

## DESCRIPTIVE NOTES

# INTRODUCTION

This map is one of a set of three bedrock geological maps which present results of 1:100 000 scale mapping by the eological Survey of Canada (GSC) and the Canada-Nunavut Geoscience Office (C-NGO) in the North Twe Island (OF 4199), Straits Bay (OF 4200), and Dewar Lakes (OF 4201) map areas, central Baffin Island (Fig. 1). An overview of the principal Archean and Paleoproterozoic plutonic and supracrustal units mapped during the first two summers of the three-year (2000–2002) partnered field project are presented in Corrigan et al. (2001) and Scott et al. (in press a). Field work in 2001 led to the completion of bedrock mapping in NTS 37 A and the western half of 27 B and rings to 70% the proportion of the central Baffin area documented on GSC bedrock maps released in 2001 and 2002. rom north to south, the open file maps provide a continuous section across the southeastern margin of the Archea Rae craton, the Paleoproterozoic Piling Group and the northern margin of the ca. 1.87-1.84 Ga Cumberland batholith. The first systematic mapping of the area was undertaken at reconnaissance level between 1965 and 1970 Jackson, 1969, 1978, 1984, 2000; Jackson and Taylor, 1972), and in 1974 and 1975 (Morgan et al., 1975, 1976; Jackson and Morgan, 1978; Morgan, 1983). More detailed work was subsequently initiated in the southeastern portion of the project area, in parts of map sheets NTS 37 A and 27 B (Tippett, 1980, 1984; Henderson et al., 1988, 989; Henderson and Henderson, 1994). The most recent work in proximity to the current project area consists of bedrock mapping and U-Pb geochronology of Archean rocks in the Eque Bay area (Bethune and Scammell, 1997), and a lake sediment and water regional geochemical survey southwest of the Barnes Ice Cap (Cameron, 1986; Friske The work presented below is based on systematic bedrock traverses with approximately three kilometres spacing.

The Central Baffin project area (Fig. 1) straddles the northern margin of the eastern segment of the ca. 1.8 GaTrans-Hudson Orogen (Hoffman, 1988; Lewry and Collerson, 1990), a Himalayan-scale collisional mountain belt that is xposed from Greenland in the east, across Baffin Island and beneath Hudson Bay, to Manitoba and Saskatchewan in the west. The northern part of the map area is underlain by various orthogneisses, metamorphosed sedimentary and rolcanic rocks of the Mary River Group, and younger felsic plutonic rocks, all of Archean age and ascribed to the Rae craton (Jackson, 1969; Bethune and Scammell, 1997; Corrigan et al., 2001). The central part of the area is underlain by siliciclastic, carbonate, and mafic volcanic rocks of the Paleoproterozoic Piling Group (Morgan et al., 1975; 1976; Morgan, 1983; Henderson et al., 1988; 1989; Henderson and Henderson, 1994), and is described in further detail below. A variety of felsic plutonic rocks belonging to the ca. 1.87-1.84 Ga Cumberland batholith are exposed in the southern part of the area. Collectively, this assemblage of rocks is thought to represent a Paleoproterozoic continental margin succession (Morgan et al., 1975) originally deposited on the southern flank of the Archean Rae craton and ubsequently deformed during the Trans-Hudson Orogen (see Corrigan et al., 2001, and references therein).

### TECTONOSTRATIGRAPHIC UNITS

The lowest exposed structural levels of the crust in the project area are represented by Archean basement, which outcrops north of Flint Lake, and as argued below, in domal structural culminations in the southern part of the map area (Fig. 2). Above this, Paleoproterozoic rocks of the Piling Group are preserved in a northeast-trending belt, the southern margin of which is intruded by the Cumberland batholith. As described below, the primary distribution of rock types within the Piling Group varies dramatically across the strike of the belt: carbonate strata are extensively exposed on the northern margin, whereas mafic volcanic rocks are exposed on the southern margin. Regional granulite facies that is manifest by partially melting of Piling Group rocks (St-Onge et al., 2001a, b, c, d). In the ollowing sections, the rocks are described from lowest to highest structural levels, based on the results of new 1:100 000-scale mapping on NTS map sheets 37 A and 27 B (west half).

In addition to continuous exposures north of Flint Lake (Fig. 2: St-Onge et al., 2001a, b: Corrigan et al., 2001), a range of dominantly felsic gneisses and weakly deformed plutonic rocks crops out in a series of structural domes (Tippett 1980; 1984; Henderson and Henderson, 1994) in the vicinity of Dewar Lakes (Fig. 2; OF 4201). The most abundant components within the gneisses (unit Agn) range in composition from biotite  $\pm$  hornblende granodiorite to monzogranite (Fig. 3); biotite + hornblende tonalite layers are rare. Mafic layers are only locally present, and range in composition from hornblende  $\pm$  biotite diorite to rare clinopyroxenite. Individual layers vary in thickness from several entimetres to several metres. Based on lithologic and compositional similarities with gneissic rocks north of Flint

Lake, which range from ca. 2.85-2.71 Ga (Jackson et al., 1990; Bethune and Scammell, 1997), we concur with

previous suggestions (Tippett 1984; Henderson and Henderson, 1994) that the gneisses exposed in the cores of the

omes are probably also Archean. West of Dewar Lakes (OF 4201), a panel of pelitic to psammitic metasedimenta

rocks with abundant biotite and melt pods (unit AMp) is interlayered with the orthogneiss. A representative suite of

ORTHOGNEISS, METASEDIMENTARY, AND PLUTONIC ROCKS (units Agn-Agk)

samples for U-Pb geochronology has been collected to test this correlation

expose the southernmost, deformed edge of the Rae craton.

The gneissic layering is truncated in numerous localities (OF 4200 and 4201) by weakly- to moderately foliated plutonic rocks that range in composition from biotite monzogranite (unit Agr) to rare syenogranite (unit Agk). The age of some of these rocks is uncertain; some plutonic units with similar physical characteristics in the Flint Lake area have yielded late Archean ages, whereas others include rafts and xenoliths of Piling group rocks and are therefore nterpreted as Paleoproterozoic (Corrigan et al., 2001). The gneissic domes are mantled by quartzite and other supracrustal rocks of the Piling Group (Fig. 2). As described below, the contact is tectonic, indicating that the gneisses exposed in the domes represent a structural asement to the Paleoproterozoic rocks. Based on lithologic and structural similarities, and pending the results of

planned U-Pb geochronological investigations, we suggest that these culminations represent erosional windows that

## PILING GROUP (units PPD-PPLg)

Rocks of the Paleoproterozoic Piling Group are part of an extensive package (Jackson and Taylor, 1972) that is exposed as far west as the southern Melville Peninsula (Penrhyn Group; Henderson, 1983) and eastward to the coast of West Greenland (Karrat Group; Taylor, 1982). The informal stratigraphic nomenclature of the Piling Group was established by Morgan and coworkers (Morgan, 1983; Tippett, 1984). These units, and their relationships to one another, are described in further detail below.

## DEWAR LAKES FORMATION (unit PPD)

The stratigraphically lowest supracrustal unit comprises white- to grey-weathering quartzite (Fig. 4) and feldspathic quartzite, locally interbedded with psammite and pelite (unit PPD). Bedding is tens of centimetres to ca. 1 metre thick, grains range from fine sand to granules. Primary sedimentary structures, such as planar lamination and crosspedding (Fig. 5), have only rarely been observed. Sillimanite and muscovite are present in areas of highest netamorphic grade. The thickness of this unit is not accurately known; estimates derived from the width of exposures range from several hundreds of metres to in excess of 1 km across the map area (OF 4201). The extent to which these apparent thicknesses are affected by early isoclinal folding, or tectonic (thrust) repetition, is not well constrained. The uppermost part of the formation, approximately several hundreds of metres thick, is characterized by thinly edded quartzite to psammite and rusty semipelite to pelite (Fig. 6). The higher proportion of pelitic material in the uppermost parts of the formation, is consistent with a postulated deeper, more distal(?) depositional setting The basal contact with the underlying gneissic rocks (unit Agn) is deformed at all observed localities (Fig. 2), such that it is not possible to unequivocally demonstrate a primary depositional relationship. The lowest exposed he trend of the lineations ranges from 301° in the east (OF 4201), to 289° in the west (OF 4199). The underlying orthogneisses (unit Agn) are also strongly recrystallized, with comparably oriented, planar fabrics developed parallel to those of the overlying quartzite, for distances of up to several tens to hundreds of metres structurally below the contact with the quartzite. Shear-sense indicators are rare, making it difficult to systematically document the sense of tectonic displacement throughout the map area.

Detrital zircons from a single sample of quartzite (unit PPD) from this formation in the vicinity of Dewar Lakes (OF 201) have a bimodal age distribution: one population is ca. 2.85–2.84 Ga, the other is ca. 2.18–2.16 Ga (Henderson and Parrish, 1992). The Archean detritus is similar in age to known felsic plutonic rocks that form extensive parts of the Rae craton, exposed to the north of the Piling group (see Bethune and Scammell, 1997), suggesting that the silicilastic rocks represent a passive margin clastic sheet that was deposited on Rae basement. The younger grain population limits the depositional age of the entire Piling Group to younger than 2.16 Ga; the source of this detritus is enigmatic, because extensive exposures of rocks of this age are not known in northeast Laurentia (cf. Scott and Gauthier, 1996; Scott et al., in press b).

## FLINT LAKE FORMATION

In the northern part of the project area (St-Onge et al., 2001a, b, c), white- to grey weathering dolostone, marble, and calcsilicate units are interlayered with minor to rare siliciclastic material (Corrigan et al., 2001). These rocks are most extensively exposed north of Flint Lake (Fig. 2), where they overlie quartzite of the Dewar Lakes Formation (Corrigan e al., 2001). The base of the formation is placed at the lowest, decimetre-thick beds of carbonate material; a transitional interval, locally up to several tens of metres thick, comprises carbonate interbedded with siliciclastic material. The contact, where exposed, is generally parallel to the stratification in the underlying quartzite. Above the transition interval, carbonate beds range from centimetres to decimetres thick (Fig. 8). Fine, sub-centimetre laminations are only rarely preserved (Fig. 9), but are well-developed in the area immediately northwest of Flint Lake (Fig. 2) Metamorphic assemblages commonly include diopside, phlogopite, and humite, as well as rare spinel and olivine. A comprehensive overview of the petrology of the carbonate rocks is presented by Gagné (2001). The maximum thickness of this formation is estimated to be 500-1000 m. The thickness of individual exposures

and the overall abundance of carbonate material decreases toward the south, such that only minor, thin exposures of carbonate material were noted in the 2001 mapping area, typically as lenses several metres to tens of metres thick, in conformable contact with underlying Dewar Lakes Formation quartzite (unit PPD). The rocks of the Flint Lake the contiguous Rae basement in the northern parts of the project area is consistent with the interpretation of a southfacing continental margin.

## BRAVO LAKE FORMATION (units PPBm-PPBs)

carbonate rocks has not been observed.

In the southern part of the project area (Fig. 2), mafic volcanic rocks and mafic and ultramafic sills (unit PPBm) are commonly interbedded with sedimentary rocks (unit PPBs: Tippett, 1984). The base of the formation is placed below the mafic volcanic rocks that conformably overlie quartzite, psammite and rusty semipelite (unit PPD) of the Dewar actinolite + epidote, whereas hornblende + actinolite characterize the higher-grade assemblages. The geochemistry of the matic and ultramatic rocks of the Bravo Lakes Formation is the subject of an ongoing Ph.D. project (S. Modeland, McGill University) and a B.Sc. project (J. Gladstone, McGill University). The tectonostratigraphy and mineral assemblages within a klippe west of the Western River (OF 4200) form part of an M.Sc. thesis study by J. Stacey (University of Calgary). There appears to be a systematic variation in the nature and distribution of mafic and ultramafic rocks (unit {PBm}) within the Bravo Lake Formation, with the overall abundance of these units increasing from east to west across the project area (Fig. 2). Whereas the mafic and ultramafic rocks of the Brayo Lake Formation (southern part of the project area; Fig. 2) and the carbonate rocks of the Flint Lake Formation (northern part of the project area; Fig. 2) both overlie iciclastic rocks of the Dewar Lakes Formation (unit {PD), the stratigraphic relationship between the volcanic and

In the eastern part of the project area (Ridges Lake; OF 4201), massive mafic flows and breccias as well as mafic and rare ultramafic sills (unit PPBm) are interbedded with quartzite, psammite, and, at higher stratigraphic levels, semipelite and rare calcsilicate rocks (unit PPBs). Individual flows are typically several metres thick, and can be traced along strike for tens to hundreds of metres. Coarsely crystalline sills are typically tens of metres thick and hundreds of metres long; the thickest sills are up to several hundred metres thick. Where sills are emplaced into semipelitic rocks in the upper part of the Bravo Lake Formation (unit PPBs), extensive rusty, reddish-brown colour anomalies are widespread, disseminated sulphide mineralization (dominantly pyrite) is common, and thin seams of pyrite and minor pyrrhotite have been observed.

At several well exposed localities southwest and east of Ridges Lake (OF 4200 and OF 4201), the uppermost part of the Bravo Lake Formation is characterized by a several metre thick interval of thinly layered carbonate material interbedded with silicate- and oxide-facies iron-formation (Fig. 10) and minor matic clastic material. This interval is reminiscent of the lowermost Astarte River Formation (see below), north of Flint Lake (Fig. 2). The overall thickness of the Bravo Lake Formation in the vicinity of Ridges Lake is estimated to be on the order of 2 km. West of Nadluardjuk Lake (OF 4200), mafic flows and flow breccias (unit PPBm) are volumetrically dominant relative to sedimentary rocks (unit PPBs). The stratigraphically lowest flows, together with thin mafic to ultramafic sills, lie above rusty semipelite and psammite, clastic rocks that are here interpreted as the uppermost part of the Dewar akes Formation (unit PPD). Upsection, several hundred metres of mafic flows and sills, and subordinate cumulate-

extured ultramafic sills, are present. Fragmental and massive mafic flows overlie the sills; rare pillowed flows indicate that the section is upright (Corrigan et al., 2001). The volcanic flows and breccias are locally intercalated with finely panded to massive calcisilicate material and volcaniclastic sedimentary beds. The uppermost part of the formation is not exposed; the aggregate preserved thickness of the Bravo Lake Formation west of Nadluardjuk Lake (OF 4200) is estimated to be approximately 800-1000 m. At the mouth of Straits Bay (OF 4200), a number of very well exposed, low-lying islands exhibit a spectacular array of primary volcanic textures. The largest of these islands, informally named Pillow Island, is dominated by at least two

distinct types of pillowed flows (unit PPBm). The stratigraphically lower pillows have a pale green matrix and medium to coarse (< 5 cm) phenocrysts of clinopyroxene. The overlying pillows are darker green with a mottled appearance that possibly mimics a relict primary (plagioclase?) porphyritic texture (Fig. 11). Several metres of ferruginous clastic sedimentary material are present near the top of the lower pillows. Numerous populations of mafic to intermediate dykes feed and cross-cut the pillowed flows. Fine- to medium grained matic dykes are aphyric, and intrude mottled and pale pillowed flows (Fig. 12). At one locality, at the northwest corner of Pillow Island, a clinopyroxene-phyric dyke appears to feed a cluster of clinopyroxene-phyric pillowed flows; on the southern side of the island, these dykes intrude the mottled pillows. A fine-grained dyke of intermediate composition (diorite?) intrudes the mottled pillows and aphyric dykes; a sample has been collected for U-Pb geochronology. The top of unit PPBm is not observed in this area. Henderson and Henderson (1994) report a U-Pb age of 1883.3  $\pm$  4.7 Ma for a mafic sill in the vicinity of Ridges ake (OF 4201). This sill has been interpreted as part of the Bravo Lake magmatic event; if correct, all rocks of the illing Group that overlie the Bravo Lake Formation are bracketed to younger than ca. 1883 Ma. Alternatively, the

#### dated sill may be part of a distinctly younger event, in which case the host sedimentary succession must be older Additional samples for U-Pb geochronology were collected from several sills in the Bravo Lake Formation.

ASTARTE RIVER FORMATION (unit PPA) This formation is most extensively exposed north and south of Flint Lake (Fig. 2) where it comprises dark, rustyweathering graphitic pelite and semipelite and minor sulphide-facies iron-formation (unit PPA). Disseminated to ocally massive seams of pyrite with minor pyrrhotite are common. Biotite and graphite characterize the assemblage n the lowest metamorphic grade rocks, whereas sillimanite and muscovite are present in highest-grade exposures Locally in the southern part of the map area, the rusty graphitic pelite and semipelite is observed in apparent stratigraphic contact with underlying Dewar Lakes Formation quartzite (unit PPD; OF 4201) or mafic volcanic rocks of ne Bravo Lake Formation (unit PPBm; OF 4201). In the northern part of the map area, the contact with the underlying carbonate rocks of the Flint Lake Formation is sharp and parallel to the underlying layering (St-Onge et al., 2001b, c). At the contact, an interval several metres thick comprises interbedded carbonate and pelite, passing upsection into monotonous, recessive-weathering pelite and of 500 m. The abrupt transition into pelitic rocks is interpreted as a response to foundering of the underlying carbonate

shelf. The cause is unclear, but it may be related to changing tectonic conditions during the onset of mafic volcanism unit PPBm) farther outboard in the basin

LONGSTAFF BLUFF FORMATION (units PPIa-PPLg) The stratigraphically highest component of the Piling Group is a relatively homogeneous package of psammite, subordinate semipelite and rare pelite (units PPIa-PPLq). Bedding thickness ranges from 10 to 50 cm in the vicinity of Longstaff Bluff (Fig. 2), to 2 to 3 metres in extreme cases in the central part of the map area. Graded bedding is ed in the thinner beds (Fig. 13); the majority of such observations indicate that the succession is upright (OF 4199, 4200, and 4201). The regular nature of the fining-upward grain size distribution within individual peds, the extreme lateral continuity of individual beds (tens to hundreds of metres for decimetre-thick beds; Fig. 14), and the overall homogeneity of the entire formation suggests that these deposits are turbidite In the centre of the belt, where metamorphic grade is sub-greenschist facies, (unit PPLb) primary grain size is well preserved. The vast majority of the psammite beds comprise fine to coarse sand; granules are rare, and pebble conglomerate has been observed only as thin layers at the base of several coarser beds. Distinctive angular feldspar crystals and crystal fragments, conspicuously white in the otherwise grey psammite, have been noted in individual beds throughout the project area (unit PPLa; Corrigan et al., 2001). Bedding-parallel calcsilicate pods, up to several tens of centimetres in diameter, are ubiquitous throughout the psammitic beds of this formation and interpreted as The base of the Longstaff Bluff Formation is well exposed at numerous localities across the map area (Fig. 2) West of the Western River (OF 4200), psammite beds that contain hornblende and actinolite (unit PPLs) overlie mafic flows and also, where it is developed, the thin carbonate ± iron-formation interval that locally characterizes the uppermost Bravo Lake Formation (unit PPBm). The detrital mafic component of the psammites gradually diminishes upsection over several tens of metres; its presence is consistent with the interpretation that the psammitic rocks stratigraphically overlie the mafic units of the Bravo Lake Formation. In the northern part of the map area, in the

vicinity of Flint Lake (St-Onge et al., 2001b,c), the lowermost psammite beds of the Longstaff Bluff Formation are

interbedded with the distinctively rusty, graphitic pelites of the uppermost Astarte River Formation (unit PPA). This transitional interval occurs over less than 100 metres, and gives way to the psammite-semipelite couplets that typify the Longstaff Bluff Formation at all metamorphic grades (units PPLb-PPLg). The overall preserved thickness of the Longstaff Bluff Formation is estimated, based on structural sections drawn throughout the map area, to be between 3 and 5 km (F. Berniolles, pers. comm., 2001). In the absence of distinctive marker units within the formation, and in view of the extensive, tight to isoclinal folding that has occurred (described below), this estimate should be taken as a first-order approximation only. This turbidite succession blankets all underlying formations, and appears to signal a dramatic change in tectonic conditions in the basin. It could be a molasse derived from an orogenically uplifted area to the south, an interpretation that will be tested throug geochemical, tracer isotopic, and geochronological investigations. The tracer isotopic work forms part of a B.Sc. thesis by S. Johns (University of Saskatoon).

## CUMBERLAND BATHOLITH (units Pcgk-Pcgr)

A suite of felsic plutonic rocks that ranges from rare tonalite, to granodiorite, monzogranite (unit PCgr), and monzogranite grading into syenogranite (unit Pcgk) dominates the southern edge of the map area (OF 4200 and OF 201) and has been interpreted as the northern margin of the Cumberland batholith (Jackson and Taylor, 1972). locally characterize individual plutons. Toward the contact with supracrustal rocks of the Piling group, garnet and sillimanite become more common accessory phases. Rafts and xenoliths of identifiable Longstaff Bluff Formation psammite are present in some of the northernmost plutons. Although no U-Pb age determinations have yet been made on rocks of the Cumberland batholith within the project area, work farther to the south has bracketed the overall age range as ca. 1.87-1.84 Ga (Jackson et al., 1990; Scott, 1997; Scott and Wodicka, 1998).

#### OTHER GRANITES (units Pggr-Pgr)

Plutons of the Cumberland batholith (units PCgk-PCgr) are themselves intruded by whitish to light pink, mediumgrained to pegmatitic garnet-biotite ± muscovite ± cordierite leucogranite dykes, sills and plutons (unit Pggr). The leucogranites (Fig. 16) underlie the islands from Fee Peninsula to Nauja Bay (OF 4199) and form several major bodies north of 68°N (OF 4200) that are in close spatial association with the Cumberland batholith. As explained below in the metamorphic section, field evidence suggests that the leucogranites are entirely derived from partial to total melting Piling Group metasedimentary rocks. The field and laboratory study of garnet-bearing assemblages in the monzogranites form part of a B.Sc. thesis by B. Sharpe (Carleton University). In the vicinity of Flint Lake (St-Onge et al., 2001b,c), weakly to non-foliated, pink to white plutons and associated matite bodies (unit Par) intrude the Archean Rae craton and the lowermost part of the Piling Group (Corrigan et al. 2001). Similar rocks along strike to the west in the adjoining map sheet have been dated at ca. 1.83 Ga (Bethune and Scammell, 1997). If this correlation is correct, these northern plutonic rocks may be unrelated to the Cumberland batholith (units PCqk-PCqr) described above. East of Wordie Bay (OF 4200), individual biotite ± hornblende monzogranite plutons cross-cut all other supracrustal and plutonic units. These plutons appear similar to unit Pgr described above; this interpretation will be

#### NEOPROTEROZOIC DIABASE DYKES (unit NFdb)

Fresh, undeformed diabase dykes (unit NFdb) of the northwest-trending 723 + 4/-2 Ma (Heaman et al, 1992) Franklin swarm (Fig. 17) are widespread across the map area. These vertical dykes range in width from several metres to hundreds of metres; the thickest dykes can be traced for tens of kilometres. Locally they anastomose. Dykelets a few metres in width are locally observed branching from the larger intrusions. The dykes generally exhibit a brownweathered surface and the larger ones, a rectangular joint pattern.

#### DEFORMATION AND METAMORPHISM The late Archean tectonothermal history of the southern Rae craton has been summarized by Bethune and Scammell

(1997), based on work immediately to the northwest of the current map area. Overviews of the area north of Flint Lake have recently been presented (Corrigan et al., 2001; St-Onge et al., 2001a, b). On OF 4199-OF 4201 fold axes and mesoscopic fabric elements are identified by type (e.g. Syncline, anticline, cleavage, gneissosity) rather than age (e.g. Evidence of the earliest Paleoproterozoic deformation in the map area (D1P) is manifest as tight, intrafolial isoclinal folds of bedding in siliciclastic rocks of the Dewar Lakes Formation (unit PPD). Tectonic imbrication of the lowest formations of the Piling Group in the Flint Lake area (St-Onge et al., 2001b, c) and structural juxtaposition of rocks of he Dewar Lakes and Bravo Lake formations onto Longstaff Bluff Formation turbidites in the southern part of the area (OF 4200 and OF 4201) are both interpreted to have occurred during D<sub>1P</sub>. Macroscopic, ENE-trending folds of Piling Group rocks and underlying structural basement units is ascribed to These folds typically plunge shallowly to the ENE, and vary from tight to open, and from map scale (OF 4199, OF 200, and OF 4201) to outcrop scale (Fig. 18). The Flint Lake area (St-Onge et al., 2001b, c) is characterized by a series of relatively open syncline-anticline pairs. In contrast, the Longstaff Bluff Formation turbidites that underlie much of the central part of the area comprise domains of either steep or shallowly dipping strata (OF 4200 and OF 4201), giving an overall stepped, south-dipping structural geometry. The basement-involved, thick-skinned D<sub>2P</sub> folds are refolded by NW- to NE-trending upright cross folds (D<sub>3P</sub>) that generate the resultant overall dome-and-basi geometry of the project area (OF 4201). This fold interference pattern provides the key structural relief for a study of tructural evolution of the orogenic margin by F. Berniolles (M.Sc. thesis; Queen's University). From the centre of the Piling Group belt (OF 4200 and OF 4201), mineral assemblages in pelitic rocks progress southward toward the Cumberland batholith from biotite-muscovite, to biotite-muscovite-cordierite ± andalusite sillimanite-k-feldspar ± melt, and ultimately garnet-cordierite-k-feldspar melt (Fig. 19). The volume of melt present in individual outcrops increases toward the batholith, from increasingly large pods (Fig. 20) through to dykes and sills (Fig. 21). In proximity to the batholith, accumulations of locally-generated melt material can be mapped as plutons of distinctive white, garnetiferous monzogranite (unit Pggr; OF 4199, OF 4200, and OF 4201). The Cumberland batholith is regarded as the source of much of the heat required for this regional metamorphic zonation. The field and laboratory study of metamorphic mineral reactions and assemblages in pelitic units of the Piling Group form part of an ongoing Ph.D. project by K. Dubach (Queen's University) and a B.Sc. thesis by M. Allan (University of Calgary). A chemical dating study of monazite by S. Gagné (M.Sc. thesis; Dalhousie University) will provide constraints on the timing of metamorphism and will document changes in monazite chemistry and texture through a continuous medium- to high-grade metamorphic sequence.

### ECONOMIC POTENTIAL

The Paleoproterozoic rocks of the project area hold significant potential for a variety of mineral deposit types. In the north, relatively thick carbonate units (Flint Lake Formation) and overlying graphitic pelite (Astarte River Formation) have elevated potential to host Mississippi Valley type (MVT) and sedimentary-exhalative (SEDEX) base metal deposits, respectively. In the south, the mafic and ultramafic rocks of the Bravo Lake Formation are exploration targets for Ni-Cu-PGE magmatic sulphide deposits. The upper-amphibolite facies siliciclastic rocks of the uppermost Dewa Lakes Formation may have potential for Broken Hill-type Pb-Zn-Ag deposits. In the northeastern part of the area,

#### REFERENCES

- Bethune, K.M. and Scammell, R.J. Geology, Koch Island area, District of Franklin, Northwest Territories, (Part of NTS 37 C), Geological Survey of Canada, Open File 3391.
- 1986: Regional geochemical reconnaissance, an introduction to the interpretation of data from central Baffin Island, District of Franklin; Geological Survey of Canada, Paper 86-10, 22p.
- Corrigan, D., St-Onge, M.R., and Scott, D.J Geology of the northern margin of the Trans-Hudson Orogen (Foxe Fold Belt), central Baffin Island, Nunavut. Geological Survey of Canada, Current Research 2001-C23, 17p.
- Friske, P.W.B., Day, S.J.A., McCurdy, M.W., and Durham, C.C. Reanalysis of 1775 lake sediments from surveys on central Baffin Island, Nunavut (Northwest Territories) parts of NTS 27 B, 27 C, 37 A, and 37 D; Geological Survey of Canada, Open File 3716, scale 1:300 000.
- 2001: Caractérisation métamorphique des marbres du Groupe de Piling. Unpublished B.Sc. thesis, Université du Québec à Montréal.
- Nature and timing of the Franklin igneous events, Canada: Implications for Late Proterozoic mantle plume and the breakup of Laurentia. Earth and Planetary Science Letters, v. 109, p. 117–131.

Heaman, L.M., LeCheminant, A.N., and Rainbird, R.H.

Survey of Canada, Paper 77-14, p. 14-17.

- Structure and metamorphism of the Aphebian Penrhyn Group and its Archean basement complex in the Lyon Inlet area, Melville Peninsula, District of Franklin, Geological Survey of Canada, Bulletin 324, 50 p.
- Henderson, J.R. and Parrish, R.R. Geochronology and structural geology of Early Proterozoic Foxe-Rinkian Orogen, Baffin Island, NWT; Geological Survey of Canada, Current Activities Forum, Program with Abstracts, p. 12.
- Geology of the Dewar Lakes area, central Baffin Island, District of Franklin, N.W.T. (parts of 27 B and 37 A); Reological Survey of Canada, Open File 2924, scale 1:100 000
- Henderson, J.R., Grocott, J., Henderson, M.N., Falardeau, F., and Heijke, P. Results of field work near Dewar Lakes, Baffin Island, N.W.T.; in Current Research, Part C; Geological Survey of Canada, Paper 88-1C, p. 101-108.
- Henderson, J.R., Grocott, J., Henderson, M.N., and Perreault, S. Tectonic history of the Lower Proterozoic Foxe-Rinkian Belt in central Baffin Island, N.W.T., in Current Research, Part C, Geological Survey of Canada, Paper 89-1C, p. 186-187.
- United plates of America, the birth of a craton: Early Proterozoic assembly and growth of Laurentia. Annual Reviews of Earth and Planetary Sciences, v. 16: 543-603.
- Reconnaissance of north-central Baffin Island: in Report of Activities, Part A; Geological Survey of Canada, Paper 69-1, pt. A, p. 171-176. McBeth Gneiss Dome and associated Piling Group, central Baffin Island, District of Franklin; in Rubidium-Strontium Isotopic Age Studies, Report 2, (ed.) R.K. Wanless and W.D. Loveridge; Geological
- Geology, Clyde River, District of Franklin, Northwest Territories; Geological Survey of Canada, Map 1582A, with expanded legend and brief marginal notes, scale 1:250 000. Geology of the Clyde-Cockburn Land map area, north-central Baffin Island, Nunavut. Geological Survey of Canada Memoir 440, 303 p.
- Precambrian metamorphism on Baffin and Bylot Islands; in Metamorphism in the Canadian Shield (ed.) J.A. Fraser and W.W. Heywood; Geological Survey of Canada, Paper 78-10, p. 249-267.
- Correlation of major Aphebian rock units in the northeastern Canadian Shield. Canadian Journal of Earth Sciences, v. 9, p. 1650-1669.
- Jackson, G.D., Hunt, P.A., Loveridge, W.D., and Parrish, R.R. Reconnaissance geochronology of Baffin Island, N.W.T.; *in* Radiogenic Age and Isotopic Studies: Report 3, Geological Survey of Canada, paper 89-2, p. 123–148.
- The Trans-Hudson Orogen: extent, subdivisions, and problems; in The Early Proterozoic Trans-Hudson
- Orogen of North America (eds.) J.F. Lewry and M.R. Stauffer; Geological Association of Canada, Special
- Lake Gillian, District of Franklin, Northwest Territories; Geological Survey of Canada, Map 1560A, scale Morgan, W.C., Bourne, J., Herd, R.K., Pickett, J.W., and Tippett, C.R.
- Geology of the Foxe Fold Belt, Baffin Island, District of Franklin; in Report of Activities, Part A; Geological Survey of Canada, Paper 75-1A, p. 343-347. Morgan, W.C., Okulitch, A.V., and Thompson, P.H.
- Stratigraphy, structure and metamorphism of the west half of the Foxe Fold Belt, Baffin Island; in Report of Activities, Part A; Geological Survey of Canada, Paper 76-1A, p. 387-391. 1997: Geology, U-Pb & Pb-Pb geochronology of the Lake Harbour area, southern Baffin Island: Implications for
- the Paleoproterozoic tectonic evolution of NE Laurentia. Canadian Journal of Earth Sciences, v. 34, p. Scott, D.J. and Gauthier, G.
- Comparison of TIMS (U-Pb) and Laser Ablation Microprobe ICP-MS (Pb) techniques for age determination of detrital zircons from Paleoproterozoic metasedimentary rocks from northeaster Laurentia, Canada, with tectonic implications. Chemical Geology, v. 131, p. 127-142.
- A second report on the U-Pb geochronology of southern Baffin Island, Northwest Territories; in Radiogenia Age and Isotopic Studies: Report 11; Geological Survey of Canada, Current Research, 1998-F, p. 47-57. Scott, D.J., St-Onge, M.R., and Corrigan, D. pterozoic Piling Group and underlying Archean gneisses, central Baffin Island
- (NTS 37 A, 27 B); Geological Survey of Canada, Current Research 2002. Scott, D.J., Stern, R.A., St-Onge, M.R., and McMullen, S.M. in press b: U-Pb geochronology of detrital zircons in metasedimentary rocks from southern Baffin Island: implications for the Paleoproterozoic tectonic evolution of Northeastern Laurentia, Canadian Journal of Earth
- St-Onge, M.R., Scott, D.J., and Corrigan, D. 2001a: Geology, MacDonald River, Nunavut. Geological Survey of Canada, Open File 3958, scale 1:100 000. Geology, Flint Lake, Nunavut. Geological Survey of Canada, Open File 3959, scale 1:100 000. 2001c: Geology, Nadluardjuk Lake, Nunavut. Geological Survey of Canada, Open File 3960, scale 1:100 000.
- 2001d: Geology, Wordie Bay, Nunavut. Geological Survey of Canada, Open File 3961, scale 1:100 000. 1982: Precambrian Geology of the Canadian North Borderlands; in Geology of the North Atlantic Borderlands,
- A geological cross-section through the southern margin of the Foxe Fold Belt, Baffin Island, Arctic Canada, and its relevance to the tectonic evolution of the northeastern Churchill Province; PhD. thesis, Queen's University, Kingston, Ontario, 409 p. Geology of a Transect Through the southern Margin of the Foxe Fold Belt, Central Baffin Island, District of

(ed.) J.W. Kerr, A.J. Fergusson, and L.C. Machan; Canadian Society of Petroleum Geologists, Memoir 7, p

Franklin; Tippett, CR. Geological Survey of Canada, Open File 1110; 77 p. Wheeler, J.O., Hoffman, P.F., Card, K.D., Davidson, A., Sanford, B.V., Okulitch, A.V., and Roest, W.R. 1996: Geological Map of Canada; Geological Survey of Canada, Map 1860A, scale 1:5 000 000.

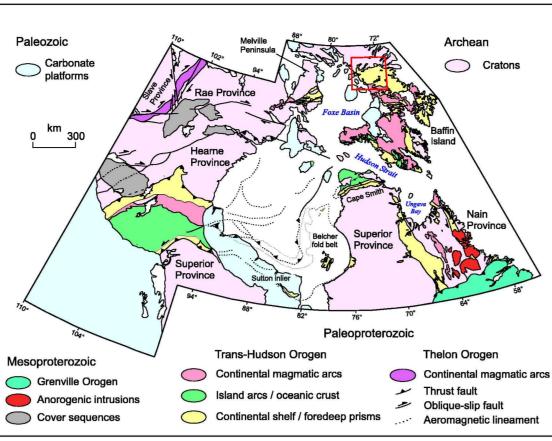


Figure 1. Geological map of northeastern Canada modified after Wheeler et al. (1996) outlining the surface extent of theTrans-Hudson Orogen. Red box outlines location and surface extent of three-year mapping project in central Baffin

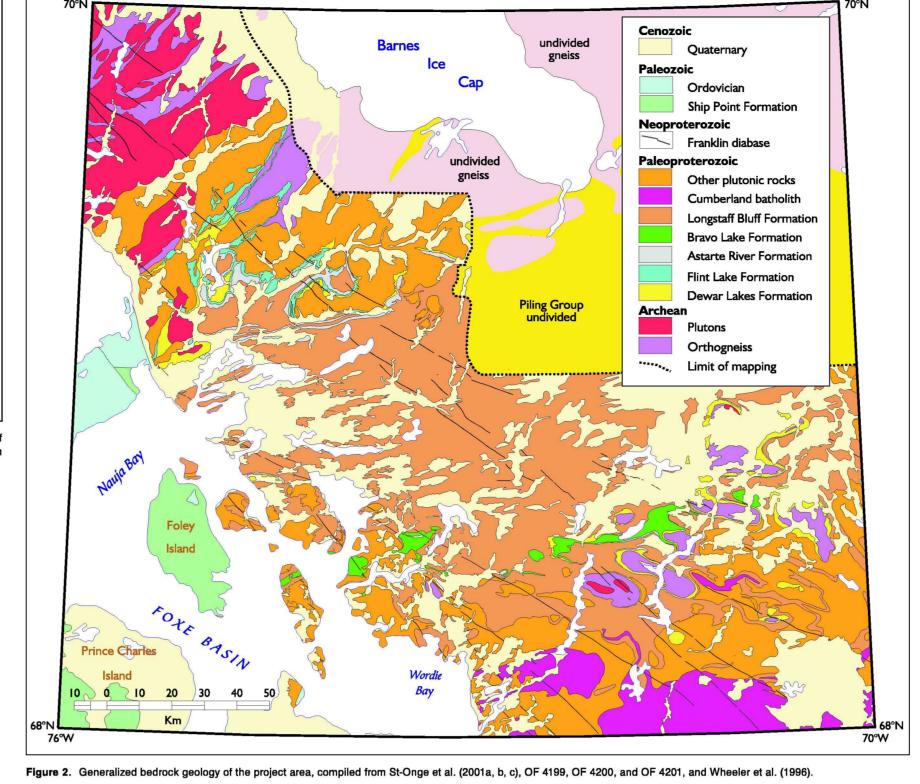


Figure 3. Layered (Archean?) orthogneiss (unit Agn), Dewar Lakes

Figure 7. Mineral elongation in quartzite, basal Dewar Lakes

Formation (unit PPD), Dewar Lakes area. Pen is 14 cm long. Location

igure 11. Mottled mafic pillowed flows, Bravo Lake Formation (un

PPBm), Straits Bay area. Hammer is 35 cm long. Location shown on OF

**Figure 16.** Garnet-biotite bearing (dark clots) leucocratic

monzogranite (unit Pggr), Clark Sound area. Pen is 14 cm long.

Location shown on OF 4199. (GSC 2001-378C).

shown on OF 4201. (GSC 2001-378W)

4200. (GSC 2001-378G).

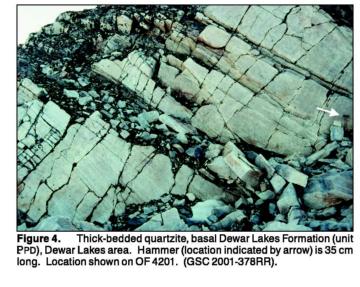


Figure 8. Shallowly-dipping calcareous marble. Flint Lake Formation

(unit PPF), Flint Lake area (St-Onge et al., 2001b). Person is two metres

Figure 12. Mafic dykes (beneath hammer) intruding mottled pillowed

Figure 17. Undeformed, vertical diabase dyke, Franklin swarm (unit

shown on OF 4199. (GSC 2001-378E).

NFdb), South Tweedsmuir Island. Hammer is 35 cm long. Location

35 cm long. Location shown on OF 4200. (GSC 2001-378H).

lows, Bravo Lake Formation (unit PPBm), Straits Bay area. Hammer is

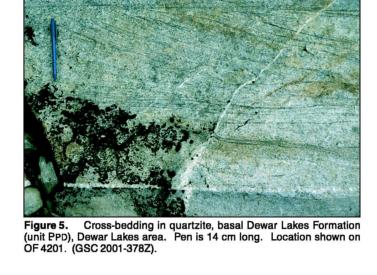


Figure 13. Psammite-pelite turbidites, Longstaff Bluff Formation (unit

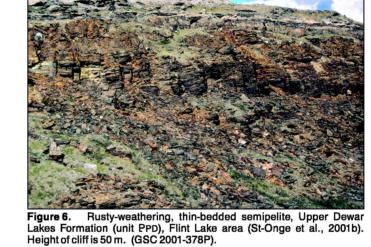
Figure 18. D<sub>20</sub> crenulated micaceous quartzite, Dewar Lake

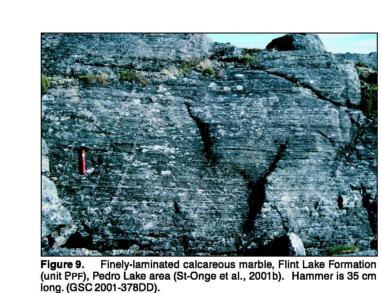
Location shown on OF 4201. (GSC 2001-378X).

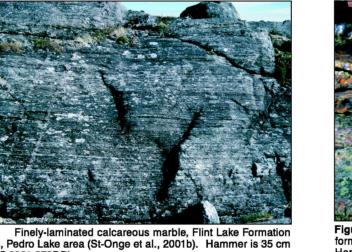
Formation (unit PPD), northeast of Dewar Lakes. Hammer is 35 cm long.

cm long. Location shown on OF 4199. (GSC 2001-378K).

PPLs), Straits Bay area. Stratigraphic tops to the right. Hammer is 35







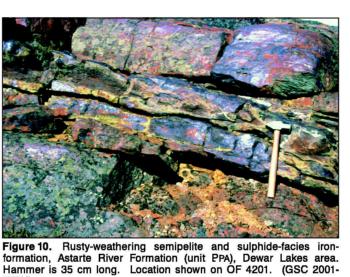


Figure 14. Relatively thin-bedded turbidites, Longstaff

long. Location shown on OF 4201. (GSC 2001-378Y).

Formation (unit PPLb), northeast of Dewar Lakes. Hammer is 35 cm

Figure 19. High grade cordierite-K-feldspar-melt pod-plagioclase

14 cm long. Location shown on OF 4200. (GSC 2001-3780).

quartz assemblage in Longstaff Bluff Formation pelite (unit PPLs). Pen is







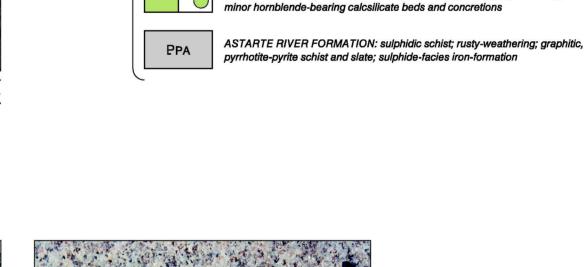


Figure 15. Potassium feldspar megacrystic granite, Cumberland

batholith (unit Pcgk), southeast of Dewar Lakes. Pen is 14 cm long

bearing Longstaff Bluff Formation pelite (unit PPLs). Pen is 14 cm long.

Location shown on OF 4200. (GSC 2001-378N).

Location shown on OF 4201. (GSC 2001-378B)

This legend is common to maps OF 4199, OF 4200, and OF 4201. All units and symbols may not appear on all maps. The prefix 'meta' applies to all lithologies in units Agn to PPLg BRAVO LAKE FORMATION (units PPBm - PPBs) Dominantly volcaniclastic sedimentary beds; millimetre- to centimetre-scale laminations, dark grey to white; minor quarzite, semipelite, iron-formation; minor QUATERNARY basalt; pillowed, fragmental and massive flows; light- to dark-green; gabbro; PLEISTOCENE-RECENT peridotite; layered peridotite-gabbro sills Unconsolidated glacial drift with associated marine, lacustrine, fluvial, and bog Q deposits. Chiefly marine muds on coastal areas. Includes extensive felsenmeer in Dominantly basalt; pillowed, fragmental and massive flows; light- to dark-green; mafic proximity to Barnes Ice Cap (Figure 2) and ultramafic cumulates; metre-scale layers, dark green to brown; minor volcaniclastic sedimentary beds; millimetre- to centimetre-scale laminations, dark grey to white; minor quarzite, semipelite, iron-formation; gabbro; peridotite; layered ORDOVICIAN(?) AND SILURIAN DEWAR LAKES FORMATION: quartzite and feldspathic quartzite, semipelite; grey, UPPER UPPER ORDOVICIAN (?) AND LOWER SILURIAN (LLANDOVERIAN) white, and black; laminated, bedded, and massive, locally cross-bedded; may include magnetite rich laminae; locally includes iron-formation; chiefly oxide facies with Calcareous dolostone, dolostone, dolomitic limestone; minor calcareous and silicate facies; metallic grey; fine- to coarse-grained; laminated to bedded; may dolomitic breccia and flat-pebble conglomerate include marble, dolomite and calcsilicate; locally includes bodies of biotite-allanite±hornblende monzogranite, granodiorite, syenogranite or **ORDOVICIAN** biotite-garnet±muscovite±sillimanite (fibrolite)±cordierite monzogranite, and UPPER MIDDLE AND UPPER ORDOVICIAN associated biotite-muscovite-garnet±tourmaline pegmatite Dolomitic limestone; minor calcareous dolostone ------UPPER LOWER AND LOWER MIDDLE ORDOVICIAN SHIP POINT FORMATION: dolostone, in part sandy, silty, argillaceous; dolomitic OS flat-pebble conglomerate; minor dolomitic sandstone, siltstone, breccia, quartz-cemented sandstone ------unconformity ------**NEOPROTEROZOIC** FRANKLIN INTRUSIONS: tholeiltic diabase dykes; medium-grained with ophitic texture: narrow chilled margins Biotite-allanite±hornblende monzogranite, granodiorite; commonly grades into biotite-allanite±hornblende syenogranite; massive, fine- to coarse-grained, pink to white; abundant crosscutting veins and sheets of associated biotite-muscovite-garnet ±tourmaline pegmatite; locally contains inclusions of layered orthogneiss (unit Agn), quartz diorite, and psammite (unit PPD); local weak foliation Biotite-garnet±muscovite±sillimanite (fibrolite)±cordierite monzogranite; leucocratic, medium-grained to pegmatitic, white- to light-pink; weakly to moderately foliated; abundant crosscutting veins, dykes, and sheets of associated muscovite-garnet±tourmaline pegmatite; contains abundant inclusions and rafts of high-grade psammite, semipelite (unit PPLg); possibly derived by partial to total melting of Piling Group sedimentary rocks (see descriptive notes) CUMBERLAND BATHOLITH (units Pcgk - Pcgr) Biotite±garnet monzogranite; commonly grades into biotite syenogranite; massive, medium- to coarse-grained, grey to pink; varies from weakly to strongly foliated; locally contains rafts and inclusions of K-feldspar megacrystic monzogranite (unit Biotite±hornblende±garnet K-feldspar megacrystic monzogranite, granodiorite; dark to buff; K-feldspar megacrysts in a finer-grained matrix of plagioclase, quartz, biotite; varies from weakly to strongly foliated; K-feldspar megacrysts commonly rimmed by plagioclase (Rapakivi texture); contains inclusions of high-grade psammite (unit PPLg) PILING GROUP (units PPD - PPLg) LONGSTAFF BLUFF FORMATION (metamorphic mineral units PPLb - PPLg) Psammite, semipelite, pelite, arkosic- and lithic-wacke; interbedded; thin- to thick-bedded, light- to dark-grey; graded beds; minor hornblende- bearing calcsilicate beds and concretions; garnet-cordierite-K-feldspar-melt pod metamorphic assemblages; locally includes bodies of Crenulation axis biotite-garnet±muscovite±sillimanite (fibrolite)±cordierite monzogranite -----ingral isograd Psammite, semipelite, pelite, arkosic- and lithic-wacke; interbedded; thin- to thick-bedded, light- to dark-grey; graded beds; minor hornblende-bearing calcsilicate beds and concretions; biotite-sillimanite-K-feldspar±melt pod metamorphic assemblages; locally includes bodies of biotite-allanite±hornblende

monzoganite, granodiorite, syenogranite or biotite-garnet±muscovite±sillimanite

Psammite, semipelite, pelite, arkosic- and lithic-wacke; interbedded; thin- to

thick-bedded, light- to dark-grey; graded beds including inverse metamorphic

biotite-muscovite-cordierite±andalusite metamorphic assemblages: locally

includes bodies of biotite-allanite±hornblende monzoganite, granodiorite,

syenogranite or biotite-garnet±muscovite±sillimanite (fibrolite)±cordierite

monzogranite, and associated biotite-muscovite-garnet±tourmaline pegmatite

Psammite, semipelite, pelite, arkosic- and lithic-wacke; interbedded; thin- to

thick-bedded, light- to dark-grey; graded beds; minor hornblende-bearing

calcsilicate beds and concretions; biotite-muscovite±garnet metamorphic

psammite, semipelite, pelite; thin- to thick-bedded, white, gritty surface; graded beds;

PPLa LONGSTAFF BLUFF FORMATION: Arkosic- and lithic-wacke; interbedded with

grading; minor hornblende-bearing calcsilicate beds and concretions;

fibrolite)±cordierite monzogranite, and associated

biotite-muscovite-garnet±tourmaline pegmatite

LEGEND

**NEOARCHEAN** Biotite±hornblende K-feldspar megacrystic monzogranite, granodiorite; pink to buff; K-feldspar megacrysts in a finer-grained matrix of plagioclase, quartz, biotite±hornblende; varies from weakly to strongly foliated, locally an L-tectonite; gradational into granitic and granodioritic rocks lacking megacrysts Biotite±hornblende monzogranite, syenogranite; pink, fine- to medium-grained; massive to moderately foliated; locally grades into megacrystic granite MARY RIVER GROUP (unit Amp) Psammite, semipelite; grey- to rusty-brown, flaggy; centimetre- to metre-scale laterally continuous layers; abundant melt pods; local interlayers of quartzite, pelite Biotite±hornblende quartzofeldspathic orthogneiss; leucocratic gneiss of plutonic Agn origin; granodioritic to monzogranitic; alternating grey to white, black, pink, fine- to medium-grained; moderately to well foliated, locally layered with concordant syenogranitic leucosome; locally contains amphibolite and tonalite bands, gabbro/anorthosite boudins; locally migmatitic D<sub>1P</sub> thrust fault (defined, approximate); teeth on hanging wall Oblique-slip fault (defined) . Normal fault (approximate); solid circle on hanging wall . . Bedding (upright, tops known) . Bedding (overturned, tops known) . Bedding (tops unknown) . Bedding (transposed) Mesoscopic S fold axis Mesoscopic M fold axis Mesoscopic Z fold axis Mesoscopic fold axial plane Syncline (upright, overturned) (arrow indicates plunge) Syncline, inferred (upright) (arrow indicates plunge) Anticline (upright, overturned) (arrow indicates plunge) Anticline, inferred (upright, overturned) (arrow indicates plunge) Synform (upright) (arrow indicates plunge) . Antiform (upright, overturned) (arrow indicates plunge) Glacial striae: direction of ice movement undetermined Cordierite±andalusite isograd (ornament on high-temperature side) (defined, approximate) . . Sillimanite-K-feldspar±melt pod isograd (ornament on high-temperature side) (defined, approximate) . . Garnet-cordierite isograd (ornament on high-temperature side) (defined, approximate) . Location of field photograph with corresponding Figure number .

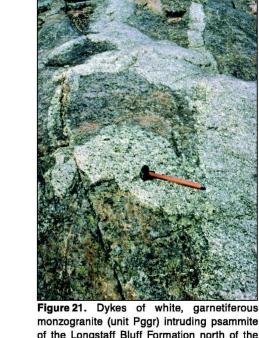
> Geology by M.R. St-Onge, D. Corrigan, F. Berniolles, K. Dubach, S. Modeland, J. Robillard, J. Stacey, J. Chakungal, S. Gagné, C. Hogue, C. Huerbert, A. Simmons, E. de Kemp, and D. Snyder (2000), Geological Survey of Canada; M.R. St-Onge, M. Allan, F. Berniolles, K. Dubach, J. Gladstone, S. Johns, B. Sharpe, J. Stacey, S. Gagné (2001), Geological Survey of Canada; D.J. Scott (2000-2001), Canada-Nunavut Geoscience Office; D.M. Carmichael and H. Helmstaedt (2000), Queen's University; D. Francis (2000), McGill University

> > Geological compilation by M.R. St-Onge, D.J. Scott, and D. Corrigan (2001)

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Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada



378D).

of the Longstaff Bluff Formation north of the Cumberland batholith. Hammer is 35 cm long. Location shown on OF 4199. (GSC 2001-

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Sheet 2 of 2, Legend and descriptive notes Recommended citation: St-Onge, M.R., Scott, D.J., and Corrigan, D. 2002: Geology, north Tweedsmuir Island, Nunavut; Geological Survey of Canada, Open File 4199, scale 1:100 000.

