Descriptive Notes

This map area is situated in southern Northwest Territories, in a flat to gently rolling Taiga Plains region north of the Mackenzie River, west of Great Slave Lake, and southeast of the Horn Plateau Cretaceous bedrock upland (Fig. 1). The surficial geology is characterized by till (36.9%), organic deposits (29.9%; subdivided as 21.0% bog and 8.9% fen), and glaciolacustrine deposits (19.6%), with lesser amounts of lacustrine deposits (6.4%), glaciofluvial (2.1%) and eolian (0.4%) materials. The area is situated within the sporadic discontinuous permafrost zone (Heginbottom et al., 1995). Peat plateau (Owb1; areas of bog uplifted by ice growth below organic/minerogenic surface materials) constitute 1.4% of the map area – far less than regions mapped south of Mackenzie River (e.g. Smith et al., 2021, 2023). Thermokarst terrain (melting of ice-rich permafrost) within areas of bog and fen is also less extensive (2.2%) than in map areas to the south.

The map area was fully glaciated by the Laurentide Ice Sheet (LIS) during the Late Wisconsinan. It is distinguished by a prominent ribbed-moraine field bordering the Horn River that is approximately 65 km wide (east-west) and 75 km north-south, extending west, north, and east of the current map area (Fig. 1). Its southern margin has been eroded and truncated by prominent shorelines and lacustrine sediments related to glacial Lake McConnell, and the subsequent proto–Great Slave Lake. The ribbed-moraine features appear to relate to the interplay between an initial south-southwest-directed ice flow that produced a series of ice-thrust ridges spaced 2 to 6 km apart, and subsequent westward-flowing ice that deformed and eroded these thrust-ridges. Individual ribs are most prominently aligned approximately 210°–200°, spaced 1.2 to 2.0 km apart (crest to crest), and are 0.6 to 1.0 km in width, and 5 to 10 m high. Actual height and widths are unknown, as intervening swales are infilled, in part, by glacial lake sediments and extensive bog and fen deposits. The ribs are highly segmented with north-south lengths ranging from 0.5 to 12 km. There is only one exposed section within the ribs. It occurs along a short reach of the Horn River, where up to 5 m of massive, over-compacted, angular blocks of diamicton are found, indicating glaciotectonic reworking. The ribbed-moraine field is situated down-flow (west) of an extensive area of thin drift (<2 m) and scoured Devonian shale and limestone bedrock exposed along the western margin of Great Slave Lake (Paulen and Smith, 2022; Smith et al., 2022). Based on petroleum-well cutting records (n=5) and seismic-shothole drillers' logs (n=566), drift thicknesses are greatest in its eastern and central region (45 to 61 m), and thin in areas west of Horn River (6 to 30 m; Smith et al., 2022). Flowsets of glacially streamlined landforms, including drumlins, drumlinoid ridges, and flutings, oriented ~248°, obliquely crosscut the ribbed-moraine ridges in the eastern extents of the map area (Fig. 1), but are not considered to correlate with actual rib formation. They appear to have more intensely reworked ribs to the east, and may account for a trend of clockwise rotation/deformation of the southern parts of individual ribs seen in the south half of the map area. Clusters of crevasse-squeeze ridges within the central area of the flowsets suggest the streamlined landforms in the east portion of the map area were created by ice streams (e.g. Evans et al., 2016).

During deglaciation, ice retreated northeastward in alignment with the Great Slave Lake trough. Glacial Lake McConnell progressively inundated the map area in step with the retreating ice margin (maximum surface elevation in the map area is ~215 m above sea level (a.s.l.)). A faint northwest-southeast-aligned fabric (most visible on air photographs) of subparallel De Geer moraines throughout the map area indicates that the LIS was grounded as it retreated through this area. The De Geer moraines onlap all glacial and deglacial landforms, including moraine ribs, drumlins, drumlinoid ridges, flutings, and eskers (Fig. 2). They are generally not, however, formed atop subaquatic fans, as would be expected, except where such features must have retrograded eastward below the ice margin, or where re-advances of the ice margin took place. Discernible De Geer moraine segments range from 200 m to 3 km in length, generally <0.5 m to at most 2 m high, and spaced 50 to 200 m apart. There are approximately 250 marginal positions recorded by the De Geer moraines marking the northeast retreat of ice across the map area. These are not, however, considered annual positions, as De Geer moraines have been demonstrated to form sub-annually (Rivers et al., 2023).

It is difficult to distinguish the progressive decanting of glacial Lake McConnell and the point at which the postglacial proto–Great Slave Lake formed (marking the separation of expanded lakes in the Great Bear and Great Slave lakes basins; Lemmen et al., 1994), and so the distinction between glaciolacustrine (glacial Lake McConnell) and lacustrine proto–Great Slave Lake and modern) map units is provisional. In the southwest corner of the map area, a prominent delta (135 m a.s.l.) formed at what was then the mouth of the Horn River and some stage of proto–Great Slave Lake (Fig. 1). Cuttings from the J-03 petroleum well within the Horn River paleodelta immediately southwest of this map (Fig. 1) reveal 155.4 m of unconsolidated material infilling what was a larger proto–Mills Lake basin. Finer and more rounded lithic material in the upper 30 m of the cuttings is considered to relate to the delta form itself. Coarser, more angular material situated below this is typical of well cuttings from the regional Laurentide till, containing both abundant local bedrock (limestone, shale, sandstone) and significant quantities of igneous and metamorphic material derived from the Canadian Shield to the east. The volume of sediment comprising this paleodelta appears incongruous to the sediment-load of the modern river that flows largely through a flat to low-lying till-covered terrain. As the LIS had already retreated from the Horn River basin when this paleodelta was forming, as evidenced by the De Geer moraines, it is suggested that the increased sedimentation relates to the melting of a residual plateau ice cap on the adjacent Horn Plateau. The southern extent of the Horn River paleodelta is reworked by another paleodelta complex north and south of the modern Mackenzie River that record fluvial drainage of proto–Great Slave Lake into the proto–Mills Lake basin, with channel surfaces declining from 130 to 122 m a.s.l. (reflecting both differential isostatic uplift and fluvial incision).

Granular aggregate resources are quite limited in this map area. Only one large pit is known to occur — located in the prominent buried esker at the east-central margin of the map area. Small, discontinuous eskers (unit GFr) and subaquatic fans (unit GFf2) elsewhere in the map area may offer limited potential. Beach ridges, most prominently found encircling ribbed-moraine uplands (Fig. 2), are unlikely to be practical resources, as these were found to be <0.5 m thick. Indeed, the absence of extensive scoured (washed) lags, and their thin nature (generally <0.3 m) in most areas of till cover contradicts the notion that catastrophic drainage of glacial Lake Agassiz through glacial Lake McConnell was routed west down the upper Mackenzie River/glacial Lake Mackenzie basin (e.g. Smith, 1994; Couch and Eyles, 2008; Murton et al., 2010). It is suggested that drainage was instead likely routed out of the north end of glacial Lake McConnell (Great Bear Basin).

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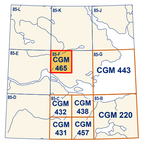
Abstract

This map encompasses flat to gently rolling terrain north of the Mackenzie River and west of Great Slave Lake. The surficial geology is largely composed of till (36.9%) and organic bog and fen deposits (29.9%), and exhibits significantly less evidence of thermokarst erosion than areas mapped to the south. The region is notable for the prominent ribbed moraine field that covers most of the map area. These were formed during the last glaciation by the Laurentide Ice sheet as a series of southward-directed glacial thrust moraines that were, in part, reworked by subsequent westward and southwestward flow. Individual ribs are aligned roughly north-south, spaced 1.2 to 2.0 km apart, 0.6 to 1.0 km in width, and 5 to 10 m high. During deglaciation, the Laurentide Ice Sheet retreated in contact with glacial Lake McConnell, which eventually inundated the entire map area. Northeastward glacial retreat is marked by a dense network of discontinuous, low amplitude De Geer moraines spaced 50 to 200 m apart.

Résumé

Cette carte comprend un terrain plat à légèrement vallonné au nord du fleuve Mackenzie et à l'ouest du Grand lac des Esclaves. La géologie des formations superficielles se compose en grande partie de till (36,9 %) et de dépôts organiques de tourbières et oligotrophes et minérotrophes (29,9 %), et présente beaucoup moins de signes d'érosion thermokarstique que les régions cartographiées au sud. La région est remarquable par le champ de moraines côtelées qui couvre la majeure partie de la région cartographique. Celles-ci ont été formées pendant la dernière glaciation par l'Inlandsis laurentidien sous la forme d'une série de moraines de poussée glaciaire dirigée vers le sud, qui ont été en partie remaniées par les écoulements ultérieurs en direction de l'ouest et du sud-ouest. Les crêtes individuelles sont alignées grossièrement nord-sud, espacées de 1,2 à 2,0 km, d'une largeur de 0,6 à 1,0 km et d'une hauteur de 5 à 10 m. Pendant la déglaciation, l'Inlandsis laurentidien s'est retiré en contact avec le Lac glaciaire McConnell, qui a fini par inonder toute la région cartographique. Le retrait glaciaire vers le nord-est est marqué par un réseau dense de moraines de De Geer discontinues et de faible amplitude, espacées de 50 à 200 m.



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

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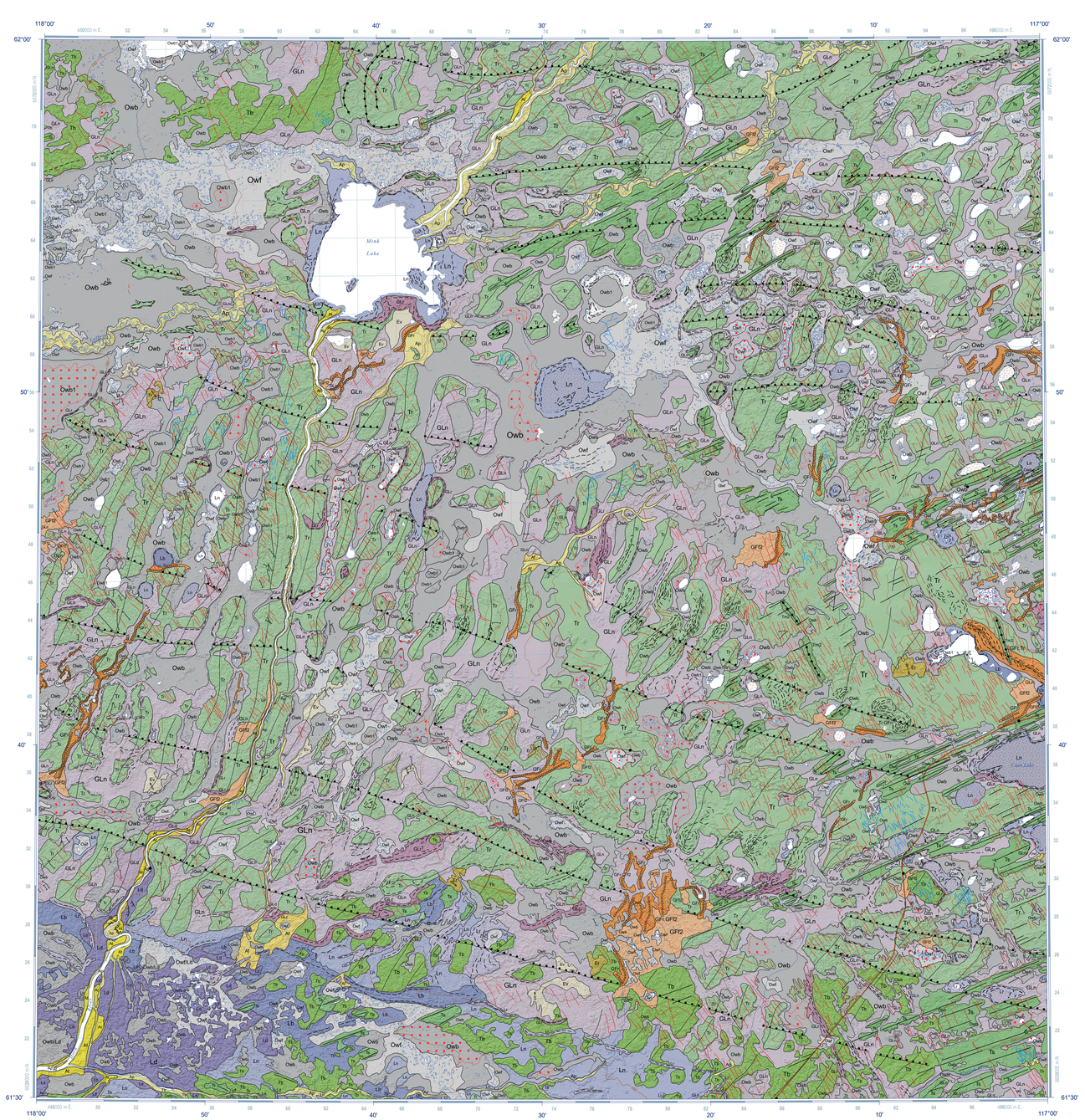
CANADIAN GEOSCIENCE MAP 465
SURFICIAL GEOLOGY
HORN RIVER
Northwest Territories
NTS 85-F/11, 12, 13, and 14
1:100 000



QUATERNARY

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 6 m thick.

Owf — **Fen:** semi-open peatlands derived from sedges and partially decayed shrubs in an eutrophic environment; mineral-rich, water table persists seasonally at surface; commonly with ribbed patterns transverse to drainage; generally covered with low shrubs and occasional trees; locally affected by permafrost conditions; may contain areas with extensive thermokarst (separatively labelled).

Owb — **Bog:** *Sphagnum* or forest peat formed in an ombrotrophic environment; water table close to surface; may be treeless or sparsely treed; may contain areas with extensive thermokarst (separately labelled); **Owb1:** raised bog; surface morphology related to growth of underlying ice, and doming of land surface; may contain areas with extensive thermokarst (separately labelled).

NONGLACIAL AND PROGLACIAL ENVIRONMENTS

EOLIAN SEDIMENTS: medium to fine sand; wind-deposited; sediments derived from glaciofluvial and glaciolacustrine sources; well sorted; typically massive.

Er — **Dune:** parabolic and linear morphologies; >2 m thick; eolian sediments in areas between dunes may be thin or absent.

Ev — **Eolian sediments, veneer:** discontinuous cover; <2 m thick.

Eb — **Eolian sediments, blanket:** continuous cover; >2 m thick.

ALLUVIAL SEDIMENTS: gravel, sand, silt, and organic detritus deposited by flowing water; sorted; commonly stratified; variable thickness.

Ap — **Floodplain:** deposited in active floodplains close to river level; includes meander channels, scroll bars, and oxbow lakes; low relief; sorted; >1 m thick.

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

At — **Terrace:** inactive terraces above modern floodplain; may exhibit sharp successive scarps defining different terrace levels; sorted; >2 m thick.

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.

Lr — **Ridged beach sediments:** pebble gravels, sand, and silt; ridges often prominent on eastern lake margins as ice-push ramparts; weakly stratified; ≤2 m high.

Ld — **Delta:** accumulation of sorted sediments at the point where a stream enters a lake; stratified; flat to gently inclined; progrades into the lake; >2 m thick.

Ln — **Littoral and nearshore sediments:** sorted gravel, sand, silt, and clay; deposited in littoral settings; exposed around modern lakes due to fluctuations in water level; <2 m thick.

Lb — **Blanket:** undifferentiated lacustrine sediments; >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; moderately sorted; average <2 m thick.

GLr — **Ridged beach sediments:** cobble gravel to sand ridges; formed along the margins of proglacial lakes; low-relief (≤2 m) ridges; poor to moderately sorted; weakly stratified and poorly framework-supported.

GLd — **Delta:** raised delta formed in a proglacial lake, fed by glaciofluvial and/or regional deglacial drainage; may exhibit descending and incised, flat to gently inclined terraces accordant with falling lake levels; 1 to >10 m thick.

GLn — **Littoral and nearshore sediments:** sand, silt, and minor clay; often infills regions between beach ridges; low relief, moderately-sorted; <2 m thick.

GF — **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 deposited by proglacial lakes; poorly to well-stratified; variable thickness.

GFf — **Outwash fan:** fan-shaped morphology; moderately sorted; sediments fine toward distal edge; >2 m thick; **GFf2**, subaqueous grounding-line fan deposited at, or immediately distal to, grounding-line margin; often forms at the distal end of esker channels where they terminate in a proglacial lake; >2 m thick.

GFr — **Esker:** gravel and sand; well sorted; massive to cross-stratified; linear to sinuous ridges; typically discontinuous short segments of larger subglacial meltwater channels; up to 30 m high.

GF — **Glaciofluvial sediments, undifferentiated:** undifferentiated glaciofluvial sediments; variable thickness.

Tm — **Moraine complex:** discontinuous moraine ridges associated with an ice standstill; **Tmf2**, subaerial recessional and subaqueous grounding-line moraine ridges formed in glacial Lake McConnell; locally winnowed; <8 m high.

Tr — **Ridged till:** contiguous moraine ridges; subparallel; includes recessional and thrust moraines; where deposited in contact with proglacial lakes, ridges formed as subaqueous grounding-line moraines or morainal banks; ≤8 m high.

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

Tb — **Till, blanket:** continuous till cover with undulating relief, >2 m thick.

Complex units: two map-unit designators separated by a dot ( ) are used where the surficial cover forms a complex area and the units are too small to be mapped individually (e.g. Tr.GFr designates an area of ridged till interspersed with glaciofluvial esker sediments). The map-unit polygon is coloured according to the dominant unit and labeled in descending order of cover.

Stratigraphic relationship: two map-unit designators separated by a slash (/) are used where a stratigraphic relationship is observed or confidently inferred (e.g. GLr/Ts indicates ridged beach sediments overlying streamlined till). The map-unit polygon is coloured according to the overlying unit.

- Geological boundary (confidence defined)
- Thermokarst depression; extensive area of thermokarst features found in bog and fen deposits where ice-rich permafrost is degrading
- Lithalsa
- Alluvial bar or levee ridge
- Terrace scarp
- Beach crest
- Iceberg scour central axis
- Moraine:
  - *De Geer*
  - *Ribbed*
  - *Major ridge*
- Ice-thrust ridge
- Esker ridge, direction known or inferred
- Crevasse-fill ridge
- Drumlin
- Fluted drift:
  - *Buried, central long axis (direction unknown)*
  - *Central long axis (direction unknown)*
  - *Central long axis (direction known)*
- Paleowind flow direction, known
- Station location (ground observation)
- Till sample location

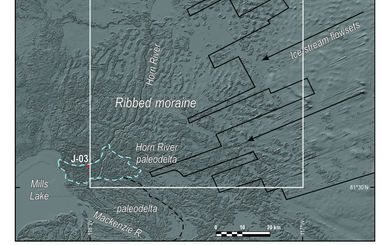


Figure 1. An ArcticDEM (Porter et al., 2022) hillshade model of the 85-F/NW map area and surrounding region. The prominent ribbed-moraine field covers most of the map area, and extends to the west and northeast. Ice-stream flowsets that postdate and obliquely crosscut moraine ribs extend into eastern parts of the map area. Petroleum well J-03 situated within the Horn River paleodelta shown at lower left, records 30 m of deltaic sediments overlying ~125 m of glacial sediments (likely till) infilling a larger proto-Mills Lake basin. Southeast corner of Horn Plateau shown in upper left; shorelines of glacial Lake McConnell (GLM) descend from ~230 m a.s.l.

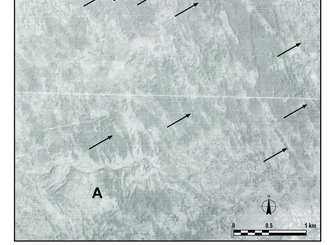


Figure 2. Section of air photograph A22427-242 (scale 1:60 000) illustrating concentric glaciolacustrine beach ridges around a ribbed-moraine upland (A), and the prominent NW-SE-aligned fabric of sub-parallel De Geer moraines superimposed on the landscape. Arrows highlight some of the abundant De Geer moraine segments visible; arrows are aligned perpendicular to individual moraines. Site (B) illustrates the crenulated margin created by De Geer moraines extending from ridged till into, or crossing, a lower-lying bog, where even the slight increase in elevation along the De Geer moraine ridge is enough to support treed/shrub growth visible in the air photograph. Center of figure situated at 61.703°N, 117.243°W.

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CANADIAN GEOSCIENCE MAP 465

Geological Survey of Canada
Canadian Geoscience Maps

Authors: I.R. Smith, R.C. Paulen, and G.W. Hagedorn

Geology by I.R. Smith, R.C. Paulen, and G.W. Hagedorn based on fieldwork (2017 and 2018), air photographs (1970, 1971; 1:60 000 scale), and ArcticDEM (v. 4.1) imagery.

Geological compilation by I.R. Smith, 2023

Geological data conforms to Surficial Data Model v. 2.5.1 (Deblonde et al., 2024).

Geomatics by L. Robertson

Cartography by D. Viner

Scientific editing by A. Weatherston

Initiative of the Geological Survey of Canada, conducted under the auspices of the GEM-2 Southern Mackenzie Corridor 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 007-17 and 008-18

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

SURFICIAL GEOLOGY
HORN RIVER
Northwest Territories
NTS 85-F/11, 12, 13, and 14
1:100 000

2 0 2 4 6 8 km

Shaded-relief image derived from the digital elevation model supplied by ArcticDEM v. 4.1
Illumination: azimuth 45°, altitude 25°; vertical factor 4x

Mean magnetic declination 2025, 16°55'E, decreasing 13.3' annually
Readings vary from 16°41'E in the SE corner to 17°08'E in the NW corner of the map.

This map is not to be used for navigational purposes.

Title photograph: Subparallel linear De Geer moraines aligned NW-SE (east-facing photograph), Northwest Territories.
Photograph by I.R. Smith. NRCan photo 2023-407

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CANADIAN GEOSCIENCE MAP 465
SURFICIAL GEOLOGY
HORN RIVER
Northwest Territories
NTS 85-F/11, 12, 13, and 14