

Exploration and mining in the Southwest Region, British Columbia



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1. Introduction

The Southwest Region (Fig. 1) has a long history of mining. This history includes: the use of native copper by First Nations; silver, gold, and coal mining by the mid-19th century; mining of iron in the mid-20th century; and substantial copper production throughout the 20th century. Although mining and exploration for metals continues in the region, most mining is for construction materials, mainly aggregates for local markets with some exports from the largest coastal quarries.

The area has one major polymetallic metal mine, **Myra Falls** (Myra Falls Mine Ltd., Trafigura Mining Group), one coal mine on care and maintenance, **Quinsam** (Quinsam Coal Corporation), and numerous industrial minerals and aggregate operations. Having been on care and maintenance since 2015, Nyrstar prepared to return Myra Falls to production in 2017 and produced some concentrate in 2018. Operations were suspended in 2018 for compliance reasons but restarted in April 2019 and have continued. The Quinsam mine, on care and maintenance since 2016, had returned to production in 2017, after being purchased by ERP Compliant Fuels LLC, and produced about 200,000 t in 2018. However, the mine was placed on care and maintenance again in May 2019 and remained so through 2022.

Mine site exploration at Myra Falls has continued since 2017. Northisle Copper and Gold Inc. was active on northern Vancouver Island. More than 30 other exploration projects were tracked, mainly grass roots or early stage and small scale.

Estimates for exploration expenditures, drilling programs, and other metrics were captured in the British Columbia Mineral and Coal Exploration Survey, a joint initiative of the Province of British Columbia Ministry of Energy, Mines and Low Carbon Innovation, the Association for Mineral Exploration in British Columbia, and EY LLP. For the Southwest Region, exploration expenditures were estimated at \$10.8 million and exploration drilling was estimated at approximately 28,570 m (Clarke et al., 2023; EY LLP, 2023).

2. Geological overview

Metallogeny in British Columbia is closely linked to the tectonic evolution of the Canadian Cordillera, first as an

accretionary orogen consisting of allochthonous terranes that were welded to and deformed with the western margin of ancestral North America, primarily during the Jurassic, and then as the site of post-accretionary tectonism and magmatism (e.g., Nelson et al., 2013).

The Southwest Region includes parts of the Insular, Coast, and Intermontane physiographic regions. Most of the area is underlain by rocks of the Wrangell terrane and the Coast Plutonic complex (Fig. 1). Wrangellia is a Devonian to Jurassic island arc terrane that underlies most of Vancouver Island and Haida Gwaii. The oldest rocks on Vancouver Island are Devonian volcanic arc andesites, basalts, breccias, tuffs, and tuffaceous sediments of the Sicker Group and allied intrusive rocks, which are overlain by Mississippian-Permian limestones, argillites, and minor conglomerate of the Buttle Lake Group. This Paleozoic basement is exposed in two major uplifts on southern and central Vancouver Island. The Cowichan anticlinorium and the Buttle Lake anticlinorium host the past volcanogenic massive sulphide polymetallic producer at Mount Sicker and the current mine at **Myra Falls**.

Unconformably overlying the Paleozoic rocks are Middle to Upper Triassic oceanic flood basalts and related sedimentary rocks of the Vancouver Group. The upper part of the Vancouver Group contains numerous skarn occurrences adjacent to Jurassic intrusions (Island Plutonic suite). The Tasu past producer on Haida Gwaii is one of the larger examples of numerous iron and iron-copper skarns. Between 1914 and 1983, it produced 12 Mt of iron concentrate as well as copper, gold, and silver.

The Vancouver Group is overlain by arc rocks of Bonanza Group (Upper Triassic-Middle Jurassic), which consist of a volcano-sedimentary succession and subaerial basalt to rhyolitic flows and tuffs (Nixon and Orr, 2007). The Bonanza Group north of Holberg Inlet host the past-producing Island Copper Cu-Mo-Au porphyry deposit and other undeveloped porphyry and epithermal prospects where they are intruded by Island Plutonic suite granodiorite and quartz diorite.

On the east coast of Vancouver Island, in the Strait of Georgia and on the western mainland, Wrangellia is buried by rocks of the Nanaimo Group, an Upper Cretaceous continental to marine molassoid succession containing debris derived from

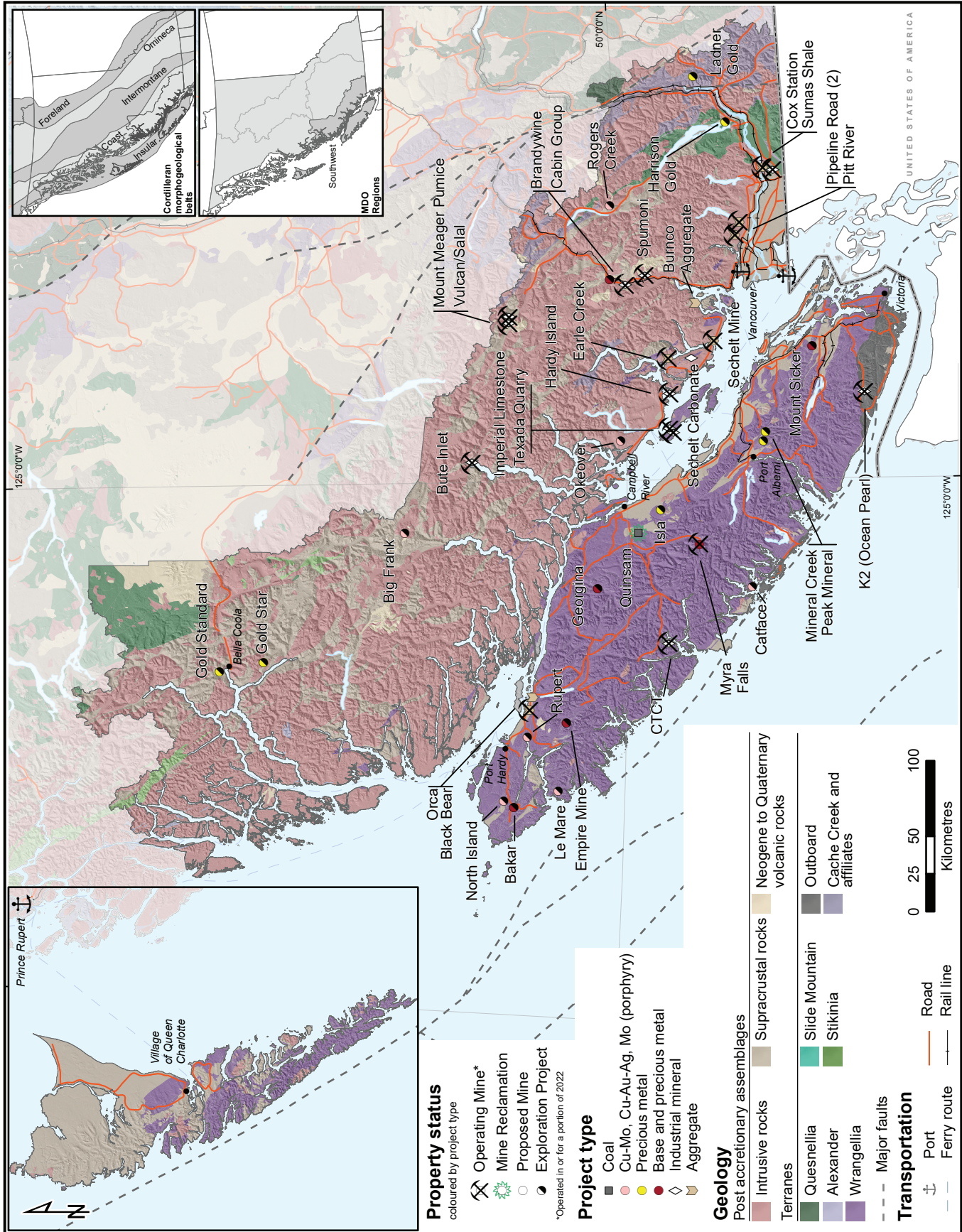


Fig. 1. Mines, proposed mines and selected exploration projects, Southwest Region, 2022. Terranes after Nelson et al. (2013).

unroofing of the Coast Belt and northern Cascades (Mustard, 1994). The Comox Formation, the basal unit of the Nanaimo Group, hosts economically important coal deposits that were mined historically in the Nanaimo area.

The Coast Mountain range is underlain by the Coast Plutonic complex, a large northwest-trending batholith consisting largely of diorite, quartz diorite, tonalite, and granodiorite calcalkaline rocks with less abundant high-grade metamorphic rocks. For the most part, uplift and erosion have removed the levels at which epithermal and porphyry-style mineralization form, with some exceptions. At the southern end of the Coast Plutonic complex, economically important deposits occur in pendants of the Gambier Group, overlapping Late Jurassic to Mid-Cretaceous arc-related volcanic and sedimentary rocks. The most productive of these deposits was the Britannia mine, a Kuroko-type polymetallic volcanogenic massive sulphide deposit that produced 517,000 t of copper along with zinc, silver, gold, lead, and cadmium between 1905 and 1974. At the southeastern edge of the Coast ranges, the Giant Mascot ultramafic-mafic intrusive suite (Late Cretaceous, Manor et al., 2014, 2015, 2016, 2017) hosts the province's only past-producing nickel mine, Giant Mascot Nickel, which operated between 1958 and 1974.

Eocene to Miocene ancestral Cascades arc magmatism extended as far northward as southwestern British Columbia, as does present day Cascades magmatism. Evidence of forearc Paleocene to Miocene magmatism can be traced from southern Oregon through Alaska (Madsen et al., 2006). Mount Washington Copper (Eocene) produced 3548 t of copper, 131 kg gold and 7235 kg silver. **Catface Copper** (Eocene) has a significant undeveloped resource. Other presumably Cenozoic targets include Giant Copper and **Okeover**. **Harmony**, on Graham Island, Haida Gwaii (Fig. 1) is a Miocene epithermal deposit with a significant undeveloped gold resource. Some recent exploration targets Neogene mineralization along a magmatic belt between the Brooks Peninsula and Alert Bay on northern Vancouver Island (Nixon et al., 2011a, b; 2020).

Quaternary Cascades magmatism has produced pumice and other volcanic rocks quarried for construction, landscaping, and other applications. The Mount Meager area has also been investigated as a possible source of geothermal energy.

On Vancouver Island, the western and southern margins of Wrangellia are structurally juxtaposed with the Pacific Rim terrane, which consists of possible mélangé deposits (Rusmore and Cowan, 1985; Brandon, 1989) and the Leech River complex, an assemblage of greenschist- to amphibolite-grade mudstones, sandstones, and mafic volcanic rocks cut by granitic bodies (Groome et al., 2003). Slate and siltstone are quarried for building stone in the Leech River complex. The Leech River has been an active placer gold camp since 1864. Gold quartz veins have been the subject of recent exploration near the Leech River fault, along the southern margin of the terrane (Fig. 1).

The Crescent terrane represents Eocene accretion of Late Cretaceous or Paleocene to Early Eocene seamounts. The Leech

River fault marks the boundary of Pacific Rim and Crescent terranes. The Metchosin Igneous complex, a partial ophiolite and northernmost extent of the Coast Range basalt province (Massey, 1986), contains three tholeiitic intrusion-hosted past producers of copper and precious metals, the most significant of which was the Sunro mine.

The southeastern Coast Belt, north of the international border is underlain by the Nooksack-Harrison and Chilliwack terranes (equivalent to Stikinia; Monger and Struik, 2006), and the Bridge River, Cadwallader, and Methow terranes, allied with the main Cache Creek terrane (Fig. 1). These represent slices of oceanic and arc-related rocks enclosed between Intermontane and Insular terranes during Middle Jurassic to Middle Cretaceous regional sinistral faulting (Bustin et al., 2013; Monger and Brown, 2016). Gambier Group-equivalent overlap deposits and parts of the Nooksack-Harrison terrane are prospective for VMS mineralization. The Coquihalla Serpentine belt, along the Hozomeen fault between the Bridge River terrane to the west and the Methow terrane to the east, hosts several gold prospects and five past producers including the Carolin mine, which operated between 1981 and 1984.

Tectonic uplift, erosion, and glaciation produced sand and gravel deposits important to the construction and transportation industries of the Lower Mainland. Most are products of the most recent retreat of the Cordilleran Ice Sheet in the Pleistocene (e.g., Howes, 1983; Clague and Ward, 2011).

3. Mines

The Southwest Region has one metal mine, one coal mine placed on care and maintenance in 2019 and numerous industrial minerals and aggregate operations (Fig. 1; Tables 1-3). Of eight large-scale industrial minerals operations in the region, two entered care and maintenance in 2016 and remained so through 2022. Aggregate operations in the region number in the 100s and only the most prominent (e.g., those producing at least 1 Mty) are reported here.

3.1. Metal mines

3.1.1. Myra Falls (Myra Falls Mine Ltd., Trafigura Mining Group)

Trafigura Mining Group, part of Trafigura Group Pte. Ltd. acquired the **Myra Falls** underground Zn-Cu-Pb-Ag-Au mine in 2020 from Nyrstar N.V. Trafigura is a private multinational commodity trading company and is not required to publish compliant production or reserves figures. However, they have a target throughput of 800,000 tpy of ore and estimate the operation has approximately 10 years of reserves (Table 1). They reported that 2022 production was not meeting the 800,000 t expectation, although production was significantly higher than in 2021. After re-starting following infrastructure upgrades and closing again for compliance reasons in 2018, the mine reopened in April 2019 and continued operation through 2022. The mine has a history of replacing reserves through exploration, which continued in 2022. Ability to store tailings may place limitations on mine life before exhaustion of

Table 1. Metal mines, Southwest Region.

Mine	Operator (partner)	Commodity; Deposit type; MINFILE	Forecast 2022 Production (based on Q1-Q3)	Reserves (last reported December 31, 2018)	Resource (last reported December 31, 2018)	Comments
Myra Falls	Myra Falls Mine Ltd. (Part of Trafigura Mining Group)	Zn, Cu, Pb, Ag, Au; Kuroko massive sulphide; 092F 330, 71, 72, 73	Not reported. Mill capacity 2000 tpd. Long term target 800,000 tpy of ore	P+Pr: 4.7 Mt 7.11% Zn, 0.78% Pb, 0.92% Cu, 76.55 g/t Ag, 1.78 g/t Au	M+I: 7.64 Mt 6.59% Zn, 0.72% Pb, 0.99% Cu, 72.52 g/t Ag, 1.79 g/t Au	Trafigura indicates the mine has reserves and resources sufficient for 10 years operation. Exploration is ongoing.

P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

Table 2. Coal mines, Southwest Region.

Mine	Operator (partner)	Commodity; Deposit type; MINFILE	Forecast 2022 Production (based on Q1-Q3)	Reserves	Resource	Comments
Quinsam	Quinsam Coal Corporation (receiver Bowra Group Inc.)	TC; Bituminous coal; 092F 319	nil	Not reported	Unofficial, non-compliant resources estimated at 40 Mt in 2013 by mine staff.	Placed on care and maintenance May 2019. Property and assets offered for sale 2020. Sale process discontinued 2021.

HCC = hard coking coal; PCI = pulverized coal injection; TC = thermal coal

P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

Table 3. Selected industrial mineral mines, quarries and aggregate quarries, Southwest Region.

Mine	Operator (partner)	Commodity; Deposit type; MINFILE	Forecast 2022 Production (based on Q1-Q3)	Reserves	Resource	Comments
Bute Inlet	Ironwood Clay Company Inc.	Clay; Sedimentary kaolin? (or illite)	na	na	na	Intermittent mining as needed.
Cabin Group	Northwest Landscape and Stone Supply Ltd.	Landscaping stone	na	na	na	
Cox Station	Mainland Construction Materials ULC	Aggregate; Crushed rock; 092GSE103	Approx. 3-4 Mty	na	na	River and rail access.
CTCT	Vancouver Island Marble Quarries Ltd.	Marble; Limestone; 092E 020	Typically, about 400 t annually	na	na	Supplies Matrix Marble and Stone Inc.
Earle Creek	Lafarge Canada Inc.	Sand and Gravel	Typically, >1 Mty	na	na	Material barged.

Table 3. Continued.

Garibaldi Pumice (Vulcan/Salal)	Garibaldi Pumice Ltd.	Pumice; Volcanic ash; 092JW 039	Typically, 10,000-20,000 m ³	na	11,396,000 m ³ pumice 4,990,000 m ³ pumicite (fines)	2014 resource. There has been both exploration and production since.
Hardy Island	Hardy Island Granite Quarries Ltd.	Dimension stone, building stone; Dimension stone-granite; 092F 425	3000-5000 tpy	na	Approx. 100,000 t	
Imperial Limestone	Imperial Limestone Co. Ltd.	Limestone; Limestone; 092F 394	Approx. 600,000 tpy	na	75 years	250,000 to 275,000 t high purity product + cement feedstock.
K2 (Ocean Pearl)	K2 Stone Quarries Inc.	Dimension stone, flagstone; Flagstone; 092C 159	15,000-20,000 t annually	na	na	Production number represents material extracted.
Mount Meager Pumice	Great Pacific Pumice Inc.	Pumice; Volcanic ash; 092JW 039	na	na	na	Production as required.
Orca	Polaris Minerals Corporation (Vulcan Materials Company and 'Namgis First Nation)	Sand and Gravel	Up to 6 Mty	na	121.6 Mt initial resource (2005)	Recently 3.5 to 5 Mty increase in mine plan. Vulcan Materials Company acquired previous owner US Concrete Inc. The quarry has a freighter loading facility.
Pipeline Road (2)	Lehigh Hanson Materials Ltd., Allard Contractors Ltd.	Sand and Gravel	na	na	na	Two adjacent operating sites.
Pitt River	Lafarge Canada Inc.	Aggregate; Crushed rock; 092GSE007	Typically, >1 Mty	na	na	River access for barging.
Sechelt	Lehigh Hanson Materials Limited	Sand and Gravel	Typically, 5-6 Mty	na	Several decades	Freighter loading facility.
Spumoni	Northwest Landscape and Stone Supply Ltd.	Flagstone; Flagstone; 092GNW100	na	na	na	Seasonal quarry.
Sumas Shale	Sumas Shale Ltd. (Lafarge Canada Inc., Clayburn Industrial Group)	Shale, clay, sandstone; Residual kaolin; 092GSE024	About 500,000 t annually	na	50+ years	Approximately 55% shale, 45% sandstone for cement production.
Texada Quarry	Texada Quarrying Ltd. (Lafarge Canada Inc.)	Limestone, aggregate; Limestone; 092F 395	Typically, approx. 3.5 to 4.5 Mty	na	100+ years	Mostly produces limestone for cement manufacture. Freighter loading facility.

P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

resources. The Myra Falls camp hosts Kuroko-type, or bimodal felsic type Zn-Cu- Pb-Ag-Au VMS deposits from which more than 30 Mt of ore have been mined since 1966.

3.2. Coal mines

3.2.1. Quinsam (Quinsam Coal Corporation, Bowra Group Inc.)

Quinsam is an underground mine that began commercial production of thermal coal in 1988 (Table 2). At its peak, it produced approximately 1 Mt clean coal annually. It ceased operation and entered care and maintenance in early 2016. It was then purchased by ERP Compliant Fuels LLC in 2017 and operated by Quinsam Coal Corporation until 2019. In 2018, its last full year of operation, it produced about 200,000 t and employed 50 people.

Quinsam placed the mine on care and maintenance at the end of May 2019. The company subsequently made an assignment into bankruptcy. The receiver and manager Bowra Group Inc. offered the property and assets for sale in 2020. That process closed without a sale, except that of the existing mined coal inventory. One conditional offer for the mine was ultimately rejected. Neither the receiver nor the Province of British Columbia support further marketing efforts. Reclamation is a long-term option for the property. Reclamation liability is estimated at \$12.4 million.

3.3. Industrial minerals and aggregates

Large quarries on the coast (Table 3) serve the Lower Mainland, Vancouver Island, and U.S. Pacific northwest markets by barge. Those with access to freighter loadout facilities can also supply eastern Pacific international markets and Hawaii. Aggregates are an important part of the mining industry on the south coast, generating many more jobs in the region than metal and coal mining. The area hosts some of the largest aggregate pits and quarries in Canada. Most quarries serve local markets. General sales and production trends follow those of the construction industry. Lafarge North America Inc., Lehigh Hanson Materials Ltd., Vulcan Materials Company, and a local company, Mainland Sand and Gravel Ltd., are the largest participants in the coast area, although hundreds of pits and quarries produce in the region.

One of the largest aggregate-only mines is the **Sechelt mine**, operated by Lehigh Hanson. The company no longer makes production figures public, but volumes have been in the 5-6 Mt range in recent years. It is permitted for up to 7.5 Mty. They expect reserves to last several more decades. A loading facility capable of accommodating Panamax-class freighters handles most of the shipments.

In addition to the **Texada Quarry**, Lafarge North America operates two of the largest aggregate quarries in the region (**Earle Creek** and **Pitt River**) each of which typically produces more than 1 Mty.

Pipeline Road is the site of large operations by Lehigh Hanson Materials Ltd. and Allard Contractors Ltd. Together they produce more than 1 Mty. Lehigh Hanson also has a large

crushed aggregate operation at Treat Creek on Jervis Inlet.

Polaris Minerals Corporation, a subsidiary Vulcan Materials Company, operates the **Orca** quarry near Port McNeill, in partnership with the 'Namgis First Nation, which holds a 12% interest. The owner-operator partnership is Orca Sand and Gravel LP. The quarry produces sand and gravel mainly for export to California. The operation was originally permitted for up to 6 Mty, but Polaris planned to increase production by 2023. In 2017, Polaris applied to the British Columbia Environmental Assessment Office for an amendment to its Orca project certificate to allow for producing aggregate at a site approximately 4 km from current operations. The new site was previously known as the **Black Bear** project. In 2020, Polaris revised the proposal to 3-4 Mty, then withdrew from the environmental assessment process with the stated intention of re-applying under new legislation.

The **Cox Station** quarry, on the north side of Sumas Mountain, is operated by Mainland Sand and Gravel Ltd. More than 95% of the crushed quartz diorite product goes to the Lower Mainland market via barge on the Fraser River. The quarry also has two CN Rail spur lines, which allow shipment by rail. Production and shipments have recently been on about 3-4 Mty.

Small operations produce building stone on Vancouver Island. Island Stone Landscape Supply is a producer and supplier of flagstone, as is San Juan Quarries. Vancouver Island Marble Quarries Ltd. continues to quarry marble on Vancouver Island and fabricate a line of products including countertops, sinks, and tiles at Matrix Marble and Stone Inc. They quarry marbles referred to as 'Tlupana Blue Grey' and 'Vancouver Island White' near Hisnit Inlet (**CTCT** quarry). K2 Stone Quarries Inc. now quarries a variety of products on Vancouver Island. In addition to the original Port Renfrew Ocean Pearl stone, they quarry sandstone near Nanaimo and a granite product near Courtenay.

Landscaping stone and dimension stone is quarried in the Squamish-Whistler corridor. The largest operator is Northwest Landscape and Stone Supply Ltd., with the **Spumoni** quarry and their **Cabin Group** property, which now has a Mines Act quarry permit. Others active in the area include Bedrock Granite Sales Ltd., Citadel Stone Ltd., and Alpine Natural Stone Ltd.

Hardy Island Granite Quarries Ltd. produces up to 5000 tpy from a Coast Plutonic complex granodiorite unit. Like Haddington Island, it is an historic quarry that mainly serves the local market. Hardy Island has opened another quarry on Valdes Island that supplies sandstone from the Nanaimo Group, another rock type common to many older buildings in Vancouver and Victoria.

3.3.1. Bute Inlet (Ironwood Clay Company Inc.)

Ironwood Clay Company Inc. mines glacial marine clay on the central coast. Until 2015, production was from the De Cosmos Lagoon south of Bella Bella (Fig. 1). The company has a site at the head of Bute Inlet, which is active and likely to supply future raw material. Mining is intermittent. Ironwood

produces cosmetic products using the clay at its Richmond plant, a business that has continued for 30 years. Glacial Bay Organic Clay Inc. also extracts material by hand near the head of Bute Inlet. Other individuals and companies supply the growing cosmetic clay market at smaller scales from locations on the central coast and Vancouver Island. Generally, Mines Act permits are not required where material is collected by hand, and these glacial marine clay operations are unreported.

3.3.2. Garibaldi Pumice and Mount Meager Pumice (Garibaldi Pumice Ltd.; Great Pacific Pumice Inc.)

In the Mount Meager area, Garibaldi Pumice Ltd. produces 15,000-20,000 m³ of pumice annually from their quarry (**Vulcan/Salal**). Neighbouring Great Pacific Pumice Inc. has been producing smaller quantities but have stockpiles in Squamish from which they can ship year-round.

3.3.3. Imperial Limestone (Imperial Limestone Co.)

In recent years, the **Imperial Limestone** quarry near Van Anda on Texada Island (Fig. 1) has produced approximately 250,000 to 275,000 tpy of high-purity product, most of which is shipped to their parent company in Seattle. Imperial Limestone Co. also mine and stockpile a larger quantity of lower quality limestone that goes to local cement plants. Quarrying at the Imperial site dates to the 1930s. The company anticipate reserves will last about 75 years.

3.3.4. K2 Ocean Pearl (K2 Stone Quarries Inc.)

K2 Stone is a natural stone product supplier with a quarry near Port Renfrew on Vancouver Island (**K2**). They extract about 15,000-20,000 t annually. The rock is trucked to Nanaimo for processing into masonry and landscaping products. The company has opened additional quarries near Nanaimo and Courtenay, producing sandstone and a salt-and-pepper granite (granodiorite).

3.3.5. Sumas Shale (Sumas Shale Ltd.)

The **Sumas Shale** quarry of Sumas Shale Ltd., operated by contractor Fraser Pacific Enterprises Inc., delivers sandstone and shale product to the Lafarge and Lehigh cement plants in Richmond and Ash Grove in Seattle. Sumas Shale Ltd is 50% owned by Lafarge Canada Inc. and 50% by Clayburn Industrial Group. Production and shipments have been approximately 500,000 tpy in recent years. Mining plans include an average 475,000 tpy of approximately 55% shale and 45% sandstone. Because Clayburn's brick and refractory products plant in Abbotsford closed, fire clay is no longer produced separately.

3.3.6. Texada Quarry (Texada Quarrying Ltd.)

The largest limestone quarry on the coast is the **Texada Quarry** operation near Gillies Bay. Texada Quarrying Ltd. is a subsidiary of Lafarge Canada Inc. The quarry also produces aggregate, mainly from quartz monzonite to gabbro dikes and sills, which would otherwise be waste rock. The site also hosts a

white carbonate quarry, one of only a few sources on the coast. The quarry, which has operated for more than 60 years, has extensive reserves and, at current rates, could produce for more than 100 years. They produce about 3.5 to 4.5 Mt annually.

4. Placer gold

Historic placer camps include the Lower Fraser River, Leech River, and China Creek. Although short lived, a gold rush in the Fraser Canyon, beginning in 1858 at Hills Bar, led miners farther up the Fraser River into the Chilcotin and Cariboo. In 1864, reports of gold in the Leech River on southern Vancouver Island led to another brief gold rush. Both camps are worked by placer miners to the present day. The Lillooet River was also on a historic route to the Cariboo. It also remains an active placer camp.

5. Mine development

Mine development projects are those for which a decision to produce has been made, key government approvals are in place, and on-site construction has begun. The Southwest Region has no such large-scale projects.

6. Proposed mines

Proposed mines are feasibility-stage projects for which proponents have begun the environmental certification process (in the case of large projects) or have submitted applications for Mines Act permits (in the case of projects below British Columbia Environmental Assessment Act thresholds). The Southwest Region has three such projects (Table 4); several small-scale and inactive larger projects are not covered in this report.

6.1. Proposed metal mines

The Southwest Region had no proposed major metal mine projects active in 2022.

6.2. Proposed coal mines

The region has no active proposed coal mine projects.

6.3. Selected proposed industrial minerals mines

Proposed mines include the **BURNCO Aggregate** project and the **Sechelt Carbonate** project, which has been inactive apart from a request by the owner to remain in the provincial environmental assessment process. The **Black Bear** aggregate project near Port McNeill was the subject of an application to amend the Orca Environmental Certificate. The application was withdrawn with a request for review under new legislation.

6.3.1. Black Bear (Polaris Materials Corporation)

As noted above, Polaris Materials Corporation included the **Black Bear** project near its Orca sand and gravel quarry in an Environmental Certificate amendment for Orca. If the project proceeds, it will be a source of up to 3-4 Mty of crushed basalt, an increase over the 250,000 tpy proposed in a 2017 project

Table 4. Selected proposed mines or quarries, Southwest Region.

Project	Operator (partner)	Commodity; Deposit type; MINFILE	Reserves	Resource	Comments
Black Bear	Polaris Materials Corporation (Vulcan Materials Company and 'Namgis First Nation)	Aggregate; Crushed rock	na	20 years (proposed life)	Orca environmental certificate amendment application withdrawn. Proposed 250,000 tpy 4 km from the Orca quarry revised to 3-4 Mtpy. Indicate intention to re-apply under 2018 Act.
BURNCO Aggregate	BURNCO Rock Products Ltd.	Aggregate; Sand and Gravel	na	Approx. 20 Mt	Has environmental certification, would require Mines Act and other permits.
Sechelt Carbonate	Ballinteer Management Inc.	Limestone, dolostone, aggregate; Limestone, dolomite, crushed rock; 093GNW031	na	Carbonate rock: 76.1 Mt Gabbro: >700 Mt	Proponent requests project remain in environmental assessment pre-application stage.

P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

description. Mine life would be extended from 10 to 20 years. This application was withdrawn with a request by the proponent to re-apply under the 2018 Environmental Assessment Act.

6.3.2. BURNCO Aggregate (BURNCO Rock Products Ltd.)

The **BURNCO Aggregate** project in the McNab Creek Valley (Fig. 1) received environmental certification in 2018 and may proceed with British Columbia Mines Act and other permitting. Certifications are valid for 5 years. Fisheries and Oceans Canada concluded that the project is unlikely to cause significant environmental harm. The proposed sand and gravel mine would ramp up to a 1.6 Mty operation, initially barging product to BURNCO Rock Products Ltd.'s ready-mix concrete plants in South Burnaby and Port Kells. BURNCO submitted revisions to the project in 2014, changing production rate, relocating some facilities, and specifying a mine life of 16 years.

6.3.3. Sechelt Carbonate (Ballinteer Management Inc.)

Ballinteer Management Inc. now holds the property comprising the **Sechelt Carbonate** project. They filed engineering, archeological, and baseline environmental studies for assessment in 2016; activity was not reported for 2017-22. The property contains resources of calcite- and dolomite bearing carbonate rock and gabbroic rock for potential use as aggregate. The original proposal was for a 4-6 tpy carbonate quarry producing both limestone and dolostone. Product was to be shipped from a barge load out on Sechelt Inlet.

7. Exploration activities and highlights

Exploration projects are categorized as grassroots, early

stage, advanced, and mine evaluation, depending upon the nature of recent work. Work directed at discovering new resources away from ore bodies in an existing mine plan can be considered mine-lease or on-site exploration. The Southwest Region had few large exploration programs in 2022 (Table 5), however it has a number of small programs.

7.1. Selected precious metal projects

Precious metal prospects are found in a variety of settings in the region and although some are at advanced stages of exploration, limited work was reported on gold projects in 2022.

7.1.1. Gold Standard (Juggernaut Exploration Ltd.)

Juggernaut Exploration Ltd. returned to the **Gold Standard** project following positive 2021 results. They reported 41 m of mineralized veins and schist at the Kraken vein. However, they noted that 2022 drill results, although returning anomalous gold, were not comparable to 2021 results.

7.1.2. Gold Star (Juggernaut Exploration Ltd.)

Juggernaut Exploration Ltd. returned to the **Gold Star** project following positive 2021 results at the Goldilocks zone. They reported sulphide mineralization and anomalous gold from drilling in 2022, but that the values did not match 2021 results.

7.1.3. Harrison Gold (Bear Mountain Gold Mines Ltd.)

Bear Mountain Gold Mines Ltd. reported engineering work at **Harrison Gold**, following underground drilling in 2021. The company is considering the possibility of accessing underground targets with minimal disruption to nearby

Table 5. Selected exploration projects, Southwest Region.

Project	Operator (partner)	Commodity; Deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Bakar	Sherpa II Holdings Corp. (District Metals Corp.)	Cu, Ag; Volcanic Redbed Cu; 102I 010, 7, 6, 15, 16, 17, 092L 080, 462, 247	na	Airborne geophysics, soil geochemistry.
Big Frank	Goldplay Mining Inc.	Cu, Au, Mo, Ag; Porphyry Cu±Mo±Au; 092N 051, 29, 28	na	2021 sampling reported with highlights of 37.3 g/t Au, 174 g/t Ag, 4.3% Cu, and 16 g/t Au and 1162 g/t Ag.
Brandywine	Bayhorse Silver Inc., (Turnagain Resources Inc.)	Ag, Au, Pb, Zn; Polymetallic veins; 092JW 001, 21, 22	na	Permitting, geology.
Catface		Cu, Mo, Ag; Porphyry Cu±Mo±Au; 092F 120, 251, 231	I: 56.863 Mt 0.040% Cu Inf: 262.448 Mt 0.38% Cu	Minor 2022 work filed for assessment. Resource estimated in 2009 did not include subsequent drilling.
Empire Mine	Coast Copper Corp.	Au, Ag, Cu, Fe, Co; Fe skarn, Cu skarn; 092L 044, 45, 46	M+I: 960,000 t 2 g/t Au, 5.6 g/t Ag, 0.34% Cu, 0.013% Co Inf: 120,000 t 1.2 g/t Au, 2.8 g/t Ag, 0.13% Cu, 0.008% Co	Drilling 10 holes, 1483.7 m, underground survey, sampling with highlights 3.37 g/t Au, 0.97% Cu and >1% Co.
Georgina	Madi Minerals Ltd.	Au, Cu, V; Polymetallic veins; 092K 070	na	Soil and rock geochemistry.
Gold Standard	Juggernaut Exploration Ltd.	Au, Ag; Au-quartz veins	na	Drilling.
Gold Star	Juggernaut Exploration Ltd.	Au, Ag; Au-quartz veins	na	Drilling.
Harrison Gold	Bear Mountain Gold Mines Ltd.	Au, Ag; Au-quartz veins; 092HSW092	Historical I: 1.845 Mt 2.79 g/t Au Inf: 0.6 Mt 2.8 g/t Au	Engineering.
Isla	Blanton Resources Corp.	Au, Ag, Cu; Polymetallic veins; 092F 643, 701, 515	na	Soil and rock geochemistry, ground magnetic survey.

Table 5. Continued.

Ladner Gold	Talisker Resources Ltd.	Au, Ag; Au-quartz veins; 092HNW003, 7, 18, 092HSW034	Carolin Inf: 12,352,124 t 1.53 g/t Au McMaster Inf: 3,575,000 t 0.69 g/t Au Tailings I: 445,378 t 1.83 g/t Au Inf: 93,304 t 1.85 g/t Au	Soil geochemistry and data review.
Le Mare	Homegold Resources Ltd.	Cu, Mo, Au, Ag, pyrophyllite; Porphyry Cu±Mo±Au; 092L 381, 328, 385, 378, 380, 329, 382, 379	na	Airborne geophysics, geology.
Mineral Creek	Theia Gold Corp.	Au, Ag; Au-quartz veins; 092F 079, 331	na	Soil geochemistry.
Mount Sicker	Sasquatch Resources Corp.	Cu, Au, Ag, Pb, Zn; Kuroko massive sulphide Cu-Pb- Zn; 092B 040, 76, 110, 1	na	Lidar survey, inversion of geophysical data.
North Island	Northisle Copper and Gold Inc.	Cu, Au, Mo, Re; Porphyry Cu±Mo±Au; 092L 185, 240, 200	I: 527,344,000 t 0.20% Cu, 0.24 g/t Au, 0.008% Mo, 0.31 ppm Re Inf: 417,272,000 t 0.15% Cu, 0.18 g/t Au, 0.006% Mo, 0.29 ppm Re	Resource includes both Hushamu and Red Dog deposits. Work in 2022 included drilling (6390 m, 15 holes), mapping, and geophysics. Highlights included 49.5 m grading 0.345% Cu, 0.435 g/t Au, 0.014% Mo, and 0.736 g/t Re at Hushamu and 100.9 m grading 0.204% Cu, 0.890 g/t Au, 0.014% Mo, and 0.573 g/t Re in a 200 m step out.
Okeover	Alpha Copper Corp.	Cu, Mo; Porphyry Cu±Mo±Au; 092K 008, 57, 168	Inf: 86.8 Mt 0.31% Cu, 0.014% Mo	Drilling, approx. 2000 m planned.
Peak Mineral	Corcel Exploration Inc.	Au, Ag, Cu; Cu±Ag quartz veins; 092F 143, 607, 606, 564	na	Rock, silt, and soil geochemistry.
Rogers Creek	Cascade Copper Corp.	Cu, Mo, Au, Ag; Porphyry Cu±Mo±Au ; 092JSE033, 34, 35, 36	na	Lidar survey, rock sampling, and mapping.

Table 5. Continued.

Rupert	Buscando Resources Corp.	Cu, Mo; Porphyry Cu±Mo±Au; 092L 273	na	Soil geochemistry, prospecting.
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M = Measured; I = Indicated; Inf = Inferred

communities. An historical (1989, restated 2002) resource estimate has 1.845 Mt grading 2.79 g/t Au in the indicated category and 0.6 Mt grading 2.8 g/t Au in the inferred category.

7.1.4. Ladner Gold (Talisker Resources Ltd.)

Talisker Resources Ltd. acquired the **Ladner Gold** project in September 2021 and completed a soil geochemistry survey. Work in 2022 included further soil sampling and a compilation and analysis of historical data (600+ drill holes, underground survey, 3D model). The project includes the past-producing Carolin mine. The mine, tailings, and another area, the McMaster zone, have resource estimates (Table 5).

7.1.5. Mineral Creek (Theia Gold Corp.)

Theia Gold Corp. reported fieldwork at their **Mineral Creek** project since acquiring the property from Tempus Resources in 2021. Work included soil geochemistry. Theia is a private company and has not reported details. Mineral Creek is a gold vein prospect hosted by Sicker Group volcanic rocks (Paleozoic).

7.1.6. Peak Mineral (Corcel Exploration Inc.)

Corcel Exploration Inc. reported soil, silt, and rock geochemistry at the **Peak Mineral** property. The company noted three gold-in-soil anomalies and rock samples grading 1.89 and 4.88 g/t Au. The property is underlain by Sicker Group (Paleozoic) volcanic rocks intruded by Mount Hall Gabbro (Triassic) and Island Plutonic Suite granodiorite (Jurassic).

7.2. Selected porphyry projects

Jurassic porphyry mineralization is a target on Vancouver Island. Southwestern British Columbia also has several advanced Eocene to Miocene porphyry copper targets.

7.2.1. Big Frank (Goldplay Mining Inc.)

Gold Play Mining Inc. reported results of 2021 sampling at **Big Frank** including 37.3 g/t Au, 174 g/t Ag, and 4.3% Cu from a grab sample near the Hannah prospect and 16 g/t Au and 1162 g/t Ag from a newly discovered vein. Further work was not reported, apart from the filing of a NI-43-101 technical report. The property includes several porphyry Cu-Mo-Au-Ag prospects.

7.2.2. Catface (Catface Copper Mines Limited)

Catface Copper Mines Limited is a subsidiary of Imperial Metals Corporation. The company reported geochemical

work at **Catface** without details. Catface is an Eocene Cu-Mo porphyry deposit.

7.2.3. Le Mare (Homegold Resources Ltd.)

Homegold Resources Ltd. reported carrying out an airborne magnetic and radiometric survey and geological work on the **Le Mare** property, where there are several porphyry Cu-Mo targets. The area is mainly underlain by the Le Mare volcanic unit of the Bonanza Group (Fig. 2).

7.2.4. North Island Project (Northisle Copper and Gold Inc.)

Northisle Copper and Gold Inc. drilled approximately 6390 m in 15 holes at its **North Island Project** (Fig. 2), including 9 holes at and near the Hushamu resource area. A highlight included 49.5 m grading 0.345% Cu 0.435 g/t Au, 0.014% Mo, and 0.736 g/t Re. The company also reported another intersection in a step out hole 200 m from the model pit shell where mineralization had not been recognized of 100.9 m grading 0.204% Cu, 0.890 g/t Au, 0.014% Mo, and 0.573 g/t Re. Work in 2022 also included mapping, sampling, and surface geophysics at a (re)discovery referred to as ‘Downward Dog’. A 2021 Preliminary Economic Assessment was updated and there was some metallurgical testing of Hushamu, Red Dog, and Northwest Expo. Of more than seven Cu-Au-Mo±Re porphyry targets and deposits spanning approximately 40 km west-northwest of the past producing Island Copper mine, two deposits have resource estimates. Hushamu has an Indicated resource of 472.9 Mt grading 0.20% Cu, 0.23 g/t Au, 0.008% Mo, and 0.35 ppm Re plus a large Inferred resource. Red Dog has an Indicated resource of 54.5 Mt grading 0.22% Cu, 0.31 g/t Au, and 0.004% Mo.

7.2.5. Okeover (Alpha Copper Corp.)

Alpha Copper Corp. mobilized to their **Okeover** project in the fall for a planned 2000 m of drilling at the North lake zone where there is an existing resource. The North Lake zone is at the northern end of an north-northwest trending string of porphyry Cu-Mo targets related to younger intrusions in Cretaceous diorite-granodiorite of the Coast Plutonic complex.

7.2.6. Rogers Creek (Cascade Copper Corp.)

Cascade Copper Corp. acquired the **Rogers Creek** property from Tocvan Ventures Corp. Cascade carried out a lidar survey, rock geochemistry, and geological mapping, including alteration mapping using Terraspec spectrometry.

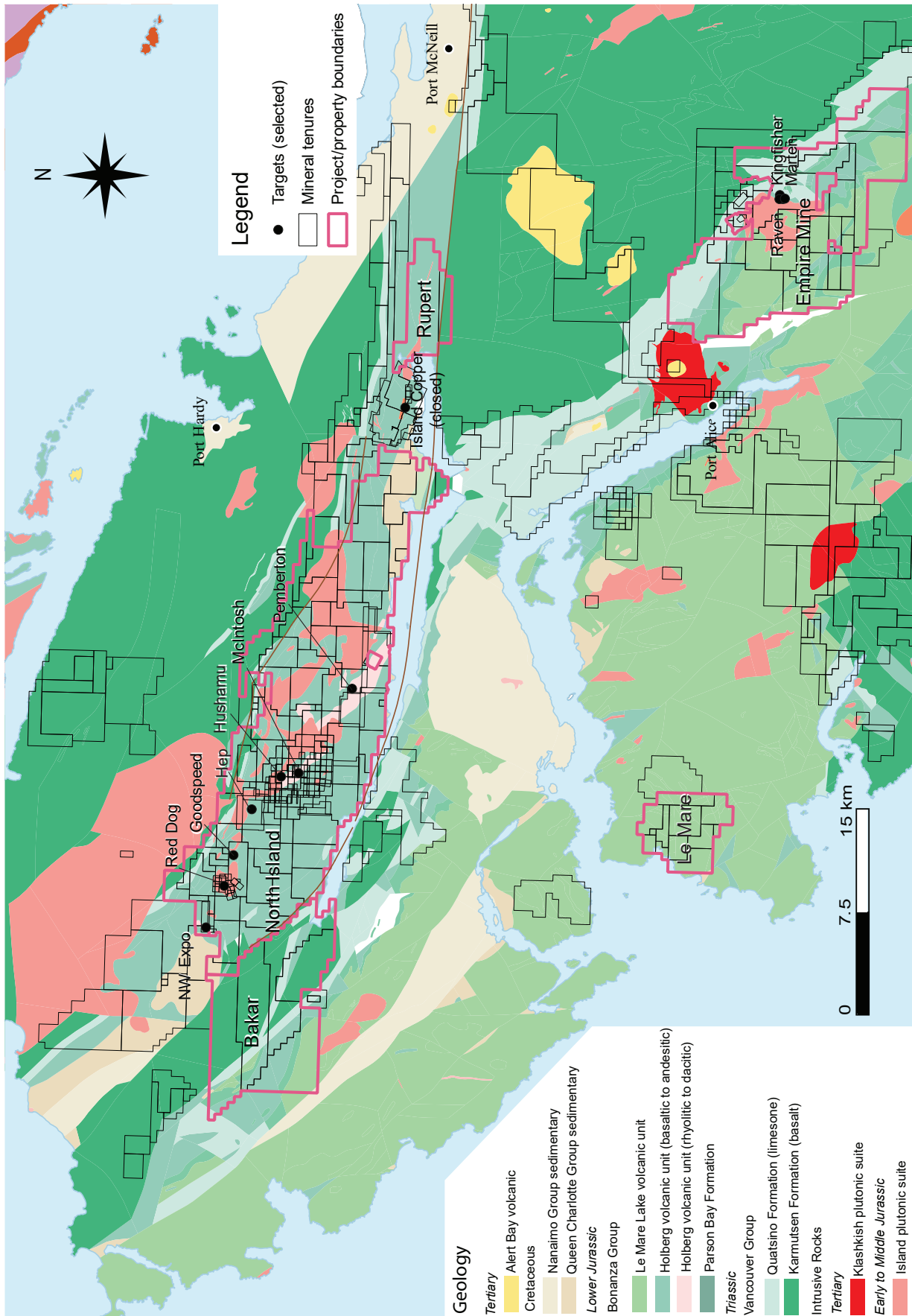


Fig. 2. Northern Vancouver Island projects mentioned in text. Geology simplified after Nixon (2011a, b).

7.2.7 Rupert (Buscando Resources Corp.)

Buscando Resources Corp. reported soil geochemical sampling and prospecting at the **Rupert** project. The principal target is calc-alkaline porphyry Cu-Mo-Au mineralization.

7.3. Selected polymetallic base and precious metal projects

Polymetallic vein, VMS and copper-silver vein occurrences are among the target types sought.

7.3.1. Bakar (District Metals Corp., Sherpa II Holdings Corp.)

The District Metals Corp.-Sherpa II Holdings Corp. joint venture reallocated its 2022 exploration drilling budget for **Bakar** (Fig. 2) while awaiting a permit for drilling. Late-season work was to include airborne VTEM, magnetics and a soil survey. Known mineralization includes Cu-Ag veins and volcanic-hosted redbed copper. Porphyry copper mineralization is also a target.

7.3.2. Brandywine (Bayhorse Silver Inc. 80%; Turnagain Resources Inc. 20%)

Bayhorse Silver Inc. reported little activity on the ground at **Brandywine** but received a permit for drilling. Brandywine has vein targets and precious metals-enriched massive sulphide targets.

7.3.3. Georgina (Madi Minerals Ltd.)

Exploration by Madi Minerals Ltd. at **Georgina** included soil and rock geochemistry, with soil samples returning anomalous gold, copper, and vanadium values. Rock samples returned up to 2.32% Cu, 202 ppm V, and 373 ppm V. The company also reported anomalous gold. The property is underlain mainly by Vancouver Group and Bonanza Group rocks.

7.3.4. Isla (Blanton Resources Corp.)

Blanton Resources Corp. reported soil and rock geochemistry and a ground magnetic survey (17.9 line-km) at the grass roots stage **Isla** property. They reported anomalous copper, gold, and arsenic. The property hosts several copper-silver MINFILE occurrences in Karmutsen Formation basalts. Targets include precious metal bearing veins.

7.3.5. Mount Sicker (Sasquatch Resources Corp.)

Sasquatch Resources Corp. reported a lidar survey and geophysical inversion of airborne time domain electromagnetic data and produced a NI-43-101 technical report. **Mount Sicker** hosts several past-producing VMS deposits hosted by Sicker Group volcanic rocks (Paleozoic) and Mount Hall gabbro (Triassic).

7.4. Selected skarn projects

Skarn deposits were historically important sources of copper and magnetite on Vancouver Island and Haida Gwaii. They commonly occur where the Island Plutonic suite intrudes the Vancouver Group.

7.4.1. Empire Mine (Coast Copper Corp.)

Coast Copper Corp. drilled 10 holes totalling 1483.7 m at **Empire Mine** in the spring and contracted geological work and an underground survey of the Kingfisher, a past producing underground magnetite iron mine. Significant drill intersections included Au, Cu, Ag and Co values. Individual underground samples also returned up to 3.37 g/t Au, 0.97% Cu, and over 1% Co. The deposits are Cu-Fe skarns in Vancouver Group and lower Bonanza Group rocks intruded by diorite to gabbro of the Island Plutonic suite (Fig. 2).

8. Geological research

McNulty et al. (2022) reported stratigraphic, volcanosedimentary facies, and U-Pb geochronologic data from the **Myra Falls** polymetallic volcanic-hosted massive sulfide deposit on Vancouver Island and concluded that a previously unrecognized unconformity separates temporally distinct felsic volcanism-related hydrothermal mineralization processes. In an effort to establish the provenance of Nanaimo Group Late Cretaceous sedimentary rocks, Boivin et al. (2022) provided U-Pb data from Mesozoic, Proterozoic, and Archean detrital zircons with cores that are mantled by pre-erosional metamorphic rims and concluded likely derivation from rapidly exhumed Coast Mountains batholith and related metasedimentary rocks. Iulianella Phillips et al. (2022) reported sampling soils to establish microbial communities at the Mount Washington high-sulphidation Au-Ag-Cu epithermal prospect on Vancouver Island, following up on previous work at the Highland Valley (porphyry Cu-Mo) and Deerhorn (porphyry Cu-Au) deposits in the Interior Plateau to test the utility of microbial composition as an exploration tool in areas of thick overburden.

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