Descriptive Notes

Field investigations within this map sheet involved two fly-camps (the unnamed valley dissecting the La Biche Range in the southeast in 2000, and Dendale Lake on the west side in 2002). Additional observations were made during helicopter-supported site inspections and overflights in the 2000 to 2002 field seasons.

The map area is situated in the Hyland Plateau, bordering the Mackenzie Mountains to the east, and the Tlogotsho Range to the north. It is framed by two north-south aligned ridges of Carboniferous Mattson Formation sandstone and Devonian Besa River Formation shale formed along the Dendale and Jedhi Deh (La Biche Range) thrusts, that are separated by the Tika synclinе basin, containing Permian Tika Formation limestone and dolostone, and Cretaceous Chinkeh through Sikanni formation sandstone, mudstone, shale, chert, and conglomerate (Fallas et al., 2014). The surfaces of most of the ridges, and a majority of the map area, comprise solutional- and mechanical-weathered bedrock, with a discontinuous scatter of glacially transported erratic clasts, often concealed beneath lichen-moss carpets. Till veneer and locally thicker till blankets associated with recessional moraines are found in the lower terrain and valleys. Large rotational bedrock landslides occur in areas underlain by Besa River Formation shale, and less competent Mattson Formation shale and siltstone beds. This map lies within the Extensive Discontinuous permafrost zone (Heginbottom et al., 1995), and several 1 to 2 m high palsas were observed in thicker peat-covered organic terrain around Dendale Lake. Many rock glaciers in the map area appear to be relict; however, some steeper sided lobate features with areas of less-weathered bedrock debris suggest active deformation and the presence of buried ice cores.

This map area was fully inundated by the Cordilleran Ice Sheet during the last (Late Wisconsinan) glaciation, over-topping summits that extend up to ~1950 m above sea level (a.s.l.). Sparse erratics and minimal till accumulations, along with deep (<3 cm) solutional-weathered bedrock and very well developed sorted nets and stone circles along summit ridges, suggest that ice cover over the La Biche Range and Tlogotsho Range may have been extensively cold-based, preserving an older periglacial landscape. These upland areas are also heavily dissected by cirque basins, suggesting antiquity beyond the Late Wisconsinan glaciation (e.g. Nelson and Jackson, 2003). Small, lobate moraines extend down-valley in many of the cirque basins, in places overriding and crosscutting regional deglacial landforms. These are interpreted to represent preservation of alpine-sector ice and local cirque glaciation that persisted after regional deglaciation (<13 ka; Bednarski, 2008).

In the northern map extents, ice-contact and proglacial glaciolacustrine deltas mark different stages of deglacial ice retreat, impoundment between retreating ice margins, and deposition within glacial Lake Nahanni. In the northeast corner of the map area, an ice-contact, northeast-aggrading delta (1300 m a.s.l.) records impoundment along upper Jackfish River between the westward retreating Cordilleran Ice Sheet and the north and eastward-retreating Laurentide Ice Sheet (Smith, 2003a). In the northern center of the map, outwash glaciolacustrine deltas descend from ~1010 to 925 m a.s.l. Southward-descending, nested lateral meltwater channels northeast of here indicate an earlier stage of ice flowing from the Liard River basin in the north. This is interpreted as evidence of the northern and eastward retreat of Laurentide ice from the Liard River basin. Therefore, these glaciolacustrine deltas also formed between these two retreating ice sheet margins, and likely marks the progressive development, and stepwise drainage of glacial Lake Nahanni as outlets emerged along the eastward retreating Laurentide Ice Sheet margin (Bednarski, 2008). In the northwest corner of the map, large ice-contact and outwash glaciolacustrine deltas formed between 940 and 895 m a.s.l., and are also considered to mark separating ice margins and deposition within glacial Lake Nahanni. Raised glaciolacustrine deltas (up to 1220 m a.s.l.) in the valley west of Dendale Lake (southwest map area) requires impoundment of drainage between retreating Cordilleran ice margins blocking the Tika Creek valley and those to the west (Smith, 2022), and would have resulted in drainage northwards across the divide into the Nahanni River basin.

In the southeast unnamed valley that bisects the La Biche Range, nested, westward-descending moraines record late deglacial retreat of a valley glacier eastward towards the upper Kotaneelee River (Smith, 2003a, b). In a northern side-valley draining into this unnamed valley, a large section of diamict, up to 20 m thick and 150 m long, was exposed by a debris flow. The lowermost section comprises 4 to 8 m of dark, shale-rich diamict, and has a clast content of <8%. Shale bedrock is exposed locally in the valley, but also occurs in the Cretaceous strata immediately to the west. This lower unit is interpreted to be a till deposited by the Cordilleran Ice Sheet during full-glacial time, and has a clast fabric–defined ice-flow direction of 95° (S1=0.59, S2=0.23). Overlying this is a 5 to 10 m thick, tan-coloured, moderate to well-stratified deposit with closed-work cobble-boulder layers and a sandy matrix that progrades down-valley. This unit is interpreted to be an outwash facies that has reworked Cretaceous and Devonian sandstone-rich till and weathered bedrock, and is considered to relate to the deglacial retreat of remnant alpine-sector ice and a former cirque glacier. Up to 10 m of chaotic diamict, containing angular boulders, overlies this, and is regarded to be a valley-side colluvial deposit.

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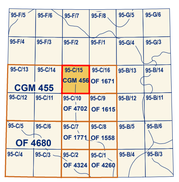
Abstract

This map area is situated within the Hyland Plateau and comprises the headwaters of the La Biche River. It is framed by the La Biche Range on the east, the Tlogotsho Range on the north, and an unnamed ridge along its western boundary. The map area was inundated by the Cordilleran Ice Sheet during the Late Wisconsinan glaciation, and ice advanced east to northeast across the region. Coalescence with the Laurentide Ice Sheet is considered to have occurred just east and north of this area. During deglaciation, ice retreated generally south and westwards. Prominent northward-aggrading ice-contact and proglacial deltas formed between retreating Cordilleran and Laurentide ice margins, within early stages of glacial Lake Nahanni. Well-developed cirque basins point to a prolonged glacial history that predates the Late Wisconsinan glaciation. Small lobate moraines extending into valley bottoms below these cirques suggests that during regional Late Wisconsinan deglaciation, upland ice persisted through a phase of late glacial–early Holocene alpine cirque glaciation.

Résumé

La présente région cartographique est située à l'intérieur du plateau Hyland et comprend le cours supérieur de la rivière La Biche. Elle est délimitée par le chaînon La Biche à l'est, le chaînon Tlogotsho au nord et une crête non dénommée le long de sa limite ouest. La région cartographique a été ensevelie sous l'Inlandsis de la Cordillère pendant la glaciation du Wisconsinien supérieur, et la glace a progressé dans une direction variant de l'est au nord-est à travers la région. On considère qu'une coalescence avec l'Inlandsis laurentidien s'est produite juste à l'est et au nord de cette région. Pendant la déglaciation, la glace s'est retirée dans une direction générale variant du sud à l'ouest. D'importants deltas d'aggradation proglaciaires et juxtaglaciaires s'avançant vers le nord se sont formés entre les marges glaciaires en retrait des inlandsis de la Cordillère et laurentidien, dans les premiers stades du Lac glaciaire Nahanni. Des bassins de cirque bien développés témoignent d'une histoire glaciaire prolongée, antérieure à la glaciation du Wisconsinien supérieur. De petites moraines lobées s'étendant au fond des vallées sous certains de ces cirques suggèrent que, pendant la déglaciation régionale du Wisconsinien supérieur, des plaques de glace situées sur les hautes terres ont perduré pendant une phase de glaciation de cirque alpin ayant duré de la fin de la période glaciaire à l'Holocène inférieur.



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

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CANADIAN GEOSCIENCE MAP 456

SURFICIAL GEOLOGY

DENDALE LAKE

Yukon–Northwest Territories

NTS 95-C/15

1:50 000

QUATERNARY

POST LAST GLACIATION

NON-GLACIAL ENVIRONMENT

ORGANIC DEPOSITS: peat and muck; formed by the accumulation of plant materials in various stages of decomposition; occur as low-relief, wet terrain over poorly drained substrates; >1 m thick.

O — **Organic deposits, undifferentiated:** undifferentiated bog and fen deposits; variable thickness.

COLLUVIAL AND MASS-WASTING DEPOSITS: rubble and diamicton formed by direct, gravity-induced movement; composition dependent on source material; poorly sorted; massive to stratified; variable thickness.

Ca — **Apron:** talus (scree); colluvial accumulations of bedrock blocks; forming aprons and fans below cliffs; up to 50 m thick.

Cz — **Landslide and slump debris:** active and inactive landslides; hummocky relief; 1 to 10s of metres thick near the toe of large landslides; **Cz4**, rotational landslide; large rotational bedrock blocks; commonly traceable upslope to active scarps and bedrock headwalls.

Cg — **Rock glacier:** rock debris deformed by the downslope flow of buried or interstitial ice, forming pronounced transverse and longitudinal ridges and furrows; largely relict forms, though some active rock glaciers are present; thickness >10 m.

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 along valley walls above modern floodplain; may exhibit sharp successive scarps defining different terrace levels; sorted; >2 m thick.

POSTGLACIAL OR LATE WISCONSINAN

PROGLACIAL AND GLACIAL ENVIRONMENTS

GLACIOLACUSTRINE SEDIMENTS: gravel, sand, silt, and clay, with gravel debris flow layers and dropstones where ice contact occurs; deposited in glacier-dammed lakes; level topography; massive to poorly stratified; moderately sorted; variable thickness.

GLd — **Delta:** delta formed in a proglacial or ice-contact lake; fed by glaciofluvial and/or regional deglacial drainage; may exhibit descending and incised, flat to gently inclined terraces accordant with falling lake levels; commonly exhibits thermokarst/kettles where formed as an ice-contact feature; 2 to >10 m thick.

GLv — **Glaciolacustrine sediments, veneer:** thin, discontinuous cover of moderate to poorly sorted sand, silt, and minor clay; <2 m thick.

GLb — **Glaciolacustrine sediments, blanket:** undifferentiated blanket of glaciolacustrine sediments; >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; poorly to well stratified; variable thickness.

GFp — **Outwash plain:** low-relief deposit often found adjacent to glacial meltwater channels; moderately sorted; massive to crudely stratified; >2 m thick.

GFt — **Terrace:** terraces formed along former glaciofluvial floodplain; flat topped; moderately to well sorted; >2 m thick.

GFf — **Outwash-fan:** fan-shaped morphology; moderately sorted; sediments fine toward distal edge; >2 m thick.

GFc — **Ice-contact sediments:** sand and gravel with minor diamicton; poorly sorted; deposited behind or at the ice margin; surface topography is undulating, irregular, or ridged; kettled or thermokarst where buried ice has melted; >2 m thick.

GFk — **Kame:** sand and gravel with minor diamicton; well to moderately sorted; flat-topped terraces impounded by topography along lateral margins of retreating valley glaciers; isolated hills (moulin) deposits; kettled/thermokarst where buried ice has melted; 2 to >10 m thickness.

TILL DEPOSITS: diamictons deposited directly by the Cordilleran Ice Sheet; sandy-silt to clayey-silt matrix; 5% to 15% clast content.

Tv — **Till, veneer:** discontinuous veneer that mimics underlying bedrock structure; bedrock outcrops are discernible; <2 m thick.

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

PRE-QUATERNARY

BEDROCK

R — **Bedrock, undifferentiated:** sedimentary bedrock; principally Carboniferous Mattson Formation sandstone with lesser Devonian Besa River shale forming thrust ridges bordering Cretaceous Sikanni through Chinkeh formation sandstone, conglomerate and shale framing the Tika syncline and La Biche River valley bottom (Fallas et al., 2014).

- Geological boundary (defined)
- Thermokarst depression:
  - *Large*
  - *Small*
- Palsa
- Terrace scarp
- Paleodrainage direction
- Meltwater channel:
  - *Minor, central axis (direction known)*
  - *Minor, central axis (lateral uphill left)*
  - *Major, scarp*
- Major moraine ridge (end, interlobate, or unspecified)
- Esker ridge (direction known or inferred)
- Drumlinoid ridge
- Drumlin ridge
- Fluted bedrock:
  - *Central long axis (well defined, direction unknown)*
  - *Central long axis (well defined, direction known)*
- Clast fabric, direction known
- Striation:
  - *Direction unknown*
  - *Direction known*
  - *Crossed (1 = older, 2 = younger)*
- Cirque headwall
- Arete
- Bedrock scarp
- Station location (ground observation or stratigraphic section)
- Sample location

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CANADIAN GEOSCIENCE MAP 456

Geological Survey of Canada
Canadian Geoscience Maps

Canada

Author: I.R. Smith

Geology and geological compilation by I.R. Smith

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

Geomatics by L. Robertson, S. Eagles, and Géotech

Cartography by D. Viner

Scientific editing by A. Weatherston

Joint initiative of the Geological Survey of Canada and the Yukon Geological Survey, conducted under the auspices of the Central Foreland NATMAP project as part of Natural Resources Canada's National Mapping (NATMAP) program

Map projection Universal Transverse Mercator, zone 10 North American Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications
Elevations in feet above mean sea level

SURFICIAL GEOLOGY
DENDALE LAKE
Yukon–Northwest Territories
NTS 95-C/15
1:50 000

1 0 1 2 3 4 km

Magnetic declination 2023, 18°52'E, decreasing 11.2' annually

This map is not to be used for navigational purposes.

Title photograph: View looking north along unnamed ridge east of Dendale Lake. Extensive outcrops of Mattson Formation sandstone preserve eastward striae directions, with locally only a scattering of glacial erratic clasts, Northwest Territories.
Photograph by I.R. Smith. NRCan photo 2021-952

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CANADIAN GEOSCIENCE MAP 456
SURFICIAL GEOLOGY
DENDALE LAKE
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