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CANADIAN GEOSCIENCE MAP 236

BEDROCK GEOLOGY

BARROW RIVER

Melville Peninsula, Nunavut
NTS 46-O and 46-P

Map Information Document

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ABSTRACT

The Barrow River bedrock geology map is the product of targeted mapping carried out during the summer of 2010, enhanced by radiometric age-dating as well as high-resolution aeromagnetic and radiometric surveys completed over previously published geological maps of the Paleoproterozoic Penrhyn Group and its Archean basement in southeastern Melville Peninsula, Nunavut. The high-resolution aeromagnetic survey was utilized to project lithological boundaries beneath Quaternary cover. The map shows complex basement-cover relationships characterized by multiple generations of thrusting and folding in a thick-skinned tectonic regime, followed by dextral transpression along the southern edge of the Penrhyn Group. A late-Archean tectonometamorphic event is recorded by ca. 2.55 Ga monazite in basement gneiss. Onset of rifting prior to deposition of the Penrhyn Group may be indicated by the emplacement of a bimodal suite of granite and leucogabbro-anorthosite at ca. 2.02 Ga. Penrhyn Group units are tentatively correlated with the Piling Group on Baffin Island.

RÉSUMÉ

Cette carte de la géologie du substratum rocheux de la région cartographique de Barrow River repose sur des travaux de terrain ciblés réalisés à l'été 2010, qui sont enrichis par des datations radiométriques ainsi que par des levés aéromagnétiques et radiométriques haute résolution ayant couvert l'étendue du Groupe de Penrhyn d'âge paléo-protérozoïque, telle que délimitée dans des cartes géologiques précédemment publiées, et de son socle archéen, dans le sud-est de la presqu'île Melville (Nunavut). Le levé aéromagnétique haute résolution a servi à extrapoler les contacts lithologiques sous la couverture quaternaire. La carte montre des relations socle-couverture complexes caractérisées par plusieurs générations de chevauchement et de plissement produites dans un régime tectonique de socle, qui a été suivi par une transpression dextre le long de la bordure sud du Groupe de Penrhyn. Un événement tectono-métamorphique tardi-archéen est daté à environ 2,55 Ma d'après les monazites contenues dans des gneiss du socle. Le début du rifting antérieur au dépôt du Groupe de Penrhyn peut être déduit de la mise en place d'une suite bimodale de granite et de leucogabbro-anorthosite à environ 2,02 Ga. Les unités du Groupe de Penrhyn sont corrélées provisoirement avec celles du Groupe de Piling dans l'île de Baffin.

SHEET 1 OF 1, BEDROCK GEOLOGY

GENERAL INFORMATION

Authors: D. Corrigan, L. Nadeau, P. Brouillette, N. Wodicka, R.G. Berman, and M.G. Houlé

Geology by D. Corrigan, L. Nadeau, P. Brouillette, S. Erdman, and R.G. Berman, 2009 and 2010

Geological interpretations and notes by D. Corrigan, 2014

Geological data conforms to Bedrock Data Model v. 2.9 (Brouillette et al., 2019).

Geomatics by A. Morin

Cartography by N. Côté

Scientific editing by A. Weatherston

Initiative of the Geological Survey of Canada, conducted under the auspices of the Melville Peninsula project as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) program

Map projection Universal Transverse Mercator, zone 17.
North American Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications

Mean magnetic declination 2020, 23°17'W, decreasing 26' annually.
Readings vary from 25°21'W in the NE corner to 21°06'W in the SW corner of the map.

This map is not to be used for navigational purposes.

Title photograph: Outcrop of Paleoproterozoic granite, dated at ca. 2.02 Ga, intruded into Archean basement of the Rae Craton. View is to the east, overlooking Foxe Basin. The granite shows very little strain and is exfoliated, forming subhorizontal fractures. A set of east-west-oriented subvertical fractures of unknown age, and another steep north-south set related to opening of the Foxe Basin crosscut to form perfect blocks, Melville Peninsula, Nunavut. Photograph by D. Corrigan. NRCan photo 2015-019

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

Data may include additional observations not portrayed on this map. *See* map info document accompanying the downloaded data for more information about this publication.

This publication is available for free download through GEOSCAN (https://geoscan.nrcan.gc.ca/).

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.

Cartographic Representations Used on Map

This map utilizes ESRI Cartographic Representations in order to customize the display of standard GSC symbols for visual clarity on the PDF of the map only. The digital data still contains the original symbol from the standard GSC symbol set. The following legend features have Cartographic Representations applied:

-Geolines contact
-Geolines fault
-Geolines fold
-Stations legacy

Descriptive Notes

This map shows results from thematic mapping conducted during the summer of 2010, as part of the Geo-mapping for Energy and Minerals (GEM-I) program. It was part of a three-year project (GEM Multiple Metals - Melville Peninsula project) aimed at increasing knowledge of the Precambrian and Quaternary geology of the Rae Craton in the Melville Peninsula area, in order to gain further insights into its age, composition, tectonothermal history, glacial history, and mineral potential (Corrigan et al., 2013).

The area was originally mapped at reconnaissance scale in 1964 by W.W. Heywood (Heywood, 1967). Mapping of the Penrhyn Group within the area covered by this map sheet was subsequently completed at 1:50 000 scale under the direction of A.V. Okulitch in 1976 and 1977, and the area to west of this map sheet in the early 1970s under the supervision of J.E. Reesor. Compilation maps resulting from the above were subsequently published by J.R. Henderson as a series of three adjacent 1:100 000 scale sheets (Henderson, 1983, 1988). The map area covers the southwestern Foxe Fold Belt, part of a Paleoproterozoic continental margin basin that was deformed and metamorphosed in the composite Trans-Hudson Orogen between ca. 1.87 Ga and 1.80 Ga (Corrigan et al., 2009, and references therein). Detailed structural analysis was published by Henderson (1983). The Penrhyn Group consists mainly of a metamorphosed clastic and carbonate cover sequence that was deposited on Archean basement and later thrust-imbricated in a thick-skinned contractional regime. Where exposed, the contact between the Penrhyn Group and Archean basement is sheared, suggesting displacement along that interface, although the amount of displacement is difficult to assess (e.g. Henderson, 1983). Overall, the Penrhyn Group shares some similarities with the Piling Group on Central Baffin Island, but in detail there are major differences. For example, the Bravo Formation, a ubiquitous, ca. 1.98–1.93 Ga mafic-volcanic-dominated supracrustal package observed on Baffin Island (Partin et al., 2014; Wodicka et al., 2014) has not been observed on Melville Peninsula. In addition, in the Penrhyn Group, calc-silicate gneiss seems to be substantially more abundant relative to marble.

The Penrhyn Group is divided into a lower and upper sequence, with the lower sequence mostly represented by quartzite, metapelite, marble, and calc-silicate gneiss.

The upper sequence contains a thin, discontinuous, sulphidic carbonaceous shale unit at the base, overlain by thick wacke-turbidite locally with Bouma sequences, which we tentatively correlate with the Longstaff Bluff Formation of the Piling Group on Central Baffin Island. However, this unit on Melville Peninsula can be differentiated from its potential Baffin Island equivalent by the greater abundance of calc-silicate and impure marble horizons, suggesting a more proximal, nearer-shore setting. Numerous syn- to post-tectonic felsic dykes, sills, and small intrusions, some of the latter fluorite-bearing, occur in the Penrhyn Group, and range in age between ca. 1.84 and 1.81 Ga (Erdmann et al., 2013).

The basement to the Penrhyn Group consists of Archean gneisses, migmatites, supracrustal rocks, and plutons of the Rae Craton, ranging in age from ca. 3.2 Ga to 2.5 Ga. These are intruded by ca. 2.14 Ga diorite, as well as a ca. 2.02 Ga bimodal plutonic suite consisting of anorthosite-leucogabbro and granite (Wodicka et al., 2011). These Paleoproterozoic plutonic suites likely formed during crustal extension related to deposition of the Penrhyn Group. Thin- and thick-skinned thrusting and folding related to the ca. 1.83–1.80 Ga Trans-Hudson Orogeny has resulted in complex basement-cover geometry, with thick to narrow basement recumbent nappes infolded with cover (Henderson, 1983). Late dextral transpression along the southern margin of the Penrhyn Group (Lyon Inlet boundary zone) resulted in tectonic uplift of the Repulse Bay block, which bounds the Penrhyn Group to the south and likely represents more deeply exhumed equivalents of Rae crust (Laflamme et al., 2014; Ganderton, 2013; Petts, 2012).

The regional metamorphic history is quite complex, with multiple Archean structural and metamorphic events affecting basement, the youngest of which is dated by U-Pb on monazite at ca. 2.55 Ga (Berman et al., 2015). Archean plutons dated at ca. 2.7 Ga intrude highly deformed migmatites and gneisses, suggesting one or more older Archean tectonometamorphic events. Metamorphic ages in the Penrhyn group record an older event at ca. 1.86–1.85 Ga, followed by numerous monazite crystallization ages spanning between ca. 1.84 and 1.80 Ga, representing various stages of growth of that mineral through syn- and post-tectonic episodes. These ages are similar to those reported from the Piling Group on Baffin Island, except that the latter record slightly older metamorphic ages of ca. 1.87 Ga (Gagné et al., 2009).

Numerous pegmatite and gabbro dykes transect the area, as well as brittle faults. The most prominent set of pegmatite dykes is oriented about 080° azimuth and represents post-collisional, orogen-normal extension at about 1.79 Ga. Both Mackenzie (ca. 1.27 Ga) and Franklin (ca. 723 Ma) mafic dykes occur on Melville Peninsula, but only the latter have been observed in this map area. Two major sets of brittle faults occur in the area; an earlier east-west set parallel to faults associated to the Mesoproterozoic Fury and Hecla Basin, as well as a northwest-southeast set associated to Phanerozoic faulting associated with extension in the Foxe Basin.

Recent re-analysis of lake-sediment samples from the area (Day et al., 2009) supports previous interpretations of potential for Sedex-type base metal and intrusion-related uranium deposits, as well as spatially correlative, elevated Au-Bi-Te-W-As anomalies possibly indicating potential for reduced intrusion-related gold. The Penrhyn and Piling groups correlate with the Karrat Group in Greenland, which hosts the Black Angel Pb-Zn Mississippi Valley–type deposit.

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ADDITIONAL INFORMATION

The Additional Information folder of this product's digital download contains figures and tables that appear in the map surround as well as additional geological information not depicted on the map, nor this document, nor the geodatabase.
-PDF of Figure 1 and Table 1 that appear in the CGM surround
-PDF of Figure 2 that does not appear in the CGM surround

Author Contact

Questions, suggestions, and comments regarding the geological information contained in the data sets should be addressed to:

D. Corrigan
Geological Survey of Canada
601 Booth Street
Ottawa ON
K1A 0E8
david.corrigan@canada.ca

Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 17
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 84°00'00"W
Eastern longitude: 81°00'00"W
Northern latitude: 68°00'00"N
Southern latitude: 67°00'00"N

Software Version

Data has been originally compiled and formatted for use with ArcGIS™ desktop version 10.7.1 developed by ESRI®.

Data Model Information

Bedrock

Based on a data-centric approach, the GSC Bedrock Model was designed using the ESRI ArcGIS® environment. The model architecture is almost entirely tailored to the proprietary functionalities of the ESRI® File Geodatabase such as *SubTypes*, *Domain Values* and *Relationship Classes*.

Consult PDFs in Data folder for complete description of the model with its feature classes, tables, attributes, and domain values.

Note: the PDF document is not intended to describe the entire GSC Bedrock Model, but it provides a complete and detailed description of a subset of the model representing the published dataset.

For a more in depth description of the data model please refer to the official publication:

Brouillette, P., Girard, É., and Huot-Vézina, G., 2019. Geological Survey of Canada Bedrock Data Model and tools: design and user guide documentation including ArcGIS(TM) add-ins; Geological Survey of Canada, Open File 8247, 129 p., 1 .zip file. https://doi.org/10.4095/314673