Targeted Geochemical and Mineralogical Surveys in the TREK Project Area, Central British Columbia (Parts of NTS 093B, C, F, G)

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Introduction

The Targeting Resources for Exploration and Knowledge (TREK) Project is focused on providing a new geological understanding of the central part of British Columbia's Interior Plateau through the integration of surficial geochemistry, airborne geophysics and geology data (Figure 1). The project is focused on an area of Stikine terrane that has the potential to host a variety of mineral deposit types, including porphyry Cu, porphyry Mo and epithermal Au deposits (e.g., Prosperity, Endako, Blackdome). In addition, the recent discovery of the Blackwater-Davidson Au deposit in the TREK Project area has identified another deposit type with significant economic potential. Exploration in this region has been hindered by Neogene Chilcotin Group basalt flows and extensive glacial drift, which obscures underlying and prospective bedrock units.

As a part of the TREK Project, a surficial geochemistry program is currently underway that aims to provide comprehensive geochemical dataset for the project area. Presented here are the program details and results from the first year of the two- to three-year program.

The TREK geochemistry program consists of three components:

- compilation of historical data from previous geochemical surveys;
- collection of new geochemical and mineralogical data; and
- reanalysis of archived till samples.

A combination of lake and stream sediment and till geochemical and biogeochemical data exist for various parts of the project area, with no one dataset covering the entire region. Typically, geochemical data from these media types are not comparable due to different methods of transport and accumulation. Lake sediment and till geochemical data, however, have been shown to be correlative (Cook et al., 1995; Rencz et al., 2002).The survey discussed here targets basal till, a common material throughout the region, which is well suited to assessing the mineral potential of areas covered by glacial drift (McClenaghan et al., 2000; Levson, 2001, 2002; Lett et al., 2006). Basal till potential maps (BTPMs) were produced and used to assist in the planning and execution of this ambitious survey. Where basal till could not be sampled, higher order bedrock derivatives, such as lake or stream sediments that are comparable to the historic geochemical data, were collected. Till geochemical data from previous surveys will be integrated with new data from this survey. Different analytical methods were used to produce these older data and so available archived till samples will be reanalyzed using modern laboratory techniques to produce a directly comparable master till geochemical dataset for the project area.

Keywords: *TREK, till geochemistry, regional geochemistry, basal till potential mapping, Quaternary geology*

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Project Area

The project area is located in the relatively low relief area of the Interior Plateau (Mathews, 1986), south of Vanderhoof and approximately 60 km west of Quesnel. It occupies parts of NTS 093B, C, F and G and covers more than twenty-eight 1:50 000 scale NTS map areas, a total of approximately 25 000 km^2 (Figure 1). Access is through a network of forest service roads in the Vanderhoof, Quesnel, Chilcotin and Central Cariboo forest districts.

The project area includes parts of the Nechako Plateau, Fraser Plateau and the Fraser Basin physiographic regions (Holland, 1976; Figure 1). The Nechako Plateau has low to moderate relief between 900 and 1200 m above sea level (asl) and includes the Nechako and Fawnie mountain ranges, which have peaks over 1600 and 2000 m asl, respectively. The Fraser Plateau has moderate to low relief between 1000 and 1500 m and includes the Ilgachuz and Itcha mountain ranges, which have peaks over 2200 m asl. Thick surficial deposits composed dominantly of till obscure most bedrock exposures on plateau surfaces. The Fraser Basin is characterized by low relief between 675 and 1000 m asl. Thick glaciolacustrine units occur over large

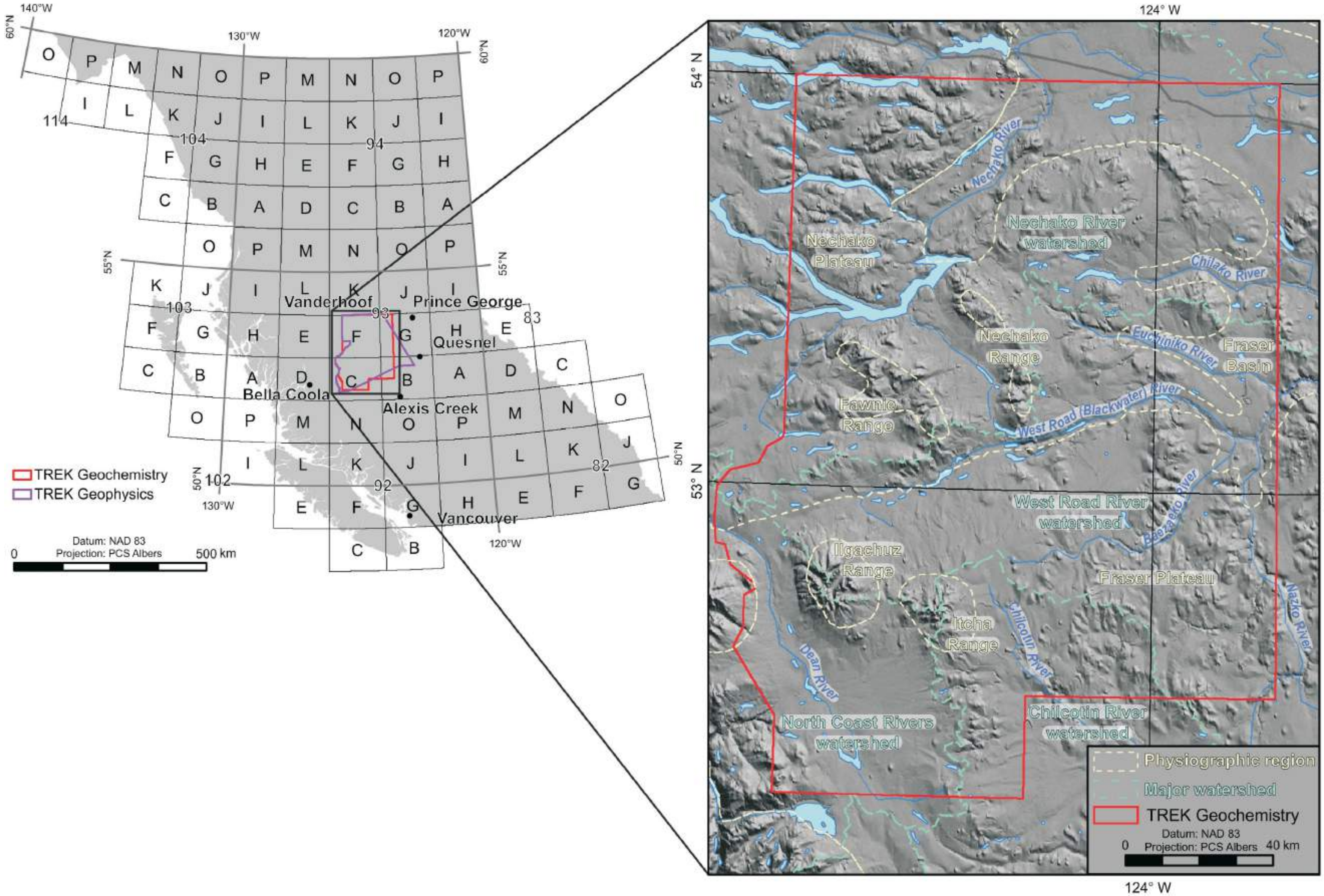

Figure 1. TREK Project geochemistry and airborne geophysics boundaries in central British Columbia. Inset map illustrates physiographic regions (Holland, 1976) and major drainages of the geochemical survey area. Digital elevation model from Canadian digital elevation data (GeoBase®, 2007).

areas of the Fraser Basin. The project area is dissected by several major rivers including the West Road (Blackwater), Baezaeko, Clisbako, Chilcotin and Clusko. Most large rivers have incised the plateau surface, exposing combinations of till, glaciofluvial and glaciolacustrine sediments, or bedrock. Major watersheds are the Nechako and West Road rivers systems that drain into the Strait of Georgia via the Fraser River, and the north coast rivers system that drains the southwest corner of the TREK Project area into the Pacific Ocean (Figure 1).

Bedrock and Economic Geology

The regional geological framework was initially established by Tipper (1969), and then compiled by Massey et al. (2005) and recompiled with regional revisions by Riddell (2006) that focused on oil and gas exploration. Bedrock mapping at 1:50 000 scale has been completed for parts of NTS 093F (Diakow and Webster, 1994; Diakow et al., 1997), NTS 093B (Metcalfe et al., 1998) and NTS 093C (Mihalynuk et al., 2008, 2009). Provided here is a geological summary of the project area from these sources (Figure 2). Basement rocks include the Devonian to Jurassic arc complex of the Stikine terrane, and in the northeast corner, the Mississippian to Early Jurassic accretionary complex of the Cache Creek terrane (Monger et al., 1991). The oldest rocks in the project area belong to the Permian to Jurassic Cache Creek Complex and the Vanderhoof metamorphic complex. The intrusive Triassic to Jurassic Brooks diorite complex is found in the north-central part of the project area. Jurassic rocks are dominant in the northeastern quadrant of the project area. These include volcanic rocks of the Entiako, Naglico and Nechako formations of the Hazelton Group; Fawnie volcanics and Ashman Formation of the Bowser Lake Group; intrusive rocks of the Stag Lake plutonic and Francois Lake suites of the Endako batholith; and the Laidman batholith. The Eocene Frank Lake pluton occurs in the northeast. Units from the Cretaceous include the Kasalka Group volcanic rocks in the northwest, the Capoose pluton in the west-central region, and unnamed andesitic volcanic rocks in the southwest. The north and southwest are composed largely of Eocene to Oligocene volcanic rocks of the Nechako Plateau Group including the Endako and Ootsa Lake formations. The majority of the project area is overlain by Miocene to Pleistocene Chilcotin Group volcanic rocks. The Ilgachuz and Itcha ranges in the southwestern part of the project area are composed of the Miocene to Pleistocene Anahim volcanics.

There are five developed prospects, seven prospects and 39 mineral showings in the TREK Project area (Figure 2). Four of the five developed prospects contain Au, Ag, Zn, Pb and Cu mineralization and include the Blackwater-Davidson intermediate sulphidation epithermal Au-Ag deposit (NTS 093F/02; MINFILE 093F 037; BC Geological Survey, 2013), the Capoose subvolcanic Cu-Ag-Au (As-Sb) and porphyry-related Au deposit (NTS 093F/06; MINFILE 093F 040), and the 3Ts polymetallic Ag-Pb-Zn±Au veins (NTS 093F/03; MINFILE 093F 068) and low-sulphide epithermal Au-Ag-Cu deposit (NTS 093F/03; MINFILE 093F 055). The fifth developed prospect, the CHU deposit, hosts porphyry Mo (low F-type) mineralization (NTS 093F/07; MINFILE 093F 001).

The Baez (NTS 093C/16; MINFILE 093C 015), Clisbako (NTS 093C/09; MINFILE 093C 016), Trout (NTS 093F/10; MINFILE 093F 044) and Wolf (NTS 093F/03; MINFILE 093F 045) prospects all host low sulphidation epithermal Au-Ag mineralization. In contrast, the April Au-Ag-Zn prospect has been classified as high sulphidation epithermal Au-Ag-Cu mineralization (NTS 093F/07; MINFILE 093F 060). At the Laidman prospect (NTS 093F/03; MINFILE 093F 067), Au, Ag, Pb and Zn occur within Au-quartz veins whereas at the Bob prospect Au, Ag, As, Sb and Hg occur within carbonate-hosted and disseminated Au-Ag mineralization (NTS 093B/13; MINFILE 093B 054).

Quaternary Geology

The Quaternary geology of the project area was first described by Tipper (1971a, b) during reconnaissance glacial and geomorphological mapping in the Interior Plateau. Soils and terrain mapping at a 1:50 000 scale was conducted from the 1970s to the 1990s by the BC Ministry of Environment; these references are too numerous to list here, but can be accessed through their website (http://www.env.gov.bc.ca/tei/access_terrain.html). Quaternary stratigraphic framework, glacial history and surficial geology mapping for the Nechako Plateau map area (NTS 093F) can be found in Giles and Levson (1994, 1997), Levson and Giles (1994), Levson et al. (1994), Weary et al. (1997) and Plouffe et al. (2001). Levson and Giles (1997) discuss the Quaternary geology for the Nechako and Fraser plateaus. Giles and Kerr (1993) and Proudfoot (1993) discuss the Quaternary geology for parts of NTS 093C, and Ferbey (2009), Ferbey et al. (2009) and Vickers and Ferbey (2009) discuss the Quaternary geology south of the project area in NTS 093B.

Through the Quaternary, BC has repeatedly been covered by a mass of interconnected glaciers collectively known as the Cordilleran Ice Sheet (CIS; Armstrong et al., 1965; Flint, 1971; Clague, 1989). Sediments of the most recent glaciation, the Fraser Glaciation, are ubiquitous within the project area; sediments deposited prior to this are rare (e.g., Giles and Kerr, 1993; Plouffe and Levson, 2001). During the Fraser Glaciation, thick units of till were deposited beneath the CIS that flowed from the Coast Mountains across the project area. Ice-flow indicators compiled for BC by Ferbey et al. (2013) indicate that flow directions were dominantly to the northeast in the northern part of the project

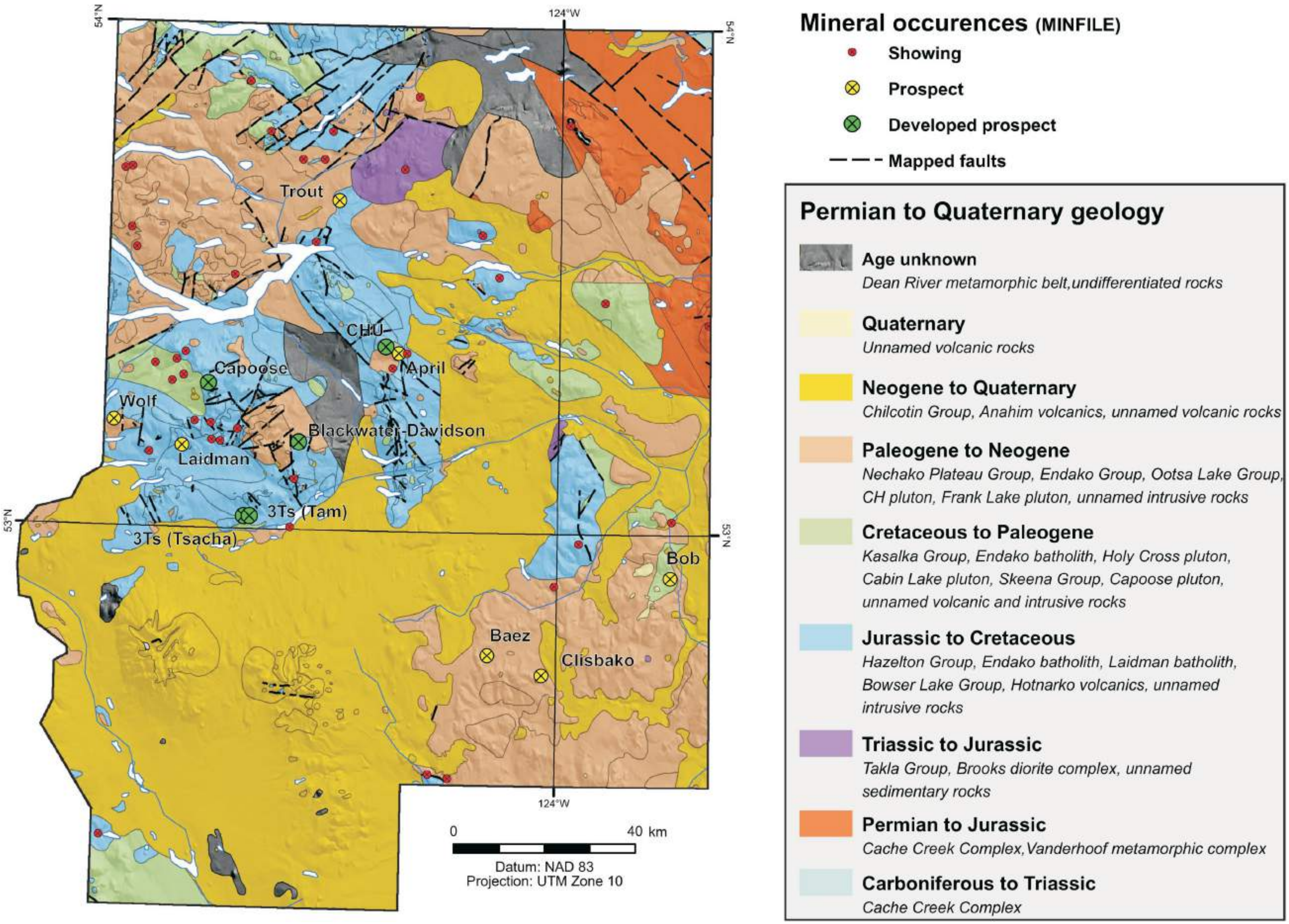

Figure 2. Generalized bedrock geology (after Massey et al., 2005) and mineral occurrences (MINFILE; BC Geological Survey, 2013) of the TREK geochemistry project area. Digital elevation model from Canadian digital elevation data (GeoBase®, 2007).

area, toward the north in the southeastern region, and toward the southeast in the south (Figure 3). Sparse southeast- and northeast-directed ice-flow indicators in the southwest could be the products of a late-glacial readvance through the Anahim Lake region from the Coast Mountains to the west (Tipper, 1971b). Ice-flow features from the glacial maximum may have been destroyed during this readvance, or covered by ablation and melt-out tills as the ice stagnated.

Deglaciation was likely a combination of frontal retreat in the northern and eastern regions of the project area (cf. Fulton, 1991) with widespread stagnation in the southwest (Giles and Kerr, 1993). During this time, large glacial lakes formed in major drainages that were impeded by ice (e.g., Clague, 1989; Plouffe, 1997), and locally in tributary valleys. Subglacial meltwater channels and eskers developed under the ice and glaciofluvial sand and gravel were deposited in channels and outwash plains in front of the ice.

Surficial Geology

Till is the dominant surficial material in the project area and occurs mostly as basal and ablation till facies. A strict definition for basal till is used here: an unsorted diamicton deposited by lodgment or melt-out processes at the base of a glacier with little or no reworking by water (Dreimanis, 1989; Benn and Evans, 2010). Basal till is typically a dense,

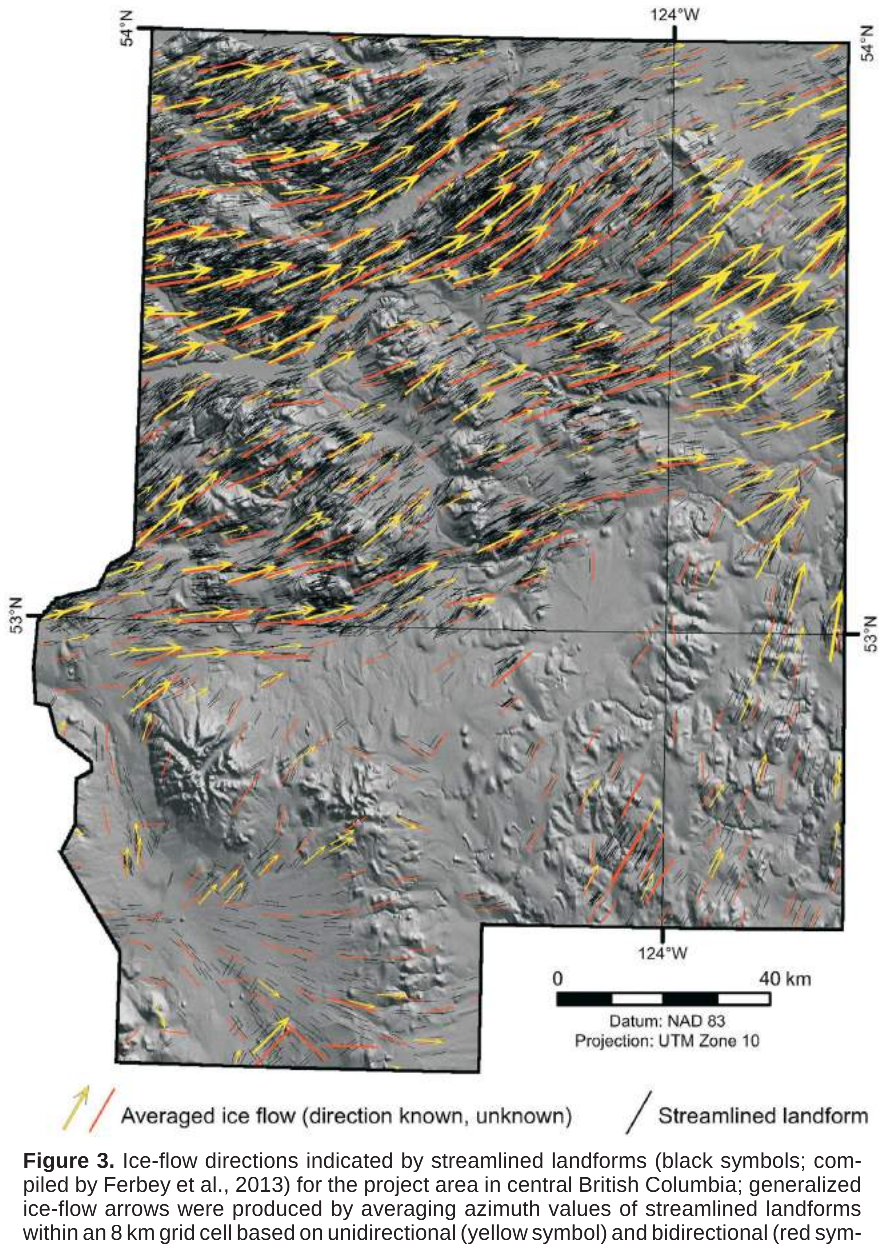

Figure 3. Ice-flow directions indicated by streamlined landforms (black symbols; compiled by Ferbey et al., 2013) for the project area in central British Columbia; generalized ice-flow arrows were produced by averaging azimuth values of streamlined landforms within an 8 km grid cell based on unidirectional (yellow symbol) and bidirectional (red symbol) features. The sizes of the generalized arrows are a function of the density of original streamlined landform data. Digital elevation model from Canadian digital elevation data (GeoBase®, 2007).

overconsolidated, matrix-supported diamicton. It generally conforms to the underlying topography with thicknesses varying from less than one metre at high elevations and in areas of high relief to tens of metres in areas of low relief. In the northern portion of the TREK Project area, it forms drumlinized and fluted terrain, indicating ice flow toward the northeast.

Ablation till is deposited during deglaciation and consists dominantly of far-travelled supraglacial and englacial material (Benn and Evans, 2010). Ablation till is found in areally small deposits in depressions or basins throughout the project area, and is widespread to the north and west of the Ilgachuz and Itcha mountain ranges. Ablation till is differentiated from basal till by its lack of density and high sand content in the matrix. It is generally matrix supported, shows some stratification, and contains sand or gravel lenses, but can also be clast supported or massive. Ablation till typically exhibits a hummocky or undulating surface expression, but in the project area it was observed conforming to the underlying topography near deposit margins.

Other glacial sediments occur within the project area. Well-sorted glaciofluvial sand and/or gravel units are found within meltwater channels and on the upper terraces of major rivers. Less sorted glaciofluvial deposits are commonly spatially associated with ablation till. Areally extensive glaciolacustrine deposits occur within the Fraser Basin in the northeastern part of the project area and in the north coast rivers watershed in the southwest. Less extensive deposits occur within tributary valleys adjacent to ablation till and ice-contact glaciofluvial deposits. Glaciolacustrine sediments in the project area vary from laminated silt and sand to unsorted diamicton. Glaciolacustrine diamicton is particularly common near the limits of glacial Lake Fraser (generally confined by the Fraser Basin; Figure 1) in the northeastern part of the project area and are interpreted as undermelt diamicton (cf. Gravenor et al., 1984). These deposits can be difficult to distinguish from basal till as they commonly part along horizontal planes. In contrast to basal tills, however, they typically lack density and have a matrix composed almost entirely of silt. Aeolian deposits are common around larger glaciolacustrine and glaciofluvial deposits. They occur as veneers (<1 m thick) and extensive dune fields, such as in the southeast corner of NTS 093G/05.

Historic Geochemical Data

Previously published biogeochemical, lake and stream sediment, and till geochemical data are summarized in Table 1 and depicted in Figure 4. Pine tree bark was targeted for biogeochemical sampling. The bark was reduced to ash and analyzed for multiple elements by instrumental neutron activation analysis (INAA), and inductively coupled plasma–emission spectrometry (ICP-ES) following an aqua-regia digestion (Dunn and Hastings, 1998, 1999, 2000). Many archived lake and stream sediment samples were recently reanalyzed by Jackaman (2006, 2008a, b, 2009a, b). Reanalysis of lake sediments was by INAA (25 elements) and inductively coupled plasma–mass spectrometry (ICP-MS; 35 elements) following an aqua-regia digestion. Lake sediments were also analyzed for fluoride by specific ion electrode (SIE) analysis, and organic content by loss-on-ignition. Archived till samples were originally analyzed by INAA for total gold determinations plus 34 elements.

Till Geochemical and Mineralogical Survey

Basal till is well suited to assessing mineral potential of an area because it is a first derivative of bedrock (Shilts, 1993) and therefore has a similar geochemical signature. It was eroded, transported and deposited under ice, thus its transport history is relatively simple and can be determined by reconstructing ice-flow histories. Furthermore, it produces a geochemical signature that is areally more extensive than the bedrock source and potentially easier to locate (Levson, 2001). Basal till in the project area is a massive, dense, dark brown, matrix-supported diamicton. In most exposures, it exhibits subhorizontal fissility and vertical jointing resulting in a blocky appearance (Figure 5). The matrix composition in the project area varies; generally, in the north it is silt to sandy silt and in the south it has a higher sand content. The matrix proportion varies from 70 to 85% with a modal clast size of small pebble and ranges up to boulder.

Table 1. Previous geochemical sampling conducted in the project area, central British Columbia.

Survey year	NTS map area	Type	Sample sites[1]	Reference
1996	093F/09, /10, /15, /16	Tree bark	224	Dunn and Hastings, 2000
1997	093F/13, /14, /12	Tree bark	100	Dunn and Hastings, 1998
1998	093K/02, /03	Tree bark	2	Dunn and Hastings, 1999
1980, 1985[2]	093A, B, G, H, J, K, N, O	Stream	470	Jackaman, 2008a
2005	093C, F	Stream	66	Jackaman, 2006
2008	093E, F, G, J, K, L, M, N, O	Stream	32	Jackaman, 2009b
1993	093F	Lake	380	Jackaman, 2009a
2005	093C, F	Lake	1324	Jackaman, 2006
2007	093G, H, J, K, N, O	Lake	89	Jackaman, 2008b
1992	093C/09, /16	Till	176	Lett et al., 2006
1993	093F/03	Till	171	Levson et al., 1994; Plouffe et al., 2001
1994	093F/07	Till	143	Weary et al., 1997; Plouffe et al., 2001
1994, 1998	093F	Till	292	Plouffe et al., 2001
1996, 1997	093F	Till	314	Plouffe and Williams, 1998; Plouffe et al., 2001

[1]Only sample sites within the study area are listed

[2]Samples reanalyzed in 2007.

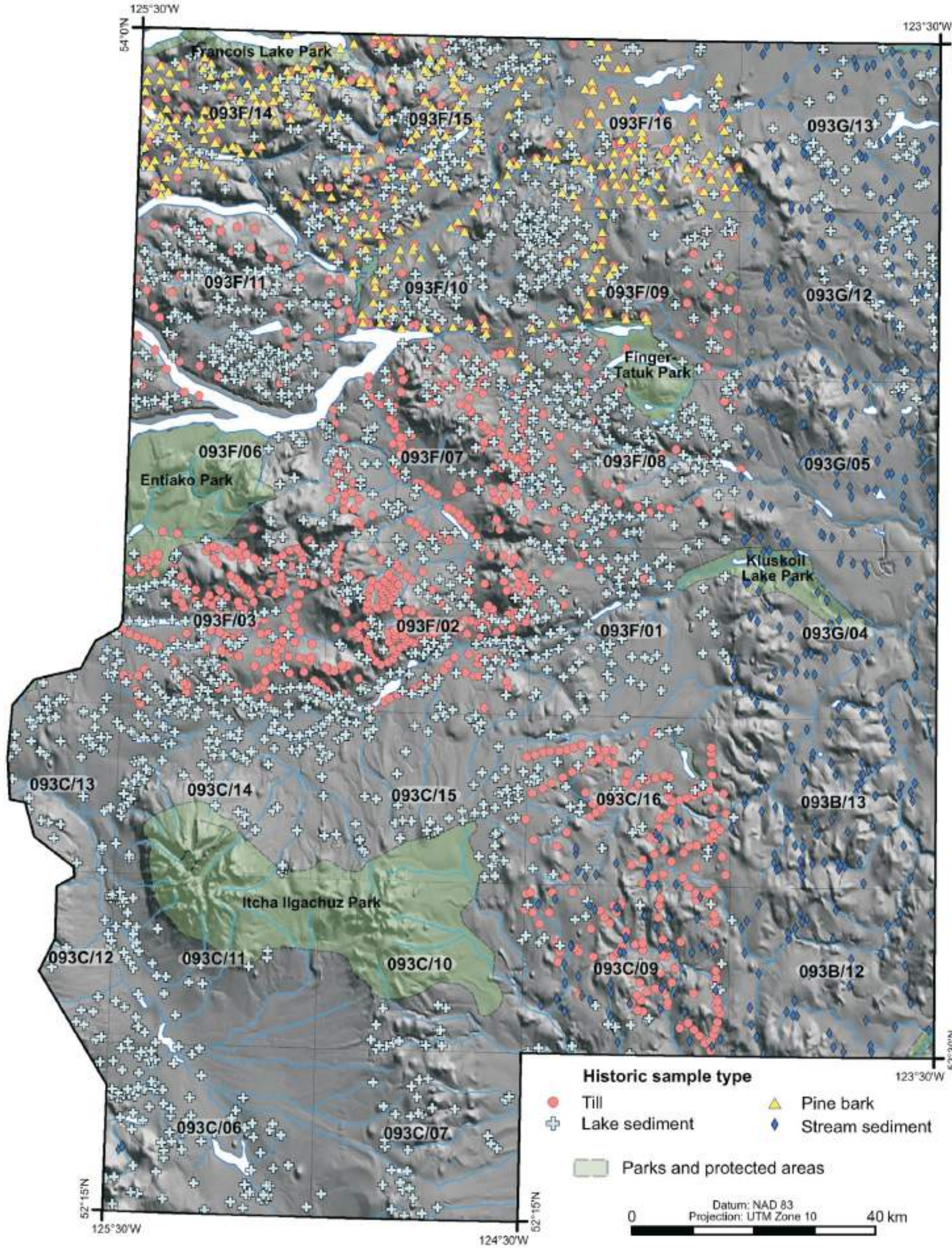

Figure 4. Distribution of archive till (red circle), lake (light blue cross) and stream (dark blue diamond) sediment geochemical data and biogeochemical (pine bark) data (yellow triangle), central British Columbia. See text for references. Digital elevation model from Canadian digital elevation data (GeoBase®, 2007).

Basal Till Potential Mapping

Basal till potential maps delineate areas where basal till is likely to occur and identify the most likely locations for basal till sample collection (Figure 6). Conversely, BTPMs highlight regions where it may be necessary to implement different geochemical sampling protocols or consider alternative sample media due to a lack of basal till.

Drift exploration potential and applicability maps have been produced in the past to assist with geochemical survey design in drift-covered terrain (e.g., Meldrum and Bobrosky, 1994a, b; Huntley and Bobrowsky, 1995; Proudfoot et al., 1995). These derivative maps rely on existing surficial geology mapping and can be limited by the detail and scope of the original mapping. A classification scheme is applied to the existing surficial mapping and the classified polygons are symbolized on the map (i.e., original surficial geology polygons labels are not included). In contrast to this, BTPMs incorporate existing surficial geology mapping and also include a significant component of new mapping. This new mapping is focused in areas where mapping detail can be improved upon or where insights into till facies or genesis can be gained using, for example, newer, higher resolution, digital imagery.

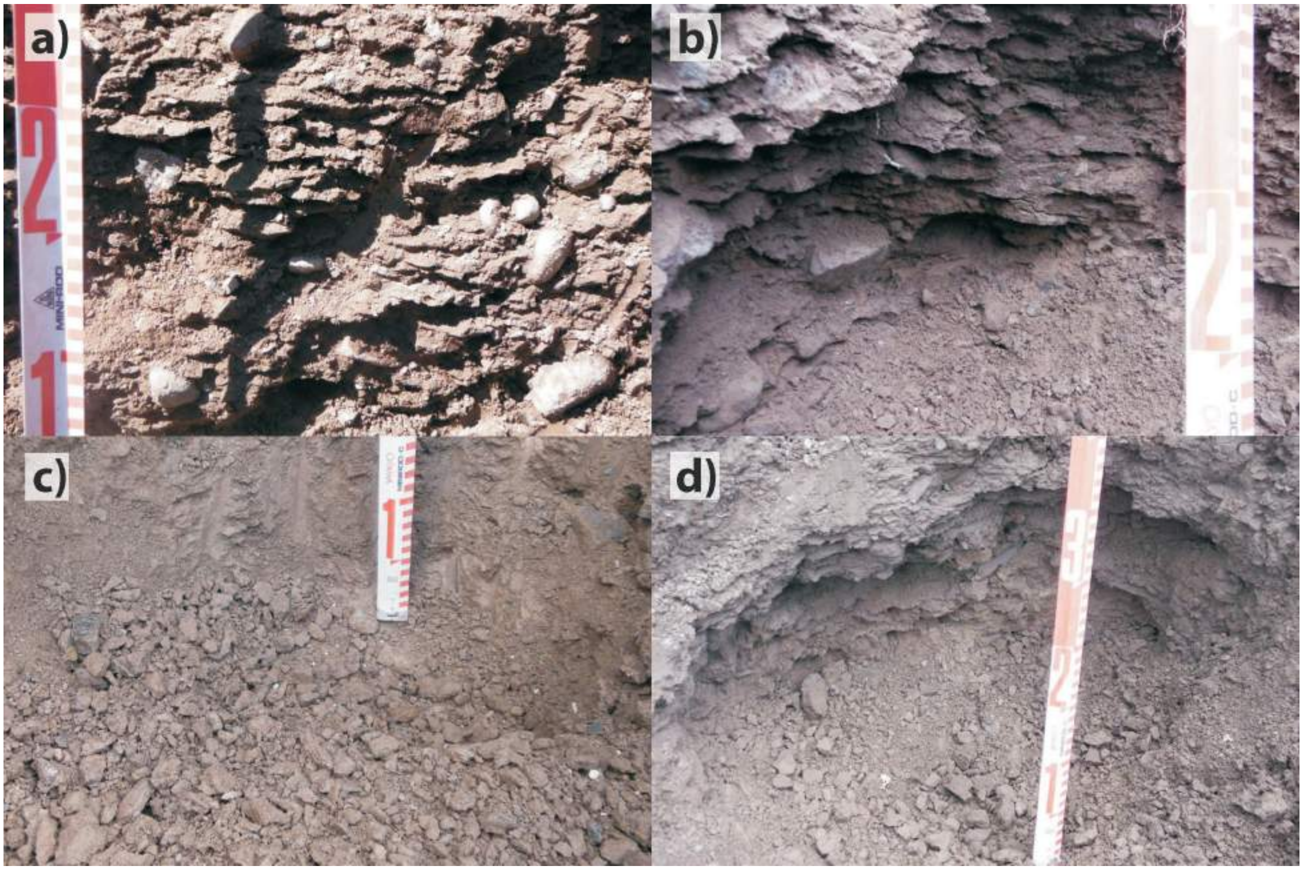

Figure 5. Exposures of basal till from different regions of the project area, central British Columbia. Note characteristic horizontal fissility in **a)** and **b)** and resulting blocky appearance in **c)** and **d)**. Till colour and composition vary with the local bedrock units.

The BTPMs used for the TREK Project were created using DAT/EM's Summit Evolution photogrammetry software (DAT/EM Systems International, 2012) and Esri's ArcGIS (Esri, 2012). On a PC workstation, digital airphotos are viewed in stereo in Summit Evolution. By interfacing with ArcGIS, shapefiles of existing surficial geology contacts can be superimposed on the digital airphoto stereopairs and be edited. New surficial geology linework can be added to existing or newly created shapefiles. Polygon labels are based on the terrain classification system for British Columbia (Howes and Kenk, 1997). During the production of BTPMs, emphasis was placed on differentiating basal till from ablation till, the latter of which is not suitable for geochemical sampling. Areas with limited indication of basal till are left unmapped.

Similar to drift exploration potential and applicability maps, a classification scheme is applied to the mapping to highlight areas (using colours) where basal till is likely to occur and therefore identify the most likely locations for basal till sample collection. A polygon's potential is largely determined by the areal extent of basal till within the polygon and its association with other surficial materials and their depositional environments (Figure 6). For example, a polygon containing only basal till would be assigned high potential as a sampler would have a good chance of collecting a basal till sample anywhere within that polygon. Conversely, a polygon containing ablation till and glaciofluvial deposits would be assigned low potential, in part because basal till has not been mapped (although it is under the ablation till), but also because these surficial materials can be associated with ice-stagnation (conducive to deposition of sand and/or gravel units) and not active ice. Unlike drift exploration potential and applicability maps, BTPMs include the original surficial geology polygon label (surficial material and surface expression). This allows the user to better understand how the classification was applied and to gain some insight into the spatial and genetic associations between different surficial material types and surface expressions. Ice-flow indicators from Ferbey et al. (2013) are also included on the maps to illustrate dominant transport directions in basal till.

This process of 'soft-copy digitizing' significantly increases the speed and efficiency of map production by eliminating the need for transferring linework from hard-copy aerial photographs to the digital environment and the inevitable corrections associated with the digitization process. Soft-copy digitizing produces files that can be immediately transferred to any GIS for planning or use in the field. Basal

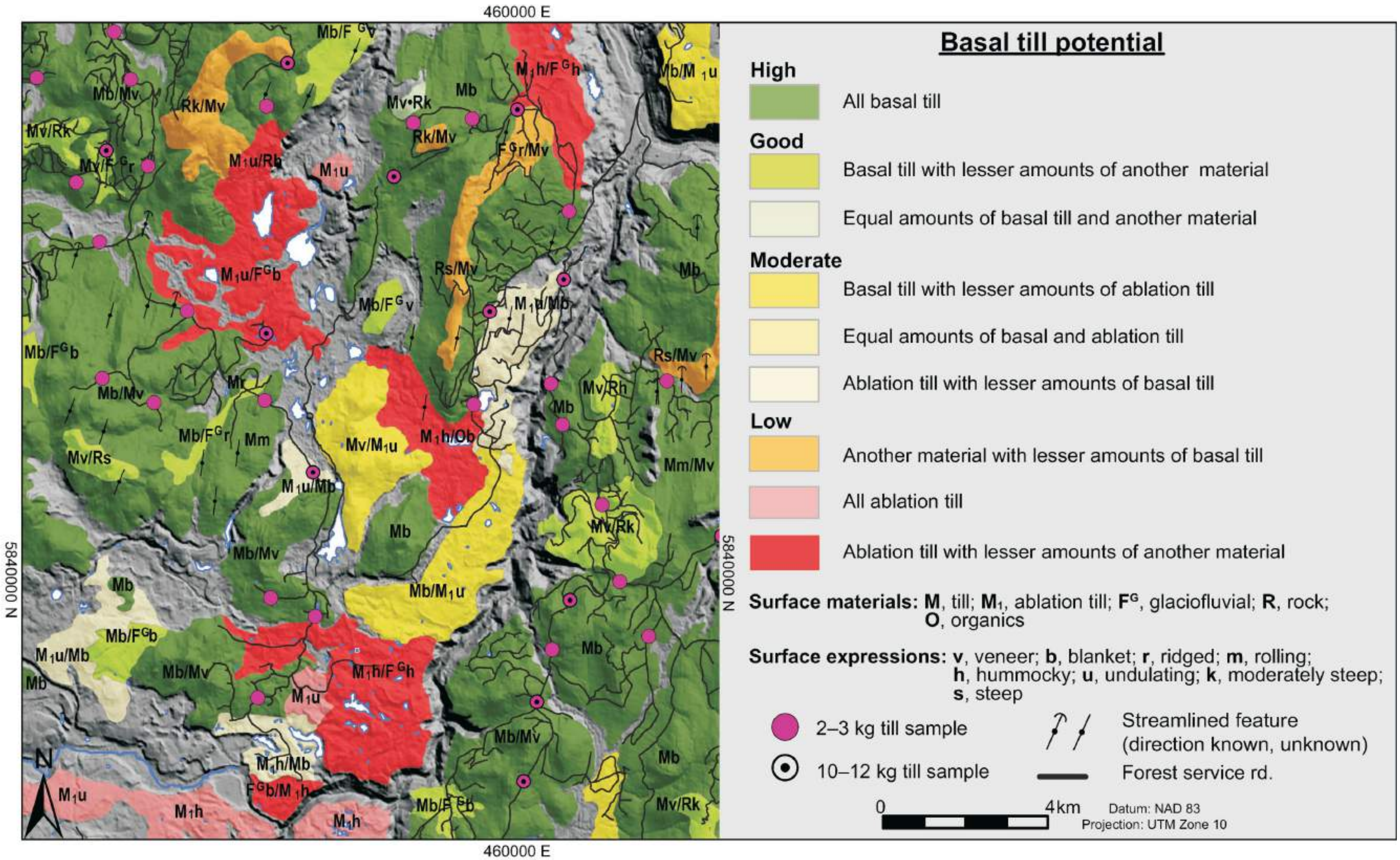

Figure 6. Example of basal till potential mapping from the southeast corner of NTS 093B/13. High potential is represented in green and low potential in red. Polygon labels are based on the terrain classification system for British Columbia (Howes and Kenk, 1997) and describe surface materials (upper-case letters) and their surface expression (lower-case letters). Emphasis is placed on differentiating basal till (M) and ablation till (M_1). Ice-flow indicators compiled by Ferbey et al. (2013). Digital elevation model from Canadian digital elevation data (GeoBase®, 2007).

till potential maps were completed for sixteen 1:50 000 scale map areas during a four month period. Extensive ground-truthing was conducted during sampling traverses throughout the 2013 field season.

Field Methods

The 2013 field season focused on regions that have not previously been sampled. Six hundred and eighty-four till samples (2–3 kg) were collected for major-, minor-, and trace-element geochemical analyses (Figure 7). At each sample site, 50 stones, of large pebble to small cobble size, were collected for lithological studies. At approximately every other site, a 10–12 kg sample was collected for mineral separation and gold grain counts (336 samples in total). Where archive sample density was low, infill sampling was conducted. Because most archived samples do not have mineralogical data, 10–12 kg samples were collected at nearly every infill site in an effort to produce an equivalent till dataset for the entire project area.

Sampling locations are based on a 2 km, staggered grid, aligned with ice flow (see Levson, 2001). These locations, however, are restricted in some areas due to lack of access or exposure. For example, large regions in NTS 093C/10, /11, /14, /15 and 093F/01 have no road access. Natural or anthropogenic exposures (>1 m) were typically required to obtain in situ basal till; till which had not been altered by soil-forming processes or biological activity. These exposures occurred dominantly as roadcuts and, in some cases, borrow pits or river and lake cuts. Soil pits were dug in some situations, although usually avoided because of time constraints.

The largest hindrance to sample collection was the lack of basal till. In large drainage networks, basal till has mostly been eroded by (glacio) fluvial processes. Some valleys, however, do have exposed stratigraphic sections from which till can be sampled. In the northeast, thick glaciolacustrine units were deposited up to an elevation of 875 m asl (Figure 8). Basal till is only found at surface where the relief is higher than the lake limit. Extensive units of ablation till were deposited by stagnating ice in the southwest, whereas areally smaller deposits of ablation till occur locally throughout the project area.

A backhoe was used to test if basal till could be accessed in areas mantled by a thin layer of ablation till. Four test sites were chosen based on the local surface expression. The first two sites were located in a clearcut that exposed a complex of hummocky ablation till and glaciofluvial deposits. Hummocks here have a maximum relief of 4 m. A 5 m wide meltwater channel incised the deposit. The first pit was excavated in a hollow between large hummocks. Bedrock was reached at 1 m below surface through a sandy diamict. The second pit was 2.5 m in depth and adjacent to the channel in an area of 1–2 m high hummocks. Exposed from the top down were interbedded sand and gravel, silt and sand laminations, and massive silt and sand. Basal till was not reached at this location. The third and fourth sites were spaced about 1.5 km apart and were situated near the contact between basal till and ablation till deposits. The surface expression was undulating, with relief of ≤1 m. Two pits were excavated to a depth of 2.5 m exposing 2 m of ablation till over at least 0.5 m of basal till. In both pits, the contact was gradational over about 10 cm and was highlighted by a brown to grey colour change and a significant increase in density and silt and clay content in the matrix of the basal till (Figure 9). These test pit results demonstrate that it may be possible to reach basal till at a reasonable depth near the contact with ablation till deposits, and that mechanized sample collection methods can be effective in certain situations.

Helicopter-supported lake sediment and lakewater geochemical sampling was conducted on the east side of the project area, where basal till exposures were limited and lake sediment samples were not previously collected. Survey protocols were based on established guidelines in Cook (1997). A total of 280 samples were collected from 264 lakes (Figure 7). Lake sites were accessed using a float-equipped Bell 206 helicopter. Sediment samples were collected from the deepest part of the lake using a torpedo-style Hornbrook sampler. Lake sediment samples generally represent a 35 cm section of material obtained from below the water-sediment interface. Samples typically consisted of organic gels with varying amounts of inorganic sediment and organic matter. Water samples were collected from the surface in 250 ml bottles.

Sample Analysis

Till and lake samples collected for geochemistry were sent to Acme Analytical Laboratories Ltd. (Vancouver, BC) for preparation. Tills were dried, an archive of the original till sample was generated, and the remaining material was sieved to produce splits of the silt plus clay-sized (<0.063 mm) fraction. Lake sediments were dried and milled with a ceramic ball to <0.0177 mm. Organic content was determined by loss-on-ignition (LOI). The 10–12 kg till samples were sent to Overburden Drilling Management Limited (Nepean, ON) where mineral concentrates (0.25–2.0 mm) and gold grain (<2.0 mm) concentrates were produced using a combination of gravity tables and heavy liquids.

New till samples were analyzed for minor and trace elements by ICP-MS following aqua-regia digestion (53 elements), major and minor elements by ICP-ES following a lithium borate fusion and dilute acid digestion (11 major oxides and 8 elements), and total gold determinations plus 34 elements by INAA. Reanalysis of the archived till samples was done by ICP-MS and for selected samples,

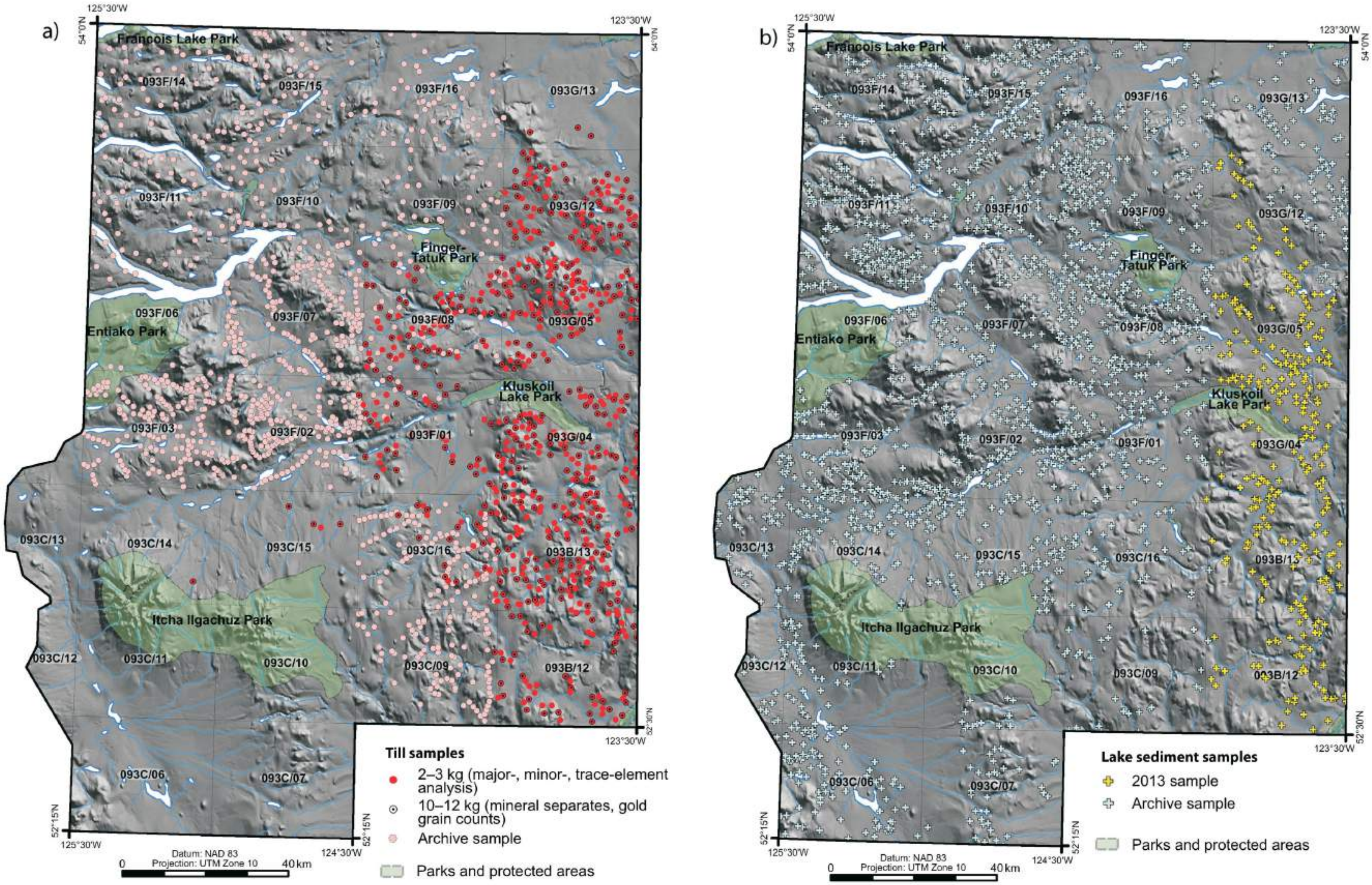

Figure 7. Distribution of previous and new sample locations in the project area, central British Columbia: **a)** till and **b)** lake sediment. Digital elevation model from Canadian digital elevation data (GeoBase®, 2007).

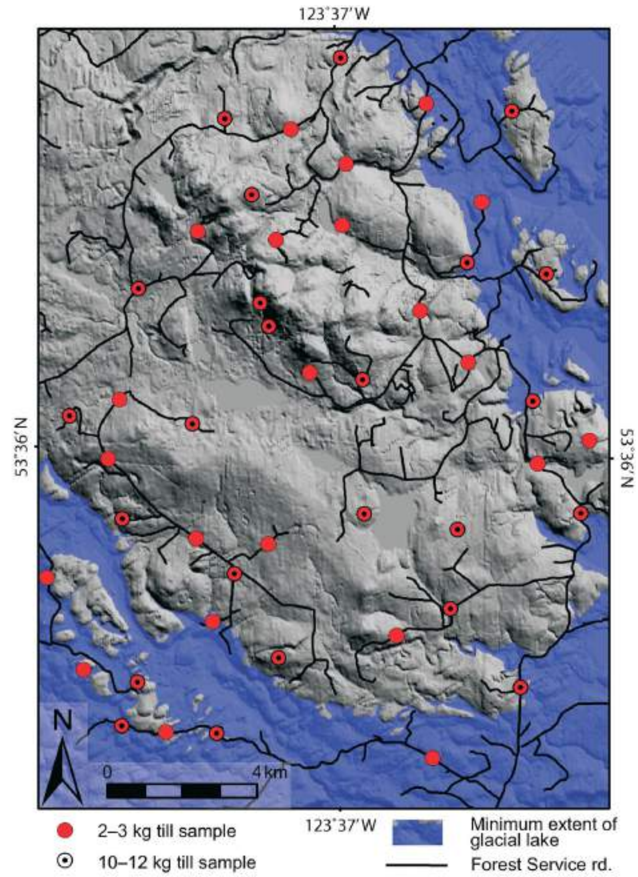

Figure 8. Digital elevation model (from Canadian digital elevation data [GeoBase®, 2007]) of the northeast corner of NTS 093G/12. The maximum level of glaciolacustrine sediments (875 m above sea level) delineates the minimum extent of one large, or several smaller glacial lakes. Within the extent of the lake, till samples were collected from islands above 875 m elevation and in natural or anthropogenic exposures, which provided access to basal till that was under the glaciolacustrine sediments.

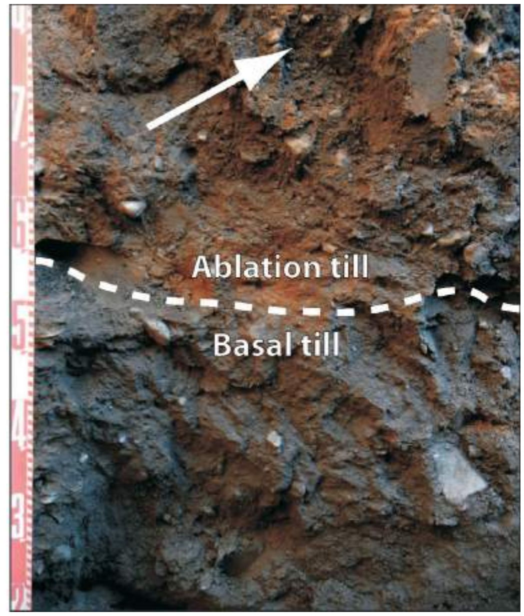

Figure 9. Gradational contact between basal till and overlying ablation till exposed in a 2.5 m deep pit. Ablation till is less dense and slightly oxidized with concentrations of sand and gravel (white arrow). Scale in centimetres.

ICP-ES. Lake sediments were analyzed for minor and trace elements by ICP-MS following aqua-regia digestion (53 elements), fluoride by SIE analysis, and total gold determinations plus 34 elements by INAA. Conductivity and pH were determined for lakewater samples. All geochemical analyses were completed at Acme Analytical Laboratories Ltd. (Vancouver, BC), except INAA, which was conducted at Becquerel Laboratories Inc. (Mississauga, ON). See Table 2 for analytical methods used for each sample type.

Quality Control

Quality control for analytical determinations includes the use of field duplicates, analytical duplicates, reference standards and blanks and is based on established protocols (Spirito et al., 2011). For each block of 20 samples, one field duplicate (taken at a randomly selected sample site), one analytical duplicate (a sample split during the preparation process), and one reference standard was included in geochemical analyses. Reference standards are CANMET till 1 and 4, TREK till standards A and B, and NVI standards 1, 2, 3 and 4. TREK and NVI standards were produced by homogenizing and sieving till with a known range of element values and elevated key metal values (e.g., Cu, Au, Mo). Duplicate samples determine sampling and analytical variability and reference standards measure the accuracy and precision of the analytical methods. Blanks are introduced throughout the sample stream to determine if there is any cross-contamination between samples.

Table 2. Sample media and analytical methods used for this program. Abbreviations: ICP-ES, inductively coupled plasma–emission spectrometry; ICP-MS, inductively coupled plasma–mass spectrometry; INAA, instrumental neutron activation analysis; SIE, specific ion electrode.

Sample type	ICP-MS (53 elements)	ICP-ES (11 oxides, 8 elements)	INAA (35 elements)	SIE (flouride)	pH	Conductivity
Till	•	•	•			
Archived till	•	•[1]				
Lake sediment	•		•	•		
Lakewater					•	•

[1]Select samples

Future Work

As a multiyear program, future TREK Project geochemical activities will include the assembly of recently acquired survey data plus the further development of geoscience information required for additional field surveys planned for the second year. The project action plan includes the following:

- evaluate and compile analytical results and field data for new basal till and pebble samples;
- evaluate and compile new lake sediment and lakewater analytical results and field data;
- evaluate and compile analytical data determined from the reanalysis of archived samples;
- update existing BTPMs based on field survey ground-truthing exercises; and
- assess alternate geochemical data collection techniques, such as treetop biogeochemical surveys and mechanically assisted methods that can be used to cover areas with challenging access or limited availability of other target media types.

Generating a comprehensive collection of high quality geochemical analytical data and field information is a primary objective of the geochemical component of the TREK Project. This is being accomplished through the collection of new samples, the reanalysis of samples collected during previous surveys and the development of BTPMs, which supports both field survey work and follow-up exercises. When packaged and released to the public, this dataset will become an important tool that will be used in the exploration for and discovery of new mineral occurrences.

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