

**GEOLOGICAL
SURVEY
OF
CANADA**

DEPARTMENT OF ENERGY,
MINES AND RESOURCES

This document was produced
by scanning the original publication.

Ce document est le produit d'une
numérisation par balayage
de la publication originale.

PAPER 68-38

**GEOLOGY OF COAL RIVER MAP-AREA,
YUKON TERRITORY AND DISTRICT OF
MACKENZIE (95 D)**

(Report, P.S. Map 11-1968 and 1 figure)

H. Gabrielse and S. L. Blusson

**MANUSCRIPT AND
CARTOGRAPHY**

AUG / 1969

SECTION



GEOLOGICAL SURVEY
OF CANADA

PAPER 68-38

GEOLOGY OF COAL RIVER MAP-AREA,
YUKON TERRITORY AND DISTRICT OF
MACKENZIE (95 D)

H. Gabrielse and S. L. Blusson

DEPARTMENT OF ENERGY, MINES AND RESOURCES

Indexed 69/70
WH

© Crown Copyrights reserved
Available by mail from the Queen's Printer, Ottawa,

from Geological Survey of Canada,
601 Booth St., Ottawa,

and at the following Canadian Government bookshops:

HALIFAX
1735 Barrington Street

MONTREAL
Æterna-Vie Building, 1182 St. Catherine Street West

OTTAWA
Daly Building, Corner Mackenzie and Rideau

TORONTO
221 Yonge Street

WINNIPEG
Mall Center Building, 499 Portage Avenue

VANCOUVER
657 Granville Street

or through your bookseller

Price: \$1.50

Catalogue No. M44-68-38

Price subject to change without notice

The Queen's Printer
Ottawa, Canada
1969

CONTENTS

	Page
Abstract	v
Introduction	1
Physical features	1
Table of formations	2
Glaciation	4
General Geology	4
Hadrynian	5
Map-unit 1	5
Map-unit 2	5
Cambrian (?)	6
Map-unit 3	6
Cambrian	6
Map-unit 4	6
Map-unit 5	7
Map-unit 6	8
Map-unit 7	8
Cambrian and Ordovician	8
Map-unit 8	8
Ordovician	9
Sunblood Formation (map-unit 9)	9
Map-unit 10	9
Ordovician (?) Silurian and Devonian	9
Road River Formation (map-unit 11)	9
Silurian	10
Nonda Formation (map-unit 12)	10
Silurian and Devonian	11
Map-unit 13	11
Devonian and Mississippian	12
Besa River Formation (map-unit 14)	12
Carboniferous	12
Mattson Formation (map-unit 15)	12
Mesozoic	13
Map-unit 16	13
Structural Geology	13
Economic Geology	15
Oil and gas	15
Metallic minerals	15
Lead, zinc	15
Copper	16
Barite	16
Springs	16
References	16
Appendix - Fossil localities and identifications	18

Illustrations

Map 11-1968	Geology of Coal River map-area	in pocket
Figure 1	Air photograph of Caribou Syncline	vi

ABSTRACT

The area mapped lies within a region of subdued mountain ranges and ridges, separated by broad, drift-filled, well-forested valleys. The entire area was covered by at least one advance of Cordilleran ice.

The region is mainly one of miogeosynclinal deposition. Strata range in age from late Proterozoic to Carboniferous or possibly Permian. Extrusive, basic volcanic rocks are dated stratigraphically as late Proterozoic and/or Early Cambrian, late Early Cambrian, and Middle Ordovician.

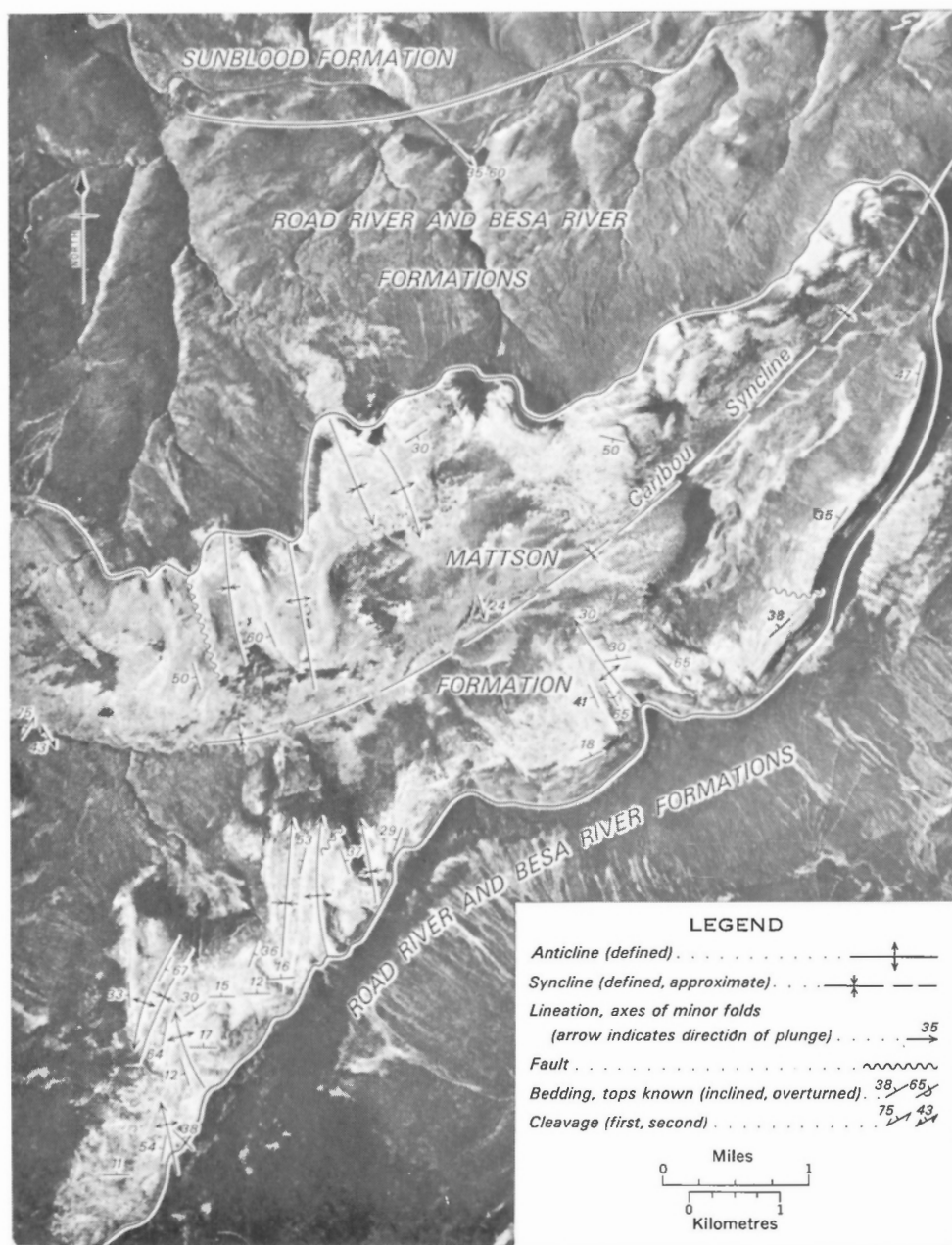


Figure 1. Vertical air photograph of Caribou Syncline showing cross-folds in sandstones of the resistant Mattson Formation (photo A17438-185).

GEOLOGY OF COAL RIVER MAP-AREA, YUKON TERRITORY AND DISTRICT OF MACKENZIE

INTRODUCTION

Coal River map-area (lat. 60° to 61° N, long. 126° to 128° W) was mapped mainly during May and June, 1967. Some general aspects of the geology had been noted previously from several traverses and a number of spot ground observations made during the 1965 and 1966 field seasons. Additional data were provided by E. F. Roots who, in 1953, traversed south-erly from the northern border of the map-area west of West Coal River to Quartz Lake. A. E. Aho kindly made available information on parts of the area obtained by prospecting parties in 1963.

Able assistance in the field was provided by W. J. P. Crawford, C. J. Dodds, R. A. Farley, and D. G. Perry. Transportation in the field was provided by a Bell G 3B helicopter supplied by Spartan Air Services Limited, Calgary, Alberta and by Beaver aircraft, supplied by Watson Lake Flying Services Limited, Watson Lake, Yukon. The writers extend their appreciation to these companies and their crews for excellent support.

Watson Lake was used as a base for supplies and communications. The southwestern part of the map-area was worked from a base camp at Irons Creek Lodge on the Alaska Highway and the remainder from a base camp on Gusty Lakes. Men and equipment were transported to the latter camp by fixed-wing aircraft from Crooked Lake near Smith River Airport. The airport is connected to the Alaska Highway by a good gravel road.

PHYSICAL FEATURES

The map-area lies almost entirely within Hyland Plateau (Bostock, 1948), a region of northerly trending, generally subdued mountain ranges and ridges separated by broad, drift-filled, well-forested valleys. The only extensive areas above timberline are those in the mountains near the head-waters of Irons Creek, between Coal and Rock Rivers in the northern half of the map-area, and north of the big bend in Caribou River. Elsewhere, isolated mountains and ridges rise above timberline but seldom do they provide a significant panorama of stratigraphy or structure.

Manuscript received: May 1, 1968.

Authors' address: Geological Survey of Canada,
601 Booth Street,
Ottawa, Canada.

TABLE OF FORMATIONS

Era	Period or Epoch	Formation	Map-unit	Lithology	Thickness (feet)
Cenozoic	Pleistocene and Recent		17	Unconsolidated glacial and alluvial deposits	
Mesozoic	Cretaceous (?)		16	Quartz monzonite; porphyritic quartz diorite or granodiorite	
Paleozoic	Carboniferous and(?) Permian	Mattson (in part)	15	Sandstone, even-grained, quartzitic; shale; argillite; slate; porcellanite	1,000 + (?)
	Devonian and Mississippian	Besa River	14	Shale, black; argillite; brown and green shale and argillite; cherty argillite	700-2,500
	Silurian and Devonian		13	Dolomite, well-bedded, light and dark grey, laminated; in part brecciated; fetid in part; fine-grained limestone; coarse-grained, vuggy, light grey dolomite	3,000 + (?)
	Lower Silurian	Nonda	12	Dolomite, cherty, black, fetid; grey dolomite; basal dolomitic siltstone and sandstone	1,000 [±]
	Upper Ordovician, Silurian and Devonian	Road River	11	Shale and siltstone, black; thin-bedded argillaceous limestone; grey and black chert	500-1,000
	Middle (?) and/or Upper (?) Ordovician		10	Siltstone, sandstone, dolomite argillite; well-bedded	300 +
	Middle Ordovician	Sunblood	9	Dolomite, dark and light grey; limestone; pink, mottled; amygdaloidal basic volcanics	2,000 +
	Cambrian and Ordovician		8	Limestone, silty, wavy banded; calcareous phyllite; phyllitic limestone	2,500 +

TABLE OF FORMATIONS (CONT'D)

Era	Period or Epoch	Formation	Map-unit	Lithology	Thickness (feet)
Paleozoic	Lower Cambrian		7	Volcanics, blocky, green, vesicular	500 +
			6	Dolomite, sandy, buff-orange; dolomitic sandstone	500 +
			5	Limestone, grey, fine-grained, silty; argillaceous limestone, siltstone and calcareous siltstone; white, cryptograin limestone; minor fine-grained sandstone	2, 300
			4	Sandstone, quartzitic, feldspathic, purple, maroon, white, cream; pebble-conglomerate; silty dolomite, bioclastic limestone; siltstone, argillite, phyllite, shale	7, 500 ±
Proterozoic	Hadrynian and/or Cambrian		3	Volcanics, flows, breccias, amygdaloidal, green and purple; minor dolomite and sandy dolomite	2, 000
			2	Phyllite, slate, fine-grained quartzite; platy black argillaceous limestone; biotite-muscovite schist	1, 000 +
	Hadrynian		1	Slate, siltstone, gritty quartzite, feldspar-quartz-pebble conglomerate; sandstone; maroon, green and buff shale and slate; phyllite; limestone; garnet-staurolite-biotite-muscovite schist	2, 000 +

Most of the drainage is southerly by Irons Creek and Coal, Rock, and Smith Rivers to Liard River. The easterly flowing Beaver River, also tributary to Liard River, drains part of the region north of Toobally Lakes; the Caribou River, tributary to South Nahanni River, drains the northeastern-most part of the map-area.

Excellent rock exposures are available along Caribou River and locally along Beaver River. The remaining streams generally expose little bedrock except where they flow in east-west trending canyons.

GLACIATION

At least one advance of Cordilleran ice, moving easterly and northeasterly, covered the entire map-area. This is revealed by the distribution of glacial erratics and the orientation of abundant glacial rock grooves, drumlinoid ridges and striae. The advance of ice from the southwest and west and subsequent southerly retreat apparently resulted in an easterly diversion of streams along the northern ice-margin. Thus, numerous channels were cut into bedrock and these commonly reveal the most continuous outcrops available for study in the map-area. Ponding of southerly flowing streams by ice also resulted in the formation of numerous glacial lakes the deposits of which are evident in the main valleys, particularly in the northern half of the map-area.

GENERAL GEOLOGY

Stratified rocks range in age from late Proterozoic to Carboniferous or possibly Permian. They display marked facies changes from east to west in pre-Middle Ordovician strata and from generally south to north in post-Middle Ordovician strata.

Lower Cambrian rocks near Toobally Lakes are dominantly clean, medium- to coarse-grained, highly feldspathic sandstones overlain by sandy dolomites whereas those between Coal and Rock Rivers are mainly impure siltstones and silty shales overlain by limestones, silty limestones and siltstone. Silurian and Devonian carbonate rocks ranging in age from Late Llandovery to Couvinian change facies northerly into shales generally along an east-west line near latitude $60^{\circ}15'N$. However, a thin basal unit of Silurian sandstone and dolomite, about 100 feet thick, is present beneath shales and cherts between Coal and Rock Rivers and east of Rock River as far north as $60^{\circ}21'N$. North of Spruce Creek the late Proterozoic(?) to Carboniferous sequence has a thickness of more than 13,000 feet. A thicker and more complete Paleozoic sequence near Caribou River, ranging in age from late Early Cambrian to Carboniferous is probably more than 9,000 feet thick.

Extrusive, basic volcanic rocks are dated stratigraphically as late Proterozoic and/or Early Cambrian, late Early Cambrian, and Middle Ordovician. The total aspect of the stratigraphy, however, is miogeosynclinal rather than eugeosynclinal.

HADRYNIAN

Map-Unit 1

Map-unit 1 includes several thousand feet of dark weathering interbedded slates and gritty feldspathic rocks with interbedded limestones near the top. Banded maroon and green weathering phyllitic slates form conspicuous members in the upper part of the sequence.

The finer grained rocks constitute considerably more than half of the total and are typically green-grey or dark grey on fresh surfaces and are commonly banded and laminated. The coarser grained rocks are locally graded or crosslaminated. The recessive nature of these rocks is largely responsible for the lack of comprehensive structural and stratigraphic data for map-unit 1.

Resistant, massive, gritty quartzites and feldspar-quartz-pebble conglomerates are characterized by grains and clasts of opalescent bluish quartz. Locally chips, or fragments of silty argillite as much as 8 inches long, are present in the quartzites. Crossbedding and other primary sedimentary structures are scarce. These resistant rocks occur in units ranging in thickness from a few feet to more than 300 feet.

Near Quartz Lake map-unit 1 includes an interbedded assemblage of thin-bedded to massive, in part graphitic, banded limestone; grey, brown, green, yellow, and buff calcareous argillite; silty argillites and fine-grained quartzite. East of Quartz Lake a prominent limestone member, more than 200 feet thick, has been strongly marmorized. The stratigraphic assignment of the rocks near Quartz Lake is uncertain and they may be in part Lower Cambrian.

Map-Unit 2

Map-unit 2 comprises a sequence of fine-grained clastic rocks characterized by greenish-grey weathering, banded phyllitic, sericitic slate and interbedded siltite or fine-grained quartzite. Banding, on a scale of 1/2 inch to 1 inch is conspicuous. In many places the rocks are strongly crenulated and east of Irons Creek kink-bands are exceptionally well developed in several localities. Between Coal and Rock Rivers strata of map-units 1 and 2 and

perhaps locally including rocks of map-units 4 and 5, have been metamorphosed, in places, to fine-grained biotite schists and, southeast of the mouth of West Coal River, to garnet-staurolite-biotite-muscovite schists. The restricted occurrence of the latter facies may reflect the presence of an underlying granitic stock.

CAMBRIAN (?)

Map-Unit 3

Between Coal and Rock Rivers and west of Toobally Lakes clastic Lower Cambrian rocks are underlain by thick sequences of basic volcanic rocks assigned to map-unit 3. Grey to buff-orange weathering, blocky grey-green, green and grey-brown amygdaloidal, chloritic volcanic flows, tuffs and breccias west of Rock River are well cleaved. Black calcite occurs as amygdules, generally from 2 to 4 millimetres in diameter. The structure of these rocks is poorly understood but they are believed to be more than 1,000 feet thick. Volcanic rocks west of Toobally Lakes are more than 2,000 feet thick and are typically blocky, green to purple weathering and highly vesicular and amygdaloidal. Epidote and calcite comprise most of the amygdules. Angular inclusions of cream and rose quartzite, in part fused, and of limestone and dolomite, are relatively common. Flow breccias appear to be fairly abundant. Buff, flaggy dolomite and sandy dolomite form minor interbeds in the volcanic assemblage.

The apparent concordance of the volcanics with overlying Lower Cambrian clastic rocks and the occurrence of similar volcanic rocks intercalated within overlying Lower Cambrian sandstones west of Toobally Lakes, suggests the possibility that the volcanics are also of Early Cambrian age.

CAMBRIAN

Map-Unit 4

Strata herein assigned to the Lower Cambrian show marked facies changes from east to west within the map-area. East and southeast of Toobally Lakes, possibly more than 4,500 feet of clastic strata consist predominantly of purple, maroon, white, and cream, quartzitic feldspathic sandstones with minor pebble conglomerate. Maroon, tan, grey, and green, platy siltstones and shales are interbedded with the coarser clastic rocks. This sequence in general appears to be somewhat finer grained and less feldspathic than correlative strata west of Toobally Lakes.

Purple, pink, cream, and white feldspathic sandstones comprise a large part of the Lower Cambrian clastic sequence, possibly as much as

7,500 feet thick, that is well exposed along the lower reaches of Spruce Creek and the unnamed creek about 6 miles farther north. Feldspar-quartz-pebble conglomerates and arkosic gritty sandstones are conspicuous and commonly display varicoloured banding. Interbeds of maroon, purple, and green shales are not uncommon, particularly in the lower part of the assemblage. Flaggy, buff, grey, and orange weathering silty and sandy dolomites, in part thinly banded, are common in the upper part of the sequence but less so in the lower part. The upper part also includes a good marker member, several hundred feet thick, consisting of flaggy, orange weathering silty dolomite underlain by flaggy, mottled, orange, red and yellow, bioclastic grey limestone in turn underlain by maroon and minor green shales. The limestones contain trilobites, and sandstones, underlying the marker member noted above, contain abundant 'Scolithus' tubes as much as two feet long and 1/4 inch in diameter. These tubes are perpendicular to bedding and emerge on bedding planes as conical-shaped rosettes.

Between Rock and Coal Rivers a stratigraphic succession (map-unit 5), apparently homotaxial with the Lower Cambrian rocks described above, includes several thousand feet of phyllitic shale and slate, siltstone, sandstone, feldspathic grit and pebble-conglomerate. Unlike the sequences farther east these rocks display very few primary structures such as cross-beds or ripple-marks. In general the western facies of Lower Cambrian rocks is much finer grained and much less pure than that farther east.

It is probable that fine-grained, mainly clastic Lower Cambrian strata are included in the successions west of the upper reaches of Rock River and west of Coal River but their separation from late Proterozoic strata is impossible on the scale of mapping involved.

Map-Unit 5

A stratigraphic section comprising 2,300 feet of fossiliferous Lower Cambrian fine-grained limestone and siltstone and including 225 feet of sandstone at the top was measured west and northwest of the unnamed peak, elevation 5,309 feet, between Coal and Rock Rivers north of Camp Creek. The lower part of the section consists mainly of thin-bedded, in part platy, fine-grained, laminated siltstone that weathers recessively. The upper part includes much relatively resistant, grey and brown weathering limestone and silty limestone. Archaeocyathids and trilobites are abundant throughout a stratigraphic interval of almost 2,000 feet.

Poorly fossiliferous, commonly fine-grained or crypto-grained limestones extend southerly to near the headwaters of Otter Creek and can be traced northerly into Flat River map-area west of Rock River (Gabrielse, *et al.*, 1965). Their stratigraphic position suggests correlation with Lower Cambrian carbonate strata described above.

Map-Unit 6

A distinctive unit of very well bedded, orange and buff weathering sandy dolomite and dolomitic sandstone forms the uppermost part of the Lower Cambrian sequence in the eastern part of the map-area and is included in the upper part of map-unit 5 west of Rock River. The rocks are commonly flaggy and well-jointed. Nodular, dark grey dolomites, in places ribbed with laminae of resistant silt, are common. Locally, mud-cracks and crossbeds are well developed. It is estimated that map-unit 6 may be as much as 500 feet thick.

Map-Unit 7

Rocks of map-unit 7 occur near the top of map-unit 6 at several localities near Gusty Lakes and may be part of one continuous unit. The most complete exposures, however, are in the core of Caribou Anticline. There, blocky, green, fine-grained vesicular volcanic flows and breccias, more than 400 feet thick, underlie about 50 to 100 feet of Lower Cambrian sandy dolomite. Some of the volcanics are tuffaceous, well layered and locally cross-bedded. Very coarse volcanic breccia was noted in one locality.

CAMBRIAN AND ORDOVICIAN

Map-Unit 8

Map-unit 8 comprises a thick sequence of silty and argillaceous carbonate rocks that exhibits a pronounced regional facies change from east to west. More than 2,500 feet of buff and grey weathering, wavy banded, silty limestone is exposed in Caribou Anticline and to the west between Caribou and Rock Rivers. These rocks are characterized by a wavy banding of silty layers and a 'Swiss-Cheese' texture resulting from the weathering of limestone pods in a resistant anastomosing network of silty layers. The unit is generally well bedded to massive. Similar strata outcrop south of Otter Creek but the rocks appear to be somewhat more argillaceous. Poorly exposed strata elsewhere between Coal and Rock Rivers comprise essentially the same facies. West of Coal River, on the other hand, homotaxial strata consist mainly of buff, silver, and grey weathering calcareous phyllite and phyllitic limestone. The best exposures of these rocks, however, occur west of Quartz Lake along and near Hyland River in Watson Lake map-area (Gabrielse, 1966).

Strata of map-unit 8 are poorly fossiliferous and only one diagnostic collection (of Early Ordovician age) was made in the report area. The Middle and/or Late Cambrian and Early Ordovician age is based in addition on early

Ordovician fossils collected from similar strata in northern Rabbit River map-area (Gabrielse, 1962) and on middle and/or late Cambrian fossils collected in Frances Lake map-area (Blusson et al., 1966).

ORDOVICIAN

Sunblood Formation (map-unit 9)

Thick-bedded, light and dark grey weathering dolomites and thin- to medium-bedded pink and grey mottled limestones of the Sunblood Formation are widespread east of Rock River. Thicknesses exceed 2,000 feet. Dolomites range from fine- to medium-grained and from light grey to black. Limestones, commonly flaggy and platy, are generally crypto- to fine-grained. Locally, they are silty and, in a few places, contain nodules of chert. Fossils including abundant Maclurites sp. are common in the limestones. Solution caves in limestone terrains are conspicuous on ridges north of Beaver River.

Massive, blocky, green weathering, amygdaloidal volcanic rocks, more than 200 feet thick occur in the lower part of the Sunblood Formation in the northern part of the map-area between Rock and Caribou Rivers. The isolated exposures may be part of one continuous unit but this was not confirmed because of poor outcrop. Sunblood strata are thin or absent south of about latitude 60° 15', presumably the result of erosion prior to deposition of the overlying Nonda Formation.

Map-Unit 10

A distinctive assemblage of well-bedded and, in places, flaggy siltstone, sandstone, dolomite and shale, more than 300 feet thick, overlies strata of the Sunblood Formation along and north of Beaver River near the eastern border of the map-area. The sandstones are typically flaggy and have thin black shale partings. They are mainly fine-grained and locally contain small fragments of black shale. No fossils were obtained from this map-unit but the strata appear to overlie the Sunblood Formation conformably and are overlain by shales and siltstones of the Road River Formation that contain Early Silurian graptolites.

ORDOVICIAN(?) SILURIAN AND DEVONIAN

Road River Formation (map-unit 11)

Incompetent, thin-bedded, dark weathering shales, siltstones, limestones and minor cherts of the Road River Formation are well exposed along and near Caribou River. Scattered exposures occur along and near the

headwaters of Spruce Creek and on Beaver River. The transition from Road River facies to correlative carbonate rocks farther south takes place near latitude 60° 15', coinciding roughly with the southern extent of the underlying Sunblood Formation.

In the Caribou River region the Road River Formation is characterized by a basal black shale and siltstone member, a few hundred feet thick, overlain by a distinctive member of light grey weathering, well-bedded, argillaceous limestone and a calcareous shale member possibly between 200 and 300 feet thick. The well-bedded calcareous beds contain a prolific Early Silurian graptolite fauna. The light coloured beds are overlain by a thick section of well-bedded, commonly jet black argillites and slaty shales that may be entirely, or in part, Besa River Formation.

Near the headwaters of Spruce Creek, only the basal part of the Road River Formation is preserved. There, the assemblage includes much thin-bedded, laminated, dark grey, fine-grained argillaceous and silty limestone, and well-bedded dark grey chert generally interbedded with carbonates. Chert commonly forms tabular beds ranging from a fraction of an inch to more than 2 inches thick and with interbeds of dolomite produces conspicuously striped outcrops. The thin-bedded chert-carbonate assemblage probably represents a transitional facies between typical Road River Formation to the north and correlative carbonates to the south. Early Silurian graptolites are common in the argillaceous and silty limestones.

SILURIAN

Nonda Formation (map-unit 12)

Strata herein assigned to the Nonda Formation (Norford, *et al.*, 1966) are generally poorly exposed as they are confined to the low-lying south-central and southeastern parts of the report area. Possibly the most complete section is exposed in a deeply incised glacial channel near the headwaters of Siwash Creek. There, the basal beds unconformably overlie strata of map-unit 8 and consist of very well bedded, homogeneous, fine-grained, dolomitic, buff siltstone and sandstones more than 100 feet thick. The rocks are strongly crossbedded, a feature emphasized by the weathering in relief of 1/16- to 1/4-inch wide resistant ribs. The basal unit is overlain by medium- to thick-bedded, medium to dark grey, fine-grained commonly fetid dolomites probably less than 1,000 feet thick.

Rocks similar to those described above outcrop east of Coal River and north of the east-west stretch of the river. Near the head of Otter Creek, however, strata in the lower part of the Nonda Formation include distinctive irregularly laminated, silty grey dolomites overlain by laminated sandy dolomites and dolomitic sandstones. This basal member, possibly 300 feet

thick, is overlain by several hundred feet of well-bedded, in part flaggy and thin-bedded, fine-grained, light grey to black dolomite locally containing lenses and layers of black chert.

Near the headwaters of Spruce Creek the Nonda Formation comprises 50 feet of grey, crystalline dolomite, sandy dolomite and dolomitic sandstone, in places displaying excellent crossbedding, overlain by about 50 feet of well-bedded, grey, crystalline dolomite. Overlying strata consist of interbedded cherts and dolomites that grade upward into cherts and shales included in the Road River Formation.

The Nonda Formation unconformably overlies strata of the Sunblood Formation and map-unit 8. The effects of this unconformity, or whether it persists in the Road River sequence farther north are not known.

SILURIAN AND DEVONIAN

Map-Unit 13

An undivided carbonate assemblage of Silurian and Devonian age outcrops in the same general area as the underlying Nonda Formation. In the southeast part of the map-area southerly and southwesterly dipping homoclinal successions may aggregate more than 3,000 feet in total thickness. The lower part of map-unit 13 includes creamy grey, well-bedded, laminated, fine-grained dolomite. Some of the beds contain vugs as much as 1 inch in diameter but commonly less than 1/4-inch, lined with coarse dolomite crystals. Intraformational breccia is not uncommon. Strata in the middle part of the map-unit are mainly thick-bedded, grey to dark grey fine-grained dolomites, commonly laminated and locally vuggy. The uppermost beds comprise interbedded black, fetid dolomites and grey dolomites in beds from 6 inches to 2 feet thick. These rocks contain crinoid ossicles with twin axial canals.

The uppermost carbonate member in the south-central part of the area is a well-bedded, commonly thick-bedded, crypto- to fine-grained limestone, locally several hundred feet thick. The limestone is interbedded in its lower part with fine-grained dark grey dolomite containing poorly preserved Amphipora sp. (?).

Very coarse grained and vuggy crinoidal dolomite occurs locally northwest of Lootz Lake and buff-orange, porous, cavernous limestone and limestone breccia outcrops in a valley about 10 miles south-southwest of Lootz Lake.

The carbonate succession described above overlies the Lower Silurian Nonda Formation and the uppermost beds appear to be early Middle Devonian (Couvinian) in age. Limestones in the Barney Lake region are probably coeval with dolomites at the top of the carbonates in the southeast corner of the map-area.

DEVONIAN AND MISSISSIPPIAN

Besa River Formation (map-unit 14)

Thin-bedded, incompetent, black and dark grey argillites and shales of the Besa River Formation are well exposed along and near Caribou River. Poor exposures occur along Spruce Creek and some fair outcrops are present along and near Tropical Creek in the southeast part of the report area.

In the Caribou River area the Besa River Formation forms the upper part of a dominantly shale sequence that includes the underlying Road River Formation. The rocks are uniformly fine-grained and range from massive, well-bedded argillites to fissile, thin-bedded, and laminated shales. The thickness in places appears to approach 2,500 feet although some Road River Formation may be included in the lower part. Along Spruce Creek black shales of the Besa River Formation can be no more than 1,000 feet thick and possibly as little as 750 feet thick. No fossils were obtained from the formation.

CARBONIFEROUS

Mattson Formation (map-unit 15)

Strata assigned to the Mattson Formation are exposed in the eastern part of the map-area north of the latitude of Spruce Creek. They comprise medium-bedded, grey, even-grained, fine-grained quartzitic sandstones interbedded with black shale and slate. The rocks are very resistant relative to the underlying Besa River shales. Maximum thicknesses appear to be about 500 feet.

A sequence of black slate, argillite, ribbon-banded black cherty argillite and porcellanite (map-unit 15a), as much as 500 feet thick, outcrops in Caribou Syncline north and northwest of Last Mountain. A bright green argillite member, about 50 feet thick, forms a conspicuous marker in the assemblage. These rocks are believed to overlie the more resistant sandstones of the Mattson Formation and may include strata of Permian age.

MESOZOIC

Map-Unit 16

A small area in the northwesternmost part of the map-area is underlain by medium-grained biotite-hornblende quartz monzonite that forms the southeast end of a batholith extending north-northwest to Hyland River in Frances Lake map-area (Blusson, et al., 1966).

Two small granitic plugs in the northeastern part of the map-area consist of relatively homogeneous, vaguely to conspicuously porphyritic hornblende and hornblende-biotite quartz diorite or granodiorite. Rubble of megacrystic, medium- to coarse-grained, biotite-quartz monzonite underlies an area a few hundred feet in diameter on the crest of a ridge north of the headwaters of Beaver River. The material is believed to be in place as no similar concentrations of granitic glacial erratics have been noted in the area.

At least three, leucocratic, fine-grained, granitic sills with a maximum width of about 20 feet occur within an interval of 200 feet in strata of the Sunblood Formation on the southeast side of Caribou Anticline. The rocks contain sparse biotite phenocrysts as much as 3 millimetres long in an even-grained, aplitic matrix. Enclosing carbonate rocks of the Sunblood Formation have been only slightly marmorized.

STRUCTURAL GEOLOGY

Northerly to north-northeasterly trending structures are dominant although northwesterly and easterly trending structures are present in the southeasternmost part of the map-area. In general, structures east of Rock River are relatively simple whereas those farther west are complex and poorly understood.

The distribution of map-units in the northeastern part of the report area is controlled largely by Caribou Anticline and its flanking synclines. Caribou Anticline is a relatively open, symmetrical structure plunging steeply south-southwest. The southeast limb is faulted along the contact between Sunblood and Road River Formations. Road River strata are highly contorted along the fault and commonly related folds display very steep plunges. The southwesterly continuation of this fault is in doubt but no large offsets are indicated by the map pattern.

The syncline west of Caribou Anticline is poorly defined but the axial region may be represented by a remarkably linear belt of steeply dipping Mattson Formation strata. Caribou Syncline, southeast of the anticline, is particularly well revealed by outcrops in the area near Last Mountain (Fig. 1). There, strata of the Mattson Formation, forming the core of the

structure, show very clearly the effects of two stages of deformation - the first producing the major, northeast trending Caribou Syncline and the second producing the northerly and northwesterly trending cross-folds. Similar cross-folds are also revealed in strata of the Mattson Formation exposed on the unnamed mountain (elevation 5,314 feet) about 12 miles to the southwest. Cleavages related to the two directions of folding are well developed in shales of the Road River, Besa River, and Mattson Formations. The northeasterly trending cleavage is commonly offset or kinked by the later cleavage.

Toobally Fault, downthrown to the east, is apparently a steeply dipping structure that has a maximum stratigraphic throw of about 13,000 feet. The southern continuation of the fault is uncertain. It may swing southwesterly into the prominent easterly directed thrust fault along the west flank of the range east of Smith River in Rabbit River map-area (Gabrielse, 1962).

Structures in the southeasternmost part of the area are truncated by a steeply dipping northeasterly trending fault that effects a dextral offset of outcrops in the order of four miles. Extremely scant data suggests the presence of a fault crossing the lower part of Siwash Creek and on trend with the northern part of Toobally Fault.

Steeply dipping strata and brecciated carbonate rocks mark the loci of faults in the south-central part of the map-area. Most of these structures appear to be downthrown to the east.

Rock River Fault is an important easterly directed thrust fault which, like Toobally Fault, exposes a thick sequence of Lower Cambrian and/or late Proterozoic volcanic rocks in its hanging-wall. A southerly continuation of Rock River Fault may be the fault that trends northerly from Barney Lake.

Outcrops of Middle (?) Devonian carbonate strata clearly define an anticline and flanking syncline northeast of Barney Lake. Another anticline farther east along Coal River is probably a continuation of the anticline mapped along and near the river to the south in Rabbit River map-area (Gabrielse, 1962).

One or more easterly directed thrust faults bound the western limit of Silurian and Devonian carbonate strata along Coal River and west of Barney Lake.

The eastern flank of the range between Coal and Rock Rivers in the northern part of the map-area is marked by easterly directed thrust faults and possibly some overturning to the east.

Structures involving rocks west of Coal River are poorly understood because of poor outcrop and the lack of marker horizons. The best exposures, near the headwaters of Irons Creek, reveal several northerly trending,

open folds. These structures plunge northerly towards a structural depression near Quartz Lake. Between Contact and Irons Creek thin-bedded phyllitic rocks display a strongly developed, northwesterly trending cleavage which is folded and kinked along northeasterly axes by a later deformation.

On a regional scale it appears as if the northerly and northeasterly structural trends are generally accordant with paleogeographic trends of pre-Silurian strata as indicated by facies changes and limits of preservation. The east-west trending facies boundaries of Silurian and Devonian strata do not share this relationship. They are, however, roughly parallel with a line joining a remarkable sequence of structural culminations extending easterly from the domal structure exposing Cambrian rocks in central Watson Lake map-area (Gabrielse, 1966) through the localities of maximum stratigraphic displacements along Rock River and Toobally Faults in Coal River map-area and Beaver River Fault in La Biche map-area (Douglas and Norris, 1959).

ECONOMIC GEOLOGY

OIL AND GAS

The map-area is unfavourable for oil and gas exploration. Potential reservoir rocks such as the locally vuggy and porous Silurian and Devonian carbonates occur only in the southernmost part of the area where they comprise most of the outcrops. Thus rocks of this facies are buried beneath younger shales only in a very small area along Tropical Creek and, locally, in the valley of Smith River.

METALLIC MINERALS

Lead, Zinc

A large lead-zinc deposit has been explored by diamond-drilling on a property southwest of Quartz Lake. There, galena and sphalerite with considerable pyrite and ankerite occur mainly as replacements of finely laminated blue-grey to dark grey limestone on the east limb of a northerly plunging, fairly open anticline modified by a small syncline. A fault trends nearly north-south along the creek where the mineralized rocks outcrop.

Typically the galena is finely crystalline to steely but coarsely crystalline galena occurs locally. Pyrite is ubiquitous and is found not only in the main body of sulphides but in nearby clastic rocks.

The general aspect of the stratigraphy suggests that the deposit is in strata of latest Proterozoic or possibly early Cambrian age.

Galena and sphalerite are reported to occur with barite in a deposit at the headwaters of Otter Creek.

Copper

Malachite staining and, in places, blebs of chalcopyrite appears to be common in all of the volcanic rocks present in the map-area. No significant concentrations of copper minerals were observed but these rocks merit careful examination.

Barite

Numerous, mainly round, barite concretions ranging from a few inches to more than 8 inches in diameter occur in a well-bedded black argillite sequence exposed in the canyon of a creek 2.8 miles northwest of Last Mountain. Similar concentrations of barite concretions were noted farther down the creek, 4.4 miles northwest of Last Mountain. Enclosing strata in the two localities appear to be correlative.

SPRINGS

A beautiful, terraced tufa deposit lies at the base of a prominent limestone ridge on the east side of Coal River at latitude 60°09'08"N and longitude 127°26'02"W. The tufa deposit is about 75 feet high and extends for several hundred yards northerly from a treeless area that lies on the present water course. Scalloped terrace-faces on the west side pond a series of 'hanging' azure blue pools which combine with creamy white to buff-brown tufa and various colours of mosses and flowers to produce a remarkable natural 'hanging garden'.

The source of the stream that contributes water to the deposit is a moss-covered pool about 175 feet long and 50 feet wide at the base of the limestone bluff to the east. This pool seems to be somewhat warmer than the main stream, possibly because the latter is greatly diluted by cold groundwater.

REFERENCES

- Blusson, S. L., Green, L. H., and Roddick, J. A.
1966: Frances Lake map-area; Geol. Surv. Can., Map 6-1966.
- Bostock, H. S.
1948: Physiography of the Canadian Cordillera, with special reference to the area north of the Fifty-fifth Parallel; Geol. Surv. Can., Mem. 247.
- Douglas, R. J. W., and Norris, D. K.
1959: Fort Liard and La Biche map-areas, Northwest Territories and Yukon; Geol. Surv. Can., Paper 59-6.
- Gabrielse, H.
1962: Rabbit River map-area, British Columbia; Geol. Surv. Can., Map 46-1962.

1966: Watson Lake map-area, Yukon Territory; Geol. Surv. Can., Map 19-1966.
- Gabrielse, H., Roddick, J. A., and Blusson, S. L.
1965: Flat River, Glacier Lake, and Wrigley Lake, District of Mackenzie and Yukon Territory; Geol. Surv. Can., Paper 64-52.
- Norford, B. S., Gabrielse, H., and Taylor, G. C.
1966: Stratigraphy of Silurian carbonate rocks of the Rocky Mountains, northern British Columbia; Bull. Can. Petrol. Geol., vol. 14, No. 4, pp. 504-519.

APPENDIX

FOSSIL LOCALITIES AND IDENTIFICATIONS

Lower Cambrian Rocks: Lower Cambrian fossil localities are described in the text. The faunas are currently being studied as part of a thesis project by R. C. Handfield.

Map-unit 8: The following fossil collection was examined by B. S. Norford:

GSC loc. 81025. On Yukon Territory-District of Mackenzie boundary; 2.4 miles south of lat. 61°N; long. 126°54'30"W.

orthid brachiopod
asaphellid and pilekid trilobites
Apatokephalus sp.
Leiostegium sp.
Pliomeroides sp.
Psalikilus sp.
Shumardia sp.

age: Early Ordovician (Canadian), Zone G

Sunblood Formation: The following fossil collections were examined by B. S. Norford:

GSC loc. 79153. On Yukon Territory-District of Mackenzie boundary; lat. 60°53'N, long. 126°54'W.

cephalopod
ostracods
inarticulate and orthid brachiopods
undetermined trilobites
agnostid, pliomerid, and raphiophorid trilobites
Carolinites sp.
Ectenonotus sp.
? Isoteloides sp.
? Nileus sp.

age: early Middle Ordovician (Whiterock)

GSC loc. 79251. On ridge crest 4 miles south of peak, elevation 5314' and 12 miles north-northwest of Gusty Lakes; lat. 60°35', long. 126°47'.

echinoderm fragments
bryozoan (?)

gastropod
? Hesperorthis sp.
Streptelasma sp.

age: Ordovician (Wilderness to Richmond)

GSC loc. 79252. South bank of creek 3 miles north of peak, elevation 4645', approximately 12 miles west-southwest of Gusty Lakes; lat. 60°27', long. 126°51'.

echinoderm fragments
? Maclurites sp.
Palliseria sp.

age: early Middle Ordovician (Whiterock)

GSC loc. 79253. One mile north of peak, elevation 4645', and 12 miles west of Gusty Lakes; lat. 60°25'30", long. 126°51'.

echinoderm fragments
orthid brachiopod
Helicotoma sp.

age: Ordovician (late Canadian to Barneveld)

GSC loc. 79254. Same location as 79253.

echinoderm fragments
bryozoans
gastropods
straight cephalopod
clam
undetermined brachiopods
? Glyptomena sp.
Glyptorthis sp.
? Rostricellula sp.

age: Middle Ordovician (Ashby to Barneveld)

In this region Maclurites sp. is characteristic of the Sunblood Formation and many occurrences of this fossil, not noted above, were observed.

Nonda Formation: The following fossil collection was identified by B. S. Norford:

GSC loc. 79240. North of big bend in Coal River, 2.86 miles bearing 326° from peak, elevation 4715'; lat. 60°14', long. 127°23'.

Halysites sp.

age: Silurian

In the region between Rock River and Toobally Lakes where the Nonda Formation changes facies northerly into Road River Formation the lowermost beds, in a few places, are of typical Nonda facies and these contain favositid and halysitid corals.

Road River Formation: The following fossil collections were identified by B.S. Norford:

GSC loc. 79151. Northeast side of Beaver River; lat. $60^{\circ}31'$, long. $126^{\circ}07'30''$.

? cephalopod

Monograptus ex. gr. M. spiralis (Geinitz)

age: Early Silurian, Late Llandovery

GSC loc. 79152. Location as for 79151, but from 50 feet of section beginning 20 feet above 79151.

Monograptus sp.

M. ex. gr. M. spiralis (Geinitz)

age: Early Silurian, Late Llandovery

GSC loc. 79154. On west side of Caribou River; lat. $60^{\circ}55'$, long. $126^{\circ}35'$.

Monograptus sp.

M. sp. aff. M. barrandei (Suess)

M. sp. aff. M. spiralis (Geinitz)

Retiolites sp.

age: Early Silurian, Late Llandovery

GSC loc. 79161. In stream gorge on north side of Rock River; lat. $60^{\circ}21'$, long. $127^{\circ}03'$.

dendroid graptolite

Monograptus sp.

M. sp. aff. M. spiralis (Geinitz)

age: Early Silurian, Middle or Late Llandovery, probably Late.

GSC loc. 81032. Same locality as 79161 in beds of typical Nonda facies underlying Road River facies.

Catenipora sp.
favositid coral

age: Late Ordovician to Late Silurian

GSC loc. 79243. North of Lootz Lake; lat. $60^{\circ}16'$, long. $126^{\circ}52'30''$.

Monograptus ex. gr. M. spiralis (Geinitz)

age: Early Silurian, Late Llandovery

GSC loc. 79244 and 79245. Same location as locality 79243.

rhynchonellid brachiopod
? Eospirifer sp.
ostracods
Monograptus sp.
Retiolites sp.

age: Silurian, probably Late Llandovery

GSC loc. 79155. Tightly folded strata on south side of Caribou River;
lat. $60^{\circ}51'$, long. $126^{\circ}35'$.

Monograptus yukonensis Jackson and Lenz

age: Early Devonian, late Siegenian or early
Emsian

GSC loc. 81028. On west side of Caribou River at lat. $60^{\circ}59'$, long.
 $126^{\circ}22'$.

straight cephalopod
tentaculitid(?)
Monograptus sp.

age: probably Early Devonian

GSC loc. 81027. West of the upper reaches of Caribou River; lat.
 $60^{\circ}48'$, long. $126^{\circ}52'$.

tentaculitids
Monograptus yukonensis Jackson and Lenz

age: Early Devonian, late Siegenian or early
Emsian

GSC loc. 79242, 79249, and 81024. On north side of Spruce Creek;
lat. 60°18'30", long. 126°33'.

sponge spicules
tentaculitid (?)
Monograptus spp.

age: Early Devonian

COMMENTS

Graptolites from transitional facies between Road River and Nonda Formations confirm a Late Llandovery age for at least the lower part of the Nonda Formation (Norford, et al., 1966). It is apparent that strata of the Road River Formation correlative with the Nonda Formation must comprise a relatively thin sequence, possibly a few hundred feet thick at most.

The lack of a late Ordovician graptolitic fauna may be the result, in part, of the reconnaissance nature of the survey. At GSC loc. 79154 on the east limb of Caribou Anticline, however, Late Llandovery beds directly overlie strata of the Sunblood Formation. This suggests that the pre-Nonda unconformity, of major importance to the south in northern Rocky Mountains, Liard Plain, and Hyland Plateau, is present not only at the base of the Nonda carbonates but also at the base of Road River shales in much of Coal River map-area.