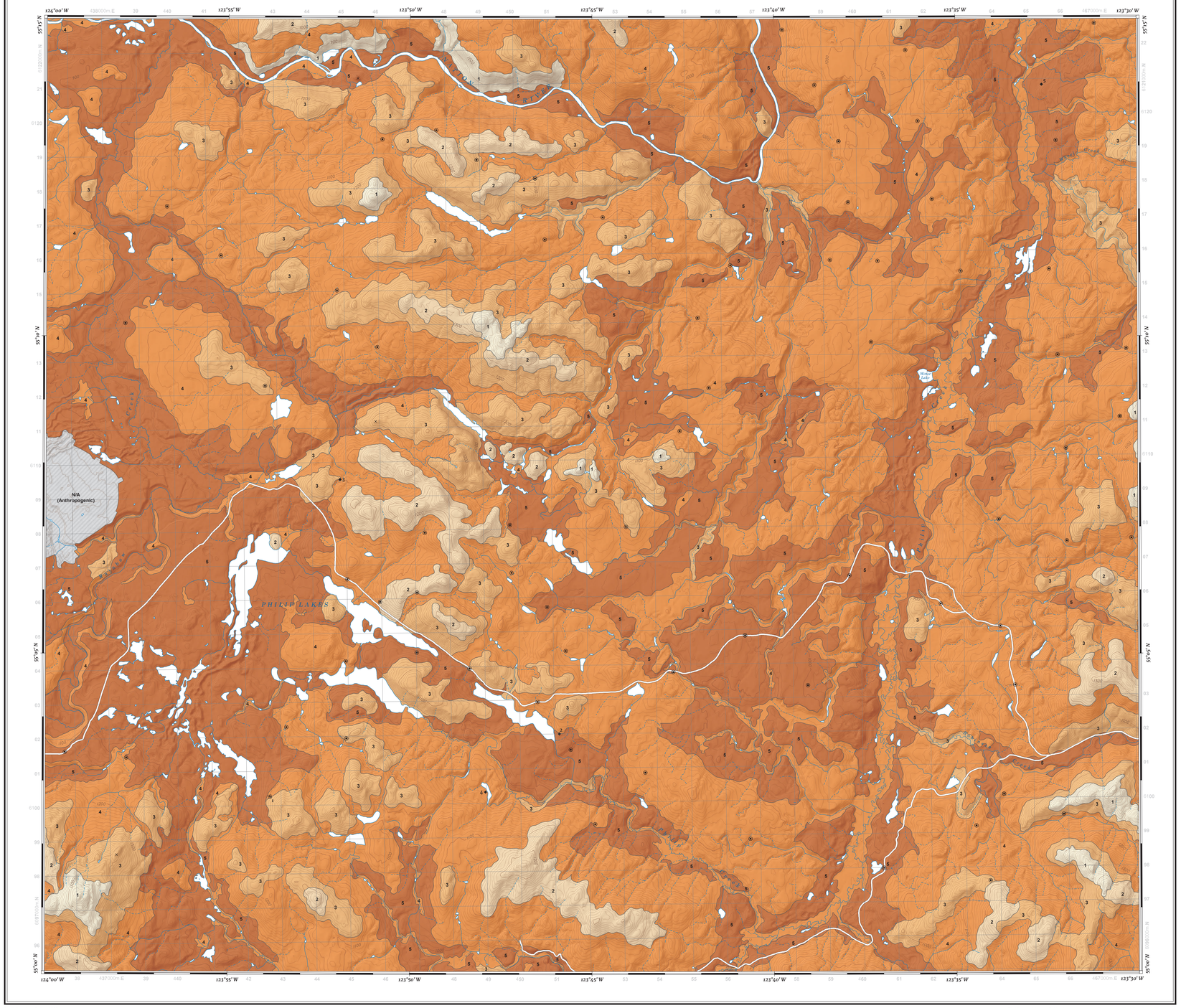


North American Datum 1983
Shaded relief and contour lines derived from the digital elevation model supplied by Natural Resources Canada. Illumination: azimuth 315°, altitude 45°, vertical exaggeration 1x.
Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications.
Contour interval 10 metres. Elevations in metres above mean sea level.

ONE THOUSAND METRE GRID
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 10 NORTH

GRID NORTH 0°37' WEST OF TRUE NORTH.
APPROXIMATE MEAN MAGNETIC DECLINATION 2021 FOR CENTRE OF MAP IS 17°09' EAST, DECREASING ANNUALLY 13.5'

Geoscience BC Map 2021-03-02c

Drift thickness of the Philip Lakes area NTS 0930/04, British Columbia

Geology by C. McGregor and D. Sacco

1 0 1 2 3 4 5
KILOMETRE SCALE

Scale 1:50,000

Cartography by B. Elder

Legend

DRIFT THICKNESS (DT) CLASSIFICATION

DT class	Description	Surficial geology map unit example*	Implications for exploration
1	Bedrock is the dominant unit exposed at surface.	**R; R.Tv**	Bedrock occurs at surface; optimal target for bedrock mapping and sampling programs.
2	Bedrock outcrops are common but not dominant, otherwise sediment cover is thin (<2 m).	**Tv.R**	Bedrock occurs at surface in less than half of drift thickness class 2 units. Bedrock mapping and sampling programs should target topographic highs where bedrock is most common. Bedrock may also be exposed in streams and meltwater channels where modern or glacial watercourses have eroded drift. Bedrock can typically be accessed in hand-dug pits on topographic highs where sediment cover is thin, but deeper excavations are required in concavities.
3	Bedrock is overlain by a continuous veneer (<2 m) of sediment with minor outcrop occurrences.	**Tv**	Bedrock may be exposed in streams and meltwater channels where modern or deglacial watercourses have eroded drift. Bedrock may be accessible in hand-dug pits on topographic highs where sediment cover is thin, but deeper excavations are required in concavities.
4	Bedrock is likely overlain by a continuous blanket (>2 m) of sediment.	**GLv/Tb**	Bedrock is unlikely to occur at surface; may be accessed with a small excavator on some topographic highs, but deeper excavations or drilling will be required in concavities. My be suitable for drill-supported till sampling where till does not occur at surface, or where profile sampling is desired.
5	Bedrock is likely overlain by thick depositional landforms and/or multiple stratigraphic sediment units.	**GFc; GLb/Tb**	Bedrock does not occur at surface. Minimum drift thicknesses of 5 m are expected. Deep excavations or drilling will be required to reach bedrock. Optimal locations for drill-supported till sampling where till does not occur at surface, or where profile sampling is desired.

**For full explanation of surficial geology classification see companion map publication "Surficial geology of the Philip Lakes map area (NTS 093O/04), British Columbia, Geoscience BC map 2021-03-02a"*

ONSITE SYMBOLS

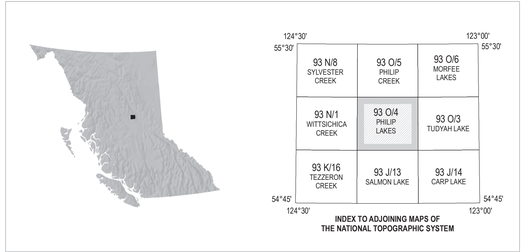
- Bedrock outcrop
- Till sample site
- Mineral occurrence (see Table 1; numbers indicate Map ID)
  - Past Producer
  - Prospect
  - Developed Prospect
  - Showing
- Park or protected area
- Road[1]
- Rail line
- Stream[2]
  - Definite
  - Intermittent or indefinite

1 - Roads displayed on map are from the CanVec 1:50k database (Natural Resources Canada) and do not include the extensive gravel forest service road network present in the area.

2 - Classification provided by BC Freshwater Atlas.

Table 1. Mineral occurrences from MINFILE database (MINFILE, 2020). Letter and number designation under deposit type correspond to definitions provided by Lefebure and Ray (1995) and Lefebure and Hoy (1996).

Map ID	MINFILE No.	Name	Status	Commodity	Deposit Type
1	093O055	CJ	Prospect	Cu, Au, Ag, Mo	L03: Alkalic porphyry Cu-Au
2	093O056	FRED	Showing	Au, Ag, Cu	
3	093O057	LAKE	Showing	Cu	
4	093O058	RPF	Showing	Cu	L03: Alkalic porphyry Cu-Au
5	103P142	NIMBLE	Showing	Mo	L05: Porphyry Mo (Low F-type)



INDEX TO ADJOINING MAPS OF THE NATIONAL TOPOGRAPHIC SYSTEM

Descriptive Notes

The mapping presented here is part of a series of surficial geology, till sampling suitability, and drift thickness maps completed for Geoscience BC's **C**entral Interior **Copper-Gold Research (CICGR)**: Surficial Exploration Project (See index map). The purpose of this map series is to inventory and characterize surficial materials and landforms to inform resource exploration (*e.g.*, mineral, water and aggregate) and infrastructure development in British Columbia. The surficial geology interpretations follow standardized mapping protocols defined by the Geological Survey of Canada (Deblonde *et al.*, 2018) and used by the British Columbia Geological Survey, ensuring accordance with existing and ongoing surficial geology mapping produced by the government. Polygons are delineated based on surficial material and morphology, and overlays are used to indicate geomorphological processes. Features such as bedrock outcrop or glaciofluvial landforms that are too small to delineate as polygons are identified using point and line symbols. The surficial geology was interpreted from 1:5 m resolution colour and near-infrared SPOT satellite imagery. Pseudo-stereo models were produced from the imagery using the Canadian Digital Elevation Model (Natural Resources Canada, 2015). The till sampling suitability mapping builds on earlier drift exploration potential maps developed by Proudfoot *et al.* (1995) and basal till potential mapping (*e.g.*, Sacco *et al.*, 2014; Ferbey, 2014).

This map series was initiated to streamline the CICGR regional till geochemical and mineralogical sampling program. Subglacial till is ideal for assessing bedrock hosted mineral potential in areas covered by Quaternary sediments because it is commonly the first derivative of bedrock (Shilts, 1993), it has a relatively simple and predictable transport history related to ice-flow directions, and geochemical and mineralogical anomalies in till are more extensive than its bedrock source (Levson, 2001). This mapping focuses on identifying discrete occurrences of subglacial till to guide exploration programs. In central British Columbia, it is specifically important to distinguish subglacial till facies from ablation till facies, as ablation till has a more complex transport and depositional history and, therefore, is less suitable for mineral exploration.

Till sampling suitability is derived from the surficial geology interpretations. Each mapped polygon is attributed a suitability using a multi-class index that considers the proportions of surficial materials and geomorphological processes that have affected them. Suitability ratings are ultimately a function of the proportion of a polygon that contains *in situ* subglacial till that is suitable for sampling. This helps to inform the planning and execution of till sampling surveys by identifying areas where subglacial till can be readily sampled and areas where extra efforts or alternative sampling methods or materials may be required.

Drift thickness mapping provides an indication of the relative thickness of Quaternary sediment cover based on the results of the surficial geology interpretations. Drift thickness estimations consider the interpreted surface expression of map units (polygons) and the potential for preserved stratigraphic sequences. Stratigraphic sequences are assumed where depositional environments were non-erosional and pre-existing materials are likely preserved (*e.g.*, beneath glaciolacustrine sediments and ablation till). The interpretations have not been calibrated with known depths to bedrock. Drift thickness maps can be used to inform bedrock mapping and prospecting programs because they identify areas where bedrock outcrops are likely present or where bedrock is overlain by shallow cover and may be accessed with hand tools. This mapping can also be used in combination with till sampling suitability to identify areas where drilling or trenching may be required to sample till, or provide information such as ice flow direction for drift-based exploration programs.

Previous surficial geology interpretations were only completed around the Mount Milligan Mine in the Philip Lakes map area (NTS map sheet 093O/04) at a scale of 1:50 000 (Kerr, 1991). The map area lies within the Nechako Plateau, the northwesternmost physiographic subdivision of the Interior Plateau (Holland, 1976). It is characterized by rolling topography with higher-relief upland areas trending north-south in the southeast, southwest, and centre portions of the map area. Surface elevations are typically between 800 m and 1500 m. The Nation River has incised the uplands in the north, leaving steep valley walls that are prone to colluviation. Topographic highs are characterized by veneers of till (**Tv**) and discontinuous bedrock outcrop. Intervening north-trending valleys on the east and west sides of the map area are occupied by thick sediment packages topped with outwash plains, and ice-contact glaciofluvial deposits that indicate the location of stagnating ice masses during deglaciation. These sediments are commonly incised by Holocene drainage systems. In the west, extensive glaciofluvial deposits are underlain by thick glaciolacustrine units. The valley fill sequences are greater than 100 m thick in some areas along the Rainbow Creek. Till blankets (**Tb**) are common on valley sides and in lower elevation areas, which are locally incised by glacial meltwater.

During the onset of glaciation, ice initially advanced from local source areas north of the map area (Ryder and Maynard, 1991, Sacco *et al.*, 2017). During the glacial maximum, glaciers sourced in the north, west and southwest coalesced, resulting in the dominant northeastern ice-flow direction (Sacco *et al.*, 2017). During deglaciation, ice-flow directions were deflected east and north in the west and southern parts of the map sheet, respectively, likely associated with local readvances.

The map sheet is generally well suited to till sampling due to the extensive occurrence of subglacial till throughout the region. At higher elevations, where till cover is thin (*e.g.*, Tv), sampling efforts should be focused on the down-ice side of the topographic high. The area east of Mount Milligan mine is poorly suited to till sampling due to the extensive cover of glaciofluvial deposits and thick drift. Here, and in other valley bottoms covered in thick glaciofluvial deposits or ablation till, machine-assisted sampling methodologies may be required to access subglacial till suitable for sampling.

Acknowledgements

Funding for this project was provided by Geoscience BC. We thank Wayne Jackaman at Noble Exploration Services Ltd. and his team for providing additional ground observations collected during the till sampling program.

Recommended citation

McGregor, C., Sacco, D.A., Knox, C. 2021, Drift thickness of the Philip Lakes map area (NTS 093O/04), British Columbia. Geoscience BC map 2012-03-02c, scale 1:50 000

References

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. (2018): Surficial data model: the science language of the integrated Geological Survey of Canada data model for surficial geology maps (ed. ver. 2.3.14); Geological Survey of Canada, Open File 8236, 50 p.

Ferbey, T., 2014. Basal till potential of the Nadina River map area (NTS 093O/11), British Columbia. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey Open File 2014-02, scale 1:50 000.

Holland, S.S., 1976. Landforms of British Columbia: a physiographic outline. British Columbia Ministry of Energy and Mines and Petroleum Resources, British Columbia Geological Survey, Bulletin 48, 138 p.

Kerr, D.E., 1991. Surficial geology of the Mount Milligan area (NTS 93N/1E; 93O/4W). British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey Open File 1991-07, scale 1:50,000.

Lefebure, D.V. and Hoy, T. (ed.), 1996. Selected British Columbia mineral deposit profiles, Volume 2 — More metallic deposits; British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey Open File 1996-13, 172 p.

Lefebure, D.V. and Ray, G.E. (ed.), 1995. Selected British Columbia mineral deposit profiles, Volume 1 — Metallics and coal; British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey Open File 1995-20, 136 p.

Levson, V.M., 2001. Regional till geochemical surveys in the Canadian Cordillera: sample media, methods, and anomaly evaluation. In: McClenaghan, M.B., Bobrowsky, P.T., Hall, G.E.M., and Cook, S.J. (Eds.), Drift Exploration in Glaciated Terrain. Geological Society, Special Publication 185, p.45-68.

MINFILE, 2020. MINFILE Mineral Occurrences Database. British Columbia Ministry of Energy Mines and Petroleum Resources, British Columbia Geological Survey. MINFILE digital data, posted October 19, 2020, URL https://catalogue.data.gov.bc.ca/dataset/minfile-mineral-occurrence-database [February, 2021].

Natural Resources Canada (2015): Canadian Digital Elevation Model, Natural Resources Canada. URL <https://open.canada.ca/data/en/dataset/7f245e4d-76c2-4caa-951a-45d1d2051333> [October 2019].

Proudfoot, D.N., Bobrowsky, P.T., and Meldrum, D.G., 1995. Drift exploration potential maps derived from terrain geology maps. In: Bobrowsky, P.T., Sibbick, S.J., Newell, J.M., and Matsuyk, P.F. (Eds.), Drift Exploration in the Canadian Cordillera, British Columbia Ministry of Energy and Mines, British Columbia Geological Survey Paper, 1995-2, p.23-31.

Ryder, J., and Maynard, D. 1991. The Cordilleran Ice Sheet in northern British Columbia. Geographie physique et Quaternaire, 45: 355–363.

Sacco, D., Ferbey, T., and Jackaman, W., 2014. Basal till potential of the Chuko River map area (NTS 093O/05), British Columbia. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey Open File 2014-06, Geoscience BC Map 2014-04-03, scale 1:50 000.

Sacco, D.A., Ward, B.C., Lian, O.B., Maynard, D.E., Geertsema, M. 2017. Quaternary geology of part of the McLeod Lake map area (NTS 093J), central British Columbia: lithostratigraphy, glacial history and chronology. Canadian Journal of Earth Sciences v.54, pp. 1063–1084.

Shilts, W., 1993. Geological Survey of Canada's contributions to understanding the composition of glacial sediments. Canadian Journal of Earth Sciences, 30, p. 333-353.