TILL GEOCHEMISTRY IN THE KOOTENAY, SLIDE MOUNTAIN AND QUESNEL TERRANES

By Roger C. Paulen[2], Peter T. Bobrowsky[1], Ray E. Lett[1], Ahren J. Bichler[2], and Candice Wingerter[2]

KEYWORDS: Quaternary, surficial geology, till, drift exploration, geochemistry, exploration, prospecting, North Thompson River, Adams Plateau, Shuswap, Eagle Bay, Fennell, Nicola.

INTRODUCTION

A regional till sampling survey was undertaken during the summer of 1998 as year three of the Eagle Bay Project (Paulen *et al*., 1998a; Bobrowsky *et al*., 1997a; Dixon-Warren *et al*., 1997a); an integrated regional exploration program centred on Devono-Mississippian rocks of the Eagle Bay Assemblage and Permian to Devonian rocks of the Fennell Formation. Interesting results from the 1997 till geochemistry survey (Bobrowsky *et al*., 1998) encouraged a further extension of the program into the Upper Triassic-Jurassic rocks of the Nicola Group. Volcanogenic massive sulphide (VMS) deposits hosted in the Fennell Formation, volcanogenic sulphide-barite deposits hosted in the Eagle Bay Formation, tombstone-style gold prospects hosted in the Baldy Batholith and the highly mineralized package of Nicola Group volcanic, sedimentary and associated intrusive rocks all suggest that the region has considerable mineral potential. Polymetallic gold-bearing veins hosted in volcanic assemblages of the Fennell Formation and the anomalous gold values in altered quartz vein float near the margin of the Thuya River Batholith also suggest a high potential for gold in the area. Related exploration studies included, mineral deposit studies in volcanogenic sediments of the lower Eagle Bay Assemblage (Höy, 1999), detailed property scale ice flow dispersal studies (Lett *et al*., 1999), till geochemistry sampling and reconnaissance mineralized boulder tracing.

The till geochemistry sampling covered approximately 1000 square kilometres within five 1:50000 scale map sheets (Figure 1). This being year three of the project, the purpose of the sampling program was to cover the remaining area of the Eagle Bay Formation north of Shuswap Lake and the Adams River, within the NTS sheets 82M/3, 82L/13 and 82L/14 and to extend the till geochemistry coverage north and west of the North Thompson River Fault into the poorly explored and poorly understood rocks of the Quesnel Terrane within the NTS sheets 92P/8 and 92P/9.

The objectives of the project were:

- to stimulate new exploration and economic activity in the area; especially in the poorly explored Quesnel Trough.
- to define new anomalies which may be used in the discovery of mineralization targets;
- to document ice flow indicators and both local and regional ice flow patterns to aid drift prospecting in the area;
- to document the dispersal of pathfinder elements down-ice from a known source;
- to provide information where mineral exploration has been hampered by thick glacial drift cover, and where traditional prospecting and exploration techniques have proven unsuccessful despite indications of high mineral potential.

The purpose of this paper is to summarize the till geochemistry activities of the 1998 summer field season and to present the results of the ice-flow indicator studies. Discussions of the paleo-ice flow history, Quaternary stratigraphy and the primary sampling media are provided to supplement the analytical results of the survey that will be released later.

[1]*British Columbia Geological Survey Branch (BCGS)*
[2]*School of Earth and Ocean Sciences, University of Victoria*

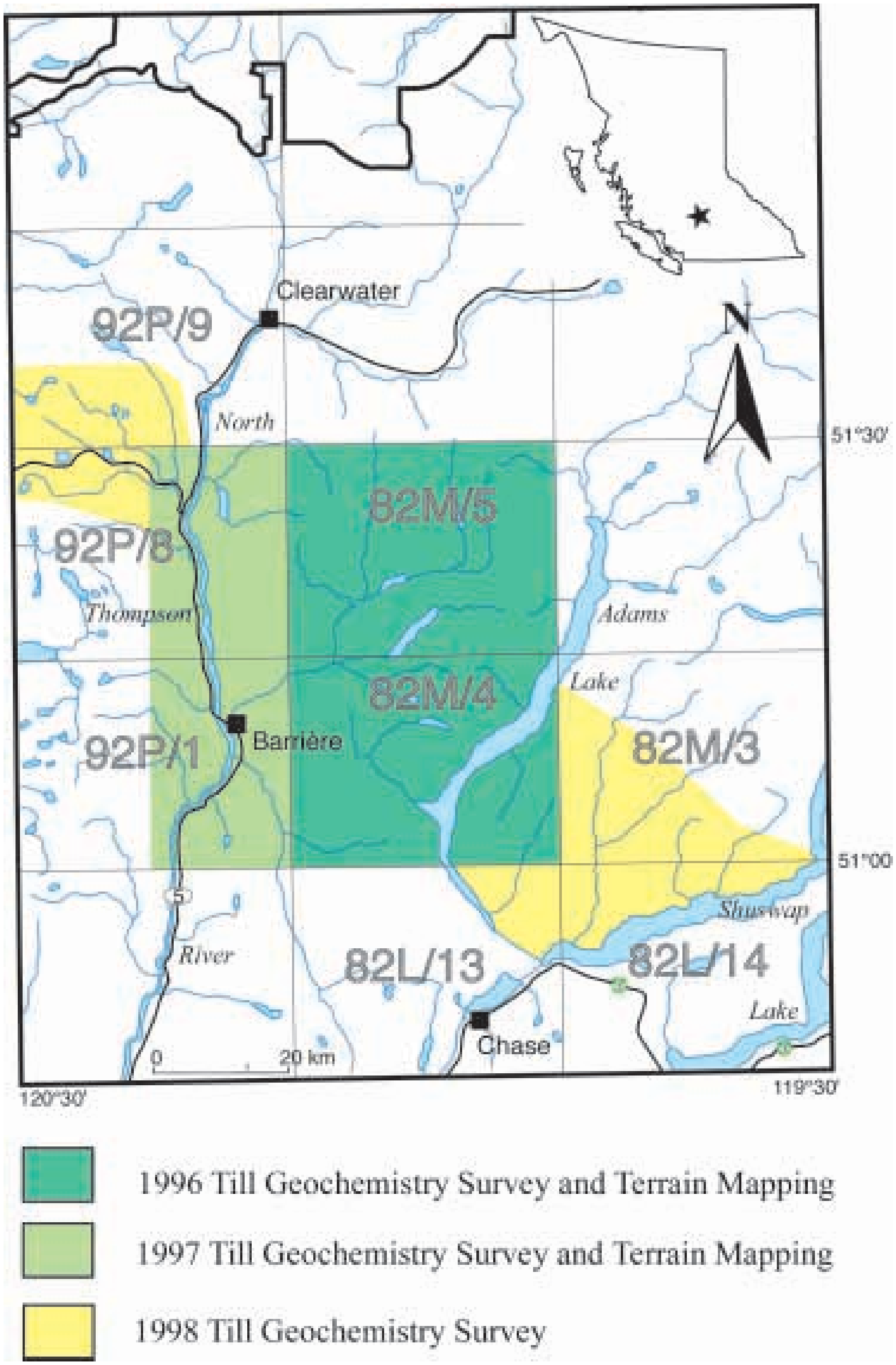

Figure 1. Location of the Eagle Bay drift exploration project (1996-1998) study area in south central British Columbia.

Photo 1. Typical topography of the study area, looking north up Scotch Creek towards the Adams Plateau.

BACKGROUND AND SETTING

The sampling survey focused on two separate regions in south-central British Columbia. The initial sampling took place in the southeastern part of the Adams Plateau that lies in the southern part of the Shuswap Highland, within the Interior Plateau (Holland, 1976). The region is characterized by moderate to high relief, glaciated and fluvially dissected topography (Photo 1). Elevations range from 370 metres above sea level along the north shore of Shuswap Lake to 1980 metres above sea level at Crowfoot Mountain, west of Seymour Arm (Shuswap Lake). Ground moraine dominates the landscape, followed in turn by colluvial, glaciofluvial, fluvial and glaciolacustrine sediments; the latter is restricted to the glacial lakes that occupied the Shuswap Basin during the most recent glacial event (Fulton, 1969).

Phase two of the program took place in the northeastern part of the Thompson Plateau, within the Interior Plateau. Topography is dominated by the high elevations of the Bonaparte Hills and the Nehalliston Plateau and is dotted with numerous small lakes and stream systems. Elevations range from 670 metres to 1680 metres above sea level. Ground moraine of various thickness dominates the landscape, followed in turn by colluvial, glaciofluvial, fluvial and organic sediments. As such, both regions are extremely favorable for a till geochemistry survey.

Bedrock Geology

The area lies within a belt of structurally complex low-grade metamorphic rocks that occur along the western margin of the Omineca Belt. This belt is flanked by high grade metamorphic rocks of the Shuswap Complex to the east and by rocks of the Intermontane Belt to the west (Figure 2). Lower Paleozoic to Mississippian rocks of the Eagle Bay Assemblage (Kootenay Terrane) underlie a major part of area. These consist of calcareous phyllite, calc-silicate schist and skarn or mafic metavolcanics overlain by felsic and locally intermediate metavolcanics and clastic metasediments. The eastern part of the Adams Plateau and west of Seymour Arm is underlain by the western margin of the Shuswap Metamorphic Complex (Silver Creek Formation, Mount Ida Group). These comprise strongly foliated and lineated assemblages of Cambrian-Ordovician paragneiss and schists intruded by Jurassic-Cretaceaous dykes, sills and small irregular bodies of granitic rocks (Okulitch, 1974).

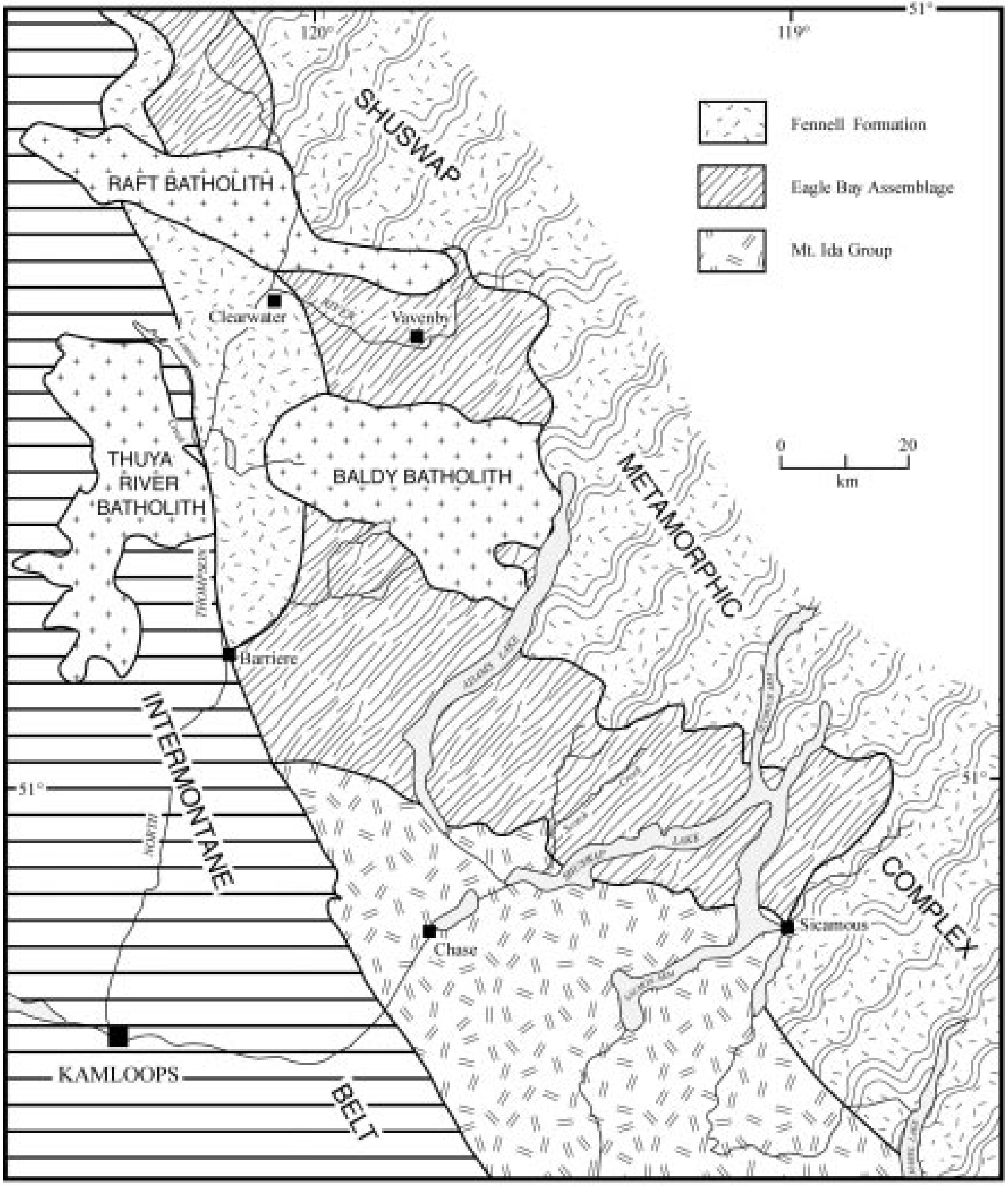

Figure 2. Geologic setting of the Adams Plateau - Clearwater - Vavenby area, modified after Schiarrizza and Preto (1987) and Campbell and Tipper (1971). Not shown are Tertiary volcanics and numerous granitic plutons.

North of Barriere, the Permian to Devonian rocks of the Fennell Formation comprise imbricated oceanic rocks of the Slide Mountain Terrane. The rocks consist of bedded cherts, gabbro, diabase, pillowed basalt and volcanogenic metasediments. The rocks are in fault contact with Permo-Triassic andesites, tuffs, argillites, greywacke and limestone of the Nicola Group (Schiarrizza and Preto, 1987) to Early Jurassic porphyritic andesite breccia, tuff and flows of the Quesnel Terrane. Mid-Cretaceous granodiorite and quartz monzonite intrusions of the Baldy Batholith and the Late Triassic - Early Jurassic monzo-granite and granodiorite of Thuya Batholith (Campbell and Tipper, 1971) underlie the area.

A major north-south fault paralleling the North Thompson River valley separates the

Kootenay and Slide Mountain terranes from the younger Quesnel Terrane. This fault is a single break to Lemieux Creek, where it separates into several splays. This extensive block faulting signifies a major, unknown structural event (Campbell and Tipper, 1971) in a highly mineralized package of Nicola Group rocks within the northwest trending Quesnel Trough.

Polymetallic precious, sedimentary exhalative and Noranda/Kuroko type VMS base metal occurrences are hosted by Devono-Mississippian felsic to intermediate metavolcanic rocks of the Eagle Bay Assemblage. Massive sulphides are hosted in oceanic basalts of the Fennell Formation. Skarn mineralization and silver-lead-zinc mineralization occur as numerous vein deposits within the Fennell Formation near the Cretaceous granitic intrusions. Porphyry copper and copper-gold skarns are hosted in the Nicola Group and molybdenite mineralization occurs near the southern margin of the Raft Batholith. The MINFILE database lists a total of 38 occurrences in the study area, 23 occur in the Eagle Bay Assemblage, 11 occur in the Nicola Group, three are associated with the Raft Batholith and one is hosted in the Silver Creek Formation. In total, there are 11 occurrences of gold, of which one is placer. Detailed property studies at various MINFILE occurrences are discussed in Lett *et al*. (1999).

METHODS

Fieldwork was based out of two camps: one in Magna Bay on Shuswap Lake for work in NTS 82M/3, 82L/13 and 82L/14 and a second near Tod Mountain for work in 92P/8 and 92P/9. Access to both areas was excellent. There is an extensive network of logging roads on the slopes and plateaus with minor access on steeper slopes. Fieldwork was conducted with 4-wheel drive vehicles along all major and secondary roads and trails of varying condition. In some cases, traverses were completed on foot where access was blocked or non-existent.

Initial work consisted of compiling and evaluating all existing terrain information available for the area. Regional Quaternary mapping completed by the Geological Survey of Canada (Tipper, 1971; Fulton, 1975) provided information on the types and distribution of the surficial sediments. Detailed local ice-flow directions were obtained by measuring and determining the directions of striations, grooves and local roche moutonnées. The MINFILE database was examined to gain insight on the local mineral showings with respect to the deposit types and host rock relationships.

At each ground-truthing field station some or all the following observations were made: GPS-verified UTM location, identifying geographic features (i.e. creek, cliff, ridge, plateau, etc.), type of bedrock exposure if present, unconsolidated surface material and expression (terrain polygon unit), general slope, orientation of striations/grooves on bedrock or of bullet-shaped boulders, large scale features of streamlined landforms, elevations of post-glacial deposits (glaciofluvial and glaciolacustrine) and active geological processes.

Bulk sediment samples (1-5 kilograms) were collected for geochemical analysis over much of the study area. Emphasis was placed on collecting basal till deposits (first derivative products according to Shilts, 1993), although ablation till, colluviated till and colluvium were also collected under certain circumstances. Natural exposures and hand excavation were used to obtain samples from undisturbed, unweathered C-horizon (parent material) deposits. At each sample site (Photo 2), the following information was recorded: type of exposure (gully, roadcut, etc.), depth to sample from top of soil, thickness of A and B soil horizons, total exposed thickness of the surficial unit, stratigraphy of the exposure, clast percentage, matrix or clast-supported diamicton, consolidation, matrix texture, presence or absence of structures, bedding, clast angularity (average and range), clast size (average and range), clast

Photo 2. Roadcut exposing basal ground moraine at a sample site.

lithologies, and colour. The samples were evaluated as being derived from one of the three categories; basal till, ablation till, or colluviated/reworked basal till. Sediment samples were sent to Eco Tech Laboratories in Kamloops for processing. This involved air drying, splitting and sieving to <63 µm. The pulps, <63 µm sample and unsieved split were subsequently returned to the BCGS. The <63 µm fraction of each sample was split and one part will be subjected to aqua regia digestion and analysis for 30 elements by ICP (inductively coupled plasma emission spectroscopy) and for major oxides by LiBO2 fusion - ICP (11 oxides, loss on ignition and 7 minor elements). The other portion will be submitted for INA (thermal neutron activation analysis) for 35 elements.

RESULTS

A total of 408 bulk sediment samples were collected for the till geochemistry study. Sample density averaged one per 2.45 km^2 for the total survey and provides a very high level of reconnaissance information for the region. Most of the samples taken for geochemical analysis were representative of basal till, most likely lodgement till. Of the 408 samples, 360 or 88% represented this sediment type which is the best media to sample for drift exploration. Ablation till only accounted for 24 samples or 6% of the total. Basal till which has undergone minor downslope movement was classed as colluviated till and this material accounted for 24 samples or 6% of the total. Together, the 12% of the samples that were collected from ablation till and colluviated till are valid, but much more difficult to interpret. Results and interpretation of the till geochemistry survey for this study will be released as a BCGS Open File at a later date.

A total 60 mineralized rock grab samples were taken from the study area, 23 are float and 37 are from reported or new gossanous outcrops. A total of 77 gossanous bedrock showings were recorded and these discoveries prompted further sampling beyond the planned boundaries of the 1998 survey area. Efforts were particularly concentrated in the paragneiss to schistose metasediments of the lower Eagle Bay Assemblage in 82M/3 and in the block faulted, brecciated mafic to andesitic volcanic and volcanogenic rocks of the Nicola Group in 92P/9. The samples will be split, one half to be assayed and the other retained for petrologic study if necessary. The analytical results and corresponding locations will be released later.

Previous geochemical studies in the area provide an indication as to the style of mineralization, configuration of the anomaly plumes and regional dispersal patterns expected for this area. Examples shown in Bobrowsky *et al*. (1997) and Paulen *et al*. (1998a) show the clastic down-ice dispersal patterns that parallel the regional ice-flow from northwest to southeast in the North Thompson River Valley and the Adams Plateau. An additional example of a property scale geochemical sampling program presented here from Crowfoot Mountain, west of Seymour Arm, is provided as a precursor to the expected ice-flow patterns in the eastern part of the Adams Plateau, which is to the southwest (Fulton *et al*., 1986).

At the Fluke Claims (MINFILE 082M104), in the flat alpine saddle between Crowfoot Mountain and Mount Moberly (NTS 82M/3), B-horizon soil geochemistry (Figure 3) illustrates a

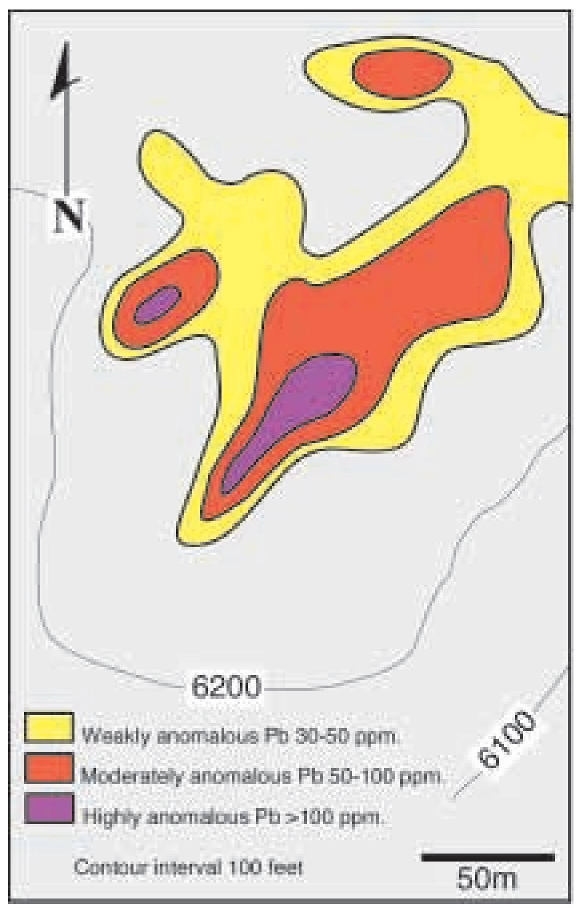

Figure 3. Lead soil anomaly for the Fluke claims (Crowfoot Property). Modified after Allen (1977).

thin ribbon anomaly of lead (Allen, 1977). The lead in B-horizon soils shows a down-ice dispersal pattern with the axis of symmetry paralleling the regional ice flow from north-northeast to south-southwest and thus reflects a typical clastic dispersal train (DiLabio, 1990).

Ice Flow Indicators

The striation record in the map area is poor due to the lack of preserved outcrop exposure. Striations were recorded at a few locations where recent logging has exposed fresh bedrock (Photo 3) There is an abundance of sculpted landforms on the plateau tops that provide regional ice flow information during the peak of glacial activity (Figure 4). Local paleo-ice flows are documented to be coincident with regional south to southeast flows (Fulton *et al*., 1986). In the northern region (NTS 92P), regional ice flow directions are to the southeast, with deviations to the south in the North Thompson River valley. In the centre of the study area, the ice flowed in a southerly direction across the Adams Plateau, except in areas of variable relief where topography deflected ice flow. Fabric data in the basal tills on the lower Adams Plateau show a strong southerly trend in agreement with the striation and landform directions (Dixon-Warren, 1998). In the easternmost region (NTS 82M/3E), the landforms and striae show a south-southwesterly flow direction as ice was diverted into the Shuswap Basin. Where the southeast and southwest flowing ice converged is unknown due to the poor striation record and an obvious lack of medial moraines, but it likely occurred near the southeastern edge of the Adams Plateau, west of Scotch Creek. Ice flow during deglaciation here would have converged southward, into the Shuswap Basin with a local deviation up to 45 degrees (Photo 4).

Photo 3. Striae measured from freshly exposed outcrop of Eagle Bay mafic metavolcanics.

Photo 4. Copper Island in Shuswap Lake. Ice flow direction from right (northeast) to left (southwest).

GLACIAL HISTORY AND STRATIGRAPHY

According to Fulton and others (Clague, 1989; Fulton, 1975; Fulton and Smith, 1978; Ryder *et al*., 1991), the present day landscape of south-central British Columbia is the result of two glacial cycles, one interglacial and vigorous early-Holocene erosion and sedimentation. Evidence for only the latter glacial deposits and the post-glacial deposits are present in the study area. Although not necessarily present in the study area, the following lithological units and their correlative geological climate units have been identified in south-central British Columbia.

Stratigraphically oldest and identified only at two locations to the south of the study area, are the interglacial Westwold Sediments. The deposits consist of cross-stratified gravely sand capped by marl, sand, silt, and clay, all of which are equivalent to the Highbury non-glacial interval in the Fraser Lowland (Sangamonian). Next in age are Okanagan Centre Drift deposits, consisting of coarse, poorly-stratified gravel, till and laminated silt. The sediments were deposited during the Okanagan Centre Glaciation, equivalent to the Semiahmoo Glaciation in the Fraser Lowland (early Wisconsinan). Middle Wisconsinan, Olympic Non-Glacial Bessette Sediments overlie the Okanagan Centre Drift.

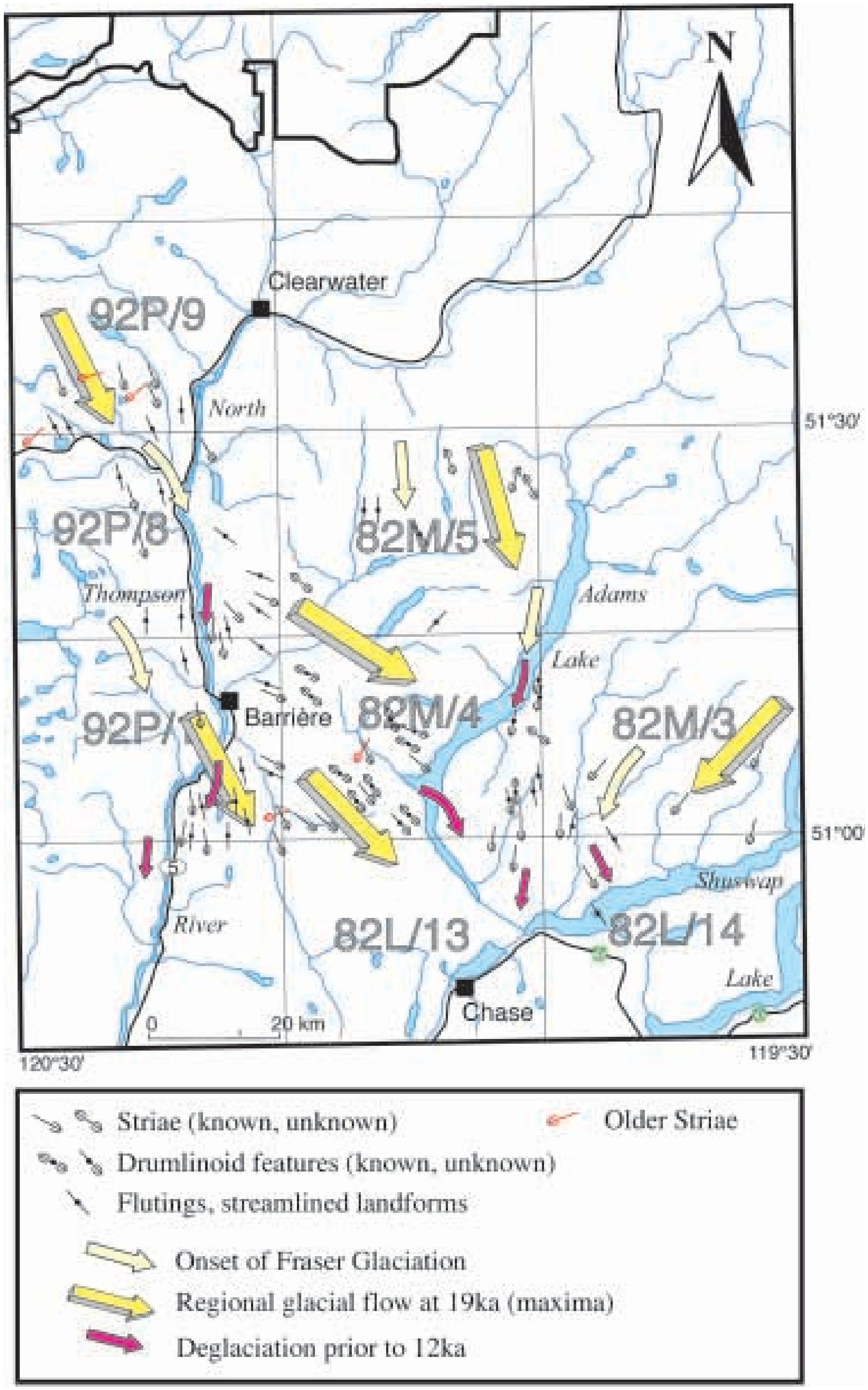

Figure 4. Summary of ice flow indicators for the Eagle Bay Project (1996-1998). Data compiled from the Eagle Bay project terrain geology maps (Dixon-Warren *et al*., 1997b; Leboe *et al*., 1997; Paulen *et al*., 1998b; Paulen *et al*. 1998c) and 1998 field observations

They consist of nonglacial silt, sand and gravel with some organic material and up to two tephras. The Kamloops Lake Drift (20.2 ka; Dyck *et al*., 1965) overlies the Bessette sediments, and underlies the present-day surface cover of postglacial deposits. This unit consists of silt, sand, gravel and till deposited during the Fraser Glaciation (Late Wisconsinan).

Rare older striae preserved on bedrock surfaces suggest an early glacial advance from the northeast to the southwest, but there is no evidence of this in the sediment record. The surface and near-surface sediments sampled in both the southern and northern regions directly result from the last cycle of glaciation and deglaciation (Fraser Glaciation), as well as ensuing post-glacial activity.

Fraser Glaciation

The onset of Fraser glaciation began in the Coast, Cariboo and Monashee Mountains. Valley glaciers descended to lower elevations to form piedmont lobes in the Interior Plateau, and eventually coalesced to form a mountain ice sheet (Ryder *et al*., 1991). Ice sheet margins reached a maximum elevation between 2200 and 2400 metres along rimming mountains; the entire Shuswap Highland was completely buried beneath an ice cap by approximately 19 ka. At Fraser Glaciation maximum, regional ice flow was to the south-southeast on the Bonaparte and Adams plateaus (Tipper, 1971) with deviations up to 45° (Fulton *et al*., 1986). This deviation was particularly noted in the eastern part of the study area, where ice from the north and west coalesced with ice flowing from the Monashee Mountains and was subsequently directed into the Shuswap Basin. Basal till deposits, which range widely in texture with the underlying bedrock, blanketed the land surface.

Deglaciation of the Interior Plateau was rapid; the equilibrium line likely rose considerably, reducing the area of accumulation for the Cordilleran ice sheet, and the ice mass decayed by downwasting. Ablation till was deposited by stagnating ice in several high-elevation portions of the region. As uplands were deglaciated prior to low benches and valleys, meltwater was channeled to valley sides, resulting in kame terraces and ice-contact sediments. Valleys clear of ice above the stagnating glaciers in their lower reaches became the confinement for meltwater blocked from drainage, thereby resulting in local mantles of glaciolacustrine sediments. The Shuswap basin experienced up to six lake level stages during deglaciation. Most of the basin exhibits fjord-like characteristics and little evidence is retained from the former glacial lakes. Radiocarbon dates of 11.3 ka at McGillivary Creek (Clague, 1980), 10.5 ka at Chase (Lowdon and Blake, 1973) and 10.1 and 9.84 ka on Mount Fadear Plateau (Blake, 1986) indicates that deglaciation began about 12 ka and the modern drainage pattern was established prior to 8.9 ka (Dyke *et al*., 1965; Fulton, 1969).

Holocene Post-Glacial

Once ice-dammed lakes drained, meltwaters carrying heavy sediment loads deposited thick units of stratified sand and gravel in valleys. As sediment loads decreased, deposition was replaced by erosion, and water courses cut down through valley fills, leaving glaciofluvial terraces abandoned on valley sides. Following the complete deglaciation of the region, unstable and unvegetated slopes were highly susceptible to erosion and sedimentation. Intense mass wasting of surface deposits on oversteepened valley slopes resulted in the deposition of colluvial fans and aprons along valley bottoms. Most post-glacial deposition occurred within the first few hundred years of deglaciation, and certainly before the eruption of Mt. Mazama, circa 7000 radiocarbon-years ago, which deposited tephra near the present-day ground surface. Fluvial fan deposits and active talus slopes typify the modern sedimentation in the area.

SURFICIAL SEDIMENTS

Several types of surficial deposits were observed in the study area including: ground moraine (basal till and ablation till), colluvial, fluvial, glaciofluvial, glaciolacustrine, organic, and anthropogenic. General observations suggest the plateaus and hills are mainly covered by combinations of till, colluvium and minor glaciofluvial deposits, whereas glaciolacustrine, glaciofluvial and fluvial sediments occur mainly in the valleys. Anthropogenic deposits are not widespread and can be found only near developed prospects and the larger communities. Organic deposits occur locally in all types of terrain.

Photo 5. Basal lodgement till exposed in a recent roadcut.

Photo 6. Exposed section of ground moraine over the Thuya River Batholith. A blanket of stoney ablation till is draped over finer basal lodgement till.

Basal Till

Throughout the region, the bedrock topography is mantled by variable amounts of massive, very poorly-sorted matrix-supported diamicton (Photo 5). Deposits range in thickness from thin (<1 metre) veneers to thick (>8 metre) blankets. Characteristics of this diamicton suggest that it is most likely a lodgement depositional environment (Dreimanis, 1988). Basal till facies tend to be variable with respect to the underlying bedrock.

In general, basal till (lodgement) deposits are primarily massive to poorly-stratified, light to dark olive grey, moderately to highly consolidated sediments derived from greenstone metavolcanics and metasediments of the Eagle Bay Assemblage, Fennell Formation or Nicola Group. The matrix is fissile and has a clayey silt to a silty-sand texture. Deposits are dense, compact, cohesive with irregular jointing patterns. Clast content ranges from 15-35%, usually averaging about 25%, and clasts range in size from granules to boulders (over 2 metres) averaging 1-2 centimetres. The clasts are mainly subrounded to subangular in shape and consist of various lithologies of local and exotic source. A number of clasts have striated and faceted surfaces.

Ablation Till

Massive to crudely stratified clast-supported diamicton occurs frequently throughout the study area (Photo 6). Most commonly, deposits of ablation till occur as a thin mantle overlying basal till and/or bedrock on the higher plateaus. Deposits also occur in areas of hummocky terrain where evidence of recessional ice and mass wasting occurred during deglaciation. In contrast to the basal tills, the diamictons are light to medium grey, moderately compact and cohesive. The sandy matrix is poorly consolidated and usually contains less than 5% silt and clay. Clast content ranges from 30-60% and average clast size is 2-5 centimetres. Clast lithology is variable but often deposits are monolithologic, primarily granodiorites and monzonite derived from the Thuya River, Baldy and Raft batholiths. The diamictons are interpreted as supraglacial or ablation till deposits, resulting from deposition by stagnating glacier ice (Dreimanis, 1988).

DRIFT EXPLORATION IMPLICATIONS

The thin drift mantling the upland plateaus and the defined valley systems provide an excellent landscape for drift prospecting. Basal tills in this region directly overlie the bedrock and are representative of the last glaciation to have affected the region. No sediments that predate this event were observed in the area. Thin deposits of basal tills, like those seen on the upland plateaus, usually reflect a more proximal source area for the sediments (Bobrowsky *et al*., 1995). Basal tills are the dominant sediment type and this media has been recognized as the ideal sampling media for drift prospecting (Shilts, 1993). If there are no complications of multiple ice-flow directions to interpret, then a dispersal plume should reflect the last glacial event. Finally, the ice flow direction is generally east-southeast to south-southeast over the Bonaparte and Adams plateaus and is south-southwest over the hills east of Scotch Creek. Such a pattern is ideal for both reconnaissance and property scale drift prospecting. Caution must be taken when following up regional anomalies where bedrock strike is parallel to ice-flow directions. Such is the case with Eagle Bay stratabound type deposits. Multiple deposits along strike can be geochemically masked or expressed as a single ribbon anomaly.

Reported geochemical anomalies from known mineral occurrences indicate that the dispersal plumes conform to classic down-ice shapes, usually proximal to the source bedrock. It is futher expected that clastic dispersal patterns associated with any anomalous values detected from this reconnaissance survey will most likely parallel ice flow and be imprinted with minor fluctuations from hydromorphic downslope dispersal. It is expected that these anomalies will occur less than 100 metres from source rock. However, boulder tracing of the Eakin Creek anomaly (Bobrowsky *et al*., 1998) has shown that in areas of particularly thick drift, and at the edges of the plateau, the dispersal train can be several kilometres in length.

CONCLUSION

The Eagle Bay project area is underlain by Nicola Group (Quesnel Terrane), Fennell (Slide Mountain), Eagle Bay (Kootenay) and Mount Ida Group (Kootenay) which is part of the complicated and poorly understood North American continental margin (Dawson *et al*., 1991). There is potential for alkalic porphyry Cu-Au-Ag deposits (plutonic assemblages), Mo-Cu porphyry deposits (plutonic assemblages), volcanogenic massive sulphide Cu (Fennell Formation) and precious metal enriched Cu-Zn-Pb sedimentary exhalative stratiform and Cu-Pb-Au volcanogenic stratabound deposits (Schiarizza and Preto, 1985).

Results from the 1996 and 1997 till sampling surveys have generated recent staking activity and led to the discovery of a tombstone-style vein or stockwork gold prospect along the margin of the Baldy Batholith (Bobrowsky *et al*., 1997b). Several other gold anomalies in till near the margins of the Thuya Batholith and associated with elevated values of Bi, As, Sb and Mo suggest that potential bulk-tonnage, intrusion hosted gold deposits may occur near outliers of the Jurassic-Cretaceous monzonites and deserve to be prospected (M. Cathro, pers. comm. 1998). Plutonic-related gold deposits of this nature are similar in nature to the Tombstone-type deposits (Pogo) in Alaska (Woodsworth *et al*., 1977) and Laforma prospects (Dawson *et al*., 1991) hosted in the calc-alkalic plutonic suites in the Stikinia Terrane (Intermontane Belt).

Due to the high number of gossanous outcrops in an area with little historical exploration, future work should expand along the mineralized belt of paragneiss in the northwestern part of 82M/3. These showings follow a continuous mineralized trend roughly along strike with the Pet (MINFILE 082M143) and Mosquito King (MINFILE 082M016) occurrences in the southeastern corner of NTS 82M/4. Till sampling should continue into the northeastern part of NTS 82M/3 to follow up the recent results in the poorly understood, drift covered region. There is excellent access due to extensive logging in recent years.

Renewed industry interest in the northwest (NTS 92P) and recent exploration programs should provide impetus for additional work in the highly mineralized, poorly understood Quesnel Trough. Historically, exploration in this region has applied soil geochemistry for reconnaissance exploration with limited success. As such, proven successful methods using C-horizon till sampling should be employed. Detailed till studies should be conducted around the Lakeview occurrence (MINFILE 092P010) as a model for clastic dispersal on the Bonaparte Plateau. Regional till sampling should extend northward and follow the Nicola Group volcanic terrane. Finally, surficial mapping at 1:50,000 scale would complement a bedrock mapping program of the same scale.

The lack of bedrock exposure in some areas implies that the proper genetic interpretation of glacial overburden is essential in delimiting and understanding potential areas of mineralization. Knowledge of ice-flow history is very critical for a drift exploration program and known geochemical anomalies that exhibit classic down-ice dispersal patterns follow the regional ice flow patterns. This indicates that the local terrain is highly suitable for drift exploration studies. Local and regional ice flow patterns are readily determined in the field at the site level. Integration of the surficial geology maps and reconnaissance till survey should now be pursued at the property scale of exploration to locate potential sites of buried mineralized zones.

ACKNOWLEDGMENTS

This work was completed as part of the British Columbia Geological Survey Branch, Eagle Bay Project. We extend our thanks to the Kamloops office of the Ministry of Energy and Mines for providing logistical services. Insight into the bedrock geology and the local mineral deposits were provided by Mike Cathro, regional geologist for the Ministry of Energy and Mines and Ron Wells of Kamloops Geological Services. Our thanks are extended to many of the prospectors who were informative and cooperative. Wayne Jackaman and Ayisha Yeow assisted with the till sampling.

REFERENCES

Allen, G.B. (1977): Detailed geochemical exploration program on the Fluke Claims of Resourcex Limited; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 6230.

Blake, W., Jr. (1986): Geological Survey of Canada Radiocarbon Dates XXV; *Geological Survey of Canada*, Paper 85-7, 32 p.

Bobrowsky, P.T., Sibbick, S.J., Matysek, P.F. and Newell, J. (1995): Drift Exploration in the Canadian Cordillera; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1995-2.

Bobrowsky, P.T., Leboe, E.R., Dixon-Warren, A., and Ledwon, A. (1997a): Eagle Bay Project: Till geochemistry of the Adams Plateau (82 M/4) and North Barriere Lake (82M/5) map areas; *in* Geological Fieldwork 1996, D.V. Lefebure, W. J. McMillan, and G. McArthur, Editors, *B.C. Ministry of Employment and Investment*, Paper 1997-1.

Bobrowsky, P.T., Leboe, E.R., Dixon-Warren, A., Ledwon, A., MacDougall, D. and Sibbick, S.J. (1997b): Till geochemistry of the Adams Plateau-North Barriere Lake Area (82M/4 and 5); *B.C. Ministry of Employment and Investment*, Open File 1997-9.

Bobrowsky, P.T., Paulen, R., Little, E., Prebble, A., Ledwon, A., and Lett, R. (1998): Till Geochemistry of the Louis Creek - Chu Chua Creek area (NTS 92P/1E and 92P/8E); *B.C. Ministry of Energy and Mines*, Open File 1998-6.

Campbell, R.B. and Tipper, H.W. (1971): Geology of Bonaparte Lake map area, British Columbia; *Geological Survey of Canada*, Memoir 363.

Clague J.J. (1980): Late Quaternary geology and geochronology of British Columbia, Part 1: Radiocarbon Dates; *Geological Survey of Canada*, Paper 80-13, 28 p.

Clague, J.J. (1989): Quaternary Geology of the Canadian Cordillera; Chapter 1 *in* Quaternary Geology of Canada and Greenland, R.J. Fulton, Editor; *Geological Survey of Canada*, Geology of Canada, no. 1 (also Geological Society of America, The Geology of North America), v. K-1, pages 15-96.

Dawson, K.M., Panteleyev, A., Sutherland Brown, A. and Woodsworth, G.J. (1991): Regional metallogeny; Chapter 19 *in* Geology of the Cordilleran Orogen in Canada, H. Gabrielse and C.J. Yorath, Editors; *Geological Survey of Canada*, Geology of Canada, no. 4 (also Geological Society of America, The Geology of North America), v. G-2, pages 707-768.

DiLabio, R.N.W. (1990): Glacial Dispersal Trains; *in* Glacial Indicator Tracing, R. Kujansuu, and M. Saarnisto, Editors, *A.A. Balkema*, Rotterdam, pages 109-122.

Dixon-Warren, A. (1998): Terrain mapping and drift prospecting in south-central British Columbia; MSc. Thesis, *Simon Fraser University*, Vancouver, British, Columbia.

Dixon-Warren, A., Bobrowsky, P.T., Leboe, E.R. and Ledwon, A. (1997a): Eagle Bay Project: Surficial Geology of the Adams Plateau (82 M/4) and North Barriere Lake (82M/5) map areas; *in* Geological Fieldwork 1996, D.V. Lefebure, W. J. McMillan, and G. McArthur, Editors, *B.C. Ministry of Employment and Investment*, Paper 1997-1.

Dixon-Warren, A., Bobrowsky, P.T., Leboe, E.R. and Ledwon, A. (1997b): Terrain Geology of the Adams Plateau; *B.C. Ministry of Employment and Investment*, Open File 1997-7.

Dreimanis, A. (1988): Till: Their Genetic Terminology and Classification; *in* Genetic Classification of Glaciogenic Deposits, R.P. Goldthwait and C.L. Matsch, Editors, *Balkema*, p. 17-67.

Dyck, W., Fyles, J.G. and Blake, W., Jr., (1965): Geological Survey of Canada Radiocarbon Dates IV; *Geological Survey of Canada*, Paper 65-4, 23 p.

Fulton, R.J. (1969): Glacial Lake History, Southern Interior Plateau, British Columbia; *Geological Survey of Canada*, Paper 69-37.

Fulton, R.J. (1975): Quaternary geology and geomorphology, Nicola-Vernon area, British Columbia (82L W and 92 E); *Geological Survey of Canada*, Memoir 380.

Fulton, R.J. and Smith, G.W. (1978): Late Pleistocene stratigraphy of south-central British Columbia; *Canadian Journal of Earth Sciences*, Volume 15, pages 971-980.

Fulton, R.J., Alley, N.F., and Achard, R.A. (1986): Surficial geology, Seymour Arm, British Columbia; *Geological Survey of Canada*, Map 1609A, 1:250 000.

Holland, S.S. (1976): Landforms of British Columbia, a physiographic outline: *B.C. Ministry of Energy, Mines and Petroleum Resources*, Bulletin 48.

Höy, T. (1999): Massive sulphide deposits of the Eagle Bay Assemblage, Adams Plateau, south central British Columbia (82M3, 4); *in* Geological Fieldwork 1998, *B.C. Ministry of Energy and Mines*, Paper 1999-1, this volume.

Leboe, E.R., Bobrowsky, P.T., Dixon-Warren, A. and Ledwon, A. (1997b): Terrain Geology Map of North Barriere Lake; *B.C. Ministry of Employment and Investment*, Open File 1997-6.

Lett, R. E., Jackaman, W. and Yeow, A. (1999): Detailed geochemical exploration techniques for base and precious metals in the Kootenay Terrane; *in* Geological Fieldwork 1998, *B.C. Ministry of Energy and Mines*, Paper 1999-1 this volume.

Lowdon, J.A. and Blake, W., Jr. (1973): Geological Survey of Canada radiocarbon dates XIII; *Geological Survey of Canada*, Paper 73-7, 61 pages.

Okulitch, A.V. (1974): Stratigraphy and Structure of the Mount Ida Group, Vernon (82L), Seymour Arm (82M), Bonaparte Lake (92P) and Kettle River (82E) map-areas, British Columbia; *Geological Survey of Canada*, Paper 74-1, Part A, pages 25-30.

Paulen, R.C., Bobrowsky, P.T., Little, E.C., Prebble, A.C. and Ledwon, A. (1998a): Surficial Deposits in the Louis Creek and Chu Chua Creek Area; *in* Geological Fieldwork 1997, D.V. Lefebure, and W. J. McMillan, Editors, *B.C. Ministry of Employment and Investment*, Paper 1998-1.

Paulen, R.C., Bobrowsky, P.T., Little, E.C., Prebble, A.C. and Ledwon, A. (1998b): Terrain geology of the Louis Creek area, NTS 92P/1E, scale 1:50 000; *B.C. Ministry of Employment and Investment*, Open File 1998-2.

Paulen, R.C., Bobrowsky, P.T., Little, E.C., Prebble, A.C. and Ledwon, A. (1998c): Terrain geology of the Chu Chua Creek area, NTS 92P/8E, scale 1:50 000; *B.C. Ministry of Employment and Investment*, Open File 1998-3.

Ryder, J.M., Fulton, R.J. and Clague, J.J. (1991): The Cordilleran ice sheet and the glacial geomorphology of southern and central British Columbia; *Géographie Physique et Quaternaire*, Volume 45, pages 365-377.

Schiarizza, P. and Preto, V.A. (1987): Geology of the Adams Plateau-Clearwater-Vavenby area; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1987-2.

Shilts, W.W. (1993): Geological Survey of Canada's contributions to understanding the composition of glacial sediments; *Canadian Journal of Earth Sciences*, Volume 30, p. 333-353

Tipper, H. (1971): Surficial Geology, Bonaparte Lake, British Columbia; *Geological Survey of Canada*, Map 1278A, 1:250 000.

Woodsworth, G.J., Pearson, D.E. and Sinclair, A.J. (1977): Metal distribution patterns across the eastern flank of the Coast Plutonic Complex, south-central British Columbia; *Economic Geology*, v. 72, pages 170-183.