# Descriptive Notes

The map area is located in southern Northwest Territories and includes the town of Enterprise, situated along Highway 1. The region is characterized by low relief that reflects the underlying gently southwest-dipping Devonian carbonate platform (Okulitch, 2006). A prominent southeast-northwest-aligned bedrock escarpment of Upper Devonian Twin Falls Formation limestone bisects the map area, and is paralleled by Highway 1. Exposed bedrock and thin sediment veneer (less than 2 m) characterize the surface immediately south of the escarpment edge.

Erosional ice-flow indicators (striae, grooves, p-forms) from 20 different sites on exposed bedrock show a clockwise rotation in ice flow during the last glaciation. The oldest flow trends southwest (230°) followed by an intermediary westward (280°) flow. During deglaciation, ice became increasingly topographically controlled, and is recorded by a northwestward flow (305°) down the Mackenzie River valley (Bednarski, 2008; Hagedorn et al., 2019; Paulen et al., 2019). A final southwestward surge of glacial ice out of the Great Slave Lake basin created drumlinoid ridges (220°) on the lowlands north of the escarpment. Till and other glacial sediments (greater than 10 m) blanket most of the terrain, but sediment cover north of the escarpment is greater, reaching up to 50 m thick (Smith et al., 2019). Surface till typically has a 1:3 sand to silt-and-clay ratio with 15 weight percent clasts of mainly local bedrock lithologies with some far-travelled Canadian Shield clasts.

During deglaciation, the retreating Laurentide Ice Sheet blocked regional northeastern drainage, forcing glacial meltwater to drain westward along the ice margin. As the ice margin retreated from the Mackenzie and Hay River valleys, new outlets opened, allowing drainage northwestward, like from glacial Lake Hay to the south (Mathews, 1980; Utting and Atkinson, 2019). Glaciofluvial sediments up to 5 m thick in the southwest portion of the map area record subaerial drainage at this time.

As ice continued to retreat, a series of proglacial lakes developed along the ice margin, recorded by successive outlet channels, beach ridges, and discontinuous glaciolacustrine sediment cover. Eventually, glacial Lake McConnell formed in the isostatically depressed Great Slave Lake basin, inundating much of the northern part of the map sheet (Craig, 1965; Lemmen et al., 1994; Smith, 1994). Glacial Lake McConnell's extent and progressive drainage are marked by flights of prominent subparallel ridges (<2 m high) composed of open-framework pebbles and cobbles in a sand matrix and discontinuous, thin (<1 m) sandy nearshore lake sediments. Elsewhere, till was washed, producing thin (<0.5 m) boulder and cobble lags. Calving of the ice margin into proglacial lakes created northwest-southeast trending iceberg scours. The subaqueous Snake Creek Moraine was deposited in glacial Lake McConnell during a prominent glacial still-stand and is approximately 150 km long, trending northwest-southeast (Lemmen et al., 1994). It is mapped as a moraine complex, with individual discontinuous ridges up to 4 m high and complexes of ridges up to 1.5 km wide (Fig. 1). The moraine complex also includes subaquatic fans deposited where southwestward-flowing subglacial meltwater conduits (often marked by eskers) terminated in glacial Lake McConnell. Glacialfluvial fans and eskers are potential exploration targets for granular resources, but were not inspected during fieldwork.

Eolian, alluvial, and organic sediments represent late to post-glacial changes to the landscape. Eolian dunes were deposited from westward katabatic winds and are composed of remobilized, sandy, glaciolacustine and glaciofluvial sediments. Dunes show parabolic and transverse morphologies and are typically 3 m thick, 25 m long, and 50 m wide. Alluvial sediments are primarily associated with the Hay River that has deeply incised bedrock creating terraces and colluvial deposits along the river channel. Elevated water tables formed due to flat and relatively impermeable till at surface, and 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.

## Acknowledgments

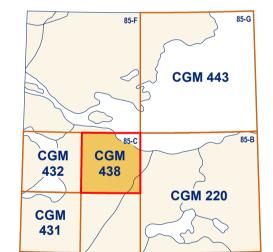
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### Suggested Readings

Paulen, R.C., Smith, I.R., and Day, S.J.A. (ed.), 2019. GEM-2 Southern Mackenzie Surficial activity 2018 report: surficial geology and heavy mineral studies in southern Northwest Territories; Geological Survey of Canada, Open File 8477, 70 p. https://doi.org/10.4095/313419

The Enterprise map area is a low-relief terrain bisected by a prominent Devonian carbonate bedrock escarpment. Ice-flow indicators show a clockwise shift in Laurentide Ice Sheet flow from southwest (230°), to west (280°), to northwest (305°). A late-stage southwestward surge from the Great Slave Lake basin is also preserved as drumlinoid ridges below the escarpment. During deglaciation, ice retreat impounded northeastern drainage forming local ice-contact lakes and areas of subaerial glaciofluvial outwash. As ice continued to retreat, the northern portion of the map area became inundated by glacial Lake McConnell, within which the Snake Creek Moraine and associated subaqueous fans formed. Prominent flights of beach ridges record the drainage of this lake. Exposed nearshore and littoral lake sediments were subsequently remobilized into eolian dunes. Bogs and fens have formed over much of the low relief landscape and display extensive thermokarst.

La région cartographique d'Enterprise présente un terrain au faible relief sectionné par un escarpement saillant formé de roches carbonatées du Dévonien. Les indicateurs d'écoulement glaciaire témoignent d'un changement de direction dans le sens horaire de l'écoulement de l'Inlandsis laurentidien, passant du sud-ouest (230°) à l'ouest (280°), puis au nord-ouest (305°). Une crue glaciaire de stade tardif en direction du sud-ouest, en provenance du bassin du Grand lac des Esclaves, a aussi laissé des traces au pied de l'escarpement sous forme de cannelures. Lors de la déglaciation, le retrait glaciaire a bloqué l'écoulement des eaux vers le nord-est, causant ainsi la formation de lacs juxtaglaciaires et de zones d'épandage fluvioglaciaires subaériennes. Alors que le retrait glaciaire se poursuivait. la partie nord de la région cartographique a été inondée par le Lac glaciaire McConnell, à l'intérieur duquel se sont formés la moraine de Snake Creek ainsi que des cônes subaquatiques. Des séries de crêtes de plage saillantes émoignent de la vidange de ce lac. Les sédiment exposés des zones infralittorales et littorales du lac ont ensuite été remobilisés en dunes éoliennes. Des tourbières ombrotrophes et minérotrophes se sont formées dans la majeure partie de ce paysage au faible relief, lequel est riche en thermokarsts.



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

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Natural Resources Ressources naturelles

**CANADIAN GEOSCIENCE MAP 438 SURFICIAL GEOLOGY** 

**ENTERPRISE** Northwest Territories



50' 502000 m E. 04 06 08 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 552000 m E.  $G \ R \ E \ A \ T \qquad S \ L \ A \ V \ E \qquad L \ A \ K \ E$ Pointe de Roche

# POST LAST GLACIATION

NONGLACIAL ENVIRONMENT **ORGANIC DEPOSITS:** peat and muck; formed by the accumulation of plant materials in various stages of decomposition; occurs as low-relief, wet terrain over poorly drained substrates; average 1 to 3 m thick, and locally up to 9 m

Fen deposits: semi-open peatlands derived from sedges and partially decayed shrubs in a eutrophic environment; mineral-rich water table persists seasonally at surface; commonly with ribbed patterns transverse to drainage; generally covered with low shrubs and sporadic trees.

Bog deposits: Sphagnum or forest peat formed in an ombrotrophic environment; water table close to surface; may be tree-less or sparsely treed

Undifferentiated deposits: undifferentiated bog and fen deposits; associated with isolated patches of organic-material accumulation and transition zones between bog and fen.

NONGLACIAL AND PROGLACIAL ENVIRONMENTS **EOLIAN SEDIMENTS:** medium to fine sand; wind-deposited; sediments derived from glaciofluvial and glaciolacustrine sources; well sorted; typically

**Dunes:** parabolic and transverse morphologies; >2 m thick; eolian sediments in areas between dunes may be thin or absent.

COLLUVIAL DEPOSITS: diamicton and rock debris formed by direct, gravityinduced movement; composition dependent on source material; poorly sorted massive to stratified; variable thickness.

Undifferentiated sediments: isolated patches, or interdune areas; variable

**Veneer:** undifferentiated colluvial deposits; <2 m thick.

**Blanket:** undifferentiated colluvial deposits; >2 m thick. ALLUVIAL SEDIMENTS: gravel, sand, silt, and organic detritus deposited by

flowing water; sorted; commonly stratified; variable thickness. Floodplain sediments: deposited in active floodplains close to river level; includes meander channels, scroll bars, and oxbow lakes; low relief; sorted;

Fan sediments: fan-shaped morphology; may show migrating stream incisions across surface; poorly sorted; >1 m thick.

sharp successive scarps defining different terrace levels; sorted; >2 m thick. Undifferentiated sediments: undifferentiated fluvial deposits; variable

Terrace sediments: inactive terraces above modern floodplain; may exhibit

LACUSTRINE SEDIMENTS: gravel, sand, silt, and clay, sometimes intermixed with organic detritus; deposited around modern lake basins during former or recent fluctuations in lake level; variable thickness.

Beach sediments: pebble gravels, sand, and silt; ridges often prominent on eastern lake margins as ice-push ramparts; weakly stratified; <2 m thick. Littoral and nearshore sediments: sand and silt and minor clay; often infills regions between beach ridges in close proximity to Great Slave Lake; low

Undifferentiated sediments: undifferentiated lacustrine sediments;

relief; moderately sorted; <2 m thick.

## POSTGLACIAL OR LATE WISCONSIN

PROGLACIAL AND GLACIAL ENVIRONMENTS GLACIOLACUSTRINE SEDIMENTS: gravel, sand, silt, and clay deposited in proglacial lakes along the margin of the retreating Laurentide Ice Sheet; often overlain by organic deposits in low-lying regions; massive to poorly stratified;

Beach sediments: cobble-gravel to sand ridges; formed along the margins of proglacial lakes; low relief (<2 m) ridges can be traced hundreds of metres progressive outlet incision and isostatic-rebound-controlled drainage of proglacial lakes; poor to moderately sorted; weakly stratified and open

> Littoral and nearshore sediments: sand, silt, and minor clay; often infills regions between beach ridges; low relief; moderately sorted; <2 m thick. GLACIOFLUVIAL SEDIMENTS: gravel, sand, and minor silt deposited by glacial meltwater from, or in contact with, glacial ice in a subglacial or subaerial

setting; channels may incise till and/or bedrock; locally winnowed where inundated by proglacial lakes; poorly to well stratified; variable thickness. Outwash plain sediments: low-relief deposit often found adjacent to glacial meltwater channels; moderately sorted; massive to crudely stratified;

Terrace sediments: terraces formed along former glaciofluvial floodplain; flat topped; moderately to well sorted; >2 m thick. Outwash-fan sediments: fan-shaped morphology; moderately sorted;

sediments fine toward distal edge; >2 m thick; GFf2, subaqueous groundingline fan deposited at, or immediately distal to, submerged glacier margin; often forms at the distal end of esker channels where they terminated in a proglacial lake; variable thickness.

**Ice-contact sediments:** sand and gravel with minor diamictons; poorly sorted; hummocky surface topography; >2 m thick.

Kame terrace: sand and gravel; well to moderately sorted; forming flat-topped terraces and isolated hills deposited by meltwater flowing between the ice sheet and topography or into an embayment within the ice; up to 8 m thick. **Esker:** gravel and sand; well sorted; massive to cross-stratified; linear to sinuous ridges; typically discontinuous short segments of larger subglacial fluvial corridors; up to 5 m high.

**Veneer:** discontinuous veneer; often associated with bedrock highs; <2 m

Undifferentiated sediments: undifferentiated glaciofluvial sediments; TILL DEPOSITS: diamictons deposited directly by the Laurentide Ice Sheet;

sandy-silt to clayey-silt matrix; 5 to 15% clast content, derived from Canadian Shield and local Palaeozoic lithologies with rare Cordilleran pebbles; up to 50 m thick; winnowed in areas of former proglacial lake inundation producing a thin (<0.5 m) discontinuous, open-work, cobble-boulder lag. Moraine complex: discontinuous moraine ridges associated with an ice standstill; extensively reworked by glacial Lake McConnell; ≤4 m thick; Tm2, subaqueous grounding-line moraine ridges of the Snake Creek Moraine deposited at the glacial margin in a proglacial lake; extensively reworked by

glacial Lake McConnell; ≤4 m thick. Ridged till: short moraine ridges associated with thrusting from surging ice and crevasse-fill ridges; ≤5 m high.

Streamlined till: associated with large, parallel ice-flow landforms including flutings and drumlins; variable thickness.

Veneer: discontinuous veneer such that underlying bedrock topography and outcrops are discernible; <2 m thick.

**Blanket:** continuous till cover with undulating relief, >2 m thick.

# PRE-QUATERNARY

**BEDROCK, PALEOZOIC** Indifferentiated sedimentary bedrock: platform Devonian carbonate and ine-grained (shale, siltstone, mudstone) sedimentary strata; exposed along prominent carbonate platforms and scarps south of Great Slave Lake and in ncised areas of the Hay River valley.

Geological contact, defined

Areas of widespread, often small individual thermokarst pond development

Winnowed sediments, gravel and sand, and local cobble lag deposits; sorted;

Terrace scarp Beach crest

⊢ Iceberg scour Minor meltwater channel:

Direction known Major meltwater channel scarp, direction known

+++++++ Direction unknown

◆ ◆ ◆ ◆ • Major

Esker ridge: <><><><> Direction unknown

>>>>>> Direction known ---- Drumlinoid ridge

Ice-flow direction unknown Ice-flow direction known

Crossed, 1= older, 2 = younger Small outcrop

Station location (ground observation)

Till sample location

Figure 1. At left, a hillshade ArcticDEM image (Porter et al., 2018) of a central portion of the map area with simplified sufficial geology, and at right, a panchromatic true-colour Landsat8 image (courtesy of the USGS) of the same area. The prominent bedrock escarpment runs down the middle of the images and the trace of Highway 1 can be seen running across it. A meltwater channel flowing west-northwest cuts the escarpment. To the east below the escarpment the Snake Creek Moraine ridges are typically higher relief, treed features. These moraines are subdued in areas where they have been more intensely reworked by glacial Lake McConnell shorelines. Glacial Lake McConnell shorelines show an eastward stepwise retreat of water levels. Organic terrain (bogs and fens) are found in flatter areas between

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https://doi.org/10.4095/328292

**Geological Survey of Canada Canadian Geoscience Maps** 

Authors: G.W. Hagedorn, I.R. Smith, R.C. Paulen Geology by G.W. Hagedorn, I.R. Smith, and R.C. Paulen, based on fieldwork (2017 and 2018), air photographs (1970 and 1971; 1:60 000), and ArcticDEM (v.7) imagery. Geological compilation by G.W. Hagedorn Geology conforms to Surficial Data Model v. 2.4.0 (Deblonde et al., 2019).

Geomatics by L. Robertson

Cartography by N. Côté Scientific editing by A. Weatherston 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 057-17 and 058-18

**SURFICIAL GEOLOGY ENTERPRISE** Northwest Territories 1:100 000

**CANADIAN GEOSCIENCE MAP 438** 

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°52'E, decreasing 8.9' Readings vary from 17°08'E in the NW corner to 16°37'E in the SE corner of the map.

This map is not to be used for navigational purposes.

Title photograph: Section of the Snake Creek Moraine and glacial Lake McConnell beach ridges, northwest of Enterprise, Northwest Territories (lat. 60°36'48.79"N, long. 116°11'34.33"W). Photograph by G.W. Hagedorn. NRCan photo 2019-680 The Geological Survey of Canada welcomes corrections or

Data may include additional observations not portrayed on this map. See map info document accompanying the downloaded This publication is available for free download through

data for more information about this publication.

GEOSCAN (https://geoscan.nrcan.gc.ca/).

**CANADIAN GEOSCIENCE MAP 438** SURFICIAL GEOLOGY **ENTERPRISE** Northwest Territories

NTS 85-C/9, 10, 15, and 16

117°00'