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GEOLOGICAL SURVEY OF CANADA — COMMISSION GÉOLOGIQUE DU CANADA

NATMAP
CARTNAT
Canada's National Geoscience Mapping Program
Le Programme national de cartographie géoscientifique du Canada

DESCRIPTIVE NOTES

The Nechako River map area (NTS 93 F), located in central British Columbia, was completely covered by the Cordilleran Ice Sheet during the Late Wisconsinan Fraser Glaciation. Lobes of ice derived from accumulation zones located in the Coast Mountains to the west flowed in a generally eastward to northeastward direction. This surficial geology map depicts the distribution of unconsolidated glacial and nonglacial sediments and landforms that are the products of the last glaciation. The map was compiled, modified, and generalized from previously published open files: (Levson and Giles, 1994; Giles and Levson, 1995; Weary et al., 1995; Plouffe, 1998; Mate and Levson, 2000; Plouffe and Levson, 2001b, 2002; Plouffe and Mate, 2001).

Physiography and bedrock geology

Most of the Nechako River map area is located within the Nechako Plateau physiographic region, which is characterized by flat or gently rolling topography with an average elevation of 1200 m above sea level (Holland, 1976). The Fawnie and Nechako ranges are two mountainous regions of the Nechako Plateau. The valleys of the Nechako, Chilako, Euchiniko, and West Road (Blackwater) rivers are part of the Fraser Basin physiographic region which lies below the level of the Nechako Plateau. The West Road (Blackwater) River is the arbitrary boundary between the Nechako and Fraser plateaus.

Much of the map area was formerly drained by the Nechako River, a tributary of the Fraser River. The Nechako River drainage was diverted during construction of Kenney Dam in 1952. The Nechako Reservoir, the impoundment behind Kenney Dam, drains through a tunnel in the Coast Mountains to the Pacific Ocean; its level is controlled at the Skins Lake spillway, located about 1 km southwest of Skins Lake.

The Nechako River map area is underlain by Triassic to Jurassic volcanic rocks and minor sedimentary rocks, all of which are intruded by a suite of Jurassic, Cretaceous, and Eocene plutons. All of these rocks are extensively covered by Miocene and Eocene felsic and mafic volcanic rocks (Tipper, 1963; Anderson et al., 1997, 1998, 2001; Wetherup, 1997; Anderson and Snyder, 1998; Whalen et al., 1998).

Map unit description and genesis

Areas of bedrock exposures large enough to be mapped are depicted as bedrock (R) units. Bedrock outcrops that are too small to be shown at this scale of mapping, but are large enough to be identified on 1:60 000 scale air photographs, are depicted by an 'x' symbol.

Till is the most areally extensive surficial deposit in the map area. It consists of a poorly sorted sediment directly deposited by glaciers, containing boulder- to pebble-sized clasts in a matrix of sand (46% on average), silt (51% on average) and clay (3% on average). Till was divided into four subunits, three of which are based on sediment thickness: Tv (till veneer), Tb (till blanket), and Tm (thick, rolling till). The fourth till subunit is Tr (ridged till), which occurs in isolated locations, mainly in the southern part of the map area. The composition and genesis of these ridges is described below under 'glacial landforms'. Till sampling for geochemical exploration is most effective in areas underlain by a till veneer and a till blanket because the till in those regions usually overlies bedrock.

Glaciofluvial deposits consist of sand and gravel with minor silt, deposited by subglacial and subaerial glacial meltwater streams. These deposits are clast supported, pebbly to bouldery, and well to poorly sorted. Glaciofluvial deposits are more common in valleys than in upland areas. They are important aggregate resources, but their quality for such usage depends on the sediment sorting and the induration of the clast lithologies.

Glaciolacustrine deposits are composed of well sorted fine sand, silt, and clay. These sediments were deposited in former glacial lakes that developed at the end of the last glaciation when the drainage was blocked by decaying ice masses. The Nechako River valley and the low regions between François and Nulki lakes were flooded by a regional glacial lake system that extended further east to the Fraser River valley (Clague, 1987; Plouffe, 1997). Other glacial lakes in the area developed in westerly draining valleys that were blocked by ice that was generally retreating to the west. The largest of these glacial lakes occupied the Knewstubb Lake valley (Huscroft, 1999; Huscroft and Plouffe, 1999; Plouffe and Levson, 2001a). In the west, smaller glacial lakes formed following local drainage impoundment by ice and sediments. Glacial lake sediments were used to built the core of Kenney Dam because of their high impermeability when compacted.

Colluvial deposits include sediments reworked by mass-wasting processes in steep terrain. Their composition is dependant on the source sediments. Colluvial deposits include landslides; the largest ones occur west of Chelaslie Arm, east of Tatelkuz Lake, and south of Entiako Lake (*see also* Lowe et al., 2001).

Alluvial deposits are composed of sediments transported and deposited by streams in postglacial time. All streams in the region contain some alluvial deposits, but only in the larger ones are such deposits extensive enough to be mapped. Mapped alluvium along the Skins Lake spillway was deposited after the completion of the Nechako Reservoir in 1952. Some alluvial deposits are potential aggregate resources, but stream siltation or contamination caused by gravel extraction can be a limiting factor for the exploitation of such resources.

Organic deposits accumulate in poorly drained depressions in sediments and bedrock. They are particularly abundant in regions underlain by impermeable till, in valleys with underfit streams, and within low-gradient meltwater channels.

Anthropogenic deposits, consisting of sediments reworked by human activities, were only mapped at the Kenney Dam site.

Glacial landforms

Glacial landforms in the map area include erosional forms (e.g. cirques, arêtes, meltwater channels), streamlined landforms of a variety of scales (striae, drumlins, etc.), and ice-contact deposits (ribbed moraines, eskers, crevasse fills).

Cirques are bowl-shaped depressions in bedrock carved by the erosional action of alpine glaciers. Arêtes are narrow bedrock ridges that separate adjacent cirques. Cirques and arêtes were only mapped in the Fawnie and Nechako ranges. Their presence reveals that valley glaciers formed in these mountain ranges, probably in the early phases of the last glaciation.

Glacial striations are linear abrasion marks formed as rock fragments embedded in the sole of a glacier were dragged across a bedrock surface. Consequently, orientation of glacial striations are indicative of the general sense of ice movement. Some striated bedrock surfaces record more than one set of striations, and for some of these the age relationship between the striation sets could be established from truncated surfaces or the presence of striae only on the stoss sides of the bedrock outcrop.

Drumlins, crag-and-tail features, and glacial flutings are macrolandforms that were observed on digital elevation models (Lowe et al., 2001), airphotos, and on the ground. Only crag-and-tail features and drumlins with asymmetrical longitudinal profiles are indicative of flow direction. Some of the drumlins in the map area are characterized by crescentic depressions at their stoss end. Cobble- and pebble-sized lag gravels directly overlying till were observed in some of the depressions. Mate (2000) has suggested a two-step process for drumlin formation in the map area: drumlins were first formed by subglacial ice erosion and deposition, followed by the erosion of crescentic depressions by subglacial meltwater.

Subdued and sinuous ridges with a general orientation perpendicular to ice flow were mapped as ribbed moraines in the southern part of the map area. Those ridges were first pointed out by Tipper (1971) who described them as drift ridges. The ribbed moraines of the Nechako River map area are similar to the ones reported by Aylsworth and Shilts (1989) for the Keewatin Ice Sheet. One difference is that here the ribbed moraines are not fluted or drumlinized. At the time of mapping, there was a lack of road access in regions of ribbed moraines, so that few field observations were made of these landforms.

A cluster of lateral moraines, generally consisting of straight and steep-sided ridges, was mapped south of West Road (Blackwater) River. These moraines are thought to have formed in a frontal position and therefore are indicative of the ice configuration during glacier retreat.

Crevasse fillings were first reported in the Nechako River map area by Tipper (1963). They consist of till ridges draped by poorly sorted gravel and massive silt (Mate and Levson, 2001). Crevasse fillings have no preferred orientation.

Eskers are sinuous ridges composed of sand and gravel deposited in channels at the glacier base or within the ice. Important esker complexes were mapped southeast of Natalkuz Lake and west of Tatelkuz Lake. Eskers can represent important aggregate resources.

Kettles are depressions left in the ground following the melting of buried ice. Kettles are most commonly found in association with ice-contact landforms (e.g. eskers) and sediments (unit Gh).

Numerous meltwater channels were mapped in the Nechako River map area. Small meltwater channels are interpreted as lateral and direct overflow meltwater channels formed in subaerial positions at the ice margin. Lateral meltwater channels, oriented subparallel to topographic contour lines, are indicative of ice-margin configuration during glacier retreat. Where present, they indicate that the higher regions were deglaciated prior to the adjacent valleys. Large meltwater channels probably formed mainly in subglacial positions (Mate, 2000), because eskers occur in some of them (*see* for example the Euchiniko River valley). The floors of the meltwater channels are commonly covered with organic deposits.

Nonglacial landforms

A partly buried valley which extends from the east end of François Lake to just north of Tachick Lake is interpreted to represent the paleodrainage of that region (Plouffe, 1991). Drainage disruption likely occurred following one of the Pleistocene glaciations.

Avalanche and debris-flow tracks are rare in the Nechako River map area. The few that occur are in the Fawnie and Nechako ranges. Site selection for infrastructure such as roads and camps should take into account regions affected by debris flows and avalanches.

Most of the landslides observed in the map area occur in till. Mate (2000) conducted a detailed study on some of the landslides in the Cheslatta River valley and west of Chelaslie Arm. Commonly, the slippage plane of most slope movements occurs in fine-grained sediments underlying the till. Anthropogenic influences that are in part responsible for triggering small landslides in the map area are road construction, logging, and water erosion along the Nechako Reservoir and Cheslatta spillway shorelines.

Dunes, characterized by rolling surfaces, were observed on glaciofluvial terraces in the Nechako River valley, due north of Knewstubb Lake. They are composed of well sorted, very fine sand and silt, and in most exposures appear to be massive. The dunes probably formed at the end of the last glaciation before a forest cover was established; they are currently inactive.

Ice-flow history

At the onset of the last glaciation, valley glaciers first formed locally in the Fawnie and Nechako ranges. However, the dominant source of ice was located in the high regions of the Coast and Cariboo mountains, to the west and southeast of the study area, respectively. Following the coalescence of valley glaciers in the Coast Mountains, ice tongues advanced in a general easterly direction into the Interior Plateau. At this early stage of glaciation, ice flow was dominantly parallel to the trunk valleys. As ice built up, glaciers eventually covered the highest summits and ice-flow direction became less constrained by topography. At glacial maximum, the ice divide located over the Coast Mountains migrated easterly to at least the western edge of the study area (Levson et al., 1999; Stumpf et al., 2000). As a result, the area over which the ice divide migrated experienced a shift from easterly to westerly ice flow. Northwesterly oriented striations found on the west shore of Ootsa Lake are related to the easterly migration of the ice divide (Mate, 2000). Westward ice flow probably only affected the western most part of the Nechako River map area during the last glaciation (Levson et al., 1999; Mate and Levson, 2000; Plouffe and Mate, 2001). Evidence for westward glacial transport has been identified west and northwest of the map area by several authors (Sutherland Brown, 1975; Stumpf et al., 2000), but it has not been documented within the Nechako River map area.

In summary, glacial transport over most of the region was to the east and northeast as revealed by regional ice-flow indicators. Only the western edge of the map area was subjected to a general westward flow event at the glacial maximum.

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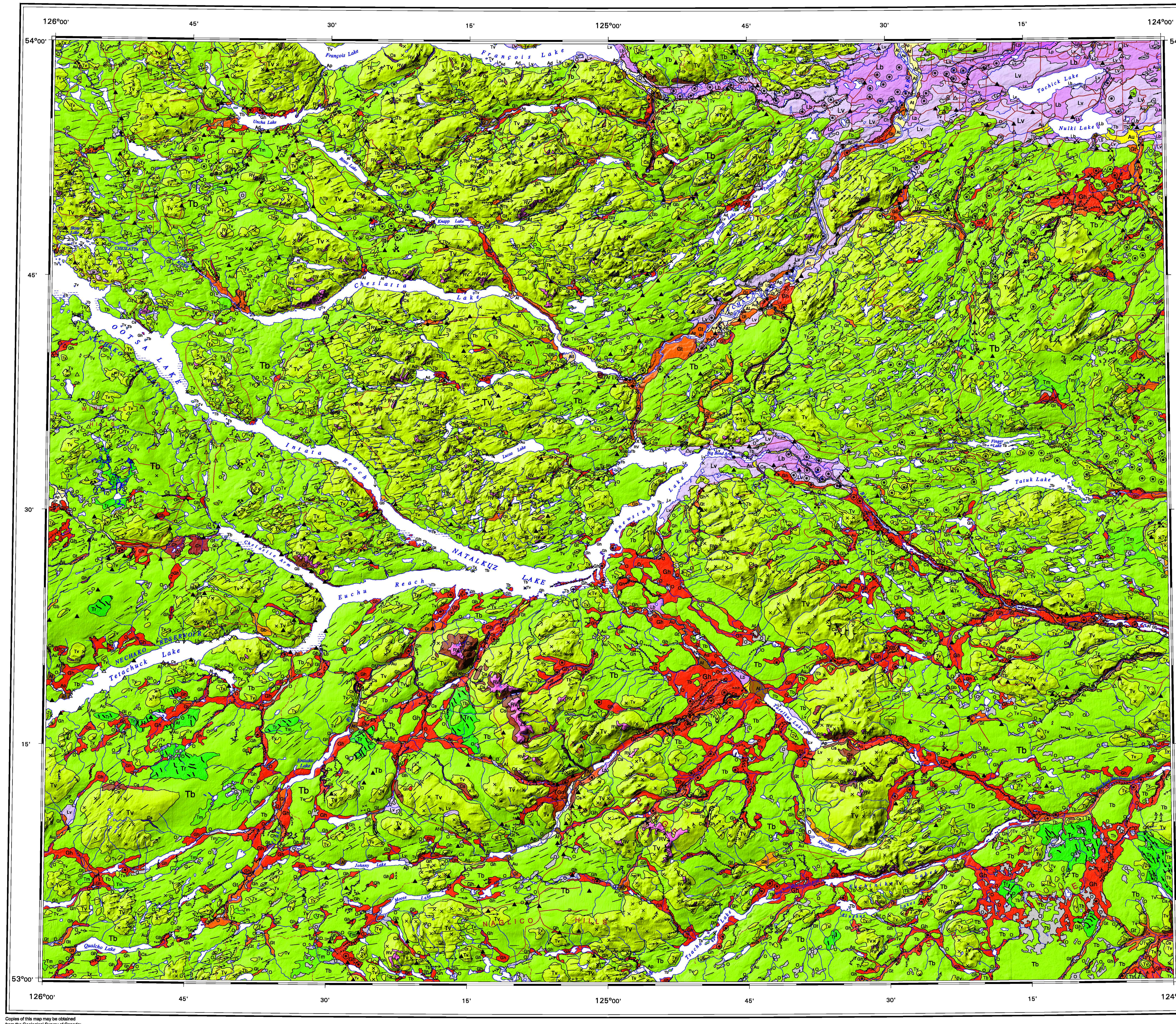

LEGEND

QUATERNARY
POST FRASER GLACIATION
NONGLACIAL ENVIRONMENT

X — ***ANTHROPOGENIC DEPOSITS:*** *rubble, diamicton, and gravel, 1 to 10 m thick, forming flat and steep surfaces, emplaced by human activity; limited to Kenney Dam site.*

O — ***ORGANIC DEPOSITS:*** *peat and muck; 1 to 10 m thick (typically 2 to 3 m) forming fens and bogs; organic deposits too small to be shown at this scale occur within other units; common within abandoned meltwater channels.*

ALLUVIAL (FLUVIAL) DEPOSITS: *gravel and sand with minor silt and clay, deposited by streams; commonly stratified; generally well sorted except in alluvial fans.*

Ap — ***Floodplain sediments:*** *sand and silt, commonly including organic materials and underlain, in many places, by gravel; 1 to 3 m thick; occur as flat surfaces close to river level; prone to flooding.*

At — ***Terrace sediments:*** *stratified sand and gravel overlain by a veneer of sand and silt; 2 to 10 m thick; forming terraces well above flood level.*

Ad — ***Deltaic sediments:*** *stratified sand and gravel underlain by silt and clay; generally 2 to 15 m thick; occur at the mouth of streams entering lakes.*

Af — ***Fan sediments:*** *poorly sorted sand and gravel, with diamicton; generally 2 to 15 m thick; forming fans at the toe of slopes.*

Au — ***Alluvial sediments, undivided:*** *undivided floodplain, terrace, deltaic, and fan sediments.*

COLLUVIAL DEPOSITS: *diamicton and rubble accumulated from various mass wasting processes, ranging from slope wash to rock fall; composition dependent on source materials.*

Ch — ***Landslide debris:*** *mostly unconsolidated sediments, with texture dependent on source materials; generally 1 to 10 m thick, but may exceed 10 m near the toe of large landslides; forming hummocky accumulations on lower slopes and valley floors; commonly developed in till.*

Cs — ***Slope colluvium:*** *rock fragments in a matrix of sand, silt, and minor clay; 1 to 5 m thick; formed by reworking of unconsolidated deposits on steep (>40°) slopes; commonly gullied.*

Ca — ***Talus:*** *rubble and block accumulations at the bottom of steep (>40°) slopes forming aprons and cones; 1 to 10 m thick.*

FRASER GLACIATION (WISCONSINAN)
PROGLACIAL AND GLACIAL ENVIRONMENT

GLACIOLACUSTRINE DEPOSITS: *well sorted, stratified sand, silt, and clay deposited in deep water of former glacial lakes; includes sporadic sand and gravel deposited in a nearshore environment; sand, silt, and clay commonly occur as rhythmites with rare debris flow interbeds; outliers are common on adjacent units; contacts between subunits Lp, Lb, and Lv are gradational.*

Lp — ***Glaciolacustrine plain:*** *well sorted, stratified sand, silt, and clay; generally >10 m thick; masking the underlying topography; locally incised.*

Lb — ***Glaciolacustrine blanket:*** *well sorted, stratified sand, silt, and clay; 3 to 10 m thick; reflecting topography of underlying units.*

Lv — ***Glaciolacustrine veneer:*** *deep-water deposits of well sorted, stratified sand, silt, and clay overlain, in places, by shallow water deposits of sand and gravel; occurs near limits of former glacial lakes; unit includes minor till outcrops; 1 to 3 m thick; reflecting topography of underlying units.*

GLACIOFLUVIAL DEPOSITS: *sand and gravel, well to poorly sorted, and commonly stratified; deposited by glacial meltwater; bedding disrupted locally following the melting of supporting ice.*

Gt — ***Glaciofluvial terrace sediments:*** *sand and gravel, stratified to massive; 1 to 10 m thick; form flat surfaces perched well above alluvial deposits or associated with meltwater channels.*

Gb — ***Glaciofluvial blanket:*** *sand and gravel, stratified to massive; generally 1 to 5 m thick; sediment cover is continuous but the underlying morphology is visible; commonly located near the mouth of meltwater channels.*

Gd — ***Proglacial deltaic sediments:*** *sand and gravel with minor silt and clay; commonly overlies glaciolacustrine silt and clay; 5 to 10 m thick; forming slightly inclined surfaces.*

Gh — ***Ice contact deposits:*** *sand and gravel, stratified to massive and commonly faulted; generally greater than 3 m thick; forming hummocky and kettled surfaces, and eskers.*

GLACIAL ENVIRONMENT

TILL: *poorly sorted diamicton consisting of pebbles, cobbles, and boulders in a sandy to clayey matrix directly deposited by glaciers; includes colluvium (reworked till) on steep slopes, and small inclusions of glaciofluvial sediments, especially in valley bottoms and near the mouth and banks of meltwater channels; till surface is commonly fluted and drumlinized; suffix "-c" denotes the presence of abundant meltwater channels (e.g., Tv-c) too small to be mapped individually.*

Tm — ***Thick till, rolling:*** *continuous till cover; greater than 3 m thick; masking the underlying topography; bedrock outcrops are rare.*

Tr — ***Till, ridged:*** *till cover with a lesser amount of sand and gravel; greater than 3 m thick; forms steep-sided to subdued, straight to sinuous ridges averaging 500 m to 2 km in length; the ridges are composed of till and sand and gravel; organic deposits commonly present in the lower ground between ridges; the ridges are generally perpendicular to ice flow and formed beneath or at the margin of a glacier.*

Tb — ***Till blanket:*** *continuous till cover with few bedrock outcrops; 1 to 3 m thick on average; conforming to and locally obscuring topography of underlying units.*

Tv — ***Till veneer:*** *discontinuous till cover with abundant bedrock outcrops; average thickness of 1 m; reflecting topography of underlying units, which is predominantly bedrock.*

PRE-QUATERNARY

BEDROCK: *sedimentary, metamorphic, volcanic, and intrusive rocks of Precambrian to Cenozoic age; including, in places a thin veneer of till and colluvium; suffix "s" denotes steep bedrock slopes with loose blocks of local bedrock and few erratics.*

RI — *Dominantly intrusive rocks.*

RV — *Dominantly volcanic rocks.*

RS — *Dominantly sedimentary rocks.*

- *Geological boundary*
- *Landslide scar (small, large)*
- *Buried valley*
- *Dunes (inactive, non directional)*
- *Debris flow track*
- *Avalanche track*
- *Paleocurrent direction (of the last glaciation, and below)*
- *Meltwater channel, small (flow direction known, unknown)*
- *Meltwater channel, large (flow direction known, unknown)*
- *Kettle hole (small, large)*
- *Esker (direction of flow known, unknown)*
- *Moraine*
- *Ribbed moraine*
- *Crevasse filling*
- *Lateral moraine (ornamented on glacier side)*
- *Glacial fluting*
- *Crag-and-tail*
- *Drumlin (direction of flow known, unknown)*
- *Glacial striae (direction of flow known, unknown)*
- *Cross striae (1 = oldest)*
- *Arête (fresh)*
- *Cirque (fresh)*
- *Cirque (weathered)*
- *Bedrock lineation*
- *Outcrop*
- *Gravel pit*
- *Quarry*
- *Field observation site (with, without sample)*

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Geological compilation by A. Plouffe, 2002

Co-ordinated by L.C. Struik through the auspices of the Nechako NATMAP Project

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Illumination: azimuth 315°, altitude 45°, vetical factor 2x

This map was produced from processes that conform to the ESS Info Publishing Services Subdivision Quality Management System, registered to the ISO 9001: 2000 standard

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

Digital base map from data compiled by Geomatics Canada, modified by ESS Info

Mean magnetic declination 2004, 21°07′E, decreasing 11.9′ annually. Readings vary from 20°42′E in the SE corner to 21°31′E in the NW corner of the map

Copies of this map may be obtained
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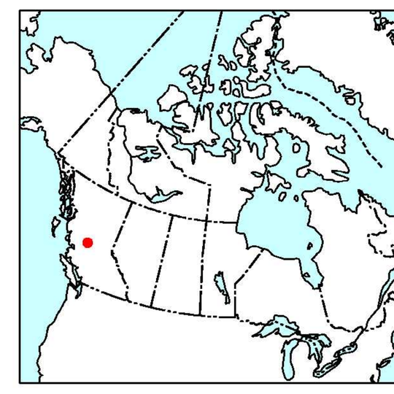


LOCATION MAP

MAP 2067A

SURFICIAL GEOLOGY

NECHAKO RIVER

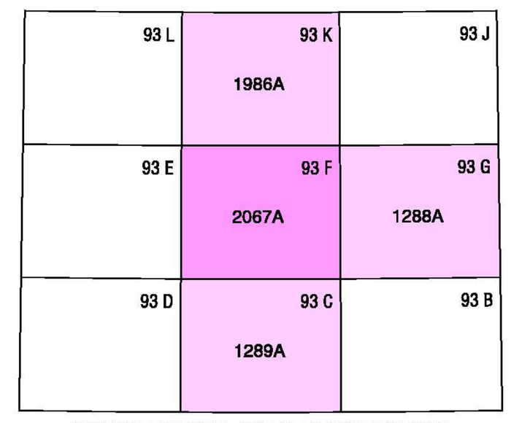
BRITISH COLUMBIA

Scale 1:250 000/Échelle 1/250 000

kilometres 5 0 5 10 15 20 kilomètres

Universal Transverse Mercator Projection
North American Datum 1983

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

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