New Results of Geological Mapping and Micropaleontological and Lead Isotopic Studies of Volcanogenic Massive Sulphide–Hosting Stratigraphy of the Middle and Late Paleozoic Sicker and Buttle Lake Groups on Vancouver Island, British Columbia (NTS 092B/13, 092C/16, 092E/09, /16, 092F/02, /05, /07)

T. Ruks, Mineral Deposit Research Unit, Department of Earth and Ocean Sciences, University of British Columbia, Vancouver BC; tyler_ruks@hotmail.com

J.K. Mortensen, Mineral Deposit Research Unit, Department of Earth and Ocean Sciences, University of British Columbia, Vancouver BC

F. Cordey, CNRS UMR 5125, Université Claude Bernard Lyon 1, 69622, Villeurbanne Cedex, France

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Introduction

Volcanogenic strata of the mid-Paleozoic Sicker Group on Vancouver Island (Figure 1) occur in several distinct basement highs (referred to herein as 'uplifts'). These rocks host the world-class Myra Falls volcanogenic massive sulphide (VMS) deposit (combined production and proven and probable reserves in excess of 40 million tonnes of Zn-Cu-Au-Ag sulphides), as well as numerous other VMS deposits and occurrences, including those in the Big Sicker Mountain area in the southeastern part of the Cowichan Lake uplift (Figure 1). Three of these deposits in the Cowichan Lake uplift, the Lenora, Tyee and Richard III (MINFILE occurrences 092B 001, 092B 002, 092B 003; MINFILE, 2010), have seen limited historical production. The Lara deposit (MINFILE occurrence 092B 129), farther to the northwest, also contains a significant drill-indicated resource of 1 146 700 tonnes grading 3.01% Zn, 1.05% Cu, 0.58% Pb, 32.97 g/t Ag and 1.97 g/t Au (Kelso et al., 2007).

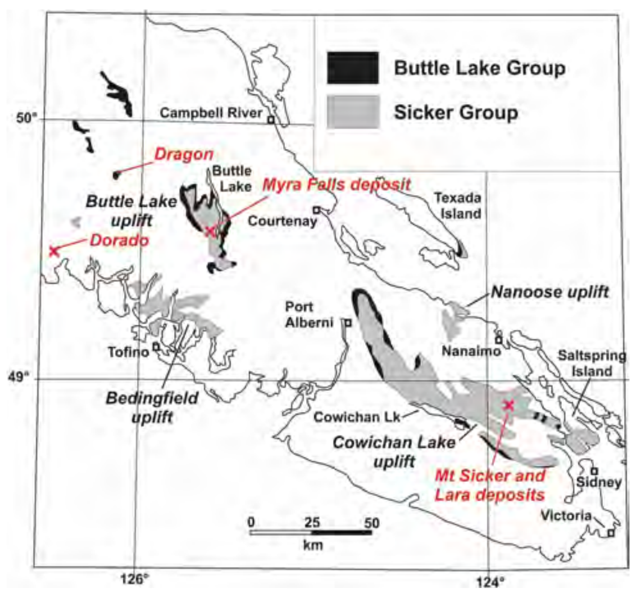

Figure 1. Distribution of Paleozoic strata of the Sicker and Buttle Lake groups on Vancouver Island and the Gulf Islands.

Geological mapping (Massey and Friday, 1987; Ruks and Mortensen, 2007) indicates that the Big Sicker Mountain area consists mainly of deformed mafic to felsic volcanic and volcaniclastic rocks of the Nitinat and McLaughlin Ridge formations, and high-level intrusions of the Saltspring intrusive suite, as well as abundant gabbroic dikes and sills of the Triassic Mount Hall gabbro (Figure 2). Recent geological mapping in the Cowichan Lake uplift (Ruks et al., 2009a; this study) has been a continuation of the authors' efforts to develop a stratigraphic framework for the Sicker Group and contained VMS mineralization. Work conducted on mineral tenure owned by project sponsors Treasury Metals Inc. and Westridge Resources Inc. in the Cowichan Lake uplift concentrated on resolving the geological setting and age of the Lara VMS deposit and other VMS occurrences in the area, as well as examining new exposures created by recent logging activity. In 2008, reconnaissance fieldwork on new bedrock exposure owned by Westridge Resources Inc. culminated in the discovery of a new VMS occurrence (Ruks et al., 2009a). Mapping in 2008 in the Mount Brenton area on mineral tenures owned by Treasury Metals Inc. identified a prospective zone

Keywords: Vancouver Island, Paleozoic, Sicker Group, Buttle Lake Group, Cowichan Lake uplift, volcanogenic massive sulphide, stratigraphy, U-Pb zircon geochronology, lithogeochemistry

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where intensely sericite-altered and pyrite-mineralized felsic ash tuff is overlain by silicified argillite and a chlorite-altered ash tuff of intermediate composition (Ruks et al., 2009a). A similar geological setting is recognized in the vicinity of VMS mineralization at the Lenora deposit north of the Chemainus River (Ruks and Mortensen, 2007). Geological mapping and sampling were also focused in the vicinity of the Lady A, Lady C and Lady D iron formations (MINFILE occurrences 092B 029, 092B 033 and 092B 076, respectively; Ruks et al., 2009a). These iron formations are similar to other iron formations occurring in rocks that are interpreted to lie stratigraphically above VMS mineralization at the Lenora, Tyee and Richard III occurrences, and are believed to represent oxide-facies iron mineralization related to hydrothermal mineralizing systems similar to those that formed the underlying VMS deposits. Resolving the timing of iron formation mineralization in the Sicker Group is critical for establishing the duration of VMS-related hydrothermal activity.

Geological mapping in the Cowichan Lake uplift of the Port Alberni area (Massey and Friday, 1989) indicates that this area is largely underlain by basalt to basaltic andesite of the Duck Lake and Nitinat formations, respectively, in addition to felsic tuffaceous volcaniclastic rocks belonging to the McLaughlin Ridge Formation. McLaughlin Ridge Formation rocks in the Port Alberni area are interpreted to represent deposition distal from a volcanic centre, which is thought to be represented in the Saltspring Island–Cowichan Lake area by felsic intrusive rocks of the Saltspring intrusive suite (Massey and Friday, 1989). However, geological mapping and geochronology of new exposures in the Port Alberni area (Ruks et al., 2009a; this study) indicate that significant quantities of felsic volcanic rocks of McLaughlin Ridge Formation age or younger are present in this area. In addition, mafic volcanic rocks in the Lacy Lake area that were previously assigned to the pre–Late Devonian Duck Lake Formation have been demonstrated to be Permian in age, based on microfossil dating (Ruks et al., 2009a). These stratigraphic revisions necessitate a reinterpretation of the nature of the Sicker Group and its VMS potential in the Port Alberni area.

Sedimentary, mafic volcanic and carbonate rocks of the Nanoose uplift have been tentatively correlated with both the Sicker and Buttle Lake groups (Yorath et al., 1999). However, no geochronological or biostratigraphic constraints are currently available from this area; hence, correlation with the Sicker Group is unproven. Reconnaissance fieldwork in the Nanoose uplift in 2009 focused on sampling prospective rock types for geochronology and biostratigraphy in order to resolve the relationship between volcanic and sedimentary rock units in the Nanoose uplift and the Sicker and younger strata elsewhere on Vancouver Island.

<table>
<tr><th colspan="2">Muller, 1977 (Vancouver Island)</th><th colspan="2">Juras, 1987 (Buttle Lake Uplift)</th><th colspan="2">Yorath et al., 1999 (Alberni area)</th></tr>
<tr><td></td><td></td><td rowspan="3">Buttle Lake Gp</td><td>Henshaw Fm</td><td rowspan="3">Buttle Lake Gp</td><td>St. Mary Lk Fm</td></tr>
<tr><td rowspan="7">Sicker Gp</td><td>Buttle Lk Fm</td><td rowspan="2">Mt Mark Fm</td><td>Mt Mark Fm</td></tr>
<tr><td>Sediment Sill Unit</td><td>Fourth Lk Fm</td></tr>
<tr><td rowspan="3">Myra Fm</td><td rowspan="5">Sicker Gp</td><td>Flower Ridge Fm</td><td rowspan="5">Sicker Gp</td><td rowspan="3">McLaughlin Ridge Fm</td></tr>
<tr><td>Thelwood Fm</td></tr>
<tr><td>Myra Fm</td></tr>
<tr><td rowspan="2">Nitinat Fm</td><td rowspan="2">Price Fm</td><td>Nitinat Fm</td></tr>
<tr><td>Duck Lk Fm</td></tr>
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Figure 2. Stratigraphic nomenclature for the Sicker and Buttle Lake groups on Vancouver Island (modified from Yorath et al., 1999).

A large expanse of volcanic and sedimentary rocks and associated VMS mineralization, inferred to be of Paleozoic age, has been mapped by previous workers in the Bedingfield uplift, near the entrance to Bedwell Sound, north of Tofino (e.g., Muller, 1977; Gatchalian, 1985; Figure 1). These units have been tentatively correlated with the Sicker Group; however, no isotopic or fossil ages are presently available for this area. Fieldwork in this area in 2009 concentrated on resolving the age of VMS mineralization and its host stratigraphy.

Mapping in the Hesquiat and Gold River areas, on the Dorado and Dragon properties, respectively (Paget Resources Corporation; Figure 1), has identified several new VMS occurrences hosted in rocks that have been tentatively correlated with the Sicker Group (Ruks et al., 2009a). Geological mapping and sampling on the Dragon property by previous workers identified several polymetallic massive sulphide lenses with grades up to 7.33% Zn, 1.34% Pb, 173 ppm Cu, 680 ppb Au and 19.2 g/t Ag over thicknesses of up to 2 m (Jones, 1997). Geological mapping of the Dragon property indicates that mafic and felsic volcanic rocks and contained VMS mineralization are overlain by volcano-sedimentary and carbonate rocks, including calcareous tuffaceous sedimentary rocks and fossiliferous limestone, respectively (Jones, 1997; Ruks et al., 2009a; this study). Nowhere else in the Sicker Group are carbonate rocks observed to directly, and apparently conformably, overlie felsic volcanic rocks and VMS mineralization. This relationship indicates that radical stratigraphic differences exist between rocks of the Dragon property and better studied exposures of the Sicker Group in the Cowichan Lake and Myra Falls areas. These stratigraphic differences may be explained by regional changes in volcanic and sedimentological facies or, alternatively, the presence of an unrecognized cycle of Paleozoic arc magmatism and VMS mineralization on Vancouver Island.

Fieldwork in the Sicker Group in 2009 commenced in late July and finished in mid-October. Both reconnaissance and detailed geological mapping, together with sampling for lithogeochemistry, U-Pb zircon dating, and Nd, Hf and Pb isotopic studies, were conducted in the Cowichan Lake, Port Alberni, Nanoose, Bedingfield, Gold River and Hesquiat areas during this period. This paper presents a summary of this fieldwork, with emphasis on key stratigraphic relationships and areas of economic importance.

Regional Geology of the Sicker Group

The mid-Paleozoic Sicker Group on southern and central Vancouver Island represents the oldest rocks in Wrangellia. Equivalents of the Sicker Group are not present in Wrangellia in northwestern British Columbia, southwestern Yukon and southern Alaska, where the oldest rock units are the Skolai Group, which is no older than Pennsylvanian (e.g., Katvala, 2006). This, and other differences between the Wrangellian stratigraphy on Vancouver Island and that in more northerly exposures, emphasize the lack of understanding regarding much of Wrangellia (e.g., Katvala, 2006) and the need for further studies. The Cowichan Lake uplift on Vancouver Island and adjacent portions of the Gulf Islands is the largest of four uplifts that expose the Sicker Group and the overlying late Paleozoic Buttle Lake Group (Figure 1).

Previous detailed studies of the Sicker Group have focused mainly on the stratigraphic setting of VMS mineralization at the Myra Falls deposits in the Buttle Lake uplift (Figure 1; e.g., Juras, 1987; Barrett and Sherlock, 1996). Regional mapping of the Cowichan Lake uplift by Massey and Friday (1987, 1989) and Yorath et al. (1999) led to a stratigraphic framework that may be applicable to the entire Sicker Group (Figure 2). This framework, however, is based on mapping in only one of the four main uplifts of Sicker Group rocks, and is supported by a limited amount of biostratigraphic and isotopic age data (e.g., Brandon et al., 1986). Major along- and across-strike facies changes and geochemical variations are to be expected in submarine volcanic sequences such as the one that forms the Sicker Group; hence, the regional applicability of the stratigraphic framework of Yorath et al. (1999) must be tested with detailed mapping and subsequent lithogeochemical and U-Pb dating studies. This is critical for regional exploration for VMS deposits within the Sicker Group. For example, the questions of whether VMS deposits and occurrences in the Cowichan Lake uplift are all of the same age, and whether their hostrocks are directly correlative with those that host the Myra Falls deposit, are of obvious importance.

The most recent regional mapping and stratigraphic work within Sicker Group rocks of the Cowichan Lake uplift has been conducted by Massey (1995) and Yorath et al. (1999). The following information regarding Sicker Group geology and stratigraphy in the Cowichan Lake uplift is derived from these accounts. The Sicker Group within the Cowichan Lake uplift is presently interpreted to represent three distinct volcanic and volcaniclastic assemblages that together are thought to record the evolution of an oceanic magmatic arc (Massey, 1995; Yorath et al., 1999). The lowermost Duck Lake Formation yields mainly normal mid-ocean-ridge basalt (N-MORB) geochemical signatures (Massey, 1995) and is interpreted to represent the oceanic-crust basement on which the Sicker arc was built. The upper portions of the Duck Lake Formation yield tholeiitic to calcalkaline compositions and may represent primitive arc rocks. The Duck Lake Formation is overlain by the Nitinat Formation, which comprises mafic, submarine volcanic and volcaniclastic rocks with dominantly calcalkaline compositions and trace-element signatures typical of volcanic arc settings. These rocks are interpreted as an early stage of arc development. The andesitic to mainly dacitic and rhyolitic McLaughlin Ridge Formation overlies the Nitinat and is believed to be correlative with the Myra Formation, the hostrocks for the Myra Falls deposits (Figure 2). Rocks of the McLaughlin Ridge and Myra Formations reflect a more evolved stage of arc activity. Eruption of Nitinat volcanic and volcaniclastic rocks appears to have occurred from several widely scattered centres, whereas the McLaughlin Ridge Formation within the Cowichan Lake uplift is thought to represent eruption from one or more major volcanic edifices. The abundance of proximal felsic volcaniclastic rocks and the presence of voluminous comagmatic felsic intrusions in the Saltspring Island and Duncan areas (Figure 1) indicate that one of these major volcanic centres was located in this area. Plant fossils indicate that at least a minor amount of the McLaughlin Ridge volcanism occurred in a subaerial setting. In the Port Alberni area, the McLaughlin Ridge Formation has previously been interpreted to comprise felsic, fine-grained tuffaceous volcaniclastic and epiclastic rocks, suggesting deposition distal from a volcanic centre (Yorath et al., 1999). The identification of significant quantities of proximal felsic volcanic rocks in the Alberni area in 2009 suggests that an additional felsic volcanic centre may be in the Port Alberni area. Deposition of sedimentary and volcano-sedimentary rocks of the overlying Fourth Lake Formation of the Buttle Lake Group followed the cessation of Sicker arc magmatism, and scarce mafic volcanic rocks contained within the Fourth Lake Formation yield enriched tholeiitic rather than the calcalkaline compositions that characterize the McLaughlin Ridge. Massey (1995) speculated that the Buttle Lake Group may represent a marginal-basin assemblage that developed on top of the Sicker arc.

Studies of the Sicker and Buttle Lake groups on southern Saltspring Island by Sluggett (2003) and Sluggett and Mortensen (2003) provided new U-Pb zircon age constraints on both felsic volcanic rocks of the McLaughlin

Ridge Formation and several bodies of Saltspring intrusions. This work demonstrated that two distinct episodes of felsic magmatism occurred in this portion of the Cowichan Lake uplift. One sample of felsic volcanic rocks from the McLaughlin Ridge Formation and three samples of Saltspring intrusions yielded U-Pb ages in the range 356.5–359.1 Ma. A somewhat older U-Pb age of 369.7 Ma was obtained from a separate body of the Saltspring intrusions at Burgoyne Bay on the southwest side of Saltspring Island, indicating that magmatism represented by the McLaughlin Ridge Formation and associated Saltspring intrusions occurred over a time span of at least 15 m.y. There is insufficient age control available at this point to determine whether the magmatism was continuous or episodic during this time period.

Rocks in the Nanoose uplift (Figure 1) have been tentatively correlated with both the Sicker Group and the Buttle Lake Group, and comprise fine clastic rocks, chert, diabasic to andesitic volcanic rocks and limestone (Yorath et al., 1999). A fossil sample from crinoidal limestone in the Nanoose uplift provided brachiopods that yielded a Permian age and fusulinids that yielded a Middle Pennsylvanian age (Muller, 1980). However, diabasic and andesitic pillow lavas in the area have unknown stratigraphic affinities. On the Ballenas Islands, however, these pillow lavas are associated with green and grey chert, and are interbedded with a red tuff breccia that contains both scoriaceous mafic volcanic clasts and crinoidal limestone clasts. The association between mafic flows, chert and a conspicuous breccia unit containing crinoidal limestone clasts is strikingly similar to geological relationships observed in the Lacy Lake–Horne Lake region (Ruks and Mortensen, 2008), suggesting a potential correlation between the two areas.

Rocks and VMS mineralization in the Bedingfield uplift (Figure 1), proximal to the entrance to Bedwell Sound, have historically been correlated with those of the Sicker Group, although no geochronological or biostratigraphic data exist to support this claim. Felsic volcanic rocks, comprising water-laid rhyolite flows and tuffs, represent the oldest rocks in the area. These have been correlated by previous workers with the McLaughlin Ridge Formation. Limestone assigned to the Buttle Lake Group is interpreted to unconformably overlie felsic volcanic rocks throughout the field area (Blackwell and Lajoie, 1986), but no description of the nature of this unconformity is provided. Polymetallic VMS mineralization occurs in several showings throughout the field area, most notably at the Bay Creek, Rant Point and Claim Post MINFILE occurrences (MINFILE 092F 343, 092F 494 and 092F 290, respectively). Volcanogenic massive sulphide mineralization in the area is hosted by variably silica-sericite–altered felsic volcanic rocks, with the most notable grades reported from the Bay Creek showing, where a 4 m thick lens of massive sulphide mineralization is reported to grade 228.00 g/t Ag, 0.41 g/t Au, 0.62% Pb, 0.061% Cu and 0.017% Zn (Gatchalian, 1985).

The age and stratigraphy of rocks underlying the Dragon and Dorado properties, in the vicinity of Gold River and Hesquiat, respectively, is poorly constrained. The Dragon property is located approximately 80 km west of Campbell River, 20 km northwest of Gold River and 65 km northwest of the Myra Falls mine of Breakwater Resources Ltd. (Figure 1). Regional mapping of the Dragon property area by Muller (1977) led to an interpretation of the rocks underlying the property as amphibolite-grade metamorphic rocks belonging to the Westcoast Crystalline Complex. Muller described the Westcoast Crystalline Complex as amphibolite-faces metamorphic rocks belonging to the middle Paleozoic Sicker Group, the late Paleozoic Buttle Lake Group and the Triassic Karmutsen Formation. After the discovery of massive sulphides in float on the Dragon property by prospector E. Specogna, work by Noranda Exploration Co. Ltd. culminated in the discovery of the Falls and North VMS occurrences (Kemp and Gill, 1993). Further geological mapping and diamond-drilling by Noranda and Westmin Resources Ltd. indicated that these showings, with grades up to 7.33% Zn, 1.34% Pb, 173 ppm Cu, 680 ppb Au, and 19.2 g/t Ag over a 2 m thickness, are associated with the contact zone between underlying bimodal volcanic rocks and overlying sedimentary rocks and limestone (Jones, 1997). Volcanic rocks of the Dragon property that underlie massive sulphide mineralization consist of massive, flow-banded rhyolite, andesite and tuffaceous felsic and intermediate volcanic rocks. Sedimentary and carbonate rocks overlying and interlayered with massive sulphide mineralization on the Dragon property consist of chert, mudstone, calcareous mudstone, fossiliferous felsic tuff, fossiliferous wackestone and marble.

The Dorado property is located approximately 17 km north of the village of Hesquiat, on the west coast of Vancouver Island. Like the Dragon property, rocks underlying the Dorado property were originally interpreted by Muller (1977) as amphibolite-facies metamorphic rocks assigned to the Westcoast Crystalline Complex. However, geological mapping of the area by Marshall et al. (2006) has shown the region to be underlain by abundant mafic volcanic rocks of potential Sicker Group affinity, and by sedimentary and carbonate rocks of potential Buttle Lake Group affinity. Following up on reports by Marshall et al. (2006) of polymetallic VMS-style stockwork mineralization in the area, Paget Resources Corporation staked the Dorado property and soon after discovered several polymetallic massive sulphide occurrences (Ruks et al., 2009a). Massive sulphide mineralization on the Dorado property is associated with the contact between massive, variably silica-altered, clinopyroxene- and feldspar-phyric basalt and calcareous sedimentary rocks.

Results of New Fieldwork in the Cowichan Lake Area

Mapping for 2009 fieldwork was conducted using ESRI's ArcPad™ 7 on a Hewlett-Packard IPaq HX4700 Pocket PC wirelessly connected to a GlobalSat® BT-359W Bluetooth GPS receiver. The BC Geological Survey's regional geology compilation for UTM Zones 9 and 10, southwestern BC, as well as numerous geological maps (Massey et al., 2005) derived from mineral exploration assessment reports, were used for reference.

Westridge Resources Inc.

Fieldwork on mineral tenure owned by Westridge Resources Inc. focused on new exposures of prospective bedrock on the north side of Big Sicker Mountain and in the Breen lake[1] area (Figure 3). In the Breen lake area, the most significant VMS showing is the Jane occurrence (MINFILE 092B 084), which consists of two adits reported to intersect several massive sulphide lenses (pyrrhotite-sphalerite-chalcopyrite) up to 0.46 m wide and 1.52 m long, from which a 0.91 m sample assayed 16.1% Zn (Fyles, 1950; Pattison and Money, 1988). In 2008, a new VMS occurrence was discovered by the authors in the Breen lake area, located approximately 1 km east of the Jane showing. This new showing comprises massive pyrite±chalcopyrite and is hosted by a dark green, silica+chlorite–altered, stockwork pyrite–mineralized, sandy intermediate (?) tuff (Figure 4A, B). Massive sulphide mineralization is concordant with the predominant fabric in the host lithology (bedding or foliation?), which dips steeply to the northeast. Due to overburden cover, the true dimensions of this VMS mineralization could not be established. Exposed VMS mineralization can be traced for approximately 3 m along strike, with a thickness of at least 1 m. Reconnaissance-scale mapping in the Breen lake area indicates that VMS showings are hosted predominantly in felsic volcanic rocks. Reworked, intermediate tuffaceous rocks become predominant to the north, presumably upsection.

Several new showings that are thought to be syngenetic in nature were discovered in the Big Sicker Mountain area. Approximately 700 m northwest of the Northeast Copper zone (MINFILE 092B 099; Figure 3), intensely silica-sericite–altered felsic crystal tuff contains up to several percent disseminated sulphides (pyrite±chalcopyrite) with abundant malachite staining in places. This mineralized tuffaceous horizon is interbedded with graphitic argillite and intermediate sandy to silty tuff. As in the Breen lake area, reworked intermediate tuffaceous rocks predominate upsection of felsic volcanic rocks (to the north). Approximately 1 km east of the Northeast Copper zone on new exposure created by recent logging road construction, a new discovery of massive magnetite mineralization was located within a variably silica-sericite-chlorite–altered quartz-feldspar porphyry. Here, veins and pods of massive magnetite up to 1 m thick cut variably altered quartz-feldspar porphyry (Figure 4C). Magnetite veins commonly have cores of semimassive pyrite. Flanking the area of massive magnetite mineralization to the west, strongly sericitized quartz-feldspar porphyry is cut by abundant stringers of pyrite and chalcopyrite. Strong chlorite alteration is localized along the margins of these stringers. Farther to the west, quartz-feldspar porphyry becomes intensely silicified and contains up to 30% disseminated pyrite±trace chalcopyrite mineralization. Stringers of pyrite and chalcopyrite also occur in this zone, with sulphide vein margins often flanked by zones of chlorite alteration.

[1] *unofficial place name*

Treasury Metals Inc.

Fieldwork on mineral tenure owned by Treasury Metals Corp. north of the Chemainus River continued to focus on establishing the timing and geological setting of VMS occurrences on the property, as well as constraining the longevity of VMS mineralizing systems in the area through establishing the age of exhalative iron formation mineralization. The Lara property is host to many VMS occurrences, the most notable of which is the Lara VMS deposit or 'Coronation Trend' (Figure 3), which consists of two main zones, the Coronation and Coronation Extension. The indicated resource for the Coronation and Coronation Extension zones (at a 1% Zn cut-off) is 1 146 700 tonnes at 3.01% Zn, 1.05% Cu, 0.58% Pb, 32.97 g/t Ag and 1.97 g/t Au (Kelso et al., 2007). Sulphide mineralization of the Coronation and Coronation Extension zones is hosted by strongly silicified, coarse-grained rhyolite crystal tuff and ash tuff (Kelso et al., 2007; Ruks et al., 2009a).

The Randy North showing (MINFILE 092B 128), located approximately 2 km north of the Coronation zone (Figure 3), consists of several zones of anomalous polymetallic mineralization hosted in strongly sericite-altered felsic volcaniclastic rocks (Kelso et al., 2007). Recent mapping (2008 fieldwork) of the Randy North zone shows that intense pyrite stockwork mineralization is hosted by moderately to strongly sericite-altered and highly foliated felsic crystal tuff, with 1–3% quartz crystals up to 5 mm in size (Ruks et al., 2009a). The Anita zone (MINFILE 092B 037), located approximately 4.7 km northwest of the Coronation zone (Figure 3), consists of polymetallic sulphide mineralization situated close to the contact between mafic tuffaceous rocks and felsic volcaniclastic rocks. The best drill intersection of the Anita horizon to date is diamond-drill hole 87-37, which intersected 2.5 m of 2.37% Cu, 0.73% Pb, 2.73% Zn, 46 g/t Ag and 0.72 g/t Au hosted in a pyritic felsic tuff. Another hole, 88-49, included a 4.9 m interval of 2.3% Cu, 0.49% Pb, 3.66% Zn, 73.9 g/t Ag and 1.9 g/t Au.

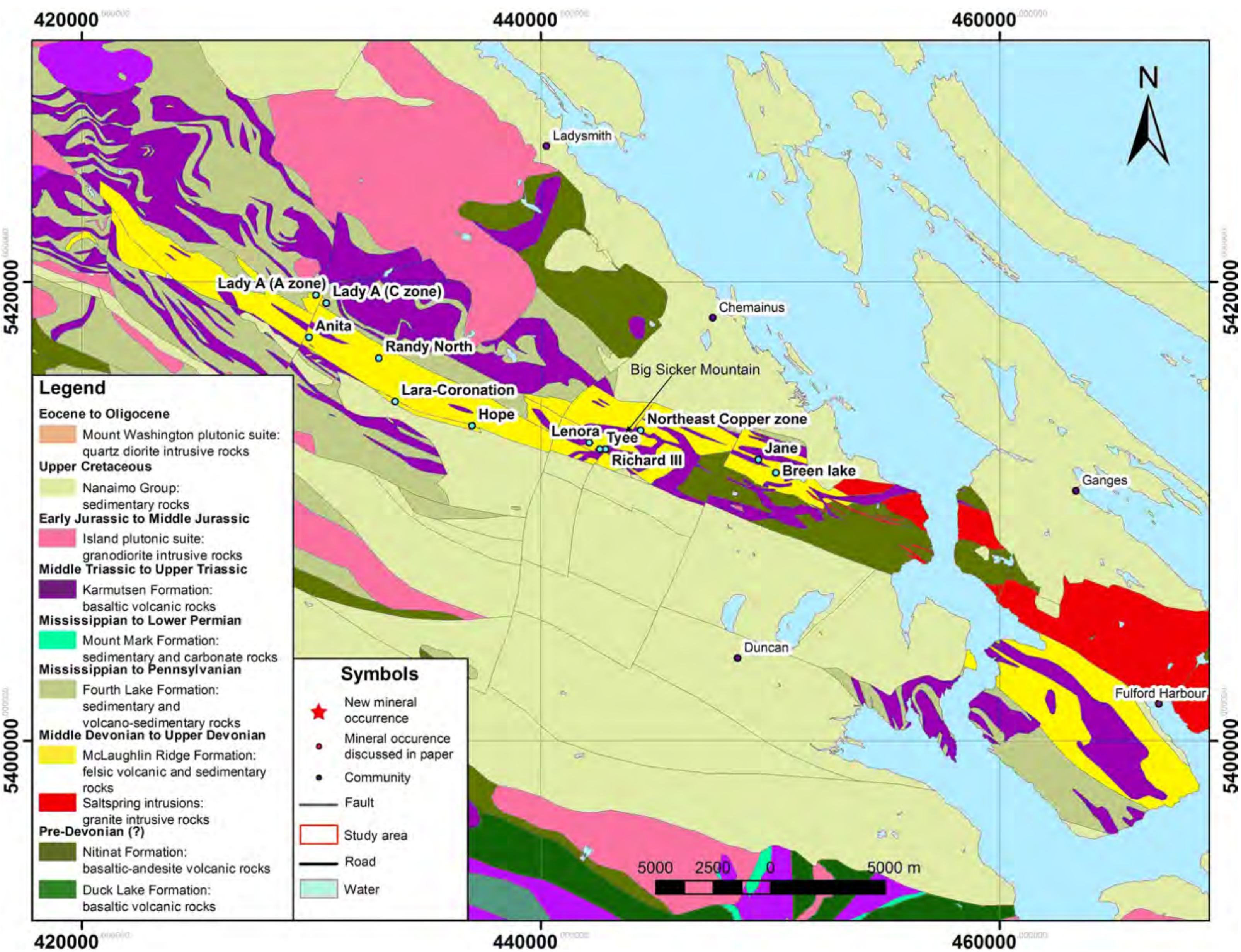

Figure 3. Regional geology, selected mineral occurrences and areas of study for 2009 fieldwork in the Cowichan Lake area, southern Vancouver Island (modified from Massey et al., 2005).

Rehabilitation of existing logging roads in the vicinity of the Lara and Randy North areas (MINFILE occurrences 092B 129 and 092B 128, respectively) since 2008 fieldwork created abundant new bedrock exposure. Mixed reconnaissance and 1:2000 scale geological mapping of this area, combined with data collected during 2008 fieldwork (Ruks et al., 2009a), indicate that stratigraphy hosting the Lara and Randy North VMS occurrences comprises largely felsic volcanic rocks, including crystal tuff, ash tuff and flows. A pervasive foliation coupled with variable quartz-sericite alteration makes protolith identification difficult in places. Although felsic volcanic units dominate the area, they are punctuated by thin zones of argillite and fine-grained intermediate tuff, indicating periods of quiescence between felsic volcanic events, and prospective stratigraphy for VMS mineralization. Exposures near the Anita shaft consist of quartz-sericite–altered felsic volcaniclastic rock with variable concentrations of sulphide mineralization. In the immediate vicinity of the Anita shaft, intensely quartz-sericite–altered felsic volcanic rock with less than 1% quartz phenocrysts contains up to 1% chalcopyrite veinlets, often associated with zones of strong silicification (Figure 5A). Similar to the Breen lake and Big Sicker Mountain areas, fine-grained, variably hematite-altered intermediate tuffaceous rocks and argillite predominate upsection of the Coronation, Randy North and Anita VMS occurrences (to the north; Figure 5B).

Exhalative magnetite iron formation of the Lady A (A zone) and Lady A (C zone) occurrences (MINFILE 092B 029 and 092B 033, respectively; Figure 3), located approximately 5 km northwest of the Lara VMS deposit, is associated with this unit. The contact between fine-grained, reworked, intermediate tuffaceous rocks, argillite and underlying variably altered and sulphide-mineralized felsic volcanic stratigraphy represents a regionally and economically significant feature coincident with the cessation of Sicker Group volcanism. Significant VMS mineralization is associated with similar contacts at large VMS deposits worldwide, including Noranda (Franklin et al., 2005) and Anyox (Macdonald et al., 1996). At the giant Bathurst camp, VMS mineralization is overlain by a district-wide exhalative chert-magnetite iron formation, similar to that of the Lady A occurrences (Galley et al., 2007).

Results of New Fieldwork in the Port Alberni Area: Bitterroot Resources Ltd.

Mapping of Sicker Group bedrock geology and sampling for lithogeochemistry, U-Pb zircon geochronology, and Pb, Nd and Hf isotope tracer studies was conducted in the Port

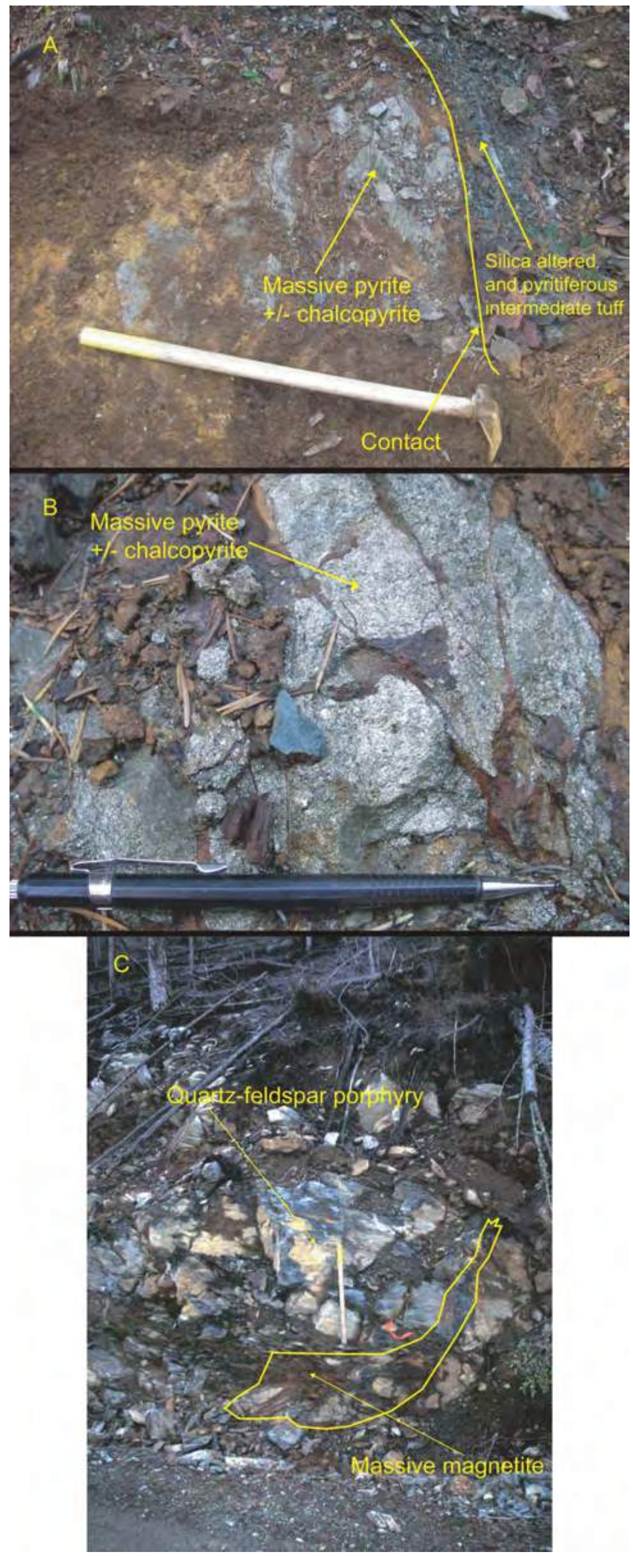

Figure 4. Mineralization in the Cowichan Lake area, southern Vancouver Island: **A)** massive pyrite+chalcopyrite mineralization, discovered during 2008 fieldwork (Ruks et al., 2009a), hosted in a silica-altered intermediate tuff and located approximately 1 km east of the Jane showing (MINFILE 092B 084) on Westridge Resources Inc. mineral tenure (UTM Zone 10, 449958E, 5412112N, NAD83); **B)** close-up of massive pyrite and chalcopyrite VMS mineralization discovered on Westridge Resources Inc. mineral tenure during 2008 fieldwork (Ruks et al., 2009a); **C)** new discovery of massive magnetite mineralization within a variably silica-sericite-chlorite–altered quartz-feldspar porphyry, approximately 1 km east of the Northeast Copper zone (MINFILE 092 099) on Westridge Resources Inc. mineral tenure (UTM Zone 10, 445393E, 5413282N).

Alberni area, much of which is covered by mineral tenure owned by project sponsor Bitterroot Resources Ltd. (Figure 1). This work was concentrated in 1) the vicinity of recent logging activity west of Horne Lake (Figure 6, study area A); 2) the vicinity of recent logging in the Duck Lake and China Creek areas (Figure 6, study areas B and C, respectively); and 3) the Rift Creek area, east of Mount Spencer (Figure 6, study area D). Bedrock exposure in all areas is moderate, with the best exposures occurring in logging-road cuts. Off-road exposures are typically covered with thick layers of moss and organic detritus, commonly in forested, low-light conditions that greatly hamper geological mapping.

Recent logging activity west of Horne Lake (Figure 6, study area A) has created significant new bedrock exposure. Examination of these new exposures has revealed the presence of a stratigraphic section with important implications for late Paleozoic magmatism in southern Wrangellia. At the base of this section, close to the shore of Horne Lake, clinopyroxene-phyric basaltic-andesite volcanic and volcaniclastic rocks of probable Late Devonian age dominate. This unit is assumed to be correlative with similar clinopyroxene-phyric mafic volcanic rocks in the vicinity of a microwave tower, approximately 6 km to the southeast (Figure 6). At the microwave tower, mafic volcanic rocks are interbedded with felsic ash tuff, which has yielded a Late Devonian U-Pb zircon age.

Overlying the mafic volcanic rocks on the west side of Horne Lake is a package of sedimentary rocks, including, in upwards stratigraphic order, medium-grained sandstone (arkosic?), chert, interbedded felsic crystal tuff and chert, and a package of felsic volcaniclastic rocks. Felsic volcaniclastic rocks in this area are similar in nature and stratigraphic position to those observed to the south of Horne Lake (Ruks et al., 2009a), and comprise rhyolitic to rhyodacitic crystal tuff, lapilli tuff and tuff breccia (Figure 7A).

Felsic volcanic rocks are overlain by a thin unit of fine-grained, intermediate tuffaceous rock and argillite, which are in turn overlain by ribbon chert and crinoidal limestone. This ribbon chert and limestone are interpreted to be correlative with a similar package in the Lacy Lake area, which has yielded radiolarian biostratigraphic ages ranging from Early to Middle Permian (Ruks et al., 2009b). Ribbon chert exposures west of Horne Lake are, in places, riddled with thick stringers and pods of fine-grained pyrite, up to 5 cm in thickness, and is overlain by a chert pebble-boulder conglomerate. This conglomerate is in turn overlain by massive pillow basalts that are probably correlative with the Middle Triassic Karmutsen Formation. The presence of probable Permian chert and limestone proximally underlain by a package of felsic volcanic rock suggests a late Paleozoic age for felsic volcanic rocks in the Horne Lake area.

Figure 5. Mineralization on Treasury Metals Inc. mineral tenure, Cowichan Lake area, southern Vancouver Island: **A)** in the immediate vicinity of the Anita shaft (MINFILE 092B 037), intensely quartz-sericite–altered felsic volcanic rock with less than 1% quartz phenocrysts contains up to 1% chalcopyrite veinlets, often associated with zones of strong silicification (UTM Zone 10, 429869E, 5417127N); **B)** similar to the Breen lake and Big Sicker Mountain areas, fine-grained, variably hematite-altered intermediate tuffaceous rocks and argillite predominate upsection of the Coronation, Randy North, and Anita VMS occurrences (to the north).

This age is in stark contrast to historic interpretations for the bedrock geology of the area, which assigned this complete stratigraphic package to the pre–Late Devonian Nitinat Formation and the Late Devonian McLaughlin Ridge Formation.

Rocks of the China Creek–Duck Lake area (Figure 6, study area B) were the focus of continued efforts to resolve the age of Duck Lake Formation mafic volcanic rocks and associated VMS mineralization. Much of the bedrock underlying the Bitterroot Resources mineral tenure in the China Creek–Duck Lake area is interpreted to comprise rocks of the Duck Lake and Nitinat formations (Massey and Friday, 1989). The Duck Lake Formation consists of pillow basalt, pillow breccia and interflow mafic tuffaceous sedimentary rocks, and is believed to represent the oceanic crust upon

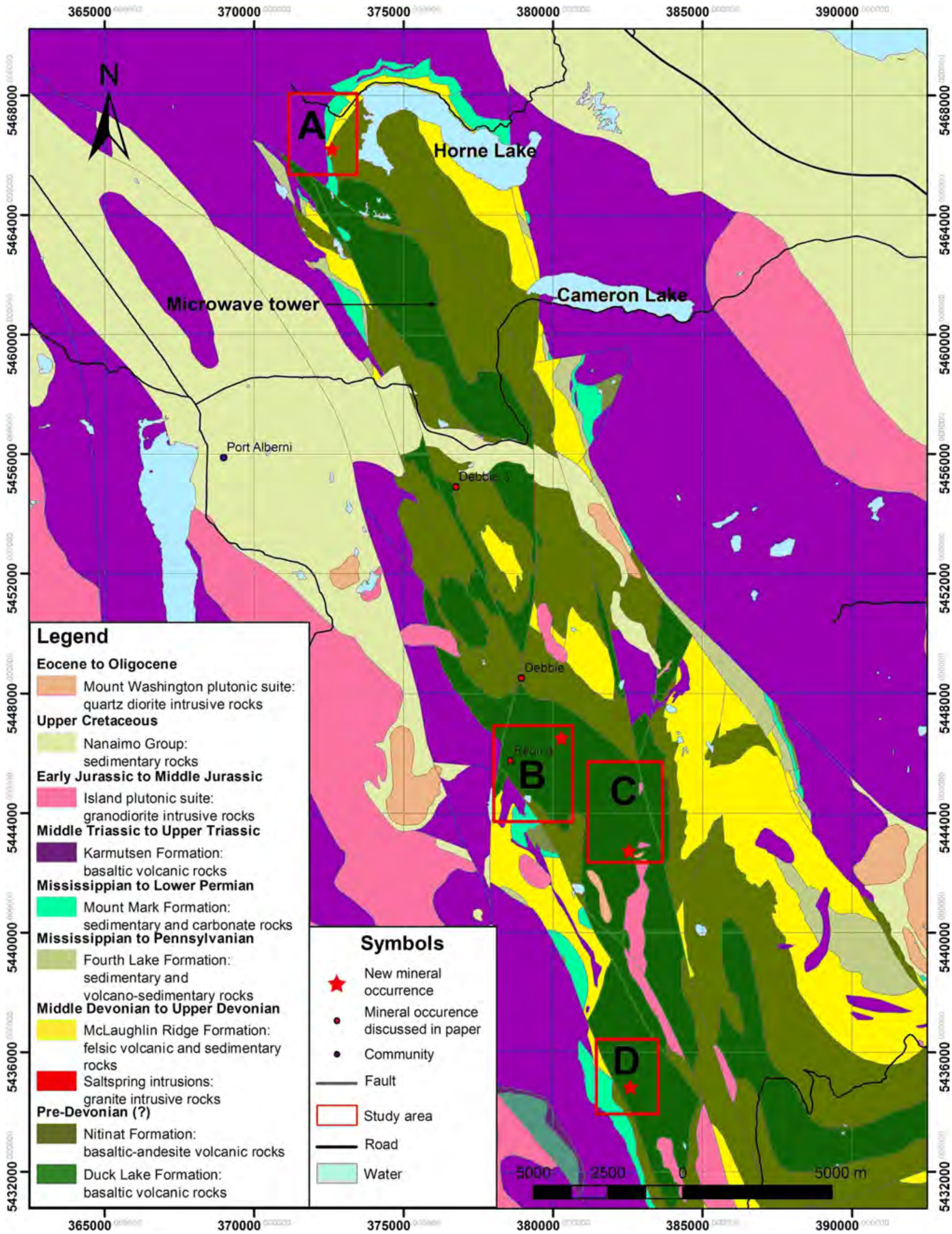

Figure 6. Regional geology (modified from Massey, 2005), selected mineral occurrences and areas of study for 2008 fieldwork in the Port Alberni area, southern Vancouver Island.

which the Sicker arc was built (Massey and Friday, 1989). As such, Duck Lake Formation rocks are interpreted as the oldest in the Sicker Group and, by default, the oldest in Wrangellia (Massey and Friday, 1989). The VMS mineralization of the Debbie 3 occurrence (MINFILE 092F 445), owned by Bitterroot Resources, consists of four stratiform lenses of banded massive sphalerite with minor chalcopyrite and galena, each band ranging between 5 and 20 cm in thickness. The best grade obtained from sampling of this mineralization by previous workers was 14.1% Zn, 0.87% Pb and 0.12% Cu over a 20 cm thickness. The mineralization is hosted in fine-grained chloritic schist with variable carbonate, sericite and silica alteration (Ruks and Mortensen, 2008). The chloritic schist hosting Debbie 3 mineralization is spatially associated with clinopyroxene-phyric andesitic volcanic rocks assigned to the Nitinat Formation. The Debbie 3 VMS occurrence is therefore believed to represent the oldest VMS mineralization in the Sicker Group. Since most exploration for VMS mineralization in the Sicker Group has focused on bimodal volcanic rocks belonging to the McLaughlin Ridge and Myra formations, the relatively unexplored Duck Lake and Nitinat formations represent attractive targets for this style of mineralization.

Fieldwork in 2008 in the China Creek–Duck Lake area discovered additional massive sulphide mineralization near the base of the Duck Lake type section (Yorath et al., 1999; Ruks et al., 2009a). Here, a bed of fine-grained massive sulphide (dominantly pyrite) was discovered in a new exposure along China Creek mainline (Figure 6, study area B), approximately 1.8 km northeast of the Regina occurrence (MINFILE 092F 078), where polymetallic VMS-style mineralization has also been reported. The bed is approximately 20 cm wide and interbedded with siliceous argillite. Mafic sandy tuff and scoriaceous mafic volcanic rocks are also found in the immediate vicinity of the mineralization. Siliceous interbeds within the massive sulphide mineralization were sampled for radiolarian biostratigraphy in 2008. Poorly preserved radiolarians were recovered from siliceous interbeds within the massive sulphide mineralization, and additional sampling of these horizons in 2009 was carried out to provide a biostratigraphic age.

Reconnaissance geological mapping of new exposure created by recent logging road construction approximately 3.4 km east of Duck Lake (Figure 6, study area C) reveals a thick section of pillow basalt and associated basaltic volcaniclastic rocks (Duck Lake Formation) overlain by a sedimentary succession comprising interbedded chert, argillite, siltstone and sandstone (McLaughlin Ridge Formation?). A new mineral occurrence was discovered in graphitic argillite of this sedimentary package, consisting of en échelon quartz-pyrite veins with strong silica-pyrite alteration haloes (Figure 7B). This sedimentary succession is similar in nature to that identified in the Peak and Kammat

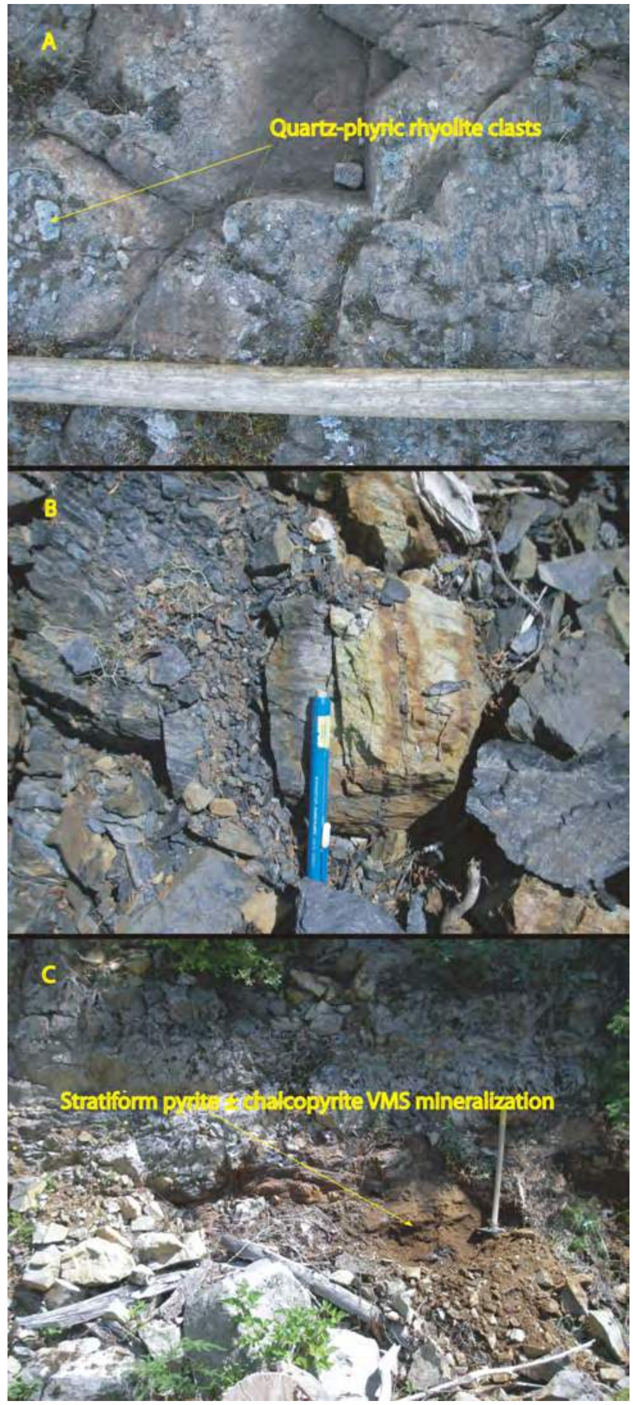

Figure 7. Rocks and mineralization in the Port Alberni area, southern Vancouver Island: **A)** potential late Paleozoic rhyolite lapilli tuff, west of Horne Lake; **B)** newly discovered en échelon quartz-pyrite veins with strong silica-pyrite alteration haloes hosted in graphitic argillite, located approximately 3.4 km east of Duck Lake (UTM Zone 10, 382588E, 5442746N); **C)** newly discovered, 10–15 cm wide stratiform band of massive fine-grained pyrite with trace chalcopyrite, interbedded with grey-green ribbon chert, located in the Rift Creek area, east of Mount Spencer (UTM Zone 10, 382597E, 5434781N).

lakes area during 2008 fieldwork, from which Late Devonian radiolarians were recovered (Ruks et al., 2009a, b), and is potentially correlative. Sampling of least-deformed pillow basalt rims from this section for U-Pb geochronology on microbial titanite (e.g., Banerjee et al., 2007) was carried out in an attempt to constrain the age of Duck Lake Formation mafic volcanic rocks in the area.

In the Rift Creek area east of Mount Spencer (Figure 6, study area D), reconnaissance geological mapping resulted in the discovery of a new massive sulphide occurrence. This occurrence, presumably hosted in rocks of the Duck Lake Formation, consists of a 10–15 cm wide stratiform band of massive, fine-grained pyrite with trace chalcopyrite, interbedded with grey-green ribbon chert (Figure 7C). The chert unit that hosts the massive sulphide mineralization sits on top of a package of mafic tuffaceous turbidites, which are spatially associated with basalt flow breccia. The mineralogy and geological setting of this new VMS occurrence is similar to VMS mineralization discovered in the China Creek area during 2008 fieldwork (Ruks et al., 2009a).

Results of New Fieldwork in the Nanoose Area

Fieldwork in the Nanoose uplift (Figure 1) concentrated on resolving the age and geological setting of abundant Paleozoic mafic volcanic rocks in the area, which have uncertain stratigraphic relationships to the Sicker Group (Yorath et al., 1999). A large body of granodiorite of the Early to Middle Jurassic Island intrusions on Nanoose Peninsula has caused strong contact metamorphism of the mafic volcanic and interlayered clastic, chert and limestone in large parts of the Nanoose uplift. As a result, radiolarians are recrystallized and no age determinations are possible. In order to find better preserved microfossils for biostratigraphic purposes and facilitate dating of this enigmatic package of rocks, fieldwork in the Nanoose uplift in 2009 was concentrated on northern Ballenas Island, where younger intrusions are absent (Yorath et al., 1999). Here, abundant basaltic volcanic rocks are interbedded with and overlie a sedimentary package comprising interbedded crinoidal limestone, argillite, chert and siltstone. Basaltic volcanic rocks contain abundant pillow flows (Figure 8A), with associated zones of basaltic pillow breccia, tuff breccia and finer grained tuffaceous rocks. Pillow basalt flows are variably plagioclase phyric, with phenocrysts often reaching sizes of 5 mm or greater and concentrations of up to 40–50%. Crinoidal limestone locally forms the matrix to brecciated mafic volcanic rocks, indicating deposition in a carbonate-rich environment (Figure 8B). Intraflow basaltic volcaniclastic rocks are often interbedded with multiple layers of stratiform, hematite-rich sedimentary rocks resembling exhalative iron formations, with individual beds reaching thicknesses of 30 cm or more (Figure 8C). Sam-

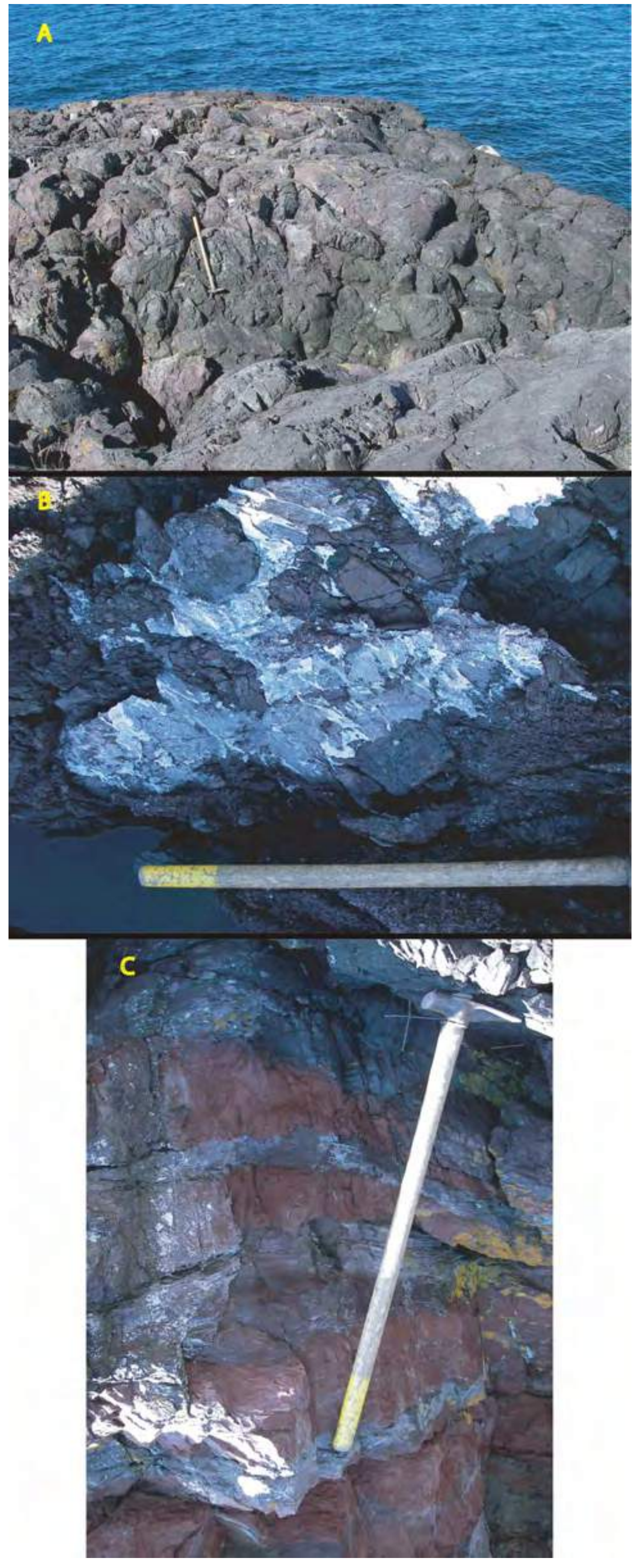

Figure 8. Rocks in the Nanoose area, southern Vancouver Island: **A)** pillow basalt on northern Ballenas Island; **B)** basalt tuff breccia with crinoidal limestone matrix (white zones), indicating volcanism in a carbonate-rich environment; **C)** stratiform, hematite-rich sedimentary rocks resembling exhalative iron formations occurring in volcano-sedimentary rocks between basalt flows.

ples of chert and carbonate were collected for both radiolarian and conodont biostratigraphy. Samples of mafic volcanic rocks were collected for U-Pb geochronology and lithogeochemistry on pillow basalt microbial titanite.

Results of New Fieldwork in the Bedingfield Uplift

Fieldwork in the Bedingfield uplift (Figure 1) concentrated on resolving the age and geological setting of proposed Sicker Group stratigraphy and VMS occurrences in the area. Reconnaissance fieldwork in the Bedingfield area was conducted over the course of four days in September. All-terrain vehicles and a 4 m (14 ft.) aluminum boat were barged to a landing at Cypress Bay, with accommodation located at the Tranquil Timber Ltd. floating barge camp near Whitepine Cove.

Volcanogenic massive sulphide mineralization of the Bay Creek, Claim Post and Rant Point occurrences (MINFILE 092F 343, 092F 290 and 092F 494, respectively; Figure 9) are located on shoreline near the entrance to Bedwell Sound, and are accessed by boat. Stockwork-style VMS mineralization of the Bay Creek showing (Figure 9) consists of 1–2% pyrite, chalcopyrite and sphalerite stringers and blebs hosted in gossanous aphyric to quartz-phyric rhyolite flows (Figure 10A). Chlorite veins and blebs are abundant. Host felsic volcanic rocks are foliated, with quartz phenocrysts often exhibiting subgrain development and stretching parallel to a southwest-dipping foliation. Mineralization in the vicinity of the Claim Post (MINFILE 092F 290) showing (Figure 10B) consists of bands of malachite-stained, semimassive pyrite and chalcopyrite up to 5 cm in thickness, hosted by strongly quartz-sericite–altered, gossanous felsic ash and crystal tuff. Deformed quartz-feldspar–phyric rhyolite porphyry plugs, which are texturally similar to the Saltspring intrusions (Figure 10C), are present in the vicinity of the showing. Mineralization in the area of the Rant Point showing (MINFILE 092F 494) consists of a shoreline gossan comprising massive, foliated rhyolite crystal tuff with up to 15–20% disseminated pyrite and trace chalcopyrite.

Work in the Herbert Inlet and Cypre River areas (Figure 9, study areas A and B, respectively) focused on examining the nature of the contact between proposed carbonate rocks assigned to the Buttle Lake Group (Mount Mark Formation) and underlying rocks assigned to the Sicker Group, as well as on locating new areas prospective for VMS mineralization. Although no continuous stratigraphic section was observed, massive recrystallized limestone with varying proportions of interbedded chert and argillite was observed juxtaposed with abundant rhyolite flows and tuffs in several locations. Previous workers in the Bedingfield area have suggested that Buttle Lake Group rocks are observed to sit unconformably on felsic volcanic rocks (e.g., Blackwell and Lajoie, 1986), but they have not documented the nature of this unconformity. The juxtaposition of carbonate rocks and underlying felsic volcanic rocks in the Bedingfield area is strikingly similar to stratigraphic relationships observed at the Dragon property, north of Gold River, where carbonate rocks are observed to conformably overlie felsic volcanic rocks, with VMS mineralization between them (e.g., Ruks et al., 2009a). In the Cypre River area, a localized gossanous zone, consisting of 5–10% pyrrhotite+pyrite+chalcopyrite stringers and blebs, is observed proximal to the contact between a volcano-sedimentary unit (comprising siltstone, mudstone and felsic lapilli tuff) and gabbro.

Results of Geological Mapping on the Dorado and Dragon Properties (Paget Resources Corporation), Hesquiat–Gold River Area

Dorado Property

Fieldwork on the Dorado property and Hesquiat Peninsula was conducted over six days in October 2009 (Figure 1). This fieldwork was designed to resolve the age and geological setting of the Dorado VMS occurrences and potential Paleozoic host stratigraphy in the area (e.g., Marshall et al., 2006; Ruks et al., 2009a). A truck and ATV were barged from Gold River into Mooyah Bay, where accommodation was located in a floating barge camp operated by Port Neville Logging Co. Ltd. Polymetallic VMS-like stockwork mineralization was first discovered on the Hesquiat Peninsula by Marshall et al. (2006). Follow-up reconnaissance geological mapping in the vicinity of Marshall’s showing by Paget Resources Corporation led to the discovery of polymetallic massive sulphide mineralization and additional polymetallic, VMS-style, stockwork sulphide occurrences (Ruks et al., 2009a). Massive sulphide mineralization has so far been discovered in two locations on the Dorado property, associated with the contact between mafic volcanic rocks and calcareous sedimentary rocks (Figure 11). The first massive sulphide mineralization discovered on the Dorado property is located in a shot-rock blast pit near the contact between a variably silica-altered, chlorite amygdule–bearing, feldspar-phyric basaltic flow and intermediate tuffaceous sandstone. Here, a massive sulphide pod, measuring 1.5 m by 3 m and consisting of fine-grained pyrrhotite with trace chalcopyrite, is hosted within the basalt (Figure 12A). Sulphide stringers up to 1 cm wide are abundant near the massive sulphide mineralization. Numerous massive sulphide boulders of similar composition are found close to the showing; some of them have been used as substrate for a bridge crossing a creek that drains immediately east of the pit. The most silicified zones within the host basalt are associated with abundant quartz and epidote veinlets. Some zones of autobreccia are present in the basalt host. These zones contain abundant

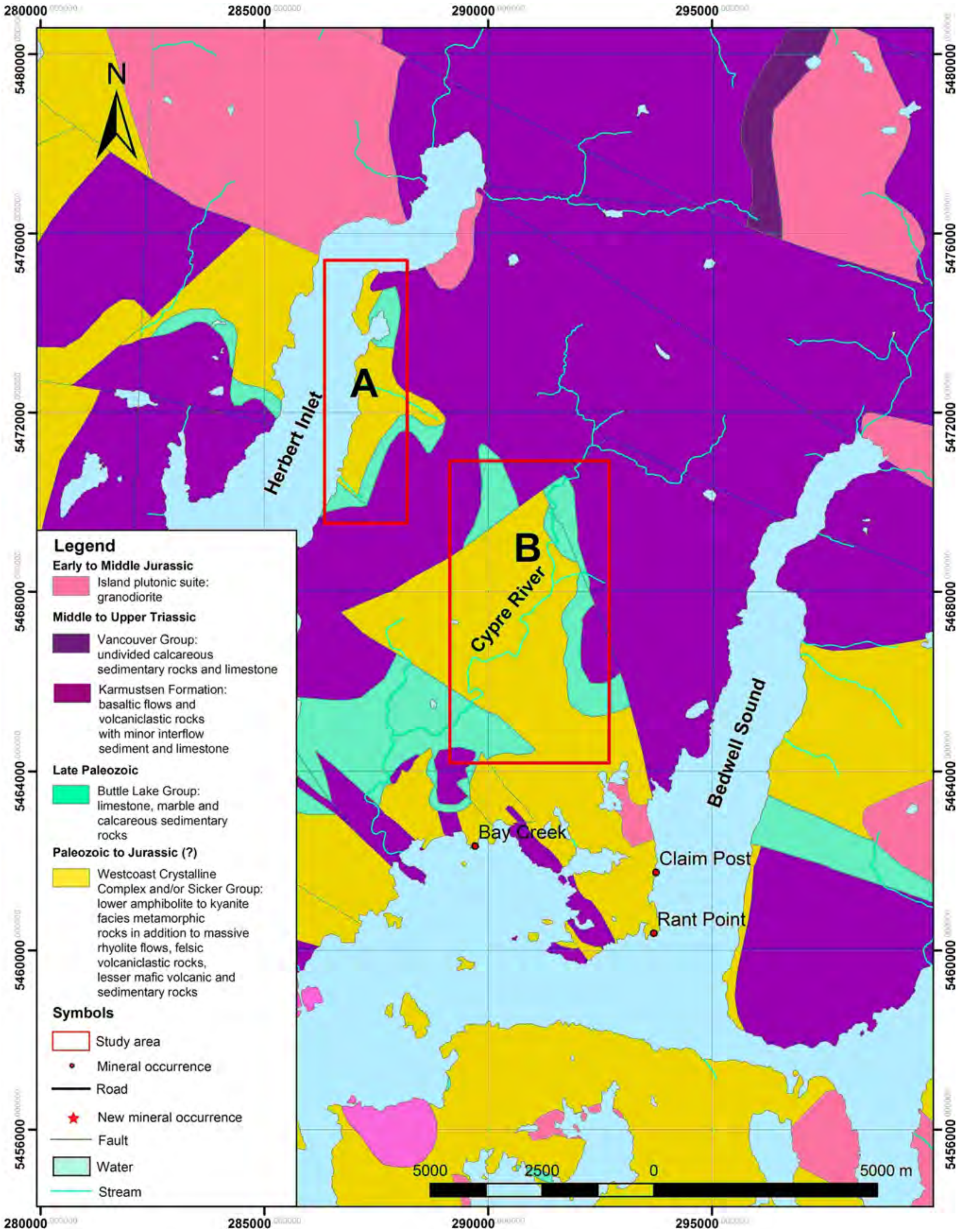

Figure 9. Geology of the Bedingfield area (after Massey et al., 2005), central Vancouver Island, showing locations of 2009 fieldwork.

grey, glassy, angular silicified clasts up to 2 cm in size. Approximately 430 m southwest of this zone is a second zone of massive sulphide mineralization. Here, boulders of fine- to medium-grained massive pyrrhotite+chalcopyrite, up to 50 cm in size, occur as float beneath a large gossanous outcrop of highly silica-altered, feldspar-clinopyroxene–phyric basalt porphyry. Pyrrhotite mineralization is abundant, as both stringers and disseminations. This altered and mineralized porphyry was traced in the map area for approximately 350 m to the southwest along an overgrown logging skidder road. Variably altered, variably sulphide-mineralized examples of feldspar- and clinopyroxene-phyric basalt are abundant to the north of the massive sulphide occurrences and are most likely representative of massive intermediate flows. These mafic volcanic rocks are massive, and less porphyritic to nearly aphyric in nature. They often contain abundant epidote alteration in the form of ovoid patches up to 10 cm in width. Fine-grained sulphide minerals are often found in the cores of these patches. In places, pyrrhotite and chalcopyrite stringers are present, typically with strong silica alteration along their margins.

Sedimentary rocks spatially related to the Dorado blast-pit sulphide occurrence first appear approximately 100 m to the south. These comprise a moderately east-dipping outcrop of recrystallized, interbedded marble and cherty carbonate. Approximately 50 m farther south, variably altered clinopyroxene- and feldspar-phyric basalt, similar to Dorado VMS hostrock, intrudes a sedimentary package (Mooyah Formation?) comprising recrystallized carbonate, chert, siltstone and fine sandstone (Figure 12B). Similar to Dorado VMS hostrocks, alteration is intense, with much of the basalt being reduced to assemblages of epidote and quartz, especially in areas proximal to contacts with sedimentary rocks.

Reconnaissance geology throughout the northern portion of the Hesquiat Peninsula concentrated on sampling exposures of potential Paleozoic stratigraphy (Mooyah Formation; Marshall et al., 2006) for geochronology and biostratigraphy, as no Paleozoic ages exist for the area. However, due to the presence of significant expanses of granitic intrusive rocks of probable Jurassic age (e.g., Marshall et al., 2006), exposures of potential Paleozoic stratigraphy are very sparse. Where observed in this study, the Mooyah Formation typically comprises a mixture of graphitic argillite, recrystallized carbonate and chert, and lesser amounts of siltstone and sandstone (Figure 12C). Carbonate hostrocks to the Silverado skarn occurrence (MINFILE 092E 017), located only 6 km east of the Mooyah Formation type section in Mooyah Bay, yield Triassic preliminary conodont ages (Marshall et al., 2006). This suggests that a potential Triassic age for the Mooyah Formation should also be considered.

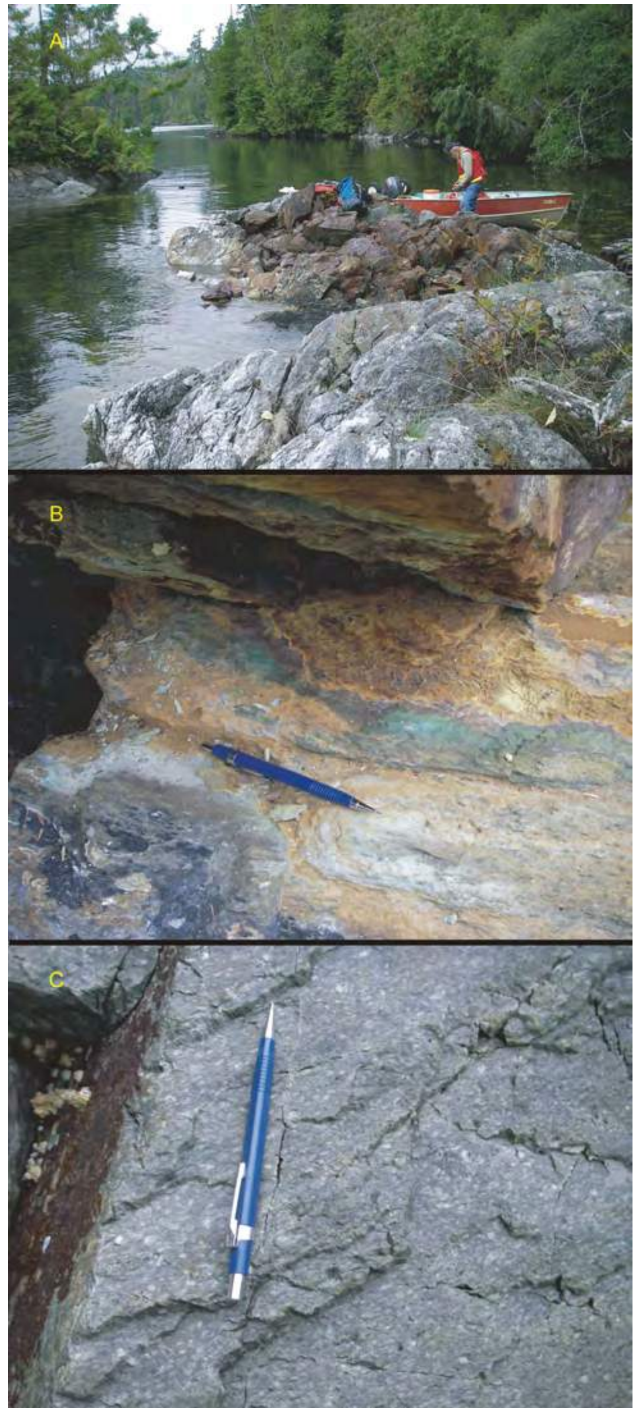

Figure 10. Rocks and mineralization in the Bedingfield uplift area, central Vancouver Island: **A)** stockwork-style VMS mineralization of the Bay Creek showing (MINFILE 092F 343), consisting of 1–2% pyrite, chalcopyrite and sphalerite stringers and blebs hosted in gossanous aphyric to quartz-phyric rhyolite flows; **B)** Claim Post showing (MINFILE 092F 290), consisting of bands of malachite-stained, semimassive pyrite and chalcopyrite up to 5 cm in thickness, hosted in strongly quartz-sericite–altered, gossanous felsic ash and crystal tuff; **C)** deformed quartz-feldspar rhyolite porphyry near the Claim Post showing, reminiscent of the Saltspring intrusions.

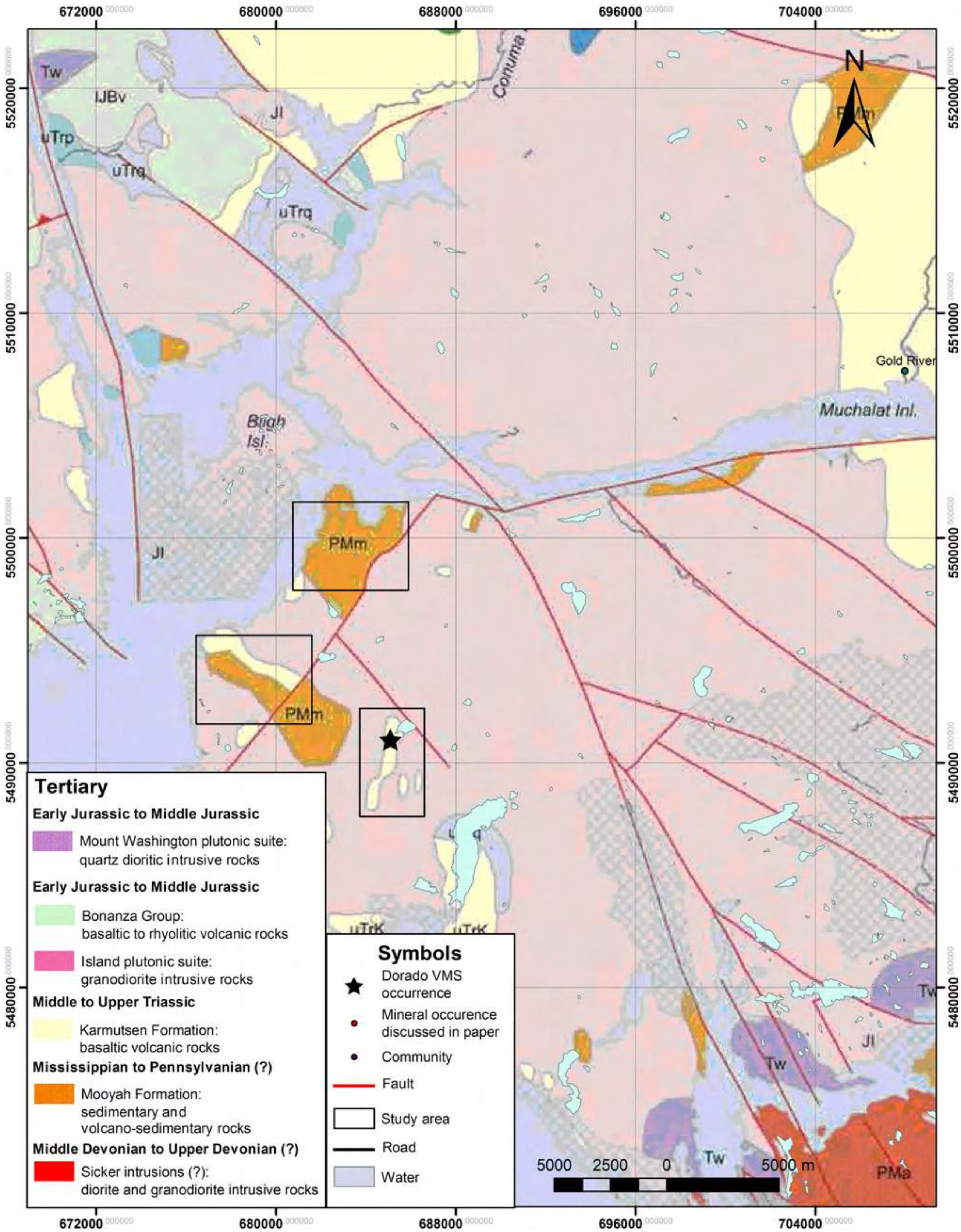

Figure 11. Geology of the Hesquiat Peninsula area (modified from Marshall et al., 2006), central Vancouver Island, showing locations of 2009 fieldwork and VMS mineral occurrences of note.

Dragon Property

The Dragon property is located approximately 80 km west of Campbell River, 20 km northwest of Gold River and 65 km northwest of the Myra Falls mine of Breakwater Resources Ltd. (Figure 1). Fieldwork in 2009 continued efforts to establish the geological setting for known mineral occurrences on the property, and for understanding the stratigraphy of the property geology in general. The work was successful in identifying several new prospective zones of mineralization.

Massive sulphide mineralization on the Dragon property typically consists of varying proportions of fine- to medium-grained massive pyrrhotite, chalcopyrite and sphalerite at the contact between felsic volcanic rocks and overlying volcano-sedimentary and carbonate rocks. Fieldwork in 2009 has been successful in tracing this prospective horizon over a strike length of 8 km, where it shows signs of VMS-style alteration and mineralization throughout (Figure 13).

The original massive sulphide discoveries on the Dragon property include the Falls and North showings, which comprise three massive sulphide lenses with grades up to 7.33% Zn, 1.34% Pb, 173 ppm Cu, 680 ppb Au and 19.2 g/t Ag over 2 m (Jones, 1997; Figure 13; Figure 14A). This massive sulphide mineralization is interlayered with laminated chert, mudstone and calcareous mudstone that strike southwesterly and dip steeply to the northwest. Bivalve (?) fossils have been observed in cherty tuff overlying the Falls and North showings. Several new VMS showings were discovered on the Dragon property during the course of 2008 fieldwork. Massive sulphide mineralization was discovered approximately 1 km south of the Falls and North showings, and abundant VMS stockwork sulphide mineralization was discovered approximately 1 km north of these two showings (Ruks et al., 2009a). In both new discoveries, VMS mineralization is associated with the contact between variably altered and sulphide-mineralized felsic volcanic rocks (often rhyolite flows) and overlying calcareous sedimentary rocks.

Fieldwork was carried out in the eastern portion of the property to identify potential deeper and older Paleozoic stratigraphy (Figure 13, study area A). However, only more felsic volcanic rocks were encountered, comprising rhyolite flows and associated volcaniclastic and tuffaceous rocks. In places, felsic volcanic rocks are intruded by gabbroic sills of probable Middle Triassic Karmutsen Formation (Mount Hall gabbro) affinity. The presence of felsic volcanic rocks towards the eastern edge of the Dragon property is attributed to a progressive flattening of dip angles as one moves eastward on the property. Work in the southern and southeastern portions of the property (Figure 13) has revealed additional locations where variably

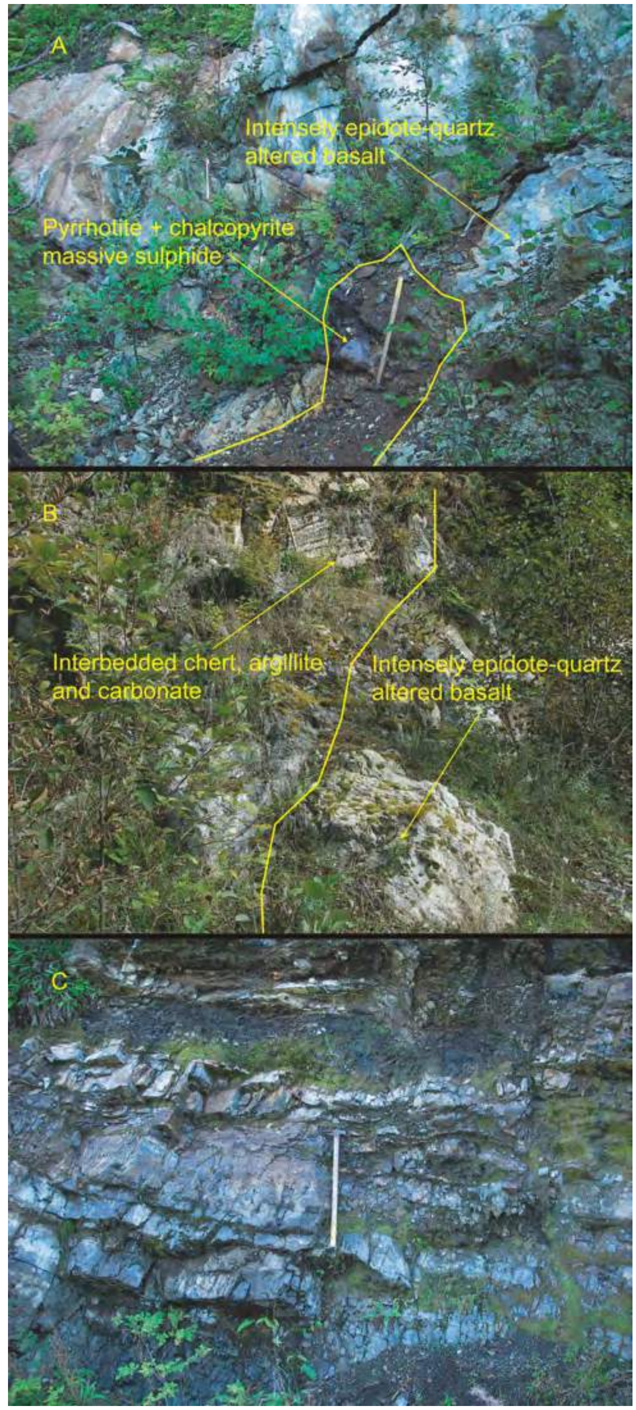

Figure 12. Rocks and mineralization of the Hesquiat Peninsula area, central Vancouver Island: **A)** pyrrhotite+chalcopyrite massive sulphide mineralization, measuring 1.5 m by 3 m, is hosted within strongly epidote-quartz–altered basalt (UTM Zone 9, 685043E, 5490975N); **B)** variably altered clinopyroxene- and feldspar-phyric basalt, similar to the Dorado VMS hostrock, intrudes a sedimentary package (Mooyah Formation?) comprising recrystallized carbonate, chert, siltstone and fine sandstone; **C)** interbedded graphitic argillite and chert of the Mooyah Formation.

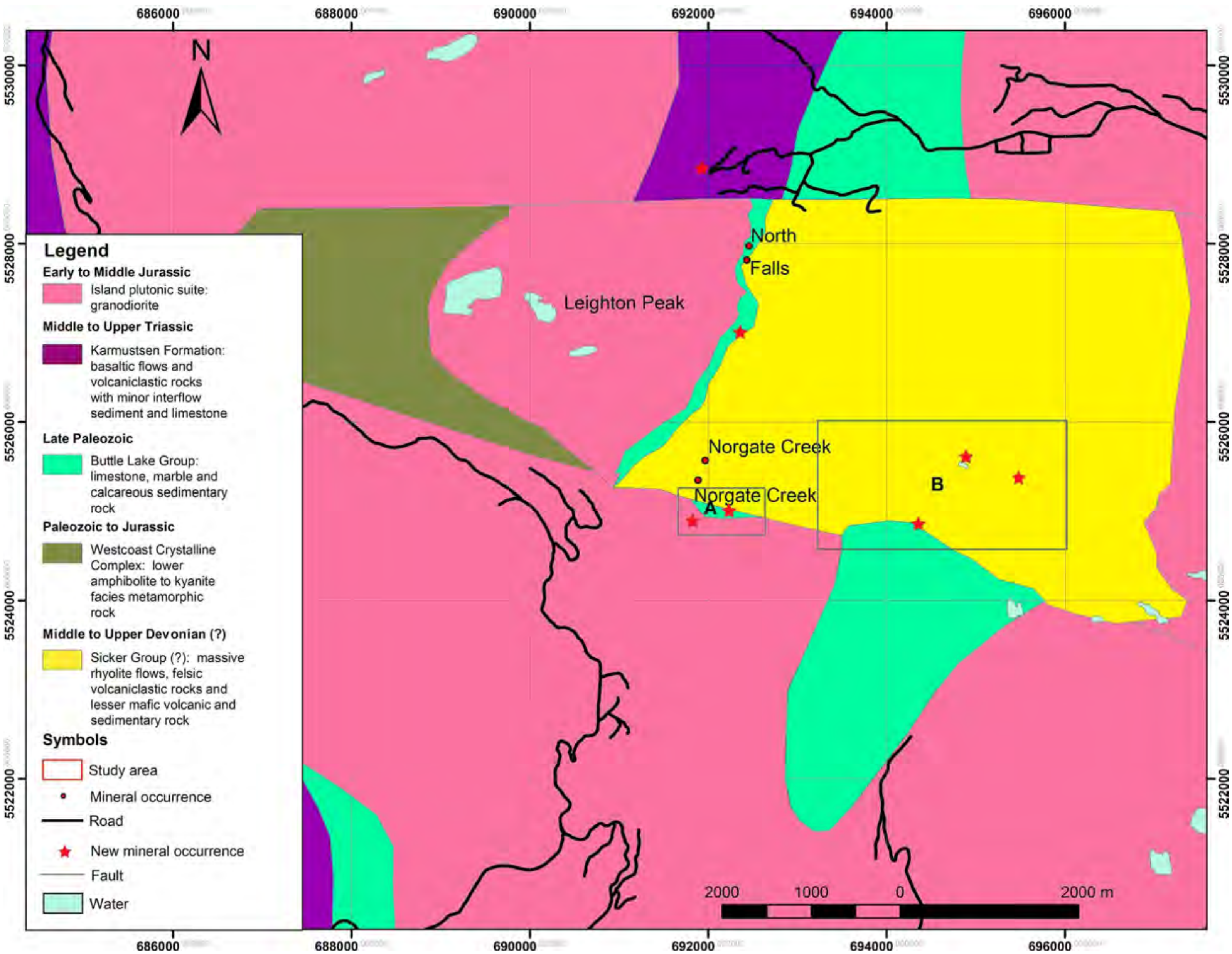

Figure 13. Regional geology of the Dragon property of Paget Resources Corporation (modified from Massey, 2005; Jones, 1997), central Vancouver Island, showing selected mineral occurrences and areas of study for 2009 fieldwork.

silica-sericite–altered and sulphide-mineralized felsic volcanic rocks (dominantly rhyolite flows) are overlain by a mixture of graphitic argillite, chert and massive carbonate. Similar to eastern portions of the property, a significant flattening of bedding exists. Several new mineral occurrences were discovered throughout the field area during the course of 2009 work. In study area A (Figure 13), gabbroic sills of probable Karmutsen Formation affinity were found on several occasions to contain chalcopyrite veins up to 1 cm width and pods of massive chalcopyrite up to 5–7 cm in width (Figure 14B). East of this occurrence, a dacitic unit was found to contain gossanous zones with stockwork-style chalcopyrite mineralization (Figure 14C). Several zones of stockwork-style VMS mineralization were encountered in study area B (Figure 13), comprising largely localized zones of pyritic stockwork-style mineralization associated with silicified felsic volcanic rocks.

Summary

Fieldwork in 2009 has continued to focus on resolving the stratigraphy and tectonic history of the Sicker Group and its contained mineral occurrences in the Cowichan Lake, Port Alberni, Nanoose, Bedingfield, Gold River and Hesquiat areas. This is being accomplished using a combination of bedrock mapping and sampling for geochronology (U-Pb, Ar/Ar), biostratigraphy (macrofossils, radiolarians and conodonts), geochemistry (major and trace elements) and isotopic analyses (Nd and Pb; whole rock and sulphides, respectively). Work in the Cowichan area was directed toward establishing the stratigraphic position and geological setting of VMS occurrences on mineral tenure owned by project sponsors Treasury Metals Inc. and Westridge Resources Inc. In addition, fieldwork and sampling were also concentrated on various exhalative iron formations to constrain the longevity of the VMS mineralizing hydrothermal system(s) in the Cowichan Lake area. Fieldwork in the Port Alberni area, sponsored by Bitterroot Resources Ltd., focused on resolving the age and geological setting of mafic volcanic rocks and associated VMS occurrences within the Nitinat and Duck Lake formations. Resolving the ages of these units is critical for understanding the temporal and metallogenic evolution of the Sicker arc, and the earliest history of Wrangellia.

Fieldwork in the Horne Lake area, in rocks previously assigned to the Nitinat and McLaughlin Ridge formations, has identified a stratigraphic section containing abundant, potential late Paleozoic volcanic rocks. This new section, coupled with recent dating studies done as part of this project, indicates that rocks in this area are probably no older than Late Devonian. Abundant mafic and newly identified felsic volcanic rocks at the top of the section are spatially associated with recently dated Early to Late Permian chert, suggesting the presence of a significant cycle of late Paleozoic magmatism in the area (Ruks et al., 2009b). New mineralization was discovered at the top of this stratigraphic section, where abundant stockwork pyrite mineralization is hosted by ribbon chert of probable Permian age.

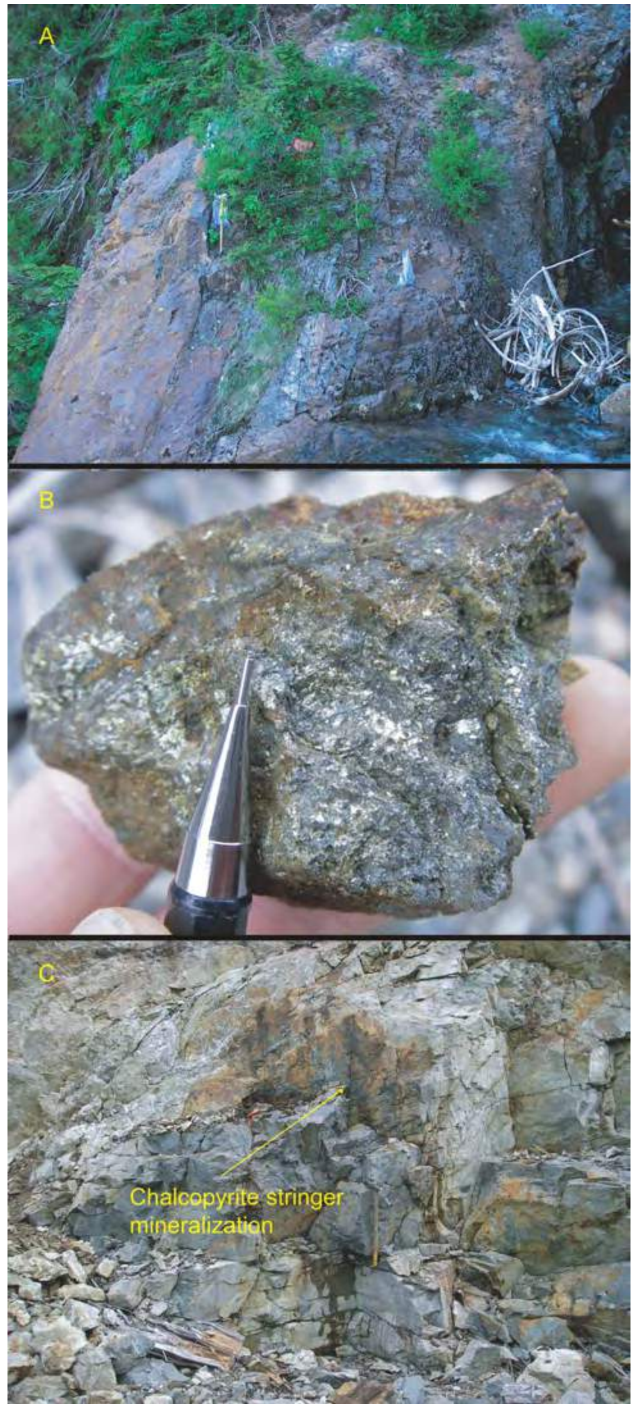

Figure 14. Mineralization on the Dragon property of Paget Resources Corporation, central Vancouver Island: **A)** massive sulphide mineralization of the Falls showing, interlayered with laminated chert, mudstone and calcareous mudstone (UTM Zone 9, 692434E, 5527815N); **B)** massive chalcopyrite mineralization associated with Karmutsen Formation gabbro (691798E, 5524865N); **C)** stockwork-style chalcopyrite stringer mineralization in altered dacite (692265E, 5525028N).

Approximately 30 km south of the Horne Lake area, reconnaissance fieldwork east of Mount Spencer (Figure 6, study area D) resulted in the discovery of a new VMS occurrence hosted in stratigraphy of the Duck Lake Formation. This mineralization consists of a 10–15 cm wide stratiform band of massive, fine-grained pyrite with trace chalcopyrite, interbedded with grey-green ribbon chert, which sits upon a package of mafic volcanic and associated volcaniclastic rocks.

Fieldwork in the Nanoose area concentrated on resolving the stratigraphic position and geological setting of mafic volcanic rocks in the area. Pillow basalts and associated basalt volcaniclastic rocks of northern Ballenas Island overlie and are interbedded with crinoidal limestone and chert. The spatial relationship of basalt, chert and crinoidal limestone in the Nanoose area is similar to that observed in the Lacy Lake area (e.g., Ruks et al., 2009a), where recent radiolarian biostratigraphy by F. Cordey has confirmed an Early to Late Permian age. Sampling of chert and carbonate units in the Nanoose area for conodont and radiolarian biostratigraphy was carried out to resolve the age of this stratigraphy.

Fieldwork on the Dorado property (Paget Resources Corporation) in the Hesquiat Peninsula area has confirmed that the oldest rocks in the area are probably sedimentary rocks assigned to the Mooyah Formation (Marshall et al., 2006), which is undated and has unknown stratigraphic affinities. Mooyah Formation rocks comprise varying proportions of graphitic argillite, siltstone, sandstone, recrystallized carbonate and chert. In the vicinity of the Dorado VMS occurrences, they are intruded by strongly silica-epidote–altered clinopyroxene and feldspar-phyric basalt subvolcanic rocks, which host VMS mineralization. Variably altered basalt flows overlie basalt subvolcanic rocks and, in places, contain stockwork-style VMS mineralization (Marshall et al., 2006; Ruks et al., 2009a), suggesting the potential for multiple stratigraphic lenses of VMS mineralization on the Dorado property. Volcanogenic massive sulphide–style alteration and mineralization in the contact areas between basalt subvolcanic rocks and host sedimentary rocks suggest that both rock types are of similar age. Significant sampling for geochronology and biostratigraphy was carried out on Mooyah Formation rocks in the Hesquiat area to ascertain potential stratigraphic affinities with Paleozoic rocks of Wrangellia.

Fieldwork on the Dragon property, north of Gold River (Paget Resources Corporation) has identified additional localities where variably altered and sulphide-mineralized felsic volcanic rocks are overlain by a package of graphitic argillite, chert and carbonate. This economically significant contact hosts VMS mineralization at the Falls and North occurrences (Ruks et al., 2009a), and has now been traced for a length of 8 km, exhibiting significant potential for VMS mineralization throughout. Fieldwork in the eastern part of the property was conducted to evaluate the potential for deeper stratigraphy and associated VMS mineralization. Here, additional stockwork-style VMS mineralization was documented, and sampling of felsic volcanic hostrocks for geochronology was carried out to ascertain the age and geological setting of mineralization.

Fieldwork in proposed Sicker Group rocks and VMS mineralization of the Bedingfield area has shown that numerous VMS occurrences, including the Bay Creek, Claim Post and Rant Point occurrences (MINFILE 092F 343, 092F 290 and 092F 494) are hosted in water-laid felsic volcanic rocks, comprising rhyolite flows and associated felsic volcaniclastic and tuffaceous rocks. Fieldwork in the Cypre River and Herbert Inlet areas indicates that felsic volcanic rocks are spatially associated with carbonate rocks, suggesting a potential stratigraphic scenario similar to that observed at the Dragon property north of Gold River, where carbonate rocks are observed to conformably overlie VMS mineralization and felsic volcanic rocks. If carbonate rocks of the Bedingfield and Dragon areas are Permian in age, this places them in a similar age range to widespread carbonate rocks of the Mount Mark Formation. This would suggest the presence on Vancouver Island of a widespread cycle of previously undocumented late Paleozoic bimodal magmatism and VMS mineralization possibly correlative with Paleozoic rocks of the Queen Charlotte Islands (Hesthammer et al., 1991) and southwestern Yukon Territory–southeastern Alaska (Israel and Cobbett, 2008). Such a correlation would suggest that Wrangellia is a long-lived, metallogenically well-endowed terrane of large geographic extent.

Future Work

Fieldwork in 2009 constitutes the final fieldwork for this project. Uranium-lead zircon dating, together with lithogeochemical and Nd and Pb isotopic studies of samples collected during the past field season, are now in progress and will be completed during the next six months. Results of this work will constrain the age and magmatic evolution of Paleozoic Wrangellia and help develop a framework through which VMS occurrences hosted by this stratigraphy can be distinguished from younger, epigenetic sulphide occurrences.

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