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Abstract

The map of surficial geology and periglacial features in Pangnirtung was done to help decision-makers, planners and engineers to better adapt the community to the impacts of climate change. The dominant surface unit on the map consists of colluvium deposits which are ice-rich sandy sediments deposited by overland-flow during snowmelt. Buried soils as old as 7080 cal BP were found imbedded in a colluvium layer. In the eastern sector of town, colluvium 1 to 4 metres thick covers till and a network of ice wedges. It also covers ice-rich marine silts and bedrock in the western sector. The central sector of town is occupied by a coarse, boulder-rich, Holocene outwash fan deposited by the Duval River. An alluvial terrace with boulders and some eroded channels were incised by the river in the fan. Bedrock and thick till deposits are found in the upper river valley and on the slopes of the fjord.

Résumé

La carte des conditions du pergélisol et des formes périglaciaires de Pangnirtung a été produite pour aider les décideurs, les urbanistes et les ingénieurs à mieux adapter la communauté aux impacts des changements climatiques. Des colluvions sableuses riches en glace et mises en place lors du ruissellement printanier occupent la plus grande superficie sur la carte. Des lits de matière organique enfouis et atteignant 7080 cal BP y sont interstratifiés. Dans le secteur est du village, les colluvions, d'une épaisseur de un à quatre mètres, recouvrent un dépôt de till et un réseau de coins de glace. Les colluvions recouvrent des dépôts marins silteux et le roc dans le secteur ouest. Un paléo-cône de déjection d'âge holocène et composé de sable et gravier a été mis en place par la rivière Duval dans le centre du village. Celui-ci a ensuite été incisé par la rivière, entaillant une terrasse alluviale et des chenaux fluviatiles. Un épais dépôt de till et du roc sont retrouvés en amont de la rivière, ainsi que sur les versants de la vallée glaciaire.

National Topographic System reference

Cover illustration:
The beautiful landscape surrounding the hamlet of Pangnirtung. Photograph by A.-S. Carbonneau. 2011-013

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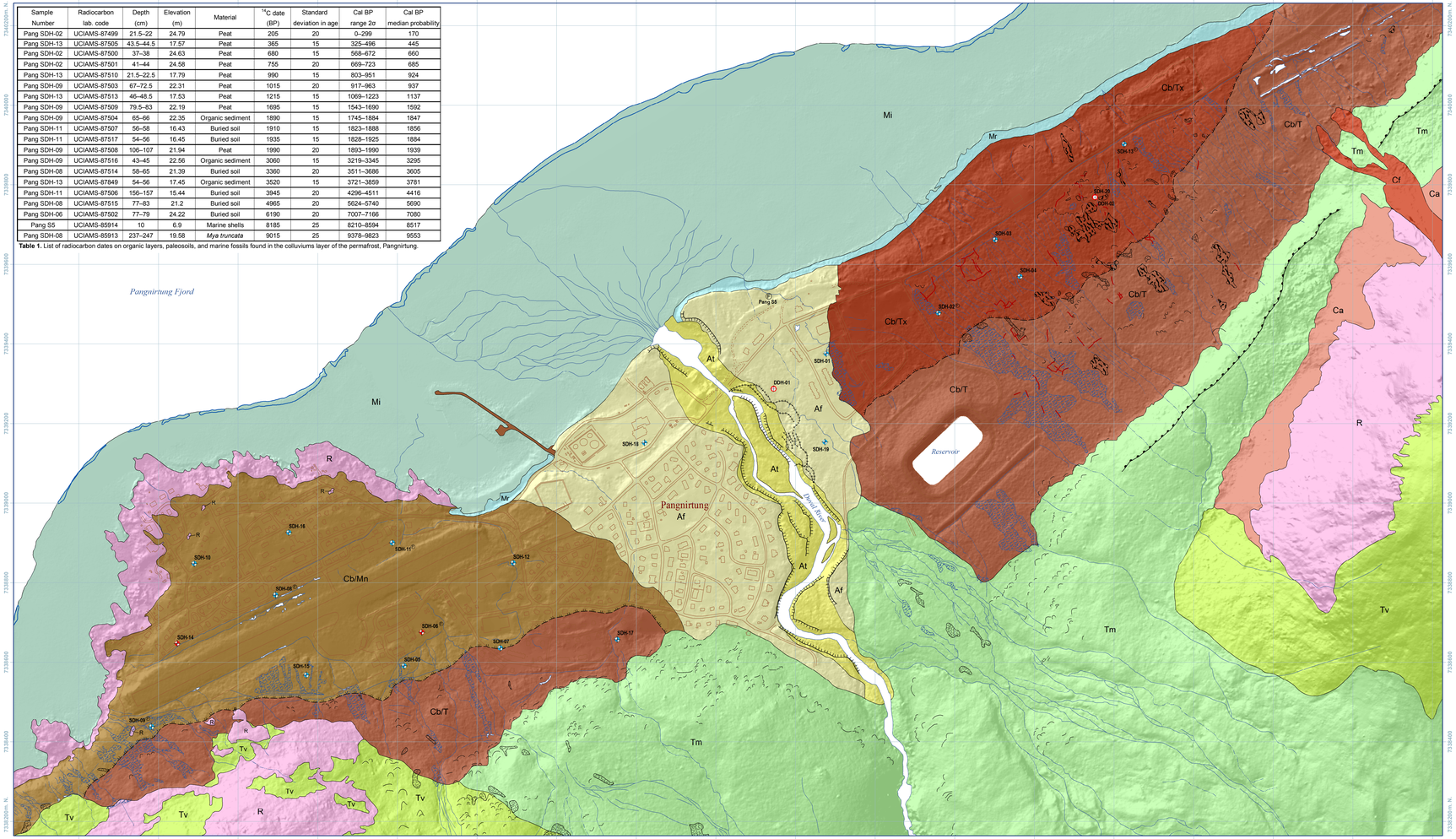
CANADIAN GEOSCIENCE MAP 65
(preliminary version)
SURFICIAL GEOLOGY AND PERIGLACIAL FEATURES
PANGNIRTUNG
Nunavut
1:5 000

Sample Number	Radiocarbon lab. code	Depth (cm)	Elevation (m)	Material	^{14}C date (BP)	Standard deviation in age	Cal BP range 2σ	Cal BP median probability
Pang SDH-02	UCIAMS-87499	21.5–22	24.79	Peat	205	20	0–299	170
Pang SDH-13	UCIAMS-87505	43.5–44.5	17.57	Peat	365	15	325–496	445
Pang SDH-02	UCIAMS-87500	37–38	24.63	Peat	680	15	568–672	660
Pang SDH-02	UCIAMS-87501	41–44	24.58	Peat	755	20	669–723	685
Pang SDH-13	UCIAMS-87510	21.5–22.5	17.79	Peat	990	15	803–951	924
Pang SDH-09	UCIAMS-87503	67–72.5	22.31	Peat	1015	20	917–963	937
Pang SDH-13	UCIAMS-87513	46–48.5	17.53	Peat	1215	15	1069–1223	1137
Pang SDH-09	UCIAMS-87509	79.5–83	22.19	Peat	1695	15	1543–1690	1592
Pang SDH-09	UCIAMS-87504	65–66	22.35	Organic sediment	1890	15	1745–1884	1847
Pang SDH-11	UCIAMS-87507	56–58	16.43	Buried soil	1910	15	1823–1888	1856
Pang SDH-11	UCIAMS-87517	54–56	16.45	Buried soil	1935	15	1828–1925	1884
Pang SDH-09	UCIAMS-87508	106–107	21.94	Peat	1990	20	1893–1990	1939
Pang SDH-09	UCIAMS-87516	43–45	22.56	Organic sediment	3060	15	3219–3345	3295
Pang SDH-08	UCIAMS-87514	58–65	21.39	Buried soil	3360	20	3511–3686	3605
Pang SDH-13	UCIAMS-87849	54–56	17.45	Organic sediment	3520	15	3721–3859	3781
Pang SDH-11	UCIAMS-87506	156–157	15.44	Buried soil	3945	20	4296–4511	4416
Pang SDH-08	UCIAMS-87515	77–83	21.2	Buried soil	4965	20	5624–5740	5690
Pang SDH-06	UCIAMS-87502	77–79	24.22	Buried soil	6190	20	7007–7166	7080
Pang S5	UCIAMS-85914	10	6.9	Marine shells	8185	25	8210–8594	8517
Pang SDH-08	UCIAMS-85913	237–247	19.58	*Mya truncata*	9015	25	9378–9823	9553

Table 1. List of radiocarbon dates on organic layers, paleosols, and marine fossils found in the colluvium layer of the permafrost, Pangnirtung.



QUATERNARY

HOLOCENE SEDIMENTS

Colluvial deposits

Ca — ***Talus:*** *generally active accumulations of blocks and rubble, as much as 50 m thick forming talus (scree) aprons at angle of repose below cliffs derived from rock falls.*

Cf — ***Bouldery debris flow:*** *blocky to gravelly debris-flow accumulations mixed with scree, 1–50 m thick, traversed by narrow channels and debris levees; interrupt scree slopes (Ca) at the exits of prominent debris hopper in cliff; surface slopes less than angle of repose but steeper than those of alluvial fans.*

Cb/Mn — ***Colluvial blanket*** (Cb) ***over littoral to nearshore sediments*** (Mn)*: colluvium made of sand and gravel layers up to 4 m thick. The underlying marine sediments are composed of gravel, sand and silt; 2–15 m thick depending on the bedrock topography, formed near or at the ice margin.*

Cb/Tx — ***Colluvial blanket*** (Cb) ***over reworked till*** (Tx)*: colluvium made of sand and gravel layers up to 4 m thick on top of pre-existing washed till deposits below the marine limit. A thin peat layer (5 to 25 cm) overlies the colluvial deposit. Affected by periglacial processes such as gelifluction lobes and frost boils. Ice wedges occasionally present in the near surface permafrost.*

Cb/T — ***Colluvial blanket*** (Cb) ***over till*** (T)*: colluvium made of sand and gravel layers up to 4 m thick underlain by a till composed of sand gravel and boulders in a silty-sand matrix; more than 20 m thick. A thin peat layer (5 to 25 cm) overlies the colluvial deposit. Affected by periglacial processes such as gelifluction lobes, frost boils and block fields. Ice wedges occasionally present in the near surface permafrost.*

Alluvial sediments

Af — ***Fan sediments:*** *the fan was built by the Duval River and debris flows during the Holocene forming channels and levees, the sediment consists of gravel, sand, and boulders with cryogenic layers and buried soils.*

At — ***Alluvial terraces:*** *gravel, sand, and boulders in terraces; 1–10 m thick, above limit of actual flooding. Formed during the Late Holocene. Affected by tension cracks along the banks of Duval River.*

Marine sediments

Mi — ***Intertidal sediments:*** *silt and sandy silt deposited in the intertidal zone; mostly boulder mudflats. No permafrost is expected.*

Mr — ***Beach sediments:*** *littoral and nearshore sediments deposited as beaches. Permafrost may be present.*

PLEISTOCENE AND EARLY HOLOCENE

Glacial sediments (Till): *sediments deposited in subglacial and ice-marginal environments.*

Tm — ***Lateral moraine:*** *5–40 m high ridges and hummocks comprised of thick till, forming lateral moraines regarded as the youngest of the Duval moraines during ice-marginal recession. Gelifluction lobes present on the slopes of the moraine. Block fields may also be present.*

Tv — ***Till veneer:*** *Diamicton with silty sand matrix, 0.5–2 m thick and discontinuous; insufficiently thick to mask the relief of underlying bedrock surface.*

PRE-QUATERNARY

R — *Bedrock (Precambrian).*

Frost boil areas

Blockfields: Localized lag concentrations of boulders due to wavewash or fluvial erosion of till matrix

String-structured drainage networks: Poorly organized surface drainage networks

Geological contact

Boulder barricade

Limit of glaciomarine submergence - approximate

Moraine ridge: lateral

Tension cracks caused by collapse of terrain due to thermal erosion

Fluvial terrace scarp

Frost crack (ice wedges)

Gelifluction lobe and sheet terminal margins

Rills and watertracks; running throughout all arctic summer

Rills and watertracks; running occasionally during spring melt

Name — *Radiocarbon dated sample location*

Name — *Thermistor cable location*

Name — *Permafrost coring site*

Name — *Permafrost coring site with radiocarbon dated sample*

Name — *Permafrost coring site with thermistor cable installed*

Name — *Permafrost coring site with thermistor cable installed and radiocarbon dated sample*

Note: Considering the practical importance of shallow depth geological formations and permafrost conditions, three composite map units (Cb/Mn, Cb/T, Cb/Tx) appear on the map.

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Surficial and periglacial-permafrost geology mapping based on ground surveys (2009–2010; M. Allard, A.-S. Carbonneau, E.L'Hérault, A.M. LeBlanc, and P. Gosselin), and air photo interpretation by A.-S. Carbonneau and M. Allard using 1:6000 scale black and white vertical photos, flight line A24493, August 20, 1976, photos 50–56 and 1:3000 scale black and white vertical photos, flight line A25553, August 1, 1980, photos 96–108.

Cartography by A.-S. Carbonneau, P. Gosselin, and R. Boivin

This project was mandated by the Government of Nunavut.

Ground Control Points provided by Université Laval.

Map projection Universal Transverse Mercator, zone 20, North America Datum 1983

Infrastructure and base data provided through the Digital Mapping Data Base, property of the Government of Nunavut.

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1:5 000

100 0 100 200 300 400 m

Shaded relief image prepared by A.-S. Carbonneau and derived from digital elevation model created from 50 cm WorldView-2 stereo satellite images acquired July 10, 2010. 1 m DEM created using a proprietary stereo image matching process by PhotoSat Information Ltd.

Illumination: azimuth 315°, altitude 45°, vertical factor 1x.

Proximity of the North Magnetic Pole causes the magnetic compass to be erratic in this area.
Magnetic declination 2012, 33°20'W, decreasing 29.2' annually.

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

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Four trim marks around perimeter of map sheet. Trim map sheet first, then fold at folding marks.

Cover and additional panels are 17cm wide when folded.