QUATERNARY GEOLOGY NOTES

INTRODUCTION

In 1995, the multidisciplinary Babine Porphyry Belt project was initiated as part of the Nechako Plateau National Mapping Program to stimulate further exploration and define new mineralization targets in the Babine Lake area. This map is compiled from fieldwork undertaken as part of this project, and compliments bedrock mapping (MacIntyre *et al.*, 1996), till geochemistry and surficial geology mapping (Huntley *et al.*, 1996a; b; Stumpf *et al.*, 1996). Final results of the till geochemical sampling program will be published at a later date.

Basal till matrix samples were collected from 304 stations (1 station per 3 kilometres) for geochemical analyses in order to locate glacially dispersed mineralization present in the region. Basal tills (lodgement and basal melt-out till) were selected since they are first derivative products of erosion and deposition with relatively simple transport histories. As such, mineralized debris dispersed within basal tills can be more readily traced to origin than in most other deposits. Samples were collected from C-horizon profiles in roadcuts, hand-dug pits, trenches, stream cutbanks, borrow pits, and forest blowdowns. Sampling and fieldwork was assisted by Jennifer Hobday and Gordon Weary.

PHYSIOGRAPHY

The Fulton Lake map area covers approximately 894 km^2, and lies close to the northern limit of the Nechako Plateau. The major valleys are broad, trend southeastward, and are occupied by Fulton and Babine lakes. Fulton Lake drains eastward into Babine Lake, which in turn drains northward into the Skeena River.

Three contrasting physiographic elements are observed in the Fulton Lake area. In the northern part of the map sheet is dominated by rugged highlands, locally exceeding 1250 metres (4100 ft). In the central part of the map area and east of Babine Lake, an undulating to rolling plateau and upland topography is common, with glacially eroded hills standing 100 to 150 m above the surrounding lowlands. A third, contrasting physiographic element occurs south of Fulton Lake, where a relatively subdued topography dominates. Southeast-trending bedrock knobs are flanked by extensive areas of organic deposits. A network of north-south oriented drainage channels incise deep gullies into sediment and bedrock, and drain into Fulton Lake.

QUATERNARY HISTORY

The contemporary landscape of the map area is a product of multiple glacial cycles throughout the Quaternary. Pre-Late Wisconsinan fluvial and lake deposits have been documented from the study area. Mammoth skeletal remains and plant material provide an Olympia nonglacial interval age of *ca.* 34 ka for these sediments (Harrington *et al.*, 1974). Pre-Late Wisconsinan sediments at the Bell mine lie unconformably over glacially eroded bedrock, suggesting at least one phase of pre-Fraser glaciation in the area.

Most landforms and sediments are inferred to be the product of Late Wisconsinan Fraser Glaciation (29-11 ka). During early stages of glacial advance, ice accumulated in montane areas of the southern Skeena Mountains and Babine Range, northwest of the study area. Broad valley glaciers from these sources probably flowed southeast along the structurally-controlled Fulton and Babine valleys. The presence of thick glaciolacustrine deposits at the Bell mine (Huntley *et al.*, 1996a) and glaciofluvial sand deposits overlain by till along the Babine valley (*e.g.*, log 2205), suggests that ponding and surface drainage processes were active prior to ice advance. Deposition in the lake continued to a minimum upper elevation of 792 metres (2600 ft), before being overridden by Fraser Glaciation ice. It remains unclear how the lake was impounded.

No upper limit to glaciation has been observed in the area. By the glacial maximum, southeast flowing glaciers inundated the entire area, coalescing to form part of the Cordilleran Ice Sheet. In many areas, bedrock is mantled by Fraser Glaciation basal till (*e.g.*, logs 2333 and AST 010). Late Wisconsinan iceflow directions are reflected by glacial streamlined landforms, including drumlins, roches mountonées and crag-and-tails. The dominant ice-flow indicators in the northern two thirds of the map area trend southeasterly; whereas south of Fulton Lake, the dominant iceflow direction is easterly. This change across the map sheet reflects the confluence of two major ice lobes in the region; one lobe came from the northwest moving parallel to the Babine Lake valley and the other was influenced by westerly flowing ice south of the map sheet. Striae directions tend to be more variable than large-scale iceflow indicators, ranging from east to south, but are generally consistent with regional flow. As glaciers thinned during later stages of the Fraser Glaciation, ice flow was locally influenced by topography. For example, near sites 1170 (west of Granisle) and 1191 (in the northwest corner of the map sheet) ice flow indicators show probable late stage deflection around topographic highs. Along the east side of Babine Lake, striae indicating ice flow towards 140° are cross-cut by younger striae parallel to 180° to 190°. In several areas, northeasterly trending till ridges are interpreted as flutings. The significance of these features to the regional glacial history is ambiguous, but they may reflect local late stage modifications of iceflow.

The distribution of washed and supraglacial tills (*e.g.*, logs 1323 and 1339), and glaciofluvial sediments (*e.g.*, logs 1055, 1115, 1129, AST 002 and AST 005) in the map area is consistent with downwasting of stagnant ice confined to valleys. Hummocky moraine and eskers occur locally along the sides of the Babine Lake valley in the southeast part of the map sheet. Also, large expanses of stagnant ice topography dominate the area around Fulton Lake. For example, in the area to the north of Fulton Lake, extensive deposits of ablation moraine or winnowed till and numerous esker systems occur, suggesting that a significant period of ice-stagnation and downwasting occurred there.

Numerous eskers, meltwater channels and glaciofluvial deltas developed in the area during deglaciation. Eskers north and south of the Fulton Lake valley occur at elevations of about 915 metres (3000 ft). These features were probably formed subglacially during ice stagnation. Glaciolacustrine sediments (*e.g.*, log 1124) occurring up to elevations of about 840 metres (2750 ft) along Fulton Lake, delineate the maximum level of a glacial lake developed in that valley. Several glaciofluvial deltas (*e.g.*, logs AST 001 and AST 006) along the Babine Lake valley, indicate maximum lake levels between about 760 and 790 metres (2500 and 2600 ft). The hydrologic relationship of these lakes to glacial lake Fraser, which had a similar range of elevations (Clague, 1988), is currently being investigated.

REFERENCES

British Columbia Ministry of Environment, Lands and Parks (1967): Soils and Landforms Map, Fulton Lake 93 L/16; *British Columbia Ministry of Environment, Lands and Parks,* Surveys and Mapping Branch, Provisional Map (scale 1:50 000).

Clague, J.J. (1988): Quaternary Stratigraphy and History, Quesnel, British Columbia; *Géographie Physique et Quaternaire*, Volume 42, pages 279-288.

Harrington, C.R., Tipper, H.W. and Mott, J.R. (1974): Mammoth from Babine Lake, British Columbia; *Canadian Journal of Earth Sciences*, Volume 11, pages 285-303.

Huntley, D.H., Stumpf, A., Levson, V.M. and Broster, B.E. (1996a): Quaternary Geology and Regional Till geochemical Sampling in the Central Babine Lake Area (93 L/16 and 93 M/01), British Columbia; *in* Geological Fieldwork 1995, Grant B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1996-1.

Huntley, D.H.., Levson, V.M. and Weary, G.F. (1996b): Surficial Geology and Quaternary Stratigraphy of the Old Fort Mountain area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Open File 1996-9.

MacIntyre, D.G., Webster, I.C.L. and Belafontaine, K.A. (1996): Babine Porphyry Belt Project Bedrock Geology of the Fulton lake Map Area (NTS 93 L/16); *in* Geological Fieldwork 1995, Grant, B. and Newell, J.M., Editors, *B.C. Ministry of Mines and Petroleum Resources*, Paper 1996-1.

LEGEND FOR STRATIGRAPHIC SECTIONS

Glaciofluvial Sediments

Bm	Massive boulders
Cm	Massive cobbles
Gm	Massive gravels
Gt	Cross-trough bedded gravels
Sm	Massive sand
Sp	Planar bedded sand
St	Cross-trough bedded sand
Sr	Ripple bedded sand
Sf	Sand and silt; deformed bedding

Glaciolacustrine Sediments

Fm	Massive silt and clay
Fl	Laminated silt and clay

Colluvial Sediments

Dcm	Massive clast-supported diamicton
Dcs	Stratified clast-supported diamicton

Morainal Sediments

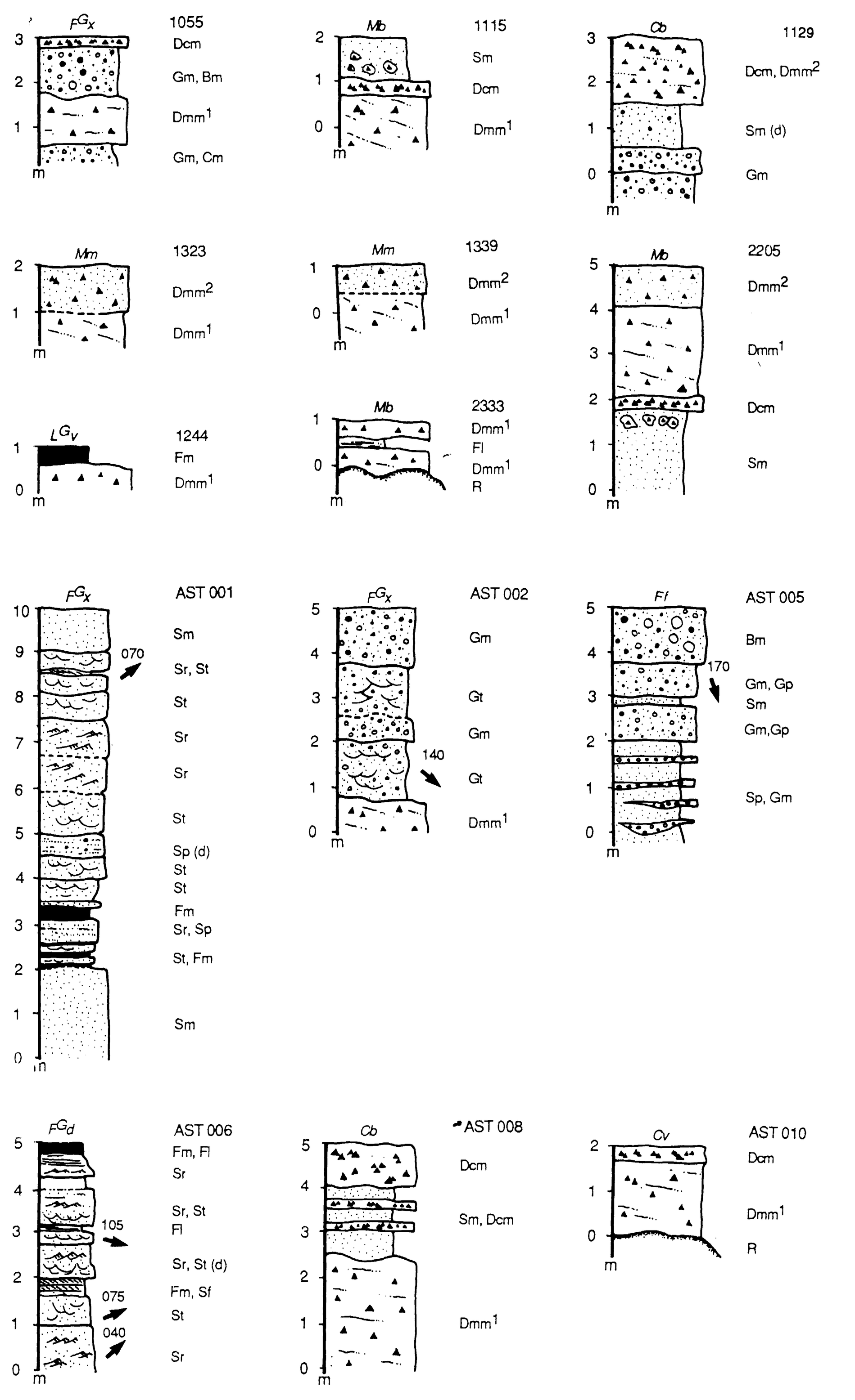
Dmm^1	Massive matrix-supported diamicton (basal till)
Dmm^2	Massive matrix-supported diamicton (supraglacial till)
Dms	Stratified matrix-supported diamicton

Bedrock

R	Bedrock; includes weathered bedrock

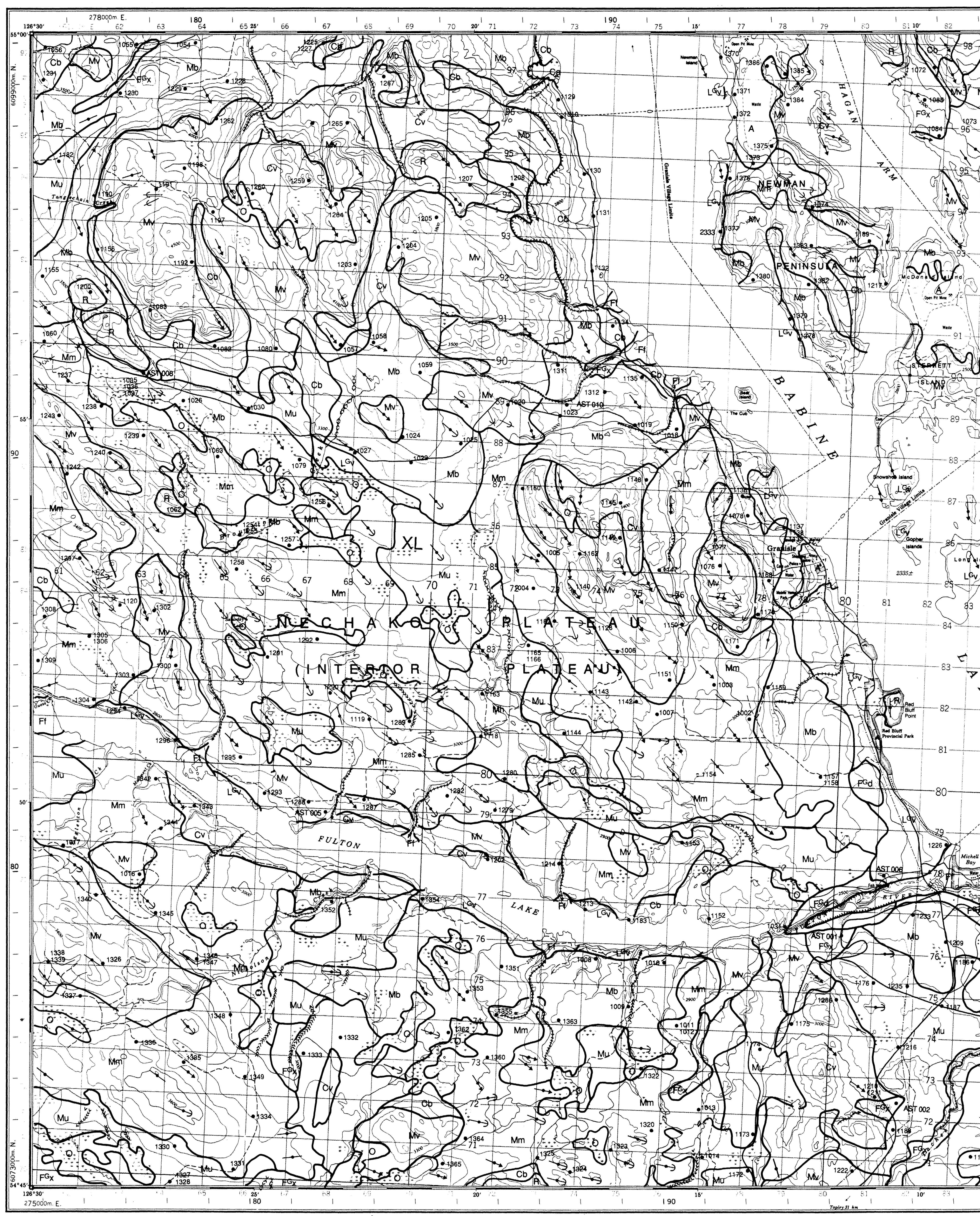
Additional Symbols

140°	Paleocurrent direction
(d)	dropstones
$F^{G}v$	Surficial geology unit (see map legend)



LANDFORM SYMBOLS

- Crag-and-tails, roches moutonnées
- Drumlins
- Glacial flutes
- Striae, glacial grooves (i, ii indicates cross-cutting relationship)
- Mineralized erratics
- Lateral moraine
- Crevasse fill deposit
- Spillway or meltwater channel (major)
- Meltwater channel (minor)
- Esker (flow direction known; unknown)
- Conical kame
- Terrace
- Slope failure
- 1364 Till sample site
- DHH001 Stratigraphic section



Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

Geological Survey Branch

OPEN FILE 1996-10

SURFICIAL GEOLOGY AND QUATERNARY STRATIGRAPHY OF THE FULTON LAKE AREA

NTS 93L/16

Geology by A.J. Stumpf, D.H. Huntley, V.M. Levson and E.K. O'Brien

Scale 1:50 000 Échelle

Miles 1 0 1 2 3 Miles

Metres 1000 0 1000 2000 3000 4000 Mètres

LEGEND

QUATERNARY

HOLOCENE

A **ANTHROPOGENIC DEPOSITS**: culturally disturbed and modified terrain.

O **ORGANIC DEPOSITS**: peat and other vegetative materials at least 50 cm thick and often few metres thick; formed by the accumulation of organic matter in depressions or level areas including bogs, fens and swamps.

F **FLUVIAL DEPOSITS**: gravel to silt-size sediments deposited by rivers, streams and creeks; commonly well-sorted and stratified; clasts well-rounded.

- **Ff** **Fluvial fan sediments**: cobble to pebble gravel, including sand and silt; generally greater than 1 m thick; well-sorted to massive; includes areas subject to debris flows, flooding and stream avulsion.

C **COLLUVIAL DEPOSITS**: massive and stratified, clast and matrix-supported diamicton or rubble resulting from mechanical or chemical weathering of bedrock and other surficial materials, and the downslope movement of materials; reworked and transported by gravitational processes including creep, sliding, debris flow, avalanching, topple and rockfall.

- **Cb** **Colluvial blanket**: diamicton or rubble masking minor topographic irregularities in the underlying unit; greater than 1 m thick.
- **Ca** **Colluvial apron and failure sediments**: rubble or diamicton in complex fans, aprons, talus cones; generally resulting from slope failures and localized mass movements including debris flows and rockfalls; generally several metres thick.
- **Cv** **Colluvial veneer**: diamicton or rubble with surface expression derived from topographic irregularities in the underlying unit; less than 1 m thick and locally discontinuous.

LATE WISCONSINAN

L^G **GLACIOLACUSTRINE DEPOSITS**: well-stratified sand, silt and clay, including minor gravel and diamicton deposited in lakes adjacent to glacial ice; slump structures, irregular topography and kettles, indicative of collapse from melting of buried ice, may be locally present.

- **$L^{G}v$** **Glaciolacustrine veneer**: sand, silt and clay with surface expression derived from topographic irregularities in the underlying unit; less than 1 m thick.

F^G **GLACIOFLUVIAL DEPOSITS**: cobble to pebble gravel, including minor sand, silt and diamicton; deposited by rivers and streams flowing from or in contact with glacial ice, including spillways, sandurs, raised deltas and kames; sorting good to poor; massive to well-stratified; evidence for ice collapse including slumping, kettles and irregular topography.

- **$F^{G}b$** **Glaciofluvial blanket**: cobble to pebble gravel, including minor sand, silt and diamicton; masking minor topographic irregularities in the underlying unit; generally several metres thick.
- **$F^{G}p$** **Glaciofluvial plain**: cobble to pebble gravel, including minor sand, silt and diamicton; generally several metres thick; topography level or nearly level.
- **$F^{G}d$** **Glaciofluvial delta**: cobble to pebble gravel, including minor sand, silt and diamicton; generally several metres thick; fan-shaped planform.
- **$F^{G}x$** **Glaciofluvial complex**: cobble to pebble gravel, including minor sand,silt and diamicton; generally several metres thick; includes areas consisting of up to 50 percent **FGb**, **FGp**, **LGv**, **Mb**, **Mu** and **Mh**.

M **MORAINAL DEPOSITS**: glacial diamicton, primarily till; generally consists of pebbles, cobbles and boulders in a clay, silt and, or sand-rich matrix; massive to stratified; deposited either directly by glacial ice, meltout or sediment gravity flow processes associated with ice.

- **Mb** **Morainal blanket**: predominantly basal till masking minor topographic irregularities in the underlying unit; greater than 1 m thick.
- **Mm** **Rolling moraine**: predominantly basal till with elongate or linear topographic surface expression; commonly drumlinized, fluted or draping glacially-sculpted bedrock; generally several metres thick.
- **Mu** **Undulating moraine**: basal and supraglacial tills with gently sloping topographic surfaces and hollows; generally several metres thick.
- **Mh** **Hummocky moraine**: predominantly supraglacial till and reworked basal tills with hummocky topographic surface expression; commonly with kettle lakes, closed depressions, ridges and knobs; generally several metres thick.
- **Mv** **Morainal veneer**: basal and supraglacial tills with surface expression derived from topographic irregularities in the underlying unit; less than 1 m thick and locally discontinuous.

PRE-QUATERNARY

R **BEDROCK**: includes areas of thin colluvial and morainal cover; subject to mass wasting processes including rockfalls, topples and avalanches.