REGIONAL STUDIES OF ESKAY CREEK-TYPE AND OTHER VOLCANOGENIC MASSIVE SULPHIDE MINERALIZATION IN THE UPPER HAZELTON GROUP IN STIKINIA: PRELIMINARY RESULTS

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INTRODUCTION

Eskay Creek type (ECT) volcanogenic massive sulphide (VMS) deposits represent an attractive exploration target because of their substantial tonnage potential and high precious metal content. Despite numerous geological and geochemical studies of Eskay Creek and years of exploration for ECT deposits in the northern Stikinia terrane, however, deposits in the immediate area of Eskay Creek are still the only significant deposits of this type that have been discovered in British Columbia. New exploration criteria must be developed in order to improve the likelihood of success in future exploration endeavors.

The British Columbia Geological Survey Branch recently completed two major syntheses that provide an excellent basis on which to build a new research project focused on developing new exploration strategies for ECT deposits. Massey (1999) compiled a summary of all known VMS deposits in B.C. and subdivided those associated with felsic volcanic rocks into Kuroko-type and Eskay Creek-type. Massey et al. (1999) undertook a detailed assessment of the potential for ECT deposits throughout British Columbia. Their report summarizes the main geological and geochemical characteristics of ECT deposits and provides brief descriptions of numerous mineral occurrences in the province that share at least some of the key characteristics of ECT deposits. Eight individual occurrences were identified that are considered to be ECT deposits, and several additional prospects were described that have potential to be ECT.

A new two-year research project was initiated by the Mineral Deposit Research Unit at UBC in 2003 aimed at better understanding the geological setting in which Eskay Creek type (ECT) deposits and occurrences formed, and devising better exploration strategies for this much sought after style of mineralization. Funding for the project derives in part from the Rocks to Riches Program, which is administered by the BC & Yukon Chamber of Mines, and by a consortium of mining and exploration companies.

Initial field work carried out during the 2003 field season had two main goals. First, we began a mapping based study of upper Hazelton Group strata in the southern Whitesail Lake area (and northernmost Bella Coola area) in southern Stikinia, aimed at refining our understanding of Hazelton Group stratigraphy in this region, constraining the environment(s) of deposition, and investigating the geological setting of ECT occurrences known to occur in the southern part of the area (Diakow et al., 2002; Haggart et al., 2003). Approximately five weeks of mapping was carried out in the southern Whitesail Lake area. Second, we began regional investigations of ECT occurrences in several other parts of Stikinia, including the Eskay Creek area itself, as well as the geological setting of other VMS occurrences hosted in older portions of the Hazelton Group to compare and contrast with the setting in which ECT mineralization is known to have formed. Approximately two weeks of regional reconnaissance work was directed towards this part of the study. The new research builds on previous work completed by the Mineral Deposit Research Unit (MDRU) at UBC under the auspices of the Iskut Project (results compiled in Lewis and Tosdal, 2000) and the Volcanogenic Massive Sulfide Deposits of the Cordillera Project (most results summarized in Juras and Spooner, 1996; and Roth, 2002).

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CHARACTERISTICS OF ECT DEPOSITS IN STIKINIA AND OUTSTANDING QUESTIONS

ECT deposits are polymetallic VMS deposits characterized by high precious metal contents and highly anomalous levels of "epithermal suite elements", especially Hg, Sb and As (Roth et al., 1999). Several lines of evidence indicate that the Eskay Creek deposit formed at shallow water depths (see summary in Barrett and Sherlock, 1996), although depths as great as 1500 m are permitted by the data (Ross Sherlock, oral communication, 2002). Fluid inclusion data suggest that the mineralizing fluids were relatively low temperatures (120-210ºC) and that boiling occurred. Microfossil studies of sedimentary rocks that are the immediate host to ore at Eskay Creek are also consistent with shallow water depths (Nadaraju, 1993), although precise depths cannot be constrained. The high precious metal contents of the ore are considered to be typical of VMS deposits formed in shallow water settings (e.g., Hannington et al., 1999).

The Eskay Creek deposit is associated with a distinctive bimodal basalt-rhyolite volcanic package (the Eskay Creek member of the Salmon River Formation; Lewis and Tosdal, 2000). The host rocks are both slightly younger (172-178 Ma vs. >181 Ma) and compositionally distinct (tholeiitic vs. mainly calc-alkaline) from volcanic rocks that comprise the rest of the Hazelton Group. Rhyolitic rocks associated with the Eskay Creek deposit are characterized by low TiO_2 values, which distinguish them from felsic volcanic units elsewhere in the Hazelton Group. Their Nd isotopic compositions lie in a restricted range with ε_{Nd} between +4 and +5.5, whereas felsic rocks of the rest of the Hazelton Group appear to have a much broader range of isotopic compositions and extend to ε_{Nd} as low as +2 (Childe, 1996, 1997).

A number of polymetallic Kuroko-type VMS deposits and prospects that do not share the ECT characteristics also occur within Early and Middle Jurassic sequences of Stikinia in British Columbia (Massey, 1999). Hydrothermal systems capable of generating VMS deposits were therefore active in a number of areas and at more than one time within Stikinia during the development of the Hazelton arc, and a key question is what specific factors determine which systems will produce an ECT deposit rather than a more typical polymetallic Kuroko-type VMS deposit. Resolution of this question is critical for developing exploration strategies specific to ECT deposits. Factors that may be important include (but are not limited to) the following: 1) water depth; 2) specific composition of associated volcanic rocks; 3) nature and/or depth of associated subvolcanic intrusions; 4) temperature of the associated magmas; 5) seafloor topography; and 6) nature of structural conduits controlling fluid flow in the subsurface.

The new research addresses the relative importance of these and other factors with the ultimate goal of devising more effective exploration criteria for ECT deposits in Stikinia and elsewhere in the world. A broad range of investigative tools is being brought to bear on the problem, including geological mapping, petrography, micropaleontology, lithogeochemistry, U-Pb and Ar-Ar geochronology and Pb and Nd isotopic studies. Specific goals of the study include: 1) comparing the lithogeochemistry of volcanic units associated with other VMS occurrences (both Kuroko-type and ECT) elsewhere in Stikinia with those at Eskay Creek to determine if systematic differences occur that may be used to target areas of high ECT deposit potential; 2) assessing the magmatic temperatures of volcanic units associated with ECT and other VMS occurrences in Stikinia using zircon geothermometry to determine whether ECT deposits are associated with anomalously high temperature magmas; 3) evaluating the water depth in which each of the known VMS occurrences formed using micropaleontology of associated clastic sedimentary units; 4) carrying out a detailed Pb isotopic study of sulphides and host rocks from both ECT and Kuroko-type VMS deposits in Stikinia to determine whether there are systematic differences in metal sources between the two styles of mineralization, and to eliminate occurrences in which the "epithermal geochemical signature" may be related to overprinting by Tertiary epithermal vein systems rather than the primary VMS mineralization itself; and 5) undertaking a 1:50,000 scale mapping study and stratigraphic analysis of a portion of southern Stikinia northeast of Bella Coola (southern Whitesail Lake and northernmost Bella Coola map areas). Here, previously unrecognized upper Hazelton Group stratigraphy have recently been shown to be age equivalent to the Eskay Creek member (Ray et

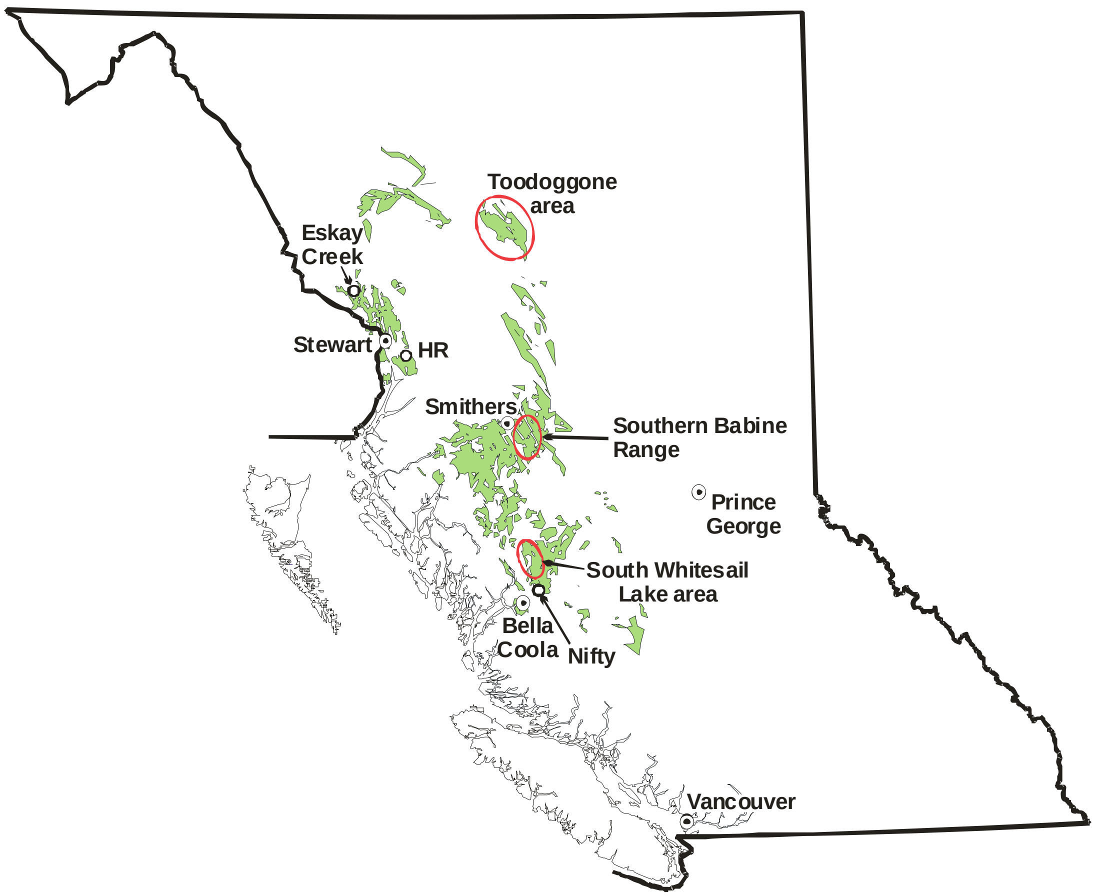

Figure 1. Distribution of Early and Middle Jurassic volcanic and sedimentary strata of the Hazelton Group (in grey) within the Stikine Terrane of British Columbia, showing specific localities referred to in the text.

al., 1998; Diakow et al., 2002). Furthermore, these rocks host both ECT-like and Kuroko-type VMS occurrences, including the Nifty occurrence in northern Bella Coola map area (BC MINFILE 093D 006)) and the Smaby occurrence in southern Whitesail Lake area (BC MINFILE 093E 025). This work is aimed at establishing a stratigraphic, geochronological and lithogeochemical framework for the upper Hazelton Group in southern Stikinia, and the position of ECT and other VMS mineralization within that framework.

MAPPING STUDIES IN THE SOUTHERN WHITESAIL LAKE MAP AREA

The first of two field seasons of mapping in the southern Whitesail Lake area focused on the area between Jumble Mountain in the south and Mount Preston in the north (Figures 1, 2). Hazelton Group volcanic and sedimentary rocks that are very well exposed in this area represent a northwestern continuation of the package of mainly felsic volcanic strata that host the Nifty VMS occurrence in northern Bella Coola map area (Ray et al., 1998; Diakow et al., 2002), approximately 45 km southeast of Jumble Mountain. U-Pb dating of volcanic rocks that host the Nifty occurrence (Ray et al., 1998) indicates an age of 164.2 ± 4.4 Ma. A felsic tuff horizon on the southeast side of Jumble Mountain has given a U-Pb zircon age of 176.6 ± 0.7 Ma (R.M. Friedman, unpublished data). Late Toarcian to Early Aalenian fossils have also been recovered from this locality. Together, these data confirm that the Jumble Mountain section and correlative rocks exposed between Jumble Mountain and Mount Preston, 30 km to the northwest, are roughly age equivalent to host rocks for the Eskay Creek deposit.

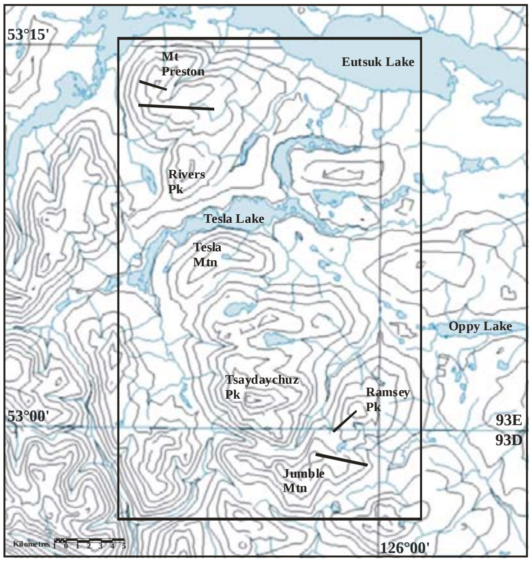

Figure 2. Regional map of the southeast Whitesail Lake and northern Bella Coola map areas. Box shows the outline of the study area and bold lines indicate measured stratigraphic sections, which are named after adjacent mountains.

Several very well exposed stratigraphic sections of Hazelton Group strata between Jumble Mountain and Mount Preston were examined in detail during the 2003 field season, and measured sections were completed in both the northern and southern parts of the study area. U-Pb dating of felsic volcanic units in these sections are in progress to provide firm temporal correlations.

The area between Jumble Mountain and Ramsey Peak (Figure 2) contains three-dimensional exposures of Hazelton Group strata within an area of approximately 50 km^2. Layered rocks in this area trend approximately east/west and dip shallowly to the north and northeast, with very minor structural disruption. The main Jumble Mountain massif itself has superb exposures of shallowly dipping volcanogenic strata that are unfortunately largely inaccessible due to very steep topography and glacial cover. This area will be spot-checked and sampled for U-Pb dating during the 2004 field season.

The base of the measured section in the Jumble Mountain area is exposed on the northeast flanks of the mountain (Figures 2, 3). The base of the section is dominated by coarse-grained, rhyolitic to dacitic fragmental rocks interbedded with massive, volcanogenic granule to pebble conglomerate, which comprises Unit A of this section (Figure 3). Conglomeratic beds generally decrease in abundance up section, becoming intercalated with finer-grained, well-bedded feldspathic-lithic wacke which forms Unit B (Figure 3). Wackes in this unit are fossiliferous, containing articulate and broken bivalves and less abundant gastropods. Ammonites recovered from this unit during previous summers have been identified as Late Toarcian to Early Aalenian (J.W. Haggart, personal communication, 2003), and a U-Pb age of 176.6 ± 0.7 Ma was obtained from a dacitic to rhyolitic crystal-lithic tuff from within this unit (R.M. Friedman, unpublished data). Fossil assemblages and sedimentary structures suggest a relatively shallow-water depositional environment. Unit C of this section is characterized by well-bedded, fine-grained tuffaceous beds intercalated with bioclastic lag deposits and less abundant feldspathic-lithic wacke (Figure 3). This unit is overlain by huge thicknesses of massive, volcanogenic, granule to boulder conglomerate. The entire measured section is intruded by a set of sparsely plagioclase-phyric to aphyric dacitic sills and dykes, which appear to be related to an aphanitic dacitic plug that intrudes the upper part of the section (Figure 3).

Exposures between the Jumble Mountain section and the Ramsey Peak area have not yet been measured or examined in detail but generally comprise large thicknesses of well-bedded, feldspathic-lithic wacke and granule to pebble mudstone, which are overlain by crowded plagioclase-phyric to aphyric, amygduloidal basaltic andesite flows(?).

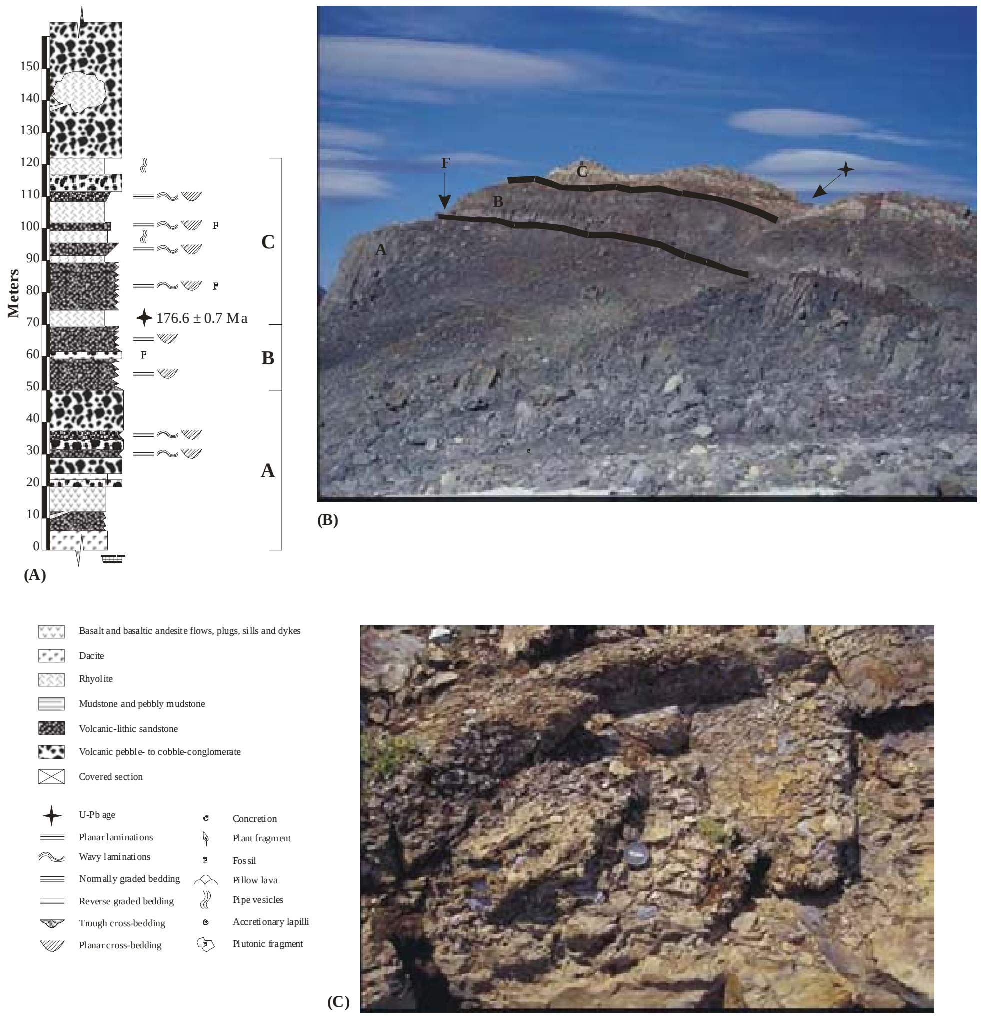

Figure 3. Measured section from the Jumble Mountain study area, showing (a) the location of section shown in Figure 2, (b) a view to the southeast across well-exposed strata northeast of Jumble Mountain, and (c) an outcrop photograph of a bioclastic lag deposit within the lower Jumble Mountain section. Units A, B, and C correspond with the vertical scale beside the measured section. Late Toarcian to Early Aalenian ammonoids have been identified at the indicated fossil site, stratigraphically below a crystal-lithic lapilli tuff which has yielded a U-Pb age of 176.6 ± 0.7 Ma.

Further to the north, volcanic stratigraphy in the Ramsey Peak area is dominated by three distinct groups of lithologies (Figure 4). The base of this section, which is presumed to overlie basaltic flows north of the Jumble Mountain section, is comprised of enormous thicknesses of massive, volcanogenic cobble to boulder conglomerate intercalated with very minor feldspathic-lithic wacke and thin tuffaceous beds. This comprises Unit A in the measured Ramsey Peak section (Figure 4). Overlying the massive conglomerates are moderately to poorly welded lapilli tuff and tuff breccia of felsic to intermediate composition and lesser volcanogenic wacke and mudstone (Unit B, Figure 4). The uppermost unit of measured section in the Ramsey Peak area, Unit C, comprises very thick, very densely welded, rhyolitic crystal-vitric tuff. Abundant plagioclase-phyric to aphyric basaltic dykes cut this section and are presumably related to a poorly exposed, plug-like basaltic intrusion that intrudes the conglomerates at the base of this section. Strata in this area continue northward from Ramsey Peak into the Oppy Lake basin, and will be examined during the 2004 field season.

Stratigraphic units in the Jumble Mountain and Ramsay Peak area extend northward along strike past Tsaydaychuz Peak, which has been mapped by Woodsworth (1980) as the Early Jurassic Telkwa Formation, to the Mount Preston

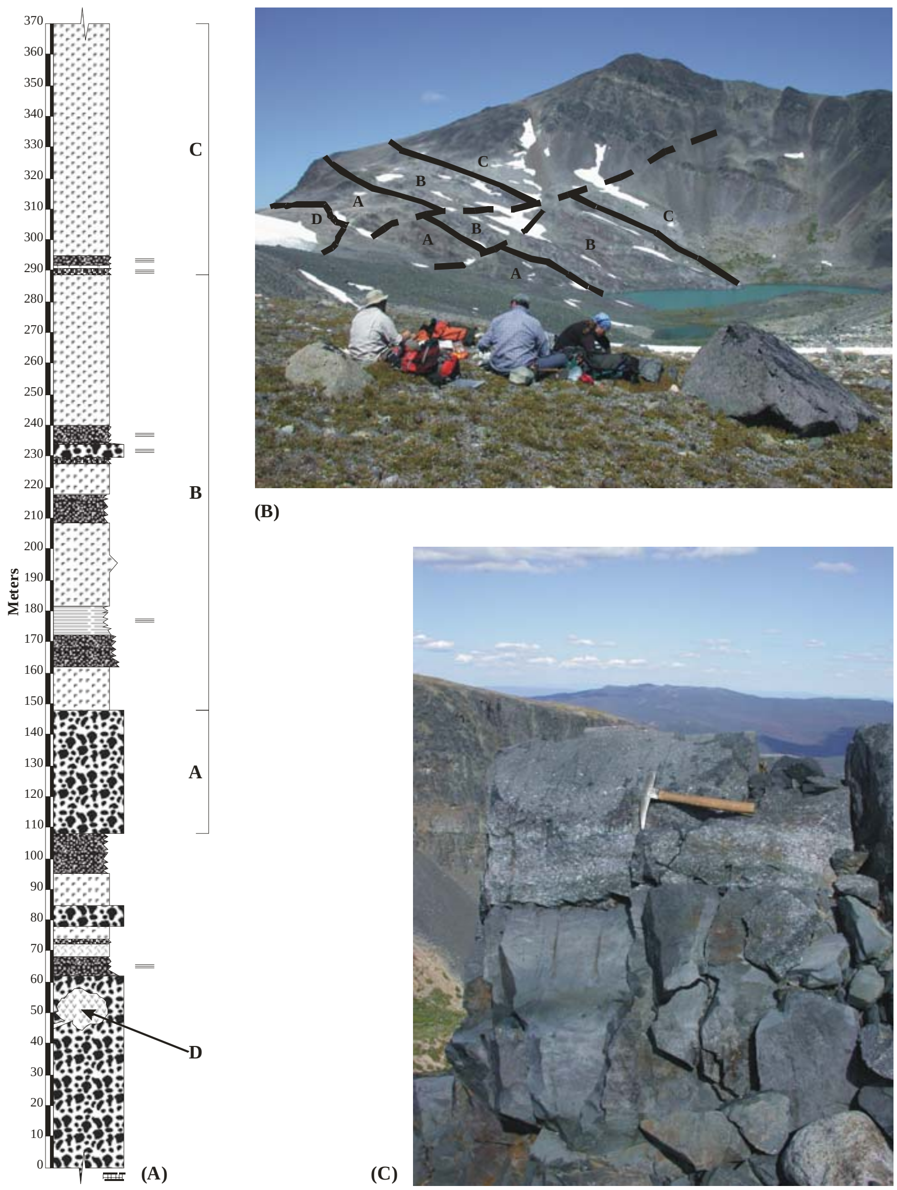

Figure 4. Measured section from the Ramsey Peak study area, showing (a) the location of section shown in Figure 2, (b) a view to the north at southern flank of Ramsey Peak, and (c) a view to the southeast across Sigutlat Lake towards the Nechako Plateau. Units A, B, C, and D correspond with the vertical scale beside the measured section. The outcrop in Figure 4c displays a sharp contact between fine-grained mudstone and densely welded, columnar jointed crystal-vitric tuff within Unit B of the Ramsey Peak section (see above).

area (Figure 2), where several measured sections were completed during the 2003 field season. Exposures in the Mount Preston area mainly consist of approximately northeast/southwest trending, shallowly-dipping volcaniclastic and sedimentary strata.

The base of the measured section in the Mount Preston area is dominated by very fine-grained feldspathic-lithic wacke to mudstone interbedded with less abundant, chloritized, densely welded, quartz-eye bearing rhyolitic crystal-vitric tuff (Figure 5). These units are overlain by a series of plagioclase-phyric to aphyric, variably amygdaloidal basalt to basaltic andesite flows, pillow lavas and broken pillow breccia (Units A and B; Figure 5). Mafic flows are overlain by large thicknesses of feldspathic-lithic wacke and mudstone of variable bedding thickness and grain size, comprising unit C in this area (Figure 5). Interbedded within the

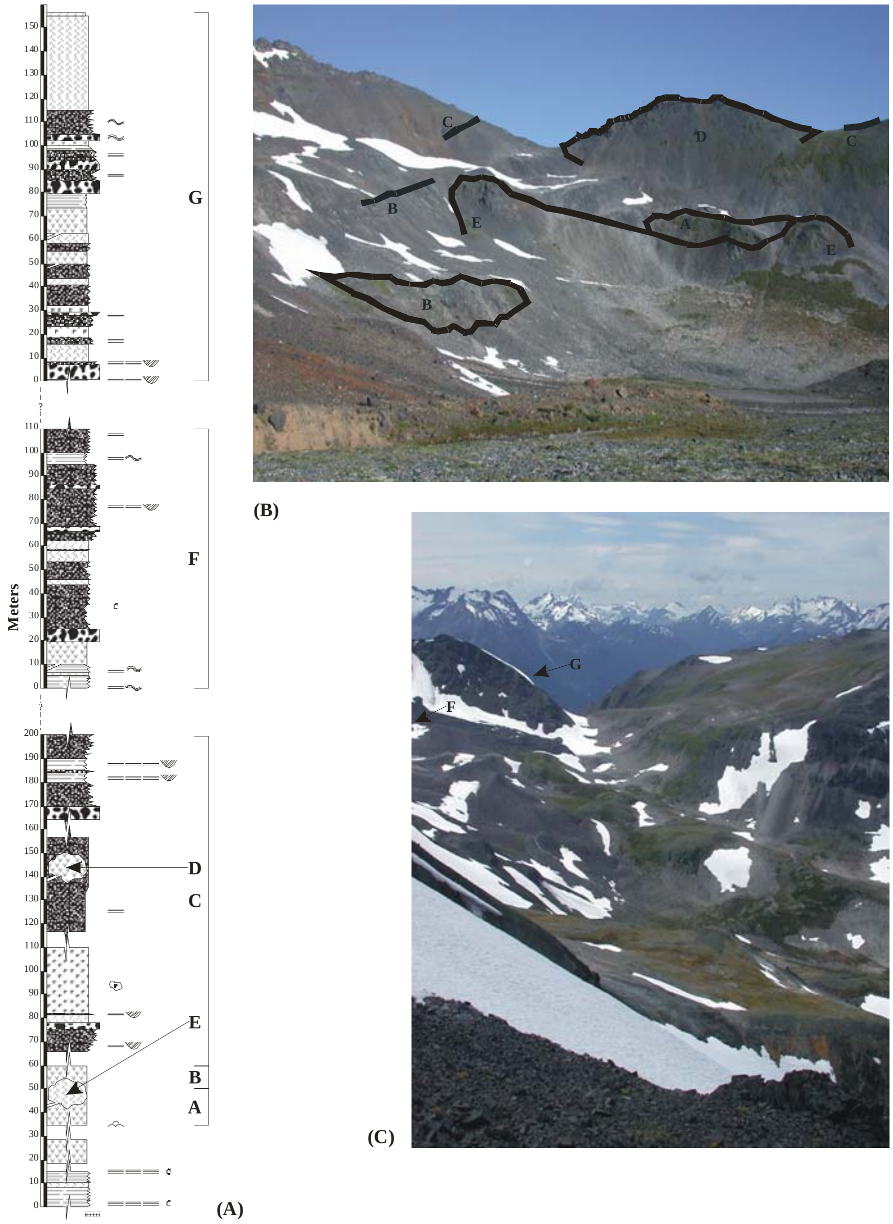

Figure 5. Measured sections from the Mount Preston study area, showing (a) locations of sections shown in Figure 2, (b) a view to the west towards Mount Preston (not visible), and (c) a view to the west into the cirque immediately south of Mount Preston. The cirque wall displays pillow basalts and broken pillow breccia (A), basaltic andesite flows (B), fine-grained volcanogenic mudstone (C), a basaltic plug (D), and a rhyolite dome (E). F and G correspond with the vertical scale beside respective measured sections.

clastic sediments is a densely welded, dacitic vitric-crystal tuff which locally contains distinctive felsic plutonic clasts. These volcanic and sedimentary strata are intruded by an aphanitic basaltic plug, Unit D, which has a distinctly triangular-shaped cross section (Figure 5). The basaltic pillow lavas that form part of the base of this section are intruded by a rhyolite to rhyodacite flow-dome complex, with a well developed carapace breccia (Unit E; Figure 5). Overlying strata in measured sections F and G (Figure 5) consist of a clastic-dominated section, with abundant planar and trough cross-laminae and mudcracks (section F; Figure 5), and a more tuffaceous-dominated section (section G; Figure 5), with variably welded, rhyolitic to dacitic lapilli tuff intercalated with less abundant clastic material.

Preliminary petrographic studies of igneous and sedimentary rock units in the southern Whitesail Lake area show the effects of weak to locally stong chlorite and carbonate alteration. Mafic minerals present within mafic flows and intrusive bodies are pervasively altered to chlorite, and amygdules, where present, are filled with epidote, calcite, and/or quartz. Plagioclase phenocrysts are euhedral and unaltered in porphyritic samples, and groundmass material typically consists of microcrystalline plagioclase that forms a trachytic texture around phenocrysts. Felsic to intermediate composition tuffaceous rocks commonly contain euhedral and broken plagioclase phenocrysts. Welded material is partially or wholly devitrified. Plutonic lithic fragments, where present, appear to be syenitic in composition with distinctive myrmekitic textures. Samples from the rhyolite to rhyodacite flow-dome complex south of Mount Preston are generally aphyric, and contain locally abundant quartz-filled vesicles. Clasts in sedimentary units consist of broken plagioclase grains, fine grained basalt, and welded tuffaceous material. Ongoing petrographic and textural studies of rocks from this region will help further refine rock-unit designations and provide additional information related to the depth of water in which the various units were deposited.

Mineral occurrences present within the southern Whitesail Lake study area include large and impressive gossans developed south of Mount Preston (Pond/Rivers Peak occurrence; BC MINFILE 093E 058) that are likely associated with porphyry-type systems related to small Late Cretaceous (?) porphyry intrusions. However copper mineralization in the form of small, mineralized quartz vein breccias were also noted in this area and this may represent older, possibly Hazelton-age, epigenetic mineralization. Several samples of the Cu-bearing breccias were collected for Pb isotope analysis to test this hypothesis. Numerous other mineral occurrences are also recorded in the BC MINFILE in the Mount Preston area (e.g., the Ron occurrences; BC MINFILE 093E 065, 079, 080, 081, 082); these are mainly narrow stringers, small pods and disseminations of chalcopyrite, pyrite, bornite and hematite in Hazelton Group volcanic rocks.

REGIONAL STUDIES

Regional studies during the 2003 field season included extensive sampling at the RDN (GOZ) property approximately 40 km northeast of Eskay Creek (BC MINFILE 104G 144; Figure 1), which is currently being explored as part of a joint venture between Barrick Gold Corporation and Rimfire Minerals Corporation. Samples were collected for U-Pb zircon dating of some of the main host rocks for mineralization on the property, and to geochemically characterize both the felsic host rocks and the intermediate(?) to mafic volcanic rocks in the area. These data will permit a comparison between the age(s) and geochemistry of volcanic rocks on the RDN property and those at Eskay Creek, and will establish the paleotectonic environment in which the Early and Middle Jurassic rocks in the area formed. Drill core from a deep drill hole on “Pillow Basalt Ridge” between the Iskut River and Forest Kerr Creek approximately 12 km northeast of Eskay Creek was also examined and sampled for lithogeochemical and dating studies. Pillow Basalt Ridge is underlain by a very thick (>1.8 km) pile of mafic volcanic rocks (and minor interlayered argillite) that is thought to be correlative with the hangingwall basalts at Eskay Creek. If this correlation is correct, the section at Pillow Basalt Ridge represents a much thicker and more extensive accumulation of presumably rift-related mafic volcanics than are preserved in the immediate Eskay Creek area. This would have important implications for the geometry and extent of Eskay Creek-age rifting in this area.

The Homestake Ridge property southeast of Stewart (Figure 1) was briefly visited together of personnel from the Bravo Ventures Group Inc., who are currently exploring the area. Samples of several of the main volcanic lithologies present in the Homestake Ridge area, as well as an extensive suite of sulphide samples, were collected for U-Pb dating, lithogeochemical and Pb isotopic studies to better constrain the nature and age of mineralization in the area.

Several mineral occurrences hosted by Hazelton Group volcanic rocks in the southern Babine Range (Figure 1) have been interpreted by Wojdak (1998) to be potentially syngenetic in origin. Volcanic and sedimentary strata in this area have been assigned to the Telkwa and Nilkitkwa formations by MacIntyre (1989) based on lithology and fossil age constraints, which indicate an age of Late Sinemurian to earliest

Toarcian for the immediate host rocks to mineralization. Syngenetic (?) mineralization in the area is therefore somewhat older than that at Eskay Creek. One of these occurrences (Harry Davis; BC MINFILE 093l 203, 204, 205 and 214), near the summit of Mt. Harry Davis north of Houston, was briefly examined and sampled for lithogeochemical analysis, Pb isotopic studies and U-Pb dating. In this area a thick section of flow-banded, quartz- and feldspar-phyric rhyolite is associated with bedded red and maroon lapilli tuffs which locally contain accretionary lapilli. Stratabound, possibly syngenetic, mineralization occurs in the form of sphalerite layers in thinly laminated chert, and epigenetic quartz-calcite-sphalerite(± fluorite) veins are also present in the area (Wojdak, 1998).

GEOCHEMICAL STUDIES – PRELIMINARY RESULTS

Geochemical studies of igneous rock units from the southern Whitesail Lake area and a regional sample suite are underway to characterize the geochemical affinity of each of the units and place constraints on the paleotectonic setting in which they were emplaced. Complete major, trace and rare earth element analyses have been obtained from 40 representative samples of intrusive and extrusive rock units from the southern Whitesail Lake study area and 29 samples of Hazelton Group rocks collected during regional investigations elsewhere in Stikinia. Preliminary interpretations of the data are presented in Figures 6 and 7, and discussed briefly below. Work thus far has focused on geochemically characterizing the various rock suites; detailed comparisons with volcanic host rocks for the Eskay Creek deposit have not yet been done.

Data from the southern Whitesail Lake study area, together with reconnaissance data from host volcanic rocks at the Nifty VMS occurrence in the northern Bella Coola map area (from Ray et al., 1998) are shown on various geochemical discriminant plots in Figure 6. The following main observations arise from the data. Volcanic and subvolcanic rock units in southern Whitesail Lake map area geochemically closely resemble the broadly age equivalent early Middle Jurassic host volcanic rocks at the Nifty occurrence which on strike to the southeast. They are broadly bimodal in composition (mainly basalt to basaltic andesitic and dacitic to rhyodacitic). The felsic units are all subalkaline; however the mafic units include both subalkaline and alkaline compositions. Although on an AFM diagram the Whitesail Lake samples fall mainly in the calc-alkaline field (as do the Nifty samples), immobile trace element plots such as Y vs. Zr (Figure 6) indicates that they are predominantly tholeiitic to transitional in composition. A plot of Rb vs. Y+Nb suggests that all of the volcanic rocks formed in a volcanic arc setting; however immobile trace element plots such as V vs. TiO_2 (Figure 6) indicate that the mafic volcanic and subvolcanic units include both island arc tholeiites and back-arc tholeiites. These mixed volcanic arc/back arc geochemical signatures are very similar to those described by Barrett and Sherlock (1996) at Eskay Creek, and is consistent with an overall rifted arc (intra-arc or back-arc) setting.

Most of the samples collected during regional investigations during the 2003 field season were from the general vicinity of known mineralization, hence most of them show evidence of moderate to strong hydrothermal alteration. Because of this, some major and trace elements have been mobilized and cannot be used to characterize the original geochemical composition and petrotectonic affinity of the samples. Data from three of the areas examined during the regional study (Pillow Basalt Ridge north of Eskay Creek), Homestake Ridge, and the southern Babine Range) are discussed briefly here, focusing mainly on immobile trace elements.

Pillow Basalt Ridge northeast of Eskay Creek comprises a thick section of basaltic flows and less abundant hyaloclastites, locally with thin interbeds of argillite. The volcanic rocks and a 28 m thick medium-grained gabbro sill that intrudes the section and is presumed to be synvolcanic range from basalt to basaltic andesite in composition. On AFM and Y vs. Zr plots the Pillow Basalt Ridge samples all fall in the tholeiitic field (Figure 7), and V vs. TiO_2 and Rb vs. Y+Nb plots indicate both island arc tholeiitic and back-arc affinities (Figure 7). These geochemical characteristics are similar to those for the hangingwall basalt at Eskay Creek and support a correlation between these two volcanic packages.

Two flow-banded felsic domes have been recognized at Homestake Ridge (R. MacDonald, personal communication, 2003). These domes were emplaced into a sequence of mainly intermediate(?) composition volcanic breccias

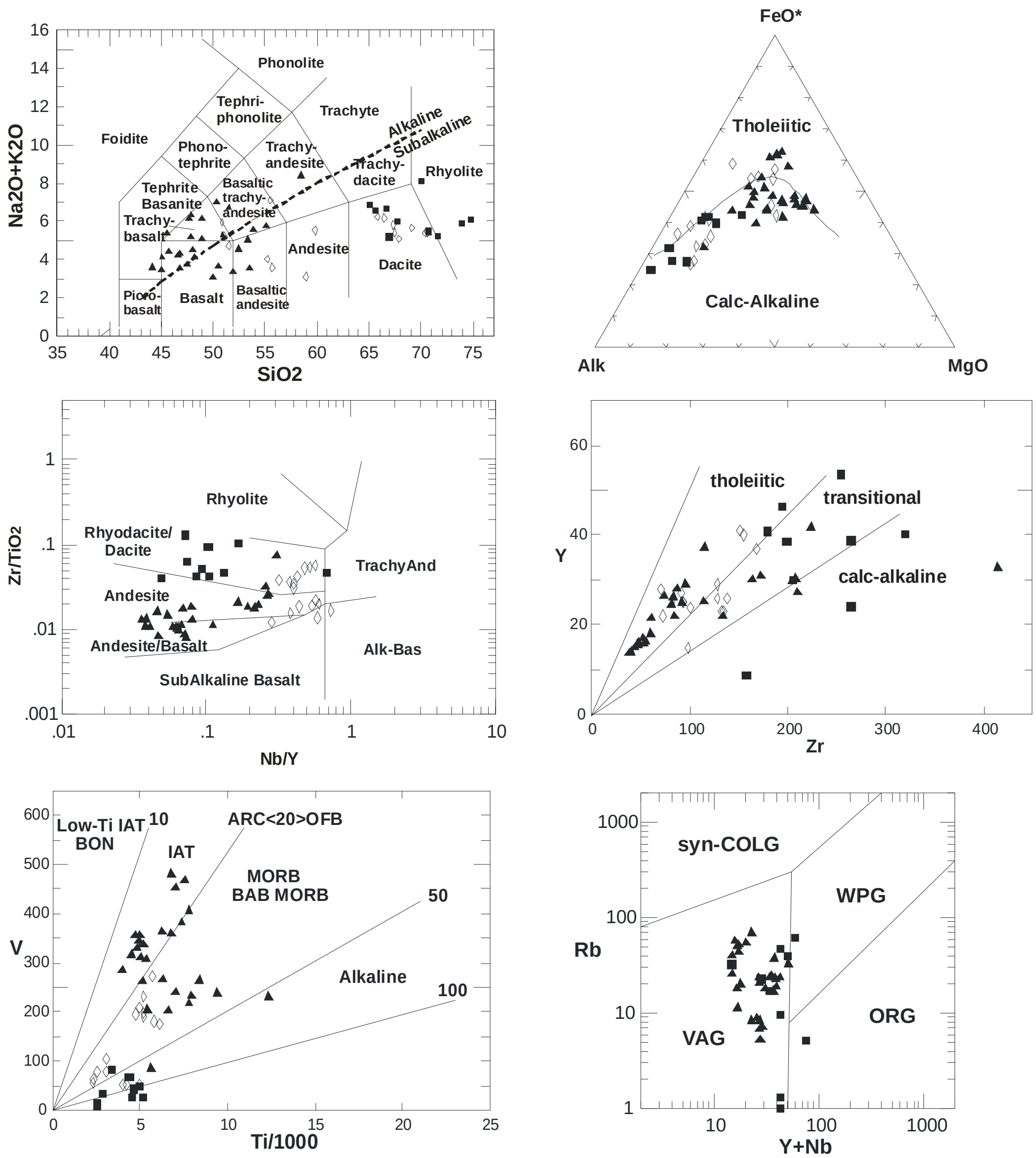

Figure 6. Geochemical discriminant diagrams for volcanic and shallow intrusive rocks in the southern Whitesail Lake study area. Closed squares indicate felsic tuffaceous and intrusive units and closed triangles indicate mafic intrusive and extrusive units. Open diamonds are analyses of felsic and mafic samples from the vicinity of the Nifty prospect (data from Ray et al., 1998).

and argillite. Several bodies of plagioclase-hornblende (± biotite) porphyry also intrude the volcaniclastic and argillite package. The felsic domes and feldspar-hornblende porphyry intrusions are similar in composition (scatter on the total alkalies vs. SiO_2 and AFM diagrams likely reflects major element mobility during the strong hydrothermal alteration that has affected all of the units in the area). They are all calc-alkaline, subalkaline and range from dacite to rhyolite in composition. On a Rb vs. Y+Nb plot all of the Homestake Ridge samples fall well within the volcanic arc field; however on a V vs. TiO_2 plot their compositions are consistent with eruption in a rifted arc setting.

A single sample from a flow-banded, sparsely quartz- and feldspar-phyric rhyolite sampled immediately south of the summit of Mt. Harry Davis in the southern Babine Range yields a calc-alkaline rhyolitic composition with a volcanic arc affinity.

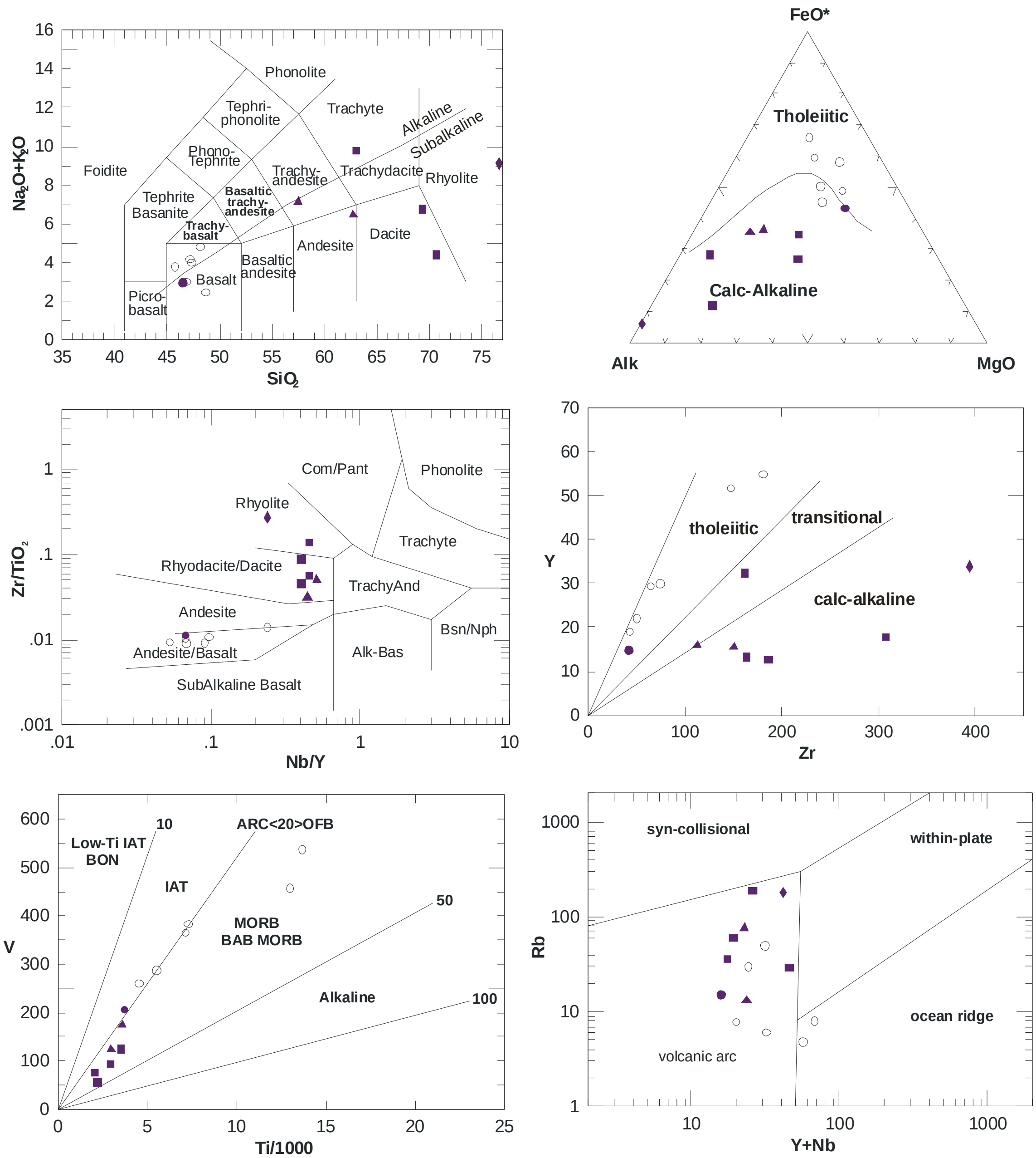

Figure 7. Geochemical discrimination diagrams for volcanic and shallow intrusive rocks from regional investigations of the upper Hazelton Group. Open circles are basalts from Pillow Basalt Ridge and the single closed circle is a gabbro body that intrudes the basalts. Closed squares and closed triangles are flow-banded rhyolite and plagioclase (± hornblende) porphyry bodies at Homestake Ridge. Closed diamond is a flow-banded rhyolite ata the HD prospect on Mt. Harry Davis in the southern Babine Range.

GEOCHRONOLOGY AND LEAD ISOTOPIC STUDIES

A number of samples are presently being processed for U-Pb zircon dating, including several felsic tuff and flow dome samples from the southern Whitesail Lake area, several samples from the RDN and Homestake Ridge properties, an intrusive diorite/gabbro from the Pillow Basalt Ridge section, and a single rhyolite unit from the southern Babine Range. An extensive suite of sulphide samples from all of the studied areas is also being prepared for Pb isotopic analysis.

DISCUSSION AND PRELIMINARY CONCLUSIONS

Although still at an early stage of a projected two-year project, our results thus far provide some new insights into the nature of upper Hazelton Group magmatism in several parts of Stikinia and the regional potential for additional ECT deposits. Mapping in the southern Whitesail Lake area has shown that the host stratigraphy for the Nifty VMS occurrence, which has been shown to be age equivalent to host rocks at Eskay Creek, extends at least another 75 km to the northwest. Furthermore facies analyses of these strata indicate predominantly shallow water deposition, and suggest formation in a rifted arc setting at the termination of Hazelton arc magmatism. Both of these characteristics, together with the presence of subaqueous felsic flow domes, are highly prospective for formation of ECT mineralization, similar to that at the Nifty occurrence. Several VMS prospects are known to occur farther along strike to the northwest in southwestern Whitesail Lake map area; these will be examined during the 2004 field season.

Preliminary work at Pillow Basalt Ridge north of Eskay Creek supports the suggestion that these basalts are stratigraphically equivalent to the hangingwall basalt at Eskay Creek. The great thickness of basalts present on Pillow Basalt Ridge (nearly 2 km), however, indicates that the latest stage of Hazelton Group magmatism in this area occurred during much more extensive rifting and associated subsidence than was manifest at Eskay Creek. The implications of this for ECT potential in the area are still uncertain.

Field examinations, preliminary geochemical studies, and discussions with industry geologists suggest that the Homestake Ridge mineralization occurs within a somewhat older portion of the Hazelton Group than Eskay Creek. In particular the plagioclase (± hornblende) porphyry bodies that intrude the section lithologically and geochemically resemble ~197-202 Ma intrusive units at the Red Mountain and Silbak Premier deposits to the northwest. Since these porphyry bodies intrude the felsic domes, intermediate volcaniclastic units and argillites that underlie much of the Homestake Ridge property, it appears unlikely that Eskay Creek stratigraphic equivalents are present in the area. U-Pb dating is underway to test this. A number of small VMS occurrences are known to be present within Betty Creek Formation-equivalent rocks of the Hazelton Group in the Kisault River valley to the south (e.g., Pinsent, 2001), however; thus the potential for syngenetic mineralization on Homestake Ridge cannot be ruled out.

Work carried out at the RDN property north of Eskay Creek was done as part of the industry-funded portion of this project, and results from that work are subject to a one-year confidentiality agreement.

Reconnaissance examinations of volcanic sections in the southern Babine Range and a single geochemical analysis of a flow-banded rhyolite unit in the area support the suggestion by Wojdak (1998) that these strata are somewhat older than the host rocks at Eskay Creek. U-Pb geochronology and Pb isotopic work is underway to more precisely constrain the age of the host rocks to possible syngenetic mineralization in this area and test whether the mineralization in this area is indeed syngenetic, or is epigenetic and unrelated to Hazelton Group magmatism.

FUTURE WORK

A considerably more extensive field season is planned for 2004, including approximately 6-8 weeks of mapping to complete the Whitesail Lake mapping project, and examination and sampling of a number of VMS (?) occurrences throughout the Hazelton Group. This regional work will be done in conjunction with industry geologists as well as BC Geological Survey

Branch and Geological Survey of Canada personnel.

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