BABINE PORPHYRY BELT PROJECT: DETAILED DRIFT EXPLORATION STUDIES IN THE OLD FORT MOUNTAIN (93M/01) AND FULTON LAKE (93L/16) MAP AREAS, BRITISH COLUMBIA

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INTRODUCTION

In conjunction with bedrock mapping (MacIntyre *et al.*, 1996, this volume) and regional till geochemistry surveys (Huntley *et al.*, 1996, this volume) in the Babine Lake area, detailed drift exploration studies were undertaken on five porphyry-related copper properties: Babs, Hearne Hill, Lennac Lake, Bell mine (Newman Peninsula), and Saddle Hill (Figure 1). The objective of our study was to investigate the effects of glacial and postglacial processes on geochemical dispersal patterns at properties in three contrasting physiographic settings. It is hoped this will help better define potential zones of mineralization, and provide models for future drift exploration programs.

The properties examined in this report are located in 93L/16 (Fulton Lake) and 93M/01 (Old Fort Mountain) map areas, and lie at the northern limit of the Nechako Plateau (Figure 1; see also Huntley *et al.*, 1996, this volume). All five mineral properties border Babine Lake and its tributary waters, including Fulton and Morrison lakes (Figure 1). Valleys in the Babine Lake area are broad, with gently sloping sides reflecting glacial modification. Regional iceflow directions in the study area are predominantly toward the south-southeast, paralleling these major topographic features (Armstrong and Tipper, 1948; Tipper, 1971a, 1994; Plouffe, 1991; Huntley *et al.*, 1996, this volume),

THE APPROACH

In areas with extensive surficial cover, traditional bedrock mapping alone is insufficient to define mineral potential. The most effective means to address this problem is to combine bedrock mapping with drift, lake and stream sediment geochemical sampling programs (Levson *et al.*, 1994). For regional scale (1: 50 000) drift exploration programs, sampling focuses on collection and geochemical analysis of basal tills. At this scale, till is usually sufficiently abundant to be an effective sample medium for detecting regional mineral dispersal patterns (Giles and Levson, 1994). At larger scales of mapping (*e.g.*, 1:10 000), supraglacial till, glaciofluvial sediments and colluvium must also be sampled in order to define dispersal patterns (O'Brien *et al.*, 1995). In this paper, we outline an approach that uses regional-scale drift exploration techniques modified for mapping and sampling at a property scale of 1:10 000.

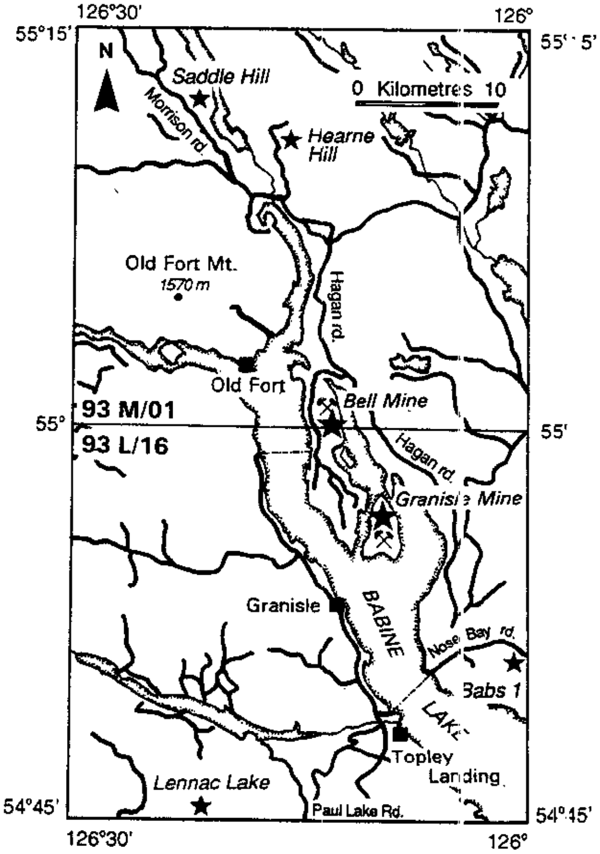

Figure 1. Location of properties studied in this report. For location of map sheets 93L/16 (Fulton Lake) and 93M/01 (Old Fort Mount Mountain), see Figure 1 in Huntley *et al.*, 1996, this volume.

FIELD METHODS

Prior to fieldwork, the MINFILE database and assessment reports were examined for criteria critical to designing an effective drift sampling program. Preliminary surficial geology mapping of each property was completed using 1:63 500 and 1:50 000 aerial photographs. Measurements of glaciated landforms, including crag-and-tail features, flutings and drumlins, were recorded to interpret local iceflow histories. These measurements were confirmed in the field by direct measurement of striae and landforms. Existing B-horizon soil data from the selected properties were also replotted to better define sampling strategies.

A sampling grid was established at each mineral property. Sampling along pre-cut grid lines was completed at the Babs and Hearne Hill properties, using a sample spacing of 200 to 400 metres. Elsewhere, sampling was completed along roads accessible by truck or foot traverse, using a sampling interval of 250 to 1000 metres. Typically, samples were collected from roadcuts, mine-pit exposures and hand-dug pits. Vertical profiles were sampled along exploration trenches at both the Hearne Hill and Lennac Lake properties, and along the eastern face of the open pit at Bell mine.

Basal till was the preferred drift sample medium. Colluvium, glacigenic debris flows, supraglacial till, glaciofluvial and glaciolacustrine deposits were also sampled to investigate the applicability of various media in geochemical sampling programs. Where possible, sample locations were chosen to coincide with soil anomalies (detected by previous exploration programs) in order to examine the degree to which pedogenic processes have influenced the geochemical composition of the near-surface medium.

In total, 173 sediment samples, weighing from 2 to 5 kilograms, were collected from the five properties. The samples were dried, split and passed through a -230 mesh (<63 µm) sieve. This fraction was analyzed by instrumental neutron activation analysis (INA) and inductively coupled plasma analysis - atomic emission spectroscopy (ICP-ES) for 47 elements.

At each property, attempts were made to trace mineralized boulders to their source. Till-clast lithologies were also studied each property. Balzer and Broster (1994) and Stumpf (1995) suggest clasts delineate much larger dispersal trains than matrix components, allowing target areas to be defined more easily. At selected sites, 20 to 25 pebble-sized clasts were collected and information was recorded pertaining to their lithology, size, degree of roundness, and presence of striated or faceted surfaces. Mineralized clasts showing evidence of mineralization were described and sampled for assay.

BABS

The Babs property comprises 21 mineral claims on the east side of Babine Lake, 6 kilometres southeast of the Granisle mine. The property has only recently been assigned a MINFILE number (93L 325). The property is currently under option to Northern Dynasty Minerals Ltd. Detailed studies were carried out on the Babs 1 claim, centred at 54°51´N, 126°W. The claim area lies on a gently sloping spur between two streams that drain into Babine Lake. Elevation ranges from 855 to 975 metres. Access is by the Nose Bay road to the junction with Pat road, 7 kilometres east of Topley Landing and the Northwood barge crossing.

Much of the east flank of the Babine valley in the vicinity of the property is underlain by granite, quartz monzonites and rhyolitic equivalents of the Early Jurassic Topley Plutonic Suite (Carter, 1981; MacIntyre *et al.*, 1996, this volume). Outcrop on the property is rare and exposed only in borrow pits, road cuts and stream cut banks. Outcrops include gossanous, sericite-clay-altered quartz-phyric crystal and lapilli tuffs, and a northeast-trending biotite feldspar porphyry dike (Figure 2). Tuffaceous rocks contain disseminated pyrite and chalcopyrite, and have iron and malachite staining on fracture surfaces. These rocks have returned anomalous values at surface of 726 ppm copper and 16 ppm silver, and up to 0.19% copper over 77.3 metres in core from limited drilling (Kemp and Roberston, 1994). Pyrite is sparsely, but not uniformly disseminated in the porphyry dike.

DRIFT EXPLORATION RESULTS

Much of the property is mantled by an undulating to gently rolling ground moraine. The surface is locally fluted, indicating regional iceflow toward 150° (Figure 2). Washed till is the dominant morainal sediment and is a pervasively oxidized, massive, poorly consolidated, matrix-supported diamicton. Basal till is subordinate, and is a dense, fissile matrix-supported diamicton with a clay-silt matrix. Extensive areas of moraine are washed, winnowed and blanketed by massive gravel and sand lag deposits with an inferred glaciofluvial origin. Additional evidence for meltwater flow is suggested by numerous small eskers and meltwater channels that apparently drained southward (Figure 2). The abundant evidence for meltwater flow on this property should be considered when interpreting geochemical dispersal patterns in soils and underlying glacial materials.

Twenty five samples of till and glaciofluvial sediments were collected over a recently cut survey grid, and in the vicinity of a 1.2 kilometre long train of well-mineralized angular biotite feldspar porphyry cobbles and boulders. Additional basal till samples were collected north and northwest of the claim area as part of the regional till sampling program to determine geochemical background (Huntley *et al.*, 1996, this volume).

Boulders in the main body of the train contain abundant chalcopyrite as disseminations and fracture fillings, and grade up to 0.9% Cu and 1.3 g/t Au (Kemp and Robertson, 1994). Six cobble to boulder-sized erratics exposed at the surface of washed till were sampled (Figure 2). A biotite feldspar porphyry clast recovered in the vicinity of the biotite feldspar porphyry

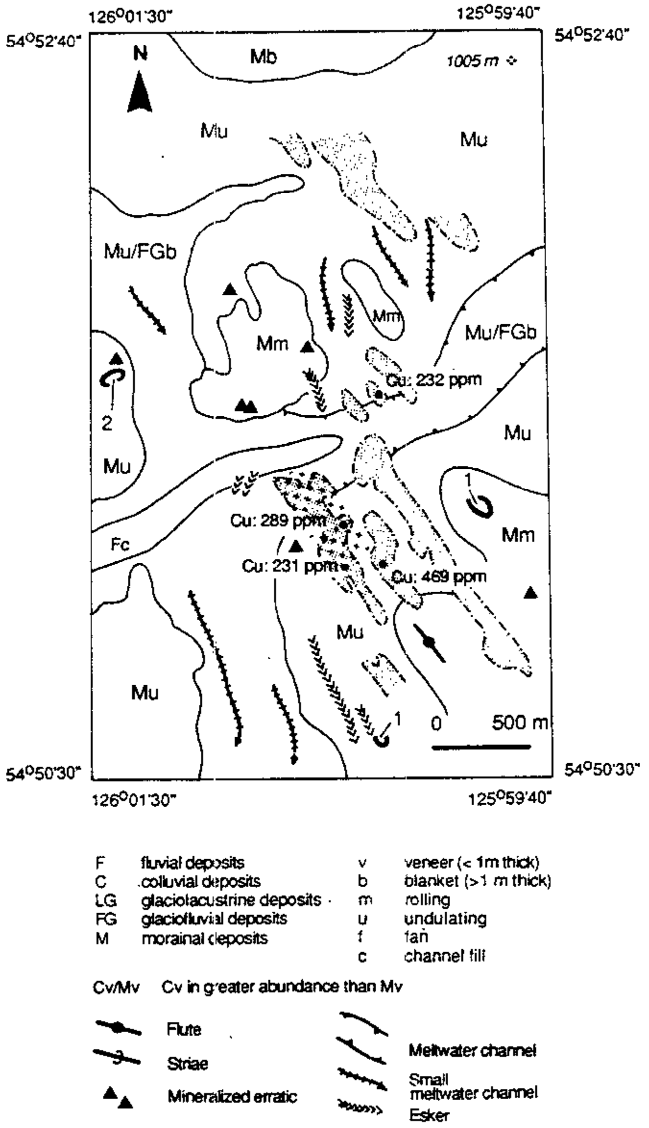

Figure 2. Simplified surficial geology of the Babs 1 property. 1. Altered quartz-phyric crystal and lapilli tuffs; 2. Biotite feldspar porphyry dike. Small crosses - approximate location of mineralized boulder train. Shaded areas - copper values in soils above 40 ppm; maximum concentrations given as point values (data modified from Kemp and Robertson, 1994).

dike returned very low copper values (5 ppm Cu). A boulder sampled 100 metres east of central part of the boulder train assayed 126 ppm lead and 2039 ppm zinc, but returned low copper values (3 ppm). In contrast, a biotite feldspar porphyry boulder found beyond the southeastern limit of the train has assayed 10 491 ppm copper and 411 ppb gold (MacIntyre *et al.*, 1996, this volume). Sparsely mineralized cobble-sized float samples, found up to 700 metres northwest of the boulder train, were not submitted for assay. The source of the mineralized erratics is unknown. Most cobbles and boulders resemble biotite feldspar porphyry exposed at the Granisle and Bell mines and lie approximately down-ice from these areas (Figure 1). However, a more local source is suggested by the angularity, abundance and size of erratics within reworked till. Erratics also closely resemble biotite feldspar porphyry dike rocks exposed close to west-central part of the map area (Figure 2). The trend of this dike crosses the up-ice projection of the main body of the boulder train (Figure 2). In addition, the boulder train is near an induced polarization chargeability anomaly attributed to significant intervals of low-grade porphyry-style copper mineralization over an area of 2 square kilometre and located approximately on the same structural trend as the Bell and Granisle deposits (B. Youngman, personal communication, 1995)

Copper values up to 467 ppm are reported from B-horizon soil samples (Kemp and Robertson, 1994). As originally plotted, copper values above a 40 ppm background, define a circular anomaly flanking the boulder train. This pattern has been reinterpreted as a linear plume reflecting southeast dispersal of copper by ice and secondary southwest dispersal by meltwater Figure 2). There is little evidence to support significant dispersal by postglacial colluviation.

HEARNE HILL (MINFILE 93M 6)

The Hearne Hill prospect lies 2 kilometres east of Morrison Lake and 32 kilometres north of Granisle. Studies focused on a 3 square kilometre area over the crest and steep western flank of Hearne Hill, centred around the "discovery showing" at 55°11' N and 126°17' W (Figure 3). The property, currently under exploration by Booker Gold Explorations Ltd., lies 1.2 kilometres east of the Morrison Lake deposit. The prospect is reached by following a steep dirt track for 6 kilometres off the Hagan road at about 46 kilometres from Topley Landing and the Northwood barge crossing (Figure 1).

Hearne Hill is underlain by Lower to Middle Jurassic lapilli crystal tuffs, andesite flows and volcaniclastic sedimentary rocks (Hazelton Group). These rocks have been intruded by a small, Early Jurassic quartz diorite stock (Topley Plutonic Suite), and a northeast-trending biotite feldspar porphyry plug and dikes of the Eocene Babine Plutonic Suite (Figure 3; Ogryzlo, 1990). The western flank of Hearne Hill is apparently the escarpment of the southeast-trending Morrison fault (Ogryzlo, 1990). West of the fault, younger Jurassic to Cretaceous Bowser Lake Group sediments and biotite feldspar porphyry of the Morrison deposit occupy the downthrown block.

Earlier studies showed that mineralization is widespread, but not uniformly distributed. Chalcopyrite, bornite and molybdenite occur as fracture fillings, and are disseminated throughout intrusive and country rocks. Mineralization is related to a weakly developed porphyry copper system (Ogryzlo, 1990) carrying between 0.1 and 0.2% Cu. This system is cut by an east-dipping breccia pipe, 50 to 60 metres in diameter. Breccia clasts are cemented with interstitial chalcopyrite, subordinate pyrite, malachite and azurite. Copper grades from the pipe range from 0.01 to 2.75% Cu. The 1995 exploration program has extended drilling northward from the breccia body into a potentially large zone of copper porphyry mineralization in breccia and vein stockwork. One drill hole has returned an assay of 0.75% Cu and 0.32 g/t over the total length of the hole (301 m). Host volcanic rocks are strongly silicified. Alteration of intrusive rocks includes replacement of plagioclase phenocrysts by sericite, and biotite by chlorite. Pyrite mineralization is associated with sericite alteration. The most intense alteration is found in the breccia pipe and adjacent wallrock.

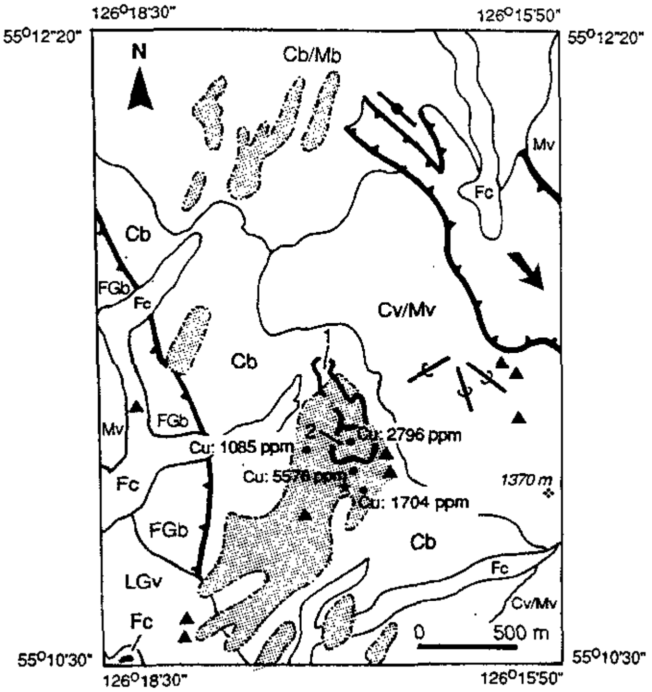

Figure 3. Simplified surficial geology of the Hearne Hill property. See Figure 2 for legend. 1. Early Jurassic quartz diorite (Topley Plutonic Suite); 2. Eocene biotite feldspar porphyry (Babine Pluton Suite). Shaded areas - copper values in soils above 100 ppm; maximum concentrations given as point values (data modified from Dirom, 1967 and Ogryzlo, 1990). Small pentangle - "discovery showing".

DRIFT EXPLORATION RESULTS

Hearne Hill is a montane upland flanking the glaciated Morrison valley. Prominent southeast-trending troughs and ridges occur along the hill crest. Fluted bedrock and striae exposed on trough walls and ridges, indicate iceflow between 120° and 160°. Striae near the summit locally crosscut this direction and indicate secondary flow at 240° into the Morrison valley (Figure 3).

Glacial deposits are rare or absent on the steep, west-facing hillside. Here, bedrock is mantled by talus and hill-slope colluvium (Figure 3). Deposits range in thickness from 0.5 to greater than 2 metres, and are commonly oxidized to bedrock. Talus consists of coarse, angular rubble derived from subaerially weathered outcrops. Hill-slope colluvium comprises poorly consolidated, massive or stratified, clast-supported diamictons. These latter sediments are interpreted as glacigenic debris flows, glaciofluvial deposits and weathered bedrock. On the hill crest, glaciofluvial gravels and sands are confined to trough floors. Adjacent ridges are mantled by morainal deposits consisting of washed basal till and supraglacial tills. These tills are poorly consolidated, massive diamictons with oxidized sandy matrices.

Forty-three colluvium, till and glaciofluvial samples were collected on, or around a recently cut survey grid. Vertical profiles were sampled at three trenches to determine vertical variations in geochemical signatures within the surficial cover. Talus and mineralized boulders were sampled for assay, and will be compared to erratics found in a linear boulder train 2.5 kilometres down-ice from the property (Huntley *et al.*, 1996, this volume). One boulder sampled from this train has assayed 591 ppm copper. It is uncertain whether these erratics are derived from the property or from an undiscovered zone of mineralized outcrop on the southwest flank of Hearne Hill.

Three copper anomalies were identified within a 200 metre radius of the discovery showing during an earlier B-horizon soil sampling program (Dirom, 1967; Ogryzlo, 1990). Copper values above 100 ppm have been replotted in Figure 3 (background threshold for copper in soils is 65 ppm). The resultant dispersal pattern is thought to primarily reflect down-slope transport of weathered bedrock and surficial deposits. This suggests that mineralized float and soil geochemical anomalies are probably sourced northeast of past exploration activity. This conclusion is supported by preliminary reports of higher grades from recent drilling in the northeast part of the property. Additional, down-slope replenishment at lower elevations is anticipated from a mineralized dike swarm extending southwest from the porphyry plug (J.M. Newell, personal communication, 1995).

LENNAC LAKE (MINFILE 93L 190,191)

The Lennac Lake property is located approximately 20 kilometres south-southwest of Granisle (Figure 1). The area is characterized by a subdued, undulating to hummocky topography, with elevations ranging from 880 to 1065 metres. Many of the ridges and knobs are bedrock cored, but locally these features are draped by a veneer or blanket of glacial sediment. Low-lying areas within the property are poorly drained by numerous streams and swamps. The area includes the Thezar #75 (West) (54°44'N, 126°20'W), Thezar #81 (East) (54°45'N, 126°20W), and Jacob (54°43'N, 126°17'W) mineral claims. Thezar #75 and #81 are currently owned by Cominco Ltd. The Jacob property was drilled by Cominco in 1993. The Lennac Lake property straddles the boundary between 93L/16 and 93L/09 map sheets (Figure 1). Access is by a four-wheel-drive road which joins the Paul Lake Recreation Road, approximately 10 kilometres northwest of the Highway 16 intersection.

Country rocks are Lower Jurassic volcanic and volcaniclastic rocks of the Telkwa Formation (MacIntyre *et al.*, 1996, this volume). Intrusions are hornblende-biotite-feldspar and quartz-hornblende-biotite-feldspar porphyries with a granodiorite composition, related to the late Cretaceous Bulkley Plutonic Suite (Plicka, 1981). They parallel northeast trending fault systems, mapped to the east of the area and occur within the Amax west and east zones of the former Thezar claims.

Mineralization is related to a hydrothermal system active during emplacement of the Bulkley intrusive rocks. Well-developed propylytic alteration zones occur in Telkwa Formation volcanic and volcaniclastic rocks to the north of the Lennac Lake area. Sulphide mineralization (pyrite, chalcopyrite, molybdenite and minor sphalerite) borders the main porphyry bodies (Plicka, 1981). Quartz-sericite-pyrite alteration occurs in intrusive rocks along the eastern margin of the Amax E zone. Azurite, malachite and bornite mineralization is exposed in a trench along the access road at the eastern limit of the property. This is the Suratt showing. Felsic volcanics exposed in trenches southeast of the Amax E zone carry gold up to 6000 ppb (Plicka, 1981).

DRIFT EXPLORATION RESULTS

In the property area, glacial flutings indicate the last major iceflow was toward the east-southeast (090° to 120°). A southeast-trending train of maroon, andesitic lapilli tuff and agglomerate, identified during a soil sampling program (Plicka, 1981) is additional confirmation of iceflow direction.

Till, glaciofluvial and glaciolacustrine sediments of variable thickness overlie undulating bedrock, including deep-weathered quartz-biotite-feldspar porphyry. Sediment cover ranging from a thin veneer (<10 cm) to several metres in thickness has hampered past exploration efforts. At several sample sites, supraglacial or washed basal till overlies compact clay-rich lodgement till. The upper till unit, although visually similar to the underlying basal till, is less compact and much sandier in texture.

Twenty-six till and meltwater sediment samples were collected from hand-dug pits and exploration trenches. Three of these samples were collected up-ice and one sample down-ice from the property to better define geochemical dispersal in till. Vertical profile samples were taken along an exposure 2 metre high in an exploration trench at the Surrat copper showing. Three samples were collected from a compact clay-rich till at the base of the section, over a distance of 4 metres. Three samples of the upper, sandy supraglacial till were collected. Data from these profiles will be used to study the geochemical variability in till, both vertically and laterally (*cf.* Broster, 1986). Examinations of clast lithologies were completed at several sites across the property. Clast samples were collected from both hand-dug pits and exploration trenches overlying bedrock. These data will be used to define local clast dispersal patterns.

BELL MINE AND NEWMAN PENINSULA (MINFILE 93M 1)

The Bell mine is situated on Newman Peninsula, within the Babine Lake basin. It is located 8 kilometres north of Granisle, at 54°58'N and 126° 12'W, and straddles the 93M/01 and 93L/16 map boundary (Figure 1). Much of the area is low lying, with elevations ranging from 715 to 915 metres. The property is presently owned by Noranda Mines Limited. Access is by the Hagan road via the Northwood barge or by private ferry operated from the property to a gravel road 10 kilometres north of Granisle (Figure 1).

Hazelton volcanics (possibly older Stuhini Group; see MacIntyre *et al.*, 1996, this volume) and Skeena sedimentary rocks are intruded by rhyodacite, biotite feldspar porphyry, and quartz feldspar porphyry. These intrusive rocks are part of the Eocene Babine Plutonic Suite.

The orebody at the Bell mine is a high-level porphyry copper-gold deposit containing symmetrical zones of biotite-magnetite and propylytic alteration associated with multiple phase Babine intrusions (Carter, 1981). Copper and gold occur in the intrusive rocks, where the Newman fault intersects an east to northeast-trending fault. These intrusions are overprinted by pervasive quartz-sericite alteration. Pyrite and chalcopyrite occur as disseminations and fracture fillings in the main stockwork and the propylytic and biotite alteration zones. Bornite and minor molybdenite are also present in the biotite-altered biotite-feldspar porphyry. Chalcopyrite, pyrite, and minor bornite occur in quartz-sericite altered rocks.

DRIFT EXPLORATION RESULTS

The Newman Peninsula has been intensely glaciated. Well formed fluting and striae are exposed on bedrock surfaces. Predominant iceflow in the area was from 120° to 180° (Armstrong and Tipper, 1948; Tipper, 1971b, 1994; Plouffe, 1991). Locally, iceflow directions deviate toward 220°, possibly due to topographic control of iceflow during early glaciation. Similar local iceflow patterns have been observed to the north and east of Babine Lake by Huntley *et al.* (1996, this volume).

Variable thicknesses of glacial, postglacial and anthropogenic sediments are exposed at the Bell mine property. Along the Babine valley and in topographic lows, sediment thicknesses reach 120 metres (Harrington *et al.*, 1974). Elsewhere, sediment occurs as a thin veneer over bedrock. Deformed laminated clays and silts are exposed along the east side of the Bell open pit. These sediments may be equivalent to mid-Wisconsinan lacustrine sediments dated at 34000±690 BP (Harrington *et al.*, 1974). Approximately 5.5 metres of grey to dark brown clayey, very dense and fissile basal till overlies this unit. The contact between these units is not exposed, and it is not certain whether silts and clays stratigraphically underlie the till. Elsewhere, till overlies deeply weathered bedrock. Locally, dense basal till is capped by a layer of supraglacial or washed till, having characteristics similar to the upper till unit, but less compact and sandier. Locally, colluvium and glaciofluvial sediments overlie basal till. Along the Babine valley, below the 760-metre level, glaciolacustrine deposits drape older sediments and bedrock.

A significant portion of the overburden cover has been disturbed by mining activity. Caution was therefore used when locating suitable sampling sites. Sixty-four till and colluvial samples were collected from hand-dug pits, road cuts and mine pit exposures. Two samples of preglacial silts and clays were collected to compare the geochemistry of the glaciolacustrine sediments with the overlying basal till, and investigate the possible presence of microfossils. Vertical profiles were sampled around Bell open pit, where till exposures are in excess of 3 metres thick. Till-clast lithologies were examined to define clast dispersal trains of distinct bedrock lithologies.

SADDLE HILL (MINFILE 93M 8)

The Saddle Hill property, 36 kilometres north of Granisle, is a rolling montane upland flanked by Morrison Lake and a tributary valley. The property comprises the Double R1 to R8 claims, and includes the former Wolf claims (Fraser, 1980). Detailed studies focused on the Double R1 to R4 claims, centred at 55°12'N, 126°23'W (Figure 4). This area covers the crest of a southeast-trending hill, and the western shore of Morrison Lake. The claims are accessed on foot, by following a disused road that intersects the Morrison road 56 kilometres north of Topley Landing and the Northwood barge landing (Figure 1).

The area is underlain by Triassic siltstones, greywackes and mudstones and Jurassic andesites, rhyolites and subordinate volcaniclastic sediments. Country rocks are intruded and hornfelsed by an Eocene composite biotite granodiorite stock that is part of the Babine Plutonic Suite (Fox, 1993). The stock is approximately 700 metres in diameter and forms an east-west oriented ellipse with a bulge to the north (Figure 4; Fraser, 1980). Granodiorite and country rocks are intruded by biotite feldspar porphyry dikes.

Mineralization is associated with the dikes. In country rocks and granodiorite, pyrite and chalcopyrite occur as fine-grained disseminations or fracture coatings. Up to 2% disseminated pyrite and 3% fracture-coating chalcopyrite is reported in granodiorite (Fox, 1993). Quartz veins and thin, sulphide-rich veins in dikes and granodiorite carry disseminated chalcopyrite, molybdenite and pyrite. Weak to intense argillic alteration occurs adjacent to fractures and quartz veins in granodiorite and dike rocks. Alteration zones are up to 10 metres wide. Biotite and hornblende phenocrysts are destroyed and sericite is present along fracture surfaces. Hornblende is replaced by secondary biotite. Secondary biotite is also associated with copper mineralization (Fraser, 1980).

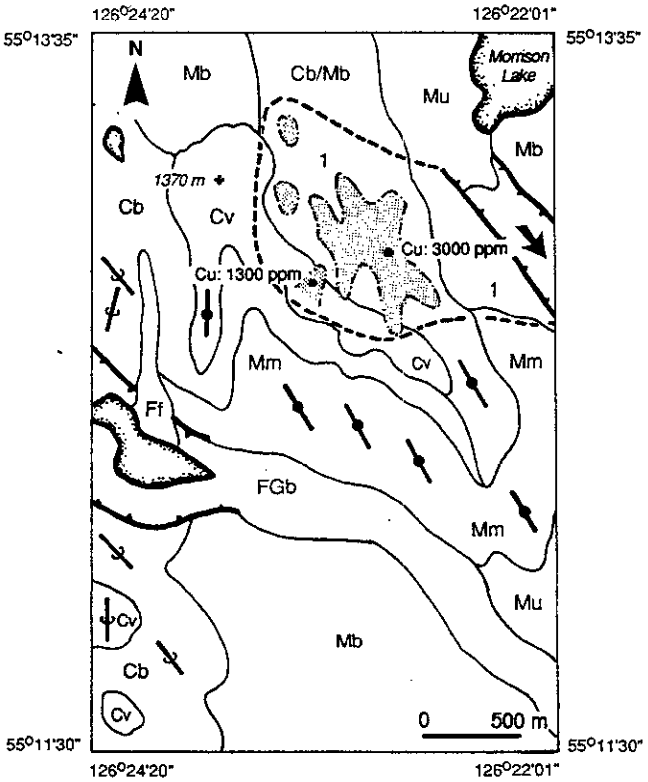

Figure 4. Simplified surficial geology of the Saddle Hill property. See Figure 2 for legend. 1. Eocene biotite granodiorite (Babine Plutonic Suite); approximate position indicated by dashed line. Shaded areas - copper values in soils above 100 ppm; maximum concentrations given as point values (data modified from Fox, 1993).

DRIFT EXPLORATION RESULTS

Glacially streamlined ridges and striae are exposed on the hill crest, spurs and valley walls (Figure 4). These features indicate iceflow between 140° and 167°. Crosscutting striae on west-facing valley walls indicate later local flow between 180° and 195°. This deviation probably reflects local topographic control on iceflow.

Massive, matrix-supported basal and supraglacial tills are confined to lower valley sides. Tills form an undulating to rolling moraine mantling bedrock. Matrices range from dense, fissile clayey silt to moderately dense, weakly fissile sandy silt. Oxidation is moderate to strong in sandier tills. Valley floors are blanketed by up to 5 metres of cobble-rich glaciofluvial sediments. On steeper slopes and over the hill crest, bedrock is locally covered by poorly consolidated, sandy supraglacial till, and massive or stratified, clast-supported hill-slope colluvium. Deposit thicknesses range from 0.2 to 1 metre. These latter deposits are commonly oxidized to bedrock.

Eleven till and three colluvium samples were taken at a spacing of 1 kilometre. Additional basal till samples were collected around the property as part of the regional till sample program (Huntley *et al.*, 1996, this volume). High values for copper (from 1000 to 3000 ppm), molybdenum (up to 80 ppm) and zinc (up to 2500 ppm) were reported in thin B-horizon soil samples collected over the stock (Fraser, 1980). Copper values above 100 ppm are replotted in Figure 4 (above a 60 ppm background threshold; Fraser, 1980). This dispersal pattern is thought to reflect primary dispersal of pyrite and chalcopyrite in till, secondary dispersal by postglacial colluviation and dispersion during pedogenesis.

SUMMARY

In montane uplands, characterized by Hearne Hill and Saddle Hill, steep bedrock slopes are predominantly mantled by veneers and blankets of postglacial hill-slope colluvium and talus. These deposits are first or second derivative products of erosion and deposition with short and simple transport histories. Dispersal patterns observed in soils and boulders in colluvium indicate a dominant down-slope dispersal of mineralized material from potential sources. On gentler slopes and hill crests, bedrock is covered by colluvium and morainal sediments, including basal till and supraglacial till. Dispersal patterns in these deposits are anticipated to reflect a dominant trend in the direction of iceflow.

In plateau areas, characterized by the Babs and Lennac Lake properties, thick, undulating or rolling moraines blanket bedrock. Moraines contain basal, washed and supraglacial tills, and subordinate glaciofluvial deposits. Because these moraines include proximally and distally-sourced mineralized float and matrix, careful interpretation of data from soil surveys, drift geochemistry, landforms and boulder trains is required to evaluate dispersal patterns. Generally, patterns reflect primary dispersal consistent with down-ice transport. Secondary dispersal down-slope or toward local topographic lows is effected by washing of finer material by glaciofluvial action and postglacial colluviation.

In valley settings, characterized by Newman Peninsula, glaciolacustrine silts are ubiquitous below 760 metres and drape other deposits. These sediments have potentially complex transport and sedimentary histories and probably mask geochemical signatures in underlying sediments. It is necessary to sample beneath glacial lake silts to gain a better assessment of geochemical values in drift.

We recommend that future drift exploration in the Babine porphyry belt should focus primarily on sampling of basal till and colluvium. These first derivative products of erosion and deposition have relatively simple transport histories and can be readily used to trace and define mineral dispersal patterns. It is stressed, however, that where possible, drift sampling should be supported by other surficial exploration techniques, including B-horizon soil sampling, landform analysis and boulder tracing.

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REFERENCES

Armstrong, J.E. and Tipper, H.W. (1948): Glaciation in North-central British Columbia; *American Journal of Science*, Volume 246, pages 283-310.

Balzer, S.A. and Broster, B.E. (1994): Comparison of Clast and Matrix Dispersal in Till: Canterbury Area, New Brunswick; *Atlantic Geology*, Volume 30, pages 9-17.

Broster, B.E. (1986): Till Variability and Compositional Stratification Examples from the Port Huron Lobe; *Canadian Journal of Earth Sciences*, Volume 23, pages 1823-1841.

Carter, N.C., (1981): Porphyry Copper and Molybdenum Deposits West-Central British Columbia; *B. C. Ministry of Energy, Mines and Petroleum Resources*, Bulletin 64, 150 pages.

Dirom, G.A. (1967): Geochemical and Magnetometer Report: "K" Group of Mineral Claims, Morrison Lake; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 1102, 7 pages.

Fox, P.E. (1993): Geophysical and Diamond Drilling Report, Saddle Hill Prospect, Babine Lake Area, British Columbia; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 23536, 13 pages.

Fraser, J.R. (1980): Geochemical Survey on the Wolf 1 Claim (Saddle Hill Property) 93M/01W; *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 8176, 7 pages.

Giles, T.R. and Levson, V.M. (1994): Surficial Geology and Drift Exploration Studies in the Tsacha Lake (93F/02) and Chedazuk Creek (93F/07) Map Areas, *in* Geological Fieldwork 1993, Grant B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1994-1, pages 27-37.

Harrington, C.R., Tipper, H.W. and Mott, J.R. (1974): Mammoth from Babine Lake, British Columbia. *Canadian Journal of Earth Sciences*, Volume 11, pages 285-303.

Huntley, D.H., Stumpf, A.J., Levson, V.M., and Broster, B.E. (1996): Quaternary Geology and Regional Till Geochemical Sampling, Central Babine Lake Area (93L/16 and 93M/01), British Columbia; *in* Geological Fieldwork 1995, Grant B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1996-1, this volume.

Kemp, R. and Robertson, K.A. (1994): Geological, Geochemical and Geophysical Report on the Babs Claim Group Located in the Omineca Mining Division (NTS 93L/16E and 93K/13W); *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 23536, 13 pages.

Levson, V.M., Giles, T.R., Cook, S.J., and Jackaman, W. (1994): Till Geochemistry of the Fawnie Creek Area (93F/03); *B.C. Ministry of Energy, Mines and Petroleum Resources*, Open File 1994-18, 34 pages with appendices.

MacIntyre, D.G., Webster, I.C.L. and Bellefontaine, K.A. (1996): Babine Porphyry Belt Project: Bedrock Geology of the Fulton Lake Map Area (NTS 93L/16); *in* Geological Fieldwork 1995, Grant B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1996-1, this volume.

O'Brien, E.K., Broster, B.E., Giles, T.R., and Levson, V.M. (1995): Till Geochemical Sampling: CH, Blackwater-Davidson and Uduk Lake Properties, British Columbia: Report of Activities; *in* Geological Fieldwork 1994, Grant B. and Newell, J.M., Editors, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1995-1, pages 207-211.

Ogryzlo, P. (1990): Geochemical and Diamond Drilling Assessment Report of the Hearne Hill Breccia Pipe; *B.C. Ministry of Mines, Energy and Petroleum Resources*, Assessment Report 20084, 19 pages.

Plicka, P. (1981): Report on the Jery Claims of Pola Resources Limited, Omineca Mining Division, Babine Lake Area, (NTS 93 L/16; Latitude 54 45 N, Longitude 126 22 W); *B.C. Ministry of Energy, Mines and Petroleum Resources*, Assessment Report 9934, 10 pages.

Plouffe, A. (1991): Preliminary Study of the Quaternary Geology of the Northern Interior of British Columbia; *in* Current Research, Part A; *Geological Survey of Canada*, Paper 91-1A, pages 7-13.

Stumpf, A.J. (1995): Quaternary Geology and Dispersal Patterns of the McAdam (NTS 21G/11) Map Area, York County, New Brunswick; *New Brunswick Department of Natural Resources and Energy, Mineral Resources* Branch, Open File Report, 217 pages.

Tipper, H.W (1971a): Smithers Map-area, British Columbia; *in* Report of Activities, *Geological Survey of Canada*, Paper 71-1, Part A, pages 34-37.

Tipper, H.W. (1971b): Glacial Geomorphology and Pleistocene History of Central British Columbia; *Geological Survey of Canada*, Bulletin 196, 89 pages.

Tipper, H.W. (1994): Preliminary Interpretation of Glacial Features and Quaternary Information from the Smithers Map Area (93L), British Columbia; *Geological Survey of Canada*, Open File 2837, scale 1:250 000)