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DEPARTMENT OF MINES
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PAPER 61-12

BANKS, VICTORIA, AND STEFANSSON ISLANDS, DISTRICT OF FRANKLIN, NORTHWEST TERRITORIES

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R. Thorsteinsson and E. T. Tozer

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CONTENTS

BANKS, VICTORIA, AND STEFANSSON ISLANDS, DISTRICT OF FRANKLIN, NORTHWEST TERRITORIES

INTRODUCTION

These notes and the enclosed map present preliminary results of a geological reconnaissance survey conducted between late June and mid-September, 1959. Two Piper Super Cub aircraft, specially equipped with large low-pressure tires and capable of landing on unprepared terrain, were used for transportation in the field; aircraft and pilots were supplied by Bradley Air Services, Ltd. The field party consisted of R.L. Christie, J.G. Fyles, and the authors, all of the Geological Survey.

Banks, Victoria, and Stefansson Islands comprise areas of about 27,000, 84,000, and 1,800 square miles respectively. Banks and Victoria Islands, situated directly north of the mainland, are the southwesternmost islands of the Arctic Archipelago. Stefansson Island lies immediately north of the prominent unnamed peninsula of northeastern Victoria Island.

The first systematic geological work on these islands was by A.L. Washburn (1947)[1]. His account contains a comprehensive summary of all previous geological information. T.H. Manning's (1953, 1956) reports on Banks Island contain many topographical and geological notes, including numerous illustrations of rock outcrops.

ACCESSIBILITY

Stefansson Island is uninhabited. The only settlement on Banks Island is Sachs Harbour, near the southwestern extremity of the island; it is the site of a Department of Transport weather station and an RCMP detachment. Settlements on the southwestern coast of Victoria Island include Holman Island—a Hudson's Bay Post and Roman Catholic mission—near the north entrance to Prince Albert Sound, and Read Island—another Hudson's Bay Post—off the south coast of Wollaston Peninsula. The following six DEW Line sites, along the south coast of Victoria Island, provide the only landing strips in the map-area.

Lady Franklin Point
Ross Point
Byron Bay
Cape Peel
Cambridge Bay
Sturt Point

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[1] Dates in parentheses refer to publications listed in the References.

Cambridge Bay is the largest settlement in the map-area. Besides constituting one of the main DEW Line sites, it has a Hudson's Bay Post, a Department of Transport weather station, an RCMP detachment, an Anglican mission, and a resident Northern Service Officer of the Department of Northern Affairs and National Resources. The south coasts of Banks and Victoria Islands may be reached by ship between August and October, and the settlements there are supplied largely by sea transport. The town of Yellowknife is the most convenient point from which to obtain access to the area by air.

GEOLOGY

Rocks of Precambrian, Palaeozoic, Mesozoic, and Cenozoic age are represented in the map-area. The preponderance of rocks, both in thickness and areal distribution, are of sedimentary origin, but metamorphic, intrusive, and extrusive rocks are also represented. The layered rocks of the map-area may be grouped into five distinct concordant successions separated from one another by major unconformities. The following is a brief description of these successions, outlining their salient characteristics and those of the intrusive rocks. Further information on the regional structural features of the islands is contained in another paper (Thorsteinsson and Tozer, 1960).

1. A formation of metasediments (map-unit 1) that consists chiefly of quartzites represents the oldest rocks in the map-area. This formation is of Precambrian age. It outcrops over a limited area on the west side of Hadley Bay in northeastern Victoria Island. The thickness of this formation is uncertain, but it is probably several hundred feet. Its regional strike is northeasterly; the dip is northwesterly.

Map-unit 1 is intruded by a small body of granodiorite (map-unit 2) exposed over about 2 1/2 square miles on the west side of Hadley Bay, and on a nearby small, unnamed island.

2. A concordant sequence of six Precambrian formations, hitherto undescribed, rests with angular unconformity on map-units 1 and 2. The five oldest formations—here named the Shaler group—together with their predominant lithology and thickness, are, in ascending order: The Glenelg, varicoloured clastic and carbonate sediments, 3,500 feet; the Reynolds Point, limestone and minor sandstone, 2,300 feet; the Minto Inlet, gypsum and anhydrite, 300 to 1,200 feet; the Wynniatt, grey limestone, 2,700 feet; and the Kilian, varicoloured clastic and carbonate sediments, anhydrite and gypsum, 1,600 feet. The relatively uniform nature of the clastic and carbonate rocks, their well-bedded character, their striking resemblance to marine lithic equivalents of Palaeozoic age, and the inclusion of evaporites—all of these are characters suggesting that the Shaler group was probably deposited mainly under marine conditions.

The Natkusiak formation, which overlies the Shaler group through a disconformity, consists of basalt flows and pyroclastic sediments. This volcanic formation, at least 1,000 feet thick, constitutes the youngest layered Precambrian formation in the map-area.

Rocks of the Shaler group and the Natkusiak formation are intruded extensively by gabbro dykes and sills. The sills and dykes do not intrude Palaeozoic rocks, and are therefore regarded as the youngest of the Precambrian rocks. The more prominent dykes (map-unit 9), but not the sills, have been mapped separately.

The principal exposures of the Shaler group form the Shaler Mountains—a belt of rugged terrain that extends northeasterly across Victoria Island from Amundsen Gulf to Hadley Bay. Rocks correlated with the Glenelg formation, on the basis of lithologic similarity, occur outside of the Shaler Mountains in widely separated parts of the map-area; these include a narrow belt of outcrops exposed in the spectacular sea-cliffs that form the southern extremity of Banks Island, small inliers located inland in southern Banks Island, and several isolated and irregular outcrop areas in southern Victoria Island. The most significant of the latter include the Richardson Islands and neighboring regions of Victoria Island proper, and a narrow belt of outcrops extending from Wellington Bay northerly into the interior of Victoria Island.

3. An apparently concordant succession of Cambrian (?), Ordovician, Silurian, and Devonian rocks lies with angular unconformity on rocks of Precambrian age. Although many individual outcrops of the Palaeozoic rocks appear to be flat-lying, regionally they constitute homoclinal sequences that slope gently away from the prominent belt of Precambrian rocks forming the Shaler Mountains. There are thus three broadly defined homoclinal sequences of Palaeozoic rocks: the Prince Albert homocline of northwesterly dipping Cambrian (?), Ordovician, Silurian, and Devonian rocks, occupying northwestern Victoria Island and northeastern Banks Island; the northerly dipping Ordovician and Silurian rocks that occupy all of Stefansson Island; and the easterly and southeasterly dipping Cambrian (?), Ordovician, and Silurian rocks that occupy much of that part of Victoria Island that lies southeast of the Shaler Mountains.

The oldest Palaeozoic formation is map-unit 10A. It is sporadically developed and is composed principally of sandstone, shale, siltstone, and dolomite. This formation appears to occupy topographic lows on the Precambrian floor. It is provisionally dated as Upper Cambrian on the basis of inarticulate brachiopods. The thickness of map-unit 10A varies from zero to about 360 feet. The best exposures occur in the south coastal region of Victoria Island, and only there has this formation been mapped separately. Elsewhere outcrops of map-unit 10A are mapped together with map-unit 10B.

Map-unit 10B is composed mainly of dolomite. In some areas it rests with gradational contact on map-unit 10A; elsewhere it lies unconformably on Precambrian rocks. Map-unit 10B outcrops over about three-quarters of the areas on Victoria and Stefansson Islands. The map-unit ranges in age from Middle Ordovician to Middle Silurian, and is therefore correlative with the widely distributed Cornwallis and Allen Bay formations of the Arctic Archipelago (see Thorsteinsson, 1959). Possibly map-unit 10B includes beds as old as Upper Cambrian or Lower Ordovician, i.e. beds older than the Cornwallis formation. The maximum thickness of the map-unit is believed to be 3,000 feet.

The Read Bay group conformably overlies map-unit 10B. Good exposures of this group are found on the north coast of Stefansson Island where three formations have been outlined: a lower limestone and dolomite formation that bears the characteristic Atrypella fauna; a middle graptolitic shale that is lower Ludlovian (Upper Silurian) in age; and an upper dolomite formation that has not yielded fossils. The aggregate thickness of the Read Bay group on Stefansson Island is about 675 feet. This group is present also on Prince Albert Peninsula of northwestern Victoria Island, but there it is mostly covered by Pleistocene deposits. The Read Bay group of this map-area yielded only Upper Silurian fossils. However, as the typical rocks of the Read Bay formation on Cornwallis Island (see Thorsteinsson, 1959) range as low as the Middle Silurian it seems likely that the Read Bay group of this area may also include rocks of this age. The upper contact of the Read Bay group is not exposed. The next younger rocks are Middle Devonian. The contact between Silurian and Devonian rocks has not been seen and is probably not exposed.

The lower part of the Middle Devonian sequence is referred to the Blue Fiord formation (see McLaren, 1959). Exposures of this formation are confined to the northwestern coast of the Prince Albert Peninsula and the Princess Royal Islands. The base of the formation is apparently covered beneath the thick Pleistocene deposits of Prince Albert Peninsula, and the top is apparently hidden beneath the waters of Prince of Wales Strait. The Blue Fiord formation is formed mainly of limestone with some dolomite and shale. It is moderately rich in fossils. Accurate data on the thickness of Blue Fiord beds is not available; nevertheless, the formation appears to be several hundred feet thick. It is possible that one or more formations lie stratigraphically between the Read Bay group and the Blue Fiord formation on Prince Albert Peninsula, but are hidden beneath the thick Pleistocene deposits of this region.

The Melville Island formation constitutes the youngest Palaeozoic rocks exposed in the map-area. This formation outcrops over a large, roughly-rectangular-shaped area in northeastern Banks Island. The maximum exposed thickness of the Melville Island formation in this region is roughly estimated at 3,000 feet. Several smaller outcrop areas of Melville Island beds occur on Banks Island; some are south of the principal exposures in the eastern coastal region, others are near the northern extremity of the island. The Melville Island formation is composed mainly of sandstone with lesser siltstone and shale. These beds lack marine fossils and may be non-marine. Lesser constituents include marine quartzose clastic rocks and limestone. Thin coal seams occur near Cape Vesey Hamilton (see Manning, 1956, p. 43). The limestone occurs as biostromes and bioherms (up to 200 feet thick) in the upper part of the formation, and forms striking features in the landscape south of Mercy Bay. Upper Devonian fossils were collected from the reefs and from sandstone beds adjacent to the reefs. Poorly preserved fossils, possibly of Middle Devonian age, were collected from stratigraphically lower beds.

Typical rocks of this formation on Melville Island (see Tozer, 1956) contain Middle Devonian as well as Upper Devonian fossils, and it is probable that Middle Devonian beds are present in the Melville Island formation on Banks Island.

4. A concordant sequence of three formations, ranging in age from lower Cretaceous to early Tertiary, occupies a large area of Banks Island and rests with transgressive unconformity on Precambrian and Palaeozoic rocks. Although largely obscured by late Tertiary and Pleistocene deposits, the Lower Cretaceous and early Tertiary sediments appear to form a broad basin—the Banks Island Basin—(see Thorsteinsson and Tozer, 1960), whose axis strikes and plunges northwesterly through about the geographic centre of Banks Island.

The oldest formation is the Lower Cretaceous Isachsen formation (see Heywood, 1957; Tozer, 1960). The thickness of this formation ranges from about 0 to 300 feet. The Isachsen consists mainly of non-marine, weakly consolidated to unconsolidated sandstone, conglomeratic sandstone, and minor coal seams. The formation has not yielded diagnostic fossils. The identification of this formation is based on its stratigraphic position below the Christopher formation and its lithologic similarity to the Isachsen formation as developed north of Parry Channel.

The Christopher formation (see Heywood, 1957; Tozer, 1960) rests with gradational contact on Isachsen beds throughout most of the area. In the vicinity of Cape Crozier, near the northern extremity of Banks Island, Isachsen beds are apparently absent and the Christopher appears to rest directly on Devonian rocks. The Christopher formation consists of dark marine shale and minor sandstone. Large septarian nodules up to 12 feet in diameter and small 'hedgehog' concretions of calcite also characterize this formation. The thickness of the Christopher is estimated to vary between 1,000 and 1,200 feet. Albian (late Lower Cretaceous) ammonoids have been collected from the Christopher formation on Banks Island.

A sequence of beds that consist mainly of non-marine sediments rests with apparently conformable, yet abrupt contact on the Christopher formation. These beds are tentatively assigned to the Eureka Sound formation (see Troelsen, 1950) on the basis of stratigraphic and lithologic correlation. Three members are recognized in the Eureka Sound formation on Banks Island. The basal member — about 25 feet thick — consists mainly of sandstone, coal, and carbonaceous shale; locally the coal has been burnt to red cinders. The middle member—about 500 feet thick—is formed of grey shale, siltstone, and fine-grained sandstone; it lacks carbonaceous material and may be, in part at least, of marine origin. The upper member—about 1,500 feet thick—comprises mainly sand, shale, coal seams up to 10 feet thick, and carbonaceous shale.

The relationship between the beds here referred to the Eureka Sound formation, and the underlying Christopher strata, presents unsolved problems. In the Sverdrup Basin of Queen Elizabeth Islands, two formations—the non-marine Hassel and the overlying Upper Cretaceous marine shales of the Kanguk—lie stratigraphically and conformably between the Christopher and the Eureka Sound formations (see Tozer, 1960). Outside of the Sverdrup Basin, in other parts of the Queen Elizabeth Islands, the Eureka Sound is transgressive and rests directly on various older systems (see Thorsteinsson and Tozer, 1957). The absence of the Hassel and Kanguk formations on Banks Island may be due to disconformity at the base of the Eureka Sound formation, although this is not apparent. Alternatively, equivalent beds of the Hassel and Kanguk formations may be represented in beds (lower and middle members respectively) here mapped as the Eureka Sound formation. If this is the case then only the upper member of beds assigned to the Eureka Sound formation on Banks Island is correlative with typical beds of this formation. The age of the Eureka Sound formation as established in other parts of the Arctic Archipelago is early Tertiary, and the formation possibly includes beds of late Upper Cretaceous age.

5. The Beaufort formation outcrops in western parts of Banks Island where it rests with transgressive unconformity on older formations. This formation is represented mainly by discontinuous exposures that are generally overlain unconformably by younger Pleistocene and recent surficial deposits. Continuous and readily mapped exposures of Beaufort beds are limited to the northwest corner of Banks Island, and only there has this formation been mapped separately. Regionally, the Beaufort beds seem to dip towards the west and northwest.

The Beaufort formation is composed of gravel and sand, with minor silt and peat. Unaltered logs and fragmented wood are conspicuous constituents in the gravel and sand. The maximum exposed thickness of this formation on Banks Island is at least 400 feet. On the basis of microfloras, Beaufort beds are dated as ranging from late Tertiary to early Pleistocene.

The type section of the Beaufort is on Prince Patrick Island where it was first described by Tozer (1956). The formation is known to form a belt of sediments fringing the northwestern islands of the Arctic Archipelago (see Thorsteinsson, 1961).

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