Natural Resources Canada | Ressources naturelles Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8557

Integrated geoscience of the Northwest Passage, Nunavut; GEM-2 Boothia Peninsula-Somerset Island project, report of activities 2018

M. Sanborn-Barrie, D. Regis, and A. Ford

2019

Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8557

Integrated geoscience of the Northwest Passage, Nunavut; GEM-2 Boothia Peninsula-Somerset Island project, report of activities 2018

M. Sanborn-Barrie, D. Regis, and A. Ford

Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8

2019

Permanent link: https://doi.org/10.4095/314501

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

Recommended citation
Sanborn-Barrie, M., Regis, D., Ford, A. 2019. Integrated Geoscience of the Northwest Passage, Nunavut; GEM-2 Boothia Peninsula-Somerset Island Project, report of activities 2018; Geological Survey of Canada, Open File 8557, 17 p. https://doi.org/10.4095/314501

Publications in this series have not been edited; they are released as submitted by the author.

Table of Contents

Foreword 2
Introduction 2
Regional Setting 3
Previous Work 4
Methodology 4
Salient Results of 2017 GEM-2 Mapping on Boothia Peninsula 7
Preliminary 2018 findings on Somerset Island and northern Boothia Peninsula 8
Lithology 8
Structural Geology 12
Economic Geology 13
GEM-2 Supported Student Research 13
Future Objectives...14
Acknowledgments..14
References...14

Foreword

The Geo-mapping for Energy and Minerals (GEM) program is laying the foundation for sustainable economic development in the North. The Program provides modern public geoscience that will set the stage for long-term decision making related to responsible land-use and resource development. Geoscience knowledge produced by GEM supports evidence-based exploration for new energy and mineral resources and enables northern communities to make informed decisions about their land, economy and society. Building upon the success of its first five years, GEM has been renewed until 2020 to continue producing new, publicly available, regional-scale geoscience knowledge in Canada's North.

During the 2018 field season, research scientists from the GEM program successfully carried out 18 research activities, 14 of which included fieldwork. Each activity included aspects of geological, geochemical and geophysical surveying. These activities have been undertaken in collaboration with provincial and territorial governments, Northerners and their institutions, academia and the private sector. GEM will continue to work with these key partners as the program advances.

Introduction

The Boothia Peninsula – Somerset Island area is an under-explored frontier region where knowledge stems from 1962 (Blackadar, 1967) and 1986-1992 (Frisch, 2011) geological mapping, undertaken without benefit of aeromagnetic constraints or extensive U-Pb geochronology (Frisch and Hunt, 1993). For these reasons, the GEM-2 activity, ***Integrated Geoscience of the Northwest Passage*** (Fig. 1), is strengthening the geoscience knowledge base of the region through modern-concept bedrock mapping supported by high-resolution geophysical and geochronological data sets. Acquisition of isotopic and geochemical data for representative samples will allow Precambrian bedrock exposed on Boothia Peninsula and Somerset Island to be time-calibrated and characterized with respect to lithogeochemistry, tectonic affinity and crust-mantle interaction.

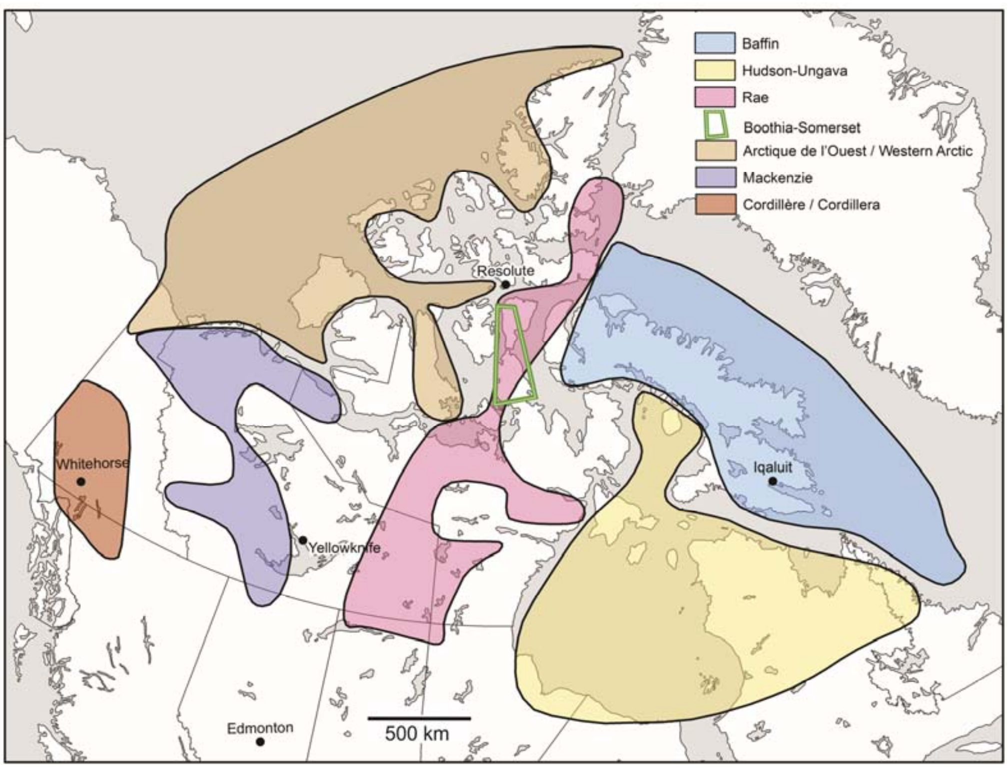

Figure 1. Map of Canada's North highlighting the six GEM-2 regions of interest, which include the Rae region (pink). Mapping as part of the GEM-2 Boothia Peninsula-Somerset Island activity, described in this report, took place in 2018 within the area indicated by the green polygon.

Regional Setting

Several activities in Nunavut during phase II of the GEM program (2014-2020) focused on the western part of the territory with field-based integrated geoscience projects in the south Rae (Percival et al., 2016; Regis et al., 2017; Acosta-Góngora et al., 2018), Thelon tectonic zone (Berman et al. 2016, 2017) and Boothia Peninsula-Somerset Island (Sanborn-Barrie et al., 2016, 2018) regions (Fig. 2). All three of these GEM-2 activities were designed to upgrade data and knowledge of the Archean western Rae craton and its tectonometamorphic reworking during various orogenic events, particularly involving the Archean Slave craton to the west and, to the south of Slave craton, the Buffalo Head terrane (Fig. 2).

The architecture of western Rae craton is complex, having been imposed through events dating back to at least 3.2 Ga (Tersmette, 2012; Davis et al., 2013, 2014) and potentially back to ca. 3.6 Ga (Thériault et al., 1994). Its evolution involved at least three distinct tectonomagmatic events including the 3.2-2.66 Ga Rae orogeny; 2.5-2.35 Ga Arrowsmith orogeny; and 2.0-1.9 Ga Thelon tectonic (and, to the south, the Taltson magmatic) events, with potential thermo-structural overprint at 1.88-1.79 Ga, attributed to far-field effects of the Trans-Hudson orogeny. The Boothia-Somerset region was further affected by shortening during the ca. 420-370 Ma Caledonian orogeny (Okulitch et al., 1986) and possibly later (ca. 25-10 Ma) extensional faulting related to the Eurekan orogeny. Collectively, these resulted in exposure of a north-trending belt of Precambrian rocks, historically designated the Boothia uplift, arch and/or horst (Kerr and Christie, 1965; Kerr, 1977), in contact to both the east and west with folded and tilted, Mesoproterozoic and Paleozoic strata (Cornwallis Fold Belt).

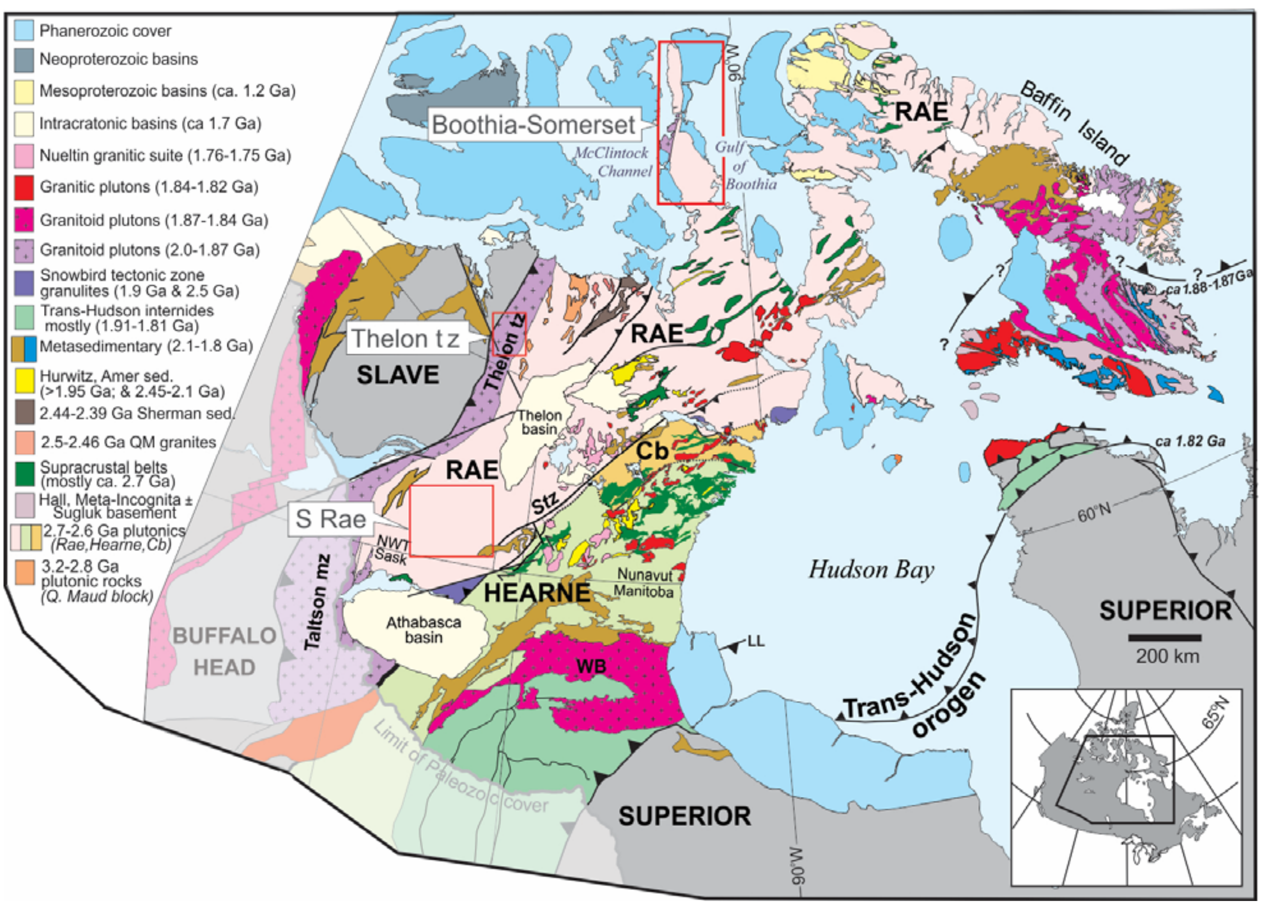

Figure 2. Geological map of northern Canada showing major tectono-magmatic elements and the location of three field-based GEM-2 activities targeted at the western Rae craton. Abbreviations: Cb=Chesterfield block; LL=Lynn Lake suture; mz=magmatic zone; Stz=Snowbird tectonic zone; tz=tectonic zone, WB= Wathaman batholith.

Previous Work

Prior to this GEM-2 initiative, much of Boothia Peninsula's crystalline rocks were last mapped in 1962 (Blackadar, 1967) when its Precambrian exposures were very broadly subdivided into mafic and felsic gneisses and granitic rocks. Timing constraints were limited to three K-Ar ages between 1.7 – 1.6 Ga, determined on biotite from gneisses and granite (Blackadar, 1967). University of Ottawa led mapping projects from 1964-1976 focused on Somerset Island's extensive Phanerozoic exposures (Dineley and Rust, 1968; Dixon, 1974; Jones and Dixon, 1975), but included structural mapping and metamorphic characterization of several transects through its basement gneisses (Giguère, 1968; Brown et al., 1969).

The GSC's Operation Boothia, initiated in 1975, was intended to provide new 1:250 000 to 1:125 000 scale maps of Boothia Peninsula and Somerset Island (Kerr, 1976), with fieldwork targeted at folded and faulted Phanerozoic strata (Cornwallis fold belt) adjacent to Precambrian basement and structural analysis of its basement rocks (Kerr and de Vries, 1977). This field campaign resulted in production of 1:250 000 scale geological maps of sedimentary cover rocks (Stewart and Kerr, 1984); however, underlying Precambrian basement was represented as one unsubdivided unit.

Geological mapping of the region north of 71°N led by Frisch in 1986-1992, resulted in subdivision of the Precambrian basement (Frisch, 2011) into pre-, late-, and post-tectonic units. Pre-tectonic rocks are widespread and include orthopyroxene-bearing tonalitic to granitic rocks of uncertain age (APog); metasedimentary rocks of uncertain age (APms) dominated by garnet ± sillimanite-bearing pelite and semipelite with minor marble/calc-silicate (APc), quartzite and iron formation (AP_{if}; Frisch and Herd 2010); and a mixed unit comprising layers of both orthogneiss and paragneiss (APgm). Late-tectonic two-pyroxene syenite (Psy) dated using U-Pb on zircon at ca. 1.94 Ga (Frisch and Hunt, 1993) is exposed at Cape Bird on southwest Somerset Peninsula (Fig. 3). Collectively, these units are interpreted to have experienced granulite-facies metamorphism at ca. 1.92 Ga (Frisch and Hunt, 1993), attaining conditions of 740-850°C and 6-8 kbar, locally up to 960°C and 8.7 kbar (Kitsul et al., 2000). They are estimated to have cooled from high-grade metamorphic conditions through ~ 600°C (U-Pb titanite closure) at 1.873 Ga (western and central basement) and 1.845 Ga (eastern basement; Frisch and Hunt, 1993). Post-tectonic 1708±5 Ma K-feldspar porphyritic granite (PMg) with minor potentially associated anorthosite (PMa) is exposed in northwestern Somerset Island around M'Clure Bay (Frisch and Hunt, 1993; Frisch, 2011).

Methodology

To update and improve understanding of the bedrock geology of this region, six weeks of fieldwork in 2018 focused on mapping Precambrian crystalline basement exposures on Somerset Island and northernmost Boothia Peninsula. The 2018 mapping extends and allows correlation with 2017 mapping (Sanborn-Barrie et al., 2018). As typical for this region, weather negatively impacted coverage in 2018 with below-average temperatures, snow and ice fog. Regardless, 990 locations were mapped by foot traverse (Fig. 3), and approximately 1200 samples were collected for further study. Bedrock mapping was assisted by 10 university students from Earth Sciences departments across Canada, of which two are undertaking MSc research and two are undertaking BSc research from data and samples collected.

Field operations in 2018 were supported by residents of Resolute Bay, six of whom worked at the camp as field, camp, and/or cook's assistant. A Letter of Agreement between Natural Resources Canada and the Hamlet of Resolute Bay provided the means to hire and pay local personnel.

Mineral abbreviations used throughout the text are those of Whitney and Evans (2010).

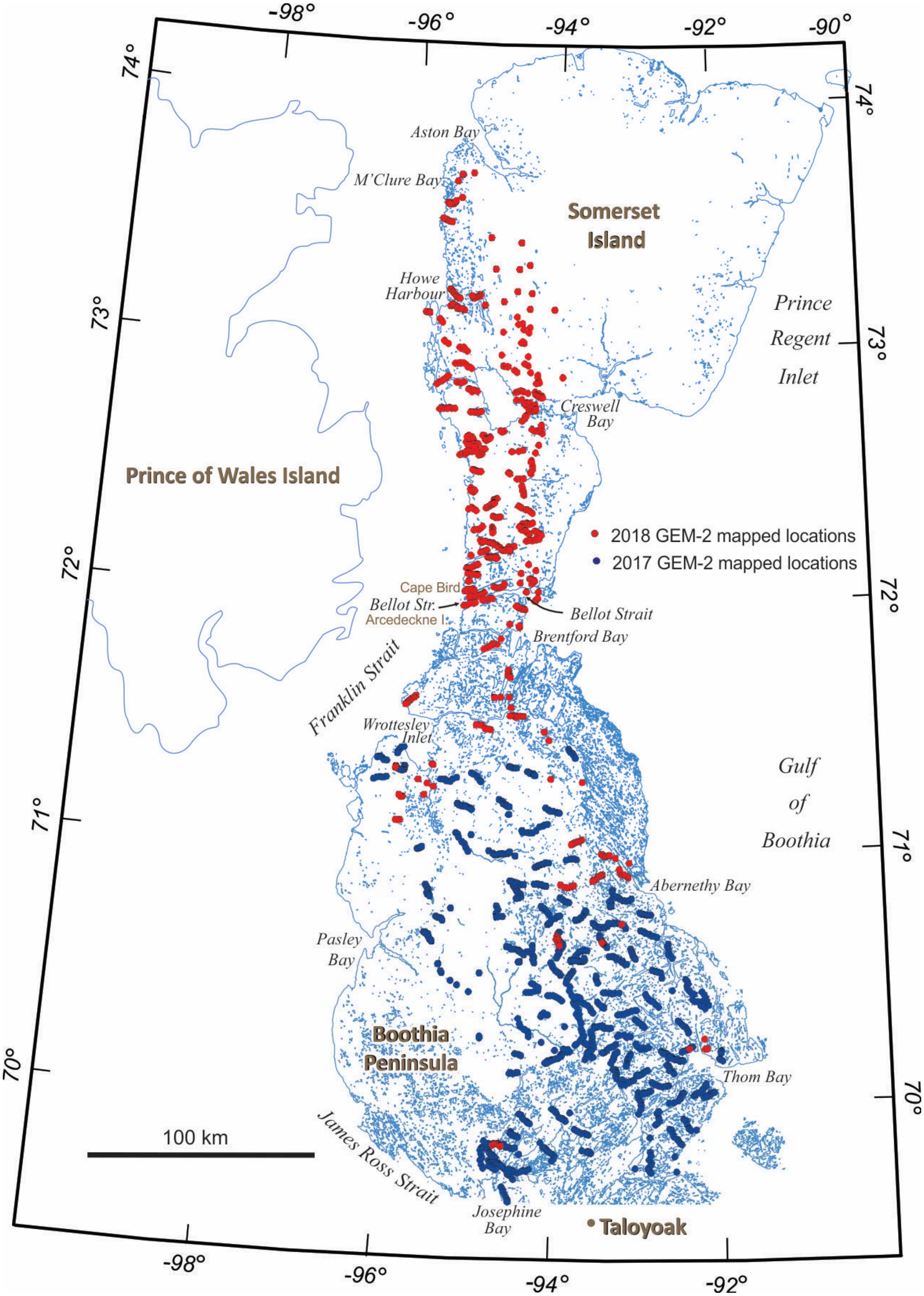

Figure 3. Locations on Boothia Peninsula and Somerset Island at which ground observations, structural measurements, and photographs of exposed Precambrian rock were gathered in 2018 (red circles) and 2017 (blue circles). At many of these locations, bedrock samples were collected for further observational and quantitative geochemical and/or isotopic analysis.

Prior to fieldwork in 2017, GEM-2 addressed the lack of geophysical data for this region by investing in three high-resolution aeromagnetic surveys (Dumont, 2014; Coyle and Oneschuk, 2015; Tschirhart and Oneschuk, 2015; Coyle et al., 2016*a,b*) that resulted in continuous coverage across the Boothia-Somerset corridor (Fig. 4). These data reflect underlying units and structures, including those beneath glacial till and Paleozoic strata (southwest and northeast Boothia Peninsula). These new aeromagnetic maps effectively guided bedrock mapping and are influencing geological interpretation for this region.

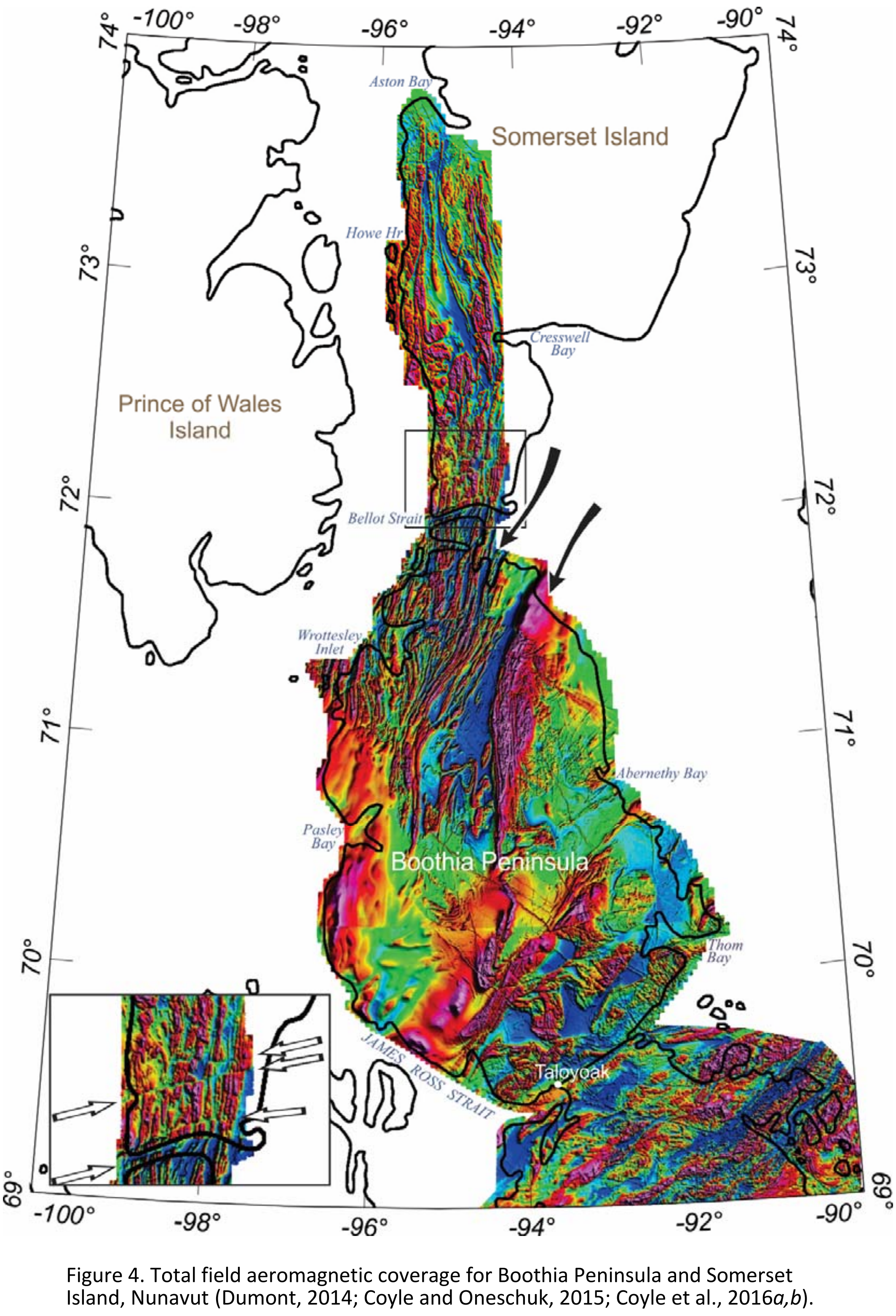

Figure 4. Total field aeromagnetic coverage for Boothia Peninsula and Somerset Island, Nunavut (Dumont, 2014; Coyle and Oneschuk, 2015; Coyle et al., 2016*a,b*).

Salient results of 2017 GEM-2 Mapping of Boothia Peninsula

2017 mapping of Boothia Peninsula (Fig. 5; *see also* Sanborn-Barrie et al., 2018) determined that ca. 2.5 Ga clastic metasedimentary rocks and their migmitized equivalents (golden brown unit in Fig. 5) dominate central and eastern Boothia Peninsula. These rocks of supracrustal affinity are infolded with Neoarchean plutonic rocks represented by Bt-Mag tonalite and Kfs-porphyritic (porphyroclastic) Bt-Grt quartz monzonite (violet unit, Fig. 5), from which they are inferred to be derived based on U-Pb zircon data (Daniele Regis, unpublished data, 2018). The clastic sequence is cut by intermediate to mafic plutonic rocks (blue units, Fig. 5) dominated by Mag-bearing Opx±Cpx±Hbl quartz diorite ± diorite with locally associated gabbro anorthosite. Collectively, intermediate to mafic plutonic rocks are reflected by magnetic highs with an overall northerly trend through central Boothia Peninsula (arrows in Figs. 4, 5).

Metasedimentary rocks exposed on northwest Boothia Peninsula (Wrottesley Inlet, Fig. 5) are dominated by Grt±Sil semipelite with lesser psammite, quartzite, marble, and calc-silicate. This clastic-carbonate sequence (medium brown, Fig. 5) is younger than the clastic sequence of central and eastern Boothia Peninsula (Daniele Regis, unpublished U-Pb detrital zircon data, 2018). The presence of marble on southern Boothia Peninsula near Josephine Bay (blue star in Fig. 5; *see Fig. 8 in* Sanborn-Barrie et al., 2018) suggests that the younger carbonate-bearing sequence may extend southward beneath Paleozoic strata and Quaternary cover (see Fig. 8).

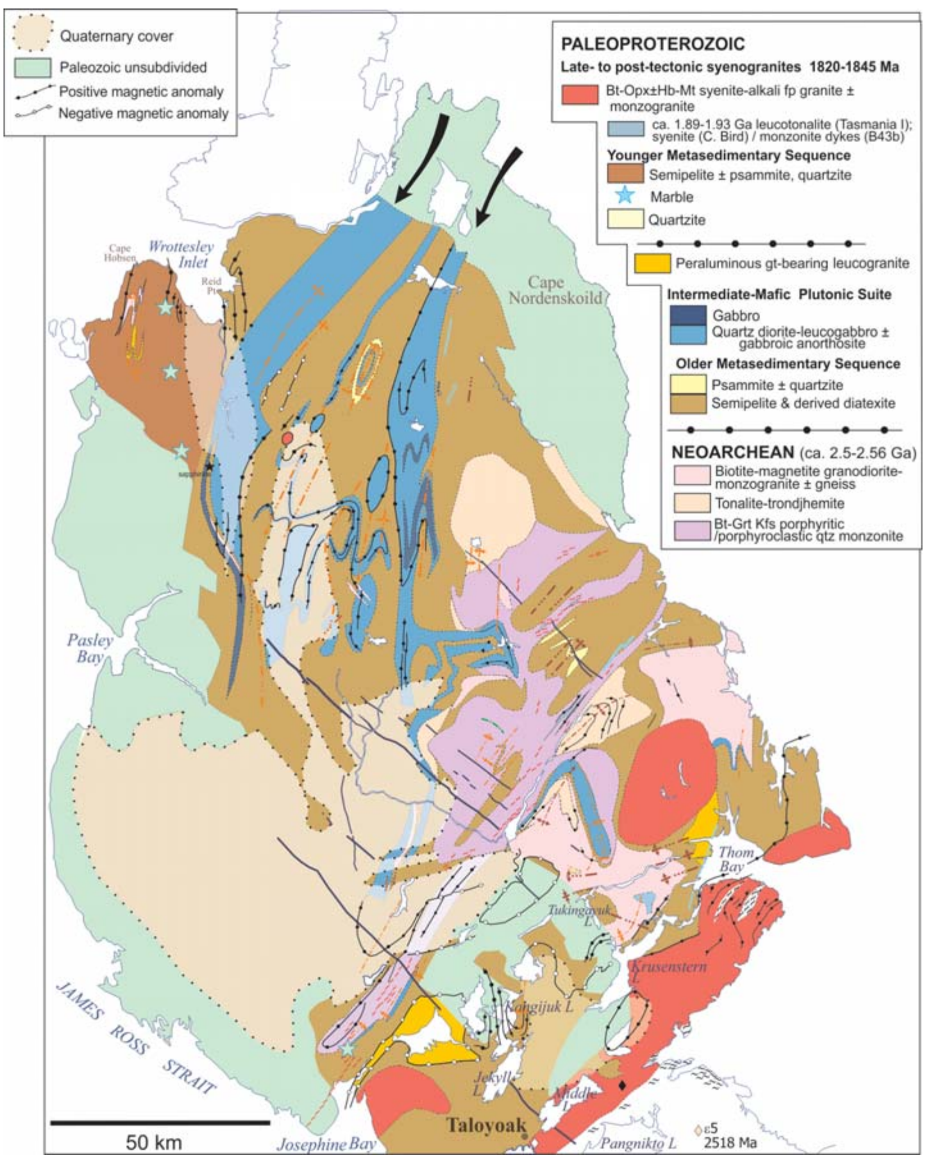

Figure 5. Preliminary GEM-2 geological map of Boothia Peninsula based on 2017 mapping. Regions of till cover indicated by transparency. Diamond symbol 25 km NE of Taloyoak denotes location of unpublished 1846 Ma U-Pb age of Ryan et al., 2009.

Weakly foliated to massive granitoid plutons (coral pink unit, Fig. 5) cut polydeformed metasedimentary rocks and associated diatexite across southern Boothia Peninsula. These late- to post-tectonic granitoids have U-Pb ages of 1.84-1.82 Ga and can be subdivided into a biotite-orthopyroxene monzogranite (charnockite) suite and a hornblende-biotite quartz syenite to syenogranite suite (Osinchuk et al., 2019).

Preliminary 2018 findings on Somerset Island and northern Boothia Peninsula

Lithology

Throughout the length of Somerset Island, units of clastic metasedimentary rocks and Opx±Cpx diorite ± quartz diorite are ubiquitous. In general, the proportion of metasedimentary rock is significantly decreased in comparison to Boothia Peninsula, with a corresponding increase in diorite ± tonalite and leucogranite. Late- to post-tectonic granitoid rocks are rare.

Tonalite suspected to form the oldest rocks (basement) on Somerset Island, based on field relationships and U-Pb constraints determined for Boothia Peninsula, is exposed along the west coast of the island from Four River Bay (Fig. 6) to Howe Harbour (see Fig. 8). Associated with tonalite are 10-100 m wide panels of inhomogeneous diatexite with screens and schlieren of Grt-Bt ±Sil semipelite (Fig. 7), which may represent remnants of the older ca. 2.5 Ga clastic sequence identified across central and eastern Boothia Peninsula. The distinctive Kfs porphyritic (porphyroclastic) Bt-Grt monzonite – granodiorite unit that forms a significant component of basement on central Boothia Peninsula (violet unit in Figs. 5, 8) was not recognized in 2018 on Somerset Island.

Figure 6. Light grey weathered tonalite-granodiorite cut by salmon-pink weathering monzogranite veins, west of Stanwell-Fletcher Lake (18SRB-M157), Four River Bay.

Figure 7. Rusty weathering Grt-Sil semipelite and inhomogeneous diatexite (18SRB-M131), 5 km east of tonalitic basement, Howe Harbour.

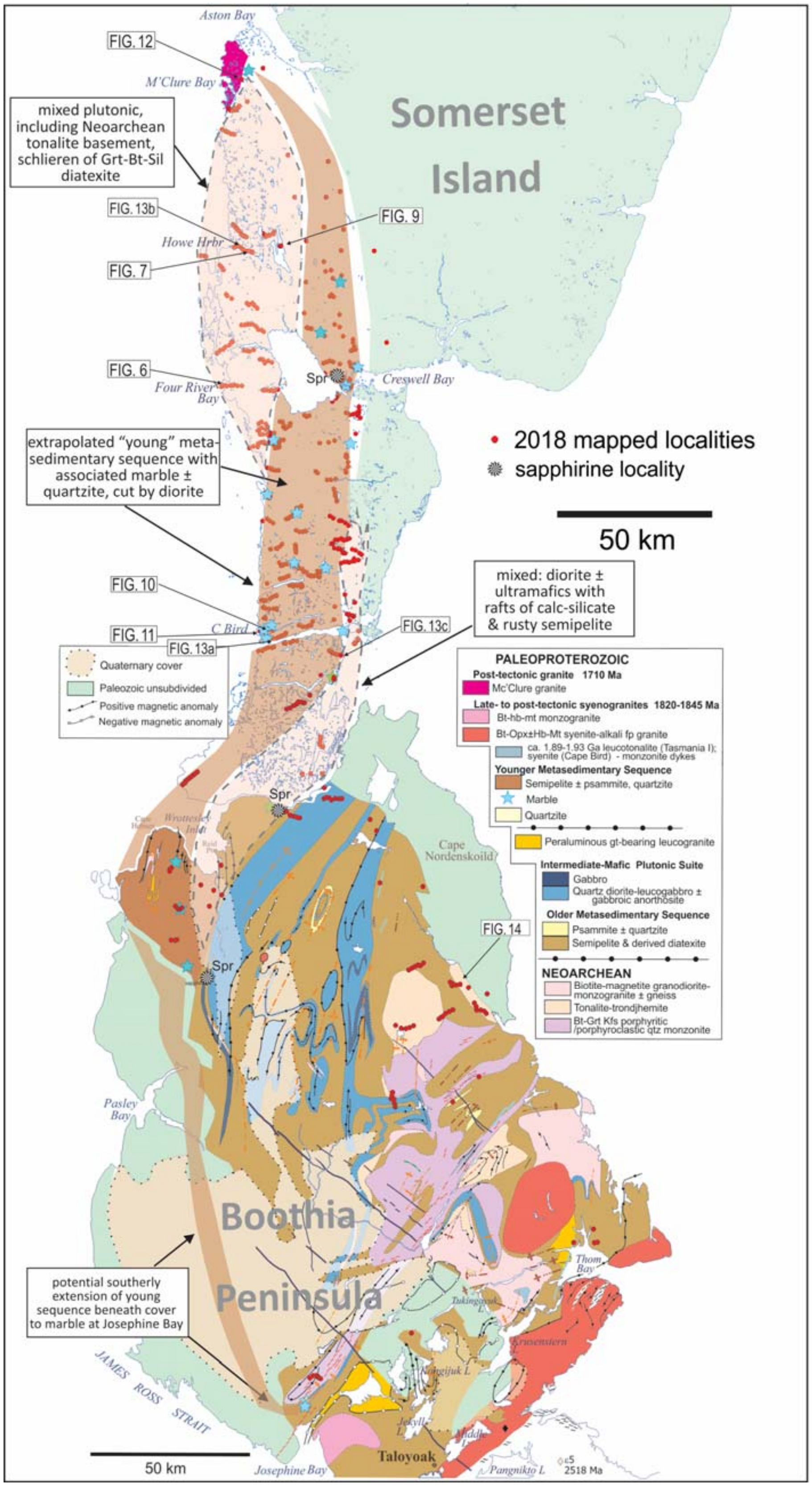

Figure 8. Geological map of Boothia Peninsula extrapolated north to Somerset Island based on 2018 observations (red circles). Spr = sapphirine; blue stars = marble occurrences; pale green stars = calc-silicate enclaves.

Medium-grained pyroxene-bearing granodioritic to tonalitic rocks of western Somerset Island (Fig. 9) cut tonalitic to dioritic rocks (described above) and were determined by Frisch and Hunt (1993) to be ca. 2484 Ma at Fiona Lake and ca. 1950 Ma at Howe Harbour. The crystallization age of the unit at Fiona Lake may therefore represent a minimum age of the tonalitic to dioritic rocks it cuts.

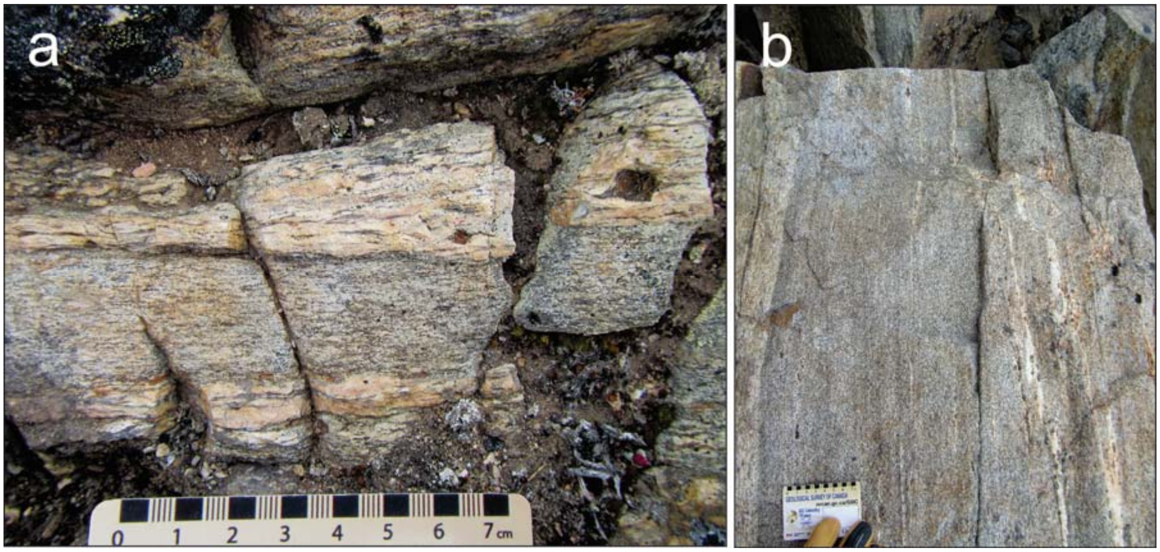

Figure 9. Opx-Mag±Grt tonalite previously dated at ca. 2484±13 Ma (FS-90-39 of Frisch and Hunt, 1993), island in Fiona Lake (18SRB-R114). ***a)*** Horizontal exposure of Opx-Mag±Grt tonalite cut by coarse-grained Grt-monzogranite veins. ***b)*** Equigranular Cpx-Opx-Mag diorite associated with light-weathering tonalite, left side of photo (18SRB-D54).

Extensive exposures of metasedimentary rocks occur on northeast Boothia Peninsula and southwest Somerset Island, east of Cape Bird. Here semipelite occurs interlayered with inhomogeneous diatexite, in contact with white weathering Grt-Sil psammite cut by Grt-leucosome, associated with 10-20 m wide panels of diopside-bearing marble (Fig. 10).

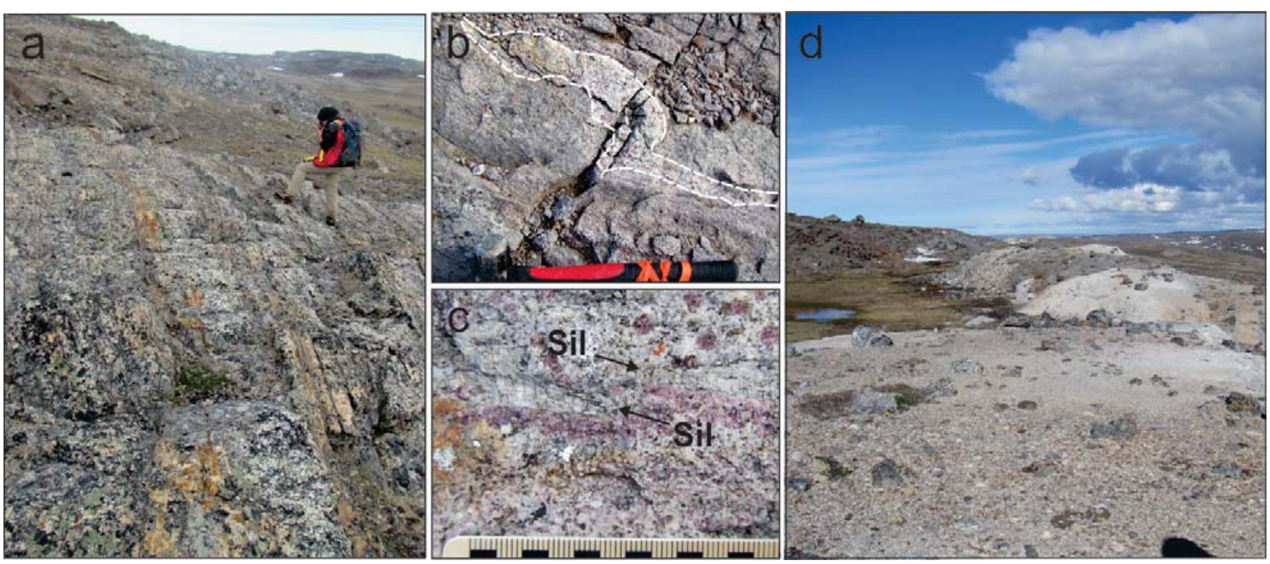

Figure 10. Clastic-carbonate rocks and derived migmatite, southwest Somerset Island. ***a)*** Steeply dipping interlayered rusty weathering graphitic semipelite in transitional contact with inhomogeneous diatexite (18SRB-R152). Foliation oriented 017/65°E with mineral lineation plunging 14°NE (034). ***b)*** Grt-Sil psammite (18SRB-R154) cut by vein of Grt-bearing leucosome (outlined by white dashed line) located 1 km east of semipelite-diatexite in ***a***. Hammer is 30 cm long. ***c)*** Detail of psammite in b showing pervasive lilac garnet and sprays of sillimanite 8 cm in length. ***d)*** Oblique view to north of white weathering marble cut by Grt-bearing homogeneous diatexite (leucosome) on west-dipping fold limb located 1.8 km east of psammite shown in ***b, c***.

On Somerset Island, there are no rocks equivalent to the voluminous 1.84-1.82 Ga charnockitic-syenogranite-alkali feldspar granite exposed across Boothia Peninsula, south of the Sanagak Lake shear zone (coral pink unit in Figs. 5, 8). Instead, restricted exposures of granitic rocks are represented by foliated syenogranite dated at ca. 1937 Ma (Frisch and Hunt,1993) at Cape Bird (Fig. 11), and massive Kfs porphyritic granite (Fig. 12) dated at 1708±5 Ma (Frisch and Hunt, 1993) around M'Clure Bay on northwest Somerset Island (Fig. 8).

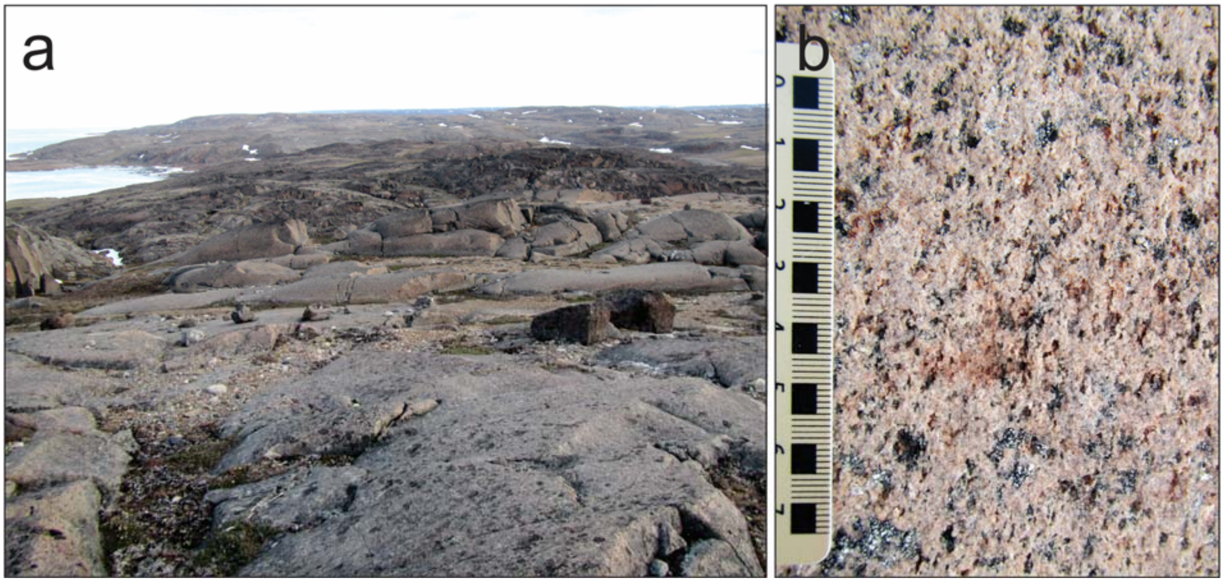

Figure 11. Foliated syenite exposed at Cape Bird (18SRB-R151), southwest Somerset Island, previously estimated to be ca. 1.94 Ga (76-DV-279d; Frisch and Hunt, 1993). ***a*)** Oblique view to north. ***b*)** Detail of horizontal exposure showing equigranular nature of Opx-Cpx-Hbl-Mag quartz syenite with weak foliation oriented 021/81°E.

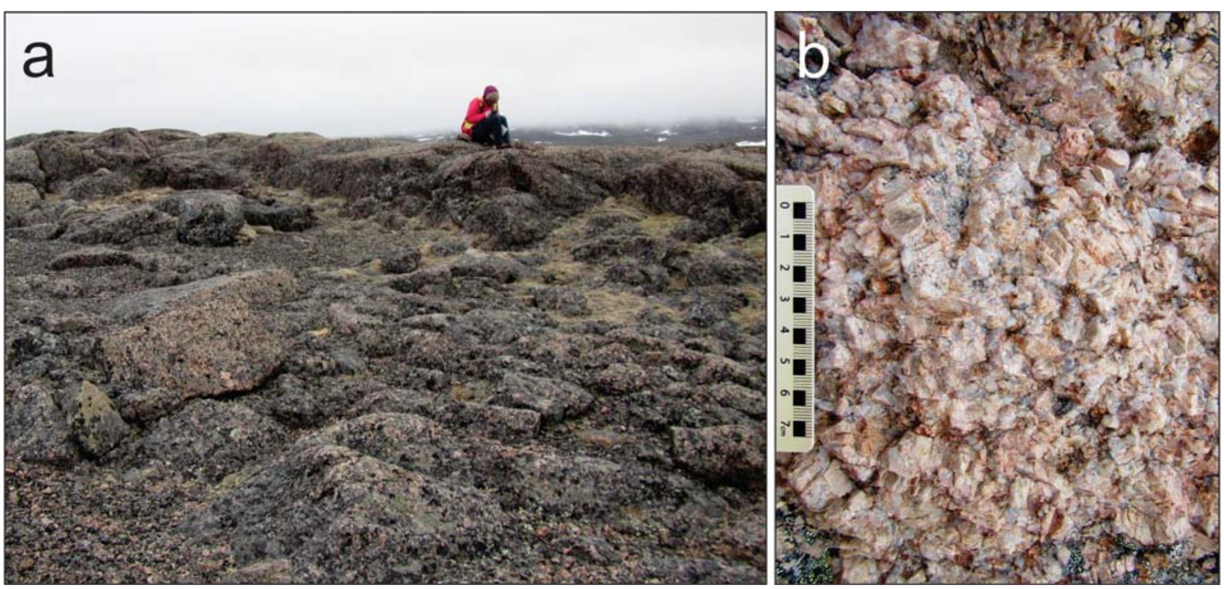

Figure 12. Massive, homogeneous quartz syenite exposed at M'Clure Bay (18SRB-O92), northwest Somerset Island, dated previously at 1708±5 Ma (76-DV-277b; Frisch and Hunt, 1993). ***a*)** Oblique overview to north. ***b*)** Detail of weathered, horizontal exposure of Kfs porphyritic Cpx±Bt quartz syenite.

Structural Geology

As noted across Boothia Peninsula, the deformational history of Somerset Island is polyphase with at least two penetrative deformation events typically reflected in exposed Precambrian basement rocks. In general, basement exposures across Somerset Island display pervasive steeply-dipping, N-S striking fabrics (Fig. 13), colinear to trends of anomalies in the aeromagnetic data (Fig. 4). The N-S structural trend is the result of macroscopic dm-scale open to isoclinal folds, many of which can also be distinguished on airphotos, which have steeply dipping, approximately N-S-trending axial surfaces. Their plunge varies slightly in direction, creating dome and basin structures (Fig. 4, Sanborn-Barrie et al., 2018).

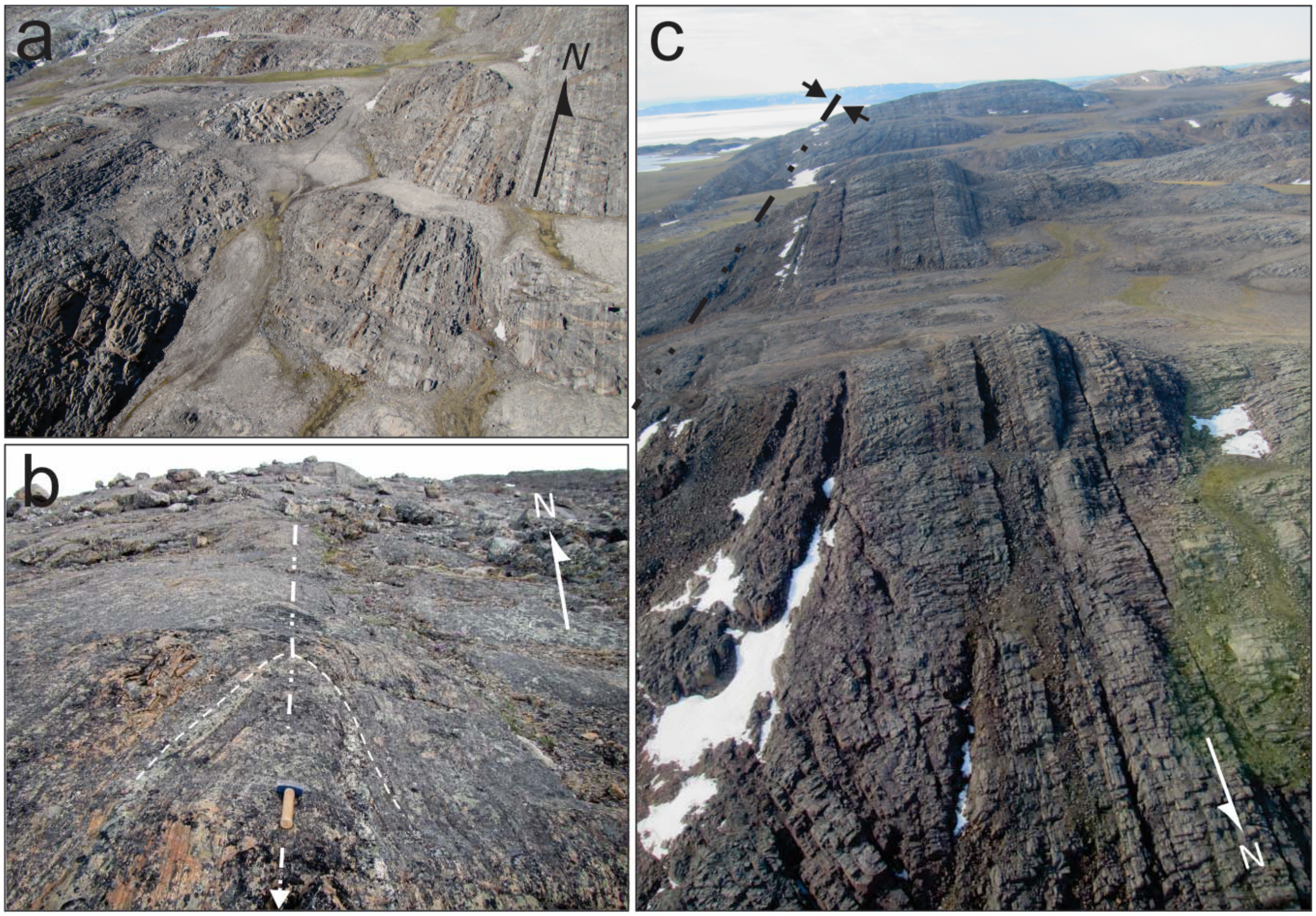

Figure 13. North-striking, steeply dipping fabric that characterizes Precambrian basement exposures on Somerset Island and northern Boothia Peninsula. **a)** Aerial view to south of north shore of western Bellot Strait where layers of tonalite, inhomogeneous diatexite, rusty semipelite and minor marble are oriented 178/80°W (600m south of 18SRB-D95). ***b)*** View to north of folded S_1 foliation (dashed line) defining steeply dipping, south-striking F_2 fold with axial plane (dot dash line) oriented 196/84°W, east of Howe Harbour (18SRB-M127). ***c)*** Aerial view to south along north-striking, west-dipping limb of regional-scale fold whose hinge zone is traced by black dashed line, northern Boothia Peninsula (18SRB-M145).

The generally steep fabrics of Somerset Island contrast with shallow to flat-lying fabrics observed on northern Boothia Peninsula (Fig. 14). Locally, Boothia's flat foliation is identified as a S_1+S_2 transposition fabric, axial planar to inclined and recumbent F_2 folds, based on rare, but widespread lower strain 'windows' revealing the presence of folded S_1 fabric (*see Fig. 11 in* Sanborn-Barrie et al., 2018).

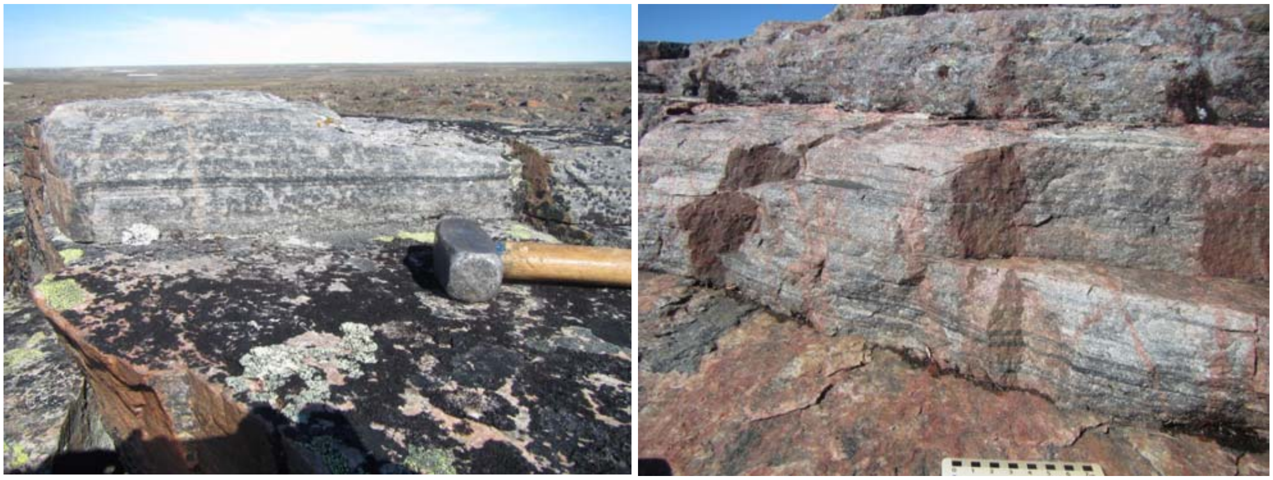

Figure 14. Strong, straight, flat-lying tectonic foliation in fine-grained tonalite, west-central Boothia Peninsula. ***a)*** Bt-Mag tonalite (18SRB-M141) with tectonic foliation oriented 210/13°NW which contains (not shown) a down-dip extensional lineation plunging 9° to the NW (330°). Hammer head is 5 cm wide. ***b)*** Light grey-weathering tonalite with straight flat-lying tectonic foliation, cut by conjugate hairline fractures that are preferentially hematixedhematized (18SRB-M142).

Economic Geology

Rusty weathering, sulphide-bearing rocks observed during the 2018 mapping campaign were observed on southern Somerset Island, within a region transected by ENE-trending lineaments (Fig. 4 inset) and fiords including Bellot Strait, False Creek and Fitz Roy Inlet. Thirty samples have been submitted to a geochemical laboratory (ActLabs) so that contents of base- and precious metals can be quantitatively determined and the prospectivity of certain units better assessed.

In addition, base metal prospects (Steve Alookie, 2002 D.I.A.N.D Report) in the Thom Bay region (Fig. 3, 5) were visited in 2018 order to compare the known base-metal mineralization in this region of Boothia Peninsula with that indicated by gossanous rocks on southern Somerset Island, currently being analysed for base and precious metals.

GEM-2 Supported Student Research

Undergraduate research (2) and graduate research projects (2) are supported as part of this GEM-2 activity. Honours BSc research is targeted at gossanous rocks prospective for base metals exposed on southern Somerset Island (T. Moum, Carleton U., supervised by Prof J. Mungell,) and deduction of the pressure-temperature-time path of high-grade pelite exposed on Bellot Strait (C. Kinney, U. Waterloo, supervised by Prof. C. Yakymchuk). Ongoing MSc research into the magmatic petrogenesis of Boothia Peninsula through time (A. Osinchuk, University of Alberta, Profs. T. Chacko and L. Heaman supervisors) is examining the oldest and the youngest granitoid suites currently recognized: a pre-tectonic K-feldspar porphyritic biotite-garnet quartz monzonite ± granodiorite suite and late- to post-tectonic syenitic suite to determine and document their geochemical and isotopic character and assess their tectonic affinity. MSc research is also ongoing into the extent, kinematics, timing and exhumation history of a regional-scale, southwest-striking ductile shear zone (D. Drayson, U. Manitoba, supervised by Prof. A. Camacho). Insight into the kinematics, timing and regional tectonic significance of the Sanagak Lake shear zone will contribute to a viable tectonic model for the Boothia-Somerset region in the context of the Columbia/Nuna supercontinent.

These research projects provide field and lab-based scientific training opportunities for young Canadians. Collectively, they will contribute insight into the magmato-tectonic processes that formed and reworked Precambrian basement rocks of Boothia Peninsula and, in turn, shed insight into the tectonic processes that affected the Canadian Arctic more than 1.8 billion years ago.

Future Objectives

Data and observations from the 2018 fieldwork will lead to the compilation and publication of new 1:150 000-scale bedrock geology maps. Geochemical and samarium-neodymium (Sm-Nd) isotope analyses, linked with new uranium-lead (U-Pb) geochronology and petrology data, will characterize the origin and metamorphic history of the different units and allow correlation with those exposed on Boothia Peninsula to the south. The timing of sedimentary deposition, magmatic activity, and structural development will be determined so that their significance with respect to orogenic events including the Archean Rae, ca. 2.5-2.35 Ga Arrowsmith, ca. 2.0-1.9 Ga Thelon, ca. 1.86-1.78 Ga Trans-Hudson and/or ca. 460 Ma Caledonian orogenies can be assessed.

Acknowledgements

We acknowledge with deepest gratitude Resolute Bay residents Martha and Nathaniel Kalluk, their granddaughter Katie, son Nathan, and also David Idlout who guided our planning and welcomed us onto their ancestral lands in order to access exposed Precambrian rocks of Creswell Bay and Somerset Island. We thank the staff of the Polar Continental Shelf Program (PCSP) for logistical support throughout our 2018 field operations, without which fieldwork would not be possible. Acasta HeliFlight Inc. and pilot Robert Fersili provided expert rotary air support. Kent van Dyk consistently provided delicious and nutritious cuisine, always served with kindness and enthusiasm. Chef van Dyk was supported by Tudjaat Cooperative Ltd. manager Gloria Burbidge and Inuit firm 953731 NWT Ltd.'s Aziz Kheraj. We thank the residents of Resolute Bay for their welcoming hospitality and support of our operations, including Hamlet staff Senior Administrative Officer Greg Holitzki and Finance Controller Conrad Hickey who together facilitated our goal to involve Resolute residents in the 2018 field operations through employment. Special thanks to members of the 2018 mapping team: Zina Beaulieu-Morrison, Emily Creaser, Derek Drayson, Sean Hicks, Carson Kinney, Talia Moum, Alix Osinchuk, Madison Ritchie, Jacob VanderWal, and Pascal Voegeli for their very capable assistance, hard work, and positive enthusiasm in all aspects of fieldwork. Dr. Jeremy Powell, GSC, reviewed this report and is thanked for his suggestions to improve clarity.

References

Acosta-Góngora, P., Martel, E., and Pehrsson, S.J., 2018. Geochemistry results from the south Rae mapping project, Northwest Territories, 2015 and 2016 field seasons; Geological Survey of Canada, Open File 8364, 1 .zip file https://doi.org/10.4095/306501

Berman, R.G., Sanborn-Barrie, M., Nadeau, L., Brouillette, P., Camacho, A., Davis, W.J., McCurdy, M., McMartin, I., Weller, O., Chadwick, T., Liikane, D., and Ma, S., 2016. Report of activities for the GEM-2 project "Geology and Mineral Potential of the Chantrey-Thelon Area": Thelon tectonic zone; Geological Survey of Canada, Open File 8129, 12 pp. doi:10.4095/299386

Berman, R.G., Davis, W.J., Sanborn-Barrie, M., Whalen, J., Taylor, B., McMartin, I., McCurdy, M., Mitchell, R., Ma, S., Coyle, M., Roberts B. and Craven J. In press. Report of 2017 activities: Thelon-Chantrey activity, Thelon Tectonic zone project; Geological Survey of Canada, Open File, 19 pp.

Blackadar, R.G., 1967. Precambrian geology of Boothia Peninsula, Somerset Island and Prince of Wales Island, District of Franklin. GSC Bulletin 151, 62 pp., 2 maps.

Brown, R.L., Dalziel, I.W.D. and Rust, B.R., 1969. The structure, metamorphism, and development of the Boothia Arch, Arctic Canada; Canadian Journal of Earth Sciences, 6, 525-543.

Coyle, M. and Oneschuk, D., 2015. First vertical derivative of the magnetic field, aeromagnetic survey of Somerset Island area, Nunavut; Geological Survey of Canada, Open Files 7669, 7670, 7672, 7673, 7674, 7675, and 7676.

Coyle, M., Boulanger, O., Tschirhart, V. and Kiss, F., 2016*a*. Residual total magnetic field, aeromagnetic survey of the northern Boothia Peninsula II, Nunavut, NTS 57-F and parts of 57-E, -F, -G, and 67-E,-H. Geological Survey of Canada, Open Files 8156, 8157, 8158, 8159, 8160, and 8161.

Coyle, M., Boulanger, O., Tschirhart, V. and Kiss, F., 2016*b*. First vertical derivative of the magnetic field, aeromagnetic survey of the northern Boothia Peninsula II, Nunavut, NTS 57-F and parts of 57-E,-F,-G and 67-E,-H. Geological Survey of Canada, Open Files 8162, 8163, 8164, 8165, 8166, and 8167.

Dineley, D.L. and Rust, B.R. 1968. Sedimentary and paleontological features of the Tertiary-Cretaceous rocks of Somerset Island, Arctic Canada. Canadian Journal of Earth Sciences, 5, 791-799.

Dixon, J. 1974. Revised stratigraphy of the Hunting Formation (Proterozoic), Somerset Island, Northwest Territories. Canadian Journal of Earth Sciences, 11, 635-642.

Dumont, R., 2014. Residual total magnetic field, aeromagnetic survey of northern Boothia Peninsula, Nunavut; Geological Survey of Canada, Open Files 7496, 7497, 7498, 7499, 7500, 7501, 7502, 7503, 7504, 7505.

Davis, W.J., Berman, R.G., and MacKinnon, A., 2013. U-Pb Geochronology of archival rock samples from the Queen Maud block, Thelon tectonic zone and Rae Craton, Kitikmeot Region, Nunavut, Canada; Geological Survey of Canada, Open File 7409, 40 pp. doi:10.4095/292663.

Davis, W.J., Berman, R.G., Nadeau, L., and Percival, J.A., 2014. U-Pb zircon geochronology of a transect across the Thelon Tectonic Zone, Queen Maud region, and adjacent Rae craton, Kitikmeot region, Nunavut, Canada; Geological Survey of Canada, Open File 7652, 41 pp. doi:10.4095/295177

Frisch, T., 2011. Geology, Precambrian geology of northern Boothia Peninsula and Somerset Island, Nunavut. Geological Survey of Canada, Open File 6051, 2 sheets; 1 CD-ROM, doi:10.4095/287896

Frisch, T. and Herd, R.K., 2010. Highly metamorphosed iron-formation on Arcedeckne Island, Boothia Peninsula, Arctic Canada, and the paragenesis of Harrisonite, $Ca(Fe,Mg)_6(SiO4)_2(PO_4)_2$. The Canadian Mineralogist, 48, 1005-1024.

Frisch, T. and Hunt, P A., 1993. Reconnaissance U-Pb geochronology of the crystalline core of the Boothia Uplift, District of Franklin, Northwest Territories. in, Radiogenic age and isotopic studies: report 7; Geological Survey of Canada; Geological Survey of Canada, Paper no. 93-2, 1993 p. 3-22, doi:10.4095/193329

Giguère, J.F., 1968. Element distribution in coexisting pyroxenes from granulite rocks of southeast Stanwell-Fletcher Lake area, Somerset Island, District of Franklin, N.W.T. University of Ottawa, Master of Science, 126 pp.

Jones, B. and Dixon, O.A., 1975. The Leopold Formation: An Upper Silurian Intertidal/Supratidal Carbonate Succession on Northeastern Somerset Island, Arctic Canada. Canadian Journal of Earth Sciences, 12, 395-411.

Kerr, J.W., 1976. Geological Investigations of Somerset Island and Boothia Peninsula (Operation Boothia: 57C,F,G; 58A to F) District of Franklin. Geological Survey off Canada Paper 76-1A. 491-492, doi:10.4095/104252.

Kerr, J.W., 1977. Cornwallis Fold Belt and the mechanism of basement uplift. Canadian Journal of Earth Sciences 14, 1374-1401.

Kerr, J.W. and Christie, R.L., 1965. Tectonic history of Boothia uplift and Cornwallis fold belt, Arctic Canada. Bulletin of American Association of Petroleum Geologists, 49, 905-926.

Kerr, J.W. and de Vries, C.D.S., 1977. Structural Geology of Somerset Island and Boothia Peninsula, District of Franklin. Report of Activities, Part A; Geological Survey of Canada, 107-111.

Kitsul, V.I., Glebovitsky, V.A., Vapnik, Y.A and Frisch, T., 2000. Gneisses from the granulite terrane of the central Boothia Uplift, Arctic Canada. The Canadian Mineralogist 38, 443-454.

Osinchuk, A., Chacko, T., Heaman, L.M., Regis, D., and Sanborn-Barrie, M. 2019. Petrogenesis of late- to post-tectonic granitoids of Boothia Peninsula, NU: Lu-Hf and Sm-Nd isotope characterization of the granitoids and their source rocks. GAC Abstract Quebec City

Okulitch, A.V., Packard, J.J., and Zolnai, A.I., 1986. Evolution of the Boothia Uplift, arctic Canada. Canadian Journal of Earth Sciences 23, 350-358.

Percival, J., A., Martel, E., Pehrsson, S. J., Acosta-Gongora, P., Regis, D., Theissen, E., Jamieson, D., Neil, B., and Knox, B., 2016. Report of 2016 bedrock activities for the geologic and metallogenic framework of the south Rae Craton, southeast NWT: GEM-2 South Rae Quaternary and Bedrock Project. Geological Survey of Canada, Open File 8142, 17 pp. doi:10.4095/299469

Regis, D., Martel, E., Davis, W. J., Pehrsson, S. J., 2017. U-Pb zircon geochronology of metaplutonic rocks across the southern Rae Province, Northwest Territories; Geological Survey of Canada, Open File 8254, 37 pages, doi:10.4095/302772

Ryan, J.J., Nadeau, L., Tremblay, T., Davis, W.J., Berman, R. G., James, D.T. and Brouillette, P., 2009. Geology and analytical results of the Boothia mainland area, Kitikmeot region, NU; Geological Survey of Canada unpublished Poster Presentation at Mineral Exploration Roundup, Vancouver, BC, January 27-29, 2009.

Sanborn-Barrie, M., Ford, A., Hillary, E., Tschirhart, V.L., Tremblay, T., and Maharaj, J., 2016*a*. Report of activities for the GEM-2 Boothia Peninsula-Somerset Island project: Integrated Geoscience of the Northwest Passage; Geological Survey of Canada, Open File 8128, 8 p. doi:10.4095/299381

Sanborn-Barrie, M., Regis, D., Ford, A., Osinchuk, A., and Drayson, D., 2018. Report of Activities for the GEM-2 Boothia Peninsula-Somerset Island Project: Integrated Geoscience of the Northwest Passage, Nunavut; Geological Survey of Canada, Open File 8339, 16 p. https://doi.org/10.4095/306597

Stewart, W. D. and Kerr, J.W., 1984*a*. Geology of Somerset Island North, District of Franklin. Geological Survey of Canada, Map 1595A.

---------- 1984*b*. Geology of Somerset Island South, District of Franklin. Geological Survey of Canada, Map 1596A.

---------- 1984*c*. Geology of Boothia Peninsula, North, District of Franklin. Geological Survey of Canada, Map 1597A.

---------- 1984*d*. Geology of Boothia Peninsula, South, District of Franklin. Geological Survey of Canada, Map 1598A.

Tersmette, D.B., 2012. Geology, geochronology, thermobarometry, and tectonic evolution of the Queen Maud block, Churchill craton, Nunavut, Canada. University of Alberta, Master of Science, 170 pp.

Thériault, R.J., Henderson, J.B., and Roscoe, S.M., 1994. Nd isotopic evidence for early to mid-Archean crust from high grade gneisses in the Queen Maud Block and south of the McDonald Fault, western Churchill Province, Northwest Territories; in Radiogenic Age and Isotopic Studies; Report 8; Geological Survey of Canada, Current Research, 37-42.

Tschirhart, V. and Oneschuk, D., 2015. Aeromagnetic interpretation products, Somerset Island, Nunavut, parts of NTS 58B/3, 4, 5, 6, 11, 12, 13, 14, parts of NTS 58C/3, 4, 5, 6, 11, 12, 13, and parts of NTS 57G/13, 14; Geological Survey of Canada, Open File 7805, 4 sheets, doi:10.4095/296720