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CANADIAN GEOSCIENCE MAP 171

PHANEROZOIC GEOLOGY

NORTHWESTERN VICTORIA ISLAND

Northwest Territories

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Cover Illustration

Looking west from outcrop of Victoria Island formation towards resistant outcrops of Neoproterozoic Shaler Supergroup in the distance. Near the head of Minto Inlet, Victoria Island. Photograph by B. Pratt. 2013-308

ABSTRACT

Victoria Island is in the western Canadian Arctic Islands, Northwest Territories, Canada (parts of NTS 87-G, 87-H, 88-A, and 88-B). The bedrock consists of Cambrian to Devonian sedimentary rocks (sandstone, limestone and dolostone) that unconformably overlie Neoproterozoic rocks. Eight map units are recognized and mapped. Strata are generally flat lying or have a very gentle northwest dip. Numerous ENE-WSW oriented normal faults offset lower Paleozoic strata and locally increase the dip. At least some of these faults were active in the Early Cambrian and again in the Middle Cambrian. The faults cut a Devonian unit indicating fault movement after that time. An anomalous circular structure in the northeastern part of the map area, approximately 25 km in diameter, contains steep dips, faulting and numerous shatter cones. It is interpreted as the root of a meteorite impact crater.

RÉSUMÉ

L'île Victoria se situe dans l'ouest de l'archipel Arctique canadien, dans le Territoires de Nord-Ouest (SNRC, parties de 87-G, 87-H, 88-A et 88-B). Le socle se compose de roches sédimentaires (grès, calcaire et dolomite) du Cambrien au Dévonien, qui reposent en discordance sur des roches du Néoprotérozoïque. Huit unités géologiques ont été définies et cartographiées. Les strates sont généralement disposées à l'horizontale ou plongent très faiblement vers le nord-ouest. De nombreuses failles d'orientation est-nord-est – ouest-sud-ouest décalent les strates du Paléozoïque inferieur et accroissent par endroits leur pendage. Un certain nombre de ces failles ont été actives au Cambrien précoce et a nouveau au Cambrien moyen. Les failles recoupent une unité du Dévonien, ce qui témoigne de leur mouvement postérieur à ce moment. Une structure circulaire de caractère anormal dans la partie nord-ouest de la région cartographique, d'un diamètre d'environ 25 km, comprend des unités fortement inclinées, de la fracturation et de nombreux cônes de fracturation. Selon les interprétations, il s'agirait de la racine d'un cratère d'impact météoritique.

ABOUT THE MAP

General Information

Authors: K. Dewing, T. Hadlari, R.H. Rainbird, J.H. Bédard

Geology by K. Dewing and T. Hadlari, based on ground and air observations 2009–2011, compilation of spectral imagery datasets 2010–2012, and compilation of Rainbird et al. (2013, 2014) maps. Also based in part on previous fieldwork reported by Ehman D. A. and Wise J. C. 1971; Fritz, W.H. 1967, 1971; PetroCanada Exploration Inc. 1978; Plauchut, B. and Jutard, G. 1967.

Geological complilation by K. Dewing and T. Hadlari, 2010–2013

Geology conforms to Bedrock Data Model v.3.1

Geomatics by C. Deblonde

Cartography by J. Gardner and M.Le

Initiative of the Geological Survey of Canada, conducted under the auspices of the Western Arctic Islands Project as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) program.

Logistical support provided by the Polar Continental Shelf Project as part of its mandate to promote scientific research in the Canadian North. PCSP 010-10 (2010) and 018-11 (2011).

Map projection Universal Transverse Mercator, zone 11.
North American Datum 1983

Base map at the scale of 1:250 000 from Natural Resources Canada, with modifications.

Elevations in metres above mean sea level.

Some geographic names on this map are not official.

All geological field data were collected in UTM zone 11.

Proximity to the North Magnetic Pole causes the magnetic compass to be erratic in this area.

The Geological Survey of Canada welcomes corrections or additional information from users.

Data may include additional observations not portayed on this map. *See* documentation accompanying the digital data.

This publication, including digital data, is available for free download through GEOSCAN (http://geoscan.nrcan.gc.ca/).

This map is not to be used for navigational purposes.

Preliminary publications in this series have not been scientifically edited.

Map Viewing Files

The published map is distributed as a Portable Document File (PDF), and may contain a subset of the overall geological data for legibility reasons at the publication scale.

ABOUT THE GEOLOGY

Descriptive Notes

Victoria Island is located in the western Canadian Arctic Islands. Despite being the ninth largest island in the world, slightly smaller than Great Britain, Victoria Island has received scant attention from geologists due to its remoteness, coupled with poor outcrop and the lack of economic potential. The objective of this project is to determine the thickness and ages of the lower Paleozoic stratigraphic units, and to map their distribution.

Compilation Methods

Lower Paleozoic strata from northwestern Victoria Island were originally described by Thorsteinsson and Tozer (1962). The only other stratigraphic information comes from industry reports submitted to the National Energy Board or the Northwest Territories Geoscience office. One hydrocarbon exploration well has been drilled on Victoria Island. The Victoria F-36 well was drilled on northwestern most Victoria Island to a depth of 2457 m. The well history report (Batten, 1975) provides sample descriptions

and wireline logs. One mining exploration core penetrates the lower Paleozoic succession (Morgan, 2007). Data from the maps of Rainbird et al. (2013a,b) were used to constrain the extent of Paleozoic strata.

This map is based on thirteen weeks of field work over three field seasons in 2009-2011. Outcrop on Victoria Island is generally poor and confined to the coast, along rivers, and isolated outcrops. Drift cover is extensive hence contacts are generally inferred.

General Geology

There are two physiographic regions on Victoria Island. The Shaler Mountains run diagonally across the island and are underlain by Neoproterozoic sedimentary and igneous rocks of the Shaler Supergroup. To the northwest and southeast of the Shaler Mountains are lowlands underlain by very gently dipping lower Paleozoic sedimentary rocks and covered by an extensive blanket of Quaternary sediments.

Lower Paleozoic strata are part of the Arctic Platform. The Arctic Platform covered most of the Arctic Islands from the Early Cambrian to Early Devonian and reflects sedimentation on the northern passive margin of ancestral North America (Laurentia).

Stratigraphy

Lower Paleozoic strata unconformably overlie Neoproterozoic strata. The lowest Paleozoic unit (Cambrian / Quyuk formation– $\in_{Q}$) consists of fine to coarse grained quartz arenite and minor mudstone. Sedimentary structures include laminations, wave and current ripples, and 10 cm to 2 m thick cross-stratified beds with *Skolithos* burrows. Mudstones contain Early Cambrian trilobites. Distribution and thickness are variable; thickness ranges from 0 m to 90 m.

The Quyuk formation is overlain by Uvayualuk formation (unit $\in_{U}$), which consists of tan dolomudstone to dolarenite that is frequently mottled or bioturbated. Thrombolite mounds are locally well developed and together with metre-scale cross-stratification suggest a shallow marine setting. Locally present at the base is a grey mudstone unit 3 to 5 m thick with a gradational contact to the dolostone. Early Cambrian trilobites were recovered from the lower mudstone beds. Thickness is 30–45 m.

Overlying the Uvayualuk formation is a 15–95 m thick unit with a distinctive stripy appearance (Mount Phayre formation– $\in_{MP}$). It consists of thin- to medium-bedded red mudstone and siltstone interbedded with green dolomudstone. Sedimentary structures include mudcracks, wave ripples, small stromatolites, micro-karsted exposure surfaces, and microbial lamination. Mudstones contain early Middle Cambrian trilobites near the base.

The most extensively exposed unit is the Cambro-Ordovician Victoria Island formation (unit $\in O_{VI}$). It consists of dolostone that is light grey to almost white weathering. The dolomite is fine- to coarsely-crystalline and mainly fabric destructive, but locally preserved primary structures include cross-bedded oolitic grainstone, thrombolite and

stromatolite bioherms, microbial lamination, and intraformational conglomerate. Fossils rare but include silicified gastropods. Silicification widespread in the upper two-thirds of the unit. Chert occurs as prominent white-weathering beds and nodules, or as silicified stromatolites. The lower contact is gradational with the Mount Phayre formation with the contact placed at the highest shale interbed. The upper contact is sharp and inferred to be unconformable. Early Ordovician conodonts occur in samples directly below the upper contact. Thickness is 550 m on the south shore of Minto Inlet.

Poorly exposed carbonate strata of probable Ordovician-Silurian age, are tentatively assigned to the Thumb Mountain, Allen Bay, Cape Storm and Douro formations (unit OS_{TMD}). Lack of outcrop makes mapping the contacts between these units difficult in most areas, and they are included in a single map unit. Thumb Mountain Formation consists of fossiliferous, nodular to thinly bedded dolomudstone, dolowackestone and dolopackstone. Fossils include crinoids, solitary rugose and colonial tabulate corals, aulocerids, gastropods, and cephalopods. These fossils and conodonts indicate an Upper Ordovician age. The Allen Bay Formation consists of thick bedded, fine to medium crystalline dolomudstone with burrow mottles. Large bioherms consisting of vuggy dolomudstone and rare stromatolites are locally present. Wireline logs indicate this map unit is 650 m on NW Victoria Island.

A Silurian shale unit (S_S) is inferred from well logs and topographic expression, but it has not been found in outcrop. Cuttings descriptions of the shale describe its as dark brown, calcareous and bituminous, interbedded with lime mudstone to wackestone.

The highlands in the northwest part of the map area are underlain by undivided Silurian Barlow Inlet and Devonian Blue Fiord formations (unit SD_{BBF}). Barlow Inlet Formation is dolostone whereas the Blue Fiord Formation is limestone with abundant brachiopods, corals and crinoids. The Blue Fiord Formation is overlain by Devonian Kitson Formation (unit D_K), consisting of dark grey shale and argillaceous limestone.

Structures

Phanerozoic strata are generally flat lying or have a very gentle northwest dip. Mapping and aeromagnetic data indicate that widespread ENE-WSW oriented normal faults offset lower Paleozoic strata. At least some of these faults were active in the Early Cambrian and again in the Middle Cambrian as shown by thickness changes in Quyuk formation and Mount Phayre formaton. The faults cut the Devonian Kitson Formation indicating principle movement after that time. The aeromagnetic signature of NW-trending Neoproterozoic dykes are not offset across the NE-trending faults, indicating minimal strike-slip motion. Vertical to steeply oblique slicken lines observed at a single outcrop indicate dip-slip motion of the ENE-WSW trending faults. NW-trending strike-slip faults, exhibiting near horizontal slicken lines at a single outcrop, connect the ENE-trending normal faults.

Mapping on northwestern Victoria Island revealed an anomalous structural entity in otherwise flat-lying lower Paleozoic carbonate rocks, south of Richard Collinson Inlet. The feature is roughly circular in plan view, approximately 25 km in diameter, and characterized by outward dips of ~45° in the centre, decreasing laterally. The core of

the feature also exhibits local vertical dips, thrust faults, and drag folds. Shatter cones are pervasive in all lithologies in the central area, including Neoproterozoic gabbro and limestone. Their abundance drops off laterally, and none was observed in surrounding, horizontally bedded strata. This structural anomaly is interpreted as the root of a meteorite impact crater, and the dipping strata the remnants of the central peak uplift (Dewing et al., 2013). Timing of impact is unknown, but it took place after regional, hydrothermal dolomitization of the Upper Ordovician carbonates and substantial burial, thus possibly in Devonian time or later.

Acknowledgments

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Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 11
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 120°00’00” W
Eastern longitude: 112°00’00” W
Northern latitude: 73°00’00” N
Southern latitude: 71°00’00” N

Data Model Information

Surface bedrock data are organized into feature classes and themes consistent with logical groupings of geological features. All field observation point data are related through the Station_ID property of the Station theme. These feature attribute names and definitions are identical in the shapefiles and the XML files.

Consult PDFs in Data folder for complete description of the feature classes, feature attributes, and attribute domains.

The Bedrock Data Model and the Bedrock Domains documents are intended to describe all bedrock features which may be compiled at the 1:50 000 scale. Therefore, some of the feature classes and feature attributes described in these documents may not be present.

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