Quaternary geology and ice flow history in the northwest part of the McLeod Lake Map Area (NTS 093J), central British Columbia: Implications for mineral exploration

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1. Introduction

The McLeod Lake map area, in central British Columbia (Fig. 1.1), has potential for economic mineral occurrences. Mineral exploration has previously been hindered by the extensive cover of surficial deposits. This hindrance has been overcome through a media-specific sampling program of basal tills, whose geochemical signature is influenced by the composition of up-ice bedrock. Knowledge of the Quaternary geology and the ice flow history are essential to the collection and interpretation of till geochemical data.

Figure 1.1. Study area (red box) located in central British Columbia, NTS 093J05/06/11/12/13/14.

2. Objectives and Methods

3. Quaternary Geology

The Quaternary geology was investigated through: (1) the compilation of previous research; (2) the investigation of stratigraphic exposures and surficial material; (3) chronologic control with radiocarbon and optically stimulated luminescence (OSL) dating.

4. Terrain Mapping

Six 1:50 000-scale terrain maps are being produced through the interpretation of aerial photographs in conjunction with digital spatial data and vigorous ground truthing.

5. Ice Flow History

The ice flow history was determined by digitizing and compiling existing macroform data and supplementing with microform and till fabric data collected in the field. Completion of the terrain maps will provide higher resolution macroform data.

6. Mineral Exploration

A regional-scale till geochemical survey was conducted in 2009 with a follow up survey in 2010 around regional geochemical anomalies. The clay plus silt fractions were analyzed for 35 elements by instrumental neutron activation analysis (INNA). The clay fractions were analyzed for 36 elements by inductively coupled plasma mass spectrometry (ICP-MS).

3. Quaternary Geology

3.1 Regional Ice Flow

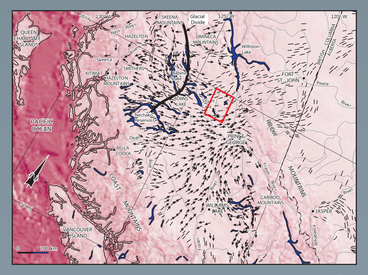

Figure 3.1.1. Regional Late Wisconsinan flow directions of the Cordilleran and Laurentide ice sheets (modified from Stumpf et al., 2000). During the last glaciation, the major regional sources of ice affecting the study area (red box) were from the Coast, Skeena and Cariboo mountains (Tipper, 1971; Levson and Giles, 1997; Plouffe, 1997, 2000). The study area is located near the convergence of these three ice sources.

3.2 Chronology

Figure 3.3.1. Organic samples from a peat deposit overlying glacial outwash sediment provide a minimum age of glacial retreat. One sample yielded a radiocarbon age of 8775 ± 30 (UCAIMS 83989). The actual date of glacial retreat is the reported age plus the time required for the development of the peat.

Figure 3.3.2. Six samples were collected for OSL dating from postglacial eolian sediment. This method of dating determines the length of time since quartz and feldspar grains were exposed to sunlight. Pilot experiments on quartz in one sample have yielded an age of 7.0 ± 0.6 ka. However, this age must be considered preliminary until a full experiment and dose-recovery tests can be completed. The actual age of glacial retreat will be the OSL ages plus the amount of time required for the sand dunes to vegetate and stabilize, provided that the dunes were not reactivated during the Holocene.

3.3 Stratigraphy

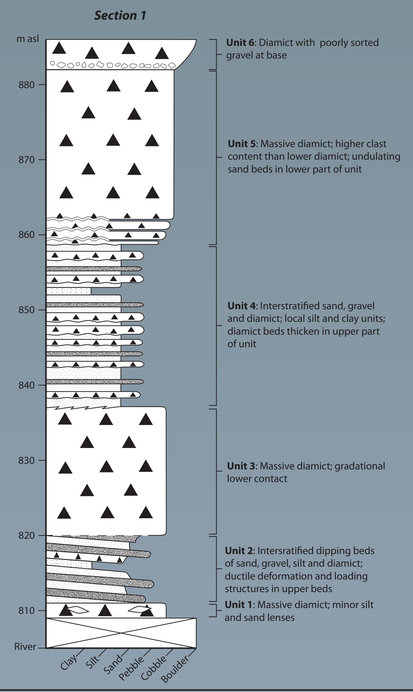

Figure 3.2.1. Section 1 along Carp Lake River illustrates a complex Quaternary stratigraphy. Multiple thick diamict units may be a result of several glaciations or ossalations of the ice front during the advance or retreat during the late Wisconsinan.

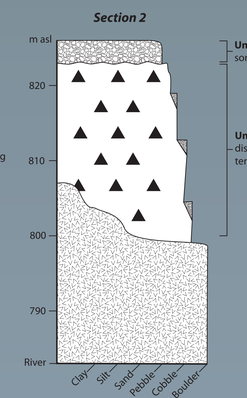

Figure 3.2.2. Section 2 along Carp Lake River shows retreat phase gravel surface, typical in the northeastern part of the study area. The gravel hinders till sampling, although the till can be accessed in road cuts, stream cuts and hand dug pits.

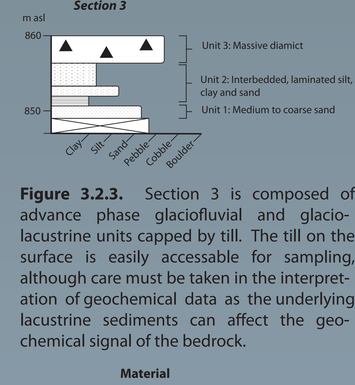

Figure 3.2.3. Section 3 is composed of advance phase glaciofluvial and glaciolacustrine units capped by till. The till on the surface is easily accessable for sampling, although care must be taken in the interpretation of geochemical data as the underlying lacustrine sediments can affect the geochemical signal of the bedrock.

4. Terrain Mapping

Polygons are delineated stereoscopically, using 3-D imagery from high resolution 1:40 000, 1996 and 1997 aerial photographs, based on surficial material and expression. Geomorphic processes are included in the polygon label and on site symbols are used to identify specific landscape features.

4.1 Till

Figure 4.1.1. Typically has a hummocky to rolling surficial expression (1). Basal till is a dense diamict with a silty matrix (2) and was targeted for the geochemical survey.

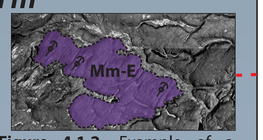

Figure 4.1.2. Example of a polygon encompassing till with a rolling surficial expresion and drumlins, dissected by meltwater during deglaciation.

4.2 Glaciofluvial Sediment

Figure 4.2.1. Commonly deposited as plains (1), terraces and eskers. Material ranges from sand to cobble gravel (2) and is easily mined for aggregate resources.

Figure 4.2.2. Polygon delineating glaciofluvial plains and terraces that impedes till sampling over a large area.

4.3 Eolian Sediment

Figure 4.3.1. Deposited soon after glacial retreat, forms dunes and veneers (1). Typically well sorted medium to fine sand (2).

Figure 4.3.2. Polygon delineating an undulating veneer of sand. Eolian cover is typically 1-3 metres thick in the study area .

4.4 Glaciolacustrine Sediment

Figure 4.4.1. Exposed section of lacustrine sediment (1). Typically plane or undulating surface expression comprised of laminated silt and clay (2).

Figure 4.4.2. Raised lacustrine plain between present day lakes.

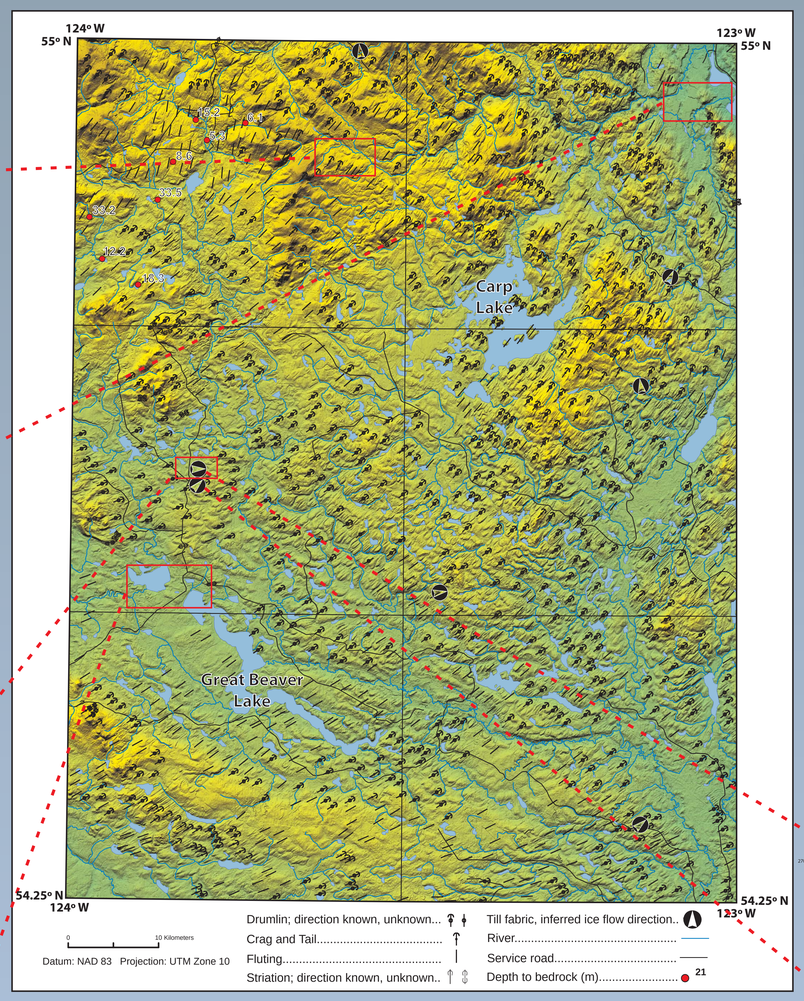

Figure 5. Shaded relief map of the study area illustrating dominant ice flow direction during the Fraser Glaciation. Macroform streamlined features are easily discerned in the elevation model. Drumlins, crag and tails and flutings were digitized from previous maps (Tipper, 1971). Striations on bedrock and till fabric data were collected during this study. Depth to bedrock provided by Barney Bowen.

5. Ice flow

Ice flow history is essential for the interpretation of till geochemical data. The dominant flow direction in the study area is inferred to be to the northeast. The flow direction in the northeast part of the study area is more northerly and in the southern areas, more easterly (Fig. 5).

5.1 Macroform Indicators

Figure 5.1.1. Crag and tails and drumlins are unidirectional flow indicators. A crag and tail (1) consist of a glacially smoothed bedrock knob in the up ice direction and a tail of sediment in the down ice direction. Drumlins (2) are comprised of sediment with a blunt nose in the up ice direction and a tapering tail pointing down ice.

5.2 Microform Indicators

Figure 5.2.1. Striations and rat tails can be preserved on bedrock and can indicate both uni-directional and bi-directional flow as well as relative chronology of flow directions. Relative chronology above is indicated by numbers.

5.3 Till Clast Fabrics

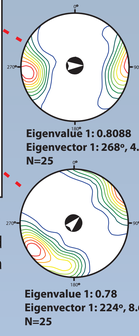

Figure 5.3.1. Stress fields in till created by an overriding glacier causes elongated clasts to become oriented in least-energy positions, which commonly is the direction of ice flow. Two three-dimensional stone a-axis fabrics measured in the same location at different depths show strong orientations to the northeast in the lower fabric and east in the upper fabric. This suggests that ice flow during a later stage of glaciation was more easterly, possibly affecting the geochemical dispersion pattern.

6. Mineral Exploration

Analysis of the regional scale trace element till geochemical data suggests that there are potential economic mineral occurrences in the area. For example, concentrations of Au, Cu, As, and Ag in the northwest part of the study area suggest porphyry Cu-Au style mineralization, similar to that of the Mount Milligan deposit to the north. These findings, combined with spatial correlations with known mineral showings demonstrate that till geochemical surveys are effective in locating anomalous mineral concentrations in areas where thick glacial deposits cover bedrock.

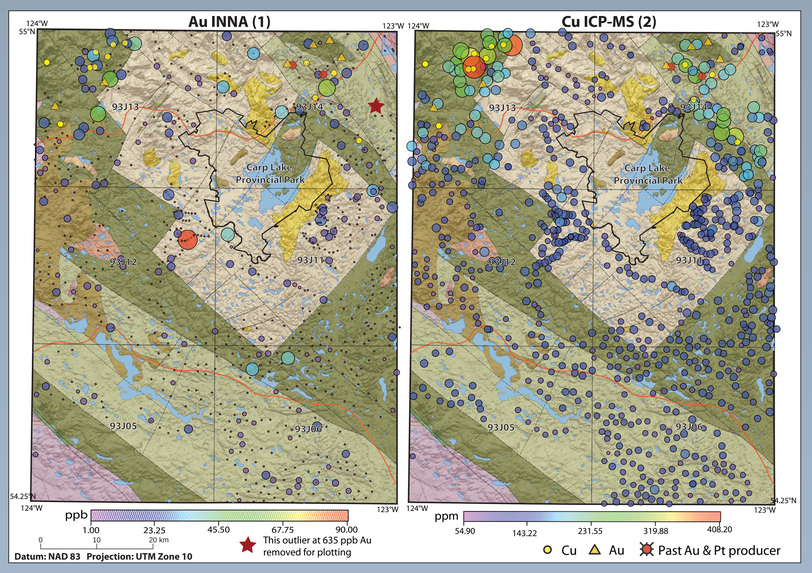

Figure 6.1. Gold (1) and copper (2) concentrations in basal till at 712 sites in part of the Mcleod Lake map area, NTS 09305/06/11/12/13/14. In these examples, the silt plus clay size fraction were analyzed for gold by INNA and the clay fraction was analyzed for copper by aqua-regia digestion followed by ICP-MS. A more comprehensive explanation of the geochemistry results can be found in Ward et al. (2011) in the Geoscience BC Summary of Activities.

References and Acknowledgements

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