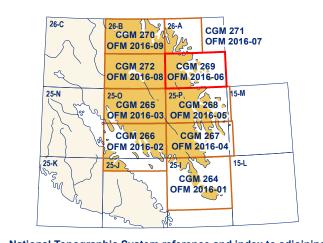


was led by the Canada-Nunavut Geoscience Office. was designed to increase the geoscient nowledge and assess the economic potential of the rea. Eastern Hall Peninsula is dominantly underlain by Archean tonalite to quartz diorite orthogneiss, while principalement des orthogneiss tonalitiques Paleoproterozoic supracrustal and intrusive rocks are quartzodioritiques de l'Archéen, tandis que des roches exposed to the west. The supracrustal rocks are supracrustales et intrusives du Paléoprotérozoïque dominated by pelitic, psammitic, amphibolite and calcsilicate units, are interpreted as correlative with the ake Harbour Group, and are cut by granulite-grade monzogranite to diorite intrusions. Hall Peninsula records three phases of metamorphism and recoupées par des intrusions de compositic deformation associated with the Trans-Hudson Orogen monzogranitique à dioritique du faciès des granulite that have produced thick-skinned, east-verging fold and La péninsule Hall a conservé les traces de trois phases thrust structures and amphibolite to granulite facies ineral assemblages. Hall Peninsula hosts a high prospective diamond kimberlite field, as well as n nd carbonate supracrustal rocks, and ultramafic ntrusions that may contain base and/or precious metal, semi-precious gemstone and carving stone resource

The Hall Peninsula Integrated Geoscience Program Le Programme géoscientifique intégré de la péninsule Hall, mené par le Bureau géoscientifique Canada unavut, a été concu pour accroître les connaissar scientifiques et évaluer le potentiel économique la région. La partie est de la péninsule Hall conti affleurent à l'ouest. Les roches supracrustales so dominées par des unités pélitiques, psammitiques amphibolitiques et calcosilicatées et corrélatives du Groupe de Lake Harbour. Elles de métamorphisme et de déformation associées ns-hudsonien, qui ont donné lieu à e socle caractérisée par la formation ructures de plissement et de chevaucheme rergence est, et à la création d'associations minéraux du faciès des amphibolites au faciès de granulites. La péninsule Hall renferme un champ de kimberlites très prometteur pour le diamant, ainsi que les roches supracrustales mafiques et carbonatées intrusions ultramafiques susceptibles de cont es ressources en métaux usuels ou précieux, er



National Topographic System reference and index to adjoining published Geological Survey of Canada maps

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GEOLOGICAL SURVEY OF CANADA **CANADIAN GEOSCIENCE MAP 269 CANADA-NUNAVUT GEOSCIENCE OFFICE** OPEN FILE MAP 2016-06 GEOLOGY LEYBOURNE

Canada Canada-NUNAVUT GEOSCIENCE OFFICE bacCo-_ob-__ by by by the the canada-NUNAVUT canada-NUNAVUT canada-NUNAVUT canada-NUNAVUT canada-NUNAVUT canada-NUNAVUT canada-NUNAVUT coscience titigakviit

ISLANDS (SOUTH) Baffin Island, Nunavut NTS 26-A (south)

1:100 000



Geological Survey of Canada **Canadian Geoscience Maps**

Authors: H.M. Steenkamp, C. Gilbert, and M.R. St-Onge Geology by H.M. Steenkamp, G. Machado, M.D. Youn I.R. St-Onge, N.M. Rayner, D.R. Skipton R., R.E. From C.B. MacKay, Z.M. Braden, C. Bilodeau, C.G. Creason B.J. Dyck, E.R. Bros, K. Martin, R. Takpanie, P. Peyto . Sudlovenick, R. Hinanik, K. Napavok, C. Gilbe P. Budkewitsch, A. Bigio, M. Senkow, M. Beauregar D.J. Mate, and J. Leblanc-Dumas, 2012–2014; R.G. Blackadar, 1965.

Geological interpretation and notes by H.M. Steenkamp, 2015

Geology conforms to Bedrock Data Model v. 2.2 Geomatics by H.M. Steenkamp and C. Gilbert Cartography by C. Gilbert

nitiative of the Canada-Nunavut Geoscience C conducted under the auspices of the Hall Pening Integrated Geoscience Project, supported by CanNo Strategic Investment for Northern Economic Development (SINED) program.

Logistical support provided by the Polar Continental Shelf Program as part of its mandate to promote scientific research in the Canadian North. PCSP 30113

GEOLOGY LEYBOURNE ISLANDS (SOUTH) Baffin Island, Nunavut NTS 26-A (south)

1:100 000

Map projection Universal Transverse Mercator, zone 20. North American Datum 1983 Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications. Elevations in metres above mean sea level

Shaded relief image derived from the digital elevation nodel supplied by the Canada-Nunavut Geoscience Office. Illumination: azimuth 315°, altitude 45°, vertical factor 1x

Mean magnetic declination 2016, 29°15'W, decreasing 24.7' annually. Readings vary from 28°53'W in the SN corner to 29°34'W in the NE corner of the map. This map is not to be used for navigational purposes.

Title photograph: Magnetite megacryst in Archean tonalite gneiss (unit At), northeastern Hall Peninsula, Nunavut. Pen magnet is 12.5 cm. Photograph by Z.M. Braden. 2015-059 The Geological Survey of Canada and the Canada Nunavut Geoscience Office welcome corrections or additional information from users. Data may include additional observations not portrayed on this map. See documentation accompanying the data.

This publication is available for free download through GEOSCAN (http://geoscan.nrcan.gc.ca/) and the Canada-Nunavut Geoscience Office (http://cngo.ca/).

indicator minerals in glacial till samples, and eventually diamond-bearing kimberlite deposits on eastern Hall Peninsula. This discovery has prompted industry-led, airborne and ground geophysical surveys (Pell and Neilson, 2010, 2011), thematic research projects focused on kimberlite emplacement (Pell et al., 2013; Zhang and Pell, 2013) and diamond genesis (Nichols et al., 2013; Nichols, 2014), and detailed bedrock and surficial geology mapping within the Chidliak diamond district Ansdell et al., 2015). The above resources have provided information that was helpful for bedrock mapping interpretation, nd adds valuable data to the maps.

e eastern half of Hall Peninsula is dominantly underlain by an Archean orthogneiss complex comprising felsic to rmediate phases. The phases all have internal compositional layering, and display complicated crosscutting Map unit At is the most abundant and compositionally variable orthogneiss unit. It is dominated by biotite±hornblende tonalite to granodiorite that weathers dull grey (Figure 3). Overall, this unit is medium to coarse grained with biotite, and cally hornblende, defining a mineral foliation. Pods, enclaves, and rafts of diorite, guartz diorite, and minor gabbro are pcally found in this unit, and have well-defined lithological boundaries and a well-developed internal compositional fabric

monzogranite has been documented within this unit. In general, unit Ag is coarse grained and contains less than 5% mafic Map unit Amk represents coarse-grained biotite monzogranite to guartz monzonite with distinctive 1-5 cm wide Kfeldspar phenocrysts and an average of 2% mafic mineral content. Areas with a greater abundance of mafic minerals (up to 10%) or a more granodioritic composition were observed within this unit. This unit weathers buff pink, and is locally injected th discontinuous granitic pegmatite veins that are less than 1.5 m wide. Magnetite-biotite monzogranite is represented by map unit Amm. This unit is typically coarse grained, and contains

eromagnetic survey data. Additionally, this unit is crosscut by granitic to syenogranitic pegmatite dykes that also contain agnetite megacrysts. Both fresh and weathered surfaces are pale to light pink. Supracrustal metasedimentary rocks were documented across Hall Peninsula, and were found to disconformably erlie the Archean orthogneiss complex. A basal quartzite (unit PLHq; Figure 4) is locally found directly in contact with the rthogneiss, or within the first few metres of metasedimentary strata. The quartzite is blueish-grey and translucent, contair vy mineral bands that may indicate original bedding, and occurs as laterally discontinuous beds that are 1 to 25 m th are metamorphic garnet, sillimanite, biotite, and magnetite have been documented within the quartzite and along beddir

Unit PLHs (Figure 5) is found in the lower part of the metasedimentary sequence and can be up to 250 m in thickness. This unit comprises (in order of abundance) interbedded semipelite, pelite, psammite, quartzite, and minor diorite, mphibolite, metaironstone, marble, and calc-silicate. The semipelitic and pelitic lithologies typically contain metamorphic arnet, sillimanite, biotite, and rare muscovite porphyroblasts. The quartzite is 20–50 cm thick, ranges from gray and anslucent to white and opaque, and commonly has heavy mineral bands. The diorite and amphibolite layers are fine to nedium grained and locally contain metamorphic garnet (unit PLHa, resolved on map where thick enough). Metaironstone ivers are less than 1.5 m thick, and have internal compositional segregation of garnet, quartz, and grunerite layers that are 1-5 cm thick. The marble and calc-silicate layers recessively weather, and typically contain metamorphic diopside clinohumite, phlogopite, and rare olivine, apatite, spinel, and graphite (unit PLHm, resolved on map where thick enough) e PLHs unit also contains 1–4 m wide dykes and sills of medium- to coarse-grained leucogranite with metamorphic garne otite, and local muscovite. Stratigraphically above unit PLHs, the metasedimentary rocks represented by unit PLHp are dominated by pelite and

psammite that contain garnet, biotite and minor sillimanite. This unit also has seams and layers of leucogranite which crease in abundance toward the west. The leucogranite is interpreted as recrystallized melt that was generated durin nal metamorphism through muscovite- and biotite-dehydration reactions in the pelitic to psammitic metasedimer (Dyck and St-Onge, 2014). Therefore, the pelitic and psammitic rocks of unit PLHp are interpreted as having restit sitions following partial melting and recrystallization of the leucogranitic melt into distinct dykes, sills and layers. The top of unit PLHp becomes increasingly dominated by leucogranitic material, to the point where rafts of restitic pelite nd psammite are floating in the leucogranite. Unit PLHw represents the areas where the volume of leucogranite exceed at of the remnant pelite or psammite. The leucogranite is fine to medium grained, weathers bright white, and cont undant lilac garnet porphyroblasts and minor biotite. Rare metamorphic cordierite was documented in the leucogranit uthwestern coast of Hall Peninsula

Paleoproterozoic igneous phases were documented across Hall Peninsula. Unit Pu (resolved on map where thick enough; Figure 6) represents mafic-ultramafic sills in the metasedimentary sequence, and plugs and sills in the Archean alite to granodiorite orthogneiss (unit At). Unit Pu includes metaperidotite, metapyroxenite, and metadunite lithologie ch typically contain orthopyroxene, hornblende, phlogopite, tremolite, actinolite, and rare serpentinite. The presence lrous phases (i.e. serpentinite or phlogopite), which are commonly found at the boundary of the mafic-ultramatic intrusi d the host rock, implies localized hydrothermal alteration at some point after emplacement of the sills and/or plugs. Tw elatively unaltered, large-scale (up to 350 m thick and 7 km long) and layered mafic-ultramafic sills were documented with unit PLHp (Steenkamp et al., 2014).

Other Paleoproterozoic igneous phases on Hall Peninsula are generally felsic, yet typically contain orthopyroxene suggesting crystallization at high temperatures. Unit Pgo represents orthopyroxene-hornblende-biotite±magne nodiorite that is typically medium to coarse grained. The relative abundance of mafic minerals in this unit ranges fro . Orthopyroxene is locally megacrystic, and hornblende and biotite define a weak to moderate mineral foliation metite is fine to very-fine grained and typically found adjacent to other mafic phases. Fresh rock surfaces are a distinctive ale green with a greasy lustre, while weathered surfaces are dark orange to brown. Unit Pmo represents orthopyroxene-biotite±magnetite monzogranite that is generally very-coarse grained, and locally contains megacrystic K-feldspar up to 4 cm wide. Garnet was observed at a few locations within a few metres of a contact one with the PLHw unit. Quartz is characteristically blueish-grey, and occurs in discontinuous ribbons that are 1–2 cm thick

define a weak foliation fabric. Biotite-garnet±orthopyroxene monzogranite containing small rafts, pods, and lenses of metasedimentary rock was identified on the western side of Hall Peninsula and is represented by unit Pmg. This lithology is coarse grained and quigranular. The abundance of garnet increases and the grain size becomes more inequigranular with proximity to included dies of metasedimentary rock. All Archean and Paleoproterozoic rock units are cut by NW-SE trending gabbroic diabase dykes (unit Nd) presumed associated with the Neoproterozoic Franklin swarm event documented elsewhere across the Canadian Arctic (Heaman al., 1992; Denyszyn et al., 2009). The dykes are fine to medium grained, homogeneous, weather brown, and are about

0 m wide and laterally continuous for hundreds of kilometres. NTERPRETED GEOLOGICAL HISTORY all Peninsula is contained within the northeastern (Quebec-Baffin) segment of the Trans-Hudson Orogen (THO), a ape (Hoffman, 1988; Lewry and Collerson, 1990). The THO marks the collision between the upper-plate collage of rchean crustal blocks (Churchill plate) and the lower-plate Superior craton. The southern Baffin Island region in particul the southward migration of the Churchill plate and its terminal collision with the Superior craton at ca. 1.82–1.80 Ga onge et al., 2009). This was the last major deformational event that the Hall Peninsula area endured, and it therefo ains lithological, structural, metamorphic, and textural evidence to attest to the timing and conditions of the associat otopic geochronology conducted on a variety of orthogneiss compositions collected across the comp

stallization ages scattered between about 2976 to 2608 Ma (Scott, 1999; Rayner, 2014, 2015; From et al., rthermore, a group of ages determined from chemically distinct zircon rim domains range from about 2740 to 2680 Ma are interpreted to represent an Archean metamorphic and/or deformational event (From et al., 2015). Further geochemica and isotopic analyses are expected to constrain the ages of the different compositional phases that make up the orthogne complex, and provide insight into potential genetic relationships between Archean rocks on Hall Peninsula and other nea Archean cratons, such as those in northern Quebec and Labrador, or southwestern Greenland, Based on stratigraphy, and the rock types and their abundance, the supracrustal metasedimentary rocks on Hall Peninsula are interpreted as correlative with the Paleoproterozoic Lake Harbour Group, which has been described and documented to the southwest on Meta Incognita and Foxe peninsulas (St-Onge et al., 1996; Sanborn-Barrie et al., 2008; St-Onge et al., 2015). The lower part of the sequence (eastern Hall Peninsula) is marked by a blue basal quartzite overlain by dominantly pelitic to semipelitic lithologies, with limited mafic, ultramafic, and carbonate components. The upper part of the sequence (use the sequence) and the sequence (use the sequence) and the sequence of the sequence (use the sequence) and the sequence (use the sequence) are the sequence (use the sequence) and the sequence (use the sequence) are the sequence (use the sequence) and the sequence (use the sequence) are the sequence) are the sequence (use the sequence) are the sequence (us uence (western Hall Peninsula) contains mostly pelitic to psammitic, restitic metasedimentary rocks and large ar leucogranite derived from partial melting of the metasedimentary units. The transition from the lithologically varied uni e east to dominantly pelitic to psammitic units in the west is interpreted to represent a change in the paleo-depositi

nvironment from a proximal shallow-marine setting with input of mafic materials, possibly from a local rifting environmer more distal continental-shelf and slope-rise setting (MacKay et al., 2013; Machado et al., 2013b; Steenkamp and St-Onge Uranium-lead detrital zircon geochronology of rock units from different stratigraphic positions in the metasedimentary sequence help constrain the maximum age of sediment deposition and the provenance of detrital materials. Zircon from the blue basal quartzite (unit PLHq) vields provenance profiles with exclusively Archean ages (primarily 2.95–2.65 Ga), similar o crystallization ages from the Archean orthogneiss complex, suggesting a local sediment source (Rayner, 2014, 2 Quartzite, psammite and semipelite layers from unit PLHs contain detrital zircon with a wide range of ages (3.8–1.9 C ayner, 2014, 2015), including known Archean orthogneiss ages, as well as detrital ages that have not yet been identified o Hall Peninsula. A psammitic layer from Beekman Peninsula yields a maximum depositional age of 1959 ± 12 Ma, the youngest from the PLHs unit (Rayner, 2014). Despite the increasing effects of metamorphic overprinting on detrital zircon rains, two samples collected from western Hall Peninsula constrain the maximum depositional age of unit PLHp to about

Mafic rocks within units PLHa and PLHs have lost all primary mineral compositions and proportions, and ous/depositional textures due to the intense metamorphic and deformational conditions of the THO. Therefore, it is ult to determine if the mafic rocks are derived from intrusive and/or extrusive protoliths. Samples of mafic rocks within e metasedimentary sequence, and ultramafic rocks found as sills and plugs in both the metasedimentary sequence ar rchean orthogneiss complex, can be classified as alkaline, calc-alkaline, transitional or tholeiltic based on their whole-rock eochemistry (MacKay and Ansdell, 2014). Further investigation of the major and minor element concentrations in these books suggest their genesis was related to partial melting of a subduction-modified mantle source that was upwelled possibly uring plume-initiated rifting of the North Atlantic Craton (MacKay, 2014).

e orthopyroxene-bearing monzogranitic to granodioritic intrusive rocks occur as laterally continuous panels that cu the psammitic upper units of the supracrustal sequence. The panels are ubiquitous in the central and western parts of Ha ninsula, and range in width from 100 m to several kilometres. Weak to moderate foliation fabrics were observed in these cks, typically defined by the preferential growth-orientation of biotite and elongate concentrations (ribbons) c uartz. Uranium-lead zircon crystallization ages have been determined from two samples as 1892 ± 7 Ma (Rayner, 2014 nd 1872 ± 5 Ma (Rayner, 2015). The presence of orthopyroxene documented in the majority of these plutonic phases uggests crystallization at high temperatures. Therefore, these rocks are thought to represent plutonism that preceded the ninal collision of the THO fall Peninsula preserves evidence of three distinct phases of deformation and metamorphism related to the THC

D₁: Initial east-west shortening (pre-thermal metamorphic peak) that produced isoclinal folds (F_{1a}) and a metamorphic foliation (S_{1a}) axial planar to F_{1a}. These early events are interpreted from micro-fabric analysis o lusion trails in porphyroblastic phases (Braden, 2013). Continued deformation around the time hal metamorphism produced isoclinal folds (F_{1b}) of S_{1a} and development of a new metamorph ation (S_{tb}) axial planar to F_{tb} . This event coincides with the partial melting of metasedimentary units the luced muscovite-bearing leucogranite sills and dykes on the eastern part of the peninsula, and voluming net-bearing leucogranite on the western part of the peninsula (Skipton et al., 2013; Dyck and St-Onge, 20 pton and St-Onge, 2014).

D2: Intensified east-west shortening continued following the thermal metamorphic peak, and resulted in the development of large-scale, east-verging, thick-skinned recumbent folds (F₂) and thrusts (T₂). Mylonite zones and ductile stretching and mineral-growth lineations (L₂) expressed as rodded quartz or amphibole (Figure 7) priented sillimanite, and aligned orthopyroxene (Dyck and St-Onge, 2014) were recognized in the hanging a ootwalls of thrust planes. Altered ultramafic intrusions (unit Pu; Figure 6) were locally identified as plugs and long thrust surfaces in the Archean orthogneiss, as well as boudinaged sills in the supracrustal sequ d on field relationships and deformation of the ultramafic bodies, it is believed that their emplacement receded or was synchronous with this deformational stage (Steenkamp et al., 2014) D_3 : Late north-south shortening produced broad, open folds (F_3), and a crenulation cleavage (S_3) defined by muscovite, biotite, and faserkiesel sillimanite reoriented axial planar to F_{s} . The F_{s} folds locally deflect the strike o older fabrics, and the interference of F_3 on F_2 folds creates doubly-plunging and bulls-eye map patterns. e metamorphic mineral assemblages documented across Hall Peninsula in pelitic to semi-pelitic rocks reflect a radual increase in peak metamorphic grade from amphibolite-facies conditions (~740°C; garnet+biotite+sillimanite+l

par±muscovite) in the east to granulite-facies conditions (>850°C; garnet+biotite+K-feldspar+melt±sillimanite) in the (Skipton et al., 2013; Skipton and St-Onge, 2014). Chemically distinct rim domains on zircon identified in Archea hogneiss, and Paleoproterozoic supracrustal and plutonic rocks are interpreted to represent zircon growth during amorphism (Rayner, 2014, 2015; From et al., 2015). Ages interpreted as metamorphic include 1855 ± 13 Ma from ite orthogneiss (unit At; Rayner, 2015), 1856–1832 Ma from K-feldspar megacrystic granite (unit Amk; Rayner, 2014 61 ± 25 Ma from quartzite (unit PLHq), 1886–1832 Ma from psammite (unit PLHp), and 1828 ± 3 Ma from orthopyroxeneiotite monzogranite (Rayner, 2014). ollowing the terminal collision of the THO, the rocks underlying Hall Peninsula experienced a very slow, protr

ry beginning in the latest Paleoproterozoic and continuing through the Phanerozoic. Muscovite extracte acrustal rocks on eastern Hall Peninsula were analyzed by 4^{0} Ar/ 3^{9} Ar step-heating and UV-laser spot da he cooling history of the area. The step-heating ages range from 1690 ± 3 to 1657 ± 3 Ma, while the spot da covite grains show a 20-30 m.y. age decrease from core to rim analyses (Skipton et al., 2015). This implies that ocks on Hall Peninsula took at least 140 m.y. to cool from peak thermal metamorphic conditions through approximately 420–450°C, the nominal closure temperature for radiogenic Ar in muscovite.

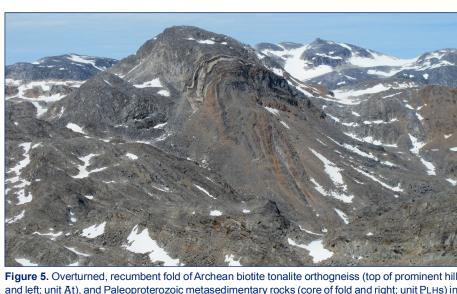
irther cooling and exhumation of Hall Peninsula during the Phanerozoic has been constrained with apatite and zirc (U-Th)/He low-temperature thermochronology (Creason and Gosse, 2014) which has been used as input parameters in the HeFTy and PECUBE thermal modelling programs (Creason, 2015). The thermal modelling results support an exhumation scenario with an extremely slow exhumation rate (8–10 m/m.y.) during the Phanerozoic. Furthermore, variations in the models isotherm outputs between about 340 to 400 Ma are coincident with post-Ordovician fault block movements in the astern Canadian Arctic (e.g. Sanford, 1987), and may indicate disturbances of the footwall isotherms due to fault motion in mberland Sound (Creason, 2015) ECONOMIC CONSIDERATIONS

eninsula hosts a variety of geological features and occurrences with potential for economic deposits. Mafic-ultramafic ayered sills bear resemblance to the lithologies in the Cape Smith belt of northern Quebec which hosts th lan Ni-Cu-platinum group element deposit (St-Onge and Lucas, 1993; Lesher, 2007; Steenkamp and St-Onge, 2014). amafic rock bodies that have hydrothermally altered mineral assemblages have also been evaluated as potential carving a resources for local Inuit artists (Figure 6; Senkow, 2013; Beauregard and Ell, 2015). supracrustal sequence contains abundant granitic pegmatites that may bear rare-earth elements (Figure 8; Bigio 015), and metamorphosed carbonate units with euhedral pale-purple spinel and light-blue apatite, which can both be Areas with voluminous biotite±hornblende granodiorite are mapped as unit Ag. Local compositional variation to used as semi-precious gemstones. Mafic metasedimentary rocks, metaironstones, and pyrrhotite-bearing silicified gossanous layers also have potential to contain base and/or precious metal concentrations (Steenkamp, 2014)

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and left; unit At), and Paleoproterozoic metasedimentary rocks (core of fold and right; unit PLHs) in the Finger Land area of northern Hall Peninsula, Baffin Island, Nunavut. View looking west, rominent hill is approximately 250 m tall. Photograph by A. Bigio. 2015-062



Figure 6 An altered ultramatic body (unit Pu) on Leybourne Island Hall Peninsula Baffin Island ut, has been tested for its suitability as a carving stone and found to be medium-hard, w eflective, black polished surface. Based on the location of the deposit (proximity to tio , and abundance and quality of the stone, this deposit is documented as a new carving sto eserve for local artists. Photograph by H.M. Steenkamp. 201



developed L₂ lineation defined by rodded quartz and oriented hornblende. This surface is a f metres above the east-verging T_2 thrust contact between Archean orthogneiss in the hanging wal and Paleoproterozoic metasedimentary rocks (unit PLHs) in the foot wall. Hammer for scale is approximately 1 m long, view to the northeast. Photograph by R.E. From. 2015-064



Figure 8. Prismatic schorl tourmaline in a quartz- and feldspar-dominated pegmatite dyke that cuts through metasedimentary rocks (unit PLHs) on central Hall Peninsula, Baffin Island, Nunavut. Photograph by A. Bigio. 2015-065

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