British Columbia Ministry of Energy, Mines and Petroleum Resources

Geoscience BC

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Geoscience BC Map 2017-02-01

Basal till potential of the Anahim Lake map area (NTS 093C/06), British Columbia

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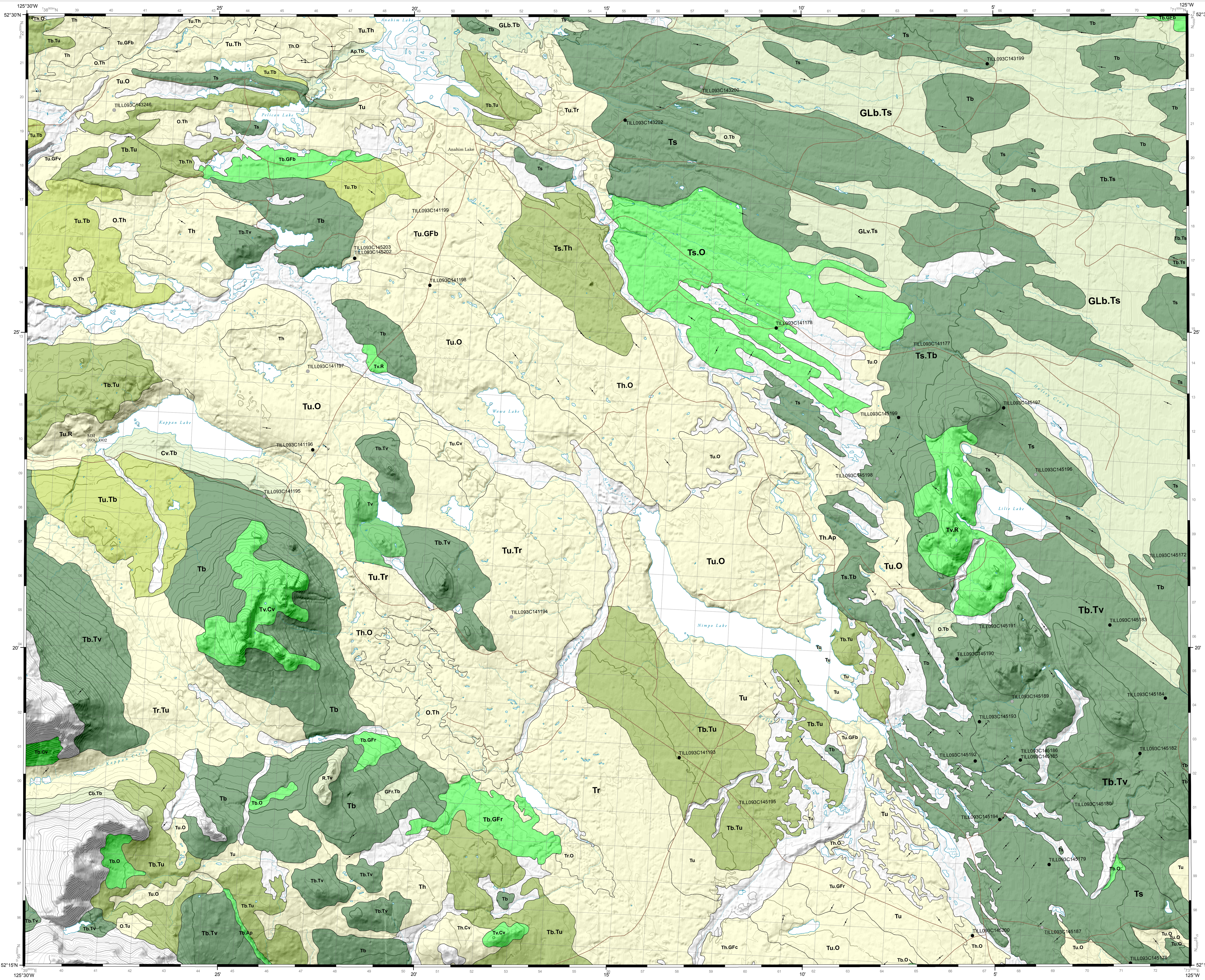

North American Datum 1983
Universal Transverse Mercator Zone 10 North
Shuttle Radar Topography (SRTM) DEM, 1 arcsecond (30 m) resolution
Contour interval 20 metres

0 1 2 4 6 8 10
Kilometres

Scale 1:50,000

NOTE: Where map units are composed of multiple surficial materials, a compound map unit designator is used, separating more extensive materials from less extensive (e.g., for Tb.Tv, Tb is more extensive than Tv).

QUATERNARY

HOLOCENE

NONGLACIAL ENVIRONMENT

ORGANIC DEPOSITS: Mostly saturated organic materials, consisting mainly of mosses, sedges, or other hydrophytic vegetation.

O **Undifferentiated organic deposits:** Bogs, fens, and swamps; generally occur where shallow lakes are infilled and in depressions along floodplains and abandoned meltwater channels.

COLLUVIAL DEPOSITS: Materials deposited by direct gravity-induced movement; lithologic composition dependent on source material; typically poorly sorted, massive to crudely stratified diamicton.

Cv **Colluvial veneer:** Deposits less <2 m thick that conform to underlying topography; typically on steep slopes.

Cb **Colluvial blanket:** Deposits >2 m thick that mask subtle variations in substrate surface but generally conform to underlying topography; typically on steep slopes.

ALLUVIAL DEPOSITS: Sand and gravel with minor silt deposited by modern streams or rivers; typically stratified, moderately sorted to well sorted, with rounded to well-rounded clasts.

Ap **Alluvial floodplain:** Gravel plains (0-3˚ surface slope), overlain in some places by sand and silt deposited during overbank flows; predominantly near present day stream level; prone to flooding.

LATE WISCONSINAN

PROGLACIAL AND GLACIAL ENVIRONMENT

GLACIOLACUSTRINE DEPOSITS: Well sorted, stratified sand, silt, and clay deposited by suspension settling and interflow and underflow currents; diamictons released from floating ice or colluviated from valley sides into glacial lakes; grain size may increase, and sorting may decrease in ice proximal environments.

GLv **Glaciolacustrine veneer:** Deposits <2 m thick that conform to underlying topography; predominantly fine-grained material or silt-rich diamictons.

GLb **Glaciolacustrine blanket:** Deposits >2 m thick that mask subtle variations in substrate surface but generally conform to underlying topography; predominantly in areas of low relief.

GLACIOFLUVIAL DEPOSITS: Poorly sorted to well sorted sand and gravel transported and deposited directly by glacial meltwater.

GFv **Glaciofluvial veneer:** Deposits <2 m thick that conform to underlying topography.

GFb **Glaciofluvial blanket:** Deposits >2 m thick that mask subtle variations in substrate surface but generally conform to underlying topography.

GFc **Ice-contact deposits:** Stratified sand and gravel with minor diamicton, forms hillocks and hollows.

GFr **Eskers:** Sinuous ridges of stratified sand and gravel deposited in subglacial, englacial, or supraglacial channels.

BASAL TILL DEPOSITS: Diamictons eroded, transported and deposited at the base of an active glacier. They are dense, massive, and matrix supported and can be fissile and jointed. Matrix is typically composed of silt, sand, and clay. Clasts are often sub-angular to sub-rounded and can be faceted and striated.

Tv **Till veneer:** Deposits <2 m thick that conform to underlying topography; predominantly in upland regions with isolated bedrock exposures.

Tb **Till blanket:** Deposits >2 m thick that mask subtle variations in substrate surface but generally conform to underlying topography; predominantly in areas of low relief.

Ts **Streamlined till:** Flutings, drumlins, and the sediment (down-ice) part of crag-and-tails.

ABLATION TILL DEPOSITS: Diamictons deposited by melt out, commonly from stagnant ice, of far-travelled supraglacial and englacial material. These deposits typically lack the density of basal till and have a high percentage of matrix sand. May be stratified and include sorted sands and gravels.

Tu **Undulating till:** Loose, sandy diamicton commonly representing thinner deposits near the margins of widespread ice stagnation, or in depressions where localized ice stagnation occurred; consist of hillocks and hollows with slopes ≤ 15°.

Th **Hummocky till:** Loose sandy diamicton commonly representing thicker deposits and widespread ice stagnation; consist of hillocks and hollows with slopes ≥ 15°.

OTHER TILL DEPOSITS: Diamictons composed of subglacial, englacial, and (or) supraglacial debris produced by glacial thrust, push, or meltout processes.

Tr **Ridged till:** Elongate ridges oriented perpendicular to ice-flow direction, formed subglacially or at glacier margin.

PRE-QUATERNARY

BEDROCK: Lithology varies greatly across the map area and includes sedimentary, metamorphic, volcanic, and intrusive rocks of Permian to Quaternary age; outcrop is generally limited to areas of high relief.

R **Undifferentiated bedrock:** High-angle slopes in upland areas or in incised meltwater channels; may be susceptible to rock fall; hummocky, or undulating expressions are the result of glacial or meltwater erosion, or preferential erosion due to structural weaknesses; streamlined bedrock is the result of glacial erosion.

Basal till potential

High

1 Only thick basal till (Tb or Ts); may contain lesser amounts of thin basal till (e.g., Tb.Tv.).

2 Only thin basal till (Tv); may contain lesser amounts of thick basal till (e.g., Tv.Tb).

3 Basal till with lesser amounts of another surficial material, excluding ablation till (e.g., Tb.Cb; Tv.R).

Moderate

4 Basal till with lesser amounts of ablation till (e.g., Tb.Tu).

5 Ablation till with lesser amounts of basal till (e.g., Tu.Tb).

Low

6 Another surficial material with lesser amounts of basal till (e.g., Cb.Tb).

Poor

7 Only ablation or ridged till at surface (Th,Tu, or Tr), or ablation or ridged till and another surficial material, excluding basal till (e.g., Th.O; GFb.Tu; Tu.Tr).

None

Surficial material other than till.

TILL SAMPLES (Labeled with sample number; Jackaman et al., 2015)

Matrix geochemistry

Matrix geochemistry and mineralogy

ICE-FLOW INDICATORS (Arnold et al., 2016)

Drumlin, Drumlinoid or fluting (flow direction known, unknown)

Striation (flow direction known, unknown)

Road

MINERAL OCCURRENCES

Provincial MINFILE database (Labeled with MINFILE name and number)

Showing

MINFILE NUMBER	NAME	STATUS	COMMODITY	DEPOSIT TYPE*
093C 002	MM	Showing	Mo, Cu	

*If deposit type is available, see Lefebure and Ray (1995), Lefebure and Höy (1996), and Simandl et al. (1999) for mineral deposit profile codes and definitions.

DESCRIPTIVE NOTES

The Anahim Lake map area is in the Fraser Plateau, a physiographic subdivision of the Interior Plateau defined by a flat to gently rolling topography. Glacial sediments cover much of the region, and bedrock outcrops are rare (Holland, 1976). Previous work in the area includes soils and terrain mapping by Baender (1980) and glacial features mapping by Tipper (1971). To the east, Kerr and Giles (1993a, b) and Proudfoot and Allison (1993a, b) completed surficial geology mapping. Bedrock geology was originally mapped by Tipper (1969) and has been updated since by Bordet (2014) and Angen et al. (2017). The present basal till potential map continues the series published by Sacco et al. (2014a to j) for Geoscience BC's Targeting Resources for Exploration and Knowledge (TREK) project area (Clifford and Hart, 2014; Sacco et al., 2014k; Sacco and Jackaman, 2015).

Surficial sediment geochemical and mineralogical anomalies can be used to locate buried bedrock mineralization (Saarnisto, 1990; Klassen, 2001). Basal till is ideal for assessing bedrock hosted mineral potential in areas covered by Quaternary sediments because it is commonly a first derivative of bedrock (Shilts, 1993), has a relatively simple and predictable transport history, and produces a geochemical and mineralogical signature that is more extensive than its bedrock source (Levson, 2001). Glacial transport and deposition of basal till produces a dispersal train elongated down ice from its bedrock source (Fig. 1). To date, all till orientation surveys conducted in British Columbia have identified known mineralized sources (Plouffe et al., 2016).

The purpose of the basal till potential map series is to assist in the design of surface sediment exploration programs by identifying areas where basal till is most likely to occur. Ice flow indicators compiled by Arnold et al. (2016) are included in the maps to illustrate the general transport directions of basal till. These data should be supplemented with additional field measurements to assess for local variability.

The basal till potential map series builds on earlier drift exploration potential maps developed by Proudfoot et al. (1995). Existing surficial geology, terrain, or soils and landform mapping data were reviewed and updated to produce the maps. Map unit definitions are based on conventions outlined by Cocking et al. (2016) and Deblonde et al. (2012) and unit colours are related to basal till potential classes. Each unit includes a label that describes the surficial material within it (mainly unconsolidated sediments) and its surface expression (individual plan-view forms and patterns of forms; Howes and Kenk, 1997).

New mapping focused on distinguishing basal till (Fig. 2) from ablation till (Fig. 3) which, because of a more complex transport and depositional history, is ill-suited for mineral exploration. The relationship between surface expression and till facies is predictable (Maynard, 1989; Aario and Peuraniemi, 1992; Proudfoot et al., 1995; Spirito et al., 2011; McClenaghan et al., 2013). For example, blanket, veneer, and streamlined units typically contain basal till facies, whereas undulating and hummocky units typically contain ablation till facies. Based on these relationships we used air photographs supplemented by sparse field data to construct our maps.

Basal till consists of sediment eroded, transported, and deposited at the base of an active glacier (Dreimanis, 1989). It typically has a relatively subdued surface expression that either follows underlying topography (Tb, Tv) or is streamlined in the direction of ice flow (Ts). It is a dense , massive, matrix-supported diamicton, with a matrix mainly of silt with lesser amounts of sand and clay (Fig. 2). Vertical joints and subhorizontal fissility intersections can give basal till a blocky appearance in section. Clasts are mostly subangular to subrounded and are commonly striated. The transport path of basal till is relatively simple and short and can be established by measuring the azimuth of ice-flow indicators produced by subglacial flow. However, multiple ice-flow events can create a more complex transport path, highlighting the importance of ice-flow history reconstructions (Ferbey and Levson, 2009; Plouffe et al., 2016).

Compared to basal till, the transport distance of ablation till is longer and the depositional history more complex. Ablation till consists of material transported in the englacial and supraglacial environments and commonly deposited by passive melt out processes. Melting of remnant ice-blocks mantled or surrounded by glacial debris produces irregular, undulating to hummocky topography (Tu, Th). Ablation till is less consolidated, has a higher percentage of gravel-sized material and a sandier matrix (Fig. 3). It can be massive to crudely stratified and may contain lenses of sorted sand and gravel. Deposited during deglaciation, ablation tills are typically the youngest Late Wisconsinan till facies exposed at surface, and can overlie basal tills. Windows through an ablation till, into an underlying basal till, can exist but may be indistinguishable in air photographs.

In a basal till potential map, each unit with till, as a primary or secondary surface material is assigned a basal till potential rating. High potential is assigned to units containing mainly basal till. The highest potential category (1) includes till blankets (>2 m thick) and streamlined till with some till veneer (<2 m thick). In these units, samples can be collected from most exposures. In the second category of high potential (2), till veneers are predominant and likely include some bedrock exposures. In these areas, sample collection may be most productive down-ice from bedrock outcrop, where till might be sufficiently thick to avoid post-depositional surface processes such as pedogenesis. In the third category of high potential (3), map units are mostly basal till (Tb, Ts, Tv) with lesser amounts of another surface material (excluding Tu or Th). Knowledge of the surface expression of this secondary material, which is provided in the map unit label, will assist in targeting basal till.

Moderate potential is assigned to units containing varying amounts of basal till and ablation till. These map units typically represent (4) thick basal till deposits in depressions or small valleys where ablation till has been deposited, or (5) near the margins of extensive ablation till map units where basal till may be found within a few metres of surface or in areas of higher elevation where ablation till thins.

Low potential (6) is assigned to units consisting mainly of surface material other than till. These areas may include basal till deposits that are too small to resolve at the current map scale, or are discontinuous. Poor potential (7) is assigned to areas of thick ablation till. These areas typically consist of hummocky ablation till and may include lesser amounts of another surficial material (e.g., ice-contact glaciofluvial deposits). These areas are still mapped as having potential because underlying basal till deposits may be present at depth.

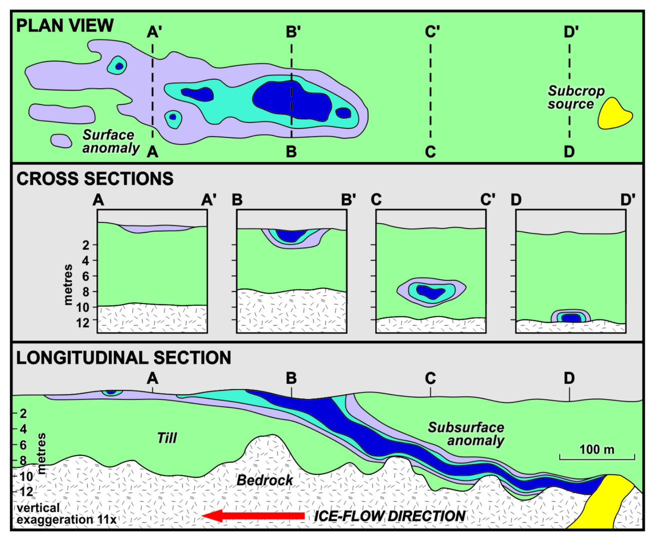

Fig. 1. Model of clastic dispersal in basal till (modified from Miller, 1984). Highest values (dark blue) define the head of a dispersal train at surface, and decrease exponentially in the down-ice direction (light purple). Note how the head of a dispersal train is offset, in the down-ice direction, from its subcrop source.

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Fig. 2. Basal till in vertical exposure. Note blocky appearance. Granule and coarser-sized clasts float in a clay-silt matrix. Measuring tape in centimetres.

Fig. 3. Ablation till exposed in road cut with higher percentage of sand and gravel, and lower density, compared to typical basal tills (see Fig. 2). Pick for scale (65 cm).

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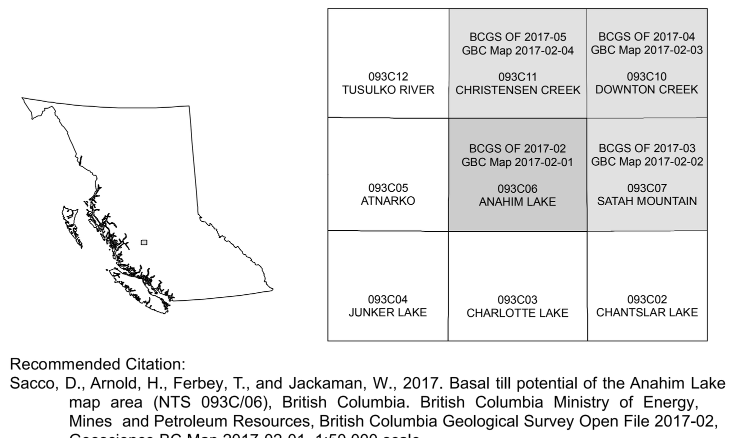

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