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CANADIAN GEOSCIENCE MAP 172

PREDICTIVE SURFICIAL GEOLOGY

WASHBURN LAKE AREA

Victoria Island, Nunavut
NTS 77-E and 77-F east

Map Information Document

Geological Survey of Canada
Canadian Geoscience Maps

2018

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MAP NUMBER

Natural Resources Canada, Geological Survey of Canada
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Predictive surficial geology, Washburn Lake area, Victoria Island, Nunavut, NTS 77-E and 77-F east

SCALE

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ABSTRACT

The predictive surficial geology map combines remotely predicted map and visually interpreted imagery from LANDSAT and SPOT data. Machine-automated classification was integrated with landform and regional ground-truth data. The tonal character of spectral data, moisture content, controlled by sediment texture, topographic position, vegetation, and material thickness is mapped by machine methods. Visual analysis of terrain form, with expert knowledge, reveals a series of crosscut streamlined flow fields that record a complex glacial history, including glaciolacustrine and marine limit water plains. Scoured bedrock in an east-west flow field indicates that it is an erosional terrain that bifurcates a high area of thick, ice-cored, hummocky terrain. Remotely predicted map methods are efficient, accurate, and save time in mapping spectral details on the ground surface, allowing the geologist more time in developing the essential 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

La carte de la géologie des formations superficielles combine la télécartographie prédictive à l'interprétation visuelle d'images révélées par des données LANDSAT et SPOT. Une classification automatisée a été intégrée aux données topographiques et à des données de la réalité de terrain à l'échelle régionale. Le caractère tonal des données spectrales, qui reflète la teneur en eau et dépend de la texture des sédiments, de la position topographique, de la végétation et de l'épaisseur des matériaux, est cartographié par des méthodes automatiques. L'analyse visuelle de la topographie par des spécialistes révèle une série de champs transversaux de formes profilées d'écoulement qui témoignent de l'histoire glaciaire complexe de cette région, laquelle a notamment été marquée par la formation de plaines glaciolacustres et de plaines littorales. Le substratum rocheux affouillé dans un champ d'écoulement est-ouest indique qu'il s'agit d'un terrain d'érosion qui bifurque de part et d'autre d'un terrain élevé à surface bosselée formé de dépôts épais à noyaux de glace. Les méthodes de télécartographie prédictive sont efficaces, précises et elles font gagner du temps pour cartographier les détails spectraux de la surface du sol, ce qui donne aux géologues plus de temps pour produire d'importants modèles géologiques des terrains glaciaires. Cette publication comprend des données prédictives de la géologie des formations superficielles en deux formats : feuille 1, matriciel (~75 %)/vectoriel (~25 %) et feuille 2, vectoriel.

SHEET 1 OF 2, PREDICTIVE SURFICIAL GEOLOGY (RASTER)

GENERAL INFORMATION

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

Geology by D.R. Sharpe, 1984, 1985, and 1987

Geological compilation by D.R. Sharpe, 2013–2014

Geology conforms to Surficial Data Model v. 2.3 (Deblonde et al., 2017).

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

Cartography by S. Eagles, R. Chan, and E. Everett

Scientific editing by E. Inglis

Initiative of the Geological Survey of Canada, conducted under the auspices 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

Proximity to the North Magnetic Pole causes the magnetic compass to be erratic in this area.
Mean magnetic declination 2018, 7°56'E, decreasing 26.8' annually
Readings vary from 2°50'E in the NE corner to 12°04'E in the SW corner of the map.

This map is not to be used for navigational purposes.

Title photograph: Sinuous ridges (near view) and streamlined forms (far view) trending approximately north; view to northwest, north of Washburn Lake, eastern Victoria Island, Nunavut. Photograph by D.R. Sharpe. 2014-068

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

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 (http://geoscan.nrcan.gc.ca/).

Map Viewing Files

The published map is distributed as a Portable Document File (PDF), and may contain a subset of the overall geological data for legibility reasons at the publication scale.

Cartographic Representations Used on Map

This map utilizes ESRI Cartographic Representations in order to customize the display of standard GSC symbols for visual clarity on the PDF of the map only. The digital data still contains the original symbol from the standard GSC symbol set. The following legend features have Cartographic Representations applied:

- field photograph location symbol moved off sample symbol

Descriptive Notes

Surficial geology map

This surficial geology map of Washburn Lake area combines a remotely predicted map (RPM) and visually interpreted imagery elements.

Remote Predictive Mapping

Remotely predicted map analysis and mapping of Washburn Lake area combine expert knowledge and machine processing to classify a series of satellite images that were merged into a seamless mosaic (Lesemann et al., 2013). Key steps used for classification follow.

• Data input includes aproximately 3–4 LANDSAT ETM+ images (30 m resolution), tiled into a mosaic, SPOT panchromatic imagery (5 m pixel size), and aerial photographs.

• Training data relate spectral signatures to areas of distinctive terrain using this imagery. Spectral characteristics include material, vegetation, and slope, linked to variation in surface moisture.

• Image classification used a Random Forest (RF) classifier, an algorithm that adds random training, validation, accuracy, and probability estimates (Parkinson, 2012).

• A surface material map integrates spatial variability and surface materials using expert knowledge of texture, landforms, and process.

• Map evaluation used field observations and photographs, as well as completed mapping (Sharpe, 1993; Hodgson and Bednarski, 1994; Rainbird and Le Cheminant, 2002; Storrar and Stokes, 2007).

• A surface geology map resulted from automated classification integrated with landform data based on visual image analysis and field data.

Visual interpretation of imagery

Geologists use visual image analysis (cognitive skills) to interpret and develop conceptual geological models and understanding not possible with spectral RPM methods. The SPOT imagery and aerial photographs were interpreted visually with the aid of field observations and ground photographs. Interpretation captured important landforms and terrain types that spectral analysis alone was not able to reliably map.

Description of the final legend

The legend integrates machine RPM and cognitive map units. Six spectral geological units (bedrock, sand and gravel, thin till, thick till, colluvial, and shallow marine deposits) were interpreted during RPM mapping. Spectral mapping distinguished light (carbonate) from dark (Precambrian bedrock) supported by bedrock mapping (Rainbird and LeCheminant, 2002). Glacial sediment, the most prominent unit across the region, was subdivided into veneer, blanket, hummocky, and streamlined units based on surface geomorphic and terrain expression. Sand and gravel was subdivided into eolian, alluvial, or glaciofluvial units based on blanket, modern and/or relict valley, or terrace

interpreted terrain associations. Marine deposits were subdivided into glaciomarine veneer and modern marine sediment based on landforms, elevation, and geographic extent. Colluvial deposits were mapped spectrally in association with hummocky terrain, and glaciolacustrine deposits were separated from these in association with high water-plane indicators. Additional information and interpretation is available as a supplemental report.

Geological summary

Complex flow patterns mark this glacial terrain with five or six streamlined flow patterns. Significant east to west and north to south flow occurred around central uplands with thick sediment or ice-cored terrain. East-west flow sets show bedrock scoured areas around streamlined ridges. Marine and lacustrine limits (~120–160 m a.s.l.) surround central and western uplands. Extensive glaciofluvial sediments highlight the highest western marine and/or lacustrine limits; some are subglacial, some proglacial. The north-south streamlined set contains a 20–25 km wide zone of distinctive (longitudinal), sinuous till ridges.

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Deblonde, C., Cocking, R.B., Kerr, D.E., Campbell, J.E., Eagles, S., Everett, D., Huntley, D.H., Inglis, E., Parent, M., Plouffe, A., Robertson, L., Smith, I.R., and Weatherston, A., 2017. Surficial Data Model, version 2.3.0: revisions to the science language of the integrated Geological Survey of Canada data model for surficial geology maps; Geological Survey of Canada, Open File 8236, 1 .zip file. https://doi.org/10.4095/302717

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Sharpe, D.R., 1993. Surficial geology, Cambridge Bay, District of Franklin, Northwest Territories; Geological Survey of Canada, Map 1825A, scale 1:250 000. https://doi.org/10.4095/184168

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Additional Information

The Additional Information folder of this product's digital download contains figures and tables that appear in the map surround as well as additional geological information not depicted on the map, nor this document, nor the geodatabase.

- PDF(s) of figures/tables that do not appear in the CGM surround
- Additional field photographs (catalogued) and descriptions
- Supplemental notes and appendix

Author Contact

Questions, suggestions, and comments regarding the geological information contained in the data sets should be addressed to:

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Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 13
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 110°00'00"W
Eastern longitude: 104°00'00"W
Northern latitude: 71°00'00"N
Southern latitude: 70°00'00"N

Software Version

Data has been originally compiled and formatted for use with ArcGIS™ desktop version 10.2.2 developed by ESRI®.

Data Model Information

Surficial

The Geological Survey of Canada (GSC) through the Geo-mapping for Energy and Minerals Program (GEM) has undertaken the Geological Map Flow to develop protocols for the collection, management (compilation, interpretation), and dissemination of surficial and bedrock geology data and map information. To this end, a data model has been created.

The Surficial Data Model (SDM) was designed using ESRI geodatabase architecture. The XML workspace document provided can be imported into a geodatabase, and the geodatabase will then be populated with the feature datasets, feature classes, tables, relationship classes, subtypes, and domains.

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SHEET 2 OF 2, PREDICTIVE SURFICIAL GEOLOGY (VECTOR)

GENERAL INFORMATION

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Descriptive Notes

The predictive surficial geology raster-based remote predictive mapping (RPM) map was generalized in order to conform to cartographic standards for a 1:250 000 vector-based surficial geology map sheet, based on the Surficial Data Model (SDM), v 2.3 (Deblonde et al., 2017). Linking this new mapping to the standard SDM in vector format facilitates the in-filling of designated unmapped areas and co-ordinating the new mapping to previously mapped adjoining areas. The common science language and common legend is to enable and facilitate the efficient digital compilation, interpretation, management, and dissemination of geological map information in a structured and consistent manner. This provides an effective knowledge management tool designed around a geodatabase that can expand, following the type of information to appear on new surficial geology maps.

The generalization process included four iterations of a 3X3 pixel majority filter, conversion of the data from raster to vector format and removal of polygons less than 30 000 m^2. Polygons below this minimum size threshold were replaced with the neighbouring classes using the expand tool in ArcGIS.

Special treatment was given to predicted bedrock in regions and outcrops to maintain the spatial distribution of small discrete outcrops without overloading the map sheet with bedrock clusters. Predicted bedrock polygons smaller than 15 000 m^2 were removed, and the ones between 15 000 m^2 and 30 000 m^2 were converted to points (“x” symbol) using the centroid command in ArcGIS. The outline of the polygon was also smoothed by 150 m using the smooth line command in ArcGIS.

It is customary over the last few years for the Geological Survey of Canada to include any relevant legacy data in new vector-based predictive surficial geology maps that cover unmapped areas. The reason is because these predictive surficial geology

maps are meant to represent our best summary of knowledge over large areas where traditional systematic mapping has not been done. Some of these additional features, many being field observations, include striations (Fyles, 1963; Rainbird and LeCheminant, 2002); drumlinoid and crag-and-tail features (Fyles, 1963); and major moraine ridges (Fyles, 1963). The corresponding geodatabase for this map is also included in this publication.

Widespread glaciofluvial erosional features and sediments, and subsequent glaciolacustrine and glaciomarine inundation, are superimposed on the landscape. Complex ice flow patterns mark the glacial terrain with five or six streamlined landform flow patterns, several showing crosscutting relationships. Significant westward and southward flow occurred around central uplands with thick sediment or ice-cored hummocky terrain. Some of these terrain features may indicate an erosional origin for drumlinoid features. Glaciomarine and glaciolacustrine limits of submergence (130–100 m a.s.l.) surround the central and western hummocky uplands. Large subglacial and proglacial glaciofluvial sand and gravel deposits highlight the highest western limits. The north-south streamlined set in the central map area contains 3–15 km wide zones of distinctive (longitudinal) sinuous ridges. The central sediment zone is truncated by a large northwesterly flowing river southeast of Namaycush Lake, exposing thick sandy sediment that has been transported 20–25 km to the southeast as an eolian veneer tens of centimetres thick.

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Deblonde, C., Cocking, R.B., Kerr, D.E., Campbell, J.E., Eagles, S., Everett, D., Huntley, D.H., Inglis, E., Parent, M., Plouffe, A., Robertson, L., Smith, I.R., and Weatherston, A., 2017. Surficial Data Model, version 2.3.0: revisions to the science language of the integrated Geological Survey of Canada data model for surficial geology maps; Geological Survey of Canada, Open File 8236, 1 .zip file. https://doi.org/10.4095/302717

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