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CANADIAN GEOSCIENCE MAP 186

RECONNAISSANCE SURFICIAL GEOLOGY

HANBURY RIVER

Northwest Territories

NTS 75-P

Map Information Document

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Cover Illustration

Thelon River delta, Eyeberry Lake, Northwest Territories. Photograph by R. Knight.
2013-033

ABSTRACT

Preliminary surficial geology studies, through aerial photograph interpretation and limited legacy data, were undertaken in the Hanbury River map area to provide an improved understanding of surficial sediments and glacial history. The general distribution and thickness of sediments reflects the nature of underlying bedrock. The eastern half of the area, underlain by relatively soft Dubawnt Group sedimentary rocks, is generally covered by thick drift with limited rock outcrop, whereas the western quarter, underlain by gneissic rocks, is extensively bare. Three main ice-flow events are identified. An early southwest flow is seen in the south-central, northwest and in the northeastern regions. The next flow was northwestward, and affected most of the map area. A final southward flow event affected only the north-central area and is confined in time to the local deglaciation sequence. A succession of glacial lakes (Hanbury, Tyrrell, Thelon) covered much of the map-area during deglaciation. Relict beaches throughout the map-area attest to a complex history of changing water levels associated with either multiple outlets and/or with differential isostatic recovery.

RÉSUMÉ

Afin de mieux comprendre les sédiments de surface et l'histoire glaciaire de la région de la carte de la rivière Hanbury, on a entrepris des études préliminaires de la géologie de surface en analysant des photos aériennes et un ensemble limité de données héritées. La distribution générale et l'épaisseur des sédiments reflètent la nature du substratum rocheux sous-jacent. La moitié est de la région, qui repose sur des roches sédimentaires relativement tendres du groupe Dubawnt, est généralement couverte de dépôts glaciaires épais et d'un socle rocheux limité, tandis que le quart ouest, qui repose sur des roches gneissiques, est considérablement dégagé. Trois principaux événements d'écoulement glaciaire sont déterminés. Un premier écoulement vers le sud-ouest est perceptible dans les régions du centre-sud, nord ouest et nord est. Le deuxième écoulement se dirigeait vers le nord-ouest et a également touché la région illustrée sur la carte. Un dernier écoulement vers le sud n'a touché que la région du centre nord et se limite à la séquence de déglaciation locale. Une succession de lacs glaciaires (Hanbury, Tyrrell, Thelon) couvrait une partie de la carte pendant la déglaciation. Les vestiges de plages que l'on trouve partout sur la carte témoignent d'un historique complexe de changement des niveaux d'eau lié à de multiples sorties ou à un relèvement isostatique différentiel.

ABOUT THE MAP

General Information

Authors: A.S. Dyke and D.E. Kerr

Geology based on aerial photograph interpretation by A.S. Dyke, 2012–2013, with minor additions and compilation by D.E. Kerr, 2014.

Geology conforms to Surficial Data Model v. 2.0

Geomatics and cartography by L. Robertson

Initiative of the Geological Survey of Canada, conducted under the auspices of the Geo-mapping Frontiers Project as part 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 1:50 000 from Natural Resources Canada, with modifications.

Elevations in metres above mean sea level

Mean magnetic declination 2014, 9º24'E, decreasing 22' annually. Readings vary from 10º35'E in the SW corner to 8º06'E in the NE corner of the map.

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

Data may include additional observations not portrayed on this map.

See documentation accompanying data.

This publication is available for free download through GEOSCAN (http://geoscan.nrcan.gc.ca/).

Preliminary publications in this series have not been scientifically edited.

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.

ABOUT THE GEOLOGY

Descriptive Notes

Glacial History

The general distribution and thickness of drift in the map-area (NTS 75-P) closely reflects the nature of the underlying bedrock (Wright, 1957). The eastern half of the area, underlain by relatively soft Dubawnt Group sedimentary rocks, is generally covered by thick drift with limited rock outcrop, whereas the western quarter, underlain by gneissic rocks, is extensively bare. In between is an area underlain by gneissic rocks with an extensive but mainly thin drift cover. An area of thick drift along the north-central boundary of the map-area is underlain by granitic rocks, which evidently are more erodible than the gneisses.

Ice-flow Sequence

The area exhibits conspicuous evidence of three main regional ice-flow events and additional localized events. An early southwest flow is seen in streamlined bedrock, most prominently in the south-central region, but also in the northwest region, and in streamlined till in the northeastern region. This flow affected the entire map area, as well as areas to the east and northwest (Craig, 1964; Wright, 1967; Prest et al., 1968), and west and south (Kerr et al., 2013, Kerr et al., 2014a, 2014b, Levson et al., 2013, Stea and Kerr, 2014). It was either an event of considerable duration, or the latest of several such previous flows, because major expressions of the topographic fabric, for example Eyeberry and Tyrrell Lakes, among many, have this orientation, as does the Thelon River.

Not recognizing the pervasive regional nature of this southwest flow event and its relative antiquity, Craig (1964) incorporated it into his deglaciation sequence. However, the early southwest flow affected a large part of the Keewatin Sector of the Laurentide Ice Sheet, extending at least from Dubawnt Lake to west of southern Bathurst Inlet (Prest et al., 1968). Dyke et al. (1982) suggested that the southwest flowset dates from the Last Glacial Maximum, which is from the peak of Oxygen Isotope Stage 2 (OIS 2), about 25,000 years ago. Kleman et al. (2002) suggested that it dates from OIS 4 (Early Wisconsinan, about 65,000 years ago) and that the terrain was deglaciated at the end of OIS 4. Determining its actual age should be a focus of future research.

The next flow was northwestward, emanating from the Keewatin Ice Divide (Lee, 1959; Aylsworth and Shilts, 1989). It too affected the entire map area, but its geomorphic expression is quite varied in intensity. Associated with this flow is the Thelon Esker, the central section of which trends across the middle of the map-area. South of the Thelon Esker, the footprint of the northwest flow is ubiquitous, and the earlier southwest flow is strongly overprinted, though mainly by streamlined till, the bedrock there not being significantly remolded. Farther north, the footprint of the northwest flow is seen along localized corridors or as a faint overprint on drift that is mainly streamlined by the earlier flow.

A striking feature of the Thelon Esker, both within the map area and generally along its length (Craig, 1964; Aylsworth and Shilts, 1989), is that all of its major tributaries join it from the south. Furthermore, most of the smaller eskers that are parallel to it, hence are generally contemporaneous with it, lie to the south of it. These particularities, as well as the variable footprint of the northwest ice flow described above, can be explained by a model of changing thermal zonation at the base of the ice sheet. Specifically, the southwest flow, self-evidently warm based, was followed by an interval of cold-based ice cover, if not of deglaciation, as proposed by Kleman et al., (2002), and then by cold-based ice cover. During or after establishment of a northwest ice flow regime, the ice became warm-based in the south. Subsequently, a flow-parallel boundary between warm-based (sliding) ice and cold-based (non-sliding) ice propagated slowly northward, thus expanding the footprint of the northwest flow and channelling much of the basal meltwater along the thermal boundary. Any esker forming along that boundary would have migrated with it or been reworked by ice flow. The near-final position of this boundary is that of the Thelon Esker. It lacks north-side tributaries because little or no meltwater was available there. Only small warm-based patches developed north of the Thelon Esker during deglaciation, accounting for the preservation of widespread southwest drift lineaments there.

The final significant ice-flow event affected only the north-central part of the map area and it is confined in time to the local deglaciation sequence. In that area, a generally southward flow, with southeast and southwest splays, affected an area nearly as far south as the Thelon Esker. One large and several smaller eskers are associated with this flow, as well as are streamlined bedrock and streamlined drift. The most proximal part of this young flow system within the map area is the splayed tip of what has been termed the hour-glass shaped Dubawnt Ice Stream (Stokes and Clark, 2003), emanating from a source northeast of the map area (Craig, 1964).

Deglaciation Pattern

Glacial Lake Thelon and its antecedents covered most if not all of the map-area during deglaciation (Craig, 1964). The former existence of these lakes is only weakly evident in the rather minor accumulations of deep water sediments. However, relict beaches distributed throughout the map-area attest to a complex history of changing water levels associated with either multiple outlets or with differential isostatic recovery during the operation of individual outlets located outside the map area, or likely both. The phases of these glacial lakes have been interpreted in only the most general fashion (Craig, 1964; Dyke, 2004). Because their outlets were mainly beyond the map area (and named lake phases are normally tied to outlets), only limited definition can be added here.

The pattern of ice recession is undefined across most of the southern and southwestern parts of the map area, where it can only be assumed that the ice front retreated generally up the youngest ice flowlines. Elsewhere, there is sufficient development of end moraines and ice-marginal glaciofluvial deposits to allow a more detailed reconstruction of the pattern of ice recession and to tie ice fronts to levels of the glacial lakes. All of these features were either previously unmapped or were not explicitly interpreted.

The oldest ice front in the map area is defined by end moraines adjacent to eskers that are tributary to the Thelon Esker in the northwest, north of Lac Du Bois. This ice front blocked regional drainage and hence was fronted by a glacial lake. East of there, an esker delta or outwash fan defines the minimum elevation of a glacial lake (about 390 m) at a slightly younger ice front. Most of the younger moraines, ice-contact escarpments in glaciofluvial deposits and glacial-flow landforms confirm that the ice front retreated southeastward and northeastward up the youngest flowlines. None of these moraines are major features, either in size or in continuity, and hence none of them represent long intervals of time or important glacier mass balance changes. The youngest definable ice front in the southeast part of the map area is associated with a glacial lake level of about 350 m where proglacial outwash forms fans at lake level.

In the northern part of the map area, which was affected by the southward flow of the Dubawnt Ice Stream, the ice front retreated generally northward. Midway through this process, the largest ice-marginal terraced and hummocky sediment accumulation in the map area, northwest of Steel Lake, was deposited subaquatically in a glacial lake. This extensive glaciofluvial complex is tens of metres thick and thus represents a more significant event than is represented by other ice-marginal features in the map area. It has a distinct ice-contact escarpment along its northern side. The escarpment is fronted by proglacial terraces that are aggraded to a lake level of about 400 m. At its eastern end, the glaciofluvial complex is fed by two large eskers, one from the north, the other one from the east. A second ice-contact escarpment extends southwestward from the junction of these eskers, indicating the contact of two ice lobes at this point. The glacial lake at this phase predates glacial Lake Thelon. It is here named glacial Lake Hanbury after the principal drainage that was blocked, though its full extent is not yet known. Its outlet was probably northward into the Back River in the vicinity of Moraine Lake (Craig, 1964, Fig. 6).

After ice withdrew eastward into the Thelon Valley, a spillway opened that allowed an early phase of glacial Lake Thelon to fall to the 320 m level. At that time, it drained into a tributary of the Thelon River north of the map area. A separate glacial lake in the southern map area (glacial Lake Tyrell) occupied the modern Tyrrell Lake basin (at about the 335–340 m level) and drained northward into Lake Thelon.

After the ice front withdrew east of the map area, a large glaciofluvial delta terrace was constructed in glacial Lake Thelon at 200 m elevation, southeast of Steel Lake, from outwash transported westward along Clark River. The northward extension of that ice front must have dammed the lower reaches of the Thelon River below a spillway at about 200 m elevation.

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Author Contact

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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: 106°00'00" W
Eastern longitude: 104°00'00" W
Northern latitude: 64°00'00" N
Southern latitude: 63°00'00" N

Data Model Information

The Geological Survey of Canada (GSC) through the Geomapping 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., Plouffe, A., Eagles, S., Everett, D., Huntley, D.H., Inglis, E., Kerr, D.E., Moore, A., Parent, M., Robertson, L., Smith, I R., St-Onge, D.A., Weatherston, A., 2014. Science language for an integrated Geological Survey of Canada data model for surficial geology maps, version 2.0; Geological Survey of Canada, Open File 7631, 464 p. doi:10.4095/294225