Natural Resources Canada | Ressources naturelles Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 9184

Bedrock geology of the Kivalliq Corridor, Nunavut, through community mapping

M. Sanborn-Barrie, A. Ford, and N.M. Rayner

2024

Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 9184

Bedrock geology of the Kivalliq Corridor, Nunavut, through community mapping

M. Sanborn-Barrie, A. Ford, and N. M. Rayner

2024

Permanent link: https://doi.org/10.4095/pquf6ssr66

This publication is available for free download through Nrcan's Open Science & Technology Repository (OSTR) at https://ostrnrcan-dostrncan.canada.ca/home

Recommended citation
Sanborn-Barrie, M., Ford, A., and Rayner N.M., 2024. Bedrock geology of the Kivalliq Corridor, Nunavut, through community mapping; Geological Survey of Canada, Open File 9184, 13 p. https://doi.org/10.4095/pquf6ssr66

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

ISSN 2816-7155 ISBN 978-0-660-71997-9 Catalogue No M183-2/9184E-PDF

Introduction

NRCan's Geomapping for Energy and Minerals (GEM) GeoNorth program is contributing to the acquisition of geoscience knowledge and data within regions of priority for northern organizations and communities. Under this program, the ***Community Bedrock Mapping of the Kivalliq Corridor*** activity aims to improve geological understanding and create a modern, updated bedrock map in a region for which a major infrastructure project has been proposed. The proposed Churchill-Kivalliq Hydro-Fibre (CKHF) link would involve construction of a 1200-km, 150 megawatt transmission line from Gillam, Manitoba northward through the Kivalliq communities of Arviat, Whale Cove, Rankin Inlet and Chesterfield Inlet and westward to Baker Lake (Fig. 1 inset) to bring broadband internet and renewable, sustainable, reliable hydroelectricity, crucial for advancing the economy of the western Hudson Bay region. In tandem with advancement of this infrastructure project, is a planned road that will allow further access to northern resources. Additionally, a major upgrade to the Rankin Inlet airport to accommodate a 3-fold increase in capacity is currently in progress. The geology and geophysical character of the CKHF link corridor, portions of which are poorly known and under explored, was identified by Inuit organizations as a priority that should be assessed and updated to deliver a modern, time-calibrated, geological map. Such a map will support and inform mineral exploration across a region where access will significantly increase, and provide a modern geological framework on which future land-use decisions can be soundly based.

This activity is using a community-based approach to engage and involve interested residents in the planning and execution of fieldwork required to collect observations and bedrock samples. The intention is to provide employment opportunities and strengthen interest, expertise, and capacity in geoscience within the western Hudson Bay communities of Whale Cove and Arviat.

Objectives:

- to refine, update, and produce new geological knowledge regarding the untapped resource potential underlying thick glacial cover of lower Nunavut;
- to deliver plain-language understanding of the geology of a proposed infrastructure corridor to support economic diversification and provide baseline data to compare and inform environmental assessments;
- to provide a meaningful way to engage Northerners, especially youth, to experience and participate in science, and to enable knowledge sharing and knowledge co-production;
- to strengthen the capacity of communities within the Kivalliq corridor to address geoscience opportunities and challenges related to proposed infrastructure developments.

Geological Setting & Previous Work

The Kivalliq corridor exposes rocks of the central part of the Hearne domain which forms the southeastern part of the aerially extensive western Churchill Province (Fig. 1). Systematic mapping of the central Hearne domain, first conducted during Operation Keewatin in 1952 (Lord 1953; Lord and Wright 1967), broadly subdivided the region into volcanic and plutonic rocks suspected to be Archean, from those of Early Proterozoic age that included sedimentary rocks with a diagnostic quartzite±dolomite association and post-tectonic granites. Subsequent more detailed (1:250,000) mapping ± metallogenic studies were undertaken in the late 1960's and early 1970's (Davidson 1970; Heywood 1967; Ridler and Shilts 1974; Fraser 1983). An Archean age for mafic plutonic rocks exposed east of Kaminak Lake (Fig. 1) was first established by the potassium-argon (K-Ar) method at 2585 ± 70 Ma (Wanless et al. 1970) in hornblende from diorite. Archean volcanic rocks were later dated (U-Pb zircon) at 2697.5 ± 1.4 Ma and 2692 ± 1 Ma from the Carr Lake - Kaminak Lake area (Mortenson and Thorpe 1987). Cavell et al. (1992) derived a SHRIMP ion microprobe age of 2700 ± 11 Ma for hornblende tonalite of the Kaminak Batholith

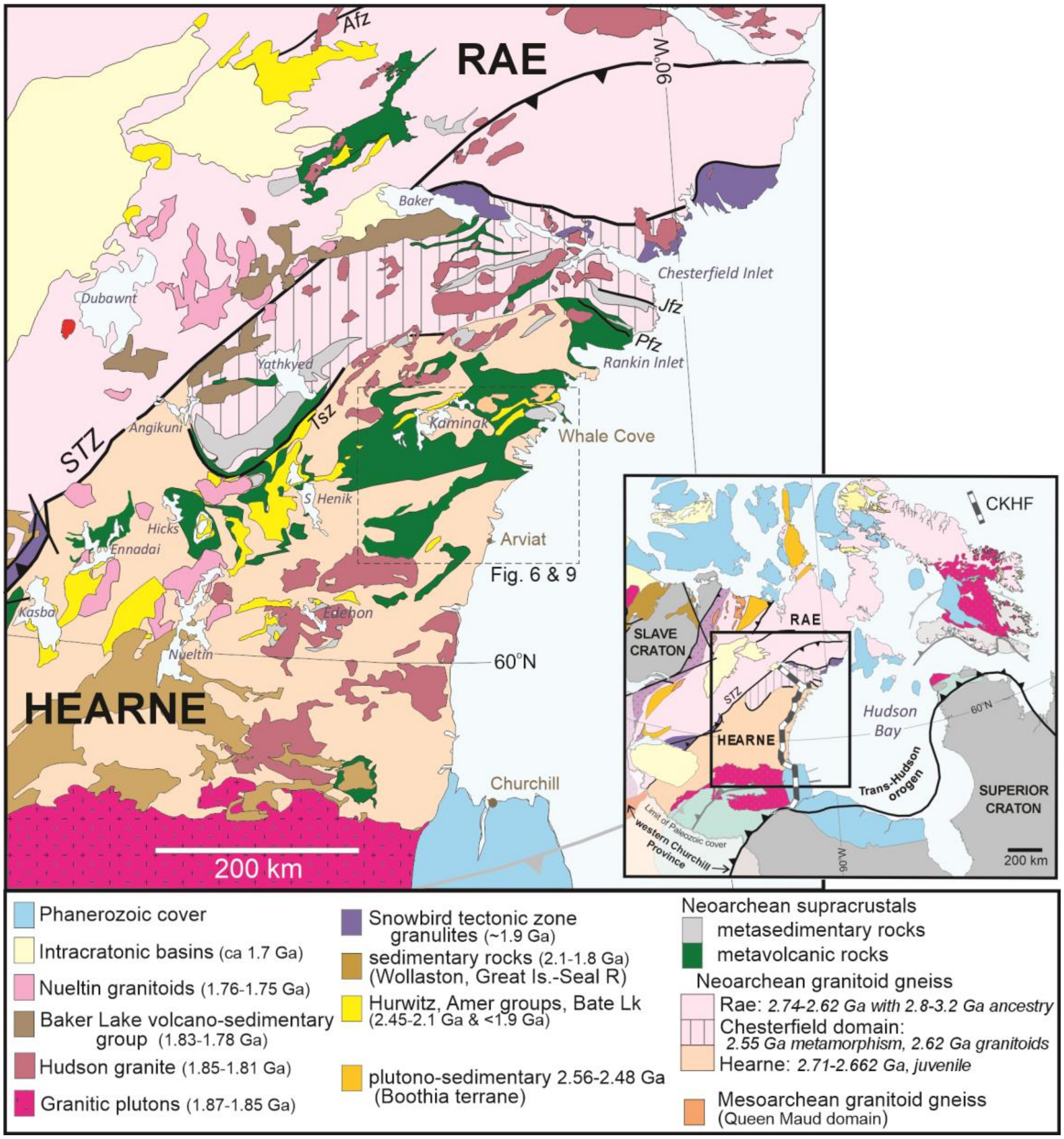

Fig. 1. Regional geology of the Hearne, Chesterfield, and southern Rae domains, western Churchill Province. Dashed box outlines area shown in more detail in Figures 6 and 9. Afz=Amer fault zone; Jfz=Josephine fault zone; Pfz=Pyke fault zone; Tsz=Tyrrell shear zone; STZ=Snowbird Tectonic Zone. Inset shows extent of the Western Churchill Province, with internal subdivisions Rae, Hearne and Chesterfield domains, bound by the Superior craton (to southeast) and Slave craton (to northwest) and proposed location of the Churchill-Kivalliq Hydro-fibre (CKHF) link.

[subsequently revised to 2679+3/-2 Ma by Davis et al. (2004)] and 2659 ± 5 Ma for an ijolite-carbonatite intrusion that cuts it.

The geological evolution of part of the central Hearne domain was a focus of NRCan's Western Churchill NATMAP program (1997-2001) with studies targeted at the Henik Lake - Kaminak Lake - Tavani region (Fig. 1), designated the central Hearne supracrustal belt (CHSB). Within this belt, bedrock mapping and supporting geochemical, geochronological and thermobarometric studies supported rapid, episodic (2711-2691 Ma, 2686-2679 Ma) generation of juvenile crust in a supra-subduction zone setting (Hanmer et al. 2004; Davis et al. 2004; Sandeman et al. 2004). Examination of supracrustal rocks contiguous with the CHSB to the southeast (Wallace River area) was undertaken by Peterson (1997) although geochemical and geochronological data for this area is largely lacking. Sedimentological and structural studies of overlying Paleoproterozoic strata (dominated by Hurwitz Group) in the Watterson - Henik - Quartzite lakes area (Fig. 1) were led by Aspler (Davis et al. 2005 *and references therein*).

This GEM GeoNorth activity is undertaking bedrock mapping across the southern half of the proposed CKHF corridor, a hard to access, heavily drift-covered region with outdated geological maps, rare or obsolete age constraints, and no lithogeochemical information with which to correlate units within, and beyond, the region. Its geology, last mapped in the late 1960's and 1970's, is portrayed on four adjoining, uncoloured 1:250 000 scale geological maps (Fig. 2).

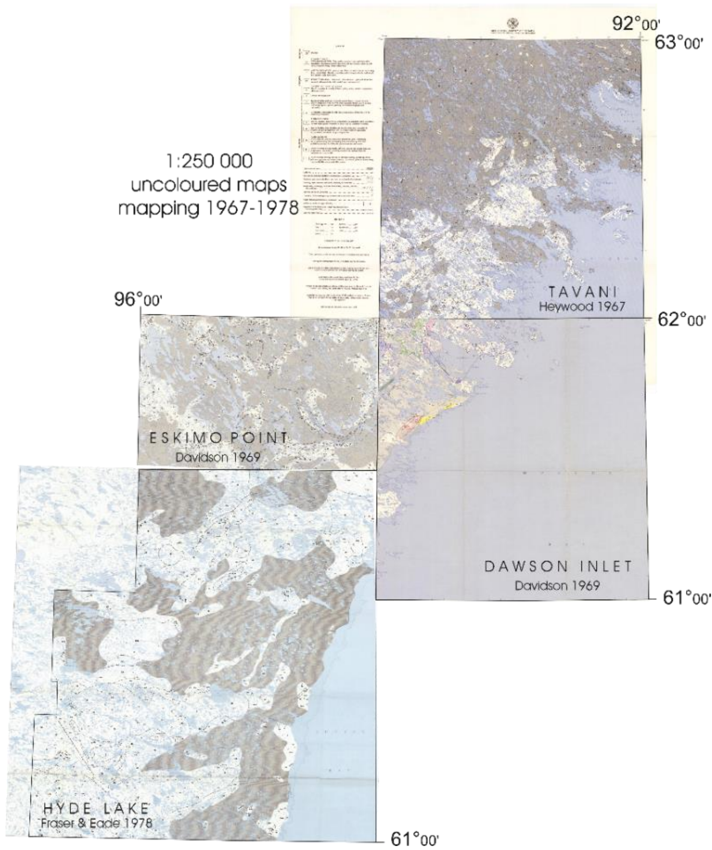

Fig. 2 Uncoloured 1: 250,000 scale geological maps of the study area by Heywood (1967), Davidson (1970) and Fraser (1983). Extent of glacial drift in grey, bedrock in white.

Community Mapping Model

This project is using a community-based approach to bedrock mapping, designed in consultation with the priorities of Inuit, with a goal to increase interest in, and access to, geoscience. Gathering of geoscience observations and investigation of their alignment with regional aeromagnetic data (through informal community workshops) was done in partnership with residents of Arviat and Whale Cove in July 2023 to increase appreciation for the record of ancient history preserved near these communities, and strengthen local capacity for mapping and prospecting.

Whale Cove, NU

While based in Whale Cove, NU (June 28 – July 16, 2023), five residents participated in helicopter safety training and were hired to assist in mapping (Fig. 3) through an agreement (NRCan AGR-4044) with the Hamlet of Whale Cove. In addition, Hamlet staff and representatives from the Issatik Hunters and Trappers Association (Fig. 4 left) were invited to join the mapping team to gain first-hand experience of why and how to map rocks. Additionally, a number of youth and residents participated in an afternoon information session (classroom) and fieldtrip (Fig. 4 right).

Fig. 3. Inuit assistants from Whale Cove. LEFT) Jacqueline Teenar prepared for a day of mapping, NRCan photo 2023-433; MIDDLE) Mikkijuk Manning tracking the flight path on a hand-held toughpad computer, NRCan photo 2023-434; RIGHT) Malachi Kritterdlik & Jeremiah Oklaga examine quartz veins, NRCan photo 2023-435.

Fig. 4. Involvement in geoscience by Whale Cove residents. LEFT) Issatik HTO members Martha Panika and Mona Okalik, 50 km southwest of Whale Cove, NU, NRCan photo 2023-436; RIGHT) Pelag Enuapik, Michael Angutetuar and Wayne Putulik check the magnetic property of a roadside exposure of iron formation, Whale Cove, NU, NRCan photo 2023-437.

Arviat, NU

While based in Arviat, NU (July 18-31, 2023), eight residents participated in helicopter safety training and were hired to assist in mapping (Fig. 5) through an agreement (NRCan AGR-6010) with the Hamlet of Arviat. In addition, workshops were held at the Hamlet Resource Centre that covered topics such as panning for gold; aeromagnetic interpretation; determining ancient ice movement trends from lakes and landforms; and recognizing features that reflect the ancient marine limit (cf. Page and McMartin 2023). In addition to regional bedrock mapping, several localities where carving stone was known to occur (Nevill Bay) or where material suitable for carving might be encountered (e.g., argillite of the Ameto

Fig. 5. Bedrock mapping with Arviat residents. LEFT) preparing to map a well-exposed section of Paleoproterozoic strata on the McConnell River, 80 km west of Arviat, NRCan photo 2023-438; MIDDLE) examining garnet-sillimanite paragneiss in Arviat, NRCan photo 2023-439; RIGHT) carver Lyta Josephie with green ultramafic stone collected for carving from a known carving stone locality on an island in Nevill Bay, south of Whale Cove, NU, NRCan photo 2023-440.

Formation, McConnell River) were visited with local carver Lyta Josephie in order to assess and collect material for carving.

Geological Findings

In 2023, 156 localities of exposed bedrock were examined (Fig. 6), with primary and tectonic structures measured (Fig. 9) and samples collected. Note the prefix 23SRB- has been omitted from station numbers throughout the text and on Fig. 6.

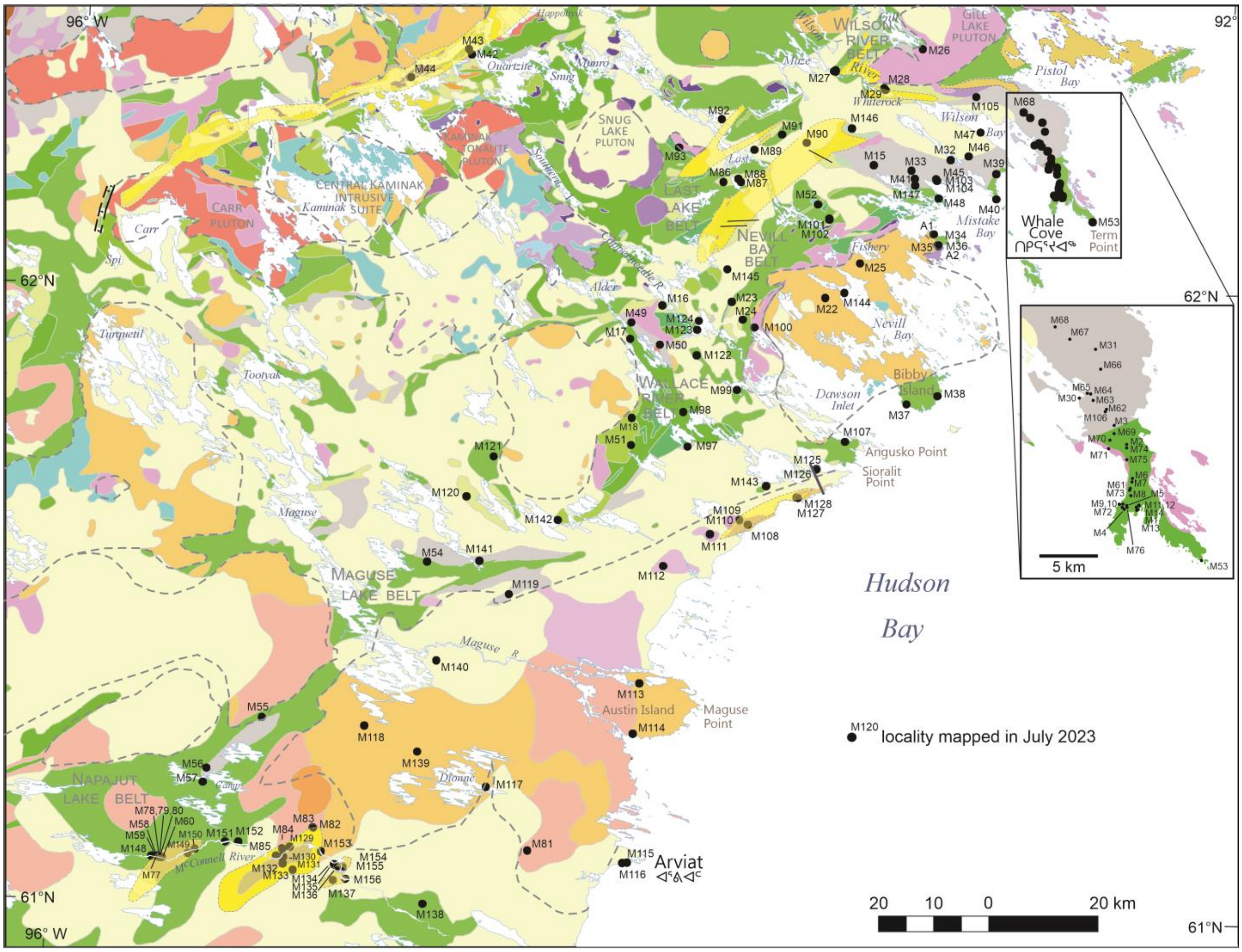

Fig. 6. Geological compilation map of the Kivalliq corridor (after Tella et al., 2007) with bedrock localities mapped in 2023 shown by black filled circles with abbreviated station number (i.e., M112). Legend as per Tella et al. (2007) with metavolcanic rocks in various tones of green; presumed Archean metasedimentary rocks in grey; dioritic rocks in blue; tonalite-granodiorite ±granite in orange-red-coral-pink purple tones; Paleoproterozoic Hurwitz Group is highlighted in transparent deep yellow. Extensive glacial cover is shown in pale yellow. Extent of plutons, where exposed and inferred beneath glacial cover from aeromagnetic data, is denoted by dashed lines (see also Fig. 9).

Supracrustal Rocks

Mafic metavolcanic rocks represented by pillowed and massive basaltic rocks near Whale Cove, across Bibby Island and near Sioralit Point (Fig. 6) typically display primary features (Fig. 7 left) many of which are indicative of younging, including pillow shape, distribution of pillow shelves (paleo-horizontal drainage cavities) and flow criteria such as blocky flow tops truncated by massive bases of overlying flows. Near Whale Cove, younging is generally west and northwest (270-300°NW), with overturned SW-dipping NE-younging flows on Term Point (M53). Well-shaped pillows exposed on Bibby Island (M37) and Angusko Point (M107) indicate top (younging) to south. Geochemical data will be used to help establish whether these exposures are correlative. Intermediate volcanic rocks consist of andesitic pyroclastic breccia (Fig. 7 middle) and pale grey-green plagioclase porphyritic dacite whose massive character suggests a flow or hypabyssal origin. White-weathering felsic metavolcanic rocks extend from Whiterock Lake (M28) where slightly quartz-phyric rhyolite is associated with siltstone, through the Nevill Bay belt (M101, Fig. 7 right) where they are in contact (060°) with mafic metavolcanic rock, southwards to the Wallace River belt (M99). U-Pb dating will test whether felsic flows at the Nevill Bay and Wallace River belt localities are contemporaneous with rhyolite at Whiterock Lake dated at 2700 ± 1 Ma (Davis and Peterson, 1998).

Fig. 7. Metavolcanic rocks. LEFT) mafic pillow buds and interpillow angular shards (hyaloclastite) exposed along road to Whale Cove airport (23SRB-M74), NRCan photo 2023-441; MIDDLE) plagioclase-phyric intermediate pyroclastic breccia, Nevill Bay belt (23SRB-M52), NRCan photo 2023-442; RIGHT) light-grey weathering rhyolite with flow banding parallel to hammer and spaced cleavage 45°counterclockwise to flow layering, Nevill Bay belt (23SRB-M101). Hammer is 26 cm long, NRCan photo 2023-443.

Chemical metasedimentary rocks are associated with mafic metavolcanic rocks, occurring as interflow strata. These may comprise discontinuous layers of light grey weathering chert, 7-20 cm thick (Fig. 8 left), or continuous alternating layers of very thinly bedded to thickly laminated magnetite and white chert (Fig. 8 middle), forming interflow horizons 20-100 cm thick. Rarely black chert alternating with white chert is associated with rusty weathering oxide-facies iron formation (e.g., M57). At other localities (e.g., M45), oxide-facies iron formation is interlayered with very fine-grained, magnetic, green-weathering horizons which may represent either thin flows or ferruginous siltstone. Strong sulphidization of magnetite-chert±jasper iron formation associated with carbonatized amygdaloidal/vesicular mafic metavolcanic rocks near Sioralit Point (M125, Fig. 6) yielded elevated Au (26-32 ppb), As (19-28 ppm), Mo (6-18 ppm) and Sn (17-25 ppm).

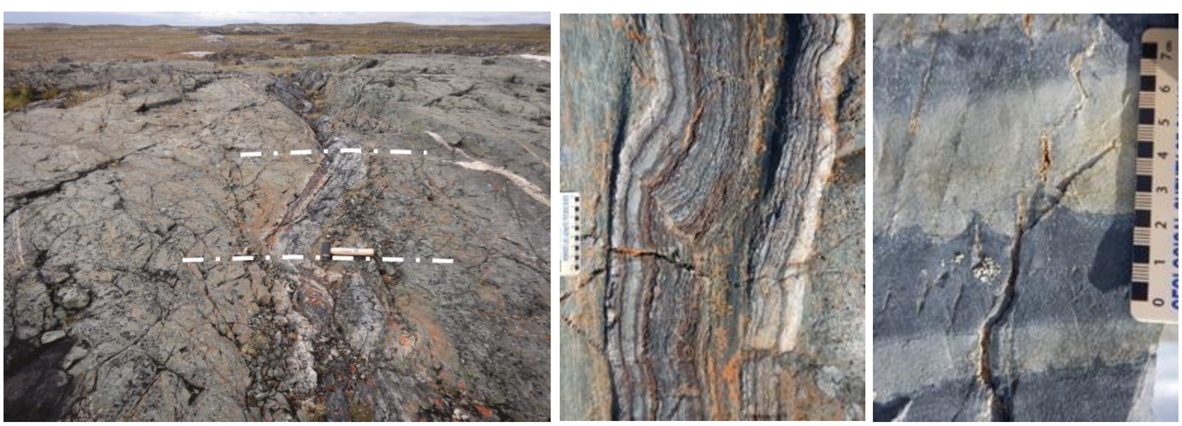

Fig. 8. Metasedimentary rocks. LEFT) Openly folded light grey chert, 20-cm thick, marking interface between massive and pillowed basaltic flows, trace of folds indicated by white dot-dash lines (23SRB-M39), NRCan photo 2023-444; MIDDLE) interflow chert-magnetite iron formation associated with basalt, Sioralit Point (23SRB-M125), NRCan photo 2023-445; RIGHT) graded lithic wacke interstratified with black siltstone showing flame structure indicative of dewatering. Younging to top of photo, Whiterock Lake (23SRB-M28), NRCan photo 2023-446.

Clastic metasedimentary rocks associated with the metavolcanic rocks are presumed to be Neoarchean in age, a hypothesis to be tested through U-Pb dating. These are typically well-bedded, fine sand to silt strata that exhibit well-preserved primary sedimentary features such as grading, flame structures (Fig. 8 right), load pockets and/or detached load balls, and cross stratification from which outcrop-scale younging can be determined. These features effectively establish younging reversals due to folding, particularly between Wilson Bay and Mistake Bay (Fig. 9) where the trace of at least six ESE-trending upright folds can be defined. Central to the Nevill Bay belt, younging (to SE at M145, M124, M123; to NW at M23) define a NE-trending syncline (Fig. 9), which is co-planar to nearby folds affecting Hurwitz Group strata, suggesting it too may be Paleoproterozoic. Detrital zircon analysed from two clastic sedimentary samples (Davis et al. 2004) interbedded with magnetite-bearing iron formation indicate mainly local provenance and a maximum depositional age of ca. 2681 Ma. Specifically, northwest of Mistake Bay (near locality M15) tuffaceous sediment yielded a dominant population of 2690-2682 Ma detrital grains, with two older grains dated at 2704 ± 6 Ma and 2745 ± 3 Ma. The dominant population accords with the age of plutonic rocks in the CHSB, while the ca. 2704 Ma grain is the age of volcanic rocks. Crystal-rich tuffaceous sediment located 100 km to the west near Tootyak Lake (Fig. 6) yielded detrital ages of 2709-2681 Ma, the range for volcanic and plutonic rocks within the CHSB.

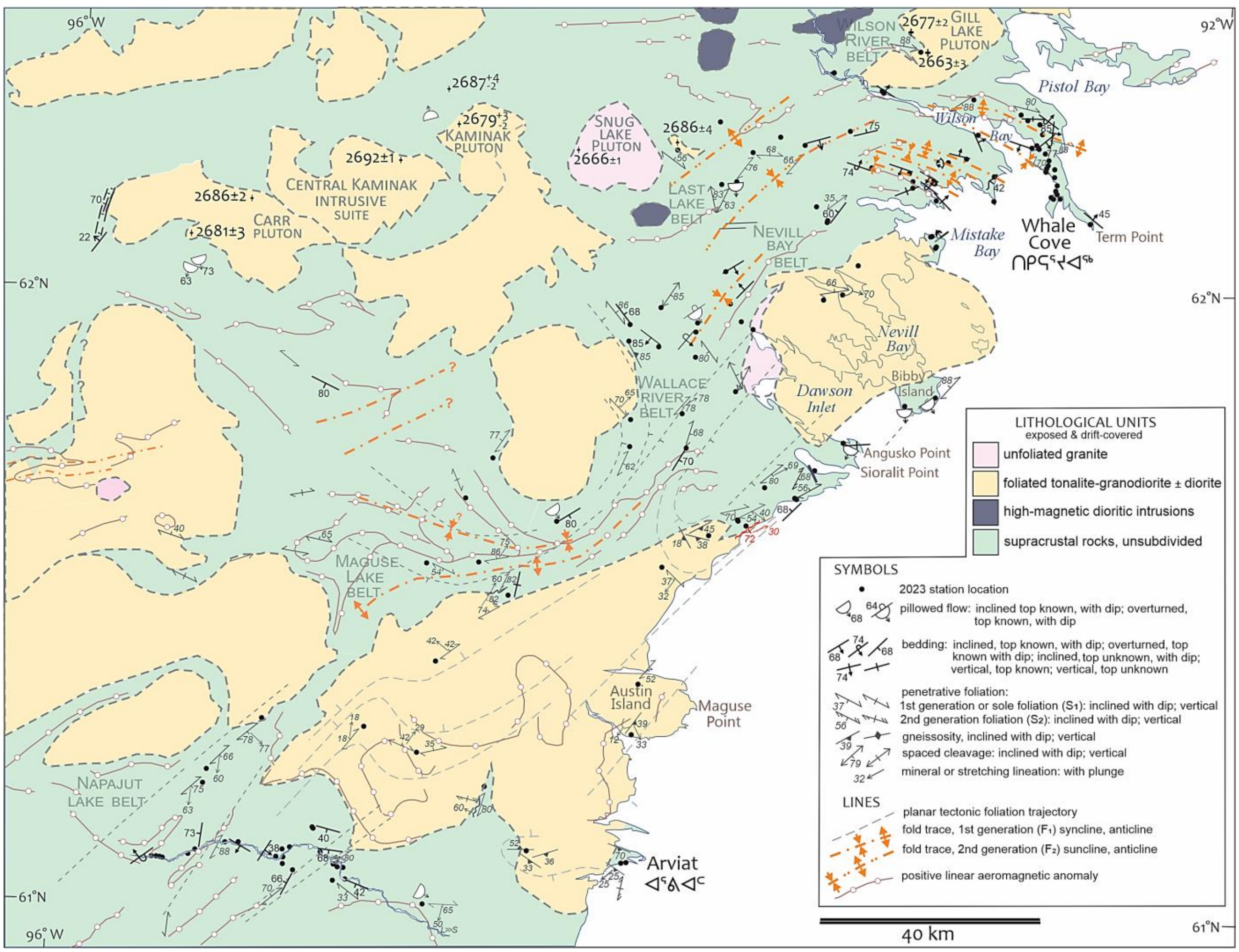

Fig. 9. Kivalliq corridor showing distribution (exposed and beneath glacial cover) of supracrustal rocks (green) relative to plutonic rocks. Elements such as bedding, younging, fabrics and defined fold traces derived by mapping in 2023 are symbolized (see legend) with linear magnetic anomalies from total magnetic data. Location and ages of dated (U-Pb zircon) plutonic rocks (Davis et al. 2004) are indicated.

Higher grade metasedimentary rocks including paragneiss (Fig. 10 left) were observed at a number of localities (i.e., M115, M116, M117, M119 on Fig. 6) in the southern part of the map area (Maguse Lake – Arviat region). Garnet-cordierite-sillimanite assemblages (Fig. 10 middle, right) characterize these localities, with sillimanite appearing to replace kyanite or andalusite at M115. These higher grade metasedimentary rocks are strongly foliated, commonly with sigmoidal fabrics indicative of shearing.

Fig. 10. High-grade metasedimentary rocks between Maguse River and Arviat, NU. LEFT) grey weathering paragneiss with irregular veins of leucosome parallel to 26 cm long hammer, Arviat (23SRB-M115), NRCan photo 2023-447; MIDDLE) detail of paragneiss with 3-cm long sillimanite porphyroblasts, possibly after kyanite, and partially replaced by pale pink andalusite (upper central field of view), red garnet porphyroblasts, 2 cm and white-weathering leucosome (23SRB-M115), NRCan photo 2023-448; RIGHT) vitreous violet iolite (variety cordierite) in leucosome cutting sillimanite-bearing pelite (23SRB-M119), NRCan photo 2023-449.

Polymictic, clast-supported conglomerate (Fig. 11 left) exposed in the northern map area on the Wilson River contains angular to lenticular compositionally variable volcanic clasts and well-rounded, pebble to boulder size medium-grained plutonic clasts (Fig. 11 middle). Volcanic clasts commonly exhibit bleached rims (Fig. 11 right) interpreted to indicate significant exposure to a weathering environment prior to reconsolidation as conglomerate. Rare, cross-bedded arkosic horizons within the conglomeratic sequence are suggestive of a fluvial environment after 2657 ± 2 Ma, the youngest detrital zircon analysed from a sample of arkose (Davis and Peterson 1998).

Fig. 11. Polymictic conglomerate, Wilson River. LEFT) subvertical exposure showing variety of clast types (23SRB-M27), NRCan photo 2023-450; MIDDLE) detail of horizontal exposure showing elongate attenuated metavolcanic clasts in contact with well-rounded plutonic clasts, all possessing the dominant foliation oriented 250/76°N (23SRB-M27), NRCan photo 2023-451; RIGHT) detail showing pale green weathered rind enveloping elongate medium green basaltic clast in contact with subrounded medium-grained plutonic clast (23SRB-M27), NRCan photo 2023-452.

Clastic metasedimentary rocks interpreted as Paleoproterozoic Hurwitz Group (Davidson 1970; Fraser 1983) due to associated white orthoquartzite (diagnostic Kinga Formation; Fig. 12 left) occur within NE-trending strands across the map area (Fig. 6). NE-trending upright folds appear to control the distribution of this younger clastic sequence. Most exposures of Hurwitz within the map area are currently portrayed on maps as "unsubdivided" providing the opportunity to document these exposures in more detail and correlate the units with better-mapped sections to the west (cf. Aspler et al. 2001). For example, the McConnell River exposes magnetite clast conglomerate (Fig. 12 middle) stratigraphically below thinly bedded pink and green orthoquartzite (lower Kinga Formation, Maguse Member?) which, in turn, is overlain by thinly bedded siltstone and mudstone (Ameto Formation) cut by gabbro (Fig. 12 right), the latter likely correlative with the 2111 ± 1 Ma Griffin sills (Heaman and LeCheminant 1993). Elsewhere along the McConnell River, exposures of mafic metavolcanic rocks contain what appear to be pinite pseudomorphs of cordierite in a groundmass of anthophyllite and biotite, resulting in a spotted texture known as "dalmationite" indicative of metamorphosed hydrothermal alteration associated with base metal mineralization (e.g., Shriver 1992). These altered mafic volcanic rocks are in contact with garnetiferous schist suspected to be metamorphosed products of highly altered volcanics or weathered regolith demarcating the unconformity between Neoarchean basement mafic metavolcanic rocks and overlying Paleoproterozoic strata. Further detailed mapping of exposures along the McConnell River in this otherwise heavily drift-covered region may shed further light on the relationship between Archean and Paleoproterozoic sequences and on potential base metal alteration ± mineralization.

Fig. 12. Paleoproterozoic rocks. LEFT) orthoquartzite with bedding plane marked by symmetrical linear ripple marks, Hudson Bay coast south of Sioralit Point (23SRB-M128), NRCan photo 2023-453; MIDDLE) polymictic conglomerate dominated by subangular clasts of magnetite iron formation, lower Hurwitz Group (23SRB-M59), NRCan photo 2023-454; RIGHT) thinly bedded indurated (hornfels) siltstone and mudstone (Ameto Formation) cut by concordant gabbro sill whose resistant character has resulted in the topographic break and waterfall, McConnell River (23SRB-M78) , NRCan photo 2023-455.

Plutonic Rocks

Plutonic rocks underlie roughly 50% of the map area (Fig. 9), with several plutons across the northern part of the study yielding U-Pb ages (Davis et al., 2004) that highlight a major pulse of plutonic activity from 2691 to 2675 Ma, closely following ca. 2709 – 2791 Ma volcanism. Medium-grained, foliated granodiorite between Nevill Bay and Dawson Inlet contains coherent layers and xenoliths of supracrustal rocks including mafic metavolcanics and iron formation (Fig. 13 left), consistent with post-volcanic emplacement during the major pulse. In contrast, fine-grained, grey biotite tonalite gneiss exposed to the south (Fig. 13 middle) lacks supracrustal xenoliths and, accordingly, may pre-date volcanism.

Fig. 13. Plutonic rocks. LEFT) Nevill Bay granodiorite containing coherent screens of mafic metavolcanic rocks and iron formation (23SRB-M144), NRCan photo 2023-456; MIDDLE) grey gneissic biotite tonalite cut by quartz syenite dyke (23SRB-M111), NRCan photo 2023-457; RIGHT) equigranular monzogranite of the Hudson suite (23SRB-M100), NRCan photo 2023-458.

Whether this tonalite gneiss represents basement to the CHSB will be tested through U-Pb dating. Granitic rocks are volumetrically minor and include the post-tectonic (with respect to Neoarchean deformation) Snug Lake pluton dated at 2666 ± 1 Ma in the north, and isolated medium-grained, equigranular monzogranite (Fig. 13 right) belonging to the ca. 1.82 Ga Hudson suite in the south along the coast of Hudson Bay.

Key Research Questions

Following on mapping in July 2023, some key research questions to be addressed by future mapping and analytical data include:

- What is the age and origin of tonalite and its flat undulating deformation fabric between Whale Cove and Arviat, and is it basement (older) to metavolcanic rocks of the Maguse Lake and Wallace River belts?
- Do mafic volcanic rocks exposed from Whale Cove to south of Arviat represent a single event formed in the same tectonic setting? or several events in different tectonic settings?
- What is the architectural relationship between a high-grade complex of garnet-cordierite paragneiss and low-grade greenstone belts peripheral to it? What was the time, source of heat, and pressure-temperature regime of metamorphism?
- Does the provenance (source rocks) of the metasedimentary units vary from north to south across the Kivalliq corridor?
- Can the contact between Neoarchean supracrustal rocks and Paleoproterozoic strata be demonstrated to be an unconformity, a fault/thrust, or both? What is the significance of alteration characteristic of base-metal mineralization along the contact?

Future Plans

This activity is planned to continue through 2024-25 with both laboratory and field components. Lab components involve the acquisition of geochemical and assay data, U-Pb geochronological and Sm-Nd isotopic analyses from representative plutonic and supracrustal samples collected in 2023, along with determination of pressure-temperature estimates and the timing of metamorphism of higher grade rocks in the vicinity of Arviat. Field mapping with community members is scheduled to resume in July 2024 so that additional localities can be mapped and correlations tested.

Acknowledgements

Bedrock mapping was assisted by Jacqueline Teenar, Malachi Kritterdlik, Jeremiah Oklaga and Mikkijuk Manning of Whale Cove, Nunavut and by Keenan Issakiark, Victor Okatsiak, John Paul Anawak, Salo Ivualuajut, Myles Mamgark, Curtis Kalaserk, Ivano Okoktok and Lyta Josephie of Arviat, Nunavut.

The following organizations and individuals are thanked for their support for this activity in 2023: Brenda Pilakapsi, Maria Serra and Luis Manzo (Kivalliq Inuit Association); Mosha Cote, Jamal Shirley and Avis Mukyungnik (Nunavut Research Institute); Katrina Horne and Lynette Thomas (Nunavut Arctic College); pilot Jamie Boles and Hudson Bay Helicopters; Brian Fleming, Simon Enuapik and Mary Adjuk (Hamlet of Whale Cove); Mona Okalik and Martha Panika (Issitak Hunters' and Trappers' Association); Stanley Adjuk, Jr., Ethan Kendrew, Curtis Chislett and Allan Voisey of Whale Cove; Michael Cohen, Sarah Curley, Melodie Obszarski and Amber Kadjuk (Hamlet of Arviat); Nicole Issakiark and Sally Kritaqliluk (Arviat Hunters' and Trappers' Association); and Anne Renee Napayok (Government of Nunavut).

References

Aspler, L.B., Wisotzek, I.E., Chiarenzelli, J.R., Losonczy, M.F., Cousins, B.L., McNicoll, V.J. and Davis, W.J. 2001. Paleoproterozoic intracratonic basin processes, from breakup of Kenorland to assembly of Laurentia: Hurwitz Basin, Nunavut, Canada. Sedimentary Geology 141-142, p. 287-318

Cavell P.A., Wijbrans J.R. and Baadsgaard, H. 1992. Archean magmatism in the Kaminak Lake area, District of Keewatin, Northwest Territories; ages of the carbonatite-bearing alkaline complex and some host granitoid rocks. Can. J. Earth. Sci. 29, no. 5, p. 896-908

Davis, W.J. and Peterson, T. 1998. New geochronological results for the Tavani area (55K), eastern Kaminak greenstone belt, District of Keewatin, Northwest Territories; *In* Radiogenic Age and Isotopic Studies: Report 11; Geological Survey of Canada, Current Research 1998-F, p. 81-88

Davis, W.J., Hanmer S. and Sandeman, H.A. 2004. Temporal evolution of the Neoarchean Central Hearne supracrustal belt: rapid generation of juvenile crust in a suprasubduction zone setting. Precambrian Research, 134, p. 85-112.

Davis, W.J., Rainbird, R.H., Aspler, L.B. and Chiarenzelli, J.R. 2005. Detrital zircon geochronology of the Paleoproterozoic Hurwitz and Kiyuk groups, western Churchill Province, Nunavut. Geological Survey of Canada Current Research 2005-F1 13 p.

Davidson, A. 1970. Geology Eskimo Point (north half 55E) and Dawson Inlet (north half 55F) map areas, District of Keewatin. Geological Survey of Canada Paper 70-27, 21 p. with maps 9-1970 and 10-1970.

Fraser, J.A. 1983. Geology of the Hyde Lake map area, District of Keewatin, NWT. Geological Survey of Canada Paper 82-9, 8 p., with map 1-1982.

Hanmer, S., Sandeman, H.A., Davis, W.J., Aspler, L.B., Rainbird, R.H., Ryan, J.J., Relf, C. and Peterson, T.D. 2004. Geology and Neoarchean tectonic setting of the Central Hearne supracrustal belt, Western Churchill Province, Nunavut, Canada. Precambrian Research 134, p. 63-83.

Heaman, L.M. and LeCheminant, A.N. 1993. Paragenesis and U-Pb systematics of baddeleyite ($Zr0_2$). Chemical Geology 110, p. 95-126.

Heywood, W.W. 1967. Geology of Tavani Map Area, District of Keewatin. Geological Survey of Canada Paper 72-47, 14 p. with map 6-1972.

Lord, C.S. 1953. Geological notes on southern District of Keewatin, Northwest Territories. Geological Survey of Canada Paper 53-22;

Lord, C.S. and Wright, G.M. 1967. Geology, Southeastern Barren Grounds District of Keewatin – District of MacKenzie. Geological Survey of Canada Map 1216A, 1: 1 000 000 scale

Mortenson, J.K. and Thorpe, R.I. 1987. U-Pb zircon ages of felsic volcanic rocks in the Kaminak Lake area. District of Keewatin. *In* Radiogenic Age and Isotope Studies: Report 1, Geological Survey of Canada Paper 87-2, p. 123-128.

Page, A.V. and McMartin, I. 2023. Ice-age legacy: a marine happening along western Hudson Bay, Nunavut and Manitoba. Geological Survey of Canada, Open File 8979 (English) and 8992 (Inuktitut), 1 sheet, https://doi.org/10.4095/331896 (English) https://doi.org/10.4095/332052 (Inuktitut)

Peterson, T.D. 1997. New mapping of Archean supracrustal rocks in the Kaminak Belt, District of Keewatin, Northwest Territories; in Current Research 1997-C; Geological Survey of Canada, p. 111-121.

Ridler, R.H. and Shilts, W.W. 1974. Exploration for Archean polymetallic sulphide deposits in permafrost terrains, Kaminak Lake area, District of Keewatin. Geological Survey of Canada Paper 73-34

Sandeman, H.A., Hanmer, S., Davis, W.J., Ryan, J.J. and Peterson, T.D. 2004. Neoarchaean volcanic rocks, Central Hearne supracrustal belt, Western Churchill Province, Canada: geochemical and isotopic evidence supporting intra-oceanic, supra-subduction zone extension. Precambrian Research 134, 113-141.

Shriver, N. 1992. A Geochemical Evaluation of the Alteration Zone at the Norbec Mine, Noranda, Quebec: Bulk Chemical Composition, Mass and Volume Change, Flux of Elements. MSc thesis, Department of Geological Sciences, McGill University, Montréal, Quebec, 83 pp

Tella, S., Paul, D., Berman, R.G., Davis, W.J., Peterson, T.D., Pehrsson, S.J. and Kerswill, J.A. 2007. Bedrock geology compilation and regional synthesis of parts of the Hearne and Rae domains, western Churchill Province, Nunavut-Manitoba. Geological Survey of Canda, Open File 5441, scale 1:550 000

Wanless, R.K., Stevens, R.D., Lachance, G.R. and Delabio, R.N. 1970. Age determinations and geological studies, K/Ar isotopic ages, Report 9 Geological Survey of Canada Paper 69-2A