Descriptive Notes

This surficial geology map of Denmark Bay–Qikiqtagafaaluk area, Nunavut, combines a remotely predicted map (RPM) and visually interpreted imagery elements.

Remote Predictive Mapping

The procedure used to produce a remotely predicted map of Denmark Bay–Qikiqtagafaaluk area, Victoria Island, Nunavut, consists of classifying a series of satellite images that were merged into a seamless image mosaic *see* Figure 1 in documentation accompanying the digital data). The key steps used for classification follow.

a) Data used in this map include ~3 to 4 LANDSAT ETM+ images (30 m resolution), tiled into a mosaic for Qikiqtagafaaluk area including NTS 67-F and NTS 67-C. SPOT panchromatic imagery (5 m pixel size) and aerial photographs were also used during training and classification to make use of their improved spatial resolution. Digital terrain models (30 m pixel size) were used to re-classify pixels.

b) Training data associate spectral signatures to a defined area representing a distinctive terrain type, map unit or landform. Training was performed directly on the LANDSAT imagery and was informed by the spectral characteristics of the surface (material, vegetation, and slope), and by landform types and landform associations. Six classes were identified based on variation in surface moisture content, and include two types of bedrock and various sediments.

c) Image classification used a Random Forest (RF) classifier; a statistical algorithm adds random training and validation before classification. Different variables were assessed for their predictive capacity within the RF model derived from LANDSAT data (e.g. band ratios, textures, transformation) and digital terrain data (e.g. relative height, slope, aspect). Model outputs provide an estimate of overall accuracy and a probability estimate (e.g. Parkinson, 2012).

d) Classification for a surface-material map was produced when the spatial variability of bedrock and moisture content of surface sediment was converted to materials using a series of expert-knowledge rules related to the understanding of texture, landforms, and geomorphic processes.

e) Evaluation of the map used statistical outputs from the algorithm and qualitative assessment relative to known terrain elements, from aerial photographs, SPOT imagery, and from field-site observations and photos from the study area, and expert knowledge from completed mapping in an adjacent area (e.g. Sharpe, 1993).

f) Reclassification with additional training data may not resolve spectral variability, thus user-defined rules were used to help guide pixel reclassification. i) Glaciomarine deposits were captured by reclassifying moist (colluvial) sediments below marine limit mapped at ~100 to 125 m a.s.l. ii) Thick sediment was captured in hummocky topography (not in this area) where some better drained hillcrests have a spectral signature associated with dry, vegetation-poor, and apparently thin sediments (<1 m thick). This is spectrally accurate, yet geologically inaccurate since hummock tops record thick sediment with buried ice determined from previous field work (e.g. Sharpe, 1992).

g) Final remotely predicted map of surficial geology

The final map results from the automated classification based on training data, the post-classification conversion to a surficial materials map, the evaluation of the classified image, and on any needed reclassification following expert evaluation. Integration of landform data (mapped by visual image interpretation aided by regional field site and photographs - see below) with the surface materials map results in a remotely-predicted map of surficial geology.

Visual Interpretation of Imagery

SPOT imagery and aerial photographs were interpreted visually with the aid of field-site observations and ground photographs. Visual interpretation focussed on important landforms and terrain types that spectral imagery was not able to reliably map. These include shoreline features (marine and lacustrine), eskers, meltwater channels, deltas, hummocky terrain, bedrock areas, and eolian sand. Some landforms, streamlined forms, eskers, and moraine ridge were imported and modified as interpreted layers from published sources (e.g. Storrar and Stokes, 2007). Additional information and interpretation of this map is available in the Map Information Document accompanying this map.

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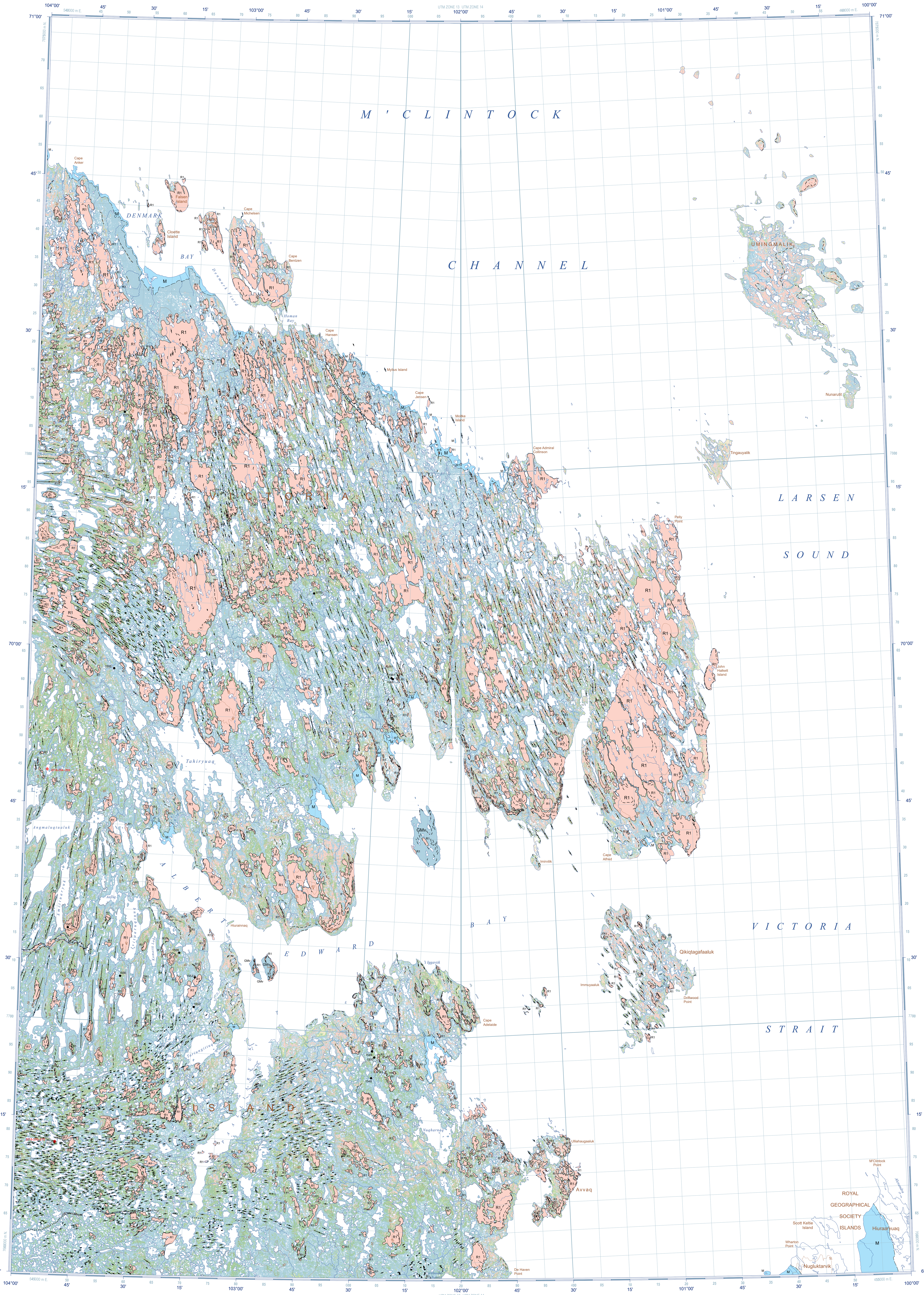
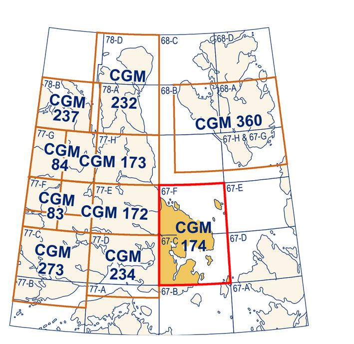


Abstract

This 1:250 000 predictive surficial geology map of Denmark Bay–Qikiqtagafaaluk area combines remote predictive mapping (RPM) and visually interpreted imagery from LANDSAT and SPOT data. Machine-automated classification of training data, conversion to surficial geology, and terrain reclassification were integrated with landform and regional ground-truth data. The map captures a sediment mosaic because spectral data realistically record moisture content on terrain surfaces in this permafrost setting. Tonal character of moisture content is controlled by sediment texture, topography, vegetation, and material thickness. Visual analysis of terrain form, with expert knowledge, reveals a series of crosscut streamlined flow fields recording complex glacial history, including marine inundation limits. Scoured bedrock in flow fields indicates erosional terrains, with little or no sediment cover. RPM methods are efficient and accurate in mapping surface spectral details, allowing more time to develop geological models of glaciated terrain. This publication includes the predictive surficial geology data in two formats: Sheet 1, raster (~75%)/vector (~25%), and Sheet 2, vector.

Résumé

Cette carte de la géologie prédictive des formations superficielles de la région cartographique de Denmark Bay–Qikiqtagafaaluk à l'échelle 1/250 000 combine la télécartographie prédictive et l'interprétation visuelle d'images obtenues par LANDSAT et SPOT. La classification automatique des données d'apprentissage, la conversion en une carte des formations superficielles et la reclassification des terrains ont été intégrées à des données sur les formes de terrain ainsi qu'à des données de la réalité de terrain à l'échelle régionale. La carte représente une mosaïque de sédiments car les données spectrales enregistrent de manière réaliste la teneur en eau des surfaces du terrain dans ce milieu à pergélisol. Le caractère tonal des données spectrales, qui reflète la teneur en eau, dépend de la texture des sédiments, de la topographie, de la végétation et de l'épaisseur des matériaux. L'analyse visuelle des formes de terrain par des spécialistes révèle une série de champs de formes profilées d'écoulement qui présentent entre eux des relations de recoupement, témoignant ainsi d'une histoire glaciaire complexe, ainsi que l'existence de limites de submersion marine. Le substratum rocheux affouillé dans les champs d'écoulement est l'indication de terrains d'érosion, qui présentent peu ou pas de couverture de sédiments. Les méthodes de télécartographie prédictive sont efficaces et précises pour cartographier les détails spectraux de la surface, ce qui donne aux géologues plus de temps pour produire des modèles géologiques des terrains glaciaires. Cette publication comprend des données de la géologie prédictive des formations superficielles en deux formats : feuille 1, matriciel (~75%)/vectoriel (~25%), et feuille 2, vectoriel.



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

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Natural Resources Canada | Ressources naturelles Canada

CANADIAN GEOSCIENCE MAP 174

PREDICTIVE SURFICIAL GEOLOGY

DENMARK BAY–QIKIQTAGAFAALUK AREA

Victoria Island, Nunavut

NTS 67-C and F

1:250 000

QUATERNARY

HOLOCENE

NONGLACIAL ENVIRONMENT

Ev — **Eolian sediments, veneer:** <1 m of fine sand, deposited downflow of Nanook River floodplain sand; spectral data only.

M — **Marine sediments, undifferentiated:** silt, sand with lag gravel, 1 to 2 m thick, deposited or wave reworked and pushed by sea ice during marine regression.

LAST GLACIATION (WISCONSIN)

PROGLACIAL AND GLACIAL ENVIRONMENT

GMv — **Glaciomarine sediments, veneer:** silt, sand, and lag gravel, 1 to 2 m deposited or wave reworked and pushed by sea ice during regression below marine limit (~120–140 m a.s.l.).

GLACIAL ENVIRONMENT

Th — **Glacial sediments, hummocky till:** sandy-silt diamicton, may be stratified; 5 to 10 m thick; forms disorganized hillocks, elongated ridges, and kame-and-kettle topography, with large ~50 m ice-wedge polygons; associated with ice-cored terrain and slump scars; spectral data only.

Tv — **Glacial sediments, veneer on bedrock topography:** sandy-silt diamicton, <2 m thick, deposited by basal glacial processes; mainly meltwater-eroded surface with exposed bedrock and boulder concentrations; spectral data only.

PRE-QUATERNARY

R1 — **Bedrock, sedimentary:** Cambrian and Ordovician carbonate rocks (dolosiltite).

Geological contact:

Defined

Approximate

Beach crest, glaciomarine, marine

Major meltwater channel

Esker ridge, paleoflow direction unknown (meltwater channels often occur with inset eskers; however, not all inset eskers can be displayed on the map)

Drumlinoid ridge or fluting

Crag-and-tail ridge, not mapped to scale

Paleocurrent measurement, bedrock erosional forms

Striation, direction known

2018-264 Field photograph location with NRCan photo catalogue number

Ground observation

1545 Sample location

SPECTRAL UNITS

Sediment complex below marine limit: mosaic of glaciomarine silt and sand (unit GMv), sandy-silt diamicton (unit Tv), 1 to 2 m thick with exposed, mainly carbonate bedrock; rare Precambrian igneous bedrock (not on this map).

Sheet 1 of 2, Predictive surficial geology (raster)

Recommended citation

Sharpe, D.R., Lesemann, J.-E., Parkinson, W., Armstrong, L., and Dods, E., 2023. Predictive surficial geology, Denmark Bay–Qikiqtagafaaluk area, Victoria Island, Nunavut, NTS 67-C and F; Geological Survey of Canada, Canadian Geoscience Map 174, scale 1:250 000. https://doi.org/10.4095/295703

CANADIAN GEOSCIENCE MAP 174

Geological Survey of Canada
Canadian Geoscience Maps

Authors: D.R. Sharpe, J.-E. Lesemann, W. Parkinson, L. Armstrong, and E. Dods

Geology by D.R. Sharpe, 1985, 1987, and 1988

Geological compilation by D.R. Sharpe, 2014 and D.E. Kerr, 2015

Geology conforms to Surficial Data Model v. 2.3.14 (Deblonde et al., 2018).

Geomatics by L. Armstrong, E. Dods, and S. Eagles

Cartography by S. Eagles, R. Chan, E. Everett, and M.J. Baldock

Scientific editing by A. Weatherston

Initiative of the Geological Survey of Canada, conducted under the auspices of the Remote Predictive Mapping activity as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) program

Map projection Universal Transverse Mercator, zone 13 North American Datum 1983

Base map at the scale of 1:250 000 from Natural Resources Canada, with modifications
Elevations in metres above mean sea level

PREDICTIVE SURFICIAL GEOLOGY
DENMARK BAY–QIKIQTAGAFAALUK AREA
Victoria Island, Nunavut
NTS 67-C and F
1:250 000

5 0 5 10 15 20 km

Proximity to the North Magnetic Pole causes the magnetic compass to be erratic in this area.
Mean magnetic declination 2023, 2°35'E, increasing 7.4' annually
Readings vary from 1°30'W in the NE corner to 6°04'E in the SW corner of the map.

This map is not to be used for navigational purposes.

Title photograph: Raised marine shoreline terraces that extend to a large sediment upland, Albert Edward Bay, Nunavut. Photograph by D.R. Sharpe.
NRCan photo 2014-066

The Geological Survey of Canada welcomes corrections or additional information from users (gscpublications-cgcpublications@nrcan-rncan.gc.ca).

Data may include additional observations not portrayed on this map. *See* map info document accompanying the downloaded data for more information about this publication.

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

CANADIAN GEOSCIENCE MAP 174
PREDICTIVE SURFICIAL GEOLOGY
DENMARK BAY–QIKIQTAGAFAALUK AREA
Victoria Island, Nunavut
NTS 67-C and F