolated bodies of amphibolite (3) resembling 1b, which are exposed in the migmatite terrain south of Queen Maud Gulf, is uncertain but, in part, they may also have been derived from volcanic rocks of the Yellowknife Group. Locally they include biotite gneiss, believed to be of sedimentary origin.

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[1] Numbers in parentheses are those of map-units on the accompanying geological map.

Acidic Volcanic Rocks (1c)

At several localities within the greenstone (1) belts are pale green to white, massive or foliated, and locally porphyritic flow rocks, which range in composition from dacite to rhyolite. They comprise much of the northernmost 30 miles of the western greenstone belt and are found in the eastern greenstone belt within 20 miles of Melville Sound. Flow rocks that occur east of the south end of Contwoyto Lake are mainly dacites.

Metasediments (2)

All rocks mapped as metasediments (2) lie west of longitude 105°30'W. They are well exposed flanking younger cover sediments on the west side of Bathurst Inlet and on the east side, south of Gordon Bay. Another belt extends eastward, across the northern half of Contwoyto Lake, and terminates in paragneiss south of the Peacock Hills. A narrow branch of this belt follows Contwoyto Lake southeastward.

The metasediments (2) comprise mainly greywacke, micaceous quartzite, argillite, derived phyllite and schist, and minor undifferentiated rocks of volcanic origin. White, muscovite-bearing quartzite (2b) outcrops 50 miles east of Contwoyto Lake. Argillite and slate (2c) occur east of Contwoyto Lake in the extreme southeast corner of the map-area. At Contwoyto Lake and, locally, north of James River, argillitic rocks are interlayered with grey, micaceous quartzite. Conglomerate (2d) in the metasediments is rare; exposures of conglomerate south of James River near Bathurst Inlet consist of pebbles, cobbles, and boulders of greywacke in a fine-grained matrix of greywacke. Sillimanite schists (2e) containing nodules of cordierite and andalusite up to half an inch long are common in the metasediments; garnetiferous schist is less common, and schists bearing staurolite or kyanite are relatively rare.

Lineation in the schist (2e) is defined by crenulations in foliation planes and by elongation of knots. Lineation and foliation trends in the metasediments are rather variable, but are principally north, northwest, and northeast.

GRANITIC ROCKS AND GNEISSES (4, 5)

The granitic rocks have been grouped into two major categories, the one, predominantly gneissic and migmatitic (4), the other, largely massive (5). Within each group, several distinct types could be recognized in the field but, because of the scale of observation, could not be delineated. At least two ages are represented. The boundary separating the Slave (structural) Province on the west from the Churchill (structural) Province on the east had been tentatively assumed to lie along Bathurst Inlet (Stockwell, 1961). Structural and lithological discontinuities, however, are more evident, east of

Bathurst Inlet, across a line that joins Melbourne Island to the mouth of Western River and is convex to the southeast. East of this line is a terrain of relatively high metamorphic grade in which foliation trends are north and northeasterly; west of the line are granites and gneisses of lower grade in which foliation trends are north and northwesterly.

Gneiss and Migmatite (4)

Map-unit 4 consists mainly of a heterogeneous assemblage of gneisses and migmatite including granite-gneiss, biotite gneiss, hornblende gneiss, garnet-pyroxene gneiss, and granulite. The unit also includes small areas of undifferentiated massive rocks. Foliation in the gneisses results from the alteration of distinct or indistinct layers of contrasting colour and mineral composition, which range in thickness from a fraction of an inch to several inches. In many places the layering is irregular and the gneisses are contorted. The content of granitic material in the migmatites ranges from 20 to more than 80 per cent. These include lit-par-lit gneisses in which the granitic layers are parallel with the foliation, and agmatite, in which granitic dykes have cut across the foliation, isolating blocks of host rock up to several feet across. The latter are abundant in the migmatites east of Bathurst Inlet.

West of Bathurst Inlet, and in the triangular sector between Bathurst Inlet and Kent Peninsula, pink to grey, medium-grained gneiss and migmatite are associated with strata of the Yellowknife Group (1-2), from which they apparently have been derived. In several places where gneiss and migmatite (4) separate these rocks from massive granite (5), hornblende gneiss grades into greenstone, and biotite gneiss grades into micaceous schist.

Predominantly grey to dark grey, but locally light grey to pink, medium-grained hornblende-plagioclase gneiss and migmatite are especially common in the region that extends from Bathurst Inlet eastward to MacAlpine Lake, and are characterized in many places by pyroxene, chiefly hypersthene. Garnet is also present in some of these rocks. The gneisses are strongly to weakly foliated and grade into granulites. Lit-par-lit amphibolite gneiss in this area is here and there truncated by younger granite. Small outcrops of calc-silicate gneiss and granulite consisting chiefly of clinopyroxene, sphene, and carbonate minerals are scattered along the valley of Ellice River. In this region also is abundant pink to red, aphanitic mylonite, which is strongly foliated in a northerly direction.

Massive and Foliated Granitic Rocks (5)

Massive granitic rocks ranging in composition from granite to quartz diorite, and locally diorite, intrude rocks of the Yellowknife Group (1-3). They are most abundant in the western half of the map-area.

Coarse-grained granite and pegmatitic granite (5a) are characteristic of the regions east and west of Contwoyto Lake. Masses of white pegmatite, up to several hundred feet in diameter and containing

tourmaline and muscovite, intrude this granite and adjacent metasediments (2). Tourmaline-muscovite pegmatite also intrudes schist of the Yellowknife Group near the east side of Bathurst Inlet, and massive granite at Galena Point. West of Bathurst Inlet, bodies of massive, medium-grained granodiorite, quartz diorite, and diorite (5c), 10 to 15 miles long, are associated with Yellowknife Group rocks and derived gneisses (1-4).

Massive granite (5g) east of the northern part of Bathurst Inlet is a complex of older hornblende granite and granodiorite invaded by muscovite-bearing leucogranite, which in some places constitutes 50 per cent of the rock. Migmatites (4) in this area also show evidence of granitization by younger granite.

In the eastern part of the map-area, bodies of brownish, foliated, hypersthene granodiorite (5d), associated with pyroxene-bearing gneiss (4d), are scattered along the west side of Perry River from MacAlpine Lake to Queen Maud Gulf. A similar body is exposed 35 miles east of Bathurst Inlet.

ANORTHOSITE AND GABBRO (6)

Small bodies of anorthosite and gabbro intrude the gneisses (4) east of Ellice River. They commonly stand above the surrounding terrain as broad, low, ridges, elongated in the direction of the strike of the foliation of the gneisses, and as low hills of circular or elliptical outline. The largest bodies are anorthosite (6b) and are about 8 miles long.

The anorthosite consists of dark grey, medium- to coarse-grained andesine or labradorite with minor amounts of mafic minerals that include clinopyroxene, biotite, and hornblende. Garnet is present in some exposures. With an increase in the percentage of mafic constituents the anorthosite grades into gabbro or diorite (6a). The anorthosite contains rare, fine-grained, mafic inclusions and is cut by fine-grained mafic dykes, which are not more than a few feet wide and a few hundred feet long.

PROTEROZOIC SEDIMENTARY AND VOLCANIC ROCKS

Epworth Formation (7-9)

The name Epworth Formation was applied by O'Neill (1924) to dolomite and minor sandstone exposed along the lower part of Tree River. Epworth Formation was later used to include argillite and quartzite units that are interlayered with the dolomite (Fraser et al., 1960). At Tree River three units have been recognized in the Epworth Formation. In order of decreasing age they are: argillite and slate, quartzite, dolomite.

Argillite and Slate (7)

A minimum of 100 feet of argillitic strata are exposed east of Tree River at the base of the Epworth section. The rock is grey, dense, thinly bedded, and slaty, and contains beds of fine-grained micaceous sandstone or siltstone in which graded bedding is developed. The sediments have been folded about northerly-trending axes. Beds dip about 50 degrees on fold limbs and are separated by a fault from granite to the east.

Quartzite (8)

Overlying argillite (7) conformably east of Tree River is a thick-bedded quartzite with a total thickness of more than 200 feet. It is buff to pink, and fine to coarse grained. The coarse facies contains clasts of feldspar. The beds are inclined with shallow to steep dips about northerly-trending fold axes and are cut by quartz stringers. Crossbeds are well developed locally.

Dolomite (9)

The uppermost unit of the Epworth Formation exposed along Tree River is a grey, buff-weathering, stromatolitic dolomite, estimated to be more than 300 feet thick. Chert occurs throughout the dolomite in layers up to 2 inches thick. At its base the dolomite is interlayered with dark grey, cherty argillite. The contact with the underlying quartzite (8) is not exposed. The dolomite beds have been folded into a shallow syncline.

Goulburn Group (10-15)

O'Neill (1924) applied the name Goulburn Formation to pink quartzite on Goulburn Peninsula east of Brown Sound. Wright (1957) used Goulburn as a group term to include a lower unit consisting of quartzite, slate, and limestone. In this paper, Goulburn Group comprises six map-units: a basal unit comprising argillite, grey quartzite, and dolomite; pink quartzite and conglomerate; argillite; dolomite; red siltstone; sandstone and conglomerate. A rough estimate of the total thickness of these strata is 15,000 feet.

Goulburn rocks outcrop on Banks Peninsula, on Kent Peninsula, on the south side of Melville Sound, and on nearby islands. They are best exposed along Bathurst Inlet and along the Burnside River valley. In this region the strata lie in a series of contiguous basins. Those nearer Bathurst Inlet are wider and presumably deeper, for they contain a greater number of the Goulburn units. Goulburn sediments (10) on the western boundary of the map-area occupy a small and relatively shallow basin in line with the main Burnside belt.

The sediments have been deformed into shallow folds with axes that strike N 35° E. Beds generally dip less than 25 degrees except along Bathurst Inlet where fold axes are northerly or parallel with the

inlet. There, plunges are shallow, either to the north or south, and dips are nearly everywhere steep.

The Goulburn strata lie unconformably above granite (5) and older rocks.

Map-unit 10

About 3,500 feet of argillite, dolomite, and quartzite form the base of the Goulburn Group and rest unconformably on Archaean strata (1, 2) or on granitic rocks (4, 5).

At the bottom of the unit (10) is 100 feet or less of pale grey to green, massive to thick-bedded, coarse-grained quartzite, which contains, here and there, beds of grit, quartz pebbles, and, locally, orthoquartzite boulders. Above the quartzite is about 200 feet of dolomite with interlayered quartzite and argillite. The dolomite is thin to thick bedded, fine grained, pale grey and weathers buff. Domical stromatolites are common in some beds.

The dolomite is overlain by thin- to thick-bedded, fissile argillite, and slate that contains layers of carbonate and quartzite in its lower part. The lower 300 feet of argillite is commonly maroon and characteristically carries ellipsoidal concretions of dolomite or limestone. The largest of these is about 8 inches long with a median diameter of about 2 inches. They lie along the bedding planes, their long axes paralleling the dip of the beds. Argillite in the upper part of the unit (10) is green to grey, and weathers pale yellowish green or buff. Locally it contains silty layers in which graded bedding and crossbedding can be seen.

Quartzite (11)

Thickly bedded, massive, pink, feldspathic quartzite or orthoquartzite is the most widespread and abundant of the Goulburn rocks and is the only Goulburn unit recognized near Kent Peninsula. In that area it includes a white to cream-coloured sandstone, which may be younger than map-unit 11 and possibly belongs to the Parry Bay Formation (17). The quartzite (11) has a maximum thickness of about 7,500 feet. It overlies strata of map-unit 10 conformably, and where this unit is absent, lies unconformably on Archaean strata (1, 2) and granitic rocks (4, 5).

Near its base the quartzite is interlayered with argillite and siltstone. In much of the upper part of the section it is reddish to purplish, and feldspathic, and bedding is indistinct or absent. Ripple marks and crossbedding occur sparingly throughout. Conglomerate layers, a few inches thick and spaced about 6 feet apart, are common in the upper part of the quartzite. In these, rounded pebbles and cobbles up to 3 inches in diameter, including quartz, quartzite, minor red argillite and porphyritic felsite, are set in a red, coarse-grained, arkosic matrix. Gash veins of milky quartz a few inches wide and a few feet long were noted in quartzite near the Bathurst fault.

Argillite (12)

Overlying quartzite (11) conformably in the Burnside River valley and along Bathurst Inlet is about 2,000 feet of argillite with interlaminated carbonate rock. The argillite comprises purplish, green, and grey argillite, and slate, and buff weathering, recessive layers of light grey limestone, dolomite, and calcareous siltstone, which constitute from 20 to 50 per cent of the rock. Soft sediment deformation, graded bedding, and crossbedding are typical of these strata.

Dolomite (13)

About 800 feet of light grey to pink dolomite overlies argillite (12) conformably along Bathurst Inlet and Burnside River. Weathered surfaces of the dolomite are light grey, buff, or pink, and are very commonly ribbed by paper-thin, wedge-like laminae of silica. In the uppermost and lowermost parts of the unit are argillite and siltstone interbeds that exhibit ripple marks and crossbedding. Small drag folds occur in the dolomite at Tinney Cove and elsewhere. Stromatolites are abundant in the dolomite, especially in the upper parts.

Siltstone (14)

Interlaminated, deep red, grey, maroon, and brown siltstone and argillite overlie dolomite (13) conformably along Bathurst Inlet. They are fine to very fine grained, locally arkosic and micaceous, and break with a hackly fracture. Characteristically they contain granules of specularite and joint surfaces coated with specularite. Red, crossbedded sandstone is abundant in the upper half of the unit. The total thickness of the siltstone (14) is unknown but may be in the order of 1,000 feet.

Sandstone (15)

The uppermost unit of the Goulburn Group is a mottled, cream-coloured, red and buff, crossbedded sandstone of unknown thickness. In some localities the matrix of this rock is kaolinitic. Conglomerate beds in the basal part of the sandstone contain pebbles of buff sandstone, quartzite, quartz, and granite. The unit has been recognized only northwest of Bathurst Lake, where it is bounded by faults and overlain unconformably by younger sandstone (16).

Map-unit 16

Coarse-grained, mottled red, buff, and grey, arkosic sandstone is exposed along the west side of Bathurst Inlet and at Tinney Cove. Kaolinite is highly characteristic of the matrix of this rock. Conglomerate layers in the sandstone contain boulders of quartz, quartzite, granite, and siltstone, which average 4 inches in diameter.

Exposed contacts with older rocks are rare, but in one place, steeply inclined sandstone of unit 15 is overlain unconformably by flat-lying sandstone of unit 16. No satisfactory estimate of the thickness of the sandstone (16) can be made because dips range from shallow to steep over relatively short distances.

Parry Bay Formation (17)

The name Parry Bay Formation is introduced in this paper to refer to Proterozoic strata consisting mainly of dolomite with some interbedded sandstone and shale. The formation, in its type locality north of Parry and Warrender Bays, southwest part of Kent Peninsula, is exposed as a series of northerly trending ridges. It outcrops also on Bear Island, Kanuyak and Barry Islands, on Banks Peninsula, on the northwest side of Arctic Sound, west of Daniel Moore Bay, and on the Galena Islands.

The maximum exposed thickness is 540 feet, but the total thickness is probably greater. In most places the strata are gently inclined to the west.

Much of the formation is thin to thick bedded, fine grained, and aphanitic, pale grey to flesh-coloured dolomite and limestone, which weather buff to light grey and typically contain chert lenses and layers up to 2 inches thick. Stromatolitic structures are abundant in some beds. Stromatolitic dolomite (17) on Kent Peninsula and on Banks Peninsula carries vugs filled with black, either dull or shiny, bituminous material, identified as impsonite[1], a hydrocarbon compound like anthraxolite but having a higher volatile content. Traces of this material are scattered through the dolomite.

The base of the Parry Bay Formation is nowhere exposed, but reddish brown dolomite and shaly dolomite on south-central Kent Peninsula are probably near the base. In this area about 50 feet of white to buff-coloured sandstone observed below the dolomite probably belongs to the Parry Bay Formation. In the upper part of the formation, represented by strata on Porden Islands, dolomite is intercalated with red and green shale and shaly dolomite.

The Parry Bay Formation overlies Goulburn strata unconformably. The relationship of the formation to map-unit 16 is not known as no contact with this rock was found.

Kanuyak Formation (17a)

The name Kanuyak was applied by O'Neill (1924) to sediments on Kanuyak and nearby islands at the mouth of Bathurst Inlet. No Kanuyak rocks have been recognized on the mainland. Except locally, Kanuyak strata are not extensive enough to be shown separately

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[1] Analysis by the Fuels and Mining Practice Division, Mines Branch, Ottawa.

on the map, and have, therefore, been grouped with those of the Parry Bay Formation (17) with which they commonly occur.

Reddish brown dolomite and limestone, and fissile or crumbly, reddish brown calcareous shale are characteristic of these sediments (17a), but their lithology varies from place to place. Some sections include fissile grey shale and grey, arenaceous limestone below the red beds. Conglomerate, at or near the base of the formation, is composed of angular clasts of chert and carbonate fragments 1 inch long in a fine-grained matrix of calcareous sandstone. Some of the beds of the Kanuyak Formation are probably of tuffaceous origin, as suggested by O'Neill (1924, p. 50A).

Kanuyak strata lie on an irregular erosion surface of Parry Bay dolomite with a slight angular unconformity and dip gently west and northwest. Exposed sections show a wide range in thickness, but the maximum thickness of the formation is probably between 100 and 200 feet.

Coppermine River Group (18-19)

In its type locality southwest of Coronation Gulf the Coppermine River Group is exposed over an area of about 5,000 square miles and comprises about 11,000 feet of amygdaloidal and massive basalt with interlayered conglomerate, overlain by about 15,000 feet of interbedded sandstone, shale, dolomite, and minor limestone (O'Neill, 1924; Fraser et al., 1960). The flows lie on dolomite of the Hornby Bay Group, apparently conformably, and dip gently north. Sediments and flows are cut by diabase and are overlain unconformably by Palaeozoic sediments.

Basalt (18)

Basalt underlies the western end of Kent Peninsula, Bear, Kanuyak, Barry, and Chapman Islands, and the mainland along Arctic Sound and Daniel Moore Bay. The basalt has a total thickness of about 2,500 feet and outcrops in a series of flows that dip gently west exposing vertical scarps from 30 to 50 feet high facing east. It is dark grey or purplish, weathers dark olive-green, and is commonly stained dark red along fractures. Fine-grained and aphanitic, massive flow layers are interbedded with amygdaloidal layers in which fillings consist mainly of calcite and silica. Pillow structures were observed at the base of the flows at two localities.

On Kanuyak Island flows lie directly and apparently conformably on Kanuyak strata (17a), and nearby on Parry Bay dolomite (17). It is probable, therefore, that Parry Bay strata, as well as Kanuyak strata, were in part eroded prior to the emplacement of basalt. O'Neill (1924) correlated the flows with those of the Coppermine River Group exposed southwest of Coronation Gulf, which they resemble closely in lithology and structure.

Sediments (19)

Gently dipping sediments on the Jameson Islands can be followed westward to the mouth of Tree River where they lie unconformably above strata of the Epworth Formation (7-9) and are known to belong to the upper part of the Coppermine River Group. Sediments of similar lithology overlie basalt (18) on the Barry Islands.

The basal sediments consist of about 50 feet of white, medium- to coarse-grained, ripple-marked sandstone. Near the top of the sandstone are layers containing pebbles of red quartzite and white quartz. Above the sandstone is about 150 feet of thinly bedded, green and dark grey shale and slate.

DIABASE (20)

Dykes and sills of fresh, grey, brown-weathering diabase intrude all other Precambrian rocks but do not intrude the Palaeozoic rocks (21-22).

The occurrence of sills and sheets of diabase is limited to areas underlain by Proterozoic rocks and to adjacent Archaean terranes. The most prominent sheet is probably several hundred feet thick and can be traced by discontinuous outcrop along the contact between the Archaean basement rocks and the Goulburn sediments on both the north and the south side of the Burnside River belt. On the south side, it comprises diorite, gabbro, and pyroxenite (20a).

The sheets commonly assume a circular or oval pattern of outcrop in which the dips are shallow and inward. These structures, which range from less than 1 mile to 25 miles in diameter, probably represent erosional remnants of the lowest parts of once extensive, undulating sheets. The association of the diabase with Proterozoic cover rocks suggests a possible control, by depth, of sill emplacement at a level now indicated by the distribution of the sediments.

Dykes of fresh grey diabase are numerous throughout the western part of the map-area, especially near Peacock Hills and between Hood and Tree Rivers. A swarm of such dykes intrudes massive granite (5) just east of the mouth of Bathurst Inlet. The trend of these dykes is predominantly N 25° W. A few dykes in these areas strike easterly and northeasterly.

Dykes are notably scarce in the area underlain by gneiss and migmatite (4) east of Bathurst Inlet. They include dykes of green, medium-grained metagabbro (20b), which are intruded by granitic stringers. The trend of these dykes is northerly, northwesterly, and northeasterly.

PALAEOZOIC SEDIMENTARY ROCKS

Sandstone (21)

Flat-lying sandstone with a maximum thickness of 280 feet is exposed across Melbourne Island and most of the eastern half of Kent Peninsula. It is pale grey to pink, coarse grained, and crossbedded. The pink layers are well indurated. Quartz pebbles, less than an inch in diameter, are found throughout the sandstone, but are not abundant.

Most of the sandstone is thick bedded, but at the base is thin bedded and friable, and is composed, in part, of shaly layers that contain linguloid shells[1]. Similar rocks exposed on the south side of Victoria Island have been provisionally dated as Upper Cambrian (Thorsteinsson and Tozer, 1961). Contacts between sandstone (21) and older rocks were not observed but from bedding attitudes measured near Cape Alexander it can be inferred that the sandstone (21) is unconformably related to Goulburn quartzite (11).

Dolomite (22)

Sandstone (21) on central Kent Peninsula is overlain conformably by flat-lying, thin- to thick-bedded, vuggy, brown to buff-coloured dolomite (22), with a maximum exposed thickness of 280 feet. The dolomite is correlated tentatively with Palaeozoic dolomite on south-central Victoria Island, considered by Thorsteinsson and Tozer (1961) to range in age from Middle Ordovician to Middle Silurian and possibly to include beds as old as Upper Cambrian.

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[1] Fossils examined by M.J. Copeland of the Stratigraphic Palaeontology Section, Geological Survey of Canada.

PROTEROZOIC CORRELATION

Tentative correlations may be made, on the basis of lithology and stratigraphic position, between Proterozoic strata in the map-area and strata in adjoining areas as follows:

Great Bear Lake	Bathurst Inlet	Thelon River
Coppermine River basalt	Coppermine River basalt	
Hornby Bay dolomite	Parry Bay dolomite	Dubawnt dolomite
Hornby Bay sandstone	Map-unit 16	Dubawnt sandstone
Epworth Formation	Goulburn Group (in part)	

Goulburn strata (10-15) were not found in contact with rocks of the Epworth Formation (7-9) in the map-area; moreover, the areas in which each group is represented do not, apparently, overlap. However, quartzite, dolomite, and argillite of the basal unit (10) of the Goulburn Group have many features in common with quartzite, dolomite, and argillite of the Epworth Formation exposed in the area north of Point Lake (Fraser et al., 1960), and may, in part, be correlative.

The sandstone of map-unit 16 is strikingly similar in appearance and composition to that of the Hornby Bay Group found north of Great Bear Lake. There, the sandstone is overlain conformably by dolomite of the Hornby Bay Group. A similar relationship may exist between map-unit 16 and dolomite of the Parry Bay Formation (17), although contacts between these formations were not discovered.

Dolomite of the Parry Bay Formation (17) is lithologically similar to the dolomite of the Hornby Bay Group. Each dolomite is overlain, in part, apparently conformably, by basaltic flows, assumed in both cases to belong to the Coppermine River Group.

There is a strong resemblance also between the sandstone of map-unit 16 and the sandstone of the Dubawnt Group (Wright, 1957) exposed in the Thelon River valley south and east of the map-area. As Dubawnt strata are not overlain by other Proterozoic rocks, there is no stratigraphic evidence to clarify this relationship. If the two sandstones are correlative, then the dolomite of the Dubawnt Group that overlies the sandstone may be correlative with the Parry Bay dolomite.

STRUCTURAL FEATURES

The distribution of rocks of the Yellowknife Group (1-3) outlines very crudely three fold directions, which are consistent with fold directions inferred from scattered measurements of foliation and lineation. The prominence of northerly trending belts of greenstone (1)

and metasediments (2) suggests that folds formed first around northerly trending axes and were subsequently modified by folding about northwest and northeast axes.

Basins filled with Goulburn sediments follow Archaean fold belts along Burnside River and along Bathurst Inlet, indicating that these regions continued to undergo deformation in Proterozoic time. Fold axes in Goulburn strata in the Burnside basins, however, diverge 20 degrees from the overall trend of the Burnside belt and may therefore be related to a later stage of deformation, possibly that associated with movement along the Bathurst fault.

The Bathurst fault is the most prominent structural and topographic feature in the map-area. It extends from Coronation Gulf, 170 miles southeast to Western River, which it follows for 30 miles or more (Wright, 1957) beyond the southern boundary of the map-area. Near Bathurst Lake topographic features and contacts indicate that, there, the structure is a fault zone rather than a single fault. The fault truncates formations of basalt (18) and older rocks. At its southern end the fault separates Archaean and Proterozoic sediments on the west from granitic rocks to the east (Wright, 1957). Sediments similar to these are found, east of the fault, near the mouth of Western River. Also, distinctive red siltstone (14) that outcrops in the Bathurst Lake region west of the fault can be matched, east of the fault, with red siltstone on Banks Peninsula. Each of these fault separations suggests a possible horizontal (left-hand) component of movement in the order of 50 miles. It is possible that some of the movement at the north end was taken up by branch faults following the east side of Bathurst Inlet. Fold structures in quartzite (11) and argillite (12) northwest of Bathurst Inlet settlement swing northward against the fault in a direction consistent with left-hand displacement.

The repetition of dolomite-basalt strata (17, 18) observed across the mouth of Bathurst Inlet implies the existence of a series of blocks, downfaulted to the east between north-trending normal faults. Outliers of Goulburn strata, presumably also downfaulted, have been mapped east and west of the Bathurst fault at the southern end of Bathurst Inlet.

The age of latest movement along the Bathurst fault is post-basalt (18) and pre-diabase (20). Sheets of diabase cross the fault without apparent displacement. Coppermine River sediments (19) on the Jameson Islands are on strike with the fault but show no displacement. Coppermine River sediments exposed on Barry Islands, an area traversed by north-trending faults, are, however, faulted against Parry Bay dolomite (17), evidence which suggests that some faults in the area are younger than the Bathurst fault.

ECONOMIC GEOLOGY

Gossans and rusty zones in the map-area are limited to Archaean rocks (1-5). Of nineteen gossans from which selected samples were collected for assay of gold and silver, only one contained more than negligible amounts of these metals. This, in greenstone (1) at 67°23'N, 110°50'W, assayed 0.017 ounce of gold and 0.92 ounce of silver per ton [1].

Gold was discovered by the Canadian Nickel Company in 1961 in metasediments (2) on the west side of Contwoyto Lake. Prospecting activity in the map-area in 1962 consequently centered around Contwoyto Lake, and by the end of August more than a thousand claims had been staked by various companies, most of them on ground underlain by metasediments (2). The gold occurs in sulphide zones, marked by small gossans, in micaceous quartzite and argillite (2). The sulphide minerals are principally pyrrhotite and arsenopyrite and are found in beds that contain medium- to coarse-grained amphibole and garnet.

A gossan in metasediments (2) southeast of Mara Lake, containing disseminated pyrrhotite and pyrite, is 300 feet wide and follows a contact between mica-quartz schist (2a) and white quartzite (2b) for about a mile. Farther north, west of Hackett River, siliceous zones in metasediments contain chalcopyrite, pyrite, and arsenopyrite over a length of about one-quarter mile.

Gossans are scattered throughout the greenstone (1) that runs southward from Grays Bay. A few of these are 100 feet or more in width. Many carry disseminated pyrite and pyrrhotite; some carry chalcopyrite and arsenopyrite. Pyritic zones up to 200 feet wide were noted in acidic flow rocks (1c). Few gossans were found in greenstone (1) east of Bathurst Inlet.

Within 10 miles of Ellice River and mainly west of it is a string of gossans that extends from latitude 66°20'N to latitude 67°20'N. They consist chiefly of disseminated pyrite, chalcopyrite, and pyrrhotite, in graphitic garnetiferous gneiss (4), amphibolite gneiss (4), and in calc-silicate gneiss (4c). Most of these are small, but at latitude 66°18'N is a gossan 200 feet wide and more than 600 feet long.

Veinlets of galena and chalcopyrite cut massive granite (5) and tourmaline-muscovite pegmatite at Galena Point.

Dark green 'copper stain' was observed on some of the basalt cliff faces southeast of Wollaston Point and on the Barry Islands. Specks of native copper were found in basalt on the Chapman Islands. A detailed account of copper showings in the vicinity of Bathurst Inlet is given in O'Neill's (1924) report.

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[1] Assays by the Mineral Sciences Division, Mines Branch, Ottawa.

Fine-grained garnet-hypersthene gneiss (4d) exposed near the mouth of Perry River and on the coast west of Chester Bay contains about 10 per cent magnetite. Magnetite iron-formation also occurs in argillite (2c) within the greenstone belt south of James River at longitude 111° 00'W.

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