## DESCRIPTIVE NOTES

The Imaiqtaqtuq map area (NTS 87-G/2) lies within the Minto Inlier, a ~300 km long by 100–150 m wide belt of gently folded sedimentary and igneous rocks of early Neoproterozoic age (late Tonian-early Cryogenian). The Neoproterozoic sedimentary rocks belong to the Shaler Supergroup, a ~4 km thick succession of shallow marine carbonate and evaporite rocks with interbedded terrigenous metasedimentary strata deposited in a shallow intracontinental epeiric sea known as the Amundsen Basin (Thorsteinsson and Tozer, 1962; Young, 1981; Rainbird et al., 1994, 1996a). The basin is considered to have formed within the supercontinent Rodinia and similar rocks outcrop in the Mackenzie Mountains of the northern Cordillera, suggesting that the basin extended for more than 1000 km to the southwest ( Rainbird et al., 1996a; Long et al., 2008). Basal strata of the Shaler Supergroup (Rae Group) are exposed only at the northeastern end of Minto Inlier, near Hadley Bay, where they unconformably overlie Paleoproterozoic sedimentary rocks, which in turn, unconformably overlie Archean granitic rocks (Campbell, 1981; Rainbird et al., 1994).

Shaler Supergroup rocks were injected by tholeiitic basaltic sills of the ca. 723–720 Ma Franklin igneous event (Heaman et al., 1992; Macdonald et al, 2010). Sills are generally 20–60 m thick, constitute 10–50% of the stratigraphic section, and commonly extend for 20 km or more along-strike with little change in thickness. Rare north-northwest striking dykes are interpreted to have intruded along syn-magmatic normal faults, to feed sills and possibly the flood basalts (Bédard et al., 2012). Sills of similar type and age also occur in the Coppermine Homocline, Brock Inlier and Duke of York Inlier to the south (Jefferson et al., 1994; Rainbird et al., 1996b; Shellnutt et al., 2004) and coeval, geochemically similar intrusions and volcanic rocks associated with the Franklin event extend from Greenland to the western Yukon (Heaman et al., 1992; Denyszyn et al., 2009; Macdonald et al., 2010). The Shaler Supergroup in Minto Inlier is capped by Natkusiak Formation flood basalt lava flows and interflow sedimentary rocks (Williamson et al., 2013). The lavas are up to 1 km thick and are the extrusive equivalent of the Franklin sills (Baragar, 1976; Jefferson et al., 1985; Dostal et al., 1986; Dupuy et al., 1995). Two main Franklin magma populations are identified and discriminated on the map where possible (*see* legend). The basal lavas and older sills (Type 1) are slightly enriched in very incompatible trace elements (high Ce/Yb), tend to be more primitive (higher MgO), and the sills may have peridotitic bases (Hayes et al., 2015). These primitive Type 1 sills have potential for Ni-Cu-PGE mineralization (Jefferson et al., 1994). Younger diabasic sills (low Ce/Yb, Type 2) correspond to the major sheet flow units of the lava succession. Where data permit, the different Franklin magma types are annotated as 1 or 2 on the map (*see* legend).

The irregular edge of the exposed Minto Inlier is defined by an erosional unconformity that separates the Neoproterozoic rocks from Lower Cambrian sandstone and siltstone that passes upward into a thick succession of mainly dolomitic carbonate rocks, ranging in age from Cambrian to Devonian (Thorsteinsson and Tozer, 1962; Dewing et al. 2015). Minto Inlier rocks are affected by open folds with northeast trending axial traces. Beds typically dip no more than 10° and there is generally no penetrative deformation fabric. The origin of the folding is unknown but it occurred after 720 Ma, before uplift and erosion of the Proterozoic rocks and prior to deposition of overlying lower Cambrian siliciclastic rocks (Durbano et al., 2015), which are not folded, but dip gently towards the northwest. Two main generations of faults are present (Bédard et al., 2012; Harris, 2014): north- to northwest trending syn-magmatic Proterozoic normal faults; and a younger set of east-northeast to east trending normal faults that cut all rocks in the area. The normal faults form horst and graben systems with up to 200 of metres of stratigraphic separation on individual faults, although throws are generally much less than this. A wide zone of intense east-northeast to east trending normal faulting stretches from Boot Inlet in the west to Wynniatt Bay in the east. This regional-scale, en-echelon, stepping normal fault system records sinistral transtensional motion (Harris, 2014). Observed contacts and lithologies were extrapolated and/or inferred using aeromagnetic data and remotely sensed imagery (e.g. orthorectified air photos, Landsat7, SPOT5, and Google Earth™). Many linear structures visible on air photos and linear discontinuities on the 1st-derivative aeromagnetic maps (Kiss and Oneschuk, 2010) are interpreted to be faults, although significant throws cannot always be demonstrated. Late Wisconsinan proglacial and glacial deposits cover about 70% of the map's terrestrial surface area. The extent of Quaternary cover shown on the map is not meant to be comprehensive, but to highlight areas where bedrock attributions are uncertain.

NTS 87-G/2 (Imaiqtaqtuq) extends along the southern shore of Kangiryuaqtihuk / Minto Inlet. North trending linear features are prominent on aeromagnetic maps (Kiss and Oneschuck, 2010). Some of these aeromagnetic linears correspond to west-side down normal faults in outcrop (UTM, 480180E, 7898000N). Along the coast, only Paleozoic strata are exposed to the west of these faults, suggesting overall west-side down motion. Some of these faults may be reactivated Neoproterozoic syn-magmatic faults. The Paleozoic rocks include Cambrian tan dolostone of the Uvayualuk Formation (Dewing et al., 2015) (UTM, 479140E, 7896850N), which is conformably overlain by Cambrian red-and-green weathering shale and dolostone of the Mount Phayre Formation and then by Cambrian to Lower Ordovician carbonate rocks of the Victoria Island formation and the Upper Ordovician Thumb Mountain Formation. Prominent east to east-northeast striking normal faults also cut these rocks. Along the shore of Kangiryuaqtihuk / Minto Inlet to the west of UTM, 480200E, 7897900N), an excellent 550 m thick section of Victoria Island formation strata is separated from dolostone of the older Uvayualuk Formation to the south by one of these faults (running through Nauyaan Tahia), implying significant north-side-down motion.

To the east of the main north-trending faults, Neoproterozoic carbonate rocks of the Wynniatt and Kilian formations and intercalated mafic Franklin sills dominate, although an isolated fault-bounded block of Paleozoic rocks can be seen at UTM, 482400E, 7898400N. Together with intercalated sills, Proterozoic strata generally strike east- to east-northeast and dip gently toward the south, defining the northern flank of the Holman Island Syncline. Rare steeper dips reflect either structural entrainment by block faults, or steeper jogs of generally shallow, concordant intrusive contacts. Near the coast of Kangiryuaqtihuk / Minto Inlet, grey, microbially laminated limestone of the Wynniatt Formation stromatolitic carbonate member (unit nPW3; Thomson et al., 2014) is well exposed in several sections (UTM, 495000E, 7902200N; 489900E, 7899800N; 486240E, 7898000N). Several thick sills are prominent along the coast, but faulting makes correlation difficult, and it is unclear how many sills are present. Most are of Type 2, but a thick Type 1 sill is the lowermost exposed along the coast at UTM, 493080E, 7902420N and UTM, 488230E, 7900855N, to either side of Hikuhuilaq (bay). Toward the southwest, there are no geochemical data on sills along the coast, but there are three places where these data reveal a thin Type 1 sill higher in the unit nPW3 section (UTM, 487000E, 7898950N; 486720E, 7898730N; 483125E, 7896810N). All other sills in this map area for which data are available are of Type 2. Another sill embedded in the unit nPW3 strata shows an outcrop pattern suggestive of a dextral Z-fold (UTM, 484600E, 7897400N). A thin layer of black nodular limestone marking the base of the upper carbonate member (unit nPW4) outcrops immediately beneath a thick capping sill (UTM, 491000E, 7898500N) that can be traced towards the southwest until it disappears under the Quaternary cover west of Imaiqtaqtuq (lake). The southern edge of this capping sill is reworked by northeast trending faults of the Imaiqtaqtuq Fault Zone.

The ~3 km wide Imaiqtaqtuq Fault Zone (IFZ) is composed of several prominent northeast trending faults that are manifested as linear valleys and strong aeromagnetic lineaments (Kiss and Oneschuck, 2010). The faults repeat sill contacts, as well as the lithostratigraphic contact between units nPW3 and nPW4 (e.g. UTM, 495940E, 7900090N vs. UTM, 496820E, 7899180N). Some of the slivers between the main faults are broken up by smaller northwest trending cross-faults that have allowed blocks to tilt, again leading to structural repetition of contacts (UTM, 492550E, 7897280N; 491990E, 7896820N). Some of the gabbroic slivers in the IFZ show a consistent, spaced fracture system that is visible on Google Earth satellite imagery (represented as inferred joints, e.g. UTM, 490700E, 7896350N), and which trends north-northeast, oblique to the main bounding faults. A northwest-trending fault that may belong to the older, syn-magmatic fault population (Bédard et al., 2012) passes near a meter-thick Fe-oxide exoskarn that decorates the upper intrusive contact of a sill (UTM, 498340E, 7899860N) at the Tuhuk occurrence (informal).

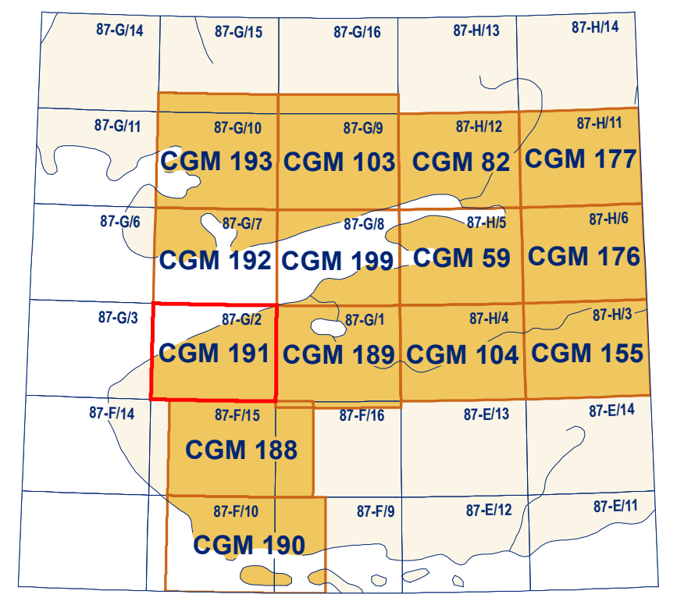
To the south of the northeast trending valley that extends from Imaiqtaqtuq (lake) towards the coast, and which forms the southern margin of the Imaiqtaqtuq Fault Zone, three distinct sills are separated by septa of fissile black nodular limestone and stromatolitic limestone of the Wynniatt Formation upper member (unit nPW4). A ~100 m thick sequence of black, nodular limestone (unit nPWM: UTM, 497800E, 7899000N) separates the 3rd sill from a 4th sill which disappears beneath Quaternary deposits to the south. This package of 4 sills is dissected by many fractures, but offsets are minor. The westward extension of the two lower sills appears to be truncated by the northeast trending fault that runs through Imaiqtaqtuq (lake), and which defines the southern limit of the IFZ. Although the 3rd sill can be traced towards the southwest as far as Imaiqtaqtuq (lake), it is covered by Quaternary deposits toward the west, but has an intrusive upper contact against thin-bedded nodular limestone of unit nPW4 to the south (UTM, 487530E, 7888820N). These contact-metamorphosed carbonate rocks are capped by a ~60 m thick sill that extends for over 9 km towards the south, but is covered by Quaternary deposits on its eastern and western sides. This sill is probably correlative with the 4th sill described above. Towards the south and east, this sill is succeeded up-section by a thin package of massive limestone of the basal evaporite member of the Kilian Formation (unit nPK1, UTM, 487990E, 7878130N). This unit nPK1 limestone is capped by a poorly-exposed 5th sill that forms a series of isolated knolls that scatter towards the northeast. Further to the southeast, rare rubbly outcrops are attributed to the Kilian Formation tan carbonate member (unit nPK2) on the basis of their appearance on the Landsat7 and SPOT5 imagery, and through correlation with outcrops in the next map area to the south (NTS 87-F/15). A 5 km wide expanse of Quaternary deposits separate these unit nPK2 outcrops from a ~30 m thick, ridge forming sill (6th sill) that is underlain by about 30–40 m of thin bedded unit nPK2 limestone. Above this sill, a poorly exposed septum of contact-metamorphosed, shaly carbonate rocks attributed to the clastic-carbonate member of the Kilian Formation (unit nPK3) are preserved beneath yet another sill (7th), which extends into adjoining mapsheets (NTS 87-G/1 and NTS 87-F/15).

## Abstract

NTS 87-G/02 is divided into fault-bounded domains by late north-trending (west-side down) and east-trending (north-side down) normal faults. Paleozoic sedimentary rocks of the Uvayualuk, Mount Phayre, Victoria Island, and Thumb Mountain formations are exposed along the coast to the west of the north-trending faults. Mostly Neoproterozoic sedimentary rocks of the upper Wynniatt and lower Kilian formations of the Shaler Supergroup (Minto Inlier) occur to the east of the north-trending faults. The northeast-trending, 4 km wide NE-trending Imaiqtaqtuq Fault Zone flanks the southeast coast of Minto Inlet, and records sinistral transtensional motions. Upper Wynniatt Formation limestones are injected by Type 1 and Type 2 Franklin sills near the coast, but only Type 2 sills are documented further south, where carbonate, shale, and evaporitic rocks of the Kilian Formation are well exposed beneath thick capping sills that form a series of south-dipping cuestas.

## Résumé

Le feuillet 87 G/2 est divisé en domaines limités par des failles normales de direction sud (compartiment ouest affaissé) et de direction ouest (compartiment nord affaissé) de formation tardive. Des roches sédimentaires du Paléozoïque appartenant aux formations d'Uvayualuk, de Mount Phayre, de Victoria Island et de Thumb Mountain affleurent le long de la côte, du côté ouest des failles de direction sud. Du côté est des failles de direction sud, on trouve principalement des roches sédimentaires du Néoprotérozoïque appartenant à la partie supérieure de la Formation de Wynniatt et à la partie inférieure de la Formation de Kilian du Supergroupe de Shaler (boutonnière de Minto). La zone de failles d'Imaiqtaqtuq, de direction nord-est et d'une largeur d'environ 4 km, flanque la côte sud-est de l'inlet Minto et conserve la trace de mouvements de transtension senestre. Près de la côte, les calcaires de la Formation de Wynniatt supérieure sont injectés de filons-couches de l'événement de Franklin des types 1 et 2. Plus au sud, seules des intrusions de type 2 ont été relevées là où des roches carbonatées, des shales et des roches évaporitiques de la Formation de Kilian sont bien exposés sous d'épais filons-couches sommitaux inclinés vers le sud, qui forment une série de cuestas.



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

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Natural Resources Canada
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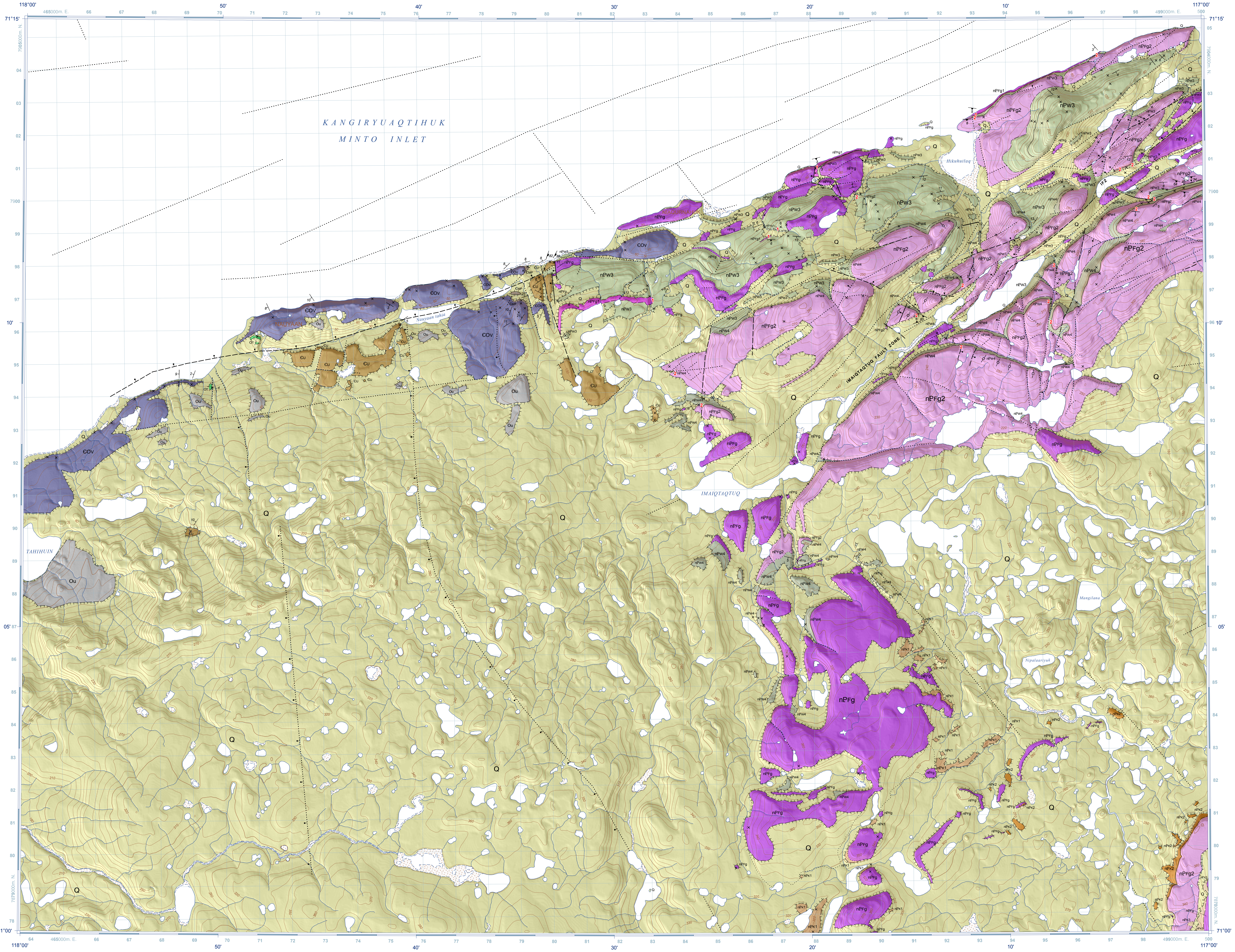
# CANADIAN GEOSCIENCE MAP 191
### GEOLOGY
# IMAIQTAQTUQ
Victoria Island, Northwest Territories
**1:50 000**



## CENOZOIC

**Q** Quaternary sediments.

## ORDOVICIAN

**Ou** Unsubdivided Paleozoic sedimentary rocks.

**OT** **Thumb Mountain Formation:** Fossiliferous dolostone consisting of finely crystalline, burrow mottled, nodular to thinly bedded dolomudstone, dolowackestone and dolopackstone. Fossils include crinoids, solitary rugose and colonial tabulate corals, aulocerids, gastropods, and cephalopods. These fossils and conodonts indicate an Upper Ordovician age. Depositional environment is interpreted as subtidal open marine setting. Thickness estimated at 250 m.

## CAMBRO–ORDOVICAN

**ЄOv** **Victoria Island formation:** Light grey to almost white weathering, fine to coarsely crystalline fabric-destructive dolostone that is widespread throughout northwestern Victoria Island. Locally preserved primary structures include horizontal bedding, crossbedded oolitic grainstone beds, thrombolite and stromatolite bioherms, microbial lamination, and intraformational conglomerate. Fossils are rare but include silicified gastropods. Silicification is widespread in the upper two-thirds of the unit. Chert occurs as prominent white-weathering beds and nodules, 5 to 60 cm thick, and composed of microcrystalline chert or as silicified stromatolites. Some vugs contain crystalline quartz. Depositional environment is interpreted as a broad, shallow carbonate platform. The lower contact is gradational with the Mount Phayre Formation unit with the contact at the highest shale interbed. The upper contact is sharp and inferred to be unconformable. Early Ordovician conodonts occur in samples directly below the upper contact. Thickness is 550 m on the south shore of Minto Inlet.

## CAMBRIAN

**ЄMP** **Mount Phayre Formation:** Thin- to medium-bedded red mudstone-siltstone interbedded with green dolomudstone. Outcrops have a distinctive stripy appearance. Sedimentary structures include mudcracks, wave ripples, small stromatolites, micro-karsted exposure surfaces, and microbial lamination indicating a shallow marine, subtidal to intertidal setting. Mudstones contain Middle Cambrian trilobites. The lower contact is covered in most places. Thickness ranges between 15–95 m.

**ЄU** **Uvayualuk Formation:** Light brown dolomudstone to dolarenite. Thrombolite mounds are locally well developed and together with metre-scale cross-stratification suggest a shallow marine setting. Although no fossils were recovered from this unit, the lower contact is gradational with mudstones that contain Cambrian trilobites. Thickness is 30–45 m.

## NEOPROTEROZOIC

**nPFg** **Franklin intrusions (ca. 720 Ma):** Typically massive, laterally extensive, diabasic or gabbroic sills with columnar jointing (~3–50 m thick, rarely up to 150 m). Some sills are composite with internal intrusive contacts. Less common, 1–40 m wide dykes are generally oriented NNW with irregular to very linear contacts. Commonly associated with fault breccias or drag folds in host metasediments. Dyke/sill junctions commonly have complex contact zones of calc-silicate contact-metamorphic rocks (reddish garnet rimmed by bright green vesuvianite), black Fe-oxide skarns, and minor sulphides.

**nPFg2** **Franklin intrusions Type 2:** Younger (based on crosscutting relationships), more evolved, predominantly diabasic sills show enrichment in magnetite, ilmenite, quartz, and alkali feldspar towards their cores, but are rarely layered. Some sills are porphyritic and contain 10–15% plagioclase>clinopyroxene> olivine phenocrysts and glomerocrysts up to 5 mm. Porphyritic rocks are marked as '**p**' on the map where the texture has been recognized. Intrusions of this series are marked as '**2**' where geochemical data exist.

**nPFg1** **Franklin intrusions Type 1:** Older, more primitive intrusions are commonly layered, with microdiabasic lower and upper border zones and olivine-enriched basal cumulate (olivine gabbro to feldspathic wehrlite,) that is locally capped by a thin, (1–2 m) feldspathic pyroxenite cumulate. The olivine cumulate is commonly covered with bright orange lichen, weathers chocolate brown, and shows a characteristic layer-parallel ribbed weathering. It is marked as '**o**' on the map where it has been recognized. The upper one half to three quarters of sills comprise massive olivine and pigeonite gabbros, a magnetite gabbro with characteristic pitted weathering (magnetite oikocrysts) and a granophyric sandwich horizon containing abundant ocelli of granophyre and coarse, bladed clinopyroxene crystals. Intrusions of this series are marked as '**1**' where geochemical data exist.

## NEOPROTEROZOIC-TONIAN TO CRYOGENIAN

**Shaler Supergroup** (nPW3–nPK3)

**Kilian Formation** (nPK1–nPK3)

**nPK3** **Tan Carbonate member:** Tan to green-grey, flaggy weathering dolostone and limestone. Gradation between parallel-laminated lutite and flat to wavy and hummocky bedded siltite. Lutite-rich layers are generally plane parallel laminated with rare siltite lenses (starved ripples?). Bed bases typically scoured grading up to lutite-rich tops. Intraformational clast breccia commonly infilling swales and gutters. Black chert nodules throughout and stromatolites at several horizons. One distinctive bioherm, from the middle of the tan carbonate member, is laterally traceable from Ulukhaktok along the Kuujjua River Valley to where it cuts across the Natkusiak plateau. Approximately 60 m thick.

**nPK2** **Clastic-carbonate member:** Variegated (red, green, grey and black) pin-stripe-laminated mudstone and siltstone, particularly at its base. Desiccation cracks common in mudstone and wavy bedding and ripple crosslamination in coarse siltstone-fine sandstone interlayers. Wavy-flaser bedded and small-scale crossbedded, 4 m thick, buff-weathering, fine-grained quartzarenite near top. Wavy-bedded dolosiltite and laterally linked stromatolite interbeds are common and increase upsection. Approximately 120 m thick.

**nPK1** **Carbonate-evaporite member:** Alternating, decametre-scale subunits of evaporite and carbonate-dominant lithofacies; evaporite: laminated red mudstone and dolomitic mudstone with interbedded nodular anhydrite and laminated gypsite and anhydrite, minor stromatolitic dolostone. Carbonate lithofacies: dolostone and minor limestone lutite/siltite rhythmite capped by arenite/rudite laterally linked stromatolites, forming repetitive metre-scale cycles. Molar-tooth structure common.

**Wynniatt Formation** (nPW3–nPW4)

**nPW4** **Upper carbonate member:** Base characterized by distinctive nodular, black calcareous shale, overlain by thin, rhythmically bedded and normally graded, quartz-sandy calcarenite. Upper, metre-scale alternations of stromatolitic dolostone and crossbedded intraclast grainstone. Local herringbone crossbedded quartz arenite and microbially laminated lime mudstone. Chert is common. Approximately 300 m thick.

**nPW3** **Stromatolitic carbonate member:** Stromatolitic dolostone with build-ups that have local synoptic relief of several meters; main build-up contains oncoids up to 20 cm. Interbedded intraclast grainstone with rip-ups and scours; mudstone/dololutite with molar-tooth structure. Parallel or microbially laminated dololutite with mudcracks, and teepee structures. Sharp, erosive upper contact. Approximately 160 m thick.

Contact; depositional, depositional-conformable or intrusive
- Defined
- Approximate
- Inferred

Contact; depositional-unconformable
- Defined
- Approximate
- Inferred

Dyke
- Defined

Fault, generic; steep dip
- Defined
- Approximate
- Inferred or concealed

Fault, normal; upright
- Defined
- Approximate
- Inferred or concealed

Station location
- × Ground observation

Planar structure
- Bedding
  - 20 Inclined
- Intrusive contact
  - 25 Inclined
- Fault
  - Vertical
- Jointing
  - 10 Inclined
  - Joint (inferred from remote imagery)
- Foliation
  - 15 Igneous layering

Linear structure
- Lineation
  - Glacial striation or groove

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Canadian Geoscience Maps

**Authors: J.H. Bédard, R.H. Rainbird, K. Dewing, and T. Hadlari**

Geology by J.H. Bédard, R.H. Rainbird, K. Dewing, T. Hadlari,
D. Thomson, J. Prince, B. Hayes, N. Williamson, M. Hryciuk,
J.C. Carpenter, A.M. Durbano, T. Dell'Oro, J. Mathieu, M.-C. Williamson,
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Cartography by N. Côté

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Map projection Universal Transverse Mercator, zone 11.
North American Datum 1983

### GEOLOGY
# IMAIQTAQTUQ
Victoria Island, Northwest Territories
**1:50 000**

1 0 1 2 3 4 km

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
model supplied by GeoBase.
Illumination: azimuth 225°, altitude 45°, vertical factor 1x

Proximity to the North Magnetic Pole causes the magnetic
compass to be erratic in this area.
Magnetic declination 2015, 20°19'E, decreasing 44.6' annually.

This map is not to be used for navigational purposes.

Title photograph: Paleozoic strata exposed along South Shore of
Minto Inlet, Victoria Island, Northwest Territories.
Photograph by J. Prince. 2014-149

The Geological Survey of Canada welcomes
corrections or additional information from users.

Data may include additional observations not portrayed on this map.
*See* documentation accompanying the data.

**Preliminary publications in this series have not been scientifically edited.**

CANADIAN GEOSCIENCE MAP 191
GEOLOGY
IMAIQTAQTUQ
Victoria Island, Northwest Territories

Canada