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CANADIAN GEOSCIENCE MAP 348
BEDROCK GEOLOGY
MUMIKSAA–MILNE INLET
Nunavut
parts of NTS 38-B and 48-A

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ABSTRACT

This map presents the field observations and initial geological interpretations for the Mumiksaa–Milne Inlet area (parts of NTS 38-B and 48-A), Baffin Island, Nunavut. The bedrock geology comprises Archean tonalitic- to monzogranitic gneiss that includes minor mafic to intermediate components, and relatively homogeneous monzogranite-granodiorite intrusions. The Archean Mary River Group forms discontinuous volcano-sedimentary belts, consisting of mafic volcanic rocks interlayered with siliciclastic strata, banded iron-formation, and felsic to intermediate and ultramafic volcanic units. The supracrustal rocks are intruded by monzogranite-granodiorite plutons. Pre-Mesoproterozoic rocks record a complex structural history involving at least two regional deformation events and mineral assemblages indicate metamorphic conditions ranging from upper-greenschist to granulite facies. Mesoproterozoic clastic and carbonate platform sequences of the Bylot Supergroup unconformably overlie Archean units in the central part of northern Baffin Island. These strata were deposited within a graben that forms part of the larger Borden Basin.

RÉSUMÉ

Cette carte présente les observations de terrain et les interprétations géologiques préliminaires pour la région de Mumiksaa–Milne Inlet (SNRC parties de 38-B et 48-A), île de Baffin, Nunavut. La géologie du substratum rocheux se distingue par la présence de gneiss archéens de composition tonalitique à monzogranitique, incluant des quantités accessoires de composantes mafiques à intermédiaires, et d'intrusions monzogranitiques à granodioritiques relativement homogènes. Le Groupe de Mary River d'âge archéen forme des ceintures volcanosédimentaires discontinues composées de roches volcaniques mafiques interstratifiées avec des roches silicoclastiques, des formations ferrifères rubanées et des unités volcaniques de composition felsique à intermédiaire ou ultramafique. Ces roches supracrustales sont recoupées par des roches plutoniques de composition monzogranitique à granodioritique. Les roches antérieures au Mésoprotérozoïque témoignent d'une évolution structurale complexe impliquant au moins deux périodes de déformation régionale, avec des associations de minéraux qui indiquent des conditions métamorphiques allant du faciès des schistes verts supérieur au faciès des granulites. Dans la partie centrale du nord de l'île de Baffin, les séquences clastiques et carbonatées d'âge mésoprotérozoïque du Supergroupe de Bylot recouvrent en discordance le socle archéen. Ces couches ont été mises en place dans un graben faisant partie du bassin de Borden.

SHEET 1 OF 1, BEDROCK GEOLOGY

GENERAL INFORMATION

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Base map at the scale of 1:250 000 from Natural Resources Canada, with modifications
Elevations in metres above mean sea level

Proximity to the North Magnetic Pole causes the magnetic compass to be erratic in this area.
Mean magnetic declination 2018, 35°02'W, decreasing 44.5' annually
Readings vary from 33°49'W in the SW corner to 36°09'W in the NE corner of the map.

This map is not to be used for navigational purposes.

Title photograph: Mesoproterozoic Angmaat Formation dolostone (white) juxtaposed against Archean granodioritic gneiss (light pink) along the northwest-southeast-striking White Bay normal fault. Facing north-northwest; width of field of view is ~10 kilometres. Aulattivik (formerly Curry Island) observed in the background (centre-right). Photograph by B.M. Saumur. 2017-103

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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:
Normal fault
Thrust fault
Reverse fault
Strike-slip fault, dextral
Strike-slip fault, sinistral
Oblique-slip fault, normal, dextral
Oblique-slip fault, normal, sinistral
Fault, motion undefined
Fold, anticline, upright
Fold, syncline, upright
Fold, antiform, upright
Fold, synform, upright
Structural form line
Grey structural symbols on map
Franklin dyke
Thin lithology, gypsum bed
Thin lithology, syenogranite dyke

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(s) of figures/tables that do not appear in the CGM surround

HOW TO READ THE GEOLOGICAL MAP

The objective of mapping northern Baffin Island in 2017 was to improve the geological knowledge and document the economic potential of the greater Pond Inlet area. Geological maps show the distribution of geological features, including different kinds of rocks and faults. Although the geology of every area is different, all geological maps have several features in common: coloured areas and letter symbols represent the kind of rock unit at the surface; lines show the type and location of contacts and faults; strike and dip symbols show which way layers are tilted; and a map legend explaining the colours and symbols utilized.

The most striking features of geological maps are its colours. Each colour represents a different geological unit. A geological unit is a volume of a certain kind of rock of a given age. Geological units are named and defined by the geologists who make the geological map, based on observations of the rocks in the field and laboratory investigations on the age of the rocks. In addition to colour, each geological unit is assigned a set of letters to uniquely symbolize it on the map. Usually the symbol is the combination of an initial capital letter followed by one or more capital or lowercase letters. The first capital letter represents the age of the geological unit. Geologists have divided the history of the Earth into Eons. All letter symbols begin with a capital letter representing an Eon: for example Ā (Archean–4000 to 2500 million years ago), mP (Mesoproterozoic–1600 to 1000 million years ago), or Q (Quaternary–2.58 million years ago until today). The capital letters that follow indicate the name of the unit, if it has one. Lowercase letters indicate the type of rock. An example of named rock units on northern Baffin Island are volcanic rocks named "Mary River Group". Therefore, ĀMv on the map would be the symbol for Mary River Group volcanic rocks (formed in the Archean). Similarly, Āmg would be the symbol for an unnamed unit of monzogranite emplaced in the Archean.

The place where two different geological units are found next to each other is called a contact, and this is represented by different kinds of lines on the geological map. When different geological units have been moved next to one another after they were formed, the contact is a fault contact. If one rock was intruded into another (for example a granite intruded into sedimentary strata), then the contact is an intrusive contact. Another kind of line shown on many geological maps is a fold axis. In addition to being moved by faults, geological units can also be bent and warped into folds. A line that follows the crest or trough of a fold is called a fold axis. Where the contact line is precisely located, it is shown as a solid line, but where it is uncertain, it is shown as dashed. The lines on the map may be modified by other symbols on the line (triangles, small tick marks, arrows, and more) which give more information about the line. For example, faults with triangles on them show that the side with the triangles has been moved up and over the side without the triangles. All the different symbols on the lines are explained in the map legend. Tilted layers are shown on a geological map with a strike and dip symbol. The symbol consists of three parts: a long line, a short line, and a number. The long line is called the strike line, and shows the direction in the layer that is still horizontal. Any tilted surface has a direction that is horizontal (think about walking on the side of a hill, there is always a way to go that is neither up nor down, but is level). The short line is called the dip line, and shows which way the layer is tilted. The number is called the dip, and shows how much the layer is tilted, in degrees, from horizontal (flat). The higher the number, the steeper the tilting of the layer. Strike and dip symbols can be modified to give more information about the tilted layers just like lines can be, and these modifications are explained in the map legend. Rocks can also contain linear features, such as stretched vesicles (bubbles) or aligned needle-shaped minerals; these are known as “lineations”. They can be shown on a map with a small arrow: the orientation of the arrow shows the direction of the lineation, whereas the number indicates its plunge, with 0° representing a horizontal lineation and 90° a vertical lineation.

All geological maps come with a table called a map legend. In the legend, all the colours and symbols are shown and explained. The map legend starts with a list showing the colour and letter symbol of every geological unit, starting at the top with the youngest or most recently formed unit, along with the name of the unit (if it has one) and a short description of the types of rock in that unit and their ages. After the list of geological units, all the different types of lines on the map are explained, and then all the different strike and dip symbols. The map legend will also include explanations of any other kind of geological symbols used on a map (for example locations where carving stone is found, locations of deposits of precious metals, and any other geological feature that might be important in the area documented by the geological map). Because the geology in every area is different, the map legend is vital to understanding the geological map.

Descriptive Notes

Introduction

The Geological Survey of Canada, under the Geo-Mapping for Energy and Minerals program (GEM-2), conducted 1:100 000-scale bedrock mapping in the Pond Inlet–Mary River area of northern Baffin Island during the summer of 2017 (NTS 37-G and part of 38-B; Figures 1, 2). This work represents the first phase of a two-year project that will also include bedrock mapping of NTS 37-E and F during the summer of 2018 (Saumur et al., 2017). Following the recent completion of similar GEM projects on southern Baffin Island (e.g. Weller et al., 2015; St-Onge et al., 2016), the study area was chosen with the goal of completing regional bedrock mapping coverage of Baffin Island north of latitude 70°N and investigating the area’s geological evolution and economic potential. Of particular interest is the Archean Mary River Group (MRG), which hosts iron-formation and includes the high-grade Mary River iron deposit that is currently exploited by Baffinland Iron Mines Corporation. Despite the current mining activity, the regional distribution, age, and geological history of the MRG remain uncertain, as well as relationships with spatially associated plutons and basement gneiss. This map summarizes the regional geology, principal tectonostratigraphic units, structural and metamorphic history and economic potential as documented during six weeks of mapping in July and August 2017.

History of bedrock mapping

The Geological Survey of Canada (GSC) conducted reconnaissance geological mapping of NTS 38-B and 37-E, F, and G in 1965–1968 as part of a regional mapping project on north-central Baffin Island. Mapping involved helicopter traverses with stops spaced ~8 km apart, supplemented by more detailed work in selected areas to examine the stratigraphy of supracrustal rocks, including MRG exposures hosting iron mineralization (Deposit No. 1 and 4; Figure 2). This work was compiled and published as a set of 1:250 000 scale bedrock maps (Jackson and Davidson, 1975; Jackson and Morgan, 1978b; Jackson et al., 1978; Davidson et al., 1979) and incorporated within a regional bedrock compilation map of northern Baffin Island (Scott and de Kemp, 1998, 1999). Jackson et al. (1975) and Jackson (2000) presented a summary of the bedrock geology, including descriptions of lithological units and preliminary accounts of metamorphism, deformation, and economic geology. Detailed sketch maps of the iron-bearing MRG were subsequently released (Jackson, 2006). Aeromagnetic geophysical data were collected during 1973 and 1974 (Figure 3; Natural Resources Canada, 2017). In the Pond Inlet-Tasiujaq area, offshore seismic data were acquired in 1971 (Kenquest Exploration, 1971), and seafloor bathymetry (multibeam imagery) was conducted by ArcticNet and the Ocean Mapping Group, University of New Brunswick, during 2003–2014.

Bedrock mapping at 1:50 000 scale was conducted by the GSC in 1994 in a 2800 km^2 area centred on Eqe Bay (NTS 37-C; Figure 1) with the goal of unravelling the tectonostratigraphic and petrogenetic history of the MRG, associated plutons, and basement gneiss. The Eqe Bay study area borders the southern edge of the present project area and is considered to contain correlative map units. Mapping results, along with geochronological and geochemical data are presented in Bethune and Scammell (1997, 2003a, 2003b).

The Canada-Nunavut Geoscience Office (CNGO) completed targeted bedrock mapping in NTS 37-E, F, and G as a subcomponent of the 2003–2005 North Baffin Project, in which surficial geology was the primary focus. The main objectives were to identify new economic mineral deposits, collect assay samples to help guide drift-prospecting surveys, and develop a stratigraphic and structural framework for the MRG through detailed mapping of specific localities. The resulting 1:50 000 scale maps of the MRG at Deposit No. 4, the “Tuktuliarvik” area (informally known as “Long Lake”) and the area informally known as “Felsenmeer flats” (Figure 2) were published in Young et al. (2004), together with an interpreted structural-stratigraphic framework. Johns and Young (2006) presented an overview of regional MRG geology and new economic mineral prospects, including Algoma-type iron-formation in NTS 37-E and 37-G, locally with associated gold- and molybdenum-bearing quartz veins. Full results of the CNGO’s North Baffin Project, including geochemical data for till and bedrock samples, are presented in Utting et al. (2008).

Targeted and 1:100 000 scale bedrock mapping by the current GEM-2 North Baffin project (Figure 1) was required to bring bedrock mapping and geoscience knowledge to an equal level with that achieved on southern Baffin Island (e.g. St-Onge et al., 2015a; Weller et al., 2015). In addition to providing a more accurate geological framework for northern Baffin Island, the new maps and associated analytical research will help resolve important scientific and economic questions. The extent of Archean versus Proterozoic crust is presently unknown, and may have implications for diamond prospectivity. Resolving the age, tectonostratigraphy, and distribution of the MRG will help determine whether correlations exist with comparable mineralized greenstone belts of the mainland Rae Craton. Finally, new insights into the tectonometamorphic history of the study area will have implications for regional correlations and understanding the tectonic assembly of Nunavut and Kalaallit Nunaat (Greenland).

Geological framework

Archean units of the Pond Inlet–Mary River area have been proposed to belong to the Repulse Bay block (or north Rae Domain) of the Rae Craton, which extends from central Nunavut to at least northern Baffin Island (e.g. Pehrsson et al., 2011, 2013; Snyder et al., 2013; cf. Jackson and Berman, 2000). Ca. 2.97–2.60 Ga granite-greenstone belts and Eo- to Mesoarchean cratonic basement characterize the Repulse Bay block (e.g. Snyder et al., 2013; LaFlamme et al., 2014; Spratt et al., 2014). To the southeast, Archean crust on northern Baffin Island is bounded by the Isortoq fault (Jackson, 2000) and the Paleoproterozoic Foxe fold belt (Figure 1), which represents the northern margin of the ca. 1880–1800 Ma Himalayan-scale accretionary/collisional Trans-Hudson Orogen (St-Onge et al., 2002; Corrigan et al., 2009). The Isortoq fault is considered to record northwest-directed thrusting of the Foxe fold belt and underlying basement over Archean crust of northern Baffin Island at ca. 1850–1820 Ma (Jackson, 2000; Jackson and Berman, 2000; Bethune and Scammell, 2003b).

Archean basement gneiss

Previous workers documented Archean basement gneiss as mainly comprising granodiorite, monzogranite, and quartz monzonite. Crystallization ages were obtained for two units interpreted as basement underlying the MRG: 2851 +20/-17 Ma for tonalite gneiss (Table 1; Jackson et al., 1990) and a preliminary age of ca. 2900 Ma for granodiorite gneiss (M.D. Young, unpublished data, 2007; Young et al., 2007). These ages are within the ca. 3000 to 2770 Ma range of protolith ages for basement gneiss from the nearby Eqe Bay area (Figure 1; Bethune and Scammell, 2003a).

Mary River Group

The MRG comprises mafic volcanic rocks with intervening strata of siliciclastic units, banded iron-formation, felsic to intermediate volcanic rocks, and ultramafic sills/volcanic rocks. Dacite in the Felsenmeer flats area (Figure 2) yielded a crystallization age of 2718 +5/-3 Ma (Table 1; Jackson et al., 1990). In the nearby Eqe Bay area, intermediate-felsic MRG volcanism occurred between ca. 2760 and 2725 Ma (Bethune and Scammell, 2003a). However, Young et al. (2007) report a considerably older age of ca. 2829 Ma (M.D. Young, unpublished data, 2007) for felsic to intermediate volcanism in the western part of NTS 37-G.

Metasedimentary and metavolcanic rocks of presumed Archean or Proterozoic age have been mapped near Pond Inlet (NTS 38-B), described as quartz-biotite-feldspar gneiss and amphibolite (‘sv’ unit in Jackson and Davidson, 1975). The relationship between these strata and the MRG on the adjacent map sheet to the south (NTS 37-G) was not addressed in previous studies.

Felsic intrusions

Quartzofeldspathic intrusions identified by previous fieldwork include foliated to massive quartz monzonite-granodiorite-monzogranite (±K-feldspar or plagioclase megacrysts) and aplitic to pegmatitic syenite dykes. An age of 2709 +4/-3 Ma is reported for monzogranite (Table 1; Jackson et al., 1990). Six calc-alkaline granite-granodiorite intrusions bordering the study area near Eqe Bay yield similar ages ranging from ca. 2726 to 2714 Ma, and thus appear in part contemporaneous with, and outlast, MRG volcanism (Bethune and Scammell, 2003a).

Regional metamorphism and deformation

Previous studies suggest that the study area was mostly metamorphosed at upper-amphibolite facies, although grades ranging from greenschist to granulite facies are documented (Jackson and Morgan, 1978a; Jackson, 2000; Jackson and Berman, 2000; Bethune and Scammell, 2003b). Greenschist- to lower-amphibolite-facies assemblages seem to be confined to MRG exposures in the western parts of NTS 37-G and the north-central portion of NTS 37-F (Jackson, 2000). Granulite-facies metamorphism defines a discontinuous ~70 km wide belt (Dexterity granulite belt) that extends for 280 km northeastward along the northern margin of the Isortoq fault, from Steensby Inlet to the east coast of Baffin Island (Figure 1; Jackson, 2000; Jackson and Berman, 2000). Less extensive zones of granulite-facies metamorphism were identified in the northern part of the study area near Pond Inlet, proximal to the mangeritic to charnockitic Bylot batholith and surrounding granulite-facies country rocks on Bylot Island (Jackson and Berman, 2000).

At least three regionally penetrative deformation events are recognized in pre-Mesoproterozoic rocks. Young et al. (2004) documented early foliations and folds (D_1) followed by northwest-vergent folding and axial-planar foliation development during D_2, and tentatively interpreted D_2 as resulting from the Paleoproterozoic Trans-Hudson Orogen (ca. 1880–1800 Ma; St-Onge et al., 2002; Corrigan et al., 2009). Later east-trending folds are recognized in the southern part of the map area, attributed to D_3 by Young et al. (2004). The northwest-trending White Bay and Tikerakdjuak fault zones developed across the northwestern part of the study area (Figure 2) during the late Paleoproterozoic to early Mesoproterozoic (Jackson, 2000). These faults are parts of rift grabens that formed the Borden basin, in which strata of the Mesoproterozoic Bylot Supergroup were deposited (ca. 1270–1200 Ma; Jackson, 2000; Turner, 2011).

The timing of tectonothermal events in the study area is poorly constrained. Field relationships suggest that basement gneiss underwent at least one episode of Archean deformation and anatexis prior to MRG deposition (Jackson and Morgan, 1978a; Jackson, 2000). This is supported by evidence of >2780 Ma tectonometamorphism in nearby basement gneiss of the Eqe Bay area (Bethune and Scammell, 2003b). Here, tectonism in the MRG is recorded by folding prior to ca. 2740 Ma and by low- to medium-pressure regional metamorphism that is attributed to emplacement of ca. 2700–2690 Ma peraluminous plutons (Bethune and Scammell, 2003b). Enderbite from the Bylot batholith yielded ca. 2540 Ma zircon (D.J. Scott and G.D. Jackson, unpublished U-Pb sensitive high-resolution ion microprobe data), interpreted as representing the timing of igneous crystallization and potentially corresponding to a regional tectonothermal event (Jackson and Berman, 2000).

Field relationships and preliminary geochronology suggest variable Paleoproterozoic overprinting of Archean rocks (Jackson, 2000). Directly south of the map area, Archean gneiss, MRG supracrustal units and plutons in the Eqe Bay area were reworked during ca. 1850–1820 Ma tectonometamorphism attributed to ductile thrusting (Isortoq fault zone) and associated ca. 1825 Ma granulite-facies metamorphism (Dexterity granulite belt; Bethune and Scammell, 2003b). Apart from local occurrences of subgreenschist-facies minerals, Mesoproterozoic Bylot Supergroup strata are unaffected by metamorphism, thereby constraining regional metamorphism to predating 1270 Ma.

2017 field observations

A team of geologists based out of Pond Inlet conducted daily helicopter-supported foot traverses in areas west and south of the community in NTS 38-B and 37-G. Helicopter-supported site visits were used to map areas with isolated outcrops separated by distances too great to cover on foot, including glaciated and mountainous terrain east of Pond Inlet and around Kangiqłuruluk (Figure 2; formerly Oliver Sound), as well as portions of southern NTS 37-G hosting extensive till cover.

Granodiorite-tonalite-monzogranite gneisses (units Ādg–Āmz*)*

These units are foliated and medium grained, with compositional banding on the 1–10 cm scale (Figure 4a). Mafic bands comprise a biotite±hornblende±magnetite assemblage, whereas felsic bands mainly consist of plagioclase-quartz±K-feldspar. The gneisses vary compositionally at the kilometre scale from dominantly granodiorite to tonalite to monzogranite, in many places comprising all three rock types. The gneisses commonly contain enclaves or bands of quartz diorite, diorite, and gabbro or, less commonly, hornblendite, which are oriented parallel to foliation and layering (Figure 4a–c). The centimetre-scale gneissosity defined by alternating mafic-/felsic-rich bands is generally accompanied by decimetre- to metre-scale compositional banding resulting from the transposition of different rock types.

The granodiorite-tonalite-monzogranite gneisses are tentatively inferred to represent the basement to MRG supracrustal strata and the host to subsequent intrusions. They are extensive in the northern part of the map area, occurring from Utsuk south to Kangiqłuruluk and west to Tuqqajaat (formerly Cape Hatt; Figure 2), as part of the footwall to the White Bay fault. They also occur in the northern part of NTS 37-G where they are intruded by felsic plutonic units, but were rarely encountered in the southern portions of NTS 37-G owing to the predominance of the MRG and more homogeneous plutonic units.

Mary River Group (units ĀMsu–ĀMif*)*

Detailed descriptions of the stratigraphy of the MRG are given in Jackson (2000), Young et al. (2004), and Johns and Young (2006). The following overview of the main MRG map units is based on new mapping of well exposed MRG sequences in the "Tuktuliarvik" area (Bros and Johnston, 2017) and Felsenmeer flats (Figure 2), supplemented by observations of a poorly exposed but extensive belt of the MRG in central NTS 37-G, as well as volumetrically small MRG exposures in other locations across NTS 37-G.

In general, the stratigraphy of the MRG in the study area comprises a lower section of dominantly mafic volcanic rocks with lesser psammite±quartzite, overlain by iron-formation and an upper sequence of psammite±quartzite and felsic-intermediate volcanic rocks with minor mafic volcanic units (Young et al., 2004; Johns and Young, 2006; Bros and Johnston, 2017; Skipton et al., 2017). Ultramafic rocks form low-volume, discontinuous layers at various stratigraphic levels. The MRG is surrounded by monzogranite-granodiorite that ranges from massive to weakly foliated, to strongly lineated and/or foliated. Gneissic rocks characteristic of potential basement (e.g. granodiorite-tonalite-monzogranite gneisses, described above) were rarely observed proximal or in direct contact with the MRG. Contact relationships are typically unexposed or ambiguous, in part owing to intense deformation, although monzogranite-granodiorite locally displays clear intrusive relationships into rocks interpreted as MRG (Figure 5a). Accordingly, monzogranite-granodiorite commonly contains mafic volcanic enclaves/rafts, ranging in size from a few decimeters to several metres, which are interpreted as being derived from the MRG. The association of strongly deformed greenstones with later syntectonic plutonic units is typical of Archean granite-greenstone belts observed worldwide (e.g. Condie, 1981; de Wit and Ashwal, 1997).

Many MRG rafts within plutonic rocks, including MRG exposures in the Long Lake area, form lens-shaped bodies and exhibit intense stretching lineations consistent with boudinage (Bros and Johnston, 2017). The MRG is moderately to strongly foliated, folded in places, and commonly exhibits stretching lineations or mineral lineations. Intense stretching lineations are pervasive in the west-central part of NTS 37-G, and locally in other areas, forming L>S- or L-tectonites (Figure 5b). Outside the MRG sequences in the west-central portion of NTS 37-G, the generally sporadic distribution of MRG rocks is attributed to granitoid emplacement and subsequent boudinage.

Concordant with the volcanic strata described below, siliciclastic sequences (unit ĀMsu) are mostly up to ~10 m thick (hundreds of metres thick in places, such as the Long Lake area). Muscovite±biotite psammite is the most common and abundant siliciclastic unit. Quartzite contains muscovite±biotite±garnet and is in sharp contact with (structurally) underlying monzogranite in the Long Lake area. Pelite and semipelite contain chlorite-muscovite-biotite±garnet±staurolite±magnetite, with staurolite locally forming megacrysts up to 7 cm long (Figure 6d). Garnet porphyroblasts are euhedral and typically 0.5–1 cm in size; megacrysts 5 cm long occur locally.

Mafic volcanic rocks (unit ĀMv) are fine to medium grained and contain hornblende-plagioclase±actinolite±clinopyroxene±magnetite±biotite±quartz±garnet ±chlorite±epidote assemblages. Mafic volcanic rocks are typically equigranular, or characterized by hornblende forming medium-grained crystals within a fine-grained matrix. Compositional banding is common, defined by alternating mafic- and felsic-rich layers 5 mm to 5 cm thick, and may represent volcanic layering. Relict volcanic textures occur locally, including fine-grained plagioclase-rich clasts or coarse-grained hornblende/clinopyroxene pods within a fine-grained mafic matrix (Figure 5b, c), or layered bomb- or lens-shaped mafic clasts (Figure 5c, d). In rare cases, mafic volcanic deposits contain thin interbeds of carbonate mud (Figure 5d). Without definitive volcanic textures, the fine- to medium-grained mafic rocks may represent thick flows or shallow subvolcanic intrusions.

Intermediate rocks are less common than mafic units in the MRG. Although they contain higher proportions of plagioclase and quartz, intermediate volcanic and subvolcanic rocks in the MRG have the same mineral assemblages and similar textures as their mafic counterparts, described above. Rhyolite is overlain by banded iron-formation and underlain by psammite in the Long Lake area. It is aphanitic, apart from fine-grained muscovite and millimetre-scale quartz bands that are parallel to compositional banding defined by alternating pale yellow- and cream-coloured bands up to 1 cm thick.

The MRG hosts oxide- and silicate-facies banded iron-formation (BIF; unit AMif) that is most abundant in the west-central portion of NTS 37-G. Iron-formation is typically 3–10 m thick, concordant with volcanosedimentary layering and locally forms larger bodies (Figure 6a) that can be >100 m thick, extending for tens of kilometres along strike (MacLeod, 2012). The MRG hosts nine high-grade iron deposits that are currently tenured to Baffinland Iron Mines Corporation, most notably the Mary River Deposit No. 1 mine (Figure 2). High-grade iron ore is interpreted to have formed from BIF that underwent pervasive desilicification resulting from circulation of hot, alkaline brine (MacLeod, 2012). These deposits are described in detail in previous studies (Jackson, 2000, 2006; Young et al., 2004; MacLeod, 2012).

The oxide-facies BIF is characterized by 1 mm–3 cm-scale banding of magnetite (±hematite) and chert (Figure 6b), with local occurrences of massive magnetite beds up to 10 m thick. Silicate-facies BIF is less common, and comprises alternating bands of quartz, magnetite, and cummingtonite-grunerite±garnet that are 1 mm–3 cm thick (Figure 6c). Whereas some BIFs have orange/purple gossanous weathering, most weather dark grey, grey-blue, or dark brown (Figure 6a). Outside the BIF, isolated ironstone layers are relatively common within mafic and ultramafic volcanic units, forming centimetre- to decimetre-scale bands of granular magnetite±hematite.

Ultramafic rocks form a relatively minor component of the MRG, and field observations in 2017 suggest that they are not as extensive as indicated by previous studies (e.g. Davidson et al., 1979). Ultramafic rocks are documented in the southeastern part of NTS 37-G (including Felsenmeer flats) and the Long Lake area, forming discontinuous layers. They typically comprise aligned orthopyroxene phenocrysts within a beige or light grey to black, fine-grained to aphanitic groundmass, suggesting a subvolcanic or volcanic protolith such as komatiite. Spinifex texture, characteristic of many komatiitic sequences, was not observed, possibly owing to extensive recrystallization and/or deformation.

Monzogranite-granodiorite (unit Amg***)***

Medium-grained biotite±hornblende±magnetite monzogranite (Figure 4d) is widespread and particularly extensive in the southern part of the map area (NTS 37-G). Plutons are homogeneous and typically weakly foliated but range from massive to strongly foliated, and occur as L- or L>S-tectonite in the central part of NTS 37-G (e.g. the Long Lake area). Coarse K-feldspar crystals (≤1.5 cm) occur in some localities. The intrusions locally contain enclaves of diorite or gabbro. In NTS 37-G, monzogranite-granodiorite encloses enclaves of fine-grained, foliated mafic rocks ranging in size from <1 m to 10–20 m; these enclaves commonly exhibit relict volcanic textures and are interpreted as being derived from the MRG (discussed above). Weakly foliated monzogranite is observed to crosscut granodiorite gneiss in several localities.

Feldspar-megacrystic monzogranite-granodiorite (unit Amf***)***

Feldspar-megacrystic monzogranite to granodiorite intrusions form 1–10 km-scale plutons in the central portion of NTS 37-G. This unit is characterized by euhedral, weakly compositionally zoned megacrysts (2–5 cm) of either potassic feldspar or plagioclase feldspar within a granitic medium- to coarse-grained groundmass. Mafic minerals include biotite+hornblende+magnetite±muscovite. The plutons locally exhibit a weak tectonic lineation or foliation, but are typically massive due to their coarse grain size and low proportion of mafic minerals. Locally, the megacrysts are aligned, potentially indicative of primary magmatic flow.

Plagioclase-megacrystic granodiorite located ~45 km east of the Long Lake area is crosscut by fine-grained granodiorite to monzodiorite, interpreted to represent a late pulse within the same magmatic system. The plagioclase-megacrystic pluton contains dioritic to gabbroic enclaves with southwest-plunging long axes, suggesting that despite the absence of penetrative tectonic fabrics, the pluton experienced deformation. Potassium-feldspar-megacrystic monzogranite-granodiorite seems to be more dominant in the western portion of NTS 37-G.

Garnet-bearing gabbro-leucogabbro-diorite-quartz diorite (unit Ag*)*

Medium- to coarse-grained, garnet-bearing mafic-intermediate rocks are common south and east of Pond Inlet in NTS 38-B, defined by the mineral assemblage hornblende-plagioclase-garnet±clinopyroxene±biotite±quartz. This unit is foliated, and locally exhibits weak compositional banding defined by alternating mafic- and felsic-rich layers. Garnet typically forms porphyroblasts 2–5 mm in size, with modal abundances of <5% to 25% (Figure 4e). Garnet is coarser (1–1.5 cm) or finer (≤1 mm) grained in some localities. Plagioclase rims (≤1 mm wide) around garnet are common near Kangiqługaapik, Utsuk, and along the coast west of Pond Inlet (Figures 2, 4e). In the latter two locations, garnet locally exhibits double coronae of clinopyroxene surrounded by plagioclase.

Anorthosite (unit Aan*)*

Clinopyroxene-bearing anorthosite occurs as a coarse-grained and massive body locally containing enclaves of tonalitic gneiss and foliated gabbro.

Layered mafic-ultramafic bodies (unit ApPmu*)*

Mafic and ultramafic bodies occur throughout the project area as enclaves in orthogneiss, with sizes ranging in scale from decimetres to kilometres. Mafic-ultramafic intrusions preserving evidence of magmatic layering were identified along the northern coast of Baffin Island, most notably on the northeastern coast of Kangiqłuruluk and at Tuqqajaat (Figure 2).

The Kangiqłuruluk intrusion forms a folded body ~5 km in size occurring within granodioritic basement gneiss. The intrusion defines a moderately north-plunging, steeply northwest-inclined, tight fold. It consists of 100–500 m layers of gabbro/diorite with hornblende-bearing clinopyroxenite and/or websterite. Within gabbroic portions, primary (S_0) decimetre-scale, rhythmic compositional layering is defined by varying proportions of plagioclase and clinopyroxene (or hornblende after clinopyroxene), producing alternating bands of leucogabbro and gabbro (Figure 4f). This layering is irregular along strike, exhibiting truncations and layer-scale deformation that possibly reflects dynamic magmatic conditions. The igneous layering is overprinted by metamorphic foliation defined by aligned plagioclase and hornblende. The smaller (~ 200 m thick), layered mafic-ultramafic intrusion at Tuqqajaat comprises peridotite overlain by layered gabbro. In both the Kangiqłuruluk and Tuqqajaat bodies, contacts between the intrusion and basement gneiss appear discordant with igneous layering within the intrusion, but parallel to gneissosity or tectonic fabrics within the basement gneiss. These contacts may be tectonic, possibly reflecting the tectonic dismemberment of one or several larger intrusions.

Metamorphosed supracrustal sequences, Pond Inlet area (unit ApPsu*)*

Metamorphosed supracrustal sequences are documented in four main areas in NTS 38-B, which comprise exposures over several kilometres (≤10 km) at Qimivvik (formerly Emmerson Island) and ~20–30 km east of Utsuk, with more limited exposures at the eastern end of Kangiqłuruluk and the coast west of Kangiqługaapik (Figure 2). These units were found to have markedly different compositions and spatial distributions than the volcanosedimentary rocks previously mapped in NTS 38-B (unit 'sv' in Jackson and Davidson, 1975). As the metasupracrustal sequences are dominantly siliciclastic (≥90% of outcrop volume), iron-formation is absent and rare mafic-ultramafic components lack obvious volcanic features, they are tentatively considered distinct from the MRG. Contacts with surrounding granodiorite-tonalite-monzogranite gneiss, monzogranite-granodiorite or garnet-bearing mafic-intermediate intrusive rocks are not exposed, except for a thrusted contact with tonalite gneiss on Qimivvik (Figure 7a; discussed below). The supracrustal sequences are foliated parallel to compositional layering, and are commonly folded and lineated.

Siliciclastic rocks form layers 5–20 cm thick and are dominantly composed of psammite containing biotite±garnet. Cordierite occurs locally (e.g. Qimivvik). Biotite semipelite is interlayered with psammite at Kangiqłuruluk and east of Utsuk, and at the latter location, pelite contains garnet (Figure 7b) and prismatic sillimanite. Semipelite and pelite at Qimivvik contain biotite-garnet±sillimanite (Figure 7c). Quartzite is rare, recognized only as layers 10–30 cm thick in psammite near the eastern coast of Kangiqłuruluk, and contains minor biotite.

Discontinuous leucogranite lenses and bands are ubiquitous in supracrustal sequences identified in NTS 38-B (Figure 7b, c). Leucogranite comprises plagioclase-quartz-K-feldspar±garnet±biotite. Sillimanite was identified in leucogranite at Qimivvik, east of Utsuk and at Kangiqługaapik. Leucogranite at Qimivvik also contains coarse-grained muscovite. Leucogranite forms dykes and sills up to 20 m wide that are generally concordant with foliation and layering in supracrustal sequences (Figure 7a), and commonly contain rafts of pelite, semipelite and psammite.

Garnet-bearing monzogranite-granodiorite (unit ApPmg*)*

Garnet-bearing monzogranite to granodiorite intrusions form 1–10 km-scale plutons in the area south and east of Pond Inlet. In places, this unit is characterized by euhedral, weakly compositionally zoned megacrysts (1–2 cm) of potassic feldspar within a medium- to coarse-grained groundmass. Mafic minerals include garnet+biotite±orthopyroxene±hornblende±magnetite. The plutons are moderately foliated, and locally contain layers of unit Ag.

Syenogranite (unit ApPs*)*

The youngest documented felsic plutonic phase comprises coarse-grained to pegmatitic, massive syenogranite dykes. The dykes intrude the granodiorite-tonalite-monzogranite gneisses, the monzogranite-granodiorite intrusions, and, although they rarely crosscut the MRG, they intrude metasupracrustal sequences in NTS 38-B. The dykes range in width from 5 cm to 3 m, and contain biotite±magnetite. Hornblende or clinopyroxene occurs locally in pegmatitic syenogranite dykes that crosscut hornblende-bearing plutonic units or hornblende-clinopyroxene-bearing mafic enclaves. The dykes typically crosscut deformation fabrics in host rocks (Figure 4c), with some dykes semi concordant to foliation, having intruded approximately parallel to foliation planes.

Massive coarse-grained syenogranite forms a pluton ~10 km in size southeast of Utsuk (Figure 2) that crosscuts foliated basement gneiss. Associated dykes of coarse-grained to pegmatitic syenogranite occur along the edges of the pluton.

Bylot Supergroup (units mPAS–mPAP*)*

Bylot Supergroup strata occur extensively in the northwestern portion of the study area. The strata are within the Milne Inlet trough, one of three northwest-trending grabens forming the Borden rift basin (Jackson and Davidson, 1975; Jackson and Iannelli, 1981). Bylot Supergroup strata nonconformably overlie granodiorite-tonalite-monzogranite gneiss and monzogranite-granodiorite, and are in faulted contact with the latter units along the normal-sense White Bay fault in the northeast (Figure 8a) and the Tikerakdjuak fault in the southwest (Figure 2). The strata are unmetamorphosed and not penetratively deformed, typically exhibiting gentle dips of ≤10° toward the northwest or southeast.

Detailed descriptions of the Bylot Supergroup are provided in Jackson (2000) and Turner (2009; 2011). A summary is given here, using previously established nomenclature for stratigraphic units, which are described in ascending stratigraphic order.

Eqalulik Group: Adams Sound Formation (unit mPAS*)*

The Adams Sound Formation is up to 100 m thick and comprises light grey to beige, fine- to medium-grained quartz sandstone and minor basal quartz-pebble conglomerate (Figure 8b). Bedding thickness ranges from thin to thick and crossbedding is common. The Adams Sound Formation is interpreted as braided fluvial strata overlain by intertidal to subtidal sandstone (Jackson, 2000).

Uluksan Group: Arctic Bay Formation (units mPAB-L–mPAB-U*)*

The Arctic Bay Formation comprises mainly carbonaceous shale and siltstone characterized by mudcracks and ripple marks (Figure 8c). The formation is divided into the Upper (unit mPAB-L) and Lower (unit mPAB-U) members: the Lower member mainly consists of dark grey to black shale interbedded with siltstone (Figure 8c) and lesser quartz sandstone and dolostone; the Upper member is also dominantly shale, but has a greater abundance of quartz sandstone and dolostone, which can be brecciated, cherty or stromatolitic. According to Jackson (2000), the Arctic Bay Formation was mostly deposited in subtidal, shoreline and deltaic environments, and the Upper member includes a carbonate-basin setting.

Uluksan Group: Iqqittuq and Angmaat formations (units mPIq–mPAn*)*

The Iqqittuq Formation (unit mPIq) is mostly composed of light grey, thinly bedded to massive dolostone that commonly contains stromatolites and is locally interbedded with grey shale. The Iqqittuq Formation is overlain by the Angmaat Formation (unit mPan), which consists of cyclic packages of stromatolitic dolostone (Figure 8d) and partly silicified sea floor precipitates. Red-green shale and gypsum occur locally, capped by dolostone that characteristically forms cliffs and ridge-tops (Figure 8e). The Angmaat Formation formed in a shallow platform environment and the Iqqittuq Formation represents a carbonate ramp, with distally steepened ramp to slope zones (Turner, 2009).

Uluksan Group: Victor Bay and Athole Point formations (units mPVB–mPAP*)*

The lower member of the Victor Bay Formation (unit mPVB) comprises grey to black, thinly bedded to massive argillaceous dolostone, argillaceous limestone and shale. The upper member is dominantly light grey, poorly bedded to massive dolostone and the uppermost strata comprise stromatolitic bioherms with average diameters of ~5 m. Both the lower and upper members contain edgewise/intraformational conglomerate and breccia. The Athole Point Formation (unit mPAP) consists of grey to black, thinly bedded argillaceous limestone, calcareous shale and siltstone, with lesser stromatolitic chert, limestone and sandstone.

Franklin dyke swarm (unit nPF***)***

Mafic dykes in the study area form part of the well-studied Neoproterozoic (ca. 723 Ma) Franklin dyke swarm (e.g. Fahrig and West, 1986; Heaman et al., 1992; Pehrsson and Buchan, 1999; Buchan and Ernst, 2013). The dykes, which vary in thickness from 10 to 50 m, are NW-SE-striking and subvertical to steeply dipping. They are laterally extensive (with individual dykes traceable for up to 60 km along strike) and form imposing ridges above preferentially weathered Bylot Supergroup strata. The dykes consist of fine- to medium-grained diabase (dolerite), gabbro or olivine gabbro. They exhibit typical chilled margins, are strongly magnetic and show characteristic ophitic to subophitic textures.

Dykes of the undated Dexterity Fiord swarm, despite being interpreted to occur near the head of Qiajivik (North Arm) through remote mapping methods (Buchan and Ernst, 2013), were not encountered during foot traverses or helicopter-supported transects.

Eclipse Group (unit K***)***

The Cretaceous Eclipse Group on northern Baffin Island and southern Baffin Island comprises beige to brown, thin- to thick-bedded quartz sandstone, locally interbedded with black coal, siltstone, or dark shale.

Quaternary deposits (unit Q***)***

Unconsolidated strata of Quaternary age include glacial till (bouldery diamicton); glaciofluvial sand and gravel; glaciolacustrine, glaciomarine and marine sand, silt and gravel; alluvial sand and gravel; and talus scree boulder diamicton.

Metamorphism

Metamorphic mineral assemblages observed in plutonic/gneissic rocks during the 2017 field season are consistent with medium-pressure and medium- to high-temperature conditions. In the Archean quartzofeldspathic units that underlie most of the map area, biotite±hornblende±magnetite (±clinopyroxene) mineral assemblages and the overall absence of orthopyroxene suggest regional metamorphism at broadly amphibolite facies. This is supported by widespread hornblende±clinopyroxene±biotite assemblages in mafic enclaves/intrusions/bands within felsic plutonic and gneissic units.

Lower-temperature variations in metamorphic grade are recognized in supracrustal rocks. Mafic volcanic rocks of the MRG (NTS 37-G) generally have hornblende-clinopyroxene-actinolite (±chlorite±epidote) assemblages, suggesting lower-amphibolite to upper-greenschist-facies metamorphism. Where present, MRG metasedimentary units also record lower-temperature conditions, including muscovite±biotite psammite and chlorite-muscovite±garnet±staurolite±biotite pelite documented in the "Tuktuliarvik" area. At this locality, actinolite in MRG mafic-intermediate rocks postdates foliation and stretching/mineral lineations that are defined by hornblende-bearing assemblages, suggesting postkinematic retrograde actinolite growth (Bros and Johnston, 2017).

Supracrustal sequences in NTS 38-B record upper-amphibolite to granulite-facies conditions, as indicated by garnet-sillimanite (or cordierite)-biotite assemblages in siliciclastic units. The presence of leucogranite veins and dykes suggests that partial melting occurred. Local granulite-facies conditions in the northern part of the map area are consistent with the assemblage hornblende-garnet-clinopyroxene in gabbro to diorite. In summary, the map area seems to record an overall decrease in regional peak-metamorphic grade from north to south.

Deformation

Archean and Paleoprotorozoic rocks record a complex deformation history attributed to at least two regional deformation events, with related large-scale regional fabrics varying on 1–10 kilometre scale. In the following discussion, designation of deformation events as 'D_1' and 'D_2' is based solely on 2017 fieldwork and does not imply equivalence to deformation events described in previous studies (e.g. D_1, D_2 in Young et al., 2004). An early foliation (S_{1a}) is recognized in gneissic rocks that potentially represent basement; this foliation is aligned parallel to gneissic layering (Figure 4a, c) and axial planar to isoclinal folds (F_{1a}). Pre-Mesoproterozoic supracrustal rocks (MRG and supracrustal units in NTS 38-B) record an early foliation oriented parallel to bedding and/or volcanic layering (Figures 5, 7). This foliation is tentatively denoted S_{1b}, as it could be younger than S_{1a} in gneissic rocks, although the relative ages of these fabrics remains speculative. Some MRG exposures do not exhibit a recognizable S_{1b} fabric (Figure 6b–d), either due to an intense overprint by L_2 stretching lineations (discussed below) or an absence of early fabric development. The early $S_{1a,\,b}$ fabrics are defined by peak metamorphic mineral assemblages.

The MRG, its potential basement gneiss, and some intrusions are affected by subsequent deformation that produced decimetre- to kilometre-scale folds with variably dipping axial planes, striking approximately east–west (ranging from west-northwest–east-southeast to west-southwest–east-northeast). Large folds are identifiable on the aeromagnetic map (Figure 3). The folds are generally tight and recumbent to overturned, and are tentatively ascribed to a regional deformation event (D_2) for ease of discussion here and in Figures 4–7. However, variability exists among fold vergence and kinematics of associated fabrics in different localities, particularly between the southern and northern ends of the study area; forthcoming structural and geochronological studies will shed light on the nature and timing of deformation events (*see* 'Future work' section below).

Regional structural patterns appear to be defined by dominant orientations of S_{1a}, S_{1b}, and late (F_2) folds. A northwest-southeast-striking structural grain characterizes the eastern half of NTS 37-G (Figure 3). In NTS 38-B and the western portion of NTS 37-G, structural grain typically strikes northwest-southeast to northeast-southwest.

The central portion of NTS 37-G, including the “Tuktuliarvik” area, is characterized by L>S- and L-tectonites with stretching lineations that plunge moderately toward the south-southeast or, alternatively, toward the northeast or southwest. These orientations are relatively consistent with those of less intense lineations elsewhere in the map area, although a shallowly northwest-plunging lineation is common in NTS 38-B. Variably oriented ductile lineations may have resulted from stretching in an orientation co-axial with F_2 hinges (pure shear) as well as along F_2 fold limbs (simple shear). Boudinage of the MRG may have also occurred during D_2.

A thrust zone is well exposed in the cliffs on the southern side of Qimivvik, where tonalitic basement gneiss overlies metasedimentary rocks (Tasiujaq thrust; Figures 2 and 7a). The thrust contact dips shallowly toward the northeast. Footwall supracrustal rocks exhibit bedding-parallel S_{1b}, defined by aligned peak metamorphic minerals and leucogranite. The S_{1b} fabric has been penetratively deformed by folds with east- to east-southeast-plunging hinges, the wavelength of which ranges from a few centimetres to ~100 metres. These folds are interpreted as being associated with thrusting. The relationship between D_2 and the Tasiujaq thrust is presently uncertain, as is the equivalence of S_{1b} here to S_{1b} in the MRG.

In Mesoproterozoic strata, which are largely subhorizontal, moderate dips of up to 40° are documented adjacent to nonconformable contacts, associated with open drag folds attributed to normal-sense displacements along the syn- to postdepositional White Bay and Tikerakdjuak fault zones (Figure 8a).

Late normal faults are recognized near Pond Inlet, most notably an east–west-striking fault that extends at least 45 km, forming an escarpment from the coast to the northern head of Utsuk and further eastward to the glacier (Figure 2). Along the northern downthrown side, gneissic monzogranite/quartz diorite is gossanous and contains abundant fine-grained, disseminated magnetite that may have resulted from fault-related fluid alteration. Offshore faults have been interpreted from a combination of seismic data (Kenquest Exploration, 1971), seafloor bathymetry (from ArcticNet and University of New Brunswick), and aeromagnetic data.

Regional tectonic considerations

The tectonostratigraphic framework based on the 2017 fieldwork sets the stage for research into regional tectonics. Geochronological and geochemical characterization of basement gneiss and plutons will help determine the Archean cratonic affinity of northern Baffin Island. Resolving the metamorphic and structural history of the study area will fill a gap in the understanding of Baffin Island geology, and may lead to tectonic links with other regions. For example, the age, stratigraphy and tectonic history of the MRG are important for proposing correlations with greenstone belts of the mainland Rae Craton, such as the Prince Albert and Roche Bay greenstone belts (Corrigan et al., 2013) on Melville Peninsula, or with the Melville Bugt group of West Kalaallit Nunaat (e.g. Dawes, 2006). The Tasiujaq thrust may represent the far-field expression of one of several orogens (St-Onge et al., 2015b), including the Arrowsmith (ca. 2.5–2.3 Ga), Ellesmere-Inglefield (ca. 1.96–1.92 Ga) or Trans-Hudson (ca. 1.88–1.80 Ga). Resolving these questions is key for plate-tectonic reconstructions of northeastern Nunavut, with potential implications for regional correlations between mineralized terranes. Elucidating structural elements associated with Paleoproterozoic tectonic events (Trans-Hudson Orogen; Taltson-Thelon Orogen), is of particular relevance to genetic models for Fe-mineralization at Mary River (MacLeod, 2012).

Economic considerations

Mineral deposits, showings and occurrences in parts of the Pond Inlet–Mary River area have been summarized in several publications (Jackson, 1969, 2000; Jackson and Sangster, 1987; Young et al., 2004; Johns and Young, 2006; Harrison, 2015) based on fieldwork and the compilation of industry assessment reports. In addition to iron-formation and associated economic iron deposits of the MRG, sparse Cu, Mo, Pb-Zn, gypsum, and coal showings have been documented. As highlighted by Saumur et al. (2017), northern Baffin Island could also be prospective for a variety of commodities based on potential regional correlations with resource-endowed units and terrains, and/or geologically analogous terrains further afield. Notable examples include: significant Mississippi Valley Type Zn-Pb mineralization in the Bylot Supergroup ~200 km to the northwest of the field area (Nanisivik; e.g. Patterson and Powis, 2002; Turner, 2011); thickened, kimberlite-bearing Archean gneiss of southern Baffin Island (Chidliak diamond district, Hall Peninsula, e.g. Nichols et al., 2013); Au-, magmatic Ni- and Fe-bearing greenstone belts of mainland Rae Craton to the southwest (e.g. Houlé et al., 2012; Corrigan et al., 2013); various localities of ilmenite, pyrite, magnetite, and copper mineralization at Melville Bugt, northwest Kalaallit Nunaat (Dawes, 2006); and carving stone occurrences on southern Baffin Island and in the Repulse Bay block (e.g. Beauregard and Ell, 2015).

New field observations have further documented and constrained previously recognized mineral showings, as well as identified new showings and constrained economically prospective units, which are described below.

Iron-formation

Several previously identified occurrences were targeted for detailed study, notably the “Tuktuliarvik” (Bros and Johnston, 2017) and Felsenmeer flats areas. Generally, the iron-formation is classified as Algoma-type, and consists of fine (millimetre- to centimetre-scale) intercalations of magnetite-hematite and quartzite. Bodies are laterally discontinuous at the mesoscale, forming boudins within other supracrustal units of the MRG. Continuing mapping efforts will constrain the regional extent and structure of the various iron-formation units, which will benefit future exploration efforts.

Zn-Pb

Minor sphalerite and galena have been identified within the hanging wall of the White Bay fault, notably along the eastern coast of Tay Sound (M.D. Young, unpublished notes, 2003), where mineralization is hosted within the Iqqittuq Formation (Young et al., 2004). This likely represents subordinate mineralization to that observed within stratigraphically equivalent units at Nanisivik (Figure 1; e.g. Turner, 2011). Late faulting along the White Bay fault may have provided pathways for hydrothermal fluids, thereby promoting local remobilization and transport of metals.

Carving stone and soapstone

Carving stone is documented in small volumes throughout the greenstone belts of NTS 37-G (Young et al., 2004). In addition, one notable new soapstone occurrence was encountered on NTS 38-B, at Tuqqajaat, where strongly serpentinized peridotite forms part of an ultramafic-mafic intrusion.

Ni-Cu-platinum group elements (PGE)

The potential for Ni-Cu-PGE mineralization in mafic and ultramafic volcanic and subvolcanic rocks of the MRG and Franklin dykes has been noted by Young et al. (2004) and Johns and Young (2006). Several new occurrences of pyrite, pyrrhotite, and chalcopyrite mineralization within mafic-ultramafic intrusive units were noted in the study area. In particular, the Kangiqłuruluk layered mafic-ultramafic intrusion contains sparse units that host trace to disseminated sulphide mineralization. Such environments could be prospective as they have been shown to be prone to magmatic Ni-Cu-PGE mineralization, for example the Raglan deposit of northern Quebec (St-Onge and Lucas, 1994; Lesher, 2007).

Future work

A second phase of bedrock geology mapping is planned for the summer of 2018 in NTS 37-E and F. In order to determine the timing of igneous crystallization and supracrustal deposition of the main map units, 12 samples were collected in the summer of 2017 for U-Pb zircon geochronological analyses. Together with in situ U-Pb monazite dating and quantitative petrology in selected samples, these analyses will also help establish the timing of regional metamorphism and deformation. A Master's thesis, based at the University of Alberta, will focus on tectonostratigraphy, structure, and metamorphism of the MRG and surrounding quartzofeldspathic units exposed in the "Tuktuliarvik" area (Bros and Johnston, 2017). This work will be complemented by research at the University of Cambridge concentrating on the pressure-temperature conditions and timing of metamorphism in the MRG.

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Coordinate System

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

Bounding Coordinates

Western longitude: 80°31'00"W
Eastern longitude: 78°35'00"W
Northern latitude: 72°35'00"N
Southern latitude: 72°00'00"N

Software Version

Data has been originally compiled and formatted for use with ArcGIS™ desktop version 10.2.2 developed by ESRI®.

DATA MODEL INFORMATION

Bedrock (Quebec)

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.