

Exploration and mining in the South Central Region, British Columbia



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1. Introduction

With four major mines in operation, the South Central Region is currently the most productive copper mining district in Canada. The region's varied geology, well-established infrastructure, and access to markets also make it an important industrial minerals centre. The Cariboo area is the province's largest placer gold camp, with active permits numbering in the hundreds. Thermal coal resources in Cenozoic basins were last mined in 2013.

The region has four major proposed metal mines and a proposed small gold mine re-start. About 80 exploration projects were tracked in 2020, although this represents a minimum because not all exploration work is recorded.

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 South Central Region, exploration expenditures were estimated at \$69.3 million and exploration drilling was estimated at approximately 212,010 m (Clarke et al., 2021; EY LLP, 2021).

After a pause in the spring, as industry and regulators developed Covid-19 protocols, exploration activity resumed at many projects, while others deferred work. Gold exploration for selected projects was well funded, and the discovery of porphyry mineralization in the Aspen Grove area demonstrated that a fresh geological interpretation in a relatively well-explored district can still generate significant new targets. The total area under tenure in the region increased about 14% between November 2019 and November 2020 to nearly 2.96 million ha.

2. Geological overview

The tectonic and metallogenic evolution of the Canadian Cordillera are intimately linked (Fig. 1, e.g., Nelson et al., 2013). The South Central Region straddles three of British Columbia's five morphogeological belts (from west to east: Coast; Intermontane; Omineca). The mid-Mesozoic and older geological framework is represented by cratonic and

pericratonic rocks in the east, and a series of Late Paleozoic through mid-Mesozoic arc and oceanic terranes to the west (Fig. 1). Younger rocks include Jura-Cretaceous siliciclastic and local volcanic rocks, Eocene volcanic rocks, Neogene and Quaternary basalt, and Middle Jurassic to Eocene granitic intrusions.

The oldest rocks in the region are Paleoproterozoic basement gneiss complexes at the eastern boundary, such as in the Monashee complex. These are interpreted as parts of the North American craton (Armstrong et al., 1991), overlain by Neoproterozoic to Paleozoic cover deposited following rifting that formed the western margin of Ancestral North America (McDonough and Parrish, 1991; Murphy et al., 1991). To the northwest, the Cassiar terrane consists of Neoproterozoic to mid-Paleozoic siliciclastic and carbonate rocks interpreted as distal facies of the North American platform (Struik, 1988a). Also affiliated with Ancestral North America, the Kootenay terrane (deep-water basin strata on Figure 1) include Neoproterozoic to mid-Paleozoic deep-water facies equivalents deposited west of the North American platform. Lower Cambrian and older rocks are similar to North American strata to the east, but the overlying lower Paleozoic succession is characterized by units of coarse siliciclastic and mafic volcanic rocks that may reflect intermittent crustal extension (Colpron and Price, 1995). This belt also includes Devonian-Mississippian calc-alkaline to alkalic volcanic rocks and associated granitoid intrusions, found mainly in the Eagle Bay assemblage (Schiarrizza and Preto, 1987), which reflect the initiation of east-dipping subduction beneath the North American plate margin. These rocks host polymetallic volcanogenic massive sulphide (VMS) occurrences, and the **Yellowhead** bulk tonnage copper deposit. Slide Mountain terrane is the easternmost tract of oceanic rocks in the Canadian Cordillera. These rocks may be the remnant of a Late Paleozoic marginal basin that formed behind a westward-retreating volcanic arc in Quesnel terrane. The Fennell Formation hosts copper-zinc-silver massive sulphide mineralization at the **Chu Chua** occurrence.

Quesnel terrane is a Late Triassic to Early Jurassic island arc complex (e.g., Mortimer, 1987; Struik, 1988a, b; Unterschutz et al., 2002). It also includes a Late Paleozoic arc sequence,

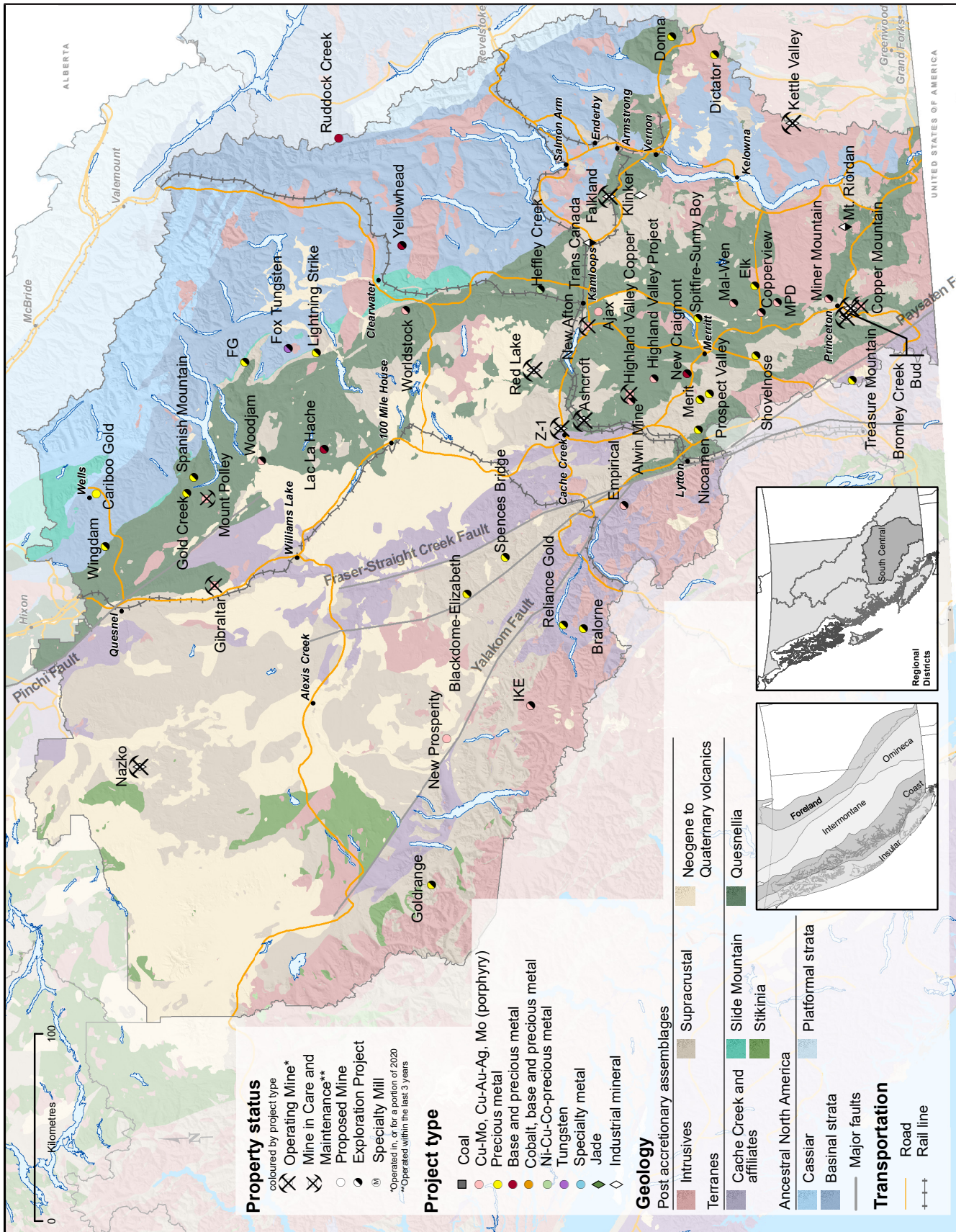


Fig. 1. Mines, proposed mines, and selected exploration projects, South Central Region, 2020. Terranes from Nelson et al. (2013).

represented by the Harper Ranch Group (Beatty et al., 2006) and, in the south, assemblages of oceanic rocks (Tempelman-Kluit, 1989). The Mesozoic rocks are represented mainly by Middle to Upper Triassic volcanic and sedimentary rocks of the Nicola Group, together with abundant Upper Triassic to Lower Jurassic calc-alkaline to alkaline intrusions (Preto, 1977, 1979; Mortimer, 1987; Panteleyev et al., 1996; Schiarizza et al., 2013). The Nicola Group consists mainly of volcanic and volcanic-derived sedimentary rocks, but also includes siltstone and slate intercalated with quartzite and limestone (Bloodgood, 1990; Schiarizza et al., 2013; Mihalynuk et al., 2015; Schiarizza, 2019; Mihalynuk and Diakow, 2020). The volcanic rocks are mainly augite-phyric shoshonitic basalts, but the western part of the group locally includes a belt of calc-alkaline volcanic rocks with substantial amounts of rhyolite and dacite (Mortimer, 1987; Preto, 1977, 1979). A younger stratigraphic component of Quesnel terrane consists of Lower to Middle Jurassic sedimentary rocks that unconformably overlie the western parts of the Nicola Group (Travers, 1978; Logan and Moynihan, 2009; Schiarizza et al., 2013).

Quesnel terrane is metallogenically important for its porphyry copper deposits (e.g., Logan, 2013; Logan and Mihalynuk, 2014). The plutons that host these deposits conform, in part, to a pattern defined by parallel belts of calc-alkaline and alkalic plutons that become progressively younger from west to east (Schiarizza, 2014). The western (Late Triassic) calc-alkaline belt includes the Guichon Creek batholith, host to the **Highland Valley Copper** copper-molybdenum mines, and the Granite Mountain batholith, host to the **Gibraltar** copper-molybdenum mine. A well-defined belt farther east comprises younger, latest Triassic alkalic plutons, which host alkalic porphyry copper-gold deposits, including producing mines at **Copper Mountain** and **New Afton** and the **Mount Polley** mine, which is currently on care and maintenance. A third belt, younger and farther to the east, is defined by several large, Lower Jurassic calc-alkaline plutons.

Cache Creek terrane, consisting of Carboniferous to Early Jurassic chert, argillite, basalt, limestone, sandstone, gabbro, and serpentinized ultramafic rocks of the Cache Creek complex, forms a belt to the west of Quesnel terrane in the central and northern parts of the region. It is interpreted, at least in part, as a subduction complex responsible for generating the Quesnel magmatic arc (Travers, 1978; Struik et al., 2001).

Cadwallader terrane, as interpreted by Schiarizza (2013), underlies parts of the Intermontane and eastern Coast belts, west of Cache Creek and Quesnel terranes. It includes a Late Permian-Early Triassic primitive oceanic arc complex, and an overlying Late Triassic-Middle Jurassic arc complex and associated siliciclastic apron.

Bridge River terrane occurs in the eastern Coast belt, west of Lytton and Lillooet, where it is partially enveloped by Cadwallader terrane. It is represented mainly by the Bridge River complex, comprising structurally interleaved slivers of chert, argillite, basalt, blueschist, gabbro, serpentinite, limestone, and sandstone (Schiarizza et al., 1997). Both

Cadwallader and Bridge River terranes are shown as ‘Cache Creek affiliates’ on Figure 1.

Stikine terrane is a mid-Paleozoic to Middle Jurassic arc terrane that is markedly similar to Quesnel terrane, and forms a predominant component of the Cordillera in central and northern British Columbia. It is represented in the northwestern part of the South Central Region by a few scattered exposures of volcanic and sedimentary rocks correlated with the Hazelton Group (Upper Triassic to Middle Jurassic; Tipper, 1959, 1969). Younger stratigraphic units overlap older terranes and cover large parts of the region. These units include: Upper Jurassic to Upper Cretaceous siliciclastic rocks of the Tyaughton-Methow basin, which overlap Cadwallader and Bridge River terranes in the eastern Coast belt (Schiarizza et al., 1997); and mid-Cretaceous arc volcanic rocks of the Spences Bridge Group, which form a northwest-trending belt that overlaps Quesnel and Cache Creek terranes in the Merritt-Lillooet area (Monger and McMillan, 1989), and continues westward across the Fraser River where it overlaps Cadwallader and possibly Stikine terranes (Mahoney et al., 2013). Eocene volcanic and subordinate sedimentary rocks (e.g., Kamloops Group, Penticton Group, Princeton Group) are predominant in some locations. Neogene basalt of the Chilcotin Group overlaps Quesnel, Cache Creek, Cadwallader, and Stikine terranes throughout much of the central part of the region (Dohaney et al., 2010). Granitic plutons, ranging from late Middle Jurassic to Eocene, occur throughout the region and, in some cases, are responsible for significant mineralization (e.g., **IKE**, **New Prosperity**).

3. Mines and quarries

The region produces copper, molybdenum, gold, and silver from four large mines, and a variety of industrial minerals (bentonite, zeolite, diatomaceous earth, gypsum, pumice, opal, and dimension stone) from about ten quarries. Almost 1000 placer mines and gravel pits have active permits, but not all produce in any given year.

3.1. Metal mines

The South Central Region hosts five of the province’s metal mines (Fig. 1; Table 1). These include the province’s two largest copper-molybdenum producers (**Gibraltar** and **Highland Valley Copper**) and two major copper-gold mines (**New Afton** and **Copper Mountain**). A third copper-gold producer, **Mount Polley**, has been on care and maintenance since 2019, awaiting a sustained improvement in copper prices. The region hosts one precious metal mine, **Bonanza Ledge**, which is undergoing development and permitting for its next phase of production.

3.1.1. Bonanza Ledge (Osisko Development Corp.)

Barkerville Gold Mines Ltd. (now under Osisko Development Corp.) restarted the **Bonanza Ledge** mine (Fig. 1; Table 1) in 2017 as an underground long-hole and cemented fill operation below the existing pit. The mine operated in 2018 but mining and milling were suspended in December of that year.

Table 1. Metal mines, South Central Region.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2020 Production (based on Q1-Q3)	Reserves	Resource	Comments
Bonanza Ledge	Osisko Development Corp.	Au; Au-quartz veins; 093H 140	nil	na	Bonanza Ledge M: 240,000 t 5.1 g/t Au I: 86,000 t 3.9 g/t Au BC Vein I: 1,192,000 t 4.7 g/t Au Inf: 472,000 t 3.9 g/t Au	Phase II in development and permitting.
Copper Mountain	Copper Mountain Mining Corporation 75%, Mitsubishi Materials Corporation 25%	Cu, Au, Ag; Porphyry Cu-Au, Alkalic; 092HSE001	70-75 Mlb Cu+Au, Ag (management's guidance)	P+Pr: 462.339 Mt 0.23% Cu, 0.10 g/t Au, 0.72 g/t Ag	M+I: 645.395 Mt 0.20% Cu, 0.10 g/t Au, 0.50 g/t Ag Inf: 323.502 Mt 0.20% Cu, 0.10 g/t Au, 0.50 g/t Ag	Deep drilling intersected mineralization at Ingerbelle. New 21-year life of mine plan with higher throughput Nov. 2020. Resources inclusive of reserves.
Gibraltar	Taseko Mines Limited 75%, Sojitz Corp. 12.5%, Dowa Holdings Co. Ltd. 6.25%, Furukawa Co. Ltd. 6.25%	Cu, Mo; Porphyry Cu+/-Mo+/- Au; 093B 012	130 Mlb Cu (±5%) + Mo (management's guidance)	P+Pr: 564 Mt 0.25% Cu, 0.008% Mo	M+I: 1081 Mt 0.25% Cu, 0.007% Mo	Resources inclusive of reserves. Exploration drilling in 2020.
Highland Valley	Teck Resources Limited	Cu, Mo; Porphyry Cu+/-Mo+/- Au; 092ISW012, 45	120,000-125,000 t Cu and 3.4-4.0 Mlbs Mo (management's guidance)	P+Pr: 484 Mt 0.31% Cu, 0.007% Mo	M: 552.3 Mt 0.29% Cu, 0.008% Mo I: 861.6 Mt 0.23% Cu, 0.009% Mo Inf: 270.5 Mt 0.20% Cu, 0.008% Mo	2040 extension plan under consideration.
Mount Polley	Imperial Metals Corporation	Cu, Au, Ag; Porphyry Cu-Au, Alkalic; 093A 008	nil	P+Pr: 53.772 Mt 0.34% Cu, 0.90 g/t Ag	M+I open pit: 186.9 Mt 0.27% Cu, 0.28 g/t Au, 0.49 g/t Ag Inf: 4.6 Mt 0.18% Cu, 0.21 g/t Au, 0.39 g/t Ag M+I underground: 7.42 Mt 0.94% Cu, 0.35 g/t Au, 6.57 g/t Ag Inf: 1.019 Mt 1.25% Cu, 0.58 g/t Au, 10.29 g/t Ag	Estimates were effective 2016. On care and maintenance since May 2019. Current reserves would support about 6 years operation. Exploration ongoing (drilling, IP in 2020).

Table 1. Continued.

New Afton	New Gold Inc.	Au, Ag, Cu; Porphyry Cu-Au, Alkalic; 092INE023	Approximately 65-75 Mlbs Cu and 62,000-72,000 oz Au including Ag by-product (management's guidance)	P+Pr: 47.301 Mt 0.66 g/t Au, 1.9 g/t Ag, 0.77% Cu	M+I: 57.008 Mt 0.61 g/t Au, 2.1 g/t Ag, 0.74% Cu Inf: 14.022 Mt 0.38 g/t Au, 1.3 g/t Ag, 0.42% Cu	M+I resources are exclusive of reserves. Exploration is ongoing at Cherry Creek 3 km west of mine and regionally.
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P = Proven; Pr = Probable; M = Measured; I = Indicated; Inf = Inferred

Underground development and permitting have been underway for the Bonanza Ledge Phase II project since mid-2019. Phase II will exploit the BC vein for a projected two years at a targeted rate of 650 tpd. About 2600 m of development are necessary, some of which will be in ore. In addition to the development, they require Mines Act and Environmental Management Act permit amendments at both the mine and mill to re-commence production. As of mid 2020 they expected to produce in 2021 with a two-year mine plan. Bonanza Ledge is part of the larger **Cariboo Gold** project, a proposal for a larger 15-year mining operation to the north.

Two types of mineralization are of interest at Bonanza Ledge: pyrite replacement and vein, which consists of native gold in quartz veins cutting pyrite-bearing, carbonaceous and chloritic phyllite of the Snowshoe Group (Proterozoic- Paleozoic).

3.1.2. Copper Mountain (Copper Mountain Mining Corporation 75%; Mitsubishi Materials Corporation 25%)

The **Copper Mountain** copper-gold open-pit mine (Fig. 1; Table 1), has produced since August 2011 and mills at a rate of close to 40,000 tpd. Addition of a third ball mill in 2020 is to increase the rate to 45,000 tpd in 2021. Expected production in 2020 is 70-75 Mlb Cu. In the first three quarters it produced 54.5 Mlbs Cu, 20,268 oz Au and 247,560 oz Ag. Mill expansion, to 65,000 tpd, is to be commissioned in 2024. The new projected mine life is 21 years based on current reserves.

Exploration drilling at the New Ingerbelle pit included about 4000 m in five holes. The holes tested the depth of mineralization; one hole returned 585 m grading 0.33% Cu, 0.21 g/t Au, and 0.45 g/t Ag, and another 120 m grading 0.69% Cu, 0.37 g/t Au, and 1.55 g/t Ag. New Ingerbelle reserves were added to Copper Mountain's mine plan in 2019.

The **Copper Mountain** ore bodies are Late Triassic alkalic porphyry Cu-Au deposits, mainly in Nicola Group rocks (Triassic) intruded by the high-level Copper Mountain intrusions (Upper Triassic). Holbek et al. (2015, 2020) described the deposit as an alkalic porphyry Cu-Au system with strong vertical continuity.

3.1.3. Gibraltar (Taseko Mines Limited 75%; Cariboo Copper Corp. 25%)

The **Gibraltar** copper-molybdenum open-pit mine (Fig. 1; Table 1) is operated by Taseko Mines Limited and Cariboo

Copper Corp., whose 25% interest is divided between Sojitz Corp. (12.5%), Dowa Holdings Co. Ltd. (6.25%) and Furukawa Co. Ltd. (6.25%). Production began in 1972 but was suspended from 1999 to 2003. Taseko restarted the mine in 2004 and carried out modernization between 2009 and 2012, which included expanding mill capacity to 85,000 tpd, and building a separate molybdenum circuit. In 2013, the mine completed its first full year of operation after this modernization.

Gibraltar is projected to produce 130 Mlb ($\pm 5\%$) Cu in 2020. By the end of the third quarter, the company had produced 98.1 Mlb Cu and 1.72 Mlb Mo. Reserves as of December 2019 (Table 1), support a 20-year projected mine life. Taseko has a multi-year permit for exploration north and northwest of the mine. They reported about 4000 m of mostly diamond drilling in 2020 (Table 1).

Ore comes from five pits (Connector, Gibraltar, Granite, Extension, and Pollyanna), but not all operate each year. Granite and Polyanna produced in 2020 and the Gibraltar pit is scheduled for mining in 2021. The calc-alkaline porphyry Cu-Mo deposit is in the Granite Mountain batholith (Upper Triassic; van Straaten et al., 2013; Schiarizza and Friedman, 2021a) in a fault-bounded section of Nicola Group and Dragon Mountain succession volcanic and sedimentary rocks (Quesnel terrane; Schiarizza 2014, 2015, van Straaten et al., 2020) bounded by Cache Creek terrane rocks to the east and west.

3.1.4. Highland Valley Copper (Teck Resources Limited)

Ore from the **Highland Valley Copper (HVC)** copper-molybdenum mine (Fig. 1; Table 1) comes from the Highmont East, Valley and Lornex pits, three of seven in the camp. Projected 2020 production is 120,000-125,000 t Cu and 3.4-4.0 Mlbs Mo in concentrate. Three-year guidance (2021-23) is 145,000-165,000 tpy Cu and 3.0-4.5 Mlbs/y Mo. After 2023, copper production is to average about 150,000 tpy to the end of the current mine plan in 2027.

Mining in the Highland Valley camp began at the Bethlehem Mine in 1962. Bethlehem was last active in 1982 but Teck proposes to return to the area as an extension project, with pushback and deepening of the Jersey and Iona pits and extracting 137 Mt of ore with average grades of 0.287% Cu and 0.0048% Mo. The HVC Bethlehem Extension now has a Mines Act permit.

The HVC 2040 extension project is at the pre-feasibility

stage. If implemented, it could extend mine life 13 years to 2040 or beyond and raise the average production rate to 175,000 tpd. Annual production of copper would increase 25% to 182,700 Mt and production of molybdenum would increase 93% to 8.5 Mlbs. Pre-feasibility level engineering suggests the project is viable and it entered the environmental assessment process in 2019.

All mineralization at Highland Valley is calc-alkaline Cu-Mo type in the Guichon Creek batholith (Upper Triassic), which has been divided into several pre-, syn- and post-mineral phases (see Byrne et al., 2013, 2020).

3.1.5. Mount Polley (Imperial Metals Corporation)

Mount Polley is a 20,000 tpd open-pit operation that also has underground resources (Fig. 1; Table 1). Opened in 1997, operations were suspended in 2001 when copper prices were low. It reopened in 2005, but a tailings dam breach forced another suspension in 2014-15. It has been on care and maintenance since May 2019 because of low copper prices. Current reserves would sustain six to seven years of mining at previous rates.

Rehabilitation work on Hazeltine Creek is ongoing. Exploration in 2020 included an 81.5 line-km IP survey and fall-winter drilling in the Frypan/Morehead area northwest of the mine. An IP survey over the mine site guided interpretation of the exploration area survey. Magnetic and soil surveys also helped prioritize targets. The company has a multi-year permit for drilling and completed approximately 4000 m in 6 holes in 2020.

The deposits at **Mount Polley** are alkalic porphyry Cu-Au in the syenitic to monzodioritic Polley stock (Upper Triassic-Lower Jurassic), which intrudes Nicola Group volcanic rocks. At least eight discrete mineralized zones have contributed to production or host resources (see Rees, 2013, Brown et al., 2016; Rees et al., 2020).

3.1.6. New Afton (New Gold Inc.)

The **New Afton** gold-copper mine (Fig. 1; Table 1) is a block cave operation that opened in mid-2012 (Hall and May, 2013). The known New Afton deposits form a high-grade keel beneath the past-producing (1978-1997) Afton open-pit mine, an alkalic porphyry in the Iron Mask batholith (Upper Triassic). In 2015, the company installed a 14,000 tpd mill. The mine produced 53.6 Mlbs copper and 47,858 oz Au in the first three quarters of 2020. Guidance for the year is 190,000 to 220,000 Au equivalent oz, or approximately 65-75 Mlbs Cu and 62,000-72,000 oz Au including Ag by-product. As of the end of Q3 they expected to finish in the middle of this guidance range.

Underground drilling included delineation of the East Extension zone. Surface drilling started in late October on the Cherry Creek trend, 3 km west of the mine's mill. Phase 1 is a 10,000 m program to test both epithermal and porphyry targets along a 12 km trend. New Gold also carried out soil surveys and mapping on the broader claim block. The main targets are

alkalic porphyry Cu-Au hosted by the Iron Mask batholith and volcanosedimentary rocks of the Nicola Group (Upper Triassic; Lipske et al., 2020).

3.2. Selected industrial mineral mines

More than a dozen industrial mineral quarries and processing plants are in the region (Fig. 1; Table 2). In addition, nearly 300 sand and gravel pits and 45 quarries have active Mines Act permits, although many are intermittently active.

3.2.1. Ashcroft (IG Machine and Fiber Ltd.)

IG Machine and Fiber Ltd, a subsidiary of IKO Industries Ltd, operates the **Ashcroft** basalt quarry and roofing granule plant. They began production in 2001 and now typically produce around 300,000 tpy. The quarry is permitted to mine 500,000 tpy and about 60% is processed into granule products. It has reserves of about 13.3 Mt.

3.2.2. Harper Ranch and Falkland (Lafarge Canada Inc.)

After operating intermittently for many years supplying cement to western Canada, the Kamloops cement plant and **Harper Ranch** limestone quarry of Lafarge Canada Inc. are now on care and maintenance. The facility will continue to serve as a distribution point for cement produced in Alberta. Apart from limestone, the cement plant used gypsum and anhydrite mined at the **Falkland** quarry, which still supplies gypsum for other uses including agriculture.

3.2.3. Kettle Valley quarries (Kelowna Sand and Gravel Ltd.)

Decorative rock and dimension stone are produced from small quarries throughout the region. Kelowna Sand and Gravel Ltd. mines gneiss, dacite tuff, and basalt at the Nipple Mountain, Kettle Valley, Canyon, and Gemini quarries and has been issued permits to explore other sites. Kettle Valley Stone Company of Kelowna produces flagstone, ashlar, facing stone, and landscape rock.

3.2.4. Nazko (Canlava Mining Corp.)

Canlava Mining produces red and black scoria from the **Nazko** quarry for geotechnical and other applications requiring lightweight fill. It is also sold for landscaping.

3.2.5. Red Lake and Bud (Absorbent Products Ltd.)

Absorbent Products Ltd. produces diatomaceous earth from the **Red Lake** quarry, and bentonite from the **Bud** quarry to manufacture cat litter, barn deodorizer, industrial absorbents, and carriers for agricultural products at their plant in Kamloops.

3.2.6. Bromley Creek (International Zeolite Corp.)

In 2014, Canadian Mining Company Inc. a subsidiary of International Zeolite, concluded its option agreement with Heemskirk Canada Ltd and regained control of the **Bromley Creek** zeolite quarry. Absorbent Products Ltd. mines zeolite

Table 2. Selected industrial mineral mines and quarries, South Central Region.

Mine	Operator (partner)	Commodity; deposit type; MINFILE	Forecast 2020 Production (based on Q1- Q3)	Reserves	Resource	Comments
Ashcroft	IG Machine and Fibers Ltd. (IKO Industries Ltd.)	Basalt (roofing granules); 092INW104	300,000 t (approx. target)	na	Approx. 13.3 Mt in 2002	Typically mines 500,000 t with 60% processed into granule products.
Bromley Creek (Zeotech)	Absorbent Products Ltd. (owner International Zeolite Corp.)	Zeolite; Open system zeolites; 092HSE243	na	na	M+I: (as of 2013-06-30); 550,000 t	
Bud	Absorbent Products Ltd.	Bentonite; 092HSE162	na	na	na	
Falkland	Lafarge Canada Inc.	Gypsum; 082LNW001	na	na	na	Finding alternate uses since closure of Lafarge's Kamloops cement plant.
Kettle Valley Quarries	Kelowna Sand and Gravel Ltd./Kettle Valley Stone Company	Ashlar, flagstone, thin veneer; 082ENW109, 111, 112	na	na	na	
Klinker	Opal Resources Canada Inc.	Opal; 082LSW125	Intermittent operation	na	na	
Nazko	CanLava Mining Corporation	Lava Rock; Cinder cone; 093B 060	na	na	Historical: 45 Mt	
Red Lake	Absorbent Products Ltd.	Diatomaceous earth; Lacustrine diatomite; 092INE081	na	na	na	
Z-1	Progressive Planet Solutions Inc.	Zeolite; Open system zeolites; 092INW095	na	na	Approx. 800,000 t	Historical resource.

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

with agricultural and absorbent applications from the quarry. International Zeolite reported a decrease in sales, which they attribute to the Covid-19 pandemic.

3.2.7. Z-1 (Progressive Planet Solutions Inc.)

The Z-1 mine is now owned by Progressive Planet Solutions, formerly Ashburton Ventures Inc. ZMM Canada Minerals Corp. is the operator. Their product is currently used as an agricultural feed additive, a growth medium, a filtration medium, a component of lightweight concrete, and for soil remediation.

4. Placer mines

The region has more than 650 placer mines. Most of these operations are small, intermittent or seasonal, and production data are not available.

5. Mine development

Mine development projects are those that have a positive production decision and key government approvals and on-site construction has begun. No major projects meet these criteria in the South Central Region.

6. Proposed mines

Proposed mines are defined as feasibility-stage projects for which the process of formal socioeconomic and environmental review has begun. For projects that exceed thresholds set by the British Columbia Environmental Assessment Act (or its federal equivalent), reviews are coordinated by the British Columbia Environmental Assessment Office and Canadian Environmental Assessment Agency. Smaller projects are reviewed by an interagency Mine Development Review Committee (MDRC) chaired by the Ministry of Energy, Mines and Low Carbon Innovation. Four projects are in this category: **Ajax**, **Cariboo Gold**, **New Prosperity**, **Ruddock Creek** (Fig. 1; Table 3). Two projects, Taseko Mines Limited's **Yellowhead** and Spanish Mountain Gold Ltd.'s **Spanish Mountain** are active but have terminated or withdrawn environmental assessments. **Ajax** was rejected by both provincial and federal levels of government, and New Prosperity's provincial certification may expire in early 2021, having been extended 12 months. In none of these cases has the operator abandoned their project.

6.1. Ajax (KGHM Ajax Mining Inc.)

The **Ajax** porphyry copper-gold project, owned by KGHM Ajax Mining Inc., is an 80:20 joint venture between KGHM

Polska Miedź S.A. and Abacus Mining and Exploration Corporation. Mineralization is in the Iron Mask batholith, a multi-phase Triassic alkalic intrusive complex. A revised Feasibility Study released in 2016 modelled Ajax as a 65,000 tpd open-pit mine with a projected 18-year life. In December 2017, the project was denied certification by the British Columbia Ministries of Environment and Climate Change Strategy and Energy, Mines and Petroleum Resources. In June 2018, the Ministers of Natural Resources and Fisheries, Oceans and the Canadian Coast Guard denied federal certification. Although KGHM Ajax has not announced plans for the site, Abacus issued an update stating that the project remains a priority and that they have begun re-engaging those potentially affected by it and considering whether to reapply for environmental certification.

6.2. Cariboo Gold (Osisko Development Corp.)

Barkerville Gold Mines Ltd., operator of the **Cariboo Gold** project, became a subsidiary of Osisko Gold Royalties Ltd. in 2019. In 2020, Osisko placed the project in a new company, Osisko Development Corp. and raised funds to advance its projects.

The project entered the early engagement phase of the

Table 3. Selected proposed mines or quarries, South Central Region.

Project	Operator (partner)	Commodity; deposit type; MINFILE	Reserves	Resource	Comments
Ajax	KGHM Ajax Mining Inc. (KGHM Polska Miedź SA 80%, Abacus Mining and Exploration Corporation 20%)	Cu, Au; Alkalic porphyry; 092INE012, 13	P+Pr (NSR cut-off US\$7.10/t): 426 Mt 0.29% Cu, 0.19 g/t Au, 0.39 g/t Ag	M+I (NSR cut-off US\$7.10/t): 568 Mt 0.26% Cu, 0.18 g/t Au, 0.35 g/t Ag	Environmental certification denied by provincial (2017) and federal ministers (2018). Proponents are investigating a possible re-submission.
Cariboo Gold Project	Osisko Development Corp.	Au; Au-quartz veins; 093H 140, 139, 19, 6	na	M+I: 21.441 Mt 4.6 g/t Au Inf: 21.649 Mt 3.9 g/t Au	Updated project description has average production rate of 4750 tpd and mine life up to 15 years. Ongoing exploration drilling.
New Prosperity	Taseko Mines Limited	Cu, Au; Porphyry; 092O 041	P+Pr (NSR cut-off \$5.50/t): 831 Mt 0.23% Cu, 0.41 g/t Au containing (recoverable) 3.6 Blb Cu, 7.7 Moz Au	M+I (cut-off 0.14% Cu): 1010 Mt 0.24% Cu, 0.41 g/t Au	Granted provincial environmental certificate and time extensions but denied federal approval. Taseko and Tsilhqot'in Nation in discussion.
Ruddock Creek	Ruddock Creek Mining Corporation (Imperial Metals 45.3%, Mitsui Mining and Smelting Co. 30%, ITOCHU Corp. 20%, JOGMEC 4.7%)	Pb, Zn, Ag; Broken Hill-type; 082M 082	na	M+I (cut-off 4.0% Pb+Zn): 6.2 Mt 6.50% Zn, 1.33% Pb Inf: 6.678 Mt 6.33% Zn, 1.20% Pb	Project at environmental assessment pre-application stage. Feb 2013 resource, prior to 2018-2019 drilling.

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

provincial environmental assessment process in 2019. In 2020, Osisko submitted a revised project description to the British Columbia Environmental Assessment Office. Proposed average production rate is 4750 tpd with a projected mine life up to 15 years. Revised resource estimates in all zones at a 2.1 g/t Au cut-off total was 21.441 Mt at 4.6 g/t Au in Measured and Indicated categories, and 21.649 Mt at 3.9 g/t Au in Inferred category. A concentrator on site would serve as a pre-concentrator to reduce transportation costs to the QR mill, 111 km away. Tailings generated at the mine site would be disposed of as paste backfill. Tailings at the mill site would be dry stacked. The QR mill currently has a capacity of 850 tpd and would require modification to process the higher feed grades of the pre-concentrated material.

A large exploration project was carried out in 2020, with six to eight drill rigs operating late in the year. The company expected about 59,000 m in 216 core holes by the end of the year. To date, the highest-grade intersection is 6530 g/t Au along 0.50 m. An underground bulk sample is in permitting stages. This drift would provide access to Cow Mountain through a portal on the Bonanza Ledge access road and create platforms for underground drilling.

Bonanza Ledge (see section 3.1.1.) is a smaller, near-term producer, part of Osisko's larger Cariboo Gold project. They expect to resume mining in 2021 with a two-year mine plan.

Mineralization is orogenic vein and replacement type (Fig. 2). Allan et al. (2017) reported $^{40}\text{Ar}/^{39}\text{Ar}$ muscovite ages, considered to mark the time of mineralization, of 148-135 Ma.

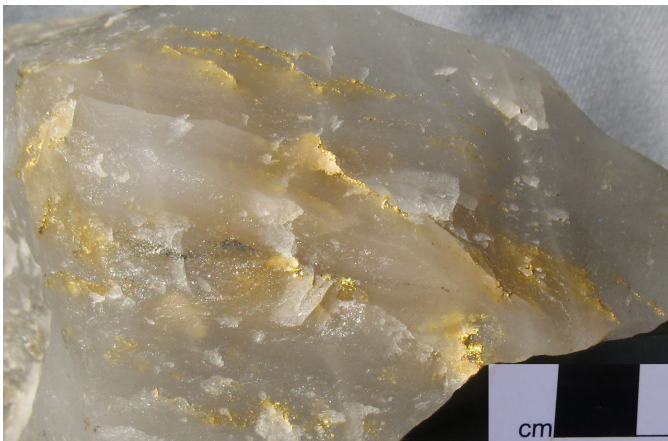


Fig. 2. Free gold in quartz from the historic Cariboo Gold Quartz mine, now part of Osisko Development Corp.'s Cariboo Gold project.

6.3. New Prosperity (Taseko Mines Limited)

The **New Prosperity** project is a porphyry gold-copper deposit with Proven and Probable reserves of 830 Mt grading 0.42 g/t Au and 0.23% Cu. In 2014, the federal government issued a decision to deny the project. Taseko was later unsuccessful in seeking a judicial review of this decision. British Columbia extended the expiry date of the project certificate that was granted to Taseko in 2010 to early 2021. In 2017, the British

Columbia Ministry of Energy, Mines and Petroleum Resources issued a permit for a detailed site investigation of the proposed mine infrastructure.

The most recent activity concerning this project has been in the courts. The Tsilhqot'in Nation challenged the 2017 permit arguing the province breached its duty to consult and accommodate. In 2019, the case reached the Supreme Court of Canada, which ruled that Taseko could proceed with investigative work. However, before the work could begin, the Tsilhqot'in Nation filed a complaint on different grounds, infringement of aboriginal rights, and a new injunction halted work. Taseko and the Tsilhqot'in Nation, facilitated by the provincial government, have since agreed to suspend litigation and regulatory matters as they discuss the conflict in confidence.

6.4. Ruddock Creek (Imperial Metals Corporation 45.3%; Mitsui Mining and Smelting Co. Ltd. 30%; Itochu Corporation 20%; Japan Oil, Gas and Metals National Corporation 4.7%)

The **Ruddock Creek** project remains in the pre-application phase of environmental assessment. A mineral resource estimate, released in March 2012, reported 4.65 Mt grading 6.77% Zn and 1.38% Pb (Indicated) and 5.38 Mt grading 6.69% Zn and 1.31% Pb (Inferred), using a 4.0% combined Pb+Zn cut-off. Ruddock Creek Mining Corporation is the operator and manager of the joint venture.

The deposit is described as sedimentary exhalative, Monashee or Broken Hill-type, in marble, gneiss, and calc-silicate rocks. The joint venture operators reported positive 2018 and 2019 drill results on deep targets at the western edge of the deposit. They did not report 2020 exploration.

7. Selected exploration activities and highlights

Exploration spending in 2020 was predominantly for gold. The largest exploration project was Barkerville Gold Mines Ltd.'s **Cariboo Gold**, now a proposed mine (see section 6.2.). Companies working in the Cariboo gold fields have expanded and consolidated their tenure holdings and there were significant programs by Kore Mining Ltd. at **FG** and Omineca Mining and Metals Ltd. at **Wingdam**. Talisker Resources Ltd. continued drilling at **Bralorne**, (see section 7.1.2.). Westhaven Gold Corp. followed 2018 and 2019 programs with a larger drill program at **Shovelnose**. Exploration continued for other gold targets, porphyry copper deposits, skarn deposits (copper, tungsten), stratiform base and precious metals, mafic- and ultramafic-hosted sulphides, and industrial minerals (Fig. 1; Table 4).

7.1. Selected precious metal projects

The South Central Region has many precious metal deposit types including: orogenic veins; transitional veins; epithermal veins; hot spring systems; replacement deposits; skarns; sediment-hosted deposits; and intrusion-related breccias. Several more properties were active than listed below.

Table 4. Selected exploration projects, South Central Region.

Project	Operator (partner)	Commodity; deposit type; MINFILE	Resource (NI 43-101 compliant unless indicated otherwise)	Comments
Alwin Mine	GSP Resource Corp.	Cu, Ag; Cu; ±Ag quartz veins; Porphyry Cu+/-Mo+/-Au; 092ISW010, 21	Historical: 390,000 t 11.7 g/t Ag, 0.69 g/t Au, 2.5% Cu	Drilling, approximately 2000 m in 10 holes. Initial result 12.1 m grading 2.27% Cu.
Blackdome-Elizabeth	Tempus Resources Ltd.	Au, Ag; Au quartz veins, Epithermal Au-Ag-Cu low sulphidation; 092O 053, 12	I: 144,500 t 11.29 g/t Au, 50.01 g/t Ag Inf: 90,600 t 8.79 g/t Au, 18.61 g/t Ag	Drilling, 5087 m in 26 holes at Blackdome; 2400 m in 12 holes at Elizabeth.
Bralorne	Talisker Resources Ltd.	Au; Au-quartz veins; 092JNE001	M+I: 260,000 tons 0.351 oz/ton Au Inf: 317,000 tons 0.231 oz/ton Au	Drilling, 23,000 m planned by year end. Updated resources estimate not including latest drilling. Example highlight intersection 995 g/t Au along 0.5 m within 227.55 g/t Au along 2.25 m.
Copperview	Golden Lake Exploration Inc.	Cu, Au; Porphyry Cu-Au (alkalic); 092HNE296, 320	na	Prospecting, geological mapping, rock and soil sampling.
Dictator	Eagle Plains Resources Ltd.	Au, Ag; Polymetallic veins Ag-Pb-Zn±Au; 082ENE022, 23, 73, 72	na	Drone magnetic survey (108 line-km). Prospecting and soil sampling. Grab samples up to 39.4 g/t Au, 912 g/t Ag.
Donna	Eagle Plains Resources Ltd.	Au, Ag; Polymetallic veins; 082LSE022, 10, 20, 16	na	Airborne magnetic and radiometric survey (211 line-km). Property expanded. Drilling started but suspended due to weather.
Elk	Gold Mountain Mining Corp.	Au, Ag; Au quartz veins; 092HNE009, 295, 41, 261	M+I: 2,699,000 t 5.22 g/t Au, 9.23 g/t Ag Inf: 454,000 t 6.4 g/t Au, 14.17 g/t Ag	Preliminary economic assessment, drilling 3200 m 12 holes.
Empirical	Clarity Gold Corp.	Cu, Mo, Au; Porphyry Cu+/-Mo+/-Au; 092INW088, 90	na	Technical report, sampling.
FG	Kore Mining Ltd.	Au, Ag; Au-quartz veins; 093A 061	M: 5,600,000 t 0.812 g/t Au I: 9,570,000 t 0.755 g/t Au Inf: 27,493,000 t 0.718 g/t Au	Drilling, approximately 7400 m in 23 holes. Expanded land position.
Fox Tungsten	Happy Creek Minerals Ltd.	W; W skarns; 093A 259, 260, 261, 211	I: 582,000 t 0.826% WO ₃ Inf: 565,400 t 1.231% WO ₃	Drilling, approximately 1100 m in 7 holes.
Gold Creek	Kore Mining Ltd.	Au, Ag; Au-quartz veins; 093A 127	na	Drilling, 1550 m in 5 holes (early December).
Goldrange	Kingfisher Resources Ltd.	Au, Ag; Cu±Ag quartz veins; 092N 058, 59, 47, 57, 48	na	Geological mapping, rock and soil sampling, airborne magnetic and lidar surveys.
Heffley Creek	Progressive Planet Solutions Inc.	Au, Ni, Cr, Pozzolan; unknown ultramafic; No MINFILE	na	Rock and soil geochemistry.

Table 4. Continued.

Highland Valley project (West Valley-Rateria)	Happy Creek Minerals Ltd.	Cu, Mo, Au, Ag, Re; Porphyry Cu±Mo±Au; 092ISE199	na	Drilling approximately 2400 m in 5 holes.
IKE	Amarc Resources Ltd.	Cu, Mo, Ag; Porphyry Cu±Mo±Au; 092O 025, 67	na	Technical report and surface work (geology, geochemistry, geophysics).
Lac La Hache	Engold Mines Ltd.	Cu, Au, Ag, Fe; Alkalic porphyry Cu-Au, Cu skarn; 092P 120, 108, 2, 153	Aurizon Inf: 1,073,000 t 2.48 g/t Au, 0.64% Cu, 5.98 g/t Ag Spout zone I: 7.6 Mt 0.28% Cu, 0.05 g/t Au, 1.26 g/t Ag, 11.4% magnetite Inf: 15.8 Mt 0.21% Cu, 0.04 g/t Au, 0.93 g/t Ag, 8.32% magnetite	Drilling at Ann North, G1 and recently discovered Road Gold zone. Highlight intersection 22.4 m grading 1.29% Cu, 0.11 g/t Au 4.36 g/t Ag and 26.91% Fe at G1.
Lightning Strike	Cariboo Rose Resources Ltd.	Au, Ag; Au-quartz veins; 093A 250	na	Rock and soil sampling. Approximate 1500 m north-south anomaly.
Mal-Wen	Victory Resources Corporation	Cu, Au, Ag; Fe skarns, Cu skarns, Au skarns; 092HNE002, 58, 59	na	Geological mapping, sampling, magnetometer survey.
Merit and Nicoamen (separate properties)	Independence Gold Corp.	Au, Ag; Epithermal Au-Ag; 092ISW106, 132, 131	na	Mapping and sampling. Highlight 7.69 g/t Au and 447 g/t Ag.
Miner Mountain	Sego Resources Inc.	Cu, Au; Alkalic porphyry Cu-Au; 092HSE203, 78	na	Trenching and drilling 3970 m. Granby mineralization extended 80 m.
MPD	Kodiak Copper Corp.	Cu, Au; Alkalic porphyry Cu-Au; 092HNE243, 55, 191, 244	na	Drilling approximately 7000 m in 10 holes, magnetic and ZTEM surveys. Highlight 282 m grading 0.70% Cu and 0.49 g/t Au.
Mt. Riordan	Garnet Peak Resources Inc.	Garnet; Garnet skarns; 082ESW102	Historical: 11,848,200 t 78% (west); 17,955,000 t 80% (north); 10,663,380 t 77% (south)	Mainly permitting, community relations. Permit received for drilling and bulk sample.
New Craigmont	Nicola Mining Inc.	Cu, Au; Cu skarn; 092ISE035	Inf: 18.669 Mt 0.13% Cu	Portal area and southern waste dump resource estimate. Metallurgical testing.
Prospect Valley	Westhaven Gold Corp.	Au, Ag; Epithermal Au-Ag-Cu low sulphidation; 092ISW111, 107	Inf: 10,077,000 t 0.511 g/t Au	Ground magnetic survey (244 line-km).
Reliance	Endurance Gold Corporation	Au, Sb, Ag; Au quartz veins, stibnite veins and disseminations; 092JNE033, 136, 191	na	Reverse circulation drilling 978 m in 17 holes. Rock channel sampling highlight of 8.97 g/t Au along 9.6 m.

Table 4. Continued.

Shovelnose	Westhaven Gold Corp.	Au, Ag; Epithermal Au-Ag-Cu low sulphidation; 092HNE309, 308	na	Drilling, 43,000 m in 100 holes. Highlights included outcrop discovery of Franz zone (51.10 g/t Au and 165.00 g/t Ag grab, 7.78 m 14.84 g/t Au and 39.4 g/t Ag drill intercept) 2.8 km from South zone. FMN zone discovered between Franz and South zone (5.5 m 4.58 g/t Au, 267.4 g/t Ag). Several other targets identified.
Spanish Mountain	Spanish Mountain Gold Ltd.	Au, Ag; Au-quartz veins; 093A 043	M+I: 273.2 Mt 0.47 g/t Au, 0.71 g/t Ag Inf: 52.4 Mt 0.37 g/t Au, 0.67 g/t Ag	Exploration drilling, geotechnical drilling, test pits. Began Preliminary Feasibility Study.
Spences Bridge and Regional	Talisker Resources Ltd.	Au, Ag; Epithermal Au-Ag-Cu low sulphidation; 092O 54, 60, 143, 092INW092, 110, 092ISW118, 124, 84	na	Large regional prospecting and sampling program continued in 2020. About 6000 soil samples, mapping, talus fines sampling, rock sampling.
Spitfire-Sunny Boy	Falcon Gold Corp.	Au, Ag, Cu, Mo; Polymetallic veins; 092ISE049, 48, 118, 119, 117	na	Reconnaissance exploration. Channel sample grading 122 g/t Au along 1 m.
Trans Canada	ZMM Canada Minerals Corp.	Zeolite; Open-system zeolites; 082LNW102	na	Continuing bulk sample.
Treasure Mountain	Nicola Mining Inc.	Ag, Pb, Zn; Polymetallic veins; 092HSW066, 117, 48, 116, 092HSE240, 136, 261, 75	I: 33,000 t 828 g/t Ag, 3.8% Zn, 4.16% Pb Inf: 120,000 t 925.6 g/t Ag, 4.36% Zn, 2.79% Pb	Rock and soil sampling. Highlight grab samples of 1300 g/t Ag and 1040 g/t Ag.
Wingdam	Omineca Mining and Metals Ltd.	Au; Au-quartz veins; 093H 012	na	Drilling, approximately 300 m in 13 holes (program to continue into 2021). Airborne magnetic survey.
Woodjam	Consolidated Woodjam Copper Corp.	Cu, Au; Alkalic porphyry Cu-Au; 093A 269, 78	Inf: 227.5 Mt 0.31% Cu (Woodjam South) Inf: 32.8 Mt 0.22% Cu, 0.59 g/t Au (Deerhorn) Inf: 8.3 Mt 0.22% Cu, 0.26 g/t Au (Takom)	Drilling, 1737 m in 4 holes at Deerhorn. Highlight intersection of 110 m 2.57 g/t Au and 0.44% Cu including 26 m of 5.89 g/t Au and 0.92% Cu. IP survey at Megaton target.
Worldstock	Pacific Empire Minerals Corp.	Cu; Porphyry Cu-Au (alkalic); 092P 145	na	Drilling, 1027 m in 10 reverse circulation holes.
Yellowhead	Taseko Mines Limited	Cu, Au, Ag; Noranda/Kuroko; 082M 008, 9	M+I: 1292 Mt 0.25% Cu, 0.028 g/t Au, 1.2 g/t Ag Inf: 109 Mt 0.21% Cu, 0.024 g/t Au, 1.2 g/t Ag	Updated Feasibility Study considers a 25-year 90,000 tpd open pit operation. Proven + Probable reserves are 817 Mt 0.28% Cu.

M = Measured; I = Indicated; Inf = Inferred

7.1.1. Blackdome-Elizabeth (Tempus Resources Ltd.)

Tempus Resources Ltd. acquired the **Blackdome-Elizabeth** project when it bought Sona Resources Corp., a subsidiary of Skeena Resources Ltd. in 2019. In 2020, they drilled 5087 m in 26 holes at Blackdome and completed about 2400 m in 12 holes of a planned 6000 m program at Elizabeth before shutting down for winter. Highlight results at Blackdome included 0.6 m grading 28.3 g/t Au and 513 g/t Ag. The linked Blackdome and Elizabeth properties were the subject of a 2010 Preliminary Economic Assessment in which mining would occur at both sites, with processing at an existing mill at Blackdome. Tempus is focussed on verifying and expanding the existing resource (Table 4).

Blackdome (Fig. 3) is a low-sulphidation epithermal deposit in Cenozoic intermediate to felsic volcanic rocks. Elizabeth, 30 km south, is a series of veins in a Paleocene quartz diorite intrusion in the Shulaps ultramafic complex. Historically they

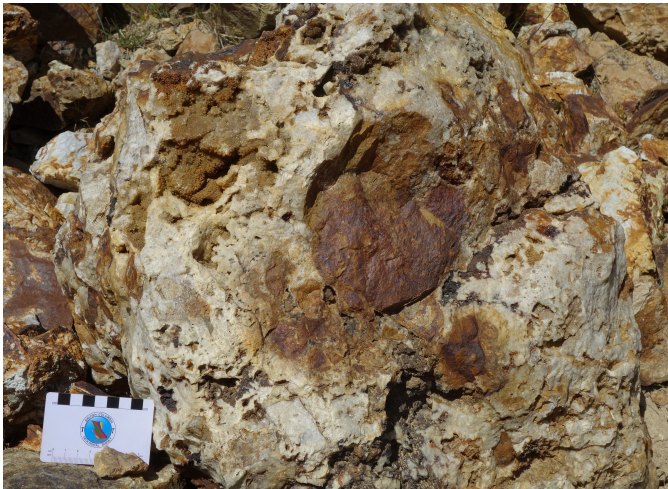


Fig. 3. Vuggy open-space quartz and limonitic volcanic clasts in a trench exposure of the Giant Vein, one of the drill targets at Tempus Resources' Blackdome epithermal gold property.

have been compared to the Bralorne-Pioneer orogenic deposits.

7.1.2. Bralorne (Talisker Resources Ltd.)

In December 2019, Talisker Resources Ltd. closed its acquisition of Bralorne Mines Ltd., operator of the past-producing **Bralorne** gold mine, which last operated between 2010 and 2014 when it suspended operation because the tailings storage facility reached capacity. The mine had been operating at a 100 tpd trial basis. The 100 tpd mine permit was updated in 2017, but both the previous and current operator anticipate a larger operation.

Talisker planned 23,000 m of drilling in 2020, continuing into early 2021. Target veins are near the mine. Highlight intersections include 995 g/t Au along a 0.5 m interval within 2.25 m grading 277.55 g/t Au. Between 1928 and 1971, the Bralorne camp produced 4.15 Moz Au at average grades of about 15 g/t Au. Veins have characteristics typical of orogenic gold deposits; the age of mineralization is estimated at ca. 68-

64 Ma ($^{40}\text{Ar}/^{39}\text{Ar}$ muscovite; Hart and Goldfarb, 2017).

7.1.3. Dictator (Eagle Plains Resources Ltd.)

Eagle Plains Resources flew a 108 line-km drone magnetic survey at the **Dictator** (Formerly Lightning Peak) property. Work in October included a soil survey and prospecting, which is to be completed in 2021. Property owner Milo Mielnichuk sampled float up to 5.84 g/t Au, 30.6 g/t Ag, 33,680 ppm Pb, and 674 ppm Zn earlier in the year. Other grab samples from old workings ran as high as 39.4 g/t Au and 912 g/t Ag. Known targets include gold- and silver-bearing quartz veins.

7.1.4. Donna (Eagle Plains Resources Ltd.)

Eagle Plains flew a 211 line-km magnetometer and radiometric survey at the **Donna** project over the St. Paul and Morgan past producers, recently added to the property. Drilling started in October but was suspended after 300 m due to an unusually heavy snowfall. Targets include near-surface intrusion-related gold at a gold-in-soil anomaly and in the Morgan mine area.

7.1.5. Elk (Gold Mountain Mining Corp.)

Freeform Capital Partners Inc. and Bayshore Minerals Incorporated are combining to operate under the name Gold Mountain Mining Corp., a subsidiary of Bayshore which holds the **Elk** property. Before the deal, Freeform reported results of a Preliminary Economic Assessment including an updated resource estimate with Measured and Indicated resources of 2,699,000 t at 5.22 g/t Au and 9.23 g/t Ag, and Inferred resource of 454,000 t at 6.40 g/t Au and 14.17 g/t Ag that support a conceptual 10-year 70,000 tpy mine. Bayshore reported a 3200 m, 21-hole drill program in the fall, before the planned reverse takeover was completed. **Elk** produced about 51,500 oz of Au between 1992 and 1995 from 14,730 t of ore, mainly from an open pit. Bulk sampling resumed in 2012-14 when 7761 t with average grade 14.81 g/t Au were processed. Gold is hosted in quartz-sulphide veins, mainly in the Osprey Lake batholith (Middle Jurassic) near an intrusive contact with Nicola Group volcanic rocks. The quartz veins may be related to later Otter feldspar porphyry dikes and stocks.

7.1.6. FG (Kore Mining Ltd.)

Kore Mining Ltd. drilled 5746 m in 15 holes at the **FG**, reporting highlight intersections including 11.0 m grading 10.0 g/t Au near surface. They also reported a discovery, the Lower Zone, below the existing FG resource where they intersected 52.5 m of 1.1 g/t Au. Highlight intersections in the Lower zone include a step out 215 m down dip returning 31.3 m grading 3.2 g/t Au. The property is underlain by Triassic shale and siltstone mapped as Slokan Group. Kore increased their tenure holdings in the area in 2020. They are considering placing their Cariboo gold properties in a company separate from their more advanced projects.

7.1.7. Gold Creek (Kore Mining Ltd.)

By early December, Kore drilled 1550 m in 5 holes at the **Gold Creek** orogenic gold project, part of their Cariboo land

holdings. Targets are gold-bearing quartz veins and stratabound vein zones in metasedimentary rocks, including a black phyllite. They compare the setting to that of the adjacent **Spanish Mountain** sediment-hosted vein deposit. The company is considering placing its British Columbia exploration properties in Karus Gold Corp., a company separate from its more-advanced US projects.

7.1.8. Goldrange (Kingfisher Resources Ltd.)

Kingfisher assembled the **Goldrange** property and conducted a grass roots program of soil and rock geochemical surveys, backpack drilling, geological mapping, an airborne magnetic survey and property-wide lidar. Targets are orogenic gold veins. Seashore Resources Partners Corp. is in the process of acquiring Kingfisher. The new company is to be named Kingfisher Metals.

The property covers several gold vein targets including possible orogenic and intrusion-related types in thrust-faulted, mainly Lower Cretaceous sedimentary and volcanic rocks at the northeastern margin of the Coast Plutonic complex and southwest of the Tchaikazan fault.

7.1.9. Lightning Strike (Cariboo Rose Resources Ltd.)

Cariboo Rose expanded their **Lightning Strike** property in the Cariboo region. They carried out rock and soil sampling (2000 samples indicating an approximately 1500 x 100 m north-south anomaly) and permitting for eventual trenching and drilling. Like **FG**, the property is underlain by Triassic shale and siltstone mapped as Slokan Group. Shale-hosted gold bearing veins are considered orogenic type.

7.1.10. Merit and Nicoamen (Independence Gold Corp.)

Independence Gold Corp. returned to the **Merit** and **Nicoamen** properties in the Spences Bridge belt, in 2020. They reported mapping and sampling, including a sample at **Merit** that returned 7.69 g/t Au and 447 g/t Ag about 70 m from a high-grade 2019 sample.

7.1.11. Prospect Valley (Westhaven Gold Corp.)

Work at **Prospect Valley** in the Spences Bridge belt included a 244 line-km ground magnetic survey over a 3 x 4 km area called the Bonanza Target, where a 43.34 g/t Au float sample of vein material was collected previously. The property has a 2012 lower-grade Inferred resource of 10.1 Mt grading 0.511 g/t Au.

7.1.12. Reliance (Endurance Gold Corporation)

Endurance carried out mapping and sampling in the Bridge River camp at the **Reliance** property. Work included biogeochemical and rock sampling. Highlight results of channel sampling included 8.97 g/t Au along 9.6 m at the Eagle South showing. Following up on the channel sampling, a reverse circulation drill program was underway in early December at the Imperial, Imperial North, Eagle South, and Eagle targets. They reported 978 m in 17 holes. The **Reliance** targets are

orogenic gold veins in shear zones in volcanic rocks and cherts of the Bridge River complex. The property has an historical resource of 410,916 t grading 5.96 g/t Au.

7.1.13. Shovelnose (Westhaven Gold Corp.)

Westhaven continued drilling the **Shovelnose** low-sulphidation epithermal prospect in 2020 with a 43,166 m program. In addition to continued drilling at the South zone, the 2018 discovery area and nearby Lear zone, new targets include the Franz zone, a prospecting discovery in outcrop approximately 2.8 km northwest of the South zone. Initial grab samples returned up to 51.10 g/t Au and 165.00 g/t Ag. Subsequent drill intersections included 7.78 m of 14.84 g/t Au and 39.40 g/t Ag. The company reports 5.50 m of 4.58 g/t Au and 267.40 g/t Ag at another newly discovered zone (FMN) between the South and Lear zones and the Franz zone. Shylock is another drill target, about 1.5 km southeast of the South zone. Westhaven reported several other targets 500 m to 4 km from the South zone emerging from 2019-20 geophysics, soil geochemistry, prospecting, and mapping.

7.1.14. Spanish Mountain (Spanish Mountain Gold Ltd.)

Spanish Mountain Gold Ltd. expects to deliver a Preliminary Feasibility Study for the **Spanish Mountain** gold property in the first quarter of 2021. The current Preliminary Economic Assessment is based on a Measured and Indicated resource of 273.2 Mt grading 0.47 g/t Au and 0.71 g/t Ag. In their phase one scenario, 39 Mt at an average diluted grade of 1.00 g/t Au and 0.74 g/t Ag would feed an 11-year, 10,000 tpd operation with average life of mine production of 104,000 oz/y Au. The new study is considering a 20,000 tpd mill throughput. The resource estimate is to be updated. The project was in the pre-application phase of environmental assessment since 2011 but the company withdrew at the end of 2019. They expect to resume under the new legislation when the project scope is finalized.

The company began drilling in the fall to expand resources in the Main zone. They drilled about 4500 m in 28 reverse circulation holes. There was additional sonic drilling for geotechnical purposes and some core drilling. They also dug 84 test pits. The deposit consists of disseminated gold in graphitic argillite and gold-bearing quartz veins in siltstone, greywacke, and tuff (Fig. 4). Host rocks are Upper Triassic and mineralization is Late Jurassic, older than that at the Cariboo

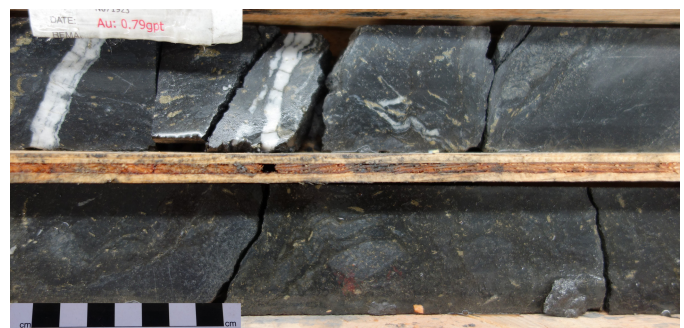


Fig. 4. Argillite with disseminated pyrite and quartz veins at Spanish Mountain. Grade is 0.79 g/t Au as indicated.

Gold project (Allan et al., 2017).

7.1.15. Spences Bridge regional program (Talisker Resources Ltd.)

Prompted by early signs of a significant epithermal gold discovery at Westhaven's **Shovelnose**, Talisker Resources now holds claims covering most of the Spences Bridge belt, which consists of Lower Cretaceous calc-alkaline volcanic rocks extending for 220 km along a northwest trend. The company conducted exploration across its 240,601 ha greenfield property portfolio, which includes about 194,000 ha along the belt.

Talisker resumed its **Spences Bridge** project in 2020 with a crew of 20 geologists collecting stream sediment samples and evaluating more than 100 anomalies found in a 2019 survey. The follow up included about 6000 soil samples from across three broadly prospective areas as well as mapping and stream, talus fine, and rock sampling. By the end of the season they reported generating 13 prospects.

7.1.16. Spitfire-Sunny Boy (Falcon Gold Corp.)

Falcon Gold acquired the **Spitfire and Sunny Boy** properties and carried out reconnaissance exploration. They reported epithermal-style veins and a channel sample grading 122.00 g/t Au along 1.0 m within 2.2 m grading 59.8 g/t Au. This confirms historical results for the Master Vein. They also collected a 22.8 g/t Au grab sample at the Cliff vein, discovered down slope.

7.1.17. Treasure Mountain (Nicola Mining Inc.)

At the **Treasure Mountain** property, Nicola Mining carried out rock and soil sampling, continuing a 2019 survey, and outlining a northwest-trending anomaly. Most work was north of the existing underground development. Highlights of vein grab samples included 1300 g/t Ag and 1040 g/t Ag. Portable drilling intersected several short high-grade zones including 589 g/t Ag along 15 cm and 489 g/t Ag along 34 cm.

The silver-lead-zinc mine produced in 2013 and is currently on care and maintenance. It has a permit for removal of 60,000 tpy to a mill offsite. Silver-lead-copper mineralization is in fault-hosted, sulphide-rich, quartz-carbonate veins.

7.1.18. Wingdam (Omineca Mining and Metals Ltd.)

Omineca, through its subsidiary CVG Mining Ltd., expanded its holdings around the **Wingdam** project and commenced a gold exploration project seeking lode gold sources of paleoplacer gold, which is the target of an underground bulk sampling project. The hard rock program is planned to include 9000 m of drilling in 27 holes, 2-3 km northwest of the placer operation. By the end of 2020, the company completed about 3000 m in 13 holes and flew an airborne magnetic survey.

The placer project had been on care and maintenance since 2012, but now dewatering of the underground workings has begun. Private companies have an option to earn up to 50% of that project by progressing to bulk sampling.

7.2. Selected porphyry projects

Although the focus of financing and exploration in 2020 largely centred on gold, porphyry copper projects also saw advances. Kodiak Copper intersected copper and gold at **MPD**, and work continued at **Miner Mountain**, **Woodjam**, and **Rateria-West-Valley**, and near mine sites described above.

7.2.1. Alwin Mine (GSP Resource Corp.)

GSP Resource Corp. reviewed historical data and commissioned a 3-D model for its **Alwin Mine** Cu-Ag-Au property in advance of drilling in the second half of the year. The first eight holes tested for replacement Cu sulphide mineralization, and subsequent drilling tested for porphyry alteration and mineralization to the north and south. The company drilled about 2000 m in 10 holes. Initial results included 12.1 m grading 2.27% Cu and 39.8 m grading 0.40% Cu near surface. Alwin produced copper, silver, and gold sporadically between 1916 and 1982.

7.2.2. Copperview (Golden Lake Exploration Inc.)

Following September drill results at MPD, Golden Lake Exploration Inc. assembled the **Copperview** property in the surrounding area. They completed initial reconnaissance including prospecting, mapping, and rock and soil geochemistry.

7.2.3. Empirical (Clarity Gold Corp.)

Grab samples at **Empirical** returned up to 1.97% Cu with Au, Mo, and Ag values. A 2020 technical report and historical reports describe sulphide occurrences consistent with porphyry Cu-Au-Mo mineralization. The property is mainly underlain by Cayoosh assemblage turbidic sandstone intruded by quartz diorite.

7.2.4. IKE (Amarc Resources Ltd.)

Amarc prepared a technical report on the **IKE** property and reported surface work (geological, geophysical and geochemical) in 2020. In addition to the porphyry Cu-Mo-Ag prospect, the property has porphyry Cu-Au-Mo-Ag, Cu-Au-Ag replacement, and Au-Ag epithermal targets. (Galicki et al., 2020).

7.2.5. Mal-Wen (Victory Resources Corporation)

Victory Resources Corporation announced a magnetometer survey, mapping, and sampling at its **Mal-Wen** property in September. Alkalic copper-gold mineralization is the target. Mal-Wen is in Nicola Group volcanosedimentary rocks that are intruded by Triassic-Jurassic rocks between Copper Mountain and New Afton where there are other active porphyry Cu-Au projects such as MPD and Miner Mountain.

7.2.6. Miner Mountain (Sego Resources Inc.)

Sego reported trenching at its Southern gold zone, with a highlight result of 30 m of 1.02 g/t Au. Drilling tested other targets in the Granby-Cuba area with four holes totalling 3970 m. A step out extended Granby mineralization by 80 m.

Miner Mountain has several alkalic porphyry Cu-Au and Au targets in a roughly 2 x 3 km area, much of which is under cover (see Britten et al., 2020).

7.2.7. Highland Valley (Happy Creek Minerals Ltd.)

Happy Creek Minerals Ltd. followed up an IP survey and mapping in 2019 with approximately 2400 m of drilling in five holes on their **Highland Valley (West Valley-Rateria)** project. The targets include the PIM, identified in 2019 in a recently logged area as a soil geochemical and IP anomaly with 0.4% Cu sampled in bedrock. Step outs at Zone 1 and Zone 2 were also priority targets. The property is in the Guichon batholith south of the Highland Valley Copper mine and north of the past producing Craigmont mine. It has about 25 known copper occurrences.

7.2.8. MPD (Kodiak Copper Corp.)

Following up on discoveries from work done in 2019, Kodiak Copper Corp. (previously Dunnedin Ventures Inc.), drilled on the **MDP** project, intersecting 282 m grading 0.70% Cu and 0.49 g/t Au at the Gate zone (Fig. 5). Complete results for the hole included 535.1 m of 0.49% Cu and 0.29 g/t Au. Another hole from the setup near the north end of an approximately 1 km long copper-in-soil anomaly had similar results at a depth of 308 to 500 m down the -71° hole. Kodiak is now funded for about 30,000 m of drilling, which will include step outs and other zones on the property. Approximately 7000 m in 10 holes were drilled in fall 2020. The company flew an airborne magnetic and ZTEM survey earlier in the year. MPD is a consolidation of the Man, Prime, and Dillard alkalic porphyry Cu-Au targets, which had historically been explored to about

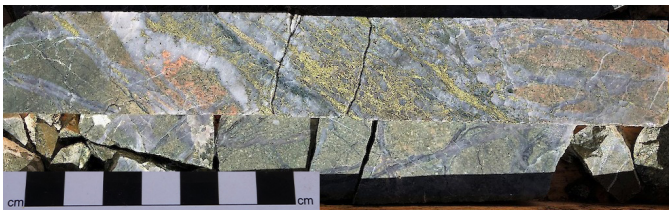


Fig. 5. Core from Kodiak Copper Corp.'s recently discovered Gate zone showing strongly chalcopyrite-mineralized quartz veins. Photo provided by Kodiak Copper Corp.

200 m depth.

7.2.9. Woodjam (Consolidated Woodjam Copper Corp.)

Consolidated Woodjam carried out drilling at the Deerhorn zone of the **Woodjam** project to test grade continuity and mineralization below previous drilling in a steeply dipping system. They also tested a parallel zone to the southwest and infilled and extended an IP survey on the Megaton target. A highlight result included 110 m of 2.57 g/t Au and 0.44% Cu including 26 m of 5.89 g/t Au and 0.92% Cu. Mineralization starts at 96 m down a -75° hole. Weather forced suspension of the program, which was to be extended based on initial results. The Woodjam project has a resource, including 32.8 Mt at 0.49 g/t Au and 0.22% Cu in the Inferred category at the

Deerhorn zone (Table 4). Woodjam comprises six zones in a cluster approximately 5 km in diameter. They exhibit both alkaline and calc-alkaline characteristics (see del Real et al., 2020).

7.2.10. Worldstock (Pacific Empire Minerals Corp.)

Pacific Empire has an option to acquire 100% of the **Worldstock** property, an alkalic porphyry Cu-Au target. They drilled 10 reverse circulation holes totalling 1027 m and used a mobile drill rig on tracks to test geophysical anomalies. They intersected copper and gold values in one of the holes. **Worldstock** is an early-stage porphyry Cu-Au target in Nicola Group volcanic and sedimentary rocks intruded by the Thuya batholith and Polaris ultramafic suite to the southwest, and by a small diorite stock to the northeast.

7.3. Selected polymetallic base and precious metal projects

The region has numerous polymetallic massive sulphide prospects, including those hosted by the Eagle Bay assemblage (e.g., Harper Creek, Samatosum, Rea, Yellowhead) and other Paleozoic strata. Few were active in 2020, with the notable exception of Yellowhead.

7.3.1. Yellowhead (Taseko Mines Limited)

The British Columbia Environmental Assessment Office terminated Yellowhead Mining Inc.'s Harper Creek copper project assessment in 2018. However, in early 2019, Taseko Mines Limited acquired Yellowhead Mining, renamed the project **Yellowhead** and is advancing the project. They indicate an intention to re-enter environmental assessment.

Taseko announced results of an updated Feasibility Study in January, including a new development plan and resource estimate (Table 5). Proven and Probable reserves now stand at 817 Mt grading 0.28% Cu at a 0.17% cut-off. In May, Taseko announced an agreement with an unnamed local First Nation regarding the company's intention to restart the project regulatory approval process. Although porphyry-like in tonnage and grade, **Yellowhead** is generally considered a marine volcanogenic and syngenetic deposit. It is hosted by metavolcanic and metasedimentary rocks of the Eagle Bay assemblage (Lower Cambrian to Mississippian).

7.4. Selected skarn projects (tungsten, copper, gold)

Historically, copper skarns have been important sources of high-grade ore. One, the Craigmont mine, has been re-activated as the **New Craigmont** exploration project. One tungsten skarn project, the **Fox**, has recently been active.

7.4.1. Fox Tungsten (Happy Creek Minerals Ltd.)

Happy Creek Minerals Ltd. drilled seven holes (1119 m) at its **Fox Tungsten** project, six of which tested the Nightcrawler zone. Nightcrawler is about 6 km south of the existing resource area at Ridley Creek (Table 4). Happy Creek also reports prospecting discoveries of scheelite approximately 5 km west of Ridley Creek.

7.4.2. Lac La Hache (Engold Mines Ltd.)

Engold Mines Ltd. reported results of drilling at the G1 and Ann North at the **Lac La Hache** project. Notable intersections include 22.4 m grading 1.29% Cu, 0.11 g/t Au, 4.36 g/t Ag, and 26.91% Fe and another longer intersection of 215 m grading 0.25% Cu, 0.04 g/t Au, 1.47 g/t Ag, and 7.51% Fe at G1. Drilling at G1 included 20 m and 50 m step out holes. They also report grab sampling up to 9.65 g/t Au at Aurizon South. Drilling at Ann North returned anomalous copper, gold, and molybdenum values. Late in the year they drilled a recent gold discovery called the Road Gold zone. **Lac La Hache** has several different target types related to alkalic intrusions. Copper skarns have had much of the recent exploration attention, but there are also porphyry targets and the Aurizon Au-Ag-Cu vein and breccia zone which has a maiden resource estimate (Table 4).

7.4.3. New Craigmont (Nicola Mining Inc.)

Nicola announced final 2019 drill results and results of flotation tests on Craigmont waste rock. After processing with an X-ray transmission sorter, material with a feed grade of 0.32% Cu and 6.4% Fe produced a Cu concentrate grading about 30% Cu. Testing using magnetic separation on magnetite concentrate produced a 65% Fe concentrate. The company also began developing a resource estimate for the historic Craigmont mine waste terraces. Inferred resources for the Southern and 3060 Portal dumps total 18,669,000 t grading 0.13% Cu (Table 4).

The Merritt mill is at the Craigmont mine site. It has undergone about \$3 million in recent modifications but is not yet recommissioned. The company plans to operate in 2021 with ore from Blue lagoon Resources Inc.'s Dome Mountain mine. The mill is a 200 tpd crushing, grinding, and flotation mill with a gravity jig and table. Originally constructed in 2012 to process ore from Treasure Mountain, Nicola operates it as a custom mill and uses the Craigmont tailings storage facility.

7.5. Selected mafic- and ultramafic-hosted projects

7.5.1. Hefley Creek (Progressive Planet Solutions Inc.)

Progressive Planet Solutions Inc. reported discovering nickel in bedrock at its **Hefley Creek** pozzolan property and then carrying out rock and soil geochemistry. Grab samples returned up to 0.26% Ni and 0.45% Cr. The samples were from altered leucogabbro and serpentinite.

7.6. Selected specialty metals and industrial mineral projects

Exploration for industrial minerals commonly goes unreported. Probably the most common type of exploration is bulk sampling for test marketing purposes. Operators indicated work at pozzolan and zeolite projects among others. A few industrial minerals explorers have reported their work.

7.6.1. Mt. Riordan (Garnet Peak Resources Inc.)

Most of Garnet Peak's effort went toward permitting and First

Nation engagement efforts for their **Mt. Riordan** project. They are permitted for exploration drilling and a bulk sample of up to 10,000 t. Depending on results of test marketing, a 25,000 tpy quarry with a 10-year life is contemplated. The product would be industrial garnet, used in water jet cutting and sand blasting.

7.6.2. Trans Canada (ZMM Canada Minerals Corp.)

ZMM indicated continuing sampling at the **Trans Canada** zeolite quarry and an intention to continue quarrying.

8. Geological research

CIM Special Volume 57, a 25-year anniversary update on porphyry deposits of the northwestern Cordillera of North America contains papers on nine porphyry deposits in the South Central Region: Gibraltar (van Straaten et al., 2020), Mount Polley (Rees et al., 2020), Woodjam (del Real et al., 2020), Maggie (Lang et al., 2020), IKE (Galicki et al., 2020), New Afton (Lipske et al., 2020), Highland Valley Copper (Ryan et al., 2020), Copper Mountain (Holbek et al., 2020), and Miner Mountain (Britten et al., 2020).

Geoscience BC's Summary of activities for 2019 contained reports on five projects in the region. Branson et al. (2020) studied magnetic surveys as an exploration tool for podiform chromite. Sacco et al. (2020) reported on surficial mapping to inform surface sediment data and till sample reanalysis. Dunn and Heberlein (2020) reported on spruce treetop sampling near the Blackwater deposit. Lett et al. (2020) tested on-site soil gas carbon dioxide and oxygen analysis over the drift-covered Mouse Mountain and Shiko Lake fault-controlled Cu-Au porphyry occurrences. Grunsky and Arne (2020) used advanced data analytics and machine learning to evaluate QUEST-South stream sediment sample re-analysis data.

Two papers on the Highland Valley district appeared in *Economic Geology*. Alva-Jimenez et al. (2020) studied the mineral chemistry of hydrothermal white mica in the Highland Valley copper district. Byrne et al. (2020) link lithochemical data to mineralogy in the Highland Valley district.

The British Columbia Geological Survey also reported on several South Central Region projects. Lett and Paulen (2021) reported on till and B-horizon soil geochemistry at the Ace property northeast of Likely. Schiarizza and Friedman provided new U-Pb zircon ages from Gibraltar (2021a) and for Eocene rocks (Skull Hill Formation) at Mount Timothy (2021b). As part of a province-wide study of Eocene magmatism, Van Wagoner et al. (2021) summarized the physical volcanology and geochemistry of the Kamloops Group in its type area. Mihaynuk and Diakow (2020) released a 1:50,000-scale map of a multi-year project in the southern Nicola belt and Friedman et al. (2020) reported two new U-Pb zircon ages from the Nicola Group, one the oldest dated thus far, the other the youngest.

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