BRITISH COLUMBIA

Ministry of Energy and Mines
Energy and Minerals Division
Geological Survey Branch

Till Geochemistry of the Tetachuck Lake and Marilla Map Areas (NTS 93 F/5 and F/12)

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BRITISH COLUMBIA GEOLOGICAL SURVEY

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ABSTRACT

A regional till geochemistry survey conducted within the Marilla (NTS 93 F/12) and Tetachuck Lake (NTS 93 F/5) map areas has identified 20 new exploration targets, all of which are multi-element anomalies. These include nine gold-silver-arsenic-antimony, six copper-lead-zinc, and four nickel-cobalt-chromium anomalies (with >95th percentile concentrations of at least one element, at one or more sites). Basal till, collected at 273 sample sites, was the preferred sampling medium. It is a first derivative product of bedrock, has been deposited in a linear direction down-ice from its source, and forms large dispersal trains. Research at the Uduk Lake prospect found that gold and arsenic dispersal trains are at least 2 km long and 0.5 km wide. Sedimentologic data collected in the field was used to distinguish basal till from other Quaternary sediments, such as glacigenic debris-flows, colluvium, glaciofluvial and glaciolacustrine sediments.

Prospective areas for precious metals are identified in the Square Lake, Chelaslie River, Chelaslie Arm, Euchu Reach, Chelaslie River, Cheslatta Lake and Intata Reach areas. Multi-element anomalies occur in each of these areas. For example, $>90^{th}$ percentile gold, arsenic, copper, lead, zinc, and barium concentrations occur around Square Lake, located in the northwest corner of the Marilla map area. The highest gold concentration in till in the study area occurs here and may be derived from mineralization associated with the Skins Lake Pluton. At least 90^{th} percentile concentrations of gold, arsenic, copper, lead and zinc occur at several sites at the southeast end of Chelaslie Arm. A 1 m wide vein sampled close to the arm assayed up to 612 ppb gold. The highest molybdenum concentration in till in the study area also occurs in this area.

Several areas with anomalous concentrations of copper, zinc and nickel occur around the Chelaslie River. A number of potential dispersal plumes are identified in this area. Other new exploration targets include $>95^{th}$ percentile gold concentrations in till along the Cheslatta River and north of Michel Creek, a large area of high lead, zinc, copper and arsenic southwest of White Eye Lake, and high gold, silver and copper at the south end of Euchu Reach.

Till geochemistry results from this study also suggest that mineralization at the Uduk Lake, Loon, Exo, Godot, Tet, Rhub, and WT occurrences may be more extensive than indicated in assessment report data. For example, at the Uduk Lake and Loon prospects, two $>95^{th}$ percentile gold concentrations occur distant to, and up-ice of, exploration trenches and areas of known mineralization. Multi-element geochemical anomalies also occur at till sites 1-2 km up-ice of the Exo prospect.

INTRODUCTION

OVERVIEW

The purpose of this report is to describe and interpret till geochemistry results from a region of the Nechako Plateau with high mineral potential but also with a widespread drift cover (Fig. 1). This work is part of the Nechako National Mapping program (NATMAP). NATMAP programs are multidisciplinary (Quaternary and bedrock geology mapping and stratigraphy, till geochemistry, etc.) and involve collaboration between universities, the Geological Survey of Canada, provincial geological surveys, and industry.

Till geochemical exploration was conducted, in the Marilla (NTS 93 F/12) and Tetachuck Lake (NTS 93 F/5) 1:50 000 scale map sheets, during the summers of 1997 and 1998 (Fig. 2). Unlike other regions in the Nechako Plateau, the Quaternary stratigraphy in this study area is exceptionally well exposed due to shoreline erosion following the completion of the Nechako Reservoir in 1952. A good understanding of the Quaternary geology is important in order to locate suitable areas for drift exploration sampling and aid in the interpretation of till geochemical data.

STUDY AREA DESCRIPTION

The centre of the study area is located approximately 85 km south of Burns Lake in central British Columbia and lies to the east of Tweedsmuir Provincial Park. Besides the Nechako Reservoir, which was built to generate power for an aluminum smelter in Kitimat, forestry is the dominant land-use in the area. Some ranching occurs north of Ootsa Lake.

Road access, typically logging roads and some well maintained secondary gravel roads, is good in most of the map area. A private barge is needed to access forestry roads south of Ootsa Lake and there is no road access south of Tetachuck Lake. The area south of Tetachuck Lake has recently been converted into a park to protect Cariboo habitat. Mineral exploration is not allowed in this area at the present time.

The study area lies entirely within the Nechako Plateau physiographic region (Holland 1976), an area of low relief (elevations up to 1500 m) with large surfaces of flat or gently rolling topography (Fig. 1). Most of the ground surface is covered with thick glacial sediments and very little bedrock is exposed. Ootsa Lake, Chelaslie Arm, and Tetachuck Lake of the Nechako Reservoir form the main valleys in the region (see Fig. 2). The Quanchus Range (including Mt. Wells, Tweedsmuir Peak and Michel Peak) lies immediately west of the study area in Tweedsmuir Provincial Park, while the Fawnie and Nechako ranges occur to the southeast. Upland elevations within the study area range from 1160 m – 1420 m a.s.l.. The elevation of the Nechako Reservoir is approximately 850 m a.s.l. and the water level fluctuates a few metres annually.

Figure 1. Aerial view of Tetachuck Lake, looking to the east, showing general landscape characteristics of the study area.

PREVIOUS STUDIES

Several recent regional geochemical exploration programs have been completed in the Nechako River map area (93 F). Regional lake sediment and till geochemistry sampling programs have been conducted by Cook and Luscombe (1994), Cook and Jackaman (1994), Levson and Giles (1994), Weary *et al.* (1997), Plouffe and Williams (1998), and Plouffe (1999). Two months after geochemical results from Cook and Jackaman (1994) and Levson and Giles (1994) were released (June 1994), 708 claim units were staked in the Nechako River map area (Lane and Schroeter 1994). For a detailed explanation of the characteristics of element dispersal plumes/trains in till in the Nechako River map area refer to Levson and Giles (1997), O'Brien (1996) and O'Brien *et al.* (1997). At Huckleberry Mine, approximately 100 km west of the study area, Ferbey and Levson (2000) use till dispersal plumes to help interpret glacial ice flow direction and attempt to model these plumes in three-dimensions.

Tipper (1963) completed the first reconnaissance mapping of the Quaternary geology and glacial landforms within the Nechako River map area (93 F). Terrain mapping of the Tetachuck Lake map sheet (NTS 93 F/5) (and areas further to the south and east) was conducted by Howes (1977) and surficial geology and soil drainage mapping of the eastern half of the Marilla map sheet was completed by Lacelle (1991). Other Quaternary geology maps for the Nechako River map area have been completed by Levson and Giles (1994), Giles and Levson (1995), Weary *et al.* (1995), and Diakow and Levson (1997). Recently, the surficial geology of the Marilla map area was mapped by Mate and Levson (2000). Large areas north and northeast of the study region have been mapped by Plouffe (1998*a*; 1998*b*) and Plouffe and Mate (2001).

Detailed work, describing the Quaternary stratigraphy and ice flow history within the Nechako River map area (93 F) is provided by Mate and Levson (1999), Mate (2000), Mate and Levson (2001), and Plouffe and Levson (2001). Other authors contributing to the understanding of the glacial history in the Nechako River map area are Levson and Giles (1997), Huscroft and Plouffe (1999), Levson *et al.* (1999), and Mate and Levson (1999).

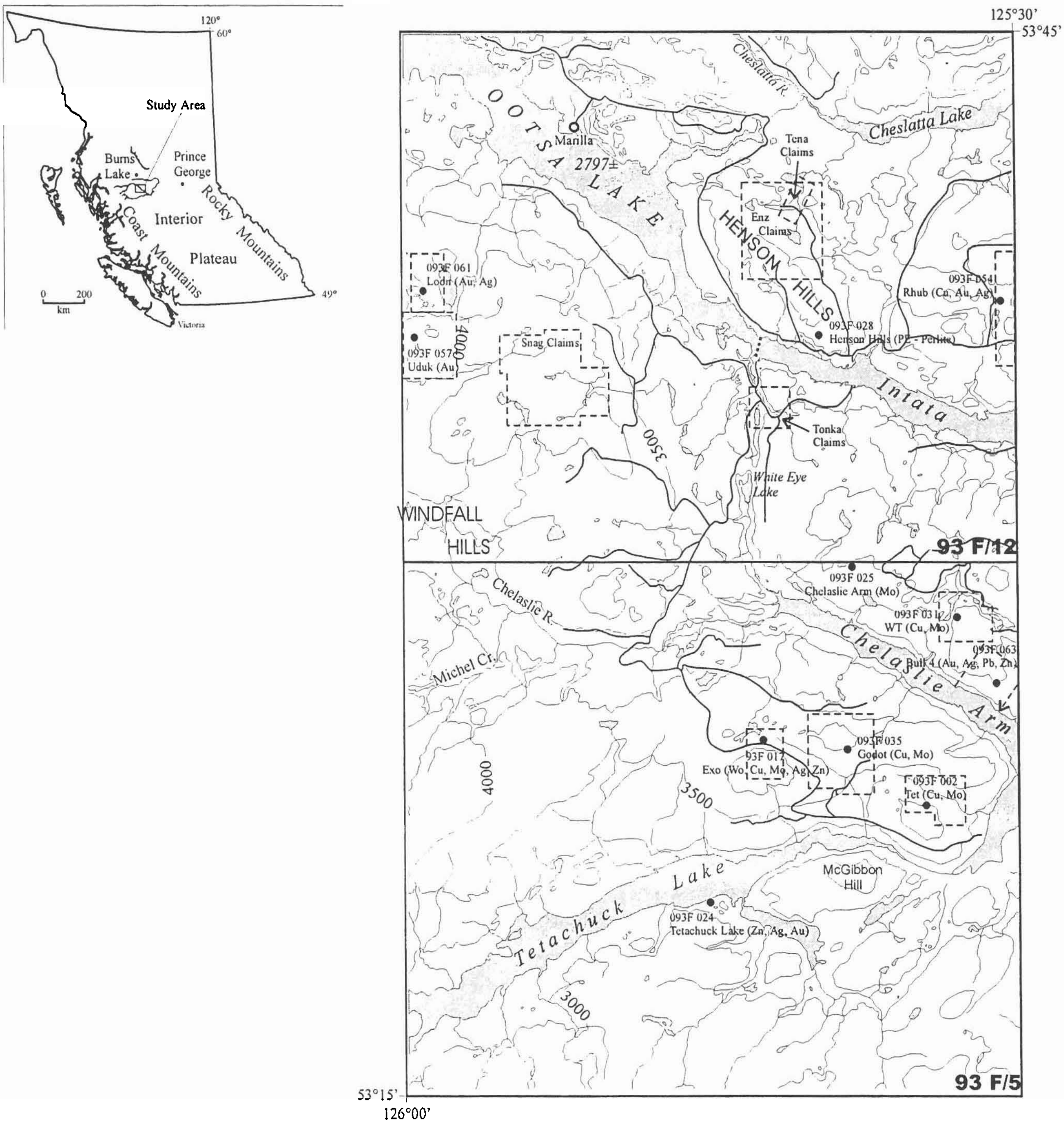

Figure 2. Location of the study area, south of Burns Lake, in the Nechako Plateau and straddling part of the Nechako Reservoir (Ootsa Lake and Tetachuck Lake). Prospects, showings and active and inactive claim boundaries are shown.

QUATERNARY STRATIGRAPHY

Stratigraphic information was collected from thirty-six large, well exposed Quaternary sections (Fig. 3). Sections occur along Cheslatta River and the shorelines of Ootsa Lake, Intata Reach, Chelaslie Arm, and Tetachuck Lake (see Fig. 2 for locations). Ten different stratigraphic units have been identified and grouped into five main stratigraphic packages (Fig. 4 and Table 1). They are A) pre-Late Wisconsinan sediments, B) Late Wisconsinan advance-phase sediments, C) Late Wisconsinan glacial sediments, D) Late Wisconsinan retreat-phase sediments, and finally E) Holocene sediments.

Unit A

Pre-Late Wisconsinan sediments (Unit A, Fig. 4) are the oldest Quaternary deposits within the study area and include an older till unit underlying organic-bearing lacustrine sand and silt. These two units were deposited before the last (Fraser) glaciation and are very rare within the Nechako Plateau. The only other reported occurrence of till deposited before the Fraser Glaciation in the region occurs along the Necoslie River roughly 200 km northeast of the study area (Plouffe and Jetté 1997). A more detailed description of the lacustrine sand and silt unit, probably correlative with the Olympia Nonglacial Interval, is provided by Levson *et al.* (1998, 1999), Mate (2000), Levson (2001a), Mate and Levson (2001), and Plouffe and Levson (2001).

Unit B

Late Wisconsinan advance-phase sediments (Unit B, Fig. 4) consist of glaciolacustrine, glaciofluvial, and debris-flow deposits. They underlie Fraser Glaciation till (Unit C, described below). Since this unit has been overridden by glacial ice it is relatively dense. Advance-phase glaciolacustrine sediments are rarely exposed in the Marilla map area (93 F/12) but occur in thick sequences (up to 15 m thick) along the north shore of Tetachuck Lake (map sheet NTS 93 F/5). This sediment is made up of silt and clay rhythmites, has a high density, and contains dropstones, numerous, small, normal faults, and some very fine sand and diamicton interbeds. It was deposited in advance-phase proglacial lakes that occurred in the Tetachuck Lake, Ootsa Lake and Cheslatta River valleys.

Advance-phase glaciofluvial sediments consist of fine to coarse sand, pebble to cobble-sized gravel, and some debris flow diamicton. They were deposited in outwash

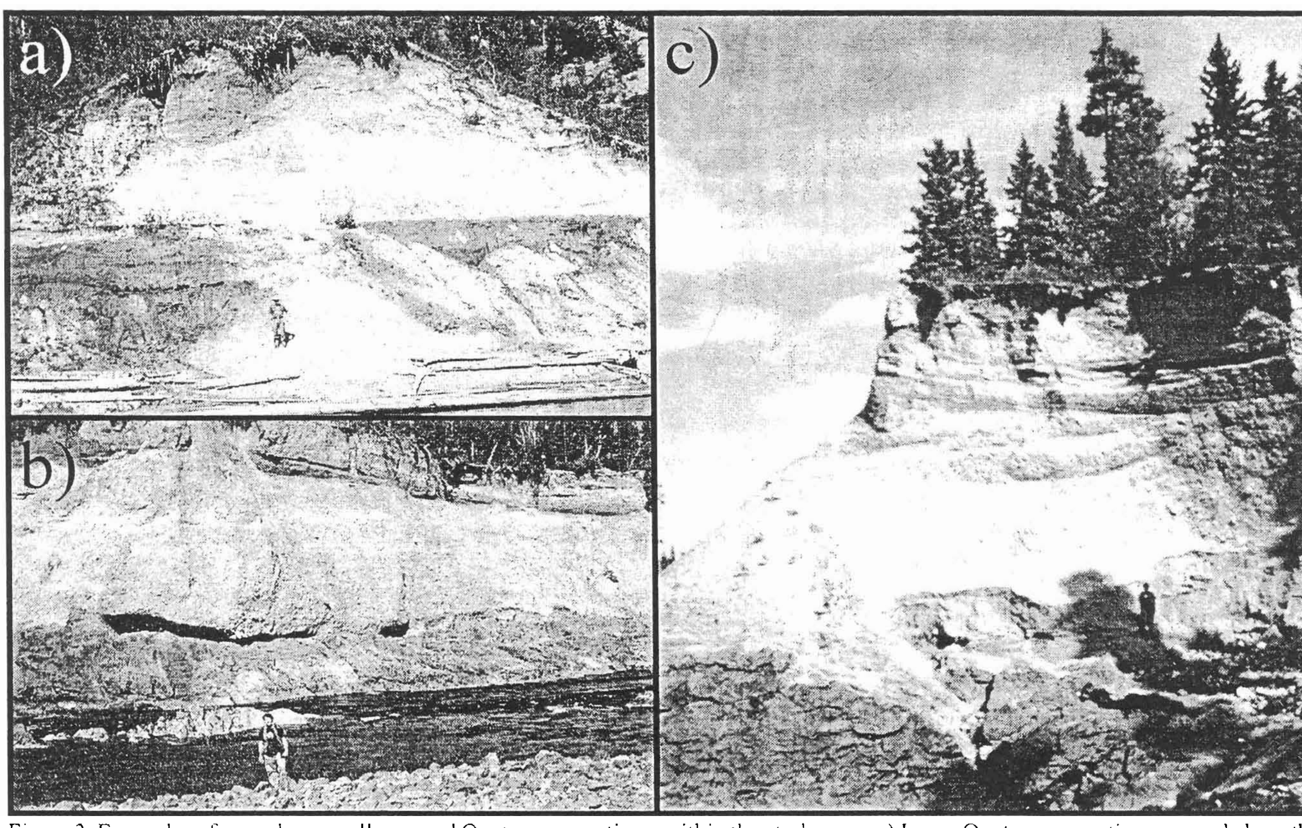

Figure 3. Examples of some large well exposed Quaternary sections within the study area. a) Large Quaternary section exposed along the shoreline of the Nechako Reservoir (Note: Dark grey area is Olympia Nonglacial Interval sediment. b) and c) Quaternary sections exposed along the Cheslatta River.

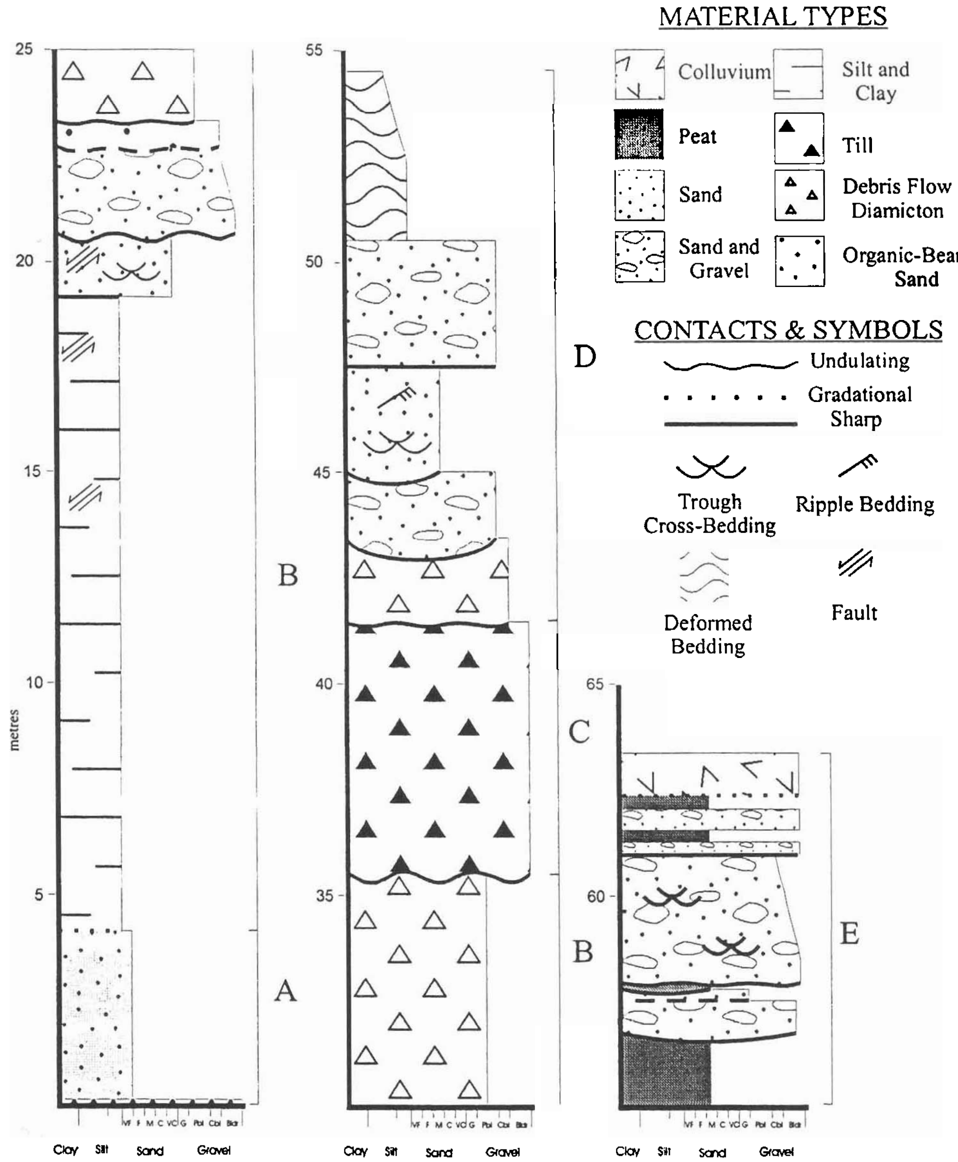

Figure 4. Composite stratigraphy of the study area. Maximum thickness for each unit in the study area is used.

TABLE 1
SUMMARY OF STRATIGRAPHIC PACKAGES FOUND IN FIGURE 4

Stratigraphic Package	Name	Sediment Types
E	Holocene Sediments	Organics, fluvial sand and gravel, and colluvium
D	Late Wisconsinan Retreat-Phase Sediments	Debris flow diamicton, glaciofluvial sand and gravel, and glaciolacustrine silt and clay
C	Late Wisconsinan Glacial Sediments	Till (lodgement and meltout)
B	Late Wisconsinan Advance-Phase Sediments	Glaciolacustrine silt and clay, glaciofluvial sand and gravel, and debris flow diamicton sediments
A	Pre-Late Wisconsinan Sediments	Till and lacustrine sand

streams in front of glacial ice. Generally they coarsen upward, suggesting a shift from distal to ice-proximal sedimentation.

Advance-phase glacigenic debris flow deposits, typically are stratified silty to silty sand diamictons, interbedded with silt, sand and gravel. Sometimes they have a high clast content (up to 50%). Similar debris flow sediments were deposited during the retreat-phase of the last glaciation.

Unit C

Till, consisting of two facies, is the dominant Late-Wisconsinan glacial sediment (Unit C, Fig. 4) in the study area. This was the unit sampled during the till geochemistry program. The first facies is a clayey to silty, massive, diamicton interpreted to be basal till, probably lodgement. It has moderate to high density, high fissility, and is moderately to well jointed with weak oxidation along joints. Clasts are commonly striated, angular to subrounded, and are of varied lithologies. Occassionally gravel and fine to coarse sand lenses occur within this facies.

The second till facies is a massive to very crudely bedded, gravelly to sandy diamicton interpreted to be melt-out till. It has a high density, strong fissility, and is well jointed. Clast content in this diamicton is usually 20-30%. Thin, wavy and discontinuous, sand and gravel lenses, approximately 10-20 cm thick and up to 8 m wide are common in this facies. Melt-out till in this area can be distinguished from lodgement till because it usually has a coarser texture and contains more sand and gravel lenses.

Unit D

Late Wisconsinan retreat-phase sediments (Unit D, Fig. 4) are made up of glaciofluvial sand and gravel, glaciolacustrine silt and clay, and debris-flow diamicton that were deposited as glacier ice retreated from the study area. Glaciofluvial sand units have a variety of textures and sedimentary structures. Sedimentary structures include horizontal bedding, trough cross-bedding, ripple bedding, and rhythmic laminations. Gravel deposits are massive to well bedded, pebble to boulder-sized, usually clast-supported and have rare interbeds of sand, silt, and diamicton.

Retreat-phase glaciolacustrine sediment deposited in localized glacial lakes and on top of stagnant blocks of ice, is comprised largely of silt and clay, with occasional dropstones. Silt dominated strata are horizontally bedded to massive and occasionally interbedded with sand. Rhythmically bedded strata of silt (light grey) and clay (light brown) commonly show internal laminations and local soft sediment deformation structures. Glaciolacustrine sedimentation on buried blocks of stagnant ice is likely responsible for local large-scale deformation of bedding.

Deposition of retreat-phase glaciolacustrine sediment, on stagnant ice blocks, in other areas of the Nechako River map sheet has been noted around Fraser Lake and Burns Lake by Plouffe (1997) and Knewstubb Lake and Big Bend Creek by Huscroft and Plouffe (1999). Retreat-phase glaciolacustrine sediments are rare within the map area and the surrounding region (Plouffe and Mate 2001). These sediments occur at elevations below 890 m, and have been identified immediately northwest of the village of Marilla and at the Fraser Mills ferry landing on the south side of Ootsa Lake (see Fig. 2).

Unit E

Holocene sediments (Unit E, Fig. 4) are made up of organics, fluvial sand and gravel, and rare colluvium. Bogs contain black, organic rich peat and support sedge and small willow vegetation. Fluvial gravels are usually clast-supported and contain angular to well rounded clasts. Sometimes these gravels are heavily oxidized. Sand typically has a fine to medium texture and may contain buried organic horizons.

QUATERNARY SEDIMENT SURFACE DISTRIBUTION

The distribution of Quaternary sediments in the Marilla map area (NTS 93F/12) is illustrated in Fig. 5. Till accounts for approximately 80% of the ground cover in the study area and mantles the underlying bedrock either as a blanket (greater than 1 m thick) or veneer (less than 1 m thick). Till at the surface is usually loose with low density, due to weathering and colluviation. Weathering alters the original geochemical signature, derived from the underlying bedrock, of till. Therefore digging is usually required before more massive, dense, unweathered, and fissile till is found. This is the desired sampling medium because its geochemical signature has been unaltered.

Holocene organic and fluvial deposits (E) and minor areas of bedrock outcrop and colluvium make up 15% of the ground cover. Mapped retreat-phase glaciofluvial sediment is rare and accounts for about 5% of the surficial cover. These sediments are found in terraces and outwash plains along the Cheslatta River and in association with meltwater channels.

GEOMORPHOLOGY

The most common landforms within the study area are northeasterly oriented, streamlined, crag-and-tails and flutings. Crag-and-tails have bedrock knobs at their up-ice (stoss-ends) while down-ice (lee) portions are ridges of till. Drumlinoid ridges, dominantly composed of till, also occur. Generally, streamlined landforms in the region are approximately 100-500 m long and 40-100 m wide.

Unusual till ridges occur in the southwest portion of the Marilla map area. They are 100's of metres long, roughly 4-8 m high, steep sided, and locally have sharp bends. Relief along ridge tops is approximately 1-4 m. Rare depressions occupied by small bogs occur along the ridge tops. The till in these forms has a clayey silt texture, and is finer-grained than tills elsewhere in the study area. Ridges are locally draped by poorly sorted gravel and massive silt. These forms are interpreted as crevasse fillings and were first identified in the study area by Tipper (1963).

Organic deposits, commonly bogs, occur in low-lying, poorly drained areas, like depressions around streamlined landforms. Fluvial sediment occurs in the Cheslatta and Chelaslie River valleys and along streams in the map area.

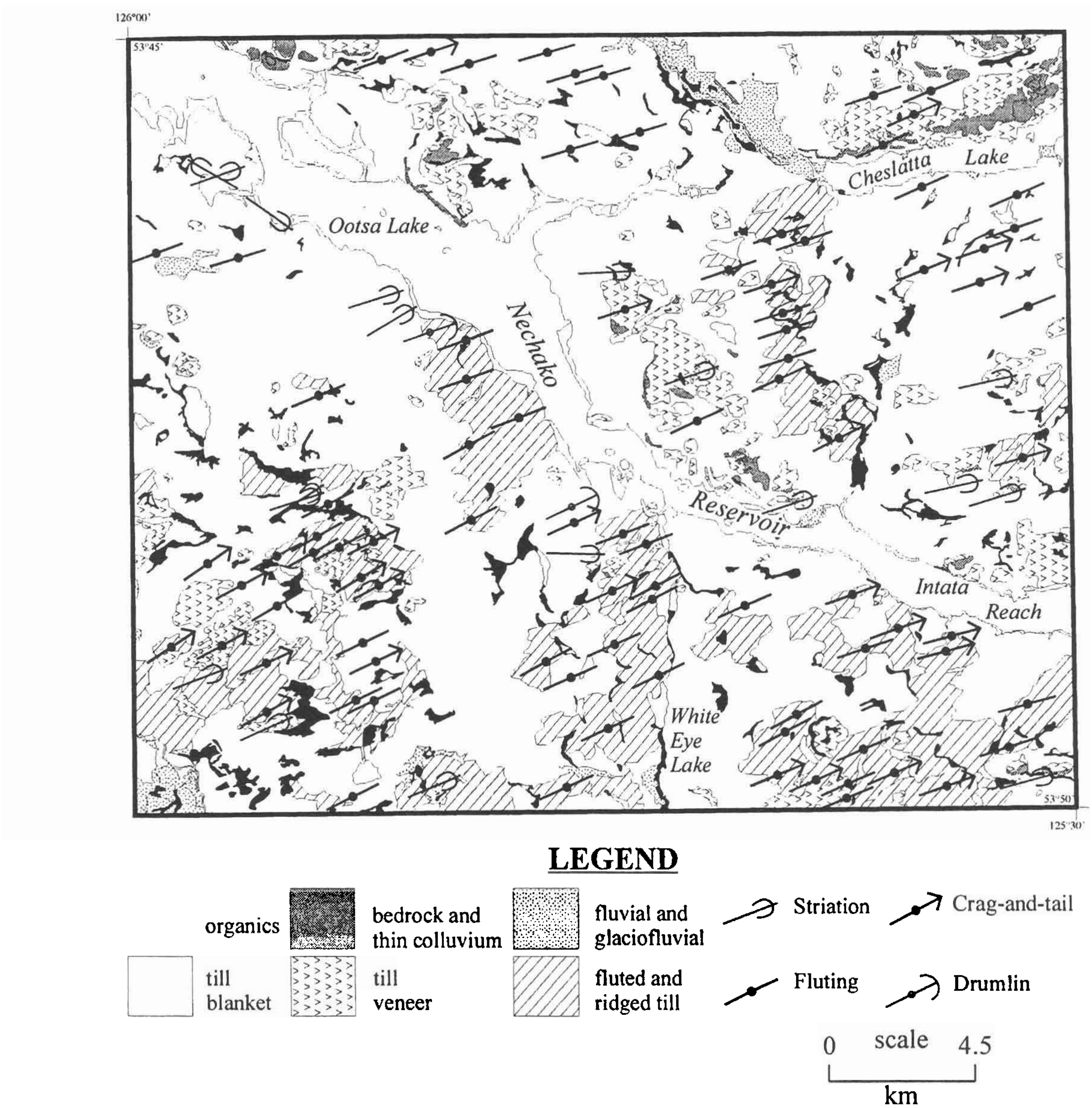

Figure 5. Simplified surficial geology and subglacial flow directions in the Marilla map area (modified from Mate and Levson 2000). Till is the dominant surficial sediment and bedrock outcrop is rare (approximately 5% of the ground cover). The dominant subglacial flow direction is to the northeast.

In river valleys this sediment is dominantly terrace and flood plain gravel and sand. Colluvium is very localized usually occurring as a veneer over bedrock. Talus deposits composed of angular gravelly debris are rare and are found along slopes at the base of steep bedrock cliffs.

ICE FLOW HISTORY

Originally, Late-Wisconsinan glacial ice advanced into the study area from the Coast Mountains (Tipper 1971). During late and probably early phases of glaciation, ice was topographically controlled and moved through major valleys like Ootsa Lake, Tetachuck Lake, and Chelaslie Arm. Rare, valley parallel striae occur along the shoreline of these valleys supporting this interpretation. Evidence of valley parallel ice movement in other regions of the Nechako Plateau has been identified by Levson and Giles (1997) and Ferbey and Levson (2001).

Topographic control on ice movement diminished as ice from the coast mountains coalesced in the study area. This resulted in a dominant regional ice flow direction to the northeast (see Appendix D). Element dispersion in till is believed to reflect this northeast ice-flow direction. Orientations of striae, crag-and-tails, flutings and drumlins support this interpretation. Collectively, crag-and-tails, flutings and drumlins within the study area have an average orientation

TABLE 2
SUMMARY OF PROSPECTS AND SHOWINGS THAT OCCUR WITHIN
THE MARILLA AND TETACHUCK LAKE MAP AREAS
(MINFILE NECHAKO RIVER NTS 093F)

Name and Minfile #	Status	Map Sheet (NTS)	Location (UTM's, NAD 27)	Commodities	Deposit Type
Loon 093F 061	Prospect	93 F/12	5946000 E 302650 N	Au, Ag	Low sulphidation epithermal
Uduk Lake 093F 057	Prospect	93 F/12	5943500 E 302000 N	Au	Low sulphidation epithermal
Exo 093F 017	Prospect	93 F/5	5921601 E 320149 N	W, Cu, Mo, Ag, Zn	Sn skarn; Mo skarn
Rhub 093F 054	Showing	93 F/12	5944350 E 334050 N	Cu, Au, Ag	
Henson Hills 093F 028	Showing	93 F/12	5942852 E 324324 N	Perlite	Volcanic glass - perlite
Tetachuck Lake 093F 024	Showing	93 F/5	5913191 E 316775 N	Zn, Ag, Au	
WT 093F 031	Showing	93 F/5	5927759 E 331015 N	Cu, Mo	Porphyry Cu±Mo±Au; Cu skarn
Godot 093F 035	Showing	93 F/5	5921027 E 324730 N	Cu, Mo	
TET 093F 002	Showing	93 F/5	5917819 E 328700 N	Cu, Mo	
Chelaslie Arm 093F 025	Showing	93 F/5	5930746 E 325422 N	Mo	
Bull 4 093F 063	Showing	93 F/5	5924300 E 332950 N	Au, Ag, Pb, Zn	Au-quartz veins; polymetallic veins Ag-Pb-Zn±Au.

of 70° (n = 164), a variance of 21° and range from 58° - 79°. Striae measurements from bedrock outcrops in the study area have an average orientation of 75° (n = 16), a variance of 34° and range from 60° - 94°.

Rare evidence indicating anomalous westward ice flow occurs in the northwest corner of the Marilla map sheet. West-trending rat-tails and striations, oriented 300°, occur on a steep, easterly exposed lee side of a northeasterly oriented (070°) roche moutonée. This anomalous flow is believed to represent a shift in an ice dome that was originally positioned over the Coast Mountains to the west (Clague 1989). Since this is the most easterly, westward ice flow indicator in the study area the extent of this event is unknown. Evidence of anomalous westward flow has been identified in areas to the west of the study area by Levson *et al.* (1998, 1999), Stumpf *et al.* (2000), and Ferbey and Levson (2001). Sometime during the Fraser Glaciation the ice divide migrated back over the coast moutains and easterly ice flow resumed.

BEDROCK GEOLOGY

Tipper (1963) first mapped the bedrock geology of the Nechako River map area (NTS 93 F) at a scale of 1:250 000. Recent 1:50 000 scale bedrock mapping of the Marilla and Tetachuck Lake map sheets was completed by Anderson *et al.* (2000*a*, 2000*b*), Quat and Struik (1999), and R.G. Anderson and L.C. Struik, unpublished data, 2000 (Fig. 6).

A large part of the study area is underlain by Mesozoic volcanic and sedimentary rocks of the Kasalka, Bowser Lake, and Hazelton Group (including informally designated volcanic units of the Naglico and Entiako formation). These rocks are intruded by several Tertiary and Cretaceous plutons, including part of the porphyritic Skins Lake Pluton north of Ootsa Lake and several granodiorite and quartz monzonite plutons south of Tetachuck lake. Hazelton Group rocks are locally overlain by Ootsa Lake Formation rhyolite, Endako Formation basalt and andesite flows, and Neogene basalt flows. Structurally, northeast to northwest trending Eocene block faults cross-cut an older northwest trending reverse fault north of Ootsa Lake.

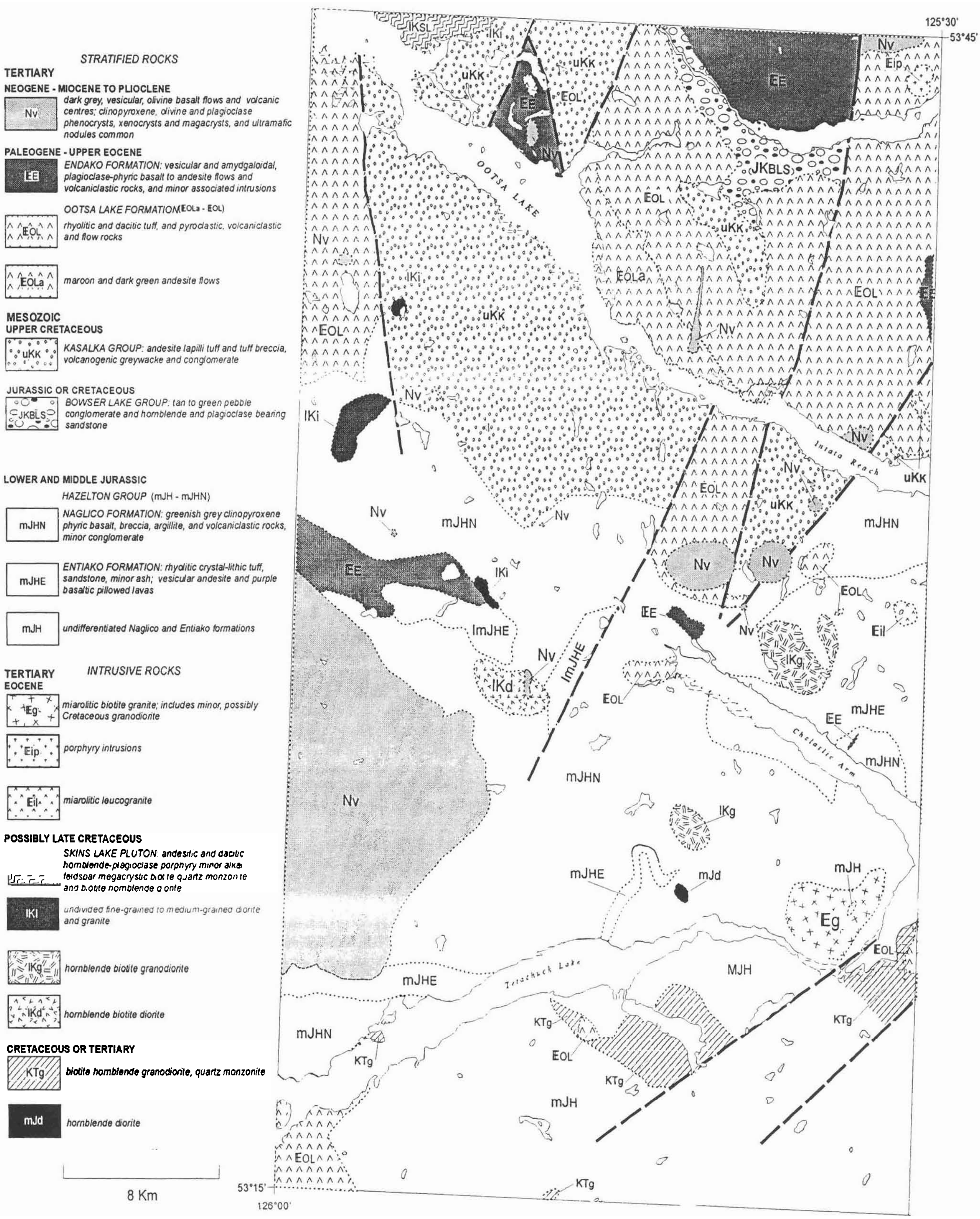

Figure 6. Simplified bedrock geology of the Marilla (NTS 93 F/12) and Tetachuck Lake (NTS 93 F/5) map sheets. Modified from Anderson et al. (2000*a*, *b*) and R.G. Anderson and L.C. Struik, unpublished data, 2000.

MINERAL OCCURRENCES

Sixty-eight mineral occurrences have been identified within the Nechako River (NTS 93 F) map area (Bailey *et al.* 1995). Of these occurrences, 3 prospects and 8 showings occur within the study area (Table 2; see Fig. 2). Two prospects, the Loon (MINFILE 093F 61) and Uduk Lake (MINFILE 093F 057) are low sulphidation epithermal deposits that contain gold and silver. They occur in altered Ootsa Lake Group volcanic rocks. The other prospect is the Exo (MINFILE 93F 017), a skarn deposit containing tungsten, copper, molybdenum, silver, and zinc.

At the Loon prospect, chip samples from silicified and brecciated Ootsa Lake Group rocks in trench 4 contained up to 1026 g/t silver and 5.4 g/t gold (Taylor 1989; MINFILE 093F 061). In October 1989, 199 soil samples were collected and analyzed by ICP (Taylor 1989). The highest silver concentration in soil was 4.7 ppm. Taylor (1990) suggests that at this property silver is the best element for tracing out known epithermal mineralization.

Most of the Uduk Lake property is covered by glacial sediments limiting bedrock exposure. Mineralization is hosted in Ootsa Lake Group rocks that have argillic alteration and quartz veining (Allen and MacQuarrie 1985). Quartz-chalcedony stockwork, locally grading into a breccia with a black matrix has been the main exploration target at this property (MINFILE 093F 057). The only visible sulphide is pyrite, occurring as fracture fillings and disseminations in vein, stockwork, and breccia zones. The highest gold soil anomaly on this property was 700 ppb, while the highest gold concentration from rock chip samples was 3600 ppb (Allen and MacQuarrie 1985).

The Exo property, in the Tetachuck lake map area, occurs within Lower Jurassic Hazelton Group volcanic and sedimentary rocks that have been intruded by a nearby granodiorite intrusion. Two mineralization zones occur at this property (Leask 1987). The first zone is a skarn assemblage containing pyrite, scheelite, chalcopyrite, and sphalerite. The second zone of mineralization is a stockwork of veinlets, hosted in bleached and silicified hornfels rocks. These veinlets also contain pyrite, chalcopyrite, scheelite, and molybdenite.

Surficial geology mapping was completed by interpretation of air photographs, field checking existing terrain map data and stratigraphic and sedimentologic studies of Quaternary exposures in the map area. Ice-flow history for the map area was largely deciphered from the study of crag-and-tail features, flutings, drumlins, striae and till fabric data.

Till samples were collected for geochemical analysis in order to locate glacially dispersed metallic minerals in the region. Sample sites were selected to provide as complete a coverage of the map area as possible using existing access routes. Sample sites consisted of natural and man-made exposures (roadcuts, river and lake shore exposures, borrow pits, soil pits and trenches). Field sites were marked with metal tags and flagging tape. Locations of samples sites were plotted on a 1:50 000 topographic base map with the aid of air photographs and a Geographic Positioning System. Each till sample site is shown with an "•" on the accompanying map and a numbered sample location map is provided as an overlay (in pocket). UTM coordinates for each sample site are given in Appendix A.

A total of 273 regional till samples were collected in the study area at an average density of approximately one sample per 3.5 square kilometres. Higher density sampling was conducted in areas of perceived higher mineral potential and around known mineral prospects, to provide a clearer understanding of glacial dispersal processes. Higher density sampling in these areas, including a number of depth-profile samples taken as part of detailed process studies, were not included in the regional data set to avoid skewing the data towards areas of known mineral potential.

Sedimentologic data were collected at all sample sites in order to distinguish till from glacigenic debris flows, colluvium, proximal glaciofluvial deposits or glaciolacustrine sediments such as subaqueous debris flows or ice-rafted debris. These sediments have different processes of transportation and deposition which must be recognized in order to understand associated mineral anomaly patterns. For example, local variations will be reflected in some sediments while regional trends may be observed in others. Analysis of these sediments will be useful only where their origin is understood.

Sedimentologic data collected at each sample site included descriptions of sediment type, primary and secondary structures, matrix texture, presence of fissility, compactness, total percentage and modal size of clasts, rounding of clasts, presence of striated clasts, and sediment genesis and thickness. Further information was noted on soil horizons, local slope, bedrock striae, bedrock lithology, clast provenance and abundance of mineralized erratics. Sedimentologic data for each of the sampled deposits are provided in Appendix A together with summary descriptions of the sample site and other relevant data.

LABORATORY METHODS

Till samples collected during the regional geochemical survey (each 3-5 kg in weight) are air dried, split and sieved to -230 mesh (<62.5 µm). One split from each sample was reserved for grain size or other follow-up analyses. The -230 mesh fraction from each sample was analyzed by instrumental neutron activation analysis (INAA) for 35 elements at Activation Laboratories Ltd. in Ancaster, Ontario and by inductively coupled plasma analysis (ICP) after aqua regia digestion for 30 elements, at Acme Analytical Laboratories Ltd. in Vancouver, British Columbia. For the ICP analysis, a 0.5 gram sample is digested with 3 millilitres of 3-1-2 HCL-HNO3-H2O for one hour and diluted to 10 millilitres with water. This leach is partial for Mn, Fe, Sr, Ca, P, La, Cr, Mg, Ba, Ti, B and W and limited for Na, K and Al. Mercury analysis was by flameless AA.

Distribution maps for most elements analyzed are provided in Appendix D. Analytical results for all samples included in the regional data set are also provided in Appendix A. Data for 27 elements analyzed by INAA and 24 elements analyzed by ICP are included. Elements analyzed by ICP or INAA that are not included are those that are generally below the analytical detection limits by these methods.

QUALITY CONTROL

In order to discriminate geochemical trends related to geological factors from those that result from spurious sampling or analytical errors, a number of quality control measures were included in both the field and laboratory components of the program. These include the use of field duplicates, analytical or blind duplicates and control standards, one of each being randomly inserted into each set of 17 routine field samples to make a block of 20 samples that is submitted for analysis.

Field duplicates were taken from randomly selected field locations and subjected to identical laboratory preparation procedures. Analytical, or blind, duplicates consist of sample splits taken after laboratory preparation procedures but prior to analysis. Control reference standards include several British Columbia Geological Survey geochemical reference materials comprising the -180 micron size fraction of a variety of bulk samples. In total, the regional till geochemical data set (excluding samples taken during detailed case studies) included 16 field duplicate pairs and 16 analytical duplicate pairs (Appendix B).

Scatter plots of analytical results from duplicate field and analytical pairs are presented for gold, arsenic and antimony (INAA data) and copper, lead, zinc, nickel, molybdenum and iron (ICP data) in Appendix B. The results show good reproducibility ($R^2 > 0.9$) for both field and analytical duplicates for most elements. The main exceptions are gold and molybdenum where concentrations are near the detection limit and reproducibility is poor (Appendix B). In the case of gold, especially poor reproducibility with field duplicates is attributed to the nugget effect whereas poor reproducibility in molybdenum is probably due to generally low (near background) molybdenum concentrations in tills in the region.

To further evaluate reproducibility in gold analysis, the remaining -230 mesh fraction of the top 10% gold (> 7 ppb) and top 5% arsenic and antimony (> 22 ppm) sample sites were re-analyzed by INAA. 5 of 43 resubmitted samples from the map area returned greater than 7 ppb gold. 5 samples yielded higher results than the first run (6 to 40 ppb) and 15 were totally or almost identical (within 3 ppb); the remainder were lower including 29 below the detection limit (< 2 ppb). These data illustrate well the reproducibility problems that are encountered with gold concentrations in clastic sediments. To avoid bias, the gold concentrations reported for the regional samples are those from the first analysis; gold concentrations from the re-analyses are reported as Au* (*rechecks) in Appendix A.

SAMPLING MEDIUM

Basal till was selected as the preferred sampling medium for this program rather than other types of surficial materials for several reasons:

- Basal tills are deposited in areas directly down-ice from their source and therefore mineralized material dispersed within the tills can be more readily traced to its origin than can anomalies in other sediment types. Processes of dispersal in ablation tills, glaciofluvial sands and gravels, and glaciolacustrine sediments are more complex and they are typically more distally derived.
- Due to the potential for the development of large dispersal trains, mineral anomalies in basal tills may be readily detected in regional surveys.
- The dominance of one main regional ice-flow direction throughout much of the last glacial period in the survey area (see below) has resulted in a simple linear, down-ice transport of material.

Sampled deposits in the area, interpreted as basal tills, typically consist of compact, fissile, matrix-supported, sandy-silt diamicton (Fig. 7). Diamicton is defined as a poorly sorted deposit consisting of mud, sand and gravel. They are typically overconsolidated and often exhibit moderate to strong subhorizontal fissility. Vertical jointing and blocky structure are also common, especially in dry exposures. Oxidation of the till, characterized by reddish brown staining, is common and may occur pervasively or along vertical joint planes and horizontal partings. Subhorizontal slickensided surfaces are sometimes present, especially in clay-rich parts of the till.

Clasts are mainly medium to large pebbles but they range in size from small pebbles to large boulders. Total gravel content generally is between 10 and 30% but locally may be up to 50%. Subangular to subrounded clasts are most

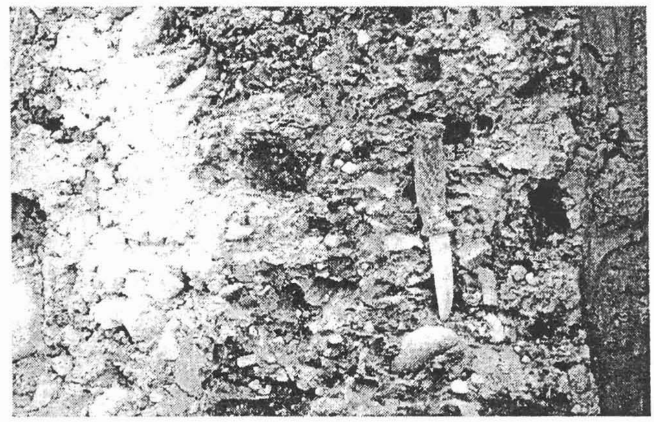

Figure 7. Example of basal till typically found within the study area. This sediment is massive, dense, poorly sorted, and has strong fissility. It was the desired sampling medium for this study.

common and typically up to about 20% are glacially abraded. Striated clasts are commonly bullet shaped, faceted or lodged; the a-axes of elongate clasts are often aligned parallel to ice-flow direction. Lower contacts of basal till units are usually sharp and planar. All of these characteristics are consistent with a basal melt-out or lodgement till origin. Injections of till into bedrock fractures locally indicate high pressure conditions at the base of the ice during deposition. The presence of sheared, folded and faulted bedrock slabs within these deposits indicates the local development of deformation tills.

During the sampling program, basal till deposits were distinguished from other facies of morainal sediments such as glacigenic debris-flow deposits. This distinction is critical as basal tills are first order derivative products whereas debris-flow deposits have undergone a second depositional phase, related either to the paleo-ice surface or the present topography, and are therefore more difficult to trace to their source.

Glacigenic debris-flow deposits typically consist of loose, massive to stratified, sandy diamicton. They are usually loose to weakly compact and either massive or interbedded with stratified silts, sands or gravels. Clasts vary in size from small pebbles to large boulders, but are usually medium to large pebbles. These diamictons typically contain 20 to 50% gravel, but locally may have up to 70% clasts. Subangular to subrounded clasts are most common, but local angular fragments dominate in some shallow exposures over bedrock.

Lenses and beds of sorted silt, sand and gravel occur in many exposures and may be continuous for up to 5 metres, although they are most frequently 10 to 100 centimetres wide. Debris-flow deposits may exhibit weak to very strong preferential oxidization along the more permeable sand and gravel beds. These deposits commonly are in gradational contact with underlying basal tills. Colluvial diamictons are also differentiated from basal tills by their loose unconsolidated character, the presence of coarse, angular clasts of local bedrock, crude stratification and lenses of sorted sand and gravel.

INTERPRETATION OF GEOCHEMISTRY RESULTS

A selection of elements (Au, Ag, As, Sb, Mo, Ni, Cr, Cu, Pb and Zn) that are commonly associated with mineral deposits in the Nechako Plateau are discussed in this section. Mean and median (background) concentrations of these elements in this area can be found in Table 3. Elevated (>90th percentile) and anomalous (>95th percentile) concentrations of these elements are interpreted and examined in relation to new prospective areas, known mineral occurrences, glacial ice flow direction and bedrock geology.

Interpretation of till geochemical results from this study area has highlighted 20 new exploration targets, most of which are multi-element anomalies (Fig. 8). Within the Nechako River map area, the concentration of elements in till is one or more orders of magnitude lower than in their source rocks (Levson et al., 1994). Therefore, moderately elevated element concentrations in till may represent high concentrations in bedrock (i.e. the study of relative element concentrations is required to locate prospective areas).

TILL GEOCHEMISTRY AROUND KNOWN MINERAL OCCURRENCES

One way to determine the significance of till geochemical values in an area is to compare them to the concentration of the same element in till occurring around areas of known mineralization and similar bedrock geology. However, since the distribution of mineralized occurrences is limited and bedrock geology is quite variable, this is often difficult in the Nechako Plateau. Fortunately, there are a few mineral occurrences in the study area that are useful for comparative purposes, as discussed below.

Uduk Lake Epithermal Gold-Silver Prospect

Anomalous gold and arsenic values in till occur around the Uduk Lake epithermal gold-silver prospect. The following discussion of the till geochemistry of the Uduk Lake property is provided so that comparisons of the regional till geochemical data can be made with till geochemical data from an area of significant gold mineralization.

A till geochemical case study of the area was conducted by O'Brien *et al.* (1997) and results of this work are summarized here. The property is underlain by andesitic to rhyolitic volcanic rocks of the Eocene Ootsa Lake Group (Tupper and St. Clair Dunn, 1994). Joints and veins on the property generally strike northerly (006^{o} to 015^{o}). Regional southeast-trending faults in the area (130^{o} to 160^{o}) are offset by northeast-trending (~050^{o}) structures. The latter parallel the local ice-flow direction. Outcrops are uncommon but bedrock often occurs at shallow depths along the southwest (up-ice) end of fluted ridges.

Gold grades up to 5 g/t have been reported with the best trench yielding 1.4 g/t over six metres and 0.41 g/t over 42 metres (Trench 4; Tupper and St. Clair Dunn, 1994). The typical range for gold is about 10-100 ppb. Arsenic concentrations are typically in the 20-200 ppm range but values up to 840 ppm occur. Silver typically ranges from <0.2 to 2 ppm with occasional values up to 12.6 ppm. The host rocks for gold-silver mineralization are rhyolite to dacite flows, tuffs and breccias locally showing sericite and quartz hydrothermal alteration. Several episodes of silicification produced breccias and veins with drusy quartz and chalcedony. Each stage of silicification produced coarser quartz grains, often accompanied by pyrite, gold and silver mineraliza-

TABLE 3
Mean and median (background) concentrations of a selection of elements within the study area. These elements are commonly associated with mineral deposits in the Nechako Plateau. Gold values are in ppb and ppm for all other elements. Elements that are highlighted with astericks were analyzed by INA. Other elements were analyzed by ICP.

	Mean (all samples)	Median (all samples)	mJHN (median)	EOL (median)	uKk (median)	mJHE (median)	Nv (median)
Au*	3.3	1	1	1	1	1	2
As*	11.92	10.4	9.3	12.3	11.2	11.6	5.3
Ag	0.5	0.5	0.5	0.5	0.5	0.5	0.53
Cu	25.6	24	27	20	22	27	20
Cr*	75.5	74	85	59	73	87	95
Mo	1.2	1	1	1	1	1	1
Ni	19.5	18	22	14	16	23	20
Pb	8.4	8	9	7	7	9	7
Zn	58.9	58	59	56	54	63	47

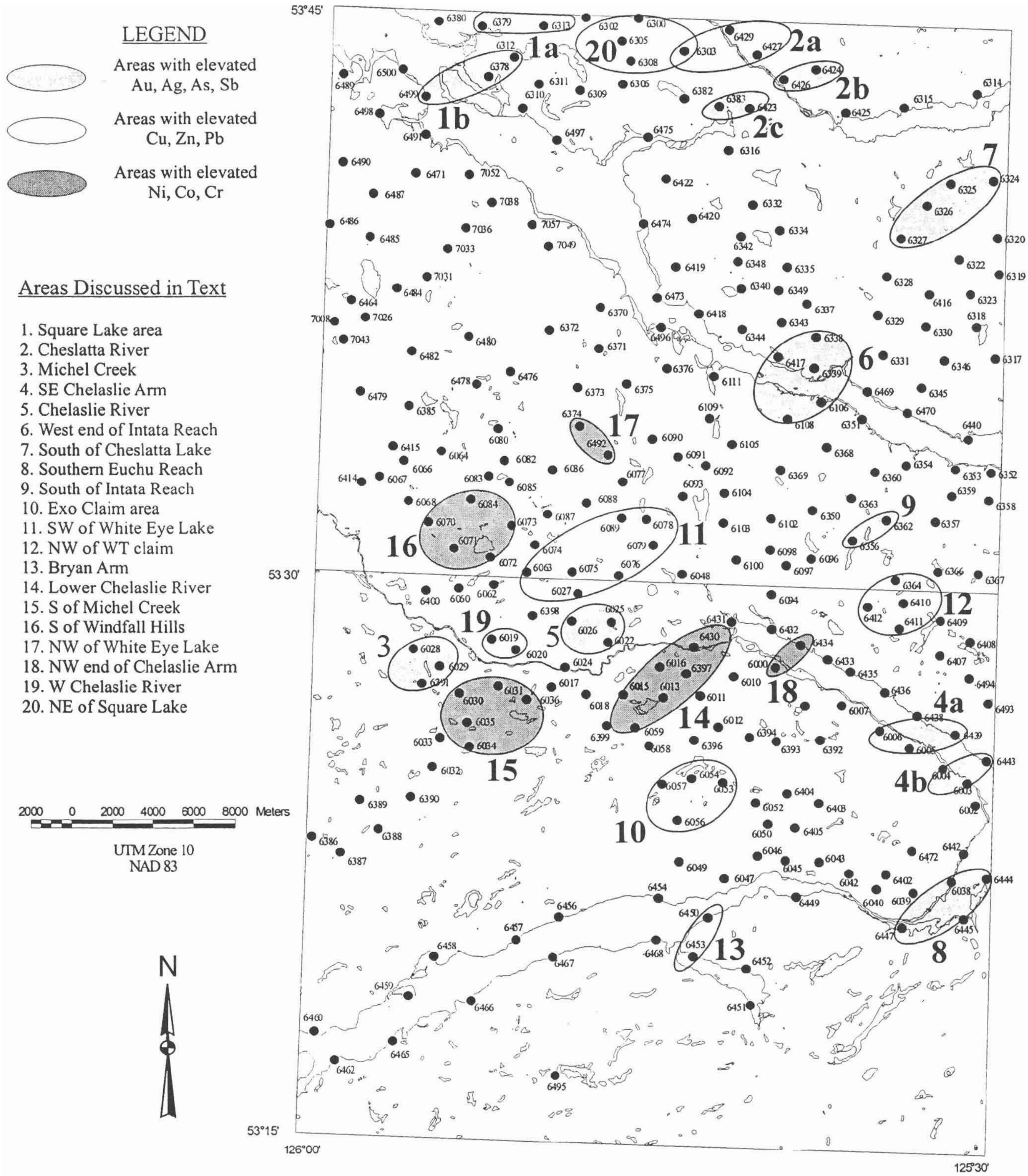

Figure 8. Areas with elevated levels of precious and base metals (concentrations exceed the 95th percentile at one or more sites in each area). Highlighted areas are indicated by multi-element anomalies, high levels of pathfinder elements, dispersal patterns consistent with northeasterly ice flow, and favourable geological units in the up-ice direction.

tion. The best gold and silver grades occur in the most hydrothermally altered host rock (Tupper and St. Clair Dunn, 1994). Pyrite occurs in veins, the stockwork, brecciated zones and occasionally is disseminated in altered rhyolite. The pyrite content was not shown to have an effect on the amount of gold and silver mineralization (Lane and Schroeter, 1995).

Basal till samples collected at the property by O'Brien *et al.* (1997) can be grouped into three data sets: profile samples from exploration trenches, near-surface samples from an area about 6 km^2 on the property, and near-surface samples 2-10 km down-ice of the property. Median (and average) gold concentrations for these three data sets in ppb are 24 (37), 9.5 (23) and 1 (2.9), respectively. This represents approximate (order of magnitude) dilution ratios from bedrock to till of about 2:1, 5:1 and 50:1, respectively, for samples directly over, within about 1 km, and within 2-10 km, of mineralized bedrock (Levson and O'Brien, 1997). Median (and average) arsenic concentrations in ppm for the same three data sets are 24 (37), 13 (16), and 11 (11.5), respectively. Median (and average) silver concentrations in ppm are 0.5 (0.7), 0.3 (0.3), and 0.2 (0.2), respectively.

Dispersal trains on the Uduk Lake property are about 2 km long and 0.5 km wide for Au and As. The geochemical dispersal pattern developed for Au (>10 ppb) forms a train 2.5 km long, elongated towards the northeast. Arsenic (>15 ppm) also forms a dispersal train with roughly the same size and shape as that of gold. Values for Ag are commonly low and anomalies are isolated. The relatively small size of the dispersal plumes may reflect limited erosion due to the highly resistant silicified rhyolite (Levson and O'Brien, 1997; O'Brien *et al.,* 1997).

Gold concentrations in basal till samples collected from exploration trenches where mineralized bedrock was exposed, vary from 12 ppb to 139 ppb. Likewise, arsenic, antimony and silver values in single trenches vary, respectively, from 21 to 140 ppm, 2.5 to 8.2 ppm and 0.3 to 1.1 ppm. In some cases till samples in trenches contain more gold than the underlying bedrock indicating that significant areas of gold mineralization are not exposed.

At the Uduk Lake property two till samples collected for this study have >95th percentile gold concentrations: 16 ppb at site 7008 and 15 ppb at site 7043. Site 7008 occurs approximately 500 m southeast of known mineralized bedrock and exploration trenches while site 7043 occurs about 250 m up-ice of trench TR94-2A (Tupper and St. Clair Dunn 1994). No known exposures of mineralized bedrock occur in the area of site 7043. Greater than 95th percentile concentrations of arsenic (30 ppm) and molybdenum (4 ppm) also occur at site 7008.

Loon Epithermal Gold-Silver Prospect

The Loon epithermal gold-silver prospect occurs directly to the north of the Uduk Lake property (DUK 1 claim). The bedrock geology of this prospect is described by Taylor (1990). Eocene Ootsa Lake Group rocks are the most widespread. They consist of felsic to intermediate composition flows and tuffs. Endako volcanics (andesitic and basaltic flows) overlie and intrude Ootsa Lake Group rocks. Alteration, common in Ootsa Lake Group rocks, rarely extends into the Endako volcanics (Taylor 1990). This suggests that the mineralizing event occurred prior to or at the same time as the emplacement of Endako volcanics.

Eleven exploration trenches have been dug on this property. Bedrock in these trenches is consistently Ootsa Lake Group rhyolite that has experienced silicification and argillic alteration. Two metre trench samples from trench TR88-4 contained up to 2365 ppb Au and 25 ppm silver.

Till site 6464 occurs 600 m southeast of trenches containing mineralized bedrock. No known areas of mineralization occur around this till site which has >95th percentile gold and arsenic concentrations (13 ppb and 29.8 ppm respectively). Angular rhyolite clasts with some sericite alteration and rare rhyolite breccia clasts were found at this site.

Exo Sn, Mo Skarn Prospect

Multi-element concentrations of arsenic, copper, lead, and zinc (>95th percentile) occur within and around the Exo tin-molybdenum skarn prospect. This property is underlain by Upper Triassic Takla Group rocks that consist of intensely hornfelsed and skarned siltstone, limestone and basic volcanics (Eldridge and Leask 1988). This property is also intruded by a Cretaceous granitic plug. Eldridge and Leask (1988) mention that a skarn deposit grading 0.26% tungsten oxide (WO_3) is exposed for 22 m at the main showing on this property and a large zone of mineralized stockwork veinlets occur 200 m east of this skarn. Grades from this zone (350 m) were 0.52% copper, 0.07% WO_3, and 4.7 g/ton Ag.

Greater than 95th percentile copper concentrations occur at both regional till sample sites within the Exo property (57 ppm site 6054 and 44 ppm site 6053). Two more sites, to the west and southwest of this property also have >95th percentile copper concentrations. Site 6057 occurs 2.5 km west from the centre of the prospect and contains 46 ppm copper. Site 6056, 2 km southwest of the centre of the prospect, has a copper concentration of 48 ppm.

Elevated (>90th percentile) and anomalous (>95th percentile) arsenic, lead and zinc concentrations also occur at sites 6054 (14 ppm Pb, 112 ppm Zn) and 6056 (33 ppm As, 22 ppm Pb, 142 ppm Zn). Additionally, >90th percentile molybdenum concentrations occur at sites 6053, 6054 and 6056 within and 1.5 km southwest from the centre of the Exo prospect.

New assay results from small veins at site 6054, collected during the 1997 field season, had copper concentrations ranging from 2531 to 5957 ppm, silver from 4.6 to 8.2 ppm, zinc from 494 to 2200 and tungsten from 510 to 4060 (samples 97-6054RA, B, and E; Appendix A).

Godot Cu, Mo Showing

At the Godot showing, disseminated chalcopyrite and molybdenite occur in granodiorite rocks that have intruded Hazelton Group volcanics (MINFILE 093F 054). Two regional till geochemistry sample sites (6050 and 6403) near the Godot showing have >95th percentile gold concentrations (29 ppb and 20 ppb, respectively) and most sites in the area have >85th percentile molybdenum (2 ppm). Greater than 95th percentile molybdenum concentrations occur in till at site 6046 (3 ppm), approximately 4 km southwest of the centre of the Godot claim. This site is roughly 1 km down-ice (northeast) of a small diorite intrusion. High gold and arsenic concentrations also occur in till around the Godot prospect. At two sites along the western boundary of the claim area (sites 6050 and 6052) disseminated pyrite was found in basalt and volcanic rock float.

Tet Cu, Mo Showing

At the Tet showing (MINFILE 93F 002), mineralization consists of disseminated pyrite with chalcopyrite and molybdenite. High gold and arsenic concentrations also occur within and around this showing. Like at the Godot property, this area is underlain by Hazelton Group volcanic rocks that are intruded by granodiorite. Till at regional site 6472 within the Tet showing has a >95th percentile arsenic concentration (21.7 ppm). Heavily oxidized rhyolite clasts with some disseminated pyrite (1-2%) occur in till at this site, which overlies an Eocene granodiorite intrusion. Site 6402, approximately 1.7 km southwest of site 6472, has elevated (>90th percentile) gold and arsenic values (7 ppb and 18.1 ppm, respectively).

WT CuMoAu Porphyry and Cu Skarn Showing

The highest copper (145 ppm, site 6407) and zinc (150 ppm, site 6409) concentrations in regional till geochemistry samples, within the study area, occur at the WT claims. Dirom and Knauer (1971) and Howell and Dirom (1972) have described the bedrock geology of this property. Intrusive, hornblende to quartz diorite occurs in the northern portion of the claim (north of site 6407). Quartz orthoclase and orthoclase porphyry latite outcrop in southern parts of the claim and andesite (in dikes) and aplite have also been mapped. Meta-sediments, mapped as hornfelsed and skarn members have also been noted in this area. Both of these members have poorly developed alteration.

At till site 6407, the anomalous copper concentration is associated with >95th percentile molybdenum. Similarly, the anomalous zinc concentration at site 6409 (along the northern border of the WT claim) is associated with a >95th percentile lead concentration (26 ppm). The highest lead concentration in the study area (32 ppm) occurs at site 6410, 3.5 km northwest from the centre of the WT claim.

Rhub Cu, Au, Ag Showing

Two sites with elevated gold concentrations in till (sites 6317 and 6323) occur near the Rhub showing on the western edge of the Marilla map sheet. Most of this property occurs in the Cheslatta Lake (NTS 93F/11) map area to the east. Greater than 95th percentile gold occurs in till at site 6323 (19 ppb) and >90th percentile gold occurs at site 6317. Greater than 70th percentile gold occurs at three other sites in this general region (6320, 6330 and 6346). Numerous (up to about 40%) heavily oxidized Ootsa Lake rhyolite clasts occur in this area in the till. One other till site in the area (6318), approximately 750 m west of the Rhub showing, has a gold concentration of 1 ppb (below detection). This low gold concentration may indicate that little gold occurs directly up-ice of this site. However, it could also be caused by the nugget effect as the antimony concentration at this same site is >90th percentile and arsenic is >70th percentile. Another site (6322) just north of the Rhub property, has similar levels of antimony and arsenic and greater than 60th percentile gold. These observations emphasize the importance of evaluating the distribution patterns of pathfinders elements like arsenic and antimony when looking for geochemical evidence of gold and other metals.

GOLD

Mean and background (median) concentrations for gold in the study area can be found in Table 3. The distribution of gold anomalies in the study area highlight known prospects like Uduk Lake and the Loon as well as several new areas that have exploration potential (described below). No known mineral occurrences occur in these areas.

Square Lake Area

The highest gold concentration in the study area (77 ppb) occurs at site 6379 (Area 1a, Figure 8). Site 6379 and is near the head of a possible gold dispersal plume that is up to 7 km long and 1.8 km wide. Greater than 95th percentile gold in till at site 6379 decreases to 90th percentile (7 ppb) at site 6313, approximately 3 km down-ice. Five and seven kilometres down-ice (at sites 6302 and 6300, respectively) gold concentrations are only slightly elevated (>60th percentile). Antimony concentrations exceed the 70th percentile at most of these sites and >90th percentile antimony occurs at site 6380, directly west of 6379. Greater than 95th percentile lead also occurs at site 6380. Gold in this area may be related to mineralization within and/or adjacent to the Skins Lake Pluton (Figure 6; Anderson et al., 2000b). Sites 6379 and 6380 overlie the pluton and 6313 occurs directly down-ice.

A similar distribution of copper values occurs roughly in the same area (discussed below). Till with a >95th percentile copper concentration (47 ppm) occurs at site 6313, while >90th and >70th percentile copper occurs farther down-ice at sites 6302 and 6300, respectively. Site 6313 also contains >70th percentile concentrations of barium (by ICP), >90th percentile concentrations of zinc and bromine, and >95th percentile concentrations of calcium and cadmium. Site 6302 contains >95th percentile concentrations of all these elements except barium.

Three other regional till geochemical sites (6312, 6378 and 6499) with >90th percentile gold concentrations also occur in the area west of Square Lake (Area 1b, Figure 8). These sites occur south of the Skins Lake pluton over Kasalka Group rocks. High gold at these sites may be related to one or more possible sources of mineralization on the west side of Ootsa Lake. Site 6499, for example, occurs on the west side of the lake in a general area of elevated gold, arsenic and antimony. Two sites south of site 6499 contain >70th percentile gold (sites 6471 and 6491). Several sites in the area (6471, 6485, 6486, 6487, 6489 and 6491) contain >70 percentile arsenic and antimony and sites 6489 and 6491 contain >90th percentile arsenic. There is little bedrock exposure but Ootsa Lake rhyolites have been mapped in this area (Figure 6).

Cheslatta River Area

Three prospective areas for gold (Areas 2a, b, c; Figure 8) occur in the Cheslatta River (Marilla map sheet) area. Sites 6427 and 6429, on the north side of the river (Area 2a, Figure 8), contain >95th percentile gold concentrations (11 ppb and 18 ppb, respectively) as well as >95th percentile antimony. A third site (6303) to the west has >90th percentile antimony, >95th percentile zinc, and >70th percentile copper and nickel. Other elements that are elevated at these sites include copper and barium (>70th percentile, sites 6427 and 6429), cobalt, zinc, cadmium and nickel (>70th percentile, site 6427), calcium and manganese (>95th percentile, site 6427), and arsenic (>70th percentile at 6429). Rare, oxidized and silicified, subangular volcanic clasts were found at station 6429.

A second prospective area (Area 2 b; Figure 8) occurs the southeast in the vicinity of sites 6424, 6425 and 6426. Site 6424 has the second highest gold (38 ppb) and antimony (3.9 ppm) concentrations in the study area and >70th percentile arsenic. Site 6426, directly to the southwest, has >95th percentile arsenic and antimony and >70th percentile copper, zinc and nickel. Site 6425, to the south of site 6424, has >95th percentile antimony and >70th percentile arsenic. Greater than 70th percentile barium (by INA) occurs at all three of these sites. Decreasing concentrations of copper, zinc, nickel, cobalt and arsenic in the down-ice direction (between sites 6426 and 6424), suggest a possible dispersal train with a source area westerly of site 6426. However, since this observation is based only two sites, the interpretation should be tested by more sampling.

A third prospective area in the Cheslatta River region occurs just southwest of the river (Area 2c; Figure 8) around sites 6383 and 6423. Concentrations of several elements (antimony, arsenic, lead, zinc and nickel) decrease in the down-ice direction from site 6383 to 6423, suggesting a possible dispersal train with a source area up-ice of site 6383. Interestingly, >70th percentile gold occurs at site 6382, up-ice (west) of site 6383. For the same reason as above, this interpretation should be tested by more sampling.

Since no samples were obtained down-ice of the three sites with >95th percentile concentrations of gold and antimony (sites 6424, 6427 and 6429), it is not possible to evaluate their significance by examining geochemical dispersal patterns in the area. Without further information they should be considered to be separate anomalies, possibly with different source areas. High gold and antimony in till at the sites may originate from one or more possible mineralized areas within Ootsa Lake Group rocks mapped by Anderson et al. (2000a) 0.5 to 2 km to the southwest (up-ice).

The bedrock geology in this area is quite variable. Sites 6383 and 6423 are underlain by Ootsa Lake volcanic rocks. Site 6424 is underlain by Endako Group basalt and Bowser Lake Group sedimentary rocks underlie site 6429. Sites 6426 and 6427 occur along the boundary between these two rock units. Although several bedrock units have been mapped in this area, outcrop is rare and a majority of the land surface is covered by thick glacial sediments.

Michel Creek

One site (6029) with >95th percentile gold and two sites (6028, 6391) with >70th percentile gold concentrations occur north of Michel Creek (Area 3; Figure 8). Till at site 6391 also has >95th percentile silver and site 6029 has >70th percentile nickel. The till at site 6028 also contains >95th percentile nickel and >70th percentile copper and zinc. All of these sites, have >95th percentile chromium, >70th percentile cobalt and >90th percentile titanium. Neogene volcanic rocks occur in the vicinity of and directly up-ice of these sites (R.G. Anderson and L.C. Struik, unpublished data, 2000). At station 6391, weathered rhyolite clasts with some quartz veins were found in till. No till sample sites occur up-ice from this area.

Southeast End of Chelaslie Arm

A large area with elevated gold, arsenic, antimony, molybdenum, copper, lead and zinc occurs at the southeastern end of Chelaslie Arm at sites 6003, 6004, 6005, 6006, 6439 and 6443 (Areas 4a and 4b, Figure 8). At least two possible sources for these metals are suggested. The highest values of these elements generally occur on the southwestern side of the area and decrease easterly. A decrease of most elements to the southeast may also reflect dispersal in that direction, possibly due to topographic control of ice flow along Chelaslie Arm.

Site 6006 occurs at the westernmost side of an area of elevated gold, arsenic and antimony (Area 4a, Figure 8). Till at this site has the highest molybdenum concentration in the study area (8 ppm), the second highest arsenic (44 ppm), >90th percentile gold, and >95th percentile copper, lead and zinc. The highest antimony concentration in the study area (5.4 ppm) occurs at an adjacent site (6007) directly to the northwest. Site 6006 has >90th percentile antimony and site 6005 to the southeast has >70th percentile antimony, molybdenum, lead, and zinc. Across the arm at site 6439, >70th percentile gold, arsenic, molybdenum and copper occur. Arsenic concentrations are lower at site 6005 (22 ppm) than at 6006 but still exceed the 95th percentile. These elements all show a general decline eastward, suggesting a possible bedrock source to the west or northwest of sites 6005 and 6006.

At station 6005, till overlies fractured and oxidized bedrock containing sulphide-rich veins up to 1 m thick. Assay results from vein samples had gold concentrations up to 612 ppb and arsenic concentrations of 85.2 ppm (97-6005RB; Appendix A). Assayed gold values from most bedrock samples from this area (98-6005R, 97-6005RA1, and 97-6005RA2; Appendix A) ranged from 23 to 28 ppb.

Another area of interest for metals at the southeast end of Chelaslie Arm occurs in the vicinity of sites 6003 and 6004 (Area 4b; Figure 8). At site 6004, the till contains >90th percentile gold, arsenic and copper, and >70th percentile molybdenum, antimony, lead and zinc. Greater than 95th percentile copper and lead, and >90th percentile zinc occur at site 6003 and similar values occur directly northeast across Chelaslie Arm at site 6443. Arsenic concentrations also exceed the 90th percentile at 6443 and the 70th percentile at sites 6002 and 6003. Sites 6002 and 6443 also have

>70th percentile antimony. Again, these data suggest a bedrock source area up-ice (southwest) of these sites.

Chelaslie River

Two sites (6022 and 6026) with >90th percentile gold occur just north of the Chelaslie River (Area 5, Figure 8). Site 6022 also has >95th percentile arsenic. Site 6026 and an adjoining site (6025) both have >70th percentile arsenic. Site 6022 also contains >95th percentile copper, nickel and cobalt, >85th percentile molybdenum, >90th percentile lead and chromium and >70th percentile zinc. Sites 6025 and 6026 also have >90th percentile copper and >70th percentile lead, zinc and nickel.

Erratics with elevated gold and arsenic were found on Chelaslie Arm several kilometers east of site 6022. At site 6434 a weathered clast, possibly rhyolite, contains 594 ppm arsenic and at site 6432 an andesite clast has 545 ppm arsenic (Appendix A). One mineralized clast found in that area (6433RB, Appendix A) contained 40 ppb gold and 74 ppm molybdenum. This clast was subangular, oxidized andesite that contained up to 10-15% sulphides. The source(s) of these erratics is not known but they may be from as far west as the area around site 6022.

Other

A number of other sites with elevated gold as well as arsenic and/or antimony occur within the study area. For example, >95th percentile gold occurs at three isolated sites: site 6357 south of Intata Reach; site 6389 southwest of Michel Creek; and site 6449 at the east end of Tetachuck Lake. Till at site 6357 also has >70th percentile arsenic, antimony and copper. Two sites down-ice of 6389 (6034 and 6390) and one site up-ice (6386) have >70th percentile gold. Site 6449 also has >95th percentile arsenic and antimony and >85th percentile molybdenum. More sampling is required in the vicinity of these sites to evaluate their significance but the presence of elevated metal concentrations in addition to gold is a good indication that there is potential in these areas.

One other area of interest occurs at the west end of Intata Reach (Area 6; Figure 8). Site 6339 in that area has >95th percentile arsenic and antimony and three adjacent sites on both sides of the lake (sites 6106, 6108 and 6417) contain >90th percentile gold and >70th percentile arsenic. Site 6417 also has >90th percentile antimony and >70th percentile zinc. Site 6329, about 4 km down-ice (NE) of 6339, has >95th percentile antimony and >90th percentile arsenic. Site 6338, about 1.5 km north of 6339, also has >95th percentile silver. These data all suggest the presence of precious metal mineralization at the west end of Intata Reach.

Relationships with Bedrock Geology

Of the 14 till sites in the study area with >95th percentile gold concentrations, four are underlain by Ootsa Lake Group rhyolite (6323, 6464, 7008 and 7043). Three other sites (6357, 6427, and 6429) occur directly (<1.8 km) down-ice from this rock type. Thus Ootsa Lake rocks account for 50% of the anomalies but underlie a much smaller proportion of the map area (Figure 6). The underlying bedrock geology also has an influence on the distribution of gold pathfinders such as antimony. Of the 14 sites with >95th percentile antimony, seven are derived from Ootsa Lake rocks and four others occur directly down-ice from the Ootsa Lake Group. The same holds true for arsenic although the relationship is less clear. Of the 14 sites with >95th percentile arsenic, six overlie or occur directly down-ice from the Ootsa Lake Group. Most of the other sites overlie the Hazelton Group and two sites occur on or near intrusive rocks (Eg and lKi; Figure 6).

ARSENIC AND ANTIMONY

Mean and background (median) concentrations for arsenic in the study area can be found in Table 3. Similar to gold, high arsenic and antimony concentrations highlight the Uduk Lake and Loon epithermal gold prospects and the potential of surrounding areas. Collectively, these elements also highlight areas discussed abover as well as a few new prospective areas.

Cheslatta River

Six sites (6424, 6425, 6426, 6427, 6429, and 6383) with >95th percentile concentrations of antimony occur in the Cheslatta River area. Sites 6429, 6427, and 6424 also have >95th percentile gold concentrations (see gold above; areas 2a, b, c; Figure 8). Arsenic concentrations exceed the 95th percentile at site 6426 and the 70th percentile at sites 6383, 6424, 6425 and 6429. Greater than 70th percentile copper, zinc, nickel and cobalt also occur at sites 6426 and 6427 and site 6383 has >70th percentile copper and chromium. The wide spacing of the sites and geochemical element distribution patterns in the area are suggestive of more than one source for the anomalies.

South of Cheslatta Lake

Two till sites with >95th percentile antimony concentrations (6324 and 6327) and two other sites with >90th percentile antimony (6325 and 6326) occur in a heavily drift covered area south of Cheslatta Lake (Area 7; Figure 8). One of these sites (6326) also has >95th percentile silver and >70th percentile gold suggesting that there is potential in the area for precious metal mineralization. Rock exposures in this area are rare but the bedrock has been mapped as Ootsa Lake rhyolite, a prospective unit for epithermal deposits. Antimony concentrations are highest at site 6327 (2.7 ppm) and decrease to >90th percentile levels at sites 6326 and 6325 (2 and 4 km down-ice of site 6327, respectively). Site 6326 also has >90th percentile arsenic and >70th percentile zinc and cobalt. These data suggest a possible source area southwest of site 6326 and north of 6327. Elevated antimony and arsenic at site 6324, about 4 km down-ice of site 6326 near the eastern edge of the study area, may reflect dispersal from this area or another source.

Southwest of White Eye Lake

Two sites with anomalous arsenic concentrations (6063 and 6075) occur southwest of White Eye Lake and north of Chelaslie River near the border of the two map sheets (Area 11; Figure 8). Site 6063 has the highest arsenic concentration in the study area (51 ppm). Site 6075 occurs approximately 2 km to the east and also has >95th percentile arsenic (26 ppm). Two more sites (6076 and 6079) with >70th percentile arsenic occur farther (2-5 km) down-ice from these sites. Site 6063 also >95th percentile zinc, >90th percentile copper and >60th percentile gold. Sites 6063, 6075 and 6076 all have at least 70th percentile copper, lead, zinc, chromium and nickel. Sites 6075 and 6076 both have >95th percentile lead as does site 6027, located about 1 km south of 6075. The concentration of most elements, with the main exception of lead, is highest at site 6063 and decreases eastward (down-ice) suggesting that the source of the metals is in the area around or up-ice of site 6063 (see also copper and zinc, below; Area 11; Figure 8). Most sites in this area overlie rocks of the Naglico and Entiako Formations (Hazelton Group). However, site 6063 is underlain by a diorite and granite pluton, which is a probable the source for mineralization in the area. At site 6398, about 2 km south of 6063, five volcanic clasts containing disseminated sulphides were found in the till (Appendix A).

Other

In addition to the areas discussed above and in the section on gold, >95th percentile arsenic occurs at two other sites (6422 and 6482). Site 6482, in the Windfall Hills area, also has >90th percentile antimony and >70th percentile zinc. Likewise site 6422, south of Chief Louis Arm, has >90th percentile lead and cobalt as well as >70th percentile antimony, copper, zinc and nickel. Other sites in the Chief Louis Arm area with elevated metal concentrations include site 6475 with >95th percentile zinc, >90th percentile nickel and cobalt and >70th copper, and site 6316 with >90th percentile copper and >70th percentile zinc, nickel, cobalt and chromium.

SILVER

Silver concentration in almost all (97%) till sample sites is at or below detection (0.5 ppm) in the study area (see Table 3). As discussed above, site 6326 has >95th percentile silver, >90th percentile arsenic and antimony and >70th percentile gold, zinc and cobalt. Other sites in the area also have high arsenic and antimony (Area 7; Figure 8).

Southern Euchu Reach

An area of elevated silver, gold and copper occurs at the south end of Euchu Reach (Area 8; Figure 8). Two sites (6445 and 6447) in the area contain >95th percentile silver. Site 6445 has >90th percentile arsenic and site 6444, 2 km to the northeast, has >90th percentile gold as does site 6038. Greater than 95th percentile copper also occurs at site 6447 and at site 6038, about 3 km to the northeast. Till at the latter site contains the second highest copper concentration in the study area (97 ppm). In combination, these data indicate that the area around the southwestern end of Euchu Reach has good exploration potential. Granodiorite and quartz monzonite intrusive rocks are mapped in this area flanked by a large Eocene granite on the west shore of the reach and a small area of Ootsa Lake volcanics to the east (Figure 6).

South of Intata Reach

The highest silver value from the survey is 0.8 ppm at site 6356, south of Intata Reach in the southeast corner of the Marilla map area (Area 9; Figure 8). Greater than 70th percentile antimony, nickel and cobalt also occur at site 6356 as well as at site 6362, two kilometers to the northeast.

North of Loon prospect

An elevated silver value (0.6 ppm) occurs at site 6486, approximately 2.5 km northwest of the Loon epithermal gold-silver prospect. Till at this site also contains >70th percentile arsenic and antimony. This area is underlain by Ootsa Lake Formation rocks. A small rock quarry occurs to the west of this site, just off the Marilla map sheet. This quarry is a dome shaped feature made up of rhyolite breccia with minor sulphides and quartz veins. Some of these breccias are clay altered and have a siliceous matrix. Assayed rock samples from the quarry (98-6486 RA, RB, and RC) contain arsenic concentrations ranging from 235 ppm to 969 ppm and gold concentrations from 9 to 21 ppb. At the Uduk Lake property (to the south) silver concentration in till from a trench sample was as high as 2.7 ppm (O'Brien 1996).

Michel Creek

Greater than 95th percentile silver (0.7 ppm) occurs north of Michel Creek (site 6391), which is also a prospective area for gold (Area 3, Figure 8). Associated silver and gold anomalies suggest that a potential gold-silver epithermal deposit occurs up-ice of this area. The area is underlain by Neogene volcanic rocks (R.G. Anderson and L.C. Struik, unpublished data, 2000).

COPPER

The mean and median copper concentrations derived from the 273 till sample sites in the study area were 25.6 ppm and 24 ppm, respectively (Table 3). Median copper concentrations in till overlying individual bedrock units in the map area are summarized in Table 3. Median (or background) copper concentrations in till from around known copper porphyry deposits in the Nechako Plateau are 181 ppm at the Huckleberry Mine (Ferbey and Levson, 2000), 66 ppm at the Nak property (Levson *et al.*, 1997), and 63 ppm at the Bell Mine (Stumpf *et al.*, 1997).

High copper concentrations are commonly derived from areas underlain by Hazelton Group rocks and in close proximity to some plutons. A majority of the regional till sites in the study area with high copper concentrations occur in the Tetachuck Lake map area where these rock types are most common. In areas where till is derived from Tertiary Ootsa Lake Group rocks, copper concentrations are generally lower.

Square Lake

An area of elevated copper occurs north of Square Lake. Site 6313 has >95th percentile (47 ppm) copper. Two kilometres to the northeast of this site, the copper concentration lowers to the >90th percentile (site 6302, 41 ppm). Further to the northeast (4.5 km down-ice from site 6313) a copper concentration of 34 ppm (>70th percentile) occurs at site 6300. These sites overlap with an area of elevated gold and other metals (Area 1a, Figure 8). In addition to high copper, site 6313 has >90th percentile gold and zinc and >70th percentile arsenic, nickel and cobalt. Site 6302 also contain >95th percentile zinc and >70th percentile antimony, nickel and cobalt. Site 6313 occurs directly down-ice of the Skins Lake pluton, a possible source of mineralization in the area.

Eight other till sites (6303, 6305, 6306, 6308, 6309, 6312, 6313, 6427 and 6429), in the area between Square Lake and the Cheslatta River, have >70th percentile copper concentrations. This large area (about 35 km^2) is underlain by a variety of different bedrock units. A few sites have elevated levels of other metals (e.g. >95th percentile zinc at site 6303) but no clear source area for the copper is apparent.

Southeast End of Chelaslie Arm

Three sites with copper concentrations that exceed the 95th percentile (6003, 6006 and 6443) and two sites that exceed the 90th percentile (6004 and 6005) occur along the shoreline of Chelaslie Arm. High gold, arsenic and molybdenum concentrations also occur at sites 6004, 6005, and 6006 (see Area 4, Figure 8). Sites with >95th percentile copper also occur south of Chelaslie Arm in the southern Euchu Reach area (sites 6038 and 6447 - see silver discussion above).

Exo Claim Area

Four sites (6053, 6054, 6056 and 6057) with >95th percentile copper are clustered within and around the area of the Exo Claims, northeast of Tetachuck Lake (Area 10, Figure 8). Most or all of these sites also show at least 70th percentile gold, arsenic, molybdenum and nickel. Sites 6054 and 6056 have >95th percentile lead and zinc and >90th percentile arsenic. Sites 6053 and 6057 have >90th percentile zinc. Sites 6056 and 6057 occur outside of the Exo claim area.

Chelaslie River

One site with >95th percentile copper (site 6022) and two sites with >90th percentile copper (sites 6025 and 6026) occur along the Chelaslie River in an area with elevated gold and other metals (Area 5, Figure 8). The highest copper concentration in this area is 53 ppm and occurs at site 6022. This site also has >95th percentile arsenic, nickel and cobalt, >90th percentile gold, chromium and lead, and >70th percentile zinc and molybdenum. Site 6022 occurs approximately 1 km down-ice from a hornblende-biotite diorite intrusive rock unit.

Southwest of White Eye Lake

A large area with elevated copper and other metals occurs southwest of White Eye Lake in the Marilla map area (Area 11, Figure 8). Site 6063 has >90th percentile copper and six other till sites (6076, 6077, 6078, 6079, 6089, and 6093) in this area have >70th percentile copper concentrations. Sites in the southwest (up-ice) part of this area also show elevated concentrations of other metals (e.g. >95th percentile lead at sites 6027, 6075 and 6076; >95th percentile zinc at 6063; see also lead and zinc below). These sites are underlain by and occur down-ice from Naglico Formation rocks and very little bedrock outcrop occurs in this area. Andesite clasts containing disseminated and vein sulphides were found at sites 6092 and 6104, down-ice from the above area, just northeast of White Eye Lake.

Northwest of WT Claim

Three till sites (6364, 6410, and 6412) with elevated copper occur north of Chelaslie Arm (Area 12; Figure 8) and northwest of the WT mineral occurrence (Figure 2). The highest lead concentration in the study area (32 ppm) and >95th percentile zinc occur in till at site 6410 and >90th percentile lead occurs at a fourth nearby site (6411). Greater than 90th percentile zinc occurs at site 6412. All four sites overlie a large, Cretaceous, hornblende-biotite diorite intrusive rock unit (Figure 6) and the area up-ice (southwest) of site 6412 is a probable source area for the metals in the till. Of the sites, 6412 is the farthest up-ice and has a >90th percentile copper concentration (41 ppm). Two >70th percentile copper concentrations (35 ppm, site 6364; 36 ppm, 6410) occur 2 km north-northeast and east-northeast of this site. Copper drops to <50th percentile levels another 2.5 km down-ice (site 6366). Elevated concentrations of lead, zinc, arsenic, antimony and cobalt also occur at most of these sites.

Tetachuck Lake - Bryan Arm

Another site with >95th percentile copper occurs on Tetachuck Lake (site 6450) near Bryan Arm (Area 13; Figure 8). An adjacent site (6453) also has >70th percentile copper. Sites 6450 and 6453 have >70th percentile gold and lead. Site 6450 also has >95th percentile zinc and >70th percentile cobalt.

NICKEL AND CHROMIUM

The average nickel concentration in till in the study area is 19.5 ppm and the median concentration is 18 ppm. The mean chromium concentration (INA) for the entire data set is 75.5 ppm and the median is 74 ppm. Table 3 summarizes median chromium and nickel concentrations in till overlying different bedrock units.

Numerous >95th percentile nickel and chromium concentrations highlight a large region in the center of the study area that is away from known prospects. (see Appendix D and Figure 8). A majority of these sites occur close to the Chelaslie River. In much of this area, elevated chromium and nickel values may simply reflect elevated concentrations in the underlying (and up-ice) bedrock geology. Bedrock units containing ultramafic xenoliths, like Neogene volcanics and basalt flows (Resnick, 1999), could be responsible for some of the anomalous chromium and nickel concentrations in till. Many of the sites with >95th percentile chromium and nickel occur over or directly down-ice of two large areas of Neogene volcanics and Endako basalts. Glacial sediments mask most of the bedrock in this part of the study area, therefore, it is possible that previously unidentified nickel source rocks exist here. Some of the chromium and nickel anomalies could potentially be associated with secondary PGE mineralization. These elements, which are simpler and less expensive to analyze, are useful pathfinders for platinum (Levinson 1974).

Lower Chelaslie River

Several sites (6013, 6015, 6016, 6059, 6397, 6430 and 6431) with elevated (>70th percentile) nickel, chromium, cobalt and copper concentrations occur in the area south of Chelaslie River (Area 14; Figure 8). The sites define an area that extends towards the northwestern tip of Chelaslie Arm and is generally parallel to the regional, northeast, ice flow direction. The second highest nickel concentration in the study area (48 ppm) and >90th percentile cobalt and chromium occurs at the up-ice end of this area at site 6015. Four adjacent sites (6016, 6022, 6024 and 6397) also have >95th percentile nickel. Greater than 90th percentile nickel occurs at two other adjacent sites (6013 and 6059) and most other sites in the area have >70th percentile nickel. Greater than 95th percentile cobalt occurs at sites 6016, 6397, 6430 and 6431. Other anomalous elements in this area include >95th percentile levels of lead at site 6016, zinc at 6016 and 6397, and silver at 6399. These sites are underlain by Naglico Formation rocks and, along the lowermost part of the Chelaslie River, by Ootsa Lake rhyolites. Two of these sites (6016 and 6397) occur within a large landslide complex and basal till samples there may have been transported short distances from their original position.

Several mineralized erratics possibly derived from this area (mostly oxidized andesites with disseminated sulphides) were collected along the southwest facing shoreline of the Chelaslie Arm (sites 6431, 6432, 6433, 6434, 6435, 6436, and 6438; Appendix A). Assay results from andesite and feldspar porphyry float samples in this area contained 260 ppm, 360 ppm, and 468 ppm copper (samples 98 -6438R, 6435C, and 6434RC, respectively, Appendix A) and up to 131 ppm nickel (sample 6432RC).

South of Michel Creek

Till at site 6035, south of Michel Creek (Area 15; Figure 8), has >95th percentile nickel, >90th percentile zinc, and >70th percentile copper and cobalt. Three adjoining sites (6030, 6031 and 6036) have >95th percentile chromium and >70th percentile nickel, and a fourth site (6034) has >90th percentile chromium. The highest chromium in the study area (160 ppm) occurs at site 6036. These sites all occur on the northeastern side of a large area of Neogene volcanics. Elevated nickel, chromium and cobalt north of Michel Creek was previously discussed (see gold and silver).

South of Windfall Hills

Three sites (6070, 6071 and 6072) south of the Windfall Hills and several other sites to the northeast (6073, 6074, 6084, 6085, 6086, 6087 and 6088) have elevated nickel, chromium and cobalt (Area 16; Figure 8). Nickel concentrations exceed the 95th percentile levels at sites 6070 and 6072, the 90th percentile at sites 6071 and 6085 and the 70th percentile at all other sites in the area. Likewise, the highest cobalt occurs at sites 6070 (>95th percentile), 6071 and 6072 (>70th percentile) and decreases in the down-ice direction. Chromium levels are >95th percentile at sites 6073, 6074, 6084, 6086 and 6087, >90th percentile at 6085 and 6088, and >70th percentile at 6070, 6071 and 6072. These sites all overlie or occur directly down-ice of Endako Formation volcanics.

Northwest of White Eye Lake

Till at two sites (6374 and 6492) several kilometers northwest of White Eye Lake (Area 17; Figure 8) contains >95th percentile nickel. Site 6492 also has >95th percentile chromium and >70th cobalt and site 6374 has >95th percentile cobalt, >90th zinc and chromium and >70th copper and gold. Kasalka Group rocks occur in this area.

Northwest End of Chelaslie Arm

A few sites with elevated nickel, chromium and cobalt occur at the northwest end of Chelaslie Arm (Area 18; Figure 8). Site 6434 has >95th percentile nickel, and cobalt. Site 6000, directly across the lake has >90th percentile nickel, chromium and copper. Most other sites near these two stations (e.g. 6432, 6433, 6009 and 6010) have at least 70th percentile levels of nickel, chromium and/or cobalt. Four float samples from site 6434 contained 112 to 342 ppm chromium, one had 468 ppm copper, and one sample from site 6432 had 131 ppm nickel (Appendix A). Elevated nickel, chromium and cobalt occur in tills for several kilometres along the north side of Chelaslie Arm between sites 6431 and 6436.

Other

Three other areas of interest for nickel and chromium occur in the region. A site south of White Eye Lake (6048) has >95th percentile chromium, >85th molybdenum and >70th nickel. Another site with >95th percentile chromium occurs between Chelaslie River and Tetachuck lake (site 6058). The site also has >70th percentile nickel and an adjacent site (6059) has >90th percentile nickel and chromium, >70th percentile zinc and cobalt. A third site on the north shore of Ootsa Lake (6418) has >95th percentile cobalt, >90th percentile zinc, and >70th percentile nickel, copper, lead and arsenic. An adjacent site (6344) has >95th percentile silver and >70th percentile cobalt.

LEAD AND ZINC

Mean lead concentration in till is 8.4 ppm while the median is 8.0 ppm (Table 3). Median lead concentrations are highest (9.0 ppm) in till overlying Hazelton Group rocks. The mean concentration of zinc in till is 58.9 ppm and the median is 58 ppm. The relationship of median lead and zinc values with the different bedrock units in the study area are summarized in Table 3.

Western Chelaslie River

One site (6020) with >95th percentile lead (14 ppm) and zinc (99 ppm) occurs along the Chelaslie River (Area 19; Figure 8), a few kilometers west of the area of high gold, arsenic and copper discussed previously (Area 5). Greater than 90th percentile lead and >70th percentile zinc occur at an adjoining site (6019) about 2 km to the northwest. Site 6020 also has >95th percentile nickel and chromium, >90th percentile cobalt, and >70th copper. Site 6019 has >90th percentile nickel and chromium and >70th percentile cobalt and copper. Three sites down-ice of 6020 contain >70th percentile zinc and lead (sites 6022, 6025 and 6026) and together define an area about 6.5 km long and 1.7 km wide. These data suggest a possible source of mineralization up-ice (southwest) of site 6020. Site 6020 is underlain by a diorite intrusion. Sites 6022, 6025, and 6026 are all underlain by the Naglico and Entiako Formations and occur a few kilometres down-ice from the diorite intrusion.

Northeast of Square Lake

Several sites with elevated zinc concentrations occur in the area north and east of Square Lake (Area 20; Figure 8). Greater than 95th percentile zinc concentrations occur at sites 6302 (88 ppm) and 6303 (85 ppm), >90th percentile at 6313 and >70th at 6300, 6305 and 6308. This area coincides with an area of high copper (see above). Elevated concentrations of copper, calcium, cadmium, barium, and bromine also occur in this region, which is largely covered by glacial sediments.

Southwest of White Eye lake

Three till sites with >95th percentile lead concentrations (6027, 6075, and 6076) occur southwest of White Eye Lake and north of the Chelaslie River near the map sheet boundaries (Area 11, Figure 8). A site with >95th percentile zinc and >70th percentile lead (site 6063) occurs 2 km west of site 6075 and both sites 6075 and 6076 have >70th percentile zinc concentrations. Greater than 95th percentile aluminum and arsenic concentrations also occur at site 6075. Site 6063 also has >95th percentile arsenic and high copper and gold. A strong indication of northeastward dispersal from this area is indicated by the pattern of arsenic concentrations (see above). This area is underlain by the Naglico and Entiako Formation rocks and is directly down-ice from a small intrusion that probably is associated with the source of mineralization in this area.

Lower Chelaslie River

The lower Chelaslie River area has several sites (6013, 6015, 6016, 6397 and 6430) with high lead and zinc (Area 14; Figure 8). Greater than 95th percentile lead (15 ppm) and zinc (91 ppm) concentrations occur at site 6016. All the other four surrounding sites have >70th percentile lead. Site 6397 has >95th percentile zinc (90 ppm). Sites 6016 and 6397 also both have >95th percentile concentrations of nickel and cobalt (see above). At site 6430, two kilometres down-ice from site 6016, lead, zinc and nickel concentrations in till decrease to 70th percentile values. Sites 6016 and 6397 are underlain by the Naglico Formation. These two sites are also located approximately 4 km down-ice (northeast) from a northeast oriented fault that cuts through the southern end of White Eye Lake.

Mineralized erratics were found at several sites along the southwest facing shoreline of the Chelaslie Arm, a few kilometers east of this area. At sites 6433, subangular to subrounded andesite clasts with disseminated sulphides were found. One sample assayed 964 ppm zinc and 187 ppm lead (6433RA, Appendix A).

Southeast End of Chelaslie Arm

Anomalous lead and zinc concentrations occur along the shoreline of Chelaslie Arm (areas 4a and 4b; Figure 8). Greater than 95th percentile lead and zinc concentrations occur (at site 6006). Another >95th percentile lead and 95th percentile zinc concentration occurs to the southeast at site 6003. Greater than 95th percentile copper and 95th percentile gold concentrations (described above) also occur at these sites.

Other

Three sites with elevated lead and zinc occur in the northwest corner of the study area. Site 6380 has >95th of lead (14 ppm) and >70th percentile zinc. Across Ootsa Lake, site 6500 has >95th percentile zinc and site 6499 has >70th percentile zinc and copper. The latter site also has high gold, arsenic and antimony (see gold). Other sites with high lead and zinc that have been previously discussed (see copper above) include sites northwest of the WT claim, in the Bryan Arm area and Chelaslie Arm area.

MOLYBDENUM

Approximately 89% of all sample sites have molybdenum concentrations at or below the detection limit (1 ppm). Consequently, the median molybdenum concentrations, for all till in the area irrespective of underlying geology, is 1 ppm and the mean is 1.2 ppm (Table 3).

Southeast End of Chelaslie Arm

The highest molybdenum concentration in till is 8.0 ppm and occurs along the shoreline of Chelaslie Arm (Area 4a; Figure 8) at site 6006. Five sites with 2 ppm molybdenum occur along the shorelines of the Arm southeast of site 6006. Greater than 95th percentile copper, lead, zinc and arsenic also occur at site 6006 and at elevated levels at other sites in the area (see above). This site is underlain by Hazelton Group rocks and occurs down-ice from an area that is covered in thick glacial sediments.

Other

A few other sites with elevated molybdenum concentrations occur at isolated sites. Greater than 95th percentile molybdenum occurs at site 6046 (3 ppm), south of the Godot claim. This site is roughly 1 km down-ice (northeast) of a small diorite intrusion. A number of other sites in this area have 2 ppm molybdenum (e.g. 6043, 6045, 6047 and 6049). Site 6732, east of the Windfall Hills has 3 ppm molybdenum and >70th percentile antimony. Several nearby sites also have >70th percentile arsenic and/or antimony (e.g. 6370, 6371 and 6373). Site 7031 at the north end of the Windfall Hills has 4 ppm molybdenum and >70th percentile arsenic, antimony, lead and chromium. Other nearby sites (e.g. 6484, 6485 and 7033) also have >70th percentile arsenic and/or antimony. Sites with 4 ppm molybdenum also occur in the vicinity of the WT and Uduk Lake properties.

SUMMARY

A new site with mid-Wisconsinan nonglacial sediments and two till units, extremely rare in the Nechako Plateau, occurs along the shore of Ootsa Lake. These two tills are separated by nonglacial, organic-bearing sands suggesting that they formed during different glaciations. These sediments are overlain by glaciolacustrine, glaciofluvial and debris-flow sediments deposited during the advance-phase of the Fraser Glaciation. Massive, poorly sorted diamicton with strong fissility, jointing, and a high density, interpreted as basal till, is the most common Pleistocene sediment within the study area. It typically has a lodgement or melt-out genesis and occurs as thick blankets that obscure the bedrock topography or as veneers which mantle relatively high relief, bedrock areas. Lodgement till was deposited during the active phases of glaciation. Most melt-out till was probably deposited as ice stagnated during early phases of deglaciation. Till commonly forms flutes and drumlinoid ridges, and occurs on the lee sides of crag-and-tail landforms.

The dominant Late Wisconsinan ice-flow direction in the study area was to the northeast. This ice-flow direction is believed to have had the greatest influence on element dispersal. Glaciofluvial, glacigenic debris-flow, and rare glaciolacustrine sediments, deposited in front of the ice margin, were overridden during ice advance and are locally preserved in valleys such as Ootsa Lake and Cheslatta River. Local, retreat-phase, glaciolacustrine deposits were formed in small glacial lakes dammed by stagnating ice blocks. During the Holocene, peat-rich bogs and marshes formed in low, poorly drained areas. These deposits are commonly associated with fluted and drumlinized terrain. Holocene sand and gravel, preserved in incised deltas and terraces, are best exposed along the Cheslatta River.

Twenty new prospective areas with anomalous multi-element concentrations have been identified within the study area. Around Square Lake, the highest gold and elevated arsenic, antimony, copper, lead, zinc and barium concentrations occur. At least two possible source areas are identified. In the Cheslatta River area, three possible sources for anomalous ($>95^{th}$ percentile) concentrations of gold, antimony, arsenic and zinc occur. Anomalous gold, arsenic, antimony, copper, lead and zinc occur at a number of sites at the southeastern end of Chelaslie Arm. At least two possible source areas are identified in that region. Other areas with gold potential and >95th percentile element concentrations at one or more sites include: gold, silver, nickel and chromium north of Michel Creek; arsenic, copper, nickel, and cobalt along Chelaslie River; silver, arsenic and antimony at the west end of Intata Reach, and south of Cheslatta Lake; and gold, arsenic and antimony at the east end of Tetachuck Lake. Three additional areas with >95th percentile silver occur in the southern part of Euchu Reach, south of Intata Reach, and north of the Loon prospect.

Areas especially prospective for copper occur north of Square Lake, at the southeast end of Chelaslie Arm, in the Exo claim area, along Chelsalie River, northwest of the WT claim, and north of Bryan Arm. All of these areas have >95th percentile concentrations of copper as well as high gold, lead, zinc, and/or arsenic.

High nickel and chromium occur mainly in the centre of the map region, down-ice of a large area of Neogene volcanics and Endako basalts. However, a few potential point sources are defined by dispersal patterns and >95th percentile levels of nickel, chromium, cobalt, lead and/or zinc in the following areas: lower Chelaslie River, south of Michel Creek, south of Windfall Hills, northwest of White Eye Lake, and northwest of Chelaslie Arm.

Five additional areas that are prospective for lead and zinc are idendified by >95th percentile concentrations in the western and lower (eastern) Chelaslie River areas, northeast of Square Lake, southwest of White Eye Lake and at the southeast end of Chelaslie Arm. The highest molybdenum concentration in till in the study area (8 ppm) occurs in the latter area along with >95th percentile copper, lead, zinc and arsenic.

Till geochemistry data suggest that there are also new prospective areas around known mineral showings such as the Uduk Lake, Loon, Exo, Godot, Tet, Rhub, and WT occurrences. This is to be expected, given the poor bedrock exposure in many of these areas. For example, at the Uduk Lake prospect, $>95^{th}$ percentile gold concentrations occur away from and up-ice of exploration trenches and areas of known mineralization. Also, gold concentrations are locally higher in till than in the underlying bedrock indicating that some sources of the gold mineralization are not yet exposed. Similarly, high gold, arsenic and antimony occur in till at least 600 m up-ice of trenches that contain known mineralization at the Loon prospect. In the Exo claim area, multi-element geochemical anomalies occur 1 to 2 km up-ice of the prospect.

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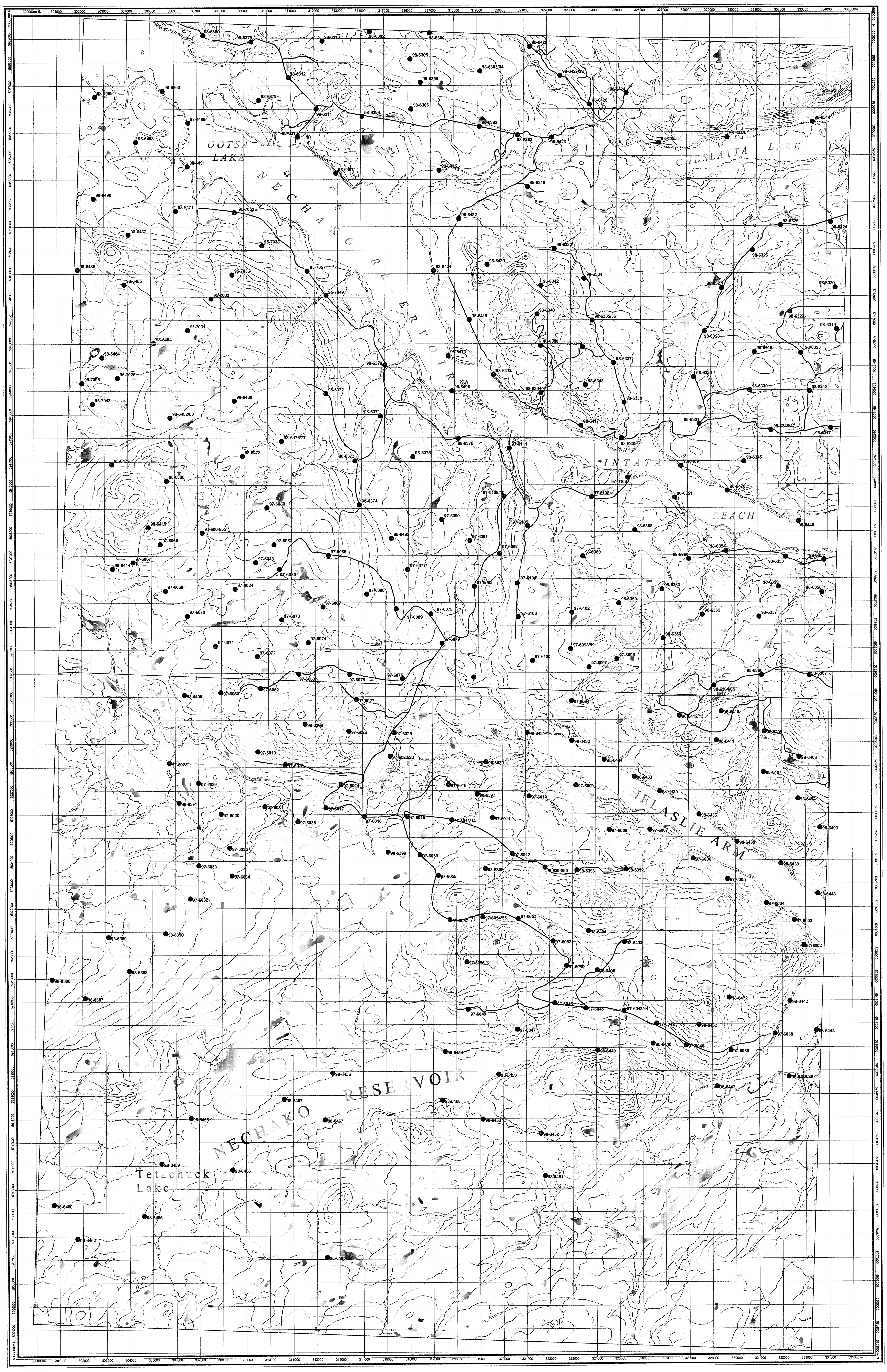

REGIONAL TILL GEOCHEMISTRY OF THE NECHAKO PLATEAU AREA

(NTS 93F/5; 93F/12)

Scale 1:75 000

3000 0 3000 6000 Metres

Contour interval 100 feet
Elevations in Feet above Mean Sea Level
North American Datum 83
Transverse Mercator Projection

Digital Base Layers National Topographic Survey 1:50 000

Legend

- Sample Site
- Contour interval 100 feet
- Gravel Road
- Road
- Rivers
- Wetland

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