Preliminary geophysical interpretation of the McKeand River area, southern Baffin Island, Nunavut: insights from gravity, magnetic and geological data

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This work was part of the larger South Baffin mapping project, a partnership between the Canada-Nunavut Geoscience Office (CNGO) and Natural Resources Canada’s (NRCan) Geo-mapping for Energy and Minerals (GEM) Program on Baffin Island. This particular mapping project is being led by the Geological Survey of Canada (GSC) in collaboration with CNGO, the Government of Nunavut, Nunavut Arctic College, Carleton University and Oxford University. Logistical support is provided by the Polar Continental Shelf Project and several local, Inuit-owned businesses. The study area comprises all or parts of six 1:250 000 map areas north of Iqaluit (NTS 26B, C, F, G, K and J). The objective of the work is to complete the regional bedrock mapping for the southern half of Baffin Island and provide a new, modern, geoscience understanding of this part of eastern Nunavut.


Abstract

The recently completed McKeand River and Amittok Lake aeromagnetic surveys on southern Baffin Island, Nunavut provide a new high-resolution magnetic dataset over an area with no previous coverage. Complemented by regional gravity data, newly acquired rock-property information and geological-mapping products, the aeromagnetic dataset yields qualitative and quantitative information on the structure and geology of the underlying bedrock. This paper presents a preliminary interpretation of these datasets that delineates three gravimetric and five magnetic domains. The gravity data outline a broad negative anomaly associated with a plutonic-intrusive suite, as well as several isolated gravity highs associated with metasedimentary strata. Magnetic domains are defined on the basis of anomaly amplitude, wavelength and texture, and are correlated to the mapped geology and magnetic properties. Associations between potential-field anomalies, physical properties and mineral occurrences help define the regional distribution of economically significant horizons.

Résumé

Les levés aéromagnétiques récemment réalisés dans la région de la rivière McKeand et du lac Amittok, dans le sud de l’île de Baffin, au Nunavut, fournissent de nouvelles données magnétiques à haute résolution d’une région qui en était auparavant dépourvue. Conjuguées aux données gravimétriques régionales, à l’information nouvellement acquise au sujet des propriétés pétrographiques et aux produits de cartographie géologique, les données aéromagnétiques fournissent des informations de nature qualitative et quantitative sur la structure et la géologie de la roche en place sousjacente. Cet article présente une interprétation préliminaire de ces ensembles de données qui délimitent trois domaines gravimétriques et cinq domaines magnétiques. Les données gravimétriques mettent en relief une grande anomalie négative associée à une suite intrusive plutonique, ainsi que plusieurs anomalies positives isolées associées aux strates de roches métasédimentaires. Les domaines magnétiques sont définis en fonction de l’amplitude, de la longueur d’onde et de la texture de l’anomalie, et sont mis en corrélation avec les unités géologiques cartographiées et les propriétés magnétiques. La relation entre les anomalies gravimétriques et magnétiques, les propriétés physiques et les venues minérales aide à définir la répartition régionale des horizons d’importance économique.

This publication is also available, free of charge, as colour digital files in Adobe Acrobat® PDF format from the Canada-Nunavut Geoscience Office website: http://cngo.ca/summary-of-activities/2015/.
Introduction

Used extensively for bedrock mapping, potential field (gravity and magnetic) maps provide continuous datasets over broad swaths of land. Laterally adjacent, contrasting physical properties (density and magnetic susceptibility) generate potential-field anomalies due to the presence (positive anomaly) or absence (negative or absent anomaly) of dense or magnetic minerals within underlying bedrock units. Subtle compositional differences create textural contrasts and discontinuities on the potential-field maps, and assist in the delineation of distinct geophysical domains that often coincide with distinct map units, lithotectonic domains, geological provinces or terrain boundaries (e.g., Pilkington et al., 2000). Anomaly amplitude and wavelength, and the orientation of magnetic lineaments provide additional information on the structure, geometry and lithology of discrete rock packages. Prospective units identified from outcrop can thus be identified and geophysically characterized for aerially constrained detailed follow-up. Geophysical interpretations supplement the geological knowledge, adding value and precision to the geological interpretation.

On southern Baffin Island, Nunavut, detailed geoscience data were previously lacking, limited to reconnaissance-scale mapping in the mid-1960s (Blackadar, 1967). Informed exploration and development of this region requires modern geoscience knowledge to minimize financial risks and exploration costs associated with focused ground follow-up. The Geo-mapping for Energy and Minerals (GEM) program addressed this knowledge gap through the Southern Baffin Island Mapping Project (Rayner et al., 2015). During eight weeks of fieldwork in 2015, all or parts of six 1:250 000 map areas (NTS 26B, C, F, G, J, K) were mapped at 1:100 000 scale. To support the bedrock mapping and compilation effort, two high-resolution magnetic surveys (Kiss and Tschirhart, 2015a, b) were flown over the study area, generating a continuous magnetic dataset for southern Baffin Island. Geophysical fieldwork, conducted in conjunction with the geological mapping, included sampling of anomalous units to determine the nature of the magnetic properties of the bedrock and to calibrate the magnetic rocks with their respective magnetic anomalies. This paper provides an overview of these investigations and presents the first potential-field interpretive products for the southern Baffin Island region via detailed integration of magnetic, gravity and geological datasets. The geophysical responses of key lithotectonic features are described and provide insight on the spatial distribution of potentially mineralized rock types, including kimberlite pipes, layered mafic–ultramafic intrusions and sulphide-bearing metasedimentary packages. Future analysis characterizing the densities of anomalous units is planned and will further constrain the modelling of regional gravity and a high-resolution ground-gravity transect.

Geological setting

The study area (Figure 1) is underlain by Archean and Paleoproterozoic rocks that have been variably deformed and metamorphosed during the accretionary and continental-collision phases of the Trans-Hudson Orogen (THO). The THO has a broad arcuate shape, extending from northeastern to south-central North America (Hoffman, 1988), and its formation involved the northward subduction of the Superior craton beneath an amalgamation of crustal blocks (Churchill plate) from 1.92 to 1.80 Ga (St-Onge et al., 2006b, 2009). Three orogen-scale, stacked tectonic elements separated by major crustal structures underlie southern Baffin Island (Figure 1; St-Onge et al., 2015).

From east to west, the bedrock in the project area comprises three major crustal entities (Figure 1):

- 2.92–2.80 Ga gneissic rocks of the Hall Peninsula crystalline basement (Scott, 1999; From et al., 2014; Steenkamp and St-Onge, 2014)
- metasedimentary units of the <2.01 to >1.90 Ga Lake Harbour Group, which include quartzite, amphibolite, calc-silicate, semipelite, pelite and psammitite, and local mafic-ultramafic metavolcanic sills (St-Onge et al., 2006a; Machado et al., 2013; Steenkamp et al., 2014)
- 1.865–1.845 Ga metapelitic units of the Cumberland Batholith (CB), comprising voluminous granodiorite to monzogranite (Whalen et al., 2010), that intrude the above units

All of the above are crosscut by ca. 720 Ma basaltic Franklin dykes, trending 110–120° (Heaman et al., 1992).

Geophysical datasets

Magnetic data

The McKeand River (Miles et al., 2015) and Amittok Lake magnetic surveys were acquired from August 5, 2014 to April 5, 2015 along east-west flight lines spaced 400 m apart and flown along a smooth drape surface at a height of 150 m. The surveys were funded jointly by the Canada-Nunavut Geoscience Office (CNGO) and GEM to support the bedrock-mapping program. The study area (Figure 2a) includes five individual surveys (Figure 2b) that were merged to create a continuous magnetic dataset. The regional magnetic data (survey NWT#31, 805 m line spacing; Natural Resources Canada, 2015) in the north were reprocessed to remove corrugations in the flight-line direction and stitched to the Amittok Lake data (Kiss and Tschirhart, 2015a). In the south, the Hall Peninsula survey (400 m line spacing; Dumont and Dostaler, 2010) and the South Baffin area IC survey (805 m line spacing; Natural Resources Canada, 2015) were stitched to the McKeand River data (Kiss and Tschirhart, 2015b). The stitched northern and southern datasets were merged to create a compilation residual total field (RTF) map for southern...
Baffin Island (Figure 2a). The datasets are available for download from the Geological Survey of Canada’s (GSC) Geoscience Data Repository (http://gdr.agg.nrcan.gc.ca/gdrdap/dap/search-eng.php).

Additional information relevant to geological interpretation was extracted from the RTF grid through the use of source edge detection (SED) processing. The SED routines have been used extensively by geophysicists to provide additional information on the structure and geometry of geological sources associated with magnetic anomalies. They operate by maximizing derivative-based mathematical functions over the magnetic source or source edge, which enhances subtle contrasts in physical properties. An edge, as discussed herein, is presumed to be a boundary that can be stratigraphic, intrusive or tectonic in origin. The first vertical derivative and tilt derivative (Miller and Singh, 1994) grids were calculated from the RTF data. The first vertical derivative accentuates short-wavelength, near-surface features within the upper crust, whereas the tilt derivative acts as an automatic gain-control filter that enhances all features equally (Nabighian et al., 2005). The enhanced magnetic signatures provided in these derivative maps help identify features such as faults, folds and the textural characteristics of magnetic-lithological units.

Magnetic susceptibility was measured on field samples and in outcrop using a Terraplus KT-10 magnetic-susceptibility meter. The values are summarized in Table 1. No magnetic remanence information was available for this study area.

Gravity data

The regional gravity database for southern Baffin Island is based on ground gravity measurements spaced 12–15 km apart, which have been used to derive a 2 km grid using

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**Figure 1:** Regional geology of southern Baffin Island, Nunavut.
minimum curvature. The data and grid are available online from the GSC’s Geoscience Data Repository (http://gdr.agg.nrcan.gc.ca/gdrdap/dap/search-eng.php). The isostatically corrected Bouguer gravity that was used for the interpretation reflects density variations in Earth’s upper and lower crust. The large station spacing only permits resolution of features wider than 25 km; it is therefore useful only for delineating major tectonic or lithological elements and crustal boundaries. At the time of writing, no density measurements were available for the study area. Gravity anomaly correlations to specific rock types are based on analogous physical-property data (V. Tschirhart, unpublished datasets, 2009–2014).

**Interpretation products**

**Regional gravity anomalies**

Within the study area, the Bouguer gravity grid (Figure 3) is dominated by three broad, long-wavelength anomalies:

- an east-southeast-trending low (L1, –53 mGal amplitude) that transects the study area from Cumberland Sound to Foxe Basin.

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**Figure 2:** a) Residual total field (RTF) data for the study area (green outline), southern Baffin Island, Nunavut; labels explained in the text. b) Location of aeromagnetic surveys within the study area.
• north-northwest-trending highs (H1, 20–26 mGal amplitude, and H2, 15 mGal amplitude) that extend from Hall and Meta Incognita peninsulas to the southern margin of the study area, respectively, and taper slightly toward the north-northwest
• a high flanked by steep gradients (H3) in the northeastern corner of the study area

The area of L1 and its neighbouring moderate (~35 to ~28 mGal) gravity anomalies is mapped as CB intruding Archean basement and Paleoproterozoic metasedimentary belts. The wavelength and amplitude of L1 suggest the presence at depth of significant volumes of low-density (<2.67 g/cc) rocks, such as CB granitoid rocks, as opposed to denser Archean gneissic basement (>2.70 g/cc; V. Tschirhart, unpublished datasets, 2009–2014). Isolated enclaves and panels of metasedimentary strata mapped at the surface (Figure 3), which have a higher mean density than that of CB granitoid rocks, are of insufficient spatial extent, and presumably thickness, to produce positive gravity responses given the large gravity-station separation.

Rafts of Lake Harbour and Piling Group metasedimentary strata within the CB provide tectonostratigraphic constraints on the location of the Baffin suture (Figure 1; St-Onge et al., 2009; Whalen et al., 2010; Weller et al., 2015), which is interpreted to record the 1.883–1.865 Ga accretion of the upper-plate Meta Incognita microcontinent to the Rae craton (St-Onge et al., 2006b, 2009; Whalen et al., 2010). In many areas, regional gravity data have been used to demarcate cryptic tectonic sutures by identifying paired positive and negative gravity anomalies, where the trace of the suture is at the inflection point between the positive and negative anomalies (Gibb et al., 1983; Thomas, 1992). In the northeastern portion of the study area, the projected location of the Baffin suture follows the southern flank of H3 before angling to the west and crosscutting moderate to low gravity anomalies (Figure 3). However, the exact location of the Baffin suture is obscured by the emplacement of the CB and accompanying widespread crustal melting (Whalen et al., 2010). As the CB intruded after accretion, its negative gravity effect may have modified any pre-existing paired positive and negative anomalies that may have been present.

The H1 gravity high extends north-northwest from western Hall Peninsula, and a parallel high (H2) with a similar amplitude extends north-northwest from Meta Incognita Peninsula (Figure 3). The H1 high coincides with three distinct entities (Figures 2, 4): Archean gneiss, CB, and the Lake Harbour metasedimentary strata, which coincide with the central axis of the high. With a width of >85 km, the anomaly presumably corresponds to a large volume of relatively high density material that apparently differs from the mapped surface bedrock geology. Comprising mainly low-density CB, the peninsulas also include moderately dense metasedimentary strata and Archean gneiss. No large-scale, dense lithological entities have been mapped at surface, suggesting the high is related to a feature at depth. Layered mafic and ultramafic sills emplaced in the metasedimentary rocks have been documented extensively on both peninsulas (Figure 3; Machado et al., 2013; Steenkamp et al., 2014; St-Onge, et al., 2015) and exhibit Ni-Cu-platinum group element (PGE) potential. If these are contemporaneous, they indicate the presence of intrusive activity on a huge scale. St-Onge et al. (2015) proposed that events of such a size could correspond to a large-igneous province (LIP) event, which can be associated with significant volumes of high-density crustal bodies (Ernst and Buchan, 1997). Figure 3 shows the location of mafic-ultramafic occurrences (purple dots from St-Onge et al., 2006; Steenkamp et al., 2014; St-Onge et al., 2015) and exhibit Ni-Cu-platinum group element (PGE) potential. If these are contemporaneous, they indicate the presence of intrusive activity on a huge scale. St-Onge et al. (2015) proposed that events of such a size could correspond to a large-igneous province (LIP) event, which can be associated with significant volumes of high-density crustal bodies (Ernst and Buchan, 1997). Figure 3 shows the location of mafic-ultramafic occurrences (purple dots from St-Onge et al., 2006; Steenkamp et al., 2014; St-Onge et al., 2015) on the gravity map. The majority of occurrences are concentrated on or around the margins of H1 or H2, warranting additional gravity modelling to examine the source of the highs and to determine if there are any links to mafic-ultramafic occurrences. Alternatively, the gravity highs may relate to the juxtaposition of accreted plates and resulting lithospheric flexure from closure of the Baffin suture (Pilkington, 1990), which could also be investigated by modelling.

<table>
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<tr>
<th>Lithology</th>
<th>Average susceptibility (10^-7 SI)</th>
<th>Log average susceptibility (10^-2 SI)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>No. of samples</th>
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Figure 3: Regional gravity data for the McKeand River study area (green outline; labels as discussed in text); location of mafic-ultramafic occurrences from St-Onge et al. (2006a), Steenkamp et al. (2014) and St-Onge et al. (2015) plotted as purple circles; projected location of Baffin suture (St-Onge et al., 2009) shown by dashed black line and geological contacts from Figure 1 as thin solid white lines.
Magnetic domains

Schetselaar et al. (2013) constructed a remote predictive map for Hall Peninsula, which includes the southeastern limit of the present study area, using remote-sensing imagery, digital elevation models and magnetic data. Map development included subdividing the area into three magnetic domains. In the present study, magnetic texture, amplitude and wavelength are used to subdivide the McKeand River area into five magnetic domains (M1–M5 on Figures 2, 4, 5), M2 generally coinciding with the projected northern extent of the CB domain of Schetselaar et al. (2013), M3 with their high-grade mobile-belt domain and M4 with an Archean gneiss-supracrustal domain.

Figure 4: First vertical derivative of the magnetic field over the McKeand River study area (green outline; labels as discussed in text), with known kimberlites plotted as white diamonds (Pell, 2010) and Keating correlation coefficients (Kiss and Tschirhart, 2015b) as white circles scaled to the coefficient values. A high correlation coefficient (>90) indicates a closer match between the observed and modelled magnetic anomalies, with a value of 100 indicating a perfect match.
The largest and most prominent features are in M1, located west of latitude 68°W and extending most of the length of the map area. The anomalies are curvilinear and oriented in a number of directions, and correspond to variable magnetic CB with magnetic susceptibilities ranging from 0.08 to 71.4 × 10⁻³ SI (Table 1). Phase-equilibrium modelling of a representative sample of CB documents competing orthopyroxene and magnetite stability fields (Weller et al., 2015), consistent with field magnetic-susceptibility measurements and remote imagery showing highly variable magnetic properties within individual plutonic bodies. Distinct fold hinges and robust deformation features are visible in the RTF (Figure 2a) and enhanced by the SED data (Figures 4, 5), and correlate with regional structural elements (Figure 2). A distinct gabbroic body is responsible for the largest magnetic anomaly in the study (indicated by a white ‘×’ on Figure 2a; maximum magnetic susceptibility of 96 × 10⁻³ SI, >3500 nT in amplitude). The gabbro is coarse grained and layered, varying in composition from hornblende gabbro to leucogabbro and anorthosite.

The M1 domain is flanked to the east by M2, a north-south belt of nonmagnetic rocks punctuated by circular to elongate magnetic anomalies and moderately magnetic CB curvilinear textures (Figure 2a). The CB monzogranite and Lake Harbour Group metasedimentary rocks have a similar average and range of magnetic susceptibilities (Table 1); however, the most magnetic psammite measured in the field corresponds to thin layers within a more extensive nonmagnetic sequence. This is reflected as a distinct magnetic signature where pronounced, elongate magnetic anomalies in M2 are interpreted to outline bands of magnetic psammite. With the exception of these psammite strata, rafts of other Lake Harbour Group metasedimentary rocks encountered in the field (e.g., pelite, semi pelite and psammite) did not have a pronounced magnetic signature or texture (Figure 2a; Table 1) and, as such, would be magnetically transparent. Within an area of predominantly CB intrusive rocks, it would thus be difficult, if not impossible, to remotely locate discrete packages of Lake Harbour Group metasedimentary rocks on the basis of magnetic signature alone. The subdued magnetic response of M2 relative to the strong magnetic signature of M1 is attributed to extensive Lake Harbour Group metasedimentary strata being present over a larger area.

A pronounced belt (M3) of linear north-south aeromagnetic highs separates the eastern (M2) domain and western (M4) Hall Peninsula gneissic rocks (Machado et al., 2013). The M3 domain is mapped as 1877 Ma magnetite-bearing tonalitic-granodioritic plutons (Scott, 1999; Steenkamp et al., 2014) that intrude both the M2 and M4 domains. In the eastern part of M4, the magnetic texture changes notably across a moderately magnetic background dominated by stippled positive anomalies that lack the pronounced linear north-northwesterly-striking magnetic fabric along the western margin. The Hall Peninsula Archean gneissic rocks host the diamondiferous Chidliak kimberlite field, and several of the stippled magnetic anomalies correspond to kimberlite pipes (Figure 4, white diamonds; Pell et al., 2013), which have a characteristic magnetic response as circular positive or negative anomalies, depending on the magnetization direction. Although the flight-line spacing of the southern RTF datasets (South Baffin IC, Hall Peninsula and McKeand River) does not permit discrimination of magnetic kimberlites between lines, the signatures of those along the lines will be recorded by the aircraft sensor (Reed and Witherly, 2007).

To determine if such signatures are present, the Keating correlation coefficient (Keating, 1995) was computed on the vertical derivative of the magnetic field (Kiss and Tschirhart, 2015a, b) prior to the 2015 field season. The Keating correlation coefficient uses a pattern recognition technique that consists of computing, over a moving window, a first-order regression between a vertical cylinder anomalous modelled from a known kimberlite and the gridded magnetic data. As a first-order assessment of the kimberlite potential west of, and for the northern extent of, the Hall Peninsula gneissic rocks, prospective kimberlite anomalies are located on the basis of magnetic signature alone (Figure 4, white circles). Ground follow-up of several magnetic ‘pimples’ during the 2015 field season either did not identify the magnetic source or located small plugs of magnetic gabbro within Lake Harbour Group metasedimentary strata.

The M5 domain occupies the northernmost section of the study area and is entirely within the area of the low-resolution magnetic data (Figure 2a). With the exception of a number of isolated Lake Harbour Group or Piling Group metasedimentary enclaves, the field observations mapped dominantly CB within the southern limits of M5. More extensive Piling Group metasedimentary outliers, comprising extensive psammite and pelite and mapped immediately north of the study area (St-Onge et al., 2006a), may contribute to the broader, subdued regional magnetic response of M5.

The 720 Ma Franklin dyke swarm is evident in the RTF and SED images as magnetic highs oriented 110–120° and traversing the length of the study area (Figure 5, blue arrows). A smaller unknown set of dykes that is just beyond the resolution limit of the data (Figure 5, green arrow) was mapped in outcrop. Their 040° trend and subdued magnetic response hinder remote identification because phases of the CB are similarly magnetic and oriented. Additional north-northeast-trending nonmagnetic lineaments (Figure 5, yellow arrows) appear to transect the CB plutonic bodies. Although there is little to no evidence for displacement along these crosscutting magnetic lineations, remote-sensing imagery and field observations suggest the nonmagnetic lin-
eaments reflect a network of fractures and normal faults (Weller et al., 2014) related to the opening of Davis Strait and formation of Cumberland Sound during the Paleocene (Clarke et al., 1989).

**Future studies and economic considerations**

Deposits of Ni-Cu-PGEs are associated with a variety of mafic and ultramafic magmatic rocks, and the tectonostratigraphic context and mineralization styles on Hall and Meta Incognita peninsulas are comparable to those of the Raglan deposit in northern Quebec (Steenkamp et al., 2014; St-Onge et al., 2015). Several new mafic-ultramafic occurrences were documented during the 2015 field season and are being investigated as part of an M.Sc. project (Liikane et al., 2015). Additional planned geophysical modelling will focus on the nature of the regional gravity highs and their relation (if

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**Figure 5**: Tilt derivative of the magnetic field over the McKeand River study area (green outline; labels as discussed in text). Black areas show positive tilt (over magnetic source body) and white areas show negative tilt (outside of magnetic source). Magnetic Franklin dykes (blue arrows), the 040° dykes (green arrows) and non-magnetic lineaments (yellow arrows) are labelled.
any) to mafic-ultramafic occurrences. Disseminated semimassive to massive sulphide occurrences are documented within Lake Harbour Group assemblages in the M2 domain (Liikane et al., 2015). The massive sulphides are moderately magnetic (10 × 10^{-3} SI) with respect to background magnetization values, but the occurrences documented in the field were not sufficiently large (<10 m) to be reflected in the aeromagnetic data.

Diamondiferous kimberlite pipes have been discovered on Hall Peninsula (Pell et al., 2013). The new magnetic surveys provide coverage over the northern extent of the Archean gneissic rocks on Hall Peninsula and to the west. Keating correlation coefficients computed on the first vertical derivative provide a first-order assessment of kimberlite potential (Kiss and Tschirhart, 2015a, b). A detailed gravity transect was conducted during the 2015 field season to further examine the western extension of the Archean gneissic rocks within the project area, and the geometry of the crystalline basement at depth.

Density measurements on selected samples aim to characterize the physical properties of the Hall Peninsula gneissic rocks, Lake Harbour Group supracrustal units and CB intrusive rocks. Provided there is a significant density contrast between the CB and Archean basement rocks, gravity-data inversions offer a method to calculate and then remove the gravity contribution of the CB. The revised data can then be analyzed to determine if gravity anomalies can shed further light on the nature of the Baffin suture.

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References


Keating, P. 1995: A simple technique to identify magnetic anomalies due to kimberlite pipes; Exploration and Mining Geology, v. 4, p. 121–125.


Scott, D.J. 1999: U-Pb geochronology of the eastern Hall Peninsula, southern Baffin Island, Canada: a northern link between the Archean of West Greenland and the Paleo-proterozoic Tornagat Orogen of northern Labrador; Precambrian Research, v. 93, p. 5–26.


