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# CANADIAN GEOSCIENCE MAP 443

## SURFICIAL GEOLOGY

# SULPHUR BAY

Western Great Slave Lake, Northwest Territories
NTS 85-G

## Map Information Document

## Geological Survey of Canada
## Canadian Geoscience Maps

2022

Canada

## MAP NUMBER

Natural Resources Canada, Geological Survey of Canada
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## TITLE

Surficial geology, Sulphur Bay, Western Great Slave Lake, Northwest Territories, NTS 85-G

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## ABSTRACT

The Sulphur Bay map sheet is a low-relief terrain underlain by lower- to middle-Devonian dolostone and limestone. A thin (<4 m thick) Laurentide Ice Sheet-derived glacial sediment cover drapes most of the landscape, except for bedrock outcrops exposed near Great Slave Lake. Relict glacial landforms record an older northwest ice flow across the region. These are strongly overprinted by subsequent west-southwest-oriented flutings and mega-scale glacial lineations formed during deglaciation. As ice retreated, the entire map area became inundated by glacial Lake McConnell and then subsequently by the expanded postglacial Great Slave Lake. This produced a discontinuous, coarse winnowed surface lag over higher terrain and thin sheets of glaciolacustrine nearshore sands over lower-lying regions. Abundant iceberg furrows occur throughout the map area. Bogs and fens have formed over much of the landscape and display extensive thermokarst.

## RÉSUMÉ

La région cartographique de Sulphur Bay présente un terrain peu accidenté au sous-sol formé de dolomie et de calcaire du Dévonien inférieur et moyen. Une mince couche (<4 m d'épaisseur) de sédiments glaciaires associés à l'Inlandsis laurentidien recouvre la majeure partie du paysage, à l'exception d'affleurements rocheux situés à proximité du Grand lac des Esclaves. Des reliefs glaciaires reliques témoignent d'un écoulement glaciaire plus ancien de direction nord-ouest dans l'ensemble de la région. Des cannelures et des linéations glaciaires à grande échelle de direction sud-ouest, formées ultérieurement lors de la déglaciation, se superposent à ces reliefs de façon très marquée. Au fur et à mesure du retrait glaciaire, l'ensemble de la région cartographique a été ennoyée par le Lac glaciaire McConnell, puis subséquemment par la phase postglaciaire étendue du Grand lac des Esclaves. Cet ennoyage a entraîné la formation par vannage d'un résidu de déflation grossier qui s'étend de manière discontinue aux terrains plus élevés et déposé de minces nappes de sables littoraux glaciolacustres dans les régions plus basses. De nombreux sillons résultant d'un affouillement par des icebergs parsèment l'ensemble de la région cartographique. Des tourbières ombrotrophes et minérotrophes se sont formées dans la majeure partie du paysage, lequel présente une abondance de formes thermokarstiques.

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## SHEET 1 OF 1, SURFICIAL GEOLOGY

### GENERAL INFORMATION

Authors: R.C. Paulen and I.R. Smith

Geology based on fieldwork (2018), air photographs (1970 and 1971; 1:60 000), and ArcticDEM (v.7) imagery (Porter et al., 2018)

Geology and geological compilation by R.C. Paulen, 2018

Geological data conforms to Surficial Data Model v. 2.4.0 (Deblonde et al., 2019)

Geomatics by L. Robertson

Cartography by E. Wieleba and N. Côté

Scientific editing by L. Ewert

Initiative of the Geological Survey of Canada, conducted under the auspices of the GEM-2 Southern Mackenzie Surficial Project as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) program

Logistical support provided by the Polar Continental Shelf Program (PCSP) as part of its mandate to promote scientific research in the Canadian north, PCSP 058-18

Map projection Universal Transverse Mercator, zone 11
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

Mean magnetic declination 2022, 16°18′E, decreasing 8.8′ annually
Readings vary from 16°52′E in the NW corner to 15°43′E in the SE corner of the map.

This map is not to be used for navigational purposes.

Title photograph: A thick exposure of till at Moraine Point, on the western shore of Great Slave Lake, Northwest Territories, (lat. 61°35’52.77”N long.115°37’51.04”W). Photograph by R.C. Paulen. NRCan photo 2020-861

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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/).

### *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:

- Terrace scarp
- Iceberg scour
- Minor meltwater channel
- Moraine ridge
- Esker ridge
- Buried drumlinoid ridge
- Drumlinoid ridge
- Crag-and-tail ridge

### *Descriptive Notes*

The Sulphur Bay (NTS 85G) map area is located along the western margin of Great Slave Lake extending from the entrance of the North Arm south towards the outlet of the Mackenzie River. The region is characterized by low relief, subdued glacial features, and abundant bog and fen. The map area is situated within the sporadic discontinuous permafrost zone (Heginbottom et al., 1995) and thermokarst terrain in areas of bog and fen is extensive. Topography is largely controlled by flat-lying to gently westward-inclined Lower and Middle Devonian carbonate platform bedrock (Okulitch, 2006). In the northern portion of the map, the unconformity between Paleozoic strata and the Precambrian Canadian Shield occurs about 10 km offshore (under Great Slave Lake). Outcrops of Lower Devonian argillaceous rocks (Mirage Point Formation) to Middle Devonian Elk Point Group are exposed where the glacial sediment cover was eroded and removed by glacial Lake McConnell. Karst morphology, including prominent sinkholes, is common, and most frequently occurs in areas underlain by the Middle Devonian Lonely Bay Formation.

Glacial flow history is reflected by different sets of streamlined glacial landforms. In the southern part of the map area, relict bedrock sculpting by earlier northwest flowing ice is preserved. An older regional northwest flow was also documented south of the map area at Pine Point (Oviatt et al., 2015; McClenaghan et al., 2018). The land area in the map is predominantly overprinted by southwestward-trending streamlined glacial landforms, which in some areas have the characteristic high elongation ratios of mega-scale glacial lineations (MSGLs), indicative of ice streaming. These landforms are commonly less than 15 m wide, but often extend for several kilometres down flow. A thick (>20 m) stack of thrusted carbonate till, commonly with steeply dipping clasts, formed at Moraine Point. This unusual landform likely is the product of intense abrasion of softer Paleozoic rocks by an abrading ice stream with Canadian Shield subglacial debris, as has also been observed along Paleozoic-Shield boundary zones elsewhere in Canada (Bukhari et al., 2021). This late southwest ice flow has also been documented around Yellowknife (Kerr, 2006) and in the upper Mackenzie River valley (Paulen et al., 2019a).

During deglaciation, ice in the isostatically-depressed Great Slave Lake basin retreated in contact with a large proglacial lake, that eventually merged with basins north and south of this map area to form glacial Lake McConnell (Craig, 1965; Lemmen et al., 1994; Smith, 1994). Successive, sometimes discontinuous, flights of prominent (<2 m high) subparallel beach ridges, comprising open-framework pebbles and cobbles in a sand matrix and discontinuous, thin (<2 m) sandy nearshore lake sediments, document the regression of glacial Lake McConnell and its later proto-Great Slave Lake extents, well into the Holocene. Elsewhere, till was winnowed to produce discontinuous, thin (<0.5 m), cobble and boulder surface lags. Icebergs calved from the retreating ice margin created abundant southeast-northwest-trending iceberg scours at lower elevations. During the Holocene, glacioisostatic uplift resulted in the continuous decanting of glacial Lake McConnell down the Mackenzie River. Beach ridges transitioned from larger berms (<2 m) at higher elevations, originally deposited by katabatic wind-driven waves, into numerous smaller berms (<1 m) formed during the regression of proto-Great Slave Lake as the postglacial isostatic uplift continued (O'Neill et al., 2019).

Elevated water tables, formed due to flat and relatively impermeable bedrock and till cover at surface, have caused extensive bogs and fens to develop. The map area lies within the discontinuous permafrost zone (Heginbottom et al., 1995) and thermokarst ponds have formed over much of the bog-covered map area.

Till samples were collected at eight sites for kimberlite indicator minerals (KIMs), magmatic and massive sulphide minerals (MMSIM), and matrix analyses (Paulen et al., 2019b). Sample and chemistry results indicate elevated counts of KIMs that are most similar to the Drybones Bay and Mud Lake kimberlites, >50 km to the northeast on the eastern shore of Great Slave Lake (Smith et al., 2021). At Gypsum Point, a beautiful composite pyrope-chrome diopside grain was recovered from an argillaceous-rich till sample (sample 18-PTA-011; Fig. 1).

Finally, no attempts were made to "edge-match" surficial geology polygons along the northern boundary of this map sheet with the adjoining Yellowknife and Hearne Lake remote predictive surficial map (CGM 200; Stevens et al., 2017). These remote predictive surficial geology maps are constructed largely from mixed manual and automated interpretations of LANDSAT data, and are typically uninformed by aerial photograph interpretation, and have no or very limited ground truthing. We consider our field- and aerial photograph-based interpretations to be a more accurate representation of the regional surficial geology.

## ACKNOWLEDGMENTS

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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 of figure 1

## Author Contact

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## Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 11
Horizontal Datum: NAD83
Vertical Datum: mean sea level

## Bounding Coordinates

Western longitude: 116°00′00″W
Eastern longitude: 114°00′00″W
Northern latitude: 62°00′00″N
Southern latitude: 61°00′00″N

## Software Version

Data has been originally compiled and formatted for use with ArcGIS™ desktop version 10.7.1 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.

Shapefile and table (.dbf) versions of the data are included within the data. Column names have been simplified and the text values have been maintained within the shapefile attributes. The direction columns are numerical, to display rotation for points, and the symbol fields will hold the correct values to be matched to the appropriate style file.

For a more in depth description of the data model please refer to the official publication:

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., 2019. Surficial Data Model: the science language of the integrated Geological Survey of Canada data model for surficial geology maps; Geological Survey of Canada, Open File 8236, ver. 2.4.0, 1 .zip file. https://doi.org/10.4095/315021