56-6

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

PAPER 56-6

GEOLOGICAL RECONNAISSANCE
IN THE
NORTHERN RICHARDSON MOUNTAINS
YUKON AND NORTHWEST TERRITORIES

(Report and Map 12 - 1956)

By

H. Gabrielse

OTTAWA
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INTRODUCTION

During the 1955 field season the writer accompanied a topographical survey party, led by Messrs. A.C. Tuttle and G.M. Armstrong of the Department of Mines and Technical Surveys, which was engaged in mapping northernmost Yukon and adjacent Northwest Territories, mainly west of Mackenzie River. This report describes the area bounded approximately by longitudes 135° and 138° W. and latitudes 67° and 68°30' N.

Transportation to and from outcrop areas was afforded by helicopter and Beaver aircraft and on three days a helicopter was made available for traverses. Data from pace and compass and helicopter traverses were plotted directly on air-photograph mosaics.

A few fossils and numerous specimens were collected in the vicinity of triangulation stations by members of the Topographical Survey. Structures were interpreted from air photographs and checked, wherever possible, from the air or on the ground.

ACKNOWLEDGMENTS

The writer is indebted to Messrs. A.C. Tuttle and G.M. Armstrong of the Topographical Survey whose interest and cooperation made the work possible. Much geological information was provided by members of the Topographical Survey and their assistance is gratefully acknowledged. The cooperation of Messrs. R.D. Maier and C.E. Thayer of Associated Helicopters Limited and Mr. L.O. Romfo of Whitehorse Flying Services was much appreciated.

PREVIOUS INVESTIGATION

Very little information has been published on the northern Richardson Mountains. Brief references to the geology are made by Isbister (1845)*, Petitot (1875), and Ogilvie (1887-88).

*Dates, etc., in parentheses are those of references at the end of this report.

The first accurate account of the geology, in a section through the Richardson Mountains, is given by McConnell (1888-89). McConnell crossed the Richardson Mountains west of Fort McPherson, via the old Peel River Portage, to La Pierre House on Bell River and thence travelled down Bell and Porcupine Rivers to Yukon River. Camsell (1906) described the geology along Peel River and in the vicinity of Mount Goodenough and McDougall Pass. An unpublished report by Perry (1953) contains much information on the geology of the southern Richardson Mountains. The Canol reports, summarized by Hume (1954), contain information on the geology of Peel River and Lower Mackenzie River.

CLIMATE, VEGETATION, AND WILDLIFE

The climate of the northern Richardson Mountains and vicinity is featured by low temperatures and low precipitation. The annual average of daily mean temperature for Aklavik is 16° F. and the annual average total precipitation is approximately 9 inches. No glaciers occur in the Richardson Mountains and very little snow remains in June.

In the summer of 1955 fine weather prevailed during much of June and early July and temperatures of over 80° F. were not uncommon in the latter part of June. Low clouds limited helicopter work in the mountains for about one week in July, and during August, fog and low clouds, high winds, temperatures near freezing, and occasional light precipitation grounded the helicopters for about 50 per cent of the time.

Most of the area is covered by tundra vegetation comprising grasses, sedges, lichens, mosses, and dwarf birch and willow. Hillocks of sedge, in many cases surrounded by peat bog, make walking extremely difficult. Only the rocky, steep, and well-grained slopes are without the typical tundra cover.

Black and white spruce, birch, poplar, and willow are confined chiefly to valleys. At the eastern front of the Richardson Mountains on Stony Creek white spruce attains a height of 40 feet and a diameter of 10 inches at the butt. Trees are locally abundant in McDougall Pass and along Bell River south of latitude 68° N.

Game is abundant on the northwest side of the Richardson Mountains but is scarce in the centre of the range. Numerous moose were seen on Peel Plateau and near Rock River. Grizzly bear, fox, and a few small herds of Dall sheep were seen in the mountains. North and west of the headwaters of Bell River the country abounds with caribou, grizzly bear, wolves, and ground squirrels. Ptarmigan, ducks, and eagles are plentiful. Grayling, pike, and trout are found in many of the streams and lakes.

PHYSICAL FEATURES

The area covered in this report includes parts of five physiographic subdivisions (Bostock, 1948). To the east lies the Mackenzie Delta, a flat, featureless plain dotted with innumerable lakes and containing many meandering streams. West of Aklavik the Richardson Mountains rise abruptly from the Mackenzie Delta forming a remarkable scarp with a relief of over 2,000 feet. South of Aklavik the Peel Plateau lies between the mountains and the delta. The Arctic Plateau and the Porcupine Plain occupy the area north and west of the Richardson Mountains respectively.

The Peel River has cut a steep terrace-face along the eastern edge of the Peel Plateau. On the west side of the river and west of Fort McPherson the plateau rises to an elevation of over 1,200 feet in 3 miles. Between Rat River and Stony Creek this declivity is cut by numerous, deeply incised stream channels, but elsewhere the plateau rises gently to the Richardson Mountains.

The Richardson Mountains are a northerly trending, folded mountain range about 160 miles long, ranging in width from 15 miles south of Vittrekwa River to 50 miles west of Mount Goodenough. The topography is relatively mature; slopes are controlled chiefly by dips of strata and by joints roughly perpendicular to bedding. The mountains are most rugged in the vicinity of McDougall Pass and north to latitude 68° N. on the east side of Bell River. The maximum relief, just south of McDougall Pass, is about 4,000 feet. Many of the broad, open valleys are underlain by synclines of relatively soft rocks. Narrow, deep valleys that trend across the structure are V-shaped.

The Richardson Mountains rise abruptly from the Peel Plateau on the east, in part reflecting the steep bedding dips and in part reflecting the influence of faults.

The southern part of the Porcupine Plain, including the Eagle and Bell Plains, appears to be a structural basin underlain by gently dipping rocks.

DRAINAGE

The Richardson Mountains, for most of their length, form the divide between the drainage areas of Porcupine River and Peel River. Streams flow northerly from the northern part of the mountains directly to the Arctic Ocean. Stream directions in the mountains are largely controlled by structure but elsewhere a dendritic pattern prevails.

Lakes in the area are mostly the result of poor drainage due to permafrost conditions. Most lakes throughout the Old Crow Plain tend to have a rectangular outline and an overall rectangular pattern. They are bounded by nearly straight shorelines joined by gentle curves, and most trend northwest or northeast. The shores of the lakes observed in the region are almost entirely of vegetable material, easily shifted by ice, wind, or wave action. The northwest orientation of the shorelines coincides with one of the main wind directions.

GLACIATION

Evidence for glaciation was seen only on the east side of the Richardson Mountains. Boulders of granitic gneiss that could only have been derived from the Precambrian terrain to the east

are ubiquitous on Mount Goodenough to an elevation of about 3,000 feet.

A tongue of the ice sheet that covered most of Mount Goodenough possibly extended into McDougall Pass. This could account for the basins of the lakes in the pass. However, no evidence was obtained to support this hypothesis.

GENERAL GEOLOGY

Because of the limited and scattered nature of the geological information only an extremely generalized report can be made on the geology of the region. Correlation of map-units with rocks of known age are, in many cases, tentative.

Summary of Stratigraphy

The Richardson Mountains consist of folded, non-volcanic, sedimentary rocks ranging in age from Precambrian? (Perry, 1953) to Late Cretaceous. Intrusive and highly metamorphosed rocks are absent.

South of latitude 67°15' N. the Range is essentially a northerly plunging anticlinorium. From south to north the nose of this structure is occupied successively by Cambrian, Ordovician, Silurian, and Devonian strata. North of latitude 67°15' Upper Devonian beds plunge northerly under Pennsylvanian-Permian? and Cretaceous strata.

Near latitude 67°57' and longitude 136°35' strata of probable Cambro-Ordovician age are exposed in a dome. Similar rocks are exposed north of Rat Lake.

Carboniferous? rocks unconformably overlie a steeply dipping assemblage of low-grade metamorphic rocks west of Mount Fitton in the northwest part of the area and are in turn overlain unconformably by Upper Jurassic? and Cretaceous strata.

Mesozoic rocks, mainly Cretaceous, underlie much of the eastern and northeastern parts of the area.

Description of Map-Units

Metamorphic Rocks of Unknown Age (pre-Carboniferous?) (A).

An extensive area west of Mount Fitton is underlain by steeply dipping, black, red, and green argillite and slate, colourless to purplish quartzite, and glossy phyllite. Similar rocks are in fault contact with Mesozoic strata southeast of Bonny Lake.

The texture of the terrain that includes these rocks appears in the air photographs to be similar to that along the Yukon-Alaska boundary north of Firth River and believed by Maddren (1912, pp. 307-308) to be of pre-Ordovician? age. In both areas the metamorphic rocks are overlain by Carboniferous? limestones. West of Mount Fitton the contact between the metamorphic rocks and overlying carbonate rocks is a pronounced angular unconformity.

Southwest of Bonny Lake a conglomerate contains well-rounded to angular pebbles and cobbles of the metamorphic rocks. There Mesozoic strata are in fault contact with the metamorphic assemblage and the conglomerate is probably of Mesozoic age.

Cambrian? and ?Ordovician (1)

Light coloured rocks in the two areas north of McDougall Pass and east of Bell River contrast strikingly with the drab rocks generally characteristic of the Richardson Mountains. Mottled, blue and grey, steeply dipping limestone and associated strata 8 miles north-northeast of Rat Lake contain Cambrian fossils (J. Spivak, personal communication, 1956). L. D. Burling (Geological Survey of Canada) comments on these fossils as follows:

> Collection 10-M-27 has an undeterminable species each of Acrothele, Olenellus and Alokistocare. These make the fauna Lower Cambrian in age.
>
> Collection 10-M-29 has an undeterminable species of Acrothele, Scenella and Olenoides. These indicate that the fauna is definitely younger than that of 10-M-27 and that it could be Middle Cambrian.

In the dome 14 miles north-northwest of Summit Lake, where limestone, quartzite, and chert occur, no fossils were found and the rocks assigned tentatively to the Cambro-Ordovician solely on the basis of their lithological similarity, in part, to the rocks north of Rat Lake and south of Vittrekwa River (Perry, 1953).

Ordovician and Silurian (2)

Along Vittrekwa River thin-bedded, black and grey shale, and black siltstone and chert, correlative to Ordovician and Silurian strata in the southern Richardson Mountains (Perry, 1953) are well exposed on the nose and limbs of a major, northerly plunging anticline. The top of the group was not definitely determined but its thickness is probably in excess of 5,000 feet.

Devonian (3)

In the Vittrekwa River area the Ordovician and Silurian assemblage is overlain by rocks of probable Upper Devonian age (Imperial Formation in part). There, the Devonian strata, which include grit, sandstone, shale, and pebble conglomerate, have a distinctive mauve colour and the coarse members characteristically contain abundant angular to subangular fragments of black chert and siltstone presumably derived from the underlying Ordovician and Silurian map-unit.

The base of the Upper Devonian rocks on Vittrekwa River is possibly marked by a conglomerate, about 20 feet thick, containing cobbles of black chert, quartzite, and siltstone. The assemblage is highly contorted near faults.

Thin-bedded, steeply dipping rocks south of Summit Lake may be equivalent, in part, to the Upper Devonian beds exposed on Vittrekwa River. Judged from the width of exposures in the latter locality the group is probably over 5,000 feet thick and may exceed 7,000 feet in thickness.

Carboniferous? (4)

An extensive area in the northwest part of the area is underlain by thick-bedded, blue-grey limestone, cherty limestone, and minor chert. These rocks overlie map-unit 1 with pronounced angular unconformity and are in turn overlain unconformably by Mesozoic strata.

The limestone terrain is on trend with Carboniferous rocks of similar lithology exposed near the Alaska-Yukon boundary (Maddren, 1912, pp. 311-312). Poorly preserved, unidentifiable brachiopods, corals, and bryozoans were collected from beds near the base of the map-unit.

Ten miles southeast of Bonny Lake rocks of possible Carboniferous age are exposed in the core of an anticline. There, porous, brecciated, coarsely crystalline limestone, cherty limestone, chert, and dolomite containing crinoid stems are overlain by black argillite, slate, siltstone, and chert. Similar rocks have been described along Porcupine River (McConnell, 1888-89, p. 126D).

Pennsylvanian and ?Permian (5)

North of Vittrekwa River and near Rat Lake Pennsylvanian and ?Permian strata overlie older rocks with angular unconformity. The base of the map-unit north of Rat Lake is marked by red-weathering, pebble and cobble conglomerate and breccia at least 150 feet thick. The conglomerate and breccia

consist of subangular to extremely angular fragments of black and grey chert, grey siltstone, and quartzite in a red siltstone matrix. Blocky, grey, cliff-forming sandstone and argillaceous siltstone overlie the conglomerate.

Fossils, largely productid brachiopods, collected from argillaceous siltstone on the north side of Summit lake are believed by P. Harker of the Geological Survey of Canada (personal communication, 1955) to be Upper Pennsylvanian or Lower Permian in age. Whorl-shaped fucoid markings are prevalent in these rocks. In this locality the map-unit is at least 1,500 feet thick. The beds are probably correlative to those on the west side of the Richardson Mountains and described by Perry (1953).

Pennsylvanian to Cretaceous (6)

Much of the report-area is underlain by cliff-forming, blocky, grey, brown, and rusty sandstone and siltstone, and grey and black shale which probably range in age from Pennsylvanian to Cretaceous. In the time available it was impossible to differentiate between late Palaeozoic and Mesozoic rocks on the basis of lithology.

Upper Jurassic? and Lower Cretaceous (7)

Fossiliferous Upper Jurassic? and Lower Cretaceous rocks are exposed in the vicinity of Bonny Lake and probably underlie much of the region to the north and south of this area. At the south end of Bonny Lake probable Upper Jurassic fossils occur in black shale and argillite which contains fossiliferous concretions. West of the lake, flaggy, buff sandstone that overlies the black shale and argillite contains early Lower Cretaceous fossils. Similar rocks were examined in the mountains south of Bonny Lake where the sandstone is locally glauconitic.

A thick, Mesozoic? conglomerate southeast of Bonny Lake consists of subangular to well-rounded pebbles and cobbles of red, green, and black argillite, black and grey chert, and grey siltstone in a rusty, sandy matrix. Many of the pebbles and cobbles have been derived from underlying rocks of map-unit 1.

North of Bonny Lake many streams are incised in black shales, argillites, and slates of similar aspect to the Upper Jurassic? rocks described above. Correlative rocks may also be exposed along the Porcupine River in the vicinity of Driftwood River (McConnell, 1888-89, pp. 125D-127D).

Dr. Frebold of the Geological Survey of Canada reports on the fossil collections as follows:

Field No. G.-F 27/8/55 (G.S.C. No. 26576) South end of Bonny Lake.

This collection contains Aucella cf. bronni Lah. (poorly preserved), and, according to Jeletzky Lima sp. indet., Arctica ? sp. indet., Solecurtus ? sp. indet., pelecypod (genus and species indet.), and a gastropod (Bulla ? sp. indet.).

Age: Probably Upper Jurassic.

Field No. G.-F 14/8/55. (G.S.C. No. 26578): 4 miles southwest of Bonny Lake.

This collection contains undeterminable belemnoids and a questionable Inoceramus.

Age: Uncertain, possibly Upper Jurassic.

Field No. G.-F 14/8/55-2. (G.S.C. No. 26580) 2 1/2 miles south-southwest of Bonny Lake.

This collection contains a poorly preserved imprint of an Aucella which may be compared with A. bronni Lah.

Age: ? Upper Jurassic.

Field No. G.-F 14/8/55/3. (G.S.C. No. 26569) 2 1/2 miles south of Bonny Lake.

This collection contains, according to Jeletzky, an ophinroid (brittle star), (genus and species indet.), Aucella ? sp. indet., and other pelecypods, (genus and species indet.).

Age: Uncertain (Upper Jurassic or Lower Cretaceous ?)

Field No. G.-F 9/8/55 (G.S.C. No. 26574) Ridge on west side of Bonny Lake.

This collection contains, according to Jeletzky, Aucella ex aff. crassa Pavlow, A. ex. aff. lahuseni Pavlow, A. sp. indet., Astarte ? sp. indet., pelecypod, (genus and species indet.).

Age: Early Lower Cretaceous.

Cretaceous (8)

Cretaceous strata underlie much of the northern and eastern parts of the area. Uppermost Jurassic rocks have been mapped by Jeletzky (personal communication, 1955) near Mount Goodenough and as the boundary between Jurassic and Cretaceous rocks was not determined map-unit 8 may contain some Jurassic rocks. The Peel Plateau is underlain by friable, buff and grey sandstone, well indurated flaggy sandstone, and soft,

grey shale and siltstone. The argillaceous rocks commonly have a white coating of alum and locally contain abundant concretions.

An excellent Cretaceous section is exposed in a stream valley on the south side of Mount Goodenough. There, about 1,000 feet of gently dipping buff and grey, flaggy, well indurated sandstone and siltstone overlies over 500 feet of black and grey shale and siltstone.

In the northwest part of the area Cretaceous rocks have been preserved in a syncline. Poorly preserved ammonites were noted in friable, flaggy, greenish buff sandstone near the south end of the structure.

Variation in degree of induration of the Cretaceous arenaceous rocks is marked; in general those with an argillaceous matrix are friable whereas those with a siliceous cement are well indurated.

Dr. Frebold, Geological Survey of Canada, comments on the fossil collections as follows:

Field No. G.-F 2/8/55 (G.S.C. No. 26572) Lat. 68°23' N., Long. 135°37' W. - triangulation station.

This collection contains, according to Jeletzky, Aucella cf. volgensis Lah., A. cf. terebratuloides Lah., A. cf. keyserlingi d'Orb., undeterminable pelecypods, and fossil wood.

Age: Early Lower Cretaceous.

Field No. G.-F 21/7/55 (G.S.C. No. 26573) Lat. 67°51' N., Long. 135°35' W. - triangulation station.

This collection contains, according to Jeletzky, Pecten (Entolium) sp. indet. A, P. (Entolium) sp. indet. B, Arctica ? sp. indet., Astarte ? sp. indet., and other pelecypods, (genus and species indet.).

Age: Unknown.

Field No. G.-F 9/7/55 (G.S.C. No. 26575) Stony Creek.

This collection contains, according to Jeletzky, Aucellina sp. indet. (? nov. sp.), Aucellina ? sp. indet., Pecten (Entolium) sp. indet. B, Arctica ? sp. indet., Tancredia ? sp. indet., Nucula sp. indet., Anomia sp. indet., pelecypod, (genus and species indet.).

Age: Late Lower or ? earliest Upper Cretaceous.

STRUCTURE

The major structural elements of the Richardson Mountains, largely interpreted from air photographs, are shown on the accompanying map. Symmetrical, northerly trending folds, generally with gently plunging axes dominate the structure. The major anticline in the southern part of the Mountains has been described. Locally, north of the confluence of Bell and Porcupine Rivers northwest of the mouth of Waters River, and near McDougall Pass, strata trend northeasterly. In the northwest part of the area axes of folds trend northwest and farther west, near the Yukon-Alaska boundary, the direction is almost east-west.

Faults are conspicuous along the eastern front of the Richardson Mountains. The faults are steeply dipping and are roughly parallel to the regional trend. The remarkable scarp on the west side of the Mackenzie Delta, in the vicinity of Mount Goodenough, and the abrupt slope on the east side of the Peel Plateau between Rat River and Stony Creek are probably the result of faults.

ECONOMIC GEOLOGY

Most of the Richardson Mountains region appears to be unfavourable for the occurrence of metalliferous deposits. Barren quartz veins in siliceous sedimentary rocks are not uncommon in some areas but they are generally related to zones of contortion or dislocation and the quartz has probably been derived from the country rocks.

Wolframite, pyrite, arsenopyrite, and molybdenite have been found in rocks of map-unit 1 near latitude 68°33' N. and longitude 138° W. (personal communication, A. Hoidahl to H.S. Bostock, 1952). Placer gold also occurs in this area. Specimens collected by Hoidahl include granitic rocks but these were not noted in the field by the writer. Presumably the granitic rocks do not underlie an extensive area. The restricted areas underlain by the metamorphic rocks of map-unit 1 merit further prospecting.

Coal has been reported from near latitude 68°38' N. and longitude 138°37' W. (personal communication, A. Hoidahl to H.S. Bostock, 1952). The area is probably underlain by Cretaceous rocks.

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